

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.

Psalms 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)

Track 2: Dinosaurs  **Trail C: How Dinosaurs Lived** (Self-paced)

Track 3: Great Battles ✕ **Trail C: The Age of Sail and the American Founding** (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.

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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

Track 2: Dinosaurs 🦖 Trail C: How Dinosaurs Lived

- 2.1 Teeth Tell Diet
- 2.2 Eggs and Nests
- 2.3 Footprints and Trackways
- 2.4 Herds
- 2.5 How Fast Could They Run?
- 2.6 Were They Warm-Blooded?
- 2.7 Feathers: What the Fossils Show
- 2.8 Babies and Growth
- 2.9 Sauropod Necks
- 2.10 Dinosaur Sounds

Track 3: Great Battles ✂ Trail C: The Age of Sail and the American Founding

- 3.1 The Spanish Armada (1588)
- 3.2 Vienna (1683): The Winged Hussars
- 3.3 Quebec (1759): The Climb to the Plains of Abraham
- 3.4 Lexington and Concord (1775)
- 3.5 Trenton (1776): Crossing the Delaware
- 3.6 Saratoga (1777): The Turning Point
- 3.7 Yorktown (1781)
- 3.8 Trafalgar (1805): “England Expects That Every Man Will Do His Duty”

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

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.

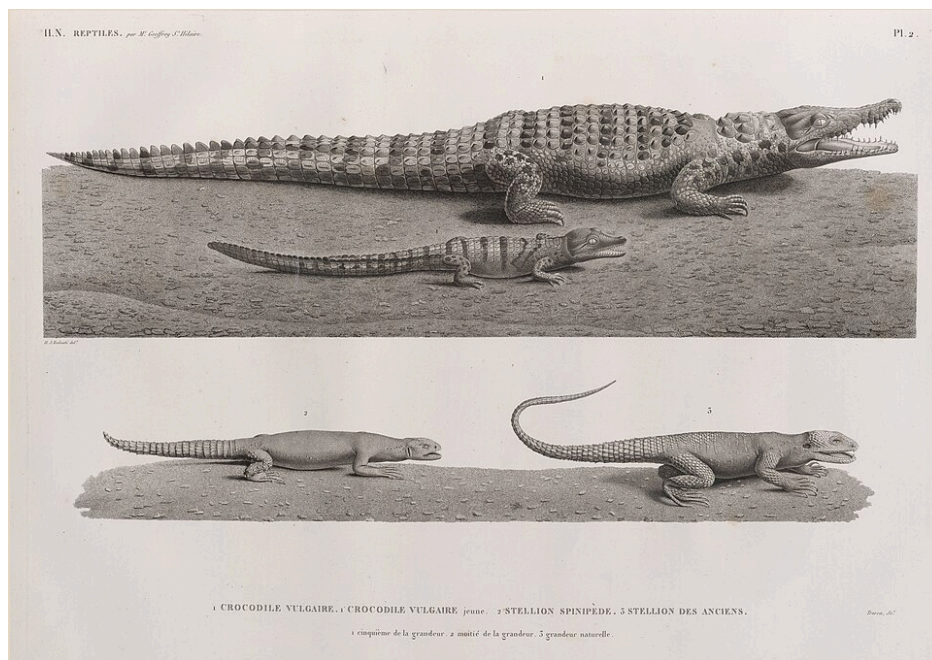
Made for the water. A crocodile's eyes, ears and nostrils are all on the top of its head. It can float with almost its whole body hidden and still see, hear and breathe. When it dives, flaps close over its ears and nose, and a clear eyelid slides across each eye like swimming goggles. Its long, strong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

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.

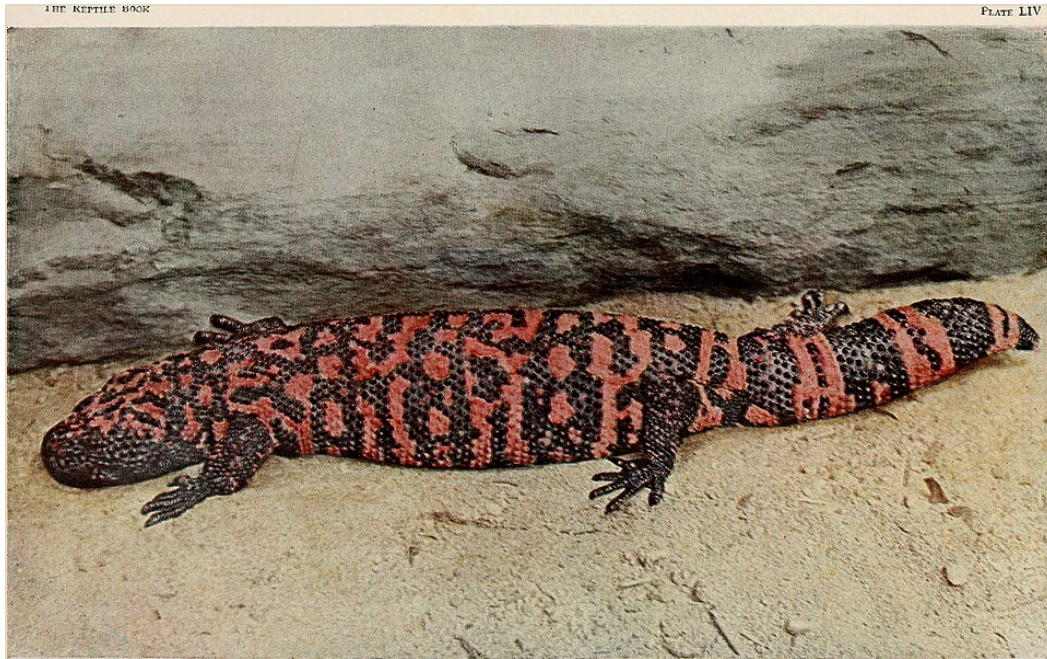
Beaded armor. A Gila monster’s skin is covered with little round bumps like beads, pink or orange and black. Inside each bead is a tiny piece of bone. The bright colors warn other animals to leave it alone, because the Gila monster is **venomous**. It is one of very few venomous lizards in the world, 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.

DINOSAURS TRAIL C: HOW DINOSAURS LIVED

The third trail of the Dinosaurs track asks how dinosaurs lived: what their teeth tell us about their food, their eggs and nests, the footprints they left in stone, herds, how fast they could run, whether they were warm-blooded, the feathers some of them had, how their babies grew, the long necks of the sauropods and what sounds they may have made. 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, for ages 7 to 9. A parent reads the story aloud, or a strong reader reads it alone. Every stop stands by itself. The track is creation-friendly: God made the land animals, dinosaurs among them, on the sixth day (Genesis 1:24-25). Children learn to keep apart what the fossils *show* and what people *think* they mean, and to say plainly when scientists do not yet know.

Five stops earn the **Dinosaur Detective 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.
- Know what a fossil is (Trail A, or ask a grown-up), and know the six days of creation from Genesis 1.

MASTERY CHECKLIST

- ☐ I can tell from a tooth whether a dinosaur ate meat or plants.
- ☐ I can name three kinds of trace fossils (footprints, eggs, nests) and what each one tells us.
- ☐ I can explain how footprints show whether a dinosaur walked or ran.
- ☐ I can tell the story of Maiasaura, the “good mother lizard,” and how growth rings show a dinosaur’s age.
- ☐ I can tell the difference between what a fossil shows and what people think it means.

OPTIONAL BOOKS AND RESOURCES

- **American Museum of Natural History: OLogy Paleontology** (<https://www.amnh.org/explore/ology/paleontology>): Free children’s pages, games and activities about fossils and dinosaurs.
- **Museum of the Rockies (Bozeman, Montana)** (<https://museumoftherockies.org>): Home of Maiasaura and Egg Mountain finds; photos for Stops C2 and C8.
- **Dinosaur Valley State Park, Texas** (<https://tpwd.texas.gov/state-parks/dinosaur-valley>): Real dinosaur trackways in the Paluxy River (Stops C3 and C5); photos and a free park map online.

2.1 TEETH TELL DIET

OBJECTIVES

- Tell what kind of teeth a meat eater had and what kind a plant eater had.
- Explain how scientists use fossil teeth to learn what a dinosaur ate.
- Say Genesis 1:30 and tell what God first gave animals to eat.

Warm-up. Run your tongue over your own teeth. The ones in front are thin and good for biting. The ones in the back are wide and bumpy, good for grinding. Your teeth tell what you eat: a little of everything! Dinosaur teeth tell stories too.

Video slot. Video coming. Dinosaur teeth for children: T. rex teeth, duck-billed dinosaur tooth batteries, sauropod peg teeth. Search approved channels (American Museum of Natural History, Natural History Museum London, Smithsonian National Museum of Natural History); preview first.

KEY TERMS

diet

The kind of food an animal usually eats.

carnivore

An animal that eats meat (say “CAR-nih-vor”).

herbivore

An animal that eats plants (say “HER-bih-vor”).

serrated

Having tiny bumps along the edge, like a bread knife, for cutting.

CORE IDEAS

The story. A fossil hunter brushes dust from a rock and finds something shiny and dark. It is a tooth, curved like a banana and as long as a grown-up’s hand. Along its edges are tiny bumps, like the edge of a bread knife. The hunter smiles. “This animal ate meat,” she says. How can she tell from just one tooth?

Knife teeth. Meat eaters, or **carnivores**, such as T. rex, had sharp, pointed teeth with **serrated** edges. The tiny bumps helped the teeth cut through meat the way a bread knife cuts through a crust. The biggest T. rex teeth, root and all, were about as long as a ruler. Spinosaurus had smooth, cone-shaped teeth like a crocodile’s, good for holding slippery fish.

Grinding teeth. Plant eaters, or **herbivores**, had very different teeth. Duck-billed dinosaurs had hundreds of small teeth packed together in rows, making a rough grinding surface, like a rasp or a cheese grater. When one tooth wore down, a new one pushed up underneath. Long-necked dinosaurs had teeth like pegs or pencils. They raked leaves off branches and

swallowed them without much chewing. Some grew a new tooth in each spot about once a month!

Clues in the teeth. Scientists look at the shape of a tooth, the scratches on it and how it wore down. Long, straight scratches can mean the animal was grinding tough plants. Sometimes they even find fossil droppings with bits of bone or plants inside. Clue by clue, they learn what a dinosaur ate.

“Every green herb.” The Bible tells us that in the beginning God gave the animals “every green herb for meat,” that is, for food (Genesis 1:30). Many Christians believe that after Adam sinned and the world was cursed, some animals began to eat other animals. The sharp teeth we find show us what a dinosaur ate in the world after the Fall. One day God will make all things new, and “the lion shall eat straw like the ox” (Isaiah 11:7).

PICTURE STUDY



Edmontosaurus (then called Trachodon), Charles R. Knight, 1909 · Painting · Made for the American Museum of Natural History, New York
Wikimedia Commons · Public domain

Charles R. Knight was one of the first great painters of dinosaurs. He painted these duck-billed dinosaurs from two skeletons set up at the American Museum of Natural History. Behind their flat “duck bills,” these dinosaurs had hundreds of grinding teeth.

Look closely

- Find the wide, flat beak at the front of the mouth.
- Look at the land around the dinosaurs. What plants can you see that they might eat?
- Find the dinosaur standing tall. What do you think it is looking at?

Talk about it

1. The beak did not have teeth in it. Where do you think the grinding teeth were?
2. Would this dinosaur want to eat the plants, or the other animals? How can you tell?

HANDS-ON: CLAY TOOTH DETECTIVE

Make three kinds of dinosaur teeth from clay and decide what each one was made to eat.

You will need

- Modeling clay or play dough
- A toothpick
- A plastic knife
- A lettuce leaf

Steps

1. Make a **knife tooth**: roll a long, curved, pointed tooth. Press the toothpick along both edges to make tiny serrations.
2. Make a **grinding tooth**: press several small square teeth side by side into a flat clay pad. Scratch the top so it is rough.
3. Make **peg teeth**: roll five thin pencil shapes and stand them in a row like a comb.
4. Pull the lettuce leaf through the peg teeth. What happens to the leaf? Rub a bit of leaf on the grinding pad. Which tooth would be best for cutting meat?

Check your work

- I made a knife tooth, a grinding pad and peg teeth.
- I can tell which tooth belonged to a carnivore and which to a herbivore.
- I can say what “serrated” means.

FIELD NOTEBOOK

1. Draw three dinosaur teeth: a knife tooth, a grinding tooth and a peg tooth. Under each, write “meat” or “plants.”
2. Copy Genesis 1:30 in your best handwriting.

Did you know? Dinosaurs kept growing new teeth all their lives, so a single dinosaur might lose hundreds of teeth. That is why fossil teeth are some of the most common dinosaur fossils. Gideon Mantell named *Iguanodon* (“iguana tooth”) because its fossil teeth looked like giant iguana teeth.

Goes deeper in. Life Science, the animals and food chains units (coming soon); and Earth Science, for fossils.

For families. The largest *T. rex* teeth measure about 12 inches (30 cm) including the root. Tooth-replacement rates come from studies of growth lines in teeth (D’Emic and others, 2013): *Diplodocus* replaced each tooth roughly every month, and *Nigersaurus*

about every two weeks. Hadrosaur “dental batteries” held hundreds of teeth. The view that animal death and meat eating began after the Fall is widely held by young-earth Christians; other Christians read Genesis 1:30 differently. The stop states the young-earth reading as the course’s position without mocking other views.

PRACTICE

1. **EASY** What is a carnivore? What is a herbivore?
2. **MEDIUM** You find a sharp, curved tooth with tiny bumps on its edges. What did the animal probably eat?
3. **MEDIUM** Why did duck-billed dinosaurs have so many teeth?

Make it a game · Who Ate What?. A grown-up names a food: a fish, a pine branch, a big animal, a fern, a leaf high in a tree. Players show a tooth with their hands: a pointed finger for a knife tooth, a flat palm for grinding teeth, or wiggling fingers for peg teeth. Then talk about which dinosaur might have eaten it.

Scripture. “And to every beast of the earth, and to every fowl of the air, and to every thing that creepeth upon the earth, wherein there is life, I have given every green herb for meat: and it was so.” (Genesis 1:30, KJV)

“Meat” in the King James Bible means food. In the beginning God gave plants to the animals to eat. God takes care of every creature He made.

Practice: answers

1. A carnivore eats meat; a herbivore eats plants.
2. Meat. Sharp, serrated teeth are for cutting meat.
3. They ground up tough plants, and new teeth kept replacing the worn ones.

2.2 EGGS AND NESTS

OBJECTIVES

- Tell how dinosaur eggs were like bird eggs.
- Describe two kinds of dinosaur nests: eggs buried in the ground and eggs kept warm by a parent.
- Tell the story of the fossil parent found sitting on its nest.

Warm-up. Hold a chicken egg gently in your hand. Feel how smooth and hard the shell is. Now guess: how big was the egg of the biggest dinosaur? Bigger than a basketball? Smaller? Hold that guess until the end of the story!

Video slot. Video coming. Dinosaur eggs and nests for children: the brooding Citipati, titanosaur eggs from Argentina, Maiasaura nests. Search approved channels (American Museum of Natural History, Natural History Museum London, Museum of the Rockies); preview first.

KEY TERMS

shell

The hard outside of an egg that protects the baby growing inside.

nest

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

embryo

A baby animal still growing inside its egg (say “EM-bree-oh”).

brood

To sit on eggs and keep them warm, as a hen does.

CORE IDEAS

The story. In 1993, a team of fossil hunters was working in the hot, windy Gobi Desert of Mongolia. One of them spotted a dark shape in the red sand. Carefully they brushed it clean. It was a dinosaur skeleton, crouched down with its arms spread wide, sitting right on top of a ring of eggs! The parent had been covering its nest when it was buried.

Eggs like a bird’s. Every dinosaur we know of hatched from an egg with a hard **shell**, like a bird’s egg. Some were round like a ball and some were long like a potato. Here is the answer to the warm-up: even the eggs of the giant long-necked dinosaurs were only about the size of a grapefruit. A small egg can hatch a baby that grows very big!

Buried nests. In Argentina, scientists found a huge nesting ground with thousands of round eggs from long-necked dinosaurs. Some eggs still had tiny **embryos** inside, with bits of baby skin showing little bumpy scales. These big dinosaurs probably dug holes, laid their eggs and

covered them with dirt or plants. The warm ground kept the eggs cozy, the way some turtles and crocodiles warm their eggs today.

Sitting nests. The parent found in the Gobi was a **Citipati** (say “CHIT-ih-PAH-tee”), a feathered dinosaur about the size of an ostrich. Its eggs were laid in pairs, in a circle, with the open middle where the parent sat. It was **brooding**, keeping the eggs warm and safe like a mother hen. This showed that some dinosaurs took care of their eggs.

God cares for little ones. Some animals watch over their eggs, and some, like the ostrich in Job 39, leave them in the warm dust. Either way, God made each creature to bring new life into the world, and He knows every egg and every nest.

PICTURE STUDY



Bird's Nest with Sprays of Apple Blossoms, William Henry Hunt, Mid-1800s · Watercolor · Yale Center for British Art, New Haven, Connecticut
Wikimedia Commons · CC0

William Henry Hunt, an English painter, painted so many birds' nests that people nicknamed him “Bird’s Nest Hunt.” No one has ever seen a living dinosaur nest, but a bird’s nest helps us picture how some dinosaurs cared for their eggs.

Look closely

- Count the eggs in the nest. What colors are they?
- Look at what the nest is made of. Can you find moss, twigs or grass?
- Find the flowers. What season do you think it is?

Talk about it

1. How is this nest like the Citipati nest in the story? How is it different?

2. Why do you think the artist painted the eggs so carefully?

HANDS-ON: A DINOSAUR NEST

Build two kinds of dinosaur nests: a buried nest and a brooding nest.

You will need

- Play dough or salt dough for eggs
- A shoebox lid or tray of sand or dirt
- Leaves or grass
- A toy dinosaur or bird (or a paper one)

Steps

1. Roll ten small eggs. Make five round, like long-necked dinosaur eggs, and five long, like Citipati eggs.
2. **Buried nest:** scoop a hole in one end of the tray, set the round eggs in it, and cover them with sand and leaves.
3. **Brooding nest:** set the long eggs in pairs in a circle at the other end, leaving an open space in the middle. Set your toy in the middle with its arms spread over the eggs.
4. Tell a grown-up which nest keeps eggs warm by the ground and which keeps eggs warm by a parent.

