

GRADE 1 LIFE SCIENCE: ANIMAL HOMES AND HABITS

A year of read-aloud visits to the homes God made for His creatures, from the squirrel burying acorns in the forest and the beaver building its dam on the pond to the great whales of the sea, the camel in the desert, the polar bear on the ice, the falling leaves of autumn and the giant footprints of the dinosaurs, each one looked at closely, counted, measured and then tried at the kitchen table with a little child's own hands.

First edition

"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)

COURSE GUIDE

This course takes a young child on a year-long walk through the homes God made for His creatures: the **forest**, the **pond**, the **ocean**, the **desert** and the **Arctic**, then **trees and flowers**, the **dinosaurs** and, last of all, the **five senses** the child uses to notice it all. Along the way your child meets a squirrel hiding acorns, an owl hunting in the dark, a mother duck and her ducklings, a beaver at work on its dam, an octopus that changes color, a camel that can go a long time without a drink, a penguin standing in the snow and a Stegosaurus with plates on its back.

Every lesson follows the same path. First comes **a story or a real animal**, read aloud by a parent. Then the child **looks closely**: at a painting, a print from an old nature book, a leaf, a track or a jar of pond water. Then the child **counts and measures**: how many acorns, which is bigger, how many hands long. Last, the child **makes and does**: builds a bear den from a blanket, makes a deer track stamp, tests a “blubber glove” in ice water or measures a dinosaur footprint in chalk on the driveway. Each lesson ends with something drawn in the nature notebook.

The thread of the year is simple: **every animal has a home, and every animal fits its home**. The squirrel has claws for climbing and cheeks for carrying. The duck has oily feathers that shed water. The camel has wide feet for sand, and the polar bear has thick fur and fat for the cold. Week by week the child learns to ask three questions about any creature: Where does it live? What does it eat? How is it made to fit its home?

The faith thread runs through the whole year. On the sixth day, “**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). Children meet the great whales of Genesis 1, Jonah and the great fish, Elijah fed by the ravens, and the lilies of the field that Jesus told us to consider. The course teaches a child to look at the world with wonder and to thank the One who made it.

WHO IT IS FOR

Written for children in grade 1 (about ages 6–7), and easy to use with ages 5–8, with every lesson read aloud by a parent or older sibling. No reading or writing is required of the child: everything is said, pointed to, sorted, counted, built, measured or drawn. Counting stays under 20. Nothing needs to be bought beyond ordinary household things: crayons, paper, a ruler, a magnifying glass, a few jars and bowls, and whatever leaves, acorns and rocks you find outside.

HOW TO USE THIS COURSE

The weekly rhythm. The year has 32 lessons, one a week, in eight units of four, plus the optional Nature Lab. Each lesson takes two sessions of 30–40 minutes. Session 1 is the warm-up, the read-aloud, the words to know and the picture study. Session 2 is the make-

and-do project, the simple practice and a page in the nature notebook. Short and happy is better than long and tired; stop while your child still wants more.

The ★ quarter path. Ten lessons are marked with ★: one or two from every unit. If you want a one-quarter course, or a lighter year alongside other science, teach just those ten. They cover each animal home, the trees, the dinosaurs and the senses.

The nature notebook. Use one plain sketchbook or a stack of paper in a folder for the whole year. After every lesson the child draws one thing: an animal in its home, a leaf, a track, a tree ring, a picture of what happened in the experiment. The parent writes the date and one sentence the child says about the drawing. By spring the notebook is a treasure.

Experiments and safety. The projects are gentle and use household things, but a grown-up is always close by. Wash hands after handling pond water, soil, feathers or anything found outdoors. Look at wild animals but do not touch or feed them, and never pick up a nest, an egg or a baby animal. Keep cactus spines, small items and ice water under a parent's eye, and taste only what a parent hands you in the tasting lesson.

Worked examples and practice. Each lesson has one very simple worked example, such as counting acorns, telling which animal is bigger or measuring a footprint with hands, and five short practice items. Most are done aloud, by pointing, drawing, sorting or matching. The answers are given for the parent, so you never have to guess.

Unit reviews and unit projects. The last week of each unit adds a short oral review: six to eight questions a parent asks aloud, worth 20 points in all, answered by telling back (narration), pointing or drawing. Each unit also ends with a unit project that gathers the unit's work, such as My Forest Animal Book, My Pond Book or My Desert in a Box. Keep them together; they make a fine show-and-tell at the end of the year.

A word about time. This course is written from a Christian view of creation (Genesis 1:1) and the Flood (Genesis 6-9). Children will see deep-time names such as "Jurassic" or "Ice Age" on museum signs, in picture books and on toy boxes, so the course teaches them as museum words, so that a child can read any sign or book with understanding. Wherever they come up, a 🕒 Thinking About Time box sets out, in very simple sentences, what the sign says, what we can see with our own eyes, and how Christians read it.

SCOPE AND SEQUENCE

Unit 1: Forest (1-4)

The squirrel that buries acorns, the deer and its tracks, the owl that hunts at night, and the bear that sleeps through the winter in its den.

Unit 2: Pond (5-8)

The frog from egg to tadpole to frog, ducks and their waterproof feathers, the beaver that builds a dam, and a close look at a jar of pond water.

Unit 3: Ocean (9–12)

The great whales of Genesis 1:21, the clever octopus, sea turtles that come ashore to lay their eggs, and Jonah and the great fish.

Unit 4: Desert (13–16)

The camel made for sand and heat, lizards that warm themselves in the sun, the cactus that stores water, and Elijah fed by the ravens by the brook.

Unit 5: Arctic (17–20)

Polar bears on the sea ice, penguins at the other end of the earth in the Antarctic, caribou on the move, and a blubber glove experiment that shows how animals stay warm.

Unit 6: Trees and Flowers (21–24)

The colors of fall leaves, the lilies of the field that Jesus told us to consider, counting the rings in a tree, and bark rubbings from the trees nearby.

Unit 7: Dinosaur Days (25–28)

The plates of Stegosaurus, the long-necked giants, the duck-billed dinosaurs and their nests, and dinosaur footprints a child can measure, with 🕒 Thinking About Time boxes for the museum words.

Unit 8: My Senses (29–32)

The eyes, ears, nose, tongue and hands God gave us, how animals use the same senses in their homes, and simple tests a child can do at the table.

Unit 9: Nature Lab (optional) (Any time)

Four outdoor lessons to use whenever the weather is fine: a nature journal walk, a backyard survey, a visit to a zoo, farm or museum, and a small specimen collection.

MATERIALS

- **Nature notebook (a plain sketchbook, or paper in a folder):** One for the whole year. The child draws; the parent writes the date and one sentence the child says.
- **Crayons, colored pencils, a glue stick, child scissors and tape:** Used in nearly every lesson for drawing, cutting and building the unit books.
- **A ruler, a measuring tape and a magnifying glass:** For measuring tracks, leaves and footprints and for looking closely at bark, feathers and pond water.
- **Clear jars, bowls and zip-top bags:** For pond water, the blubber glove, collecting leaves and sorting found things.
- **Play dough or salt dough, and a box or shoebox:** For animal tracks, a desert in a box and small animal homes.

- **Vegetable shortening and a bowl of ice water:** For the blubber glove experiment in Unit 5.
- **Things found outdoors:** Acorns, leaves, pinecones, bark, feathers seen (not collected from nests), rocks and seeds. Gather through the year.
- **Sidewalk chalk and a blanket or two:** For measuring dinosaur footprints on the driveway and building a bear den indoors.
- **Optional: a picture field guide to birds, trees or animals:** Never required. Any library picture guide helps with the Nature Lab walks.

GRADING

There are no letter grades in this course. Young children learn science by looking, telling back and doing, so the parent keeps a simple checklist instead: Did the child narrate the lesson, take part in the make-and-do, draw a notebook page and answer the oral review? The weights below are a guide for families who must report something to a school or state.

- Oral narration (tells the story or lesson back in his or her own words): 40%
- Make and do (takes part, follows steps, counts or measures): 25%
- Nature notebook (one dated drawing each lesson): 20%
- Unit reviews (oral, 20 points each): 15%

No letter grades. Mark each checklist item: Got it ✓, Growing ~, or Try again later. If a report is needed, use Satisfactory, Needs time, or Excellent.

- Narration is the heart of the checklist. A child who can tell back where an animal lives, what it eats and one way it fits its home has learned the lesson.
- Unit reviews are always oral. Ask the questions aloud and let the child answer by telling, pointing or drawing. The parent writes down the answers.
- A notebook page earns its check when it has the date, a drawing and one sentence the child said. Neatness is not graded.
- If a lesson did not take, try it again another day or skip ahead and return later. Many children understand an idea weeks after it was first taught.
- Keep the unit projects and the notebook together as the record of the year.

A NOTE TO PARENTS

You do not need to be a scientist to teach this course. Read the lesson aloud, look at the picture together, and then get down on the floor and do the project with your child. Ask “What do you see?”, “How many?” and “Why do you think God made it that way?” Those three questions are most of what a good first science teacher does.

Go outside as often as you can. A squirrel at the feeder, a duck on a park pond, a track in the mud or a leaf on the sidewalk will teach more than a page ever could. Bring the nature notebook, sit still, and let your child look for a long time. Wonder grows slowly and quietly.

Above all, the course hopes to raise a child who notices the world, cares gently for living things and gives thanks to the One who made them. “But ask now the beasts, and they shall teach thee; and the fowls of the air, and they shall tell thee” (Job 12:7).

CONTENTS

Unit 1: Forest

- 1.1 Squirrels and Acorns ★
- 1.2 Deer
- 1.3 Owls at Night
- 1.4 Bears in Winter

Unit 2: Pond

- 2.1 Frogs ★
- 2.2 Ducks
- 2.3 Beavers Build Dams
- 2.4 A Close Look at Pond Water

Unit 3: Ocean

- 3.1 Whales: The Great Whales ★
- 3.2 Octopus ★
- 3.3 Sea Turtles
- 3.4 Jonah and the Great Fish

Unit 4: Desert

- 4.1 Camels ★
- 4.2 Lizards
- 4.3 Cactus
- 4.4 Elijah Fed by Ravens

Unit 5: Arctic

- 5.1 Polar Bears ★
- 5.2 Penguins of the Antarctic ★
- 5.3 Caribou
- 5.4 Staying Warm: The Blubber Glove Experiment

Unit 6: Trees and Flowers

- 6.1 Leaves of Fall ★
- 6.2 Lilies of the Field (Matthew 6:28)
- 6.3 Tree Rings
- 6.4 Bark Rubbing

Unit 7: Dinosaur Days

- 7.1 Stegosaurus Plates ★
- 7.2 Long Necks
- 7.3 Duck-Billed Dinosaurs
- 7.4 Dinosaur Footprints You Can Measure

Unit 8: My Senses

- 8.1 Seeing ★
- 8.2 Hearing
- 8.3 Smelling and Tasting
- 8.4 Touching

Unit 9: Bonus: Nature Lab (optional)

9.1 Nature Journal Walk

9.2 Backyard Survey

9.3 Zoo, Farm or Museum Visit

9.4 Specimen Collection

★ quarter path ·  Thinking About Time box

FOREST

“And God made the beast of the earth after his kind” (Genesis 1:25). In this first unit your child walks into the forest and meets four of the animals God put there: the squirrel, the deer, the owl and the bear. Each one has a home, a food and a set of habits that fit the life God gave it. Your child will hold an acorn, make a deer track, take apart a pretend owl pellet and build a bear den.

The unit follows the forest through the year. In the fall a squirrel buries acorns and a bear eats until it is fat. A buck grows antlers and drops them in the winter. An owl hunts in the dark while the family sleeps. In the coldest weeks a mother bear’s cubs are born in the den, and in the spring everyone comes out again. Along the way your child learns to look for clues like a naturalist: a nibbled bush, a track in the mud, a gray pellet under a tree.

Everything in this unit is said, pointed to, sorted, built, measured or drawn. No reading is needed. Keep the acorns from Lesson 1.1, the track prints from Lesson 1.2, the sorted “bones” from Lesson 1.3 and the food cards from Lesson 1.4; they all go into the forest book at the end.

BEFORE YOU BEGIN

- Can count objects up to 10
- Can tell bigger from smaller and longer from shorter
- Can listen to a short story read aloud and tell part of it back
- Can hold a crayon and draw simple animals and trees

MASTERY CHECKLIST

- I can tell how a squirrel buries acorns for winter and how a forgotten acorn grows into an oak tree.
- I can name a buck, a doe and a fawn and tell how a fawn hides.
- I can recognize a deer track and count the points on a buck’s antlers.
- I can tell three things that help an owl hunt at night and say what an owl pellet is.
- I can tell how a bear gets fat in the fall and sleeps in its den in winter.
- I can measure with a ruler and say which of two things is longer.

OPTIONAL BOOKS AND RESOURCES

- **Smithsonian’s National Zoo and Conservation Biology Institute**
(<https://nationalzoo.si.edu/>): Free. Browse animal pages and pictures with your child. If you visit Washington, D.C., the zoo is free to enter.
- **All About Birds, from the Cornell Lab of Ornithology**
(<https://www.allaboutbirds.org/>): Free. Look up the great horned owl and the snowy owl, and play the recorded calls so your child can hear a real hoot (Lesson 1.3).

- ***The Tale of Squirrel Nutkin* by Beatrix Potter (free at Project Gutenberg)**
(<https://www.gutenberg.org/ebooks/search/?query=squirrel+nutkin>): Free. A short picture book to read aloud with Lesson 1.1. Potter drew her squirrels from real ones she watched in the English Lake District.

1.1 SQUIRRELS AND ACORNS ★

OBJECTIVES

- Tell what a squirrel eats, where it sleeps and how it hides acorns for winter.
- Look at a real acorn and find its cap, its shell and the seed inside.
- Explain how a forgotten acorn can grow into an oak tree.

Warm-up. Your parent hides five acorns (or five nuts, or five small blocks) around one room while you cover your eyes. Now be a squirrel and find them. Count the ones you find. Did you find all five? Squirrels hide acorns all fall long, and they have to remember where they put them.

Video. Coming soon. Gray squirrels burying and digging up acorns, building a leaf nest and chewing with their front teeth (search SciShow Kids, Homeschool Pop (Alternate), Smithsonian National Zoo, PBS Nature clips and nature footage of squirrels in fall).

KEY TERMS

acorn

The nut of an oak tree. It has a little cap and a hard shell, and inside is a seed that can grow into a new oak tree.

nest

The home a squirrel makes high in a tree out of leaves and twigs. A squirrel's nest is called a drey.

bury

To dig a little hole, put something in it and cover it up with dirt.

gnaw

To chew and chew with sharp front teeth, the way a squirrel opens a nut.

CORE IDEAS

The story. Hold an acorn in your hand. It is small and smooth, with a little bumpy cap on top like a hat. Now look up. An acorn comes from a big oak tree. In the fall, oak trees drop thousands of acorns onto the forest floor. And who comes running? The squirrels! A gray squirrel picks up an acorn in its front paws, turns it around, and sniffs it. Then it does something surprising. It does not eat the acorn. It runs a little way off, digs a small hole, drops the acorn in, and pats the dirt down on top. Then it runs back for another one.

How they figured it out. People who watch squirrels all fall see them bury acorn after acorn, one in each hole, all over the woods. Why? Winter is coming. In winter there are no fresh acorns, and the squirrel does not sleep all winter like a bear. It stays awake and gets hungry. So in the fall it **buries** food to dig up later. A squirrel finds its buried acorns with its nose and its memory. But it never finds them all. The ones it forgets stay in the ground, and

in spring some of them sprout and grow into little oak trees. The squirrel planted a forest without even meaning to.

The big idea. A squirrel is made for life in the trees. Its sharp front teeth never stop growing, so it must **gnaw** on hard nuts and bark to keep them short. Its long fluffy tail helps it balance when it runs along a branch, and on a cold night it wraps the tail around itself like a blanket. High in a tree it builds a **nest**, a big ball of leaves and twigs called a drey. Look up into bare trees in winter and you may spot one.

God's handiwork. God made the oak tree to drop acorns, and He made the squirrel to love them. The squirrel gets food for the winter, and the oak tree gets its seeds planted all over the woods. The two fit together like a lock and a key. The Bible says the trees of the LORD are "full of sap" and that He planted them (Psalm 104:16). Next time you see a squirrel race up a trunk with an acorn in its mouth, remember: it is doing the job God gave it, and a new tree may grow because of it.

PICTURE STUDY



A Red Squirrel, Hans Hoffmann, 1578 · Watercolor and gouache on vellum · National Gallery of Art, Washington, D.C.

Hans Hoffmann was a painter from Nuremberg in Germany who loved the careful nature pictures of Albrecht Dürer and painted the same way. Here he painted one red squirrel, every hair of its coat, with nothing else around it, so that we look only at the animal.

Red squirrels live in the forests of Europe. They have tufts of fur on their ears, and they bury nuts in fall just as our gray squirrels do.

Look closely

- Find the squirrel's tail. Is it bigger or smaller than its body? Trace its curl with your finger.
- Look at the front paws. What is the squirrel holding?
- Find the ears. Can you see the little tufts of fur on top?
- Point to the eye. Which way is the squirrel looking?

Talk about it

1. What do you think this squirrel will do next: eat the nut, or bury it?
2. How is this red squirrel like the squirrels in your yard? How is it different?
3. Why do you think the painter left the background empty?

Safety first. Watch wild squirrels from a few steps away. Never try to touch, chase or hand-feed one; a scared squirrel can bite. Acorns are for looking at and hiding, not for eating. Keep acorns and acorn pieces away from babies and toddlers, and wash your hands after the hunt.

MAKE AND DO: BE A SQUIRREL: BURY AND FIND

You will do what a squirrel does in the fall. You will bury ten acorns, wait, and then see how many you can find again. Then you will open one acorn to see the seed inside.

You will need

- Ten acorns (or ten walnuts, pecans or large pebbles if there are no oaks near you)
- A small bag or cup
- A sandbox, a garden bed or a big tub of dirt or sand
- A ruler or a stick
- A nutcracker or a small hammer for a parent to use
- Crayons and paper

Steps

1. Take a walk under an oak tree and gather ten acorns in your cup. Count them: one, two, three, all the way to ten. Pick up a few acorn caps too.
2. Look at one acorn closely. Find the cap, the smooth shell and the pointed tip. Feel it. Is it hard or soft?
3. Go to the sandbox or garden bed. Dig ten little holes with your fingers, just as a squirrel does with its paws. Put one acorn in each hole and pat the dirt down. Do not put them all in one spot; squirrels spread them out.
4. Go inside and do something else for at least a few minutes. A squirrel waits weeks!
5. Come back and be the squirrel. Find as many acorns as you can. Count them.
6. Tell your parent: How many did you bury? How many did you find? How many are still lost? The lost ones are the ones that might grow into trees.

7. Ask your parent to crack open one acorn with the nutcracker. Look inside. The yellow-white part is the seed. That is what grows into an oak tree.
8. Draw a picture of an acorn with its cap, and next to it draw a big oak tree.

Tips

- Mark the edges of the burying spot with sticks so the “squirrel” does not have to search the whole yard.
- If you use a tub of sand indoors, put a towel under it.
- Leave one acorn buried in a garden bed and check it in the spring. It may sprout!

Check your work

- I buried acorns one by one like a squirrel.
- I counted how many I found and how many were lost.
- I can show the cap, the shell and the seed of an acorn.

NATURE NOTEBOOK

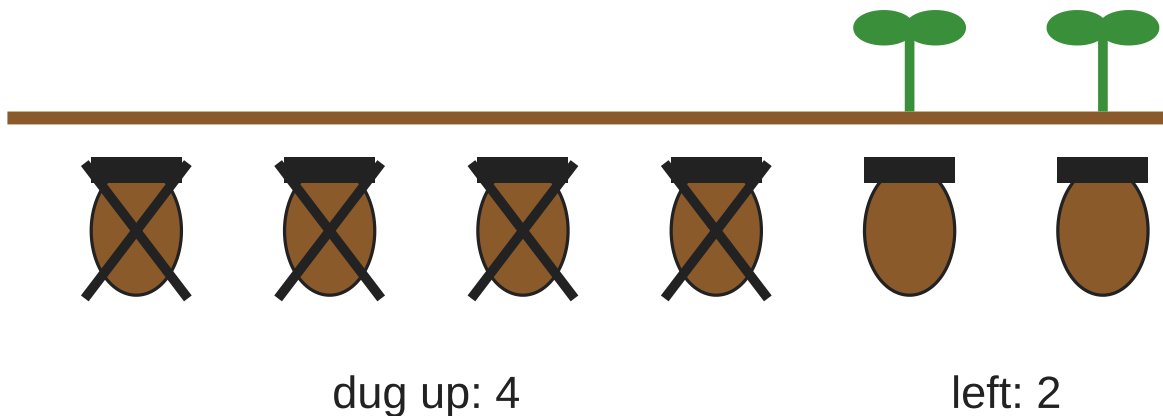
1. Draw a squirrel. Give it a big bushy tail, small ears and an acorn in its paws. Your parent can write the date at the top.
2. Draw an acorn very big. Label the cap and the shell, and draw the seed inside.
3. Draw a bare tree with a leaf nest high in the branches. Draw where you think the squirrel climbs up.

From history. In 1903 an English artist named Beatrix Potter published *The Tale of Squirrel Nutkin*. Before she drew Nutkin, she spent hours watching real red squirrels in the Lake District of England and drawing them again and again until they looked just right. The squirrels in her book gather nuts in the fall and carry them across a lake on little rafts, but their furry tails, their paws and their bright eyes are drawn from the real animals she studied.

WORKED EXAMPLES

Example 1. Look at the picture. A squirrel buried 6 acorns in the fall. In winter it dug up 4 of them. How many acorns are still in the ground?

Buried 6 acorns. Dug up 4. Left 2.



Six buried acorns. Four were dug up. Two were left to grow.

1. Count all the acorns in the row: one, two, three, four, five, six. The squirrel buried 6.
2. The acorns with an X on them are the ones the squirrel dug up and ate. Count the Xs: one, two, three, four.
3. Cover the 4 crossed-out acorns with your hand. Count the acorns you can still see: one, two.
4. Six take away four leaves two. Those 2 acorns stay in the ground, and they may grow into oak trees.

Answer: 2 acorns are still in the ground.

PRACTICE

1. **EASY** Point to an acorn's cap. Now point to its shell. Which tree do acorns come from?
2. **EASY** What does a squirrel do with an acorn in the fall? Show me with your hands.
3. **MEDIUM** Your parent puts out 7 acorns (or buttons). Take away 3 for the squirrel to eat. How many are left in the ground?
4. **MEDIUM** Why do a squirrel's front teeth stay sharp and short even though they never stop growing?
5. **HARD** Tell your parent how a squirrel can plant an oak tree without meaning to.

COMMON MISTAKES

- Thinking squirrels sleep all winter like bears. Squirrels stay awake in winter and dig up the food they buried in the fall.
- Thinking a squirrel keeps all its acorns in one big pile. It buries them one at a time in many different spots.
- Thinking a squirrel's nest is a bird's nest. A squirrel's drey is a big round ball of leaves and twigs, much bigger than most birds' nests, with the squirrel curled up inside.

Make it a game · Squirrel, Where Is Your Acorn?. Set out five paper cups upside down in a row. While you watch, your parent hides one acorn under a cup, then slowly slides the cups around. Point to the cup with the acorn. If you are right, you get to be the squirrel and hide it for your parent. Make it harder by hiding two acorns, then three. Squirrels have to remember hundreds of hiding places. Can you remember three?

Scripture. "The trees of the LORD are full of sap; the cedars of Lebanon, which he hath planted;" (Psalm 104:16, KJV)

God plants the great trees of the forest. One of the ways He does it is by sending a little squirrel to bury an acorn and forget where it is.

Practice answers

1. The child points to the bumpy cap on top and the smooth shell below it. Acorns come from oak trees.
2. It digs a little hole, puts the acorn in and covers it with dirt. The child pretends to dig and pat the dirt down.
3. 4 are left.
4. The squirrel gnaws on hard nuts, bark and shells all the time, and the chewing wears the teeth down.
5. The squirrel buries acorns in the fall to eat later, but it forgets some. A forgotten acorn stays in the ground, sprouts in the spring and grows into an oak tree.

1.2 DEER

OBJECTIVES

- Tell what a deer eats and how it stays safe from danger.
- Name a buck, a doe and a fawn, and tell how a fawn hides.
- Recognize a deer track and count the points on a buck's antlers.

Warm-up. Sit very still on the floor. Your parent walks quietly around the room behind you. Without turning your head, try to point to where your parent is. Now cup your hands behind your ears and listen again. Is it easier? A deer can turn its big ears to catch the smallest sound.

Video. Coming soon. White-tailed deer in the forest: a doe with a spotted fawn, a buck with antlers, deer browsing on leaves and bounding away with the white tail up (search SciShow Kids, Homeschool Pop (Alternate), PBS Nature clips, state wildlife agencies and nature footage of deer at dawn).

KEY TERMS

buck

A father deer. A buck grows antlers on his head.

doe

A mother deer. A doe has no antlers.

fawn

A baby deer. A fawn has white spots on its back.

antlers

The branching bones that grow on a buck's head. They fall off every winter and grow back every spring.

CORE IDEAS

The story. Early in the morning, when the grass is still wet, is the best time to see a deer. Stand at the edge of the woods and look. There! A gray-brown shape steps out, slim legs, a long neck, big ears turning this way and that. It lowers its head to nibble. Then it freezes and stares right at you. If you move, up goes its tail like a white flag, and in three big bounds it is gone. That is a white-tailed deer, the most common deer in the woods of North America.

How they figured it out. Deer are shy, so people who want to learn about them learn to be quiet and to look for clues. The best clue is a **track**. A deer's foot is a hoof split into two toes, so its track looks like two teardrops side by side, or an upside-down heart. Another clue is a nibbled bush. Deer have no top front teeth, only bottom ones and a hard pad on top, so they tear leaves and twigs instead of cutting them neatly. In the fall you may find a small tree with the bark rubbed off: a **buck** did that, rubbing his new antlers.

The big idea. There are three deer names to learn: a buck, a **doe** and her **fawn**. The buck grows **antlers**, which are real bone. They grow all summer covered in soft fuzzy skin called velvet, the velvet rubs off in the fall, and in winter the antlers drop off. In spring he grows a brand-new pair. A fawn is born in late spring with white spots on its back. The spots look like dots of sunlight on the forest floor, so the fawn is hard to see. When the doe goes off to eat, the fawn lies perfectly still in the grass and waits for her to come back. Deer eat leaves, twigs, buds, grass, apples and acorns. Their eyes are on the sides of their heads, so they can watch almost all the way around for danger.

God's handiwork. The Bible says, "ask now the beasts, and they shall teach thee" (Job 12:7). A deer teaches us to be watchful and quick. God gave the deer long legs for running, big ears for listening, side eyes for watching, and a fawn's spots for hiding. Every part fits the life God gave it. And every winter the buck loses his heavy antlers, and every spring God grows him new ones.

PICTURE STUDY



Elk Grazing in the Wind River Country, Albert Bierstadt, 1861 · Oil on canvas · National Museum of Wildlife Art, Jackson, Wyoming

Albert Bierstadt was a painter who went west with a government survey party to the Rocky Mountains in 1859. He made sketches of the mountains and the animals, took them home to his studio, and painted big, bright pictures that showed people in the East what the West looked like.

The animals in this picture are elk. An elk is a kind of deer, much bigger than a white-tailed deer, with a dark neck and a pale rump. Elk live in the mountain forests and meadows of the West, and the bulls grow very large antlers.

Look closely

- Find the elk. Count them. Are they standing up or lying down?
- Does any elk have antlers? If so, that one is a bull, a father elk.

- Look at the mountains far away and the trees nearby. Which look bigger in the picture, and why?
- Find the light. Is it morning, midday or evening? What makes you think so?

Talk about it

1. How is an elk like the white-tailed deer in this lesson? How is it different?
2. If you walked into this valley, what would the elk do?
3. Why do you think Bierstadt wanted to paint the animals together with the mountains?

Safety first. Watch deer from far away and never walk up to one, even a fawn lying alone. The doe is nearby and will come back; a fawn that is touched may be left behind. After walking in tall grass or woods, have a parent check you for ticks.

MAKE AND DO: DEER TRACK STAMPS

A real naturalist learns to read tracks. You will make a deer track stamp, print a deer trail across a paper, and measure the tracks with a ruler.

You will need

- A large potato or a thick piece of craft foam, and a butter knife (a parent does the cutting)
- Brown or black washable paint on a paper plate
- A long strip of paper, such as the back of wrapping paper or two sheets taped end to end
- A ruler
- Crayons
- Play dough or a patch of soft mud outdoors (optional)

Steps

1. Have your parent draw a deer track on scrap paper to copy: two teardrops side by side, pointed at the front, like an upside-down heart. Trace it with your finger.
2. Ask your parent to cut a potato in half and carve two teardrop shapes side by side on the flat side, so the two teardrops stick up. That is your stamp.
3. Dip the stamp in the paint and press it on the paper. Press it again a little farther along. Make a trail of tracks across the whole paper.
4. Real deer tracks are about as long as your pointer finger, around 3 inches. Measure one of your tracks with the ruler. Is it longer or shorter than a real one?
5. Count the tracks in your trail. How many did you make?
6. Now make a fawn trail. Press the stamp lightly or carve a smaller one. A fawn's track is smaller than its mother's.
7. If you have play dough, press two thumbs side by side into it, pointed ends together, to make a track. Outdoors, look for real tracks in mud or snow and compare.

8. Draw a deer at the end of your trail. Give it big ears, side eyes and a white tail.

Tips

- Put newspaper under your work. Washable paint comes out of clothes but is easier to wipe off a table.
- If you find real deer tracks, lay the ruler next to one and have a parent take a picture for your notebook.
- Try other tracks too: a dog's track has four toes and claws, a deer's has two toes and no claws.

Check your work

- I made a deer track with two toes like an upside-down heart.
- I measured a track with a ruler.
- I can tell a big deer's track from a fawn's track.

NATURE NOTEBOOK

1. Draw a doe and her fawn. Give the fawn white spots. Your parent can write the date at the top.
2. Draw a buck's head with antlers. Count the points and write the number under it.
3. Draw three deer tracks in a row, pointed ends facing the way the deer was walking. Draw an arrow to show which way it went.

From history. A little more than a hundred years ago, white-tailed deer had almost disappeared from many states because too many were hunted all year round. Americans decided to care for them. States passed laws that allowed hunting only in a short season each year, hired game wardens, and set aside land where deer could live. The deer came back, and today they are so common that many families see them in their own yards. That is stewardship: caring for what God has made so that it is still here for our children.

WORKED EXAMPLES

Example 1. Look at the picture of the buck's antlers. Count the points on the left antler and on the right antler. How many points does this buck have in all?

Count the points on each antler



left: 4 points

right: 4 points

An eight-point buck: four points on each antler.

1. A point is a tip that sticks up on the antler. Touch each tip on the left antler and count: one, two, three, four. The left antler has 4 points.
2. Now touch each tip on the right antler: one, two, three, four. The right antler has 4 points.
3. Put them together: four and four make eight.
4. People who see a buck like this call him an eight-point buck.

Answer: 4 points on each side, 8 points in all. He is an eight-point buck.

PRACTICE

1. **EASY** Which deer has antlers: the buck, the doe or the fawn?
2. **EASY** Draw a deer track in the air with your finger. What shape is it?
3. **MEDIUM** A fawn is lying in the grass with no mother in sight. Should you pick it up? Why or why not?
4. **MEDIUM** Your parent draws a buck with 3 points on one antler and 3 on the other. How many points in all? Now draw one with 5 and 5.
5. **HARD** Tell your parent three ways a deer stays safe from danger.

COMMON MISTAKES

- Thinking antlers are horns that stay on forever. Antlers are bone that drops off every winter and grows back every spring; horns, like a goat's, stay on for life.
- Thinking a fawn lying alone has been lost or left behind. The doe hides her fawn on purpose and comes back to feed it.
- Thinking deer eat only grass. Deer browse on leaves, twigs, buds, acorns and fruit, and they eat a lot of acorns in the fall.

Make it a game · Freeze Like a Fawn. You are a fawn in the tall grass. Your parent is a fox walking by. When the fox is near, lie perfectly still, not even a wiggle. If the fox sees you move, you are spotted! When the fox is gone, hop up and bound away like a deer, hands up for your white tail. Then trade: you be the fox and your parent be the fawn. Play five rounds and count how many times the fawn stayed hidden.

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

God says we can learn from watching animals. A deer teaches us to be watchful and to listen. The animals show us how wise their Maker is.

Practice answers

1. The buck.
2. Two teardrops side by side, like an upside-down heart, with the pointed ends at the front.
3. No. The doe is nearby and will come back. The fawn is staying still and hiding, just as it is supposed to. Leave it alone and walk away.
4. 3 and 3 make 6 points. The child draws two antlers with 5 points each, 10 in all.
5. Any three: big ears that turn to hear sounds; eyes on the sides of its head to see all around; long legs to run and bound away; a white tail flag to warn other deer; a fawn's spots and lying still to hide; gray-brown fur that matches the woods.

1.3 OWLS AT NIGHT

OBJECTIVES

- Tell that owls hunt at night and name three things that help them do it.
- Explain what an owl pellet is and what is inside it.
- Read a simple picture chart of what an owl ate.

Warm-up. Hold a pencil straight out in front of you and look at the tip. Now, without moving your eyes, try to look at the ceiling. You can roll your eyes up, can't you? An owl cannot. Its eyes are stuck looking straight ahead. To look up, it must tip its whole head. Try looking around the room by turning only your head, never your eyes. That is how an owl looks at the world.

Video. Coming soon. Owls at night: great horned owl turning its head, silent flight compared with other birds, an owl coughing up a pellet, and an owl pellet taken apart (search SciShow Kids, Homeschool Pop (Alternate), Cornell Lab of Ornithology, Smithsonian National Zoo and nature footage of owls hunting).

KEY TERMS

nocturnal

Awake and busy at night, asleep in the day. Owls are nocturnal.

talons

An owl's sharp, curved claws. It grabs mice with its talons.

pellet

A little lump of fur and bones that an owl coughs up after a meal, because it cannot eat those parts.

hoot

The deep call an owl makes at night: hoo, hoo-hoo, hoo, hoo.

CORE IDEAS

The story. Step outside on a dark evening and listen. Hoo, hoo-hoo, hoo, hoo. That deep call is a great horned owl, and it is awake when you are getting ready for bed. Owls are **nocturnal**: they sleep in the daytime, tucked against a tree trunk, and they hunt at night. If you ever see one fly over at dusk, you will notice something strange. It makes no sound at all. A crow's wings flap and whoosh. An owl slips through the dark like a shadow.

How they figured it out. People who study owls have found three secrets. First, the eyes. An owl's eyes are huge and face forward, like yours, so it can tell exactly how far away a mouse is. But its eyes cannot move in its head, so the owl turns its whole head, almost all the way around, to look behind it. Second, the ears. They are hidden under the feathers on the sides of the face, and the round flat face works like a dish to catch sounds. An owl can hear a

mouse rustling under leaves, even under snow. Third, the feathers. The front edge of each wing feather has a soft fringe like a comb, so the air slides over it quietly. The owl hears the mouse, the mouse never hears the owl.

The big idea. An owl grabs its food with its **talons** and often swallows a mouse whole. But it cannot digest fur and bones. A few hours later it coughs up a tidy gray lump called a **pellet**. Scientists collect pellets from under owl trees and pick them apart. Inside they find tiny skulls, leg bones and fur, and from the skulls they can count just how many mice and voles the owl ate. A pellet is like a little report of the owl's dinner. Farmers like owls for this reason: one owl family eats a great many mice in a year.

God's handiwork. The night is not empty. The Bible says, "Thou makest darkness, and it is night: wherein all the beasts of the forest do creep forth" (Psalm 104:20). While you sleep, God's owls are flying, mice are scurrying, and deer are stepping softly through the trees. God made the owl just right for the dark: big eyes, sharp ears, silent wings. Next time you hear a **hoot** from your window, you will know who is at work.

PICTURE STUDY



Great Horned Owl (Plate 61 of The Birds of America), John James Audubon (engraved by Robert Havell Jr.), about 1830 · Hand-colored engraving, from *The Birds of America* · Printed copies are kept in many libraries and museums; Audubon's original watercolors are at the New-York Historical Society

John James Audubon set out to paint every bird in America at its real size. He walked and rode through the woods for years, and in the end he made a giant book called *The Birds of America*. Each page was as tall as a child.

Here he painted a pair of great horned owls, the owls whose deep hoot you may hear at night in the woods. The tufts on their heads look like ears or horns, but they are only feathers.

Look closely

- Find the eyes. What color are they? Do they face forward like yours?
- Find the feather tufts on top of the heads. Remember: they are not the real ears.
- Look at the feathers. Are they all one color, or do they have stripes and spots? How would they help an owl hide against a tree trunk in the day?
- Find the feet and talons. What are they gripping?

Talk about it

1. What do you think these two owls are listening for?
2. Why would brown, speckled feathers be good for an owl that sleeps against a tree in the daytime?
3. Audubon painted birds at their real size. How big do you think a great horned owl is: as big as your hand, as big as a cat, or as big as you?

Safety first. Go outside at night only with a parent, with a flashlight, and stay close. Real owl pellets for taking apart should come clean and wrapped from a science supply store, never picked up from the ground; wash your hands after touching one. Never touch a live owl or a baby owl on the ground; tell a parent.

MAKE AND DO: PRETEND OWL PELLET

Scientists learn what an owl ate by taking apart its pellets. You will take apart a pretend pellet that your parent makes, sort what is inside, and count what the owl ate.

You will need

- A few cotton balls or a wad of brown yarn
- Small “bones”: pieces of uncooked spaghetti, toothpicks broken in half, dry white beans and a few pumpkin seeds
- Two toothpicks or a plastic fork for picking
- A paper plate
- A sheet of paper with three boxes drawn on it, labeled with a picture of a mouse, a bird and a beetle
- A magnifying glass, if you have one

Steps

1. While you are out of the room, your parent makes a pellet: squeeze a few cotton balls or yarn around the “bones.” Put in 3 beans for mouse skulls, 2 pumpkin seeds for bird skulls, and 1 toothpick for a beetle, with some spaghetti bits for leg bones.
2. Your parent sets the pellet on your paper plate. Look at it first. What color is it? How big is it compared with your thumb?
3. Pick the pellet apart slowly with the toothpicks, the way a scientist does, without breaking the bones.

4. Every time you find a “skull,” put it in the right box on your paper: beans with the mouse, pumpkin seeds with the bird, toothpicks with the beetle.
5. Count what is in each box. How many mice did the owl eat? How many birds? How many beetles? Which did it eat the most of?
6. Tell your parent: What did this owl have for dinner?
7. Make a pellet for your parent to take apart. Change the numbers so they have to count carefully.
8. If your family buys a real cleaned owl pellet, take it apart the same way, on newspaper, and wash your hands after.

Tips

- Dark yarn makes the “bones” harder to find, just like a real gray pellet.
- Glue your sorted bones onto the paper to keep for your portfolio.
- Real pellets usually hold the bones of more than one mouse, so the owl really does eat a lot.

Check your work

- I took a pellet apart carefully.
- I sorted the bones into groups and counted each group.
- I can tell what an owl pellet is and why the owl makes one.

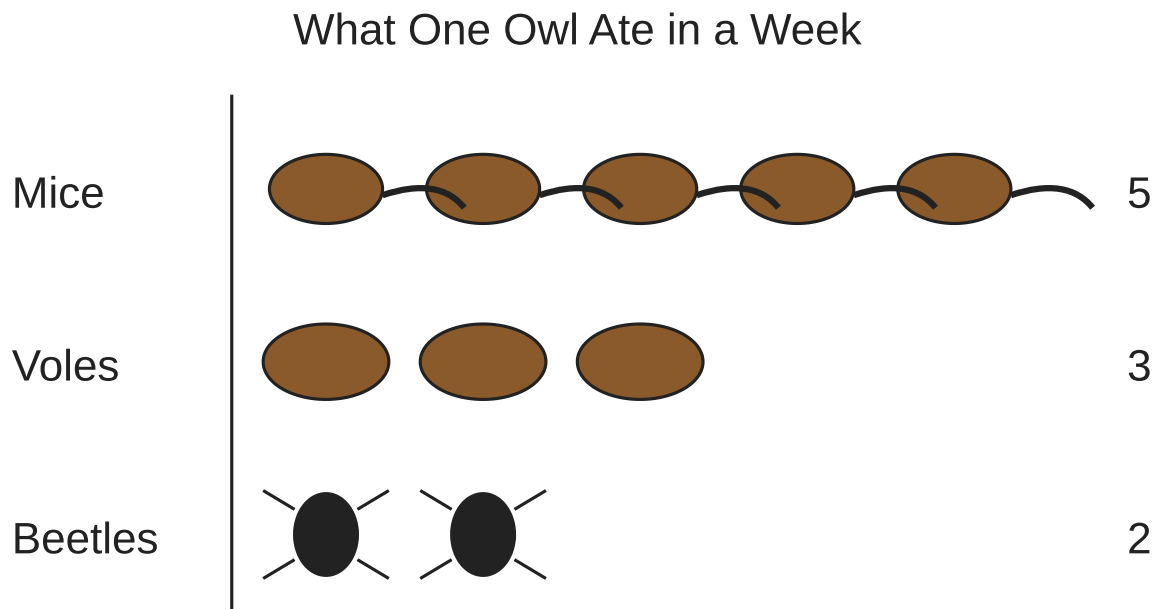
NATURE NOTEBOOK

1. Draw an owl’s face: two big round eyes facing forward, a hooked beak, and a round flat face. Your parent can write the date at the top.
2. Draw a night picture: a dark sky, a tree, an owl on a branch and a mouse in the grass below. Use a white or yellow crayon for the moon.
3. Draw the bones you found in your pretend pellet, sorted into groups, and write how many were in each group.

From history. John James Audubon finished *The Birds of America* in 1838 after more than ten years of work. The pages were so big that they were called “double elephant” size, and the birds were painted at their true size, so a great horned owl on the page is as big as a great horned owl in the woods. Audubon could not draw the birds well from a distance, so he studied each one up close and then painted it in the pose he had seen it take in the wild. Only a few hundred copies of the book were ever made, and today they are among the most valuable books in the world.

WORKED EXAMPLES

Example 1. Look at the picture chart. A scientist took apart one owl's pellets from a whole week and counted the skulls. How many mice did the owl eat? How many voles? How many beetles? What did it eat the most of?



What one owl ate in a week, counted from its pellets.

1. Find the mouse row. Touch each picture and count: one, two, three, four, five. The owl ate 5 mice.
2. Find the vole row and count: one, two, three. The owl ate 3 voles.
3. Find the beetle row and count: one, two. The owl ate 2 beetles.
4. The longest row is the mouse row, so the owl ate mice the most.
5. Count all the pictures together: five, six, seven, eight, nine, ten. The owl ate 10 animals in one week.

Answer: 5 mice, 3 voles and 2 beetles. It ate the most mice. That is 10 animals in all.

PRACTICE

1. **EASY** When does an owl hunt, in the day or at night? What is the word for an animal that is awake at night?
2. **EASY** Show me how an owl looks behind itself.
3. **MEDIUM** Your parent sets out 4 beans for mouse skulls and 2 seeds for bird skulls. Sort them. Which did the owl eat more of? How many animals in all?
4. **MEDIUM** Why can a mouse not hear an owl coming?
5. **HARD** Tell your parent what an owl pellet is and how a scientist uses one.

COMMON MISTAKES

- Thinking the feather tufts on a great horned owl's head are its ears. They are only feathers. The real ears are hidden under the feathers on the sides of the face.
- Thinking an owl can spin its head all the way around in a circle. It turns its head very far, almost all the way around, but not in a full circle.
- Thinking an owl pellet is droppings. A pellet comes out of the owl's mouth. It is the fur and bones the owl could not digest.

