Explore Tracks · Trail A

Three interest tracks for curious Scouts: Animals (mammals), Dinosaurs and Great Battles of the ancient world. Short, self-paced stops with true stories, great pictures, hands-on projects and games.

First edition

> *The works of the LORD are great, sought out of all them that have pleasure therein.*
> *Psalm 111:2 (KJV)*

Course Guide

Explore Tracks are for children who want more of what they love. Each track is a trail of short stops. At every stop the child hears a true story, studies a great picture, does something with his or her hands, plays a game and adds a page to a Field Notebook.

Trail A is the first trail of each track at the 🟢 Scout level (ages 7–9). The Animals track meets ten mammals. The Dinosaurs track meets ten famous dinosaurs and learns the museum words Triassic, Jurassic and Cretaceous, with a creation-friendly view of the dates on museum signs. The Great Battles track visits eight battles of the ancient world, from Marathon to Alesia, and ends with two victories God gave His people at Jericho and through Gideon.

WHO IT IS FOR

Written for children about ages 7–9 who are read to by a parent, or who read short passages on their own. Older siblings can join in. Nothing earlier is required.

HOW TO USE THIS COURSE

1. **One stop at a time.** A stop takes 15–25 minutes: read the story aloud, look at the picture, do the hands-on part and play the game. Two or three stops a week works well.
2. **Any order.** The tracks are independent. Do one track at a time, or rotate between them.
3. **Field Notebook.** Every stop ends with a page for the notebook. At the end of the trail the pages become a booklet, and the parent signs the Trail A certificate.
4. **Badge quizzes.** Each track has two short, optional oral quizzes. They are for fun, not grades.

SCOPE AND SEQUENCE

Track 1: Animals 🐾 Trail A: Mammals (Self-paced)

MATERIALS

- **Field Notebook (a sketchbook or composition book)**One for the whole trail.
- **Colored pencils, a ruler, scissors and glue**For drawings and maps.
- **Household things**Each hands-on project lists what it needs: blocks, clay, string, toy figures, cups.
- **A Bible (KJV)**For the verse at each stop and the Jericho and Gideon stop.

GRADING

Explore Tracks are not graded. A stop is done when the child has heard the story, done the hands-on part and made a notebook page.

Badges and the Trail A certificate are earned by finishing the stops.

A NOTE TO PARENTS

You do not need to be an expert. Read the story aloud, look at the picture together and ask, “What do you notice?” Each stop has a short *For families* note with background and any facts that scholars still discuss.

Dinosaur dates: museums give ages in millions of years. This trail teaches the period names as museum vocabulary and explains that the dates are interpretations; many Christian families understand the fossils within a young earth and the Flood.

Battles are told for young children: who, where, the plan, what happened and why it mattered, with honor for courage and wisdom and no gory detail.

Contents

Track 1: Animals 🐾 Trail A: Mammals

1.1 Lions and the Lion of Judah
1.2 Elephants
1.3 Whales, the “Great Whales” of Genesis
1.4 Bats
1.5 Horses
1.6 Wolves and Dogs
1.7 Bears
1.8 Cheetahs, the Fastest Runner
1.9 Kangaroos
1.10 The American Bison’s Comeback

Each stop takes 15–25 minutes. Tracks may be done in any order, and a child may do just one track.

TRACK 1

Animals 🐾 Trail A: Mammals

The first trail of the Animals track visits ten mammals, from the lion and the great whales to the American bison that came back from the edge. Each stop is a short read-aloud story, a picture to study, something to draw or build, two or three quick questions, a game and a verse of Scripture.

This is the 🟢 **Scout** level, written for ages 7 to 9. A parent reads the story aloud, or a strong reader reads it alone. Every stop stands by itself, so a child may start with the animal he loves best. The 🔵 Ranger and 🔴 Expert levels of these same stops will add maps, numbers and primary sources later.

Five stops earn the **Mammal Scout badge, part 1**, and ten stops earn part 2 and the **Trail A certificate**. The badge quizzes are at the end of the trail and are optional.

BEFORE YOU BEGIN

- Listen to a story of about five minutes and tell it back.
- Draw a simple animal shape with a pencil.
- Find Africa, Asia, Australia, North America and the oceans on a globe (a grown-up may help).

MASTERY CHECKLIST

☐ I can say what makes an animal a mammal: hair or fur, breathing air, and feeding its babies milk.
☐ I can tell one true and surprising fact about each of the ten mammals on this trail.
☐ I can point to where each animal lives on a globe or map.
☐ I can say one way God’s design helps each animal live where it lives.
☐ I can keep a Field Notebook page with a drawing, a title, a date and one sentence.

OPTIONAL BOOKS AND RESOURCES

- **Project Gutenberg** (https://www.gutenberg.org): Free old nature books to read aloud, such as Thornton W. Burgess’s animal stories.
- **Biodiversity Heritage Library** (https://www.biodiversitylibrary.org): Old animal drawings and plates (Audubon and others) to copy in the Field Notebook.

1.1 Lions and the Lion of Judah

OBJECTIVES

- Tell how lions live together in a family called a pride.
- Name two things that help a lion hunt.
- Explain why the Bible calls Jesus “the Lion of the tribe of Juda.”

> **Warm-up.** Stand up tall and give your loudest roar. Now whisper a roar. Which one would make a zebra run? A lion’s roar can be heard about five miles away. Can you think of a place about five miles from your house?

Video slot. Video coming. Lions in a pride: lionesses hunting and cubs at play, no kills shown. Search approved nature channels (e.g., Homeschool Pop (Alternate), Smithsonian’s National Zoo).

KEY TERMS

mammal
An animal with hair or fur that breathes air and feeds its babies milk.

pride
A family group of lions that live and hunt together.

lioness
A female lion. Lionesses do most of the hunting.

mane
The long, thick hair around a male lion’s head and neck.

CORE IDEAS

The story. The sun is going down over the grassy plains of Africa. Under a flat-topped acacia tree, a big male lion lifts his head. His shaggy golden mane shakes as he opens his mouth and roars: *Aaa-OOOH! Ooh! Ooh!* The sound rolls across the grass for miles. It tells every animal, “This is our land.”

A family called a pride. Most cats live alone, but lions live together. A lion family is called a **pride**. It may have a few grown males, several **lionesses** (mother lions, aunts and sisters) and their cubs. The lionesses do most of the hunting. They creep low through the tall grass, the same color as their fur, and work together like a team. The cubs stay behind and pounce on each other’s tails. That play is practice for when they grow up.

Built for the job. A lion has soft pads on its feet so it can walk without a sound. It has sharp claws that it can pull back in, like a house cat. Its eyes see well in dim light, so it often hunts at dusk or at night. And after a big meal, a lion rests. Lions may sleep or lie still for up to twenty hours a day!

Where lions live. Most wild lions live in Africa, south of the great Sahara Desert. A small group also lives in the Gir Forest of India. Long ago lions lived in the lands of the Bible too, and the Bible mentions them many times. David fought a lion to save his father's sheep. God shut the lions' mouths when Daniel was thrown into their den.

The Lion of Judah. A lion is strong, brave and kingly. That is why, long ago, Jacob called his son Judah "a lion's whelp," a young lion (Genesis 49:9). King David came from Judah's family, and so did Jesus. In the book of Revelation, Jesus is called "the Lion of the tribe of Juda" (Revelation 5:5). The Lion of Judah is the strongest King of all, and He uses His strength to save His people.

PICTURE STUDY



Daniel in the Lions' Den, Peter Paul Rubens, c. 1614–1616 · Oil on canvas · National Gallery of Art, Washington, D.C.
Wikimedia Commons · Public domain

Peter Paul Rubens was a famous painter from Flanders, in what is now Belgium. He studied real lions so that he could paint them life-size. In this painting, Daniel sits on a rock in the den and looks up to God in prayer, while the lions yawn, stretch and lie around him.

Look closely

- Count the lions. How many can you find? Are any of them lionesses?
- Look at Daniel's face and hands. What is he doing?
- Find the light. Where does it come from?

Talk about it

1. Do the lions look hungry, sleepy or angry? Why do you think Rubens painted them that way?

2. What does this painting tell us about how God cared for Daniel (Daniel 6:22)?

HANDS-ON: HOW LONG IS A LION?

A big male lion can be about 9 feet long from his nose to the tip of his tail. Find out how big that is in your own house.

You will need

- A tape measure or yardstick
- Painter’s tape or a long piece of string
- Paper and crayons

Steps

1. With a grown-up, measure 9 feet along the floor. (That is 3 yardsticks laid end to end.)
2. Mark the start and the end with tape. This is the lion’s nose and the tip of his tail.
3. Lie down beside it. How many of you does it take to make one lion?
4. Draw a lion along a long strip of paper, with a big mane at one end and a tufted tail at the other.

Check your work

- I measured 9 feet.
- I compared the lion to my own size.
- My lion drawing has a mane and a tufted tail.

FIELD NOTEBOOK

1. Draw a lion’s head with its mane. Write the title “Lion,” the date and one fact you learned.
2. Draw a lion paw print: one big pad and four toe prints. (Cats pull their claws in, so claw marks usually do not show.)

> **Did you know?** A male lion can weigh about 400 pounds, as much as two or three grown men. Lion cubs are born with spots on their fur. The spots fade as they grow up. A lion’s tail has a dark tuft of hair at the end, like a paintbrush.

> **Goes deeper in.** Life Science, Grade 2, Unit 1 “Mammals” (coming soon); and Geography, for Africa on the map.

> **For families.** A gentle stop for young children: the video and story show hunting only from a distance, with no kill. If your child asks about Daniel 6, read the chapter together; it is a short and wonderful story of faithfulness.

PRACTICE

1. EASY What is a family of lions called?
2. EASY Who does most of the hunting in a pride?
3. MEDIUM Why does the Bible call Jesus “the Lion of the tribe of Juda”?

Make it a game · Lion, Lion, Cub. Play like Duck, Duck, Goose. The child who is “it” walks around the circle saying “cub, cub, cub…” and then roars “LION!” The lion chases the child who was tapped back to the empty spot.

Scripture. “The wicked flee when no man pursueth: but the righteous are bold as a lion.” (Proverbs 28:1, KJV)

A lion does not run away. God wants us to be brave like a lion when we do what is right.

Practice: answers

1. A pride.
2. The lionesses (the female lions).
3. Jesus came from the family of Judah, and like a lion He is strong and kingly; He uses His strength to save His people (Revelation 5:5).

1.2 Elephants

OBJECTIVES

- Name three ways an elephant uses its trunk.
- Explain how an elephant family is led by the oldest mother.
- Tell the story of Hansken, the elephant Rembrandt drew.

> **Warm-up.** Try to pick up a pencil using only your nose and your upper lip. It is hard! An elephant's trunk is its nose and upper lip joined together, and it can pick up a single peanut.

Video slot. Video coming. Elephant families: the trunk, ears and the matriarch. Search approved nature channels (Smithsonian's National Zoo, San Diego Zoo Wildlife Alliance, Homeschool Pop (Alternate)).

KEY TERMS

trunk
An elephant's long nose and upper lip joined together.

tusk
A very long front tooth that grows out of an elephant's mouth.

herd
A family group of elephants that travel together.

matriarch
The oldest mother elephant, who leads the herd.

CORE IDEAS

The story. In 1637, a young elephant was shown at the fair in Amsterdam, a busy city in Holland. Her name was Hansken. She had been born on the island of Ceylon, near India, and had come to Holland by ship when she was a baby. Crowds paid to see her, and she had been trained to do tricks for them. One of the people who came to look was the great painter Rembrandt. He took out his chalk and drew her, again and again, so that he could get her wrinkly skin just right.

A nose that is also a hand. An elephant's **trunk** is its nose and upper lip together. It has thousands of muscles and no bones at all. An elephant uses its trunk to smell, to breathe, to pull down branches, to drink and to give itself a dust bath or a shower. It can lift a heavy log, and it can pick up one small peanut.

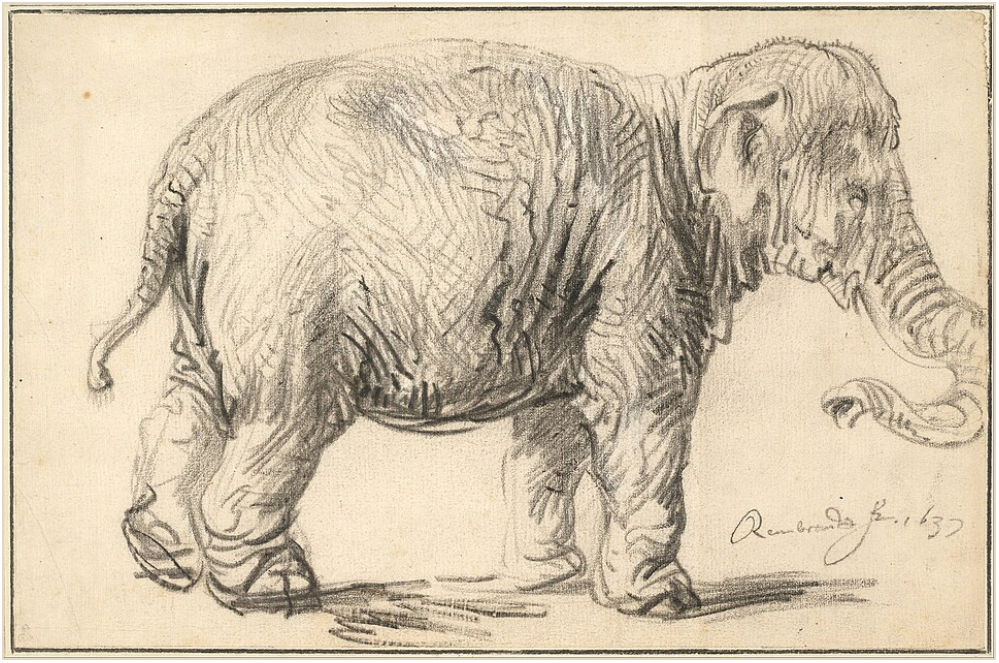
Tusks and ears. An elephant's **tusks** are really two very long front teeth. Elephants use them to dig for water and to strip bark from trees. Their huge ears work like fans. On a hot

day, an elephant flaps its ears, and the blood flowing through them cools down, which cools the whole elephant.

A family led by Grandmother. Elephants live in a family group called a **herd**. The leader is the oldest and wisest mother, the **matriarch**. She remembers where to find water in a dry year and which paths are safe. When danger comes, the big elephants make a circle around the babies. A baby elephant grows inside its mother for about 22 months before it is born, almost two whole years!

The biggest land animal. The African bush elephant is the largest animal that walks on land. A big male can weigh more than six tons, as much as four or five cars. There are also Asian elephants, which are a little smaller and have smaller, rounder ears. Hansken was an Asian elephant.

PICTURE STUDY



Elephant (Hansken), Rembrandt van Rijn, 1637 (signed and dated) · Black chalk on paper · Albertina, Vienna
Wikimedia Commons · Public domain

Rembrandt was one of the greatest artists of the Dutch Golden Age. Few people in Holland had ever seen an elephant, so when Hansken came to Amsterdam, he drew her from life with black chalk. Look how he shows her heavy weight with just a few lines.

Look closely

- Find the wrinkles on Hansken’s skin. How did Rembrandt draw them?
- Look at her legs. Do they look like tree trunks?
- Find her trunk. Is it straight or curled?

Talk about it

1. Why do you think Rembrandt drew Hansken more than once?
2. If you could draw a real animal from life, which one would you choose?

HANDS-ON: ELEPHANT FOOT MEASURE

People who study elephants use a clever rule of thumb: the distance around an elephant's front footprint, times two, is about how tall the elephant is at the shoulder.

You will need

- A long piece of string
- Cardboard or a big paper bag
- A yardstick
- Scissors (with a grown-up)

Steps

1. Draw a circle about 18 inches across on the cardboard. This is a grown elephant's footprint. Cut it out.
2. Lay the string around the edge of the footprint and mark how long it is (about 56 inches).
3. Double that length. Measure it up a wall from the floor and put a sticky note there (about 9 feet 4 inches). That is about how tall the elephant would be!
4. Stand under the sticky note. How many of you would fit?

Check your work

- I made an elephant footprint.
- I measured around it with string.
- I doubled the string to find the elephant's height.

FIELD NOTEBOOK

1. Draw an elephant from the side, like Rembrandt did. Label the trunk, tusk, ear and tail.
2. Write: "The leader of an elephant herd is called the _____."

> **Did you know?** An elephant may eat around 300 pounds of plants in a single day. Elephants "talk" with deep rumbles so low that people can hardly hear them, but other elephants far away can. King Solomon had a great throne made of ivory, the material of elephant tusks, and covered it with gold (1 Kings 10:18).

> **Goes deeper in.** Life Science, Grade 6, Lesson 6.3 "Elephants" in the Social Animals unit (coming soon).

> **For families.** Rembrandt signed and dated this drawing 1637 (Albertina, inv. 17558); Hansken was shown at the Amsterdam fair that year. She was born in Ceylon about 1630, reached Holland in 1633 and died in Florence in 1655. Old sources describe several

tricks; the stop just says she did tricks. Hansken's life as a traveling show animal is told simply. If your child is curious about elephants and ivory, explain that wild elephants are now protected so they are not hunted for their tusks.

PRACTICE

1. EASY What are an elephant's tusks?
2. EASY Name two things an elephant does with its trunk.
3. MEDIUM How do big ears help an elephant on a hot day?

Make it a game · Follow the Matriarch. One child is the matriarch and leads the "herd" around the yard. When she says "Danger!", the herd makes a circle around the smallest child or a stuffed-animal "calf."

Scripture. "But ask now the beasts, and they shall teach thee; and the fowls of the air, and they shall tell thee:" (Job 12:7, KJV)

Job says the animals can teach us. The elephant family teaches us to care for the little ones and to listen to the wise and old.

Practice: answers

1. Two very long front teeth.
2. Any two: smell, breathe, drink, pick up food, pull branches, give itself a shower or dust bath, lift logs.
3. The elephant flaps its ears; the blood in them cools, which cools the whole elephant.

1.3 Whales, the "Great Whales" of Genesis

OBJECTIVES

- Explain why a whale is a mammal and not a fish.
- Tell how big a blue whale is, compared with things we know.
- Say what Genesis 1:21 tells us about the great whales.

> **Warm-up.** Take a deep breath and hold it as long as you can. How many seconds did you last? A sperm whale can hold its breath for more than an hour while it dives deep for food.

Video slot. Video coming. Blue whales and humpbacks: spouting, breaching and the size of the blue whale. Search NOAA Fisheries, Smithsonian Ocean, Homeschool Pop (Alternate).

KEY TERMS

whale
A very large sea animal that is a mammal: it breathes air and feeds its babies milk.

blowhole
The nostril on top of a whale's head, used for breathing at the surface.

spout
The cloud of misty air a whale blows out when it breathes.

krill
Tiny shrimp-like animals that some whales eat by the ton.

CORE IDEAS

The story. On the fifth day of creation, God filled the seas with living things. The Bible says, "And God created great whales, and every living creature that moveth" (Genesis 1:21). Of all the creatures in the sea, whales are named first. And they really are great!

A fish? No, a mammal! A whale lives in the sea and swims with its tail, but it is not a fish. A fish breathes water through gills. A whale breathes air, just like you. It comes up to the surface and breathes out through a **blowhole** on top of its head. Whoosh! A cloud of mist shoots up. That is the **spout**. Then the whale takes a big breath and dives. Mother whales give birth to live babies, called calves, and feed them milk. That is why whales are **mammals**.

The biggest animal ever known. The blue whale is the largest animal that has ever lived, as far as anyone knows, bigger even than the largest dinosaurs. It can grow to about 100 feet long. That is longer than two school buses parked end to end. Its heart alone weighs

about 400 pounds, as much as two grown men, and its tongue can weigh as much as a small elephant!

A giant that eats tiny food. You might think such a giant would eat giant food. But the blue whale eats some of the smallest animals in the sea: **krill**, tiny creatures like little shrimp. Instead of teeth, it has long, bristly plates called baleen, like a huge comb. It gulps a mouthful of sea water, pushes the water out through the baleen and keeps the krill. A blue whale may eat about four tons of krill in a day.

Songs in the sea. Humpback whales sing long, rolling songs of moans, squeaks and whoops. The sound travels far through the water. Sailors long ago heard strange noises through the hulls of their ships and did not know what they were. Now we know: the great whales were singing.

PICTURE STUDY



Stranded Whale near Beverwijk, Jan Saenredam, 1602 · Engraving · Rijksmuseum, Amsterdam
Wikimedia Commons · CC0

In December 1601 a sperm whale washed up on the beach near Beverwijk in Holland. People came from miles around to see it, and the Dutch artist Jan Saenredam made this engraving of the crowd. In 1602 there were no photographs, so pictures like this were the only way to show far-away people what a whale looked like.

Look closely

- Find the whale. How does its size compare to the people?
- Look for people measuring or climbing. What are they doing?
- Find the horses and carriages. How did people travel to see the whale?

Talk about it

1. Why do you think so many people came to see the whale?
2. What would you have done if you had been there?

> **Safety first.** Stay out of the street. Measure in a yard, park or quiet driveway with a grown-up.

HANDS-ON: A BLUE WHALE IN THE YARD

See how long a blue whale really is by measuring one outside.

You will need

- A long tape measure, or a string 10 feet long
- Sidewalk chalk or two sticks
- A grown-up helper

Steps

1. Mark a starting line. This is the whale's nose.
2. Measure 10 feet with the string, mark it, and do it again until you have measured ten times. You have measured 100 feet.
3. Mark the end. This is the tip of the whale's tail.
4. Walk from nose to tail and count your steps. Then draw a whale outline with chalk if you can.

Check your work

- I measured about 100 feet.
- I counted my steps from nose to tail.
- I can say about how many school buses long a blue whale is (about two).

FIELD NOTEBOOK

1. Draw a whale at the surface, with its spout. Label the blowhole, tail and flipper.
2. Copy the first words of Genesis 1:21 in your best handwriting: "And God created great whales."

> **Did you know?** Blue whales make some of the loudest sounds of any animal on earth. A humpback whale sometimes leaps almost all the way out of the water and lands with a giant splash. This is called breaching. Whale calves are usually born tail first, and their mothers help them up to the surface for their first breath.

> **Goes deeper in.** Life Science, Grade 1, Lesson 3.1 "Whales" and Grade 6, Lesson 7.1 "Blue whale" (coming soon).

For families. Some children wonder about Jonah. The Bible says “a great fish” (Jonah 1:17), and in the King James Version Jesus says “the whale’s belly” (Matthew 12:40). Stop D10 in the Ocean Life trail looks at Jonah more closely.

PRACTICE

1. EASY Do whales breathe water or air?
2. EASY What is the largest animal ever known?
3. MEDIUM Give two reasons a whale is a mammal and not a fish.

Make it a game · Spout and Dive. When the leader says “Spout!”, everyone jumps up and blows like a whale. When she says “Dive!”, everyone crouches down and holds their breath. Anyone who moves the wrong way becomes the next leader.

Scripture. “And God created great whales, and every living creature that moveth, which the waters brought forth abundantly, after their kind, and every winged fowl after his kind: and God saw that it was good.” (Genesis 1:21, KJV)

God made the biggest animal in the world, and He said it was good.

Practice: answers

1. Air. They breathe at the surface through a blowhole.
2. The blue whale.
3. Any two: it breathes air; it has live babies; it feeds its babies milk.

1.4 Bats

OBJECTIVES

- Explain why a bat is the only mammal that can truly fly.
- Tell how many bats find food in the dark by echoes.
- Name one way bats help people.

Warm-up. Stand in a quiet room, close your eyes, and clap once. Can you hear the clap bounce back from the walls? That bounce is an echo. Many bats "see" with echoes.

Video slot. Video coming. How bats fly and find insects by echolocation; the evening flight at a bat cave. Search Bat Conservation International, the National Park Service (Carlsbad Caverns), Smithsonian.

KEY TERMS

bat
A mammal with wings made of skin stretched over long finger bones.

echo
A sound that bounces back off something.

echolocation
Finding things by making sounds and listening to the echoes.

roost
A place where bats or birds rest or sleep.

CORE IDEAS

The story. Every summer evening, near San Antonio, Texas, something amazing happens at Bracken Cave. As the sun sets, a dark cloud begins to pour out of the cave. It twists into the sky like smoke. But it is not smoke. It is millions and millions of bats, flying out for their nightly supper! Bracken Cave is the summer home of one of the largest groups of bats in the world, more than fifteen million Mexican free-tailed bats.

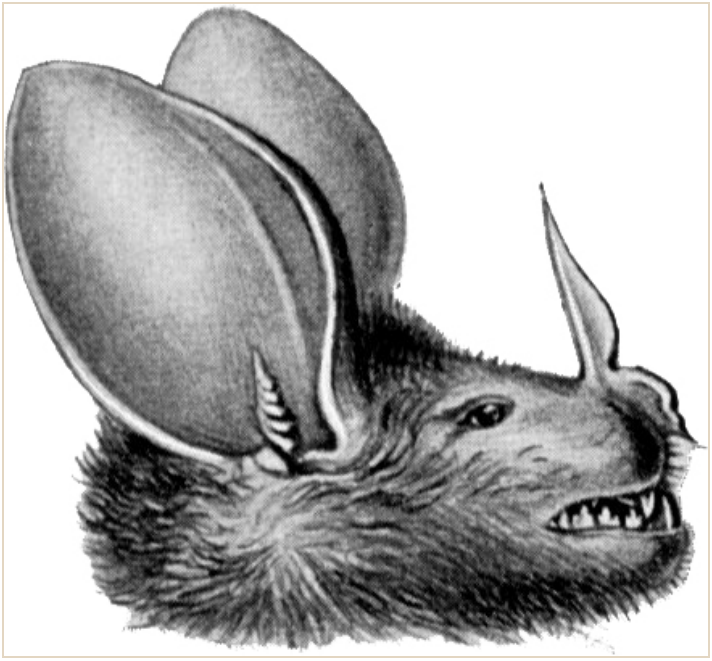
Flying with your hands. Birds fly, and so do bees, but a bat is the only **mammal** that can truly fly. A bat has fur, breathes air and feeds its babies milk. Its wings are really its hands! A bat's wing is made of thin skin stretched between very long finger bones. The scientific name for bats means "hand-wing." By moving its fingers, a bat can twist and turn in the air.

Seeing with sound. How does a bat catch a tiny moth in the dark? Many bats make high squeaks, too high for people to hear. The sound bounces off a moth and comes back as an **echo**. By listening, the bat can tell where the moth is and which way it is flying. This is called **echolocation**. Some bats can catch hundreds of insects in one night.

Upside-down sleepers. In the daytime, bats **roost** in caves, hollow trees, barns and under bridges. They hang upside down by their feet. Their toes lock in place, so a bat can hang without using its strength, even while it sleeps.

Good neighbors. Bats help people a great deal. Insect-eating bats eat beetles and moths that would harm farmers' crops. Fruit bats in warm countries carry pollen from flower to flower and drop seeds that grow into new trees. God made even the little bat to do important work.

PICTURE STUDY



A Bat's Face (Chrotopterus), from Plate 67 of Art Forms in Nature, Ernst Haeckel, 1904 · Lithograph · From the book Kunstformen der Natur (Art Forms in Nature)
Wikimedia Commons · Public domain

Ernst Haeckel was a German scientist and artist who drew living things in beautiful patterns. On one page he drew the faces of many kinds of bats; this is one of them, a big-eared bat from South America. Look at its huge ears and its nose shaped like a leaf. These shapes help the bats send out and catch their echoes.

Look closely

- Find the ears. How big are they next to the face?
- Find the leaf-shaped nose.
- Find the teeth. What do you think this bat eats?

Talk about it

1. Why might a bat that uses echoes need big ears?
2. Is this bat scary, funny or beautiful to you? Why?

> **Safety first.** Never touch a bat, alive or dead. A bat on the ground may be sick. Tell a grown-up. Bats are wonderful to watch from a distance.

HANDS-ON: A HAND-WING BAT

Make a bat that shows the finger bones in its wings, then play a game that works like echolocation.

You will need

- Black or brown paper
- A white crayon or chalk
- Scissors and a craft stick
- Tape

Steps

1. Trace your hand on the paper with your fingers spread. Draw long lines from the palm out through each finger. These are the bat's finger bones.
2. Draw the wing skin from fingertip to fingertip, and add a small furry body and ears. Cut it out and tape it to a craft stick.
3. Play the game "Bat and Moth" below.

Check your work

- My paper bat shows long finger bones in the wing.
- I can explain how the game is like echolocation.

FIELD NOTEBOOK

1. Draw a bat hanging upside down. Label the wing, the fingers and the feet.
2. Write one way bats help farmers.

> **Did you know?** There are more than 1,400 kinds of bats. Some are smaller than your thumb, and the biggest fruit bats have wings wider than a grown man is tall. Bats are not blind. Many see quite well, and most fruit bats find their food by sight and smell. In Austin, Texas, about one and a half million bats live under the Congress Avenue Bridge, and people gather on summer evenings to watch them fly out.

> **Goes deeper in.** Life Science, Grade 2, Lesson 1.2 "Bats fly" and Grade 6, Unit 3 "Echolocation" (coming soon).

> **For families.** The safety note matters: in North America bats are a common carrier of rabies, so children should look, not touch. A summer evening bat watch near a pond or a bridge makes a fine family outing.

PRACTICE

1. EASY What is a bat’s wing made of?
2. MEDIUM How does echolocation help a bat catch a moth in the dark?
3. EASY True or false: all bats are blind.

Make it a game · Bat and Moth. One blindfolded player is the bat and calls “Bat!” The other players are moths and must answer “Moth!” each time. The bat follows the sound to tag a moth. Play in a clear, safe space.

Scripture. “O LORD, how manifold are thy works! in wisdom hast thou made them all: the earth is full of thy riches.” (Psalm 104:24, KJV)

“Manifold” means many and different. The bat, with its hand-wings and echoes, is one of God’s many wise works.

Practice: answers

1. Thin skin stretched over very long finger bones.
2. The bat makes high squeaks; the sound bounces off the moth and comes back as an echo, which tells the bat where the moth is.
3. False. Bats can see; many see well.

1.5 Horses

OBJECTIVES

- Measure a horse in “hands.”
- Name two ways God designed horses to stay safe.
- Tell how horses have helped people for thousands of years.

> **Warm-up.** Put your hand flat on the table with your fingers together. How wide is it? Horse people measure horses in hands, and one hand is 4 inches.

> **Video slot.** Video coming. Horse gaits and how horses are measured in hands. Search approved channels (e.g., Homeschool Pop (Alternate), the Kentucky Horse Park, Smithsonian).

KEY TERMS

foal
A baby horse.

hand
A unit used to measure a horse’s height: one hand is 4 inches.

hoof
The hard covering on a horse’s foot (plural: hooves).

gait
A way of moving: walk, trot, canter or gallop.

CORE IDEAS

The story. Long ago in Paris, a young painter named Rosa Bonheur wanted to paint the most exciting picture of horses anyone had ever seen. So twice a week, for about a year and a half, she went to the great horse market in Paris. She stood among the stamping, snorting horses with her sketchbook and drew them as they trotted, reared and tossed their manes. Her big painting, *The Horse Fair*, made her famous around the world.

A helper for people. For thousands of years horses have carried people, pulled plows and wagons, and carried messages fast. Before cars and trains, a horse was the fastest way to travel on land. Farmers, soldiers, mail riders and country doctors all needed good horses.

Measured by hands. People measure a horse from the ground to the top of its shoulders, called the withers. They measure it in **hands**, and one hand is 4 inches. A small pony may be about 10 hands. A big draft horse, like a Clydesdale, can be 18 hands tall, which is 6 feet just to its shoulders!

Made to watch and run. A horse's eyes are on the sides of its head, so it can see almost all the way around without turning. Its legs are long and strong, and each foot ends in a hard **hoof**. Horses can even doze standing up, because their legs can lock in place. If danger comes, they are ready to run.

A baby that stands right away. A baby horse is called a **foal**. Within about an hour after it is born, a foal wobbles up onto its long legs. Soon it can walk and run beside its mother. In the book of Job, God asks, "Hast thou given the horse strength?" (Job 39:19). Only God could make such a strong and beautiful animal.

PICTURE STUDY



The Horse Fair, Rosa Bonheur, 1852–1855 · Oil on canvas · The Metropolitan Museum of Art, New York
Wikimedia Commons · Public domain

Rosa Bonheur was a French painter who loved animals and studied them carefully. This painting is more than 16 feet wide. It shows the Paris horse market, where powerful work horses called Percherons were shown to buyers.

Look closely

- Find the white horses. Where is the light shining on them?
- Find a horse rearing up on its back legs.
- Look at the men leading the horses. Do they look calm or busy?

Talk about it

1. What sounds would you hear if you stepped into this painting?
2. Why did Rosa Bonheur go to the horse market so many times?

HANDS-ON: HOW MANY HANDS TALL AM I?

Measure yourself the way people measure horses.

You will need

- A ruler or tape measure
- A pencil and paper
- A door frame and a grown-up

Steps

1. Stand against the door frame and have a grown-up mark your shoulder height.
2. Measure from the floor to the mark in inches.
3. Count by 4s (or divide by 4) to find how many hands tall you are. A grown-up can help with the math.
4. Compare: a pony is about 10 hands; a big draft horse is about 18 hands.

Check your work

- I measured my shoulder height.
- I changed inches into hands (4 inches = 1 hand).
- I compared myself to a pony and a draft horse.

FIELD NOTEBOOK

1. Draw a horse from the side. Label the mane, tail, hoof and withers.
2. Write the four gaits in order from slowest to fastest.

> **Did you know?** A horse's gaits, from slow to fast, are the walk, the trot, the canter and the gallop. You can estimate a horse's age by looking at its teeth. That is where the saying "long in the tooth" comes from. Horses breathe only through their noses, not their mouths.

> **Goes deeper in.** Life Science, Kindergarten, Lesson 1.4 "Horses and Work" (coming soon).

> **For families.** Horse-loving children may enjoy Anna Sewell's *Black Beauty* (1877, public domain) as a read-aloud.

PRACTICE

1. EASY How many inches are in one "hand"?
2. MEDIUM A horse is 15 hands tall. How many inches is that?
3. EASY What is a baby horse called?

Make it a game · Walk, Trot, Canter, Gallop. A caller shouts the four gaits in any order. Everyone moves around the yard at that speed. “Whoa!” means stop.

Scripture. “Hast thou given the horse strength? hast thou clothed his neck with thunder?” (Job 39:19, KJV)

God asks Job this question to show that only He could make a creature so strong and fine.

Practice: answers

1. 4 inches.
2. 15 × 4 = 60 inches (5 feet) to the withers.
3. A foal.

1.6 Wolves and Dogs

OBJECTIVES

- Tell how a wolf pack lives as a family.
- Explain why dogs and wolves are close relatives.
- Name one way a dog's nose helps people.

> **Warm-up.** Close your eyes. A grown-up holds an orange, a cinnamon stick and a bar of soap near your nose, one at a time. Can you name each one by smell? A dog could find them anywhere in the house.

Video slot. Video coming. Gray wolf packs in Yellowstone, and working dogs (search-and-rescue). Search the National Park Service (Yellowstone), Smithsonian, Homeschool Pop (Alternate).

KEY TERMS

pack
A family group of wolves that live and hunt together.

howl
A long, loud call that wolves use to talk to each other far away.

breed
A kind of dog, like a beagle or a collie, with its own look and skills.

scent
A smell an animal can follow.

CORE IDEAS

The story. Deep in the snowy forest, a gray wolf lifts its nose to the sky and howls: *Owwwoooooo!* Far away, another wolf answers. Then another. Soon the whole family is singing together. Wolves **howl** to call their family together, and to tell other wolves, "This place is ours."

A family called a pack. A wolf **pack** is usually a family: a mother, a father and their young. The parents lead the pack. The older brothers and sisters help care for the new pups, bringing them food and watching over them. Wolves hunt together, too, for large animals like deer and elk, and they may travel many miles in one day.

Cousins in the house. The dog lying on your rug is a close relative of the wild wolf. Dogs and wolves have the same number of teeth, and they can even have puppies together. Long, long ago, people began to keep and train dogs, and over many years they bred dogs for different jobs. Now there are hundreds of **breeds**, from the tiny Chihuahua to the giant Great Dane. They all belong to one dog family.

The amazing nose. A dog's nose is far better than ours. A dog can follow the **scent** of one person across fields and through a crowd. Bloodhounds can follow trails that are more than a day old. Dogs help people every day: they find lost hikers, sniff out danger, guide people who cannot see, guard sheep and pull sleds through the snow.

Friends of people. Wolves are wild and should be watched from far away. But dogs have been friends and helpers of people in nearly every land. A good dog is loyal, brave and glad to see you. Those are good things for a person to be, too.

PICTURE STUDY



Dignity and Impudence, Sir Edwin Landseer, 1839 · Oil on canvas · Tate, London
Wikimedia Commons · Public domain

Sir Edwin Landseer was the most famous animal painter in England in the 1800s. Here he painted two dogs side by side in one kennel: a big bloodhound and a small, scruffy white terrier. The title tells you what each dog is like. "Dignity" means calm and noble; "impudence" means cheeky.

Look closely

- Find the big dog and the little dog. Which one is "Dignity"?
- Look at the bloodhound's long ears and droopy face. Bloodhounds are famous trackers.
- Look at the little dog's eyes. What is he thinking?

Talk about it

1. Which dog are you more like today, Dignity or Impudence?
2. If you painted your own pet, what title would you give the painting?

HANDS-ON: SCENT TRAIL

Find out how a tracking dog works by following a scent trail yourself.

You will need

- A cotton ball
- Vanilla or peppermint extract
- A small treat or toy
- A grown-up

Steps

1. A grown-up dabs extract on the cotton ball and touches it to spots along a path in the house or yard, about every 3 feet, ending at the hidden treat.
2. Get on your hands and knees and sniff your way along the trail like a hound.
3. Take turns making trails for each other. Make the next one longer!

Tips

- Use only a little extract so it does not soak in.
- If you have a dog, hide a treat and watch how it finds it with its nose.

Check your work

- I followed the scent trail to the end.
- I can explain how a dog finds a lost person.

FIELD NOTEBOOK

1. Draw a wolf howling at the sky.
2. List three jobs that dogs do to help people.

> **Did you know?** A gray wolf’s howl can be heard miles away. Wolf pups are born deaf and blind, in a den dug in the earth. A dog’s nose has many millions more smell sensors than a person’s nose.

> **Goes deeper in.** Life Science, Kindergarten, Lesson 2.1 “Dogs” and Grade 6, Lesson 6.2 “Wolves” (coming soon).

> **For families.** The stop says plainly that dogs and wolves are one family of animals; the Life Science series treats dog breeds as variety within a created kind. Watching how a family dog uses its nose is a perfect follow-up.

PRACTICE

1. EASY What is a family of wolves called?

2. EASY Why do wolves howl?
3. MEDIUM Name two jobs dogs do for people.

> **Make it a game · Wolf Pack Howl.** One player hides and howls. The pack must find her by listening. Whoever finds her first hides next.

> **Scripture.** “The wolf also shall dwell with the lamb, and the leopard shall lie down with the kid; and the calf and the young lion and the fatling together; and a little child shall lead them.” (Isaiah 11:6, KJV)

Isaiah gives a picture of the peace of Christ’s kingdom, when even the wolf and the lamb are at peace.

Practice: answers

1. A pack.
2. To call their family together and to tell other wolves that this is their land.
3. Any two: find lost people, guide people who cannot see, guard sheep, pull sleds, sniff out danger, guard homes.

1.7 Bears

OBJECTIVES

- Name the bears of North America.
- Tell what many bears do in winter.
- Tell the true story of how the teddy bear got its name.

> **Warm-up.** Do you have a teddy bear? Hold it up. Do you know whose name is hidden in the word “teddy”? You will find out today.

> **Video slot.** Video coming. Bears in Yellowstone and Alaska: black, brown and polar bears; winter dens. Search the National Park Service (Katmai, Yellowstone), Smithsonian, Homeschool Pop (Alternate).

KEY TERMS

den
A sheltered home, such as a cave or a hollow, where a bear sleeps in winter.

cub
A baby bear.

hibernate
To spend the winter in a long, deep sleep without eating.

omnivore
An animal that eats both plants and meat.

CORE IDEAS

The story. In November 1902, President Theodore Roosevelt went bear hunting in Mississippi. For days he found no bear. Then his guides caught an old black bear and tied it to a tree, so that the President could shoot it. Roosevelt refused. It would not be fair or sporting. A newspaper artist named Clifford Berryman drew a cartoon of the President turning away from the bear. A shopkeeper in New York, Morris Michtom, saw it and made a soft toy bear. He called it “Teddy’s bear,” and the teddy bear was born.

Kinds of bears. There are eight kinds of bears in the world. In North America we have the black bear, the brown bear (often called the grizzly) and the white polar bear of the Arctic. Other bears live in Asia and South America. The giant panda of China is a bear too!

Big and strong. The polar bear is the largest bear, and a big male can weigh more than 1,000 pounds. Under its thick white fur, its skin is black. Brown bears catch salmon in rushing rivers with their paws and mouths. Bears are **omnivores**. They eat berries, nuts, roots, insects, honey, fish and meat.

The long winter sleep. When winter comes and food is scarce, many bears go into a **den**: a cave, a hollow log or a hole dug under a tree. There they **hibernate** for months. A black bear may go more than three months without eating or drinking anything at all! It lives on the fat it stored up in the fall.

Tiny cubs. Mother bears give birth to their **cubs** in the den in the middle of winter. A black bear cub is born tiny, weighing less than a pound, about as much as a can of soup. It drinks its mother's rich milk and grows fast. By spring, when the mother bear walks out of the den, the cubs are ready to tumble along behind her.

PICTURE STUDY



American Black Bear, John James Audubon and John Woodhouse Audubon, 1840s · Hand-colored lithograph · From The Viviparous Quadrupeds of North America
Wikimedia Commons · CC BY 2.0

John James Audubon is famous for his paintings of birds. Late in his life he and his sons made a second great book, about the furry animals of North America. This plate shows the American black bear.

Look closely

- Look at the bear's claws. What might it use them for?
- Find the details in the fur. How did the artist show that it is thick?
- What is in the background?

Talk about it

1. Does this bear look fierce, curious or calm?
2. Why do you think Audubon wanted to draw the animals of America?

> **Safety first.** If you ever see a real bear outdoors, stay calm, do not run, stand together, back away slowly and tell a grown-up. Never feed a bear.

HANDS-ON: BUILD A BEAR DEN

Make a winter den and find out how a den keeps a bear warm.

You will need

- Blankets, couch cushions or a table
- A flashlight
- A teddy bear
- Two cups of warm water and a kitchen thermometer (optional)

Steps

1. Build a small den under a table with blankets and cushions.
2. Put your teddy bear inside, curled up for winter.
3. Optional: put one cup of warm water inside the den, wrapped in a blanket, and one outside. After 20 minutes, which is warmer? A den holds in warmth.
4. Crawl inside with a flashlight and read a bear story.

Check your work

- I built a den.
- I can explain why a den keeps a bear warm.
- I know whose name is in “teddy bear.”

FIELD NOTEBOOK

1. Draw a bear in its winter den with two tiny cubs.
2. Write the three kinds of North American bears: black, brown (grizzly) and polar.

> **Did you know?** A black bear is not always black. It can be brown, cinnamon-colored or even nearly white. Polar bears are strong swimmers and can swim for many miles in icy water. A bear can run faster than a person, so people in bear country make noise on the trail and never run from a bear.

> **Goes deeper in.** Life Science, Grade 1, Lesson 1.4 “Bears in winter” and Lesson 5.1 “Polar bears” (coming soon).

> **For families.** The teddy bear story is well documented: Berryman’s cartoon ran in the *Washington Post* in November 1902. Families in bear country may want to add the bear-safety rules for hiking and camping.

PRACTICE

1. EASY Whose name is in the word “teddy bear”?
2. EASY What do many bears do in winter?
3. MEDIUM Why did President Roosevelt refuse to shoot the bear tied to a tree?

Make it a game · Bear Wakes Up. One child is the sleeping bear in a “den.” The others creep close, whispering “Is the bear awake?” When the bear jumps up and growls, everyone runs back to base.

Scripture. “The LORD that delivered me out of the paw of the lion, and out of the paw of the bear, he will deliver me out of the hand of this Philistine.” (1 Samuel 17:37, KJV)

Young David had faced a lion and a bear while keeping sheep. He trusted God to help him again against Goliath.

Practice: answers

1. President Theodore (Teddy) Roosevelt.
2. They go into a den and hibernate (sleep for months without eating).
3. It would not be fair or sporting to shoot a bear that was tied up and could not get away.

1.8 Cheetahs, the Fastest Runner

OBJECTIVES

- Tell about how fast a cheetah can run, and for how long.
- Name three parts of a cheetah's body made for speed.
- Tell how a cheetah is different from a leopard.

Warm-up. Run as fast as you can across the yard and back. Now try to keep running fast for one whole minute. Could you? A cheetah is the fastest land animal, but it can sprint for only about half a minute.

Video slot. Video coming. A cheetah running in slow motion, showing the spine and tail. Search approved nature channels (Smithsonian's National Zoo, Cincinnati Zoo, Homeschool Pop (Alternate)); no kill footage.

KEY TERMS

sprint
To run very fast for a short time.

spine
The backbone.

tear marks
The black lines that run from a cheetah's eyes down to its mouth.

rosette
A spot shaped like a little rose. Leopards have rosettes; cheetahs have solid round spots.

CORE IDEAS

The story. On the open grassland of Africa, a cheetah crouches low. Its eyes are fixed on a gazelle far away. Slowly, slowly it creeps closer. Then, like a rocket, it bursts forward! In just a few seconds it is racing as fast as a car on the highway, about 60 miles an hour. It is the fastest runner on land.

Built for speed. Everything about the cheetah is made to run. It has long, thin legs and a light body. Its **spine** bends and stretches like a spring, so each stride is very long. Its claws do not pull all the way in like a house cat's; they grip the ground like the cleats on a runner's shoes. And its long tail works like a boat's rudder, helping it turn sharply without falling over.

A short race. A cheetah cannot run fast for long. Its sprint lasts only about 20 or 30 seconds. After that it is hot and out of breath, and it must rest. So a cheetah sneaks up as close as it can before it starts to run.

Not a leopard. People sometimes mix up cheetahs and leopards. A cheetah has solid black spots, while a leopard's spots are **rosettes**, shaped like little roses. A cheetah also has black **tear marks** running from its eyes to its mouth, which may help it see in bright sunshine. And a cheetah does not roar. It purrs, and it makes a high chirp that sounds like a bird!

A royal gift. Long ago, kings and princes in India and Persia tamed cheetahs and took them hunting. In the 1760s, a cheetah was sent from India as a gift to King George III of England. The painter George Stubbs painted it, and you can see that painting today.

PICTURE STUDY



Cheetah and Stag with Two Indians, George Stubbs, c. 1765 · Oil on canvas · Manchester Art Gallery, England
Wikimedia Commons · Public domain

George Stubbs was an English painter who studied the bodies of animals more carefully than almost anyone of his time. The cheetah in this painting was real. It had been sent from India as a gift to King George III, and its Indian keepers came with it to England.

Look closely

- Find the cheetah. Is it running, or waiting?
- Look at the cheetah's spots. Are they solid spots or rosettes?
- Find the stag. Where is it looking?

Talk about it

1. Why do you think the keepers are holding the cheetah back?
2. What do you think will happen next?

HANDS-ON: SPRINT TEST

Find out how long it takes you to run a distance that a cheetah covers in about one second.

You will need

- A stopwatch or phone timer
- A tape measure or a 10-foot string
- Sidewalk chalk or two cones
- A grown-up to time you

Steps

1. Measure 100 feet in a safe, open place and mark the start and the finish.
2. A grown-up says “Go!” and starts the timer. Run as fast as you can to the finish.
3. Write down your time. Try three times and circle your best.
4. A cheetah at top speed runs 100 feet in about one second. How many seconds did you take? How many times faster is the cheetah?

Tips

- Run on soft ground, away from the street.

Check your work

- I measured 100 feet.
- I timed three runs and found my best.
- I compared my time with a cheetah’s (about one second).

FIELD NOTEBOOK

1. Draw a cheetah running. Label the long tail, the spots and the tear marks.
2. Draw one cheetah spot and one leopard rosette side by side.

> **Did you know?** Cheetah cubs have long, fluffy gray fur on their backs that may help them hide in the grass. A running cheetah may cover more than 20 feet in a single stride. Most wild cheetahs live in Africa; a very few still live in Iran, in Asia.

> **Goes deeper in.** Life Science, Grade 6, Animal Design and Behavior (coming soon).

> **For families.** The video note asks for footage without kills. The stop says “about 60 miles an hour,” which matches measured speeds: Sarah at the Cincinnati Zoo was radar-timed at up to 61 mph (2012), and collars on wild cheetahs in Botswana recorded a top speed of 58 mph (Wilson et al., Nature, 2013). Older books often say 70 mph, but that figure was never well measured.

PRACTICE

1. EASY What is the fastest land animal?
2. MEDIUM How does the cheetah’s tail help it run?
3. EASY How long can a cheetah sprint at top speed?

> **Make it a game · Cheetah Tag.** The cheetah may run fast only for a count of 10. Then she must walk for a count of 10 to “rest.” Everyone else may jog.

> **Scripture.** “I returned, and saw under the sun, that the race is not to the swift, nor the battle to the strong” (Ecclesiastes 9:11, KJV)

Even the fastest cheetah does not win every race. God rules over all things, not speed or strength.

Practice: answers

1. The cheetah.
2. It works like a rudder, helping the cheetah balance and turn sharply.
3. Only about 20 to 30 seconds.

1.9 Kangaroos

OBJECTIVES

- Tell what a marsupial is.
- Explain how a joey grows in its mother's pouch.
- Tell how Captain Cook's voyage first showed a kangaroo to England.

> **Warm-up.** Put your feet together and jump as far as you can. Measure your jump with big steps. A red kangaroo can leap about 25 feet in one bound!

Video slot. Video coming. Red kangaroos hopping, and a joey in the pouch. Search approved nature channels (e.g., Australian Museum, San Diego Zoo Wildlife Alliance, Homeschool Pop (Alternate)).

KEY TERMS

marsupial
A mammal whose babies grow in a pouch on the mother's body.

joey
A baby kangaroo.

pouch
The pocket of skin on a mother kangaroo's belly where her baby lives and drinks milk.

mob
A group of kangaroos.

CORE IDEAS

The story. In the summer of 1770, Captain James Cook's ship, the *Endeavour*, struck a coral reef off the coast of Australia. While the sailors mended the ship by the bank of a river, they saw a strange animal. It was gray, about as big as a deer, and it did not run. It hopped on two huge back legs, with its long tail behind it! The people who lived there called it something like "gangurru." The sailors wrote it down as "kangaroo."

A painting from a skin. The ship's naturalist, Joseph Banks, brought a kangaroo skin back to England. Nobody in England had ever seen a kangaroo. Banks asked the painter George Stubbs to paint one. Stubbs had never seen a living kangaroo either, so he painted it from the skin and from what the travelers told him. His painting, *The Kongouro from New Holland*, was the first picture of a kangaroo most English people ever saw.