Check your work

- I made a buried nest and a brooding nest.
- My Citipati eggs are in pairs, in a circle.
- I can tell what “brood” means.

FIELD NOTEBOOK

1. Draw a Citipati sitting on its ring of eggs, with its feathered arms spread wide. Label the eggs and the parent.
2. Draw a chicken egg and a grapefruit-sized dinosaur egg side by side. Write: “Big dinosaurs, small eggs.”

Did you know? The first dinosaur eggs known to science were found in the Gobi Desert in 1923 by a team led by Roy Chapman Andrews (Trail B, Stop B8). For many years people thought those eggs belonged to a horned dinosaur, and that a dinosaur found nearby had come to steal them. The parent found sitting on its nest in 1993 helped show that this kind of dinosaur was guarding its own eggs.

Goes deeper in. Life Science, the animals and life cycles units (coming soon); and Gardening & Animals, for birds, nests and eggs.

For families. The brooding Citipati (specimen IGM 100/979, nicknamed “Big Mama”) was found in 1993 at Ukhaa Tolgod, Mongolia, by an American Museum of Natural History and Mongolian Academy of Sciences team and reported by Norell and others in *Nature* (1995). The titanosaur nesting ground at Auca Mahuevo, Argentina, was found in 1997; some eggs held embryos with skin impressions (Chiappe and others, 1998). Titanosaur eggs there are roughly 5–6 inches (13–15 cm) across. A few elongated eggs from large feathered dinosaurs were longer, up to about 18 inches, so “grapefruit-sized” describes the long-necked dinosaurs, not every kind.

PRACTICE

1. **EASY** How were dinosaur eggs like bird eggs?
2. **MEDIUM** What did fossil hunters find in the Gobi Desert in 1993?
3. **MEDIUM** How did the long-necked dinosaurs probably keep their eggs warm?

Make it a game • Guard the Nest. One player is the Citipati and crouches over three “eggs” (balled-up socks) with arms spread wide. The others tiptoe close and try to touch an egg. If the Citipati tags a player, that player freezes for three seconds. Take turns being the parent.

Scripture. “Which leaveth her eggs in the earth, and warmeth them in dust,” (Job 39:14, KJV)

God asked Job about the ostrich, who lays her eggs in the warm ground. God knows how every creature cares for its eggs, even ones Job had never thought about.

Practice: answers

1. They had hard shells.
2. A Citipati skeleton sitting on its nest of eggs, with its arms spread over them.
3. They buried them in the ground under dirt or plants.

2.3 FOOTPRINTS AND TRACKWAYS

OBJECTIVES

- Tell the story of the footprints Pliny Moody found in Massachusetts.
- Explain what a trackway can tell us that a bone cannot.
- Make a footprint and a plaster cast of it.

Warm-up. Walk across damp sand, soft dirt or a floury cookie sheet in your bare feet (a grown-up can help). Look back at your prints. Can someone else tell whether you walked or ran? Which way you went? Footprints tell stories!

Video slot. Video coming. Dinosaur footprints and trackways for children: Dinosaur Valley State Park, Texas; Dinosaur State Park, Connecticut; the Amherst College footprint collection. Search approved channels (Texas Parks and Wildlife, Connecticut state parks, Smithsonian National Museum of Natural History); preview first.

KEY TERMS

footprint

The mark a foot leaves pressed into soft ground.

trackway

A line of footprints made by one animal walking or running.

trace fossil

A fossil that shows something an animal did, such as a footprint, a nest or a burrow, instead of a part of its body.

cast

A copy made by pouring something soft into a mold and letting it harden.

CORE IDEAS

The story. In 1802, a farm boy named Pliny Moody was plowing a field in South Hadley, Massachusetts, when his plow turned up a slab of stone. On it were big, three-toed footprints, like giant bird tracks. The family set the stone by their door as a doorstep. Some people joked that the prints were made by “Noah’s raven,” the bird Noah sent out from the Ark.

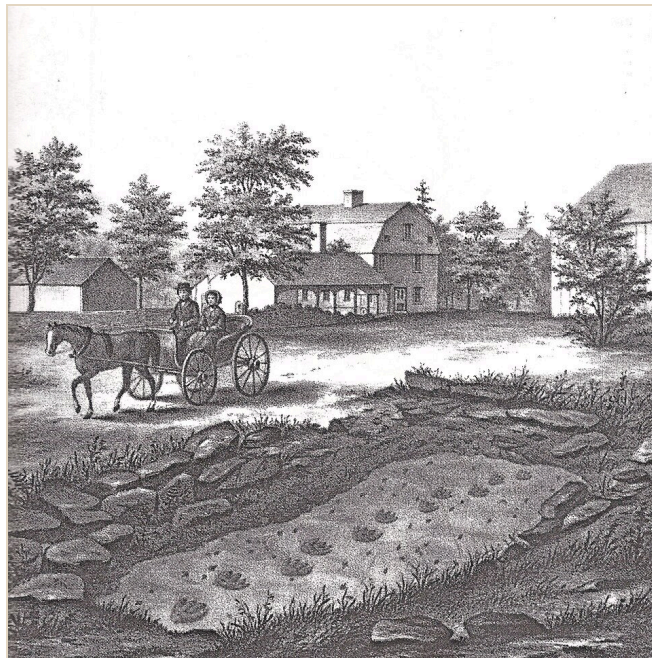
A minister reads the tracks. Years later, a pastor and scientist named Edward Hitchcock began collecting these stone footprints along the Connecticut River. He gathered thousands of them! Hitchcock thought they were made by giant birds. Today scientists think most were made by dinosaurs with three-toed feet much like a bird’s. Hitchcock’s great collection is still at Amherst College.

What tracks tell. A footprint is a **trace fossil**. It does not show the animal's body; it shows what the animal *did*. A **trackway**, a line of prints, tells even more. Did the animal walk on two legs or four? Was it walking slowly or running? Was it alone or with others? Did its tail drag on the ground? (Almost never!)

Tracks in Texas. In 1938, a fossil hunter named Roland T. Bird followed giant footprints along the Paluxy River in Texas. He found the round prints of a huge long-necked dinosaur and, right beside them, the three-toed prints of a meat eater. Was the meat eater following it? People still wonder.

Quickly covered. A footprint in mud is gone after the next rain. For a track to last, it had to be covered quickly with more mud or sand that later turned to stone. Many Christian geologists think the great Flood of Noah's day explains why so many tracks were covered so fast. Every footprint is a true story of a real animal God made, walking on a real day.

PICTURE STUDY



*The Moody Footmark Quarry, South Hadley, Edward Hitchcock, 1858 · Printed drawing (from Hitchcock's book *Ichnology of New England*) · From *Ichnology of New England* (Boston, 1858)*
Wikimedia Commons · Public domain

This picture comes from Edward Hitchcock's big book about the stone footprints of New England. It shows the quarry on the Moody farm, near where Pliny Moody first plowed up a slab of tracks. Hitchcock used the word "ichnology," which means "the study of tracks."

Look closely

- Find the flat layers of rock. Where do you think the footprints were?
- Look for people or tools. How big is the quarry compared to them?
- Look at the trees and the land around it. Does this look like a farm?

Talk about it

1. Why would a scientist want to draw a picture of the place where the tracks were found?
2. If you found a slab of footprints on your farm, what would you do with it?

Safety first. A grown-up mixes the plaster. Plaster gets warm as it hardens; do not put hands or feet into wet plaster, and do not pour leftover plaster down the drain.

HANDS-ON: MAKE A FOSSIL TRACK

Press a footprint into clay and make a plaster cast, just as scientists copy fossil tracks.

You will need

- A ball of modeling clay or play dough, flattened to about an inch thick
- A toy dinosaur, or your fingers
- A strip of cardboard and tape
- Plaster of Paris, water, a paper cup and a craft stick (with a grown-up)

Steps

1. Press the toy dinosaur's foot deep into the clay. Or press three fingers in to make a three-toed track.
2. Wrap the strip of cardboard around the track like a fence and tape it.
3. A grown-up mixes plaster with water until it is like thick pancake batter. Pour it into the fence to about an inch deep.
4. Wait about an hour, then peel away the clay. Your cast shows the foot that made the print!

Check your work

- I made a clear footprint in clay.
- I made a plaster cast of my footprint.
- I can tell what a trace fossil is.

FIELD NOTEBOOK

1. Draw a trackway of six three-toed prints in a line. Draw arrows to show which way the dinosaur was going.
2. Write: "A footprint shows what an animal did."

Did you know? You can still see dinosaur tracks in the riverbed at Dinosaur Valley State Park in Glen Rose, Texas, when the water is low. In Connecticut, workers digging for a building in 1966 uncovered hundreds of tracks, and Dinosaur State Park was built over them so people could see them.

Goes deeper in. Earth Science, the fossils and rock layers units (coming soon); and History, for New England in the 1800s.

For families. Pliny Moody's find is usually dated to 1802; the "Noah's raven" nickname is reported in histories of the find. Edward Hitchcock (1793–1864), a Congregational minister and president of Amherst College, published *Ichnology of New England* in 1858; his collection is at the Beneski Museum of Natural History, Amherst College. Roland T. Bird excavated the Paluxy River trackways in 1938 for the American Museum of Natural History. Tracks must be buried rapidly to be preserved; the link to the Flood is the young-earth reading, and mainstream geologists explain the same tracks by local floods and tides over long ages. Plaster gets warm as it sets; do not set it on skin. Keep plaster out of the sink.

PRACTICE

1. **EASY** What did Pliny Moody find while plowing?
2. **MEDIUM** Name two things a trackway can tell us that a bone cannot.
3. **EASY** Why is a footprint called a trace fossil?

Make it a game • Track Detective. One player walks, hops, tiptoes or runs across damp sand, snow or a sheet of paper with chalky feet while the others look away. The others study the tracks and guess how the player moved. Then switch.

Scripture. "Thy way is in the sea, and thy path in the great waters, and thy footsteps are not known." (Psalm 77:19, KJV)

We can follow a dinosaur's footprints in stone, but we cannot track God the same way. He is greater than we can see, yet the next verse says He led His people "like a flock."

Practice: answers

1. A stone slab with big three-toed footprints.
2. Any two: whether the animal walked or ran, on two legs or four, alone or with others, which way it went, whether its tail dragged.
3. Because it shows something the animal did, not a part of its body.

2.4 HERDS

OBJECTIVES

- Name two kinds of clues that some dinosaurs lived in herds.
- Tell two ways a herd helps keep animals safe.
- Say Ecclesiastes 4:12 and tell what it means for a family.

Warm-up. Think of animals that live in groups today: cows, sheep, zebras, elephants, geese. Why do you think they stay together? Make a list with a grown-up before you read the story.

Video slot. Video coming. Did dinosaurs live in herds? Trackways of many dinosaurs walking together and bonebeds of horned dinosaurs, for children. Search approved channels (American Museum of Natural History, Royal Tyrrell Museum, Natural History Museum London); preview first.

KEY TERMS

herd

A large group of animals of one kind that live and travel together.

bonebed

A layer of rock packed with the bones of many animals buried together.

parallel

Going the same way side by side, like the two rails of a train track.

predator

An animal that hunts other animals for food.

CORE IDEAS

The story. In Texas, on a ranch called Davenport Ranch, Roland T. Bird mapped a wide rock covered with giant round footprints. They were not just one trackway. More than twenty long-necked dinosaurs had walked across the mud, side by side, all going the same way. It looked like a herd on the move!

Clue one: trackways. When many trackways run **parallel**, all heading the same way at the same time, it is a clue that the animals were traveling together. Roland Bird thought the little ones walked in the middle of the group, with the big ones around them. Later scientists are not so sure. Even good scientists sometimes read the same tracks in different ways.

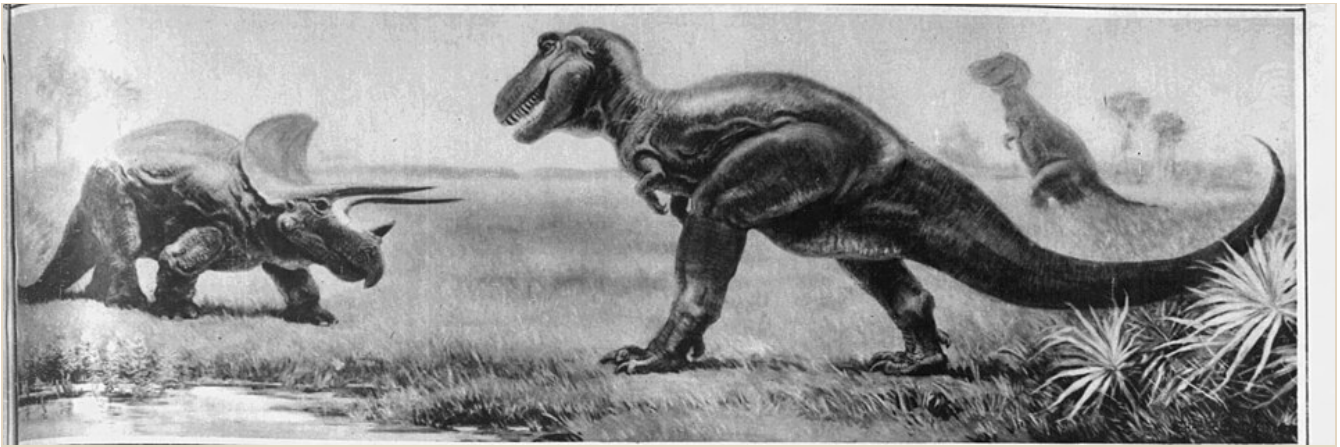
Clue two: bonebeds. In Alberta, Canada, scientists have found **bonebeds** with the bones of thousands of horned dinosaurs called Centrosaurus, buried all together, young and old. In Montana there is a huge bonebed of duck-billed Maiasaura. So many animals of one kind in

one place is a strong clue that they lived in groups, and that something buried them all at once, perhaps a great flood.

Why live in a herd? A herd has many eyes and ears. If one animal sees a **predator**, like a T. rex, all of them can run or stand together. Horned dinosaurs may have faced outward in a ring, horns pointed at the enemy, the way musk oxen do today. A herd can also travel together to find food and water.

Together is stronger. God made many creatures to live together, and He made people to live in families and churches. The Bible says, “A threefold cord is not quickly broken” (Ecclesiastes 4:12). One string snaps easily; three strings twisted together hold strong.

PICTURE STUDY



Tyrannosaurus and Triceratops (Field Museum mural), Charles R. Knight, 1928 · Oil painting (mural) · Field Museum, Chicago
Wikimedia Commons · Public domain

Charles R. Knight painted a whole set of large murals of ancient animals for the Field Museum in Chicago between 1926 and 1930. This one is the most famous of them all: a meat eater meets a horned plant eater. Knight wanted visitors to feel as if they were standing right there.

Look closely

- Find the Triceratops. Are there any more animals behind it, far away?
- Look at the Triceratops's head. Which way are its horns pointing?
- Look at the T. rex. Is it running or standing still?

Talk about it

1. If Triceratops lived in a herd, how might the others help the one in front?
2. What do you think happens next? Tell the story.

HANDS-ON: HERD TRACKWAY MAP

Make a map of a herd's trackways, like Roland Bird's map in Texas.

You will need

- A long sheet of paper (taped-together paper or the back of wrapping paper)
- A big sponge or potato cut in a round shape, and a small one (with a grown-up)
- Washable paint on a paper plate
- A pencil

Steps

1. Dip the big round stamp in paint. Stamp a line of footprints from one end of the paper to the other: left, right, left, right.
2. Stamp four or five more big trackways side by side, all going the same way. These are the grown-ups.
3. With the small stamp, add two or three small trackways. Where will you put the young ones?
4. Draw an arrow showing the way the herd was going. Tell a grown-up why you put the young ones where you did.

Check your work

- My trackways are parallel and go the same way.
- I added small trackways for young dinosaurs.
- I can name two clues that dinosaurs lived in herds.

FIELD NOTEBOOK

1. Draw a ring of horned dinosaurs facing outward with their horns pointed at a predator. Put a young one in the middle.
2. Write: "Trackways and bonebeds are clues to herds."

Did you know? Some fossil hunters have found trackways of a few meat eaters walking side by side too. Whether meat eaters hunted together like wolves is still being studied. The clues are good for plant eaters such as horned dinosaurs, duckbills and long-necked dinosaurs.

Goes deeper in. Life Science, the animals and ecosystems units (coming soon); and Gardening & Animals, for herds of cattle and sheep.

For families. Roland T. Bird mapped the Davenport Ranch sauropod trackways in Medina County, Texas, around 1940; they record more than twenty individuals moving in one direction (later studied by John Ostrom and others). Bird's idea that juveniles walked inside the group has been questioned. Centrosaurus bonebeds in Alberta, including the

Hilda mega-bonebed, contain remains of many hundreds to thousands of animals; the Maiasaura bonebed in Montana is estimated at thousands of animals. Mainstream geologists attribute such bonebeds to local floods or droughts; many creation geologists see them as evidence of catastrophic burial in the Flood. Both agree many animals were buried together. Knight's Field Museum murals date from 1926 to 1930; this one was publicized in 1928.

PRACTICE

1. **EASY** What is a herd?
2. **MEDIUM** Name two clues that some dinosaurs lived in herds.
3. **MEDIUM** How does living in a herd help keep animals safe?

Make it a game • Herd and Hunter. One player is the T. rex. The rest are a herd of Triceratops holding hands in a ring around a “baby” (a stuffed animal). The T. rex walks around the outside and tries to tag the baby; the herd turns and moves to keep the T. rex out. Play gently and walk, do not run. Switch roles.

Scripture. “And if one prevail against him, two shall withstand him; and a threefold cord is not quickly broken.” (Ecclesiastes 4:12, KJV)

One alone can be beaten, but two or three together stand strong. God gives us families and friends so we do not have to stand alone.

Practice: answers

1. A large group of animals of one kind that live and travel together.
2. Parallel trackways going the same way, and bonebeds with many dinosaurs of one kind buried together.
3. Many eyes and ears watch for danger, and the animals can stand or run together against a predator.