Make it a game • Owl and Mouse. One player is the owl and sits in the middle of the room with eyes closed. The other players are mice. The mice creep as quietly as they can toward a "seed" (a sock) placed next to the owl. When the owl hears a sound, it points at the noise and says "Hoo!" If the owl points at a mouse, that mouse must freeze. If a mouse grabs the seed and gets back to the wall, the mice win. Trade places and play again. Which is harder, being the owl or the mouse?

Scripture. "Thou makest darkness, and it is night: wherein all the beasts of the forest do creep forth." (Psalm 104:20, KJV)

God made the night, and He made animals that are busy in it. The owl's big eyes, hidden ears and silent wings are His gifts for working in the dark.

Practice answers

1. At night. Nocturnal.
2. The child keeps the eyes still and turns the whole head far around. An owl cannot roll its eyes, so it turns its head.
3. More mice. 6 animals in all.
4. The owl's wing feathers have soft fringed edges, so its wings make almost no sound when it flies.
5. A pellet is a lump of fur and bones the owl coughs up because it cannot digest them. A scientist takes it apart, sorts the bones and skulls, and counts them to find out what and how many the owl ate.

1.4 BEARS IN WINTER

OBJECTIVES

- Tell how a black bear gets ready for winter and what it does in its den.
- Name three foods a bear eats in the fall.
- Measure a bear's paw print with a ruler and compare it with your own hand.

Warm-up. Pretend it is fall and you are a bear. Your parent scatters ten “berries” (balls of crumpled paper) on the floor. You have until your parent counts to ten to gather as many as you can into your lap. Count your berries. A bear eats and eats in the fall, because soon the snow will come and there will be nothing left to eat.

Video. Coming soon. Black bears in fall eating acorns and berries, a bear den in winter, newborn cubs in the den, and a thin bear coming out in spring (search SciShow Kids, Homeschool Pop (Alternate), National Park Service, Smithsonian National Zoo and nature footage of black bears).

KEY TERMS

den

A bear's winter home: a hollow tree, a cave, a hole under a fallen log or a hole the bear digs.

hibernate

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

fat

The soft layer under a bear's skin where its body stores food energy. A bear lives on its fat all winter.

cub

A baby bear.

CORE IDEAS

The story. Lie down on the floor and stretch out as long as you can. A big black bear lying down is longer than you are, and it is heavier than a grown-up. In the fall, the black bear is the hungriest animal in the woods. It eats from morning until night: acorns, beechnuts, berries, apples, grubs under logs, and honey if it can find a bee tree. It gets rounder and rounder. It is not being greedy. It is packing a lunch for the whole winter inside its own body, as **fat**.

How they figured it out. Scientists who study bears have crawled into bear dens in winter to see what is happening inside. They found the bear curled up in a hollow tree, a rock cave, or a hole under the roots of a fallen tree, lined with leaves. The bear does not eat. It does not drink. Its heart beats slowly and its breathing is slow. If you listened, you might hear only a

sigh now and then. Scientists call this **hibernating**. A bear in its **den** is not sleeping as deeply as a woodchuck, and it can wake up if it is bothered, so people leave bear dens alone.

The big idea. Something wonderful happens in the den in the middle of winter. The mother bear's **cubs** are born there. They are tiny, about the size of a squirrel, with closed eyes and thin fur. They snuggle against their mother's warm body and drink her milk while she sleeps. By spring, when the snow melts and green plants come up, the cubs are fluffy and strong, and the mother leads them out of the den. She is thin now; her winter fat is used up. All summer she will eat and teach her cubs what to eat, and next fall they will all get fat together.

God's handiwork. After the Flood, God promised that the seasons would always come around: "seedtime and harvest, and cold and heat, and summer and winter, and day and night shall not cease" (Genesis 8:22). The bear does not worry about winter. God made it to eat when the food is there and to sleep when it is gone. Its fat is its pantry, its den is its bedroom, and its cubs are born safe and warm in the coldest part of the year.

PICTURE STUDY



Morning in a Pine Forest, Ivan Shishkin and Konstantin Savitsky, 1889 · Oil on canvas · State Tretyakov Gallery, Moscow

Ivan Shishkin was a Russian painter who loved the forest so much that people called him the "king of the forest." He painted the tall pines and the morning mist. His friend Konstantin Savitsky helped by painting the bears.

These are brown bears, cousins of the American black bear. Brown bears live the same kind of year: they get fat in the fall, sleep in a den in winter, and the mother's cubs are born in the den. These cubs are out in the woods now, so it must be a warm time of year.

Look closely

- Count the bears. Which one is the mother? How many cubs does she have?
- Find the broken tree. What are the cubs doing on it?
- Look at the light and the mist. Is it morning, noon or night? How can you tell?
- Find the tall pine trees behind the bears. Are they bigger or smaller than the bears?

Talk about it

1. Were these cubs born in the summer or in the winter den? How do you know?
2. What do you think the mother bear is watching for?
3. If these bears are getting fat for winter, what foods might they look for in the forest?

Safety first. Never go near a wild bear or a bear cub, and never go near a bear den. If your family lives or hikes where there are bears, follow your parents' rules: keep food put away, stay together and make noise on the trail. Do not eat any berries you find outdoors unless a parent says they are safe.

MAKE AND DO: BUILD A BEAR DEN

You will do what a bear does: get fat, find a den and settle in. You will sort a pile of bear foods, make a den, and then measure a bear paw print against your own hand.

You will need

- Two chairs and a blanket, or a big cardboard box
- Old leaves, a towel or crumpled newspaper for lining
- A toy bear or stuffed animal
- Ten picture cards your parent draws or cuts from a magazine: acorns, berries, an apple, honey, a fish, a grub, and a few things a bear does not eat (a car, a shoe, a book, a chair)
- A sheet of paper, a pencil and a ruler
- Crayons

Steps

1. Spread the cards out. Sort them into two piles: bear food and not bear food. Count each pile.
2. Now "eat" the bear-food cards one at a time by stuffing them inside your shirt. Look how round you are getting! That is like a bear putting on fat.
3. Make a den: hang the blanket over the chairs or turn the box on its side. Line the floor with leaves, a towel or newspaper, just as a bear scrapes leaves into its den.
4. Crawl in with your toy bear and curl up. Breathe slowly. Count ten slow breaths. That is how a bear rests all winter, except that a bear does this for months.
5. In the den, tuck the smallest stuffed animal next to you. That is the cub, born in the middle of winter.

6. Come out of the den in “spring.” Take the food cards out of your shirt. You are thin again, just like a bear in spring, so go find some new food cards!
7. Now measure. Use the ruler to draw a line 7 inches long on your paper. A big black bear’s back paw print is about that long. Lay your hand next to the line, fingers together, and have your parent mark how long your hand is. Which is longer?
8. Draw a bear in its den, curled up, with a cub beside it.

Tips

- Draw a paw shape around your 7-inch line: a wide pad with five toes and five claws. Black bears have five toes on each foot.
- Real dens are small and snug. A bear does not want a big drafty cave; it wants a space just its own size that stays warm.
- Keep the sorted food cards for the unit portfolio.

Check your work

- I can sort bear food from things a bear does not eat.
- I built a den and told what a bear does inside it.
- I measured a bear paw print and my own hand with a ruler and said which is longer.

NATURE NOTEBOOK

1. Draw a fat bear in the fall under an oak tree with acorns on the ground. Your parent can write the date at the top.
2. Draw a cut-away picture of a den under a fallen tree, with a sleeping mother bear and a tiny cub inside.
3. Trace your hand. Next to it draw a bear’s paw print 7 inches long with five toes. Write which one is bigger.

From history. In November 1902 President Theodore Roosevelt went bear hunting in Mississippi. His helpers caught a bear and tied it to a tree so the president could shoot it, but Roosevelt refused; he said it would not be fair. A newspaper artist named Clifford Berryman drew a cartoon of the president turning away from the little bear. A shopkeeper in Brooklyn, New York, named Morris Michtom saw the cartoon, and his wife sewed a soft toy bear, which they called “Teddy’s bear.” That is where the teddy bear got its name.

WORKED EXAMPLES

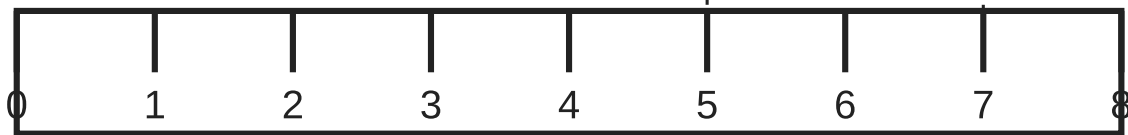
Example 1. Look at the ruler in the picture. The bear's back paw print reaches to 7 inches. A child's hand reaches to 5 inches. Which is longer? How much longer?

Measure with a ruler (inches)

Bear paw print: 7 inches



My hand: 5 inches



7 is 2 more than 5, so the paw is 2 inches longer.

A black bear's back paw print is about 7 inches long. A child's hand is about 5 inches.

1. Find the paw print bar. Follow it to the right and read the number on the ruler where it ends: 7 inches.
2. Find the hand bar. Read where it ends: 5 inches.
3. 7 is more than 5, so the bear's paw is longer than the hand.
4. Count up from 5 to 7 on the ruler: six, seven. That is 2 more inches.

Answer: The bear's paw print is longer. It is 2 inches longer than the child's hand.

PRACTICE

1. **EASY** Name three things a bear eats in the fall.
2. **EASY** Point to three places in a picture or in your yard where a bear might make a den.
3. **MEDIUM** Why does a bear eat so much in the fall?
4. **MEDIUM** Use a ruler. Draw a line 4 inches long for a cub's paw and a line 7 inches long for the mother's paw. Which is longer? How much longer?
5. **HARD** Tell your parent the story of a bear's year: fall, winter and spring.

COMMON MISTAKES

- Thinking a bear is greedy for eating so much in the fall. The bear must store fat, because it eats nothing at all during its winter sleep.

- Thinking all animals sleep through the winter. Squirrels, deer, owls and foxes stay awake and busy in winter; bears, woodchucks and some bats sleep.
- Thinking cubs are born in the spring, like fawns. Bear cubs are born in the den in the middle of winter while the mother is still hibernating.

Make it a game · Fatten Up Before the Snow. Scatter twenty paper “acorns” and “berries” around the room. You are the bear. Your parent is the weather and slowly says, “Fall... fall... fall...” while you gather food into a bowl. When your parent says “Snow!” you must run to your den (a blanket) and curl up. Count the food in your bowl. Ten or more means you are fat enough to sleep until spring. Fewer than ten means you had better hurry and gather more. Play three rounds and try to beat your own count.

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 the seasons would keep coming. The bear trusts that promise without knowing it: it eats in the harvest, sleeps through the cold, and wakes to another spring.

Practice answers

1. Any three: acorns, nuts, berries, apples, grubs, honey, fish.
2. A hollow tree, a cave or rock pile, a hole under a fallen log or tree roots, or a hole dug in a hillside.
3. It stores the food as fat under its skin. In winter there is no food, so the bear lives on its fat while it sleeps in the den.
4. The mother’s paw is longer, by 3 inches.
5. In the fall the bear eats and eats and gets fat. In winter it curls up in a den, does not eat or drink, and sleeps, and the cubs are born in the den. In spring it comes out thin and hungry with its cubs and starts eating again.

UNIT 1 REVIEW

This is an oral review. Read each question aloud and let your child answer by telling, pointing, sorting, drawing or showing. Have a few acorns, some buttons, a ruler and paper ready. Give full points for a clear answer in your child's own words. The review is worth 20 points.

1. (3 pts) Hold an acorn. Show me its cap and its shell. What does a squirrel do with acorns in the fall, and why?
2. (3 pts) A squirrel buried 8 acorns and dug up 5. How many are left in the ground? What might happen to them? (Use buttons to help.)
3. (3 pts) Which deer has antlers? What happens to the antlers every winter? Draw a deer track in the air with your finger.
4. (2 pts) How does a fawn stay safe when its mother goes away to eat?
5. (3 pts) When does an owl hunt? Tell me two things that help it hunt in the dark.
6. (3 pts) Here are 4 beans for mouse skulls and 3 seeds for bird skulls from an owl pellet. Sort them. Which did the owl eat more of? How many animals in all? What is an owl pellet?
7. (3 pts) Tell me a bear's year: what does it do in the fall, in the winter and in the spring? Where are the cubs born?

UNIT PROJECT: MY FOREST ANIMAL BOOK

Make a book with four pages, one for each forest animal: squirrel, deer, owl and bear. On each page draw the animal, its home and one thing it eats, and have a parent write one sentence you say about it. Add your real acorn hunt count, a deer track print from your stamp, the sorted "bones" from your pretend owl pellet, and your traced hand next to the 7-inch bear paw. Then give a "forest tour" to your family: open each page and tell what you learned.

- **Animals:** All four animals are drawn with their home and a food, and the drawings show real details such as the squirrel's tail, the buck's antlers, the owl's big eyes and the bear's den.
- **Records:** The acorn count, the track print, the sorted pellet bones and the hand-and-paw measurement are all in the book.
- **Telling:** On the forest tour the child tells in their own words how the squirrel buries acorns, how the fawn hides, how the owl hunts at night and how the bear spends the winter.
- **Care:** The pages are neat and colorful, and the book is put together so it can be read again.

Answer key

1. The child points to the bumpy cap and the smooth shell. A squirrel buries acorns one at a time in little holes so it can dig them up and eat them in winter, when there is no fresh food.

2. 3 are left. They may sprout in the spring and grow into oak trees.
3. The buck. The antlers drop off every winter and grow back in the spring. The track is two teardrops side by side, like an upside-down heart.
4. It lies perfectly still in the grass, and its white spots help it hide. The doe comes back to feed it.
5. At night. Any two: big forward-facing eyes; a head that turns almost all the way around; hidden ears and a round face that catch tiny sounds; soft fringed wing feathers for silent flight; sharp talons.
6. The child makes two groups. More mice. 7 animals in all. A pellet is the lump of fur and bones an owl coughs up because it cannot digest them.
7. In the fall the bear eats and eats and gets fat. In winter it sleeps in a den without eating or drinking. The cubs are born in the den in winter. In spring the thin mother bear comes out with her cubs and starts eating again.

POND

“Let the waters bring forth abundantly the moving creature that hath life” (Genesis 1:20). In this unit your child goes down to the water’s edge and meets the animals God put in and around a pond. A frog starts life as a dot in a clump of jelly and changes into a hopping frog. A mother mallard leads her ducklings to the water, and their oiled feathers keep them dry. A beaver cuts down trees with its teeth and builds a dam that makes a whole pond. Last of all, your child scoops up a jar of pond water and finds it full of tiny living things, just as Antonie van Leeuwenhoek did long ago.

Each lesson is something to see, hold, build or test: a paper plate frog wheel, a waxed paper duck in the “rain,” a stick-and-mud dam in a baking pan and a pond in a jar. Along the way your child counts ducklings, measures sticks with a ruler and reads a simple picture chart.

Everything in this unit is said, pointed to, built, measured or drawn. No reading is needed. Keep the frog wheel from Lesson 2.1, the paper ducks from Lesson 2.2, a drawing or photo of the dam from Lesson 2.3 and the picture chart from Lesson 2.4; they all go into the pond book at the end. Plan a visit to a real pond with your child if you can, and always stay close by near the water.

BEFORE YOU BEGIN

- Can count objects up to 10
- Can tell longer from shorter and more from fewer
- Can listen to a short story read aloud and tell part of it back
- Knows from Unit 1 that animals have homes and habits that fit their lives

MASTERY CHECKLIST

- I can tell the frog’s life cycle in order: eggs, tadpole, tadpole with legs, frog.
- I can tell how a duck keeps its feathers dry and how its webbed feet help it swim.
- I can tell how a beaver builds a dam and why its lodge has doors under the water.
- I can look at pond water with a magnifying glass and tell what tiny living things I found.
- I can measure sticks with a ruler and read a simple picture chart.

OPTIONAL BOOKS AND RESOURCES

- **Mallard, from All About Birds (Cornell Lab of Ornithology)**
(<https://www.allaboutbirds.org/guide/Mallard>): Free. Photos of the drake, the hen and ducklings, plus recordings of the hen’s quack and the drake’s softer call (Lesson 2.2).
- **Thornton W. Burgess animal stories (free at Project Gutenberg)**
(<https://www.gutenberg.org/ebooks/search/?query=thornton+burgess>): Free. Gentle

old read-aloud stories about pond animals. *The Adventures of Paddy the Beaver* fits Lesson 2.3, and *The Adventures of Grandfather Frog* fits Lesson 2.1.

- **Smithsonian's National Zoo and Conservation Biology Institute**
(<https://nationalzoo.si.edu/>): Free. Animal pages and pictures of frogs, ducks and beavers to browse with your child.

2.1 FROGS ★

OBJECTIVES

- Tell the four steps of a frog's life in order: eggs, tadpole, tadpole with legs, frog.
- Name two things about a frog's body that help it live in and around a pond.
- Tell one way a frog is different from a toad.

Warm-up. Squat down low like a frog, with your hands on the floor between your feet. Now jump forward as far as you can! Your parent puts a piece of tape where your heels land. Try three jumps. Which jump was the longest? A frog's long back legs fold up like a spring, just like yours did, and then push hard.

Video. Coming soon. Frog life cycle from frogspawn to tadpole to froglet, and frogs calling and catching insects with their tongues (search SciShow Kids, Homeschool Pop (Alternate), Smithsonian National Zoo, PBS Nature clips and slow-motion pond nature footage).

KEY TERMS

tadpole

A baby frog. It lives under water, swims with a tail and has no legs at first.

gills

Little parts on a tadpole (and on a fish) that take air out of the water so it can breathe under water.

metamorphosis

A big change of shape as an animal grows up, like a tadpole turning into a frog.

amphibian

An animal like a frog that lives the first part of its life in water and later can live on land too.

CORE IDEAS

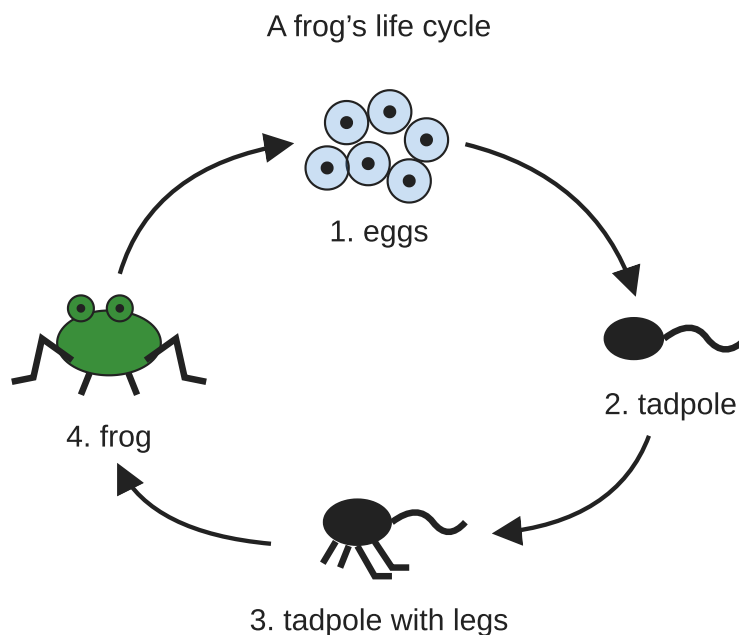
The story. Early in the spring, go to the edge of a pond and look into the shallow water. You may see a floating clump of clear jelly full of little black dots. It looks a bit like tapioca pudding. Those are frog eggs! Now listen. On spring evenings a pond can be very loud with peeps, croaks and trills. Those are father frogs singing to call mother frogs to the water. Each kind of frog has its own song.

How they figured it out. Naturalists learned the frog's story by watching the same pond day after day. Each black dot in the jelly grows a little tail and starts to wiggle. Soon a tiny **tadpole** swims out. A tadpole lives under water like a fish. It breathes with **gills** and nibbles soft green plants. Then, little by little, it changes. Two back legs pop out first. Then two front legs. The tail gets shorter and shorter, and the tadpole grows lungs to breathe air. One day a

little frog climbs out onto a rock. This big change is called **metamorphosis**. Look at the picture of the frog's life cycle and follow the arrows with your finger.

The big idea. A frog is made for pond life. Its long back legs are strong for jumping, and its back feet are webbed for swimming. Its eyes sit high on top of its head, so it can hide in the water with only its eyes peeking out. Its skin is smooth and wet, and a frog can even take in a little air through its skin. A frog catches flies and bugs with a long sticky tongue that flips out fast. Toads are cousins of frogs, but a toad has bumpy, dry skin and shorter legs, and it hops instead of making big leaps. In winter many pond frogs rest quietly at the bottom of the pond until spring comes again.

God's handiwork. God gave the frog two lives in one: first a swimming tadpole in the water, then a hopping frog on the land. That is why a frog is called an **amphibian**. Frogs eat many mosquitoes and other bugs, and herons, snakes and fish eat frogs. The Bible tells how God once sent so many frogs that "the frogs came up, and covered the land of Egypt" (Exodus 8:6). The same God made every frog in your pond, and He knows each one.



A frog's life cycle: eggs, tadpole, tadpole with legs, frog. Then the frog lays eggs and it starts again.

PICTURE STUDY



Batrachia (Frogs), Plate 68 from Art Forms in Nature, Ernst Haeckel, 1899–1904 (published in parts) · Printed plate (lithograph) from the book Kunstformen der Natur (Art Forms in Nature) · Published in Leipzig, Germany; copies are kept in many libraries

Ernst Haeckel was a German scientist who loved to draw. He made a big book of one hundred pictures of living things: sea jellies, shells, flowers, birds and more. On this page he put many kinds of frogs and toads from around the world, all together, so we can compare them.

Some frogs live in ponds, some live high in trees, and some live in wet forests. Each one has a body that fits its home.

Look closely

- Count as many frogs as you can. Ask your parent to help you keep track.
- Find a frog that looks like it is jumping or climbing. Look at its legs.
- Find one frog with smooth skin and one with bumpy skin. Which one might be a toad?
- Look at the feet. Can you find webbed toes, or round sticky pads on the toes for climbing?

Talk about it

1. Which frog would you most like to see in real life? Why?
2. How are all these frogs alike? How are they different?
3. Why do you think the artist arranged them like a pattern on the page?

Safety first. Always have a grown-up with you near a pond; stay back from deep or steep edges. Look at frogs and eggs where they are. If you gently hold a frog, wet your hands

first, hold it only a moment, put it back where you found it, and wash your hands with soap afterward. Never touch your mouth or eyes after touching a frog or pond water. Use the scissors only with a parent's help.

MAKE AND DO: FROG LIFE CYCLE WHEEL

You will make a spinning wheel that shows a frog growing up. Each time you turn it, a new step shows in the window: eggs, tadpole, tadpole with legs and frog.

You will need

- Two paper plates the same size
- One brass paper fastener (brad)
- Crayons or markers
- A pencil and a ruler
- Scissors (for a parent to use or help with)

Steps

1. On the first plate, use the ruler to draw two lines that cross in the middle, like a plus sign. Now the plate has four parts, like four slices of pie.
2. In the first part, draw a clump of frog eggs: little circles with black dots in the middle.
3. Going around the plate, draw a tadpole with a tail in the next part, a tadpole with back legs and front legs in the next part, and a frog in the last part.
4. Ask your parent to cut a pie-slice window out of the second plate, about the same size as one of your four parts.
5. Put the window plate on top of the picture plate. Your parent pushes the brass fastener through the middle of both plates and opens its legs on the back.
6. Write or have your parent write "A Frog Grows Up" on the top plate. Draw lily pads and water around the window.
7. Turn the bottom plate. Say each step out loud as it shows in the window: eggs, tadpole, tadpole with legs, frog. Then keep turning: the frog lays eggs, and it starts again!

Tips

- Draw the pictures big and simple so they fill each part.
- Turn the wheel the same way every time so the steps come in the right order.
- If you live near a pond, take your wheel along in spring and see which step the real tadpoles are on.

Check your work

- My wheel shows all four steps in the right order.
- I can turn the wheel and tell what happens at each step.
- I can tell which legs grow first: the back legs.

NATURE NOTEBOOK

1. Draw a frog sitting on a lily pad. Give it big eyes on top of its head and long folded back legs. Your parent can write the date at the top.
2. Draw a frog and a toad side by side. Make the frog's skin smooth and the toad's skin bumpy.
3. Draw a pond with a frog hiding in the water so only its eyes and nose peek out.

From history. In 1758 a German painter and naturalist named August Johann Rösel von Rosenhof, who lived in the city of Nuremberg, finished a whole book about the frogs and toads of his own country. He kept frogs, gathered their eggs and watched the tadpoles change day by day. Then he painted every step in careful, colored pictures, from the jelly eggs to the grown frog. People still admire his frog pictures today, because he drew only what he had seen with his own eyes.

WORKED EXAMPLES

Example 1. Look at the frog life cycle picture. Start at the eggs and follow the arrows. What comes right after the tadpole? How many legs does the frog have at the end?

(Use the map or drawing "Follow the arrows to see a frog grow up." shown earlier in this lesson.)

1. Put your finger on the eggs at the top. Follow the arrow to the right. That is the tadpole. It has a tail and no legs.
2. Follow the next arrow down. The tadpole now has legs. So the tadpole with legs comes right after the tadpole.
3. Count the back legs that grew first: one, two. Then count the front legs: one, two.
4. Two back legs and two front legs make four legs. Follow the last arrow to the frog and count its legs to check: one, two, three, four.

Answer: The tadpole with legs comes right after the tadpole. The frog has 4 legs.

PRACTICE

1. **EASY** Point to the steps of the frog's life cycle in order, starting with the eggs. Say the name of each step.
2. **EASY** Your parent says a clue. You say "frog" or "toad." Smooth, wet skin. Bumpy, dry skin. Long legs for big leaps. Short legs for little hops.
3. **MEDIUM** In a jar there are 4 tadpoles with legs and 3 tadpoles with no legs yet. Use buttons to show them. How many tadpoles are in the jar?
4. **MEDIUM** Why is it good for a frog to have its eyes on top of its head?
5. **HARD** Tell your parent how a tadpole is different from a frog. Try to say two things.

COMMON MISTAKES

- Thinking a tadpole is a little fish. A tadpole is a baby frog. It looks like a fish for a while, but it grows legs and lungs and becomes a frog.
- Thinking the front legs grow first. The back legs come first, then the front legs, and then the tail shrinks away.
- Thinking frogs and toads are exactly the same. They are cousins, but frogs have smooth, wet skin and long legs, and toads have bumpy, dry skin and shorter legs.

Make it a game · Tadpole to Frog. Your parent calls out a step, and you act it out. “Eggs!” Curl up in a tight little ball. “Tadpole!” Lie on your tummy and wiggle like a tail. “Back legs!” Kick your legs. “Front legs!” Push up on your arms. “Frog!” Hop and catch a pretend fly with your tongue. Your parent calls them in order at first, then mixed up. If a step is called out of order, say “Not yet!” and stay where you are.

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)

When God sent the frogs on Egypt, they came up out of the waters, just as real frogs come up out of the pond. God is the Maker of every frog, and even the frogs obey Him.

Practice answers

1. Eggs, tadpole, tadpole with legs, frog (and then back to eggs).
2. Smooth, wet skin: frog. Bumpy, dry skin: toad. Long legs for big leaps: frog. Short legs for little hops: toad.
3. 7 tadpoles.
4. The frog can hide in the water with only its eyes peeking out. It can watch for bugs to eat and for animals that might eat it.
5. Any two: a tadpole lives only under water, but a frog can live on land too; a tadpole breathes with gills, but a frog breathes with lungs (and through its skin); a tadpole has a tail, but a grown frog does not; a tadpole has no legs at first, but a frog has four legs; a tadpole eats soft plants, but a frog eats bugs.

2.2 DUCKS

OBJECTIVES

- Tell how a duck keeps its feathers dry and how its webbed feet help it swim.
- Tell the difference between a mallard drake, a hen and a duckling.
- Show by a simple test that oily or waxy things make water roll off.

Warm-up. Put a sheet of wax paper and a paper towel side by side. Use a spoon or a straw to drip three drops of water on each one. Look closely. What happens to the drops on the wax paper? What happens on the paper towel? A duck's feathers are more like the wax paper. Today you will find out why.

Video. Coming soon. Mallard ducks preening, dabbling “bottoms up” for food, paddling with webbed feet underwater, and a mother duck leading her ducklings (search SciShow Kids, Homeschool Pop (Alternate), Cornell Lab of Ornithology, Smithsonian National Zoo and nature footage of ducklings).

KEY TERMS

duckling

A baby duck. It is covered in soft fluffy feathers and follows its mother everywhere.

webbed feet

Feet with skin stretched between the toes, like a paddle, for pushing through water.

preen

To clean and smooth the feathers with the bill. A duck spreads a little oil from near its tail over its feathers when it preens.

down

The very soft, fluffy feathers close to a bird's skin that keep it warm.

CORE IDEAS

The story. A man named Robert McCloskey wanted to write a picture book about a family of mallard ducks in the city of Boston. But he wanted his ducks to look just right. So he brought real ducks home to his apartment! He watched them waddle, swim, flap and sleep, and he drew them again and again. In 1941 his book *Make Way for Ducklings* came out. It tells how Mrs. Mallard leads her eight ducklings across busy streets while a police officer stops the cars. Today there are bronze statues of the mother duck and her eight ducklings in the Boston Public Garden, and children climb on them every day.

How they figured it out. Watch a duck on a pond and you will see it twist its neck around and rub its bill on its back, over and over. It is **preening**. Near the duck's tail is a tiny spot that makes oil. The duck rubs its bill there and spreads the oil all over its feathers. Then

water rolls right off, the same way water ran off the wax paper. Under the outside feathers is a coat of soft **down** that stays dry and warm, even on a cold pond.

The big idea. A duck is made for the water. Its **webbed feet** are paddles. When it pushes back, the toes spread wide and push the water. When it pulls forward, the toes fold up so they slip through the water. Its flat bill has little ridges along the edges, like a tiny comb, that let water drain out while it keeps the food in. A mallard often tips “bottoms up,” with its tail in the air and its head under water, to eat water plants, seeds, snails and bugs. The father mallard, the drake, has a shiny green head. The mother, the hen, is speckled brown, so she is hard to see when she sits on her nest in the grass.

Try it and see. Mallard eggs hatch in the spring. The fluffy **ducklings** can walk and swim very soon after they hatch. They line up behind their mother and follow her to the water. Next time you are near a pond, count the ducklings in the line. Watch for a duck that is preening, and a duck that is tipping bottoms up.

PICTURE STUDY



Summer, or Wood Duck (Plate 206, The Birds of America), John James Audubon, 1830s · Hand-colored engraving made by Robert Havell from Audubon's watercolor · Audubon's watercolor is at the New-York Historical Society, New York; prints are kept in many museums and libraries

John James Audubon painted every kind of bird he could find in America, life-size. Here he painted wood ducks, sitting on a branch the way they really do. Wood ducks are unusual ducks: they make their nests in holes high up in trees near the water.

When wood duck ducklings hatch, they do not wait long. Their mother calls from below, and the tiny ducklings jump out of the tree hole, flutter down to the ground and follow her to the water.

Look closely

- Find the ducks with the brightest colors. Those are the drakes, the father ducks.
- Find the plainer brown ducks. Those are the hens. Why might a mother duck be better off in plain colors?
- Look at the feet holding the branch. Can you see the webbing between the toes?
- Point to a bill. Is it pointed like an owl's beak or flat like a spoon?

Talk about it

1. How is a wood duck like a mallard? How is it different?
2. Would you be brave enough to jump out of a tree hole like a wood duck duckling?
3. Why do you think Audubon painted the ducks the same size as real ducks?

Safety first. Always have a grown-up with you near a pond. Watch wild ducks from a few steps away; do not chase them or try to pick up a duckling. Do not feed ducks bread. Bread fills them up but does not give them what they need; if your park allows feeding, use a little cracked corn, oats or thawed frozen peas. Wash your hands with soap after touching ducks, feathers or pond water. Use the scissors only with a parent's help.

MAKE AND DO: THE WATERPROOF DUCK

You will make two paper ducks. One will get a coat of crayon wax, like a duck's preen oil. The other will not. Then you will make it "rain" on both ducks and see which one stays dry.

You will need

- Two paper duck shapes cut from plain white paper (a parent can trace around a cookie cutter or draw a simple duck)
- Crayons (press hard)
- A cup of water and a spoon, or a spray bottle
- A tray or baking pan
- A real feather, if you have one

Steps

1. Lay both paper ducks on the tray. Name them: one is the Preened Duck and one is the Plain Duck.
2. Color the Preened Duck all over with crayon. Press hard so the wax covers every bit of paper, the way a duck spreads oil on every feather.
3. Leave the Plain Duck white, with no crayon at all.
4. Guess: Which duck will stay drier when it rains? Tell your parent your guess.
5. Make it rain! Drip five spoonfuls of water on each duck, or give each one three sprays.
6. Look closely. On which duck does the water make round beads that roll off? Which duck gets soggy and dark?
7. Tip the tray a little. Watch the beads slide off the Preened Duck.

8. If you have a real feather, drip a drop of water on it too. Does the drop bead up or soak in?
9. Tell your parent: Was your guess right? Why does a real duck preen its feathers so often?

Tips

- The more crayon you press on, the better the water will bead up.
- Do the test on a tray so the water does not spill on the table.
- Let the ducks dry and keep them for your pond book.

Check your work

- I made one waxed duck and one plain duck.
- I saw that water beads up and rolls off the waxed duck.
- I can tell how a real duck keeps its feathers dry.

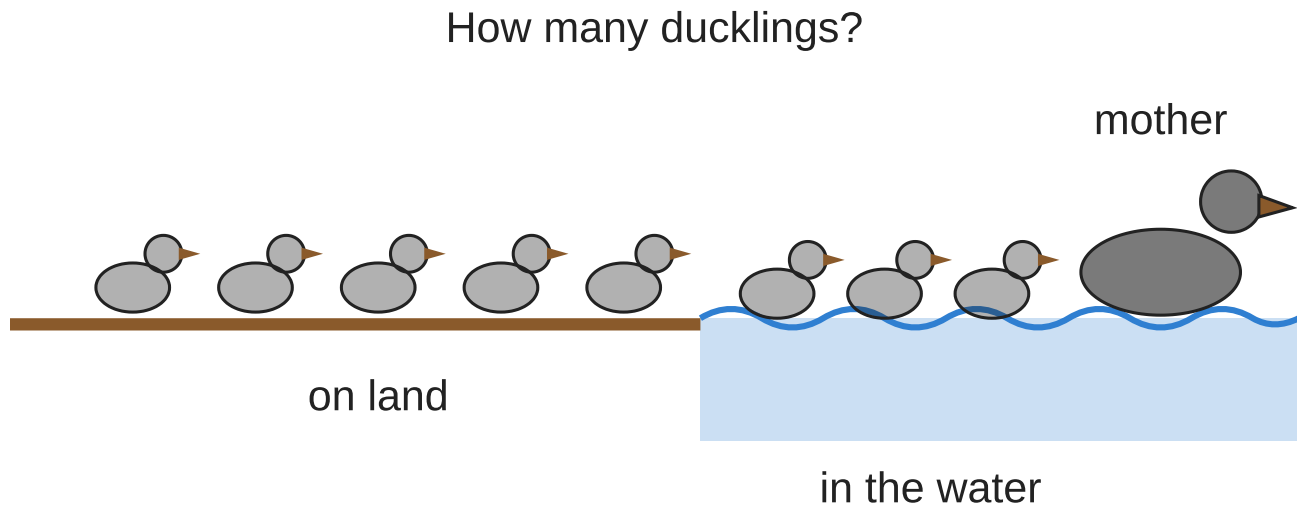
NATURE NOTEBOOK

1. Draw a mallard drake with a green head and a mallard hen in speckled brown. Your parent can write the date at the top.
2. Draw a duck tipping “bottoms up” with only its tail in the air. Draw what it might be eating under the water.
3. Trace your hand with your fingers spread. Color the spaces between your fingers to make a webbed foot.

From history. In 1987 an artist named Nancy Schön made bronze statues of Mrs. Mallard and her eight ducklings, Jack, Kack, Lack, Mack, Nack, Ouack, Pack and Quack, and they were set up in the Boston Public Garden, near the pond where the ducks in the book made their home. Every spring families in Boston hold a Duckling Day parade. Children dress up as ducklings and march in a line behind a “mother duck,” just as Robert McCloskey drew it.

WORKED EXAMPLES

Example 1. Look at the picture. A mother mallard is leading her ducklings into the pond. How many ducklings are there in all? Some are already in the water. How many are still on land?



Mrs. Mallard and her ducklings: 3 in the water, 5 on land.

1. Find the mother duck. She is the big duck at the front. Do not count her; count only the little ducklings.
2. Count all the ducklings, touching each one: one, two, three, four, five, six, seven, eight. There are 8 ducklings, just like in *Make Way for Ducklings*.
3. Now count only the ducklings in the blue water behind their mother: one, two, three. Three are swimming.
4. Count the ducklings still on the brown ground: one, two, three, four, five. Check: 3 in the water and 5 on land make 8 in all.

Answer: There are 8 ducklings in all. 5 are still on land.

PRACTICE

1. **EASY** Which mallard has a shiny green head, the drake or the hen? Which one is speckled brown?
2. **EASY** Show with your hand how a duck's foot paddles. Spread your fingers when you push back, and close them when you pull forward.
3. **MEDIUM** 6 ducklings are swimming. 4 more ducklings jump into the water. Use buttons to show it. How many ducklings are swimming now?
4. **MEDIUM** Why is it good for the mother duck to have plain brown feathers?
5. **HARD** Tell your parent why water rolls off a duck's back. Use the word "preen."

COMMON MISTAKES

- Thinking a duck's feathers stay dry all by themselves. The duck must preen and spread oil on them often to keep them waterproof.
- Thinking all ducks say "quack." In mallards, the loud quack comes from the hen. The drake makes a softer, raspy sound.
- Thinking bread is good food for ducks. Ducks fill up on bread but do not get what they need from it. In the wild they eat water plants, seeds, snails and bugs.

Make it a game · Follow the Mother Duck. One person is the mother duck, and everyone else lines up behind as ducklings. The mother duck walks around the house or yard doing duck things: waddling, flapping, preening, paddling and tipping bottoms up. The ducklings must copy every move, in a straight line, without passing her. When the mother duck says "Quack!" everyone freezes. Then take turns being the mother duck. Count how many ducklings are in your line.

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

Ducks do not plant gardens, but God feeds them with water plants, seeds and bugs in the pond. If He cares for the ducks, He will surely care for you.

Practice answers

1. The drake (the father) has the green head. The hen (the mother) is speckled brown.
2. The child spreads the fingers wide and pushes back, then squeezes the fingers together and brings the hand forward.
3. 10 ducklings.
4. She sits on her nest on the ground for a long time. Her brown, speckled feathers match the grass and leaves, so foxes and other animals have a hard time seeing her and her eggs.
5. When a duck preens, it rubs its bill on an oil spot near its tail and spreads the oil over its feathers. The oil keeps water from soaking in, so the water rolls right off, like water off the waxed paper duck.

2.3 BEAVERS BUILD DAMS

OBJECTIVES

- Tell how a beaver builds a dam and why the dam makes a pond.
- Point to the dam, the lodge, the dry room and the underwater door in a picture, and tell how they keep the beaver family safe.
- Measure sticks with a ruler and tell which is longest and which is shortest.

Warm-up. Put a little water in a baking pan and tip it so the water runs to one end. Now build a wall of building blocks or a rolled-up wet washcloth across the middle. Does the wall hold the water back? Does any water sneak through? Beavers build walls like this across streams, and they work hard to stop every leak.

Video. Coming soon. Beavers cutting trees with their teeth, building a dam and a lodge, slapping their tails and swimming under the ice to their winter food pile (search SciShow Kids, Homeschool Pop (Alternate), Smithsonian National Zoo, PBS Nature clips and nature footage of beaver ponds).

KEY TERMS

dam

A wall built across a stream to hold back the water. A beaver dam is made of sticks, mud and stones, and it turns the stream into a pond.

lodge

A beaver's home: a big mound of sticks and mud in the pond, with doors under the water and a dry room inside.

rodent

An animal with big front teeth that never stop growing, like a squirrel, a mouse or a beaver. Rodents gnaw to keep their teeth short.

CORE IDEAS

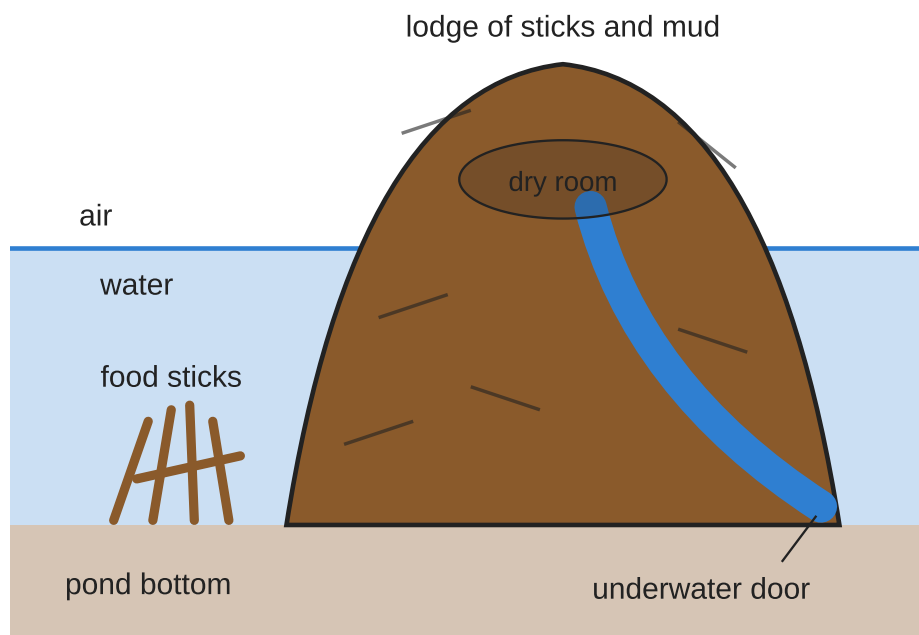
The story. If you walk along a stream in beaver country, you may find a tree stump that looks like a giant sharpened pencil, with a pile of wood chips all around it. No one used an ax. A beaver did that with its teeth! A beaver is a **rodent**, like the squirrel, and its big front teeth never stop growing. They are orange on the front and very strong. The beaver gnaws round and round the trunk until the tree falls down. Then it chews off the branches and drags them to the water.

How they figured it out. Beavers do most of their work in the evening and at night, so people who wanted to learn about them had to sit quietly by the water at dusk and watch. They saw beavers push sticks into the bottom of a stream and pile on more sticks, mud and stones. Bit by bit the beavers build a **dam**, a wall across the stream. The dam holds back the

water, and a deep, quiet pond spreads out behind it. If the dam springs a leak, the beavers hear the water trickling and hurry to patch it with more mud.

The big idea. Why do beavers want a pond? For safety. Out in the pond the beavers build a **lodge**, a big mound of sticks and mud. Its doors are under the water, so foxes, coyotes and wolves cannot get in. The beaver swims in through an underwater tunnel and climbs up into a dry room above the water, where the family sleeps. A beaver's body is made for this work. Its back feet are webbed for swimming. Its flat, scaly tail helps it steer, and it slaps the water with a loud SMACK to warn the family of danger. It can close its ears and nose under water, and see-through eyelids cover its eyes like swimming goggles. In fall the beavers stick a big pile of branches into the mud at the bottom of the pond. In winter, when ice covers the top, they swim out under the ice and bring back bark to eat.

God's handiwork. A beaver pond is a home for many animals besides beavers. Frogs lay eggs in it, ducks raise their ducklings on it, fish swim in it, and deer and moose come to drink. God gave a small animal the skill to build a home that helps a whole neighborhood of His creatures.