A baby in a pocket. A kangaroo is a **marsupial**, a mammal whose babies grow in a **pouch**. A newborn kangaroo, called a **joey**, is about the size of a jelly bean. It has no fur, and it cannot see. Yet it crawls up through its mother's fur, all by itself, into her pouch. There it

drinks her milk and grows for months. Later the joey pokes its head out to look at the world, and at last it hops out, though it dives back in when it is scared.

Champion hoppers. The red kangaroo is the largest marsupial. Its back legs are huge and springy, and its long tail helps it balance, like a third leg when it stands still. A red kangaroo can hop at more than 30 miles an hour. Springy tendons in its legs store up energy with each bounce, so a kangaroo can travel a long way without getting tired.

A mob in the outback. Kangaroos live in groups called **mobs**. They graze on grass in the cool morning and evening and rest in the shade during the heat of the day. God made them just right for the dry, hot land of Australia.

PICTURE STUDY



The Kongouro from New Holland, George Stubbs, 1772 · Oil on panel · National Maritime Museum, Greenwich, London
Wikimedia Commons · Public domain

George Stubbs painted this kangaroo in 1772 for Joseph Banks, who had sailed with Captain Cook. Stubbs had only a skin and the travelers' descriptions to work from, yet his painting is a good likeness.

Look closely

- Find the kangaroo's big back legs and its tail. How does it hold itself up?
- Look at its ears and face. What is it looking at?
- What kind of land is behind it?

Talk about it

1. Why was this painting so exciting to people in England in 1772?

2. How would you draw an animal you had never seen?

HANDS-ON: KANGAROO LONG JUMP

Compare your jumps with a kangaroo's.

You will need

- A tape measure
- Sidewalk chalk or a stick
- Paper and pencil

Steps

1. Mark a starting line. Jump forward with both feet together, like a kangaroo.
2. Mark where your heels land. Measure your jump in feet.
3. Jump three times and write down your best jump.
4. Measure out 25 feet. That is about how far a red kangaroo can jump in one bound. How many of your jumps fit in one kangaroo jump?

Check your work

- I measured three jumps.
- I compared my best jump to a kangaroo's 25-foot leap.

FIELD NOTEBOOK

1. Draw a mother kangaroo with a joey peeking out of her pouch.
2. Write: "A kangaroo is a _____. Its baby is called a _____."

> **Did you know?** A kangaroo cannot easily walk backward. Koalas and wombats are marsupials too, and so is the Virginia opossum of North America. Kangaroos "box" with their front paws and kick with their strong back legs when they fight.

> **Goes deeper in.** Life Science, Grade 4, Lesson 5.2 "Marsupials" (coming soon); and Geography, for Australia on the map.

> **For families.** The kangaroo's name is usually traced to the Guugu Yimithirr word *gangurru*, from the people who lived near the Endeavour River in northern Queensland. The Ranger level will add a map of Cook's voyage.

PRACTICE

1. EASY What is a baby kangaroo called?
2. EASY What is a marsupial?
3. MEDIUM How did people in England first see what a kangaroo looked like?

Make it a game · Kangaroo Relay. Teams hop like kangaroos with a stuffed-animal "joey" held in front. If the joey falls, go back to the start and hop again.

Scripture. "And God made the beast of the earth after his kind, and cattle after their kind, and every thing that creepeth upon the earth after his kind: and God saw that it was good." (Genesis 1:25, KJV)

God made the kangaroo too, after its kind, and fitted it for its land.

Practice: answers

1. A joey.
2. A mammal whose babies grow in a pouch on the mother.
3. Joseph Banks brought a kangaroo skin back from Captain Cook's voyage, and George Stubbs painted a kangaroo from it in 1772.

1.10 The American Bison's Comeback

OBJECTIVES

- Tell how many bison once lived on the Great Plains, and how few were left by 1889.
- Name the people who worked to save the bison.
- Explain what it means to take care of God's creatures.

Warm-up. Look for a picture of the old "buffalo nickel" (1913–1938). It shows an American bison. Why would a country put an animal on its money?

Video slot. Video coming. Bison in Yellowstone and the Wichita Mountains; the story of the bison's rescue. Search the National Park Service, U.S. Fish and Wildlife Service, Smithsonian.

KEY TERMS

bison
A large, shaggy wild ox of North America, often called a buffalo.

herd
A large group of animals that live and travel together.

Great Plains
The wide grassy middle of North America.

conservation
Wise care and protection of animals, plants and land.

CORE IDEAS

The story. Two hundred years ago, the Great Plains of North America were covered with bison. There were tens of millions of them. Travelers wrote that a single herd could take hours or even days to pass by. The ground shook and the dust rose when they ran. The Plains Indian nations, such as the Lakota and the Comanche, depended on the bison for food, clothing and shelter.

Almost gone. Then everything changed. In the 1870s and 1880s, as railroads crossed the plains, hunters with rifles shot bison by the hundreds of thousands, mostly for their hides. In only about fifteen years, the great herds were gone. In 1889, a scientist named William Hornaday counted fewer than 1,100 bison left in all of North America. In Yellowstone National Park, the only place where wild bison had never disappeared, the herd fell to about two dozen animals.

The rescuers. Some people decided that the bison must not disappear. A few ranchers had saved small herds. William Hornaday and Theodore Roosevelt helped start the American Bison Society in 1905. In 1907, fifteen bison were sent by train from the Bronx Zoo in New

York to the Wichita Mountains in Oklahoma, to start a new wild herd. Bison from ranches were also brought into Yellowstone to make its herd strong again.

Back from the edge. The plan worked! Today there are about half a million bison in North America, on ranches and in parks. In 2016, the bison was named the national mammal of the United States. It is a true story of **conservation**: people taking wise care of God's creatures.

A mighty animal. The bison is the heaviest land animal in North America. A big bull can weigh about 2,000 pounds and stand six feet tall at its hump. Even so, it can run about 35 miles an hour. Visitors to Yellowstone must stay far away from bison, because they can be dangerous.

PICTURE STUDY



Buffalo Bull, Grazing on the Prairie, George Catlin, 1832–1833 · Oil on canvas · Smithsonian American Art Museum, Washington, D.C.
Wikimedia Commons · Public domain

George Catlin traveled up the Missouri River in 1832 to paint the Plains Indians and the animals of the West, when the great bison herds still roamed. He painted this bull grazing on the open prairie.

Look closely

- Find the bison's hump. Where is it?
- Look at the land. Do you see any trees? Any houses?
- Is the bison in the middle of the painting or to one side?

Talk about it

1. How does the prairie in this painting make you feel?

2. Why do you think Catlin wanted to paint the West before it changed?

HANDS-ON: A HERD ON PAPER

See what a big difference there is between tens of millions and about a thousand.

You will need

- A sheet of paper
- A pencil, or a stamp pad and your fingertip

Steps

1. Make 100 small dots on your paper, in 10 rows of 10. Each dot is one bison.
2. Ten pages like yours would show 1,000 bison, about how many were left in 1889.
3. To show the tens of millions of bison of long ago, you would need more than a hundred thousand pages like yours, enough to fill many shelves of books!
4. On a new page, draw one big bison and write: “Saved!”

Check your work

- I made 100 dots in rows of 10.
- I can tell about how many bison were left in 1889 (fewer than 1,100).
- I can name one person who helped save the bison.

FIELD NOTEBOOK

1. Draw a bison. Label the hump, horns, beard and tail.
2. Write the names William Hornaday and Theodore Roosevelt, and one thing they did.

> **Did you know?** The bison’s big shoulder hump is made of strong muscle, which helps it swing its head to push snow aside in winter. Bison often face into a winter storm instead of turning away from it. Bison calves are born a reddish orange color and are sometimes called “red dogs.”

> **Goes deeper in.** Life Science, Grade 4, Lesson 5.4 “The bison saved” and Grade 8, Lesson 7.3 “Conservation success” (coming soon).

> **For families.** The stop names the hide hunters and the railroads plainly and notes that the Plains nations depended on the bison, without blame-laden language. The Expert level adds Hornaday’s 1889 report, *The Extermination of the American Bison*, as a primary source.

PRACTICE

1. EASY About how many bison were left in North America in 1889: about 100, about 1,000, or about 1,000,000?

2. MEDIUM Name one thing people did to save the bison.
3. EASY What is the national mammal of the United States?

> **Make it a game · Stampede and Storm.** Everyone is a bison on the prairie. When the leader shouts “Stampede!”, the herd runs to the far side of the yard. When she shouts “Storm!”, every bison stops and faces the leader, head down, like bison facing into the wind.

> **Scripture.** “A righteous man regardeth the life of his beast: but the tender mercies of the wicked are cruel.” (Proverbs 12:10, KJV)

A good person takes care of animals. The people who saved the bison showed this kind of care.

Practice: answers

1. About 1,000 (Hornaday counted fewer than 1,100).
2. Any one: ranchers kept small herds; the American Bison Society was started in 1905; fifteen bison were sent from the Bronx Zoo to Oklahoma in 1907; Yellowstone’s herd was protected and made stronger.
3. The American bison (named in 2016).

Track 1 badge quizzes

The badge quizzes are optional. Read each question aloud; the child may answer by talking, pointing or drawing. Four right out of five earns the badge. Badges and the certificate are earned by doing the stops, not by scores.

Badge quiz 1 (Stops A1–A5)

1. What is a family of lions called?
2. Who leads an elephant herd?
3. Why is a whale a mammal and not a fish? Give one reason.
4. How does a bat find a moth in the dark?
5. How many inches are in one hand, the unit for measuring horses?

Badge quiz 2 (Stops A6–A10)

6. Name one job a dog does with its nose to help people.
7. Who is the teddy bear named after?
8. What is the fastest land animal?
9. Where does a newborn kangaroo grow?
10. Name one person who helped save the American bison.

TRAIL CERTIFICATE: MY MAMMAL FIELD NOTEBOOK AND TRAIL A CERTIFICATE

Gather the Field Notebook pages from this trail into one booklet with a cover: “My Mammal Field Notebook,” your name and the dates you started and finished. Add a table of contents listing the ten animals.

When the booklet is done, a parent signs the Trail A certificate.

- **Ten stops**: At least one page for each stop, each with a title and a date.
- **Drawings**: Each animal is drawn with care, with at least two labels.
- **Facts**: Each page has at least one true fact in a complete sentence.
- **Cover**: A cover and a table of contents.

Answer key

1. A pride.
2. The matriarch, the oldest mother elephant.
3. It breathes air (or: it has live babies, or: it feeds its babies milk).
4. By echolocation: it makes sounds and listens for the echoes.
5. 4 inches.
6. Finding lost people, tracking, sniffing out danger (any reasonable answer).
7. President Theodore (Teddy) Roosevelt.
8. The cheetah.
9. In its mother’s pouch.

10. William Hornaday or Theodore Roosevelt (or the ranchers who kept small herds).

Explore Tracks · Trail B

The second trail of three interest tracks for curious Scouts: Animals (birds), Dinosaurs (the dinosaur hunters) and Great Battles of the Middle Ages. Short, self-paced stops with true stories, great pictures, hands-on projects and games.

First edition

> *The works of the LORD are great, sought out of all them that have pleasure therein.*
> *Psalm 111:2 (KJV)*

Course Guide

Explore Tracks are for children who want more of what they love. Each track is a trail of short stops. At every stop the child hears a true story, studies a great picture, does something with his or her hands, plays a game and adds a page to a Field Notebook.

Trail B is the second trail of each track at the 🟢 Scout level (ages 7–9). The Animals track meets the birds, from the eagle of Isaiah 40:31 to a real backyard bird count. The Dinosaurs track meets the dinosaur hunters, from Mary Anning in 1811 to Mary Schweitzer's soft tissue in 2005, and practices telling observations from interpretations, with a creation-friendly view of the dates on museum signs. The Great Battles track visits eight battles of the Middle Ages, from Tours (732) to Lepanto (1571). Trail A is not required first.

WHO IT IS FOR

Written for children about ages 7–9 who are read to by a parent, or who read short passages on their own. Older siblings can join in. Nothing earlier is required.

HOW TO USE THIS COURSE

1. **One stop at a time.** A stop takes 15–25 minutes: read the story aloud, look at the picture, do the hands-on part and play the game. Two or three stops a week works well.
2. **Any order.** The tracks are independent. Do one track at a time, or rotate between them.
3. **Field Notebook.** Every stop ends with a page for the notebook. At the end of the trail the pages become a booklet, and the parent signs the Trail B certificate.
4. **Badge quizzes.** Each track has two short, optional oral quizzes. They are for fun, not grades.

SCOPE AND SEQUENCE

Track 1: Animals 🐾 Trail B: Birds (Self-paced)

MATERIALS

- **Field Notebook (a sketchbook or composition book)**One for the whole trail.
- **Colored pencils, a ruler, scissors and glue**For drawings and maps.
- **Household things**Each hands-on project lists what it needs: blocks, clay, string, toy figures, cups.
- **A Bible (KJV)**For the verse at each stop.

GRADING

Explore Tracks are not graded. A stop is done when the child has heard the story, done the hands-on part and made a notebook page.

Badges and the Trail B certificate are earned by finishing the stops.

A NOTE TO PARENTS

You do not need to be an expert. Read the story aloud, look at the picture together and ask, “What do you notice?” Each stop has a short *For families* note with background and any facts that scholars still discuss.

Dinosaur dates: museums give ages in millions of years. This trail teaches the period names as museum words and explains that the dates are interpretations; many Christian families understand the fossils within a young earth and the Flood. Stop B10 (soft tissue) presents the young-earth reading and the discoverer’s own old-earth reading fairly.

Battles are told for young children: who, where, the plan, what happened and why it mattered, with honor for courage, faith and wisdom and no gory detail. Both sides are described fairly, in the terms of their own time.

Contents

Track 1: Animals 🐾 Trail B: Birds

1.1 Eagles: “Mount Up with Wings”
1.2 Owls, the Silent Hunters
1.3 Hummingbirds, the Smallest Birds
1.4 Penguins
1.5 Ostriches: Job 39
1.6 Parrots
1.7 Migration: Birds That Know the Way
1.8 Nests: Bird Builders
1.9 John James Audubon, the Bird Painter
1.10 The Backyard Bird Count

Each stop takes 15–25 minutes. Tracks may be done in any order, and a child may do just one track.

TRACK 1

Animals 🐾 Trail B: Birds

The second trail of the Animals track visits the birds: the eagle that “mounts up with wings,” the silent owl, the tiny hummingbird, the penguin, the ostrich of Job 39, parrots, migration, nests, John James Audubon the bird painter and a real backyard bird count. Each stop is a short read-aloud story, a picture to study, something to draw or build, quick questions, a game and a verse of Scripture.

This is the 🟢 **Scout** level, written for ages 7 to 9. A parent reads the story aloud, or a strong reader reads it alone. Every stop stands by itself. The 🔵 Ranger and 🔴 Expert levels of these same stops will add maps, numbers and primary sources later.

Five stops earn the **Bird Scout badge, part 1**, and ten stops earn part 2 and the **Trail B certificate**. The badge quizzes are at the end of the trail and are optional.

BEFORE YOU BEGIN

- Listen to a story of about five minutes and tell it back.
- Sit still and quiet for five minutes while watching something.
- Find North America, Africa, Australia, Antarctica and the oceans on a globe (a grown-up may help).

MASTERY CHECKLIST

☐ I can say what makes an animal a bird: feathers, wings, a beak, and eggs with hard shells.
☐ I can tell one true and surprising fact about each bird on this trail.
☐ I can name three kinds of nests and the birds that build them.
☐ I can tell why many birds migrate and one way they find their way.
☐ I can name five birds I have seen myself and keep a bird list in my Field Notebook.

OPTIONAL BOOKS AND RESOURCES

- **Cornell Lab of Ornithology: All About Birds** (https://www.allaboutbirds.org): Free bird guide with photos and recorded songs; good for checking a bird you saw.
- **Great Backyard Bird Count** (https://www.birdcount.org): The free February count used in Stop B10. Families may take part by keeping a paper list.
- **Biodiversity Heritage Library** (https://www.biodiversitylibrary.org): Old bird plates by Audubon, Gould and Lear to copy in the Field Notebook.

🟢 SCOUT · STOP B1 · TRACK 1 · STOP 1.1 · 15–25 MINUTES

1.1 Eagles: "Mount Up with Wings"

OBJECTIVES

- Describe how an eagle soars without flapping.
- Name two parts God gave the eagle for hunting: eyes and talons.
- Say Isaiah 40:31 and tell what it promises.

Warm-up. Stretch your arms out as wide as you can. Ask a grown-up to measure from fingertip to fingertip. A big bald eagle's wings stretch about 6 to 7 feet, wider than most grown-ups can reach!

Video slot. Video coming. Bald eagles soaring, fishing and at the nest; an eagle nest camera. Search the U.S. Fish and Wildlife Service, the National Park Service, the Cornell Lab of Ornithology (Bird Cams).

KEY TERMS

bird
An animal with feathers, wings and a beak that lays eggs with hard shells.

soar
To glide high in the air on rising air without flapping.

talon
A long, sharp, curved claw on a bird of prey.

bird of prey
A bird that hunts other animals with its feet and hooked beak, such as an eagle, hawk or owl.

CORE IDEAS

The story. High over a river in Alaska, a bald eagle spreads its great wings and does not flap them at all. It rides the warm air rising from the ground, round and round, higher and higher, until it is a tiny speck in the sky. Then it tips its wings and glides down toward the water. Its sharp eyes have spotted a fish.

Riding the wind. When the sun warms the ground, warm air rises in columns called thermals. Eagles hold their wings wide and let the rising air carry them up, the way a bit of ash floats up from a campfire. Because they do not need to flap much, eagles can stay in the air for a long time without getting tired.

Eyes and feet. An eagle can spot a rabbit or a fish from very far away. Its eyes are much sharper than ours. When it dives, it swings its feet forward and grabs its food with its **talons**, long curved claws. Rough bumps on the bottom of its toes help it hold a slippery fish.

A bird for a nation. In 1782, the bald eagle was put on the Great Seal of the United States. It is not really bald: "bald" is an old word for white-headed. Young bald eagles are brown all over and do not get their white heads and tails until they are about five years old. Once there were very few bald eagles left in the lower 48 states. People protected them, and now there are many again.

"Wings as eagles." The prophet Isaiah watched eagles too. He wrote that people who trust God "shall mount up with wings as eagles" (Isaiah 40:31). An eagle does not soar by its own hard work but by resting on the wind. In the same way, God gives strength to tired people who wait on Him.

PICTURE STUDY



White-headed Eagle (Bald Eagle), Plate 31 of The Birds of America, John James Audubon, 1828 · Hand-colored engraving (from Audubon's watercolor) · From The Birds of America
Wikimedia Commons · Public domain

John James Audubon painted every bird in his great book life-size. To fit a bald eagle on the page, he posed it bending down over its catch. Stop B9 tells more about Audubon.

Look closely

- Find the white head and tail. Find the hooked yellow beak.
- Look at the feet. How is the eagle holding the fish?
- Look at the eagle's eye. What does it seem to be doing?

Talk about it

1. Why do you think Audubon painted the eagle with its wings lifted up?
2. Why might a country choose an eagle for its emblem?

HANDS-ON: SOARING PAPER EAGLE

Make a paper glider with wide eagle wings and see how a wide wing helps a bird glide.

You will need

- A sheet of paper
- Crayons
- A paper clip
- Scissors (with a grown-up)

Steps

1. Fold the paper in half the long way and open it again.
2. Draw an eagle seen from below: a white head and tail and long brown wings spread wide with “finger” feathers at the tips. Cut it out along the outline.
3. Clip a paper clip on the head for weight.
4. Hold it gently and push it forward from shoulder height. Try bending the wing tips up a little. Which way does it glide farther?

Check your work

- My eagle has wide wings, a white head and a white tail.
- I tried my glider at least three times.
- I can tell what a thermal is (rising warm air).

FIELD NOTEBOOK

1. Draw an eagle soaring with its wings spread. Label the head, beak, wing, tail and talons.
2. Copy Isaiah 40:31 in your best handwriting.

> **Did you know?** Bald eagles build the biggest nests of any bird in North America. They add to the same nest year after year, and some weigh as much as a small car. Bald eagles live only in North America. In December 2024 a law made the bald eagle the official national bird of the United States, though it had been the national emblem since 1782.

> **Goes deeper in.** Life Science, Grade 3, Unit 2 “Birds” (coming soon); and Gardening & Animals, for birds of prey.

> **For families.** Bald eagles fell to a few hundred nesting pairs in the lower 48 states by the 1960s and were removed from the endangered species list in 2007 (U.S. Fish and Wildlife Service). The Great Seal was adopted in 1782; the national-bird law was signed in December 2024. The Hebrew word in Isaiah 40:31 may include large vultures as well as eagles; the KJV says “eagles.”

PRACTICE

1. EASY What does “bald” mean in the name bald eagle?
2. MEDIUM How can an eagle fly high without flapping?
3. EASY What are an eagle’s talons?

> **Make it a game · Eagle Eye.** One player hides a small toy somewhere in plain sight in a room or yard. The others stand still in one spot and use only their “eagle eyes” to find it. The first to spot it and point is the next to hide.

> **Scripture.** “But they that wait upon the LORD shall renew their strength; they shall mount up with wings as eagles; they shall run, and not be weary; and they shall walk, and not faint.” (Isaiah 40:31, KJV)

An eagle rests on the wind and rises. When we are tired, we can rest on God and He makes us strong.

Practice: answers

1. White-headed. The eagle has white feathers on its head, not a bare head.
2. It holds its wings wide and rides rising warm air (thermals).
3. Its long, sharp, curved claws.

1.2 Owls, the Silent Hunters

OBJECTIVES

- Explain how special feathers let an owl fly silently.
- Tell why an owl turns its whole head to look around.
- Say what an owl pellet is.

> **Warm-up.** Turn your head as far to the left as you can, then as far to the right. Some owls can turn their heads about three quarters of the way around, much farther than you can!

Video slot. Video coming. Barn owls in slow motion: silent flight and hunting by sound. Search the Cornell Lab of Ornithology, the Smithsonian, approved nature channels (vetted per video).

KEY TERMS

nocturnal
Awake and active at night.

owl pellet
A little bundle of bones and fur that an owl coughs up after a meal.

facial disk
The round, dish-shaped face of an owl that gathers sound to its ears.

prey
An animal that is hunted for food.

CORE IDEAS

The story. It is a dark night on a farm. A mouse creeps out from under the barn to look for seeds. High above, a barn owl glides across the field. The mouse hears nothing at all: no flapping, no whoosh. Suddenly the owl drops down out of the dark. The barn owl found the mouse by its tiny rustling sounds, even though it could hardly see it.

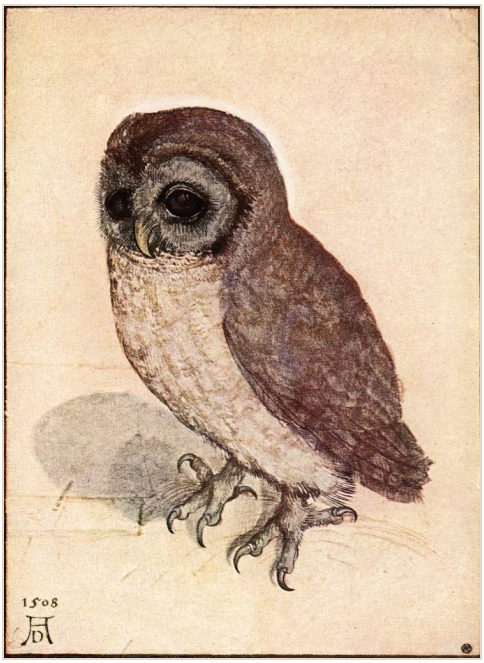
Silent wings. Most birds make a whooshing sound when they fly. But the front edge of an owl's wing feathers has a soft fringe like the teeth of a comb, and the feathers are velvety on top. These special feathers break up the air so gently that the owl's flight is almost silent. Engineers have studied owl feathers to make quieter fans and trains.

A face that hears. Many owls have a round, flat face called a **facial disk**. It works like a satellite dish, gathering sounds and sending them to the ears, which are hidden under the feathers. In barn owls, one ear opening is a little higher than the other. This helps the owl tell exactly where a sound is coming from, up or down, left or right.

Turning heads. An owl's big eyes are shaped like tubes, and they cannot roll around the way yours can. So instead, an owl turns its whole head. It has twice as many bones in its neck as you have, and it can turn its head about 270 degrees, three quarters of the way around.

Owl pellets. Owls often swallow a mouse whole. Later, the owl coughs up the parts it cannot digest, the bones and fur, in a neat little bundle called an **owl pellet**. Scientists open pellets to find out what owls have been eating.

PICTURE STUDY



Little Owl, Albrecht Dürer, 1506 · Watercolor and gouache on paper · Albertina, Vienna
Wikimedia Commons · Public domain

Albrecht Dürer was a great German artist who loved to paint animals exactly as they looked. He painted this little owl about five hundred years ago. You can almost feel how soft its feathers are.

Look closely

- Look at the eyes. Do they look at you?
- Find the tiny light spots on the feathers.
- Find the beak. Is it big or small?

Talk about it

1. How do you think Dürer made the feathers look so soft?
2. If this owl could talk, what would it say to you?

> **Safety first.** Use only owl pellets sold for schools, which have been heated to make them clean. Wear gloves or use tweezers, and wash your hands afterward. Never pick up a pellet or a feather from a wild bird’s roost.

HANDS-ON: OWL PELLET DETECTIVE

Open an owl pellet and find out what the owl ate. (If you cannot get a pellet, try “Owl Ears” in the tips.)

You will need

- A clean owl pellet from a school supply store
- Tweezers or a toothpick
- A paper plate
- Gloves
- A bone chart (often comes with the pellet)

Steps

1. Put the pellet on the plate. Gently pull it apart with the tweezers.
2. Separate the fur from the bones. Look for tiny skulls, jaws and leg bones.
3. Use the chart to match the bones. Was it a mouse, a vole, a shrew or a bird?
4. Glue a few bones on a card and label them.

Tips

- Owl Ears: cup your hands behind your ears like a facial disk. Have someone whisper across the room. Can you hear better with “owl ears” or without?

Check your work

- I found at least three bones.
- I can say what the owl ate.
- I washed my hands.

FIELD NOTEBOOK

1. Draw an owl’s face with its round facial disk and big eyes. Label the eyes, beak and disk.
2. Write: “An owl flies silently because…” and finish the sentence.

> **Did you know?** The little elf owl of the American Southwest is about the size of a sparrow; the great gray owl can be more than 2 feet tall. The “horns” of a great horned owl are only tufts of feathers, not ears. Snowy owls often hunt in the daytime during the long summer days of the Arctic.

Goes deeper in. Life Science, Grade 3, Unit 2 “Birds” and Grade 5, “Food chains” (coming soon).

For families. The 270-degree figure and the extra neck vertebrae (14, versus 7 in people) follow the Johns Hopkins study of owl necks (2013). Uneven ear openings are best known in barn owls and some other owls, not all. Pellet dissection is a classic science activity; buy heat-sterilized pellets.

PRACTICE

1. EASY What is an owl pellet?
2. MEDIUM Why does an owl turn its whole head instead of its eyes?
3. EASY What does nocturnal mean?

Make it a game · Silent Owl. One player sits blindfolded in the middle as the “mouse.” The others are owls and try to tiptoe up and touch the mouse’s shoulder. If the mouse hears an owl and points at it, that owl must go back to the wall.

Scripture. “I am like a pelican of the wilderness: I am like an owl of the desert.” (Psalm 102:6, KJV)

The writer felt lonely, like an owl alone in a wild place. But in the same psalm he trusts that God hears the prayers of the lonely.

Practice: answers

1. A bundle of bones and fur an owl coughs up after it eats.
2. Its eyes are tube-shaped and cannot move in their sockets.
3. Awake and active at night.

1.3 Hummingbirds, the Smallest Birds

OBJECTIVES

- Tell how a hummingbird can hover and fly backward.
- Explain why a hummingbird must eat so often.
- Describe the long trip ruby-throated hummingbirds make each fall.

> **Warm-up.** Flap your arms up and down as fast as you can for ten seconds. How many flaps did you do? A ruby-throated hummingbird beats its wings about 50 times every second!

Video slot. Video coming. Hummingbirds in slow motion: hovering, flying backward, feeding at flowers. Search the Cornell Lab of Ornithology, the Smithsonian, the National Park Service.

KEY TERMS

hover
To stay in one place in the air.

nectar
The sweet juice inside flowers.

pollen
Yellow dust in flowers that helps them make seeds.

torpor
A deep, cold sleep that saves energy, like a one-night hibernation.

CORE IDEAS

The story. A bright red flower nods in a summer garden. Suddenly, with a buzz like a big bee, a tiny bird zips in and stops in mid-air in front of it. Its wings are a blur. It pokes its long, thin beak into the flower and drinks. Then it flies backward, turns and zooms away. That was a ruby-throated hummingbird.

Wings like a figure eight. Hummingbirds are the only birds that can hover in one place for a long time and fly backward. Most birds push on the air mostly as their wings go down. A hummingbird twists its wings so that it pushes on the air going down and coming back up, tracing a sideways figure eight. That is why it can stay still in the air like a tiny helicopter.

Always hungry. All that flapping takes a lot of energy. A hummingbird’s heart can beat more than a thousand times a minute. It must drink **nectar** from hundreds of flowers every day, and it catches tiny insects too. At night, to save energy, it may go into **torpor**, a deep sleep in which its body cools down and its heart slows.

A long trip for a tiny bird. A ruby-throated hummingbird weighs about as much as a penny. Yet every fall, many of them fly from North America to Mexico and Central America for the winter. Some fly straight across the Gulf of Mexico, about 500 miles over water, without stopping!

Helpers for flowers. When a hummingbird drinks, yellow **pollen** sticks to its head. At the next flower, some pollen rubs off, and that helps the flower make seeds. God made the hummingbird and the flower to help each other.

PICTURE STUDY



Hummingbirds, from A Monograph of the Trochilidae, John Gould, 1849–1861 · Hand-colored lithograph · From A Monograph of the Trochilidae, or Family of Humming-birds
Wikimedia Commons · Public domain

John Gould was an English bird expert and artist. He loved hummingbirds so much that he made a great five-volume book about them. To show how hummingbird feathers glitter, the printers used gold and shiny varnish under the colors.

Look closely

- Find the long, thin beaks. What are they made for?
- Look for colors that seem to shine.
- Find a hummingbird near a flower or a nest. What is it doing?

Talk about it

1. Why do you think Gould wanted his pictures to shine?
2. Which hummingbird would you most like to see in real life?

HANDS-ON: A HUMMINGBIRD FEEDER

Make a simple feeder and watch for hummingbirds (spring to fall in most of North America).

You will need

- A small clean bottle or a store feeder
- White table sugar and water (no honey, no red dye)
- Red ribbon or red tape
- String
- A grown-up for the stove

Steps

1. With a grown-up, stir 1 part sugar into 4 parts water and bring it to a boil. Let it cool.
2. Fill the feeder. Tie red ribbon around it; red attracts hummingbirds.
3. Hang it in a shady spot near flowers, where you can see it from a window.
4. Change the sugar water every few days, more often in hot weather, and wash the feeder.

Check your work

- My feeder uses 1 part sugar to 4 parts water.
- I hung it where I can watch it.
- I wrote down the date and time of any visitor.

FIELD NOTEBOOK

1. Draw a hummingbird hovering at a flower. Draw a sideways figure eight beside its wing to show how it moves.
2. Make a chart: date, time, and how many hummingbirds came to the feeder.

> **Did you know?** The bee hummingbird of Cuba is the smallest bird in the world, about 2 inches long. A hummingbird nest is about the size of half a walnut shell and is held together with spider silk, so it can stretch as the babies grow. Hummingbirds live only in North and South America and the islands near them.

> **Goes deeper in.** Life Science, Grade 2, “Pollination” and Gardening & Animals, “A garden for birds and butterflies” (coming soon).

> **For families.** The 1:4 sugar recipe and “no red dye” follow the National Audubon Society. The wing-beat rate (about 53 per second), weight (about 3 grams) and Gulf crossing (about 500 miles) are for ruby-throated hummingbirds (Cornell Lab, All About Birds); other kinds differ.

PRACTICE

1. EASY Name one thing a hummingbird can do that most birds cannot.
2. MEDIUM Why must a hummingbird eat so often?
3. EASY What is the smallest bird in the world?

Make it a game · Nectar Relay. Set out paper “flowers” around the yard with a few dried beans on each. Players are hummingbirds and must “sip” (pick up) one bean at a time, buzzing as they fly, and bring it back to the nest cup. Which team fills its cup first?

Scripture. “Behold the fowls of the air: for they sow not, neither do they reap, nor gather into barns; yet your heavenly Father feedeth them. Are ye not much better than they?” (Matthew 6:26, KJV)

God fills the flowers with nectar for the tiny hummingbird. He cares for us even more.

Practice: answers

1. Hover in one place, or fly backward.
2. Its fast wings and heartbeat use a great deal of energy.
3. The bee hummingbird of Cuba.

1.4 Penguins

OBJECTIVES

- Explain how a penguin “flies” underwater.
- Tell how emperor penguin fathers keep their eggs warm.
- Find Antarctica on a globe.

> **Warm-up.** Put a ball or a beanbag on top of your feet and try to walk without dropping it. Emperor penguin fathers carry their egg on their feet like this for about two months!

> **Video slot.** Video coming. Emperor penguins: the huddle, the father with the egg, penguins swimming. Search the British Antarctic Survey, the Smithsonian, approved nature channels (vetted per video).

KEY TERMS

flipper
A penguin’s stiff, flat wing, used for swimming.

Antarctica
The icy continent at the bottom of the world, around the South Pole.

huddle
A tight group that stands close together to keep warm.

colony
A big group of birds that nest in the same place.

CORE IDEAS

The story. It is the middle of winter in Antarctica, the coldest place on earth. The sun does not rise for weeks. The wind howls across the ice. Thousands of emperor penguin fathers stand pressed together in a great **huddle**. Each one has a single egg balanced on his feet, tucked under a warm flap of feathered skin. The mothers have gone far away to the sea to eat.

The patient fathers. For about two months, the fathers hold the eggs and do not eat at all. The huddle slowly shuffles, so that birds on the cold outside take turns moving into the warm middle. If the chick hatches before the mother is back, the father feeds it a little milky food from his throat. Then the mothers come back from the sea, full of fish, and find their families by their calls.

Birds that fly underwater. Penguins are birds. They have feathers, beaks and wings, and they lay eggs. But penguins cannot fly in the air. Their wings are stiff, flat **flippers**, and with them penguins “fly” through the water instead. Emperor penguins can dive deeper than 1,600 feet to catch fish and squid.

Dressed for the cold. A penguin’s short feathers lie close together like shingles on a roof, keeping out wind and water. Under its skin is a thick layer of fat. Its black back and white front help it hide in the sea: from above it looks like the dark water, and from below it looks like the bright sky.

Penguins of the south. Wild penguins live in the southern half of the world. Some, like the emperor, live in Antarctica. Others live in South America, Africa, Australia and New Zealand. The little Galápagos penguin lives almost on the equator.

PICTURE STUDY



Emperor Penguin (Aptenodytes forsteri), Lithograph printed by Charles Joseph Hullmandel, 1844 · Hand-colored lithograph · From The Zoology of the Voyage of H.M.S. Erebus & Terror
Wikimedia Commons · Public domain

In 1839–1843, two British ships, the *Erebus* and the *Terror*, sailed to Antarctica. Scientists on board brought back penguin skins and notes, and artists in London made colored prints from them for a book about the animals of the voyage. This plate shows the emperor penguin.

Look closely

- Find the bright patch of color on the penguin’s neck.
- Look at the flippers. Do they look like wings for flying?
- Look at the feet. Why might short legs be good on the ice?

Talk about it

1. Why do you think the artist put the sea behind the penguins?
2. How is a penguin like other birds, and how is it different?

HANDS-ON: PENGUIN EGG WALK AND BLUBBER GLOVE

Find out how hard it is to carry an egg like an emperor dad, and how fat keeps a penguin warm.

You will need

- A plastic egg or a small ball
- Two zip-top sandwich bags
- Solid vegetable shortening
- A bowl of ice water
- Tape

Steps

1. Egg walk: put the egg on your feet and shuffle across the room without dropping it.
2. Blubber glove: with a grown-up, scoop a thick layer of shortening into one bag. Put your hand in the empty bag, then push it into the shortening bag so the fat is all around your hand. Tape the tops together loosely.
3. Put your “blubber” hand and your bare hand in the ice water.
4. Which hand gets cold first?

Check your work

- I carried the egg on my feet.
- I tested the blubber glove.
- I can tell how fat helps a penguin stay warm.

FIELD NOTEBOOK

1. Draw an emperor penguin father with an egg on his feet. Label the flipper, beak, feet and egg.
2. Draw a map of the world and color Antarctica white.

> **Did you know?** The emperor penguin is the biggest penguin. It stands almost 4 feet tall, a little shorter than many seven-year-olds. Penguins slide on their bellies across the ice, pushing with their feet. This is called tobogganing. Penguins can drink salt water. A special gland above the eyes takes the extra salt out.

> **Goes deeper in.** Life Science, Grade 3, Unit 2 “Birds” and Geography, Antarctica (coming soon).

> **For families.** Emperor penguin facts follow the British Antarctic Survey and the Australian Antarctic Program: the male incubates for about 65 days without food; recorded dives exceed 500 m (over 1,600 ft); height up to about 115 cm (45 in). The plate

is from *The Zoology of the Voyage of H.M.S. Erebus & Terror* (1844), printed by Hullmandel (Wikimedia Commons file page).

PRACTICE

1. EASY Can penguins fly in the air?
2. MEDIUM How do emperor penguin fathers stay warm in the winter?
3. EASY Where do wild penguins live: the north or the south of the world?

Make it a game · Penguin Huddle. Everyone huddles in a tight group. The leader calls "Wind!" and the players on the outside must shuffle around to the middle, while the inside ones move out. Keep your "egg" (a beanbag) on your feet the whole time.

Scripture. "He giveth snow like wool: he scattereth the hoarfrost like ashes." (Psalm 147:16, KJV)

God rules the snow and ice. He made the emperor penguin able to live where almost nothing else can.

Practice: answers

1. No. They "fly" underwater with their flippers.
2. They huddle close together and take turns in the warm middle.
3. The south (the Southern Hemisphere).

1.5 Ostriches: Job 39

OBJECTIVES

- Tell three ways the ostrich is the biggest bird.
- Read Job 39:13–18 and tell what God says about the ostrich.
- Explain why the “head in the sand” story is not true.

Warm-up. Look at your feet and count your toes: ten. Now guess how many toes an ostrich has on each foot. Only two! That helps it run very fast.

Video slot. Video coming. Ostriches running and the size of an ostrich egg. Search the San Diego Zoo Wildlife Alliance, the Smithsonian’s National Zoo, approved nature channels.

KEY TERMS

ostrich
The largest living bird. It cannot fly, but it runs very fast.

flightless
Not able to fly.

plume
A big, soft, fluffy feather.

savanna
A wide, grassy land with a few trees.

CORE IDEAS

The story. Long ago, God spoke to a man named Job out of a whirlwind. He asked Job about the wonders of His creation. One of the animals God talked about was the ostrich. God said that the ostrich does not seem very wise, but “what time she lifteth up herself on high, she scorneth the horse and his rider” (Job 39:18). That means when an ostrich gets up and runs, it laughs at a horse and rider, because it can outrun them!

The biggest bird. The ostrich lives on the dry **savannas** and deserts of Africa. It is the biggest bird in the world. A male can be about 9 feet tall and weigh more than two grown men. It lays the biggest egg of any living bird, as heavy as about two dozen chicken eggs.

Running, not flying. An ostrich has wings but cannot fly. Instead it runs on two long, strong legs. Each foot has just two toes, and one is very big, almost like a hoof. An ostrich can run about 40 miles an hour, as fast as a car on a town road, and keep going a long way. It holds out its wings to help it balance and turn.

Big eyes. An ostrich's eyes are about 2 inches across, the biggest eyes of any land animal, and bigger than its brain! Its height and sharp eyes help it see danger far across the plains. Zebras and antelope often graze near ostriches, which act like lookouts.

Head in the sand? People say that a frightened ostrich buries its head in the sand. That is not true. An ostrich that is nesting may lie flat on the ground with its long neck stretched out, to hide. From far away, it can look as though its head is in the ground. The parents also put their heads down to turn their eggs in the shallow nest.

PICTURE STUDY



Ostrich (Struthio camelus), Plate I of A Book of Birds, Color plate in W. P. Pycraft's book, 1908 · Color plate · From A Book of Birds by W. P. Pycraft, London
Wikimedia Commons · Public domain

This picture comes from a bird book written for families more than a hundred years ago by W. P. Pycraft, a bird scientist at the Natural History Museum in London. It shows a male ostrich, black with white wing and tail plumes, striding along on his long legs.

Look closely

- Find the toes on each foot.
- Look at the feathers. Which ones are fluffy plumes?
- Compare the neck and legs. Which is longer?

Talk about it

1. How would you feel standing next to an ostrich?
2. Why do you think God told Job about the ostrich?

HANDS-ON: LIFE-SIZE OSTRICH AND EGG

See how big an ostrich and its egg really are.

You will need

- Painter’s tape
- A tape measure
- A sheet of paper and a pencil
- A chicken egg (to compare)

Steps

1. On a wall or a door, put a piece of tape 9 feet from the floor (a grown-up helps). That is the top of a big ostrich’s head.
2. Stand beside it. Mark your own height. How much taller is the ostrich?
3. On paper, draw an oval about 6 inches long and 5 inches wide. That is an ostrich egg.
4. Put the chicken egg on top of your drawing. How many chicken eggs would fit?

Check your work

- I marked 9 feet on the wall.
- I compared my height to the ostrich.
- I drew a life-size ostrich egg.

FIELD NOTEBOOK

1. Draw an ostrich running with its wings spread. Label the two-toed foot, the neck and the plumes.
2. Write: “She scorneth the horse and his rider” (Job 39:18).

> **Did you know?** An ostrich egg shell is so strong that a grown-up can stand on it without breaking it. Ostriches swallow pebbles. The stones help grind up the food in their stomachs. A kick from an ostrich is very powerful, so even lions are careful around them.

> **Goes deeper in.** Life Science, Grade 3, Unit 2 “Birds” and Bible reading, Job 38–39.

> **For families.** Read Job 39:13–18 aloud together. The passage says the ostrich “leaveth her eggs in the earth” and forgets that a foot may crush them; ostriches do lay in shallow ground scrapes, and the passage is God’s poetry about how He provides even for a creature that seems foolish. Speed is given as about 40 mph; many sources give up to about 43 mph (70 km/h). Height up to about 9 ft and weight up to about 320 lb (San Diego Zoo Wildlife Alliance; Britannica).

PRACTICE

1. EASY Can an ostrich fly?

2. MEDIUM Does an ostrich really bury its head in the sand? What does it do instead?
3. EASY How many toes does an ostrich have on each foot?

> **Make it a game · Ostrich Race.** Players race with their hands tucked behind them like folded wings. Then race again around a cone with arms held out like wings for balance. Which way is easier to turn?

> **Scripture.** “What time she lifteth up herself on high, she scorneth the horse and his rider.” (Job 39:18, KJV)

God made the ostrich able to outrun a horse. He is the one who gives every animal its gifts.

Practice: answers

1. No, but it can run very fast.
2. No. It may lie flat with its neck on the ground to hide, or put its head down to turn its eggs.
3. Two.

1.6 Parrots

OBJECTIVES

- Describe a parrot's beak and feet and how it uses them.
- Tell how some parrots can copy words.
- Tell the story of Edward Lear, who painted parrots as a young man.

Warm-up. Try to hold a grape with your toes. Hard, isn't it? Many parrots hold their food in one foot, like a hand, and take bites from it!

Video slot. Video coming. Parrots in the wild: macaws at a clay lick, parrots using beak and feet; an African grey talking. Search the Smithsonian's National Zoo, the San Diego Zoo Wildlife Alliance, approved nature channels.

KEY TERMS

parrot
A bird with a strong, hooked beak and feet with two toes in front and two behind.

mimic
To copy sounds or actions.

macaw
A large, brightly colored parrot with a long tail.

flock
A group of birds that live and travel together.

CORE IDEAS

The story. In 1830, a young man named Edward Lear went to the London Zoo again and again. He was only eighteen. He sat with paper and pencils in front of the parrots and drew the birds from life, feather by feather. Then he made the drawings into big colored prints. His book of parrots made people say he was one of the best bird painters in England. Later, Edward Lear became famous for something else: funny poems, like "The Owl and the Pussy-cat."

A beak like a nutcracker. A parrot has a strong, hooked **beak**. The top part curves down over the bottom part. It can crack hard nuts and seeds that people need a hammer to open. A parrot also uses its beak like a third foot to pull itself up when it climbs through the trees.

Feet like hands. Look at a parrot's foot and you will see two toes pointing forward and two pointing back. This helps it grip branches tightly. Many parrots pick up food with one foot and hold it up to the beak, the way you hold a sandwich.

Copycats with feathers. Some parrots, like the African grey, can **mimic** words, whistles, even a ringing telephone. In the wild, parrots live in noisy **flocks** and learn the calls of their flock. A pet parrot may treat its family as its flock and learn the sounds it hears around the house.

Colors from the Creator. Parrots live mostly in warm places: South and Central America, Africa, Asia and Australia. Many are bright green, red, yellow or blue. A flock of scarlet macaws flying over the rainforest looks like a rainbow with wings.

PICTURE STUDY



Blue and Yellow Macaw, from Illustrations of the Family of Psittacidae, or Parrots, Edward Lear, 1830–1832 · Hand-colored lithograph · From Lear's book of parrots, London
Wikimedia Commons · Public domain

Edward Lear drew this parrot from a living bird when he was still a teenager. He drew the birds himself on lithograph stones, and the prints were colored by hand.

Look closely

- Find the hooked beak.
- Look at the feet. How many toes point forward? How many point back?
- Count the colors you can see.

Talk about it

1. Why do you think Lear drew from live birds, not stuffed ones?
2. What would this parrot say if it could talk?

HANDS-ON: A PARROT TOE GRIP

Find out why two toes forward and two toes back make a strong grip.

You will need

- A broom handle or a thick stick
- A grown-up helper

Steps

1. Hold the stick with all four fingers on one side and nothing on the other (thumb off). Ask a grown-up to gently try to pull it out of your hand.
2. Now hold it with two fingers in front and your thumb and one finger wrapped behind. Try again.
3. Which grip held better?
4. Draw a parrot foot gripping a branch in your Field Notebook.

Check your work

- I tried both grips.
- I can say how many toes a parrot has in front and behind.

FIELD NOTEBOOK

1. Draw a parrot holding a nut in its foot. Label the hooked beak, the two front toes and the two back toes.
2. Write the name Edward Lear and one thing he did.

> **Did you know?** The kākāpō of New Zealand is a parrot that cannot fly. It is the heaviest parrot in the world, and it walks and climbs instead. Macaws in South America gather at riverbanks to eat clay, which scientists think gives them salt they need. The United States once had its own parrot, the Carolina parakeet. The last known one died at the Cincinnati Zoo in 1918.

> **Goes deeper in.** Life Science, Grade 3, Unit 2 “Birds”; Composition, nonsense verse (Lear) (coming soon).

> **For families.** Lear’s *Illustrations of the Family of Psittacidae, or Parrots* came out in parts from 1830 to 1832; he began at 18, drawing living birds, many at the Zoological Society’s gardens in London. Read James 3:7–10 together for the point about the tongue.

PRACTICE

1. EASY How are a parrot’s toes arranged?
2. MEDIUM Why might a pet parrot learn the words its family says?
3. EASY Who was Edward Lear?

> **Make it a game · Parrot Says.** One player is the parrot. Another says a short word or makes a sound, and the parrot must copy it exactly. Take turns making the sounds harder: a whistle, a word in another language, a tongue twister.

> **Scripture.** “For every kind of beasts, and of birds, and of serpents, and of things in the sea, is tamed, and hath been tamed of mankind:” (James 3:7, KJV)

People can teach a parrot to talk. James says the harder job is taming our own tongue, so that we speak kind and true words.

Practice: answers

1. Two point forward and two point back.
2. In the wild, parrots learn the calls of their flock; a pet treats its family as its flock.
3. An English artist who painted parrots as a young man and later wrote funny poems.

1.7 Migration: Birds That Know the Way

OBJECTIVES

- Explain what migration is and why many birds migrate.
- Name two ways birds find their way.
- Tell about the Arctic tern, which makes the longest journey.

Warm-up. Go outside and find where the sun is (do not look right at it). Point to it. Birds can use the sun like a compass to find their way.

Video slot. Video coming. Bird migration: geese in V-formation, the Arctic tern, tracking birds. Search the Cornell Lab of Ornithology (BirdCast), the U.S. Fish and Wildlife Service, the Smithsonian Migratory Bird Center.

KEY TERMS

migration
A long trip that animals make each year to a different place and back.

V-formation
The shape of a V that geese fly in to save energy.

compass
A tool that shows which way is north.

season
One of the four parts of the year: spring, summer, fall and winter.

CORE IDEAS

The story. One cool fall morning, you hear honking high overhead. You look up and see a long V of Canada geese flying south. Where are they going? How do they know the way? Long ago, the prophet Jeremiah wondered at the same thing. He wrote that “the stork in the heaven knoweth her appointed times” and that the crane and the swallow “observe the time of their coming” (Jeremiah 8:7).

Why birds migrate. In the far north, summer is full of insects, seeds and long days, a perfect time to raise babies. But winter brings snow and ice, and food is hard to find. So many birds fly south to warmer places for the winter and come back in the spring. This long trip is called **migration**.

How they find the way. Birds do not have maps, but God gave them other ways to find the way. Many birds use the sun by day and the stars by night. Many can sense the earth’s magnetic pull, like a built-in **compass**. They also remember rivers, mountains and coastlines. Many young songbirds make their first trip alone, with no one to show them the way.

The champion traveler. The Arctic tern is a small white bird with a black cap. It nests in the far north in summer, then flies all the way to the seas around Antarctica for the southern summer, and back again. Scientists who tracked terns with tiny devices found that they flew about 44,000 miles in one year. That is like flying around the whole earth more than one and a half times!

The V of the geese. Geese fly in a **V-formation**. Each goose rides on the air stirred up by the wings of the goose ahead, so it does not have to work as hard. When the leader gets tired, it drops back, and another goose takes the front. Teamwork helps the whole flock fly farther.

PICTURE STUDY



Geese Flying Past the Full Moon, Utagawa Hiroshige, 1832–1835 · Woodblock print · San Diego Museum of Art
Wikimedia Commons · Public domain

Utagawa Hiroshige was a famous Japanese artist who made prints from carved wooden blocks. In this print, wild geese fly past a full autumn moon. In Japan, as in America, geese flying overhead were a sign that fall had come.

Look closely

- Count the geese. Are they flying in a line?
- Find the moon. Is it big or small in the picture?
- What time of day is it?

Talk about it

1. How does this picture make you feel: quiet, lonely, happy?
2. What sign of fall do you notice where you live?

HANDS-ON: MIGRATION MAP

Draw the paths of migrating birds on a map of the world.

You will need

- A printed world map or a big sheet of paper
- Colored pencils or yarn
- Glue or tape

Steps

1. Find the Arctic (top) and Antarctica (bottom).
2. Draw an Arctic tern's nest near the top. Draw a long, curving line all the way down the Atlantic Ocean to Antarctica, and another line back up.
3. In a second color, draw a Canada goose path from Canada to the southern United States.
4. In a third color, draw a ruby-throated hummingbird's path from the eastern United States across the Gulf of Mexico (from Stop B3).