2.5 HOW FAST COULD THEY RUN?

OBJECTIVES

- Explain how footprints help scientists guess a dinosaur's speed.
- Compare walking steps and running steps by measuring your own.
- Name a fast kind of dinosaur and tell why T. rex was probably not a fast runner.

Warm-up. Walk ten steps across the yard. Then run ten steps. Did you go farther when you ran? Why? Keep that in mind: it is the secret scientists use to measure dinosaur speed.

Video slot. Video coming. How fast could dinosaurs run? Measuring speed from trackways; ostrich-like dinosaurs; T. rex speed, for children. Search approved channels (American Museum of Natural History, Natural History Museum London, Royal Veterinary College); preview first.

KEY TERMS

speed

How fast something moves.

stride

The distance from one footprint to the next print of the same foot.

hip height

How tall an animal is from the ground to the top of its leg at the hip.

ostrich dinosaur

A light, long-legged dinosaur shaped a lot like an ostrich, such as *Struthiomimus* ("ostrich mimic").

CORE IDEAS

The story. No one has ever timed a dinosaur with a stopwatch. So how can we know how fast they ran? A scientist named R. McNeill Alexander, who studied how animals move, had an idea. He watched people, horses and ostriches walking and running and measured their footprints. The faster an animal goes, the farther apart its footprints are.

Steps in stone. Here is the secret. Long legs take long steps, and running steps are longer still. If scientists know how long a dinosaur's legs were (its **hip height**) and how far apart its footprints are (its **stride**), they can figure out about how fast it was going. Most dinosaur trackways show animals walking along at an easy pace, like you on a walk to the park.

The fast ones. A few trackways show dinosaurs moving fast. One set of three-toed tracks in Texas may show a meat eater running about as fast as a bicycle racing downhill. The fastest

dinosaurs were probably the light **ostrich dinosaurs**, with long thin legs, big eyes and no teeth. They look built for speed, like the ostrich, the fastest runner on two legs today.

Was T. rex fast? In movies, T. rex chases cars. But a grown T. rex weighed as much as an elephant or more. Scientists have used computers to test how its leg bones and muscles worked. Most think a grown T. rex could walk fast but could not really run; maybe it went about as fast as a strong man running. Young T. rexes, with longer, thinner legs for their size, were probably faster.

Run the race. God made some creatures for speed and some for strength. The Bible says we should “run with patience the race that is set before us” (Hebrews 12:1). Our race is the Christian life. We do not have to be the fastest, but we keep going, step by step, looking to Jesus.

PICTURE STUDY



Leaping Laelaps, Charles R. Knight, 1897 · Watercolor · American Museum of Natural History, New York
Wikimedia Commons · Public domain

When Charles R. Knight painted this in 1897, most people pictured dinosaurs as slow, dragging lizards. Knight, guided by the scientist Edward Drinker Cope, showed them leaping and moving fast. The dinosaur is now called *Dryptosaurus*. Many scientists today think Knight was right that meat eaters like this were quick and lively.

Look closely

- Find the dinosaur in the air. Where are its feet? Where is its tail?
- Look at the dinosaur on the ground. What is it doing?
- Look at the background. Is it daytime? Where are they?

Talk about it

1. How did Knight make this picture look full of motion?
2. Could a big dinosaur really leap like this? What clues would you look for to find out?

HANDS-ON: MEASURE YOUR STRIDE

Use your own footprints to see how stride changes with speed, the way scientists study dinosaur trackways.

You will need

- Sidewalk chalk, or damp sand
- A tape measure
- A pencil and your Field Notebook

Steps

1. Measure your hip height: from the floor to the top of your leg. Write it down.
2. Wet the bottoms of your shoes (or walk barefoot in damp sand). **Walk** across a sidewalk. A grown-up marks where your right foot landed twice in a row. Measure that stride.
3. Now **run** across the same place. Mark and measure your running stride.
4. Compare: how many times longer than your hip height is your walking stride? Your running stride?

Check your work

- I measured my hip height, my walking stride and my running stride.
- I found that my running stride was longer.
- I can tell how footprints show whether a dinosaur was walking or running.

FIELD NOTEBOOK

1. Draw two trackways: one with prints close together (walking) and one with prints far apart (running). Label them.
2. Draw an ostrich dinosaur next to a T. rex. Under each, write “fast” or “slow.”

Did you know? An ostrich can run about 40 miles an hour, faster than a racehorse over a short dash. The ostrich dinosaurs looked so much like ostriches that one was named *Struthiomimus*, “ostrich mimic,” and another *Gallimimus*, “chicken mimic.”

Goes deeper in. Arithmetic, for measuring and comparing lengths; and Life Science, for bones, muscles and how animals move (coming soon).

For families. R. McNeill Alexander published his method for estimating dinosaur speed from stride length and hip height in *Nature* (1976). Speeds from trackways are estimates;

the fast Texas theropod trackway was estimated by James Farlow (1981) at roughly 25 miles an hour (about 40 km/h). Biomechanical studies (Hutchinson and Garcia, *Nature* 2002; Sellers and others, 2017) concluded that adult T. rex could not run fast; estimates are around 10–15 miles an hour or less. Ostrich-dinosaur speeds are inferred from body shape, not trackways, and are uncertain. Laelaps was Cope’s name; the genus was renamed Dryptosaurus by Marsh in 1877 because “Laelaps” was already in use.

PRACTICE

1. **EASY** When you run, are your footprints closer together or farther apart than when you walk?
2. **MEDIUM** What two things do scientists measure to guess how fast a dinosaur moved?
3. **MEDIUM** Which were probably faster: ostrich dinosaurs or a grown T. rex? Why?

Make it a game • Dinosaur Relay. Mark a start and finish line. Players race as different dinosaurs: a long-necked dinosaur (slow, giant steps), a T. rex (fast walk, no running), an ostrich dinosaur (run!) and a Stegosaurus (slow, on hands and feet). Who reaches the finish first? Who would win in real life?

Scripture. “Wherefore seeing we also are compassed about with so great a cloud of witnesses, let us lay aside every weight, and the sin which doth so easily beset us, and let us run with patience the race that is set before us,” (Hebrews 12:1, KJV)

A runner drops anything heavy that would slow him down. Christians lay aside sin and keep going in God’s race with patience, step by step.

Practice: answers

1. Farther apart.
2. How long its legs were (hip height) and how far apart its footprints were (stride).
3. Ostrich dinosaurs. They were light, with long thin legs; a grown T. rex was very heavy.

2.6 WERE THEY WARM-BLOODED?

OBJECTIVES

- Tell the difference between a warm-blooded and a cold-blooded animal.
- Name two clues scientists use to ask whether dinosaurs were warm-blooded.
- Test why a big body stays warm longer than a small one.

Warm-up. Put your hand on your neck or your cheek. You feel warm, even if the room is cool. Your body makes its own heat! A lizard cannot do that. It has to lie in the sun to warm up. Which kind were the dinosaurs?

Video slot. Video coming. Warm-blooded or cold-blooded dinosaurs, for children: lizards basking in the sun, birds and mammals, bone growth. Search approved channels (American Museum of Natural History, Natural History Museum London, Smithsonian National Museum of Natural History); preview first.

KEY TERMS

warm-blooded

Able to make its own body heat and stay warm inside, like birds, dogs and people.

cold-blooded

Getting its warmth from outside, from the sun or warm rocks, like lizards, snakes and turtles.

bask

To lie in the sun to soak up its warmth.

growth rings

Lines inside a bone (or a tree) that show how it grew, like rings in a tree stump.

CORE IDEAS

The story. On a cool morning a lizard creeps out onto a rock. It is slow and stiff. It lies still in the sun, and slowly it warms up. By noon it is darting about, quick as a flash. Near the rock, a robin hops about, busy from the first light of dawn. The robin did not need the sun to warm up. Its own body made the heat.

Two ways to stay warm. Animals like the lizard are called **cold-blooded**. Their blood is not really cold; they just get their warmth from outside, so they **bask** in the sun. Animals like the robin, a dog or you are **warm-blooded**. They burn food inside to make heat, like a little furnace. That is why warm-blooded animals need to eat much more food.

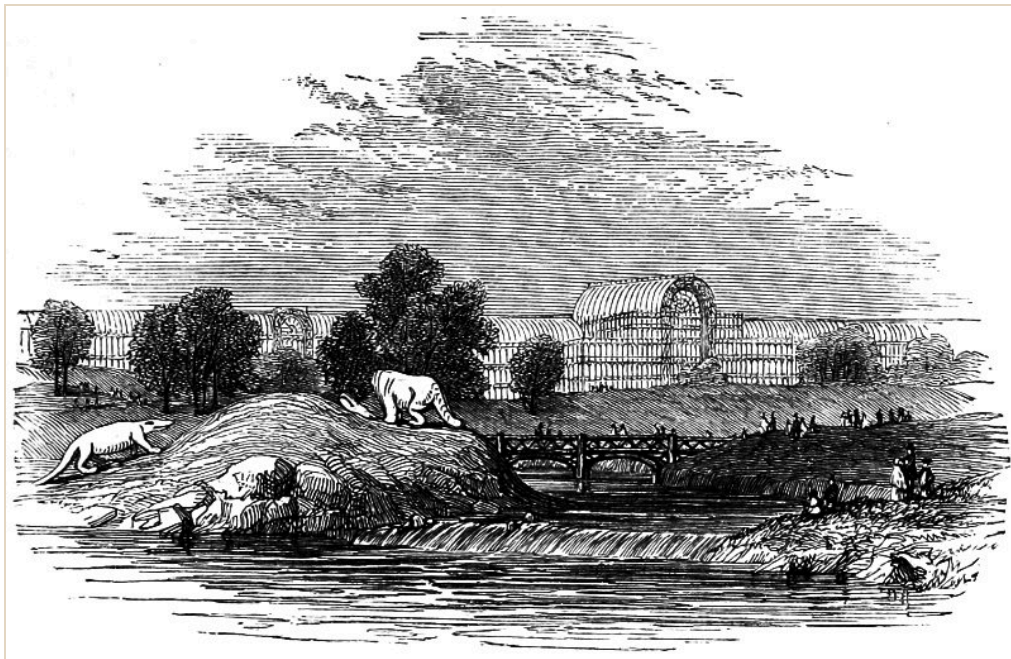
First guesses. Dinosaurs are reptiles, and most reptiles today are cold-blooded, so for a long time people pictured dinosaurs as big, slow lizards. But Richard Owen, who gave dinosaurs their name, thought they were more like big mammals, such as elephants and

rhinoceroses. The sculptor Benjamin Waterhouse Hawkins built them that way at the Crystal Palace in London.

Clues from fossils. Scientists look at many clues. Many dinosaurs stood with their legs straight under them, like a horse, not sprawled out like a lizard. Some had feathers, which help keep a body warm. Their bones show **growth rings** and patterns that tell us many grew very fast, the way warm-blooded animals do. And dinosaur bones have been found in the far north of Alaska, where it is cold and dark much of the year.

Still asking. Many scientists now think many dinosaurs were warm-blooded or somewhere in between. Giant ones may also have stayed warm just by being big, the way a big pot of soup stays hot longer than a small cup. Scientists keep testing. God, who made cold and heat (Genesis 8:22), made each creature just right for its life.

PICTURE STUDY



*The Crystal Palace models, from Owen's guidebook, Benjamin Waterhouse Hawkins (models), with Richard Owen, 1854 · Printed illustration · From *Geology and Inhabitants of the Ancient World* (London, 1854)*
Wikimedia Commons · Public domain

In 1854, Benjamin Waterhouse Hawkins finished life-size models of ancient animals for a park around the Crystal Palace in London, with Richard Owen as his adviser. This picture comes from the guidebook sold to visitors. Hawkins and Owen made the dinosaurs look like heavy, four-legged animals, more like a rhinoceros than a lizard. The models still stand in the park today.

Look closely

- Find an animal standing on four thick legs. Does it look more like a lizard or like an elephant?

- Find the water. Which animals are near it?
- Look at the legs. Are they straight under the body or sprawled out to the sides?

Talk about it

1. Why do you think Owen wanted his dinosaurs to look like big mammals instead of lizards?
2. We now know some of these animals walked on two legs. Is it wrong for scientists to change their pictures when they learn more?

Safety first. Use warm tap water only, not boiling water. A grown-up fills the containers.

HANDS-ON: BIG POT, SMALL CUP

Test whether a big body stays warm longer than a small one.

You will need

- A big jar or pot and a small cup
- Warm tap water (a grown-up fills them)
- A kitchen thermometer, or your finger
- A clock or timer

Steps

1. A grown-up fills the big jar and the small cup with the same warm tap water.
2. Feel the water in each (or read the thermometer). They should feel the same.
3. Wait twenty minutes. Feel or measure each again.
4. Which one cooled faster? Talk about it: how might a giant long-necked dinosaur stay warm even without making much heat?

Check your work

- I compared the big jar and the small cup after twenty minutes.
- I found that the small cup cooled faster.
- I can tell the difference between warm-blooded and cold-blooded.

FIELD NOTEBOOK

1. Make two columns: “Warm-blooded” and “Cold-blooded.” Draw two animals in each.
2. Draw a dinosaur and write one clue that it might have been warm-blooded.

Did you know? A hummingbird is warm-blooded and so tiny that it must eat many times its body weight in nectar and bugs each day. A crocodile is cold-blooded and can go months without a meal. Making your own heat takes a lot of food!

Goes deeper in. Life Science, the animals and body systems units (coming soon); and Trail B, Stop B5 on the Crystal Palace dinosaurs.

For families. Richard Owen argued in his 1842 report that dinosaurs were advanced reptiles with features suggesting a more mammal-like body plan; how far he thought they were “warm” is debated, so the stop says only that he pictured them like large mammals. The modern warm-blooded debate grew from the work of John Ostrom and Robert Bakker in the late 1960s and 1970s. Evidence includes fast-growing bone tissue, upright posture, feathers in some groups and dinosaur fossils (including juveniles) from northern Alaska. Some studies suggest many dinosaurs were “in between” (Grady and others, *Science* 2014); the question is open. “Warm-blooded” and “cold-blooded” are everyday words for endotherm and ectotherm.

PRACTICE

1. **EASY** Why does a lizard lie in the sun?
2. **MEDIUM** Why do warm-blooded animals need to eat more food?
3. **MEDIUM** Name two clues that some dinosaurs may have been warm-blooded.

Make it a game • Sun and Shade. Players are lizards. When the leader calls “Sun!”, lizards move fast. When the leader calls “Shade!”, lizards move very slowly. When the leader calls “Robin!”, everyone moves quickly no matter what, because birds make their own heat. Anyone who moves at the wrong speed becomes the next leader.

Scripture. “While the earth remaineth, seedtime and harvest, and cold and heat, and summer and winter, and day and night shall not cease.” (Genesis 8:22, KJV)

God promised Noah that cold and heat, summer and winter would keep coming. He made animals with different ways to live through them.

Practice: answers

1. To warm up. It is cold-blooded and gets its heat from outside.
2. They burn food inside their bodies to make their own heat.
3. Any two: legs straight under the body, feathers, bones that show fast growth, fossils found in cold northern places.

2.7 FEATHERS: WHAT THE FOSSILS SHOW

OBJECTIVES

- Tell the story of Archaeopteryx and its feathers in stone.
- Describe what was found on some small dinosaurs from China.
- Keep apart what the fossils show (observation) and what people think it means (interpretation).

Warm-up. Hold a feather (from a craft store or a pillow) and look closely. Run your finger along it one way, then the other. Can you “unzip” it and zip it back together? Feathers are amazing, and some fossils have them pressed into stone!

Video slot. Video coming. Feathered dinosaur fossils for children: Archaeopteryx, Sinosauropteryx, Microraptor; how a feather is made. Search approved channels (Natural History Museum London, American Museum of Natural History, Smithsonian National Museum of Natural History); preview first.

KEY TERMS

feather

A light covering made of a center shaft with many tiny branches, found on birds and some dinosaurs.

Archaeopteryx

A feathered animal with wings, teeth and a long bony tail, found in stone in Germany (say “ar-kee-OP-ter-iks”).

filament

A thin, hair-like strand. Some dinosaurs were covered with fuzz made of filaments.

scales

Small, hard, overlapping plates or bumps on the skin of reptiles and some dinosaurs.

CORE IDEAS

The story. In Germany there are quarries of smooth, fine stone that was once used for printing pictures. In 1861, quarry workers split open a slab and found something wonderful: the skeleton of a creature the size of a crow, with wings, and the shapes of its feathers pressed into the stone around it. It was named **Archaeopteryx**, “ancient wing.”

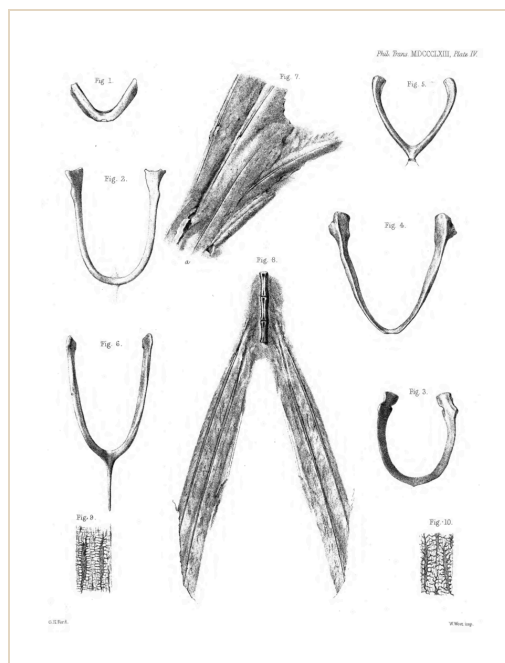
A strange bird. Archaeopteryx had feathers like a bird’s, with a shaft down the middle, and wings. But it also had teeth in its jaws, claws on its wing fingers and a long bony tail. The famous scientist Richard Owen studied one in London and called it a bird. Scientists have argued about it ever since.

Fuzz in China. In 1996, a farmer in China found a small dinosaur in fine layers of stone. Along its back and tail was a fringe of dark fuzz, made of thin **filaments**. Since then, many dinosaurs with fuzz or real feathers have been found there. One small one, Microraptor, had long feathers on its arms *and* its legs, like four wings! Other dinosaurs, like the duckbills, show skin with bumpy **scales**.