Inside a beaver lodge: the dry room is above the water, and the door is under the water. The winter food sticks are stuck in the mud nearby.

PICTURE STUDY



American Beaver, from *The Viviparous Quadrupeds of North America*, John James Audubon, 1840s · Hand-colored lithograph printed by J. T. Bowen in Philadelphia · Prints are kept in many museums and libraries
Photo: Free Public Domain Illustrations by rawpixel · CC BY 2.0 (<https://creativecommons.org/licenses/by/2.0>) · via Wikimedia Commons

After John James Audubon finished his great book of birds, he began a new one about the four-footed animals of North America. He worked on it with his friend John Bachman, a pastor in South Carolina who loved animals, and with his own sons. This page shows the American beaver.

Audubon wanted his animals to look alive, so he showed them doing what they really do, beside the water where they live.

Look closely

- Find a beaver's flat tail. What shape is it? Does it look furry or scaly?
- Find the front teeth or the front paws. What might the beaver be doing with them?
- Look at the fur. How do you think it would feel? Thick fur keeps a beaver warm in cold water.
- Find the water. Is the beaver close to it or far from it?

Talk about it

1. What do you think the beaver will do next?
2. How is this beaver like the squirrel from the forest unit? How is it different?
3. If you could add one thing to the picture, would you add a dam or a lodge? Where would you put it?

Safety first. Never go near a wild beaver or try to touch one; a scared beaver can bite hard. Watch from far away with a grown-up. Stay off beaver dams and lodges, which can break or be slippery, and keep away from deep water. Do the dam project outside or over a towel, and let a parent cut any sticks that need trimming.

MAKE AND DO: BUILD A BEAVER DAM

You will be a beaver! You will build a dam across a pretend stream in a pan and see if it can hold back the water to make a pond.

You will need

- A large baking pan or a plastic storage tub
- A handful of small sticks and twigs from the yard
- Mud from the garden, or play dough or modeling clay
- Some small stones or pebbles
- A cup or pitcher of water
- A ruler
- An old towel

Steps

1. Set the pan on the towel, outside if you can. Prop up one end of the pan with a book so it slopes a little. The high end is upstream, and the low end is downstream.
2. Measure your sticks with the ruler. Sort them into a pile of long sticks and a pile of short sticks.
3. Build your dam across the middle of the pan, from one side to the other. Lay the long sticks first, pushed against each other, like a beaver does.
4. Pack mud or clay into the cracks between the sticks. Push stones against the bottom to make it strong.
5. Guess: Will your dam hold the water? Tell your parent.
6. Slowly pour water into the upstream end. Watch! Does a pond form behind your dam?
7. Look for leaks. Where does water sneak through? Be a beaver and patch the leaks with more mud.
8. Pour again. Did your patching help? Tell your parent what made your dam stronger.

Tips

- Mud and clay are the beaver's secret: sticks alone let lots of water through.
- Pour the water slowly, like a stream, not all at once like a flood.
- Take a picture of your dam with the pond behind it for your pond book.

Check your work

- I built a dam of sticks, mud and stones across my stream.
- I watched water pile up behind it to make a pond.

- I found a leak and patched it like a beaver.

NATURE NOTEBOOK

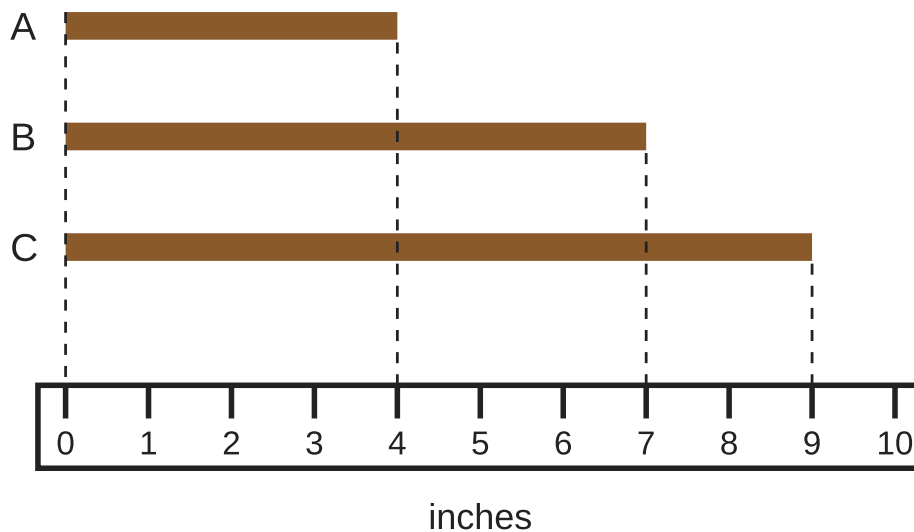
1. Draw a beaver with its orange front teeth, its webbed back feet and its flat tail. Your parent can write the date at the top.
2. Draw a stream with a beaver dam across it. Draw the pond on one side of the dam and the little stream on the other side.
3. Draw a lodge cut open like the picture in the lesson. Show the dry room and the underwater door, and draw the beaver family inside.

From history. In the 1860s a lawyer from New York named Lewis Henry Morgan went to the woods near Lake Superior in Michigan, where there were many beaver ponds. Summer after summer he studied the dams, lodges and canals the beavers had made, measured them and had them drawn. In 1868 he wrote a whole book about what he found, called *The American Beaver and His Works*. The book is full of pictures of real dams and lodges, and people who study beavers still read it today.

WORKED EXAMPLES

Example 1. A beaver has three sticks, A, B and C. Look at the picture of the sticks next to the ruler. How long is each stick? Which stick is the longest? Which is the shortest?

Which stick is longest?



Three beaver sticks measured with a ruler.

1. Every stick starts at the 0 on the ruler. To measure, look at where the other end of the stick stops.
2. Follow the dotted line down from the end of stick A. It stops at 4. Stick A is 4 inches long.
3. Do the same for stick B. It stops at 7. Stick B is 7 inches long. Stick C stops at 9. Stick C is 9 inches long.
4. The biggest number is 9, so stick C is the longest. The smallest number is 4, so stick A is the shortest.

Answer: A is 4 inches, B is 7 inches and C is 9 inches. Stick C is the longest, and stick A is the shortest.

PRACTICE

1. **EASY** Look at the picture of the beaver lodge. Point to the dry room. Point to the underwater door. Point to the winter food sticks.
2. **EASY** Tell two things a beaver does with its flat tail. Show with your hand how it slaps the water.
3. **MEDIUM** A beaver family has 2 parents and 4 baby beavers, called kits. Use buttons to show them. How many beavers live in the lodge?

4. **MEDIUM** Why are the doors of a beaver lodge under the water?
5. **HARD** Name three other animals that might use a beaver pond, and draw one of them in the pond.

COMMON MISTAKES

- Thinking beavers live inside the dam. The dam is the wall that makes the pond. The family lives in the lodge, out in the pond or against the bank.
- Thinking beavers eat fish. Beavers eat plants: bark, twigs, leaves, roots and water plants. They use the wood for building and eat the bark.
- Thinking beavers sleep all winter like bears. Beavers stay awake. They swim under the ice to the food pile they stored in the fall.

Make it a game · Tail Slap!. Everyone is a beaver. Pick a couch or a blanket to be the lodge. The beavers crawl around the room gnawing pretend trees and carrying pretend sticks. When the parent claps loudly, that is the tail slap: danger is coming! All the beavers must “swim” to the lodge as fast as they can and stay very still. The last beaver in becomes the clapper for the next round.

Scripture. “Through wisdom is an house builded; and by understanding it is established:” (Proverbs 24:3, KJV)

A beaver builds its house with the skill God gave it, stick by stick and mud by mud. People build good homes too, with wisdom and understanding from God.

Practice answers

1. The child points to the room inside the lodge above the water, to the opening of the tunnel near the pond bottom, and to the pile of sticks under the water beside the lodge.
2. It steers with its tail when it swims, and it slaps the water with a loud smack to warn the family of danger. (It also leans on its tail to balance when it sits up to gnaw.) The child slaps a hand flat on the table or floor.
3. 6 beavers.
4. So foxes, coyotes, wolves and other hungry animals cannot get in. The beavers can swim in, but those animals cannot.
5. Any three, such as frogs, ducks, fish, turtles, herons, deer, moose, muskrats or dragonflies. The child draws one of them in or beside the water.

2.4 A CLOSE LOOK AT POND WATER

OBJECTIVES

- Scoop pond water safely with a parent and look at it closely with a magnifying glass.
- Name some tiny living things found in pond water and make a picture chart of what you found.
- Tell a simple pond food chain, from tiny green plants to bigger animals.

Warm-up. Look at your thumb with just your eyes. Now look at it through a magnifying glass (or through a clear glass of water held close). What can you see now that you could not see before? Try a leaf, a crumb and a piece of cloth too. A magnifying glass helps us see small things big.

Video. Coming soon. Life in a drop of pond water under a magnifying glass and microscope: water fleas, algae, snails, mosquito larvae, and the story of Antonie van Leeuwenhoek and his tiny microscopes (search SciShow Kids, Homeschool Pop (Alternate), Science Max, Smithsonian, and close-up nature footage of pond life).

KEY TERMS

magnifying glass

A curved, clear glass that makes small things look bigger when you look through it.

microscope

A tool with very strong lenses that makes tiny things look much, much bigger, so we can see things too small for our eyes alone.

algae

Tiny green plant-like living things that grow in water. Some float like green threads or make the water look green.

food chain

A chain of who eats whom. Tiny green plants are eaten by tiny animals, and those are eaten by bigger animals.

CORE IDEAS

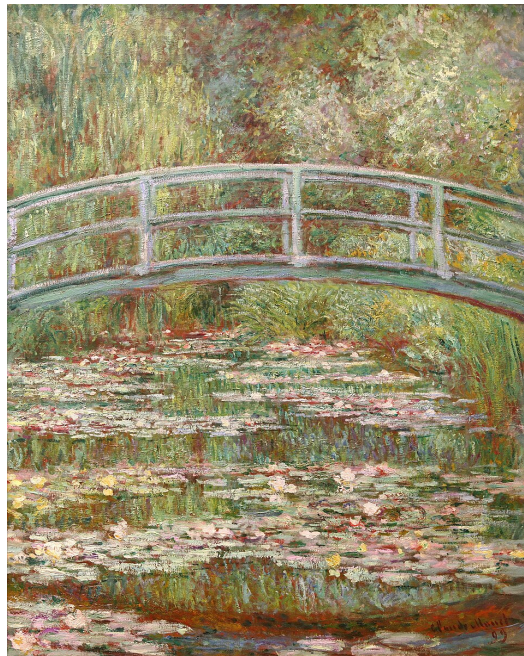
The story. Long ago, in the town of Delft in the Netherlands, there lived a cloth seller named Antonie van Leeuwenhoek. He liked to grind tiny, tiny lenses, smaller than a pea, and fit them into little metal holders. These were his **microscopes**. In 1674 he took some water from a lake near his town and looked at a drop of it through one of his lenses. He was amazed! The water was full of green threads and many tiny creatures swimming about, too small to see with his eyes alone. He called them “little animals” and wrote letters about them to scientists in London.

How they figured it out. You can look at pond water too. With a parent, scoop some water from the edge of a pond into a clear jar. Add a little mud and a few leaves from the bottom. Let it sit still until the mud settles. Now look closely at the sides of the jar with a **magnifying glass**. You may see tiny water fleas hopping jerkily through the water. You may see a snail sliding up the glass, a wiggly worm, a beetle rowing with its legs, or mosquito babies wriggling up to the top for air. Some of the little creatures are babies that will grow into dragonflies and other insects.

The big idea. A pond is full of life, even the parts that look empty. Green **algae** grow in the sunny water. Tiny water fleas and tadpoles eat the algae. Small fish eat the water fleas, and a heron or a raccoon may eat the fish. That is a **food chain**. The frogs, ducks and beavers you met in this unit all need the pond, and the pond is full of food, from the smallest green thread to the biggest fish.

God's handiwork. On the fifth day of creation God said, "Let the waters bring forth abundantly the moving creature that hath life" (Genesis 1:20). Leeuwenhoek found that the waters really are full, even in a single drop! God made creatures too small for us to see, and He cares for them all. When you finish looking, pour your pond water and its little creatures gently back into the pond where they belong.

PICTURE STUDY



Bridge over a Pond of Water Lilies, Claude Monet, 1899 · Oil on canvas · The Metropolitan Museum of Art, New York

Claude Monet was a French painter who loved to paint light, water and gardens. At his home in Giverny, France, he had a pond dug, planted water lilies in it and built a wooden footbridge across it. Then he painted the pond again and again, in different seasons and different light.

Monet painted the top of the pond: the lily pads, the flowers and the reflections. Under that calm, pretty surface, the water was full of tiny living things he could not see.

Look closely

- Find the bridge. Trace its curve with your finger.
- Find the round lily pads floating on the water. Can you find any flowers?
- Look for places where the water shows a reflection of the plants above.
- Point to the greenest part of the picture and the lightest part.

Talk about it

1. What animals do you think might live in Monet's pond? Where would a frog sit? Where would a duck swim?
2. If you scooped a jar of water from this pond, what tiny things might you find?
3. How does this painting make you feel: busy, or calm and quiet?

Safety first. Only go to a pond with a grown-up, and scoop from the very edge where the water is shallow; never lean out over deep water. Do not drink pond water or put your fingers in your mouth. If you have a cut on your hands, cover it or wear gloves. Do not pick up anything that might bite or sting; just watch it. Wash your hands with soap when you are done, and pour the water and creatures back into the pond the same day.

MAKE AND DO: A POND IN A JAR

You will be a pond scientist like Leeuwenhoek. You will scoop up some pond water, look at it closely, count the living things you find and make a picture chart.

You will need

- A large clear jar or plastic container with a lid
- A cup or small net (a kitchen strainer works), taped to a stick if you like
- A white plate or a white plastic tray
- A magnifying glass
- A spoon or an eyedropper
- Paper and crayons
- Rubber boots, if the pond edge is muddy

Steps

1. With your parent, walk to the edge of a pond, creek or even a big puddle that has been there a long time. Scoop water from the shallow edge into your jar. Add a spoonful of mud and a few leaves from the bottom.
2. Look at the jar right away. Is the water clear or cloudy? Can you see anything moving?
3. Set the jar down on a table or step and wait until the mud settles to the bottom. Be patient, like a scientist.

4. Look at the sides of the jar with your magnifying glass. Look near the top, the middle and the bottom.
5. Pour a little water onto the white plate. Tiny creatures are easier to see on white. Use the spoon or eyedropper to move one gently, and look at it with the magnifying glass.
6. Count each kind of living thing you can find: snails, water fleas, worms, beetles, wigglers or green threads.
7. Make a picture chart. Draw one small picture in a row for each one you counted, one row for each kind.
8. Tell your parent: Which kind did you find the most of? Which kind did you find the fewest of?
9. Pour the water, mud and creatures gently back into the pond.

Tips

- The best creatures live near plants and the muddy bottom, not in the open middle of the pond.
- Sit still and look for a whole minute. Many tiny animals freeze when the jar is moved and start moving again when it is quiet.
- If you cannot visit a pond, ask a parent to set a bucket of rainwater with a handful of grass and leaves outside for a week or two, then look in it.

Check your work

- I scooped pond water safely with a grown-up.
- I looked closely with a magnifying glass and counted what I found.
- I made a picture chart and told which kind I found the most of.

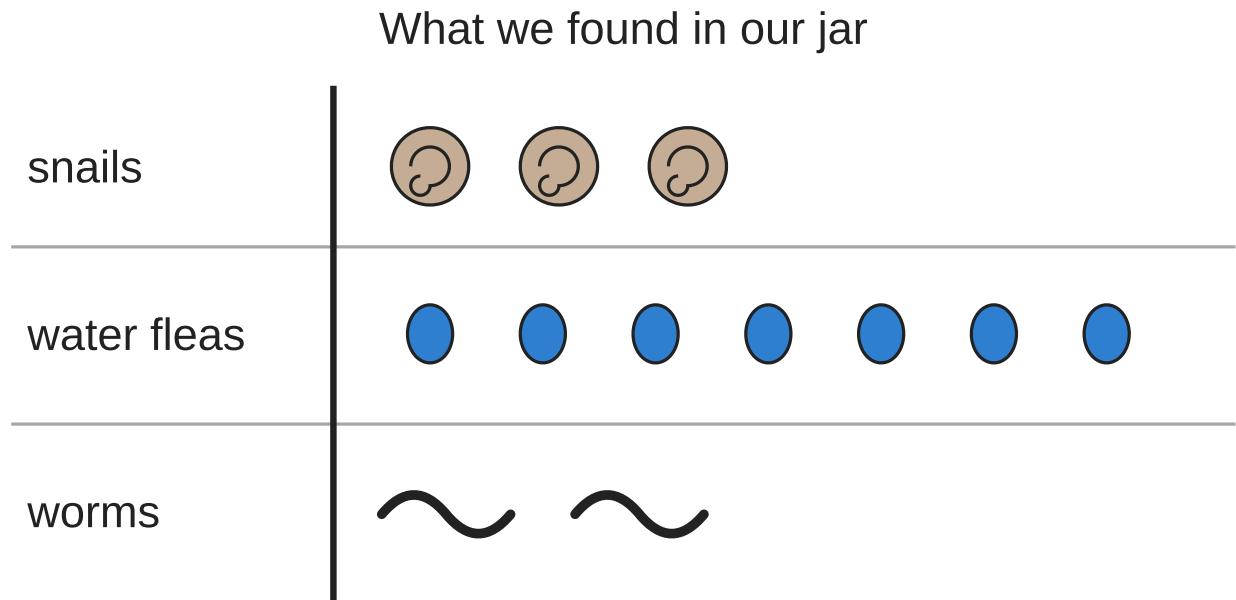
NATURE NOTEBOOK

1. Draw your jar of pond water. Draw the mud at the bottom and every creature you saw, as big as you like. Your parent can write the date and the name of the pond at the top.
2. Draw one tiny creature very, very big, as if you were looking through Leeuwenhoek's microscope. Count and draw its legs if you could see them.
3. Draw a pond food chain with arrows: green algae, then a water flea, then a small fish, then a heron.

From history. Antonie van Leeuwenhoek never went to a university, and he wrote his letters in plain Dutch, not the Latin that scholars used. Still, the scientists of the Royal Society in London read them, checked what he saw with their own microscopes, and made him a member of their society. He made hundreds of little microscopes in his life, each one small enough to fit in your hand, with a lens smaller than a pea. Only a few still exist today, and they are kept in museums as treasures.

WORKED EXAMPLES

Example 1. A family looked in their jar of pond water and made a picture chart. Look at the chart. How many of each kind did they find? Which kind did they find the most of? How many more water fleas than snails were there?



What we found in our jar of pond water.

1. Find the snail row. Touch each snail and count: one, two, three. There are 3 snails.
2. Find the water flea row and count: one, two, three, four, five, six, seven. There are 7 water fleas. Find the worm row and count: one, two. There are 2 worms.
3. The longest row has the most. The water flea row is the longest, so they found the most water fleas. The worm row is the shortest, so they found the fewest worms.
4. To find how many more water fleas than snails, match each snail with a water flea. Three water fleas get a snail partner. Count the water fleas left over with no partner: one, two, three, four.

Answer: 3 snails, 7 water fleas and 2 worms. They found the most water fleas. There were 4 more water fleas than snails.

PRACTICE

1. **EASY** Who was the man in Delft who made tiny lenses and saw “little animals” in lake water? What did he use to see them?
2. **EASY** Your parent names some things found in a pond. Sort them into “living” and “not living”: a snail, a pebble, green algae, a water flea, a bit of sand.

3. **MEDIUM** You count 9 water fleas in your jar. 4 of them hop down into the mud where you cannot see them. How many can you still see? Use buttons to help.
4. **MEDIUM** Put this pond food chain in order, starting with what gets eaten first: small fish, green algae, heron, water flea.
5. **HARD** A jar of pond water looks clear and empty. Tell your parent why a scientist would still look at it with a magnifying glass.

COMMON MISTAKES

- Thinking clear water has nothing living in it. Pond water that looks clear can be full of creatures too small to see without a magnifying glass or microscope.
- Thinking water fleas are like the fleas on a dog. Water fleas are tiny water animals that eat algae. They only look like they hop like fleas.
- Thinking a food chain starts with an animal. Every pond food chain starts with green living things like algae and water plants, which grow with the help of sunlight.

Make it a game • I Spy in the Pond. Your parent picks one thing in the pond book, a pond picture, or the real jar, and says, “I spy with my little eye something that...” and gives one clue, such as “has a shell,” “hops in the water,” or “is green and stringy.” You guess what it is. Each wrong guess gets another clue. Then you take a turn as the spy. Play until everyone has found five pond things.

Scripture. “And God said, Let the waters bring forth abundantly the moving creature that hath life, and fowl that may fly above the earth in the open firmament of heaven.” (Genesis 1:20, KJV)

God filled the waters with living creatures, from the frogs and ducks we can see to the tiny water fleas we need a magnifying glass to find. “Abundantly” means a great many, and a single jar of pond water shows how true that is.

Practice answers

1. Antonie van Leeuwenhoek. He used a microscope he made himself, with a tiny glass lens.
2. Living: the snail, the green algae and the water flea. Not living: the pebble and the sand.
3. 5 water fleas.
4. Green algae, then water flea, then small fish, then heron. (The water flea eats the algae, the fish eats the water flea, and the heron eats the fish.)
5. Some living things in the water are too small to see well with our eyes alone. A magnifying glass or microscope makes them look bigger, so we can see the tiny animals and green algae that are really there.

UNIT 2 REVIEW

This is an oral review. Read each question aloud and let your child answer by telling, pointing, counting, drawing or showing. Have some buttons, a ruler, a few sticks and paper ready. Give full points for a clear answer in your child's own words. The review is worth 20 points.

1. (3 pts) Tell me how a frog grows up, from the beginning. Which legs grow first?
2. (2 pts) How is a frog different from a toad? Tell me one way.
3. (3 pts) Why does water roll off a duck's back? Show me how a duck paddles with its feet.
4. (3 pts) A mother duck has 8 ducklings. 3 are in the water. How many are still on land? (Use buttons.) Which mallard has the green head?
5. (3 pts) What does a beaver build its dam out of, and what does the dam do? Where does the beaver family live?
6. (3 pts) Here are two sticks. Measure each one with the ruler. Which one is longer?
7. (3 pts) What did Leeuwenhoek see in a drop of lake water? Tell me a pond food chain that starts with green algae.

UNIT PROJECT: MY POND BOOK

Make a book with four pages, one for each pond lesson: frogs, ducks, beavers and pond water. On the frog page, draw the frog's life cycle or attach your frog wheel. On the duck page, glue your waxed paper duck and draw a mallard family. On the beaver page, draw a dam and a lodge cut open, or add a photo of your dam in the pan. On the pond water page, glue your picture chart from the jar. Have a parent write one sentence you say on each page. Then give a "pond tour" to your family: open each page and tell what you learned.

- **Animals:** Each page shows real details: the four steps of the frog's life, the drake's green head and the duck's webbed feet, the beaver's dam and underwater door, and the tiny creatures from the jar.
- **Records:** The frog wheel, the waterproof duck test, the dam and the pond water picture chart are all in the book.
- **Telling:** On the pond tour the child tells in their own words how a tadpole becomes a frog, how a duck stays dry, how a beaver builds and what lives in a drop of pond water.
- **Care:** The pages are neat and colorful, and the book is put together so it can be read again.

Answer key

1. Eggs in a clump of jelly, then a tadpole with a tail that lives under water, then a tadpole with legs, then a frog. The back legs grow first.
2. Any one: a frog has smooth, wet skin and a toad has bumpy, dry skin; a frog has long legs for big leaps and a toad has shorter legs for little hops.
3. The duck preens: it spreads oil from a spot near its tail over its feathers, so water cannot soak in. The child spreads the fingers to push back and closes them to pull forward.

4. 5 are still on land. The drake (the father) has the green head.
5. Sticks, mud and stones. The dam holds back the stream and makes a pond. The family lives in a lodge of sticks and mud in the pond, with doors under the water and a dry room inside.
6. The child lines up the end of each stick with the 0, reads the number at the other end, and names the stick with the bigger number as the longer one.
7. Green threads and many tiny moving creatures, which he called little animals. Food chain: green algae, eaten by water fleas, eaten by small fish, eaten by a heron (or a similar chain).

OCEAN

“And God created great whales, and every living creature that moveth, which the waters brought forth abundantly” (Genesis 1:21). In this unit your child goes down to the sea and meets four of the creatures God put there. The blue whale is the biggest animal of all. The octopus is soft, clever and full of tricks. The sea turtle swims across the ocean and comes back to the beach to lay her eggs. And the great fish that God prepared carried the prophet Jonah through the deep.

Your child will walk the length of a blue whale, make an eight-armed octopus that hides by matching its color, dig a sea turtle nest and crawl toward the “moonlight” like a hatchling, and sort sea animals into fish and whales. Along the way your child learns a naturalist’s question for every sea animal: does it breathe water with gills, or does it come up to breathe air?

Everything in this unit is said, pointed to, sorted, built, counted or drawn. No reading is needed. Keep the whale drawing from Lesson 3.1, the paper-bag octopus from Lesson 3.2, the nest egg count from Lesson 3.3 and the great fish puppet and sorting cards from Lesson 3.4; they all go into the ocean book at the end.

BEFORE YOU BEGIN

- Can count objects up to 16
- Can tell bigger from smaller and longer from shorter
- Can listen to a short story read aloud and tell it back in order
- Can sort objects into two groups by one feature

MASTERY CHECKLIST

- I can tell why a whale is not a fish: it breathes air through a blowhole, has warm blood and feeds its calf milk.
- I can tell how a blue whale eats tiny krill with its baleen.
- I can count an octopus’s eight arms and tell three ways it stays safe.
- I can tell how a mother sea turtle makes a nest and how the hatchlings find the sea.
- I can tell the story of Jonah and the great fish in order.
- I can sort sea animals into fish and whales.

OPTIONAL BOOKS AND RESOURCES

- **Smithsonian Ocean** (<https://ocean.si.edu/>): Free. Photos, short articles and videos about whales, octopuses and sea turtles from the Smithsonian’s National Museum of Natural History. A parent can pick pictures to show.
- **Monterey Bay Aquarium** (<https://www.montereybayaquarium.org/>): Free to browse. The aquarium’s live animal cameras let your child watch real sea creatures, including

the open sea and kelp forest tanks, from home.

- **NOAA Fisheries Species Directory** (<https://www.fisheries.noaa.gov/species-directory>): Free. Pictures and plain facts about blue whales, humpback whales and green, loggerhead and other sea turtles, from the U.S. government's ocean scientists. Best read aloud by a parent.

3.1 WHALES: THE GREAT WHALES ★

OBJECTIVES

- Tell three ways a whale is different from a fish: it breathes air through a blowhole, its babies drink milk, and its tail moves up and down.
- Explain that a blue whale is the biggest animal God made and that it eats tiny krill it strains through its baleen.
- Compare the lengths of a dolphin, a killer whale and a blue whale on a picture chart.

Warm-up. Take a big breath of air. Now blow it out hard through your lips, “Pfooooo!” That is what a whale does when it comes up to the top of the sea. It blows out old air through a hole on top of its head, and a spray of water shoots up like a fountain. Then it takes a new breath. Put your hand on your chest. Can you feel your own lungs fill up? A whale has lungs just like you.

Video. Coming soon. Blue whales and humpback whales spouting, diving with tails up, and feeding, plus a whale mother and calf (search NOAA Fisheries, Smithsonian Ocean, SciShow Kids, Homeschool Pop (Alternate), Monterey Bay Aquarium and nature footage of whales).

KEY TERMS

whale

A very big animal that lives in the sea but breathes air, has warm blood and feeds its babies milk. A whale is not a fish.

blowhole

The nose on top of a whale’s head. The whale breathes in and out through it when it comes up to the top of the water.

baleen

Long, stiff plates like the teeth of a comb that hang in some whales’ mouths. They let the water out and keep the food in.

calf

A baby whale. It stays close to its mother and drinks her milk.

CORE IDEAS

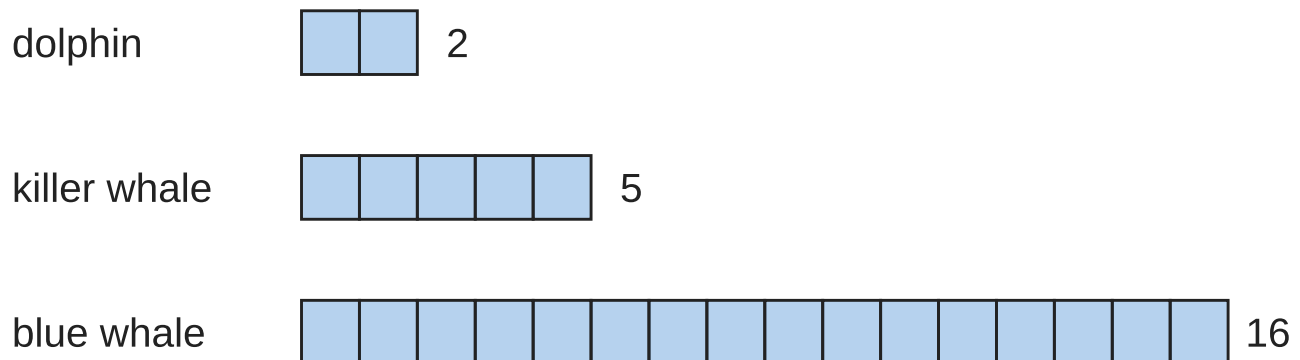
The story. In the American Museum of Natural History in New York City, there is a giant room called the Hall of Ocean Life. When you walk in, you look up, and up, and up. Hanging from the ceiling is a model of a blue whale, made just as long as a real one. Children stand under it and gasp. Its mouth is wider than a car. Its tail is as wide as a big room. As far as anyone knows, it is the biggest animal God ever made, even heavier than the biggest dinosaurs.

How they figured it out. Long ago, people called whales fish, because whales swim in the sea. But people who watched them closely saw that whales are very different. A fish breathes water through its gills. A whale must come up to breathe air through its **blowhole**, and its breath makes a spout. A fish's tail goes side to side. A whale's tail goes up and down. And a mother whale feeds her **calf** milk, just as a mother cow does. So a whale is not a fish at all. It belongs with the warm-blooded animals that breathe air and nurse their babies.

The big idea. The great blue whale eats some of the smallest animals in the sea. They are called krill, and each one is about as long as your finger. The whale opens its huge mouth and gulps a big swallow of seawater full of krill. Then it pushes the water back out through its **baleen**, which hangs from its top jaw like a curtain of comb teeth. The water goes out. The krill stay in. Gulp! Lunch is served.

God's handiwork. On the fifth day of creation, the Bible says, "God created great whales" (Genesis 1:21). Of all the sea creatures, the whales are the ones named first. God made them to dive deep, to sing to each other across the ocean, and to care for their calves. When we look at a whale, we see how big and strong our God is.

Each box = about 1 grown-up lying down



How long are they? Each box is about one grown-up lying down.

PICTURE STUDY



The Stranded Whale near Beverwijk, Jan Saenredam, 1602 · Engraving · Rijksmuseum, Amsterdam (and other museums that keep prints)

In the winter of 1601, a great sperm whale washed up on the beach near the town of Beverwijk in Holland. People came from miles around to see it. Jan Saenredam was a Dutch artist who made pictures by cutting fine lines into copper plates and printing them. He drew the whale and the crowd so that people who could not travel to the beach could see it too.

Back then, almost no one had ever seen a whale up close. This print was like a newspaper photograph. It showed everyone how big a whale really is.

Look closely

- Find the whale. Now find a person standing next to it. Who is bigger?
- Find the whale's tail. Trace it with your finger.
- Look for the whale's mouth. A sperm whale has teeth only on its bottom jaw.
- Count some of the people you can see near the whale. Are they excited?

Talk about it

1. If you were on that beach, what would you want to do first?
2. Why do you think the artist put so many people in the picture?
3. How is this whale different from the blue whale in the museum?

MAKE AND DO: HOW LONG IS A BLUE WHALE?

You cannot bring a blue whale home, but you can find out how long one is. You will lay out a string as long as a big blue whale, then fill it with people and toys to see just how big it is.

You will need

- A long ball of string or yarn, or a garden hose and some sidewalk chalk
- A long tape measure (for a parent)
- A big open space: a park, a field, a long sidewalk or a quiet parking lot
- Two sticks or two shoes to mark the ends
- Crayons and paper

Steps

1. Go outside to a big open place. Put a shoe down. This is the whale's nose.
2. Your parent measures out 100 feet with the tape measure and puts the other shoe there. This is the end of the whale's tail. (100 feet is about as long as the biggest blue whales.)
3. Lay the string from shoe to shoe, or draw a chalk line.
4. Walk from the nose to the tail. Count your steps out loud. Was it a long walk?
5. Lie down at the nose end. Your parent marks where your feet are. How much of the whale did you fill? Get up and look back at the line.
6. Now try your family. How many of you would it take, lying head to toe, to fill the whole whale?
7. Come inside and draw a long blue whale across a whole sheet of paper. Draw yourself very small next to it.

Tips

- A sidewalk chalk whale can stay on the driveway for a few days. Show it to visitors.
- If you have no big space, use a hallway and say, "The whale keeps going, out the door and down the street!"
- Talk about how much food such a big animal needs. A blue whale can eat millions of tiny krill in one day.

Check your work

- I walked the length of a blue whale.
- I saw how much bigger a whale is than I am.
- I can tell how a whale breathes and what it eats.

NATURE NOTEBOOK

1. Draw a whale at the top of the sea with a spout coming out of its blowhole. Your parent can write the date at the top.
2. Draw a fish and a whale side by side. Draw arrows to show the fish's tail going side to side and the whale's tail going up and down.
3. Draw a mother whale and her calf swimming close together.

From history. Matthew Fontaine Maury was an American Navy officer who studied the sea. He read the old logbooks of hundreds of ships, where captains had written down where they saw whales. In 1851 he made a Whale Chart, a map of the oceans showing where different whales were found at different times of the year. Maury loved the Bible and believed God made the sea with paths and patterns that people could learn.

WORKED EXAMPLES

Example 1. Look at the picture chart. Each box is about as long as one grown-up lying down. Which animal is the longest? How many boxes long is it?

(Use the map or drawing “How long are they? Each box is about one grown-up lying down.” shown earlier in this lesson.)

1. Find the dolphin row. Count its boxes: one, two. A dolphin is about 2 grown-ups long.
2. Find the killer whale row. Count: one, two, three, four, five. A killer whale is about 5 grown-ups long.
3. Find the blue whale row. Its row is the longest one on the chart. Count every box with your finger: it has 16.
4. 16 is more than 5, and 5 is more than 2. The blue whale is the longest.

Answer: The blue whale is the longest. It is about 16 boxes long, as long as 16 grown-ups lying head to toe.

PRACTICE

1. **EASY** Point to where a whale’s blowhole is on your own body. What comes out of it?
2. **EASY** Show me with your hand how a fish’s tail moves. Now show me how a whale’s tail moves.
3. **MEDIUM** A mother whale and her calf come up to breathe. The mother blows 3 spouts and the calf blows 4. How many spouts in all? (Use buttons to help.)
4. **MEDIUM** Run a comb through a bowl of water with a few rice grains in it. What stays in the comb and what runs out? Which whale part is like the comb?
5. **HARD** Tell your parent why a whale is not a fish. Give two reasons.

COMMON MISTAKES

- Thinking a whale is a big fish. A whale breathes air, has warm blood and feeds its babies milk.
- Thinking the spout is water the whale drank. The spout is the whale’s warm breath mixed with spray from the top of its head.
- Thinking the biggest whale must eat the biggest food. The blue whale eats tiny krill, millions of them.

Make it a game · Whale or Fish? Your parent names a sea animal or a clue, such as “breathes air,” “has gills,” “drinks milk as a baby,” “tail goes side to side” or “shark.” If it belongs to a whale, stand up tall and blow a spout with your arms over your head. If it belongs to a fish, wiggle your hand like a fish tail. Take turns giving clues.

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

The great whales are the first sea creatures named in the Bible. God made them on the fifth day, and He called them good.

Practice answers

1. The child points to the top of the head. The whale breathes out air through it, and it makes a spout of spray.
2. A fish’s tail goes side to side. A whale’s tail goes up and down.
3. 7 spouts.
4. The water runs out and some rice is caught. The comb is like baleen, which lets the seawater out and keeps the krill in.
5. Any two: a whale breathes air with lungs through a blowhole, not water with gills; a mother whale feeds her calf milk; a whale has warm blood; a whale’s tail moves up and down, not side to side.

3.2 OCTOPUS ★

OBJECTIVES

- Count an octopus's eight arms and tell what its suckers do.
- Tell three ways an octopus stays safe: it hides in a den, it changes color, and it squirts ink.
- Explain why an octopus can squeeze through a very small hole.

Warm-up. Find a suction cup (from a bath toy, a soap holder or a window hook). Press it hard onto a smooth spot like a window, a mirror or the side of the tub. Now try to pull it off. It holds on tight! An octopus has rows and rows of round suckers on its arms that hold on just like that.

Video. Coming soon. Octopus changing color and skin bumps to hide, squirting ink, squeezing through a small gap, and a coconut octopus carrying shells (search Smithsonian Ocean, Monterey Bay Aquarium, SciShow Kids, Homeschool Pop (Alternate), Science Max and nature footage of octopuses).

KEY TERMS

octopus

A soft sea animal with eight arms and no bones. “Octo” means eight.

sucker

A round cup on an octopus's arm. Suckers grab and hold things, and they can even taste what they touch.

ink

A dark cloud an octopus squirts into the water so an animal chasing it cannot see where it went.

den

An octopus's home: a little cave in the rocks, a crack, or even an empty shell.

CORE IDEAS

The story. In 2016, an octopus named Inky lived in a tank at the National Aquarium of New Zealand, in the town of Napier. One night the lid of his tank was left open a tiny bit. Inky climbed up and slipped out through the gap. He slid across the floor in the dark. He found a drain in the floor that ran all the way down to the sea. Then he squeezed into the pipe and was gone! In the morning, the keepers found only a wet trail. Inky had gone home to the ocean.

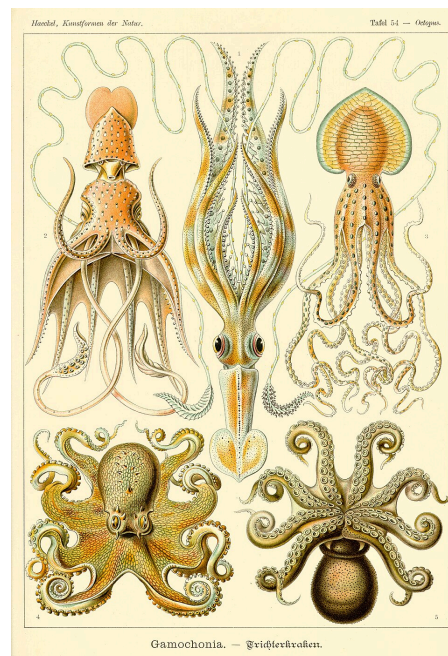
How they figured it out. How could Inky fit through such small spaces? People who study octopuses found the answer: an octopus has no bones at all. Its body is soft and stretchy. The

only hard part is its beak, which looks like a parrot's beak. If the beak can fit through a hole, the whole octopus can squeeze through after it.

The big idea. An octopus has eight arms covered in **suckers**. The suckers grab crabs and clams, and they taste whatever they touch. An octopus lives in a **den**, a cozy cave in the rocks. When danger comes, it has tricks. It can change the color of its skin in a blink, and even make bumps on its skin, so it looks just like a rock or some seaweed. If a hungry fish still finds it, the octopus squirts a dark cloud of **ink** and jets away, shooting water out like a squirt gun.

God's handiwork. The Bible says the sea is full of "things creeping innumerable, both small and great" (Psalm 104:25). The octopus creeps along the sea floor on its eight arms. It has three hearts and blue blood. It can open a jar to get a crab inside. God packed a lot of surprises into one soft little sea creature.

PICTURE STUDY



*Gamochonia (Octopuses and Squids), Plate 54 from Art Forms in Nature, Ernst Haeckel, 1904 · Color printed plate (lithograph) from a book · Published in the book *Kunstformen der Natur*, Leipzig, Germany; copies are kept in many libraries*

Ernst Haeckel was a German scientist who studied sea creatures and loved to draw them. He made a big book of one hundred pictures called *Art Forms in Nature*. On this page he drew octopuses and their cousins the squids, some seen from the top and some from below, arranged so neatly that the page looks like a beautiful pattern.

Haeckel looked at real animals for a long time before he drew them. That is what a naturalist does.

Look closely

- Find an octopus. Count its arms. Do you get eight? (A squid has ten: eight arms and two long ones.)
- Find some suckers. Are they big or small? Are they in rows?
- Look at how the arms curl. Make your arm curl like one of them.
- Find an animal's eyes. Where are they?

Talk about it

1. Which animal on the page do you like best? Why?
2. How can you tell an octopus from a squid on this page?
3. If you could see one of these octopuses in the sea, what would you watch it do?

MAKE AND DO: MAKE A PAPER-BAG OCTOPUS

You will make your own octopus with eight arms and lots of suckers. Then you will help it hide, the way a real octopus does.

You will need

- One paper lunch bag
- Crayons or markers
- Child-safe scissors
- Round stickers, paper dots from a hole punch, or a glue stick and small paper circles
- Some newspaper or tissue to stuff the head
- A rubber band or string

Steps

1. Color your paper bag any color you like. Real octopuses can be red, brown, white, gray or spotted.
2. With help, cut the open end of the bag into eight long strips. These are the arms. Count them out loud: one to eight.
3. Stuff the closed end of the bag with crumpled newspaper. Tie it off with the rubber band. Now your octopus has a round head and eight dangling arms.
4. Stick round dots in rows on the arms for suckers.
5. Draw two eyes on the head.
6. Help your octopus hide! Lay it on something its own color, like a brown blanket or a green rug. Can your parent find it fast? Now put it on something a different color. Is it easier to see?
7. Make a den for it under a chair or in a box. Put a "crab" (a toy or a block) in the den for its dinner.

Tips

- Curl the arms by wrapping each strip around a pencil for a moment.

- To make ink, cut a cloud shape from black paper. When a “shark” comes, toss the ink cloud and hide the octopus behind your back.

Check your work

- My octopus has eight arms with suckers.
- I showed how an octopus hides by matching its color.
- I can tell why an octopus can squeeze through a small hole.

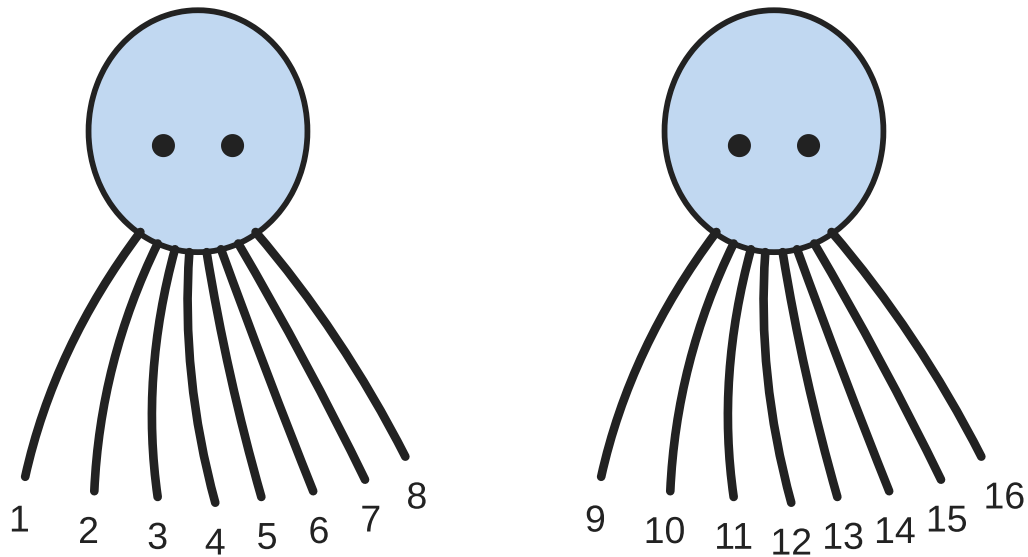
NATURE NOTEBOOK

1. Draw an octopus with all eight arms. Count them as you draw. Your parent can write the date at the top.
2. Draw an octopus hiding in its den in the rocks, with just its eyes and one arm peeking out.
3. Draw an octopus swimming away from a fish, with a big cloud of ink behind it.