Check your work

- My map shows three bird journeys.
- I labeled north and south.
- I can tell which bird goes the farthest (the Arctic tern).

FIELD NOTEBOOK

1. Draw a V of geese flying across the page. Write the date you last saw or heard geese.
2. Copy the first part of Jeremiah 8:7: "Yea, the stork in the heaven knoweth her appointed times."

Did you know? A bar-tailed godwit was tracked flying from Alaska to Tasmania, Australia, without stopping: more than 8,000 miles in about 11 days. Many songbirds migrate at night. On a spring night, thousands of birds may be flying over your house. Before people understood migration, some thought swallows slept at the bottom of ponds all winter.

Goes deeper in. Life Science, Grade 4, "Seasons and animal journeys" and Geography, using a world map (coming soon).

For families. Arctic tern distance follows Egevang et al., *PNAS* (2010): an average of about 70,900 km (about 44,000 miles) a year for terns tracked from Greenland. The godwit record (2022, about 13,560 km, Alaska to Tasmania in about 11 days) was reported by the tracking team and Guinness World Records. "Turtle" in KJV Jeremiah 8:7 means turtledove.

PRACTICE

1. EASY What is migration?
2. MEDIUM Name two ways birds find their way.
3. EASY Which bird makes the longest migration?

> **Make it a game · Follow the Leader V.** Players line up in a V behind a leader and “fly” around the yard. When the leader calls “Tired!”, she moves to the back of one arm of the V and the next player takes the front.

> **Scripture.** “Yea, the stork in the heaven knoweth her appointed times; and the turtle and the crane and the swallow observe the time of their coming; but my people know not the judgment of the LORD.” (Jeremiah 8:7, KJV)

The “turtle” here is the turtledove, a bird. Birds keep the times God set for them. God wants His people to listen to Him too.

Practice: answers

1. A long trip animals make each year to another place and back.
2. Any two: the sun, the stars, the earth’s magnetic pull, landmarks like rivers and coasts.
3. The Arctic tern.

🟢 SCOUT · STOP B8 · TRACK 1 · STOP 1.8 · 15–25 MINUTES

1.8 Nests: Bird Builders

OBJECTIVES

- Name four kinds of bird nests and what they are made of.
- Tell how a bird builds a nest with only its beak and feet.
- Explain why we look at nests but do not touch them.

> **Warm-up.** Put two clothespins together like a beak and try to pick up a piece of yarn with them. Birds build whole nests with nothing but a beak and feet.

> **Video slot.** Video coming. How birds build nests: weaver birds, robins and an eagle nest camera. Search the Cornell Lab of Ornithology (NestWatch, Bird Cams), approved nature channels.

KEY TERMS

nest
A home a bird builds to lay its eggs and raise its babies.

weaver
An African bird that ties grass into knots to weave a hanging nest.

clutch
All the eggs a bird lays in one nest at one time.

fledgling
A young bird that has just left the nest.

CORE IDEAS

The story. In the spring, a robin hops across the lawn with a beak full of dry grass. She flies to the fork of a tree, drops the grass and goes back for more. She brings twigs, grass and mud. She sits in the middle of the pile and turns round and round, pressing it into a cup with her breast. In a few days her nest is done. Soon there will be bright blue eggs in it.

Builders without hands. Birds have no hammers and no hands. They build with their beaks and feet alone. Yet each kind of bird builds its own kind of nest, the right shape for its eggs, often the very first time it tries.

Many kinds of nests. Robins make neat cups of grass and mud. Bald eagles pile up sticks into huge platforms high in a tree. Hummingbirds make tiny cups held together with spider silk. Many **weaver** birds of Africa tie real knots in strips of grass to weave a ball that hangs from a branch, with the door underneath. The ovenbird of South America builds a round house of mud that dries hard in the sun, like a little clay oven.

Some birds hardly build at all. A killdeer lays its speckled eggs in a little scrape on the gravel. The eggs look just like stones. Woodpeckers chip a hole in a tree. And the emperor penguin, as you learned, has no nest at all, only its father's feet!

Look, but do not touch. If you find a nest with eggs or babies, stay back and watch quietly. If the parents are frightened away, the eggs can get cold. In the United States, the nests and eggs of most wild birds are protected by law. The best way to help a bird family is to give it space.

PICTURE STUDY



Bird's Nest, Apple Blossom and Primroses, William Henry Hunt, about 1845–1850 · Watercolor · Birmingham Museums Trust, England
Wikimedia Commons · Public domain

William Henry Hunt was an English painter who painted bird nests so often that people nicknamed him "Bird's Nest Hunt." He painted every twig and every egg with tiny brushstrokes.

Look closely

- Count the eggs. What color are they?
- Find the different materials in the nest: twigs, grass, moss.
- Look at the plants. What season do you think it is?

Talk about it

1. Why do you think Hunt liked to paint nests?
2. How long do you think it took the bird to build this nest?

> **Safety first.** Never take a nest, egg or feather from the wild. Watch nests from a distance and leave quickly if the parents seem upset.

HANDS-ON: BUILD A NEST WITH A “BEAK”

Try to build a bird’s nest, then put out nesting materials to help real birds.

You will need

- Twigs, dry grass, leaves and moss from the yard
- A little mud or play dough
- Two clothespins (your “beak”)
- A mesh bag or an empty suet cage
- Short pieces of plain cotton string (under 3 inches)

Steps

1. Use only the clothespins to pick up and place twigs and grass. Try to make a cup shape.
2. Press a little mud into the bottom to hold it together. Is it easy?
3. Fill the mesh bag with short string and dry grass and hang it outside in spring for birds to use.
4. Watch the bag from a window. Write down any birds that take something.

Tips

- Do not put out dryer lint, long strings or plastic, which can harm birds.

Check your work

- I built a nest cup.
- I used only my “beak” for at least part of it.
- I put out nesting materials for real birds.

FIELD NOTEBOOK

1. Draw three kinds of nests: a robin’s cup, a weaver’s hanging ball and an eagle’s stick platform. Label them.
2. If you find a nest, draw it from a distance and write the date and place.

> **Did you know?** All the eggs in one nest are called a clutch. A robin usually lays 3 to 5 blue eggs. The sociable weaver of southern Africa builds giant shared nests with many rooms for many families. Some are used for many years. Some swiftlets in Asia build nests out of their own saliva, which hardens like glue.

> **Goes deeper in.** Gardening & Animals, “Helping birds in your yard” and Life Science,

Grade 2, “Animal homes” (coming soon).

For families. The U.S. Migratory Bird Treaty Act protects the nests, eggs and feathers of most native birds (U.S. Fish and Wildlife Service); a few non-native birds such as house sparrows and starlings are not covered, but the stop simply teaches “look, don’t touch.” Nesting-material tips follow the National Audubon Society and Cornell’s NestWatch.

PRACTICE

1. EASY What does a robin use to build its nest?
2. MEDIUM Why is a weaver’s hanging nest a safe home?
3. EASY What should you do if you find a nest with eggs?

Make it a game · Nest Builders. Teams get a pile of pillows, blankets and soft toys. Each team must build a “nest” big enough for one player to sit in, in three minutes, using only one hand each.

Scripture. “Yea, the sparrow hath found an house, and the swallow a nest for herself, where she may lay her young, even thine altars, O LORD of hosts, my King, and my God.” (Psalm 84:3, KJV)

Birds nested near God’s house. The writer longed to be close to God, as safe as a bird in its nest.

Practice: answers

1. Grass, twigs and mud.
2. It hangs from a thin branch with the door underneath, so snakes and other hunters have a hard time getting in.
3. Stay back, watch quietly, and do not touch it.

1.9 John James Audubon, the Bird Painter

OBJECTIVES

- Tell the story of John James Audubon and his book The Birds of America.
- Explain why Audubon painted birds life-size.
- Draw a bird from careful observation.

> **Warm-up.** Look at a picture of a bird for one minute. Then turn the picture over and draw it from memory. Now look again. What did you miss? Audubon spent hours looking at every bird he painted.

Video slot. Video coming. John James Audubon and The Birds of America: the giant book and the life-size paintings. Search the National Audubon Society, the Smithsonian, the New-York Historical Society.

KEY TERMS

naturalist
A person who studies plants and animals in nature.

life-size
The same size as the real thing.

engraving
A picture printed from lines cut into a metal plate.

bird banding
Putting a small marked band on a bird's leg to learn where it goes.

CORE IDEAS

The story. In 1804, on a farm in Pennsylvania, a young man named John James Audubon found a pair of little birds called phoebes nesting in a cave near a creek. He wondered: would the same birds come back next year? So he tied a light silver thread around the legs of the young birds. The next spring, two phoebes with silver threads came back to nest nearby! This is often called the first time anyone in America marked birds to follow them, the idea we now call **bird banding**.

A dream to paint every bird. Audubon was born in 1785 on the island now called Haiti and grew up in France. He came to America as a young man and fell in love with its birds. He decided to paint every kind of bird in North America, life-size. He walked and paddled through forests, swamps and rivers for years, watching and drawing.

Starting over. Once, Audubon came home from a trip and found that rats had chewed up about two hundred of his drawings. He was so sad he could hardly sleep for days. But then

he took his notebook and pencils and went back into the woods to draw them all again, better than before.

A giant book. No one in America would print his paintings, so in 1826 he sailed to Great Britain. There his work was turned into copper **engravings** and colored by hand. *The Birds of America* was printed from 1827 to 1838. It has 435 pictures, and the pages are more than three feet tall, so that even big birds like the wild turkey could be shown **life-size**.

Why it matters. Audubon did not just paint birds standing still. He showed them flying, hunting, feeding their young and fighting off danger, as they really live. His pictures helped people love and protect America's birds. Later, people who wanted to protect birds named their club the Audubon Society after him.

PICTURE STUDY



Wild Turkey, Plate 1 of The Birds of America, John James Audubon (engraved by W. H. Lizars, Edinburgh), 1827 · Hand-colored engraving · From The Birds of America
Wikimedia Commons · Public domain

The wild turkey male was the very first plate in Audubon's great book. It is shown life-size, standing tall among the cane, and it fills the whole giant page. The first few plates were engraved in Edinburgh by W. H. Lizars; later Robert Havell of London engraved the rest.

Look closely

- Find the red skin on the turkey's head and neck.
- Look at the tail and wing feathers. How many colors can you see?
- Look at the feet. Is the turkey walking or standing still?

Talk about it

1. Why do you think Audubon chose the turkey for the first page?
2. How is this picture different from a photograph?

HANDS-ON: DRAW A BIRD LIKE AUDUBON

Draw a bird from careful looking, the way Audubon did.

You will need

- A bird to look at: a real bird outside, a bird feeder, or a photo in a bird guide
- Pencil, eraser and colored pencils

Steps

1. Look at the bird for two whole minutes before you draw. Notice the shape of the beak, the color of the eyes, the length of the tail.
2. Lightly sketch the big shapes first: an oval for the body and a circle for the head.
3. Add the beak, eye, wings, tail and feet.
4. Color it carefully. Then show the bird doing something: eating, flying or sitting on a branch.
5. Write the bird's name, the date and where you saw it.

Check your work

- I looked for two minutes before drawing.
- My bird shows a beak, an eye, wings, tail and feet.
- My bird is doing something.

FIELD NOTEBOOK

1. Put your Audubon-style drawing in your Field Notebook.
2. Write: "Audubon's book The Birds of America has ___ pictures." (435)

> **Did you know?** A complete first set of The Birds of America is one of the most valuable books in the world. Audubon painted the Carolina parakeet and the passenger pigeon, two American birds that are now gone forever. The pages of The Birds of America are called "double elephant folio" size, about 39 by 26 inches.

> **Goes deeper in.** Art, picture study (Audubon), and Life Science, Grade 3, Unit 2 "Birds" (coming soon).

> **For families.** The phoebe-thread story and the rat story (about 200 drawings, around 1812) are both from Audubon's own *Ornithological Biography*.

PRACTICE

1. EASY What was the name of Audubon's great book?

2. MEDIUM Why were the pages of his book so big?
3. MEDIUM What did Audubon do when rats ate his drawings?

> **Make it a game · Bird in Action.** Like charades: one player picks a bird from this trail and acts it out (an eagle soaring, an owl turning its head, a hummingbird hovering, a penguin sliding). The others guess the bird.

> **Scripture.** “Whatsoever thy hand findeth to do, do it with thy might; for there is no work, nor device, nor knowledge, nor wisdom, in the grave, whither thou goest.” (Ecclesiastes 9:10, KJV)

Audubon worked hard and did not give up when his drawings were ruined. Whatever work God gives us, we should do it with all our might.

Practice: answers

1. The Birds of America.
2. So the birds could be shown life-size.
3. He went back into the woods and drew them all again.

🟢 SCOUT · STOP B10 · TRACK 1 · STOP 1.10 · 15–25 MINUTES

1.10 The Backyard Bird Count

OBJECTIVES

- Take part in a real bird count by watching and counting birds for at least 15 minutes.
- Name five common birds by sight.
- Explain how families who count birds help scientists.

Warm-up. Look out a window for one minute and count every bird you see. Write the number down. At the end of this stop, you will count again for longer.

Video slot. Video coming. How to identify common backyard birds and take part in the Great Backyard Bird Count. Search the Cornell Lab of Ornithology, the National Audubon Society, Birds Canada.

KEY TERMS

bird count
Counting the birds in one place for a set time, so scientists know how many there are.

field marks
Special colors or shapes that help you tell one bird from another.

binoculars
A tool with two eyepieces that makes faraway things look closer.

citizen scientist
An ordinary person who helps real scientists by watching and counting.

CORE IDEAS

The story. Every February, all over the world, families sit by their windows with a notebook, a pencil and a cup of hot chocolate. They watch the bird feeder, the trees and the sky. They count every bird they see for at least fifteen minutes. This is the Great Backyard Bird Count. It started in 1998, and now people in more than a hundred countries take part.

Why count birds? No scientist can be everywhere at once. But if thousands of families each count the birds in their own yard, scientists can learn how many birds there are, where they are, and whether there are more or fewer than before. People who help this way are called **citizen scientists**. A child can be one!

An older count. More than a hundred years ago, on Christmas Day in 1900, a bird scientist named Frank Chapman asked people to go out and count birds instead of hunting them. Twenty-seven people counted that first day. The Christmas Bird Count still happens every winter.

How to tell birds apart. Bird watchers look for **field marks**. Is the bird big like a crow or small like a sparrow? What color is it? Does it have a crest on its head, like a cardinal or a blue jay? Does it have stripes on its wings? How does it move: hopping, walking, or climbing down a tree headfirst like a nuthatch?

Watching God's birds. Jesus said that not one sparrow falls to the ground without our Father (Matthew 10:29). When we sit quietly and watch, we see how many birds God has made and how He cares for each one. Counting them is a way of noticing His work.

PICTURE STUDY



Cardinal Grosbeak (Northern Cardinal), Plate 159 of The Birds of America, John James Audubon, 1832 · Hand-colored engraving · From The Birds of America
Wikimedia Commons · CC0

The northern cardinal is one of the easiest backyard birds to know. Audubon painted a male and a female together, so we can see how different they look.

Look closely

- Find the male (bright red) and the female (brown with red).
- Find the crest on top of each head.
- Look at the thick beak. What do you think a beak like this cracks open?

Talk about it

1. Why do you think the male and female look so different?
2. Have you ever seen a cardinal near your home?

HANDS-ON: MY OWN BIRD COUNT

Do a real bird count, like the Great Backyard Bird Count. You can do it any day, and you can send it in during the February count if your family chooses.

You will need

- A window or a quiet spot outside
- A timer
- A notebook and pencil
- A bird guide or bird app (a grown-up helps)
- Binoculars, if you have them

Steps

1. Set the timer for at least 15 minutes.
2. Watch quietly. For each kind of bird, write its name (or draw it if you do not know the name).
3. For each kind, write down the most you saw at one time, so you do not count the same bird twice.
4. When the timer rings, look over your list.
5. If it is the February count, a grown-up can help you send your list to birdcount.org.

Check your work

- I counted for at least 15 minutes.
- I wrote down each kind of bird.
- I wrote the most of each kind I saw at one time.

FIELD NOTEBOOK

1. Make a page called “My Bird List.” Write every kind of bird you have seen on this trail, with the date and place.
2. Draw your favorite bird from your count.

> **Did you know?** The northern cardinal is the state bird of seven states, more than any other bird. A male cardinal is bright red; the female is mostly tan and brown with touches of red. Many birds that visit feeders in winter also eat weed seeds and insects, which helps gardens.

> **Goes deeper in.** Gardening & Animals, “A bird feeder and a bird list” and Life Science, Grade 4, “Citizen science” (coming soon).

> **For families.** The Great Backyard Bird Count began in 1998 (Cornell Lab of Ornithology and National Audubon Society; Birds Canada is now a partner) and runs four days each February; participants count for at least 15 minutes. Submitting online needs a free

account, which a parent should set up. The first Christmas Bird Count was on December 25, 1900, with 27 counters (National Audubon Society). The cardinal is the state bird of seven states.

PRACTICE

1. EASY When is the Great Backyard Bird Count held?
2. MEDIUM Why do scientists want families to count birds?
3. EASY What are field marks?

Make it a game · Bird Bingo. Make a bingo card of nine common birds (robin, cardinal, crow, sparrow, blue jay, pigeon, goose, chickadee, duck). Take a walk and mark each one you see. Three in a row wins.

Scripture. “By them shall the fowls of the heaven have their habitation, which sing among the branches.” (Psalm 104:12, KJV)

God made places for the birds to live and gave them songs. When we count them, we notice His care.

Practice: answers

1. Every February.
2. They cannot be everywhere at once; many counts from many places show how many birds there are and where.
3. Colors and shapes that help you tell one bird from another.

Track 1 badge quizzes

The badge quizzes are optional. Read each question aloud; the child may answer by talking, pointing or drawing. Four right out of five earns the badge. Badges and the certificate are earned by doing the stops, not by scores.

Badge quiz 1 (Stops B1–B5)

1. How does an eagle fly high without flapping?
2. Why can't a mouse hear an owl coming?
3. What can a hummingbird do that most birds cannot?
4. Who keeps the emperor penguin egg warm in winter?
5. What does the ostrich do to "the horse and his rider" (Job 39:18)?

Badge quiz 2 (Stops B6–B10)

6. How are a parrot's toes arranged?
7. Which bird makes the longest migration?
8. Name one bird and the kind of nest it builds.
9. Why did Audubon make his book so big?
10. What are field marks?

TRAIL CERTIFICATE: MY BIRD FIELD NOTEBOOK AND TRAIL B CERTIFICATE

Gather the Field Notebook pages from this trail into one booklet with a cover: "My Bird Field Notebook," your name and the dates you started and finished. Put your bird list from Stop B10 at the front.

When the booklet is done, a parent signs the Trail B certificate.

- **Ten stops**: At least one page for each stop, each with a title and a date.
- **Bird list**: A list of at least five birds the child has seen, with dates and places.
- **Observation**: At least one drawing made from a real bird or a careful look at a picture (Stop B9).
- **Care**: Drawings are labeled and done carefully.

Answer key

1. It rides rising warm air (thermals) with its wings spread wide.
2. The owl's soft, fringed feathers make its flight almost silent.
3. Hover in one place, or fly backward.
4. The father, on his feet.
5. It scorns them: it can outrun them.
6. Two forward and two back.
7. The Arctic tern.
8. Any one: robin, a cup of grass and mud; eagle, a big stick platform; weaver, a hanging woven ball; hummingbird, a tiny cup with spider silk; ovenbird, a mud oven.

9. To show the birds life-size.
10. Colors and shapes that help you tell birds apart.

SCHOOL LAUNCH · EXPLORE TRACKS

Explore Tracks · Trail C

The third trail of three interest tracks for curious Scouts: Animals (reptiles and amphibians), Dinosaurs (how dinosaurs lived) and Great Battles of the Age of Sail and the American Founding. Short, self-paced stops with true stories, great pictures, hands-on projects and games.

First edition

> *O LORD, how manifold are thy works! in wisdom hast thou made them all: the earth is full of thy riches.*
> *Psalm 104:24 (KJV)*

Course guide

Explore Tracks are for children who want more of what they love. Each track is a trail of short stops. At every stop the child hears a true story, studies a great picture, does something with his or her hands, plays a game and adds a page to a Field Notebook. Each stop also names the School Launch course where the subject goes deeper.

Trail C is the third trail of each track at the 🟢 Scout level (ages 7–9). The Animals track meets the reptiles and amphibians, from the crocodile and the Komodo dragon to the frogs, salamanders and the Gila monster of the American desert. The Dinosaurs track asks how dinosaurs lived: what their teeth, eggs, footprints and bones tell us about what they ate, how they raised their young, how fast they moved and what they may have sounded like, and it keeps practicing the difference between what we observe and how it is interpreted. The Great Battles track visits eight battles from the Spanish Armada (1588) to Trafalgar (1805), including five from the French and Indian War and the American War for Independence: Quebec, Lexington and Concord, Trenton, Saratoga and Yorktown. Trails A and B are not required first.

WHO IT IS FOR

Written for children about ages 7–9 who are read to by a parent, or who read short passages on their own. Older siblings can join in. Nothing earlier is required.

HOW TO USE THIS COURSE

1. **One stop at a time.** A stop takes 15–25 minutes: read the story aloud, look at the picture, do the hands-on part and play the game. Two or three stops a week works well.
2. **Any order.** The tracks are independent. Do one track at a time, or rotate between them.
3. **Battle stops.** Each battle has a terrain map to draw, a tabletop activity with blocks or toy figures, and a “Choose your move” puzzle: the child picks the commander’s next step before hearing what really happened.
4. **Field Notebook.** Every stop ends with a page for the notebook. At the end of the trail the pages become a booklet, and the parent signs the Trail C certificate.
5. **Badge quizzes.** Each track has two short, optional oral quizzes. They are for fun, not grades.

SCOPE AND SEQUENCE

Track 1: Animals 🐾 Trail C: Reptiles and Amphibians (Self-paced)

MATERIALS

- **Field Notebook (a sketchbook or composition book)** One for the whole trail.
- **Colored pencils, a ruler, scissors and glue** For drawings and maps.

- **Household things**Each hands-on project lists what it needs: blocks, clay, string, toy figures, cups, a tape measure, sidewalk chalk.
- **A Bible (KJV)**For the verse at each stop.

GRADING

Explore Tracks are not graded. A stop is done when the child has heard the story, done the hands-on part and made a notebook page.

Badges and the Trail C certificate are earned by finishing the stops.

A NOTE TO PARENTS

You do not need to be an expert. Read the story aloud, look at the picture together and ask, “What do you notice?” Each stop has a short *For families* note with background and any facts that scholars still discuss.

Reptiles and amphibians: the stories are for watching, not handling. Some of these animals are venomous or poisonous (the Gila monster, many snakes, poison dart frogs), and pet reptiles and amphibians can carry germs such as Salmonella. Each stop with an outdoor or animal activity has a safety line: look but do not touch wild animals, and wash hands after any contact with a pet reptile or amphibian or its tank.

Dinosaur dates: museums give ages in millions of years. This trail teaches the period names as museum words and explains that the dates are interpretations; many Christian families understand the fossils within a young earth and the Flood. Where a date comes up, a ⏳ box sets out “What the sign says / What we observe / How Christians read it.” The questions in this trail, such as feathers, warm blood and dinosaur sounds, also separate what the fossils actually show from what scientists still debate.

Battles are told for young children: the map, the plan, the people and why it mattered, with honor for courage, faith and wisdom and no gory detail. Casualties are given as numbers, and deaths are stated plainly but not described. Both sides are described fairly, in the terms of their own time: English and Spanish, the defenders of Vienna and the Ottoman army, French and British at Quebec, and the British and the Americans in the War for Independence, including colonists who stayed loyal to the King. Paintings were chosen for composition and story.

Contents

Track 1: Animals 🐾 Trail C: Reptiles and Amphibians

1.1 Crocodiles: Armor-Plated River Giants
1.2 Komodo Dragons: The Biggest Lizard
1.3 Snakes: No Legs, No Problem
1.4 Sea Turtles: Back to the Beach
1.5 Chameleons: Colors, Eyes and a Super Tongue
1.6 Giant Tortoises of the Galápagos
1.7 Frogs: From Tadpole to Hopper
1.8 Salamanders: Quiet Creatures Under the Log
1.9 Poison Dart Frogs: Bright Colors Say “Beware!”
1.10 The Gila Monster: A Desert Lizard That Helps Medicine

Each stop takes 15–25 minutes. Tracks may be done in any order, and a child may do just one track.

TRACK 1

Animals 🐾 Trail C: Reptiles and Amphibians

The third trail of the Animals track visits the reptiles and amphibians: the armored crocodile, the Komodo dragon, snakes, sea turtles, the color-changing chameleon, the giant tortoises of the Galápagos, frogs, salamanders, the bright poison dart frogs and the Gila monster of the desert. Each stop is a short read-aloud story, a picture to study, something to draw or build, quick questions, a game and a verse of Scripture.

This is the 🟢 **Scout** level, written for ages 7 to 9. A parent reads the story aloud, or a strong reader reads it alone. Every stop stands by itself. The trail shows these creatures as God's handiwork, each made "after his kind" (Genesis 1:25), and tells the care of rare animals as good stewardship. The 🔵 Ranger and 🔴 Expert levels of these same stops will add maps, numbers and primary sources later.

Five stops earn the **Reptile and Amphibian Scout badge, part 1**, and ten stops earn part 2 and the **Trail C certificate**. The badge quizzes are at the end of the trail and are optional.

BEFORE YOU BEGIN

- Listen to a story of about five minutes and tell it back.
- Find Africa, Australia, Asia, North America, South America and the oceans on a globe (a grown-up may help).

MASTERY CHECKLIST

☐ I can tell the difference between a reptile (dry, scaly skin) and an amphibian (smooth, damp skin, often starting life in water).
☐ I can tell one true and surprising fact about each animal on this trail.
☐ I can put the stages of a frog's life in order: egg, tadpole, froglet, frog.
☐ I can tell one way people have helped protect a reptile or amphibian.
☐ I can tell what to do if I see a wild snake, lizard or frog: look, don't touch, and tell a grown-up.

OPTIONAL BOOKS AND RESOURCES

- **Smithsonian's National Zoo: Reptiles and Amphibians** (https://nationalzoo.si.edu/animals/reptiles-amphibians): Free animal pages and photos for many of the creatures on this trail.
- **Galápagos Conservancy** (https://www.galapagos.org): The story of Diego and the Española tortoises, with photos, for Stop C6.
- **Biodiversity Heritage Library** (https://www.biodiversitylibrary.org): Old natural history plates by Catesby, Gessner, Günther and Ditmars to copy in the Field Notebook.

1.1 Crocodiles: Armor-Plated River Giants

OBJECTIVES

- Tell what makes an animal a reptile: scaly skin, lungs, and eggs laid on land.
- Name two ways God made the crocodile for life in the water: eyes and nostrils on top, and a strong tail.
- Tell how a mother crocodile cares for her babies.

Warm-up. Lie on your tummy on the floor with your chin on your hands. Can you see, breathe and listen without lifting your head much? A crocodile floats almost hidden, with only its eyes, ears and nose above the water.

Video slot. Video coming. Nile and saltwater crocodiles for children: floating, sunning on a bank, a mother carrying hatchlings in her mouth. Search approved channels (Smithsonian's National Zoo, San Diego Zoo Wildlife Alliance, BBC Earth); preview first.

KEY TERMS

reptile
An animal with dry, scaly skin that breathes with lungs and usually lays eggs on land, such as a crocodile, snake, lizard or turtle.

crocodile
A large reptile with a long snout, strong jaws and a long tail that lives in and near warm rivers, swamps and coasts.

scute
A hard, bony plate in the skin of a crocodile or the shell of a turtle.

hatchling
A baby animal that has just come out of its egg.

CORE IDEAS

The story. On a muddy bank of the Nile River in Africa, a mother crocodile lies beside a mound of sand. For about three months she has guarded the eggs buried inside. One morning she hears tiny squeaks coming from under the sand. Her babies are calling! She digs them out with her feet, then very gently picks them up in her huge jaws and carries them down to the water.

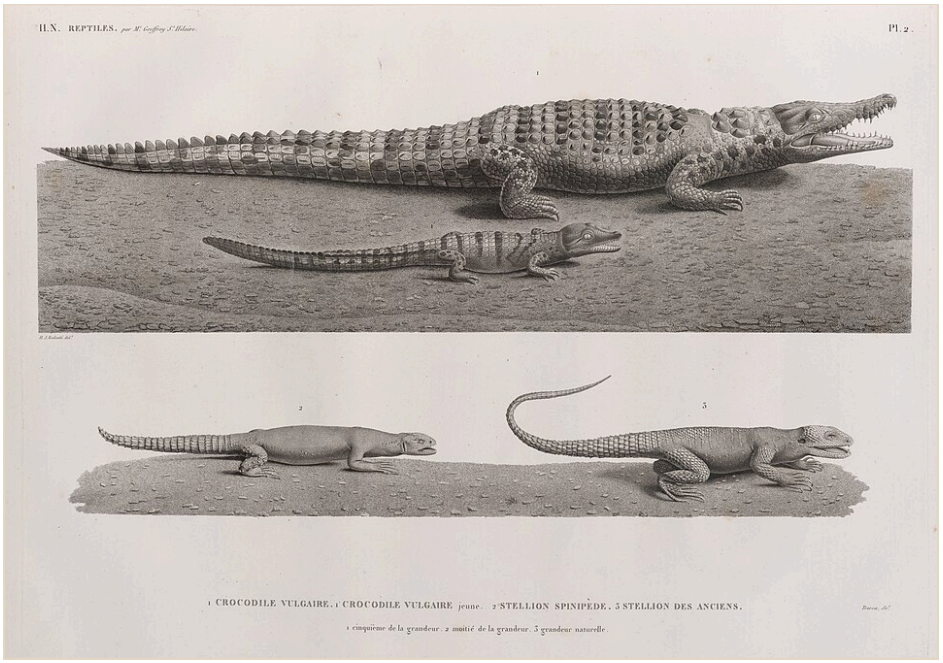
Made for the water. A crocodile's eyes, ears and nostrils are all on the top of its head. It can float with almost its whole body hidden and still see, hear and breathe. When it dives, flaps close over its ears and nose, and a clear eyelid slides across each eye like swimming goggles. Its long, strong tail pushes it through the water.

Living armor. A crocodile's back is covered with **scutes**, hard bony plates set in its thick skin. On sunny mornings crocodiles lie on the bank with their mouths open to warm up, because a reptile's body takes its warmth from the sun and the air around it.

The biggest reptile. The saltwater crocodile of Australia and Southeast Asia is the largest reptile in the world. A big male can be longer than a car and heavier than a horse. Crocodiles are strong and dangerous, so people watch them only from a safe place.

Scales like a seal. In the book of Job, God asks Job about a mighty creature called leviathan, whose "scales are his pride, shut up together as with a close seal" (Job 41:15). Many Bible readers think this sounds like a crocodile. Whatever leviathan was, God made it, and only God is stronger.

PICTURE STUDY



Common Crocodile and Young Crocodile, with Two Lizards, from the Description de l'Égypte (Reptiles, Plate 2), Drawn by Henri-Joseph Redouté, engraved by Tresca, for Étienne Geoffroy Saint-Hilaire, 1809 · Engraving · From the Description de l'Égypte, Natural History plates; New York Public Library Wikimedia Commons · Public domain

More than two hundred years ago, a team of French scholars traveled to Egypt and drew everything they found: temples, plants, fish and reptiles. Their great book of pictures, the *Description de l'Égypte*, includes this careful drawing of a grown-up Nile crocodile and a young one, with two Egyptian lizards drawn underneath.

Look closely

- Find the rows of scutes on the big crocodile's back and tail.
- Find the eyes and the nostrils. Where are they on the head?
- Look at the young crocodile. How is it different from the grown-up?

Talk about it

1. Why do you think the artists drew the crocodile so carefully, scale by scale?
2. The lizards below are reptiles too. How are they like the crocodile, and how are they different?

HANDS-ON: EGG-CARTON CROCODILE

Turn an egg carton into a bumpy, armor-plated crocodile with its eyes and nose on top.

You will need

- A cardboard egg carton
- Green paint or crayons
- Glue and paper
- Scissors (with a grown-up)

Steps

1. Cut the lid off the egg carton. The bumpy bottom is the crocodile's back with its scutes.
2. Cut a long, narrow snout and a long tail from paper or the carton lid and glue them on each end.
3. Paint or color your crocodile green and brown.
4. Glue two bumps for eyes and two dots for nostrils on the top of the head. Float it in a sink: can you see the eyes above the water?

Check your work

- My crocodile has a bumpy back, a long snout and a long tail.
- Its eyes and nostrils are on top of its head.
- I can tell what a scute is.

FIELD NOTEBOOK

1. Draw a crocodile floating in a river with only its eyes and nose above the water line.
2. Draw a mother crocodile carrying a baby in her mouth, and write: "God made the crocodile."

> **Did you know?** Crocodiles grow new teeth all their lives. When one tooth wears out, a new one is already growing underneath to take its place. A crocodile may go through thousands of teeth. You can tell a crocodile from an alligator by its snout: a crocodile's is narrow and pointed, and a big tooth near the front of its lower jaw shows even when its mouth is shut.

> **Goes deeper in.** Life Science, the unit on reptiles and amphibians (coming soon); and Geography, for the Nile River and northern Australia.

For families. Nile crocodile eggs hatch after roughly 80 to 90 days, and the hatchlings call from inside the eggs; mothers of several crocodile species carry hatchlings to water in their mouths. Large male saltwater crocodiles commonly reach about 17 feet and can exceed 1,000 pounds. The identity of leviathan in Job 41 is debated: many commentators suggest the crocodile, others a larger or now-unknown creature; the stop says “many Bible readers think.”

PRACTICE

1. EASY Where are a crocodile’s eyes and nostrils?
2. MEDIUM How does a mother crocodile carry her hatchlings to the water?
3. EASY What are scutes?

Make it a game · Crocodile Bank. One player is the crocodile and lies “floating” on the floor with eyes peeking. The others tiptoe past the “river.” When the crocodile slaps the floor and calls “Snap!”, everyone freezes. Anyone still moving becomes the next crocodile.

Scripture. “His scales are his pride, shut up together as with a close seal.” (Job 41:15, KJV)

God made the strong creatures and knows every scale on them. Nothing is too strong for Him.

Practice: answers

1. On the top of its head, so it can see and breathe while almost hidden in the water.
2. Gently, in her mouth.
3. Hard, bony plates in a crocodile’s skin.

1.2 Komodo Dragons: The Biggest Lizard

OBJECTIVES

- Find the Komodo dragon's islands in Indonesia on a map or globe.
- Tell how a Komodo dragon uses its forked tongue to smell.
- Tell why baby Komodo dragons live in the trees.

Warm-up. Lie down on the floor and ask a grown-up to mark your head and your feet with two books. A big Komodo dragon can be about 10 feet long. Is that longer or shorter than you? Than a grown-up?

Video slot. Video coming. Komodo dragons for children: walking, tongue-flicking, young dragons in trees. Search approved channels (Smithsonian's National Zoo, San Diego Zoo Wildlife Alliance, BBC Earth); preview first.

KEY TERMS

lizard
A reptile with scaly skin, four legs, a long tail and usually eyelids and ear openings.

Komodo dragon
The largest lizard in the world, which lives on a few islands in Indonesia.

forked tongue
A tongue split into two tips at the end, used by snakes and some lizards to pick up smells.

island
Land with water all around it.

CORE IDEAS

The story. More than a hundred years ago, people on the small island of Komodo told Dutch officials about giant "land crocodiles." In 1910, a Dutch officer named Lieutenant van Steyn van Hensbroek went to see for himself. He found a huge lizard and sent a photograph and a skin to Peter Ouwens, the director of a museum on the island of Java. In 1912 Ouwens wrote the first scientific description of the animal we call the **Komodo dragon**.

The biggest lizard. A Komodo dragon is not a real dragon, but it is the biggest **lizard** in the world. A large one can be about 10 feet long and weigh more than a grown man. It has a heavy body, strong legs with sharp claws, and a long, powerful tail.

Smelling with its tongue. A Komodo dragon flicks out its long yellow **forked tongue** again and again. The tongue gathers tiny bits of smell from the air and carries them to a special place in the roof of its mouth. In this way a dragon can find food that is far away.

Babies in the trees. A mother Komodo dragon lays her eggs in a burrow. When the babies hatch, they quickly climb up into the trees. There they eat insects and small lizards and stay safe from the big dragons on the ground. When they grow too heavy to climb, they come down to live on the ground.

A home kept safe. Komodo dragons live wild on only a few islands in the country of Indonesia. In 1980, Indonesia made Komodo National Park to protect the dragons and their islands. Taking good care of God's creatures is part of the work God gave people at the very beginning (Genesis 2:15).

PICTURE STUDY



Komodo Dragon on Rinca Island, Charles J. Sharp, 2015 · Color photograph · Rinca Island, Komodo National Park, Indonesia (Wikimedia Commons, CC BY-SA 4.0)
Wikimedia Commons · CC BY-SA 4.0

A wildlife photographer named Charles Sharp took this picture on Rinca, one of the islands in Komodo National Park. He caught a big male Komodo dragon just as it flicked out its long, forked tongue to smell the air.

Look closely

- Find the forked tongue. How many tips does it have?
- Find the claws on the front foot. How many can you see?
- Look at the ground and the dry leaves. Is this a wet place or a dry place?

Talk about it

1. What do you think the dragon is smelling with its tongue?
2. Why do you think people first called this lizard a "dragon"?

HANDS-ON: LIFE-SIZE DRAGON ON THE GROUND

Measure out a full-grown Komodo dragon and see how big the world's largest lizard really is.

You will need

- A tape measure or yardstick
- Sidewalk chalk (outside) or a long piece of string (inside)
- Crayons and paper

Steps

1. With a grown-up, measure 10 feet on a sidewalk or across the floor.
2. Draw a big Komodo dragon outline that long with chalk, or lay out the string in a dragon shape. Make the tail about half the length.
3. Lie down beside it. How many of you would fit?
4. Draw a small picture of your dragon on paper and write "10 feet" beside it.

Check your work

- My dragon outline is about 10 feet long.
- Its tail is about half its length.
- I can tell how a Komodo dragon smells its food.

FIELD NOTEBOOK

1. Draw a Komodo dragon with its forked tongue out. Label the tongue, claws and tail.
2. Draw a baby Komodo dragon safe up in a tree.

> **Did you know?** A Komodo dragon can eat a huge meal all at once and then go a long time before it needs to eat again. Komodo dragons can also swim from island to island. Their scaly skin has tiny bony pieces inside it, like a coat of chain mail.

> **Goes deeper in.** Life Science, the unit on reptiles and amphibians (coming soon); and Geography, for the islands of Indonesia.

> **For families.** Van Steyn van Hensbroek's visit was in 1910; Peter Ouwens of the Zoological Museum at Buitenzorg (Bogor) described *Varanus komodoensis* in 1912. Komodo National Park was established in 1980. Wild Komodo dragons live on Komodo, Rinca, Flores and a few small nearby islands. Burden's book *Dragon Lizards of Komodo* was published in New York in 1927; if a suitable public-domain photograph from it cannot be found on Wikimedia Commons, substitute any pre-1931 published photograph of a Komodo dragon. Scientists debate how much venom versus bacteria matters in a dragon's bite, so the stop leaves that out.

PRACTICE

1. EASY What is the biggest lizard in the world?
2. MEDIUM How does a Komodo dragon find food that is far away?
3. MEDIUM Why do baby Komodo dragons climb trees?

> **Make it a game · Dragon Sniff.** A grown-up hides a cotton ball with a drop of vanilla or peppermint somewhere in a room. Players are Komodo dragons: they crawl slowly and use only their noses to find it. The first dragon to find the smell hides it next time.

> **Scripture.** “And God made the beast of the earth after his kind, and cattle after their kind, and every thing that creepeth upon the earth after his kind: and God saw that it was good.” (Genesis 1:25, KJV)

The Komodo dragon is one of the creeping things God made on the sixth day. He looked at all of them and called them good.

Practice: answers

1. The Komodo dragon.
2. It flicks its forked tongue to pick up smells from the air.
3. To stay safe from the big dragons on the ground (and to find insects to eat).

1.3 Snakes: No Legs, No Problem

OBJECTIVES

- Tell how a snake moves without legs.
- Name two special things about snakes: they smell with their tongues and shed their skin.
- Tell what to do if you see a snake outdoors.

> **Warm-up.** Lie on your tummy and try to move across the floor without using your arms or legs. It is hard! Snakes do it every day, and some can move quite fast.

Video slot. Video coming. How snakes move and shed their skin, for children. Search approved channels (Smithsonian's National Zoo, San Diego Zoo Wildlife Alliance, National Park Service); preview first.

KEY TERMS

snake
A reptile with a long body, scaly skin and no legs.

shed
To slip out of an old outer layer of skin when a new one has grown underneath.

venom
A poison some animals put into another animal with a bite or a sting.

belly scales
The wide scales under a snake that grip the ground and help it move.

CORE IDEAS

The story. A boy named Sam was helping his grandfather in the garden when he found something strange under a bush: a thin, see-through tube, as long as his arm, with a pattern of tiny scales on it. It even had a clear bump where each eye had been! "That's a snakeskin," said Grandpa. "The snake has grown, and it crawled right out of its old skin like you pull off a sock."

Moving without legs. A snake has no legs, but it has many ribs and strong muscles. Under its body are wide **belly scales** that catch on bumps in the ground. By pushing against rocks, sticks and dirt with its curves, a snake slides forward. Some snakes climb trees, and some swim.

Smelling with a tongue. A snake flicks its forked tongue in and out to gather smells from the air. Snakes have no eyelids. A clear scale covers each eye like a little window. When a snake grows, it rubs its nose on something rough and **sheds** its whole skin, even the window scales.

Big mouths. A snake swallows its food whole. Its jaws are joined loosely and its skin stretches, so it can swallow an egg or a mouse wider than its own head. Most snakes are harmless to people, and many help farmers by eating mice and rats. A few have **venom**, so wise people never touch a wild snake.

Wise as serpents. Jesus told His followers to be “wise as serpents, and harmless as doves” (Matthew 10:16). A snake is careful and watchful. Jesus wants us to be careful and wise too, but always gentle and good.

PICTURE STUDY



The Rattle-Snake, from The Natural History of Carolina, Florida and the Bahama Islands, Mark Catesby, 1731–1743 · Hand-colored etching · From Catesby’s Natural History of Carolina, Florida and the Bahama Islands
Wikimedia Commons · CC BY-SA 4.0

Mark Catesby was an English naturalist who traveled in the American colonies and drew the animals and plants he found. He etched the copper plates for his book himself and colored many of the prints by hand. His rattlesnake is one of the first pictures of an American snake ever printed.

Look closely

- Find the rattle at the end of the tail.
- Look at the pattern on the snake’s back. What shapes do you see?
- Find the eye. Does it have an eyelid?

Talk about it

1. Why might a rattlesnake shake its rattle?
2. Why do you think Catesby drew the snake so large on the page?

Safety first. Never touch or pick up a wild snake, even a small one. Stand still, then back away slowly and tell a grown-up.

HANDS-ON: SPIRAL PAPER SNAKE

Make a coiled paper snake that stretches out long when you lift it.

You will need

- A paper plate or a circle of paper
- Crayons or markers
- A piece of string
- Scissors (with a grown-up)

Steps

1. Draw a spiral on the plate from the outside edge to the middle, like a snail shell.
2. Color a scale pattern along the spiral: stripes, diamonds or spots.
3. Cut along the spiral line. The middle is the head. Draw two eyes and a forked tongue.
4. Tie a string to the head and lift it. Watch your snake uncoil and sway.

Check your work

- My snake has scales, eyes and a forked tongue.
- It coils and stretches out.
- I can tell what to do if I see a snake outdoors.

FIELD NOTEBOOK

1. Draw a snake and its shed skin side by side. Label the tongue, eye scale and belly scales.
2. Copy Matthew 10:16 in your best handwriting.

Did you know? Snakes do not have outside ears, but they can feel sounds and footsteps through the ground. A rattlesnake’s rattle is made of loose rings of the same stuff as your fingernails, and a new ring is added each time it sheds. Snakes live on every continent except Antarctica.

Goes deeper in. Life Science, the unit on reptiles and amphibians (coming soon); and Gardening & Animals, for the creatures that live in a garden.

For families. Catesby’s two volumes appeared in parts between 1731 and 1743, with an appendix in 1747. The stop does not discuss the serpent of Genesis 3; families may connect it if they wish. If your child is afraid of snakes, the project and game work well without the video. In North America, local venomous snakes include rattlesnakes,

copperheads, cottonmouths and coral snakes; teach the “stop, back away, tell” rule for all snakes rather than identification.

PRACTICE

1. EASY How does a snake smell things?
2. MEDIUM Why does a snake shed its skin?
3. EASY What should you do if you see a snake outdoors?

Make it a game · Snake in the Grass. Players hold hands in a line to make a long snake. The head tries to catch the tail by turning and curving, while the whole snake stays joined. If the line breaks, the head goes to the end and the next player becomes the head.

Scripture. “Behold, I send you forth as sheep in the midst of wolves: be ye therefore wise as serpents, and harmless as doves.” (Matthew 10:16, KJV)

A snake is careful and watchful. Jesus wants us to be wise and careful, and also gentle and kind like a dove.

Practice: answers

1. With its forked tongue, which picks up smells from the air.
2. Because it has grown and a new skin has grown underneath.
3. Do not touch it; back away slowly and tell a grown-up.

1.4 Sea Turtles: Back to the Beach

OBJECTIVES

- Tell how a mother sea turtle lays her eggs on a beach.
- Tell how baby sea turtles find their way to the sea.
- Name one way people can help sea turtles.

Warm-up. Flap your arms slowly up and down like big flippers, as if you are flying underwater. A sea turtle swims with its front flippers just like that.

Video slot. Video coming. Sea turtle hatchlings crawling to the ocean; a mother turtle nesting at night. Search approved channels (NOAA Fisheries, U.S. Fish and Wildlife Service, National Park Service); preview first.

KEY TERMS

sea turtle
A turtle that lives in the ocean and has flippers instead of feet.

flipper
A wide, flat limb used for swimming.

shell
The hard, bony case that covers and protects a turtle's body.

nest
A place an animal makes to lay its eggs and keep them safe.

CORE IDEAS

The story. On a dark summer night on a Florida beach, a big loggerhead sea turtle pulls herself out of the waves. She drags her heavy body up the sand with her flippers. Above the high-tide line, she digs a deep hole with her back flippers and lays about a hundred white eggs, round like ping-pong balls. She covers them with sand and slowly crawls back into the sea. Her work is done.

The great escape. About two months later, the sand over the nest begins to wiggle. Tiny turtles, small enough to fit in your hand, dig their way up together. They wait until night, when it is cooler and safer, then scramble toward the ocean. They head for the brighter, open sky over the water.

Made for the sea. A sea turtle cannot pull its head into its **shell** the way a box turtle can. Its shell is smooth and flat for gliding through the water, and its front **flippers** work like wings. Sea turtles swim across whole oceans, and many mothers come back to nest on the same beach where they hatched.

Helping the turtles. Bright lights near a beach can confuse baby turtles and lead them the wrong way. So people who live near nesting beaches turn off their outside lights at night in the summer. Volunteers mark nests to keep them safe. This is good stewardship: caring for the creatures God put in our keeping.

Things creeping innumerable. Psalm 104 praises God for the “great and wide sea” full of living things, “both small and great beasts” (Psalm 104:25). A sea turtle is one of those great beasts, and God guides even the tiny hatchling across the sea.

PICTURE STUDY



The Turtle Pound, Winslow Homer, 1898 · Watercolor over graphite on paper · Brooklyn Museum, New York
Wikimedia Commons · Public domain

Winslow Homer was an American painter who loved the sea. On a winter trip to the islands of the Caribbean, he painted two men at a turtle pound, a pen in the water where turtles caught at sea were kept. In those days, people often caught sea turtles for food. Today sea turtles are protected by law.

Look closely

- Find the turtle. Can you see its flippers?
- Look at the colors of the water. How many blues and greens can you find?
- Look at the two men. What is each one doing?

Talk about it

1. How does Homer make the sunshine look bright and hot?
2. How is a sea turtle’s flipper different from a box turtle’s foot?

HANDS-ON: HATCHLING RACE TO THE SEA

Make paper hatchlings and help them find the sea, the way real hatchlings follow the light.

You will need

- Green and brown paper
- A blue towel or blue paper (the sea)
- A flashlight
- Crayons and scissors (with a grown-up)

Steps

1. Cut out five small turtle shapes with flippers. Color the shells.
2. Lay the blue towel at one end of a dim room for the sea. Put a pillow “sand dune” at the other end and hide the hatchlings behind it.
3. Shine the flashlight low over the sea. Move each hatchling, one hop at a time, toward the light.
4. Now shine the light from the wrong side, like a porch light. Which way would the hatchlings go? Talk about why people turn off beach lights.

Check your work

- I made five paper hatchlings.
- I showed how hatchlings head toward the light over the sea.
- I can tell one way people help sea turtles.

FIELD NOTEBOOK

1. Draw a mother sea turtle digging her nest on the beach at night, with the moon over the water.
2. Draw baby turtles crawling to the sea. Label the shell and flippers.

> **Did you know?** The leatherback is the largest sea turtle. It has no hard shell on top, only thick, leathery skin over bony bits, and it eats jellyfish. There are seven kinds of sea turtles in the world. Sea turtles can cry salty tears: special glands near their eyes get rid of extra salt from the sea water.

> **Goes deeper in.** Life Science, the unit on reptiles and amphibians (coming soon); and Geography, for oceans and coasts.

> **For families.** Loggerhead clutches average about 100 to 120 eggs and hatch after roughly 50 to 65 days, depending on sand temperature. All sea turtles found in U.S. waters are protected under the Endangered Species Act. Homer’s watercolor was painted in 1898 in the Caribbean (often associated with the Bahamas); the Brooklyn Museum lists it under the title “The Turtle Pound” (some records show “The Turtle Pond”).

PRACTICE

1. EASY Where does a mother sea turtle lay her eggs?
2. MEDIUM How do baby sea turtles find the ocean?
3. EASY Name one way people help sea turtles.

Make it a game · Hatchling Dash. Players crawl on hands and knees from a “nest” (a blanket) to the “sea” (the other side of the room). One player is a hungry crab who can tag hatchlings by touching them. Tagged hatchlings go back to the nest. Who reaches the sea?

Scripture. “So is this great and wide sea, wherein are things creeping innumerable, both small and great beasts.” (Psalm 104:25, KJV)

The sea is full of God’s creatures, big and small. The same God who made the sea guides the tiny turtles home.

Practice: answers

1. In a hole she digs in the sand on a beach.
2. They crawl toward the brighter, open sky over the water.
3. Turning off beach lights at night, or marking and protecting nests.

1.5 Chameleons: Colors, Eyes and a Super Tongue

OBJECTIVES

- Tell why a chameleon changes color.
- Describe how a chameleon's eyes can look two ways at once.
- Tell how a chameleon catches insects with its tongue.

> **Warm-up.** Close one eye and look to your left with the other. Now switch eyes and look right. Can you look both ways at the same time? A chameleon can!