See and think. Here is what the fossils *show*: some dinosaurs had fuzz or feathers, and some had scales. Here is what people *think* it means. Most scientists today think birds came from dinosaurs over a very long time. Many Christians believe God made birds on day five and land animals on day six, as separate kinds, and that God gave feathers to some dinosaurs just as He gave scales to others. A careful thinker tells which part is the observation and which is the interpretation.

Under His wings. A mother bird spreads her feathers over her chicks to keep them warm and safe. The Bible uses that picture for God: “He shall cover thee with his feathers, and under his wings shalt thou trust” (Psalm 91:4).

PICTURE STUDY



The London Archaeopteryx, plate from Richard Owen's report, From Richard Owen's paper (artist of the plate not named here), 1863 · Lithograph (printed drawing) · Published in Philosophical Transactions of the Royal Society, London; the fossil is at the Natural History Museum, London
Wikimedia Commons · Public domain

Richard Owen read his report on the London Archaeopteryx to the Royal Society in 1862, and it was printed with careful drawings of the fossil in 1863. Before photographs were easy to print, an artist drew every bone and feather mark by hand so other scientists could study them.

Look closely

- Find the lines of the feathers. Where do they spread out from?
- Find the long tail. Does it have bones down the middle?
- Look for small claws. Where are they?

Talk about it

1. Why do you think the artist drew the fossil so carefully, line by line?
2. Which parts of this animal look like a bird's? Which do not?

HANDS-ON: FEATHER DETECTIVE

Study a real feather up close and compare it to dinosaur fuzz.

You will need

- A craft-store feather (not a feather picked up outdoors)
- A cotton ball
- A magnifying glass
- A pencil and your Field Notebook

Steps

1. Look at the feather with the magnifying glass. Find the shaft, the stiff center line.
2. Find the vanes, the soft flat sides. Gently pull two branches apart, then smooth them back together with your fingers. They “zip” back!
3. Pull a few wisps from the cotton ball. These are like the thin filaments of dinosaur fuzz: no shaft and no zipping.
4. Draw the feather and the fuzz side by side. Which would be better for flying? Which would keep a body warm?

Check your work

- I found the shaft and the vanes on my feather.
- I compared a feather to fuzz.
- I can tell one thing the fossils show and one thing people think it means.

FIELD NOTEBOOK

1. Draw Archaeopteryx. Label its feathers, its teeth, its wing claws and its long bony tail.
2. Make two columns: “The fossil shows” and “People think.” Write one sentence in each.

Did you know? Scientists can sometimes tell the color of fossil feathers! Tiny color specks inside feathers last in some fossils. The little fuzzy dinosaur from China, *Sinosauropteryx*, seems to have had a reddish-brown tail with light stripes, like a raccoon's. Only one feather was found before the first Archaeopteryx skeleton.

Goes deeper in. Life Science, the birds and classification units (coming soon); Trail D, Stop D1 “Every living thing” on day six (coming soon).

For families. An isolated feather was found at Solnhofen, Bavaria, in 1860–1861, and the first skeleton (the London specimen) in 1861; the British Museum bought it in 1862, and Owen’s description appeared in *Philosophical Transactions* (1863). *Sinosauropteryx* was found in Liaoning in 1996; its color pattern was reported by Zhang and others (*Nature* 2010) and refined later. *Microraptor* was described in 2000 and 2003. Most paleontologists hold that birds descend from theropod dinosaurs. Young-earth creationists generally hold that birds (day five) and dinosaurs (day six) were created separately; some creation scientists regard *Archaeopteryx* as a true bird and question whether all reported “protofeathers” are feathers. The stop presents the observation (fuzz, feathers and scales are found) apart from both interpretations.

PRACTICE

1. **EASY** Name two ways *Archaeopteryx* was different from birds today.
2. **MEDIUM** What was found on the small dinosaur from China in 1996?
3. **MEDIUM** “Some dinosaurs had feathers.” Is that an observation or an interpretation? “Birds came from dinosaurs.” Which is that?

Make it a game • Feather, Fuzz or Scale?. The leader names an animal: a robin, a crocodile, *Archaeopteryx*, a snake, a duckbill dinosaur, *Sinosauropteryx*, a parrot. Players flap their arms for feathers, wiggle their fingers for fuzz, or tap their arms for scales.

Scripture. “He shall cover thee with his feathers, and under his wings shalt thou trust: his truth shall be thy shield and buckler.” (Psalm 91:4, KJV)

A mother bird covers her chicks with her feathers. God keeps His people safe, and His truth protects us like a shield.

Practice: answers

1. Any two: it had teeth, claws on its wing fingers, a long bony tail.
2. Fuzz made of thin filaments along its back and tail.
3. The first is an observation (we can see it in fossils). The second is an interpretation (an explanation of what it means).

2.8 BABIES AND GROWTH

OBJECTIVES

- Tell the story of Maiasaura, the “good mother lizard.”
- Explain how growth rings in bones show how a dinosaur grew.
- Compare the size of a baby dinosaur with a grown one.

Warm-up. Ask a grown-up how long you were when you were born. Then measure how tall you are now. How many times bigger have you grown? A baby Maiasaura grew from about the length of your arm to longer than a car!

Video slot. Video coming. Maiasaura nests and babies at Egg Mountain, Montana; how dinosaurs grew, for children. Search approved channels (Museum of the Rockies, American Museum of Natural History, Field Museum); preview first.

KEY TERMS

hatchling

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

Maiasaura

A duck-billed dinosaur whose name means “good mother lizard” (say “MY-ah-SORE-ah”).

growth spurt

A time when a young animal or person grows very fast.

juvenile

A young animal that is no longer a baby but not yet grown up.

CORE IDEAS

The story. In 1978, in a small rock shop in Montana, a woman named Marion Brandvold showed two visiting fossil hunters, Jack Horner and Bob Makela, a coffee can of little bones. They were the bones of baby dinosaurs! She took them to the place she had found them, and there they found a bowl-shaped nest with the bones of many babies inside.

The good mother. The babies were duck-billed dinosaurs. Their little teeth were already worn down from chewing, but their leg bones were not yet strong enough for walking far. So who brought them food? Horner and Makela thought the parents must have fed them in the nest, the way robins feed their chicks. They named the dinosaur **Maiasaura**, “good mother lizard.” Nearby they found so many nests that people called the place Egg Mountain.

Small to big. A Maiasaura **hatchling** was only about as long as your arm. A grown Maiasaura was about 30 feet long, longer than a car! Dinosaurs grew fast. A young T. rex had a big **growth spurt** in its teenage years and may have gained several pounds every single day.

Rings inside the bones. How do scientists know? They cut a very thin slice of fossil bone and look at it under a microscope. Many bones have lines in them, like the rings in a tree stump. Each line may mark one year of growth. By counting the rings, scientists can guess how old a dinosaur was. The famous T. rex named SUE has growth lines that show it was about 28 years old.

Growing well. God made every creature to grow. The Bible says that when Jesus was a boy, He “increased in wisdom and stature, and in favour with God and man” (Luke 2:52). Children grow taller year by year, and they can grow in wisdom and in loving God too.

PICTURE STUDY



Hadrosaurus, Charles R. Knight, 1897 · Painting · Made for the American Museum of Natural History, New York

Wikimedia Commons · Public domain

Charles R. Knight painted these duck-billed dinosaurs in 1897, long before *Maiasaura* was found. *Maiasaura* belongs to this same family of duckbills. Knight painted animals at the zoo all his life, so his dinosaurs look like real living creatures.

Look closely

- Find the wide duck-like bill on each dinosaur.
- Look at the water and the shore. What might these animals eat here?
- Which dinosaur looks biggest? Which looks smallest?

Talk about it

1. If you added a nest of *Maiasaura* babies to this picture, where would you put it? Why?
2. How did Knight make these animals look alive and not like statues?

HANDS-ON: BABY AND GROWN-UP STRING

See how much a *Maiasaura* grew by laying out its size with string.

You will need

- A ball of string or yarn
- A tape measure
- Scissors (with a grown-up)
- Two sticky notes

Steps

1. Measure and cut a piece of string about 16 inches long (about as long as your arm). Label it “hatchling.”
2. Measure and cut a piece about 30 feet long (outside or down a long hallway). Label it “grown-up.”
3. Lay the two strings side by side. Lie down beside them. Which are you closer to?
4. Count how many hatchling strings would fit along the grown-up string.

Check your work

- I laid out a hatchling string and a grown-up string.
- I counted how many hatchlings fit along the grown-up.
- I can tell what “*Maiasaura*” means.

FIELD NOTEBOOK

1. Draw a *Maiasaura* nest with babies inside and a parent bringing leaves. Label the hatchlings.
2. Draw a bone slice with growth rings. Count your rings and write the dinosaur’s age.

Did you know? *Maiasaura* is the state fossil of Montana. In 1985 a piece of *Maiasaura* bone flew into space with an astronaut, so it was the first dinosaur in space! You can count the rings on a tree stump the same way scientists count growth rings in bone.

Goes deeper in. Life Science, the life cycles units (coming soon); and Arithmetic, for measuring and comparing lengths.

For families. The first *Maiasaura* nest was found in 1978 near Choteau, Montana, after Marion Brandvold, who ran a rock shop in Bynum, showed baby bones to John (Jack) Horner and Robert Makela; Horner and Makela named *Maiasaura peeblesorum* in *Nature* (1979). The parental-feeding idea is an interpretation from worn hatchling teeth and weak leg joints, and some scientists have questioned it. Hatchlings were roughly 16 inches (41 cm) long; adults about 30 feet (9 m). Growth-rate estimates for *T. rex* (Erickson and others, *Nature* 2004) reach about 4–5 pounds a day at peak; SUE’s age of about 28 is

from the same research. A Maiasaura bone fragment and eggshell flew aboard Spacelab 2 with Loren Acton in 1985.

PRACTICE

1. **EASY** What does the name Maiasaura mean?
2. **MEDIUM** Why did Jack Horner think Maiasaura parents fed their babies?
3. **MEDIUM** How can scientists tell how old a dinosaur was?

Make it a game • Grow, Maiasaura, Grow! Everyone starts curled up small like a hatchling in an egg. The leader calls out, “One year!” and everyone grows a little taller. At “Five years!” everyone stands tall and stretches like a grown Maiasaura. Then the leader calls, “Egg!” and everyone curls up again. Speed it up each round.

Scripture. “And Jesus increased in wisdom and stature, and in favour with God and man.” (Luke 2:52, KJV)

“Stature” means height. Jesus grew up as a real boy. We grow taller each year, and we can grow in wisdom and in loving God too.

Practice: answers

1. “Good mother lizard.”
2. The babies’ teeth were worn from eating, but their legs were not yet strong enough to walk far for food.
3. By counting growth rings inside a thin slice of its bone.

2.9 SAUROPOD NECKS

OBJECTIVES

- Tell how long the longest sauropod necks were and why they were not too heavy.
- Compare a sauropod neck with a giraffe's neck.
- Explain why scientists changed their minds about sauropods living in water.

Warm-up. Hold a broom by the very end of the handle and try to lift the brush end up high. It is hard! Now imagine holding up a neck longer than a school bus. How did the long-necked dinosaurs do it?

Video slot. Video coming. Sauropod necks for children: Brontosaurus, Diplodocus, Mamenchisaurus; hollow neck bones and air sacs; giraffe neck comparison. Search approved channels (Field Museum, American Museum of Natural History, Natural History Museum London); preview first.

KEY TERMS

sauropod

A huge plant-eating dinosaur with a long neck, a long tail, a small head and four thick legs (say “SORE-oh-pod”).

vertebra

One of the bones that make up the backbone and neck (more than one are called vertebrae, say “VER-teh-bray”).

air sac

A balloon-like bag of air connected to the lungs, as in birds. Some reached into sauropod bones.

hollow

Having empty spaces inside, not solid all the way through.

CORE IDEAS

The story. Imagine standing in a forest of tall trees. Something moves high above you, as high as the roof of a house. A small head, chewing leaves, swings down on the end of a long, long neck, and then up again to the treetops. It is a **sauropod**, one of the long-necked giants. Its neck lets it reach food no other animal can.

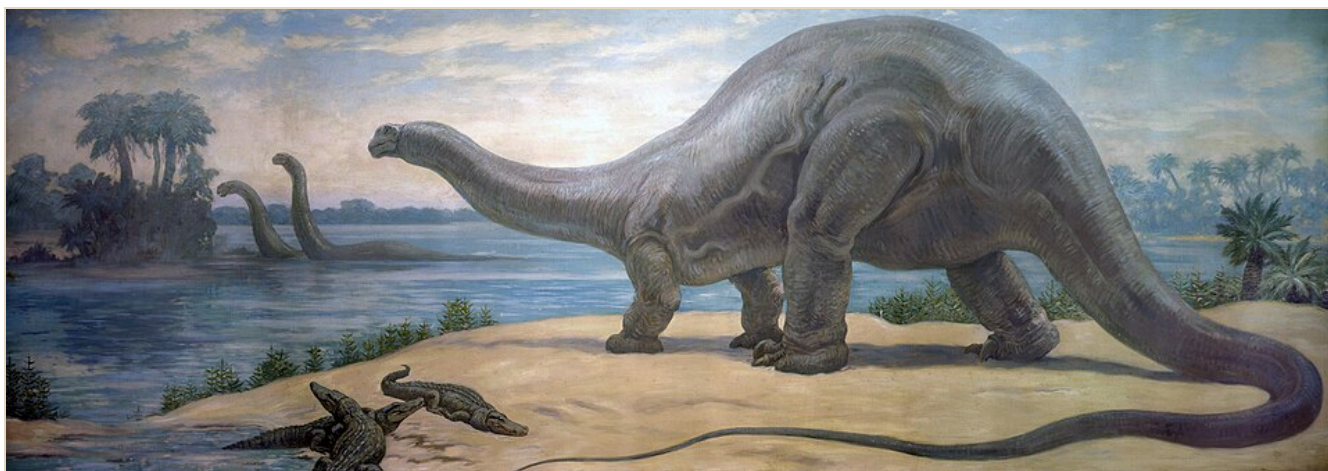
Longer than a bus. The longest sauropod necks were more than 40 feet long, longer than a school bus. A giraffe has only seven neck bones, the same number as you, but they are very long ones. Some sauropods had up to nineteen neck **vertebrae**! With a long neck, a sauropod could stand in one spot and eat from a wide circle of trees and ferns without walking much.

Light as a bird's bones. How could they hold up such long necks? God built them wisely. Sauropod neck bones were **hollow** in many places, with big spaces inside, like the bones of birds. Scientists think **air sacs** from the lungs filled those spaces, making the neck much lighter than solid bone. Strong ropes of muscle and tough cords along the neck helped hold it up, like the cables on a bridge.

In the water or on land? People once thought sauropods were too heavy to walk on land. They pictured them standing in deep lakes, letting the water hold them up. Charles Knight painted them that way. But then scientists found sauropod trackways on dry ground, and they figured out that deep water would squeeze a sauropod's chest so hard it could not breathe. Now they know sauropods walked on land on their thick, pillar-like legs.

Manifold works. Scientists still wonder how high sauropods held their heads, and how their hearts pumped blood all the way up. Every answer shows how carefully God made them. "O LORD, how manifold are thy works! in wisdom hast thou made them all" (Psalm 104:24).

PICTURE STUDY



Brontosaurus (Field Museum mural), Charles R. Knight, About 1929 · Oil painting (mural) · Field Museum, Chicago

Wikimedia Commons · Public domain

Charles R. Knight painted this mural for the Field Museum in Chicago, part of a great set of paintings he made there between 1926 and 1930. In his day, most scientists thought giant sauropods spent much of their time in water, and Knight painted what the scientists of his time believed.

Look closely

- Find the long necks. Follow one from the head all the way to the body.
- Look for water. Are the dinosaurs in it, beside it, or both?
- Compare the head to the body. Is the head big or small?

Talk about it

1. If Knight painted this picture today, what might he change?

2. Why would a small head be helpful on the end of such a long neck?

HANDS-ON: BUILD A SAUROPOD NECK

Make a neck from many small bones and test how it bends and how light it is.

You will need

- An egg carton cut into single cups (with a grown-up), or empty thread spools
- A long piece of string or a pipe cleaner
- A small ball of clay for the head
- A few drinking straws and a pencil

Steps

1. Poke a hole in the bottom of each egg cup. Thread twelve or more cups onto the string. These are the vertebrae.
2. Tie a knot at one end and press the clay head onto it.
3. Hold the other end and gently lift the neck. How does it bend? Try curving it up, down and side to side.
4. Hold a straw (hollow) in one hand and a pencil (solid) in the other. Which is lighter for its size? Why would hollow neck bones help a sauropod?

Check your work

- My neck has twelve or more vertebrae and a head.
- I can show how a long neck bends.
- I can tell why hollow bones made a long neck lighter.

FIELD NOTEBOOK

1. Draw a sauropod next to a giraffe and a school bus. Label the neck of each animal.
2. Draw a hollow neck bone (with spaces inside) and a solid bone. Write: "Hollow bones are lighter."

Did you know? The name Brontosaurus means "thunder lizard." For many years scientists said Brontosaurus was really the same animal as Apatosaurus and stopped using the name. Then in 2015 some scientists studied the bones again and said Brontosaurus was different enough to keep its own name. Science keeps checking! Some Christians also think of the great beast Behemoth in Job 40 when they see a sauropod (Trail D, Stop D2).

Goes deeper in. Life Science, for skeletons, lungs and the heart (coming soon); and Arithmetic, for comparing lengths.

For families. Neck-length estimates for the longest sauropods (such as Mamenchisaurus sinocanadorum and Supersaurus) run from roughly 40 to nearly 50 feet; the stop says

“more than 40 feet.” Mamenchisaurus had 19 cervical vertebrae. Air-filled (pneumatic) vertebrae are observed; the air-sac system is inferred by comparison with birds. Kenneth Kermack (1951) argued that water pressure would make deep wading impossible, and sauropod trackways on land were documented by Roland T. Bird and others. Neck posture and blood pressure are still debated. Brontosaurus was reinstated as a genus by Tschopp, Mateus and Benson (2015). Knight’s Field Museum murals were painted 1926–1930; the date of this panel is given as about 1929.