From history. Long ago, the Greek thinker Aristotle watched octopuses in the sea near Greece and wrote about them. He noticed that an octopus can change its color to match the stones it sits on, so that fish swim right past it. People who study octopuses today still see the same thing he saw, and they are still learning how the octopus does it.

WORKED EXAMPLES

Example 1. Look at the picture. There are two octopuses. Each one has 8 arms. How many arms are there in all?



$$8 + 8 = 16 \text{ arms}$$

Two octopuses: 8 arms and 8 arms make 16 arms.

1. Count the arms on the first octopus: one, two, three, four, five, six, seven, eight. It has 8.
2. The second octopus has 8 arms too.
3. Keep counting on from 8 as you touch each arm of the second octopus: nine, ten, eleven, twelve, thirteen, fourteen, fifteen, sixteen.
4. 8 and 8 make 16.

Answer: There are 16 arms in all.

PRACTICE

1. **EASY** How many arms does an octopus have? Hold up that many fingers.
2. **EASY** Point to the suckers on your paper octopus. What do suckers do?
3. **MEDIUM** An octopus found 5 crabs and 3 clams near its den. How many things did it find to eat? (Use blocks to help.)
4. **MEDIUM** A fish is chasing an octopus. Tell me two things the octopus can do to get away.
5. **HARD** Tell your parent how Inky got out of the aquarium and why he could fit through such small places.

COMMON MISTAKES

- Thinking an octopus has eight legs. They are called arms, and they grab, hold and taste.
- Thinking an octopus is a fish. It has no bones, no fins and no scales. It belongs to the same big group as snails and clams.
- Thinking an octopus's ink is poison. The ink is a dark cloud that hides the octopus so it can get away.

Make it a game · Octopus Hide and Seek. One player is the octopus and holds a colored scarf or towel. The octopus must hide by lying still on something the same color as the scarf, like a rug or a blanket. The other player is a hungry fish and counts to eight with eyes closed, then looks. If the fish finds the octopus, the octopus may “squirt ink” (throw a dark sock) and crawl away to a den (under the table) before being tagged. Then switch.

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

“Innumerable” means too many to count. The sea is full of creatures God made, and the octopus is one of the most surprising.

Practice answers

1. Eight. The child holds up eight fingers.
2. They grab and hold things like crabs and rocks, and they taste what they touch.
3. 8 things.
4. Any two: squirt a cloud of ink; change color to match the rocks; jet away by squirting water; squeeze into a small crack or its den.
5. Inky climbed out through a small gap at the top of his tank, slid across the floor and went down a drainpipe to the sea. He could fit because an octopus has no bones; only its hard beak has to fit through the hole.

3.3 SEA TURTLES

OBJECTIVES

- Tell how a mother sea turtle comes up on the beach at night to dig a nest and lay her eggs in the sand.
- Tell how the baby turtles hatch, dig out and crawl to the sea.
- Name two ways a sea turtle is made for the sea: flippers for swimming and a smooth shell.

Warm-up. Hold a ping-pong ball (or a small round ball) in your hand. A sea turtle egg is about that size and shape, but its shell is soft and leathery, not hard like a chicken egg. Now lie on your tummy on the floor and pretend your arms are big flat flippers. Pull yourself forward a little way. Is it hard to crawl like that? That is how a mother sea turtle crawls up the beach.

Video. Coming soon. Sea turtle mother digging a nest on a beach at night and baby sea turtles hatching and crawling to the ocean, plus green sea turtles swimming (search NOAA Fisheries, U.S. Fish and Wildlife Service, Smithsonian Ocean, SciShow Kids, Homeschool Pop (Alternate) and nature footage of sea turtles).

KEY TERMS

sea turtle

A turtle that lives in the ocean. It swims with flippers and comes up to the top of the water to breathe air.

flipper

A flat, wide leg made for swimming. A sea turtle has four flippers.

nest

The deep hole a mother sea turtle digs in the sand, where she lays her eggs and covers them up.

hatchling

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

CORE IDEAS

The story. On a dark summer night, on a sandy beach, a big sea turtle swims out of the waves. Slowly, slowly, she drags herself up the sand with her front flippers. Far from the water she stops. With her back flippers she scoops out a deep hole, like a jar in the sand. Then she lays her eggs in it, plop, plop, plop, a whole pile of soft round eggs. She pushes sand over them, pats it down, and crawls back to the sea. She never comes back to see her babies. God takes care of them.

How they figured it out. A scientist named Archie Carr wanted to know where sea turtles go. Starting in the 1950s, he and his helpers went to a beach in Costa Rica called Tortuguero, a name that comes from the Spanish word for turtle. When a mother green turtle came up to nest, they clipped a small metal tag with a number onto her flipper. Years later, they found the very same turtles coming back to the very same beach to lay eggs again. Sea turtles swim far across the ocean, but they find their way home.

The big idea. The eggs lie warm in the sand. After many weeks, the baby turtles, called **hatchlings**, break out of their shells. They wiggle and dig up through the sand together, usually at night when it is cool. Then they run for the sea! They go toward the brightest place they see, which on a dark beach is the moonlight and starlight shining on the water. Once in the waves, they paddle with their tiny **flippers** and swim away.

In the world today. Bright lights from houses and roads can trick the hatchlings into crawling the wrong way. So in many beach towns, families turn off their outside lights during turtle season and close their curtains at night. Volunteers walk the beaches in the morning, look for turtle tracks and put little fences around the nests. God gave us the job of caring for His creatures (Genesis 2:15), and these helpers are doing it.

PICTURE STUDY



The Turtle Pound, Winslow Homer, 1898 · Watercolor over pencil on paper · Brooklyn Museum, New York

Winslow Homer was an American painter who loved the sea. He traveled to the warm islands of the Bahamas and painted the people who lived and worked there. In this watercolor, two fishermen are putting a sea turtle into a turtle pound, a pen built in the shallow water to keep the turtles they caught.

Homer painted fast, with wet colors, so you can almost feel the bright sun and the warm water.

Look closely

- Find the sea turtle. Can you see its flippers?
- Look at the turtle's shell. Is it big or small next to the men?
- Find the water. What colors did Homer use to paint it?
- Look at the two men. How are they working together?

Talk about it

1. Does the turtle look heavy? How can you tell?
2. What do you think the men will do next?
3. Would you like to see a sea turtle in the water? What would you want to watch it do?

Safety first. If you visit a beach where sea turtles nest, never touch, pick up or shine a light on a nesting mother turtle or on hatchlings, and never dig into a marked nest. Watch quietly from far away, and only join a turtle walk led by park rangers or beach workers. Stay close to a grown-up near the water.

MAKE AND DO: DIG A SEA TURTLE NEST

You will be a mother sea turtle. You will dig a nest, lay your eggs, cover them up, and then be the hatchlings that dig out and race to the sea.

You will need

- A sandbox, a garden bed, or a big tub of sand or dirt
- Ping-pong balls, or 12 small round balls or crumpled paper balls (the eggs)
- A blue towel or blanket (the sea)
- A flashlight
- Crayons and paper

Steps

1. Lay the blue towel a little way from the sandbox. That is the sea.
2. Start on the towel. Crawl from the "sea" to the sandbox on your tummy, pulling with your arms like front flippers.
3. Dig a deep hole in the sand with your hands, scooping like back flippers.
4. Lay your eggs: drop the balls into the hole one at a time and count them out loud.
5. Cover them with sand and pat it smooth so no raccoon or crab can find them. Then crawl back to the sea.
6. Now be a hatchling. Dig the eggs back up and count them again. Did you find them all?
7. Hatchling race: turn off the lights in a room (or wait for dusk). Your parent holds a flashlight low by the blue towel, like moonlight on the water. Crawl toward the light!
8. Draw a beach with a turtle nest in the sand and baby turtles crawling to the waves.

Tips

- Push a stick in next to your nest and tie a ribbon on it, like the markers volunteers use to keep people from stepping on real nests.
- Talk about why a porch light could send a hatchling the wrong way.

Check your work

- I dug a nest and counted my eggs like a mother sea turtle.
- I crawled toward the light like a hatchling going to the sea.
- I can tell why people turn off their lights near turtle beaches.

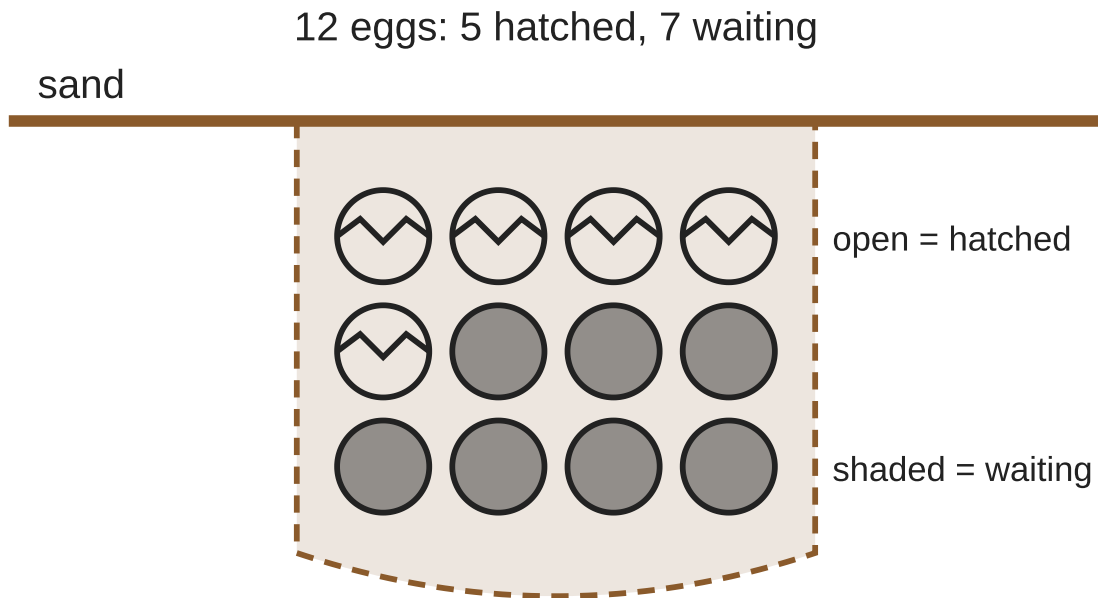
NATURE NOTEBOOK

1. Draw a sea turtle swimming, with four flippers and a shell. Your parent can write the date at the top.
2. Draw a nest under the sand, full of round eggs, with the beach on top.
3. Draw the moon shining on the sea and little hatchlings crawling toward it.

From history. Archie Carr loved animals from the time he was a boy. He became a professor at the University of Florida and spent his life studying sea turtles. He wrote a book about them called *The Windward Road*, and many people who read it started working to protect turtle beaches. Today the beach at Tortuguero, where he tagged green turtles, is a national park in Costa Rica.

WORKED EXAMPLES

Example 1. Look at the picture of a turtle nest. The round eggs are still closed. The open, broken eggs have hatched. How many eggs are in the nest? How many have hatched? How many are still waiting to hatch?



A sea turtle nest: 5 eggs hatched, 7 still waiting.

1. Count every egg in the nest, open and closed: there are 12.
2. Count only the open, broken eggs: one, two, three, four, five. 5 have hatched.
3. Count only the round closed eggs: one, two, three, four, five, six, seven.
4. Check: 5 open and 7 closed make 12 eggs in all.

Answer: There are 12 eggs. 5 have hatched, and 7 are still waiting to hatch.

PRACTICE

1. **EASY** Show me how a sea turtle swims. What does it swim with?
2. **EASY** Where does a mother sea turtle lay her eggs: in the water, in a tree, or in the sand?
3. **MEDIUM** Put these in order with pictures or words: hatchlings crawl to the sea; mother digs a nest; eggs hatch; mother lays eggs.
4. **MEDIUM** Nine hatchlings ran to the sea. Four were already in the waves. How many were still crawling on the sand? (Use buttons to help.)
5. **HARD** Tell your parent why families near turtle beaches turn off their outside lights at night.

COMMON MISTAKES

- Thinking a sea turtle lays its eggs in the water. It comes up on the beach and buries them in the sand.
- Thinking a sea turtle can pull its head and flippers into its shell. A land turtle often can, but a sea turtle cannot.
- Thinking sea turtles breathe underwater like fish. They have lungs and must come up to breathe air, though they can hold their breath a long time.

Make it a game · Hatchling Dash. Play in a darkened room. The children are hatchlings curled up “in their eggs” on the floor. A parent says, “Hatch!” and the hatchlings wiggle out and crawl toward the parent’s flashlight, the moon on the sea. But a second player holds a “porch light” flashlight and tries to switch it on to lure hatchlings the wrong way. The parent calls, “Lights out!” and the porch light must turn off. Every hatchling that reaches the moonlight is safe in the sea.

Scripture. “The fowl of the air, and the fish of the sea, and whatsoever passeth through the paths of the seas.” (Psalm 8:8, KJV)

Sea turtles travel far across the ocean, through the “paths of the seas,” and find their way back to the beach where they nest. God gave them that sense of direction.

Practice answers

1. The child moves both arms like big paddles. A sea turtle swims with its flippers.
2. In a nest she digs in the sand of a beach.
3. Mother digs a nest; mother lays eggs; eggs hatch; hatchlings crawl to the sea.
4. 5 were still crawling on the sand.
5. Hatchlings crawl toward the brightest light, which should be the moonlight on the sea. Bright house or street lights can trick them into crawling the wrong way, away from the water.

3.4 JONAH AND THE GREAT FISH

OBJECTIVES

- Tell the story of Jonah and the great fish in order, from the storm to the city of Nineveh.
- Sort sea animals into fish and whales by looking for gills or a blowhole.
- Count the three days and three nights Jonah was inside the great fish.

Warm-up. Fill a bowl with water. Put a straw in it and blow gently: bubbles! Your breath is air, and it comes from your lungs. A fish does not breathe air. It takes in water through its mouth and pushes it out past its **gills**, which take what the fish needs right out of the water. A whale has to come up and breathe air, just like you. Today we will read about a man who spent three days inside a great sea creature.

Video. Coming soon. Bible story of Jonah and the great fish read aloud for children (KJV text), plus footage of a fish’s gills moving and a whale breathing at the surface to compare (search Moody Science classics, Homeschool Pop (Alternate), SciShow Kids, Smithsonian Ocean and nature footage of large fish and whales).

KEY TERMS

fish

An animal that lives in water and breathes with gills. Most fish have scales and fins, and their tails swish side to side.

gills

The feathery parts on the sides of a fish’s head that let it breathe in the water.

Nineveh

A big, real city of long ago, in the land that is now called Iraq. God sent Jonah there.

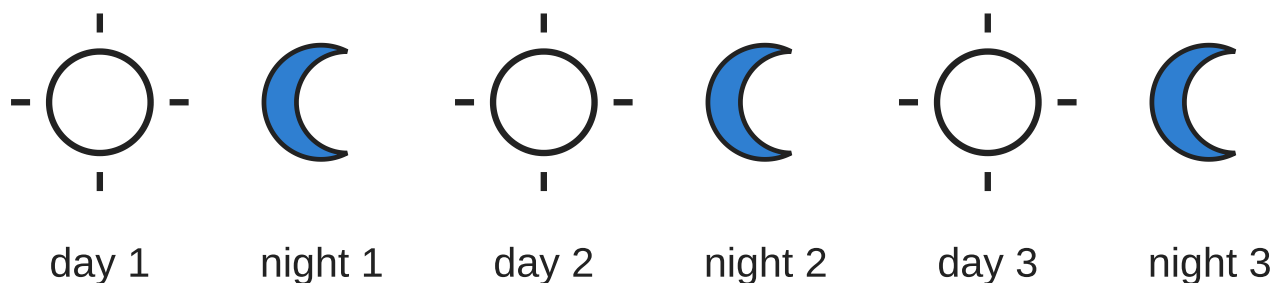
CORE IDEAS

The story. God told a prophet named Jonah to go to the great city of Nineveh and warn the people about their wicked ways. But Jonah did not want to go. He ran the other way. He went down to the seaport of Joppa and got on a ship sailing far off. Then God sent a great wind, and a terrible storm shook the ship. The sailors were afraid. Jonah knew the storm came because he ran from God. He told them to throw him into the sea, and the sea would be calm. So they did, and the sea grew still.

The great fish. But God was not done with Jonah. The Bible says, “Now the LORD had prepared a great fish to swallow up Jonah” (Jonah 1:17). Jonah was inside the fish three days and three nights. There, in the dark, he prayed to God and was sorry. Then the LORD spoke to the fish, and it spat Jonah out onto dry land. This time Jonah obeyed. He went to Nineveh, and the people listened, turned from their evil, and God spared the city.

The big idea. What kind of animal was the great fish? The book of Jonah calls it a “great fish.” When Jesus told about Jonah, our English Bible says “the whale’s belly” (Matthew 12:40). Long ago, people used the word fish for any big swimming sea creature. Today scientists sort sea animals more carefully. A **fish** breathes water with **gills**, and its tail swishes side to side. A whale breathes air through a blowhole, and its tail goes up and down. The Bible does not tell us exactly which creature God used. It tells us God prepared it for His job.

God’s handiwork. The sea, the wind and the great fish all did what God told them. Only Jonah ran away, and God brought him back. God rules over every creature in the sea, and He cared even for the people of Nineveh. Jesus said that Jonah’s three days in the great fish pointed to His own three days in the tomb before He rose again.



3 days + 3 nights = 6

Three days and three nights inside the great fish (Jonah 1:17).

PICTURE STUDY



The Prophet Jonah, Michelangelo Buonarroti, 1508–1512 · Fresco (paint on wet plaster) on a ceiling · Sistine Chapel, Vatican City

Michelangelo was a great Italian artist. For four years he painted the high ceiling of the Sistine Chapel in Rome, standing on tall wooden platforms and reaching up over his head, with paint dripping down on him. He painted stories from Genesis and the prophets of the Bible.

Jonah is painted right above the altar, at one end of the chapel. Michelangelo shows Jonah after he came out of the great fish, leaning back and looking up toward God.

Look closely

- Find the great fish. Is it bigger or smaller than Jonah? (The artist made it small so it would fit.)
- Look at Jonah's face. Which way is he looking?
- Find the green leaves above Jonah. Later in the story, God made a plant grow to shade Jonah.
- Look at Jonah's body. He is leaning back. Can you sit like that?

Talk about it

1. Why do you think Michelangelo painted Jonah looking up?
2. How do you think Jonah felt when he was back on dry land?
3. If you painted Jonah and the great fish, what would you show?

MAKE AND DO: FISH OR WHALE? A GREAT FISH SORTING PUPPET

You will make a great fish with a mouth that opens and a little Jonah who fits inside. Then you will use it to tell the story, and you will sort sea animal cards into fish and whales.

You will need

- A paper plate, folded in half to make a big mouth
- Crayons or markers
- Glue or tape and child-safe scissors
- A craft stick or a strip of cardboard for Jonah
- Eight index cards or squares of paper
- Pictures or drawings of sea animals: a shark, a tuna, a goldfish, a clownfish, a blue whale, a humpback whale, a dolphin, a killer whale

Steps

1. Fold the paper plate in half. This is the great fish's mouth. Color it gray, blue or green, and draw a big eye on each side.
2. Cut a tail and fins from the leftover paper and tape them on.
3. Draw a small Jonah on paper, cut him out and tape him to the craft stick.
4. Tell the story with your puppet: the ship, the storm, the splash, the great fish swallowing Jonah, three days and three nights, and the fish spitting Jonah onto dry land.
5. Now draw or glue one sea animal on each of the eight cards.
6. Sort the cards into two piles. Fish breathe with gills and swish their tails side to side. Whales and dolphins breathe air with a blowhole and move their tails up and down.
7. Count each pile. How many fish? How many whales and dolphins?

Tips

- A shark is a fish, even though it is big. It has gills.
- A dolphin is a small kind of toothed whale. It breathes through a blowhole.
- Keep the puppet so your child can retell the story to the family at dinner.

Check your work

- I can tell the story of Jonah in order with my puppet.
- I sorted sea animals into fish and whales.
- I can tell how a fish breathes and how a whale breathes.

NATURE NOTEBOOK

1. Draw the ship in the storm with big waves and Jonah falling into the sea. Your parent can write the date at the top.
2. Draw a fish and label its gills. Next to it, draw a whale and label its blowhole.

3. Draw Jonah on dry land, looking up and thanking God.

From history. Nineveh was a real city on the Tigris River. For a long time its ruins lay buried under big mounds of dirt. In the 1840s an English explorer named Austen Henry Layard dug into the mounds and found the walls of a great king's palace, covered with carved stone pictures. Many of those carvings are now in the British Museum in London, where visitors can see the city Jonah once walked through.

WORKED EXAMPLES

Example 1. Jonah was inside the great fish three days and three nights. Look at the picture. How many suns are there? How many moons? How many pictures in all?

(Use the map or drawing "Three days and three nights inside the great fish (Jonah 1:17)." shown earlier in this lesson.)

1. Count the suns. Each sun is one day: one, two, three. There are 3 suns.
2. Count the moons. Each moon is one night: one, two, three. There are 3 moons.
3. Now count every picture in the row: one, two, three, four, five, six.
4. 3 days and 3 nights make 6 pictures.

Answer: 3 suns, 3 moons, and 6 pictures in all.

PRACTICE

1. **EASY** Where did God tell Jonah to go? Where did Jonah go instead?
2. **EASY** Point to where a fish's gills are on your own head. Point to where a whale's blowhole would be.
3. **MEDIUM** Sort these: shark, dolphin, goldfish, blue whale, tuna. Which are fish and which are whales?
4. **MEDIUM** Tell the story of Jonah in four parts: what happened first, next, then and last.
5. **HARD** The Bible says God "prepared" a great fish. Tell your parent what that means and what the story teaches about God.

COMMON MISTAKES

- Thinking every big sea animal is a whale. A shark is a very big fish, because it breathes with gills.
- Thinking a whale is a fish because it swims. A whale breathes air, has warm blood and feeds its babies milk.
- Thinking Jonah was punished and then forgotten. God kept Jonah alive in the great fish and gave him a second chance to obey.

Make it a game • Jonah Says. Play like Simon Says, but only obey when the caller says "The LORD says." Commands can be sea motions: "The LORD says swim like a fish (tail

side to side)." "The LORD says blow like a whale." "The LORD says go to Nineveh" (walk to the far wall). If the caller gives a command without "The LORD says" and you do it, you get "swallowed" and must sit in the great fish (a blanket) for three claps before coming back.

Scripture. "Now the LORD had prepared a great fish to swallow up Jonah. And Jonah was in the belly of the fish three days and three nights." (Jonah 1:17, KJV)

God rules over the sea and every creature in it. He prepared a great fish to carry Jonah safely through the deep and give him a second chance.

Practice answers

1. God told him to go to Nineveh. Jonah ran the other way and got on a ship going far across the sea.
2. The child points to the sides of the head or neck behind the cheeks for gills, and to the top of the head for a blowhole.
3. Fish: shark, goldfish, tuna. Whales: dolphin, blue whale.
4. First, Jonah ran from God on a ship. Next, a storm came and the sailors threw him into the sea. Then, a great fish swallowed him, and he prayed inside it three days and three nights. Last, the fish spat him onto dry land, and he went to Nineveh.
5. God made the great fish ready and sent it to swallow Jonah and keep him alive. The story teaches that God rules over the sea and its creatures, that He brings back people who run away, and that He shows mercy to those who turn from their sin.

UNIT 3 REVIEW

This is an oral review. Read each question aloud and let your child answer by telling, pointing, sorting, drawing or showing. Have some buttons, the paper-bag octopus and the sea animal cards ready. Give full points for a clear answer in your child's own words. The review is worth 20 points.

1. (3 pts) Is a whale a fish? Tell me two reasons why or why not.
2. (3 pts) What does the great blue whale eat, and how does it get its food out of the water?
3. (3 pts) Count the arms on the paper octopus. If there were two octopuses, how many arms would there be? (Use buttons to help.)
4. (3 pts) Tell me two ways an octopus stays safe. Why can it squeeze through a tiny hole?
5. (3 pts) Tell me the story of a sea turtle nest, from the mother coming out of the sea to the babies going back in.
6. (2 pts) Why do people near turtle beaches turn off their outside lights at night?
7. (3 pts) Use your great fish puppet to tell the story of Jonah. How long was Jonah inside the great fish?

UNIT PROJECT: MY OCEAN BOOK

Make a book with four pages, one for each lesson: the whale, the octopus, the sea turtle and Jonah's great fish. On each page draw the animal in its ocean home and have a parent write one sentence you say about it. Add your long blue whale drawing with you drawn small beside it, a photo or drawing of your paper-bag octopus hiding, your nest egg count, and your fish-and-whale sorting cards glued into two groups. Then give an "ocean tour" to your family: open each page and tell what you learned.

- **Animals:** All four sea creatures are drawn in their ocean homes with real details such as the whale's spout, the octopus's eight arms and suckers, and the sea turtle's flippers and sand nest.
- **Records:** The whale-and-me drawing, the octopus picture, the egg count and the fish-and-whale sorting cards are all in the book, and the sorting is correct.
- **Telling:** On the ocean tour the child tells in their own words why a whale is not a fish, how an octopus hides, how sea turtle hatchlings find the sea and how God prepared a great fish for Jonah.
- **Care:** The pages are neat and colorful, and the book is put together so it can be read again.

Answer key

1. No. Any two: a whale breathes air through a blowhole with lungs; it has warm blood; a mother whale feeds her calf milk; its tail moves up and down, not side to side.
2. Tiny krill. It gulps a mouthful of seawater, then pushes the water out through its baleen, which works like a comb and keeps the krill inside.
3. One octopus has 8 arms. Two octopuses have 16 arms.

4. Any two: it hides in its den; it changes color to match the rocks; it squirts ink; it jets away. It can squeeze through a tiny hole because it has no bones; only its hard beak has to fit.
5. The mother crawls up the beach at night, digs a deep nest in the sand with her back flippers, lays her eggs, covers them and goes back to the sea. Weeks later the hatchlings break out, dig up through the sand together and crawl toward the light on the water into the sea.
6. Hatchlings crawl toward the brightest light. Bright lights on land can lead them the wrong way, away from the sea.
7. Jonah ran from God on a ship; a storm came; the sailors threw him into the sea; God's great fish swallowed him; he prayed inside it; the fish spat him onto dry land; he went to Nineveh and the people turned from their evil. He was inside three days and three nights.

DESERT

A **desert** is a very dry place where it hardly ever rains. The sun can be hot in the day and the nights can be cold. Water is hard to find. It may look as if nothing could live there, but God filled the desert with living things made just for it. In this unit we meet some of them.

We will see how a camel's hump, wide feet and long eyelashes help it cross the sand, and hear how camels once came to Texas. We will watch lizards move from sun to shade all day long, and we will learn how the giant saguaro cactus stores water and gives birds a home. Last, we will read the true story of the prophet Elijah, whom God fed by sending ravens to him in a dry land.

In every lesson, ask: **How does this living thing get water, stay cool and find food in the desert?** And remember that the same God who feeds the ravens takes care of us.

BEFORE YOU BEGIN

- Can count objects to 10 and tell which group has more
- Knows that animals need food, water and a home (Units 1-3)
- Can listen to a short story and tell it back in order

MASTERY CHECKLIST

- I can tell how a camel's hump, feet, eyelashes and nose help it live in the desert.
- I can tell a one-hump camel from a two-hump camel.
- I can tell where a lizard goes in the cool morning and at hot noon, and why.
- I can name ways a cactus keeps water, and tell who lives in a saguaro.
- I can retell the story of Elijah and the ravens and describe a raven.

OPTIONAL BOOKS AND RESOURCES

- **Saguaro National Park (National Park Service)** (<https://www.nps.gov/sagu/>): Free. Photos and short pages about saguaros, desert lizards and the birds that nest in cactus holes. Good for Lessons 4.2 and 4.3, and for planning a visit if you live in or travel to Arizona.
- **Arizona-Sonora Desert Museum** (<https://www.desertmuseum.org/>): A living museum and zoo of desert plants and animals near Tucson, Arizona. Its website has pictures and facts about saguaros, horned lizards, Gila monsters and ravens for a parent to read aloud.
- **All About Birds: Common Raven (Cornell Lab of Ornithology)** (https://www.allaboutbirds.org/guide/Common_Raven): Free. Photos and recordings of a raven's deep croak, and tips for telling a raven from a crow (Lesson 4.4).

4.1 CAMELS ★

OBJECTIVES

- Tell how a camel's hump, wide feet, long eyelashes and closing nose help it live in the hot, sandy desert.
- Tell the difference between a camel with one hump and a camel with two humps.
- Retell the true story of the camels that came to Texas.

Warm-up. Pour some flour, salt or sand into a baking pan. Poke it with one finger. Now press your whole flat hand down, pushing just as gently. Which one sank deeper? Which one stayed on top? Keep that in mind, because a camel walks on sand all day.

Video. Coming soon. Camels walking in desert sand, kneeling to rest, closing their nostrils in blowing sand and drinking at a water hole; one-hump and two-hump camels side by side (search Smithsonian National Zoo, San Diego Zoo, SciShow Kids, Homeschool Pop (Alternate) and nature footage of camels in the Sahara and Gobi).

KEY TERMS

desert

A very dry place where it hardly ever rains. Some deserts are sandy and some are rocky.

hump

The big lump on a camel's back. It is full of fat, which is food the camel's body saves for later.

dromedary

A camel with one hump. Dromedaries live in the hot deserts of Arabia and North Africa.

Bactrian camel

A camel with two humps and a thick, shaggy winter coat. Bactrian camels live in the deserts of Asia, where winters are very cold.

CORE IDEAS

The story. In 1856 a ship sailed into a little port in Texas. Out walked something no one in town had ever seen: camels! The United States Army had brought them across the ocean. The soldiers needed animals that could carry heavy loads across the dry lands of the Southwest, where water was hard to find. The next year, a leader named Edward Beale took a line of camels on a long trip across the desert all the way to California. He was amazed. The camels carried big loads, ate scratchy bushes that horses would not touch, and walked for days without a drink.

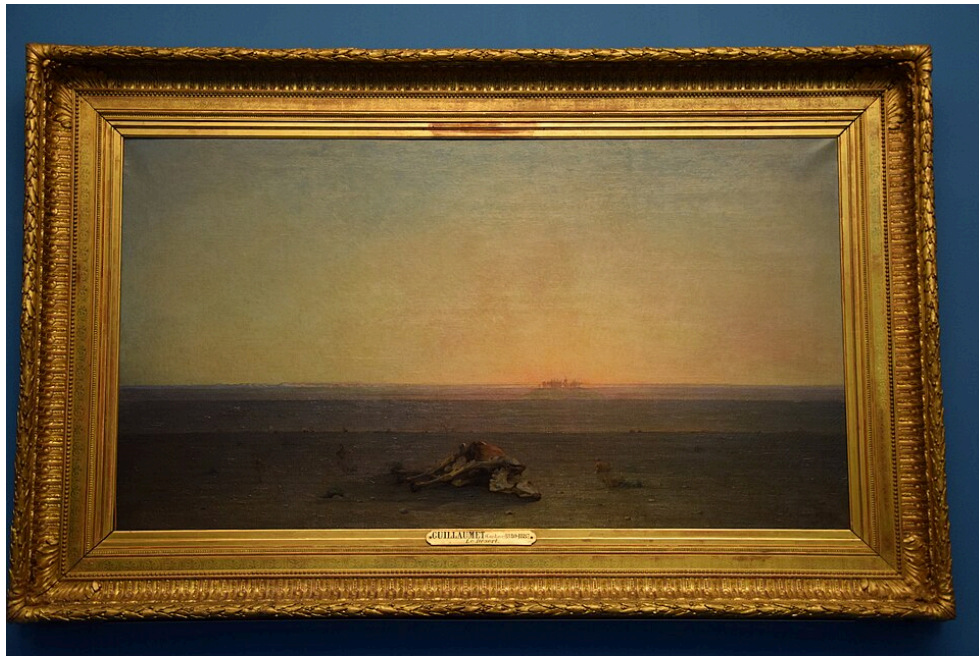
How they figured it out. Many people think a camel's **hump** is full of water. People who have cared for camels know better. The hump is full of fat. Fat is food the body saves for later. When a camel cannot find food, its body uses up the fat, and the hump gets smaller and

floppy. When the camel eats well again, the hump grows plump. And when a thirsty camel finally finds water, it can drink a huge amount very fast, much more than a horse could.

The big idea. Every part of a camel fits the **desert**. Its feet are wide and soft, like big pads, so it walks on top of the sand instead of sinking in. It has two rows of long eyelashes to keep blowing sand out of its eyes, and it can shut its nostrils tight in a sandstorm. Its tough lips can eat thorny plants. There are two kinds of camels. The **dromedary** has one hump. The **Bactrian camel** has two. Here is a trick: lay a capital D on its side and it has one hump. Lay a capital B on its side and it has two.

God's handiwork. Camels are in the Bible many times. When Abraham's servant went to find a wife for Isaac, he brought ten camels, and kind Rebekah drew water for all of them (Genesis 24). That was a lot of water! God made the camel ready for the desert before anyone ever rode one. Its feet, eyes, nose and hump all show that He planned it well.

PICTURE STUDY



The Sahara (also called The Desert), Gustave Guillaumet, 1867 · Oil on canvas · Musée d'Orsay, Paris

Gustave Guillaumet was a French painter who traveled many times to the Sahara, the great desert of North Africa. He wanted people in France to feel how big, flat and empty the desert is.

In this painting there are no trees and no water. Far away, a caravan, a line of camels and travelers, walks across the sand. Near the front are the bones of a camel. The desert is a hard place, and only animals made for it can cross it.

Look closely

- Find the line where the land meets the sky. Is the land flat or bumpy?
- Look far away. Can you find the tiny caravan of camels?

- Look at the colors. Which colors did the painter use most? Do they look hot or cool?
- Can you find any trees, grass or water anywhere in the picture?

Talk about it

1. How would you feel walking across this desert? What would you want to bring?
2. Why would travelers choose camels instead of horses to cross a place like this?
3. Why do you think the painter made the sky so big?

MAKE AND DO: CAMEL FEET IN THE SAND

A camel's foot is wide and flat, like a big soft pad. You will test whether a wide foot really sinks less in sand than a small, pointy one. Then you will make a camel with one hump or two.

You will need

- A baking pan or plastic tub
- Sand, salt or flour (enough to fill the pan about as deep as your finger is long)
- A small toy animal or a full soup can
- A bottle cap and a piece of cardboard about the size of your hand
- Brown paper, crayons, scissors, glue and a few cotton balls

Steps

1. Fill the pan with sand, salt or flour and smooth the top flat with your hand.
2. Set the bottle cap on the sand, open side up, and stand the toy or soup can on top of it. Let go. Watch how far the cap sinks.
3. Smooth the sand again. Now lay the cardboard flat on the sand and stand the same toy or can on it. Let go and watch.
4. Tell your parent: Which one sank deeper, the small cap or the wide cardboard? Which is more like a camel's foot?
5. Now make a camel. Cut a camel body from brown paper. Choose: will it be a dromedary or a Bactrian camel? Glue on one or two cotton-ball humps.
6. Draw long eyelashes on your camel and wide, flat feet. Tell your parent what each part does.

Tips

- Use the same toy or can both times so the test is fair.
- Do this outside or put a towel under the pan to catch spills.

Check your work

- I saw that the wide foot sank less than the small foot.
- I made a camel with the right number of humps for its kind.
- I can tell what a camel's hump, feet and eyelashes do.

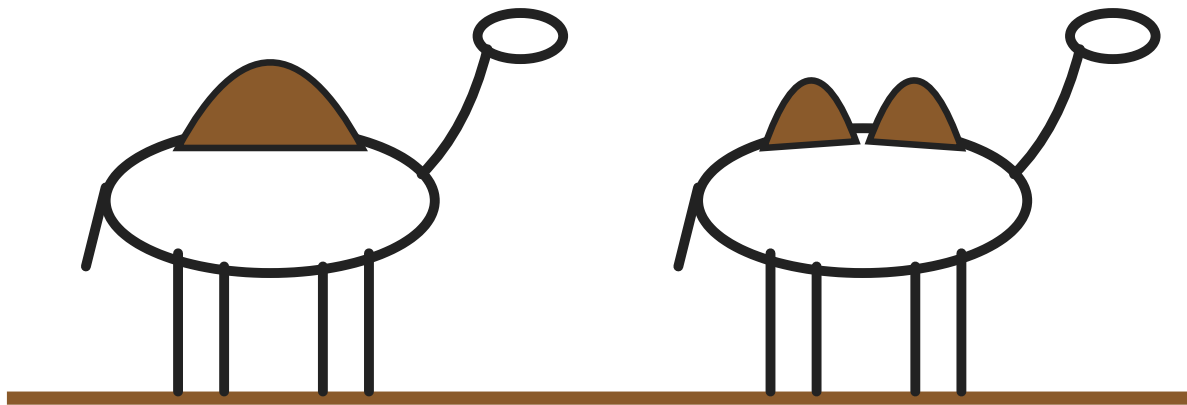
NATURE NOTEBOOK

1. Draw a dromedary and a Bactrian camel side by side. Count and label the humps: 1 and 2.
2. Draw a camel's face up close. Give it long eyelashes and narrow nostrils. Your parent can write "keeps sand out" beside them.
3. Trace around your own foot on paper. Next to it, draw a big round camel foot. Which is wider?

From history. One of the camel drivers who came to America with the army's camels was a man from the Middle East named Hadji Ali. American soldiers had trouble saying his name, so they called him "Hi Jolly." He stayed in the Southwest for the rest of his life. Today in the little town of Quartzsite, Arizona, there is a stone pyramid over his grave with a metal camel standing on top.

WORKED EXAMPLES

Example 1. Look at the picture. Count the humps on each camel. Which camel has more humps? How many humps are there in all?



Dromedary: 1 hump

Bactrian: 2 humps

One hump or two? Count them.

1. Put your finger on the first camel, the dromedary. Count its humps: one. It has 1 hump.
2. Put your finger on the second camel, the Bactrian camel. Count its humps: one, two. It has 2 humps.
3. Compare: 2 is more than 1, so the Bactrian camel has more humps.
4. Count all the humps together: one, two, three. 1 and 2 make 3.

Answer: The dromedary has 1 hump and the Bactrian camel has 2. The Bactrian camel has more. There are 3 humps in all.

PRACTICE

1. **EASY** Point to the hump on your camel picture. What is inside a camel's hump: water or fat?
2. **EASY** How many humps does a dromedary have? How many does a Bactrian camel have? Hold up that many fingers.
3. **MEDIUM** Three dromedaries walk in a line. Count all their humps. Now one Bactrian camel joins them. How many humps are there now?
4. **MEDIUM** Sort these camel parts. Which ones keep sand out? Which one keeps the camel from sinking? Long eyelashes, wide feet, nostrils that close.

5. **HARD** Tell your parent why the army brought camels to Texas.

COMMON MISTAKES

- Thinking a camel's hump is full of water. The hump is full of fat, which the camel's body uses for food when there is little to eat.
- Thinking every desert is hot all the time. Deserts are dry places. Many get cold at night, and the deserts where Bactrian camels live have freezing winters.
- Thinking all camels have two humps. The dromedary has one hump; the Bactrian camel has two.

Make it a game • Camel Caravan. You are the camels and your parent is the camel driver. Crawl in a line across the room with a pillow on your back for a load. When the driver says "Sandstorm!" close your eyes tight and squeeze your nose. When the driver says "Water!" pretend to drink and drink and drink. When the driver says "Rest!" kneel down on your knees the way a camel does. Anyone who does the wrong thing becomes the next driver.

Scripture. "And when she had done giving him drink, she said, I will draw water for thy camels also, until they have done drinking." (Genesis 24:19, KJV)

Thirsty camels drink a lot of water. Rebekah carried jar after jar from the well until all ten camels were full. Her kindness to the animals showed what a good heart she had.

Practice answers

1. Fat. The fat is food the camel's body saves for later.
2. A dromedary has 1 hump. A Bactrian camel has 2 humps.
3. 3 humps for the three dromedaries. With the Bactrian camel's 2 humps, there are 5 humps.
4. Long eyelashes and nostrils that close keep sand out of the eyes and nose. Wide feet keep the camel from sinking in the sand.
5. The army needed animals that could carry heavy loads across the dry Southwest. Camels can go a long time without water, eat tough desert plants and walk on sand.

4.2 LIZARDS

OBJECTIVES

- Tell how a lizard warms up in the sun and cools off in the shade.
- Name the parts of a lizard: dry scales, four legs with claws, and a long tail.
- Name two desert lizards, the horned lizard and the Gila monster, and tell why we never touch wild lizards.

Warm-up. Find a sunny spot on the floor by a window and a spot in the shade. Lay your hand flat on the sunny spot, then on the shady spot. Which one is warmer? A lizard does this all day long, but it uses its whole body.

Video. Coming soon. Desert lizards basking on rocks in the morning sun and hiding in shade at midday; horned lizards eating ants; a chuckwalla wedged in a rock crack (search SciShow Kids, Homeschool Pop (Alternate), National Park Service, Arizona-Sonora Desert Museum and nature footage of Sonoran and Mojave Desert lizards).

KEY TERMS

lizard

An animal with dry, scaly skin, four legs with claws, and usually a long tail.

scales

Small, hard, dry plates that cover a lizard's skin like a coat of tiny tiles.

bask

To lie in the sun to warm up.

cold-blooded

Getting warm or cool from the sun, air and ground around you. A lizard cannot make its own body heat the way you can.

CORE IDEAS

The story. It is early morning in the desert. The air is cool. A flat rock is just starting to feel the sun. Out from under a bush creeps a little lizard that looks like a spiky pancake. It is a horned lizard. It climbs onto the rock and spreads itself flat, turning its side to the sun. It lies very still. It is **basking**, soaking up the warm sunshine. Soon it is warm enough to run, and off it goes to eat ants, one after another.

How they figured it out. Long ago, in the 1940s, two scientists named Raymond Cowles and Charles Bogert went out into the desert to watch lizards all day long. They used quick little thermometers to check how warm the lizards were. They found that a lizard is not just warm or cold by luck. It moves to stay just right. In the cool morning it lies in the sun. In the hot middle of the day it runs into the shade or under a rock or into a hole in the ground. Late in the day it comes out again.

The big idea. A lizard is **cold-blooded**. You make your own heat inside your body, but a lizard gets its warmth from the sun and the warm ground. Its skin is covered with dry **scales**, not slimy like a frog's skin. The scales help keep water inside its body, which is very important in the dry desert. Lizards have four legs with claws for climbing and digging. Many have long tails, and some can even drop the tail to escape a hungry bird and grow a new one. The chuckwalla hides in a crack in the rocks and puffs itself up so no one can pull it out. The Gila monster has a bite with venom, so we look at it from far away.

God's handiwork. The Bible says, "But ask now the beasts, and they shall teach thee" (Job 12:7). What does a lizard teach us? God made it to fit its home. It does not need a coat or a fan. It just moves between sun and shade, all day, the way He made it to. Some horned lizards can even squirt a little blood from their eyes to scare away a coyote!