> **Video slot.** Video coming. Chameleons changing color and catching insects with their tongues, in slow motion. Search approved channels (Smithsonian's National Zoo, San Diego Zoo Wildlife Alliance, BBC Earth); preview first.

KEY TERMS

chameleon
A lizard that can change its color, move its eyes separately and catch insects with a long, sticky tongue (say "kuh-MEEL-yun").

camouflage
Colors or shapes that help an animal blend in with what is around it.

grip
To hold on tightly.

Madagascar
A large island off the east coast of Africa where about half of the world's kinds of chameleons live.

CORE IDEAS

The story. On a branch in a forest on the island of Madagascar, a green chameleon sits so still you might think it was a leaf. One eye turns forward. The other turns backward. A cricket lands on a twig nearby. Both eyes swing around and point at it. Then, faster than you can blink, the chameleon's tongue shoots out, sticks to the cricket and pulls it back into its mouth. Snap! Lunch.

Eyes like turrets. A chameleon's eyes sit in little cones that can turn by themselves. One eye can watch for danger behind while the other looks for food ahead. When it spots an insect, it points both eyes at it to judge how far away it is.

The super tongue. A chameleon's tongue is folded up inside its mouth like a spring. It can shoot out farther than the chameleon's whole body is long! The end is thick and sticky, like a sticky ball, and it grabs the insect.

Changing colors. Many people think chameleons change color only to hide, but that is not the whole story. Their color often shows how they feel and helps them warm up or cool down. A calm chameleon may be green and brown, which is good **camouflage** in the leaves. An excited or angry one may turn bright colors to “talk” to other chameleons. Tiny crystals in their skin bounce light in different ways to make the colors.

Made to grip. A chameleon’s toes are joined in two bundles that **grip** a branch like a pair of tongs. Its tail curls around twigs like an extra hand. Psalm 104 says, “O LORD, how manifold are thy works!” God made His creatures in many, many wonderful ways.

PICTURE STUDY



A Chameleon, Ustad Mansur, c. 1612 · Opaque watercolor on paper · Royal Collection, United Kingdom
Wikimedia Commons · Public domain

Ustad Mansur was the leading animal painter for Jahangir, an emperor of India who loved to study nature. Jahangir gave him the title “Wonder of the Age.” Mansur painted this chameleon with tiny brushes, showing every bump on its skin.

Look closely

- Find the toes. How are they gripping the branch?
- Find the tail. What is it doing?
- Look closely at the skin. How did the painter show the tiny bumps?

Talk about it

1. Why do you think an emperor wanted a painting of a chameleon?
2. How is this painting like Audubon’s or Catesby’s careful drawings of animals?

HANDS-ON: COLOR-CHANGING CHAMELEON

Make a chameleon that seems to change color when you slide it over different papers.

You will need

- A clear plastic sheet protector or a clear plastic lid
- A permanent marker (with a grown-up)
- Several sheets of colored paper
- Scissors (with a grown-up)

Steps

1. Draw a chameleon outline with the marker on the clear plastic: a curled tail, bundled toes and a big round eye.
2. Cut it out, or leave it on the sheet.
3. Slide your chameleon over green paper, then red, then yellow. Watch it “change color.”
4. Tell a grown-up two reasons a real chameleon changes color.

Check your work

- My chameleon has a curled tail, bundled toes and a big eye.
- I showed it on at least three colors.
- I can tell two reasons chameleons change color.

FIELD NOTEBOOK

1. Draw a chameleon catching a bug with its tongue. Label the eye, tongue, toes and tail.
2. Color two chameleons: one calm (green and brown) and one excited (bright colors).

> **Did you know?** Some chameleons are huge, as long as a house cat with its tail, and some are so tiny they can sit on the tip of your finger. The chameleon is named in the King James Bible, in Leviticus 11:30, in a list of creeping animals. Chameleons can also see a kind of light called ultraviolet that people cannot see.

> **Goes deeper in.** Life Science, the unit on reptiles and amphibians (coming soon); and Art, for Mughal painting and drawing from nature.

> **For families.** The Royal Collection Trust dates Ustad Mansur’s *Chameleon* to about 1612 (RCIN 912081). Research published in 2015 showed that panther chameleons change color by adjusting tiny guanine nanocrystals in skin cells called iridophores. The Hebrew animal translated “chameleon” in Leviticus 11:30 is uncertain; modern translations vary. Tongue length “longer than its body” is true of some species and is a common figure, not a rule for all.

PRACTICE

1. EASY What can a chameleon’s eyes do that ours cannot?
2. MEDIUM Name two reasons a chameleon changes color.
3. EASY How does a chameleon catch an insect?

Make it a game · Chameleon, Chameleon. The leader calls, “Chameleon, chameleon, change to… red!” Players race to touch something red in the room and freeze like a chameleon on a branch. The last one to freeze becomes the leader.

Scripture. “O LORD, how manifold are thy works! in wisdom hast thou made them all: the earth is full of thy riches.” (Psalm 104:24, KJV)

“Manifold” means many and different. God made the chameleon’s eyes, tongue and colors with great wisdom.

Practice: answers

1. Move separately and look in two directions at once.
2. Any two: to show how it feels, to signal other chameleons, to warm up or cool down, to blend in.
3. It shoots out its long, sticky tongue.

1.6 Giant Tortoises of the Galápagos

OBJECTIVES

- Find the Galápagos Islands on a map or globe.
- Tell the difference between a tortoise and a sea turtle.
- Tell how Diego the tortoise helped save his kind.

Warm-up. Walk across the room as slowly as you can, taking one tiny step every time a grown-up counts to three. A giant tortoise is slow, but it can keep going for a very long time.

Video slot. Video coming. Galápagos giant tortoises in the wild and at the breeding center; Diego the tortoise. Search approved channels (Galápagos Conservancy, San Diego Zoo Wildlife Alliance, Smithsonian's National Zoo); preview first.

KEY TERMS

tortoise
A turtle that lives only on land, with a high, domed shell and thick, stumpy legs.

Galápagos Islands
A group of islands in the Pacific Ocean, about 600 miles west of South America, that belong to Ecuador (say "guh-LAH-puh-gus").

breeding program
A plan in which people care for animals so they can raise many young and help their kind grow in number.

stewardship
Taking good care of something that belongs to someone else. The earth belongs to God, and He gave people the job of caring for it.

CORE IDEAS

The story. Long ago, a giant tortoise was carried away from his home on Española, one of the Galápagos Islands. Many years later he was living at the San Diego Zoo in California, and people called him Diego. Back on Española, only fourteen tortoises of his kind were left. In 1976, Diego was flown back to the Galápagos to join them at a tortoise center.

Diego's big family. At the center, people kept the tortoises safe and cared for their eggs and babies. Diego became the father of more than 800 young tortoises! Year after year, the young ones were taken back to Española and set free. In 2020, when there were more than two thousand tortoises on the island again, Diego and his friends went home too.

Gentle giants. A Galápagos **tortoise** can weigh more than 500 pounds, as much as three grown men. It eats grass, leaves and cactus pads, and it can go a long time without food or

water. Some live to be more than 100 years old. It has a huge shell and thick legs like an elephant's, not flippers like a sea turtle.

Islands named for tortoises. The islands are named after the tortoises. *Galápago* is an old Spanish word for a tortoise. Long ago, sailors took thousands of tortoises onto their ships for food, because a tortoise could stay alive for months on board. That is one reason so few were left. Now the islands are a protected park.

Keeping the garden. When God put Adam in the garden of Eden, He told him "to dress it and to keep it" (Genesis 2:15). The people who cared for Diego and his family were doing that work: keeping God's creatures safe.

PICTURE STUDY



Giant Tortoises of the Galápagos Islands, Gustav Mützel, 1896 · Engraving · From The Royal Natural History, Volume 9, edited by Richard Lydekker, London
Wikimedia Commons · Public domain

Gustav Mützel was a German artist who drew animals for natural history books. More than a hundred years ago, he drew this group of Galápagos giant tortoises for a big English book called *The Royal Natural History*. He showed them at home on their island, with cactus, rocks and little finches.

Look closely

- Find the tortoise stretching its neck up high. What is it reaching for?
- Look at the big plates on the shells. Can you count the plates on one shell?
- Look at the legs. Are they like flippers or like an elephant's legs?

Talk about it

1. Why might a tortoise with a long neck be able to reach food other tortoises can't?
2. The tiny birds in front are Galápagos finches. Why do you think the artist put them in the picture?

HANDS-ON: TORTOISE SHELL BOWL

Make a model tortoise and look closely at the shapes on a tortoise's shell.

You will need

- A paper bowl
- Brown and green paper
- Crayons or markers
- Glue and scissors (with a grown-up)

Steps

1. Turn the bowl upside down. This is the shell.
2. Draw large six-sided shapes all over it, the shell plates. Color them brown and gold.
3. Cut out a head with a long neck, four thick legs and a short tail. Glue them under the edge.
4. Talk with a grown-up about what in your house might weigh as much as a 500-pound tortoise. (Hint: a piano might!)

Check your work

- My tortoise has a domed shell with plates.
- It has thick legs, not flippers.
- I can tell how Diego helped his kind.

FIELD NOTEBOOK

1. Draw a map of the Galápagos Islands west of South America. Mark Española.
2. Draw Diego the tortoise and write: "Diego went home in 2020."

> **Did you know?** Different islands in the Galápagos have tortoises with different shells. Some have round, dome-shaped shells. Others have "saddleback" shells that curve up high in front, so they can stretch their necks up to reach cactus pads. Galápagos tortoises love to soak in muddy pools to stay cool.

> **Goes deeper in.** Life Science, the unit on reptiles and amphibians (coming soon); and Geography, for South America and the Pacific Ocean.

> **For families.** The Española breeding program began with 14 tortoises (12 females and 2 males) from the island plus Diego, who came from the San Diego Zoo in 1976. About 1,900 young were returned to Española before the program ended, and Diego and 14 others were returned on June 15, 2020 (Galápagos National Park Directorate and

Galápagos Conservancy). Sources give Diego as the father of 800 to 900 or about 40% of the young; the stop says “more than 800.” The islands’ name is usually traced to *galápago*, an old Spanish word for a tortoise; some sources connect it to a saddle shape. Günther’s 1877 monograph has 54 lithographed plates.

PRACTICE

1. EASY What are the Galápagos Islands named after?
2. MEDIUM How is a tortoise different from a sea turtle?
3. MEDIUM How did Diego help his kind?

Make it a game · Tortoise and Hare Relay. Split into two teams. The “tortoises” must walk heel to toe; the “hares” must hop and then stop to count to ten after every five hops. Race across the room and back. Who wins: slow and steady, or fast and stopping?

Scripture. “And the LORD God took the man, and put him into the garden of Eden to dress it and to keep it.” (Genesis 2:15, KJV)

God gave people the job of caring for His world. Saving the Española tortoises was good work done for God.

Practice: answers

1. The giant tortoises (galápago is an old Spanish word for tortoise).
2. A tortoise lives on land and has thick legs and a domed shell; a sea turtle lives in the ocean and has flippers.
3. He became the father of more than 800 young tortoises that were set free on Española.

1.7 Frogs: From Tadpole to Hopper

OBJECTIVES

- Tell what makes an animal an amphibian.
- Put the four stages of a frog's life in order: egg, tadpole, froglet, frog.
- Tell the story of the frogs in Egypt from Exodus 8.

Warm-up. Squat down low with your hands on the floor, then jump as far forward as you can. Measure it! Some frogs can jump more than twenty times their own body length.

Video slot. Video coming. Frog life cycle for children: eggs, tadpoles growing legs, froglets. Search approved channels (Smithsonian's National Zoo, National Park Service, BBC Earth); preview first.

KEY TERMS

amphibian
An animal with smooth, damp skin that usually starts life in water and later lives on land, such as a frog, toad or salamander.

tadpole
A young frog or toad that lives in water, breathes with gills and has a tail but no legs.

metamorphosis
A big change in an animal's body shape as it grows up (say "met-uh-MOR-fuh-sis").

gills
Body parts that let an animal breathe underwater.

CORE IDEAS

The story. In early spring, Anna and her father found a clump of jelly at the edge of a pond, full of tiny black dots. They scooped a little into a jar of pond water. A week later the dots had become wiggly **tadpoles**! Day after day Anna watched. Back legs popped out. Then front legs. The tails got shorter and shorter. One morning, tiny frogs climbed onto a rock, and Anna and her father let them go back to the pond.

A double life. A frog is an **amphibian**. The word means "double life," because most amphibians live first in water and then on land. A tadpole breathes underwater with **gills**, like a fish. As it grows into a frog, it grows lungs and can breathe air. This big change is called **metamorphosis**.

Wonderful skin. A frog has smooth, damp skin with no scales. It can breathe through its skin, and it drinks water through its skin too, so it never needs to sip with its mouth. That is why frogs stay near water or in damp places.

Made to hop and catch. A frog's long back legs fold up like springs for jumping and swimming. Its sticky tongue is attached at the front of its mouth and flips out to catch insects. When a frog swallows, it blinks and pulls its big eyes down into its head to help push the food down!

Frogs in Egypt. When Pharaoh would not let God's people go, God sent a plague of frogs. "Aaron stretched out his hand over the waters of Egypt; and the frogs came up, and covered the land of Egypt" (Exodus 8:6). There were frogs in houses, beds and ovens! God showed that He rules over all His creatures.

PICTURE STUDY



Batrachia (Frogs), from Kunstformen der Natur, Ernst Haeckel, 1904 · Color lithograph · From Kunstformen der Natur (Art Forms in Nature)
Wikimedia Commons · Public domain

Ernst Haeckel was a German scientist and artist who made a book of one hundred beautiful pictures of living things. On this page he gathered many kinds of frogs, posed in different ways, so we can compare them.

Look closely

- Count how many frogs you can find on the page.
- Find a frog with its legs stretched out. Find one sitting.
- Look at the eyes. Where are they on the head?

Talk about it

1. Which frog do you like best, and why?
2. How many different colors and patterns can you see? Why might God make so many kinds?

HANDS-ON: FROG LIFE-CYCLE WHEEL

Make a turning wheel that shows the four stages of a frog’s life.

You will need

- Two paper plates
- A brass paper fastener
- Crayons
- Scissors (with a grown-up)

Steps

1. Divide one plate into four parts like a pie. In the parts draw: eggs, a tadpole, a froglet with legs and a tail, and a frog.
2. Cut one pie-shaped window out of the second plate. Write “A Frog’s Life” on it.
3. Put the window plate on top and push the fastener through both centers.
4. Turn the wheel and tell the story of each stage in order.

Check your work

- My wheel shows egg, tadpole, froglet and frog.
- The stages are in the right order.
- I can tell what “amphibian” means.

FIELD NOTEBOOK

1. Draw the four stages of a frog’s life in a circle with arrows between them.
2. Copy Exodus 8:6 and draw frogs hopping all over Egypt.

> **Did you know?** The wood frog of North America can freeze almost solid in winter and thaw out alive in spring. Toads are a kind of frog with drier, bumpier skin. Each kind of frog has its own call. On a spring night you can learn to tell them apart by listening.

> **Goes deeper in.** Life Science, the unit on reptiles and amphibians (coming soon); and Gardening & Animals, for a garden pond.

> **For families.** If you collect frog eggs or tadpoles, take only a few, use pond water (not tap water, which may contain chlorine), keep the jar out of direct sun and return the froglets to the same pond. Some states regulate collecting amphibians; check local rules. Haeckel’s *Kunstformen der Natur* was issued in parts from 1899 to 1904; Haeckel held evolutionary views, but the plate is used here for its art and careful observation.

PRACTICE

1. EASY What is a baby frog that lives in water called?

2. MEDIUM Put these in order: frog, egg, froglet, tadpole.
3. MEDIUM How does a frog drink?

> **Make it a game · Lily Pad Hop.** Lay pillows or paper “lily pads” across the floor. Players hop from pad to pad like frogs without touching the “water.” Each time everyone crosses, take one lily pad away. How far can the frogs jump?

> **Scripture.** “And Aaron stretched out his hand over the waters of Egypt; and the frogs came up, and covered the land of Egypt.” (Exodus 8:6, KJV)

God made the frogs, and He can send them where He wills. Even the frogs obey their Maker.

Practice: answers

1. A tadpole.
2. Egg, tadpole, froglet, frog.
3. Through its skin.

1.8 Salamanders: Quiet Creatures Under the Log

OBJECTIVES

- Tell how a salamander is different from a lizard.
- Tell the old story of the “fire salamander” and what was really happening.
- Look for salamanders carefully and put their home back the way it was.

Warm-up. Touch something dry and rough, like a towel. Now touch something smooth and damp, like a washcloth dipped in water. A lizard’s skin is dry and scaly. A salamander’s skin is smooth and damp.

Video slot. Video coming. Salamanders for children: red efts, hellbenders, an axolotl, a salamander under a log. Search approved channels (Smithsonian’s National Zoo, National Park Service, U.S. Fish and Wildlife Service); preview first.

KEY TERMS

salamander
An amphibian with a long body, a tail, four short legs and smooth, damp skin.

moist
A little bit wet; damp.

regrow
To grow back a body part that was lost.

habitat
The natural home of an animal, where it finds food, water and shelter.

CORE IDEAS

The story. Long ago in Europe, people sat by the fire on cold nights. Now and then, when a damp log was put on the flames, a black-and-yellow creature crawled out of it! People thought it had been born in the fire. They called it a salamander and told stories that it could live in flames. What was really happening? The salamander had been sleeping inside the damp, rotten log, and when the log got hot, it hurried out.

Not a lizard. A **salamander** looks a little like a lizard, but it is an amphibian, like a frog. A lizard has dry scales and claws. A salamander has smooth, **moist** skin and no claws. Many salamanders lay their eggs in water, and the babies have feathery gills.

Hide and seek. Salamanders need damp places to keep their skin wet. In the daytime they hide under logs, rocks and leaves in woods and near streams. At night, especially after rain, they come out to hunt worms, insects and slugs. Some kinds have no lungs at all and breathe only through their skin!

Growing back. If a salamander loses its tail, or even a leg, it can **regrow** it. The new part grows back with bones and muscles, good as new. Scientists study salamanders to learn how God made this amazing healing work.

Through the fire. Salamanders cannot really live in fire. But God made a true promise to His people: “When thou walkest through the fire, thou shalt not be burned” (Isaiah 43:2). God is with His children in every hard time.

PICTURE STUDY



De Salamandra (The Salamander), from Historiae animalium, Book II, Conrad Gessner, 1586 printing (first printed in Zurich in 1554) · Woodcut · From Gessner’s Historiae animalium, Book II (“Egg-laying four-footed animals”), page 80; Biodiversity Heritage Library
Wikimedia Commons · Public domain

Conrad Gessner was a Swiss doctor who tried to write about every animal known in his day. His great book had many woodcut pictures. In it he told the old stories about salamanders, but he also wrote about what people had really seen, and this picture looks like a real spotted salamander.

Look closely

- Find the four legs. How many toes can you count on each foot?
- Look at the patches and dots. How did the woodcut artist make them?
- Look at the tail. Is it long or short compared with the body?

Talk about it

1. How is a woodcut different from a painting or a photograph?
2. Why do you think people long ago believed salamanders lived in fire?

HANDS-ON: LOG-ROLLING SALAMANDER HUNT

Go on a careful hunt for salamanders and other small creatures, and leave their homes just as you found them.

You will need

- A damp woods, garden or yard (with a grown-up)
- Your Field Notebook and a pencil
- Clean, wet hands (so you don't harm a salamander's skin)

Steps

1. With a grown-up, find a log or flat rock in a damp, shady place, best after a rain.
2. Roll it slowly toward you, so anything underneath can escape away from you.
3. Look carefully. Do you see a salamander, worm, beetle or pill bug? Draw what you see. Try not to touch a salamander, and if you must, only with clean, wet hands.
4. Roll the log or rock gently back exactly where it was, so the creatures keep their home.

Check your work

- I rolled a log or rock gently and put it back.
- I drew at least one creature I found.
- I can tell how a salamander is different from a lizard.

FIELD NOTEBOOK

1. Draw a salamander and a lizard side by side. Label: "smooth, damp skin, no claws" and "dry scales, claws."
2. Draw what you found under your log, with the date and place.

> **Did you know?** The hellbender, a salamander that lives in rocky streams in the eastern United States, can grow as long as two feet. The biggest salamanders in the world live in China and can be longer than a grown-up is tall. The axolotl of Mexico keeps its feathery gills its whole life and never leaves the water.

> **Goes deeper in.** Life Science, the unit on reptiles and amphibians (coming soon); and Gardening & Animals, for creatures of the woods and garden.

> **For families.** The legend of salamanders living in fire goes back to ancient writers such as Pliny and was repeated in medieval bestiaries; the usual explanation is salamanders sheltering in damp firewood. Gessner's Book II on egg-laying quadrupeds was published in Zurich by Froschauer in 1554. Salamander skin absorbs oils, lotions and bug spray easily, so avoid handling; the stop teaches "look, don't touch." Some salamanders, like the fire salamander and the newts, have skin toxins; wash hands after any contact. Check local rules before collecting any amphibian.

PRACTICE

1. EASY Is a salamander a reptile or an amphibian?
2. MEDIUM Why did people long ago think salamanders lived in fire?
3. MEDIUM What should you do after you look under a log?

Make it a game · Salamander, Lizard!. The leader calls out a clue: “smooth, damp skin,” “dry scales,” “claws,” “lays eggs in water,” “feathery gills.” Players crouch down low like a salamander for salamander clues and stand up tall like a lizard on a sunny rock for lizard clues.

Scripture. “When thou passest through the waters, I will be with thee; and through the rivers, they shall not overflow thee: when thou walkest through the fire, thou shalt not be burned; neither shall the flame kindle upon thee.” (Isaiah 43:2, KJV)

The old stories about salamanders in fire were not true, but God’s promise is. He is with His people in every trouble.

Practice: answers

1. An amphibian.
2. Salamanders hiding in damp logs crawled out when the logs were put on the fire.
3. Roll it gently back where it was so the creatures keep their home.

1.9 Poison Dart Frogs: Bright Colors Say "Beware!"

OBJECTIVES

- Tell what a poison dart frog's bright colors warn other animals.
- Tell how these frogs got their name.
- Tell how a poison dart frog parent carries its tadpoles.

Warm-up. Look around your home for things colored bright red, yellow or orange that mean "Careful!" or "Stop!" A stop sign? A warning sticker? Bright colors can be a warning, in nature too.

Video slot. Video coming. Poison dart frogs in the rainforest and a parent carrying tadpoles. Search approved channels (Smithsonian's National Zoo, San Diego Zoo Wildlife Alliance, BBC Earth); preview first.

KEY TERMS

poison dart frog
A small, brightly colored frog of Central and South America whose skin can be poisonous.

poison
Something that makes an animal or person sick or can kill if it is eaten or touched.

warning colors
Bright colors that tell other animals, "Don't eat me!"

rainforest
A warm, wet forest where it rains almost every day and many plants and animals live.

CORE IDEAS

The story. Deep in a rainforest in Colombia, a tiny golden frog hops across the leaves in broad daylight. It does not hide. A hungry bird sees it but flies right past. Why? The bird knows that a frog this bright is bad news. The golden poison frog is one of the most **poisonous** animals in the world, though it is only about as long as your thumb.

How they got their name. For a very long time, the Emberá people of Colombia have hunted with blowguns and darts. They carefully rubbed the tips of their darts on the backs of golden poison frogs. The poison on the darts helped them bring down birds and animals for food. That is why these frogs are called **poison dart frogs**, though only a few kinds were ever used this way.

Colors that warn. Most frogs are green or brown so they can hide. Poison dart frogs are red, blue, yellow, orange and gold. These **warning colors** tell other animals, "Don't eat me!" A frog that wears warning colors does not need to hide.

A ride on Dad's back. In many kinds of poison dart frogs, the father watches over the eggs on the forest floor. When the tadpoles hatch, they wiggle up onto his back. He climbs a tree and carries them, one or two at a time, to tiny pools of rainwater held in the leaves of plants. There each tadpole grows into a frog.

The wise see danger. The bird that flew past the golden frog was wise. The Bible says, "A prudent man foreseeth the evil, and hideth himself" (Proverbs 22:3). A prudent person notices warnings and stays away from what will hurt him.

PICTURE STUDY



Dyeing Poison Frog (Hyla tinctoria), three hand-colored pictures, Unknown natural history artist (from the collection of Theodorus van Lidth de Jeude), Between 1700 and 1880 · Hand-colored pictures pasted on a page · Iconographia Zoologica, Special Collections, University of Amsterdam
Wikimedia Commons · Public domain

Before cameras could take color photographs, scientists asked artists to paint animals so that people far away could see their true colors. Long ago, a Dutch collector pasted these three little pictures of the dyeing poison frog of South America onto one page. Its old name, written at the top, is *Hyla tinctoria*.

Look closely

- Name every color you can see on the three frogs.
- Look at the toes. What shape are the tips?
- Compare the three frogs. How is each pattern different?

Talk about it

1. Why was it important for the artist to get the colors exactly right?
2. If you were a bird, would you try to eat these frogs? Why or why not?

Safety first. Never touch a frog you don't know in the wild, and never touch your mouth or eyes after handling any frog or toad. Wash your hands with soap and water.

HANDS-ON: WARNING-COLOR FROG

Design your own poison dart frog with bold warning colors.

You will need

- A sheet of white paper or a smooth stone
- Bright paints, markers or crayons
- A black marker

Steps

1. Draw a small frog shape with round toe pads, or paint the frog on a smooth stone.
2. Pick two or three bright colors, such as yellow and black, or blue and black, or red and blue.
3. Color your frog in a bold pattern: spots, stripes or patches.
4. Show your frog to a family member and ask: "Would you eat this?" Explain what its colors mean.

Check your work

- My frog has bright warning colors.
- I can tell what warning colors mean.
- I can tell how these frogs got their name.

FIELD NOTEBOOK

1. Draw a poison dart frog father carrying tadpoles on his back up a tree.
2. Make a page of "warning colors": draw a poison dart frog, a bee and a stop sign.

Did you know? Poison dart frogs raised in zoos are not poisonous! Scientists think the frogs get their poison from the tiny ants and mites they eat in the wild. Zoo frogs eat crickets and fruit flies instead. In some kinds, the mother comes back to feed her tadpoles by laying eggs in their pool for them to eat.

Goes deeper in. Life Science, the unit on reptiles and amphibians (coming soon); and Geography, for the rainforests of Central and South America.

For families. The golden poison frog (*Phyllobates terribilis*) lives in a small area of Colombia's Pacific rainforest; the Emberá use it (and two related species are used similarly) to poison blowgun darts. In many dendrobatid species the male guards eggs and carries tadpoles; in the strawberry poison frog the female carries them and feeds them unfertilized eggs. Wild toxicity comes from the diet. No public-domain picture could

be confirmed by file name; choose any pre-1931 color plate of a *Dendrobates* species from Wikimedia Commons or the Biodiversity Heritage Library.

PRACTICE

1. EASY What do a poison dart frog's bright colors tell other animals?
2. MEDIUM Why are they called poison dart frogs?
3. MEDIUM How does a poison dart frog father take care of his tadpoles?

Make it a game · Hide or Warn?. Spread colored paper squares (green, brown, red, yellow, blue) around a room or yard. The leader says "Hungry bird!" and players have ten seconds to pick up only squares that a bird would be safe to eat: the green and brown ones. Anyone who grabs a bright warning color is "sick" and sits out the next round.

Scripture. "A prudent man foreseeth the evil, and hideth himself; but the simple pass on, and are punished." (Proverbs 22:3, KJV)

A wise animal heeds the warning colors. A wise child heeds God's warnings and stays away from what is harmful.

Practice: answers

1. "Don't eat me! I am poisonous."
2. Hunters in Colombia rubbed their dart tips on the frogs to make poison darts for hunting.
3. He carries them on his back up to little pools of water in plants.

🟢 SCOUT · STOP C10 · TRACK 1 · STOP 1.10 · 15–25 MINUTES

1.10 The Gila Monster: A Desert Lizard That Helps Medicine

OBJECTIVES

- Find the deserts of Arizona and northern Mexico on a map.
- Tell two ways the Gila monster is made for desert life.
- Tell how the Gila monster helped people make a medicine.

Warm-up. Say “HEE-luh MON-ster” three times. That is how you say Gila monster! It is named for the Gila River in Arizona.

Video slot. Video coming. Gila monsters in the Sonoran Desert for children. Search approved channels (Arizona-Sonora Desert Museum, San Diego Zoo Wildlife Alliance, Smithsonian’s National Zoo); preview first.

KEY TERMS

Gila monster
A large, slow lizard with beaded pink-and-black skin that lives in the deserts of the southwestern United States and northern Mexico (say “HEE-luh”).

desert
A dry place that gets very little rain.

venomous
Able to put venom (poison) into another animal with a bite or sting.

burrow
A hole or tunnel in the ground that an animal uses for a home.

CORE IDEAS

The story. In the Sonoran Desert of Arizona, the sun is blazing hot. Nothing moves. But under the ground, in a cool **burrow**, a Gila monster is resting. In the evening, after a spring rain, it waddles out on short legs. Its tongue flicks in and out. It is hunting for a nest of bird or quail eggs to eat. It walks slowly. There is no need to hurry.

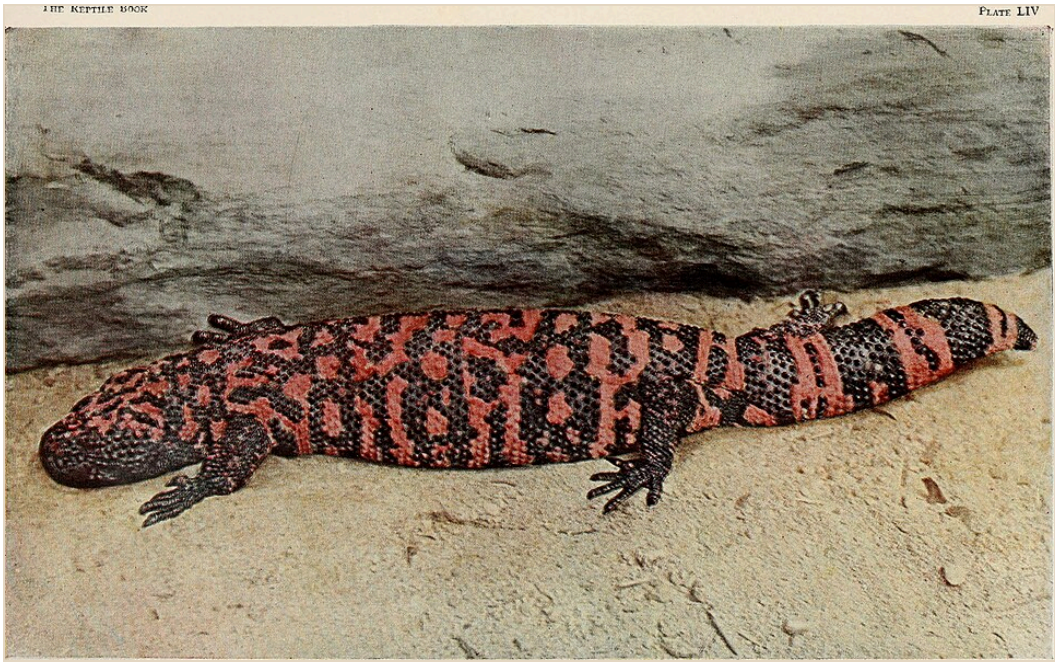
Beaded armor. A Gila monster’s skin is covered with little round bumps like beads, pink or orange and black. Inside each bead is a tiny piece of bone. The bright colors warn other animals to leave it alone, because the Gila monster is **venomous**. It is one of very few venomous lizards in the world, and the only one that lives in the United States.

Made for the desert. A Gila monster spends most of its life underground, away from the heat. When it finds food, it can eat a very big meal at once. It stores extra fat in its fat tail, like a camel stores fat in its hump. Then it can go for months without eating again.

A surprise medicine. A scientist named Dr. John Eng studied the spit of the Gila monster. In 1992 he found something in it that helps the body control sugar in the blood. Other scientists used what he learned to make a medicine for people with diabetes, a sickness in which the body cannot control its blood sugar. A slow desert lizard helped thousands of people!

Very good. For a long time, people were afraid of Gila monsters and killed them. In 1952, Arizona made a law to protect them. When God finished making the world, "God saw every thing that he had made, and, behold, it was very good" (Genesis 1:31). Even a creature people fear has a place in God's good plan.

PICTURE STUDY



Gila Monster, from The Reptile Book (Plate LIV), Raymond L. Ditmars, 1907 (this printing 1915) · Color-printed photograph · From Ditmars, The Reptile Book (New York: Doubleday, Page) Wikimedia Commons · No restrictions

Raymond Ditmars was the keeper of reptiles at the Bronx Zoo in New York. He loved reptiles and wanted people to understand them instead of fearing them. In 1907 he wrote *The Reptile Book*, filled with photographs of North American reptiles. This picture is a colored plate from a later printing of his book.

Look closely

- Look at the skin. Can you see the tiny beads? What colors are they?
- Look at the tail. Is it thin or fat? Why?
- Look at the legs. Is this a lizard made for running fast or walking slowly?

Talk about it

1. What do you think the bright pink and black colors tell other animals?
2. Why do you think Ditmars wanted people to stop being afraid of reptiles?

Safety first. Never touch or bother a Gila monster or any wild lizard. If you see one in the desert, enjoy it from a distance and tell a grown-up.

HANDS-ON: BEADED GILA MONSTER

Make a Gila monster with beaded skin and a fat tail.

You will need

- Black construction paper
- Pink, orange or yellow dot stickers, paint or cereal rings
- Glue
- Scissors (with a grown-up)

Steps

1. Draw a Gila monster shape on black paper: a blunt head, four short legs and a short, fat tail. Cut it out.
2. Cover the body with pink and orange “beads” in bands and patches.
3. Draw a cool burrow under the ground on another paper and slide your Gila monster inside.
4. Tell a grown-up how a fat tail helps a Gila monster in the desert.

Check your work

- My Gila monster has beaded skin and a fat tail.
- I showed its burrow.
- I can tell how the Gila monster helped make a medicine.

FIELD NOTEBOOK

1. Draw the desert in two layers: the hot sun on top and a Gila monster resting in its cool burrow underneath.
2. Write: “Arizona protected the Gila monster in 1952.”

Did you know? A Gila monster does not have fangs like a rattlesnake. Its venom flows along grooves in its bottom teeth when it bites and holds on. Gila monsters are so slow and shy that they hardly ever bite people who leave them alone. They may spend about nine-tenths of their lives underground.

Goes deeper in. Life Science, the unit on reptiles and amphibians (coming soon); and Geography, for the deserts of North America.

For families. Dr. John Eng, an endocrinologist with the U.S. Department of Veterans Affairs, identified exendin-4 in Gila monster saliva in 1992; a synthetic version, exenatide (Byetta), was approved by the FDA in 2005 for type 2 diabetes, and it helped open the

way to later medicines of the same family. In 1952 Arizona protected the Gila monster, often called the first venomous animal in North America given legal protection. The Reptile Book (Doubleday, 1907) is in the public domain; if no suitable Gila monster photograph is found on Commons, look in the Biodiversity Heritage Library scan.

PRACTICE

1. EASY Where does the Gila monster live?
2. MEDIUM Why does a Gila monster have a fat tail?
3. MEDIUM How did the Gila monster help people?

Make it a game · Desert Burrow. Lay blankets or pillows around the room as cool burrows. The leader calls “Hot sun!” and every Gila monster crawls slowly into a burrow. At “Cool evening!” they crawl out to hunt for “eggs” (balled-up socks). Remember: Gila monsters never run!

Scripture. “And God saw every thing that he had made, and, behold, it was very good. And the evening and the morning were the sixth day.” (Genesis 1:31, KJV)

God made every creature on this trail, from the crocodile to the Gila monster, and He called His work very good.

Practice: answers

1. In the deserts of the southwestern United States and northern Mexico.
2. It stores extra fat there, so it can go a long time without eating.
3. Something in its spit helped scientists make a medicine for diabetes.

Track 1 badge quizzes

The badge quizzes are optional. Read each question aloud; the child may answer by talking, pointing or drawing. Four right out of five earns the badge. Badges and the certificate are earned by doing the stops, not by scores.

Badge quiz 1 (Stops 1–5)

1. How does a mother crocodile carry her hatchlings to the water?
2. What is the biggest lizard in the world, and how does it smell its food?
3. Why does a snake shed its skin?
4. Why do people near nesting beaches turn off their lights at night?
5. Name one amazing thing about a chameleon.

Badge quiz 2 (Stops 6–10)

6. Which tortoise helped save his kind on Española Island?
7. Put these in order: frog, egg, froglet, tadpole.
8. Why did people long ago think salamanders lived in fire?
9. What do a poison dart frog's bright colors tell other animals?
10. How did the Gila monster help people?

TRAIL CERTIFICATE: MY REPTILE AND AMPHIBIAN FIELD NOTEBOOK AND TRAIL C CERTIFICATE

Gather the Field Notebook pages from this trail into one booklet with a cover: "My Reptile and Amphibian Field Notebook," your name and the dates you started and finished.

Add a two-column page at the front: "Reptiles" (crocodile, Komodo dragon, snake, sea turtle, chameleon, tortoise, Gila monster) and "Amphibians" (frog, salamander, poison dart frog), with a small drawing of each.

When the booklet is done, a parent signs the Trail C certificate.

- **Ten stops**: At least one page for each stop, each with a title and a date.
- **Reptile or amphibian**: All ten animals are sorted correctly into reptiles and amphibians.
- **Observation**: At least one drawing made from a real animal (Stop C7 or C8) or a careful look at a picture.
- **Care**: Drawings are labeled and done carefully.

Answer key

1. Gently, in her mouth.
2. The Komodo dragon; it flicks its forked tongue.
3. Because it has grown and has a new skin underneath.
4. So baby sea turtles are not confused and can find their way to the sea.

5. Any one: it changes color; its eyes move separately; its tongue shoots out longer than its body; its toes and tail grip branches.
6. Diego.
7. Egg, tadpole, froglet, frog.
8. Salamanders hiding in damp logs crawled out when the logs were put on the fire.
9. “Don’t eat me! I am poisonous.”
10. Something in its spit helped scientists make a medicine for diabetes.

Explore Tracks · Trail D

The fourth trail of three interest tracks for curious Scouts: Animals (ocean life), Dinosaurs (dinosaurs and the Bible) and Great Battles of the Nineteenth Century. Short, self-paced stops with true stories, great pictures, hands-on projects and games.

First edition

> *O LORD, how manifold are thy works! in wisdom hast thou made them all: the earth is full of thy riches. So is this great and wide sea, wherein are things creeping innumerable, both small and great beasts.*
> *Psalm 104:24–25 (KJV)*

Course Guide

Explore Tracks are for children who want more of what they love. Each track is a trail of short stops. At every stop the child hears a true story, studies a great picture, does something with his or her hands, plays a game and adds a page to a Field Notebook. Each stop also points to the matching lesson in a School Launch course, so the child can go deeper.

Trail D is the fourth trail of each track at the 🟢 Scout level (ages 7–9). The Animals track goes down into the sea, from sharks, octopuses and coral reefs to the dark home of the anglerfish, and ends with Jonah's great fish and the Leviathan of the Bible. The Dinosaurs track opens the Bible beside the fossils: the living things God made, Behemoth (Job 40) and Leviathan (Job 41), the Ark and the Flood, dragon stories from around the world, and how to read a museum sign carefully. The Great Battles track visits eight battles of the nineteenth century, from Waterloo (1815) to Appomattox (1865), five of them from the American Civil War. Trails A–C are not required first.

WHO IT IS FOR

Written for children about ages 7–9 who are read to by a parent, or who read short passages on their own. Older siblings can join in. Nothing earlier is required.

HOW TO USE THIS COURSE

1. **One stop at a time.** A stop takes 15–25 minutes: read the story aloud, look at the picture, do the hands-on part and play the game. Two or three stops a week works well.
2. **Any order.** The tracks are independent. Do one track at a time, or rotate between them.
3. **Field Notebook.** Every stop ends with a page for the notebook. At the end of the trail the pages become a booklet, and the parent signs the Trail D certificate.
4. **Badge quizzes.** Each track has two short, optional oral quizzes. They are for fun, not grades.

SCOPE AND SEQUENCE

Track 1: Animals 🐾 Trail D: Ocean Life (Self-paced)

MATERIALS

- **Field Notebook (a sketchbook or composition book)**One for the whole trail.
- **Colored pencils, a ruler, scissors and glue**For drawings, terrain maps and ocean-depth charts.
- **Household things**Each hands-on project lists what it needs: blocks, clay, string, toy figures, cups, a shallow pan or box of sand.
- **A Bible (KJV)**For the verse at each stop.

GRADING

Explore Tracks are not graded. A stop is done when the child has heard the story, done the hands-on part and made a notebook page.

Badges and the Trail D certificate are earned by finishing the stops.

A NOTE TO PARENTS

You do not need to be an expert. Read the story aloud, look at the picture together and ask, “What do you notice?” Each stop has a short *For families* note with background and any facts that scholars still discuss.

Ocean life: the Animals stops tell what scientists have observed and what is still unknown, especially about the deep sea and the giant squid, which was first filmed alive in its deep home only in 2012. The last stop reads Jonah and the Leviathan passages as true Scripture; where the Bible does not name an exact kind of animal, the stop says so rather than guessing.

Dinosaur dates: museums give ages in millions of years. Stops marked ⏳ (D5, D7, D8 and D9) include a short box with three parts: *What the sign says*, *What we observe* and *How Christians read it*. The trail teaches the period names as museum words and explains that the dates are interpretations; many Christian families understand the fossils within a young earth and the Flood. Where Christians differ, as on what happened to the dinosaurs, each view is presented fairly.

Battles are told for young children: the map, the plan, the people and why it mattered, with honor for courage, faith and wisdom and no gory detail. Losses are given as numbers, and wounds and deaths are stated plainly but not described. Both sides are described fairly, in the terms of their own time. The Civil War stops say plainly that slavery was the central cause of secession, as the seceding states’ own declarations said, while honoring the courage of soldiers on both sides. The trail ends with Grant’s generous terms at Appomattox.

Contents

Track 1: Animals 🐾 Trail D: Ocean Life

1.1 Sharks: Rows of Teeth and Sandpaper Skin
1.2 Octopus: Eight Arms and Three Hearts
1.3 Coral Reefs: Cities Built by Tiny Animals
1.4 The Giant Squid: A Sea Monster Found
1.5 Dolphins: Breathing, Whistling and Playing
1.6 Jellyfish: No Brain, No Bones, No Problem
1.7 Anglerfish and the Deep Sea
1.8 Salmon: The Long Way Home
1.9 Seals and Sea Lions: Flippers, Whiskers and Blubber
1.10 Jonah and Leviathan

Each stop takes 15–25 minutes. Tracks may be done in any order, and a child may do just one track.

TRACK 1

Animals 🐾 Trail D: Ocean Life

The fourth trail of the Animals track dives into the sea: sharks with their rows of spare teeth, the eight-armed octopus, coral reefs built by tiny animals, the giant squid that a Newfoundland minister photographed, playful dolphins, jellyfish, the glowing anglerfish of the deep, salmon swimming home, seals and sea lions, and the great fish and leviathan of the Bible. Each stop is a short read-aloud story, a picture to study, something to draw or build, quick questions, a game and a verse of Scripture.

This is the 🟢 **Scout** level, written for ages 7 to 9. A parent reads the story aloud, or a strong reader reads it alone. Every stop stands by itself. The sea creatures are taught as God's handiwork, made "after their kind" (Genesis 1:21), and caring for them is taught as good stewardship (Genesis 2:15). The 🔵 Ranger and 🔴 Expert levels of these same stops will add maps, numbers and primary sources later.

Five stops earn the **Ocean Scout badge, part 1**, and ten stops earn part 2 and the **Trail D certificate**. The badge quizzes are at the end of the trail and are optional.

BEFORE YOU BEGIN

- Listen to a story of about five minutes and tell it back.
- Find the Atlantic and Pacific Oceans, Australia and Alaska on a globe (a grown-up may help).

MASTERY CHECKLIST

☐ I can tell the difference between a fish and a sea mammal, and name one of each.
☐ I can tell one true and surprising fact about each animal on this trail.
☐ I can tell how two sea animals hide, hunt or stay warm.
☐ I can tell why the deep sea is dark and name one animal that makes its own light.
☐ I can tell the story of Jonah and the great fish in order.

OPTIONAL BOOKS AND RESOURCES

- **Smithsonian Ocean** (https://ocean.si.edu): Free pages, photos and short videos on sharks, coral, the giant squid and the deep sea.
- **Monterey Bay Aquarium Live Cams** (https://www.montereybayaquarium.org/animals/live-cams): Free live cameras of jellies, sea otters, sharks and a kelp forest; good for Stops D1 and D6.
- **NOAA Ocean Exploration** (https://oceanexplorer.noaa.gov): Photos and videos from deep-sea dives; use them with Stop D7.

🟢 SCOUT · STOP D1 · TRACK 1 · STOP 1.1 · 15–25 MINUTES

1.1 Sharks: Rows of Teeth and Sandpaper Skin

OBJECTIVES

- Tell two ways a shark is different from most other fish: a skeleton of cartilage and skin like sandpaper.
- Explain why a shark never runs out of teeth.
- Name the biggest fish in the sea and tell what it eats.

> **Warm-up.** Press the tip of your nose and wiggle it. Now bend your ear. They bend because they are made of cartilage, not bone. A shark's whole skeleton is made of cartilage, like your nose and ears!

> **Video slot.** Video coming. Sharks for children: a whale shark feeding, a shark's rows of teeth, a hammerhead swimming. Search approved channels (Monterey Bay Aquarium, Smithsonian Ocean, NOAA Fisheries, National Geographic Kids); preview first.

KEY TERMS

fish
An animal that lives in water, breathes with gills and swims with fins.

gills
Slits on the side of a fish's head that take air out of the water so the fish can breathe.

cartilage
A strong, bendy material, like the inside of your nose and ears. A shark's skeleton is made of it.

predator
An animal that hunts other animals for food.

CORE IDEAS

The story. Far out in the warm blue sea, a shadow glides under a fishing boat. It is long and gray, with a tall fin on its back and a tail that swishes from side to side. It is a shark. The sailors lean over the side to watch. The shark does not even look at them. It has smelled a school of fish far ahead, and off it goes.

No bones at all. Sharks are fish. They breathe with **gills** and swim with fins. But a shark has no bones! Its skeleton is made of **cartilage**, which is light and bendy, so a shark can turn quickly. Its skin is covered with tiny tooth-shaped scales. Rub a shark one way and it feels smooth; rub it the other way and it feels like sandpaper.

A mouth full of spare teeth. A shark has rows and rows of teeth, one behind another. When a front tooth breaks or falls out, a new one moves forward to take its place, like a

moving sidewalk. One shark may use thousands of teeth in its life. That is why shark teeth are some of the easiest things to find on certain beaches.

Super senses. Sharks are **predators**, and God gave them keen senses for hunting. A shark can smell a tiny bit of blood in the water from far away. Tiny pores on its snout can even feel the weak electric signals every living animal gives off, so a shark can find a fish hiding in the sand. The hammerhead's wide, flat head spreads those pores out like a metal detector.

Big and gentle. There are hundreds of kinds of sharks. Some are smaller than your hand. The biggest is the whale shark, the largest fish in the world, as long as a school bus. But it does not hunt big animals. It swims with its huge mouth open and strains tiny floating creatures out of the water. Divers can swim right beside it.

PICTURE STUDY



The Gulf Stream, Winslow Homer, 1899 · Oil on canvas · The Metropolitan Museum of Art, New York
Wikimedia Commons · Public domain

Winslow Homer was an American painter who loved the sea. He sailed to the Bahamas and Florida and painted the warm waters of the Gulf Stream. In this picture a sailor is alone on a boat whose mast has broken off. Sharks circle in the waves. Far away, a ship sails by.

Look closely

- Count the sharks. Where are their fins and tails?
- Find the broken mast. Find the ship far away on the edge of the sea.
- Look at the color of the water. Is it calm or rough?

Talk about it

1. How do you think the sailor feels? What would you do if you were on that boat?

2. Do you think the faraway ship will see him? Why?

HANDS-ON: SHARK TOOTH CONVEYOR BELT

Make a paper model of a shark's jaw that shows how new teeth move forward to replace old ones.

You will need

- A paper plate
- A strip of white paper about 2 inches wide and 12 inches long
- A pencil and a gray crayon
- Scissors and tape (with a grown-up)

Steps

1. Fold the paper plate in half to make a shark's open mouth. Color the outside gray.
2. Draw a row of pointed triangle teeth all along the paper strip.
3. Ask a grown-up to cut two slits at the front edge of the mouth, one on each side. Thread the strip through so a few teeth stick out at the front and the rest are hidden inside.
4. Pretend a front tooth broke off. Pull the strip forward so a new tooth moves up. Keep going until you have used them all!

Check your work

- My shark mouth has a row of teeth that moves forward.
- I can show how a new tooth replaces an old one.
- I can tell what a shark's skeleton is made of (cartilage).

FIELD NOTEBOOK

1. Draw a shark from the side. Label the fin on its back, the tail, the gills and the teeth.
2. Draw a whale shark next to a school bus to show how big it is.

> **Did you know?** Some sharks, like the nurse shark, can rest on the sea floor and pump water over their gills. Others must keep swimming to breathe. Shark eggs come in tough cases that people call "mermaid's purses," though many sharks are born alive instead. People are not a shark's food: shark bites on people are very rare.

> **Goes deeper in.** Life Science, the fish and ocean animals unit (coming soon); and Geography, for the Gulf Stream and the warm seas.

> **For families.** There are more than 500 known kinds of sharks (NOAA Fisheries). Whale sharks are commonly reported at about 40 feet long, with some estimates larger. The

"tiny pores" are the ampullae of Lorenzini, which sense electric fields. Homer's *The Gulf Stream* (1899) is tense but not graphic; you may preview it before showing it.

PRACTICE

1. EASY What is a shark's skeleton made of?
2. MEDIUM Why does a shark never run out of teeth?
3. EASY What is the biggest fish in the world, and what does it eat?

Make it a game · Shark Sense. One player is the shark and closes their eyes. Another player hides a "fish" (a small toy) somewhere close by, then quietly gives clues by saying "warmer" or "colder" as the shark moves. The shark uses its "super senses" to find the fish. Then switch.

Scripture. "The fowl of the air, and the fish of the sea, and whatsoever passeth through the paths of the seas." (Psalm 8:8, KJV)

David marveled at all the creatures God made, even the ones that swim far out in the paths of the sea. Sharks are part of God's handiwork too.

Practice: answers

1. Cartilage, a strong, bendy material like the inside of your nose and ears.
2. It has rows of spare teeth, and a new one moves forward whenever one falls out.
3. The whale shark. It eats tiny floating creatures that it strains from the water.

1.2 Octopus: Eight Arms and Three Hearts

OBJECTIVES

- Name three surprising parts of an octopus: eight arms, three hearts and blue blood.
- Tell three ways an octopus hides or escapes from danger.
- Explain why an octopus can squeeze through a tiny hole.

Warm-up. Try to touch and pick up three things at once using only one hand. Hard, isn't it? An octopus has eight arms, and every one of them can feel, grab and even taste on its own!