PRACTICE

1. **EASY** How many neck bones does a giraffe have? How many did some sauropods have?
2. **MEDIUM** What made a sauropod’s long neck lighter?
3. **MEDIUM** Why did scientists stop thinking sauropods lived in deep water?

Make it a game • Long-Neck Reach. Hang paper “leaves” at different heights around the room or yard with tape. Players are sauropods: they must keep both feet planted in one spot and reach with their arms (the neck) to collect as many leaves as they can. Then try it as a short-necked dinosaur with elbows tucked in.

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. A giant with a hollow, light neck shows God’s wisdom in the way He made each creature.

Practice: answers

1. A giraffe has seven. Some sauropods had up to nineteen.
2. Its neck bones were hollow, with spaces probably filled by air sacs.
3. They found sauropod trackways on land, and deep water would have squeezed their chests so they could not breathe.

2.10 DINOSAUR SOUNDS

OBJECTIVES

- Tell why we cannot be sure what dinosaurs sounded like.
- Explain how Parasaurolophus may have used its hollow crest to make sound.
- Make a low and a high sound with tubes of different lengths.

Warm-up. Roar like a movie dinosaur! Now close your mouth and hum as low as you can, so your chest buzzes. Some scientists think real dinosaurs may have made sounds more like that low hum than a big roar.

Video slot. Video coming. What did dinosaurs sound like? Parasaurolophus crest sound model; birds and crocodiles calling with closed mouths, for children. Search approved channels (Natural History Museum London, American Museum of Natural History, Cornell Lab of Ornithology for bird sounds); preview first.

KEY TERMS

crest

A bony shape on top of an animal's head.

Parasaurolophus

A duck-billed dinosaur with a long, hollow, tube-shaped crest (say “PAR-ah-sore-OL-oh-fus”).

voice box

The part in the throat that makes sounds for calling and singing.

pitch

How high or low a sound is.

CORE IDEAS

The story. About a hundred years ago, fossil hunters in Alberta, Canada, dug up the skull of a duck-billed dinosaur with something strange on its head: a long, curved tube sweeping back like a horn. Later, scientists found that the tube was hollow inside. Think of a trumpet or a church organ pipe. Long, hollow tubes make deep, booming sounds. Could this dinosaur have played its own head like a horn?

Sounds don't fossilize. We can dig up bones, teeth, eggs and footprints, but a sound is gone the moment it ends. And the soft **voice box** in the throat almost never turns into a fossil. So no one knows for sure what dinosaurs sounded like. Scientists look for clues instead.

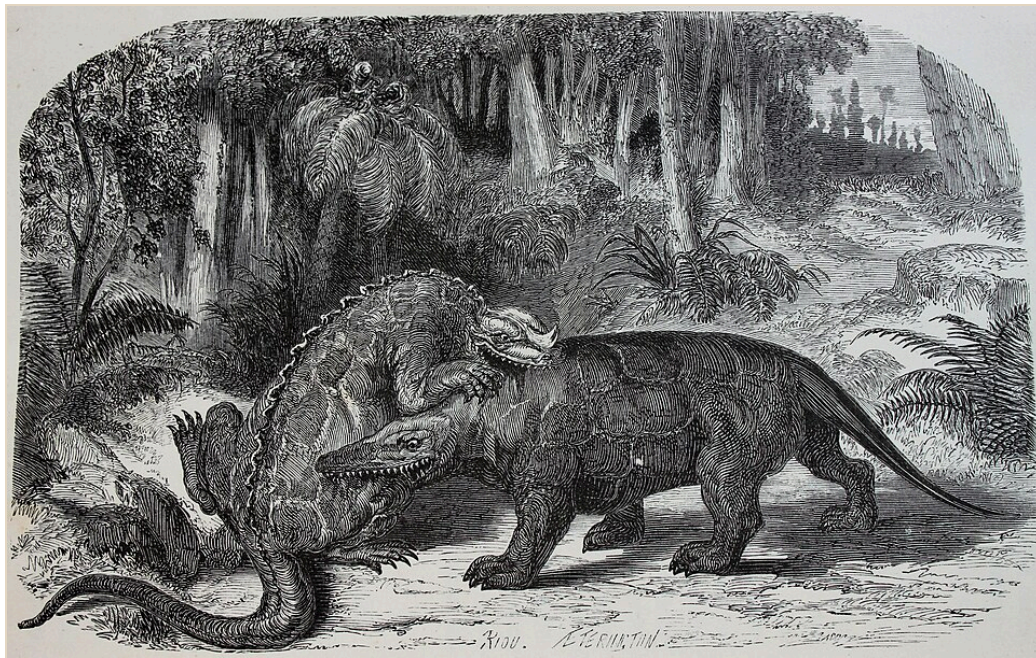
The trumpet crest. **Parasaurolophus** had a long, curved **crest** on the back of its head, longer than a baseball bat. Inside, tubes ran from its nose up into the crest and back down

again. Scientists made a computer model of the crest and played air through it. Out came a deep, rumbling, horn-like sound, like a low note on a tuba. Each *Parasaurolophus* may have called to its herd this way.

Clues from cousins. Dinosaurs' nearest living relatives are birds and crocodiles. Crocodiles bellow and rumble. Many birds, like doves and emus, make booming sounds with their mouths closed. In 2023, scientists described the voice-box bones of an armored dinosaur from Mongolia, and they looked a bit like a bird's. Maybe some dinosaurs boomed, honked, hissed or even chirped, but probably not the roars from the movies!

Everything that hath breath. Whatever sounds the dinosaurs made, they made them with the breath God gave them. The last verse of the Psalms calls every creature to join in: "Let every thing that hath breath praise the LORD" (Psalm 150:6). Our voices are for praising God too.

PICTURE STUDY



Iguanodon and Megalosaurus, from The World Before the Deluge, Édouard Riou, 1863 · Engraving (printed illustration) · From Louis Figuier's book La Terre avant le déluge ("The Earth Before the Deluge"), Paris, 1863

Wikimedia Commons · Public domain

Édouard Riou, a French artist who also drew pictures for Jules Verne's adventure books, made this picture for a popular book about ancient animals. He followed the ideas of his day, so his dinosaurs look like giant lizards on four legs. He drew them with their mouths wide open, as if roaring.

Look closely

- Find the two dinosaurs. Which one has a horn on its nose?
- Look at their mouths. What sound do you imagine they are making?

- Look at the land and sky. How did Riou make the scene feel wild?

Talk about it

1. Riou could not hear a real dinosaur. How do you think he decided they would roar?
2. Iguanodon's "nose horn" turned out to be a thumb spike. What does that teach us about guessing?

HANDS-ON: CREST HORN

Make a Parasaurolophus horn from tubes and hear how a longer tube makes a lower sound.

You will need

- A short cardboard tube (toilet paper tube)
- A long cardboard tube (wrapping paper tube or paper towel tubes taped together)
- Tape and markers

Steps

1. Decorate the long tube like a Parasaurolophus crest.
2. Put your lips to the short tube and hum "ooo" as low as you can. Listen.
3. Now hum the same way into the long tube. Is the sound louder? Deeper? Does the tube buzz?
4. Try humming the same note in each tube and listen to which tube booms. Tell a grown-up: does a longer tube make a higher or a lower pitch?

Check your work

- I made a crest horn from a long tube.
- I compared a short tube and a long tube.
- I can tell why no one knows exactly what dinosaurs sounded like.

FIELD NOTEBOOK

1. Draw Parasaurolophus with its long crest. Draw the tube inside the crest from the nose, up and back down.
2. Write a list of sounds a dinosaur might have made: boom, honk, hiss, rumble. Circle your best guess.

Did you know? Some large animals today, like elephants, make sounds so low that people can barely hear them, but they travel a long way. Scientists who studied the ears of some dinosaurs think they heard low sounds best. A Parasaurolophus herd might have called to each other across a valley with deep, low booms.

Goes deeper in. Life Science, for hearing and sound (coming soon); and Art, for how artists picture things no one has seen.

For families. The *Parasaurolophus* sound model was made in 1997 by Tom Williamson (New Mexico Museum of Natural History) and Carl Diegert (Sandia National Laboratories) from CT scans of a skull. The closed-mouth vocalization hypothesis is from Riede and others (*Evolution*, 2016). The ankylosaur *Pinacosaurus larynx* was described by Yoshida and others (*Communications Biology*, 2023). Riou’s illustrations appeared in Figuier’s *La Terre avant le déluge* (1863; English translation *The World Before the Deluge*, 1865). *Parasaurolophus* was named by William Parks in 1922 from a skull found in Alberta in 1920 by a University of Toronto team; the stop says “about a hundred years ago.” In the project, a tube resonates best at certain notes, and longer tubes favor lower notes.

PRACTICE

1. **EASY** Why don’t we know for sure what dinosaurs sounded like?
2. **MEDIUM** How might *Parasaurolophus* have used its crest?
3. **MEDIUM** Which living animals give scientists clues about dinosaur sounds?

Make it a game • Find Your Herd. Each player secretly picks one dinosaur call: a low boom, a honk, a hiss or a chirp (two players get each sound). Everyone closes their eyes (or a grown-up guides them in a safe open space) and makes their call softly. Players find the others with the same call by listening. The first herd together wins.

Scripture. “Let every thing that hath breath praise the LORD. Praise ye the LORD.” (Psalm 150:6, KJV)

The very last verse of the Psalms calls every breathing creature to praise God. We can use our voices to praise Him.

Practice: answers

1. Sounds do not leave fossils, and the soft voice box almost never fossilizes.
2. Air blew through hollow tubes inside the crest to make a deep, horn-like call.
3. Birds and crocodiles.

TRACK 2 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. A tooth is sharp, curved and has tiny bumps on its edges. Did its owner eat meat or plants?
2. What was the Citipati found in the Gobi Desert doing?
3. What is a trace fossil? Give one example.
4. Name one clue that some dinosaurs lived in herds.
5. How do footprints show that a dinosaur was running?

Badge quiz 2 (Stops 6–10)

6. What is the difference between a warm-blooded and a cold-blooded animal?
7. Name two ways Archaeopteryx was different from birds today.
8. What does Maiasaura mean?
9. What made a sauropod's long neck light enough to hold up?
10. How might Parasaurolophus have used its hollow crest?

TRAIL CERTIFICATE: MY DINOSAUR DETECTIVE NOTEBOOK AND TRAIL C CERTIFICATE

Gather the Field Notebook pages from this trail into one booklet with a cover: "My Dinosaur Detective Notebook," your name and the dates you started and finished.

Add a "Clues" page: draw one fossil clue for each stop (a tooth, an egg, a footprint, a trackway map, a stride, a growth ring, a feather, a neck bone, a crest) and write what it tells us.

Add the plaster track cast from Stop C3, or a photo of it.

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.
- **Clues page:** Each clue is drawn and matched with what it tells us about how dinosaurs lived.
- **Observe or interpret:** The child can say what a fossil shows and, separately, what people think it means (Stop C7).
- **Care:** Drawings are labeled and done carefully.

Answer key

1. Meat. Sharp, serrated teeth cut meat.
2. Sitting on its nest, keeping its eggs warm and safe (brooding).
3. A fossil that shows something an animal did, such as a footprint, a nest or a burrow.

4. Either: parallel trackways going the same way, or bonebeds with many dinosaurs of one kind buried together.
5. The footprints are farther apart (a longer stride).
6. A warm-blooded animal makes its own body heat; a cold-blooded animal gets its warmth from outside, like the sun.
7. Any two: teeth, claws on its wing fingers, a long bony tail.
8. "Good mother lizard."
9. Hollow neck bones, probably filled with air sacs.
10. To make a deep, horn-like call by blowing air through the tubes inside.

GREAT BATTLES ✕ TRAIL C: THE AGE OF SAIL AND THE AMERICAN FOUNDING

The third trail of the Great Battles track sails from the Spanish Armada in 1588 to Nelson's victory at Trafalgar in 1805. On the way it rides with the winged hussars to Vienna, climbs the cliffs at Quebec, and follows the American Revolution from Lexington and Concord to Trenton, Saratoga and Yorktown. Each battle is taught through **the map** (the land or sea), **the plan, the people** (their courage and faith) and **why it mattered**.

This is the ● **Scout** level, for ages 7 to 9. A parent reads the story aloud, or a strong reader reads it alone. Battles are told plainly and gently: who fought, where, the plan, what happened and why it mattered. Numbers of soldiers and losses are given as numbers, deaths are stated plainly but not described, and pictures are chosen for their story, not for violence. Both sides are described fairly and in the terms of their own time. Every stop stands by itself.

Every stop has a **terrain map** to draw, a **tabletop** activity, and a **"Choose your move"** puzzle in which the child makes the commander's choice before learning what happened. Five stops earn the **Battle Scout badge, part 1**; eight 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 Europe, the Atlantic Ocean and the eastern United States on a globe (a grown-up may help). Trails A and B are helpful but not required.

MASTERY CHECKLIST

- ☐ I can put the eight battles of this trail in order on a timeline, from the Armada (1588) to Trafalgar (1805).
- ☐ I can find each battle on a map of Europe or North America.
- ☐ I can tell how the wind, the water, a cliff, a river or the hills helped decide three of the battles.
- ☐ I can tell the story of the American Revolution in four battles: Lexington and Concord, Trenton, Saratoga and Yorktown.
- ☐ I can name a leader from this trail and one virtue he or she showed, and draw a terrain map with a title, a key and both sides.

OPTIONAL BOOKS AND RESOURCES

- **American Battlefield Trust** (<https://www.battlefields.org>): Free battle maps, short videos and pictures for Lexington and Concord, Trenton, Saratoga, Yorktown and Quebec.

- **National Park Service** (<https://www.nps.gov>): Free pages, maps and Junior Ranger booklets for Minute Man, Saratoga and Colonial (Yorktown) National Historical Parks; good for planning a visit.
- **Royal Museums Greenwich** (<https://www.rmg.co.uk>): Pictures of the Armada and Trafalgar paintings, ship models and Nelson's life, for Stops C1 and C8.
- **Project Gutenberg** (<https://www.gutenberg.org>): Free old read-alouds such as H. E. Marshall's *Our Island Story* (the Armada, Trafalgar) and *This Country of Ours* (Quebec and the American Revolution).

3.1 THE SPANISH ARMADA (1588)

OBJECTIVES

- Find Spain, England, the English Channel and Calais on a map.
- Tell how the English used fireships to break up the Armada's crescent.
- Explain how the wind and storms helped decide what happened.

Warm-up. Float a few paper boats or bottle caps in a bowl of water. Blow gently from one side. Which way do the boats go? Can they sail against your breath? In 1588 the wind helped decide a great sea battle.

Video slot. Video coming. The Spanish Armada of 1588 for young viewers: the crescent, the fireships at Calais and the storms. Search approved channels (Royal Museums Greenwich, Simple History, The History Guy); preview first.

KEY TERMS

armada

The Spanish word for a fleet of warships. The Spanish Armada was the great fleet sent against England in 1588.

fleet

A large group of ships sailing together under one leader.

fireship

An old ship filled with things that burn, set on fire and sent drifting toward enemy ships.

Channel

The English Channel, the narrow sea between England and France.

CORE IDEAS

The map. England is an island. To reach it, an army must cross the sea. In the summer of 1588, King Philip II of Spain sent about 130 ships up the English Channel, the narrow sea between England and France. His plan was to meet a Spanish army waiting in the Netherlands and carry it across to England.

The people. Philip was a Catholic king who ruled the largest empire in the world. He wanted to stop English sailors from raiding his treasure ships, to stop England from helping the Dutch who had risen against him, and to bring England back to the Catholic Church. Elizabeth I, England's Protestant queen, called her people to defend the land. Her fleet was led by Lord Howard, with the famous sea captain Sir Francis Drake.

The plan. The Spanish ships sailed in a great crescent, like a new moon, with the strongest ships on the tips. The English ships were smaller and quicker, and they kept their distance and fired their guns. For a week neither side could break the other. Then the Armada

dropped anchor near Calais in France. At night the English sent eight **fireships** drifting toward them on the wind.

What happened. Afraid of the flames, the Spanish captains cut their anchor ropes and scattered in the dark. The next day the English fought them near Gravelines. Then a strong wind blew the Armada north. It could not turn back, so it sailed all the way around Scotland and Ireland. Storms wrecked many ships on the rocky coasts. Only about half of the Armada ever reached home.

Why it mattered. England was not invaded. The English, and the Dutch, believed that God had sent the wind. A medal made afterward said in Latin, “God blew and they were scattered.” England went on to grow into a great sea power.

PICTURE STUDY



The Defeat of the Spanish Armada, 8 August 1588, Philip James de Loutherbourg, 1796 · Oil on canvas ·
National Maritime Museum, Greenwich, London
Wikimedia Commons · Public domain

Philip James de Loutherbourg painted this more than two hundred years after the battle. He loved stormy skies and moving water, and he painted the fight near Gravelines as a sea full of crashing ships and smoke.

Look closely

- Find the biggest ship. Count its masts.
- Look at the sky and the waves. Is the weather calm or rough?
- Find a flag. Can you tell which side it belongs to?

Talk about it

1. Why do you think the painter made the sky so dark and wild?
2. How would the wind matter to ships that move only by sails?

Safety first. Do not use real fire. The “fireships” in the tabletop activity get red and orange paper flames only.

HANDS-ON: TABLETOP ARMADA: THE FIRESHIPS

Set up the Armada’s crescent on the water and see what fireships drifting on the wind can do.

You will need

- A baking pan or tub with a little water (the Channel)
- About 10 small paper boats or bottle caps (the Armada)
- About 6 more in another color (the English)
- Two paper boats with red and orange paper flames taped on (fireships)
- A paper fan, or your own breath (the wind)

Steps

1. Set the Spanish ships in a crescent shape at one end of the pan, like a new moon.
2. Set the English ships behind them, the way the wind came.
3. Put the two fireships behind the English and fan or blow them gently toward the crescent.
4. Did the crescent stay together? Now fan the scattered Spanish ships toward the far end. Can they sail back against the wind?