PICTURE STUDY



Lacertilia (Lizards), Plate 79 from Art Forms in Nature, Ernst Haeckel, 1904 · Color print (lithograph) from a book · Published in Leipzig, Germany, in the book Kunstformen der Natur (Art Forms in Nature)

Ernst Haeckel was a German scientist who loved to draw. He made a whole book of pictures showing the beautiful shapes of living things. On this page he gathered many kinds of lizards from around the world and arranged them in a pattern, almost like a design on a rug.

Each lizard is drawn carefully, scale by scale. Look closely, and you will see that God made lizards in many shapes.

Look closely

- Count how many lizards you can find on the page.
- Find a lizard with a tail that curls up like a spring.
- Look for lizards with spikes, crests or frills. Point to them.

- Look closely at the skin. Can you see the tiny scales?

Talk about it

1. Which lizard would you most like to see in real life? Why?
2. How are all these lizards alike? How are they different?
3. Why do you think the artist put the lizards in a pattern instead of in a desert scene?

Safety first. Never pick up or touch a wild lizard. Some, like the Gila monster, have a venomous bite, and any lizard may bite if scared. Watch from a few steps away. If you touch a pet lizard or any reptile, wash your hands with soap right away, because reptiles can carry germs. Rocks in hot sun can be too hot to touch; test with the back of your hand first. Never look straight at the sun.

MAKE AND DO: SUN ROCK, SHADE ROCK

You will find out why a lizard climbs onto a rock in the morning. Then you will make a paper lizard and move it through a desert day.

You will need

- Two rocks about the same size and color (or two dark cups of water)
- A sunny spot and a shady spot outside or by a window
- A kitchen timer or clock
- Paper, crayons and child scissors
- A large sheet of paper for a desert map

Steps

1. Feel both rocks with your hand. Do they feel the same?
2. Put one rock in the sun. Put the other rock in the shade.
3. Wait about half an hour. While you wait, draw and cut out a paper lizard. Give it four legs, claws, scales and a long tail.
4. Go back and feel the rocks with the back of your hand. Which rock is warmer? Which would a cold lizard pick in the morning?
5. On the big paper, draw a desert: a sun rock, a shady bush and a hole in the ground.
6. Play a desert day with your paper lizard. Your parent calls out “Cool morning!”, “Hot noon!” and “Cool evening!” Move your lizard to the right place each time and tell why.

Tips

- Use rocks that are the same size and color so the test is fair. The only thing that changes is sun or shade.
- On a cloudy day, try again later. The sun has to be shining for this to work.

Check your work

- I felt that the rock in the sun was warmer.
- I made a paper lizard with scales, claws and a tail.
- I can tell where a lizard goes in the morning and at hot noon.

NATURE NOTEBOOK

1. Draw a horned lizard flat on a rock with the sun shining on it. Label the horns, the scales and the tail.
2. Draw a lizard hiding in the shade of a bush at hot noon. Draw the sun high in the sky.
3. If you see a lizard outside or at a zoo, draw it and ask your parent to write where and when you saw it.

From history. The Texas horned lizard is the state reptile of Texas. Texas Christian University in Fort Worth even calls its sports teams the Horned Frogs, after this spiky little lizard. Long ago, children in Texas often caught horned lizards to play with. Today people know they should be left alone in the wild, and many families are glad just to spot one sunning on a rock.

WORKED EXAMPLES

Example 1. Look at the picture chart. Each green dot is one lizard. In the cool morning, where are most of the lizards? At hot noon, where are most of them?

	Sunny rock	Shade
Morning		
Hot noon		

Each green dot = 1 lizard

Where are the lizards? Each green dot is one lizard.

1. Find the Morning row. Count the dots on the sunny rock: one, two, three, four, five. Count the dots in the shade: one. 5 is more than 1, so most lizards are on the sunny rock.
2. Find the Hot noon row. Count the dots on the sunny rock: one. Count the dots in the shade: one, two, three, four, five. 5 is more than 1, so most lizards are in the shade.
3. Count all the lizards in each row: 6 in the morning and 6 at noon. They are the same six lizards. They just moved!

Answer: In the morning most lizards (5) are on the sunny rock to warm up. At hot noon most lizards (5) are in the shade to cool off.

PRACTICE

1. **EASY** Is a lizard's skin wet and slimy, or dry and scaly?
2. **EASY** A lizard has 4 legs. Two lizards sit on a rock. Count all their legs.
3. **MEDIUM** It is a cool morning. Point to where a lizard should go: the sunny rock or the shady bush. Now it is hot noon. Point again.
4. **MEDIUM** On your lizard drawing, point to the scales, the claws, the tail and the eyes.
5. **HARD** Sort these animals: horned lizard, frog, Gila monster, toad. Which two are lizards? How can you tell?

COMMON MISTAKES

- Thinking a “horned toad” is a toad. It is really a horned lizard, with dry scales, claws and a tail.
- Thinking cold-blooded means a lizard is always cold. A lizard in the sun can be very warm; it just gets its heat from outside instead of making it inside.
- Thinking lizards are slimy like frogs. Lizard skin is dry and covered with scales.

Make it a game · Sun or Shade?. Pick one sunny spot and one shady spot in the yard or the house. You are the lizard. Your parent calls out times and weather: “Cool morning!” “Hot noon!” “Cloudy and cold!” “Evening!” Scurry on all fours to the right spot. At a sunny spot, lie flat and still to bask. If you go to the wrong place, you have to freeze like a lizard until the next call.

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

When we watch a lizard move from sun to shade, it teaches us how wisely God made it for its desert home.

Practice answers

1. Dry and scaly.
2. 8 legs (4 and 4).
3. Cool morning: the sunny rock, to warm up. Hot noon: the shady bush (or under a rock or into a hole), to cool off.
4. The child points to each part. Scales cover the skin, claws are on the toes, the tail is at the back, and the eyes are on the head.
5. The horned lizard and the Gila monster are lizards. They have dry, scaly skin and claws. Frogs and toads are not lizards; they have smooth or bumpy skin without scales and they start life as tadpoles in water.

4.3 CACTUS

OBJECTIVES

- Tell four ways a cactus keeps water in the dry desert: a thick stem with pleats, waxy skin, spines and wide roots.
- Tell how the giant saguaro cactus is a home for desert birds.

Warm-up. Rub your finger on the skin of an apple or a cucumber. It feels smooth and a little waxy. Now rub a paper towel. Which one do you think would dry out faster if you left it on the counter? The wax on the apple keeps its water in. A cactus has waxy skin too.

Video. Coming soon. Saguaro cactus in the Sonoran Desert: pleats swelling after rain, Gila woodpeckers and elf owls in saguaro holes, night-blooming flowers visited by bats (search National Park Service Saguaro National Park, Arizona-Sonora Desert Museum, SciShow Kids, Homeschool Pop (Alternate) and nature footage of the Sonoran Desert).

KEY TERMS

cactus

A plant that stores water in its thick stem and has spines instead of flat leaves.

spine

A stiff, sharp point on a cactus. Spines are the cactus's leaves. They protect it and give it a little shade.

saguaro

A giant cactus with arms that grows in the Sonoran Desert of Arizona and Mexico. Say it "suh-WAH-roh."

roots

The parts of a plant under the ground that drink up water.

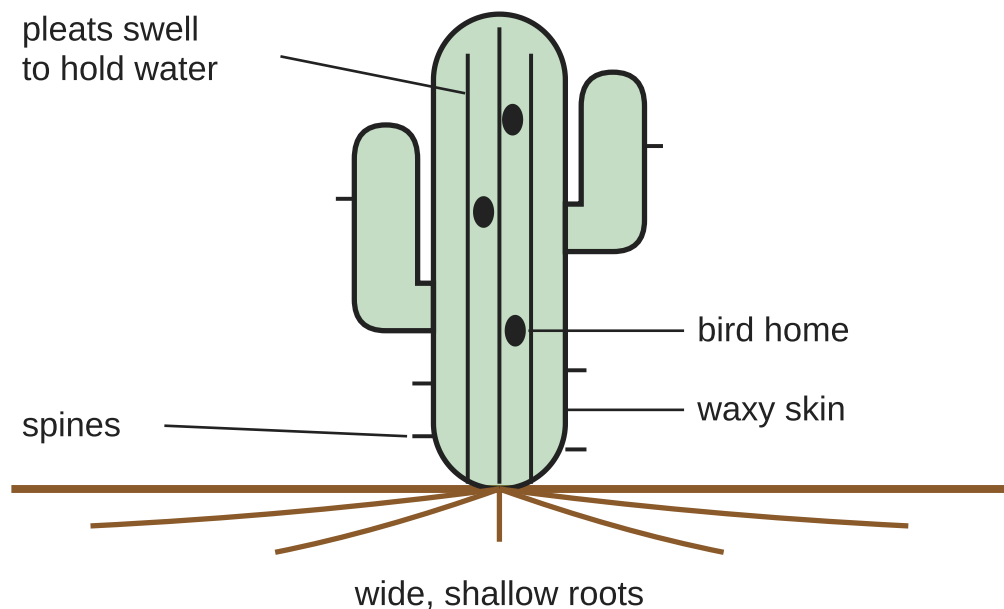
CORE IDEAS

The story. If your family has a little cactus in a pot, look at it closely (but do not touch!). It is fat and green, with sharp spines and no flat leaves. Now picture a cactus taller than your house, with arms reaching up to the sky. That is the **saguaro**. It grows in the Sonoran Desert in Arizona. In 1903 scientists built a desert laboratory on a rocky hill in Tucson, Arizona, covered with saguaros. They wanted to learn how plants could live where it hardly ever rains.

How they figured it out. The scientists measured the saguaros again and again. They found something surprising. After a big rain, a saguaro got fatter! Its stem has long folds called pleats, like the folds in an accordion or a paper fan. When the cactus drinks, the pleats spread open and the stem swells up with water. In the long dry months, the cactus uses the water slowly and the pleats fold back in. The saguaro is like a giant green water bottle.

The big idea. A cactus is made to save water. Its **roots** spread out wide, just under the top of the ground, so when rain falls they can drink it up fast before the sun dries it. Its skin is thick and waxy, so water does not leak out. Its **spines** are its leaves. Flat leaves would lose too much water in the hot sun, but spines lose very little. Spines also keep thirsty animals from biting into the cactus, and they make a little bit of shade. The green stem does the work that leaves do in other plants: it makes food from sunlight.

God's handiwork. The saguaro is a home too, like an apartment house in the desert. A Gila woodpecker pecks a hole in its side. The cactus grows a hard lining around the hole, so it stays dry inside. When the woodpecker moves out, a tiny elf owl may move in. In late spring, white flowers open on top of the saguaro. Bats, birds and bees come to drink their sweet nectar, and later birds eat the red fruit. God made one plant to feed and shelter many neighbors.



The parts of a saguaro that help it save water, and the holes where birds live.

PICTURE STUDY



The Night-Blowing Cereus, from The Temple of Flora, Philip Reinagle and Abraham Pether, for Robert John Thornton, 1800 · Color engraving, finished by hand · Published in London in Robert John Thornton's book *The Temple of Flora*

Robert John Thornton was an English doctor who loved flowers. He asked artists to paint the most beautiful flowers in the world for a big book. Philip Reinagle painted this flower, and Abraham Pether painted the moonlit sky behind it.

The flower belongs to a cactus called the night-blooming cereus. Its big white flower opens only at night and closes again by morning. That is why the painters put a moon in the sky.

Look closely

- Find the big white flower. How many petals can you count?
- Find the moon. Is it day or night in this picture?
- Look in the background. Can you find a tower with a clock?
- Find the long green stem of the cactus. Does it have flat leaves?

Talk about it

1. Why might a cactus flower open at night instead of in the hot daytime?
2. Which animals do you think visit a flower at night?
3. If you could stay up to see one flower open, what would you want to see?

Safety first. Cactus spines are sharp and some have tiny hooks that are hard to pull out. Look at a cactus, but never touch it with your bare hands. A grown-up can use thick gloves or kitchen tongs to move a cactus pot. Never drink juice from a wild cactus.

MAKE AND DO: THE WAXY SKIN TEST AND AN ACCORDION CACTUS

Does waxy skin really keep water in? You will test it with two wet paper towels. Then you will fold a paper cactus with pleats that open and close like a real saguaro.

You will need

- Two paper towels
- A cup of water
- Wax paper
- Two plates
- A sheet of green paper, tape and crayons

Steps

1. Dip both paper towels in water and squeeze them out the same way, so they are equally wet.
2. Roll up one paper towel and wrap it all the way around in wax paper. This is your “cactus with waxy skin.”
3. Roll up the other paper towel and leave it open. This is your “plant with no wax.”
4. Put each one on a plate in a sunny window. Leave them for the afternoon or overnight.
5. Unwrap the waxy one and feel both towels. Which one is still wet? Which one dried out?
6. Now fold the green paper back and forth like a fan, making long pleats. Tape the ends together to make a tube and stand it up. Squeeze it gently, then let it spread. This is how a saguaro’s pleats open when it drinks.
7. Draw spines and a little bird hole on your paper cactus.

Tips

- Make the towels the same size and equally wet so the test is fair. The only difference is the wax paper.
- Make your pleats about as wide as your finger. Narrow pleats work best.

Check your work

- I saw that the wax-wrapped towel stayed wet longer.
- I made a pleated paper cactus that can spread open.
- I can name four ways a cactus keeps water.

NATURE NOTEBOOK

1. Draw a saguaro with arms. Draw the pleats going up and down, the spines and the roots spreading wide under the ground.
2. Draw a woodpecker making a hole in a saguaro, and an elf owl peeking out of another hole.

3. Look at a real cactus at home, at a store or in a garden. Draw it and count its spines in one bunch. Ask your parent to write the number.

From history. The desert laboratory in Tucson was built by the Carnegie Institution, a science group started by Andrew Carnegie, a rich steelmaker who gave money to build libraries and science labs. A few years later, two plant scientists gave the saguaro its science name, *Carnegiea gigantea*, in his honor. The name means “Carnegie’s giant.” The white saguaro blossom is now the state flower of Arizona.

WORKED EXAMPLES

Example 1. Look at the saguaro picture. How many arms does it have? How many holes for birds? Are there more arms or more holes?

(Use the map or drawing “Count the arms and the bird holes.” shown earlier in this lesson.)

1. Find the arms. They reach up from the sides. Count them: one, two. There are 2 arms.
2. Find the dark holes in the cactus. Touch each one: one, two, three. There are 3 holes.
3. Compare: 3 is more than 2. There are more holes than arms.
4. Each hole can be a home, so this one saguaro has room for 3 bird families.

Answer: 2 arms and 3 holes. There are more holes than arms.

PRACTICE

1. **EASY** Point to the spines on the saguaro picture. What do spines do for a cactus?
2. **EASY** Is a cactus’s skin waxy or soft and fuzzy?
3. **MEDIUM** A saguaro has 3 bird holes. A woodpecker pecks 2 new holes. How many holes are there now?
4. **MEDIUM** Sort these plants into “desert” and “pond”: saguaro, cattail, water lily, small pot cactus.
5. **HARD** Why do a cactus’s roots spread out wide and stay near the top of the ground?

COMMON MISTAKES

- Thinking a cactus has no leaves. Its spines are its leaves.
- Thinking you can drink water from any cactus. Cactus juice is not clean drinking water and can make a person sick.
- Thinking every desert is all sand. Many deserts are rocky and full of plants like cactus, bushes and wildflowers.

Make it a game · Who Lives in the Saguaro?. Stand tall with your arms up like a saguaro. Your parent names an animal or thing. If it could live in or visit a saguaro (woodpecker, elf owl, bee, bat, a raindrop to drink), keep your arms up and say “Come in!” If it could not (whale, polar bear, goldfish, beaver), fold your arms down and say “Not here!” Then switch: you call out animals for your parent.

Scripture. “The wilderness and the solitary place shall be glad for them; and the desert shall rejoice, and blossom as the rose.” (Isaiah 35:1, KJV)

When the saguaros bloom, the desert really does blossom. God promises even dry places can be made full of joy and flowers.

Practice answers

1. They keep animals from biting the cactus, make a little shade, and lose much less water than flat leaves would.
2. Waxy. The wax keeps water from leaking out.
3. 5 holes.
4. Desert: saguaro and small pot cactus. Pond: cattail and water lily.
5. Rain in the desert does not come often and dries up fast. Wide roots near the top can soak up the water quickly, all around the cactus, before the sun dries it.

4.4 ELIJAH FED BY RAVENS

OBJECTIVES

- Retell how God sent ravens to feed Elijah by the brook Cherith (1 Kings 17:1–7).
- Describe a raven: a big black bird with a thick beak and a wedge-shaped tail that is smart and hides food for later.
- Tell one way God takes care of the birds and of us.

Warm-up. While you cover your eyes, your parent hides five crackers around the room. Now be a raven and find them! Ravens are clever birds. They hide extra food and come back for it later.

Video. Coming soon. Common ravens flying, croaking, hiding food and solving puzzles; ravens compared with crows; a read-aloud or animated retelling of Elijah and the ravens from 1 Kings 17 (search Cornell Lab of Ornithology, All About Birds, SciShow Kids, Moody Science classics, nature footage of ravens, and a trusted children’s Bible story channel).

KEY TERMS

raven

A big, shiny black bird with a thick beak and a deep, croaking voice. It is bigger than a crow and very smart.

prophet

A person God sends to tell His message to the people.

brook

A small stream of water that runs over the ground.

drought

A long time with no rain, when the ground and the streams dry up. Say it “drowt.”

CORE IDEAS

The story. Long ago in the land of Israel there was a wicked king named Ahab. God sent a **prophet** named Elijah to tell him that no rain would fall until God said so. Then God told Elijah to go and hide by the **brook** Cherith. God said, “thou shalt drink of the brook; and I have commanded the ravens to feed thee there” (1 Kings 17:4). So Elijah went. Every morning the ravens flew in with bread and meat. Every evening they came again. Elijah drank from the brook. After a while the brook dried up, because there had been no rain in the land. Then God sent Elijah to a new place, and He took care of him there too.

How they figured it out. What kind of bird is a **raven**? A scientist named Bernd Heinrich spent many cold winters in the woods of Maine just watching ravens. He saw that ravens are very smart. They find food, call other ravens to share a big meal, and hide extra food in the

snow or under leaves to eat later. Other scientists have watched ravens solve puzzles to get a treat. Ravens live in many places: forests, mountains, the cold north and the hot, dry desert.

The big idea. A raven looks like a crow, but it is bigger, about as long as a grown-up's arm. Its beak is thick and strong. It has shaggy feathers on its throat. When it flies, its tail looks like a wedge, a point in the middle, but a crow's tail looks like a fan. A raven says "croak" in a deep, rough voice. Ravens eat almost anything: seeds, bugs, eggs, small animals and scraps. Usually ravens *take* food. That is what makes Elijah's story so amazing. God commanded the ravens, and they *brought* food to a man, morning and evening, every day.

God's handiwork. God made the raven, and He feeds it. The Bible asks, "Who provideth for the raven his food?" (Job 38:41). The answer is God. Jesus said, "Consider the ravens" (Luke 12:24). They do not plant or harvest, yet God feeds them, and you are worth much more to Him than the birds. In a dry land, in a time of **drought**, God took care of Elijah. He takes care of His children today too.

PICTURE STUDY



Elijah in the Desert, Washington Allston, 1818 · Oil on canvas · Museum of Fine Arts, Boston

Washington Allston was one of the first great American painters. He loved painting big, wild landscapes and stories from the Bible. Here he shows Elijah alone in a dry, empty land, waiting for God to send help.

Allston made the land look huge and the man look small. That helps us feel how alone Elijah was, and how much he needed God to feed him.

Look closely

- Find Elijah. Is he big or small in the picture?

- Find the big, bare, twisted tree. Does it have any green leaves? What does that tell you about the rain?
- Look in the sky. Can you find the ravens flying in?
- Look at the colors of the ground and the sky. Do they look wet or dry?

Talk about it

1. How do you think Elijah felt before the ravens came? How did he feel after?
2. Why do you think the painter made Elijah so small?
3. What would you say to God if you were Elijah, waiting by the brook?

Safety first. If you see ravens or crows outside, watch them from a distance. Never touch a wild bird, a nest, or a dead bird. Check for food allergies before using crackers or other snacks in the games.

MAKE AND DO: MAKE A RAVEN PUPPET AND TELL THE STORY

You will make a raven puppet from a paper bag, then use it to act out the story of Elijah and the ravens by the brook.

You will need

- A brown or white paper lunch bag
- Black paper, or black crayon or marker
- Yellow or gray paper for the beak, and two white paper circles for eyes
- Glue and child scissors
- A blue towel or scarf for the brook
- A few crackers or small pieces of bread

Steps

1. Color the paper bag black, or glue black paper all over it. Ravens are black from beak to tail.
2. The flat bottom of the bag is the raven's head. Glue on two eyes and a big, thick beak.
3. Cut two wings from black paper and glue them to the sides. Cut a tail shaped like a wedge, pointed in the middle, and glue it to the back.
4. Lay the blue towel on the floor for the brook Cherith. Your parent sits by the brook and plays Elijah.
5. Put your hand in the puppet. Fly in with a cracker in the raven's beak. Say "Morning!" and give it to Elijah. Fly away.
6. Fly in again with another cracker and say "Evening!" Do this for three days. Count how many trips you make.
7. At the end, roll up the towel. The brook dried up. Tell your parent what God did next.

Tips

- Give your raven shaggy throat feathers by fringing a small piece of black paper and gluing it under the beak.
- Switch parts so you can be Elijah too.

Check your work

- I made a raven with a thick beak and a wedge-shaped tail.
- I acted out the ravens coming morning and evening.
- I can retell the story of Elijah and the ravens.

NATURE NOTEBOOK

1. Draw Elijah sitting by the brook with two ravens flying in, one carrying bread. Your parent can write “1 Kings 17” at the top.
2. Draw a raven and a crow side by side. Make the raven bigger and give it a wedge tail. Give the crow a fan tail.
3. Draw a morning sun and an evening moon. Under each, draw a raven carrying food.

From history. Ravens show up in another old Bible story too. After the Flood, Noah sent out a raven from the ark before he sent out the dove (Genesis 8:7). In London, England, ravens have lived at the Tower of London for a very long time. An old saying claims that if the ravens ever leave, the kingdom will fall, so a special keeper called the Ravenmaster feeds them and cares for them every day.

WORKED EXAMPLES

Example 1. The ravens came to Elijah 2 times every day, once in the morning and once in the evening. How many times did they come in 3 days?

1. Draw 3 boxes in a row, one for each day.
2. In each box draw a sun for the morning trip and a moon for the evening trip. Each box now has 2 pictures.
3. Count all the pictures: Day 1: one, two. Day 2: three, four. Day 3: five, six.
4. 2 and 2 and 2 make 6.

Answer: The ravens came 6 times in 3 days.

PRACTICE

1. **EASY** Who brought food to Elijah? Flap your arms if you know!
2. **EASY** What two foods did the ravens bring, and where did Elijah get water?
3. **MEDIUM** The ravens came 2 times a day. Count how many times they came in 4 days. Use your fingers.

4. **MEDIUM** Look at a raven and a crow, in a book or on your drawing. Which bird is bigger? Point to the tail that is shaped like a wedge.
5. **HARD** Why did the brook Cherith dry up? Tell your parent in your own words.

COMMON MISTAKES

- Thinking ravens and crows are the same bird. They are cousins, but a raven is bigger, has a thicker beak, a wedge-shaped tail and a deeper croak.
- Thinking the ravens just happened to drop some food near Elijah. The Bible says God commanded them, and they came every morning and every evening.
- Thinking God cares only about people and not animals. The Bible says God gives the ravens their food (Job 38:41; Luke 12:24).

Make it a game · Raven Delivery. One person is Elijah and sits by a blue towel brook. The other is the raven. Hide five crackers around the room ahead of time. The raven must find one cracker, fly it to Elijah, and fly away again. Each time, Elijah calls out “Morning!” or “Evening!” in turn and counts the deliveries. When all five are delivered, switch places. Remember: real ravens hide food, so the raven may hide one more cracker for the next round!

Scripture. “And the ravens brought him bread and flesh in the morning, and bread and flesh in the evening; and he drank of the brook.” (1 Kings 17:6, KJV)

Every single day, morning and evening, God sent food. He did not forget Elijah once. He does not forget us either.

Practice answers

1. The ravens, because God commanded them to.
2. Bread and meat (the Bible says “bread and flesh”). Elijah drank water from the brook Cherith.
3. 8 times (2, 4, 6, 8).
4. The raven is bigger. The raven has the wedge-shaped tail, pointed in the middle; the crow’s tail is shaped like a fan.
5. There was no rain in the land, just as God had told Elijah. With no rain to fill it, the brook slowly ran out of water.

UNIT 4 REVIEW

This is an oral review. The parent reads each question aloud and the child answers out loud, points or draws. Accept answers in the child's own words. The review is worth 20 points.

1. (3 pts) What is inside a camel's hump? Is it water?
2. (3 pts) How many humps does a dromedary have? A Bactrian camel? Tell one other part of a camel that helps it in the desert.
3. (3 pts) Where does a lizard go on a cool morning? Where does it go at hot noon? Why?
4. (3 pts) Is lizard skin slimy or dry? Name one desert lizard. Should you pick up a wild lizard?
5. (3 pts) Tell two ways a cactus keeps water in the dry desert.
6. (3 pts) Who makes holes in a saguaro, and who might move in later?
7. (2 pts) Tell the story of Elijah and the ravens.

UNIT PROJECT: MY DESERT IN A BOX

Make a desert scene in a shoebox or on a tray. Spread sand, salt or brown paper on the bottom and add rocks. Make a camel with the right number of humps, a lizard on a sunny rock and another in the shade, a pleated paper saguaro with bird holes, and a raven with bread in its beak by a little blue-paper brook. Then give your parent a tour, telling how each living thing finds water, stays cool and gets food, and retell the story of Elijah.

- **Accuracy:** The camel has one or two humps to match its kind, the lizards are in sun and shade, the cactus has pleats, spines and roots, and the raven is black with a wedge tail.
- **Telling:** The child explains, in their own words, how each animal or plant is made for the desert.
- **The story:** The child retells Elijah and the ravens in order: no rain, the brook, ravens morning and evening, the brook dries up.
- **Care:** The scene is finished, neat and colorful, and each part is labeled (a parent may write the labels).

Answer key

1. Fat, not water. The fat is food the camel's body saves for later.
2. A dromedary has 1 hump; a Bactrian camel has 2. Any one: wide feet keep it from sinking in sand; long eyelashes keep sand out of its eyes; nostrils close in a sandstorm; tough lips eat thorny plants.
3. In the cool morning it lies on a sunny rock to warm up (it basks). At hot noon it goes into the shade, under a rock or into a hole to cool off. A lizard gets its warmth from the sun and ground around it.
4. Dry and covered with scales. A horned lizard, a Gila monster or a chuckwalla. No: watch wild lizards from a distance; some, like the Gila monster, have a venomous bite.

5. Any two: its pleats swell to store water in the thick stem; waxy skin keeps water in; spines (its leaves) lose little water and protect it; wide, shallow roots soak up rain fast.
6. A Gila woodpecker pecks the holes. Later an elf owl or other birds may move in.
7. There was no rain in the land. God sent Elijah to hide by the brook Cherith and commanded the ravens to feed him. The ravens brought bread and meat every morning and every evening, and Elijah drank from the brook until it dried up.

ARCTIC

“He giveth snow like wool” (Psalm 147:16). In this unit your child travels to the coldest places on earth: the Arctic around the North Pole and Antarctica around the South Pole. There, where people need heavy coats and fires to live, God placed animals that are perfectly at home on the snow and ice. Your child will meet the polar bear, the penguin and the caribou, and then test with their own hands how a seal stays warm in icy water.

Each lesson begins with real people who went to the far north or south: Captain Phipps’s sailors who saw the white “sea bear,” the three men who walked through the Antarctic winter night for emperor penguin eggs, the missionary who brought reindeer to Alaska, and the scientists who measured fur and blubber at the top of Alaska. Your child will make a giant polar bear paw, carry an egg on their feet like a penguin father, test snowshoe hooves in a pan of flour, and plunge a hand into ice water inside a homemade blubber glove.

One big idea runs through the unit: polar bears live at the top of the world and penguins live at the bottom, so they never meet. Keep a globe handy and point to the top and bottom often. Save the paper paw, the paper penguin, the lichen yarn and the blubber glove chart; they all go into the Arctic book at the end.

BEFORE YOU BEGIN

- Can count objects up to 20
- Can tell taller from shorter and wider from narrower
- Can point to the top and bottom of a globe
- Can listen to a short story read aloud and tell part of it back

MASTERY CHECKLIST

- I can tell where polar bears live, what they eat, and three things that help them live on the ice.
- I can tell that penguins are birds that swim instead of fly, and that they live in the south, far from polar bears.
- I can tell how an emperor penguin father keeps his egg warm.
- I can tell that caribou and reindeer are the same kind, that mothers grow antlers too, and how wide hooves help in snow.
- I can do a fair test with a blubber glove and tell why blubber keeps a seal warm.
- I can read a simple picture chart or bar chart and tell which is most.

OPTIONAL BOOKS AND RESOURCES

- ***The Worst Journey in the World* by Apsley Cherry-Garrard (free at Project Gutenberg)** (<https://www.gutenberg.org/ebooks/search/?query=worst+journey+in+the+world>): Free. The book is for grown-ups, but a parent

can read aloud a few short passages about the emperor penguins and the winter trip for their eggs (Lesson 5.2).

- ***South by Ernest Shackleton* (free at Project Gutenberg)**

(<https://www.gutenberg.org/ebooks/search/?query=shackleton+south>): Free.

Shackleton's own story of the *Endurance*. A parent can share the parts about the ship in the ice and the blubber stove (Lesson 5.4).

- **Smithsonian's National Zoo and Conservation Biology Institute**

(<https://nationalzoo.si.edu/>): Free. Look up seals and other cold-water animals together and compare their pictures with the animals in this unit.

5.1 POLAR BEARS ★

OBJECTIVES

- Tell where polar bears live and what they eat.
- Name three things God gave the polar bear to live on the ice: thick fur, a layer of blubber and big paws.
- Measure how many of your hand widths fit across a polar bear's paw.

Warm-up. Put an ice cube on a plate. Touch it with one fingertip and count slowly to five. How does your finger feel? Now wrap the ice cube in a thick sock and touch the sock. Can you still feel the cold? Today you will meet an animal that lives on ice all year long and never gets cold.

Video. Coming soon. Polar bears walking and swimming on the Arctic sea ice, a mother bear and cubs coming out of a snow den, and a bear waiting by a seal's breathing hole (search Smithsonian National Zoo, San Diego Zoo Wildlife Alliance, SciShow Kids, Homeschool Pop (Alternate) and nature footage of polar bears).

KEY TERMS

Arctic

The cold land and frozen sea around the North Pole, at the very top of the world.

sea ice

Ocean water that freezes into a hard, flat floor of ice. Polar bears walk and hunt on it.

blubber

A thick layer of fat under the skin that keeps an animal warm.

seal

A sea animal with flippers and a fat, smooth body. Seals are the polar bear's main food.

CORE IDEAS

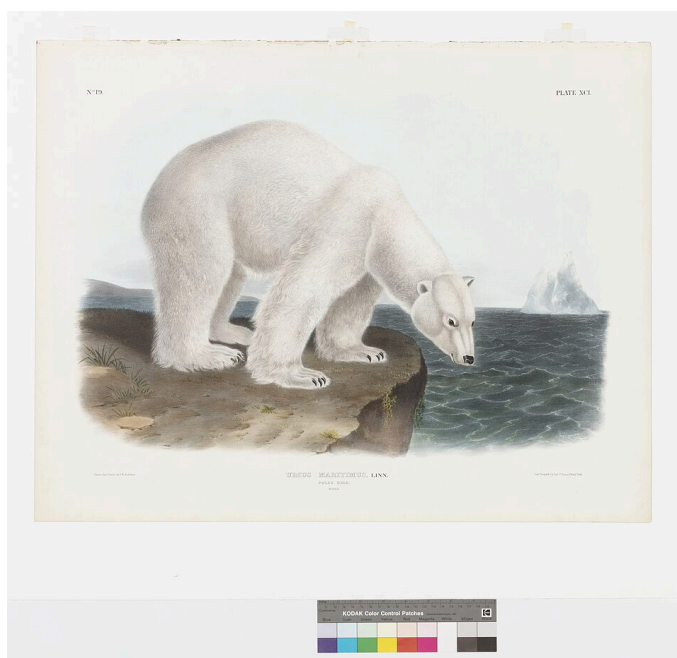
The story. In the summer of 1773, two ships from England sailed north toward the North Pole. Their captain was Constantine Phipps. The ships came to a group of icy islands and could go no farther, because the sea was frozen into a hard white floor. On the ice the sailors saw great white bears walking and swimming. Phipps wrote down what the bear looked like, and the next year he gave it a science name that means "sea bear." We call it the **polar bear**.

How they figured it out. People who watch polar bears found that they spend most of their lives on the **sea ice** of the **Arctic**. A polar bear is a strong swimmer. It paddles with its big front paws. But its favorite food is the **seal**. A seal swims under the ice and comes up at a little hole to breathe. The bear smells the hole and waits beside it, very still, for a long, long time. When the seal pops up, the bear grabs it. A polar bear is the biggest meat-eating animal that lives on land. A big one standing up is taller than a door.

The big idea. God gave the polar bear everything it needs for the cold. Its fur is thick and looks white like snow, so seals do not see it coming. Under the fur its skin is black. Under the skin is a thick layer of **blubber**, like a warm coat on the inside. Its paws are as wide as a dinner plate. They spread its weight on thin ice like snowshoes, and little bumps and fur on the bottom keep it from slipping. In the fall a mother bear digs a den in a snowbank. Her tiny cubs are born there in the middle of winter, and in the spring they tumble out into the sun.

God's handiwork. God asked Job, "Out of whose womb came the ice?" (Job 38:29). Only God made the ice, and only God could make a bear that is happy on it. Where we would freeze, the polar bear naps on the snow with its nose tucked in its paws.

PICTURE STUDY



Polar Bear, from The Viviparous Quadrupeds of North America, John James Audubon and his son John Woodhouse Audubon, 1840s · Hand-colored lithograph · Plates from the book are in many libraries and museums.

John James Audubon is famous for painting the birds of America. When he was older, he began a second big book about the furry four-footed animals of North America. His sons helped him paint, and his friend John Bachman, a pastor in South Carolina, wrote the words. This picture of a polar bear is one of its plates.

The Audubons painted animals as large and true as they could, so that people who had never been to the Arctic could see what a polar bear really looks like.

Look closely

- Find the polar bear's paws. Are they big or small for its body?
- Look at the color of the fur. Is it pure white, or can you see some yellow and gray?
- Find the polar bear's nose and eyes. What color are they?

- Look around the bear. Is it standing on ice, on rock or in the water? Where do you think it will hunt?

Talk about it

1. What do you think the bear is looking for?
2. How is this bear different from the black bear we met in the forest?
3. If you could add one more animal to this picture, what would it be? (Hint: what does a polar bear eat?)

Safety first. A grown-up cuts the cardboard. Polar bears are big, strong hunters and can be very dangerous. We only watch them in pictures, on video or behind the strong walls of a zoo.

MAKE AND DO: MAKE A POLAR BEAR PAW

You will make a polar bear paw as big as a real one and test why the bumps on the bottom keep a bear from slipping on the ice.

You will need

- A piece of cardboard at least 14 inches across (cut from the side of a big box)
- A ruler and a pencil
- Scissors (for a grown-up)
- Cotton balls or white yarn, and glue
- A piece of sandpaper about as big as a playing card
- A piece of smooth paper the same size
- Two coins and a baking sheet or a big hardback book

Steps

1. Use the ruler to draw a line 12 inches long across the cardboard. A big polar bear's front paw can be that wide.
2. Draw a big round paw around the line, with five toes on top. Your grown-up cuts it out.
3. Glue cotton balls or white yarn all over the top of the paw. That is the thick fur.
4. Lay your own hand on the paw. Is the paw bigger or smaller than your hand?
5. Now test the bumps. Lay the sandpaper and the smooth paper side by side on the baking sheet with a coin on each one.
6. Slowly lift one end of the baking sheet, like a hill of ice. Which one slides down first?
7. The smooth paper slides first. The rough sandpaper holds on, just as the little bumps on a polar bear's foot grip the ice.

Tips

- Glue a small square of sandpaper on the bottom of your cardboard paw for the bumps.
- Keep your paw for the Arctic book at the end of the unit.

Check your work

- I made a polar bear paw 12 inches wide.
- I found out that rough bumps slip less than a smooth bottom.
- I can tell three things that keep a polar bear warm and safe on the ice.

NATURE NOTEBOOK

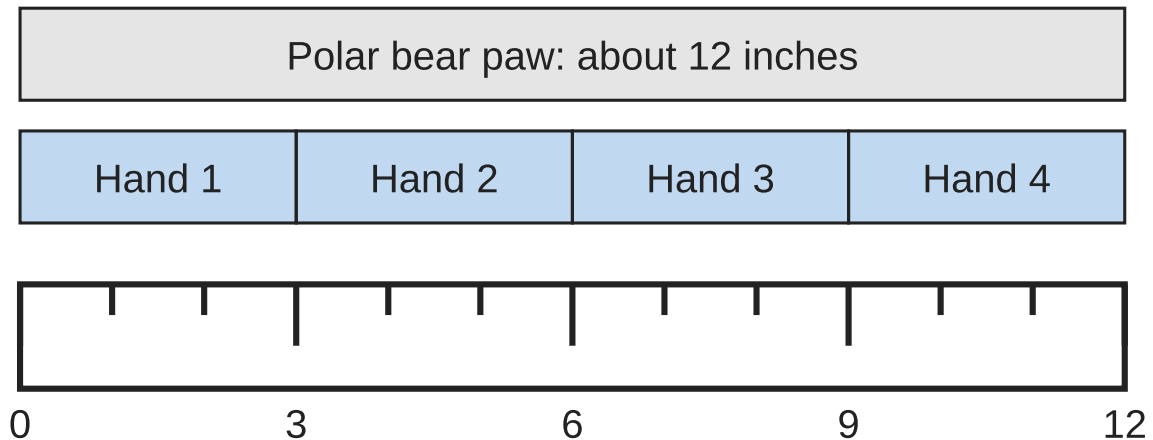
1. Draw a polar bear waiting beside a seal's breathing hole in the ice. Your parent can write the date at the top.
2. Draw a polar bear cut in half like a cake: white fur on the outside, black skin next, then a thick yellow layer of blubber. Label the three layers with your parent's help.
3. Trace your hand on a page and write how many of your hands fit across a polar bear's paw.

From history. One of the sailors on Phipps's ships in 1773 was a young man named Horatio Nelson, who later became England's most famous admiral. The story is told that one foggy night he slipped off across the ice with a friend to chase a polar bear, because he wanted its skin to take home to his father. His gun would not fire, and the bear came closer. The captain fired a cannon from the ship, the loud bang scared the bear away, and young Nelson came back to a good scolding.

WORKED EXAMPLES

Example 1. A big polar bear's front paw is about 12 inches across. A child's hand is about 3 inches wide. Look at the picture. How many hand widths fit across the paw?

A polar bear paw and my hand widths



4 hand widths fit across the paw (inches).

Four hand widths fit across one big polar bear paw.

1. Find the long bar on top. It is the polar bear's paw. It goes from 0 to 12 on the ruler.
2. Find the blue boxes. Each one is a hand, 3 inches wide.
3. Count the hands from left to right: 1, 2, 3, 4.
4. The last hand ends at 12, right where the paw ends.

Answer: 4 hand widths fit across the polar bear's paw.

PRACTICE

1. **EASY** Where do polar bears live? Point to the top or the bottom of a globe.
2. **EASY** What is a polar bear's favorite food? How does it catch it?
3. **MEDIUM** Name three things that keep a polar bear warm or safe on the ice.
4. **MEDIUM** A mother polar bear has 2 cubs. Another mother has 1 cub. Count the cubs with buttons. How many cubs in all?
5. **HARD** Tell your parent the story of a polar bear family from fall to spring.

COMMON MISTAKES

- Thinking a polar bear's skin is white. Its fur looks white, but its skin underneath is black.

- Thinking polar bears and penguins live together. Polar bears live at the top of the world and penguins live at the bottom, so they never meet in the wild.
- Thinking a polar bear is cuddly like a teddy bear. It is a powerful hunter, and people must stay far away from it.

Make it a game · Seal at the Breathing Hole. Lay a hula hoop or a ring of string on the floor. That is the seal's breathing hole. You are the polar bear. Sit beside the hole, perfectly still and quiet. Your parent is the seal and pokes a hand up into the hole at a surprise moment. Can you tag it before it pulls back? If you wiggle or make a sound, the seal swims away to another hole. Take turns being the bear and the seal, and count how many seals each bear catches.

Scripture. "Out of whose womb came the ice? and the hoary frost of heaven, who hath gendered it?" (Job 38:29, KJV)

God reminded Job that He made the ice and the frost. He also made the polar bear to live happily on that ice.

Practice answers

1. In the Arctic, on the sea ice around the North Pole, at the top of the world.
2. Seals. The bear waits very still beside the hole where a seal comes up to breathe, and grabs it when it pops up.
3. Any three: thick fur, a layer of blubber, black skin, big wide paws that work like snowshoes, bumps and fur on the bottom of its paws.
4. 3 cubs.
5. In the fall the mother bear digs a den in a snowbank. The tiny cubs are born in the den in the middle of winter. In the spring the mother and cubs come out, and she takes them onto the ice to hunt seals.

5.2 PENGUINS OF THE ANTARCTIC ★

OBJECTIVES

- Tell that penguins are birds that cannot fly but swim with their flippers, and that most of them live in the far south.
- Tell how an emperor penguin father keeps his egg warm on his feet all winter.
- Compare the heights of an emperor penguin and an Adélie penguin on a block chart.

Warm-up. Stand up straight with your arms stiff at your sides. Now waddle across the room with tiny steps, rocking from side to side, without bending your knees much. That is how a penguin walks on land. Now lie on your tummy on the floor and push yourself along with both arms. That is how a penguin slides on the snow, and in the water it zooms like a rocket.

Video. Coming soon. Emperor penguins huddling in the Antarctic winter, a father penguin with an egg on his feet, Adélie penguins diving and “flying” underwater, and penguins tobogganing on their bellies (search Smithsonian, SciShow Kids, Homeschool Pop (Alternate), Monterey Bay Aquarium, San Diego Zoo Wildlife Alliance and nature footage of Antarctic penguins).

KEY TERMS

Antarctica

The icy land around the South Pole, at the very bottom of the world.

penguin

A bird with feathers and a beak that cannot fly but swims very fast in the sea.

flipper

A flat, stiff wing or arm shaped like a paddle, used for swimming.

huddle

To crowd close together to stay warm.