Video slot. Video coming. Octopus changing color, squeezing through small spaces and squirting ink. Search approved channels (Monterey Bay Aquarium, Smithsonian Ocean, NOAA Ocean Exploration, National Geographic Kids); preview first.

KEY TERMS

octopus
A soft sea animal with eight arms covered in suckers and no bones.

sucker
A round cup on an octopus arm that grips things and can feel and taste them.

camouflage
Colors or shapes that help an animal blend in with what is around it.

ink
A dark cloud an octopus squirts into the water to hide while it escapes.

CORE IDEAS

The story. A diver swims slowly over a rocky sea floor, looking for an octopus. She sees rocks, weeds and shells, but no octopus. Then one of the "rocks" moves! Its bumpy brown skin turns smooth and pale, and eight long arms ripple out. The octopus had been sitting right in front of her the whole time.

A wonderful body. An **octopus** has eight arms lined with **suckers**. Each sucker can grip, and it can taste too, so an octopus can taste a crab just by touching it. An octopus has three hearts and blue blood. It has no bones at all. The only hard part of its body is its beak, which is shaped like a parrot's beak and is used to crack open shells.

Masters of hiding. An octopus can change its color in the blink of an eye. It can make its skin bumpy like a rock or smooth like sand. This **camouflage** keeps it safe from hungry fish and seals. If a hunter finds it anyway, the octopus squirts a dark cloud of **ink** and shoots away backward by pushing water out of its body like a jet.

Squeeze and slip. Because it has no bones, an octopus can squeeze through any hole its beak can fit through. It hides in cracks, empty shells and even old bottles on the sea floor. Octopuses in aquariums are known for climbing out of their tanks, and the keepers have to put tight lids on them!

A careful mother. A mother octopus lays thousands of tiny eggs in a den. For weeks she stays with them, cleaning them and blowing fresh water over them, and she hardly ever leaves to eat. God gave the octopus a clever body and a mother's care for her young.

PICTURE STUDY



Octopus Stirrup Jar from Gournia, Unknown Minoan potter, About 1500 BC (museum dating) · Painted clay · Heraklion Archaeological Museum, Crete, Greece
Wikimedia Commons · CC BY 3.0

Long ago, the Minoan people lived on the island of Crete in the Mediterranean Sea. They were sailors and fishermen who knew sea creatures well. A potter painted this octopus so its arms wrap all the way around the jar, the way a real octopus wraps around a rock.

Look closely

- Find the octopus's two eyes. Find its head (really its body).
- Follow one arm with your finger. Where does it go?
- Look for other shapes between the arms. What might they be?

Talk about it

1. Why do you think the potter spread the arms all over the jar?
2. What do you think the jar was used to carry?

HANDS-ON: COLOR-CHANGING OCTOPUS

Make a paper octopus that can “change color” to hide on different backgrounds.

You will need

- Two sheets of paper
- Crayons or colored pencils
- Scissors (with a grown-up)
- A few things to hide on: a rug, a book cover, a rock or a pillow

Steps

1. Draw an octopus with a round head and eight wavy arms on one sheet. Cut it out.
2. Color one side to match one hiding place, such as gray and bumpy like a rock.
3. Color the other side to match a different hiding place, such as tan like sand or the color of your rug.
4. Lay the octopus on each background. Ask someone to find it. Flip it over to “change color” and hide somewhere new.

Check your work

- My octopus has eight arms.
- Each side matches a different hiding place.
- I can tell two other ways an octopus escapes (ink and jetting away).

FIELD NOTEBOOK

1. Draw an octopus and label the arms, suckers, eyes and beak. Write “3 hearts” and “blue blood” beside it.
2. Draw an octopus hiding in a shell or a crack in a rock.

> **Did you know?** The word octopus comes from Greek words meaning “eight feet.” An octopus can grow back an arm it has lost. Most octopuses live only a year or two. The giant Pacific octopus is the biggest kind; its arms can stretch wider than a car is long.

> **Goes deeper in.** Life Science, the ocean animals unit (coming soon); and History, for the Minoans of Crete.

> **For families.** Octopus blood is blue because it carries oxygen with copper (hemocyanin) instead of iron. The jar is a Late Minoan “Marine Style” stirrup jar from Gournia, Crete; the date is the museum’s. An octopus can pass through openings only slightly larger than its beak. Aquarium escape stories (such as “Inky” in New Zealand, 2016) are as reported by the aquariums.

PRACTICE

1. EASY How many arms and how many hearts does an octopus have?
2. MEDIUM Name two ways an octopus hides or escapes from danger.
3. MEDIUM Why can an octopus fit through a tiny hole?

Make it a game · Octopus Tag. One player is the octopus and stands in the middle with arms spread. The others are fish and try to run past. Anyone tagged becomes an “arm” and holds hands with the octopus. Keep going until the octopus has eight arms (or everyone is caught).

Scripture. “But ask now the beasts, and they shall teach thee; and the fowls of the air, and they shall tell thee: Or speak to the earth, and it shall teach thee: and the fishes of the sea shall declare unto thee.” (Job 12:7–8, KJV)

Job said the creatures of the sea teach us about God. A clever octopus shows how wise its Maker is.

Practice: answers

1. Eight arms and three hearts.
2. Any two: changing color, changing the bumps on its skin, squirting ink, jetting away, squeezing into a crack.
3. It has no bones; only its beak is hard.

1.3 Coral Reefs: Cities Built by Tiny Animals

OBJECTIVES

- Tell what a coral polyp is and how corals build a reef.
- Name the biggest coral reef in the world and find it on a globe.
- Name two animals that live on a coral reef and how they help each other.

Warm-up. Stack ten blocks one on top of another. Now imagine that each block is smaller than a grain of rice, and that millions of tiny builders keep stacking for years and years. That is how a coral reef is built!

Video slot. Video coming. Coral reefs for children: coral polyps feeding at night, clownfish in an anemone, parrotfish on the Great Barrier Reef. Search approved channels (NOAA Ocean Service, Smithsonian Ocean, Monterey Bay Aquarium, National Geographic Kids); preview first.

KEY TERMS

coral
A tiny sea animal that builds a hard cup around itself; many corals living together make a reef.

polyp
One little coral animal, shaped like a tube with a ring of tentacles on top.

reef
A long ridge of rock or coral near the top of the sea.

habitat
The home where an animal finds its food, water and shelter.

CORE IDEAS

The story. A boy puts on a snorkel mask and lies face down in the warm, clear water off the coast of Australia. Below him is a whole city of color: pink, purple and yellow shapes like trees, fans, brains and towers. Striped fish dart in and out. A sea turtle paddles past. He is floating over the Great Barrier Reef.

Rocks that are alive. Those colorful shapes are **coral**. They look like plants or rocks, but corals are animals! Each tiny coral animal is called a **polyp**. It is a soft tube with a ring of tentacles on top, often smaller than a pea. At night, the polyps reach out their tentacles to catch tiny floating food.

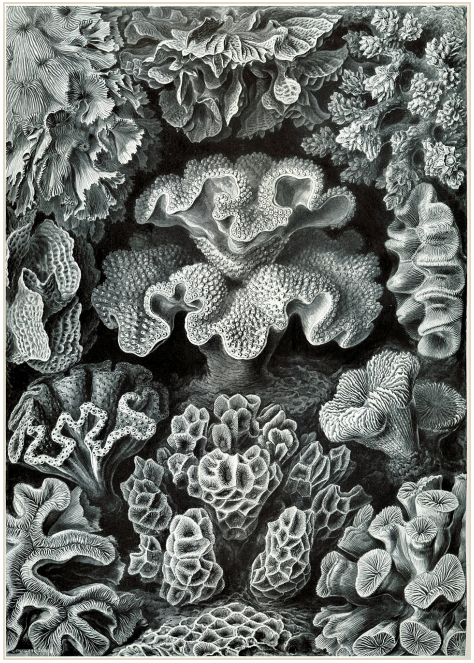
Builders of the sea. Each polyp builds a hard cup of stone around its soft body. Thousands of polyps live together, side by side, and their cups join into one big piece of coral. New polyps grow on top of old ones, year after year. Over a long time, the coral grows into a **reef**.

The Great Barrier Reef is the biggest of all, about 1,400 miles long, made of thousands of smaller reefs.

A busy habitat. A coral reef is a **habitat** for a huge crowd of creatures: fish, crabs, shrimp, sea stars, eels and turtles. The orange clownfish lives among the stinging arms of a sea anemone. The anemone does not sting it, and the clownfish keeps the anemone clean. Parrotfish crunch on coral with their beak-like teeth, and the bits they leave behind become fine white sand.

Things creeping innumerable. The psalmist looked at the sea and saw creatures "innumerable, both small and great" (Psalm 104:25). A coral reef shows it well. God made great reefs out of animals too small to notice, and He gave people the job of caring for them wisely.

PICTURE STUDY



Hexacoralla (Six-Rayed Corals), Plate 9 of Art Forms in Nature, Ernst Haeckel (drawings), Adolf Giltsch (lithograph), 1899–1904 · Color lithograph · From the book Kunstformen der Natur (Art Forms in Nature)
Wikimedia Commons · Public domain

Ernst Haeckel was a German scientist who studied sea creatures under the microscope and drew them with great care. His book of one hundred prints showed how beautiful and orderly these small animals are. This page shows stony corals, the kind that build reefs.

Look closely

- Find a coral with wavy grooves like a brain.
- Find a coral made of many little star-shaped cups. Each cup was the home of one polyp.
- Look at how the corals are arranged on the page. Is it messy or in a pattern?

Talk about it

1. Why do you think the artist put the corals in a neat pattern instead of the way they grow on a reef?
2. Which coral would you most like to see in the sea? Why?

HANDS-ON: EGG-CARTON CORAL REEF

Build a little coral reef and fill it with the creatures that live there.

You will need

- A cardboard egg carton
- Paints or markers in bright colors
- Pipe cleaners, tissue paper or yarn
- Paper, crayons, scissors and glue (with a grown-up)

Steps

1. Cut the egg cups apart. Each cup is one coral polyp's stony home.
2. Paint the cups in bright reef colors. Glue them close together on a piece of cardboard to make a reef.
3. Poke short pieces of pipe cleaner or tissue into some cups to be the polyps' tentacles.
4. Draw and cut out a clownfish, a parrotfish, a sea turtle and a crab. Glue them on or around your reef.

Check your work

- My reef has many coral cups joined together.
- I added at least three reef animals.
- I can tell what a polyp is.

FIELD NOTEBOOK

1. Draw one coral polyp up close with its ring of tentacles. Next to it, draw a big piece of coral made of many polyps.
2. Find Australia on a globe. Draw its shape and mark the Great Barrier Reef along the northeast coast.

> **Did you know?** Corals are cousins of jellyfish and sea anemones: they all have stinging tentacles. On a few nights each year, after a full moon, many corals on the Great Barrier Reef let out tiny eggs all at once, like an underwater snowstorm. Reef-building corals have tiny plant-like helpers living inside them that make food from sunlight and give the corals their colors.

> **Goes deeper in.** Life Science, the ocean habitats unit (coming soon); and Geography, for Australia and the Pacific Ocean.

For families. The Great Barrier Reef is about 2,300 km (about 1,400 miles) long and is made of roughly 2,900 individual reefs (Great Barrier Reef Marine Park Authority). The helpers are algae called zooxanthellae. Haeckel's *Kunstformen der Natur* was issued in parts from 1899 to 1904; Haeckel promoted evolutionary ideas, but his drawings are used here only as careful art. Care for reefs is taught as stewardship (Genesis 2:15).

PRACTICE

1. EASY Is coral a plant, a rock or an animal?
2. MEDIUM How do tiny polyps build a giant reef?
3. EASY How do the clownfish and the sea anemone help each other?

Make it a game · Clownfish, Find Your Anemone. Lay a few pillows or hula hoops on the floor as anemones. Everyone swims around like fish. When the leader calls "Shark!" every fish must hurry to an anemone. Take one anemone away each round, and players may share as long as they all fit.

Scripture. "So is this great and wide sea, wherein are things creeping innumerable, both small and great beasts." (Psalm 104:25, KJV)

A coral reef is full of more creatures than anyone can count, from tiny polyps to great sea turtles. God made them all.

Practice: answers

1. An animal. Each tiny coral animal is a polyp.
2. Each polyp builds a hard cup; thousands join together, and new ones grow on top of old ones year after year.
3. The anemone gives the clownfish a safe home, and the clownfish keeps the anemone clean.

1.4 The Giant Squid: A Sea Monster Found

OBJECTIVES

- Tell the true story of the giant squid that Moses Harvey photographed in Newfoundland.
- Name two giant parts of a giant squid: its long tentacles and its huge eyes.
- Tell what a legend is and how real evidence can show what is true.

> **Warm-up.** Hold up a dinner plate in front of your face. A giant squid's eye is about as big as that plate! It has some of the biggest eyes of any animal in the world.

Video slot. Video coming. The giant squid: first video in the deep sea (Japan, 2012) and the Smithsonian giant squid. Search approved channels (Smithsonian Ocean, NOAA Ocean Exploration, Ocean Exploration Trust, PBS Nature); preview first.

KEY TERMS

squid
A sea animal like an octopus, with eight arms, two long tentacles and a long body.

tentacle
A long, bendy feeler. A squid has two extra-long tentacles with suckers at the tips for grabbing food.

legend
An old story passed down that may have some truth in it but is not fully proven.

evidence
Something you can see or touch that helps show what is true.

CORE IDEAS

The story. For hundreds of years, sailors told tales of a huge sea monster called the kraken, with long arms that could wrap around a ship. Many people laughed and said it was only a **legend**. Then, in the autumn of 1873, three fishermen near St. John's, Newfoundland, rowed out to a strange shape in the water. It was alive! A long arm wrapped around their boat. A boy named Tom Piccot grabbed a hatchet and chopped it off, and the creature slid away into the deep.

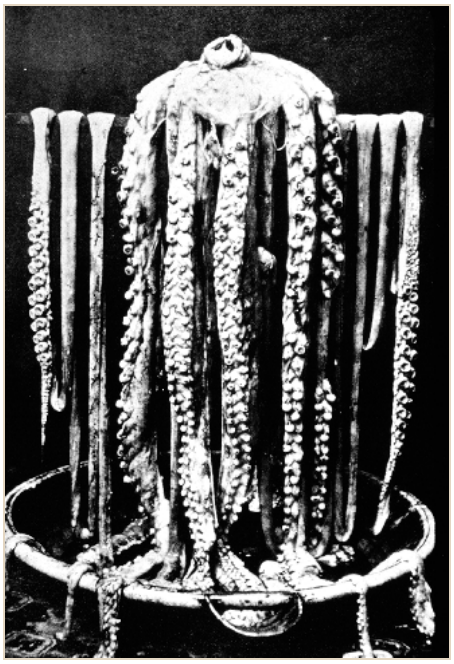
A minister with a camera. A Presbyterian minister in St. John's named Moses Harvey loved studying nature. He bought the long arm from the fishermen. A few weeks later, other fishermen caught a whole giant **squid** in their net in Logy Bay. Mr. Harvey hung it over the curtain rod above his bathtub and took its photograph. It was one of the first photographs of a giant squid. Now there was **evidence**: the "monster" was a real animal.

Arms, tentacles and eyes. A giant squid has eight arms and two extra-long **tentacles**, with toothed suckers at the tips for grabbing fish. The biggest giant squid are about as long as a school bus from the tip of the body to the end of the tentacles. Their eyes are as big as dinner plates. Those huge eyes help them see in the dark, deep water where they live.

A battle in the deep. Giant squid have one great enemy: the sperm whale. Sperm whales dive deep to hunt them, and many sperm whales have round scars on their skin from squid suckers. Squid beaks have been found in their stomachs. No one has ever seen one of those deep-sea fights, but the scars are good clues.

Seen at last. For many years no one had seen a living giant squid in its home. In 2004, scientists from Japan lowered a camera deep into the sea and took the first photographs of a live giant squid in the wild. In 2012, they filmed one swimming. God had made this wonder of the deep long before anyone saw it.

PICTURE STUDY



The Giant Squid in Moses Harvey's Bathtub, Photograph made for Rev. Moses Harvey, 1873–1874 · Photograph · St. John's, Newfoundland (copies in museums and archives)
Wikimedia Commons · Public domain

This old photograph was made in Moses Harvey's house in St. John's, Newfoundland. The squid was draped over a rail so all its arms hung down where they could be seen. It was later sent to scientists at Yale College, who studied it and wrote one of the first good descriptions of the giant squid.

Look closely

- Find the squid's body at the top. Find the arms hanging down.
- Look closely at the arms. Can you see the rows of round suckers?

- Look at the bathtub at the bottom. How does it help you guess how big the squid is?

Talk about it

1. Why do you think a photograph helped people believe the giant squid was real?
2. What would you have said if you saw this hanging in your bathroom?

HANDS-ON: LIFE-SIZE GIANT SQUID ON THE SIDEWALK

Use sidewalk chalk to draw a giant squid as long as a real one.

You will need

- Sidewalk chalk
- A tape measure or a long piece of string
- A driveway, sidewalk or long hallway with paper taped down
- A dinner plate

Steps

1. With a grown-up, measure 35 to 40 feet along the ground. Mark the start and the end.
2. Draw the squid's long body with two fins at the top end.
3. Trace around the dinner plate to draw a giant eye on the body.
4. Draw eight arms, then two very long tentacles reaching all the way to the end mark. Lie down beside it. How many of you would fit?

Check your work

- My squid has eight arms and two longer tentacles.
- Its eye is as big as a dinner plate.
- I can tell how Moses Harvey showed the giant squid was real.

FIELD NOTEBOOK

1. Draw a giant squid. Label the body, fins, eye, eight arms and two tentacles.
2. Draw a sperm whale with round sucker scars on its skin.

> **Did you know?** A giant squid has three hearts and blue blood, like its cousin the octopus. Its beak is hard and sharp, like a parrot's. The Smithsonian's National Museum of Natural History in Washington, D.C., has a real giant squid on display. A different animal, the colossal squid, is heavier still and has eyes just as big.

> **Goes deeper in.** Life Science, the ocean animals unit (coming soon); and History, for the fishing life of old Newfoundland.

> **For families.** The tentacle was taken off Portugal Cove in October 1873 by Theophilus Piccot, his son Tom and a third man; the whole squid came from Logy Bay later that year,

and the photograph is dated 1873 or 1874 in different sources. Harvey sent the specimen to A. E. Verrill at Yale. Length estimates for the largest giant squid are about 12–13 m (roughly 40 feet) including tentacles (Smithsonian). Kubodera and Mori photographed a live giant squid off the Ogasawara Islands in 2004 (published 2005); the first deep-sea video was made in 2012.

PRACTICE

1. EASY How big is a giant squid’s eye?
2. MEDIUM What did Moses Harvey do that helped prove the giant squid was real?
3. EASY Which big animal hunts giant squid in the deep sea?

Make it a game · Kraken Says. Play like “Simon Says,” but the leader is the Kraken. “Kraken says wave eight arms!” “Kraken says make your eyes as big as plates!” “Kraken says swim backward!” If the leader does not say “Kraken says,” stay still.

Scripture. “They that go down to the sea in ships, that do business in great waters; These see the works of the LORD, and his wonders in the deep.” (Psalm 107:23–24, KJV)

The fishermen of Newfoundland worked on the great waters, and they saw one of God’s wonders of the deep with their own eyes.

Practice: answers

1. About as big as a dinner plate.
2. He got a whole giant squid from fishermen and photographed it hanging over his bathtub.
3. The sperm whale.

🟢 SCOUT · STOP D5 · TRACK 1 · STOP 1.5 · 15–25 MINUTES

1.5 Dolphins: Breathing, Whistling and Playing

OBJECTIVES

- Explain why a dolphin is a mammal and not a fish.
- Tell how a dolphin breathes and how it rests without drowning.
- Tell how dolphins use whistles to call to each other.

Warm-up. Take a deep breath and hold it while a grown-up counts. How long did you last? A bottlenose dolphin usually comes up to breathe every few minutes, and it breathes through a hole on top of its head!

Video slot. Video coming. Bottlenose dolphins for children: a pod leaping, a mother and calf, a dolphin breathing through its blowhole. Search approved channels (NOAA Fisheries, Monterey Bay Aquarium, Smithsonian Ocean, National Geographic Kids); preview first.

KEY TERMS

mammal
An animal that breathes air, has warm blood and feeds its babies milk.

blowhole
The hole on top of a dolphin’s or whale’s head that it breathes through.

pod
A family group of dolphins or whales that swim together.

calf
A baby dolphin or whale.

CORE IDEAS

The story. A sailboat cuts through the waves off the coast of Florida. Suddenly a gray back curves out of the water beside the bow, then another, then five more. A **pod** of bottlenose dolphins is racing the boat! They leap and splash and ride the wave the boat pushes in front of it. The children on deck can hear a soft “pfoosh” each time a dolphin breathes.

Not a fish. Dolphins live in the sea and have fins, but they are not fish. They are **mammals**, like dogs, horses and people. They breathe air, they have warm blood, and the mother feeds her baby milk. A dolphin breathes through a **blowhole** on top of its head. It pops up, breathes out and in with a quick puff, and closes the blowhole tight before it dives again.

Mother and calf. A baby dolphin, called a **calf**, is born underwater, usually tail first. Right away its mother nudges it up to the surface for its first breath. The calf swims close beside its mother for a year or more, drinking her milk and learning to catch fish.

Whistles and naps. Dolphins talk to each other with clicks, squeaks and whistles. Each dolphin makes its own special whistle, almost like a name, and others in the pod know it. Because a dolphin must remember to breathe, it never falls all the way asleep. It rests one half of its brain at a time while the other half stays awake. Dolphins are some of the most playful animals God made. They toss seaweed, chase each other and leap for joy.

PICTURE STUDY



The Dolphin Fresco, Unknown Minoan painter (restored in the early 1900s), About 1600–1450 BC (museum dating) · Fresco (paint on wet plaster) · From the palace of Knossos; Heraklion Archaeological Museum, Crete, Greece
Wikimedia Commons · CC0

This wall painting comes from the palace of Knossos on the island of Crete. The Minoan people painted it on wet plaster, so the colors soaked in. Many pieces were broken and missing, and people in the 1900s carefully put it back together and filled in the gaps. The painter had clearly watched real dolphins swimming in the sea.

Look closely

- Count the dolphins. Which way are they all swimming?
- Find the little fish. How are they different from the dolphins?
- Look at the dolphins' stripes and fins. Does this look like a real dolphin to you?

Talk about it

1. Why do you think someone wanted dolphins painted on the wall of a room?
2. What part of the picture do you think was filled in later? How could you tell?

HANDS-ON: BLOWHOLE BREATH TEST

Find out how often a dolphin breathes and practice “surfacing” like one.

You will need

- A timer or a clock with a second hand
- A blue blanket or towel on the floor (the sea)
- Paper and a pencil

Steps

1. Lie on the blue blanket like a dolphin swimming. Take a deep breath and “dive” by holding it (stop at once if you feel uncomfortable).
2. When you need air, “surface”: lift your head and blow out with a big “pfoosh” through a pretend blowhole.
3. Have a grown-up time you. Write down how many seconds you lasted.
4. Talk about it: why does a dolphin need a blowhole on top of its head instead of on its face?

Check your work

- I “surfaced” and blew out like a dolphin.
- I wrote down my time.
- I can tell three things that make a dolphin a mammal.

FIELD NOTEBOOK

1. Draw a dolphin leaping out of the water. Label the blowhole, the fin on its back, the flippers and the tail.
2. Draw a mother dolphin and her calf swimming side by side.

> **Did you know?** Dolphins are small toothed whales. The orca, or killer whale, is really the biggest kind of dolphin. A dolphin’s tail moves up and down when it swims, but a fish’s tail moves side to side. Dolphins also find food with clicks and echoes; you can learn more at Trail F, Stop F1 “Echolocation.”

> **Goes deeper in.** Life Science, the mammals unit (coming soon); and History, for the Minoans of Crete.

> **For families.** Signature whistles in bottlenose dolphins are well studied (for example, the Sarasota Dolphin Research Program). Resting one brain half at a time is called unihemispheric sleep. The Knossos fresco was heavily restored by the Gilliéron workshop for Arthur Evans; the dating is the museum’s. If your child practices breath-holding, keep it short and on dry land.

PRACTICE

1. EASY Is a dolphin a fish or a mammal?
2. MEDIUM Name two things that show a dolphin is a mammal.
3. MEDIUM How does a dolphin rest without forgetting to breathe?

Make it a game · Signature Whistle. Each player makes up their own special whistle, hum or call. Everyone learns each other's calls. Then one player closes their eyes, and another makes their call from somewhere in the room. Can the listener tell whose call it was and point to where it came from?

Scripture. "Let the heaven and earth praise him, the seas, and every thing that moveth therein." (Psalm 69:34, KJV)

When dolphins leap and play, the sea seems to be praising God. Everything that moves in the sea was made to show His glory.

Practice: answers

1. A mammal.
2. Any two: it breathes air, it has warm blood, the mother feeds her calf milk.
3. It rests one half of its brain at a time while the other half stays awake.

1.6 Jellyfish: No Brain, No Bones, No Problem

OBJECTIVES

- Tell three things a jellyfish does not have: a brain, a heart and bones.
- Explain how a jellyfish swims and how it catches food.
- Tell why you should never touch a jellyfish, even one on the beach.

> **Warm-up.** Open your hand wide, then squeeze it closed, then open it again, slowly, over and over. That is how a jellyfish swims: it opens and squeezes its bell to push water and move along.

Video slot. Video coming. Jellyfish for children: moon jellies pulsing, a lion's mane jellyfish, glowing jellies in the deep. Search approved channels (Monterey Bay Aquarium Jelly Cam, MBARI, NOAA Ocean Exploration, Smithsonian Ocean); preview first.

KEY TERMS

jellyfish
A soft, jelly-like sea animal with a bell-shaped body and stinging tentacles. It is not really a fish.

bell
The round, umbrella-shaped top of a jellyfish.

sting
To poke with a tiny dart that has poison on it. Jellyfish tentacles sting.

drift
To float along wherever the water or wind carries you.

CORE IDEAS

The story. A girl walks along the beach in the early morning with her grandfather. On the wet sand lies something round and clear, like a plate of jelly. "Don't touch it," Grandpa says. "It's a jellyfish. Even washed up on the sand, it can still sting." They crouch down and look closely. Inside the clear jelly she can see four pale rings, like flower petals. It is a moon jelly.

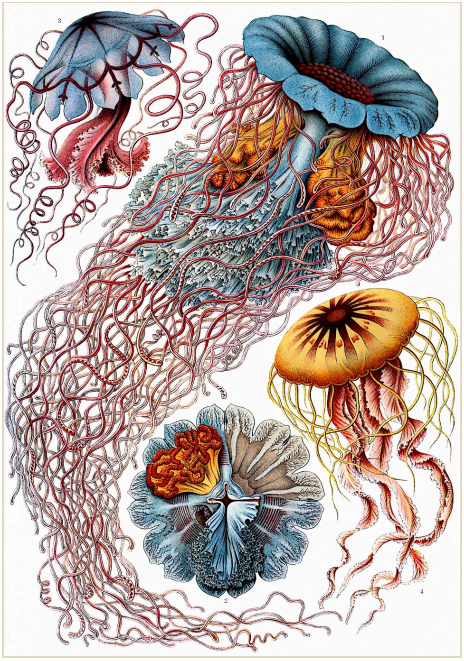
A strange, simple body. A **jellyfish** is not a fish at all. It has no brain, no heart, no bones and no blood. Its body is mostly water. The top part, called the **bell**, opens and squeezes, opens and squeezes, to push the jellyfish through the water. But a jellyfish is not a strong swimmer. Mostly it **drifts** wherever the ocean carries it.

Stinging tentacles. Long tentacles hang down from the bell. They are covered with thousands of tiny stinging darts. When a small fish or shrimp bumps a tentacle, the darts shoot out and **sting** it. Then the tentacles pull the food up to the jellyfish's mouth, under the

middle of the bell. Some jellyfish stings are mild, but a few are very dangerous, which is why we look and never touch.

Big, glowing and hungry. The biggest jellyfish is the lion's mane. Its bell can be wider than a grown-up is tall, and its tentacles can be longer than a blue whale. Many jellyfish in the deep sea glow with their own blue or green light. And jellyfish are food for others: big leatherback sea turtles eat almost nothing but jellyfish. God made even this simple creature for its own place in the sea.

PICTURE STUDY



Discomedusae (Disk Jellyfish), Plate 8 of Art Forms in Nature, Ernst Haeckel (drawings), Adolf Giltsch (lithograph), 1899–1904 · Color lithograph · From the book Kunstformen der Natur (Art Forms in Nature)
Wikimedia Commons · Public domain

Ernst Haeckel, a German scientist and artist, drew this jellyfish for his book of one hundred nature prints. He named this kind Desmonema after one he saw. Its long, curling tentacles look like ribbons or hair floating in the water.

Look closely

- Find the bell at the top. What shape is it?
- Follow the long tentacles with your finger. How do they move?
- Find the smaller drawings around the big jellyfish. What do you think they show?

Talk about it

1. Why might a jellyfish that is dangerous to touch also be beautiful to look at?
2. If you could color this jellyfish any way you liked, what colors would you choose?

HANDS-ON: JELLYFISH IN A BOTTLE

Make a jellyfish that drifts and floats inside a bottle of water.

You will need

- A clear plastic bottle with a cap, filled with water
- A thin plastic grocery bag
- A piece of string or thread
- Scissors and a few drops of blue food coloring (with a grown-up)

Steps

1. Cut a square from the plastic bag. Pinch the middle into a small ball of air and tie it off with string to make the bell.
2. Cut the loose plastic below the knot into thin strips for tentacles.
3. Push the jellyfish into the bottle, add a drop of blue food coloring, and fill the bottle to the top with water. Screw the cap on tight.
4. Tip and turn the bottle slowly. Watch your jellyfish drift and float like a real one.

Check your work

- My jellyfish has a bell and tentacles.
- It floats and drifts in the bottle.
- I can tell why we never touch a real jellyfish.

FIELD NOTEBOOK

1. Draw a jellyfish. Label the bell, the tentacles and the mouth. Write “no brain, no heart, no bones” beside it.
2. Draw a leatherback sea turtle swimming toward a jellyfish for its dinner.

> **Did you know?** A group of jellyfish is sometimes called a “bloom” or a “smack.” Jellyfish are cousins of coral (Stop D3). The Portuguese man-of-war looks like a jellyfish but is really a crowd of tiny animals living together as one. If you ever see a jellyfish on the beach, look with your eyes and keep your hands and feet away.

> **Goes deeper in.** Life Science, the ocean animals unit (coming soon); and Art, for drawing patterns in nature.

> **For families.** Jellyfish are about 95 percent water. The stinging cells are called nematocysts, and they can still fire after a jellyfish washes up. The record lion’s mane, found in Massachusetts Bay in 1870, was reported with a bell about 7 feet wide and tentacles about 120 feet long; this is an old report, not a modern measurement. If a sting happens, seek local lifeguard or medical advice; treatment varies by species. Haeckel promoted evolutionary ideas; his drawings are used here only as art.

PRACTICE

1. EASY Name two things a jellyfish does not have.
2. MEDIUM How does a jellyfish catch its food?
3. EASY Should you touch a jellyfish on the beach?

Make it a game · Jellyfish Drift. Everyone is a jellyfish and can only move by opening and closing their arms slowly while drifting. The leader calls out the ocean's "current": "Drift left!" "Drift to the window!" "Big wave!" Jellyfish must go where the current says. Anyone who walks fast instead of drifting sits out one turn.

Scripture. "And God said, Let the waters bring forth abundantly the moving creature that hath life, and fowl that may fly above the earth in the open firmament of heaven." (Genesis 1:20, KJV)

On the fifth day God filled the waters with moving creatures. Even a jellyfish, with no brain or bones, moves and lives because God made it.

Practice: answers

1. Any two: a brain, a heart, bones, blood.
2. Its tentacles sting small animals that bump into them and pull the food up to its mouth.
3. No. It can still sting, even out of the water.

1.7 Anglerfish and the Deep Sea

OBJECTIVES

- Describe the deep sea: dark, cold and pressing hard on everything.
- Tell how an anglerfish uses its glowing lure to catch food.
- Tell about one of the first people to visit the deep sea.

Warm-up. Go into a closet or bathroom with a grown-up and turn off the light. Wait a moment. Can you see anything? That is what the deep sea is like all the time. Now switch on a small flashlight. In the deep sea, many animals make their own light!

Video slot. Video coming. Deep-sea anglerfish and glowing deep-sea animals filmed by research submarines. Search approved channels (MBARI, NOAA Ocean Exploration, Ocean Exploration Trust/Nautilus Live, Smithsonian Ocean); preview first.

KEY TERMS

deep sea
The deepest part of the ocean, where sunlight never reaches.

anglerfish
A fish with a “fishing rod” on its head that has a glowing tip to attract food.

lure
Something used to attract an animal so it can be caught.

pressure
A push or squeeze. Deep in the sea, the heavy water presses hard on everything.

CORE IDEAS

The story. In 1934, two men squeezed into a hollow steel ball called a bathysphere, with windows no bigger than a dinner plate. A ship lowered them on a long cable into the sea near Bermuda, down, down, down, more than half a mile. One of them, William Beebe, pressed his face to the window. Outside was blackness, but then he saw sparks and flashes, like fireworks: fish and shrimp glowing with their own light.

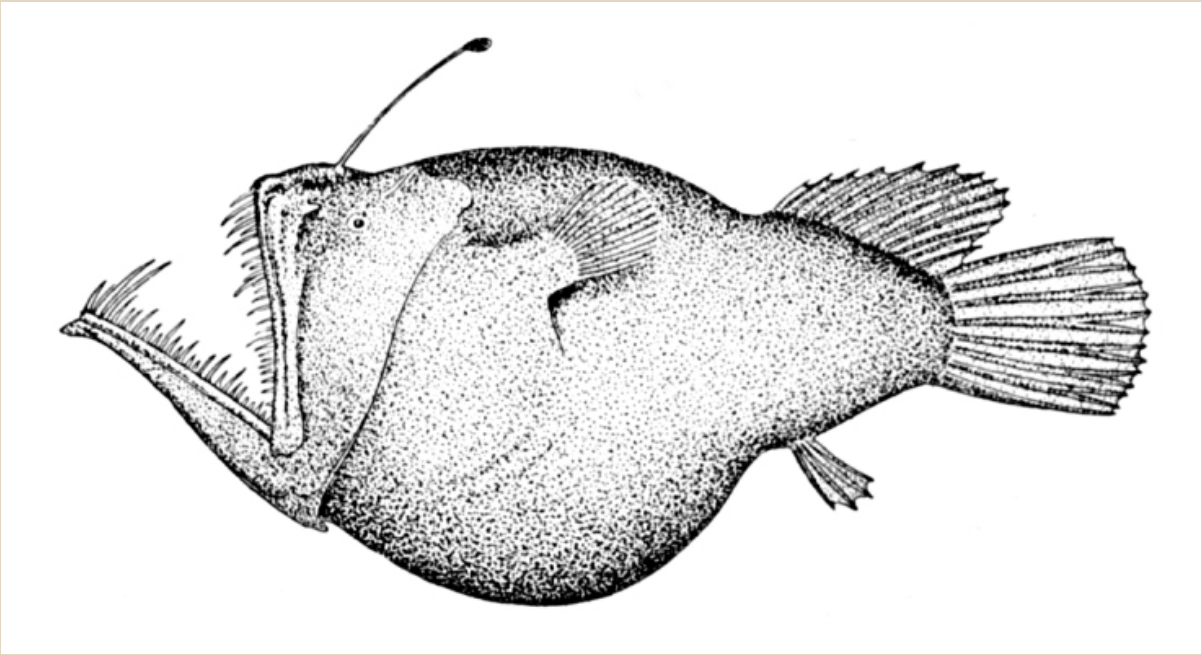
The dark, cold deep. Sunlight only reaches a little way into the ocean. Below that, the **deep sea** is dark all the time, day and night. The water is icy cold. And the weight of all the water above presses down with great **pressure**, enough to crush a soda can flat. Yet God has filled even this dark place with living creatures made just right for it.

Fishing in the dark. One of those creatures is the **anglerfish**. An angler is a person who fishes with a rod and line. The anglerfish has its own fishing rod: a long spine growing from its head with a glowing tip. In the dark, small fish swim toward the light, thinking it is food.

Then, snap! The anglerfish opens its huge mouth and gulps them down. Its long, sharp teeth point inward so its dinner cannot get out.

Small but fierce. In pictures, anglerfish look like monsters, but most deep-sea anglerfish are small, many no bigger than your fist. Food is hard to find in the deep, so an anglerfish can swallow a fish nearly as big as itself; its stomach stretches like a balloon. The glow in its lure is made by tiny living things called bacteria that live inside it.

PICTURE STUDY



Deep-sea anglerfishes, from the atlas of Oceanic Ichthyology, Scientific illustrators for G. Brown Goode and Tarleton H. Bean, 1896 · Printed scientific drawings · From Oceanic Ichthyology, published by the Smithsonian Institution's U.S. National Museum
Wikimedia Commons · Public domain

Long before submarines, American ships dragged nets along the bottom of the deep Atlantic and brought up strange fish. Two Smithsonian scientists, George Brown Goode and Tarleton Bean, wrote a big book about them, with an atlas of more than four hundred drawings.

Look closely

- Find an anglerfish. Find its "fishing rod" and the knob at the tip.
- Look at the teeth. Which way do they point?
- Compare the fish on the page. Which one looks strangest to you?

Talk about it

1. Why do you think the drawings are in black and white instead of color?
2. The scientists never saw these fish alive. What do you think they wished they could see?

HANDS-ON: GLOWING ANGLERFISH

Make an anglerfish with a lure that lights up in the dark.

You will need

- Black or dark blue paper
- White and yellow crayons or chalk
- A pipe cleaner or straw
- A small flashlight, or a bit of foil or glow-in-the-dark sticker

Steps

1. Draw a big round anglerfish on the dark paper with white crayon. Give it a huge mouth and long, pointy teeth.
2. Tape a pipe cleaner to the top of its head for the fishing rod.
3. Put a ball of foil or a glow sticker on the tip of the rod for the lure.
4. Turn off the lights and shine a small flashlight on the lure. Pretend to be a little fish swimming toward the light!

Check your work

- My anglerfish has a big mouth, sharp teeth and a fishing rod with a lure.
- I tried it in the dark.
- I can tell why the deep sea is dark.

FIELD NOTEBOOK

1. Draw the ocean from top to bottom: sunny blue at the top, darker in the middle and black at the bottom. Draw an anglerfish in the deep, dark part.
2. Draw the bathysphere on its cable with a person looking out the window.

> **Did you know?** In 1960, Jacques Piccard and Don Walsh rode a deep-sea vessel called the *Trieste* to the bottom of the Challenger Deep in the Pacific Ocean, nearly 7 miles down, the deepest place in all the oceans. Most of the deep sea has still never been seen by anyone. The monkfish that people eat in restaurants is a kind of anglerfish that lives in shallower water.

> **Goes deeper in.** Earth Science, the oceans unit (coming soon); and Geography, for the Pacific and Atlantic Oceans.

> **For families.** William Beebe and Otis Barton reached 3,028 feet in the bathysphere off Bermuda on August 15, 1934. Total darkness to human eyes begins around 1,000 m (about 3,300 feet). *Oceanic Ichthyology* (Goode and Bean) is dated 1895 on its title page and was issued in 1896; plate numbers for the anglerfish vary by edition, so search the

book on the Biodiversity Heritage Library. In some deep-sea anglerfish only the female has the lure; the tiny males are not discussed at this level.

PRACTICE

1. EASY Why is the deep sea always dark?
2. MEDIUM How does an anglerfish catch food in the dark?
3. EASY What did William Beebe ride in to go deep in the sea?

Make it a game · Anglerfish in the Dark. In a dim room, one player is the anglerfish and sits still holding a flashlight. The others are little fish and creep toward the light. When the anglerfish switches the light off and says “Snap!”, any fish within arm’s reach is caught and becomes the next anglerfish.

Scripture. “Yea, the darkness hideth not from thee; but the night shineth as the day: the darkness and the light are both alike to thee.” (Psalm 139:12, KJV)

No one sees the deep sea without a light, but God sees every creature there. Darkness is never dark to Him.

Practice: answers

1. Sunlight cannot reach that far down into the water.
2. It waves a glowing lure on a rod on its head; small fish swim to the light, and it gulps them.
3. A hollow steel ball called a bathysphere.

1.8 Salmon: The Long Way Home

OBJECTIVES

- Tell the journey of a salmon from stream to sea and back again.
- Explain how a salmon finds its way back to the stream where it hatched.
- Tell one way people help salmon get past dams.

Warm-up. Close your eyes and have a grown-up hold something under your nose: an orange, a cinnamon stick or soap. Can you tell what it is by smell alone? A salmon finds its way home by smelling the water of the stream where it was born!

Video slot. Video coming. Salmon run for children: salmon leaping up waterfalls, bears catching salmon in Alaska, a fish ladder at a dam. Search approved channels (National Park Service, NOAA Fisheries, U.S. Fish and Wildlife Service, Explore.org Katmai bear cams); preview first.

KEY TERMS

salmon
A strong fish that hatches in a river, grows up in the sea and swims back up the river to lay its eggs.

migrate
To travel a long way at a certain time to find food or to have young.

spawn
To lay and fertilize eggs in the water.

fish ladder
A set of water steps built beside a dam so fish can swim up past it.

CORE IDEAS

The story. In a cold, clear stream in Alaska, a tiny pink egg lies hidden among the pebbles. One day it hatches. Out wiggles a little fish with its own lunch, a round yolk sac, stuck to its belly. It is a baby **salmon**. For many months it grows in the stream, eating insects and hiding from bigger fish.

Off to sea. When it is big enough, the young salmon swims downstream, all the way to the ocean. Its body changes so it can live in salt water. For one to five years, depending on the kind, it swims far out in the sea, eating shrimp and smaller fish and growing big and strong.

The way home. Then something amazing happens. The salmon turns around and **migrates** home, often hundreds of miles, to the very same stream where it hatched. Scientists think it uses its sense of smell to find the way: every stream smells a little different, and the salmon remembers. It swims upstream against the rushing water and leaps right up small waterfalls.

A gift to the forest. At last the salmon reaches the gravel where it began. The mother digs a nest with her tail, and the salmon **spawn**, laying thousands of new eggs. Pacific salmon die after spawning, and their bodies become food for bears, eagles, gulls and even the trees along the bank. When people built big dams on rivers, the salmon could not get past, so builders added **fish ladders**: water steps the fish can climb. Caring for rivers this way is good stewardship of what God has made.

PICTURE STUDY



Salmon, Takahashi Yuichi, About 1877 · Oil on paper · University Art Museum, Tokyo University of the Arts, Japan
Wikimedia Commons · Public domain

Takahashi Yuichi was one of the first Japanese artists to paint in oil paints, the way European painters did. He painted this salmon hanging in a kitchen, salted to keep it through the winter. Some of it has already been sliced off for dinner. The painting is so real that it is one of Japan’s treasured works of art.

Look closely

- Find the straw rope. Where is the salmon tied?
- Look at the skin. Where does it shine? Where is it rough?
- Find the place where the fish has been cut. What color is the inside?

Talk about it

1. Why do you think a painter would choose an ordinary kitchen fish to paint?
2. How do you think this salmon got from the river to the kitchen?

HANDS-ON: SALMON JOURNEY MAP

Make a map game that follows a salmon from its stream to the sea and back.

You will need

- A large sheet of paper
- Crayons or markers
- A paper salmon cut out (or a small toy fish)
- One die

Steps

1. Draw a stream at the top of the paper, a winding river down the middle and the blue sea at the bottom.
2. Draw about 20 stepping-stone spaces down the river and back up again. Mark some spaces “waterfall: go back 1,” “fish ladder: go ahead 2” and “bear! go back 3.”
3. Put your salmon on the gravel nest at the top. Roll the die to swim down to the sea, then turn around and swim back home.
4. When your salmon reaches the stream again, draw new pink eggs in the gravel.

Check your work

- My map shows the stream, the river and the sea.
- My salmon made the whole journey down and back.
- I can tell how a salmon finds its home stream (by smell).

FIELD NOTEBOOK

1. Draw the salmon’s life in a circle: egg, baby with a yolk sac, young fish going to sea, big fish in the ocean, salmon leaping home.
2. Draw a bear standing in a waterfall catching a leaping salmon.

> **Did you know?** Some sockeye salmon turn bright red with green heads when they swim home to spawn. Salmon can leap up waterfalls taller than a grown-up. Bonneville Dam on the Columbia River, finished in 1938, was built with fish ladders, and people can watch the salmon swim past through underwater windows.

> **Goes deeper in.** Life Science, the fish and life cycles unit (coming soon); Geography, for the rivers of Alaska and the Pacific Northwest; and Gardening & Animals, for caring for streams.

> **For families.** Pacific salmon (sockeye, chinook, coho, chum, pink) die after spawning; Atlantic salmon may spawn more than once. The smell (olfactory imprinting) explanation for homing is well supported, and salmon may also use Earth’s magnetic field at sea. Leap

heights of up to about 10–12 feet are reported for Atlantic salmon. Takahashi Yuichi's *Salmon* (c. 1877) is an Important Cultural Property of Japan.

PRACTICE

1. EASY Where does a salmon hatch, and where does it grow up?
2. MEDIUM How does a salmon find its way back to its home stream?
3. EASY What is a fish ladder?

Make it a game · Swim Upstream. Two players hold a jump rope low and wiggle it like rushing water. The salmon must jump over the "waterfall" to get home. After each jump, raise the rope a little higher. Who can leap the highest waterfall?

Scripture. "All the rivers run into the sea; yet the sea is not full; unto the place from whence the rivers come, thither they return again." (Ecclesiastes 1:7, KJV)

Solomon saw how the water goes to the sea and comes back again. God made the salmon to follow the rivers to the sea and return to the place it came from.

Practice: answers

1. It hatches in a stream and grows up in the sea.
2. By smell: it remembers how its home stream smells.
3. A set of water steps beside a dam that lets fish swim up past it.

1.9 Seals and Sea Lions: Flippers, Whiskers and Blubber

OBJECTIVES

- Tell two ways to tell a seal from a sea lion.
- Explain how blubber and whiskers help seals live in the sea.
- Tell how people worked together to save the northern fur seals.

Warm-up. Lie on your tummy on the floor with your arms at your sides. Try to move across the room without using your hands, just by wiggling. That is how a seal moves on land! Now get up on your hands and knees and walk. That is more like a sea lion.

Video slot. Video coming. Seals and sea lions for children: harbor seals on rocks, California sea lions barking and walking on their flippers. Search approved channels (NOAA Fisheries, Monterey Bay Aquarium, National Park Service, Smithsonian Ocean); preview first.

KEY TERMS

pinniped
A sea mammal with flippers for feet, such as a seal, sea lion or walrus. The word means “fin-footed.”

flipper
A wide, flat arm or leg used for swimming.

blubber
A thick layer of fat under the skin that keeps sea animals warm.

whiskers
Long, stiff hairs on the face that help an animal feel things around it.

CORE IDEAS

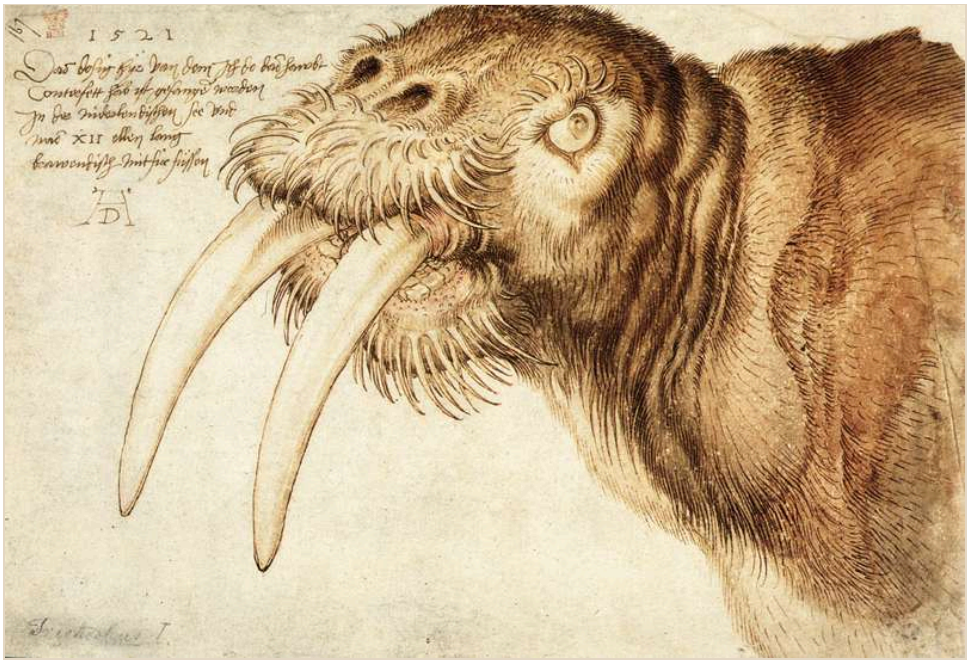
The story. On a pier in California, a crowd of brown animals lies piled up in the sun like puppies, honking and barking. One lifts its head, pushes up on its front flippers and waddles to the edge. Splash! It dives in and twists through the water as fast as a torpedo. These are California sea lions. On the rocks across the bay, a spotted harbor seal lies on its belly, quiet as can be.

Seal or sea lion? Seals and sea lions are both **pinnipeds**, sea mammals with **flippers**. Here is how to tell them apart. A sea lion has little ear flaps you can see, and it can turn its back flippers forward to walk on land. A seal has only tiny ear holes, and it cannot walk on its flippers, so it wiggles along on its belly. Sea lions bark loudly; seals mostly grunt and stay quiet.

Made for cold water. Many seals and sea lions swim in icy seas. Under their skin is a thick layer of fat called **blubber**, like a warm coat on the inside. Their **whiskers** are very sensitive. In dark or muddy water, a harbor seal can follow the tiny swirls a fish leaves behind just by feeling them with its whiskers.

The seals that came back. Far north, on the Pribilof Islands of Alaska, millions of northern fur seals come ashore each summer. Long ago, hunters killed so many for their thick fur that very few were left. In 1911, the United States, Great Britain, Japan and Russia signed a treaty, an agreement to stop hunting fur seals at sea. The herds grew large again. It was a good example of people caring for God's creatures together.

PICTURE STUDY



Head of a Walrus, Albrecht Dürer, 1521 · Pen and ink with watercolor on paper · The British Museum, London
Wikimedia Commons · Public domain

The walrus is the seals' big cousin: it is a pinniped too. Albrecht Dürer, a great German artist, drew this walrus head in 1521 while he was traveling in the Low Countries (where Belgium and the Netherlands are today). Few people in his part of Europe had ever seen a walrus, so he wrote a note on the drawing about the animal.

Look closely

- Find the tusks. How long are they compared to the head?
- Find the whiskers. How did Dürer draw so many?
- Look for the writing at the top. Why would an artist write on a drawing?

Talk about it

1. Do you think Dürer saw a living walrus or only a head? What makes you think so?

2. How is a walrus like a seal? How is it different?

HANDS-ON: BLUBBER GLOVE TEST

Find out how blubber keeps a seal warm in icy water.