Check your work

- My Armada sailed in a crescent.
- I sent the fireships on the wind.
- I can tell why the Spanish ships could not turn back.

FIELD NOTEBOOK

1. **Terrain map.** Draw England, France, Spain and the Netherlands. Mark the English Channel and Calais. Draw the Armada’s crescent in the Channel, then an arrow showing its long way home around Scotland and Ireland.
2. Write: “God blew and they were scattered. 1588.”

Did you know? When the Armada was first seen off the coast of England, people lit a chain of bonfires called beacons on hilltops, one after another, to carry the news across the country faster than a horse could ride. A famous story says Drake was playing a game of bowls when the news came and finished his game first; no one knows whether it is true.

Goes deeper in. History, the unit on the Reformation and the age of exploration (coming soon); and Geography, for the British Isles and the English Channel.

For families. Figures are approximate: about 130 Spanish ships and roughly 30,000 men sailed; estimates of ships lost run from about 50 to over 60, most to storms off Scotland and Ireland, not to English guns. The fireship attack was the night of 7–8 August 1588 (new-style calendar), followed by the battle off Gravelines. The Latin words “Flavit [Jehovah/Deus] et dissipati sunt” appear on commemorative medals (Dutch examples survive); the Drake bowls story is a later tradition and is marked as such. Both rulers’ motives are given in their own terms.

PRACTICE

1. **MEDIUM Choose your move.** You are Lord Howard. The Armada is anchored close together near Calais, and the wind is blowing from you toward them. Will you (a) sail straight into the crescent and fight ship to ship, (b) send burning ships drifting at them in the night, or (c) wait in port for them to come to you?
2. **EASY** Who was queen of England in 1588?
3. **EASY** What wrecked most of the Armada’s lost ships?

Make it a game • Beacon Fires. Players stand far apart in a line across a yard or a long room, each holding a flashlight or a red paper “flame.” The first player sees the “Armada” (a grown-up waves a towel) and raises the flame. The next raises theirs as soon as they see it, and so on down the line. Time how fast the news travels, then try to beat your time.

Scripture. “Fire, and hail; snow, and vapour; stormy wind fulfilling his word:” (Psalm 148:8, KJV)

The wind and the storms obey God. The people of 1588 remembered that the wind is in His hands, not in the hands of kings.

Practice: answers

1. Howard chose (b). Eight fireships drifted down on the wind, the Spanish cut their anchors and scattered, and their crescent was broken.
2. Elizabeth I.
3. Storms on the way home around Scotland and Ireland.

3.2 VIENNA (1683): THE WINGED HUSSARS

OBJECTIVES

- Find Vienna, the Danube River and Poland on a map of Europe.
- Tell how King Jan Sobieski’s army came down from the hills to free the city.
- Describe the winged hussars and their great charge.

Warm-up. Lie on the floor and hold a feather or a paper strip above you. Now imagine hundreds of horsemen with tall feathered wings on their backs, riding down a hill toward you. How would you feel?

Video slot. Video coming. The Battle of Vienna, 1683, for young viewers: Jan III Sobieski and the Polish winged hussars. Search approved channels (Kings and Generals, Simple History, The History Guy); preview first.

KEY TERMS

siege

When an army surrounds a city or castle to make it give up.

Ottoman Empire

A great Muslim empire ruled by a sultan from Constantinople (Istanbul) (say “OT-oh-man”).

hussar

A horse soldier. The Polish hussars carried long lances and wore feathered wings on their backs (say “huh-ZAR”).

relief army

An army that comes to rescue a city under siege.

CORE IDEAS

The map. Vienna is a city on the Danube River in Austria. In the summer of 1683 it had strong stone walls, and on its west side rose a ring of steep, wooded hills called the Vienna Woods. On July 14 a huge Ottoman army arrived and surrounded the city. Its diggers began tunneling under the walls to break them open.

The people. The Ottoman army was led by the grand vizier Kara Mustafa, the sultan’s chief minister. He hoped to win Vienna, a great prize, and push the empire deeper into Europe. Inside the walls, Count Starhemberg and about 15,000 soldiers, helped by the townspeople, held on week after week. They prayed and waited for help. Help was coming from King Jan III Sobieski of Poland, who marched with his army to join the Austrian and German princes.

The plan. The rescuers did not come by the easy road. They climbed up through the steep Vienna Woods to the hilltops above the Ottoman camp, where few guards were watching.

Early on the morning of September 12, a Capuchin friar, Marco d'Aviano, said Mass on the hill called the Kahlenberg. Then the **relief army** started down the slopes.

What happened. They fought their way down all day. Late in the afternoon, Sobieski led one of the largest cavalry charges in history, many thousands of horsemen. At the front rode the Polish **hussars** with their long lances and tall wings of feathers. The Ottoman lines broke, and by evening the siege was over. Sobieski wrote to the Pope: "We came, we saw, God conquered."

Why it mattered. The Ottoman Empire had been pushing into Europe for three hundred years. After Vienna it began to be pushed back. Within a few years Hungary was free of Ottoman rule. The Pope set September 12 as a feast day to give thanks.

PICTURE STUDY



Jan III Sobieski at Vienna, Jan Matejko, 1883 · Oil on canvas · Vatican Museums, Vatican City
Wikimedia Commons · Public domain

The Polish painter Jan Matejko painted this enormous picture for the two hundredth anniversary of the battle and gave it to the Pope. It still hangs in a room in the Vatican called the Sobieski Room.

Look closely

- Find King Sobieski. How did the painter make him stand out?
- Look for a horseman with feathered wings.
- Find the banners and the city in the distance.

Talk about it

1. Why do you think Matejko gave his painting to the Pope?

2. Sobieski said, “God conquered.” Why might a king say that instead of “I conquered”?

HANDS-ON: TABLETOP VIENNA: DOWN FROM THE HILLS

Build the city, the camp and the hills, and send the relief army down the slopes.

You will need

- Blocks for the city walls
- Pillows or rolled towels under a green blanket (the Vienna Woods)
- Toy soldiers or blocks in two colors
- A few toy horses, or blocks with paper feather wings taped on (the hussars)
- A blue ribbon (the Danube)

Steps

1. Lay the blue ribbon on one side. Build Vienna’s walls beside it.
2. Put the Ottoman camp in a ring around the city.
3. Make the hills with pillows under the blanket on the west side, away from the river.
4. Line up the relief army on the hilltops, with the hussars in front. Move them down the slopes all together. Which way does a charge go faster: uphill or downhill?

Check your work

- My map has the city, the river, the camp and the hills.
- My hussars have wings.
- I can tell why coming from the hills was a good plan.

FIELD NOTEBOOK

1. **Terrain map.** Draw Vienna with its walls beside the Danube River. Draw the Ottoman camp around it and the wooded hills to the west. Add arrows for the relief army coming down from the Kahlenberg.
2. Draw a winged hussar. Write: “We came, we saw, God conquered. 1683.”

Did you know? The hussars’ wings were wooden frames with real feathers, often from eagles, fastened to their backs or saddles. No one is sure why they wore them. Some say the wings made a whooshing noise that frightened the enemy’s horses; others think they simply looked splendid. Their lances could be longer than two grown-ups lying head to toe.

Goes deeper in. History, the unit on early modern Europe (coming soon); and Geography, for the Danube and Central Europe.

For families. The siege ran from July 14 to September 12, 1683. Army sizes are uncertain: the Ottoman force is often given as 90,000–150,000 and the relief army as about 65,000–80,000; the cavalry charge is usually put at about 18,000–20,000 riders.

Sobieski's "Venimus, vidimus, Deus vicit" is from his report to Pope Innocent XI, who extended the feast of the Holy Name of Mary to the whole Church in thanksgiving. Popular tales that the croissant or Vienna's coffeehouses began with this battle are legends and are left out. Kara Mustafa was executed on the sultan's orders that December; the story does not mention it.

PRACTICE

1. **MEDIUM Choose your move.** You are King Sobieski. The enemy camp lies around Vienna, and steep wooded hills rise above it. Will you (a) march along the flat river road where the enemy is waiting, (b) climb through the woods to the hilltops and come down on them, or (c) wait far away until the enemy goes home?
2. **EASY** What did the Polish hussars wear on their backs?
3. **EASY** What did Sobieski write to the Pope?

Make it a game • Hussar Charge. Players tuck paper "feathers" into the backs of their collars. Everyone lines up at the top of a gentle slope or one end of a yard. On "Charge!" all walk fast together, staying in one straight line, to the far side. If the line breaks, go back and try again. The goal is to arrive all together, not first.

Scripture. "Some trust in chariots, and some in horses: but we will remember the name of the LORD our God." (Psalm 20:7, KJV)

Sobieski had thousands of horses, but he gave the victory to God. Horses and armies are good gifts; our trust belongs to the Lord.

Practice: answers

1. Sobieski chose (b). The relief army came over the hills, fought its way down, and his great cavalry charge broke the siege.
2. Tall wings made of feathers.
3. "We came, we saw, God conquered."

3.3 QUEBEC (1759): THE CLIMB TO THE PLAINS OF ABRAHAM

OBJECTIVES

- Find Quebec and the St. Lawrence River on a map of North America.
- Tell how General Wolfe's soldiers climbed the cliffs in the night.
- Explain how this battle helped lead, years later, to the American Revolution.

Warm-up. Look out a window at night, or turn off the lights. How far can you see? Now imagine climbing a steep cliff in the dark, as quietly as you can, with a heavy pack and a musket. That is what thousands of soldiers did at Quebec.

Video slot. Video coming. The Battle of the Plains of Abraham, Quebec, 1759, for young viewers: Wolfe, Montcalm and the climb up the cliffs. Search approved channels (American Battlefield Trust, Simple History, The History Guy); preview first.

KEY TERMS

French and Indian War

The war in North America (1754–1763) between Britain and France, with Indian nations fighting on both sides.

cliff

A very steep, high wall of rock or earth.

volley

When many soldiers fire their muskets all at the same moment.

Plains of Abraham

A flat, open field on top of the cliffs just outside the city of Quebec.

CORE IDEAS

The map. Quebec, the capital of New France, stood high on cliffs above the wide St. Lawrence River in what is now Canada. Its walls and cliffs made it very hard to attack. All summer in 1759 a British army camped near it and could not get in. Winter was coming, and when the river froze, the British ships would have to leave.

The people. The British general was James Wolfe, only 32 years old, often sick but brave and determined. The French general was the Marquis de Montcalm, a skilled soldier who had defended New France for years. Each believed he was serving his king and his country. The war between them was called the **French and Indian War**.

The plan. Wolfe found a narrow, steep path up the **cliff** at a cove upriver from the city. On the night of September 12, his soldiers floated quietly down the river in boats. When a French guard called out, a story says a British officer answered in French, and the boats

slipped by. Then the men pulled themselves up the cliff by roots and bushes. By morning about 4,500 British soldiers stood in lines on the **Plains of Abraham**.

What happened. Montcalm was amazed and marched out to meet them. The British waited until the French were very close, then fired great **volleys**. The battle was over in less than half an hour. Both generals were killed: Wolfe on the field, and Montcalm the next morning. Five days later Quebec surrendered.

Why it mattered. Soon all of Canada became British. The American colonists no longer feared France on their border. But Britain had spent a great deal on the war and began to tax the colonies to pay for it. That led, a few years later, to the American Revolution. You will meet one of Wolfe's officers, William Howe, again in that war.

PICTURE STUDY



The Death of General Wolfe, Benjamin West, 1770 · Oil on canvas · National Gallery of Canada, Ottawa
Wikimedia Commons · Public domain

Benjamin West was born in Pennsylvania and became a painter in London. He painted Wolfe's last moments as a calm, quiet scene, almost like a painting of a saint. People were surprised that he dressed everyone in the real clothes of 1759 instead of ancient robes, and the painting became famous.

Look closely

- Find General Wolfe. Where are the other people looking?
- Find the flag. What shape does it make above the group?
- Find the runner in the distance bringing news. What news might he carry?

Talk about it

1. West was not there, and some of the men in the picture were not either. Why might he have put them in?
2. Why do you think West made the scene so calm and still?

HANDS-ON: TABLETOP QUEBEC: UP THE CLIFF

Build the river and the cliff and find the one narrow path to the top.

You will need

- A blue towel (the St. Lawrence River)
- A stack of books or a sturdy box (the cliffs)
- A strip of paper or a piece of string (the narrow path)
- A small box for the city of Quebec
- Toy soldiers or blocks in two colors, and a few small boats (paper or toy)

Steps

1. Lay the blue river along the table. Set the books along its edge for the cliff, with the city box on top at one end.
2. Lay the string up the side of the cliff a little way from the city. That is the only path.
3. Float the British boats along the river and land them below the path. Move the soldiers up the path one at a time.
4. Line them up on top, on the Plains of Abraham. Now bring the French out of the city to meet them.

Check your work

- My map has the river, the cliff, the path and the city.
- My soldiers climbed one at a time.
- I can tell why the British came at night.

FIELD NOTEBOOK

1. **Terrain map.** Draw the St. Lawrence River with the city of Quebec on the cliff. Draw the British boats on the river, the narrow path up the cliff, and the two armies facing each other on the Plains of Abraham.
2. Write: "Quebec, September 13, 1759."

Did you know? In Quebec City today there is one monument that honors both generals together, Wolfe and Montcalm. It says in Latin that their courage gave them a shared death, history a shared fame and those who came after a shared monument. The Plains of Abraham are now a big city park. They are named after Abraham Martin, a farmer and river pilot who once owned land there, not after Abraham in the Bible.

Goes deeper in. History, the unit on colonial America (coming soon); and Geography, for Canada and the St. Lawrence River.

For families. The British landed at the Anse au Foulon before dawn on September 13, 1759; the force on the plain is usually given as about 4,400–4,800, with the French roughly equal on the field. Each side had about 650 killed or wounded. The story of an officer (often named as Captain Simon Fraser) answering a sentry in French comes from eyewitness accounts but details vary; the stop marks it as “a story.” The tale that Wolfe recited Gray’s “Elegy” on the river is left out as uncertain. West’s painting is not a factual record; several men shown were not present. It is chosen for its composition and contains no gore.

PRACTICE

1. **MEDIUM Choose your move.** You are General Wolfe. All summer your attacks have failed, and the river will freeze soon. Will you (a) attack the strong French lines along the river again, (b) sail home before winter, or (c) slip your men down the river at night and climb a narrow path up the cliff?
2. **EASY** Who were the two generals at Quebec?
3. **MEDIUM** How did this battle help lead to the American Revolution?

Make it a game • Quiet on the River. One player is the French guard and sits with eyes closed at one end of the room. The others are Wolfe’s soldiers and creep from the far end, one at a time. If the guard hears a sound, the guard points and says, “Who goes there?” A soldier who is pointed at goes back to start. A soldier who touches the guard’s chair has climbed the cliff.

Scripture. “Have not I commanded thee? Be strong and of a good courage; be not afraid, neither be thou dismayed: for the LORD thy God is with thee whithersoever thou goest.” (Joshua 1:9, KJV)

Climbing a cliff in the dark takes courage. God told Joshua that He goes with His people everywhere, even into dark and hard places.

Practice: answers

1. Wolfe chose (c). By morning his army stood on the Plains of Abraham, and the battle there won Quebec.
2. James Wolfe for Britain and the Marquis de Montcalm for France.
3. Britain had spent so much on the war that it taxed the colonies to pay for it, and the colonists were angry.

3.4 LEXINGTON AND CONCORD (1775)

OBJECTIVES

- Trace the road from Boston to Lexington and Concord on a map.
- Tell how Paul Revere and other riders warned the militia.
- Explain why this day is called the start of the American Revolution.

Warm-up. Hold up one flashlight, then two. If one light meant “by land” and two meant “by sea,” what message would two lights send? On the night of April 18, 1775, two lanterns shone from a church steeple in Boston.

Video slot. Video coming. Lexington and Concord, April 19, 1775, for young viewers: Paul Revere’s ride, the Minutemen and the North Bridge. Search approved channels (American Battlefield Trust, National Park Service: Minute Man National Historical Park, Simple History); preview first.

KEY TERMS

militia

Ordinary townspeople and farmers who trained to defend their town when needed.

Minutemen

Militia who promised to be ready to march at a minute’s warning.

regulars

Full-time, trained soldiers. The British regulars wore red coats.

colony

A land settled and ruled by a faraway country. Massachusetts was one of Britain’s thirteen colonies in America.

CORE IDEAS

The map. In 1775 Boston sat on a small piece of land with water almost all around it. A country road ran west from there through the village of Lexington to the town of Concord, about 18 miles away. Along the road were farms, woods and long stone walls. The colonists had hidden gunpowder and cannon in Concord.

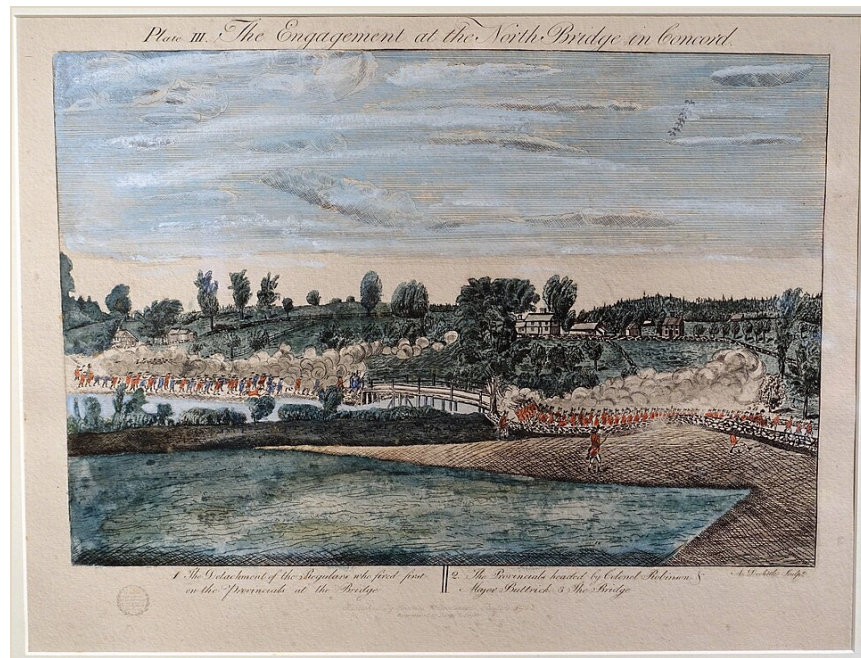
The people. General Thomas Gage, the British governor, hoped to stop a war by taking those supplies away. The colonists felt their rights as Englishmen were being taken: they were taxed by a Parliament where they had no vote, and now soldiers were coming for their powder. On the night of April 18, about 700 British **regulars** set out by boat across the river. Two lanterns in the steeple of the Old North Church gave the signal, and Paul Revere, William Dawes and Dr. Samuel Prescott rode through the dark to warn the countryside.