CORE IDEAS

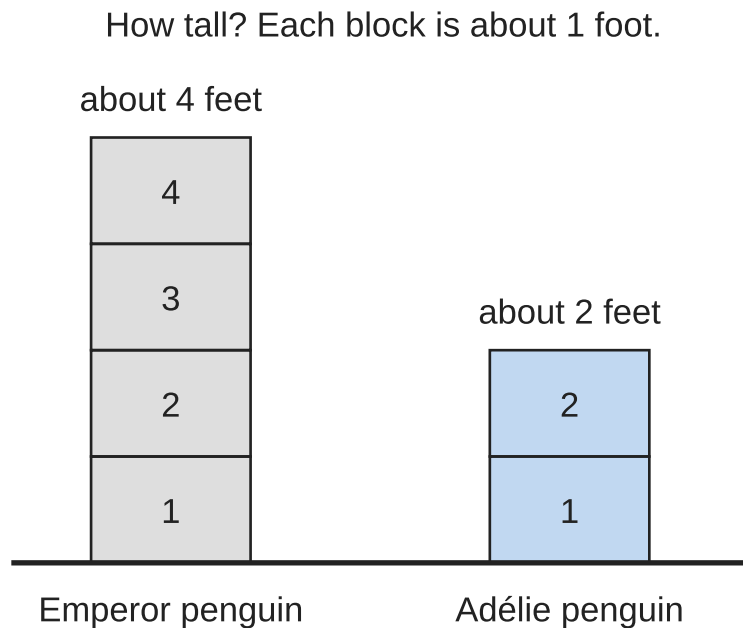
The story. In the winter of 1911, three brave men set out across the ice of **Antarctica**, at the bottom of the world. Their names were Edward Wilson, Henry Bowers and Apsley Cherry-Garrard. In the Antarctic winter the sun does not come up at all, so they walked in the dark, pulling their sleds. It was so cold that their clothes froze stiff as boards. Why did they go? They wanted to bring home the eggs of the emperor penguin, so scientists could study them. After many hard weeks, they came home with three penguin eggs. Cherry-Garrard later carried them all the way to a museum in London.

How they figured it out. The men learned something amazing. Emperor penguins lay their eggs in the coldest, darkest part of winter, right on the ice. The mother lays one egg. Then

she goes to the sea to eat, and the father takes the egg. He holds it on top of his feet and covers it with a warm, feathery fold of skin on his belly. All winter he stands there. He does not eat at all. Hundreds of fathers **huddle** close together, taking turns on the windy outside of the crowd. When the chick hatches, the mother comes back with food.

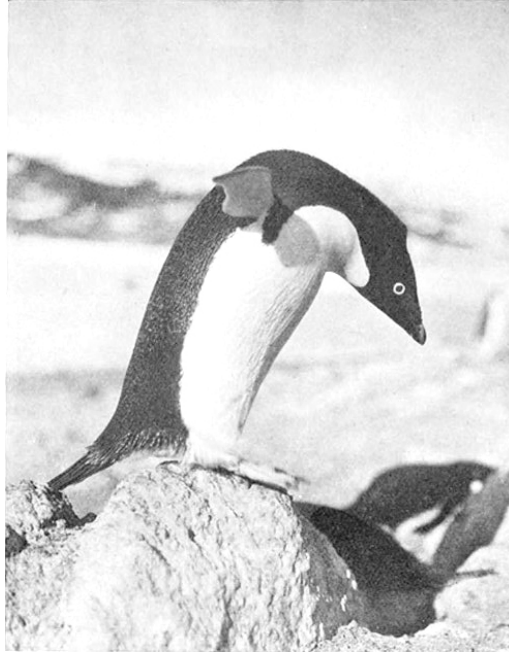
The big idea. A **penguin** is a bird. It has feathers, a beak, and it lays eggs. But God made its wings into stiff **flippers**, so it cannot fly in the air. Instead it “flies” under the water, catching fish and krill. Its feathers are short, thick and oily, packed close like shingles on a roof, and under its skin is a layer of fat. The emperor is the tallest penguin. The little Adélie penguin, with a white ring around each eye, is about half as tall. Almost all penguins live in the southern half of the world, far from the polar bears in the north.

God’s handiwork. The Bible says, “ask now the beasts, and they shall teach thee; and the fowls of the air” (Job 12:7). A penguin father teaches us patience. He stands in the dark and the wind for weeks, keeping one little egg safe until the chick is born.



The emperor penguin is about twice as tall as the Adélie penguin.

PICTURE STUDY



An Adélie Penguin about to Dive, Herbert Ponting, About 1911 · Photograph · Taken in Antarctica on Captain Scott's British Antarctic Expedition; prints are kept at the Scott Polar Research Institute, Cambridge, England.

Herbert Ponting was the photographer who went to Antarctica with Captain Robert Scott and the three men who fetched the emperor penguin eggs. He carried heavy cameras and glass plates across the ice. His fingers sometimes stuck to the frozen metal of his camera. His photographs were some of the first pictures most people ever saw of Antarctic penguins.

The Adélie penguins in his pictures are small and busy. This one is just about to dive into the icy sea to catch food. They nest on rocky ground in the summer and build their nests out of little stones.

Look closely

- Find the penguin. Is it standing on the ice or in the water? Which way is it leaning?
- Look at their colors. Which part is black and which part is white?
- Find a penguin's flippers. Are they held out or close to its body?
- Look at the ground. Is it snow, ice, rock or water?

Talk about it

1. Why do you think penguins have black backs and white fronts? (Hint: think of what a seal sees looking up from the water, and what a bird sees looking down.)
2. How do you think Mr. Ponting felt taking pictures in such cold?
3. What do you think this penguin will do next? What will it look for in the water?

MAKE AND DO: KEEP THE EGG WARM

You will be an emperor penguin father. Can you keep your egg on your feet, off the cold ice, while you move?

You will need

- A plastic egg, a small beanbag or a rolled-up pair of socks (the egg)
- A small towel (the warm fold of skin)
- A blanket or white sheet on the floor (the ice)
- Paper, crayons and scissors

Steps

1. Stand on the blanket with your feet close together. Your parent sets the egg on top of your feet.
2. Hang the towel from your waistband in front so it covers the egg. That is your warm belly fold.
3. Shuffle slowly across the blanket without letting the egg touch the “ice.” Count your steps out loud.
4. If the egg rolls off, start again. Real penguin fathers must be very careful. An egg on the ice would freeze.
5. Now huddle. Gather everyone in the family close together with their eggs. Whoever is on the outside counts to ten, then shuffles to the middle.
6. Draw and cut out a paper penguin with a black back, a white front, two flippers and an orange beak. Tape a paper egg on its feet.

Tips

- Stuffed animals can join the huddle too.
- Keep your paper penguin for the Arctic book at the end of the unit.

Check your work

- I carried an egg on my feet like an emperor penguin father.
- I can tell why penguins huddle together.
- I made a penguin with flippers, a beak and the right colors.

NATURE NOTEBOOK

1. Draw an emperor penguin father with an egg on his feet under his belly fold. Your parent can write the date at the top.
2. Draw a penguin swimming under the water, chasing a fish with its flippers out.
3. Draw a globe. Put a polar bear at the top and a penguin at the bottom.

From history. Apsley Cherry-Garrard wrote a book about the winter trip for the penguin eggs and called it *The Worst Journey in the World*. When he brought the three eggs to the

Natural History Museum in London, he had to wait in the hall before anyone would take them from him. The eggs are still kept at the museum today.

WORKED EXAMPLES

Example 1. Look at the block chart. Each block stands for 1 foot. How tall is the emperor penguin? How tall is the Adélie penguin? Which is taller, and by how many blocks?

(Use the map or drawing “Each block is about 1 foot.” shown earlier in this lesson.)

1. Count the blocks under the emperor penguin: 1, 2, 3, 4. It is about 4 feet tall.
2. Count the blocks under the Adélie penguin: 1, 2. It is about 2 feet tall.
3. 4 is more than 2, so the emperor penguin is taller.
4. Count up from 2 to 4: three, four. That is 2 more blocks.

Answer: The emperor penguin is taller. It is about 4 feet tall and the Adélie is about 2 feet, so the emperor is 2 blocks (about 2 feet) taller, twice as tall.

PRACTICE

1. **EASY** Is a penguin a bird or a fish? Tell two reasons.
2. **EASY** Point to the bottom of a globe. What land is there? Which animal from this lesson lives there?
3. **MEDIUM** Who keeps the emperor penguin egg warm all winter, and how?
4. **MEDIUM** Ten penguins are in a huddle. Four penguins are on the windy outside. How many are in the warm middle? Use buttons to help.
5. **HARD** Sort these into two groups, Arctic (top of the world) and Antarctic (bottom of the world): polar bear, emperor penguin, seal, Adélie penguin.

COMMON MISTAKES

- Thinking penguins live at the North Pole with polar bears. Almost all penguins live in the southern half of the world.
- Thinking a penguin is not a bird because it cannot fly. It has feathers and a beak and lays eggs, so it is a bird.
- Thinking all penguins live on ice. Some kinds live on warmer shores, in places such as South Africa, Australia and South America.

Make it a game • Penguin Huddle. Everyone is a penguin. Your parent is the wind and says “Whoosh!” When the wind blows, all the penguins must huddle close together, touching shoulders, in under five seconds. Whoever is on the outside of the huddle when the wind stops must shuffle to the middle next time. Between winds, penguins waddle around or slide on their bellies. Play until everyone has had a turn in the warm middle.

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

Even a bird that cannot fly has something to teach us. The penguin father shows how God made him to care for his little one through the long, dark winter.

Practice answers

1. A bird. Any two: it has feathers, it has a beak, it lays eggs, it has wings (flippers).
2. Antarctica, around the South Pole. Penguins, such as emperor and Adélie penguins, live there.
3. The father. He holds the egg on top of his feet under a warm fold of skin on his belly and does not eat until the mother comes back.
4. 6 penguins are in the middle.
5. Arctic: polar bear. Antarctic: emperor penguin, Adélie penguin. Seals live in both.

5.3 CARIBOU

OBJECTIVES

- Tell that caribou and reindeer are the same kind of deer and that both fathers and mothers grow antlers.
- Tell how a caribou's wide hooves help it walk on snow and dig for lichen.
- Read a picture chart and count the caribou in a herd.

Warm-up. Fill a pan with flour, sugar or sand and smooth it flat. Poke it with one finger. Now press the palm of your open hand on it just as hard. Which one sank deeper? Which one left a wide, shallow print? Keep the pan. A caribou's feet will explain the answer.

Video. Coming soon. A great herd of caribou crossing a river on migration, caribou digging through snow for lichen, a newborn caribou calf, and reindeer herding in the far north (search National Park Service, Smithsonian, SciShow Kids, Homeschool Pop (Alternate) and nature footage of caribou and reindeer).

KEY TERMS

tundra

Cold, flat land in the far north with no trees, where the ground under the top stays frozen all year.

herd

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

lichen

A tough, crusty plant-like living thing that grows on rocks and ground. Caribou love to eat it.

hoof

The hard foot of an animal like a deer, horse or caribou.

CORE IDEAS

The story. In the summer of 1892, a ship sailed across the cold sea from Siberia to Alaska. It was carrying reindeer. A missionary named Sheldon Jackson had seen that the native people of northern Alaska often did not have enough to eat. In other cold lands, families kept herds of tame reindeer for meat, milk and warm skins. So Jackson brought reindeer to Alaska and found herders to teach the people how to care for them. Soon reindeer herds were growing on the Alaska **tundra**.

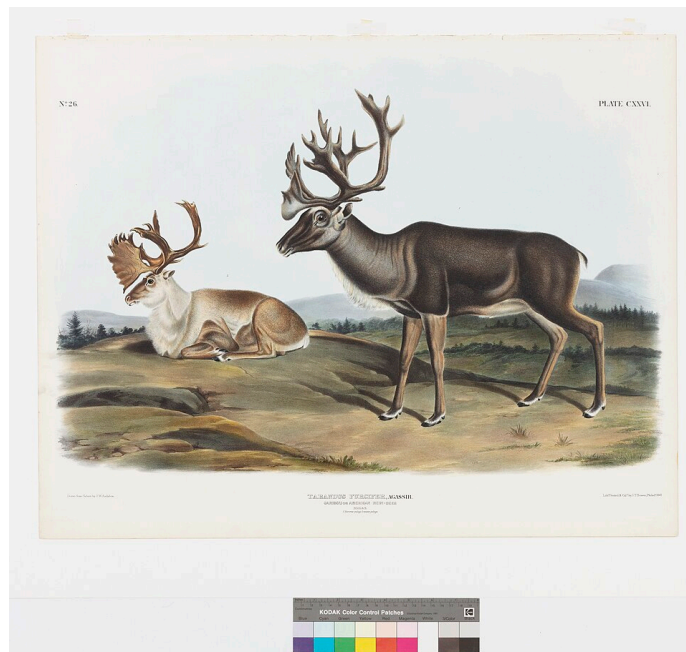
How they figured it out. Alaska already had wild deer that looked just like the reindeer. They were called caribou. People who studied them found that caribou and reindeer are the same kind of animal. "Reindeer" is the name for the ones in Europe and Asia, many of them tame. "Caribou" is the name for the wild ones in North America. They are the only deer in

which the mothers grow antlers as well as the fathers. The fathers drop their big antlers in early winter. The mothers keep theirs until spring.

The big idea. God gave the caribou big, wide **hooves**, like snowshoes. They spread out so the caribou does not sink deep in the snow, just as your flat hand did not sink deep in the pan. In winter the edges of the hooves are hard and sharp, good for gripping ice. The caribou uses them like shovels to dig down through the snow to its favorite food, **lichen**. Its hair is thick and full of air, and even its nose is covered with fur. Every year a great **herd** walks a very long way, to find food in winter and to have calves in the spring. A newborn calf is soon up on its wobbly legs and running beside its mother.

God's handiwork. When a caribou walks, its feet make a soft clicking sound. Some scientists think the click, click, click helps the herd stay together, even in a snowstorm. God asked Job, "canst thou mark when the hinds do calve?" (Job 39:1). God knows every caribou calf born on the wide, empty tundra, even when no person sees it.

PICTURE STUDY



Caribou, or American Reindeer, from The Viviparous Quadrupeds of North America, John James Audubon and John Woodhouse Audubon, 1840s · Hand-colored lithograph · Plates from the book are in many libraries and museums.

This plate comes from the same big book of four-footed animals as the polar bear in Lesson 5.1. The Audubons wanted to show every furry animal of North America, from the tiny mouse to the great caribou of the north.

This plate shows two caribou fathers. One wears his dark summer coat and the other his pale winter coat, so you can see how a caribou's coat changes with the seasons. Look closely at the antlers. They are tall and curved, with flat parts near the front like hands. No other deer has antlers quite like a caribou.

Look closely

- Find the antlers. Count the points you can see on one side.
- Look at the feet. Are the hooves big or small?
- Find the long hair on the caribou's neck. What color is it?
- Look at the land. Do you see any trees, or is it open?

Talk about it

1. How is this caribou like the deer we met in the forest? How is it different?
2. The book says both of these caribou are fathers. If you saw a caribou with antlers in the wild, could it be a mother? (Hint: mothers grow antlers too.)
3. Where do you think these caribou are going?

MAKE AND DO: SNOWSHOE HOOVES AND LICHEN DIG

You will test why wide feet are good on snow, then dig for lichen like a hungry caribou.

You will need

- The pan of flour, sugar or sand from the warm-up
- A pencil and a jar lid
- A toy animal or a block the same weight for each test, or just your hand pressing the same each time
- Small pieces of green or gray yarn, or crumpled bits of green paper (the lichen)
- A spoon

Steps

1. Smooth the pan flat. Stand the pencil on its eraser end and press down gently. Look at the hole.
2. Smooth the pan again. Lay the jar lid flat and press down just as gently. Look at the print.
3. Which one sank deeper, the narrow pencil or the wide lid? The wide lid stayed near the top, like a caribou's hoof on snow.
4. Now bury ten bits of yarn "lichen" in the pan while you close your eyes.
5. Be a caribou. Scrape with the spoon or curl your fingers like a hoof and dig in short strokes, the way a caribou paws the snow.
6. Count the lichen you find. Did you find all ten?

Tips

- Flour makes a big mess. Work on a tray or outside.
- If you have real snow, try the pencil and the lid outdoors in the snow too.
- Keep a few bits of lichen yarn for the Arctic book.

Check your work

- I found that a wide foot sinks less than a narrow one.
- I dug for lichen and counted what I found.
- I can tell why a caribou has big hooves.

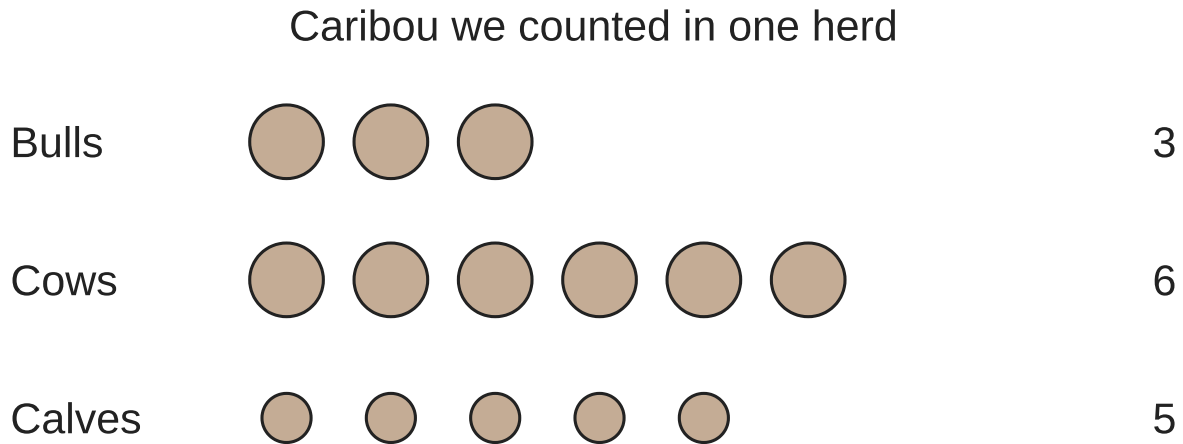
NATURE NOTEBOOK

1. Draw a caribou digging through snow to find lichen. Your parent can write the date at the top.
2. Draw a caribou hoof print beside your own shoe print. Which is wider?
3. If you can find real lichen on a rock or tree near home, draw it and color it. Look, but leave it where it grows.

From history. The reindeer that Sheldon Jackson brought to Alaska came with herders from Siberia, and a few years later more herders came all the way from Norway to teach the Alaskan people. These herders from Norway were Sámi, a people who had kept reindeer for a very long time. They taught how to milk reindeer, drive them with sleds and keep the herds safe.

WORKED EXAMPLES

Example 1. A family saw a caribou herd and made a picture chart. Each circle is one caribou. How many bulls (fathers), cows (mothers) and calves are there? How many in all? Which group is biggest?



Each circle is one caribou. In all: 14.

Each circle is one caribou.

1. Count the bulls row: 1, 2, 3. There are 3 bulls.
2. Count the cows row: 1, 2, 3, 4, 5, 6. There are 6 cows.
3. Count the calves row: 1, 2, 3, 4, 5. There are 5 calves.
4. Add them up. Start at 6 and count on 5 more: 7, 8, 9, 10, 11. That is 11. Count on 3 more: 12, 13, 14.
5. The cows row is the longest, so cows are the biggest group.

Answer: 3 bulls, 6 cows and 5 calves, 14 caribou in all. Cows are the biggest group.

PRACTICE

1. **EASY** Are caribou and reindeer the same kind of animal or different kinds?
2. **EASY** Point to the antlers on a caribou in the picture study. Can a mother caribou have antlers too?
3. **MEDIUM** What does a caribou eat in winter, and how does it find it under the snow?
4. **MEDIUM** A caribou has 4 feet. Count the feet on 3 caribou. Use buttons or draw dots.
5. **HARD** Tell why wide feet help a caribou walk in snow. Use the pencil and the jar lid to show your parent.

COMMON MISTAKES

- Thinking only father deer grow antlers. In caribou, the mothers grow antlers too.
- Thinking reindeer are only make-believe. Reindeer are real animals, the same kind as wild caribou, and families in the far north really do keep herds of them.
- Thinking lichen is just moss. People call it “reindeer moss,” but lichen is a different living thing that can grow on bare rock.

Make it a game · Click, Click, Follow the Herd. One person is the lead caribou and walks around the house or yard clicking their tongue, “click, click, click,” with every step. Everyone else is the herd and must follow with eyes closed or covered (a parent keeps the way safe), listening for the clicks. Stop and ask: where is the leader? Point! Then open your eyes and see if you were right. Take turns being the leader.

Scripture. “Knowest thou the time when the wild goats of the rock bring forth? or canst thou mark when the hinds do calve?” (Job 39:1, KJV)

A hind is a mother deer. People rarely see a wild deer give birth, but God sees every one, even on the faraway tundra.

Practice answers

1. The same kind. Wild ones in North America are called caribou, and the ones in Europe and Asia, many of them tame, are called reindeer.
2. Yes. Caribou are the only deer in which the mothers grow antlers too.
3. Lichen. It digs down through the snow with its wide, sharp-edged hooves.
4. 12 feet (4, 8, 12).
5. Wide feet spread the caribou’s weight out, so it does not sink in deep. The narrow pencil sank in, but the wide lid stayed near the top.

5.4 STAYING WARM: THE BLUBBER GLOVE EXPERIMENT

OBJECTIVES

- Tell how blubber, fur and feathers keep cold-land animals warm.
- Make a blubber glove, predict what will happen, and test it in ice water.
- Read a bar chart and tell which hand stayed in the cold water longest.

Warm-up. On a cold day, what do you put on before you go outside? Run and get one warm thing: a coat, a hat, mittens or a blanket. Put it on. Where does the warmth come from? Your coat does not make heat. Your body makes the heat, and the coat keeps it in. Polar bears, seals and penguins have their own coats built right into their bodies.

Video. Coming soon. The blubber glove experiment with shortening and ice water, seals and walruses resting on ice, and how fur, feathers and blubber keep Arctic animals warm (search SciShow Kids, Science Max, Homeschool Pop (Alternate), Smithsonian, NOAA Fisheries and nature footage of seals and walruses).

KEY TERMS

blubber

A thick layer of fat under the skin of seals, whales, walruses and polar bears that keeps them warm.

insulation

A layer that keeps warmth in and cold out, like a coat, a blanket, fur or blubber.

predict

To say what you think will happen before you try it.

experiment

A careful test to find out what really happens.

CORE IDEAS

The story. About the year 1950, two scientists named Per Scholander and Laurence Irving went to Point Barrow, at the very top of Alaska. Outside their laboratory the snow blew and the sea was frozen. Seals lay on the ice. Arctic foxes curled up on the snow to sleep. The scientists wondered how these animals could stay warm out there.

How they figured it out. They did careful tests. They measured how thick the fur of each animal was and how well it kept heat in. They found that the thick fur of an Arctic fox kept it so warm that it could lie out in weather much colder than a kitchen freezer and still be comfortable. Seals have short fur, but under their skin is a thick layer of **blubber**. The scientists found that the blubber keeps the warmth inside the seal's body, even when it swims in icy water. Fur, feathers and blubber are all **insulation**. They do not make heat. They keep the body's own heat from getting out.

The big idea. Fur works by trapping air between the hairs, like a fluffy blanket. Feathers do the same for a penguin. But wet fur goes flat and loses its warmth, so animals that swim in cold water all day, such as seals, whales and walruses, need blubber. Fat lets heat pass through very slowly, even when it is wet. The polar bear has both: thick fur for the wind and blubber for the water.

Try it and see. Today you will do an **experiment** like a real scientist. You will make a “blubber glove” out of shortening and plastic bags and dip your hand in ice water. First you will **predict**: Will the blubber glove keep your hand warmer than a bare hand? Then you will test it and count. God made the seal’s blubber long before anyone made a glove, and when we copy His design, it works.

PICTURE STUDY



The Endurance in the Ice at Night, Frank Hurley, 1915 · Photograph · Taken in the frozen Weddell Sea near Antarctica; Hurley’s glass negatives and prints are kept in libraries in England and Australia.

In 1915 the ship *Endurance*, led by Ernest Shackleton, was trapped in the frozen sea near Antarctica. The ice held it like a hand squeezing a nut. Frank Hurley was the ship’s photographer. One dark winter night he set up his camera on the ice and lit many flashes all around the ship at once. The frost on every rope and mast lit up white.

Later the ice crushed the ship. The men camped on the ice and then on a rocky island. They stayed alive by eating seals and penguins and burning seal blubber in a stove for cooking and warmth. Every one of the men was rescued.

Look closely

- Find the ship’s masts. What is covering the ropes?
- Look at the ground around the ship. Is it water or ice?
- Is this picture taken in the daytime or at night? How can you tell?
- Find the darkest part of the picture and the brightest part.

Talk about it

1. How do you think the men on the ship kept warm?
2. Why do you think seal blubber burns well in a stove?
3. What animals might live on the ice near this ship?

Safety first. Use only a few seconds in the ice water, and take your hand out right away if it hurts. Dry your hands with a towel when you are done. Work on a tray or outdoors in case of spills. Plastic bags are only for hands; never put one over your head.

MAKE AND DO: MAKE A BLUBBER GLOVE

You will build a pretend layer of blubber and test it in ice water, just as scientists test how animals stay warm. First you predict, then you test, then you count and record.

You will need

- A big bowl of water with lots of ice cubes
- Four zipper sandwich bags or quart freezer bags
- A cup of white vegetable shortening (or lard)
- A spoon and a roll of tape
- A towel
- Paper and a crayon

Steps

1. Predict. Ask: "Which hand will stay in the ice water longer, a bare hand or a hand in a blubber glove?" Your parent writes down your guess.
2. Make the blubber glove. Spoon the shortening into one bag and spread it all over the inside. Turn a second bag inside out and push it into the first bag, so the shortening is squished between the two bags. Tape the tops of the two bags together all the way around so you can slip your hand into the middle.
3. Make a plain glove the same way with the other two bags, but with no shortening. This shows whether the bags alone keep you warm.
4. Test 1: Put one bare hand in the ice water. Your parent counts the seconds out loud. Take it out when it feels too cold. Write the number.
5. Test 2: Dry your hand. Put on the plain glove and dip it in the water the same way. Count and write the number.
6. Test 3: Put on the blubber glove and dip it in the water the same way. Count and write the number.
7. Look at your three numbers. Which kept your hand warm the longest? Was your prediction right?

Tips

- Keep it fair: dip the same hand each time, just as deep, into the same bowl of ice water.
- Do not let water get inside the gloves. Keep the open tops above the water.
- Let your hand warm up between tests.
- Draw your results as three bars, like the chart in this lesson, and save it for the Arctic book.

Check your work

- I made a prediction before I tested.
- I tested a bare hand, a plain glove and a blubber glove and counted the seconds for each.
- I can tell why blubber keeps a seal warm in icy water.

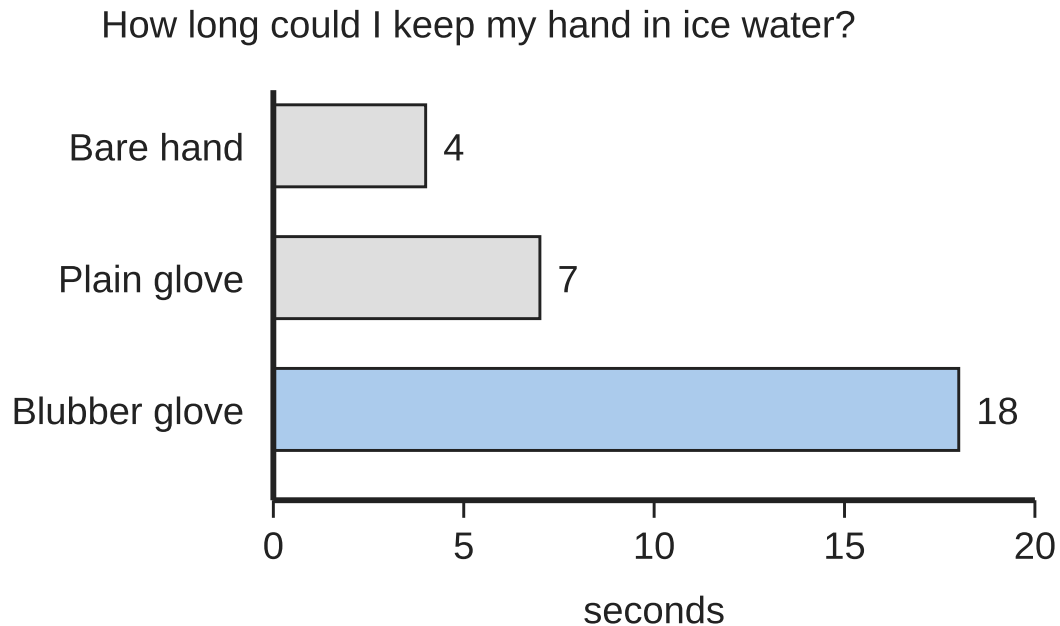
NATURE NOTEBOOK

1. Draw a seal lying on the ice. Draw a dotted line inside its body to show where the blubber is. Your parent can write the date at the top.
2. Draw your blubber glove and write your three numbers from the test next to it.
3. Draw three cold-land animals and what keeps each one warm: a fox (fur), a penguin (feathers and fat) and a seal (blubber).

From history. The Inuit people of the far north knew how to stay warm long before scientists measured fur. They made winter clothes out of caribou skins, because caribou hair is thick and full of air. Often they wore two coats: an inner one with the fur turned in against the body and an outer one with the fur turned out to the wind. On their feet they wore boots of sealskin, which keeps out water.

WORKED EXAMPLES

Example 1. One family did the blubber glove test. The bar chart shows how many seconds each hand stayed in the ice water. Which kept the hand in longest? How many more seconds was the blubber glove than the bare hand?



One family's results. Your numbers may be different, but the blubber glove should still win.

1. Find the bare hand bar. Follow it to the end: 4 seconds.
2. Find the plain glove bar: 7 seconds.
3. Find the blubber glove bar: 18 seconds. It is the longest bar.
4. Count on from 4 to 18: 4 to 14 is 10, and 14 to 18 is 4 more. 10 and 4 make 14.

Answer: The blubber glove kept the hand in longest, 18 seconds. That is 14 seconds more than the bare hand.

PRACTICE

1. **EASY** What is blubber? Point to where it is on a seal in your drawing.
2. **EASY** Match each animal to what keeps it warm: Arctic fox, seal, penguin. (fur, blubber, feathers)
3. **MEDIUM** Does a coat make heat? Where does the warmth come from?
4. **MEDIUM** Look at your own test. Which number was biggest: bare hand, plain glove or blubber glove? Was your prediction right?
5. **HARD** Why do seals and whales need blubber instead of just thick fur?

COMMON MISTAKES

- Thinking a coat or blubber makes heat. It only keeps in the heat the body already makes.
- Thinking fat animals are just eating too much. For seals and polar bears, a thick layer of blubber is exactly what God made them to have, and it keeps them alive in the cold.
- Changing two things at once in a test, such as using a different hand or colder water for the blubber glove. A fair test changes only one thing.

Make it a game · Warm or Cold?. Your parent names something, and you must quickly say whether it helps keep warm or not. Fur? Warm! A wet sock? Cold! Blubber? Warm! Feathers? Warm! A fan blowing? Cold! A blanket? Warm! For every right answer, take one step toward the “den” (a pillow across the room). Reach the den and curl up like a polar bear to win.

Scripture. “He giveth snow like wool: he scattereth the hoarfrost like ashes. He casteth forth his ice like morsels: who can stand before his cold?” (Psalm 147:16–17, KJV)

We cannot stand long in God’s cold, as the ice water showed us. But God gave the seal, the polar bear and the penguin warm coats so they can live where we cannot.

Practice answers

1. A thick layer of fat under the skin. The child points just under the skin all around the seal’s body.
2. Arctic fox: fur. Seal: blubber. Penguin: feathers (and a layer of fat too).
3. No. Your body makes the heat, and the coat is insulation that keeps the heat in. Fur and blubber work the same way.
4. Answers will vary. Usually the blubber glove has the biggest number. The child tells whether the guess matched the test.
5. They swim in icy water. Wet fur goes flat and stops keeping them warm, but blubber keeps the heat in even when it is wet.

UNIT 5 REVIEW

This is an oral review. Read each question aloud and let your child answer by telling, pointing, sorting, drawing or showing. Have a globe or ball, some buttons and paper ready. Give full points for a clear answer in your child's own words. The review is worth 20 points.

1. (3 pts) Point to where polar bears live on the globe. What do they eat, and how do they catch it?
2. (3 pts) Tell me three things God gave the polar bear to live on the ice.
3. (3 pts) Is a penguin a bird? Can it fly? Point to where most penguins live on the globe.
4. (3 pts) How does an emperor penguin father keep his egg warm all winter? Why do the penguins huddle?
5. (3 pts) Are caribou and reindeer the same kind of animal? Which caribou grow antlers? How do wide hooves help?
6. (2 pts) Here are 4 buttons for bulls and 5 buttons for calves. How many caribou in all? Which group has more?
7. (3 pts) Tell me about your blubber glove test. Which hand stayed in the ice water longest? Why does blubber keep a seal warm?

UNIT PROJECT: MY ARCTIC AND ANTARCTIC BOOK

Make a book with two halves. On the top half, called "Top of the World," draw the polar bear and the caribou with their homes and foods, and glue in your polar bear paw tracing (or a photo of your cardboard paw) and a few bits of lichen yarn. On the bottom half, called "Bottom of the World," draw the emperor penguin father with his egg and glue in your paper penguin. On the last page, put your blubber glove chart and have a parent write one sentence you say about how blubber keeps animals warm. Then give your family a "polar tour," pointing to the top and bottom of a globe as you turn the pages.

- **Animals:** The polar bear, caribou and penguin are drawn in the right half of the book with real details such as big paws, antlers on a mother caribou, flippers and an egg on the penguin father's feet.
- **Records:** The paw tracing, the paper penguin, the lichen bits and the blubber glove chart with three numbers are all in the book.
- **Telling:** On the polar tour the child tells in their own words how each animal stays warm and finds food, and that polar bears and penguins live at opposite ends of the world.
- **Care:** The pages are neat and colorful, and the book is put together so it can be read again.

Answer key

1. The child points to the top, the Arctic around the North Pole. Polar bears eat seals. The bear waits very still beside a seal's breathing hole in the ice and grabs the seal when it comes up.

2. Any three: thick fur that looks white, black skin, a thick layer of blubber, huge wide paws like snowshoes, bumps and fur on the bottom of its paws to keep from slipping, strong swimming.
3. Yes, it is a bird with feathers and a beak, and it lays eggs. It cannot fly in the air, but it swims fast with its flippers. The child points to the bottom, Antarctica and the southern half of the world.
4. He holds the egg on his feet under a warm fold of skin on his belly and does not eat until the mother comes back. They huddle close together to stay warm, and they take turns on the windy outside.
5. Yes, they are the same kind. Both fathers and mothers grow antlers. Wide hooves keep the caribou from sinking deep in the snow and help it dig through the snow to find lichen.
6. 9 caribou in all. There are more calves.
7. The child tells the test: a bare hand, a plain bag glove and a blubber glove dipped in the same ice water, counting the seconds. The blubber glove usually lasts longest. Blubber is a thick layer of fat that keeps the body's heat in, even in icy water.

TREES AND FLOWERS

Trees and flowers do not run, swim or fly, but they are full of life all the same. They are homes and food for squirrels, birds, bees and bats. In this unit you will look closely at the plants God made, just as Jesus told us to: “Consider the lilies of the field, how they grow” (Matthew 6:28).

You will find out why green leaves turn red and gold in the fall, take apart a flower to see how it makes seeds, count the rings in a slice of wood like Andrew Ellicott Douglass, and make crayon rubbings of tree bark. Along the way you will press leaves, measure tree trunks with your hands and string, and begin a book about the trees near your home.

BEFORE YOU BEGIN

- Can count objects to 20
- Can sort things into groups by color or shape
- Can hold a crayon on its side and rub
- Can name a few animals that live in trees (from Unit 1)

MASTERY CHECKLIST

- I can tell why green leaves turn yellow, orange and red in the fall.
- I can name a tree that drops its leaves and a tree that stays green all winter.
- I can point to the petals, stamens, pistil, stem and leaves of a flower and tell that a flower makes seeds.
- I can retell what Jesus taught about the lilies of the field.
- I can count the rings on a tree cookie and tell what a wide ring and a thin ring mean.
- I can make a bark rubbing and tell how bark protects a tree.

OPTIONAL BOOKS AND RESOURCES

- **Arbor Day Foundation tree guides** (<https://www.arborday.org/>): Free. Look for the “What Tree Is That?” guide, which helps a parent and child name a tree step by step from its leaves. Good for choosing your family tree for the portfolio.
- **USDA Forest Service** (<https://www.fs.usda.gov/>): Free. The Forest Service shares fall color reports, tree facts and pages for kids. A parent can browse for pictures of leaves, bark and tree rings.

6.1 LEAVES OF FALL ★

OBJECTIVES

- Tell in simple words why green leaves turn yellow, orange and red in the fall.
- Sort fall leaves by color and count them on a picture chart.
- Name trees that drop their leaves and trees that stay green all winter.

Warm-up. Hold a green leaf in one hand and a dry fall leaf in the other (or look at two pictures). Bend each one gently. Which one bends, and which one crackles? Smell them both. Tell your parent three ways the two leaves are different.

Video. Coming soon. Why leaves change color in the fall, for young children: search SciShow Kids, Homeschool Pop (Alternate), the USDA Forest Service, Science Max, and nature footage of maple forests in autumn.

KEY TERMS

chlorophyll

The green coloring inside a leaf. It helps the leaf make food for the tree from sunlight.

deciduous tree

A tree that drops all its leaves in the fall and grows new ones in the spring, like a maple or an oak.

evergreen

A tree that stays green all winter long, like a pine, a spruce or a fir.

bud

A tiny packed-up beginning of a new leaf or flower. It waits on the twig all winter for spring.

CORE IDEAS

The story. Go outside on a cool fall day and pick up a leaf from under a maple tree. It may be red as an apple or yellow as butter. In the summer, that very same leaf was green. In New England, whole hillsides of maples turn orange and red every October, and families drive for miles just to look. Where did all that color come from?

How they figured it out. Scientists looked very closely at leaves. They found that a green leaf is like a little kitchen. It uses sunlight, air and water to make sugar, which is food for the tree. The green coloring that does this work is called **chlorophyll**. But a leaf has yellow and orange colors in it all summer long, too! The green is so strong that it hides them. When fall comes, the days get shorter and the nights get cooler. The tree stops making new green. The old green fades away, and the yellow and orange that were hiding all along can finally be seen. Some trees, like red maples, also make brand-new red colors in the fall. Sunny days and cool nights make the reds brightest.

The big idea. Trees that drop all their leaves in the fall are called **deciduous trees**.

Maples, oaks and birches are deciduous. Before a leaf falls, the tree grows a thin, corky wall where the leaf stem meets the twig. The leaf is cut off from its water, and the wind blows it down. But look closely at the twig! A tiny **bud** is already waiting there for spring. Other trees, like pines, spruces and firs, are **evergreen**. Their narrow needles have a waxy coat, and they stay green all winter.

God's handiwork. Fallen leaves are not wasted. They make a warm blanket on the ground. Worms and bugs eat them and slowly turn them into rich, dark soil. Squirrels stuff dry leaves into their round nests high in the trees to stay warm in winter. God made the seasons to come around again and again, and in every season the trees do just what He made them to do.

PICTURE STUDY



Autumn - On the Hudson River, Jasper Francis Cropsey, 1860 · Oil on canvas · National Gallery of Art, Washington, D.C.

Jasper Cropsey was an American painter who loved the fall colors of New York, where he grew up. He painted this big picture while he was living in London, England, from his memories and sketches of the Hudson River valley. English trees do not turn such bright colors, and the story is told that some people there could hardly believe the painting was true until they saw real American fall leaves.

Look closely

- Find the brightest red tree. Then find a yellow tree and an orange tree.
- Can you find any trees that are still green? Do you think they are evergreens?
- Look far away to the hills. What color are they? Why do far-off things look bluer and paler?

- Look closely for any people or animals. They are small, so you will need sharp eyes.

Talk about it

1. What time of year did Cropsey paint? How can you tell?
2. If you could walk into this painting, what would you hear and smell?
3. Which color in the painting do you like best, and where do you see it outside your own window?

Safety first. Stay with a grown-up on your leaf walk. Do not touch any plant with leaves in groups of three, which may be poison ivy. Do not eat any berries, seeds or mushrooms you find. Wash your hands when you come inside.

MAKE AND DO: FALL LEAF HUNT AND COLOR CHART

You will go on a leaf hunt, sort your leaves by color like a real scientist, and make a picture chart that shows what you found. Then you will press your best leaves to keep.

You will need

- A paper bag or basket
- A large sheet of paper and crayons
- Paper towels or old newspaper
- Two or three heavy books

Steps

1. Walk outside with a grown-up and gather fallen leaves. Try to find as many different colors as you can. Pick leaves from the ground, not from the tree.
2. At home, lay all your leaves on the table. Sort them into piles: red, yellow, orange, brown and green.
3. Count the leaves in each pile.
4. On your big paper, write each color down the left side. Next to each color, draw one small leaf for every leaf in that pile. This is your picture chart.
5. Look at your chart. Which color has the longest row? Which has the shortest?
6. Pick your three favorite leaves. Lay them flat between paper towels, put them inside a heavy book, and stack more books on top.
7. Wait about one week, then open the book. Your pressed leaves are ready to glue into your nature notebook.

Tips

- Dry, crunchy leaves break easily. Fresh fallen leaves press best.
- If you find a leaf that is half green and half yellow, you have caught the green fading away!

Check your work

- I sorted my leaves by color.
- I made a picture chart and told which color I found the most of.
- I pressed leaves to keep.

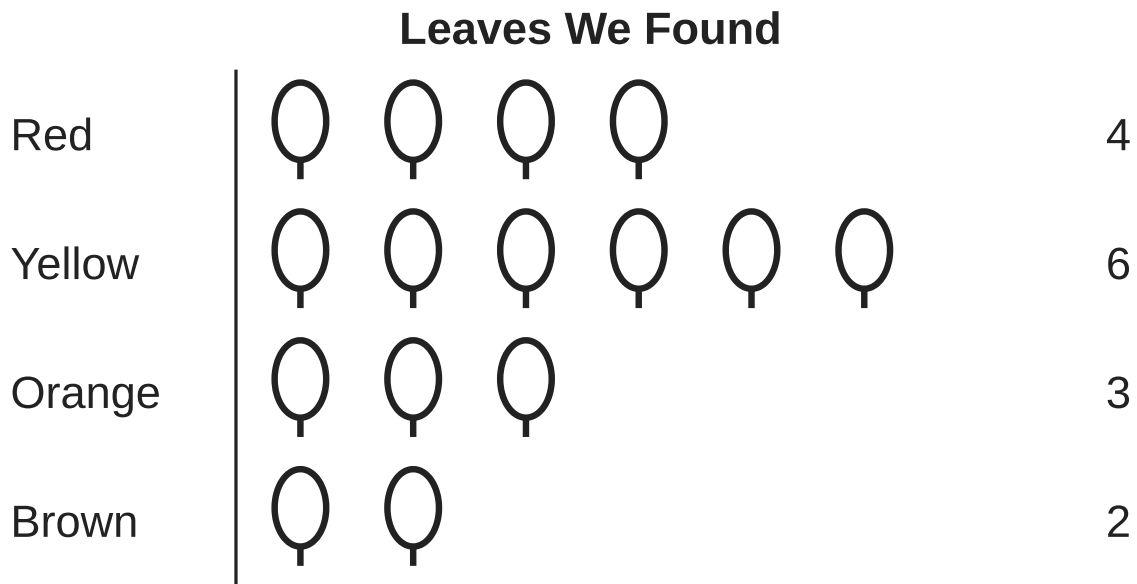
NATURE NOTEBOOK

1. Draw one fall leaf from your hunt. Color it exactly as it looks, even the spots and edges. Write the date beside it.
2. Find a bare twig after the leaves have fallen. Draw the twig and circle the buds waiting for spring.
3. Draw two trees side by side: one deciduous tree with bare branches and one evergreen tree with needles. Label them.

From history. Henry David Thoreau lived in Concord, Massachusetts, and loved to walk in the woods every day. He gathered fall leaves, pressed them, and wrote down which trees turned red first and which turned last. His essay about fall colors, called “Autumnal Tints,” was printed in *The Atlantic Monthly* in October 1862. In it he told his neighbors to stop and really look at the scarlet oaks and red maples all around them.