You will need

- A large bowl of ice water
- Two zipper plastic bags
- Solid vegetable shortening (about a cup)
- A spoon and a timer

Steps

1. With a grown-up, spoon shortening into one bag. Turn the second bag inside out, slip it inside the first and zip the two together so the shortening is a layer between them. This is your “blubber glove.”
2. Put one bare hand into the ice water. Count how long until it feels too cold. Take it out and warm it up.
3. Put the same hand inside the blubber glove and put it in the ice water. Count again.
4. Which way could you keep your hand in longer? Why?

Check your work

- I tested my hand with and without blubber.
- I can tell which one stayed warmer.
- I can tell what blubber is and why seals need it.

FIELD NOTEBOOK

1. Draw a seal and a sea lion side by side. Circle the sea lion’s ear flap. Draw arrows to show how each one moves on land.
2. Draw a seal’s face with long whiskers and write “whiskers feel the fish.”

> **Did you know?** Elephant seals can dive more than a mile deep and hold their breath for over an hour. Baby seals are called pups. Harp seal pups are born with fluffy white fur that helps them hide on the ice. The biggest sea lion, the Steller sea lion, can weigh more than a small car.

> **Goes deeper in.** Life Science, the mammals unit (coming soon); Geography, for Alaska and the Bering Sea; and History, for the 1911 fur seal treaty.

> **For families.** Seals and sea lions are pinnipeds: “true” (earless) seals, eared seals (sea lions and fur seals) and the walrus. The North Pacific Fur Seal Convention of 1911 was signed by the United States, Great Britain (for Canada), Japan and Russia, and is often called one of the first international wildlife agreements. Harbor seal whisker-tracking is

from studies by Wolf Hanke and colleagues (2001). Dürer's walrus drawing (1521) is in the British Museum; scholars think he drew from a dead specimen or head. The blubber test uses cold water only briefly; take hands out at once if they ache.

PRACTICE

1. MEDIUM Name two ways to tell a sea lion from a seal.
2. EASY What is blubber, and what does it do?
3. EASY How did people help the northern fur seals?

Make it a game · Seal or Sea Lion?. The leader calls out "Seal!" or "Sea lion!" For "Seal," everyone drops to the floor and wiggles on their tummy. For "Sea lion," everyone walks on hands and knees and barks. The leader may also call "Walrus!": everyone holds two fingers down from their mouth like tusks.

Scripture. "And the LORD God took the man, and put him into the garden of Eden to dress it and to keep it." (Genesis 2:15, KJV)

God gave people the work of caring for His creation. When nations agreed to protect the fur seals, they were keeping what God made.

Practice: answers

1. Any two: a sea lion has ear flaps; it can walk on its flippers; it barks loudly. A seal has ear holes and wiggles on its belly.
2. A thick layer of fat under the skin that keeps the animal warm.
3. Four countries signed a treaty in 1911 to stop hunting them at sea, and the herds grew again.

1.10 Jonah and Leviathan

OBJECTIVES

- Tell the story of Jonah and the great fish in order.
- Tell what the Bible says about leviathan and why no one could tame it.
- Explain how Jesus used the story of Jonah.

Warm-up. Think of the biggest sea animal you have learned about on this trail. Could you catch it with a fishing pole? God asked Job a question like that about a creature called leviathan. Today we hear two true stories from the Bible about God and the great creatures of the sea.

Video slot. Video coming. The story of Jonah for children, read from the Bible or told with pictures. Search approved channels (The Bible Project, Crossway, Answers in Genesis Kids, a trusted church children's ministry); preview first.

KEY TERMS

prophet
A person God sends to speak His message to people.

Nineveh
A great city long ago in the land of Assyria, where Iraq is today.

repent
To be sorry for doing wrong and turn away from it.

leviathan
A huge, mighty sea creature described in the Book of Job and the Psalms.

CORE IDEAS

The story. God told the **prophet** Jonah, "Go to **Nineveh** and tell the people to stop their wickedness." But Jonah did not want to go. He ran the other way, to the seaport of Joppa, and got on a ship sailing far off to Tarshish. Out at sea, God sent a great wind. The waves rose so high that the sailors thought the ship would break apart.

Into the deep. Jonah knew the storm was his fault. "Throw me into the sea," he told the sailors, "and the sea will be calm." At last they did, and the storm stopped. But God had a plan for Jonah. "Now the LORD had prepared a great fish to swallow up Jonah" (Jonah 1:17). For three days and three nights Jonah was inside the fish. There, in the dark, he prayed and thanked God. Then God spoke to the fish, and it spat Jonah out onto dry land.

A second chance. This time, Jonah obeyed. He went to Nineveh and preached. The king and all the people believed God, and they **repented**. God showed mercy and did not destroy the city. Long afterward, Jesus said that as Jonah was three days and three nights in the belly of

the great fish, so He would be three days and three nights in the heart of the earth (Matthew 12:40). Then He rose again.

The mighty leviathan. In the Book of Job, God describes another great creature, **leviathan**. It has strong scales close together like shields, terrible teeth, and no hook or spear can take it. “Canst thou draw out leviathan with an hook?” God asks Job (Job 41:1). No one can tame it. Yet Psalm 104:26 says God made leviathan “to play” in the sea. The strongest creature in the sea is like a plaything to God. The same God who rules leviathan and the great fish rules the storms of our lives too.

PICTURE STUDY



Jonah and the Whale, Pieter Lastman, 1621 · Oil on oak panel · Museum Kunstpalast, Düsseldorf, Germany
Wikimedia Commons · Public domain

Pieter Lastman was a Dutch painter who loved painting Bible stories. He was the teacher of the famous painter Rembrandt. Here he shows the moment the great fish spits Jonah out onto dry land. Like many artists of his time, he painted the fish as a strange sea monster, because the Bible does not tell us what kind of fish it was.

Look closely

- Find Jonah. What is he doing with his arms? What does his face show?
- Look at the great fish. Find its mouth and its eye.
- Look at the sky and the water. Is the storm over, or still going?

Talk about it

1. What do you think Jonah said to God right after this moment?
2. Why did the painter make the fish look so huge?

HANDS-ON: JONAH STORY WHEEL

Make a turning wheel that tells the story of Jonah in four pictures.

You will need

- Two paper plates
- Crayons
- A brass paper fastener
- Scissors (with a grown-up)

Steps

1. Draw lines to divide one plate into four parts, like a pie.
2. In the four parts draw: 1) Jonah running away on the ship in the storm, 2) Jonah inside the great fish praying, 3) the fish spitting Jonah onto land, 4) Jonah preaching in Nineveh.
3. Ask a grown-up to cut one pie-shaped window out of the second plate. Draw waves and the words “Jonah and the Great Fish” on it.
4. Put the window plate on top and push the fastener through both centers. Turn the wheel and tell the story to someone.

Check your work

- My wheel shows four parts of the story in the right order.
- I told the story to someone using my wheel.
- I can tell what Jesus said about Jonah.

FIELD NOTEBOOK

1. Draw Jonah praying inside the great fish. Write Jonah 1:17 underneath.
2. Draw what you think leviathan might have looked like, using the words in Job 41: scales like shields, strong teeth.

> **Did you know?** The Book of Jonah calls the creature “a great fish.” In Matthew 12:40, the King James Bible uses the word “whale.” The Bible does not say what kind of animal it was; it says God prepared it. Jonah’s prayer from inside the fish is in Jonah chapter 2. You can find Nineveh on a map near the city of Mosul in Iraq.

> **Goes deeper in.** Literature, for Bible stories and retelling; History, for Assyria and Nineveh; and Geography, for the lands of the Bible.

> **For families.** Hebrew *dag gadol* means “great fish”; the Greek *ketos* in Matthew 12:40 means a great sea creature, rendered “whale” in the KJV. Christians have identified leviathan in different ways: a crocodile, a great whale, or a now-extinct sea creature (some creationists suggest a great sea reptile). The stop does not choose one and treats

the passages as true. Isaiah 27:1 also names leviathan. Lastman's *Jonah and the Whale* (1621) is in the Museum Kunstpalast, Düsseldorf.

PRACTICE

1. EASY Where did God tell Jonah to go, and where did Jonah go instead?
2. MEDIUM How long was Jonah inside the great fish, and what did he do there?
3. MEDIUM What does Psalm 104:26 say God made leviathan to do?

Make it a game · Storm on the Sea. Players sit on a blanket "ship." The leader is the wind and calls "Little waves!" (everyone sways gently), "Big waves!" (sway hard), or "Great fish!" (everyone curls up small). When the leader calls "The LORD calms the sea!" everyone sits perfectly still. Anyone who moves becomes the next wind.

Scripture. "Now the LORD had prepared a great fish to swallow up Jonah. And Jonah was in the belly of the fish three days and three nights." (Jonah 1:17, KJV)

God was in charge of the sea, the storm and the great fish. He did not give up on Jonah, and He gave Jonah a second chance to obey.

Practice: answers

1. God told him to go to Nineveh; Jonah got on a ship sailing to Tarshish instead.
2. Three days and three nights. He prayed to God.
3. To play in the sea.

Track 1 badge quizzes

The badge quizzes are optional. Read each question aloud; the child may answer by talking, pointing or drawing. Four right out of five earns the badge. Badges and the certificate are earned by doing the stops, not by scores.

Badge quiz 1 (Stops 1–5)

1. Why does a shark never run out of teeth?
2. How many hearts does an octopus have, and what color is its blood?
3. What tiny animals build a coral reef?
4. Where did Moses Harvey hang the giant squid to photograph it?
5. How does a dolphin breathe?

Badge quiz 2 (Stops 6–10)

6. Name two things a jellyfish does not have.
7. What does an anglerfish use to catch food in the dark?
8. How does a salmon find its home stream?
9. Which can walk on its flippers, a seal or a sea lion?
10. Who prepared the great fish that swallowed Jonah?

TRAIL CERTIFICATE: MY OCEAN FIELD NOTEBOOK AND TRAIL D CERTIFICATE

Gather the Field Notebook pages from this trail into one booklet with a cover: “My Ocean Field Notebook,” your name and the dates you started and finished.

Add an “Ocean from top to bottom” page (from Stop D7) and put each animal from the trail where it lives: near the shore, on the reef, in the open sea or in the deep.

When the booklet is done, a parent signs the Trail D certificate.

- **Ten stops**: At least one page for each stop, each with a title and a date.
- **Ocean zones**: The ocean page shows at least six animals placed where they live.
- **Fish or mammal**: The child can sort the trail’s animals into fish, mammals and others (such as octopus, squid, coral and jellyfish).
- **Care**: Drawings are labeled and done carefully.

Answer key

1. It has rows of spare teeth, and a new one moves forward when one falls out.
2. Three hearts and blue blood.
3. Coral polyps.
4. Over the rail above his bathtub.
5. Through a blowhole on top of its head (it breathes air; it is a mammal).
6. Any two: a brain, a heart, bones, blood.
7. A glowing lure on a “fishing rod” on its head.

8. By smell.
9. A sea lion.
10. The LORD (God).

Explore Tracks · Trail E

The fifth trail of three interest tracks for curious Scouts: Animals (insects and small creatures), Dinosaurs (sea and sky reptiles, and the Ice Age) and Great Battles of the World Wars. Short, self-paced stops with true stories, great pictures, hands-on projects and games.

First edition

> *O LORD, how manifold are thy works! in wisdom hast thou made them all: the earth is full of thy riches.*
> *Psalm 104:24 (KJV)*

Course guide

Explore Tracks are for children who want more of what they love. Each track is a trail of short stops. At every stop the child hears a true story, studies a great picture, does something with his or her hands, plays a game and adds a page to a Field Notebook.

Trail E is the fifth trail of each track at the 🟢 Scout level (ages 7–9). The Animals track gets down on hands and knees with the small creatures, from the ant of Proverbs 6:6 and the locusts of Exodus 10 to Jean-Henri Fabre, the patient insect watcher, and ends with a bug hotel to build. The Dinosaurs track goes to sea and sky with the ichthyosaurs, plesiosaurs, mosasaurs and pterosaurs (reptiles that lived alongside the dinosaurs but were not dinosaurs), then meets the woolly mammoths, saber-toothed cats and giant ground sloths of the Ice Age and the La Brea Tar Pits. The Great Battles track visits eight battles of the two World Wars, from the Marne (1914) to the Battle of the Bulge (1944–1945). Earlier trails are not required first.

WHO IT IS FOR

Written for children about ages 7–9 who are read to by a parent, or who read short passages on their own. Older siblings can join in. Nothing earlier is required.

HOW TO USE THIS COURSE

1. **One stop at a time.** A stop takes 15–25 minutes: read the story aloud, look at the picture, do the hands-on part and play the game. Two or three stops a week works well.
2. **Any order.** The tracks are independent. Do one track at a time, or rotate between them.
3. **Goes deeper in.** Each stop names the School Launch course that teaches the same topic in full (for example Life Science, Earth Science, Gardening & Animals, Geography or History), so a stop can lead straight into a lesson.
4. **Field Notebook.** Every stop ends with a page for the notebook. At the end of the trail the pages become a booklet, and the parent signs the Trail E certificate.
5. **Badge quizzes.** Each track has two short, optional oral quizzes. They are for fun, not grades.

SCOPE AND SEQUENCE

Track 1: Animals 🐾 Trail E: Insects and Small Creatures (Self-paced)

MATERIALS

- **Field Notebook (a sketchbook or composition book)**One for the whole trail.
- **Colored pencils, a ruler, scissors and glue**For drawings and maps.
- **A magnifying glass and a clear jar with a lid**For looking closely at small creatures. Watch, then let them go where you found them.

- **Household things**Each hands-on project lists what it needs: blocks, clay, string, toy figures, cups, sticks, pinecones and cardboard tubes.
- **A Bible (KJV)**For the verse at each stop.

GRADING

Explore Tracks are not graded. A stop is done when the child has heard the story, done the hands-on part and made a notebook page.

Badges and the Trail E certificate are earned by finishing the stops.

A NOTE TO PARENTS

You do not need to be an expert. Read the story aloud, look at the picture together and ask, “What do you notice?” Each stop has a short *For families* note with background and any facts that scholars still discuss.

Small creatures: the Animals stops invite children to look closely at real insects and spiders. Each one has a safety line: look with eyes and a magnifying glass, do not handle bees, wasps or spiders, wash hands afterward, and let every creature go where it was found.

Dinosaur dates: museums give ages in millions of years for the sea and sky reptiles and in tens of thousands of years for the Ice Age. Stops where dates come up are marked ⏳ and include a short box: *What the sign says*, *What we observe* and *How Christians read it*. The trail teaches the period names as museum words and explains that the dates are interpretations; many Christian families understand the fossils within a young earth and the Flood, with the Ice Age coming after the Flood.

Battles are told for young children: who, where, the plan, what happened and why it mattered, with honor for courage, faith and wisdom and no gory detail. Casualties are given as numbers, and wounds and deaths are stated plainly but not described. Both sides are described fairly, in the terms of their own time. The World War II stops name the crimes of the Nazi regime plainly, in words suited to young children and without images; you may wish to preview those paragraphs.

Contents

Track 1: Animals 🐾 Trail E: Insects and Small Creatures

1.1 Ants: “Go to the Ant”
1.2 Honeybees: Sweeter than Honey
1.3 Monarch Butterflies: The Great Journey
1.4 Spiders: “In Kings’ Palaces”
1.5 Beetles: So Many Kinds
1.6 Fireflies: Little Lights
1.7 Dragonflies: Champions of the Air
1.8 Locusts: The Eighth Plague (Exodus 10)
1.9 Fabre the Insect Watcher
1.10 Make a Bug Hotel

Each stop takes 15–25 minutes. Tracks may be done in any order, and a child may do just one track.

TRACK 1

Animals 🐾 Trail E: Insects and Small Creatures

The fifth trail of the Animals track gets down on hands and knees to meet the small creatures: the ant of Proverbs 6, honeybees and their waggle dance, monarch butterflies and their journey to Mexico, spiders and their webs, beetles of every kind, fireflies, dragonflies, the locusts of Exodus 10, Jean-Henri Fabre the insect watcher, and a bug hotel to build at home. Each stop is a short read-aloud story, a picture to study, something to draw or build, quick questions, a game and a verse of Scripture.

This is the 🟢 **Scout** level, written for ages 7 to 9. A parent reads the story aloud, or a strong reader reads it alone. Every stop stands by itself, and most of the activities happen outdoors with a magnifying glass and a Field Notebook. Small creatures are watched gently and put back where they were found. The 🔵 Ranger and 🔴 Expert levels of these same stops will add diagrams, numbers and primary sources later.

Five stops earn the **Bug Scout badge, part 1**, and ten stops earn part 2 and the **Trail E certificate**. The badge quizzes are at the end of the trail and are optional.

BEFORE YOU BEGIN

- Listen to a story of about five minutes and tell it back.
- Sit still and quiet for five minutes while watching something small outdoors (a grown-up may help).

MASTERY CHECKLIST

☐ I can tell the difference between an insect (six legs, three body parts) and a spider (eight legs, two body parts).
☐ I can tell the four stages of a butterfly's life: egg, caterpillar, chrysalis and butterfly.
☐ I can tell one true and surprising fact about each creature on this trail.
☐ I can tell the story of the locusts in Exodus 10 and say what Proverbs 6:6 teaches.
☐ I can watch one small creature for ten minutes and draw and date it in my Field Notebook, as Fabre did.

OPTIONAL BOOKS AND RESOURCES

- **BugGuide (Iowa State University)** (https://bugguide.net): Free photo guide to the insects and spiders of North America; good for naming a creature you found.
- **Monarch Watch (University of Kansas)** (https://monarchwatch.org): Free pages on the monarch life cycle, migration and tagging, and on planting milkweed, for Stop E3.
- **Project Gutenberg** (https://www.gutenberg.org): Free old English translations of Jean-Henri Fabre's insect books, such as *The Life of the Spider* and *The Life of the Caterpillar*, to read aloud with Stop E9.

1.1 Ants: "Go to the Ant"

OBJECTIVES

- Name the three body parts and six legs of an ant.
- Tell how ants in a colony work together without anyone giving orders.
- Say Proverbs 6:6 and tell what the ant teaches us.

Warm-up. Try to pick up a grown-up. Too heavy? Many ants can carry ten or more times their own weight. That would be like you carrying ten children on your back at once!

Video slot. Video coming. Ants at work: harvester ants storing seeds, leafcutter ants carrying leaves, an ant trail. Search approved channels (Smithsonian Channel, PBS Nature, BBC Earth, National Geographic Kids); preview first.

KEY TERMS

insect
A small animal with six legs and three body parts: head, thorax and abdomen.

colony
A big family of ants (or bees) that live and work together.

queen
The ant that lays all the eggs for the colony.

antenna
A feeler on an insect's head used to smell, touch and taste. Two are called antennae.

CORE IDEAS

The story. One hot summer afternoon, a girl sat on the back steps eating a cookie. A crumb fell on the sidewalk. A few minutes later, one tiny black ant found it. The ant hurried away. Soon there was a whole line of ants marching to the crumb and back, each one carrying a bit of cookie home. How did they all know where to go?

Made for the job. An ant is an **insect**. It has six legs and three body parts: a head, a middle part called the thorax, and a back part called the abdomen. On its head are two bent **antennae**. Ants smell with their antennae. The first ant left a smell trail on the ground on its way home, and the other ants followed the smell to the crumb.

A big family. Ants live together in a **colony**, sometimes thousands in one nest. The **queen** lays the eggs. The worker ants dig tunnels, feed the babies, guard the door and gather food. The queen does not give orders! Each ant does its work, and the whole colony is fed.

Ants that store food. In the land of Israel live harvester ants. All summer they gather seeds and carry them into rooms under the ground. When winter comes, they have food saved up.

In the jungles of South America, leafcutter ants carry pieces of leaves home and use them to grow a garden of tiny mushrooms to eat.

“Go to the ant.” King Solomon watched ants too. He wrote to the lazy person, called a “sluggard”: “Go to the ant, thou sluggard; consider her ways, and be wise” (Proverbs 6:6). The ant has “no guide, overseer, or ruler,” yet it works hard and saves food for later. God made the little ant to be a lesson for us.

PICTURE STUDY



The Grasshopper and the Ants, from Aesop’s Fables, Arthur Rackham, 1912 · Pen and ink drawing (printed in a book) · From Aesop’s Fables, translated by V. S. Vernon Jones (London: Heinemann, 1912) Wikimedia Commons · Public domain

Aesop told an old fable about a grasshopper who sang all summer while the ants worked. When winter came, the ants had food and the grasshopper had none. Arthur Rackham drew pictures for a book of Aesop’s fables in 1912. His pictures are full of tiny, careful lines.

Look closely

- Find the grasshopper. Find the ants.
- What are the ants doing? What is the grasshopper doing?
- Look for clues that tell you what season it is.

Talk about it

1. How is this fable like what Solomon says in Proverbs 6:6–8?
2. What do you think the grasshopper should have done in the summer?

HANDS-ON: ANT WATCH PICNIC

Set out a tiny picnic for ants and watch how they find it, like the girl in the story.

You will need

- An index card or paper plate
- Three tiny crumbs of food: a bit of cookie, a bit of apple and a bit of bread
- A magnifying glass (if you have one)
- Your Field Notebook and a pencil

Steps

1. Put the three crumbs on the card, a little apart from each other.
2. Set the card outside near a crack in the sidewalk or the edge of a garden, where you have seen ants.
3. Check every five minutes for fifteen minutes. Which food did the ants find first? Do they come in a line?
4. Draw the card, the crumbs and the ant trail. Leave the ants in peace when you are done.

Check your work

- I watched for at least fifteen minutes.
- I can tell which food the ants liked best.
- I counted an ant’s six legs (with the magnifying glass or in a picture).

FIELD NOTEBOOK

1. Draw a big ant. Label the head, thorax, abdomen, six legs and two antennae.
2. Copy Proverbs 6:6 in your best handwriting.

> **Did you know?** All the worker ants in a colony are sisters, daughters of the same queen. Some queen ants live for many years. Ants are found almost everywhere on land except the coldest places, like Antarctica.

> **Goes deeper in.** Life Science, Grade 3, Unit “Insects and Spiders” (coming soon); and Literature, for Aesop’s fables.

> **For families.** Harvester ants of the genus *Messor* live in Israel and store seeds in underground chambers, which fits Proverbs 6:8 (“gathereth her food in the harvest”). How much an ant can lift depends on the kind; “ten or more times its weight” is a safe figure. The Rackham drawing is from the 1912 Heinemann edition with an introduction by G. K. Chesterton; if you cannot find it, Milo Winter’s picture of the same fable in *The Aesop for Children* (1919) works as well. Fire ants sting; choose a spot without fire-ant mounds for the project.

PRACTICE

1. EASY How many legs does an ant have?
2. MEDIUM How did the other ants find the cookie crumb?
3. EASY What does Solomon tell the sluggard to do?

Make it a game · Ant Trail. One player is the scout ant. The scout walks a winding path through the house or yard, dropping small paper squares as a “smell trail,” and hides a snack (the food) at the end. The other ants follow the trail, picking up every square, find the food and carry it back “home” together.

Scripture. “Go to the ant, thou sluggard; consider her ways, and be wise:” (Proverbs 6:6, KJV)

No one has to tell the ant to work. God made it a little teacher of hard work and of saving for later.

Practice: answers

1. Six.
2. They followed the smell trail the first ant left on the ground.
3. “Go to the ant” and watch how it works and saves food, and be wise.

1.2 Honeybees: Sweeter than Honey

OBJECTIVES

- Name the three kinds of honeybees in a hive: queen, workers and drones.
- Tell how bees make honey and why their comb is built of six-sided cells.
- Describe the waggle dance a bee uses to show where flowers are.

Warm-up. Taste a drop of honey on a spoon. One worker bee makes only about one-twelfth of a teaspoon of honey in her whole life. It takes about twelve bees working all their lives to fill one teaspoon!

Video slot. Video coming. Honeybees in the hive: the waggle dance, building comb, gathering nectar and pollen. Search approved channels (PBS Nature, BBC Earth, Smithsonian Channel, a state university extension bee program); preview first.

KEY TERMS

hive
The home of a family of honeybees.

nectar
A sweet juice inside flowers. Bees turn it into honey.

pollen
A fine yellow powder made by flowers. Bees carry it from flower to flower, and it helps plants make fruit and seeds.

honeycomb
Rows of six-sided wax rooms, called cells, that bees build to hold honey, pollen and baby bees.

CORE IDEAS

The story. Early one morning, a worker bee flew home to her hive with her body full of sweet nectar and her back legs packed with yellow pollen. Inside, in the dark, she began to dance. She ran in a straight line, wiggling her body, then circled back and did it again. The other bees crowded close to feel her dance. Soon many of them flew off, straight to a field of clover she had found.

A hive family. A hive may hold tens of thousands of bees. There is one **queen**, who lays the eggs. The **workers** are her daughters: they clean, feed the babies, build comb, guard the door and gather food. The **drones** are the boy bees. Their one job is to mate with a new queen.

Making honey. A worker sips **nectar** with her long tongue and carries it home. Bees pass it from mouth to mouth and fan it with their wings until most of the water dries out. Then it is

honey! They store it in **honeycomb** made of wax from their own bodies. Each cell has six sides. Six-sided cells fit together with no space wasted.

The waggle dance. A scientist named Karl von Frisch watched bees for many years. He learned that the waggle dance is a map. The direction of the wiggly run tells which way to fly, compared with the sun. The longer the wiggle, the farther away the flowers are. He won a Nobel Prize for this work in 1973.

Sweeter than honey. As bees visit flowers, pollen sticks to their fuzzy bodies and rubs off on the next flower. This helps apples, cherries, pumpkins and many other foods grow. In the Bible, God promised Israel “a land flowing with milk and honey.” King David said God’s words are “sweeter also than honey and the honeycomb” (Psalm 19:10).

PICTURE STUDY



The Beekeepers, Pieter Bruegel the Elder, c. 1568 · Pen and brown ink on paper · Kupferstichkabinett (Museum of Prints and Drawings), Berlin
Wikimedia Commons · Public domain

Pieter Bruegel lived in what is now Belgium more than four hundred years ago. He liked to draw farmers at work. Here beekeepers are moving their beehives, which in those days were baskets woven of straw, called skeps.

Look closely

- Find the beekeepers’ faces. What are they wearing to keep from being stung?
- Find the straw beehives. How many can you count?
- Find the boy in the tree. What do you think he is doing?

Talk about it

1. Why would the artist hide the beekeepers' faces?
2. How is a straw skep different from a beehive today?

> **Safety first.** Look at bees from a few steps away and move slowly; a bee that is not bothered rarely stings. Never poke a hive or nest. If anyone in the family is allergic to bee stings, keep their medicine close and stay well back.

HANDS-ON: WHY HEXAGONS?

Find out why bees build their cells with six sides.

You will need

- Paper and scissors (with a grown-up)
- A coin or bottle cap to trace circles
- The hexagon and square shapes a grown-up draws for you (all about the same size)
- Yellow and orange crayons

Steps

1. Trace and cut out six circles, six squares and six hexagons (six-sided shapes).
2. Push the circles together on the table. Are there gaps between them?
3. Now fit the hexagons together like a honeycomb. Are there gaps?
4. Color your hexagon comb yellow and glue it in your Field Notebook. Draw a bee on it.

Check your work

- I tested circles and hexagons.
- I can tell why bees use six-sided cells: they fit together with no gaps.
- I can name the queen, the workers and the drones.

FIELD NOTEBOOK

1. Draw a honeybee with pollen on its back legs. Label the head, wings, stinger and pollen.
2. Draw a picture of the waggle dance with arrows.

> **Did you know?** A bee's wings beat about two hundred times every second; that makes the buzz. Worker bees in summer live only about six weeks. Honey keeps for a very long time without spoiling if it is sealed.

> **Goes deeper in.** Gardening & Animals, for bees, pollination and keeping a hive; and Life Science, Grade 3, Unit "Insects and Spiders" (coming soon).

> **For families.** The figure of about 1/12 teaspoon of honey per worker is widely used by bee scientists and extension programs. Karl von Frisch shared the 1973 Nobel Prize in

Physiology or Medicine with Konrad Lorenz and Nikolaas Tinbergen. “A land flowing with milk and honey” first appears in Exodus 3:8. Bruegel’s drawing (Berlin, KdZ 713) carries an old Dutch saying about the person who knows where the nest is and the one who robs it.

PRACTICE

1. EASY Which bee lays all the eggs in the hive?
2. MEDIUM What does the waggle dance tell the other bees?
3. EASY How many sides does a honeycomb cell have?

Make it a game · Waggle Dance. One player hides a paper flower in the room or yard while the others close their eyes. The “bee” comes back and may not talk or point. She can only waggle-walk in the direction of the flower, with a long wiggle for far away and a short wiggle for close. The others try to find the flower from the dance.

Scripture. “More to be desired are they than gold, yea, than much fine gold: sweeter also than honey and the honeycomb.” (Psalm 19:10, KJV)

David is talking about God’s words. Honey is the sweetest thing he knew, and God’s Word is sweeter still.

Practice: answers

1. The queen.
2. Which way to fly and how far to go to find the flowers.
3. Six.

1.3 Monarch Butterflies: The Great Journey

OBJECTIVES

- Name the four stages of a butterfly's life: egg, caterpillar, chrysalis and butterfly.
- Tell why monarch caterpillars eat only milkweed.
- Describe the monarchs' long trip to the mountains of Mexico.

Warm-up. Lie on the floor and wiggle like a caterpillar. Now curl up tight and hold still: you are a chrysalis. Count to ten, then slowly stand and flap your arms like wings. You just did a butterfly's whole life!

Video slot. Video coming. Monarch butterfly life cycle (caterpillar to chrysalis to butterfly) and the monarchs wintering in Mexico. Search approved channels (U.S. Fish and Wildlife Service, National Park Service, Monarch Watch, PBS Nature); preview first.

KEY TERMS

metamorphosis
A big change in body shape as an animal grows up, like a caterpillar turning into a butterfly.

caterpillar
The young, worm-like stage of a butterfly or moth that hatches from the egg and eats leaves.

chrysalis
The hard case a caterpillar makes around itself while it changes into a butterfly (say "KRIS-uh-lis").

migration
A long trip that animals make at the same time each year to find food or a better place to live.

CORE IDEAS

The story. In August, a boy found a fat caterpillar with yellow, black and white stripes munching a milkweed leaf in the ditch by his house. He watched it every day. One morning it hung upside down in the shape of a J. By evening it had turned into a smooth green **chrysalis** with tiny gold dots. Two weeks later the case turned clear, and out climbed an orange and black monarch butterfly.

Four stages. A monarch's life has four parts: a tiny egg, a hungry **caterpillar**, a still chrysalis, and a butterfly with wings. This great change is called **metamorphosis**. Inside the chrysalis, the caterpillar's body is made over into a whole new shape. No one can watch it happen from the outside.

Milkweed only. Monarch caterpillars eat just one kind of plant: milkweed. Milkweed has a bitter juice that makes the caterpillars, and the butterflies they become, taste bad to birds. Their bright orange color is like a warning sign that says, “Don’t eat me!” A bird that tries one usually spits it out and leaves monarchs alone after that.

The great journey. In the fall, monarchs from the eastern United States and Canada fly south, some of them as far as 3,000 miles, to the same few mountains in Mexico. There they hang by the millions on fir trees all winter. In spring they fly north and lay eggs on milkweed. It takes their children, grandchildren and great-grandchildren to get all the way back north. For many years no one knew where they went. In 1975, two searchers, Ken Brugger and Catalina Aguado, found the trees covered with orange wings.

Made new. No one teaches a monarch the way to Mexico; God built that into it. And the change from caterpillar to butterfly is a picture the Bible uses for us. “If any man be in Christ, he is a new creature: old things are passed away; behold, all things are become new” (2 Corinthians 5:17).

PICTURE STUDY



Cassava with White Peacock Butterfly, Plate 4 of Metamorphosis insectorum Surinamensium, Maria Sibylla Merian, 1705 · Hand-colored engraving (from Merian’s watercolor) · From Metamorphosis insectorum Surinamensium (The Metamorphosis of the Insects of Suriname)
Wikimedia Commons · Public domain

Maria Sibylla Merian was a German artist who loved caterpillars. In 1699 she sailed all the way to Suriname in South America to paint insects. She was one of the first to show the egg, caterpillar, chrysalis and butterfly together on the very plant the caterpillar eats. This butterfly is not a monarch, but it changes in the same way.

Look closely

- Find the caterpillar. Find the chrysalis. Find the butterflies.
- What plant is the caterpillar eating?
- Find the little lizard. What do you think it is looking for?

Talk about it

1. Why do you think Merian painted the whole life cycle in one picture?
2. What would a picture of a monarch's life cycle need to show?

HANDS-ON: LIFE CYCLE WHEEL

Make a turning wheel that shows the four stages of a monarch's life.

You will need

- Two paper plates
- Crayons or markers
- A brass paper fastener
- Scissors (with a grown-up)

Steps

1. Draw two lines across the first plate to make four pie pieces. In each piece draw one stage: an egg on a milkweed leaf, a striped caterpillar, a green chrysalis with gold dots, and an orange monarch.
2. On the second plate, cut out one pie-piece window.
3. Put the window plate on top and push the fastener through the middle of both plates.
4. Turn the wheel and tell the story of the monarch in order.

Check your work

- My wheel shows all four stages in the right order.
- I can tell what monarch caterpillars eat (milkweed).
- I can tell where eastern monarchs go in winter (the mountains of Mexico).

FIELD NOTEBOOK

1. Draw a monarch butterfly with its wings open. Color the orange and black carefully and add the white dots on the edges.
2. Draw a map arrow from your home toward Mexico. Write: "Monarchs fly south in the fall."

> **Did you know?** The monarchs that fly to Mexico live about eight months, much longer than their summer parents, who live only a few weeks. People put tiny round stickers on monarch wings to learn where they travel. Monarchs from west of the Rocky Mountains spend the winter on the coast of California instead.

Goes deeper in. Life Science, Grade 3, Unit “Insects and Spiders” (coming soon); Gardening & Animals, for planting milkweed and a butterfly garden; and Geography, for the route to Mexico.

For families. Canadian scientists Fred and Norah Urquhart spent decades tagging monarchs; Ken Brugger and Catalina Aguado located the overwintering colony in Michoacán, Mexico, on January 2, 1975, and the find was announced in *National Geographic* in August 1976. Milkweed contains cardenolides that make monarchs distasteful. Planting a native milkweed is good stewardship (Genesis 2:15); check a local native plant society for the right kind for your area. Merian’s plate shows the white peacock butterfly (*Anartia jatrophae*); monarchs do not appear in her 1705 book.

PRACTICE

1. EASY Put these in order: butterfly, egg, chrysalis, caterpillar.
2. MEDIUM Why do birds leave monarchs alone?
3. EASY Where do eastern monarchs spend the winter?

Make it a game · Find the Milkweed. A grown-up hides ten green paper leaves around the room or yard: five marked with an M for milkweed and five plain. The monarchs flutter around and may land and lay an “egg” (a dot) only on milkweed leaves. Whoever finds the most milkweed leaves without landing on a plain one wins.

Scripture. “Therefore if any man be in Christ, he is a new creature: old things are passed away; behold, all things are become new.” (2 Corinthians 5:17, KJV)

A caterpillar becomes a whole new creature with wings. God makes the people who trust in Christ new on the inside.

Practice: answers

1. Egg, caterpillar, chrysalis, butterfly.
2. Milkweed makes monarchs taste bad, and their orange color warns birds.
3. On fir trees in the mountains of Mexico.

🟢 SCOUT · STOP E4 · TRACK 1 · STOP 1.4 · 15–25 MINUTES

1.4 Spiders: "In Kings' Palaces"

OBJECTIVES

- Tell two ways a spider is different from an insect.
- Describe how an orb-weaver spider spins its web.
- Say Proverbs 30:28 and tell what it says about the spider.

Warm-up. Count your arms and legs together. Four! Now hold up eight fingers. A spider walks on eight legs. Try to crawl on the floor using both hands and both feet. Imagine needing to move eight legs in order!

Video slot. Video coming. An orb-weaver (garden) spider spinning its web, step by step. Search approved channels (BBC Earth, PBS Nature, Smithsonian Channel, National Geographic Kids); preview first.

KEY TERMS

arachnid
An animal with eight legs and two body parts, such as a spider (say "uh-RAK-nid"). Arachnids are not insects.

silk
The thin, strong thread a spider makes inside its body.

spinneret
A tiny spout at the back end of a spider where the silk comes out.

orb web
A round web with spokes like a wheel and a sticky spiral, spun by orb-weaver spiders.

CORE IDEAS

The story. On a cool, foggy morning, a boy walked out to feed the chickens. Between two fence posts hung a round web, shining with tiny drops of dew like a necklace of glass beads. In the very middle sat a big black and yellow garden spider, waiting. A fly buzzed too close and stuck fast. Quick as a wink, the spider ran down the threads to get her breakfast.

Not an insect. Spiders look like bugs, but they are not insects. A spider is an **arachnid**. It has eight legs, not six. It has two body parts, not three. It has no wings and no antennae. Most spiders have eight eyes, though many still cannot see very well. They feel the world through their legs.

Spinning the web. A spider makes **silk** inside its body and pulls it out through tiny spouts called **spinnerets**. To build an **orb web**, the spider first makes a bridge line, then spokes like a wagon wheel, then a sticky spiral going round and round. The spider knows which

threads are sticky and does not get caught. Many orb weavers eat their old web and spin a fresh one almost every day.

Garden helpers. Spiders eat flies, mosquitoes and bugs that harm plants, so they are a farmer's friends. Baby spiders, called spiderlings, can let out a long silk thread and float away on the breeze to find a new home. Spider silk is very strong for how thin it is, and scientists still study it.

Small but wise. Proverbs 30 names four little creatures that are "exceeding wise": the ant, the coney, the locust and the spider. "The spider taketh hold with her hands, and is in kings' palaces" (Proverbs 30:28). A tiny spider can climb into the grandest palace in the world. Being small does not stop God's creatures from doing great things.

PICTURE STUDY



Guava Branch with Spiders, Ants and a Hummingbird, Plate 18 of Metamorphosis insectorum Surinamensium, Maria Sibylla Merian, 1705 · Hand-colored engraving (from Merian's watercolor) · From Metamorphosis insectorum Surinamensium (The Metamorphosis of the Insects of Suriname); this copy is in the British Library, London
Wikimedia Commons · CC0

Maria Sibylla Merian painted this branch in Suriname, South America. It shows big hairy spiders, smaller spiders with webs, and ants marching along the branch. When Europeans saw it, many did not believe a spider could be so big. Today we know big hairy spiders like these really do live there.

Look closely

- Count the spiders. Which is the biggest?
- Find a web. Find the lines of ants.
- Count the legs on one spider. Are there eight?

Talk about it

1. Why do you think people in Europe were surprised by this picture?
2. How can you tell the spiders from the ants?

> **Safety first.** Look at spiders, but do not touch them with bare hands. Most spiders are harmless, but black widow and brown recluse bites can make a person very sick. Let a grown-up check any spider before you get close.

HANDS-ON: WEB HUNT AND YARN WEB

Go looking for real webs, then spin one of your own.

You will need

- A spray bottle of water
- A paper plate with eight small notches cut around the edge (a grown-up helps)
- A long piece of yarn, with tape on one end
- Your Field Notebook

Steps

1. Early in the morning, look for webs in bushes, porches and fences. Gently mist a web with water to make it shine. Do not break it.
2. Draw the web you found. Is it round, messy or shaped like a funnel?
3. Now make an orb web: wrap the yarn across the plate through opposite notches to make spokes.
4. Then weave the yarn round and round from the middle out, over and under the spokes, like a sticky spiral.

Check your work

- I found and drew at least one real web.
- My yarn web has spokes and a spiral.
- I can tell two ways a spider is different from an insect.

FIELD NOTEBOOK

1. Draw a spider next to an ant. Label the spider’s two body parts and eight legs and the ant’s three body parts and six legs.
2. Copy Proverbs 30:28.

> **Did you know?** Not all spiders spin webs. Jumping spiders hunt by leaping on their food, and they have very good eyes. Wolf spider mothers carry their babies on their backs. A spider is never stuck in its own web because it walks on the dry threads and has special feet.

Goes deeper in. Life Science, Grade 3, Unit “Insects and Spiders” (coming soon); and Art, for Maria Sibylla Merian.

For families. Merian’s plate also shows a tree spider over a hummingbird’s nest; the picture gave rise to the name “bird-eating spider,” though such spiders very seldom if ever catch birds. The plate is shown here for its spiders and ants; the alt text and questions keep to those. Proverbs 30:28 in some newer translations reads “lizard” instead of “spider,” because the Hebrew word is uncertain; the KJV reads “spider.” In North America, black widows and brown recluses are the spiders whose bites need a doctor.

PRACTICE

1. EASY How many legs does a spider have?
2. MEDIUM Name two ways a spider is different from an insect.
3. EASY Where does a spider’s silk come out?

Make it a game · Spider and Fly. Draw a big web on the driveway with chalk (or lay one out with string). One player is the spider in the middle. The flies must hop across the web from one side to the other, landing only on the lines. The spider may move only along the lines too. A fly who is tagged becomes the next spider.

Scripture. “The spider taketh hold with her hands, and is in kings’ palaces.” (Proverbs 30:28, KJV)

The spider is small, but it holds on and gets into a king’s house. God gives little creatures, and little children, their own kind of wisdom.

Practice: answers

1. Eight.
2. Any two: eight legs, not six; two body parts, not three; no wings; no antennae.
3. From its spinnerets, at the back end of its body.

🟢 SCOUT · STOP E5 · TRACK 1 · STOP 1.5 · 15–25 MINUTES

1.5 Beetles: So Many Kinds

OBJECTIVES

- Tell what makes a beetle a beetle: hard wing covers over its flying wings.
- Name three different beetles and one amazing thing about each.
- Say Genesis 1:25 and tell what God said about the creeping things.

Warm-up. Hold one hand flat. Cup your other hand over it like a shell. Now open the shell and wiggle the fingers underneath. That is how a beetle flies: it lifts its hard wing covers and unfolds thin wings from underneath!

Video slot. Video coming. Beetles for young viewers: a ladybug opening its wings, dung beetles rolling balls, stag beetles. Search approved channels (BBC Earth, Smithsonian Channel, PBS Nature, the Natural History Museum, London); preview first.

KEY TERMS

beetle
An insect with a pair of hard wing covers that close over its flying wings.

wing cover
A beetle's hard front wing that protects the soft flying wing underneath. Its science name is elytron (say "EL-ih-tron").

grub
A young beetle. It hatches from an egg and looks like a fat worm.

kind
A group of living things God made to bring forth young like themselves (Genesis 1).

CORE IDEAS

The story. A girl and her grandfather rolled back an old log at the edge of the woods. Underneath, the ground was cool and damp. A shiny black beetle scurried away. A brown one hid under a leaf. A tiny one with red spots climbed onto Grandpa's finger, lifted its red shell, unfolded two thin wings and flew away. Then they rolled the log gently back, so the beetles would have their home again.

Wearing armor. All of those were **beetles**. A beetle is an insect with six legs, but its two front wings are hard **wing covers** that meet in a straight line down its back. They protect the beetle like a suit of armor. Folded underneath are two thin wings for flying.

So many kinds. Scientists have named about 400,000 different beetles, more than any other group of animals on earth! About one out of every four animals people have named is a beetle. They come in green, gold, black, red and even rainbow colors. Some are smaller than the dot on this i, and some are as big as your hand.

Amazing beetles. The ladybug eats tiny plant-eating bugs called aphids, so gardeners love it. The dung beetle rolls a ball of animal droppings in a straight line, and scientists found it steers by the light of the Milky Way at night. The stag beetle has huge jaws like a deer's antlers. The bombardier beetle sprays a hot, popping mist at anything that tries to eat it.

Every creeping thing. On the sixth day, God made "every thing that creepeth upon the earth after his kind: and God saw that it was good" (Genesis 1:25). With so many beetles, God shows that He loves variety. He made each kind with care, even the ones only a beetle hunter will ever see.

PICTURE STUDY



Stag Beetle, Albrecht Dürer, 1505 · Watercolor and gouache on paper · J. Paul Getty Museum, Los Angeles
Wikimedia Commons · Public domain

Albrecht Dürer was a great German artist who loved to paint small things from nature, like a hare, a clump of grass and this beetle. He painted it so carefully that it looks as if it could walk off the page.

Look closely

- Find the big jaws. What do they look like?
- Count the legs. Find the antennae.
- Find the shadow under the beetle. How does it make the beetle look real?

Talk about it

1. Why do you think the stag beetle got its name? (A stag is a boy deer.)
2. Why would a great artist spend so much time painting one beetle?

HANDS-ON: BEETLE BOARD

Make a cool, dark hiding place and see which beetles come to stay.

You will need

- A flat board or a piece of old carpet about the size of a book
- A shady spot of bare ground or grass
- A magnifying glass
- Your Field Notebook

Steps

1. Lay the board flat on the ground in a shady spot. Water the ground a little first if it is dry.
2. Wait one or two days.
3. With a grown-up, lift the board slowly. Look quickly. How many beetles can you see? Look for other small creatures too.
4. Draw one beetle. Then put the board gently back.

Check your work

- I checked my beetle board at least once.
- I drew a beetle and counted its six legs.
- I put the board back gently so the animals could stay.

FIELD NOTEBOOK

1. Draw a beetle with its wing covers open and its thin flying wings spread. Label the wing covers, the flying wings, the six legs and the antennae.
2. Draw three different beetles: a ladybug, a dung beetle with its ball and a stag beetle.

> **Did you know?** Fireflies are beetles too (Stop E6). The heaviest beetles, such as the Goliath beetle of Africa, can weigh about as much as a small apple. Some beetle grubs live inside wood for years before they grow up.

> **Goes deeper in.** Life Science, Grade 3, Unit “Insects and Spiders” (coming soon); Gardening & Animals, for ladybugs and garden pests; and Art, for Albrecht Dürer.

> **For families.** Roughly 400,000 beetle species have been described (estimates vary). The Milky Way navigation of dung beetles was reported by Marie Dacke and colleagues in *Current Biology* (2013). Dürer’s *Stag Beetle* (1505) is in the J. Paul Getty Museum. The bombardier beetle’s spray is near boiling hot; the stop does not suggest handling one.

PRACTICE

1. EASY What do a beetle’s hard wing covers protect?

2. MEDIUM Why do gardeners like ladybugs?
3. EASY What does the dung beetle use to steer at night?

> **Make it a game · Draw-a-Beetle Dice Game.** Each player needs paper, a pencil and a turn with one die. Roll to draw a beetle: 6 = body (you need this first), 5 = head, 4 = a wing cover (2), 3 = a leg (6), 2 = an antenna (2), 1 = an eye (2). You need the head before eyes or antennae. If you roll a part you already have all of, pass the die. The first to finish a whole beetle calls out “Beetle!”

> **Scripture.** “And God made the beast of the earth after his kind, and cattle after their kind, and every thing that creepeth upon the earth after his kind: and God saw that it was good.” (Genesis 1:25, KJV)

Every little beetle is one of the creeping things God made and called good.

Practice: answers

1. The thin flying wings folded underneath.
2. Ladybugs eat aphids, little bugs that harm plants.
3. The light of the Milky Way.

1.6 Fireflies: Little Lights

OBJECTIVES

- Tell why a firefly is really a beetle and not a fly.
- Explain that a firefly's light is "cold light" that stays cool.
- Describe how fireflies talk to each other with flashes.

Warm-up. Turn off the lights and hold a flashlight. Flash it two quick times, then wait. Flash it two quick times again. Fireflies talk in blinks like that, and each kind has its own pattern.

Video slot. Video coming. Fireflies flashing at night; the synchronous fireflies of the Great Smoky Mountains. Search approved channels (National Park Service, PBS Nature, Smithsonian Channel, National Geographic Kids); preview first.

KEY TERMS

firefly
A kind of beetle that makes light in the back part of its body. Some people call it a lightning bug.

bioluminescence
Light made by a living thing (say "BY-oh-loo-mih-NES-ens").

signal
A sign that sends a message, like a wave, a whistle or a flash of light.

larva
The young, worm-like stage of an insect. Firefly larvae glow too and are called glowworms.

CORE IDEAS

The story. On a warm June night in the Great Smoky Mountains of Tennessee, a family sat quietly in the dark woods. At first they saw a few little green-yellow lights blinking here and there. Then thousands of fireflies began to flash all together, on and off, on and off, so that the whole forest seemed to blink at once. Then all went dark, and a few seconds later it began again. No one said a word. It was too beautiful.

Not a fly at all. A **firefly** is not a fly. It is a beetle! It has hard wing covers like other beetles (Stop E5). Under its belly, near the end, is a light. Many people call fireflies lightning bugs. They come out on summer evenings in fields, yards and woods.

Cold light. A light bulb gets hot when it glows, and a candle burns. A firefly's light stays cool. Special stuff inside its body mixes with air and shines. Light made by a living thing is called **bioluminescence**. Almost all of the firefly's energy turns into light, not heat. People have never made a lamp that does it quite so well.

Talking in flashes. Fireflies use their lights as a **signal**. A firefly flying in the air flashes its own pattern: one long flash, or two quick ones, or a J-shaped swoop. Another firefly waiting in the grass answers back with the right flash, and they find each other. Each kind of firefly has its own code. Even the **larvae** glow; they are called glowworms.

Let your light shine. Jesus said, “Let your light so shine before men, that they may see your good works, and glorify your Father which is in heaven” (Matthew 5:16). A firefly does not keep its light hidden. When we do good and kind things, people can see them, and they can thank God.

PICTURE STUDY



Catching Fireflies, Kitagawa Utamaro, c. 1796–1797 · Color woodblock print · Cleveland Museum of Art (other copies are in other museums)
Wikimedia Commons · CC0

In Japan long ago, families went out on summer evenings to watch and catch fireflies by the water. Kitagawa Utamaro made this print by carving pictures into wooden blocks, putting ink on them and pressing paper on top, one color at a time.

Look closely

- Find the stream. Find someone wading in the water.
- Find the little cage. What is inside it?
- Look for the fireflies. How did the artist show tiny lights?

Talk about it

1. How can you tell it is a summer evening?
2. How is this firefly evening like or unlike one in your own yard?

HANDS-ON: FIREFLY FLASH CODES

Use a flashlight to talk like a firefly, then watch real fireflies on a summer evening.

You will need

- Two flashlights
- Two index cards and a pencil
- A clear jar with air holes in the lid (for a real firefly, if it is summer)
- Your Field Notebook

Steps

1. Make up a firefly code on a card, such as two quick flashes, then wait. Give your partner a different card with the “answer” code.
2. In a dark room, the “flier” flashes the code while walking around. The “grass” firefly answers only when it sees the right code.
3. On a summer evening, sit outside at dusk and count real flashes. Are they long or short? Do they swoop?
4. If you catch a firefly, keep it only a short while, then let it go the same night.

Check your work

- I flashed a firefly code and got the right answer.
- I can tell why a firefly’s light is called cold light.
- I can tell that a firefly is a beetle.

FIELD NOTEBOOK

1. Draw a firefly. Color its glowing tail yellow-green. Label the wing covers, the six legs and the light.
2. Draw dots and dashes to show the flash pattern of a firefly you saw or imagined.

Did you know? There are about 2,000 kinds of fireflies in the world. Some fireflies can trick other kinds by copying their flash code. Fireflies need dark nights; bright yard lights can make it hard for them to see each other’s signals.