What happened at Lexington. At dawn about 77 **militia** stood on Lexington's village green. Their captain, John Parker, did not want to start a war. The British marched up and ordered them to go home. As the militia began to leave, a shot rang out. No one knows who fired it. The British fired volleys, and 8 Lexington men were killed.

The plan at Concord. The British marched on to Concord to search for the supplies. From a hill outside town, the militia saw smoke rising and feared the town was burning. They marched down to the North Bridge, under orders not to fire first. The British soldiers at the bridge fired, the militia fired back, and the British fell back. All the long way to Boston, militia from many towns fired from behind trees and stone walls. By night the British had lost 73 men killed and the Americans 49.

Why it mattered. The war for American independence had begun. The poet Ralph Waldo Emerson later wrote that the farmers at the bridge "fired the shot heard round the world."

PICTURE STUDY



The Engagement at the North Bridge in Concord (Plate III), Amos Doolittle, from drawings by Ralph Earl, 1775 · Hand-colored engraving · Copies are kept in several American libraries and museums
Wikimedia Commons · Public domain

Amos Doolittle was a young silversmith from Connecticut who marched to Boston with the militia. A few weeks after the battle, he and the painter Ralph Earl visited Concord, talked with people who had been there and drew the places. Doolittle then engraved four prints. They are some of the very first American pictures of the Revolution.

Look closely

- Find the bridge and the river.
- Find the redcoats. Find the militia. How can you tell them apart?

- Look at the houses and hills. Does this look like a real place?

Talk about it

1. This picture is not as smooth or fancy as a painting in a museum. Why is it still very important?
2. Why would people in 1775 want to buy a picture of this battle?

HANDS-ON: TABLETOP ROAD TO CONCORD

Lay out the long road on the floor and see why the march back to Boston was so hard.

You will need

- Masking tape (the road)
- Paper labels: Boston, Lexington, Concord, North Bridge
- Blocks or Lego bricks (stone walls) and toy trees or green paper
- Toy soldiers or blocks in red and in brown or blue

Steps

1. Tape a long road across the floor. Put Boston at one end, Lexington in the middle and Concord at the far end, with the North Bridge just past it.
2. Line the road with stone walls and trees.
3. March the redcoats from Boston to Concord in a column.
4. Place the militia behind the walls and trees along the road. March the redcoats back to Boston. Why was the way back harder than the way out?

Check your work

- My road has Boston, Lexington, Concord and the bridge.
- I placed walls and trees along the road.
- I can tell why the militia stayed behind walls and trees.

FIELD NOTEBOOK

1. **Terrain map.** Draw Boston by the water. Draw the road west to Lexington and Concord. Mark the village green, the North Bridge and the stone walls along the road. Add a red arrow out and a red arrow back.
2. Draw the Old North Church with two lanterns in its steeple.

Did you know? Paul Revere never reached Concord. A British patrol stopped him on the road. Dr. Samuel Prescott jumped his horse over a wall and got away to carry the warning. That night Revere had first warned Samuel Adams and John Hancock, who were staying at the house of Lexington's minister, the Rev. Jonas Clarke.

Goes deeper in. History, the unit on the American Revolution (coming soon); and Literature, for Longfellow's poem "Paul Revere's Ride."

For families. Numbers: about 700 British regulars in the first column; about 77 Lexington militia; 8 killed at Lexington. Day totals (usual figures): British 73 killed, 174 wounded, 26 missing; Americans 49 killed, 39 wounded, 5 missing. Who fired first at Lexington is unknown. Captain Parker's famous words ("Stand your ground...") were recorded decades later, so they are left out. Emerson's line is from his "Concord Hymn" (1837). Longfellow's poem (1860) is stirring but not accurate in every detail. British motives (seizing military stores to prevent war) and colonial motives (their rights as Englishmen) are both given.

PRACTICE

1. **MEDIUM Choose your move.** You are a militia officer on the hill outside Concord. You see smoke rising from the town, and redcoats are guarding the North Bridge. Will you (a) stay safely on the hill, (b) march down to the bridge in good order, under orders not to fire first, or (c) send everyone home?
2. **EASY** Why were they called Minutemen?
3. **EASY** What did the British want to find in Concord?

Make it a game • Pass the Warning. Players stand in different rooms or far apart in the yard. The first "rider" gets a secret message from a grown-up, such as "The regulars are coming by sea!" The rider runs to the next player and whispers it, and that player runs on to the next. The last player says the message out loud. Did it arrive the same as it started?

Scripture. "And I looked, and rose up, and said unto the nobles, and to the rulers, and to the rest of the people, Be not ye afraid of them: remember the Lord, which is great and terrible, and fight for your brethren, your sons, and your daughters, your wives, and your houses." (Nehemiah 4:14, KJV)

Nehemiah's people stood guard to protect their families and homes. The militia of 1775 were farmers and neighbors who left their fields to protect their towns.

Practice: answers

1. The militia chose (b). When the British at the bridge fired, the militia fired back, and the British fell back toward town.
2. They promised to be ready to march at a minute's warning.
3. The colonists' hidden gunpowder and cannon (military supplies).

3.5 TRENTON (1776): CROSSING THE DELAWARE

OBJECTIVES

- Find the Delaware River, Pennsylvania, New Jersey and Trenton on a map.
- Tell how Washington's army crossed the icy river on Christmas night.
- Explain why the small victory at Trenton gave the Americans new hope.

Warm-up. Put a few ice cubes in a bowl of cold water and hold your fingers in it for a slow count of ten. Brr! Now imagine pushing a heavy boat through icy water all night in a snowstorm. That was Christmas night, 1776.

Video slot. Video coming. Washington crosses the Delaware and the Battle of Trenton, December 1776, for young viewers. Search approved channels (American Battlefield Trust, Mount Vernon, Simple History); preview first.

KEY TERMS

Continental Army

The American army of the Revolution, led by George Washington.

Hessians

German soldiers, many from the land of Hesse, whom the British king hired to fight in America.

enlistment

A soldier's promise to serve for a certain time. Many of Washington's men would go home when theirs ended on December 31.

watchword

A secret word or phrase soldiers use to know their friends in the dark.

CORE IDEAS

The map. By December 1776, the Americans had lost New York and been chased across New Jersey. Washington's army camped on the Pennsylvania side of the wide Delaware River. On the New Jersey side, in the town of Trenton, about 1,500 **Hessian** soldiers were spending the winter under Colonel Johann Rall. The river was cold and full of floating ice.

The people. Washington's soldiers were tired, hungry and ragged. Some had no shoes. Many of their **enlistments** ended on the last day of the year, and people wondered if the army would melt away. Thomas Paine wrote, "These are the times that try men's souls." Washington decided he must strike before it was too late. The Hessians were tough, well-trained professional soldiers, doing their duty far from home.

The plan. On Christmas night, about 2,400 men began crossing the river in big, flat cargo boats called Durham boats. Fishermen from Marblehead, Massachusetts, rowed and poled

them through the ice. Colonel Henry Knox, who had a booming voice, shouted directions in the storm. Snow and sleet fell. The crossing took hours longer than planned, but Washington would not turn back. The **watchword** was “Victory or Death.”

What happened. The army marched about nine miles through the storm and reached Trenton at about eight in the morning. They came into the town from two sides at once. The Hessians fought bravely, but they were surprised and surrounded. In about an hour it was over. Colonel Rall was mortally wounded, and about 900 Hessians were taken prisoner. Very few Americans were hurt in the fighting.

Why it mattered. Trenton was a small battle with a big meaning. Days later Washington won again at Princeton. People across America took heart, and many soldiers agreed to stay in the army. The Revolution was still alive.

PICTURE STUDY



Washington Crossing the Delaware, Emanuel Leutze, 1851 · Oil on canvas · The Metropolitan Museum of Art, New York
Wikimedia Commons · Public domain

Emanuel Leutze grew up in America and painted this in Germany, 75 years after the crossing. The painting is enormous: about 12 feet tall and 21 feet wide. Leutze changed some things to tell the story more boldly. The crossing really happened at night, in a storm, in larger boats.

Look closely

- Find Washington. Why does he stand out?
- Count the men in his boat. What jobs are they doing?
- Look at the ice and the sky. What time of day did the painter choose?

Talk about it

1. The flag in the picture, the Stars and Stripes, was not adopted until 1777. Why might Leutze have put it in?
2. Why do you think Leutze made the crossing look brighter than it really was?

HANDS-ON: TABLETOP CROSSING: FERRY THE ARMY

Ferry the whole army across an icy river and find out why the crossing took so long.

You will need

- A blue sheet or towel (the Delaware River)
- White paper scraps (the ice)
- Two or three shoeboxes or boxes (the Durham boats)
- About 24 toy soldiers or blocks, plus a few toy horses and “cannon” (pencils or spools)
- A timer

Steps

1. Spread the river on the floor with ice scraps on it. Put the army on one bank and label the other bank “New Jersey.”
2. Each boat may carry only 4 soldiers, or 1 horse, or 1 cannon at a time.
3. Push the boats across, unload them and bring them back empty. Count your trips and time the whole crossing.
4. When everyone is across, march them in two groups to Trenton and come in from two sides.

Check your work

- I moved the whole army across.
- I counted the trips.
- I can tell why the real crossing took all night.

FIELD NOTEBOOK

1. **Terrain map.** Draw the Delaware River running down the page, with Pennsylvania on the left and New Jersey on the right. Mark McConkey’s Ferry where the army crossed and Trenton downriver. Draw the two roads the army took into town.
2. Write the watchword: “Victory or Death.”

Did you know? One of the few Americans wounded at Trenton was a young lieutenant named James Monroe. He later became the fifth President of the United States. The crossing is acted out on the Delaware every Christmas Day at Washington Crossing, Pennsylvania, in real Durham boats, when the river is safe.

Goes deeper in. History, the unit on the American Revolution (coming soon); and Art, for history painting and Leutze.

For families. Usual figures: about 2,400 Americans crossed at McConkey's Ferry on December 25–26, 1776; about 1,500 Hessians were in Trenton; about 22 Hessians were killed and some 900 captured. No Americans are known to have been killed in the fighting, though accounts say two men died from the cold on the march. The old story that the Hessians were drunk after Christmas is a myth and is left out. Paine's line opens *The American Crisis* (December 1776); tradition says Washington had it read to the troops before the attack, which is likely but not certain.

PRACTICE

1. **MEDIUM Choose your move.** You are General Washington. It is Christmas night. The crossing is hours late, the storm is getting worse, and you will now reach Trenton in daylight, not in the dark. Will you (a) turn back to camp, (b) keep going and attack anyway, or (c) wait on the river bank for a better night?
2. **EASY** Who were the Hessians?
3. **EASY** What was the watchword on the night of the crossing?

Make it a game • Ice on the River. Lay pillows or paper “ice floes” across the floor. Players are boats and must cross from one side of the room to the other stepping only on the floes. A grown-up is the storm and slowly takes away one floe after each crossing. How few floes can the boats use and still get the whole army across?

Scripture. “Thou therefore endure hardness, as a good soldier of Jesus Christ.” (2 Timothy 2:3, KJV)

Washington's men endured cold, hunger and a long night. Paul tells Christians to endure hard things too, faithfully, like good soldiers.

Practice: answers

1. Washington chose (b). He kept going, reached Trenton about eight in the morning, and surprised and captured most of the Hessians.
2. German soldiers hired by the British king to fight in America.
3. “Victory or Death.”

3.6 SARATOGA (1777): THE TURNING POINT

OBJECTIVES

- Trace Burgoyne’s march from Canada down to Saratoga on a map of New York.
- Tell how the Americans used trees, hills and the Hudson River to stop him.
- Explain why Saratoga is called the turning point of the Revolution.

Warm-up. Lay a few pillows or chairs across a hallway and try to push a wagon or a laundry basket through. How fast can you go? In 1777 American soldiers chopped down trees across the roads to slow a whole British army.

Video slot. Video coming. The Battles of Saratoga, 1777, for young viewers: Burgoyne’s march, Bemis Heights and the surrender. Search approved channels (American Battlefield Trust, National Park Service: Saratoga National Historical Park, Simple History); preview first.

KEY TERMS

surrender

To give up and stop fighting.

turning point

A moment when things begin to change direction.

fortify

To make a place stronger with walls, ditches or logs so it is easier to defend.

ally

A friend who joins your side, especially a country that helps you in a war.

CORE IDEAS

The map. In 1777 the British had a big plan. General John Burgoyne would march south from Canada along Lake Champlain and the Hudson River to the town of Albany in New York. If the British held the Hudson, they could cut New England off from the other colonies. But the way south ran through thick forests, swamps and creeks.

The people. Burgoyne, called “Gentleman Johnny,” was a bold and confident general. His army of about 7,000 included British soldiers, German soldiers, Canadians and Indian allies. The Americans were led by General Horatio Gates. A Polish engineer, Thaddeus Kosciuszko, chose where to build their defenses. Daniel Morgan led riflemen who could hit a target far away, and General Benedict Arnold fought with great daring.

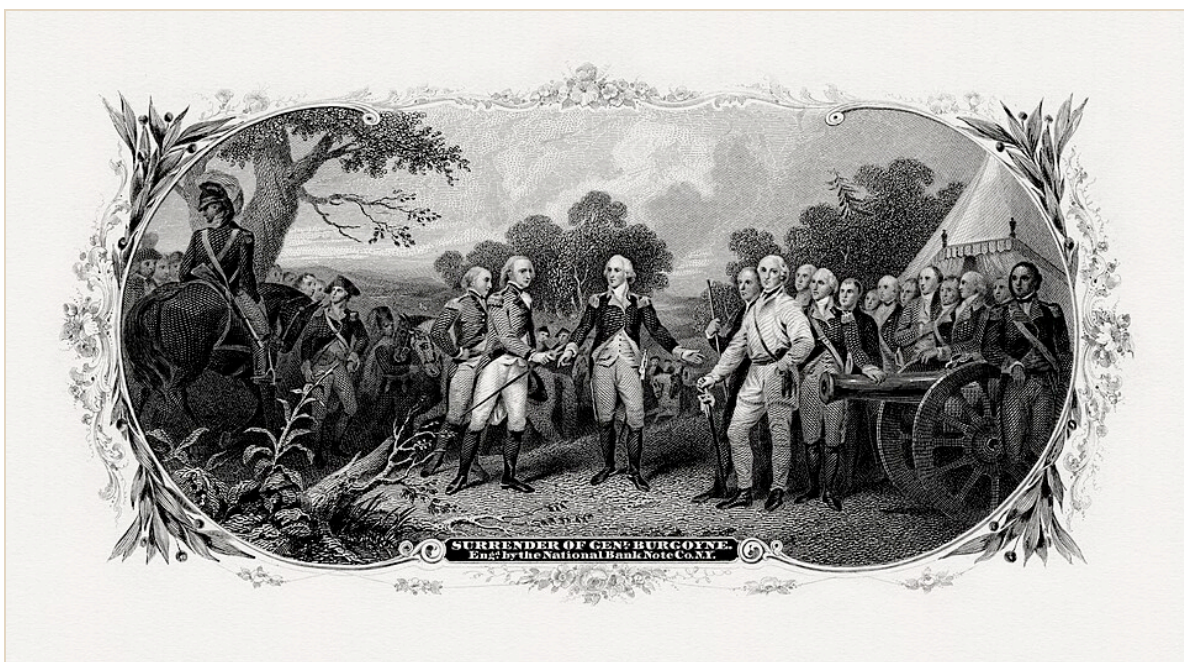
The plan. First, American axmen cut down hundreds of trees across the road and broke the bridges. Burgoyne’s army had to clear the way, and it crawled along, sometimes only about a mile a day. Then Kosciuszko **fortified** a high bluff called Bemis Heights, where the road

squeezed between the hills and the Hudson River. To reach Albany, the British would have to get past it.

What happened. The two armies fought twice. On September 19 the British held the field at Freeman's Farm but lost many men. On October 7 they attacked again near Bemis Heights, and the Americans drove them back. Burgoyne retreated to Saratoga, but American soldiers closed in all around him. The help he hoped for never came. On October 17, 1777, he **surrendered** his whole army, about 6,000 men.

Why it mattered. For the first time, a whole British army had given up. The king of France saw that the Americans could win, and in February 1778 France became America's **ally**. French soldiers, money and, above all, ships would help win the war. That is why Saratoga is called the turning point.

PICTURE STUDY



The Surrender of General Burgoyne, John Trumbull, 1821 · Oil on canvas · Rotunda of the United States Capitol, Washington, D.C.

Wikimedia Commons · Public domain

John Trumbull had been an officer in the Continental Army. Years later he painted the great scenes of the Revolution and visited many of the men to paint their faces from life. Here General Gates does not take Burgoyne's sword. He invites him into his tent instead, as a gentleman.

Look closely

- Find Burgoyne in red and Gates in blue. What is Burgoyne holding out?
- Find the tent. Who is being invited in?
- Look at the faces. Does anyone look angry or proud?

Talk about it

1. Why do you think Gates treated the man he had beaten with good manners?
2. Why might Congress want this picture to hang in the Capitol?

HANDS-ON: TABLETOP SARATOGA: THE ROAD BETWEEN THE HILL AND THE RIVER

Build the narrow place where the road ran between Bemis Heights and the Hudson River, and see why it was a good place to defend.

You will need

- A blue ribbon or towel (the Hudson River)
- A stack of books (Bemis Heights)
- Masking tape (the road)
- Twigs, pencils or toy trees (fallen trees)
- Toy soldiers or blocks in two colors

Steps

1. Lay the river down the table. Put the books beside it, leaving only a narrow gap. Tape the road through the gap.
2. Lay twigs across the road north of the gap. These are the fallen trees.
3. Put the Americans on top of the books, looking down at the road.
4. March the British down the road. Clear each fallen tree before they may move on. Can they get past the hill without being seen?