WORKED EXAMPLES

Example 1. A family went on a leaf hunt and made the picture chart below. Each drawn leaf stands for one real leaf. Which color did they find the most of? Which color did they find the fewest of? How many leaves did they find in all?



Each leaf drawing stands for one leaf. Count each row.

1. Count the leaves in each row. Red: 4. Yellow: 6. Orange: 3. Brown: 2.
2. The longest row is yellow, with 6. They found the most yellow leaves.
3. The shortest row is brown, with 2. They found the fewest brown leaves.
4. Add them all up: $4 + 6 = 10$. Then $10 + 3 = 13$. Then $13 + 2 = 15$.

Answer: Most: yellow (6). Fewest: brown (2). In all: 15 leaves.

PRACTICE

1. **EASY** Point to something green in your room. What is the green coloring in a leaf called, and what does it help the leaf do?
2. **EASY** Sort these trees into two groups, “drops its leaves” and “stays green all winter”: maple, pine, oak, spruce.
3. **MEDIUM** You find 7 red leaves and 5 yellow leaves. How many leaves is that in all? Which color do you have more of?
4. **MEDIUM** Go outside and find a twig on a deciduous tree. Point to a bud. What is waiting inside it?
5. **HARD** Tell in your own words where the yellow in a fall leaf comes from.

COMMON MISTAKES

- Thinking frost paints the leaves. Shorter days and cooler nights tell the tree to stop making green; the yellow and orange were there all summer.
- Thinking all trees lose their leaves in the fall. Evergreens like pines and spruces stay green all winter.
- Thinking a tree with bare branches is dead. It is resting for the winter, and its buds are ready to open in spring.

Make it a game · Falling Leaf or Evergreen?. A parent calls out the name of a tree. If it drops its leaves in fall (maple, oak, birch, apple), spin slowly to the floor like a falling leaf. If it stays green all winter (pine, spruce, fir, holly), stand tall and still with your arms out like an evergreen. Then switch, and you call out trees for your parent.

Scripture. “To every thing there is a season, and a time to every purpose under the heaven:” (Ecclesiastes 3:1, KJV)

God made the seasons. In spring the buds open, in summer the leaves make food, in fall they turn bright and drop, and in winter the tree rests. Each season has its own good work.

Practice answers

1. Chlorophyll. It helps the leaf make food (sugar) for the tree from sunlight.
2. Drops its leaves: maple and oak. Stays green all winter: pine and spruce.
3. 12 leaves in all. You have more red leaves (2 more).
4. A new leaf (or flower) packed up tight, waiting to open in the spring.
5. The yellow was in the leaf all summer, but the strong green hid it. In the fall the tree stops making green, the green fades, and the yellow can be seen.

6.2 LILIES OF THE FIELD (MATTHEW 6:28)

OBJECTIVES

- Retell what Jesus taught about the lilies of the field and why we do not need to worry.
- Name and point to the main parts of a flower: petals, stamens with pollen, pistil, stem and leaves.
- Tell that a flower's job is to make seeds.

Warm-up. Look at any flower, a real one or a picture. Count its petals out loud. Smell it. Then gently touch the very middle with one fingertip. Does any yellow or orange dust come off? Keep that question in mind. You will find out what the dust is today!

Video. Coming soon. Parts of a flower and how bees carry pollen, for young children: search SciShow Kids, Homeschool Pop (Alternate), Moody Science classics, and close-up nature footage of wildflowers and bees in spring.

KEY TERMS

petal

One of the bright, soft parts of a flower. Petals help bees and butterflies find the flower.

pollen

A fine dust, often yellow, made inside a flower. It helps the flower make seeds.

pistil

The part in the very middle of a flower. Seeds begin to grow down inside it.

seed

A tiny package with a baby plant inside and food for it to start growing.

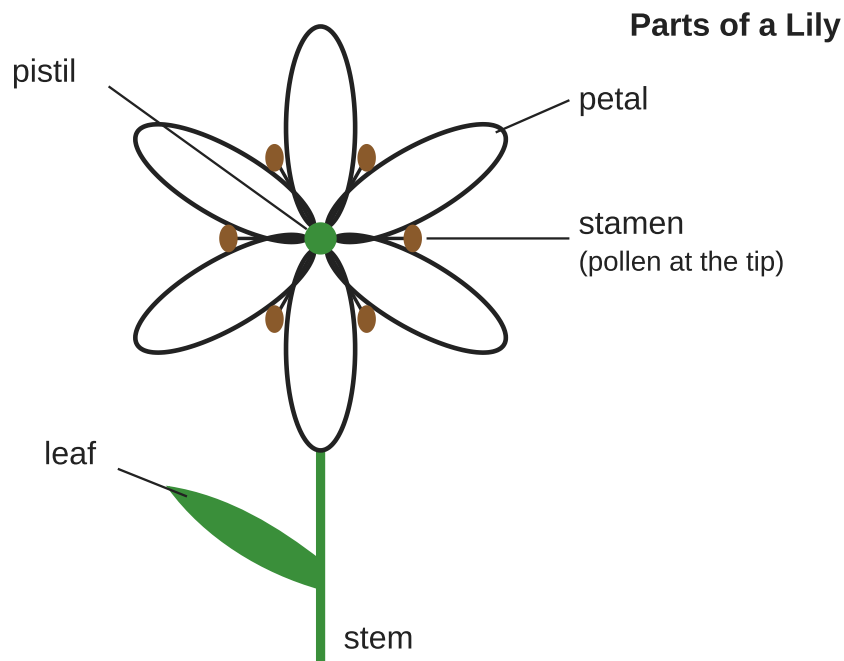
CORE IDEAS

The story. One day Jesus sat on a hillside in Galilee and taught a great crowd of people. We call His words the Sermon on the Mount. Many people were worried about having enough food and clothes. So Jesus pointed to the wildflowers growing all around them. “Consider the lilies of the field, how they grow; they toil not, neither do they spin.” Flowers do not work at a job, and they do not spin thread to make clothes. Yet Jesus said that even King Solomon, the richest king of Israel, was never dressed as beautifully as one of them. If God dresses the flowers, He will surely take care of His children.

How they figured it out. “Consider” means look closely and think hard. That is just what a scientist does! Nobody knows for sure which flower Jesus pointed to. Many people who have walked the hills of Galilee in spring think of the bright red anemones and other wildflowers that cover the fields there. Botanists, the scientists who study plants, have looked closely at flowers of every kind. They found that most flowers are built from the same few parts.

The big idea. Look at a lily. On the outside are six bright **petals**. They help bees and butterflies find the flower. Inside are six thin stalks called stamens. At their tips is a fine dust called **pollen**. In the very middle stands one longer part, the **pistil**. When a bee carries pollen to the pistil, **seeds** can begin to grow down inside it. So a flower is not only for looks. Its job is to make seeds, and seeds grow into new plants. Below the flower is the stem, which carries water up. The leaves make food from sunlight, and the roots drink water from the soil.

God's handiwork. A flower does not worry or hurry. It grows each day just as God made it to grow. Bees and hummingbirds visit it to drink sweet nectar, and birds and mice eat its seeds. When you see a flower in a field or a garden, remember what Jesus said: your Father in heaven knows what you need.



The parts of a lily. Count the petals and the stamens.

PICTURE STUDY



White Lily (Lilium candidum), from *Les Liliacées*, Pierre-Joseph Redouté, published 1802–1816 · Stipple engraving printed in color and finished by hand · Published in Paris; copies are kept in many libraries and museums

Pierre-Joseph Redouté was a flower painter born in the Ardennes, in what is now Belgium, who did his great work in Paris. Empress Josephine of France grew rare plants at her home, Malmaison, and Redouté painted many of them. His pictures were so true and so lovely that people called him “the Raphael of flowers.”

Les Liliacées is a set of books filled with his paintings of lilies and their plant cousins. A botanist could use these pictures to learn the plants, because every petal, stamen and leaf is drawn just as it really is.

Look closely

- Count the petals on one open flower.
- Find the stamens. What color are the tips where the pollen is?
- Find a flower that has not opened yet. What does a lily bud look like?
- Look at the leaves. Are they wide or narrow? Where do they join the stem?

Talk about it

1. Why do you think Redouté painted the flower on a plain background with nothing else around it?
2. Jesus said Solomon in all his glory was not dressed like one of these. What makes this lily look like it is dressed in fine clothes?
3. If you painted one flower as carefully as Redouté, which flower would you choose?

Safety first. Lilies are very dangerous to cats. Even a little pollen or a nibble of a leaf can make a cat very sick, so keep lilies where pets cannot reach them and throw the flower parts away in a closed trash can. Lily pollen stains clothes, so wear an old shirt. Never eat any part of a flower, and wash your hands when you are done.

MAKE AND DO: TAKE APART A FLOWER

Real botanists learn a flower by gently taking it apart and laying out every piece. You will do the same and make a flower-parts page for your nature notebook.

You will need

- One fresh flower: a lily from the grocery store is best, or a tulip or any large garden flower
- A sheet of plain paper
- Clear tape
- A magnifying glass, if you have one
- Crayons or colored pencils

Steps

1. Look at the whole flower first. Find the stem, the leaves and the flower on top.
2. Gently pull off the petals one at a time. Tape them in a row across the top of your paper and count them.
3. Find the stamens with pollen on their tips. Look at the pollen with your magnifying glass. Carefully take off the stamens, tape them in a row and count them.
4. Find the pistil standing in the middle. Tape it on the paper by itself.
5. Tape a leaf and a short piece of stem at the bottom of the page.
6. With your parent's help, write a label next to each row: petals, stamens, pistil, leaf, stem.
7. Tell your parent the job of each part.

Tips

- Hold the flower over the paper while you work so the pollen falls on the paper, not on your clothes.
- If the pistil is thick at the bottom, ask a grown-up to slice it across. You may see tiny white beginnings of seeds inside.

Check your work

- I took apart a flower and laid out its parts.
- I counted the petals and the stamens.
- I can tell that a flower's job is to make seeds.

NATURE NOTEBOOK

1. Draw one whole flower from life. Look at it often while you draw. Label the petals, stem and leaves.
2. Copy the words “Consider the lilies of the field, how they grow” and draw a field of wildflowers around them.
3. Watch a flower outside for five minutes. Draw any bee, butterfly or other visitor you see.

From history. In the 1700s a Swedish botanist named Carl Linnaeus wanted to give every plant a name and sort plants into groups. He did it by counting! He counted the stamens and pistils inside each flower. Lilies, with six stamens, went into his group of plants with six stamens. Linnaeus sent his students all over the world to find new plants, and the two-part names he gave them, like *Lilium candidum* for the white lily, are still used today.

WORKED EXAMPLES

Example 1. Look at the lily drawing. How many petals does it have? How many stamens? How many pistils? How many of these parts are there in all?

(Use the map or drawing “Count the petals, the stamens and the pistil.” shown earlier in this lesson.)

1. Count the petals, the big rounded parts around the outside: 1, 2, 3, 4, 5, 6. There are 6 petals.
2. Count the stamens, the thin stalks with pollen dots at the tips: 1, 2, 3, 4, 5, 6. There are 6 stamens.
3. Find the pistil in the very middle. There is only 1.
4. Add them: $6 + 6 = 12$. Then $12 + 1 = 13$.

Answer: 6 petals, 6 stamens and 1 pistil: 13 parts in all. The lily has the same number of petals and stamens.

PRACTICE

1. **EASY** On a real flower or on the lily drawing, point to the petals, the stem and a leaf.
2. **EASY** Jesus said the lilies “toil not, neither do they spin.” What two things do the lilies not do?
3. **MEDIUM** A tulip has 6 petals. How many petals are on 2 tulips?
4. **MEDIUM** Match each part to its job. Parts: petal, root, leaf, pollen. Jobs: drinks water from the soil; makes food from sunlight; helps the flower make seeds; helps bees find the flower.
5. **HARD** Why did Jesus tell the people to look at the flowers? Tell it in your own words.

COMMON MISTAKES

- Thinking flowers are only for looking pretty. A flower's job is to make seeds, so new plants can grow.
- Thinking plants eat dirt. Roots drink water from the soil, but the leaves make the plant's food from sunlight, air and water.
- Thinking the "lilies of the field" must be white Easter lilies. Nobody knows for sure which flower Jesus meant; many think He meant the bright wildflowers of the Galilee hills.

Make it a game • Busy Bee. Draw four big flowers on paper plates and set them around the room. Put a pinch of cocoa powder or a small pom-pom "pollen" on the first flower. You are the bee! Buzz to the first flower, pick up the pollen, and carry it to the middle of the next flower. Your parent calls out a flower part each time you land (petal, stem, pistil, pollen), and you point to it on the plate before you buzz on.

Scripture. "And why take ye thought for raiment? Consider the lilies of the field, how they grow; they toil not, neither do they spin: And yet I say unto you, That even Solomon in all his glory was not arrayed like one of these." (Matthew 6:28-29, KJV)

"Raiment" means clothes, and "arrayed" means dressed. God takes care of the flowers, and He takes even better care of His children.

Practice answers

1. The petals are the bright parts around the outside of the flower; the stem is the long stalk holding the flower up; the leaf is the flat green part on the stem.
2. They do not work (toil), and they do not spin thread to make clothes. God dresses them anyway.
3. 12 petals ($6 + 6 = 12$).
4. Petal: helps bees find the flower. Root: drinks water from the soil. Leaf: makes food from sunlight. Pollen: helps the flower make seeds.
5. The people were worried about food and clothes. Jesus showed them that God makes even the wildflowers beautiful, so they could trust Him to take care of them too.

6.3 TREE RINGS

OBJECTIVES

- Tell that a tree grows one new ring of wood each year, just under its bark.
- Count the rings on a tree slice or a drawing and find a wide ring and a thin ring.
- Tell that a wide ring means a good growing year and a thin ring means a hard, dry year.

Warm-up. Find a stump in a park, a log in a woodpile, or the cut end of a wooden board. Run your finger across the cut end. Do you see curved lines or circles? Are they all the same distance apart? Tell your parent what you notice.

Video. Coming soon. How to read tree rings, for young children: search SciShow Kids, Homeschool Pop (Alternate), the USDA Forest Service, Science Max, and close-up footage of tree stumps and log slices.

KEY TERMS

trunk

The thick main stem of a tree. It holds the tree up and carries water from the roots to the leaves.

tree ring

The circle of wood a tree grows in one year. It looks like a light band with a dark line at its outside edge.

tree cookie

A thin, round slice cut straight across a log or branch, so you can see its rings.

CORE IDEAS

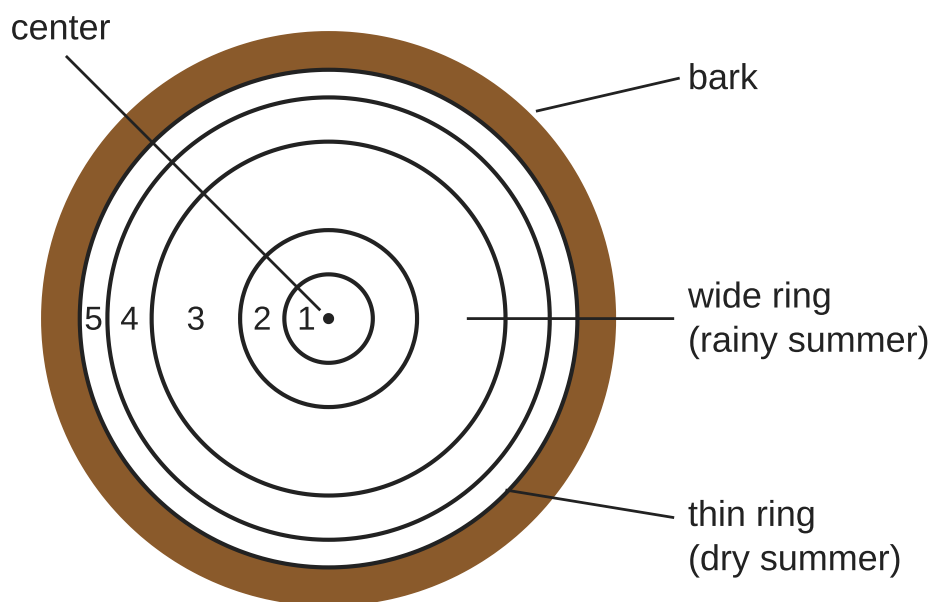
The story. Andrew Ellicott Douglass was an astronomer, a scientist who studies the stars. In the early 1900s he lived near Flagstaff, Arizona, where tall ponderosa pines grow. Douglass liked to look down as well as up! When loggers cut the pines, he looked closely at the stumps. The circles of wood were not all the same. Some were wide, and some were thin.

How they figured it out. Each year a tree grows one new layer of wood, all the way around, just under its bark. In spring it grows fast, and the new wood is light in color. In late summer it grows slowly, and the wood is darker. One light band and the dark line at its edge make one **tree ring**. Douglass noticed that in rainy years the pines grew wide rings, and in dry years they grew thin rings. Trees all around Flagstaff had the same wide and thin rings in the same order. The trees were keeping a diary of the weather! Douglass spent many years learning to read it.

The big idea. A tree grows taller only at the tips of its branches. It grows fatter by adding a new ring around its **trunk**, just under the bark. So the ring in the very middle is the oldest

wood, and the ring next to the bark is the newest. When you count the rings on a **tree cookie**, you are counting the summers that tree grew. A wide ring means a good year with plenty of rain and sun. A thin ring means a hard year, maybe very dry. A dark scar can show where a fire once burned or a branch broke off.

Try it and see. Look for a stump in a park or a log in a woodpile. Use a magnifying glass. Start at the center and count out to the bark. Can you find a wide ring and a thin one? God made each tree to write its own story in wood, one ring at a time, and He lets us read it.



A tree cookie. Ring 1 is in the middle and ring 5 is next to the bark.

PICTURE STUDY



Grizzly Giant, Mariposa Grove, Carleton E. Watkins, 1861 · Albumen silver print from a large glass-plate negative (photograph) · Prints are kept in several American museums and libraries

Carleton Watkins was a photographer in California. He carried a huge wooden camera and big, heavy glass plates by mule into the mountains of Yosemite. There he photographed the Grizzly Giant, one of the giant sequoia trees of the Mariposa Grove.

Watkins's pictures helped people far away in the East see how wonderful Yosemite was. In 1864, President Abraham Lincoln signed a law to protect Yosemite Valley and the Mariposa Grove of big trees for people to enjoy.

Look closely

- Look at the bottom of the trunk. How wide is it compared with the trees around it?
- Look at the bark. Is it smooth, or full of long, deep grooves?
- Look up to the branches. Are they near the ground or high up?
- Find a broken or bent place. What might have happened to the tree there?

Talk about it

1. If you could stand next to this tree, how many people holding hands do you think it would take to reach around it?
2. If this tree were cut, do you think its rings would be easy to count? Why or why not?
3. Why do you think people wanted to protect these big trees?

Safety first. Only a grown-up should cut a log or branch with a saw. Watch out for splinters when you handle wood. Look before you reach into a woodpile, because spiders and other creatures like to hide there.

MAKE AND DO: READ A TREE COOKIE

You will read the rings on a real slice of wood, then make your own paper tree cookie that tells a tree's story.

You will need

- A tree cookie: a wood slice from a craft store, or the end of a log or a thick branch cut by a grown-up
- A magnifying glass
- A paper plate
- Crayons, including brown

Steps

1. Look at your tree cookie with the magnifying glass. Find the center, the rings and the bark around the edge.
2. Put your finger on the center. Move it out toward the bark, and count each dark line you cross. That is how many rings your tree cookie has.
3. Find the widest ring. That was a good growing year with lots of rain.
4. Find the thinnest ring. That was a hard year, maybe dry.
5. Now make a paper tree cookie. Draw a small dot in the middle of the paper plate. Draw rings around it, one at a time, out toward the edge.
6. Make one ring very wide for a rainy summer and one ring very thin for a dry summer.
7. Color a thick brown edge all the way around for the bark. Tell your parent the story of your tree, ring by ring.

Tips

- Wet the tree cookie with a damp cloth. The rings often show up better when the wood is a little wet.
- Count the dark lines only. A light band and its dark line together make one ring.

Check your work

- I found the center, the rings and the bark on a real tree cookie.
- I counted the rings and found a wide one and a thin one.
- I made a paper tree cookie and told its story.

NATURE NOTEBOOK

1. Lay paper over your tree cookie and trace around its edge. Then draw its rings inside, as carefully as you can.
2. Draw a stump you find on a walk. Draw the rings you can see and circle the widest one.
3. Draw a tall tree. Put a star at each tip where the tree grows taller, and draw an arrow on the trunk where it grows fatter.

From history. Andrew Ellicott Douglass later started a laboratory at the University of Arizona just for studying tree rings, and it is still at work today. He and his helpers matched the rings in old wooden beams to the rings in living trees. In 1929, a charred beam found at Show Low, Arizona, helped them learn when the old stone houses of the Pueblo people in the Southwest were built.

WORKED EXAMPLES

Example 1. Look at the tree cookie drawing. How many rings does it have? Which ring is the widest? Which ring is the newest?

(Use the map or drawing “Count from the center out to the bark.” shown earlier in this lesson.)

1. Start at the center. Count each ring out to the bark: 1, 2, 3, 4, 5. There are 5 rings.
2. Look at how wide each ring is. Ring 3 is much wider than the others. It is the widest ring, so that was a rainy summer.
3. Ring 5 is the thinnest, so that was a dry summer.
4. The newest wood grows just under the bark. Ring 5 is next to the bark, so it is the newest.

Answer: 5 rings. Ring 3 is the widest (a rainy summer). Ring 5, next to the bark, is the newest.

PRACTICE

1. **EASY** On the tree cookie drawing, point to the center and point to the bark. Which ring is the newest wood?
2. **EASY** Finish the sentences: A wide ring means a ____ year. A thin ring means a ____ year.
3. **MEDIUM** You count 4 rings on one branch slice and 9 rings on another. Which slice has more rings? How many more?
4. **MEDIUM** Draw a tree cookie with 3 rings. Make ring 2, the one between the center ring and the outside ring, the widest.
5. **HARD** Why is the newest wood next to the bark and not in the middle of the trunk?

COMMON MISTAKES

- Thinking a tree grows taller from the bottom. It grows taller only at the tips of its branches, so a mark on the trunk stays at the same height year after year.
- Counting the light band and the dark line as two rings. One light band and one dark line together make one ring.
- Thinking the biggest tree is always the oldest. A tree in a sunny, rainy place can grow fat quickly, while a tree in a dry, rocky place may grow very slowly.

Make it a game • Tree Ring Hop. With sidewalk chalk (or a rope indoors), draw a big tree cookie on the ground: a small circle in the middle and rings around it, some wide and some thin, with a bark edge outside. Start in the center. Each time your parent calls “Spring!” hop out to the next ring. When your parent calls “Rainy summer!” or “Dry summer!” hop to a wide ring or a thin ring that matches. Reach the bark and shout, “I’m the newest wood!”

Scripture. “And he shall be like a tree planted by the rivers of water, that bringeth forth his fruit in his season; his leaf also shall not wither; and whatsoever he doeth shall prosper.” (Psalm 1:3, KJV)

A tree by the water grows wide, strong rings even in a dry year. The Bible says a person who loves God’s Word is like that tree.

Practice answers

1. The center is the middle of the circle; the bark is the thick edge around the outside. The ring next to the bark (ring 5) is the newest.
2. A wide ring means a good (rainy) year. A thin ring means a hard (dry) year.
3. The slice with 9 rings has more, 5 more ($9 - 4 = 5$).
4. The drawing should show a center, 3 rings with the second ring clearly the widest, and bark around the outside.
5. A tree grows fatter by adding a new layer of wood each year just under its bark, all the way around. So each new ring goes on the outside, and the oldest wood stays in the middle.

6.4 BARK RUBBING

OBJECTIVES

- Tell how bark protects a tree, the way skin protects your body.
- Make bark rubbings and compare the bark of two or more kinds of trees.
- Measure around a tree trunk with hands or string and tell which tree is bigger around.

Warm-up. Lay a sheet of thin paper over a coin. Hold the paper still and rub the side of a crayon back and forth over it. Watch the coin's picture appear! Now try it on something else with bumps, like the bottom of a shoe or a basket. Today you will do this on a tree.

Video. Coming soon. Tree bark and how to make a bark rubbing, for young children: search SciShow Kids, Homeschool Pop (Alternate), the USDA Forest Service, Smithsonian, and nature footage of birch, oak and sycamore trunks.

KEY TERMS

bark

The tough outside covering of a tree trunk and branches. It keeps the tree safe, like your skin keeps you safe.

inner bark

The soft, living layer just under the rough outer bark. It carries food from the leaves down to the roots.

texture

How something feels when you touch it: rough, smooth, bumpy, ridged or peeling.

rubbing

A picture made by laying paper on a bumpy surface and rubbing the side of a crayon over it.

CORE IDEAS

The story. Long ago, the Ojibwe people and their neighbors in the north woods built canoes from the bark of the paper birch tree. Birch bark is white, smooth, light and does not soak up water. The builders took off big sheets of it, sewed them together with thin spruce roots, and sealed the seams with sticky tree pitch. These light canoes carried families and their goods across lakes and rivers. A grown man could carry one on his shoulders from one lake to the next.

How they figured it out. Canoe builders had to know their trees very well. They learned that each kind of tree has bark of its own kind. You can learn this too, with your eyes and your fingers. A paper birch has white, papery bark that curls. A shagbark hickory has long strips that hang loose like a shaggy coat. An oak has deep ridges and cracks. A beech is

smooth and gray, like an elephant's leg. A sycamore has patches of tan, green and white, like a puzzle.

The big idea. Bark is a tree's skin. The rough outer bark is dead, like the ends of your hair and fingernails. It keeps out bugs, sickness and cold. Thick bark can even protect some trees from fire. Just under it is the soft **inner bark**, which is alive. It carries sugar food down from the leaves to the trunk and roots. That is why we must never peel bark off all the way around a living tree. The tree could starve and die. As a tree grows fatter, its outer bark stretches and cracks. That is what makes the ridges and patterns you see.

In the world today. Bottle corks come from the bark of the cork oak, which grows in Portugal and Spain. Workers carefully strip off the thick outer bark only every several years, and the tree grows new bark again. Bark is a home, too. Nuthatches, brown creepers and woodpeckers hunt insects in its cracks, and some bats sleep under loose bark. When you lay paper on a trunk and rub it with a crayon, you are making a picture of a tree's skin, just the way God made it.

PICTURE STUDY



Study of the Trunk of an Elm Tree, John Constable, about 1821 · Oil on paper · Victoria and Albert Museum, London

John Constable was an English painter who grew up in the farm country of Suffolk. He loved trees and drew and painted them all his life. He often painted outdoors, right in front of what he was looking at, so he could get it true.

In this small study he did not paint a whole tree or a big view. He painted just one trunk, up close, as if he were standing right next to it. It is almost like a bark rubbing in paint!

Look closely

- Find the cracks and ridges in the bark. Do they run up and down, or side to side?
- Find the side of the trunk where the sun is shining. Find the shady side.
- Look at the colors in the bark. Is it only brown, or can you find gray, green and other colors too?
- Look at the bottom of the picture. What is growing around the foot of the tree?

Talk about it

1. Why do you think Constable painted only the trunk and not the whole tree?
2. If you could touch the bark in this painting, how do you think it would feel?
3. Which tree near your home would you choose to paint up close like this?

Safety first. Stay with a grown-up outdoors. Do not touch any plant or hairy vine on a tree trunk with leaves in groups of three, which may be poison ivy. Never peel bark off a living tree. Watch for stinging insects, and check for ticks after walking in the woods.

MAKE AND DO: MY BARK RUBBING BOOK

You will make bark rubbings of three different trees, measure around each trunk, and put them together in a little book. Then you can play a matching game with your rubbings.

You will need

- Thin paper, such as printer paper (3 or more sheets)
- Crayons with the paper wrappers peeled off
- Masking tape
- A piece of string or yarn and scissors
- A clipboard or a piece of cardboard, if you have one

Steps

1. Walk outside with a grown-up and choose three trees with different bark.
2. Feel each trunk with your hands. Tell your parent if it is rough, smooth, bumpy, ridged or peeling.
3. Tape a sheet of paper to the first trunk at about the height of your chest.
4. Hold a crayon on its side and rub it up and down over the paper. Watch the bark pattern appear!
5. Wrap the string around the trunk at the same height. Have your parent cut it where the ends meet. Tape the string to the back of the rubbing.
6. Write the tree's name on the rubbing if you know it. If you can, tape a fallen leaf from that tree next to it.
7. Do the same for the other two trees. Lay the three strings side by side. Which tree is biggest around?
8. Staple or tie your rubbings together to make a bark book.

Tips

- Press firmly and use the long side of the crayon, not the tip.
- Smooth bark makes a light, soft rubbing. Rough bark makes bold lines. Both are good!

Check your work

- I made rubbings of three different trees.
- I told how each bark feels.
- I measured around each trunk with string and found the biggest tree.

NATURE NOTEBOOK

1. Draw a close-up of one tree's bark, just like Constable did. Draw every crack and ridge you can see.
2. Look closely at a tree trunk for living things: moss, lichen, ants, spiders or birds. Draw what you find.
3. Draw two trees side by side, one with smooth bark and one with rough bark. Write "smooth" and "rough" under them.

From history. Edwin Tappan Adney was an artist and writer who spent much of his life learning how bark canoes were made. He visited native canoe builders, measured their canoes, and built many small, exact model canoes so the old ways would not be forgotten. After he died, Howard Chapelle finished his notes, and the Smithsonian published them in 1964 as a book, *The Bark Canoes and Skin Boats of North America*. Adney's model canoes are kept at the Mariners' Museum in Newport News, Virginia.

WORKED EXAMPLES

Example 1. Mia measured around two tree trunks with her hands, putting one hand-width after another. The oak was 9 hands around. The birch was 5 hands around. Which tree is bigger around? How many hands bigger?

1. Compare the numbers: 9 is more than 5.
2. So the oak is bigger around than the birch.
3. To find how many hands bigger, count up from 5 to 9: 6, 7, 8, 9. That is 4 more.
4. Check: $9 - 4 = 5$. Yes!

Answer: The oak is bigger around, by 4 hands.

PRACTICE

1. **EASY** Close your eyes and feel the bark of a tree (or feel your bark rubbings). Is it rough, smooth, bumpy, ridged or peeling?
2. **EASY** Match each tree to its bark. Trees: paper birch, shagbark hickory, beech, oak.
Bark: smooth and gray; white and papery; long, loose strips; deep ridges and cracks.

3. **MEDIUM** You made 3 bark rubbings and your brother made 4. How many rubbings did you make in all?
4. **MEDIUM** Which part of the bark is alive, the rough outside or the soft layer just under it? What does the living part carry?
5. **HARD** Why should we never peel the bark off all the way around a living tree?

COMMON MISTAKES

- Thinking bark is all dead. The rough outer bark is dead, but the inner bark just under it is alive and carries the tree's food.
- Thinking it does not hurt a tree to peel its bark. Peeling bark lets in bugs and sickness, and peeling it all the way around can kill the tree.
- Thinking all bark looks the same. Each kind of tree has its own bark, so you can learn to name trees by their bark even in winter.

Make it a game • Mystery Bark. After you make your bark rubbings, mix them up. Your parent holds up one rubbing without telling which tree it came from. Run to the tree you think it matches and put your hand on the trunk. Hold the rubbing against the bark to check. Score a point for each match, then trade places and let your parent guess.

Scripture. "The trees of the LORD are full of sap; the cedars of Lebanon, which he hath planted; Where the birds make their nests: as for the stork, the fir trees are her house." (Psalm 104:16-17, KJV)

God planted the trees and filled them with sap, the watery food that flows inside them. Trees are His, and they are homes for birds and many other creatures.

Practice answers

1. Answers will vary. A child should use a texture word, such as "The oak feels rough and ridged" or "The beech feels smooth."
2. Paper birch: white and papery. Shagbark hickory: long, loose strips. Beech: smooth and gray. Oak: deep ridges and cracks.
3. 7 rubbings (3 + 4 = 7).
4. The soft inner bark just under the outside is alive. It carries sugar food from the leaves down to the trunk and roots.
5. The inner bark carries food from the leaves to the roots. If a ring of bark is taken off all the way around, the food cannot get through, and the tree could starve and die.

UNIT 6 REVIEW

This is an oral review. A parent reads each question aloud, and the child answers in his or her own words, pointing or drawing where asked. Give full points for answers that show the main idea, even in simple words. The review is worth 20 points.

1. (3 pts) Why do green leaves turn yellow and orange in the fall?
2. (3 pts) Name one tree that drops its leaves in the fall and one tree that stays green all winter. What is waiting on the bare twigs?
3. (3 pts) Tell what Jesus said about the lilies of the field. What does it teach us?
4. (3 pts) Point to (or name) three parts of a flower. What is a flower's job?
5. (3 pts) What is a tree ring? What does a wide ring tell us, and what does a thin ring tell us?
6. (2 pts) Where does a tree grow its newest wood: in the middle of the trunk or just under the bark?
7. (3 pts) How does bark help a tree? Which part of the bark is alive?

UNIT PROJECT: MY FAMILY TREE BOOK

Choose one tree near your home to be your family's tree. Visit it often and make a little book all about it. Include a drawing of the whole tree, a pressed leaf, a bark rubbing with a string that shows how big around the trunk is, a drawing of its buds, flowers or seeds, and a paper tree cookie that tells a pretend story of its rings. On the last page, draw any animal you saw living in or visiting your tree, and tell your parent one thing you learned about God's care from the trees and flowers.

- **Observation:** Drawings show real details of the tree, such as the shape of its leaves, the pattern of its bark and its buds or seeds.
- **Collection:** The book includes a pressed leaf, a bark rubbing and a measuring string, each labeled with help as needed.
- **Narration:** The child can tell about each page in his or her own words, using words like bark, ring, bud and seed.
- **Care:** Pages are neat and colorful, and the child took care of the tree while studying it (no peeled bark or broken branches).

Answer key

1. In the fall the days get shorter and cooler, and the tree stops making the green. The green fades, and the yellow and orange that were hiding in the leaf all summer can be seen.
2. Drops its leaves: maple, oak or birch (deciduous). Stays green: pine, spruce or fir (evergreen). Buds are waiting on the twigs for spring.
3. He said to consider the lilies, how they grow; they do not work or spin, yet even Solomon was not dressed like one of them. It teaches us not to worry, because God cares for us even more than for the flowers.
4. Any three: petals, stamens, pollen, pistil, stem, leaves. A flower's job is to make seeds.

5. A tree ring is the wood a tree grows in one year. A wide ring means a good, rainy year. A thin ring means a hard, dry year.
6. Just under the bark. The oldest wood is in the middle.
7. Bark is like the tree's skin: it keeps out bugs, sickness and cold. The soft inner bark just under the outside is alive and carries food from the leaves to the roots.

DINOSAUR DAYS

“And God made the beast of the earth after his kind” (Genesis 1:25). Among all the creatures God made, few amaze children like the dinosaurs. In this unit your child meets four of them through their bones and footprints: Stegosaurus with its plates and tail spikes, the giant long-necked Diplodocus, the duck-billed dinosaurs with their beaks and crests, and the three-toed dinosaurs that left their tracks in stone. Your child will look, count, measure and compare, just as real fossil scientists do.

Each lesson begins with real people and real places: Arthur Lakes finding giant bones in the hills of Colorado, Andrew Carnegie sending copies of his dinosaur around the world, William Parker Foulke digging up Hadrosaurus in New Jersey, and the farm boy Pliny Moody plowing up footprints in Massachusetts. Your child will build a zigzag Stegosaurus out of clay, make neck-bone paper chains, test a honking “crest” tube, and make and measure a wet-footprint trackway.

Museum signs and dinosaur books often use words like Jurassic and Cretaceous and say dinosaurs lived very long ago, before people. Each lesson has a short “Thinking About Time” box that helps you explain what the sign says, what we can really see, and how many Christians read it in light of creation and Noah’s Flood. Save the clay Stegosaurus, the paper chains, the crest tube and the footprint tracings; they all go into the home dinosaur museum at the end.

BEFORE YOU BEGIN

- Can count objects up to 20
- Can tell longer from shorter and bigger from smaller
- Can use hands, paper clips or squares to measure something
- Can listen to a short story read aloud and tell part of it back

MASTERY CHECKLIST

- I can point to the plates and tail spikes on a Stegosaurus and tell why it was named “roof lizard.”
- I can tell how a long neck helped Diplodocus reach its food, and that a giraffe and I each have 7 neck bones.
- I can tell how a duck-billed dinosaur used its beak and its teeth, and what a crest is.
- I can measure two footprints and tell which animal was bigger.
- I can tell what a long stride means in a trackway.
- I can tell what a museum sign means by a word like Jurassic, and what we can really see.

OPTIONAL BOOKS AND RESOURCES

- **Smithsonian National Museum of Natural History** (<https://naturalhistory.si.edu/>): Free online. Look together at the fossil hall pictures for Stegosaurus, long-necked dinosaurs and duck-billed dinosaurs. The signs use long-age numbers, so a parent may want to preview them and use the “Thinking About Time” boxes to talk about them.
- **Dinosaur National Monument (National Park Service)** (<https://www.nps.gov/dino/>): Free. See photos of the “wall of bones” that Earl Douglass found for the Carnegie Museum (Lesson 7.2). If you ever visit Utah or Colorado, children can see real dinosaur bones still in the rock.

7.1 STEGOSAURUS PLATES ★

OBJECTIVES

- Tell how Arthur Lakes found giant bones in Colorado and why Stegosaurus was named “roof lizard.”
- Point to the plates and the tail spikes on a Stegosaurus picture and count them.
- Build a Stegosaurus model with two zigzag rows of plates.

Warm-up. Run your fingers down the middle of your back, from your neck to your waist. Feel the bumps? That is your backbone. Now lay a pillow on the table and stand some playing cards or crackers up in a row along the top of it. That is a little like how Stegosaurus wore its plates.

Video. Coming soon. Stegosaurus plates and tail spikes for young children: search Smithsonian National Museum of Natural History fossil hall footage, SciShow Kids, Homeschool Pop (Alternate), and museum skeleton walk-around videos.

KEY TERMS

fossil

A part or a sign of a living thing from long ago that has turned to stone, like a bone, a shell or a footprint.

plate

A big, flat, thin piece of bone. Stegosaurus had two rows of plates standing up along its back.

tail spike

A long, sharp, pointed bone at the end of a tail. Stegosaurus had four of them.

paleontologist

A scientist who digs up fossils and studies them.

CORE IDEAS

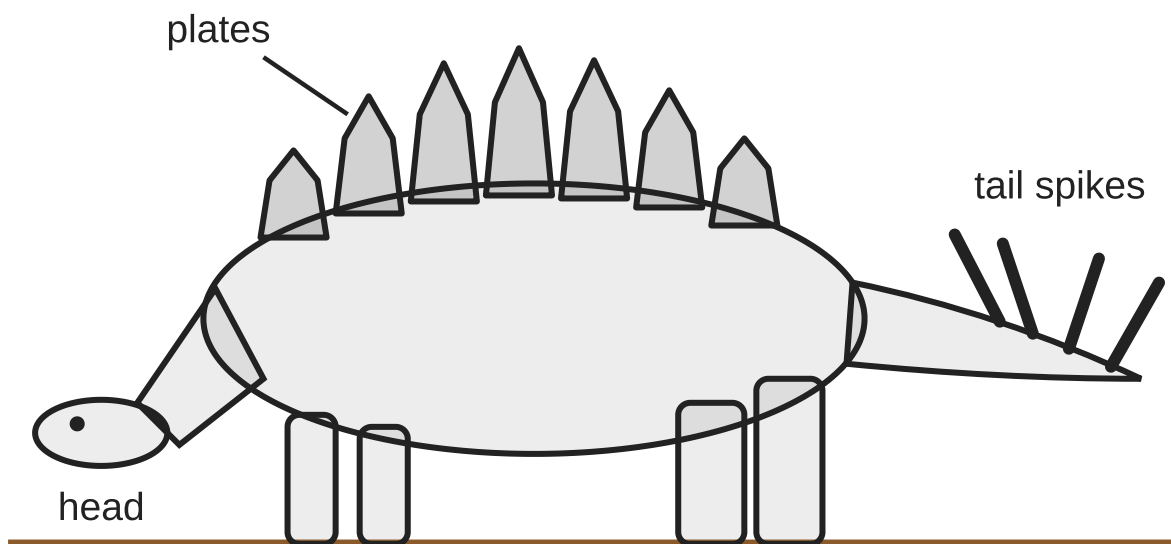
The story. In 1877, a teacher named Arthur Lakes was walking in the hills near Morrison, Colorado. He loved to draw rocks and hunt for fossils. One day he saw giant bones sticking out of the rock. They were so big he could hardly believe they were bones! Lakes packed them up and sent them far away to a scientist named Othniel Charles Marsh at Yale College. Marsh studied the bones and the big, flat plates found with them. He named the animal **Stegosaurus**, which means “roof lizard.” He thought the plates lay flat on its back, like shingles on a roof.

How they figured it out. Marsh had a puzzle. The bones were mixed up in the rock. Where did the plates go? More Stegosaurus skeletons were found. One was found lying on its side, with its plates still in place, like a toy that tipped over in the sand. Now scientists could see

the answer. The plates stood up tall along the back. They were set in **two rows**, in a zigzag. At the very end of the tail were **four sharp spikes**.

The big idea. Stegosaurus had a small head and a big, round back. Its front legs were short and its back legs were long, so its back rose up like a hill. It ate plants. It nipped them off with a beak at the front of its mouth. Scientists still wonder what the plates were for. Maybe they made Stegosaurus look big and scary. Maybe they helped Stegosaurus friends know each other. Maybe they soaked up the warm sun. But the tail spikes were surely for fighting. Scientists found a bone from a meat-eating dinosaur with a hole in it. The hole was just the size of a Stegosaurus spike!

God's handiwork. God made every creature "after his kind" (Genesis 1:25). He gave the little rabbit fast legs, the turtle a hard shell and Stegosaurus a tail full of spikes. Today you can see Stegosaurus skeletons in big museums. Look at the picture chart. Count the plates and the spikes. Then build your own Stegosaurus with two zigzag rows of plates, just as the bones show.



From the side we can see one row of plates. Count the plates. Count the tail spikes.

Thinking About Time

What the sign says. A museum sign may say Stegosaurus lived in the Jurassic. That is a museum word for a time very, very long ago, before any people.

What we observe. We can see and touch Stegosaurus bones and plates that have turned to stone. They were dug out of layers of rock.

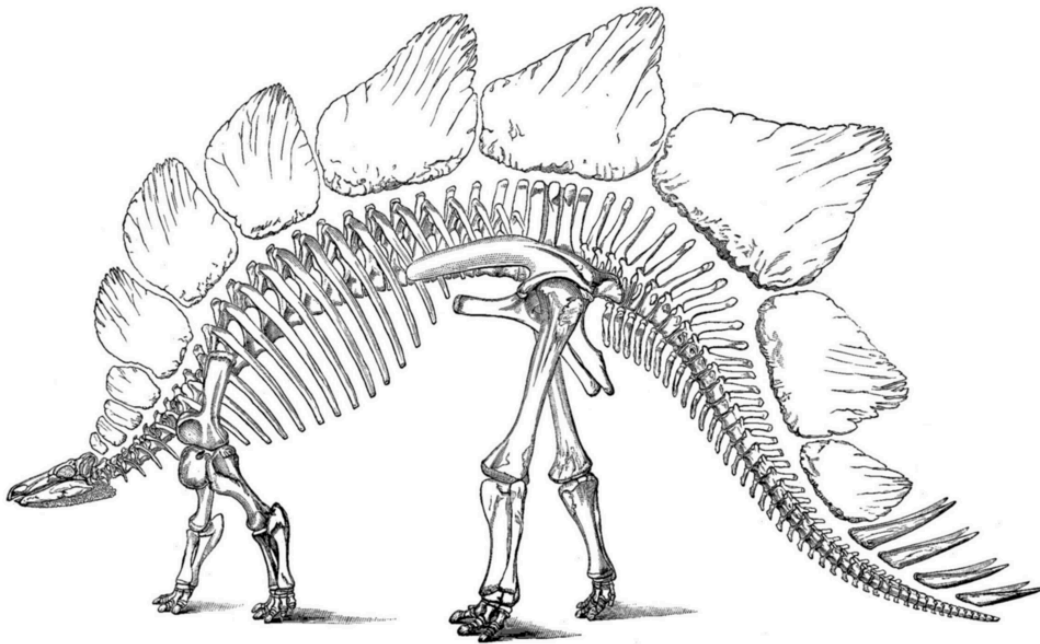
How Christians read it. Many Christians believe God made the land animals on the sixth day, the same day He made Adam. They believe many dinosaurs were buried in mud

in Noah's Flood, and that is why we find their bones in rock.