Goes deeper in. Life Science, Grade 3, Unit “Insects and Spiders” (coming soon); and Art, for Japanese woodblock prints.

For families. The synchronous fireflies of the Great Smoky Mountains are *Photinus carolinus*; they display for about two weeks in late May or June, chiefly near Elkmont, and the National Park Service manages viewing. Firefly light comes from a reaction of luciferin with the enzyme luciferase and oxygen. Utamaro’s print is dated c. 1796–97 by the Cleveland Museum of Art; the picture-study questions are written to fit any copy of the print. Turning off porch lights on summer nights is a simple kindness to fireflies.

PRACTICE

1. EASY Is a firefly a fly or a beetle?
2. MEDIUM Why is a firefly’s light called cold light?
3. EASY Why do fireflies flash?

Make it a game · Firefly Find. Play in a dim room or at dusk. Each player picks a secret flash code with a flashlight, such as one long, two short or three quick. All the fireflies scatter and flash their codes. One player calls out a code, and must find and tag the firefly who flashes it. Then that firefly calls the next code.

Scripture. “Let your light so shine before men, that they may see your good works, and glorify your Father which is in heaven.” (Matthew 5:16, KJV)

A firefly shines where everyone can see. Jesus wants our good works to shine so that people thank God.

Practice: answers

1. A beetle.
2. It stays cool; almost all the energy becomes light, not heat.
3. To send signals so they can find fireflies of their own kind.

1.7 Dragonflies: Champions of the Air

OBJECTIVES

- Tell how a dragonfly's four wings let it hover and fly backward.
- Describe a dragonfly's big eyes and how it catches food in the air.
- Tell how a dragonfly begins its life under the water.

Warm-up. Stand up and try to run backward, then sideways, then stop still. Can you do it without wobbling? A dragonfly can fly forward, backward, sideways and up and down, and it can stop in the air in a moment!

Video slot. Video coming. Dragonflies in slow motion: hovering, catching insects; a nymph climbing out and the adult unfolding its wings. Search approved channels (BBC Earth, PBS Nature, Smithsonian Channel, National Wildlife Federation); preview first.

KEY TERMS

dragonfly
An insect with a long thin body, big eyes and four strong clear wings that hunts other insects in the air.

hover
To stay in one place in the air.

compound eye
An eye made of thousands of tiny eyes packed together.

nymph
The young dragonfly that lives under the water before it grows wings (say "nimf").

CORE IDEAS

The story. A boy sat on the end of a dock with his fishing pole. A bright blue dragonfly zipped past, stopped in the air right in front of his nose, hung there like a tiny helicopter, then shot off backward. Zip! It snatched a mosquito out of the air and landed on the tip of his fishing pole to eat it. "Thank you," said the boy. That was one less mosquito to bite him.

Four wings. A **dragonfly** has four long, clear wings, and it can move each one by itself. That lets it **hover**, turn quickly and even fly backward. Dragonflies are among the fastest insects. Some can fly faster than you can ride a bicycle.

Big eyes. Most of a dragonfly's head is eyes! Each one is a **compound eye** made of thousands of tiny eyes packed together, so it can see almost all the way around itself. It spots a fly, aims for where the fly is going, and catches it with its spiny legs held like a basket. One study found that dragonflies catch their food more than nine times out of ten.

Born under water. A dragonfly starts its life as an egg in a pond or stream. The young **nymph** has no wings. It lives under the water for months or even years, eating tadpoles and bugs. At last it climbs up a plant stem into the air. Its skin splits down the back, and out comes a dragonfly. It pumps up its crumpled wings, lets them dry in the sun, and flies away.

Manifold works. People who build helicopters and tiny flying machines have studied how dragonflies fly. The psalm says, “O LORD, how manifold are thy works! in wisdom hast thou made them all” (Psalm 104:24). “Manifold” means many and of many kinds. A dragonfly is one of God’s wise and wonderful works.

PICTURE STUDY



Dragonfly and Bellflower, Katsushika Hokusai, Late 1820s · Color woodblock print · The Metropolitan Museum of Art, New York
Wikimedia Commons · CC0

Katsushika Hokusai was a Japanese artist who drew all his long life. He is famous for a great wave, but he also made prints of flowers. In this one, a dragonfly flies over a patch of bellflowers.

Look closely

- Find the dragonfly. Count its wings.
- Look at the bellflowers. What shape are their petals?
- Is the dragonfly flying or resting? How can you tell?

Talk about it

1. Why do you think Hokusai put a dragonfly with the flowers?
2. What would you add if you made this picture?

HANDS-ON: CLOTHESPIN DRAGONFLY

Make a dragonfly with four wings that you can hold out to “hover.”

You will need

- A wooden clothespin
- Two pipe cleaners
- Waxed paper or clear plastic from a package
- Markers, scissors and glue (with a grown-up)

Steps

1. Color the clothespin bright blue or green. That is the long body.
2. Cut four long, thin wings from waxed paper. Draw veins on them with a marker.
3. Glue two wings on each side of the clothespin near the top, one pair a little in front of the other.
4. Wrap a pipe cleaner around the top for big eyes. Clip your dragonfly to a curtain or a plant to rest.

Check your work

- My dragonfly has four wings and big eyes.
- I can tell how a dragonfly can hover and fly backward.
- I can tell where a dragonfly nymph lives (under water).

FIELD NOTEBOOK

1. Draw the life of a dragonfly in three boxes: an egg in the water, a nymph on the pond bottom, and a dragonfly flying.
2. Draw a dragonfly from above. Label the four wings, the big eyes, the six legs and the long tail part (abdomen).

> **Did you know?** A dragonfly nymph catches its food by shooting out a long lower lip with hooks on the end. Dragonflies do not sting or bite people. Damselflies are their thinner cousins; most damselflies fold their wings together over their backs when they rest, but dragonflies hold theirs out flat.

> **Goes deeper in.** Life Science, Grade 3, Unit “Insects and Spiders” (coming soon); Earth Science, for ponds and streams; and Art, for Hokusai.

> **For families.** The “more than nine times out of ten” figure comes from studies of dragonfly hunting success (commonly cited as about 90–95 percent). A dragonfly compound eye may hold up to about 30,000 facets (ommatidia). Speeds are hard to measure; the stop says only that some are faster than a bicycle. The Hokusai print is dated c. 1833–34 and is often called *Bellflower and Dragonfly*; museum titles vary slightly.

PRACTICE

1. EASY How many wings does a dragonfly have?
2. MEDIUM Why can a dragonfly see almost all the way around itself?
3. EASY Where does a young dragonfly (nymph) live?

> **Make it a game · Hover!.** Everyone is a dragonfly zipping around the yard with arms out as wings. When the leader calls “Hover!”, freeze in place and buzz. When the leader calls “Backward!”, fly backward carefully. When the leader calls “Mosquito!”, try to tag the leader before reaching the safe tree. The first dragonfly to tag the leader becomes the next leader.

> **Scripture.** “O LORD, how manifold are thy works! in wisdom hast thou made them all: the earth is full of thy riches.” (Psalm 104:24, KJV)

God made many, many kinds of creatures, and each one shows His wisdom, even a tiny dragonfly over a pond.

Practice: answers

1. Four.
2. Its huge compound eyes are made of thousands of tiny eyes and cover most of its head.
3. Under the water in a pond or stream.

1.8 Locusts: The Eighth Plague (Exodus 10)

OBJECTIVES

- Tell the story of the plague of locusts in Exodus 10.
- Explain what a locust is: a kind of grasshopper that gathers in huge swarms.
- Tell how the wind brought the locusts and took them away at God's command.

> **Warm-up.** Stand at a line and jump forward as far as you can. Ask a grown-up to measure. A grasshopper can jump about twenty times the length of its own body. For you, that would be a jump longer than a school bus!

Video slot. Video coming. Grasshoppers and desert locusts: how a grasshopper jumps, and a locust swarm (for young viewers). Search approved channels (BBC Earth, Smithsonian Channel, National Geographic Kids, the UN Food and Agriculture Organization locust pages); preview first.

KEY TERMS

locust
A kind of grasshopper that, when there are very many, gathers in a huge flying crowd.

swarm
A huge crowd of insects moving together.

plague
A terrible trouble that spreads over a land. God sent ten plagues on Egypt.

Pharaoh
The title of the king of ancient Egypt.

CORE IDEAS

The story. Long ago, God's people, the Israelites, were slaves in Egypt. God sent Moses to tell Pharaoh, "Let my people go." Pharaoh said no, again and again. So God sent plagues on Egypt. Before the eighth plague, Moses warned Pharaoh: locusts are coming. Pharaoh still would not listen. Moses stretched out his rod over the land, and the LORD sent an east wind all that day and all that night. In the morning, the wind brought the locusts.

Not one green thing. The Bible says the locusts "covered the face of the whole earth, so that the land was darkened." They ate every plant and all the fruit the hail had left. Not one green leaf was left in the fields or on the trees in all Egypt. Then Pharaoh hurried to call Moses and said, "I have sinned." Moses prayed, and God turned "a mighty strong west wind," which carried every locust into the Red Sea (Exodus 10:19).

What is a locust? A **locust** is a kind of grasshopper. Most of the time locusts live alone, like other grasshoppers. But when there are many of them close together, they change color, get

hungry and restless, and fly off together in a giant **swarm**. A swarm can have millions and millions of locusts and eat as much food in a day as a whole city of people.

Locusts today. Desert locusts still swarm in parts of Africa and Asia, and farmers there watch for them. In the 1870s, great clouds of Rocky Mountain locusts landed on the farms of the American prairie. Pioneer families, like Laura Ingalls Wilder's, saw their wheat eaten in a day. That kind of locust is gone now; no one has seen a living one since 1902.

The wind obeys God. In Exodus 10, the locusts came when God sent the east wind and left when He sent the west wind. Insects, wind and kings are all under God's rule. Locusts are not only for plagues: John the Baptist ate "locusts and wild honey" in the wilderness (Matthew 3:4).

PICTURE STUDY



The Plague of Locusts, James Tissot, c. 1896–1902 · Gouache (thick watercolor) on board · The Jewish Museum, New York
Wikimedia Commons · Public domain

James Tissot was a French painter who spent the last years of his life painting the stories of the Bible. He traveled to the Holy Land to see the real places and people so his paintings would look true. This painting shows Exodus 10.

Look closely

- Look at the sky. What makes it look dark?
- Look at the land and the plants. What is happening to them?
- Look for people. How do you think they feel?

Talk about it

1. Which verse of Exodus 10 do you think Tissot was painting?
2. Why do you think Pharaoh changed his mind after the locusts came?

HANDS-ON: GRASSHOPPER LOOK AND LEAP

Look closely at a real grasshopper, then see how your jump compares.

You will need

- A clear jar or bug box with air holes and a few fresh leaves
- A magnifying glass
- A tape measure or a long piece of string
- Your Field Notebook

Steps

1. In late summer, look in tall grass for a grasshopper. Cup your hands gently to catch it and put it in the jar.
2. Look with the magnifying glass. Count its legs. Find the two big back legs for jumping. Find its antennae and wings.
3. Let it go where you found it. Draw it in your Field Notebook.
4. Measure your best jump with the string. Then lay out how far you would jump if you were a grasshopper: twenty of you lying head to toe!

Check your work

- I found the grasshopper's two big jumping legs.
- I let the grasshopper go where I found it.
- I can tell how a locust is different from a grasshopper living alone.

FIELD NOTEBOOK

1. Draw the eighth plague in two pictures: the east wind bringing the locusts, and the west wind carrying them into the Red Sea.
2. Draw a grasshopper. Label the big jumping legs, wings and antennae.

> **Did you know?** God's law in Leviticus 11:22 said Israel could eat locusts and grasshoppers. People in some lands still eat them today, roasted or fried. A grasshopper "hears" with ears on the sides of its body, not on its head.

> **Goes deeper in.** History, for Moses and ancient Egypt; Life Science, Grade 3, Unit "Insects and Spiders" (coming soon); and Literature, for the pioneer stories of Laura Ingalls Wilder.

> **For families.** The story follows Exodus 10:1–20 (KJV); the quoted phrases are from verses 15–17 and 19. The locusts of Egypt were most likely the desert locust (*Schistocerca gregaria*), which changes from a solitary to a swarming form when

crowded. The Rocky Mountain locust swarms of 1874–1877 are well recorded; the last living specimen was collected in 1902. Wilder's *On the Banks of Plum Creek* (1937) tells of the grasshopper years in Minnesota; it is summarized here, not quoted. The plague is told plainly as God's judgment on Pharaoh's hard heart.

PRACTICE

1. EASY Which wind brought the locusts to Egypt?
2. MEDIUM Where did the west wind carry the locusts?
3. EASY What is a locust?

Make it a game · East Wind, West Wind. Mark one side of the yard "east" and the other "west." The players are locusts, crouched in the middle like grasshoppers. When the leader calls "East wind!", the locusts hop to the east side. When the leader calls "West wind!", they hop to the west side and sit down quietly in the "Red Sea." If the leader calls "Pharaoh says!", nobody moves. Anyone who moves sits out one turn.

Scripture. "And the LORD turned a mighty strong west wind, which took away the locusts, and cast them into the Red sea; there remained not one locust in all the coasts of Egypt." (Exodus 10:19, KJV)

God sent the locusts, and God took every one of them away. The wind and the smallest creatures obey Him.

Practice: answers

1. An east wind.
2. Into the Red Sea. Not one locust was left in Egypt.
3. A kind of grasshopper that gathers in huge swarms when there are very many.

1.9 Fabre the Insect Watcher

OBJECTIVES

- Tell the story of Jean-Henri Fabre, who spent his life watching insects.
- Describe Fabre's experiment with the marching caterpillars.
- Practice watching one small creature patiently, as Fabre did.

Warm-up. Set a timer for two minutes. Sit very still and watch something outside the window: a bird, a leaf, a bug. Do not talk! When the timer rings, tell one thing you saw that you would have missed if you had only glanced.

Video slot. Video coming. Jean-Henri Fabre and his garden (the Harmas) at Sérignan, France; processionary caterpillars marching in a line. Search approved channels (Smithsonian Channel, BBC Earth, the Muséum national d'Histoire naturelle); preview first.

KEY TERMS

entomologist
A scientist who studies insects (say "en-tuh-MOL-uh-jist").

observe
To watch something carefully and notice what is really there.

experiment
A careful test to find out what will happen.

instinct
Something an animal knows how to do without being taught, because God made it that way.

CORE IDEAS

The story. Two hundred years ago, in the hills of southern France, a little boy named Jean-Henri Fabre was sent to live with his grandparents on their farm. His family was poor, and he had no toys. But he had eyes! He watched beetles, bees and grasshoppers for hours. One evening he heard a little song in the bushes and crept up, again and again, until he found the singer: a grasshopper.

A teacher who kept learning. Fabre was born in 1823. He grew up to be a schoolteacher. He had little money, but he taught himself from books and saved up to buy more. Wherever he lived, he watched insects. He wanted to know not just what they looked like, but what they did and why.

The Harmas. When Fabre was 55 years old, he bought a house with a stony, weedy field in the village of Sérignan. He called the field the Harmas, an old word for wasteland. He let the

thistles and wildflowers grow, and the insects came. He watched them there for more than thirty years, until he died in 1915, at 91.

The marching caterpillars. Pine processionary caterpillars travel nose to tail in a line, each one following the silk thread of the one ahead. One day a line of them crawled up onto the rim of a big flowerpot and made a circle, with no leader at all. Fabre watched. Around and around they went, for seven days, before they finally broke free! He learned that their **instinct** was to follow, even when it led nowhere.

Books full of stories. Fabre wrote ten books about what he saw. He wrote them like stories, so that children and grown-ups loved to read them. People called him “the Homer of insects,” after the great storyteller of Greece. The Bible says, “It is the glory of God to conceal a thing: but the honour of kings is to search out a matter” (Proverbs 25:2). Fabre spent his life searching out God’s hidden wonders.

PICTURE STUDY



Portrait of Jean-Henri Fabre, Unknown photographer, Early 1900s · Black-and-white photograph · Wikimedia Commons (from a printed source)
Wikimedia Commons · Public domain

This photograph shows Jean-Henri Fabre when he was old and famous. By then people came from far away to visit the insect watcher of Sérignan, but he still spent his days in his weedy garden.

Look closely

- Look at his face. Is he young or old? How can you tell?
- What is he wearing?
- Look at his eyes. What kind of man do you think he was?

Talk about it

1. What would you ask Fabre if you could meet him?
2. Why might a person who watches insects need to be patient?

HANDS-ON: FABRE'S TEN MINUTES

Be an insect watcher like Fabre: pick one small creature and watch it for ten whole minutes.

You will need

- A timer
- A magnifying glass (if you have one)
- Your Field Notebook and a pencil
- A spot outside where you can sit: a garden, a flower bed or a patch of weeds

Steps

1. Sit quietly and look until you find one small creature: an ant, a bee on a flower, a beetle, a caterpillar or a spider.
2. Set the timer for ten minutes. Watch only that one creature. Do not touch it.
3. Write or tell a grown-up three things it did. Where did it go? What did it eat or carry?
4. Draw it, and write the date, the time and the place at the top of the page, as a real scientist does.

Check your work

- I watched one creature for ten minutes.
- I wrote down three things it did.
- My page has a drawing, a date and a place.

FIELD NOTEBOOK

1. Draw a circle of marching caterpillars around the rim of a flowerpot.
2. Copy Proverbs 25:2.

> **Did you know?** Fabre also wrote science schoolbooks, and he loved plants and mushrooms as well as insects. His house and garden at Sérignan, the Harmas, are still kept and can be visited today. Fabre found that the caterpillars in the flowerpot went around the rim hundreds of times.

> **Goes deeper in.** Life Science, Grade 3, Unit "Insects and Spiders" (coming soon); History, for France in the 1800s; and Literature, for Fabre's own insect stories.

> **For families.** Jean-Henri Fabre (1823–1915) was born in Saint-Léons, Aveyron, bought the Harmas at Sérignan-du-Comtat in 1879 and published the ten volumes of *Souvenirs entomologiques* between 1879 and 1907. The processionary-caterpillar circle happened in

January 1896; Fabre counted about seven days and some 335 trips around the rim. The nickname “Homer of insects” is often credited to Victor Hugo, but historians doubt that, so the stop says only “people called him.” Fabre did not accept Darwin’s theory and wrote with wonder about instinct; a line often quoted, “I do not believe in God; I see Him,” is widely attributed to him but its source is uncertain, so it is not used here. Older English translations of Fabre (e.g., by Alexander Teixeira de Mattos) are free on Project Gutenberg.

PRACTICE

1. EASY What did Fabre spend his life watching?
2. MEDIUM What happened when the caterpillars made a circle on the flowerpot?
3. EASY What did Fabre call his weedy field?

Make it a game · Fabre’s Eye. A grown-up sets ten small things on a tray: a leaf, a pebble, a button, a feather and so on. Players look for one minute. Then the tray is covered and one thing is taken away. Who can tell what is missing? Take turns hiding things. Good watchers, like Fabre, notice small changes.

Scripture. “It is the glory of God to conceal a thing: but the honour of kings is to search out a matter.” (Proverbs 25:2, KJV)

God hides wonders in His creation, and it is a good and honorable thing to search them out, as Fabre did.

Practice: answers

1. Insects.
2. They kept following each other around and around for seven days.
3. The Harmas.

1.10 Make a Bug Hotel

OBJECTIVES

- Build a simple bug hotel from sticks, stems, pinecones and bark.
- Name three small creatures that might move in and how each helps the garden.
- Tell how caring for little creatures is part of keeping God's garden (Genesis 2:15).

> **Warm-up.** Pretend you are a tiny ladybug and winter is coming. Look around the room. Where would you hide to stay safe and dry? Under a cushion? In a crack? Bugs need hiding places too, and today you will build them one.

Video slot. Video coming. How to build a bug hotel (insect hotel) for children; mason bees nesting in hollow stems. Search approved channels (Royal Horticultural Society, the Xerces Society, National Wildlife Federation, a state university extension program); preview first.

KEY TERMS

habitat
The place where an animal lives and finds food, water and shelter.

shelter
A safe place to hide from cold, rain and hungry animals.

pollinator
An animal, such as a bee or butterfly, that carries pollen from flower to flower so plants can make fruit and seeds.

mason bee
A gentle bee that lives alone, not in a hive, and builds its nest in small holes, sealing it with mud.

CORE IDEAS

The story. One fall afternoon, a family built a little wooden box and filled it with bundles of hollow stems, pinecones, bark and sticks. They hung it on the garden fence and called it the Bug Hotel. All winter, nothing seemed to happen. But in the spring, the children saw something wonderful. A small blue-black bee was flying in and out of a hollow stem. A few days later, the end of the stem was plugged with mud. A mother mason bee had moved in!

Who checks in? A bug hotel gives little creatures **shelter**. **Mason bees** lay their eggs in hollow stems about as thick as a pencil. Ladybugs hide between pinecones in winter. Beetles crawl under the bark, and spiders spin webs in the corners. Pill bugs, also called roly-polies, curl up in damp leaves at the bottom.

Good guests. The guests in a bug hotel pay their rent by helping the garden. Mason bees are **pollinators**; they help apple and cherry trees make fruit. Ladybugs eat aphids that hurt plants. Beetles and spiders eat other pests. Pill bugs help turn dead leaves back into rich soil.

Keeping the garden. When God made the first man, He "put him into the garden of Eden to dress it and to keep it" (Genesis 2:15). To dress a garden is to work it; to keep it is to care for it. Building a **habitat** for small creatures is one way we can keep the part of God's world He has given us, even if it is only a backyard.

Hotel keepers. A good hotel keeper checks on the guests. Look at your bug hotel each week, quietly and without poking. Write down who you see in your Field Notebook. By the end of a year, you may have a whole list of tiny neighbors you never knew you had.

PICTURE STUDY



Study of Butterfly and Insects, Jan van Kessel the Elder, c. 1655 · Oil on copper · National Gallery of Art, Washington, D.C.
Wikimedia Commons · Public domain

Jan van Kessel lived in Antwerp, a city in what is now Belgium, about 370 years ago. He painted tiny pictures of insects on thin sheets of copper, so small and careful that each one looks almost real. This little painting is only about as big as a postcard.

Look closely

- Count the insects. How many different kinds can you find?
- Find the butterfly. Find the moths.
- Look at the shadows under the insects. Which way is the light coming from?

Talk about it

1. Which of these insects might move into your bug hotel?
2. Why do you think people liked to hang little paintings of insects in their homes?

> **Safety first.** A grown-up does any cutting with saws, pruners or a drill. Wear gloves when gathering sticks and bark, and wash your hands afterward. Hang the hotel away from doors and play areas, and do not poke inside it.

HANDS-ON: BUILD A BUG HOTEL

Build a small hotel for the creatures of your garden and check on it all year.

You will need

- A clean, empty can (with no sharp edges), a milk carton with the top cut off, or a small wooden box
- Hollow stems or bamboo cut to fit (a grown-up cuts them), about as thick as a pencil
- Pinecones, small sticks, pieces of bark and dry leaves
- String or wire for hanging

Steps

1. Pack the hollow stems tightly into the can or box so they point out the open end. Leave one end of each stem closed if you can.
2. Fill the gaps with pinecones, sticks and bark. Pack everything tight so nothing falls out.
3. Hang or set the hotel in a sunny, sheltered spot about as high as your waist, with the open side facing away from the rain (south or east is best).
4. Check it every week. Draw any guests you see in your Field Notebook.

Check your work

- My bug hotel has hollow stems, pinecones and bark.
- It is hung in a sheltered spot, out of the rain.
- I can name three guests and how each helps the garden.

FIELD NOTEBOOK

1. Draw your bug hotel. Label each part: stems, pinecones, bark and leaves.
2. Start a guest list: write the date and draw each creature you see at the hotel.

> **Did you know?** Most bees do not live in hives. Many kinds, like mason bees, live alone, and they very seldom sting. Pill bugs are not insects; they have fourteen legs and are cousins of crabs and shrimp. A pile of dead leaves left under a bush is a free bug hotel too.

> **Goes deeper in.** Gardening & Animals, for pollinators and a wildlife-friendly garden; and Life Science, Grade 3, Unit “Insects and Spiders” (coming soon).

For families. Mason bees (genus *Osmia*) prefer holes about 5/16 inch (8 mm) across and 5 to 6 inches deep. Replace or clean nesting stems every year or two to keep mites and mold down. Wasps may also nest in a bug hotel; they are part of the garden too, but keep the hotel away from doors. The stop teaches stewardship (Genesis 2:15), not alarm. The Van Kessel painting is in the National Gallery of Art (gift of John Dimick); its public-domain image can be downloaded from the gallery's website.

PRACTICE

1. EASY Which bee might lay its eggs in a hollow stem in your bug hotel?
2. MEDIUM Name one bug hotel guest and how it helps the garden.
3. EASY What two jobs did God give Adam in the garden?

Make it a game · Who Lives Here?. A grown-up makes two sets of cards: one with guests (mason bee, ladybug, beetle, spider, pill bug) and one with rooms (hollow stem, pinecone, under the bark, web corner, damp leaves). Lay all the cards face down. Take turns turning over two cards. If the guest matches its room, keep the pair and tell how that guest helps the garden.

Scripture. "And the LORD God took the man, and put him into the garden of Eden to dress it and to keep it." (Genesis 2:15, KJV)

From the very beginning, God gave people the job of caring for His world. A bug hotel is a small way to keep the garden.

Practice: answers

1. A mason bee.
2. Any one: mason bee, pollinates fruit trees; ladybug, eats aphids; beetle or spider, eats pests; pill bug, turns dead leaves into soil.
3. To dress it (work it) and to keep it (care for it).

Track 1 badge quizzes

The badge quizzes are optional. Read each question aloud; the child may answer by talking, pointing or drawing. Four right out of five earns the badge. Badges and the certificate are earned by doing the stops, not by scores.

Badge quiz 1 (Stops 1–5)

1. What does Proverbs 6:6 tell the sluggard to do?
2. What does a honeybee's waggle dance tell the other bees?
3. What is the only plant monarch caterpillars eat?
4. How many legs does a spider have, and is it an insect?
5. What do a beetle's hard wing covers protect?

Badge quiz 2 (Stops 6–10)

6. Why do fireflies flash their lights?
7. Where does a young dragonfly live before it has wings?
8. In Exodus 10, how did God take the locusts away?
9. What did Fabre's marching caterpillars do on the rim of the flowerpot?
10. Name one guest that might live in a bug hotel and how it helps the garden.

TRAIL CERTIFICATE: MY BUG FIELD NOTEBOOK AND TRAIL E CERTIFICATE

Gather the Field Notebook pages from this trail into one booklet with a cover: "My Bug Field Notebook," your name and the dates you started and finished. Put your bug hotel guest list from Stop E10 at the back, and keep adding to it.

Add one "Fabre's Ten Minutes" page from Stop E9 with a drawing, a date and a place.

When the booklet is done, a parent signs the Trail E certificate.

- **Ten stops**: At least one page for each stop, each with a title and a date.
- **Insect or spider?**: One labeled drawing shows an insect's six legs and three body parts beside a spider's eight legs and two body parts.
- **Observation**: At least one drawing made from a real creature the child watched outdoors, with the date and place.
- **Care**: Drawings are labeled and done carefully, and creatures were watched gently and returned.

Answer key

1. "Go to the ant" and watch its ways and be wise: work hard and save for later.
2. Which way to fly and how far to go to find flowers.
3. Milkweed.
4. Eight legs. No, it is an arachnid, not an insect.
5. The thin flying wings folded underneath.

6. To send signals so they can find fireflies of their own kind.
7. Under the water in a pond or stream.
8. He sent a mighty strong west wind that carried them into the Red Sea.
9. They followed each other around and around in a circle for seven days.
10. Any one: mason bee, pollinates fruit trees; ladybug, eats aphids; beetle or spider, eats pests; pill bug, turns dead leaves into soil.

Explore Tracks · Trail F

The sixth trail of the Animals track for curious Scouts: animals doing amazing things. Ten short, self-paced stops with true stories, great pictures, hands-on projects and games.

First edition

> *And out of the ground the LORD God formed every beast of the field, and every fowl of the air; and brought them unto Adam to see what he would call them: and whatsoever Adam called every living creature, that was the name thereof. Genesis 2:19 (KJV)*

Course guide

Explore Tracks are for children who want more of what they love. Each track is a trail of short stops. At every stop the child hears a true story, studies a great picture, does something with his or her hands, plays a game and adds a page to a Field Notebook.

Trail F is the sixth trail of the Animals track at the 🟢 Scout level (ages 7–9). Instead of one kind of animal, it looks at what animals can do: bats that find their way by sound, creatures that hide in plain sight, sleepers that wait out the winter, beavers and weaver birds that build, animal partners, the sea otter and its rock, and long journeys over land and sea. The child meets the sled dogs who carried medicine to Nome, Alaska, in 1925, sees how engineers copy designs found in animals, and ends in Genesis 2, where Adam names the animals. Each stop links to the full lesson in Life Science, Gardening & Animals, Geography or History. Earlier trails are not required first.

WHO IT IS FOR

Written for children about ages 7–9 who are read to by a parent, or who read short passages on their own. Older siblings can join in. Nothing earlier is required.

HOW TO USE THIS COURSE

1. **One stop at a time.** A stop takes 15–25 minutes: read the story aloud, look at the picture, do the hands-on part and play the game. Two or three stops a week works well.
2. **Any order.** The stops stand alone. Follow the trail from F1 to F10, or start with whatever the child is curious about today.
3. **Field Notebook.** Every stop ends with a page for the notebook. After five stops the child earns a badge; at the end of the trail the pages become a booklet, and the parent signs the Trail F certificate.
4. **Badge quizzes.** The trail has two short, optional oral quizzes, one after each five stops. They are for fun, not grades.

SCOPE AND SEQUENCE

Track 1: Animals 🐾 Trail F: Animals Doing Amazing Things (Self-paced)

MATERIALS

- **Field Notebook (a sketchbook or composition book)** One for the whole trail.
- **Colored pencils, a ruler, scissors and glue** For drawings, maps and trading cards.
- **Household things** Each hands-on project lists what it needs: sticks, string, paper cups, a blindfold, rocks, clay, a shoebox.
- **A Bible (KJV)** For the verse at each stop.

GRADING

Explore Tracks are not graded. A stop is done when the child has heard the story, done the hands-on part and made a notebook page.

Badges and the Trail F certificate are earned by finishing the stops.

A NOTE TO PARENTS

You do not need to be an expert. Read the story aloud, look at the picture together and ask, “What do you notice?” Each stop has a short *For families* note with background and any facts that scientists still discuss, such as exactly how far some animals travel or how certain partners help each other.

This trail presents the abilities of animals as the handiwork of their Creator, who made each creature “after his kind.” The stop on designs copied by engineers shows how people learn from what God has made. Animal numbers (speeds, distances, sleeping times) are given as careful estimates, and the *For families* note says when sources differ.

Watching real animals is part of the fun. Some hands-on parts go outdoors; their safety lines remind children to watch wild animals from a distance, never to touch or feed them, and to wash hands after handling nests, feathers or soil.

Contents

Track 1: Animals 🐾 Trail F: Animals Doing Amazing Things

1.1 Echolocation: Seeing with Sound
1.2 Camouflage: Now You See Me
1.3 Hibernation: The Long Winter Sleep
1.4 Animal Builders: Beavers and Weaver Birds
1.5 Animal Partners: Better Together
1.6 Animal Tools: The Sea Otter’s Rock
1.7 Long Journeys: The Godwit’s Great Flight
1.8 Animals That Helped People: The Sled Dogs of Nome (1925)
1.9 Design Copied by Engineers
1.10 Adam Names the Animals (Genesis 2:19)

Each stop takes 15–25 minutes. Tracks may be done in any order, and a child may do just one track.

TRACK 1

Animals 🐾 Trail F: Animals Doing Amazing Things

The sixth trail of the Animals track looks at the amazing things God made animals able to do: bats and dolphins that “see” with sound, hares that change their coats, groundhogs that sleep all winter, beavers and weaver birds that build, partners like the oxpecker and the rhinoceros, the sea otter and its rock, the godwit’s eleven-day flight, the sled dogs of the 1925 serum run to Nome, inventions copied from animals, and Adam naming the animals in Genesis 2. Each stop is a short read-aloud story, a picture to study, something to make, quick questions, a game and a verse of Scripture.

This is the 🟢 **Scout** level, written for ages 7 to 9. A parent reads the story aloud, or a strong reader reads it alone. Every stop stands by itself, so a family may do them in any order. The 🔵 Ranger and 🔴 Expert levels of these same stops will add maps, numbers and primary sources later.

Five stops earn the **Amazing Animals badge, part 1**, and ten stops earn part 2 and the **Trail F certificate**. The badge quizzes are at the end of the trail and are optional.

BEFORE YOU BEGIN

- Listen to a story of about five minutes and tell it back.
- Find Alaska, Africa and the Pacific Ocean on a globe (a grown-up may help).

MASTERY CHECKLIST

☐ I can tell how a bat uses echoes to find food in the dark.
☐ I can tell one way an animal hides, one way an animal gets through winter and one thing an animal builds.
☐ I can tell how two animal partners help each other and how a sea otter uses a tool.
☐ I can tell the story of the Nome serum run and name Togo and Balto.
☐ I can name an invention copied from an animal or plant and tell what Adam did in Genesis 2:19.

OPTIONAL BOOKS AND RESOURCES

- **Smithsonian’s National Zoo and Conservation Biology Institute** (https://nationalzoo.si.edu): Free animal pages with photos and live animal cameras; good for bats, beavers and many others on this trail.
- **Biodiversity Heritage Library** (https://www.biodiversitylibrary.org): Free old books with animal plates, including Lewis Henry Morgan’s *The American Beaver and His Works* (1868) for Stop F4 and Audubon’s animal plates.
- **Iditarod Trail Committee** (https://iditarod.com): Maps, photos and the story of the serum run trail for Stop F8.

- **Your public library** (https://www.worldcat.org): Search for picture books on hibernation, animal builders, migration and the Nome serum run to borrow and read aloud.

🟢 SCOUT · STOP F1 · TRACK 1 · STOP 1.1 · 15–25 MINUTES

1.1 Echolocation: Seeing with Sound

OBJECTIVES

- Tell how a bat finds a moth in the dark by listening to echoes.
- Name two animals that use echolocation: bats and dolphins.
- Say Psalm 94:9 and tell who made ears.

Warm-up. Stand facing a wall in a big, quiet room and clap once. Now stand in the middle of a soft, cozy bedroom and clap again. Did the claps sound different? Sound bounces off hard things and comes back. That bounce is called an echo.

Video slot. Video coming. How bats and dolphins use echolocation to find food in the dark. Search approved channels (Smithsonian's National Zoo, National Park Service, PBS Nature, BBC Earth, National Geographic Kids); preview first.

KEY TERMS

echo
A sound that bounces off something and comes back to you.

echolocation
Finding things by making sounds and listening for their echoes.

bat
A furry animal with wings made of skin stretched over long finger bones. Bats are the only animals with fur that can truly fly.

nocturnal
Awake and busy at night and asleep in the day.

CORE IDEAS

The story. The sun has set over a quiet pond. A little brown bat drops from a crack in an old barn and flutters out over the water. It is too dark to see, but the bat is shouting the whole time: tiny squeaks, over and over, too high for your ears to hear. Suddenly it swoops, twists and snaps up a moth in midair. How did it know where the moth was?

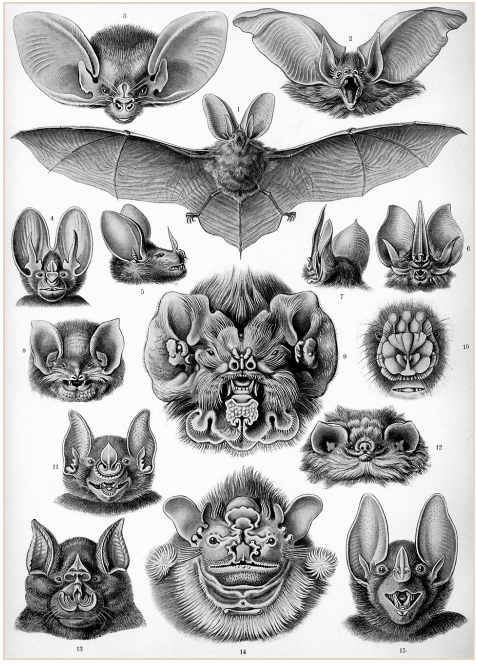
Listening for echoes. Each squeak flies out from the bat's mouth or nose and bounces off whatever is ahead: a tree, a wall, a moth. The bounce comes back as an **echo**. The bat's big ears catch the echo. A quick echo means "something close!" A slow echo means "something far away." This way of finding things is called **echolocation**. It is like seeing with sound.

Faster and faster. When a bat closes in on a bug, it squeaks faster and faster, until the squeaks run together like a buzz. Then it scoops up the bug, sometimes with its wing or the skin between its back legs, and eats it on the wing. A bat can do this again and again all night long, catching many small insects in a single hour.

Clicks under the sea. Dolphins use echolocation too. A dolphin makes fast clicks in its head. A rounded, fatty bump on its forehead, called the melon, sends the clicks out into the water. The echoes come back through its lower jaw to its ears. With clicks a dolphin can find a fish hiding under the sand, even in muddy water.

The One who made the ear. For a long time no one knew how bats flew in the dark. In the 1930s, scientists with a special microphone finally heard the bats' high squeaks. But God knew all along, because He made the bat. The psalm says, "He that planted the ear, shall he not hear?" The God who made such clever ears hears every one of our prayers.

PICTURE STUDY



Chiroptera (Bats), Plate 67 of Art Forms in Nature, Ernst Haeckel, 1904 · Color lithograph (printed picture) from the artist's drawings · From the book Kunstformen der Natur (Art Forms in Nature)
Wikimedia Commons · Public domain

Ernst Haeckel was a German scientist who loved to draw. In this page he lined up the faces of many kinds of bats, like a family photo. Look at their ears and noses: those are the parts bats use for echolocation.

Look closely

- Find the bat with the biggest ears. Find one with a leaf-shaped flap on its nose.
- Count how many bat faces you can see.
- Look at the middle of the page. How is the picture arranged?

Talk about it

1. Why do you think so many bats have such big ears?
2. Which bat face do you like best, and why?

HANDS-ON: ECHO CATCH

Use a ball to see how an echo works: the sound goes out, bounces and comes back.

You will need

- A soft rubber ball
- A wall with space in front of it (outdoors or a garage)
- A blindfold or scarf

Steps

1. Stand close to the wall and bounce the ball off it. Count how fast it comes back. Then step far back and try again. Which came back faster?
2. Say to yourself: the close wall is like a close moth. The far wall is like a far tree.
3. Now play bat. Put on the blindfold and stand in an open, safe spot. A grown-up stands somewhere near you. You call out “Squeak!” and the grown-up answers “Echo!” Point to where the echo came from.
4. Try it from three different places. How many times did you point the right way?

Check your work

- I bounced the ball from close and far.
- I found the “echo” with my ears at least once.
- I can tell what an echo is.

FIELD NOTEBOOK

1. Draw a bat flying at night. Draw curved lines coming out of its mouth (the squeaks) and curved lines bouncing back from a moth (the echoes).
2. Copy Psalm 94:9 in your best handwriting.

> **Did you know?** Not all bats use echolocation. Many big fruit bats, called flying foxes, find their food mostly with their large eyes and good noses. A few birds use echoes too: the oilbird of South America makes clicking sounds to find its way in the dark caves where it nests, and people can hear those clicks.

> **Goes deeper in.** Life Science, the animals and senses units (coming soon); and Trail A, Stop A4 “Bats,” and Trail D, Stop D5 “Dolphins.”

> **For families.** In the 1790s Lazzaro Spallanzani and Louis Jurine showed that bats needed their hearing, not their sight, to avoid obstacles in the dark. In 1938 Donald Griffin and George W. Pierce recorded bat calls with an ultrasonic microphone at Harvard, and Griffin coined the word “echolocation” in 1944. Insect-catch rates for bats vary widely by species and night; the stop says “many” rather than repeat a single number. The oilbird’s clicks are audible to people; most bat calls are ultrasonic.

PRACTICE

1. EASY What is an echo?
2. MEDIUM How does a bat find a moth in the dark?
3. EASY Name an animal in the sea that uses echolocation.

Make it a game · Bat and Moth. Play in a clear, safe space. One player is the bat and wears a blindfold. The others are moths. The bat calls “Bat!” and every moth must answer “Moth!” right away. The bat follows the sounds and tries to gently tag a moth. A tagged moth becomes the next bat. Moths may walk, not run.

Scripture. “He that planted the ear, shall he not hear? he that formed the eye, shall he not see?” (Psalm 94:9, KJV)

God made the bat’s wonderful ears. The One who made every ear hears us too, even in the dark.

Practice: answers

1. A sound that bounces off something and comes back.
2. It squeaks and listens for the echo that bounces back off the moth.
3. The dolphin (also whales such as orcas and sperm whales).

1.2 Camouflage: Now You See Me

OBJECTIVES

- Tell what camouflage is and how it helps an animal.
- Tell how the snowshoe hare changes its coat for winter.
- Find a hidden animal in a picture and tell what made it hard to see.

Warm-up. Lay a green leaf on the grass and a green leaf on a white sheet of paper. Step back three big steps. Which leaf is easier to see? An animal that matches what is around it is hard to find.

Video slot. Video coming. Animal camouflage for children: snowshoe hares, stick insects, flounders and owls that blend in. Search approved channels (PBS Nature, BBC Earth, Smithsonian's National Zoo, National Park Service); preview first.

KEY TERMS

camouflage
Colors, patterns or shapes that help an animal blend in with what is around it.

predator
An animal that hunts other animals for food.

prey
An animal that is hunted by other animals.

molt
To lose old fur, feathers or skin and grow new ones.

CORE IDEAS

The story. In the summer woods of northern Canada, a snowshoe hare sits very still beside a fallen log. Its fur is brown, just like the dead leaves and the bark. A hungry lynx walks right past and never sees it. The hare does not run. It does not even twitch its nose. Being hard to see is how it stays safe.

A new coat for winter. When fall comes and the days grow short, something wonderful happens. The hare begins to **molt**. Its brown fur falls out, and new white fur grows in its place. By the time the snow comes, the hare is white from its ears to its big furry feet. In spring it turns brown again. God gave it two coats, one for each season.

Hiding in plain sight. Matching is called **camouflage**. Many animals use it. A walking stick insect looks like a twig. A flounder lies flat on the sea floor and looks like sand. A screech owl sits by a tree trunk, and its gray, streaky feathers look like bark. Some of these animals are **prey**, hiding from hunters. Others are **predators**, hiding so they can sneak up on their food.

Dark on top, light below. Look at a penguin or a shark. Its back is dark and its belly is light. From above, its dark back matches the deep water. From below, its light belly matches the bright sky. A painter named Abbott Thayer noticed this more than a hundred years ago and wrote about it. It helps many animals hide from both sides.

Kept safe. Camouflage is one of the ways God cares for small, quiet creatures that cannot fight or run very far. The Bible calls God our “hiding place.” Like the hare tucked beside the log, we can be still and trust Him to keep us.

PICTURE STUDY



Young Hare, Albrecht Dürer, 1502 · Watercolor and gouache (thick, chalky paint) on paper · Albertina Museum, Vienna, Austria
Wikimedia Commons · Public domain

Albrecht Dürer was a German artist who lived more than five hundred years ago. He painted this hare so carefully that you can almost count the hairs. This kind of hare stays brown all year, the color of a plowed field or dry grass.

Look closely

- Find the whiskers and the long ears. Which way are the ears pointing?
- Look at the fur. How many colors can you find in it: brown, gold, gray, white?
- Look closely at the hare’s eye. Some people say they can see a window reflected in it. Can you?

Talk about it

1. If this hare sat in a brown field, would a fox see it easily? Why or why not?
2. Why do you think Dürer painted the hare on a plain background instead of in a field?

HANDS-ON: HIDE THE MOTHS

Make paper moths and camouflage them so well that your family cannot find them.

You will need

- Paper
- Crayons or colored pencils
- Scissors (with a grown-up)
- Tape or sticky putty

Steps

1. Cut out five small moth shapes, about as big as your thumb.
2. Walk around the room and pick five hiding places: a bookshelf, a rug, a curtain, a plant, a chair.
3. Color each moth to match its hiding place. Copy the colors and patterns as closely as you can.
4. Tape each moth to its spot, out in the open but matching. Give your family two minutes to find them. Which moth was found last? Why?

Check your work

- I made five moths, each colored to match a different spot.
- I hid them in plain sight, not under or behind things.
- I can tell which moth was hardest to find and why.

FIELD NOTEBOOK

1. Draw a snowshoe hare twice: once brown beside a log in summer and once white in the snow in winter. Label “summer coat” and “winter coat.”
2. Draw a fish that is dark on top and light below, and write “dark on top, light below.”

Did you know? The snowshoe hare gets its name from its huge back feet, which spread out like snowshoes so it can run on top of deep snow. Its coat change follows the length of the days, not the snow. The ptarmigan, a bird of the far north, also turns white in winter, even on its feet.

Goes deeper in. Life Science, the animals unit, “How animals stay safe” (coming soon); and Art, for Dürer and drawing from nature.

For families. Dürer’s *Young Hare* (1502) is in the Albertina, Vienna; because it is light-sensitive it is rarely shown, and a copy is usually on display instead. The “window in the eye” is a common observation about the painting. Abbott Handerson Thayer (1849–1921) described countershading in the 1890s and published *Concealing-Coloration in the*

Animal Kingdom (1909) with his son Gerald. Snowshoe hare molts are triggered by day length (photoperiod). Chameleons have their own stop (Trail C, C5).

PRACTICE

1. EASY What is camouflage?
2. MEDIUM What color is a snowshoe hare in summer, and what color in winter?
3. MEDIUM Why is a shark dark on top and light below?

Make it a game · Freeze, Hare!. One player is the fox and turns around, eyes closed, counting to ten. The others are hares and find a spot to crouch near something their clothes match. When the fox opens its eyes, the hares must freeze. Any hare the fox sees moving is caught. The last hare not caught is the next fox.

Scripture. “Thou art my hiding place; thou shalt preserve me from trouble; thou shalt compass me about with songs of deliverance. Selah.” (Psalm 32:7, KJV)

God gave the hare a coat to hide in. He is our hiding place, and He keeps us safe.

Practice: answers

1. Colors, patterns or shapes that help an animal blend in with what is around it.
2. Brown in summer and white in winter.
3. From above, its dark back matches the deep water; from below, its light belly matches the bright sky.

1.3 Hibernation: The Long Winter Sleep

OBJECTIVES

- Tell what hibernation is and why some animals do it.
- Tell how a groundhog gets ready for winter and what happens to its body.
- Name one animal that hibernates and one that stays awake all winter.

Warm-up. Put your hand on your chest and count your heartbeats while a grown-up watches the clock for 15 seconds. A groundhog's heart beats about as fast as yours in summer. In its winter sleep, it beats only about once every ten or twelve seconds!

Video slot. Video coming. Hibernation for children: groundhogs, bears and bats in winter. Search approved channels (National Park Service, U.S. Fish and Wildlife Service, PBS Nature, Smithsonian's National Zoo); preview first.

KEY TERMS

hibernate
To go into a long, deep winter sleep, when the body cools and slows way down.

burrow
A hole or tunnel in the ground that an animal digs to live in.

fat
Stored food in the body that an animal can live on when it cannot eat.

den
A safe, hidden home where a wild animal rests or sleeps.

CORE IDEAS

The story. All summer long, a groundhog in a Pennsylvania meadow eats and eats: clover, grass, dandelions and the farmer's beans. By fall it is round and fat. One cool day in October it waddles down into its **burrow**, deep under the ground where the frost cannot reach. It pulls dirt across the tunnel behind it, curls into a furry ball and goes to sleep. It will not come out again until the end of winter.

A very deep sleep. This is **hibernation**. It is much deeper than your sleep at night. The groundhog's body cools down until it is almost as cold as a refrigerator. Its heart beats only about five times a minute, and it breathes only now and then. If you picked it up, it would not wake. Its body burns its stored **fat** very slowly, like a candle that burns all winter.

Why sleep all winter? In winter, the plants a groundhog eats are buried in snow. There is almost nothing to eat. Staying awake and warm takes lots of food. So God gave the groundhog a way to "turn down" its body and wait. Some bats hibernate in caves. Chipmunks hibernate, waking now and then to nibble from their store of seeds.

Bears and the others. Black bears sleep in a **den** all winter and do not eat or drink for months, but they do not cool down as much as a groundhog, and they can wake up quickly. Mother bears even have their tiny cubs in the den! Many animals do not hibernate at all. Deer, foxes, rabbits and chickadees stay awake and find food all winter.

A time for everything. When spring comes, the groundhog wakes up thin and hungry and crawls out into the sunshine. God made the seasons: summer for eating and growing, winter for resting and waiting. The Bible says, “To every thing there is a season.”

PICTURE STUDY



The Fox Hunt, Winslow Homer, 1893 · Oil on canvas · Pennsylvania Academy of the Fine Arts, Philadelphia
Wikimedia Commons · Public domain

Winslow Homer was an American painter who lived by the sea in Maine. In this big painting, a fox is out in the deep winter snow. The fox does not hibernate. It must keep hunting all winter, and so must the hungry crows.

Look closely

- Find the fox. How deep is the snow on its legs?
- Count the crows. What are they doing?
- Find the red berries. Why might they be important to animals in winter?

Talk about it

1. How would this winter day be different for a groundhog asleep in its burrow?
2. How does Homer make the snow look cold and deep?

HANDS-ON: A BURROW IN A BOX

Make a cutaway model of a groundhog's winter burrow, so you can see under the ground.

You will need

- A shoebox, set on its long side
- Brown and white paper, or crayons
- Cotton balls (snow)
- Clay or playdough (the groundhog)
- Glue and scissors (with a grown-up)

Steps

1. Color or glue brown paper on the inside of the box. This is the dirt. Glue cotton balls along the top edge for the snow.
2. Draw a tunnel going down and sideways through the dirt, with a round room at the end.
3. Make a groundhog out of clay, curled into a tight ball, and put it in the room. Add a little dried grass for its bed if you have some.
4. Show a grown-up and tell them three things that happen to the groundhog's body while it hibernates.

Check your work

- My burrow is below the snow, where the frost cannot reach.
- My groundhog is curled up in a ball.
- I told three things about hibernation.

FIELD NOTEBOOK

1. Draw a line across your page for the ground. Above it, draw winter snow and a deer finding food. Below it, draw a groundhog asleep in its burrow. Label "awake" and "hibernating."
2. Copy Ecclesiastes 3:1.

> **Did you know?** The common poorwill, a bird of the American West, is the only bird known to go into a long hibernation-like sleep. In 1946 a scientist named Edmund Jaeger found one sleeping in a crack in a rock in California, cold and still, and it came back to the same spot for several winters. And every February 2, on Groundhog Day, people in Punxsutawney, Pennsylvania, watch a groundhog to see if it sees its shadow. That is a fun old custom, not a real weather forecast!

> **Goes deeper in.** Life Science, the animals unit, "Animals in winter" (coming soon); and Earth Science, for the seasons; and Trail A, Stop A7 "Bears."