Check your work

- My map has the river, the heights, the road and fallen trees.
- My British cleared the trees one by one.
- I can tell why the Americans built their defenses on the heights.

FIELD NOTEBOOK

1. **Terrain map.** Draw the Hudson River running down the page from Canada toward Albany. Mark Lake Champlain, Saratoga, Bemis Heights and Albany. Draw fallen trees across the road and the American defenses on the heights.
2. Write: "Saratoga, October 17, 1777. The turning point."

Did you know? Benedict Arnold was wounded in the leg at Saratoga while leading a brave charge. A few years later he turned traitor and tried to hand the fort at West Point to the British. Today Saratoga battlefield has a stone monument of just a boot, honoring his wounded leg. It does not say his name.

Goes deeper in. History, the unit on the American Revolution (coming soon); and

Geography, for the Hudson River and the Appalachian valleys.

For families. The two battles were Freeman's Farm (September 19) and Bemis Heights (October 7, 1777); the surrender at Saratoga (now Schuylerville) was October 17. Burgoyne began with roughly 7,000–8,000 men and surrendered about 5,800–6,000. Philip Schuyler, who commanded before Gates, ordered the felling of trees and breaking of bridges. The Franco-American treaties were signed February 6, 1778. Trumbull's painting dates to 1821 and was installed in the Rotunda in 1826. Burgoyne's British, German, Loyalist and Indian forces are named fairly; his famous London wager is left out.

PRACTICE

1. **MEDIUM Choose your move.** You are Thaddeus Kosciuszko, the American engineer. Burgoyne's army is coming down the road beside the Hudson River. Where will you build the defenses: (a) in an open field where everyone can see far, (b) on high bluffs where the road squeezes between the hills and the river, or (c) far away from the river and the road?
2. **EASY** What did American axmen do to slow Burgoyne's army?
3. **MEDIUM** Which country became America's ally after Saratoga?

Make it a game • Fallen Trees. One team (the Americans) has one minute to lay pillows, towels and cushions across a hallway or path. The other team (Burgoyne's army) must carry a basket of "supplies" to the far end, picking up and stacking each obstacle neatly before passing it. Time the march, then switch sides.

Scripture. "A man's heart deviseth his way: but the LORD directeth his steps." (Proverbs 16:9, KJV)

Burgoyne made a big plan, but things did not go as he planned. People make plans, and God rules over how they turn out.

Practice: answers

1. Kosciuszko chose (b), Bemis Heights. The British could not get past it to Albany, and the fighting there led to Burgoyne's surrender.
2. They cut down trees across the road and broke the bridges.
3. France.

3.7 YORKTOWN (1781)

OBJECTIVES

- Find Yorktown, the York River and Chesapeake Bay on a map of Virginia.
- Tell how the American army on land and the French fleet at sea trapped Cornwallis.
- Explain how Yorktown led to the end of the war and American independence.

Warm-up. Put a toy in a corner of a room. Have one person block the doorway and another stand in front of the toy. Can the toy get out? At Yorktown a British army was caught in a corner between an army on land and a fleet at sea.

Video slot. Video coming. The Siege of Yorktown, 1781, for young viewers: Washington, Rochambeau, the French fleet and the surrender. Search approved channels (American Battlefield Trust, National Park Service: Colonial National Historical Park, Simple History); preview first.

KEY TERMS

peninsula

A piece of land with water on three sides.

redoubt

A small fort made of earth and logs (say “ree-DOWT”).

trench

A long ditch soldiers dig to shelter in as they move closer to an enemy.

independence

Being free to govern yourselves instead of being ruled by another country.

CORE IDEAS

The map. Yorktown is a small tobacco port on the York River in Virginia, on a **peninsula** near the wide Chesapeake Bay. In the summer of 1781, British General Charles Cornwallis brought his army of about 8,000 men there. He built defenses around the town and waited for British ships to bring supplies or carry his men away by sea.

The plan. Far to the north, General Washington and the French general, the Comte de Rochambeau, learned that a French fleet under Admiral de Grasse was sailing for the Chesapeake. They acted fast. They pretended they would attack New York, even building ovens in New Jersey as if for a long camp. Then they marched their armies more than 400 miles south. On September 5, de Grasse’s fleet fought the British fleet at the mouth of the bay and drove it away. Cornwallis was trapped.

The people. The American and French armies together had about 17,000 men or more. They dug long **trenches**, closer and closer to the British lines, and fired their cannon day

and night. The young Marquis de Lafayette, a Frenchman who loved the American cause, was there. On the night of October 14, French soldiers and American soldiers led by Alexander Hamilton charged two **redoubts** at the same time, with bayonets and unloaded muskets, and took them both in a short time.

What happened. Cornwallis tried to escape across the river at night, but a storm scattered his boats. On October 17 a drummer boy climbed onto the British wall and beat a signal asking to talk. On October 19, 1781, the British army marched out and laid down its weapons. Cornwallis said he was sick and sent General Charles O'Hara in his place.

Why it mattered. After Yorktown, Britain decided the war could not be won. Fighting soon died down, and in 1783 the Treaty of Paris made peace. Britain agreed that the United States was free and independent.

PICTURE STUDY



Surrender of Lord Cornwallis, John Trumbull, 1820 · Oil on canvas · Rotunda of the United States Capitol, Washington, D.C.

Wikimedia Commons · Public domain

John Trumbull painted this for the United States Capitol, where it still hangs. In the middle, the American General Benjamin Lincoln rides forward to receive the British surrender. Washington sits on his horse on the right, under the American flag, and the French leaders line up on the left.

Look closely

- Find the two long lines of officers. Which side is American and which is French?
- Find General Lincoln on his horse in the middle.
- Find Washington. How did the painter show that he is the leader?

Talk about it

1. Why do you think Trumbull put the French and the Americans side by side?
2. Cornwallis is not in the picture. Why not?

HANDS-ON: TABLETOP YORKTOWN: THE TRAP

Build the town, the river and the bay, and close the trap by land and by sea.

You will need

- A blue towel (the York River and Chesapeake Bay)
- Blocks (the town and its walls)
- Two pieces of yarn or string (the trenches)
- Two small cups (the redoubts)
- Paper boats in two colors (French and British fleets)
- Toy soldiers or blocks in three colors (British, American and French)

Steps

1. Lay the river along one side and the bay at the end. Build Yorktown on the river bank with the British inside. Put the two redoubt cups just outside the walls.
2. Put the French fleet at the mouth of the bay. Sail the British fleet toward it and let the French drive it away.
3. Lay the first trench in a curve around the town on the land side. Put the Americans and French behind it.
4. Move the trench closer. Take the two redoubts at the same time with one American and one French group. Can the British get out by land or by sea?

Check your work

- My map has the town, the river, the bay and both fleets.
- My trench moved closer to the town.
- I can tell why the British could not escape by sea.

FIELD NOTEBOOK

1. **Terrain map.** Draw the York River flowing into Chesapeake Bay. Mark Yorktown and Gloucester Point across the river. Draw the French fleet at the mouth of the bay, the trenches curving around the town and Redoubts 9 and 10.
2. Write: "Yorktown, October 19, 1781."

Did you know? At the surrender, General O'Hara first tried to hand his sword to the French general Rochambeau. Rochambeau pointed to Washington. Washington pointed to his second in command, General Lincoln, since O'Hara was Cornwallis's second in

command. A famous story says the British band played a tune called “The World Turned Upside Down,” but no one is sure it is true.

Goes deeper in. History, the unit on the American Revolution and the new nation (coming soon); and Geography, for Chesapeake Bay.

For families. Figures are approximate: Cornwallis had about 7,000–9,000 men; the allied army about 17,000–19,000, roughly half American and half French. The naval Battle of the Capes was September 5, 1781; the siege began September 28; Redoubts 9 (French) and 10 (American, under Hamilton) were taken on the night of October 14; the surrender was October 19. The “World Turned Upside Down” story first appears decades later and is marked as uncertain. The preliminary peace came in 1782 and the Treaty of Paris was signed September 3, 1783.

PRACTICE

1. **MEDIUM Choose your move.** You are General Washington, near New York in the summer of 1781. You learn that a big French fleet is sailing to Chesapeake Bay, near Cornwallis’s army in Virginia. Will you (a) attack the strong British army in New York, (b) secretly march your army hundreds of miles south to trap Cornwallis, or (c) stay where you are and wait?
2. **EASY** Which country’s fleet kept the British ships out of Chesapeake Bay?
3. **EASY** What is a redoubt?

Make it a game • Close the Trap. One player is Cornwallis and stands in a corner of the yard or room. Two teams start far away: the “army” on the land side and the “fleet” on the water side (mark it with a blanket). Each time a grown-up claps, both teams take one step closer. Cornwallis may try to slip out, but only through a gap no one is guarding. Can the teams close every gap before he escapes?

Scripture. “Blessed are the peacemakers: for they shall be called the children of God.” (Matthew 5:9, KJV)

Yorktown was the last great battle of the Revolution, and peace followed. Jesus blesses those who make peace.

Practice: answers

1. Washington chose (b). He fooled the British in New York, marched south with Rochambeau, and the army and the fleet trapped Cornwallis at Yorktown.
2. France’s, under Admiral de Grasse.
3. A small fort made of earth and logs.

3.8 TRAFALGAR (1805): “ENGLAND EXPECTS THAT EVERY MAN WILL DO HIS DUTY”

OBJECTIVES

- Find Cape Trafalgar, Spain and Britain on a map.
- Tell how Admiral Nelson’s two columns cut through the enemy’s line.
- Say Nelson’s famous signal and tell what “duty” means.

Warm-up. Hold up a red sock, a blue sock and a white sock. If red meant “Come here,” blue meant “Stop” and white meant “Go,” you could talk without a sound. Before radios, ships talked to each other with colored flags.

Video slot. Video coming. The Battle of Trafalgar, 1805, for young viewers: Nelson, HMS Victory and the famous signal. Search approved channels (Royal Museums Greenwich, the National Museum of the Royal Navy: HMS Victory, Simple History); preview first.

KEY TERMS

admiral

The commander of a fleet of warships.

ship of the line

A big wooden warship with two or three decks of cannon, strong enough to fight in the main battle line.

signal flags

Colored flags that ships raised on their masts to send messages.

duty

What you ought to do because it is right and it is your job, even when it is hard.

CORE IDEAS

The map. In 1805 the French emperor Napoleon ruled much of Europe. He wanted to cross the Channel and invade Britain, but first he needed to beat the British navy. On October 21, a fleet of 33 French and Spanish **ships of the line** sailed out of the Spanish port of Cádiz. Off Cape Trafalgar, on the southwest coast of Spain, 27 British ships were waiting.

The people. The British were led by Vice-Admiral Horatio Nelson in his flagship, HMS *Victory*. Nelson had lost his right arm and the sight of one eye in earlier battles, but his sailors loved him because he cared for them and led from the front. The French admiral, Pierre de Villeneuve, and the Spanish admiral, Federico Gravina, were brave men too. Before the battle, Nelson knelt in his cabin and wrote a prayer asking God for victory and that “humanity after Victory” would mark the British fleet. Humanity means kindness to the beaten enemy.

The plan. In those days fleets usually sailed in two long lines side by side and fired at each other. Nelson had a bolder plan. His ships would sail in two columns, straight at the enemy's long line, and cut it into pieces. Just before the fighting, he raised **signal flags** that spelled out: "England expects that every man will do his duty."

What happened. The two British columns broke through the line, and the battle became a crowd of ships fighting close together. In the afternoon Nelson was shot by a marksman high on a French ship and was carried below. He lived long enough to hear that the battle was won. His last words included, "Thank God I have done my duty." Eighteen French and Spanish ships were captured or destroyed. No British ship was lost.

Why it mattered. Napoleon never again had a fleet strong enough to invade Britain. For about a hundred years after Trafalgar, Britain's navy ruled the seas. Britain mourned Nelson as a hero, and his column still stands in Trafalgar Square in London.

PICTURE STUDY



The Battle of Trafalgar, J. M. W. Turner, 1822-1824 · Oil on canvas · National Maritime Museum, Greenwich, London
Wikimedia Commons · Public domain

Joseph Mallord William Turner painted this for King George IV. Instead of showing one moment, Turner put several moments of the battle into one picture. The great ship in the middle is HMS *Victory*.

Look closely

- Find the *Victory*. How many masts does she have?
- Look at the very top of her masts for a row of flags. Some say they spell part of Nelson's signal. Which word might it be?

- Find the small boats in front. What are the people in them doing?

Talk about it

1. Sailors who were at Trafalgar said Turner got some details wrong. Why might an artist care more about the feeling than every rope and sail?
2. How did Turner make the *Victory* look important?

HANDS-ON: TABLETOP TRAFALGAR: CUT THE LINE

Set up the two fleets on the floor and try Nelson's bold plan.

You will need

- About 16 paper boats or blocks in one color (French and Spanish)
- About 12 in another color (British)
- One special boat with a flag for the *Victory*
- A blue sheet or open floor (the sea)

Steps

1. Set the French and Spanish ships in one long, curving line across the sea.
2. Set the British in two columns, one behind another, pointing at the middle of the enemy line. Put the *Victory* at the front of one column.
3. Move the two columns straight forward until they push through the line.
4. Look at the enemy line now. How many pieces is it in? Can the ships at the front easily turn back to help?

Check your work

- My enemy fleet was in one long line.
- My British fleet sailed in two columns.
- I can tell how cutting the line helped the British.

FIELD NOTEBOOK

1. **Terrain map.** Draw the southwest coast of Spain with Cádiz and Cape Trafalgar. Draw the long curving line of French and Spanish ships and the two British columns cutting through it. Add an arrow for the wind, blowing from behind the British.
2. Copy Nelson's signal: "England expects that every man will do his duty."

Did you know? HMS *Victory* still exists. She sits in a dry dock in Portsmouth, England, and visitors can walk her decks. Nelson first wanted the signal to say "Nelson confides that every man will do his duty." His signal officer suggested "England," and changed "confides" to "expects," because "expects" could be sent with one flag group and "confides" had to be spelled out letter by letter.

Goes deeper in. History, the unit on Napoleon and the age of revolutions (coming soon); and Art, for J. M. W. Turner.

For families. October 21, 1805: 27 British ships of the line against 33 French and Spanish. In the battle 17 allied ships were captured and 1 blew up; a storm afterward wrecked several prizes. No British ship was lost; British losses were about 450 killed, while French and Spanish losses in killed, wounded and captured ran into many thousands. The signal officer was Lieutenant John Pasco. Nelson's prayer and his dying words are recorded by eyewitnesses; the stop quotes only short parts. Whether the flags on Turner's *Victory* spell "duty" is a common reading of the painting, so it is put as "some say." Villeneuve and Gravina are presented fairly as brave commanders.

PRACTICE

1. **MEDIUM Choose your move.** You are Admiral Nelson. The enemy fleet is in one long line, and it has more ships than you. Will you (a) sail in a long line beside them and trade cannon fire, the usual way, (b) sail straight at them in two columns and cut their line into pieces, or (c) stay away and wait for a better day?
2. **EASY** What was the name of Nelson's flagship?
3. **MEDIUM** What does "duty" mean?

Make it a game • Signal Flags. Make three paper flags: red, blue and yellow. Agree on a code: red means "walk forward," blue means "stop," yellow means "turn around." The admiral stands at one end of the yard and raises one flag at a time without speaking. The fleet must obey the flags. Then make up a new signal using two flags at once.

Scripture. "So likewise ye, when ye shall have done all those things which are commanded you, say, We are unprofitable servants: we have done that which was our duty to do." (Luke 17:10, KJV)

Nelson's sailors were asked to do their duty. Jesus teaches that when we have done all that God asks, we have only done our duty, so we should be humble and thankful, not proud.

Practice: answers

1. Nelson chose (b). His two columns broke the enemy line, and the British won without losing a ship.
2. HMS *Victory*.
3. What you ought to do because it is right and it is your job, even when it is hard.

TRACK 3 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 each badge. Badges and the certificate are earned by doing the stops, not by scores.

Badge quiz 1 (Stops 1–5)

1. What did the English send drifting at the Armada in the night near Calais?
2. Who led the great charge that saved Vienna, and what did his hussars wear on their backs?
3. How did General Wolfe’s soldiers reach the Plains of Abraham?
4. Name one rider who warned the militia before Lexington and Concord.
5. What river did Washington’s army cross on Christmas night, 1776?

Badge quiz 2 (Stops 6–8)

6. Why is Saratoga called the turning point of the Revolution?
7. What did American axmen do to slow General Burgoyne?
8. At Yorktown, who trapped Cornwallis on land, and who trapped him by sea?
9. Say Nelson’s signal at Trafalgar.
10. How did Nelson’s ships attack the enemy’s long line?

TRAIL CERTIFICATE: MY BATTLE MAP BOOK AND TRAIL C CERTIFICATE

Gather the terrain maps from this trail into one booklet: “My Battle Map Book: The Age of Sail and the American Founding,” with your name and dates. Add a timeline page with all eight battles in order, from the Armada (1588) to Trafalgar (1805).

Pick one person from the trail (Elizabeth I, Jan Sobieski, James Wolfe, John Parker, George Washington, Thaddeus Kosciuszko or Horatio Nelson) and write or tell one sentence about a virtue they showed: courage, perseverance, faith, duty or wisdom.

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

- **Eight maps:** A labeled terrain map for each battle, with a title and a date.
- **Timeline:** The battles are placed in the right order.
- **Virtue:** One person’s virtue is named and explained.
- **Care:** Maps are neat and labeled.

Answer key

1. Fireships.
2. King Jan III Sobieski of Poland; feathered wings.
3. They floated down the river at night and climbed a narrow path up the cliff.
4. Any one: Paul Revere, William Dawes or Samuel Prescott.
5. The Delaware River.

6. A whole British army surrendered, and afterward France joined America as an ally.
7. They cut down trees across the road and broke the bridges.
8. The American and French armies on land; the French fleet at sea.
9. "England expects that every man will do his duty."
10. In two columns that cut straight through it.