For families. Woodchuck (groundhog) heart rates fall from roughly 80 beats a minute to about 4–10 in deep hibernation, and body temperature falls from about 99°F to around 40°F; sources vary slightly. Scientists debate whether bears are “true” hibernators: their body temperature drops only several degrees, but they go months without eating, drinking or passing waste. Jaeger’s poorwill observations were published in *The Condor* (1948–1949). Homer’s *The Fox Hunt* was painted at Prouts Neck, Maine; hungry crows sometimes harry a fox in a hard winter. The picture is not graphic, but some children may want to talk about winter hunger.

PRACTICE

1. EASY What does it mean to hibernate?
2. MEDIUM Why does a groundhog eat so much in summer and fall?
3. EASY Name an animal that stays awake all winter.

Make it a game · Groundhog, Wake Up!. Everyone curls up on the floor like a hibernating groundhog, breathing slowly and staying perfectly still. The leader walks around calling out seasons: “Fall!” “Winter!” “Still winter!” Anyone who moves before the leader calls “Spring!” is out. On “Spring!” everyone pops up and stretches.

Scripture. “To every thing there is a season, and a time to every purpose under the heaven:” (Ecclesiastes 3:1, KJV)

God made a season for the groundhog to eat and a season for it to sleep. He gives us times to work and times to rest too.

Practice: answers

1. To go into a long, deep winter sleep, when the body cools and slows way down.
2. To store fat that its body lives on all winter while it sleeps.
3. Any one: deer, fox, rabbit, chickadee, squirrel (gray), owl.

1.4 Animal Builders: Beavers and Weaver Birds

OBJECTIVES

- Tell how a beaver builds a dam and a lodge.
- Tell how a weaver bird weaves its nest out of grass.
- Say Psalm 127:1 and tell who must build the house.

> **Warm-up.** Take three long pieces of yarn or grass and try to braid or tie them together using only one hand and your mouth. (Just pretend with your mouth!) Hard, isn't it? A weaver bird ties knots with only its beak and feet.

Video slot. Video coming. How beavers build dams and lodges; weaver birds weaving nests. Search approved channels (PBS Nature, BBC Earth, National Park Service, U.S. Fish and Wildlife Service, Smithsonian's National Zoo); preview first.

KEY TERMS

dam
A wall built across a stream to hold back the water and make a pond.

lodge
A beaver's home: a dome of sticks and mud in the pond, with doors under the water.

weave
To make something by passing strands over and under each other.

gnaw
To bite and chew on something hard again and again.

CORE IDEAS

The story. Night falls on a little stream in the north woods. A beaver swims to the bank, stands up on its back feet and begins to **gnaw** a young aspen tree. Chip, chip, chip. Its big orange front teeth cut a ring around the trunk until the tree tips over with a crash. The beaver cuts the tree into pieces and drags the branches down to the water.

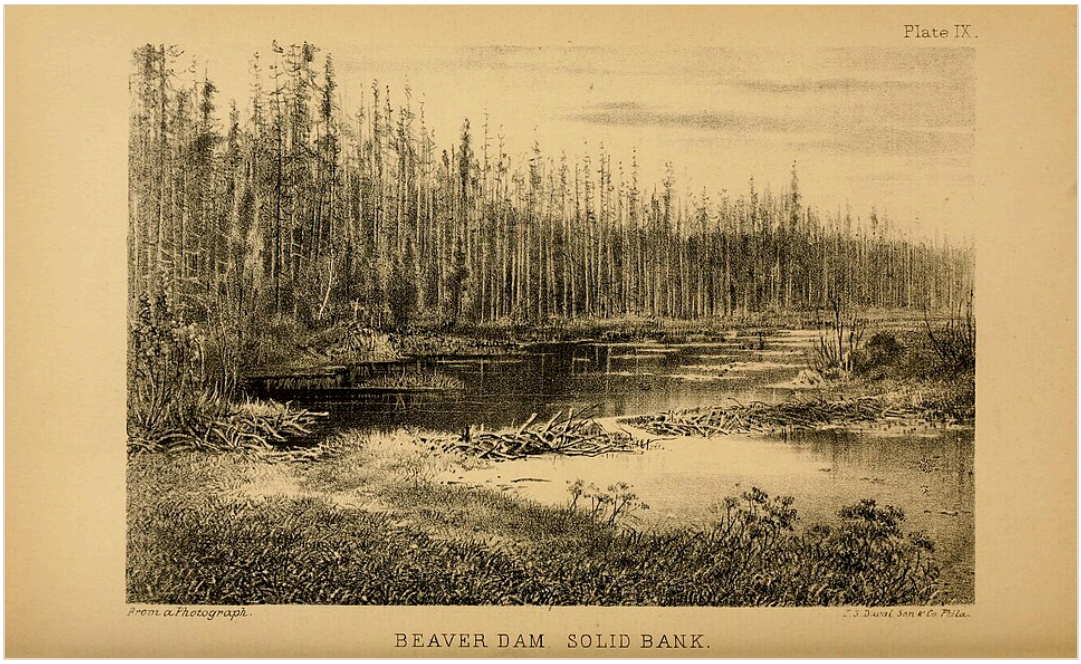
A wall of sticks. The beaver pushes sticks into the stream bed and piles on more sticks, stones and mud, which it carries in its front paws. Night after night the wall grows. This is a **dam**. It holds back the stream, and a pond spreads out behind it. When the beaver hears water trickling through a leak, it hurries to patch it with mud.

A house with an underwater door. In the middle of the pond the beavers build their **lodge**, a dome of sticks plastered with mud. The doors are under the water, so wolves and coyotes cannot get in. Inside, above the water, is a dry room where the beaver family sleeps. In winter the mud freezes as hard as stone, and the beavers stay snug inside.

The weaver bird. Far away in Africa, a little yellow weaver bird builds a different kind of home. He tears long strips from grass and palm leaves. Holding one end with his feet, he pokes the strip in and out with his beak and even ties real knots. Bit by bit he **weaves** a round, hanging nest with a door at the bottom, so snakes have a hard time getting in. If the mother bird does not like his nest, he may pull it apart and build it again!

Who taught them? No one gives a young beaver building lessons out of a book, and a young weaver bird never went to weaving school. God made them able to build. People are builders too. The Bible reminds us, “Except the LORD build the house, they labour in vain that build it.” Whatever we build, we need God’s help.

PICTURE STUDY



A beaver dam, plate from The American Beaver and His Works, Lewis Henry Morgan (author); the plates were drawn and printed for his book, 1868 · Printed plate (lithograph) in a book · From Morgan’s book; free to view at the Biodiversity Heritage Library
Wikimedia Commons · Public domain

Lewis Henry Morgan worked for a railroad in the woods of northern Michigan in the 1860s. He became so curious about beavers that he spent years walking the streams, measuring their dams and drawing maps. He found and studied more than sixty beaver dams near the town of Ishpeming. His book was filled with pictures like this one.

Look closely

- Find the dam. Which side is the pond, and which side is the stream running away?
- Look at the sticks. Are they neat or tangled?
- Find something in the picture that shows how big the dam is.

Talk about it

1. Why do you think Morgan drew the dams instead of just writing about them?
2. What would you want to measure if you found a beaver dam?

> **Safety first.** Building with water and mud is best done outdoors or in a large pan on a towel. Stay with a grown-up near any real stream or pond.

HANDS-ON: BUILD A BEAVER DAM

Build a little dam in a pan and see if you can make a pond like a beaver.

You will need

- A long baking pan or a plastic tub
- Sand or dirt
- Small sticks and twigs
- Pebbles
- Mud (dirt mixed with a little water)
- A cup of water

Steps

1. Fill the pan with sand and dig a little stream bed down the middle, from one end to the other.
2. Tip the pan a little by putting a book under one end. Pour water at the high end and watch it run down.
3. Now build a dam across the middle: push sticks in first, then add pebbles, then pack mud into the gaps.
4. Pour water again. Does a pond form behind your dam? Find a leak and patch it with mud, just like a beaver.

Check your work

- My dam has sticks, stones and mud.
- My dam held back water and made a little pond.
- I found a leak and patched it.

FIELD NOTEBOOK

1. Draw a beaver pond from the side, cut open like a cake: the dam, the pond, the lodge, the underwater door and the beavers in their dry room.
2. Draw a weaver bird’s hanging nest with the door at the bottom.

> **Did you know?** A beaver’s front teeth are orange because they have iron in them, which makes them strong. They never stop growing, so all that gnawing keeps them from getting too long. One of the longest beaver dams ever found is in Wood Buffalo National

Park in Canada. It is about half a mile long and was first spotted in pictures taken from space.

Goes deeper in. Life Science, the animals unit (coming soon); Gardening & Animals, for ponds and wildlife; and Trail B, Stop B8 “Nests.”

For families. Lewis Henry Morgan (1818–1881) published *The American Beaver and His Works* in 1868 after studying beavers near Ishpeming in Michigan’s Upper Peninsula, where he was a director of a railroad; his map showed 64 dams. The book is free at the Biodiversity Heritage Library; choose any dam plate for the picture study. The Wood Buffalo dam (about 850 m, or 2,790 ft) was found on satellite images in 2007. The weaver described is a village or southern masked weaver; males build and the female inspects.

PRACTICE

1. EASY What does a beaver use to build its dam?
2. MEDIUM Why are the doors of a beaver lodge under the water?
3. EASY How does a weaver bird make its nest?

Make it a game · Patch the Leak. Players sit in a circle, shoulder to shoulder: they are the dam. One player is the water and walks around the outside. When the water taps someone, that player stands and steps out, making a “leak.” The two players beside the gap must scoot together to close it before the water can slip through. Then the leak becomes the water.

Scripture. “Except the LORD build the house, they labour in vain that build it: except the LORD keep the city, the watchman waketh but in vain.” (Psalm 127:1, KJV)

God made the beaver and the weaver bird able to build. When we build a home, a family or anything good, we need Him to help us.

Practice: answers

1. Sticks, stones and mud.
2. So wolves, coyotes and other hunters cannot get in.
3. It weaves strips of grass and leaves in and out with its beak and feet and ties knots.

1.5 Animal Partners: Better Together

OBJECTIVES

- Tell how the oxpecker and the rhinoceros help each other.
- Tell how the clownfish and the sea anemone help each other.
- Say Ecclesiastes 4:9 and give an example of “two are better than one.”

> **Warm-up.** Try to scratch the very middle of your back. Can you reach it? Now ask someone to scratch it for you. Some animals have a friend to reach the places they cannot!

Video slot. Video coming. Animal partners for children: oxpeckers on rhinos and buffalo, clownfish in anemones, cleaner fish. Search approved channels (BBC Earth, PBS Nature, Smithsonian’s National Zoo, Monterey Bay Aquarium); preview first.

KEY TERMS

partners
Two who work together and help each other.

oxpecker
A small African bird that rides on big animals and eats the bugs on their skin.

tick
A tiny bug-like creature that clings to an animal’s skin and drinks its blood.

sea anemone
A soft sea animal shaped like a flower, with stinging arms called tentacles (say “uh-NEM-uh-nee”).

CORE IDEAS

The story. On a hot African plain, a huge rhinoceros munches grass. Hop, hop, hop: a little brown bird with a red beak walks right up the rhino’s leg, onto its back and even onto its face! The rhino does not mind. The bird is an **oxpecker**, and it is busy eating breakfast: the **ticks** and flies hiding in the rhino’s thick skin.

Help for both. The oxpecker gets a meal and a ride. The rhino gets rid of the bugs that bite it. And there is more. Rhinos cannot see very well. When a person or a lion comes near, the oxpeckers flutter up and call out loudly, “Hiss-s-s! Danger!” The rhino lifts its head and gets ready. In the Swahili language of East Africa, one name for the oxpecker means “the rhino’s guard.” Oxpeckers ride on buffalo, giraffes and zebras too.

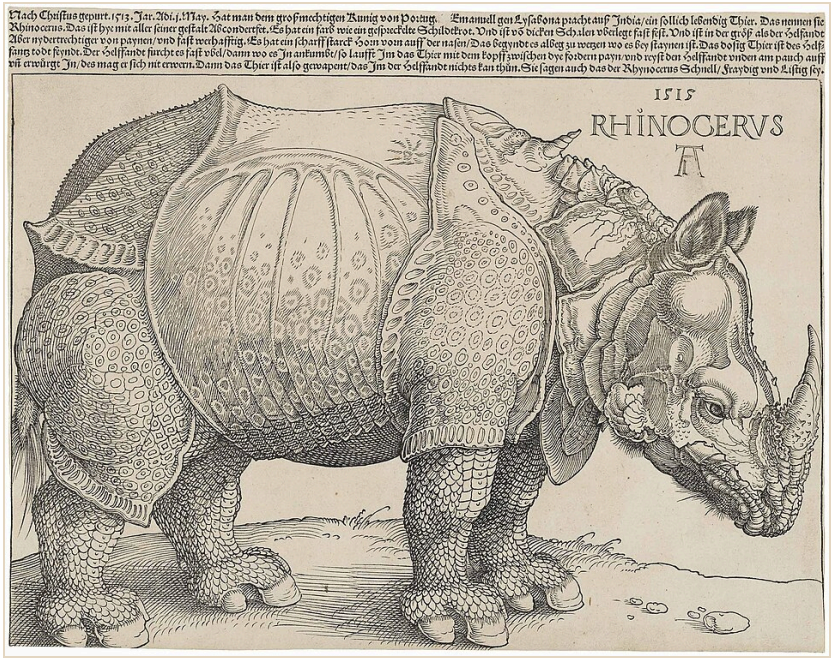
Partners in the sea. Under the ocean, a bright orange clownfish lives among the waving arms of a **sea anemone**. Those arms sting other fish, but a special slimy coat on the clownfish keeps it from being hurt. The anemone gives the clownfish a safe home. The

clownfish chases away fish that come to nibble the anemone and helps keep it clean. They are **partners**.

A cleaning station. On a coral reef, big fish line up at a “cleaning station,” where little cleaner fish swim right into their mouths and gills to pick off tiny pests. The big fish open wide and wait. They could swallow the little cleaners in one gulp, but they don’t! Each one helps the other.

Two are better than one. God made many creatures to need each other. He made people that way too. Brothers and sisters, friends and neighbors help each other carry things, find things and stay safe. The Bible says, “Two are better than one; because they have a good reward for their labour.”

PICTURE STUDY



Rhinoceros, Albrecht Dürer, 1515 · Woodcut (a print made by carving a picture into a block of wood) · Prints are in many museums, among them the British Museum, London, and the National Gallery of Art, Washington
Wikimedia Commons · Public domain

In 1515 a live rhinoceros from India arrived in Portugal as a gift for the king. People in Europe had not seen one in more than a thousand years. Albrecht Dürer never saw it himself. He made this famous picture from a letter and a sketch someone sent him.

Look closely

- Find the horn on the nose. Now find the little extra horn on the back. Real rhinos do not have that one!
- Look at the skin. What does it look like: armor, a turtle shell, or something else?
- Look at the legs and feet. What patterns did Dürer draw?

Talk about it

1. Where would an oxpecker like to hide and hunt for ticks on this rhinoceros?
2. Why do you think Dürer made some mistakes? What would have helped him draw it better?

HANDS-ON: PARTNER MATCH CARDS

Make a set of cards that match animal partners, then play a matching game with them.

You will need

- Eight index cards
- Crayons or colored pencils

Steps

1. On four cards, draw one partner on each: oxpecker, clownfish, cleaner fish, honeyguide bird.
2. On the other four cards, draw the other partner: rhinoceros, sea anemone, big reef fish, honey hunter (a person) with a bee nest.
3. On the back of each pair, write one word about how they help: “bugs,” “home,” “clean,” “honey.”
4. Mix the cards face down and play a memory game to find the pairs. When you find a pair, tell how the two help each other.

Check your work

- I made four pairs of partner cards.
- I can tell how each pair helps each other.
- I played the matching game at least once.

FIELD NOTEBOOK

1. Draw a rhinoceros with oxpeckers riding on its back. Write: “The oxpecker eats the ticks. The rhino gets clean.”
2. Draw a clownfish peeking out of a sea anemone.

> **Did you know?** In parts of Africa, a bird called the honeyguide leads people to wild bees’ nests. Honey hunters call to it with a special sound, the bird flies ahead from tree to tree, and the people open the nest and take the honey. The honeyguide then eats the leftover wax, which it loves. Scientists have recorded the honeyguide answering the hunters’ calls.

> **Goes deeper in.** Life Science, the animals and habitats units (coming soon); Trail D, Stop D3 “Coral reefs”; and Art, for Dürer’s prints.

For families. Oxpeckers are not purely helpful: they sometimes peck at wounds and drink blood, so scientists debate how much the rhino gains. The stop keeps to the well-documented benefits (tick removal and alarm calls). A study by Plotz and Linklater (*Current Biology*, 2020) found black rhinos with oxpeckers detected approaching people far more often. Swahili *askari wa kifaru*, "the rhino's guard," is widely reported. The honeyguide study is Spottiswoode, Begg and Begg, *Science* (2016), with Yao honey hunters in Mozambique. Dürer's rhinoceros was sent to King Manuel I of Portugal in 1515; it later died in a shipwreck on its way to the pope in 1516.

PRACTICE

1. EASY What does the oxpecker eat off the rhinoceros?
2. MEDIUM How does the oxpecker help the rhino besides eating bugs?
3. MEDIUM How do the clownfish and the sea anemone help each other?

Make it a game · Rhino and Oxpecker. Play in pairs. One player is the rhino and wears a blindfold (rhinos see poorly). The other is the oxpecker and stays beside the rhino. A grown-up quietly walks toward them. The oxpecker must hiss "Danger!" and the rhino must turn to face the sound before the grown-up taps them. Then switch.

Scripture. "Two are better than one; because they have a good reward for their labour." (Ecclesiastes 4:9, KJV)

The oxpecker and the rhino are better together. God gives us families and friends so we can help each other too.

Practice: answers

1. Ticks and other bugs.
2. It calls out loudly when danger comes near, warning the rhino.
3. The anemone gives the clownfish a safe home; the clownfish chases away fish that would eat the anemone and helps keep it clean.

1.6 Animal Tools: The Sea Otter's Rock

OBJECTIVES

- Tell how a sea otter uses a rock to open its food.
- Name one other animal that uses a tool.
- Tell how people helped sea otters come back after they were nearly gone.

Warm-up. Lie on your back on the floor and put a book on your tummy. Can you hold it steady with your hands while you lie there? That is how a sea otter eats its lunch: floating on its back, using its tummy as a table!

Video slot. Video coming. Sea otters cracking shells with rocks, floating in kelp, and other animal tool users. Search approved channels (Monterey Bay Aquarium, U.S. Fish and Wildlife Service, PBS Nature, BBC Earth); preview first.

KEY TERMS

tool
Something used to help do a job, like a hammer, a spoon or a rock.

sea otter
A furry sea animal of the Pacific coast that floats on its back and eats shellfish.

kelp
A very tall seaweed that grows in thick underwater forests.

shellfish
Sea animals with shells, such as clams, mussels, crabs and sea urchins.

CORE IDEAS

The story. Off the rocky coast of California, a sea otter dives down, down, down to the sea floor. It feels around with its front paws and grabs a big clam. Then it grabs something else: a flat, smooth rock. Up it pops to the top of the water, rolls onto its back and lays the rock on its chest.

Bang, bang, crack! The otter holds the clam in both paws and bangs it down on the rock. Bang! Bang! Bang! The shell cracks open, and the otter licks out the soft clam inside. Using something to help do a job is using a **tool**. Few animals use tools, and the sea otter is one of the best at it.

A pocket for the rock. A sea otter has a loose fold of skin under each front leg, like a little pocket. When it finds a good rock, it can tuck the rock into the pocket and keep it for the next dive, along with extra food. Some otters keep a favorite rock for a long time.

The thickest fur. Sea otters have no blubber to keep them warm in the cold sea. Instead, God gave them the thickest fur of any animal, so thick that the water never reaches their skin. At night they wrap themselves in **kelp** so they do not drift away while they sleep, and sometimes they float together holding paws. Long ago hunters took so many otters for their fur that only a few were left. In 1911 nations agreed to protect them, and today there are many again in places.

Taught by the beasts. Other animals use tools too. Some crows bend twigs into hooks to pull bugs out of holes. Some dolphins carry a sponge on their noses to protect them while they dig. The Bible says, “Ask now the beasts, and they shall teach thee.” When we watch an otter crack a clam, we learn about the wise God who made it.

PICTURE STUDY



Sea Otter, Plate 137 of The Viviparous Quadrupeds of North America, John Woodhouse Audubon (son of John James Audubon), 1849 · Hand-colored lithograph (printed picture colored by hand) · From The Viviparous Quadrupeds of North America, by John James Audubon and John Bachman
Wikimedia Commons · CC BY 2.0

John James Audubon, the famous bird painter, also made a big book of North American animals with fur, working with his friend John Bachman and his two sons. His son John Woodhouse Audubon drew this sea otter. In those days few artists had ever seen a live sea otter.

Look closely

- Find the whiskers. What do you think the otter uses them for?
- Look at the fur. How did the artist show that it is thick and soft?
- Look at the front paws and the back feet. Which ones look better for swimming?

Talk about it

1. This otter is resting on the rocks. Where would you rather draw a sea otter, and what would it be doing?
2. Why might a book of animal pictures have been very important before there were cameras?

> **Safety first.** Do the tool test on a towel on the floor or a sturdy table, with a grown-up. Keep fingers clear of the rock. Check for nut allergies first; use pistachios in their shells only if everyone is safe with nuts, or use the crackers instead.

HANDS-ON: OTTER TOOL TEST

Find out why a rock makes a sea otter's job easier.

You will need

- A few pistachios or walnuts in their shells (or hard crackers wrapped in a paper napkin, if there are allergies)
- A smooth, fist-sized rock, washed
- A folded towel
- A spoon

Steps

1. Lie on your back like an otter with the folded towel on your tummy.
2. Try to open a nut with only your fingers. Was it easy or hard?
3. Sit up. Put the rock on the towel. Hold the nut in your fingertips and tap it gently on the rock, the way an otter does, until it cracks. A grown-up stays beside you.
4. Try the spoon too. Which tool worked best? Tell why a rock is a good tool for an otter.

Check your work

- I tried with no tool and with a tool.
- I worked safely with a grown-up.
- I can tell how a sea otter uses its rock.

FIELD NOTEBOOK

1. Draw a sea otter floating on its back with a rock on its chest and a clam in its paws. Label "rock," "clam," "paws" and "thick fur."
2. Draw a second picture of an otter wrapped in kelp, asleep.

> **Did you know?** A sea otter has up to about a million hairs on a patch of skin the size of a postage stamp, more than on your whole head. Otters eat a lot: about a quarter of their

own weight every day. They love to eat sea urchins, spiky animals that chew on kelp, so where there are otters, the kelp forests often grow thick and healthy.

Goes deeper in. Life Science, the animals unit (coming soon); Gardening & Animals, for caring for creation; and Trail D “Ocean Life.”

For families. The maritime fur trade (1700s–1800s) reduced sea otters to perhaps 1,000–2,000 animals in scattered groups; the International Fur Seal Treaty of 1911 protected them, and populations recovered in Alaska, Canada and parts of California, though some groups remain small. Fur density is commonly given as 600,000 to 1,000,000 hairs per square inch. Plate 137 was drawn by John Woodhouse Audubon and issued in 1849 (printed by J. T. Bowen, Philadelphia). New Caledonian crows and the Shark Bay sponging dolphins are well-documented tool users. Conservation is told here as good stewardship (Genesis 2:15).

PRACTICE

1. EASY What tool does a sea otter use, and what does it use it for?
2. MEDIUM How does a sea otter stay warm in cold water without blubber?
3. EASY Why does a sea otter wrap itself in kelp at night?

Make it a game · Otter Raft. Everyone lies on their backs on the floor, “floating.” Holding paws (hands) with the players beside you, the raft must stay together while the leader calls out waves: “Small wave!” (wiggle) or “Big wave!” (rock side to side). If anyone lets go, the raft starts over. Can your raft last through ten waves?

Scripture. “But ask now the beasts, and they shall teach thee; and the fowls of the air, and they shall tell thee:” (Job 12:7, KJV)

When we watch a sea otter use its rock, the animal is teaching us about the wise God who made it.

Practice: answers

1. A rock, to crack open clams and other shellfish.
2. Its fur is the thickest of any animal, so the water never reaches its skin.
3. So it does not drift away while it sleeps.

1.7 Long Journeys: The Godwit's Great Flight

OBJECTIVES

- Tell the story of the bar-tailed godwit's nonstop flight from Alaska across the Pacific.
- Name two other animals that make long journeys.
- Find Alaska, New Zealand and the Pacific Ocean on a globe.

> **Warm-up.** How long can you flap your arms like wings without stopping? Try it while a grown-up counts. Now imagine flapping for eleven days and nights without ever stopping to eat, drink or sleep. One little bird did just that!

Video slot. Video coming. Bar-tailed godwit nonstop flight from Alaska to New Zealand; gray whale migration; wildebeest migration. Search approved channels (U.S. Fish and Wildlife Service, U.S. Geological Survey, PBS Nature, BBC Earth); preview first.

KEY TERMS

migration
A long trip that animals make each year to find food, warmth or a place to raise their young.

nonstop
Going all the way without stopping.

godwit
A shorebird with long legs and a long, slightly upturned beak for probing in mud.

fuel
Something that is burned to give energy. A bird's fuel is the fat stored in its body.

CORE IDEAS

The story. On the muddy shores of western Alaska, a flock of brown shorebirds called bar-tailed **godwits** is eating and eating. They poke their long beaks into the mud for worms and clams. All summer they raised their chicks here. Now autumn is coming, and they are getting ready for one of the longest trips any animal makes.

Filling the tank. Before they go, the godwits eat until they are round and heavy with fat. That fat is their **fuel**. Then, on a day when the wind blows the right way, they rise into the sky and head south, out over the wide Pacific Ocean. There are no islands to rest on for most of the way, and godwits cannot swim or land on the water to rest.

Eleven days in the air. The godwits fly day and night, **nonstop**, for about eight to eleven days. They do not eat. They do not drink. They do not land. They fly more than 7,000 miles until at last they reach New Zealand or Australia, thin and tired, on the other side of the

world. In 2022, a young godwit wearing a tiny tracking tag flew more than 8,000 miles in about eleven days without stopping, farther than any bird ever measured.

Other great journeys. Godwits are not the only long travelers. Gray whales swim from warm lagoons in Mexico to the cold seas near Alaska and back again each year. In East Africa, great herds of wildebeest and zebras walk in a giant loop, following the rains to find fresh grass. This kind of yearly trip is called **migration**.

Who shows the way? How does a young godwit, on its very first trip, know when to leave and which way to go? Scientists are still learning. The Lord asked Job, “Doth the hawk fly by thy wisdom, and stretch her wings toward the south?” No man taught the birds. God made them and guides them, and He guides us on our journeys too.

PICTURE STUDY



Wild Geese Flying across the Moon, Utagawa Hiroshige, c. 1830s · Woodblock print · Copies are in many museums
Wikimedia Commons · Public domain

Hiroshige was a Japanese artist who made prints by carving pictures into wooden blocks and pressing them onto paper, one color at a time. In autumn, wild geese fly south across Japan, and he showed them crossing the full moon at night. Many birds fly their long journeys in the dark.

Look closely

- Count the geese. Which way are they flying?
- Find the moon. How much of the picture does it fill?
- Look at the shape of the whole print. Is it tall, wide or square? Why might the artist choose that shape?

Talk about it

1. Why might birds travel at night?
2. How does this picture make you feel: calm, busy, lonely or something else?

HANDS-ON: MEASURE THE GREAT FLIGHT

Use a globe and a string to follow the godwit's journey across the Pacific.

You will need

- A globe (or a world map)
- A piece of string or yarn
- Two small stickers or bits of tape
- A marker

Steps

1. Find Alaska and put a sticker on its west coast. Find New Zealand and put a sticker there.
2. Stretch the string from Alaska to New Zealand across the Pacific Ocean. Mark the string at each sticker.
3. Look along the string. How many big pieces of land does it cross? Where could a godwit stop to rest?
4. Now use the same string to measure from your home to somewhere far away. Is the godwit's trip longer or shorter?

Check your work

- I found Alaska, New Zealand and the Pacific Ocean.
- I measured the godwit's flight with string.
- I can tell why the godwit cannot stop to rest on the way.

FIELD NOTEBOOK

1. Draw a map with Alaska at the top and New Zealand at the bottom and a big blue Pacific Ocean in between. Draw a dotted line for the godwit's flight and write "11 days, nonstop!"
2. Draw a godwit with its long beak. Copy Job 39:26 underneath.

> **Did you know?** Before their long flight, the parts of a godwit's body used for digesting food shrink, making it lighter, while its heart and flying muscles grow bigger. During the flight it can rest half of its brain at a time, which may help it keep going. When it reaches New Zealand, it may have burned up nearly half of its body weight.

> **Goes deeper in.** Geography, for maps and oceans (coming soon); Life Science, the animals unit; and Trail B, Stop B7 "Migration."

For families. The 2022 record bird, a juvenile tagged “234684” in Alaska, flew about 13,560 km (8,425 miles) to Tasmania in 11 days and 1 hour (reported by Birds Tasmania and Pūkorokoro Miranda Naturalists’ Trust). Typical southbound flights are about 11,000–12,000 km (7,000+ miles) over 8–10 days (U.S. Geological Survey Alaska Science Center). Organ shrinkage before migration was documented by Piersma and Gill (1998). Unihemispheric sleep in godwits is likely but not yet directly measured, so the stop says “can” and “may.” Gray whale round trips are about 10,000–12,000 miles.

PRACTICE

1. EASY What is migration?
2. MEDIUM Why can’t a godwit stop to rest on its flight across the Pacific?
3. EASY Name another animal that makes a long journey.

Make it a game · Godwit Fuel. Scatter 20 dried beans or paper scraps (worms) on the floor. Each player is a godwit and has one minute to “eat” as many as they can carry in one hand. Then the leader calls “Fly!” and everyone flaps around the room. Every time the leader claps, each godwit must drop one worm (burning fuel). The godwit with fuel left when the leader calls “New Zealand!” makes it across.

Scripture. “Doth the hawk fly by thy wisdom, and stretch her wings toward the south?” (Job 39:26, KJV)

God asked Job who teaches birds to fly south. No person did. God made them, guides them, and guides us too.

Practice: answers

1. A long trip animals make each year to find food, warmth or a place to raise their young.
2. There is almost no land to rest on, and it cannot swim or land on the water to rest.
3. Any one: gray whale, wildebeest, zebra, Arctic tern, monarch butterfly, salmon, sea turtle, caribou.

🟢 SCOUT · STOP F8 · TRACK 1 · STOP 1.8 · 15–25 MINUTES

1.8 Animals That Helped People: The Sled Dogs of Nome (1925)

OBJECTIVES

- Tell the story of the 1925 serum run to Nome.
- Name the two famous lead dogs, Togo and Balto, and tell what each one did.
- Find Alaska, Nenana and Nome on a map.

> **Warm-up.** Go outside on a cold day, or open the freezer and put your face near it for a few seconds. Brr! The sled dogs of Nome ran through cold so bitter it was colder than the inside of your freezer, in the dark and the wind.

Video slot. Video coming. The 1925 serum run to Nome: Togo, Balto and the sled dog relay. Search approved channels (Smithsonian, National Park Service, Iditarod Trail Committee, The History Guy, Simple History); preview first.

KEY TERMS

sled dog
A strong dog trained to pull a sled across snow and ice.

musher
The person who drives a dog sled.

relay
A race or trip in which one team carries something part of the way and hands it to the next team.

serum
A medicine that helps the body fight a sickness.

CORE IDEAS

The story. In January 1925, the town of Nome, Alaska, was in trouble. Children were getting sick with diphtheria, a dangerous sickness of the throat, and some had already died. Dr. Curtis Welch had medicine called **serum** that could help, but his old supply was used up. The nearest new serum was in Anchorage, nearly a thousand miles away. It was the middle of winter. The sea was frozen, and no road or train went to Nome.

A relay of dogs. The serum was sent by train as far as the town of Nenana. From there, the only way left was by dog sled. Twenty **mushers** and about 150 **sled dogs** made a **relay**. Each team ran its part of the trail and handed the package to the next team. Many of the mushers were mail carriers, some of them Alaska Native men, who knew the trail well. It was so cold, down to 50 degrees below zero, that some mushers got frostbite, and at the stops along the way the serum was warmed by the stove to keep it safe.

Togo and the ice. The longest and hardest part was run by Leonhard Seppala and his lead dog, **Togo**, who was twelve years old. To save a whole day, Togo led the team straight across Norton Sound, a bay of the sea covered with ice that could crack and float away. In the dark and the wind, Togo found the way. Not long after they crossed, the ice broke up behind them.

Balto brings it home. The last part of the trail was run by Gunnar Kaasen with his lead dog, **Balto**, through a howling snowstorm. Kaasen could hardly see his own dogs, but Balto kept to the trail. Early in the morning of February 2, 1925, they pulled into Nome. The serum had come 674 miles in about five and a half days. The sickness was stopped, and many children lived.

Bearing burdens. Each musher and each dog team carried the load for a while and then passed it on. No one could have done it alone. The Bible says, “Bear ye one another’s burdens.” God made dogs strong and faithful, and in Nome they helped save many lives.

PICTURE STUDY



Leonhard Seppala and his Siberian racers, Ruby, Alaska, Lomen Brothers (photographers in Nome, Alaska), 1916 · Black-and-white photograph · University of Washington Libraries, Special Collections, Seattle
Wikimedia Commons · Public domain

Leonhard Seppala came to Alaska from Norway to dig for gold and became one of the best dog mushers in the world. His dogs were small, fast Siberian huskies. This photograph was taken in 1916, nine years before the serum run, when Seppala and his dogs won a big race called the All-Alaska Sweepstakes. You can see how the dogs were hitched in a line, with the lead dog out in front.

Look closely

- Find the musher. What is he wearing to keep warm?

- Count the dogs. Can you tell which one is the lead dog?
- Look at the harnesses. How are the dogs hitched to each other?

Talk about it

1. What do you think the dogs need from their musher to be ready for a long run?
2. Why might a musher trust his lead dog to find the trail in a storm?

> **Safety first.** Ask the owner before petting any dog, and let the dog sniff your hand first.

HANDS-ON: THE SERUM RUN RELAY

Carry the “serum” in a relay around your home or yard and mark the route on a map.

You will need

- A small box wrapped in a towel (the serum)
- Paper and crayons for a map
- Two or more players (or one player and a stuffed animal at each stop)

Steps

1. With a grown-up, find Alaska on a map. Find Nenana and Nome, or ask the grown-up to point to them. Draw a simple map with Nenana on one side and Nome on the other, and a frozen bay (Norton Sound) near Nome.
2. Set up the relay: each player stands at a different “roadhouse” around the room or yard.
3. The first player carries the serum to the next roadhouse and hands it over gently. Keep going until the serum reaches “Nome.”
4. Talk about it: what would happen if one team gave up?

Check your work

- I drew a map with Nenana, Nome and the frozen bay.
- I carried the serum in a relay and handed it on.
- I can tell what Togo and Balto each did.

FIELD NOTEBOOK

1. Draw a dog team crossing the ice in the dark, with the lead dog out in front. Label “musher,” “sled,” “lead dog” and “serum.”
2. Write: “1925: 20 mushers, about 150 dogs, 674 miles.”

> **Did you know?** Later in 1925, a bronze statue of Balto was put up in Central Park in New York City, and Balto himself came to see it. You can still visit it today. Togo’s story became famous later. Today the Iditarod sled dog race in Alaska helps people remember the serum run and the mushers and dogs who carried mail and medicine across Alaska.

Goes deeper in. History, the twentieth century (coming soon); Geography, for Alaska; and Gardening & Animals, for working dogs.

For families. The relay ran from Nenana on January 27 to Nome on February 2, 1925 (about 127½ hours, 674 miles); the serum had come about 298 miles by train from Anchorage. Seppala and Togo ran about 91 miles of the relay itself (plus the long run out from Nome to meet it), the longest and most dangerous leg; Kaasen and Balto ran the final 53 miles. The Balto statue by F. G. R. Roth was dedicated in December 1925. Death counts are uncertain, and Dr. Welch believed some earlier deaths had been diphtheria; the stop says “some.” Several of the early relay mushers were Athabascan mail carriers. Exact photo dates vary; choose a public-domain photograph from before 1931.

PRACTICE

1. EASY What did the dog teams carry to Nome in 1925?
2. MEDIUM What was hard and dangerous about Togo’s part of the trail?
3. EASY Which lead dog brought the serum into Nome?

Make it a game · Gee and Haw. Mushers steer dogs with words: “Gee!” means turn right, “Haw!” means turn left, “Hike!” means go and “Whoa!” means stop. One player is the musher and calls the commands; the others are the dog team, walking in a line with hands on the shoulders of the dog in front. The lead dog listens and turns the right way. Anyone who turns the wrong way moves to the back of the line.

Scripture. “Bear ye one another’s burdens, and so fulfil the law of Christ.” (Galatians 6:2, KJV)

Each musher and dog team carried the serum for a while and passed it on. We help each other carry hard things too.

Practice: answers

1. Serum, a medicine to stop a sickness called diphtheria.
2. He led his team across the frozen sea ice of Norton Sound, which could break, in the dark and wind.
3. Balto, with musher Gunnar Kaasen.

1.9 Design Copied by Engineers

OBJECTIVES

- Tell how burrs on a dog gave George de Mestral the idea for Velcro.
- Tell how a bird's beak and a bird's wings helped engineers build a train and an airplane.
- Name one animal or plant design that people have copied.

Warm-up. Find a shoe or jacket with a hook-and-loop strap (Velcro). Pull it open and listen to the rip. Press it closed again. Look closely: one side is scratchy and one side is soft. Where do you think the idea came from?

Video slot. Video coming. Inventions copied from nature for children: Velcro and burrs, the kingfisher bullet train, the Wright brothers and birds. Search approved channels (Smithsonian National Air and Space Museum, PBS, Science Channel kids clips, BBC Earth); preview first.

KEY TERMS

engineer
A person who designs and builds machines, bridges, roads and other useful things.

design
A plan for how something is made so that it works well.

burr
A prickly seed case that sticks to fur and clothes.

invent
To make something new that no one has made before.

CORE IDEAS

The story. In 1941, a Swiss **engineer** named George de Mestral came home from a walk in the mountains with his dog. Both of them were covered with prickly **burrs**. As he picked them off, he wondered: why do these stick so well? He put a burr under his microscope and saw hundreds of tiny hooks. The hooks caught on the little loops of thread in his clothes and the fur of his dog.

Hooks and loops. George had an idea: what if he made one strip covered with tiny hooks and another covered with tiny loops? Press them together, and they would hold. It took him years of trying to get it right. At last he **invented** Velcro. He named it from two French words, *velours* (velvet) and *crochet* (hook). Today it is on shoes, jackets and even space suits.

A train with a bird's beak. In Japan, a very fast train made a loud boom every time it rushed out of a tunnel. An engineer named Eiji Nakatsu loved to watch birds. He thought of

the kingfisher, which dives from the air into the water with hardly a splash. Its long, pointed beak slips smoothly from air into water. So the engineers gave the train a long nose shaped like a kingfisher's beak. The boom grew quieter, and the train used less electricity.

Wings that twist. Long before that, two brothers in Ohio, Wilbur and Orville Wright, wanted to build a flying machine. Wilbur watched big birds soaring and saw that they twisted the tips of their wings to keep their balance. The brothers built wings that could twist the same way. On December 17, 1903, their airplane flew at Kitty Hawk, North Carolina.

Copying the best Designer. When engineers copy a burr, a beak or a wing, they are copying the work of the greatest **design**er of all. The psalm says, "O LORD, how manifold are thy works! in wisdom hast thou made them all." God's creatures are full of good ideas, waiting for careful people to notice them.

PICTURE STUDY



First Flight, John T. Daniels (who pressed the camera button for the Wrights), December 17, 1903 · Black-and-white photograph (from a glass plate negative) · Library of Congress, Washington, D.C. Wikimedia Commons · Public domain

Orville Wright set up his camera on a tripod and asked John Daniels, a man from the nearby lifesaving station, to squeeze the bulb if the airplane flew. Daniels had never taken a picture before. He snapped this one just as the Flyer lifted off. It is one of the most famous photographs ever taken.

Look closely

- Find Orville lying on the lower wing. He is the pilot.
- Find Wilbur, standing on the sand. What does he look like he is doing?

- Look at the wings. Are there two or one? What are they made of?

Talk about it

1. How are the Flyer's wings like a bird's wings? How are they different?
2. How do you think Wilbur felt at that moment?

HANDS-ON: NATURE'S IDEA LAB

Look closely at nature, like George de Mestral did, and invent something from what you find.

You will need

- A magnifying glass
- A hook-and-loop strap (Velcro)
- Things from outdoors: a burr if you can find one, a feather, a leaf, a pinecone
- Paper and a pencil

Steps

1. Look at the Velcro under the magnifying glass. Find the hooks and the loops. Draw them.
2. Look at the burr (or a feather or pinecone) the same way. Draw what you see. Does the burr have hooks like the Velcro?
3. Pick one thing from nature. Think: what does it do well? (A feather is light. A pinecone opens when dry.)
4. Draw an invention that copies it, and give your invention a name. Explain it to your family.

Check your work

- I looked at Velcro and something from nature with a magnifying glass.
- I drew what I saw.
- I drew and named my own invention copied from nature.

FIELD NOTEBOOK

1. Make two columns: "God's design" and "What people made." Draw a burr and Velcro, a kingfisher and the bullet train, a soaring bird and the Wright Flyer.
2. Copy Psalm 104:24.

> **Did you know?** Engineers have copied many other creatures. Owls fly silently because of the soft, comb-like edges on their feathers, and the same Japanese engineer used that idea to make part of the train quieter. Gecko feet, which stick to walls without glue, have given scientists ideas for new kinds of sticky tape.

Goes deeper in. Life Science, the animals unit (coming soon); History, for the Wright brothers; and Trail B, Stop B2 “Owls.”

For families. George de Mestral’s walk is usually dated to 1941; he patented hook-and-loop fastening in the 1950s (Swiss patent 1955). The kingfisher-nosed train is the JR West 500 Series Shinkansen (1997); Eiji Nakatsu’s team reported a quieter tunnel exit and lower power use. Wilbur Wright wrote to Octave Chanute on May 13, 1900: “My observation of the flight of buzzards leads me to believe that they regain their lateral balance … by a torsion of the tips of the wings.” The famous photograph was taken by John T. Daniels of the Kill Devil Hills Life-Saving Station.

PRACTICE

1. EASY What plant part gave George de Mestral the idea for Velcro?
2. MEDIUM Why did engineers shape a Japanese train’s nose like a kingfisher’s beak?
3. EASY What did Wilbur Wright learn by watching birds?

Make it a game · Copycat Inventor. One player names an animal: “Duck!” The others take turns inventing something people could make by copying it: “Flippers for swimming, like a duck’s webbed feet!” Every good idea earns a point. Then the next player names an animal.

Scripture. “O LORD, how manifold are thy works! in wisdom hast thou made them all: the earth is full of thy riches.” (Psalm 104:24, KJV)

“Manifold” means many and different. Engineers find good ideas in God’s works because He made them all with wisdom.

Practice: answers

1. Burrs, prickly seed cases covered with tiny hooks.
2. The kingfisher dives into water with hardly a splash, so the beak shape made the train quieter coming out of tunnels.
3. Birds twist the tips of their wings to keep their balance.

1.10 Adam Names the Animals (Genesis 2:19)

OBJECTIVES

- Tell what happened when God brought the animals to Adam.
- Tell why giving a good name means looking carefully.
- Make a set of animal-fact trading cards from this trail.

Warm-up. Look out the window or around the room and find one living thing you do not know the name of: a bug, a weed, a bird. Make up a good name for it that tells something true about it. That is what Adam did for every animal!

Video slot. Video coming. Genesis 2 for children: God brings the animals to Adam to be named; Carl Linnaeus and scientific names. Search approved channels (The Bible Project kids clips once vetted, Answers in Genesis Kids, Christian Light, Smithsonian for Linnaeus); preview first.

KEY TERMS

Adam
The first man, whom God made from the dust of the ground (Genesis 2:7).

name
A word we call a person, animal or thing by. A good name often tells something true about it.

kind
A group of creatures God made to have young “after his kind,” like dogs or cats (Genesis 1).

steward
Someone who takes care of what belongs to another. God made people stewards of His world.

CORE IDEAS

The story. In the beginning, God planted a garden in Eden and put the first man, Adam, there “to dress it and to keep it.” Then God did a wonderful thing. He formed the beasts of the field and the birds of the air, and He brought them to Adam “to see what he would call them.” One by one they came: the lion with its mane, the eagle with its sharp eyes, the little mouse, the long-necked giraffe.

Looking carefully. To give a good name, Adam had to look closely. How does it move? What sound does it make? What color is it? What does it eat? Adam was the first person to study the animals. Whatever Adam called each living creature, the Bible says, “that was the name thereof.” God let Adam’s names stand.

Names that tell the truth. Many animal names still tell us something true. A hummingbird hums. A woodpecker pecks wood. A snowshoe hare has feet like snowshoes. A sea otter lives in the sea. When you learn an animal's name and why it has it, you are doing a little of what Adam did.

A scientist who named. Thousands of years later, a Swedish scientist named Carl Linnaeus, who loved God and His creation, set out to give every plant and animal a clear name. In the 1700s he gave each one a two-part Latin name, like a last name and a first name. The gray wolf is *Canis lupus*, and the house cat is *Felis catus*. Scientists all over the world still use his kind of names today.

Stewards of God's animals. Naming the animals showed that God had given people a special job: to know, rule over and take care of His creatures. On this trail you have met bats that see with sound, hares that change coats, otters with tools, dogs that saved a town and birds that cross oceans. Every one of them is God's work. Like Adam, we are to know them, name them and take good care of them.

PICTURE STUDY



Adam Naming the Animals, from the Aberdeen Bestiary (folio 5 recto), Unknown English illuminator, c. 1200 · Ink, paint and gold leaf on parchment · University of Aberdeen Library, Scotland (MS 24)
Wikimedia Commons · Public domain

A bestiary is an old book about animals. This one was copied and painted by hand in England about eight hundred years ago. On this page, Adam sits like a teacher and points to the animals as he names them. Behind them shines a background of real gold.

Look closely

- Find Adam. What is he doing with his hand?

- Count the animals. Which ones can you name?
- Look at the background. What makes it shine?

Talk about it

1. Compare Adam's size with the animals'. Why might the artist have drawn him that way?
2. Which animal on this trail would you most like to have seen Adam name, and what might he have called it?

HANDS-ON: ANIMAL-FACT TRADING CARDS

Make a set of trading cards for the animals on this trail, one card for each stop.

You will need

- Ten index cards
- Crayons or colored pencils
- A pencil
- A small envelope or rubber band to keep them together

Steps

1. On the front of each card, draw one animal from the trail: bat, snowshoe hare, groundhog, beaver, oxpecker, sea otter, godwit, sled dog, kingfisher, and one animal of your own choosing for this stop.
2. Write its name at the top. Under the name, write why the name fits, if you know.
3. On the back, write one amazing fact: "I see with sound." "I crack clams on a rock." "I flew 11 days nonstop."
4. Trade cards with a family member, or quiz them: read the fact and let them guess the animal.

Check your work

- I made ten cards, each with a drawing, a name and a fact.
- My facts are true and come from this trail.
- I can tell what Adam did in Genesis 2:19.

FIELD NOTEBOOK

1. Draw Adam naming three animals. Under each animal, write the name Adam might have given it.
2. Copy Genesis 2:19 in your best handwriting.

> **Did you know?** Scientists are still finding and naming new kinds of animals every year, especially insects, deep-sea creatures and tiny frogs. Whoever describes a new animal

first gets to give it its scientific name. Linnaeus also gave people a name: *Homo sapiens*, which means “wise man.”

Goes deeper in. Life Science, “Classifying living things” (coming soon); Literature, for the creation account; and Gardening & Animals, for caring for animals (Genesis 2:15).

For families. Genesis 2:19–20 names cattle, fowl and beasts of the field; the text does not say how long the naming took. Carl Linnaeus (1707–1778) published *Systema Naturae* (first edition 1735); the 10th edition (1758) is the starting point for animal names. He was the son of a Lutheran pastor and wrote of the Creator in his works. The Aberdeen Bestiary page shows Adam clothed; if you choose a different picture of this scene, check it, since many paintings show Adam unclothed. The University of Aberdeen has the whole bestiary online.

PRACTICE

1. EASY Who brought the animals to Adam, and why?
2. MEDIUM Why did Adam need to look carefully at each animal?
3. EASY What scientist gave plants and animals two-part Latin names?

Make it a game · Name That Creature. One player acts out an animal without words: how it moves, eats or hides. The others must give it a good, true “Adam name” that describes it, like “Long-Ears-That-Hops” for a rabbit. Then someone guesses its real name. The best describing name wins a turn to act.

Scripture. “And out of the ground the LORD God formed every beast of the field, and every fowl of the air; and brought them unto Adam to see what he would call them: and whatsoever Adam called every living creature, that was the name thereof.” (Genesis 2:19, KJV)

God made every animal and let Adam name them. We know God’s creatures by looking carefully, and we care for them as His stewards.

Practice: answers

1. God brought them, to see what Adam would call them.
2. To give each one a good name that fit it, he had to see how it looked, moved and lived.
3. Carl Linnaeus.

Track 1 badge quizzes

The badge quizzes are optional. Read each question aloud; the child may answer by talking, pointing or drawing. Four right out of five earns the badge. Badges and the certificate are earned by doing the stops, not by scores.

Badge quiz 1 (Stops 1–5)

1. How does a bat find a moth in the dark?
2. What does the snowshoe hare do to hide in winter?
3. What does a groundhog live on while it hibernates?
4. Why are the doors of a beaver lodge under the water?
5. How does the oxpecker help the rhinoceros?

Badge quiz 2 (Stops 6–10)

6. What does a sea otter use a rock for?
7. How long can a bar-tailed godwit fly without stopping?
8. Name the two famous lead dogs of the 1925 serum run.
9. What gave George de Mestral the idea for Velcro?
10. What did God bring to Adam, and what did Adam do?

TRAIL CERTIFICATE: MY AMAZING ANIMALS NOTEBOOK AND TRAIL F CERTIFICATE

Gather the Field Notebook pages from this trail into one booklet with a cover: “My Amazing Animals Notebook,” your name and the dates you started and finished.

Put your animal-fact trading cards from Stop F10 in an envelope glued to the back cover.

When the booklet is done, a parent signs the Trail F certificate.

- **Ten stops**: At least one page for each stop, each with a title and a date.
- **Trading cards**: Ten cards, each with a drawing, a name and one true fact.
- **Hands-on**: At least one project was built or tested and told about (the burrow, the dam, the tool test or the relay).
- **Care**: Drawings are labeled and done carefully.

Answer key

1. It squeaks and listens for the echo bouncing back (echolocation).
2. It molts and grows a white coat to match the snow.
3. The fat stored in its body.
4. So hunters like wolves and coyotes cannot get in.
5. It eats ticks off its skin and calls out to warn of danger.
6. To crack open clams and other shellfish on its chest.
7. About eight to eleven days, from Alaska across the Pacific to New Zealand or Australia.
8. Togo (who crossed the sea ice) and Balto (who ran the last leg into Nome).
9. Burrs with tiny hooks stuck on his dog and his clothes.

10. God brought the animals, and Adam named them (Genesis 2:19).