Try it. Find the word Jurassic in a dinosaur book or on a museum sign, and read it aloud with your parent.

Genesis 1:24

PICTURE STUDY



Restoration of the Skeleton of Stegosaurus ungulatus, Drawn for Othniel Charles Marsh, 1891 (this printing 1896) · Printed drawing (a scientific plate) · Published in the *American Journal of Science* (1891) and again in a U.S. Geological Survey report (1896); copies in many libraries

Othniel Charles Marsh studied Stegosaurus bones for many years. In 1891 he had this drawing made to show the whole skeleton standing, the way he thought it looked. It was one of the first drawings ever made of a whole Stegosaurus skeleton.

Marsh drew the plates in one single row down the middle of the back, and he gave the tail eight spikes. Later, a skeleton was found with its plates still in place, and scientists learned there were two rows in a zigzag and only four tail spikes. Good scientists change their pictures when new bones teach them something.

Look closely

- Find the head. Is it big or small next to the body?
- Follow the backbone from the head to the tip of the tail with your finger. Where is the back the highest?
- Count the spikes on the tail in this drawing.
- Look at the front legs and the back legs. Which are longer?

Talk about it

1. How is this drawing different from what scientists think Stegosaurus looked like today?
2. Why do scientists change their drawings when they find new bones?
3. This drawing shows only bones. What would you add to make Stegosaurus look alive?

Safety first. A grown-up should cut the cardboard. Use child-safe scissors, and keep clay and dry spaghetti out of mouths.

MAKE AND DO: BUILD A ZIGZAG STEGOSAURUS

You will build your own Stegosaurus out of clay and cardboard. You will put the plates in two zigzag rows and add four tail spikes, just as the bones show.

You will need

- Play dough or modeling clay (a lump about the size of your fist)
- A piece of thin cardboard, such as a cereal box
- Child-safe scissors and crayons
- 4 short pieces of dry spaghetti or 4 pretzel sticks
- A pencil

Steps

1. Roll a big, fat oval for the body. Roll a small ball for the head and a long, skinny snake for the tail. Press them together.
2. Roll 4 legs. Make the 2 back legs longer than the 2 front legs. Stand your Stegosaurus up. Does its back make a hill?
3. Draw 12 plates on the cardboard: some big, some small. They can look like kites or leaves. A grown-up can help cut them out. Color them.
4. Push the plates into the back in two rows. Put one on the left, then one on the right, then left, then right, in a zigzag. Put the biggest plates in the middle of the back.
5. Push 4 spikes into the end of the tail. Point them up and out.
6. Count aloud: How many plates? How many spikes? Tell your parent the name Stegosaurus means “roof lizard” and why.

Tips

- If a plate flops over, make the bottom of it a little wider and push it deeper into the clay.
- Look at your model from the side. Now look at it from the top. From the top you can see the zigzag best.

Check your work

- My Stegosaurus has two zigzag rows of plates.
- My Stegosaurus has four tail spikes.

- I can tell why it was named “roof lizard.”

NATURE NOTEBOOK

1. Draw Stegosaurus from the side. Label the head, the plates and the tail spikes. Your parent can help you write the words.
2. Draw Stegosaurus from the top, like a bird flying over it. Show the two zigzag rows of plates.
3. Draw one plate big on its own page. Draw a dinner plate next to it. Which one is bigger? (The biggest Stegosaurus plates were bigger than a dinner plate.)

From history. In 1982, Stegosaurus became the state fossil of Colorado, where Arthur Lakes found those first bones. It happened because schoolchildren in Colorado wrote letters and worked hard to ask their state leaders for it. Children helped choose the state fossil!

WORKED EXAMPLES

Example 1. Look at the picture chart of Stegosaurus. How many plates can you see? How many tail spikes? Which is more?

(Use the map or drawing “Count the plates, then the spikes.” shown earlier in this lesson.)

1. Put your finger on the plate nearest the head. Count each plate as you move toward the tail: 1, 2, 3, 4, 5, 6, 7.
2. Now put your finger on the tail. Count the spikes: 1, 2, 3, 4.
3. Compare: 7 is more than 4. Count up from 4 to 7: 5, 6, 7. That is 3 more.

Answer: There are 7 plates and 4 tail spikes. There are more plates, 3 more than the spikes.

PRACTICE

1. **EASY** Point to the plates on the picture chart. Now point to the tail spikes. Which ones are flat, and which ones are sharp and pointy?
2. **EASY** What does the name Stegosaurus mean?
3. **MEDIUM** One Stegosaurus has 4 tail spikes. How many tail spikes do 2 Stegosauruses have? Use your fingers to count.
4. **MEDIUM** Did Stegosaurus eat plants or other animals? Tell one clue.
5. **HARD** Draw Stegosaurus plates two ways: in one straight row, and in two zigzag rows. Point to the way scientists think is right and tell why.

COMMON MISTAKES

- Thinking the plates lay flat like a roof. That was Marsh's first guess, but the plates stood up tall along the back.
- Thinking every dinosaur ate meat. Stegosaurus ate plants. Its spikes were for keeping safe, not for hunting.
- Thinking a fossil bone is just an old bone. A fossil bone has turned to stone, so it is heavy and hard like a rock.

Make it a game · Stegosaurus Says. Play like "Simon Says." The parent calls out Stegosaurus moves: "Stegosaurus says plates up!" (stand tall with hands pointed up over your back). "Stegosaurus says swing your spikes!" (swing your arms behind you like a tail). "Stegosaurus says munch the plants!" (pretend to nip leaves with a beak). If the parent does not say "Stegosaurus says," stay still! Take turns being the caller.

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

God made every kind of animal, from the smallest beetle to Stegosaurus with its plates and spikes. He looked at all He made and said it was good.

Practice answers

1. The plates are the flat ones on the back. The tail spikes are the sharp, pointy ones at the end of the tail.
2. "Roof lizard." Marsh thought the plates lay flat on its back like a roof.
3. 8 tail spikes (4 and 4 more make 8).
4. Plants. It had a beak at the front of its mouth for nipping off plants and small teeth for chewing them.
5. Two zigzag rows. A Stegosaurus skeleton was found lying on its side with the plates still in place, and they were in two rows, set in a zigzag.

7.2 LONG NECKS

OBJECTIVES

- Tell the story of Andrew Carnegie’s long-necked dinosaur, *Diplodocus*.
- Count and compare the neck bones of a giraffe and a *Diplodocus*.
- Explain how a long neck helps a big plant-eater reach its food.

Warm-up. Put a toy on the floor a little way in front of you. Keep both feet still. Can you reach it? Now try again holding a long wooden spoon. A long reach lets you get the toy without taking a step. A long neck worked the same way for a giant dinosaur.

Video. Coming soon. Long-necked dinosaurs (sauropods) and *Diplodocus* for kids: search Carnegie Museum of Natural History and Smithsonian dinosaur hall footage, National Park Service Dinosaur National Monument wall of bones, SciShow Kids and Homeschool Pop (Alternate); giraffe neck nature footage for comparison.

KEY TERMS

sauropod

A giant dinosaur with a small head, a very long neck, a long tail and four thick legs, like *Diplodocus*.

neck bones

The small bones, one after another, that make up the neck. You have 7. So does a giraffe.

plant-eater

An animal that eats leaves, grass, seeds or other plants, not other animals.

cast

A copy of a bone made by pouring plaster into a mold. It looks just like the real fossil.

CORE IDEAS

The story. When your great-great-grandparents were young, a rich man named Andrew Carnegie lived in Pittsburgh, Pennsylvania. He made steel, and he built a big museum. He wanted the biggest dinosaur in the world for it! So he sent fossil hunters out west. In the summer of 1899, they dug in the rocks of Wyoming and found the bones of a giant long-necked dinosaur. Scientists named it ***Diplodocus carnegii***, which means “Carnegie’s *Diplodocus*.” It was longer than two school buses parked end to end!

How they figured it out. The King of England, Edward VII, saw a drawing of the dinosaur and wished his country had one too. Carnegie had workers make plaster copies, called **casts**, of every bone. In 1905, a whole *Diplodocus* made of casts was put together in a museum in London. Later, more copies went to Paris, Berlin and other cities. Children all over the world could look up at the same dinosaur! Scientists counted its bones. Its neck had 15 neck bones.

Many of them had hollow spaces inside, like a bird's bones, so the long neck was not too heavy.

The big idea. Diplodocus was a **sauropod**. It had a small head, a very long neck, a long tail and four legs as thick as tree trunks. It ate plants. Its teeth were like the pegs of a rake, and it used them to strip leaves off branches. A long neck is a wonderful tool for a big, heavy animal. It can stand still and swing its head far to the left, far to the right, up high and down low, to reach many leaves. That saves a lot of walking! Here is a surprise. A giraffe has a long neck, but it has only 7 neck bones, the same as you. Its neck bones are just very long.

God's handiwork. In the book of Job, God tells Job to look at a giant animal called **behemoth**. God says He made it, that it "eateth grass as an ox," and that it moves its tail like a cedar tree (Job 40:15-17). Some Bible readers think behemoth may have been a long-necked dinosaur like this one. Whatever it was, God made it, and God made Diplodocus too.

Neck bones

Giraffe



Diplodocus



One box = one neck bone

Each box stands for one neck bone. Count the boxes in each row.

Thinking About Time

What the sign says. A museum sign may say Diplodocus lived in the Jurassic. That is a museum word for a time very, very long ago, before any people.

What we observe. We see huge stone bones in layers of rock in Wyoming, Utah and Colorado. Some lie together in a big jumble, as if they were swept there by water.

How Christians read it. Many Christians believe God made these big animals with the other land animals, so they lived at the same time as people. Job 40 may even tell about one. Many were buried in Noah's Flood.

Try it. Look at a picture of the wall of bones at Dinosaur National Monument. Can you find a long neck?

PICTURE STUDY



Brontosaurus, Charles R. Knight, 1897 · Painting (shown here as printed in a newspaper in 1919) · Painted for the American Museum of Natural History, New York

Charles R. Knight loved animals. As a boy he drew them at the zoo, and he grew up to paint animals for museums. In 1897 he worked with scientists at the American Museum of Natural History in New York to paint *Brontosaurus*, a long-necked dinosaur like *Diplodocus*. He looked closely at the bones so his painting would be as true as he could make it.

In Knight's day, many scientists thought long-necked dinosaurs were so heavy that they had to stay in water to hold their bodies up. Today, scientists think they walked on dry land on their strong legs. We know because we have found their footprints on land.

Look closely

- Find the long neck. Follow it with your finger all the way to the small head.
- Find the tail. Is it longer or shorter than the neck?
- Look at the place around the dinosaur. Is it dry land, water or both?
- Look at the legs. What do they remind you of?

Talk about it

1. Why do you think Knight made the head so small next to the body?
2. In Knight's day, scientists thought these dinosaurs had to stay in water. Why do scientists think differently today?
3. If you could paint a long-necked dinosaur, what would it be doing?

MAKE AND DO: NECK BONE CHAINS: GIRAFFE AND DIPLODOCUS

You will make two paper chains. Each paper loop stands for one neck bone. One chain will be a giraffe neck and one will be a Diplodocus neck. Then you will see which neck is longer and which one can reach a paper leaf.

You will need

- 22 strips of paper, all the same size (about as long as your hand and two fingers wide)
- Tape or a glue stick
- Crayons
- Green paper cut into a few leaves
- A ruler or a piece of string

Steps

1. Color 7 strips yellow for the giraffe. Color 15 strips green or brown for Diplodocus.
2. Make a loop with one strip and tape it. Put the next strip through the loop and tape it. Keep going to make a chain.
3. Make a giraffe chain with 7 loops. Count them as you go.
4. Make a Diplodocus chain with 15 loops. Count them as you go.
5. Lay the two chains side by side on the floor. Which is longer? Measure each one with a ruler or a piece of string.
6. Tape a paper leaf high on a wall. Hold the bottom of each chain at the same spot below it and lift. Which neck reaches the leaf?
7. Touch your own neck. Tell your parent: "I have 7 neck bones, the same as a giraffe!"

Tips

- Use strips that are all the same size. Then the only thing that changes is how many loops you use.
- A real giraffe's neck bones are very long. To show that, you could make a second giraffe chain with 7 extra-long strips.

Check your work

- I made a 7-loop chain and a 15-loop chain.
- I can tell which neck had more neck bones.
- I can tell how a long neck helps a big animal reach food.

NATURE NOTEBOOK

1. Draw a Diplodocus from the side. Draw a school bus under it to show how long it was.
2. Draw a giraffe and a Diplodocus side by side. Write 7 by the giraffe's neck and 15 by the dinosaur's neck.

3. Draw a long neck reaching up to a tall tree and down to a low fern. Draw arrows to show where the head can reach without walking.

From history. Andrew Carnegie’s museum kept hunting for dinosaurs. In 1909, a fossil hunter from the museum named Earl Douglass found a wall of dinosaur bones in the rocks of Utah, including the bones of long-necked dinosaurs. Today that place is Dinosaur National Monument. You can walk inside a building there and see a whole wall of real bones still in the rock.

WORKED EXAMPLES

Example 1. Look at the picture chart. Count the neck bones of the giraffe and of Diplodocus. Which neck has more bones? How many more?

(Use the map or drawing “One box is one neck bone.” shown earlier in this lesson.)

1. Point to each box in the giraffe row and count: 1, 2, 3, 4, 5, 6, 7. The giraffe has 7 neck bones.
2. Point to each box in the Diplodocus row and count all the way to 15. Diplodocus had 15 neck bones.
3. 15 is more than 7. To find how many more, count on from 7 to 15 on your fingers: 8, 9, 10, 11, 12, 13, 14, 15. That is 8 more.

Answer: The giraffe has 7 neck bones and Diplodocus had 15. Diplodocus had more, 8 more neck bones.

PRACTICE

1. **EASY** Touch your neck. How many neck bones do you have? (Hint: it is the same number as a giraffe.)
2. **EASY** Did Diplodocus eat plants or other animals?
3. **MEDIUM** Sort these animals into two groups, long neck and short neck: giraffe, Diplodocus, pig, swan, frog.
4. **MEDIUM** Which was longer: one school bus or one Diplodocus? Show with your arms.
5. **HARD** Tell in your own words why Andrew Carnegie sent copies of his dinosaur to other countries.

COMMON MISTAKES

- Thinking a longer neck must have more bones. A giraffe’s long neck has 7 bones, the same as yours. Its bones are just longer.
- Thinking long-necked dinosaurs had to live in water. Scientists once thought so, but their strong legs and their footprints on land show that they walked on dry ground.

- Thinking the biggest dinosaurs must have been the scariest. Diplodocus and the other long-necks ate plants.

Make it a game · Long-Neck Reach. The parent hides paper leaves around a room, some high and some low. The child is a long-necked dinosaur and stands inside a hula hoop or a ring of string, with feet that may not move. Use a long wooden spoon as your neck and head, and tap each leaf you can reach without stepping. Count your leaves. Then move your hoop to a new place and play again. Which spot let you reach the most leaves?

Scripture. “Behold now behemoth, which I made with thee; he eateth grass as an ox.” (Job 40:15, KJV)

God showed Job one of the biggest animals He had made. A huge animal that ate grass like an ox reminds us how great and strong God is, who made it.

Practice answers

1. 7 neck bones.
2. Plants. It used its peg-like teeth to strip leaves off branches.
3. Long neck: giraffe, Diplodocus, swan. Short neck: pig, frog.
4. Diplodocus. It was longer than two school buses parked end to end.
5. The King of England saw a drawing and wanted one, so Carnegie had plaster casts made of every bone. He sent copies to London and other cities so people all over the world could see Diplodocus.

7.3 DUCK-BILLED DINOSAURS

OBJECTIVES

- Tell how William Parker Foulke and Joseph Leidy found and studied Hadrosaurus, and how it became the first dinosaur skeleton to stand in a museum.
- Describe a duck-billed dinosaur's beak, teeth and crest.
- Test whether a long tube or a short tube makes a lower sound.

Warm-up. Take a bite of a cracker with your front teeth. Then chew it with your back teeth. Your front teeth bite off a piece. Your back teeth grind it up. A duck-billed dinosaur did the same thing with plants: a beak in front to nip, and many teeth in back to grind.

Video. Coming soon. Duck-billed dinosaurs (hadrosaurs), Hadrosaurus, Parasaurolophus crest sounds and Maiasaura nests for kids: search Academy of Natural Sciences of Drexel University, Smithsonian, Museum of the Rockies, SciShow Kids and Homeschool Pop (Alternate).

KEY TERMS

duck-billed dinosaur

A plant-eating dinosaur with a wide, flat beak, a little like a duck's bill. Scientists also call it a hadrosaur.

beak

A hard mouth part with no teeth, used for nipping and picking up food.

crest

A bump, fan or tube that sticks up on top of an animal's head.

nest

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

CORE IDEAS

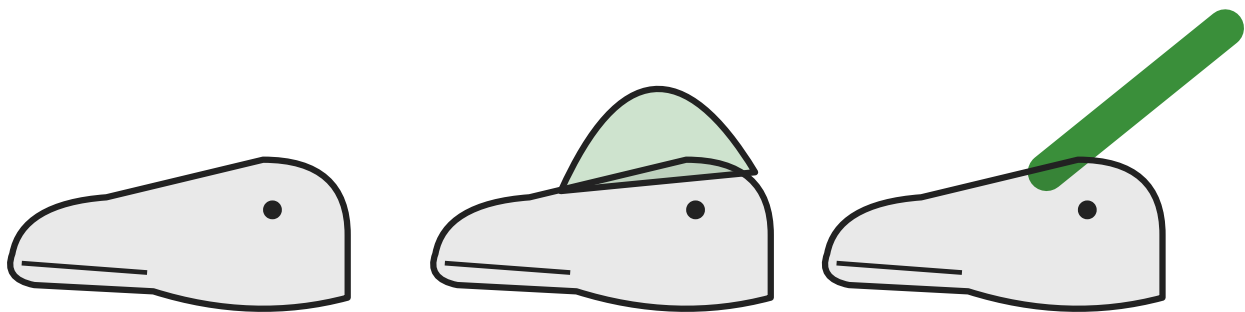
The story. In 1858, a man named William Parker Foulke was visiting the town of Haddonfield, New Jersey. He heard that, years before, workers digging on a farm had found giant bones. Foulke wanted to see more! He hired diggers, and they dug in the old pit. They found many big bones: leg bones, hip bones, backbones and teeth. Foulke took them to a scientist in Philadelphia named Joseph Leidy. Leidy named the animal **Hadrosaurus**.

How they figured it out. Leidy looked closely at the legs. The back legs were much longer than the front legs. So he said Hadrosaurus could stand up on its back legs, a little like a kangaroo. Before this, people pictured dinosaurs as giant lizards on four legs. In 1868, an artist named Benjamin Waterhouse Hawkins put the bones together, standing tall, at the Academy of Natural Sciences in Philadelphia. It was the first dinosaur skeleton ever set up in a museum! Crowds came to see it. But no one had found its head. Hawkins had to make a

pretend one. Later, scientists found whole skeletons of its cousins, with heads. Their mouths ended in a wide, flat beak, like a duck's bill.

The big idea. Duck-billed dinosaurs ate plants. The **beak** in front had no teeth. It nipped off leaves and twigs. But farther back were rows and rows of teeth packed close together, like a cheese grater. When a tooth wore down, a new one grew in to take its place. Some duck-bills had a **crest** on the head. Parasaurolophus had a long, hollow tube. Scientists think air going through it may have made a deep honk, like a horn. In Montana, scientists found duck-billed dinosaur **nests** with baby bones in them. They named that dinosaur Maiasaura, which means "good mother lizard."

God's handiwork. God gave the duck-billed dinosaurs just what they needed: a beak for nipping, teeth for grinding and new teeth to replace old ones. He made mothers that cared for their babies in nests. "O LORD, how manifold are thy works!" (Psalm 104:24).



Edmontosaurus

no crest

Corythosaurus

round crest

Parasaurolophus

long tube crest

Three duck-billed dinosaurs. Which ones have a crest?

Thinking About Time

What the sign says. A museum sign may say duck-billed dinosaurs lived in the Cretaceous. That is a museum word for a time very, very long ago, before any people.

What we observe. We find their bones, teeth, eggs and nests in rock in places like New Jersey, Montana and Canada.

How Christians read it. Many Christians believe God made these animals in the beginning to have babies "after their kind," and that many were buried quickly in mud during Noah's Flood.

Try it. Look for the word Cretaceous in a dinosaur book. Say it slowly with your parent: creh-TAY-shus.

PICTURE STUDY



The Hadrosaurus Skeleton at the Academy of Natural Sciences, Photograph of the skeleton built by Benjamin Waterhouse Hawkins, about 1868 · Photograph · Academy of Natural Sciences, Philadelphia

This old photograph shows the Hadrosaurus skeleton that Benjamin Waterhouse Hawkins set up in 1868. It was the first dinosaur skeleton ever put together and stood up in a museum. Hawkins used the real bones that Foulke had dug up, and he made the missing parts, like the head, out of plaster.

Hawkins stood the dinosaur up tall on its back legs, the way Joseph Leidy said it could stand. Today scientists think duck-billed dinosaurs held their backs and tails out straight, but this skeleton was a giant step in learning what dinosaurs looked like.

Look closely

- Find the long back legs and the short front arms.
- Find the tail. Where does it go? Does it reach the ground?
- Find the head. Remember, no head bones were found. Who made this head?
- Look for something in the photograph that helps you see how tall the skeleton is.

Talk about it

1. Why did Hawkins have to make a pretend head?
2. Why do you think so many people came to see this skeleton?
3. How would you stand this dinosaur up if you were building it?

MAKE AND DO: BEAK AND HONKING CREST

First you will use a clothespin as a duck-bill beak to nip up “plants.” Then you will test a question: does a long tube or a short tube make a lower sound? This helps us think about the long, hollow crest of Parasaurolophus.

You will need

- A clothespin
- A small bowl of dry cereal, torn bits of green paper or real leaves
- A short cardboard tube (from toilet paper)
- A long cardboard tube (from wrapping paper or paper towels taped together)
- Paper and crayons

Steps

1. Beak test: Hold the clothespin like a beak. Pinch up 10 pieces of cereal or paper leaves, one at a time, and drop them into an empty bowl. Count as you go.
2. Tell your parent: The beak nips the food. Where would the grinding teeth be?
3. Sound test: First, guess. Will the long tube or the short tube make a lower, deeper sound? Draw a picture of your guess.
4. Put your lips on one end of the short tube and hum or say “ooooo.” Listen.
5. Now do the same with the long tube. Hum the same way. Listen.
6. Which tube made the lower, deeper sound? Was your guess right? Draw a smiling face if it was.
7. Tell your parent: Parasaurolophus had a long, hollow crest. What kind of sound might it have made?

Tips

- Hum the same way into both tubes. Only the tube should change.
- Let your parent try too, while you listen with your eyes closed. Can you tell which tube is which?

Check your work

- I can nip up food with a beak.
- I can tell which tube made the lower sound.
- I can tell what a crest is.

NATURE NOTEBOOK

1. Draw a duck’s head and a duck-billed dinosaur’s head side by side. Circle the part that is alike.
2. Draw a nest with eggs. Draw one baby duck-billed dinosaur coming out of an egg. Label it Maiasaura, “good mother lizard.”

3. Draw Parasaurolophus with its long crest. Draw music notes coming out of the crest to show its honk.

From history. In 1991, New Jersey made Hadrosaurus its state dinosaur. In Haddonfield, the town where Foulke dug up the bones, a statue of Hadrosaurus now stands in the middle of town, and there is a marker at the place where the bones were found.

WORKED EXAMPLES

Example 1. Look at the picture chart of three duck-billed dinosaur heads. How many have a crest? Which one has the longest crest?

(Use the map or drawing “Count the crests.” shown earlier in this lesson.)

1. Look at each head, one at a time, and put your finger on top of it.
2. Edmontosaurus: the top of its head is smooth. No crest.
3. Corythosaurus: it has a round crest, like a helmet. That is 1.
4. Parasaurolophus: it has a long tube going back from its head. That is 2.
5. Compare the two crests. The tube of Parasaurolophus sticks out much farther than the round crest.

Answer: 2 of the 3 heads have a crest. Parasaurolophus has the longest crest.

PRACTICE

1. **EASY** Find a picture of a duck. How is a duck-billed dinosaur’s mouth like a duck’s bill? How is it different?
2. **EASY** What does the name Maiasaura mean, and what did scientists find with it?
3. **MEDIUM** In your sound test, which tube made the lower, deeper sound: the long tube or the short tube?
4. **MEDIUM** A nest had 6 eggs. 4 babies hatched. How many eggs have not hatched yet? Use 6 buttons or beans to show it.
5. **HARD** Tell why Benjamin Waterhouse Hawkins had to make a pretend head for the Hadrosaurus skeleton, and how scientists later learned it had a duck bill.

COMMON MISTAKES

- Thinking duck-billed dinosaurs were big ducks that swam and quacked. They were dinosaurs that walked on land. Only their wide, flat beak was a little like a duck’s.
- Thinking an animal with a beak has no teeth at all. Duck-billed dinosaurs had no teeth in the beak, but rows and rows of teeth farther back.
- Thinking dinosaurs never cared for their babies. Nests of Maiasaura with babies in them show that some dinosaur parents did.

Make it a game · Honk and Find. One player is the mother duck-billed dinosaur and hides somewhere in the house or yard with the long tube. Every little while, the mother gives a deep “ooooo” honk through the tube. The other players are the babies. They follow the honk to find her. When they find her, they switch. Can you find your mother just by listening?

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 of all sorts. Beaks, crests, grinding teeth and caring mothers all show God’s wisdom in what He made.

Practice answers

1. Alike: both are wide and flat at the front. Different: the dinosaur had rows and rows of grinding teeth behind its beak. A duck has no teeth.
2. “Good mother lizard.” Scientists found its nests with baby bones in them.
3. The long tube.
4. 2 eggs (6 take away 4 is 2).
5. The head bones of Hadrosaurus were never found, so he had to make one. Later, scientists found whole skeletons of its cousins with their heads, and those had wide, flat, duck-like beaks.

7.4 DINOSAUR FOOTPRINTS YOU CAN MEASURE

OBJECTIVES

- Tell how Pliny Moody found footprints in stone and how Edward Hitchcock studied them.
- Measure and compare footprints by counting squares, hand-widths or inches.
- Tell what footprints can show: how big an animal was and whether it walked or ran.

Warm-up. Press your hand into a flat piece of play dough and lift it. Then press in a fork, a toy car wheel or a button. Mix them up and have your parent guess what made each print. A print can tell who was there, even when they are gone.

Video. Coming soon. Dinosaur footprints and trackways for kids: search National Park Service fossil tracks, Dinosaur State Park (Connecticut), Dinosaur Valley State Park (Texas), Smithsonian, SciShow Kids and Homeschool Pop (Alternate); footage of children measuring real tracks.

KEY TERMS

footprint

The mark a foot leaves when it presses into something soft, like mud, sand or snow. Scientists also call it a track.

trackway

A line of footprints made by one animal as it walked or ran.

stride

How far apart the steps are. Long strides usually mean the animal was going fast.

measure

To find out how long, tall or far something is, using a ruler, hands or squares.

CORE IDEAS

The story. In 1802, a young man named Pliny Moody was plowing his family's farm in South Hadley, Massachusetts. His plow turned up a flat stone with strange marks on it. The marks looked like footprints of a giant bird, each with three toes! His family used the stone as a doorstep. People who saw it joked that the tracks were made by "Noah's raven," the bird Noah sent out from the ark.

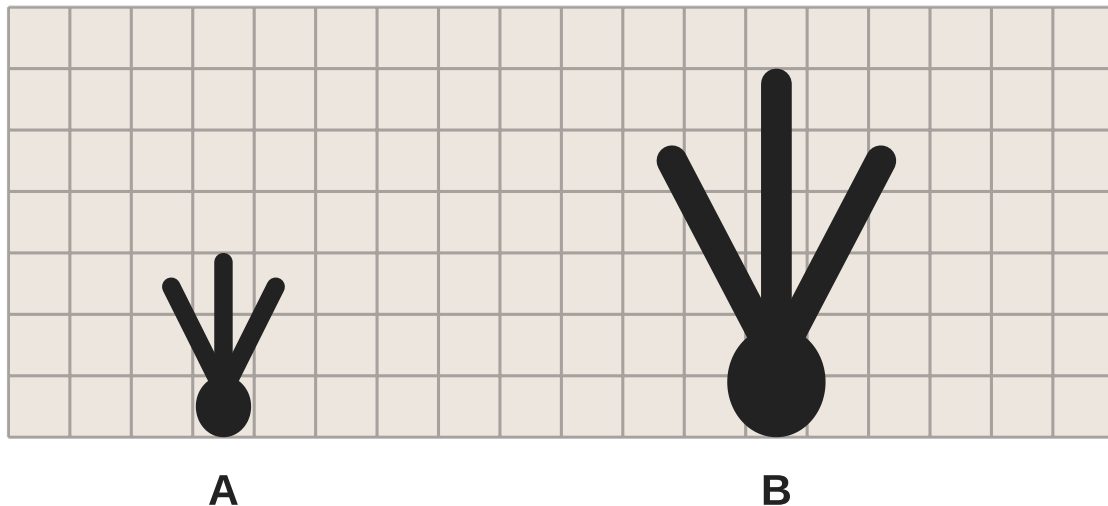
How they figured it out. In 1835, a doctor named James Deane wrote a letter about more tracks in stone to Edward Hitchcock. Hitchcock was a minister and a science teacher at Amherst College. He went out to look. Then he spent the rest of his life finding tracks, measuring them, drawing them and putting them in his college museum. He thought giant birds had made them. Today scientists think most of these tracks were made by dinosaurs.

Many dinosaurs had feet with three toes, a lot like a bird's feet. So Hitchcock was a careful measurer, and he was partly right!

The big idea. A footprint is a fossil too. It shows where a real animal once stepped in soft mud that later turned to stone. Footprints are like clues. A **longer footprint** means a bigger animal. Toe marks show what kind of foot it had. Three thin toes, round blobs or wide pads each tell a different story. The **stride**, or how far apart the steps are, shows how fast it was going. Steps close together mean walking. Steps far apart mean running. Many trackways side by side can show animals walking together in a group.

In the world today. You can see real dinosaur footprints at Dinosaur State Park in Connecticut and at Dinosaur Valley State Park in Texas. You can also make your own tracks today and **measure** them, just as Hitchcock did. Count squares, use your hands or use a ruler. Then you will be a footprint detective too!

Which footprint is longer?



All the squares are the same size.

Count the squares from the back of the heel to the tip of the middle toe.

Thinking About Time

What the sign says. A museum sign may say these tracks were made in the Jurassic. That is a museum word for a time very, very long ago, before any people.

What we observe. We see footprints pressed into stone that was once soft mud. In some stones we also see ripple marks from water and tiny dents from raindrops.

How Christians read it. Many Christians believe many tracks were made in wet mud during the time of Noah's Flood. The mud was covered quickly, so the tracks did not wash away, and later it turned to stone.

Try it. Make a footprint in wet sand. Pour a little water over it. Then make another and cover it with dry sand right away. Which one is easier to find later?

Genesis 7:17

PICTURE STUDY



Fossil Footprints Called Brontozoum and Amblonyx, from Ichnology of New England, Made for Edward Hitchcock, 1858 · Lithograph (a printed picture in a book) · Published in Boston for the Commonwealth of Massachusetts; copies in many libraries

Edward Hitchcock wrote a big book about the footprints in the stones of the Connecticut River valley. He called it *Ichnology of New England*. “Ichnology” (ik-NOL-uh-jee) means the study of tracks. The pictures in the book were drawn with great care so that other scientists could see the tracks just as they were in the stone and could measure them too.

Look at this page like a scientist. Hitchcock wanted every toe, every shape and every size to be right.

Look closely

- Count the toes on one footprint.
- Find the biggest footprint and the smallest footprint.
- Find the heel end and the toe end of a footprint. Which way was the animal walking?
- Find a footprint where you can see the shape of the toes clearly. Are the toes thin or fat?

Talk about it

1. Why did Hitchcock want the drawings to be so careful?

2. Hitchcock thought birds made these tracks. Why might he have thought that?
3. What else would you like to know about the animal that made these tracks?

Safety first. Wet feet make floors slippery. Do the footprint walk outside on a sidewalk or driveway, or on paper laid on a floor with a grown-up holding your hand.

MAKE AND DO: MAKE AND MEASURE A TRACKWAY

You will make your own trackway, first walking and then running. Then you will measure your footprints and your strides, just like a footprint detective.

You will need

- A sidewalk or driveway on a dry, sunny day (or a long strip of brown paper)
- A bucket of water and an old towel
- Chalk
- A ruler, or your hands for measuring
- Paper and crayons

Steps

1. Dip your bare feet in the water and stand on the towel for a second so you are not dripping.
2. Walk slowly across the sidewalk. Look behind you at your wet footprints.
3. Dip your feet again. Now run across, next to your first trackway. Look at the new footprints.
4. Quickly, before the prints dry, draw around a few of them with chalk.
5. Measure one footprint with a ruler or with your hand-widths. How long is it?
6. Measure the space between two walking steps. Then measure the space between two running steps. Which is longer?
7. Have your parent make a wet footprint next to yours. Draw around it with chalk. Whose foot is longer? Who is bigger?

Tips

- Measure from the back of the heel to the tip of the longest toe, every time.
- If the prints dry too fast, try it on a shady part of the sidewalk, or step in a little flour on dark paper instead.

Check your work

- I made a walking trackway and a running trackway.
- I measured a footprint and a stride.
- I can tell what bigger footprints and longer strides mean.

NATURE NOTEBOOK

1. Trace around your foot on paper. Then trace around a grown-up's foot. Write how many hand-widths long each one is.
2. Draw a three-toed dinosaur footprint. Draw a bird footprint next to it. How are they alike?
3. Draw a trackway: footprints close together, then farther and farther apart. Write "walking" and "running" under the right parts.

From history. In 1966, a man driving a bulldozer in Rocky Hill, Connecticut, was digging to make room for a new building. He turned over a slab of stone and saw three-toed dinosaur tracks. The building was moved to another place, and the tracks were kept safe. Today a dome covers them, and the place is called Dinosaur State Park.

WORKED EXAMPLES

Example 1. Look at the picture chart. Footprint A and footprint B are on a grid of squares. How many squares long is each one? Which dinosaur was bigger?

(Use the map or drawing "Count the squares for each footprint." shown earlier in this lesson.)

1. Find the back of the heel of footprint A. Count squares up to the tip of its middle toe: 1, 2, 3. Footprint A is 3 squares long.
2. Do the same for footprint B: 1, 2, 3, 4, 5, 6. Footprint B is 6 squares long.
3. 6 is more than 3, so footprint B is longer. Count on from 3 to 6: 4, 5, 6. B is 3 squares longer.
4. A longer footprint means a bigger animal.

Answer: Footprint A is 3 squares long and footprint B is 6 squares long. B is 3 squares longer, so the dinosaur that made B was bigger.

PRACTICE

1. **EASY** Point to the footprints on the picture chart. How many toes does each footprint have?
2. **EASY** What did people call the tracks Pliny Moody found, and why?
3. **MEDIUM** A big track is 9 paper clips long. A small track is 5 paper clips long. Which track is longer? How many paper clips longer?
4. **MEDIUM** You made a walking trackway and a running trackway. In which one were the steps farther apart?
5. **HARD** Draw a dinosaur trackway that shows the dinosaur walking and then starting to run. Explain your drawing.

COMMON MISTAKES

- Thinking a footprint is not a real fossil. Footprints in stone are fossils too. They are signs that a real animal once walked there.
- Thinking three-toed tracks must have been made by birds. Many dinosaurs had three-toed feet that look a lot like bird feet.
- Thinking only the size of the foot matters. How far apart the steps are tells us if the animal was walking or running.

Make it a game · Track Detective. While the child hides their eyes, the parent presses a few things into play dough or wet sand: a hand, a fork, a toy animal's feet, a shoe. The child opens their eyes and must guess what made each print. Then measure each print with a ruler or paper clips and line them up from shortest to longest. Switch places and play again.

Scripture. "But ask now the beasts, and they shall teach thee; and the fowls of the air, and they shall tell thee: Or speak to the earth, and it shall teach thee: and the fishes of the sea shall declare unto thee." (Job 12:7-8, KJV)

Footprints in stone are a way the earth can "teach" us. When we look closely and measure carefully, we learn about the creatures God made.

Practice answers

1. 3 toes.
2. "Noah's raven" tracks, because they looked like the footprints of a big bird, and Noah sent a raven out from the ark.
3. The big track is longer, by 4 paper clips (count on from 5: 6, 7, 8, 9).
4. In the running trackway. Running makes longer strides.
5. The footprints start close together (walking) and then get farther and farther apart (running), because a running animal takes longer strides.

UNIT 7 REVIEW

This is an oral review. Read each question aloud and let your child answer by telling, pointing, counting, drawing or showing. Have paper, crayons and a few buttons ready. Give full points for a clear answer in your child's own words. The review is worth 20 points.

1. (3 pts) Draw or point to a Stegosaurus. Show me its plates and its tail spikes. How many tail spikes did it have? How were the plates set on its back?
2. (2 pts) What does the name Stegosaurus mean, and why did Marsh choose that name?
3. (3 pts) Tell me the story of Andrew Carnegie's dinosaur.
4. (2 pts) A giraffe has 7 neck bones. Diplodocus had 15. Which had more? How many neck bones do you have?
5. (3 pts) Why do we call some dinosaurs "duck-billed"? What did they have behind the beak? What is a crest?
6. (2 pts) What did scientists find in Montana that shows some duck-billed dinosaur mothers cared for their babies?
7. (3 pts) Tell me about Pliny Moody and Edward Hitchcock.
8. (2 pts) One footprint is 4 squares long. Another is 8 squares long. Which dinosaur was bigger? If its steps are far apart, was it walking or running?

UNIT PROJECT: MY HOME DINOSAUR MUSEUM

Turn a table or shelf into a small dinosaur museum. Set out your zigzag clay Stegosaurus, your giraffe and Diplodocus neck-bone chains, your clothespin beak and crest tube, and your footprint tracings with their measurements. Make a small label card for each one. Your child tells what to write and a parent writes it, such as "Stegosaurus had 4 tail spikes." Then invite your family in and give a museum tour, telling the story of each dinosaur and how scientists figured it out.

- **Models:** The Stegosaurus has two zigzag rows of plates and 4 tail spikes; the neck chains have 7 and 15 loops; the crest tube and beak are included.
- **Measuring:** The footprint tracings are labeled with how long they are (in squares, hand-widths or inches), and the child can tell which is longer.
- **Telling:** On the museum tour the child tells in their own words the story of each dinosaur and one thing scientists learned from its bones or tracks.
- **Care:** The models and labels are neat and set out so visitors can see them, and the museum is cleaned up afterward.

Answer key

1. The child points to the plates on the back and the spikes at the end of the tail. Stegosaurus had 4 tail spikes. The plates stood up tall in two rows, in a zigzag.
2. "Roof lizard." Marsh thought the plates lay flat on its back like shingles on a roof.
3. Carnegie wanted a giant dinosaur for his museum. His fossil hunters found the bones of a long-necked dinosaur, Diplodocus, in Wyoming. The King of England wanted one too, so

Carnegie had plaster copies made of every bone and sent them to London and other cities.

4. Diplodocus had more neck bones. I have 7, the same as a giraffe.
5. They had a wide, flat beak, like a duck's bill, for nipping plants. Behind it were rows and rows of teeth for grinding, and new teeth grew in when old ones wore out. A crest is a bump, fan or tube on top of the head.
6. Nests with baby bones in them. They named the dinosaur Maiasaura, "good mother lizard."
7. Pliny Moody plowed up a stone with three-toed footprints on his family's farm, and people called them "Noah's raven" tracks. Edward Hitchcock, a minister and science teacher, spent his life finding, measuring and drawing tracks. He thought birds made them, but scientists today think most were made by dinosaurs with bird-like feet.
8. The one with the 8-square footprint was bigger. Steps far apart mean it was running.

MY SENSES

All year we have watched animals: squirrels hiding acorns, owls hunting at night, camels in the desert and penguins on the ice. Every one of them uses its senses to find food, stay safe and get home. Now we turn and look at ourselves. God made you with five senses: **seeing, hearing, smelling, tasting and touching**. The Bible says, “I will praise thee; for I am fearfully and wonderfully made” (Psalm 139:14).

In this unit your child will watch their own pupils grow and shrink, send a voice down a string, find out that the nose helps us taste, and name things in a mystery bag by touch alone. They will meet Antonie van Leeuwenhoek peering through his tiny lenses, Alexander Graham Bell making the first telephone call, and Helen Keller learning the word “water” at a pump. Along the way we compare our senses with the animals we have studied, and thank the God who “planted the ear” and “formed the eye” (Psalm 94:9).

BEFORE YOU BEGIN

- Can count objects to 20
- Can sort things into two groups and tell why
- Can name the main parts of the face: eyes, ears, nose, mouth

MASTERY CHECKLIST

- I can name my five senses and the body part for each one.
- I can point to my pupil and iris and tell what my pupil does in bright and dim light.
- I can tell that sound is made by shaking, and that my ears catch it.
- I can name sweet, salty, sour and bitter, and tell how my nose helps me taste.
- I can describe things by touch with words like rough, smooth, soft and hard.
- I can tell how my senses help keep me safe.

OPTIONAL BOOKS AND RESOURCES

- ***The Story of My Life* by Helen Keller (free at Project Gutenberg)** (<https://www.gutenberg.org/ebooks/2397>): Free. A parent can read aloud the short passage in Chapter 4 where Helen learns the word “water” at the pump (Lesson 8.4).
- **Perkins School for the Blind** (<https://www.perkins.org/>): Free. The school where Anne Sullivan studied. Its site has pictures and stories about Braille and Helen Keller that parents can browse with children.

8.1 SEEING ★

OBJECTIVES

- Name the parts of the eye we can see in a mirror: eyelid, eyelashes, iris and pupil.
- Tell how the pupil gets smaller in bright light and bigger in dim light.
- Tell how God made the eyes to see and how eyelids, eyelashes and tears keep them safe.

Warm-up. Sit with your child by a window. Close your eyes tight and count slowly to ten. Now open them. Was the room very bright for a moment? Then cover one eye with a hand and look around. Does the room look a little different with only one eye? Today we learn about the gift of seeing.

Video. Coming soon. How the eye works for young children: the pupil getting bigger and smaller in light and dark, eyelids and tears protecting the eye, and close-up looks at animal eyes such as owls, cats and flies (search SciShow Kids, Homeschool Pop (Alternate), Science Max, Moody Science classics and nature footage).

KEY TERMS

sense

A way God made your body to learn about the world. Seeing, hearing, smelling, tasting and touching are your five senses.

pupil

The round black dot in the middle of your eye. It is a little opening that lets light in.

iris

The colored ring around the pupil. It may be brown, blue, green or gray.

eyelid

The flap of skin that closes over your eye to keep it safe and wet.

CORE IDEAS

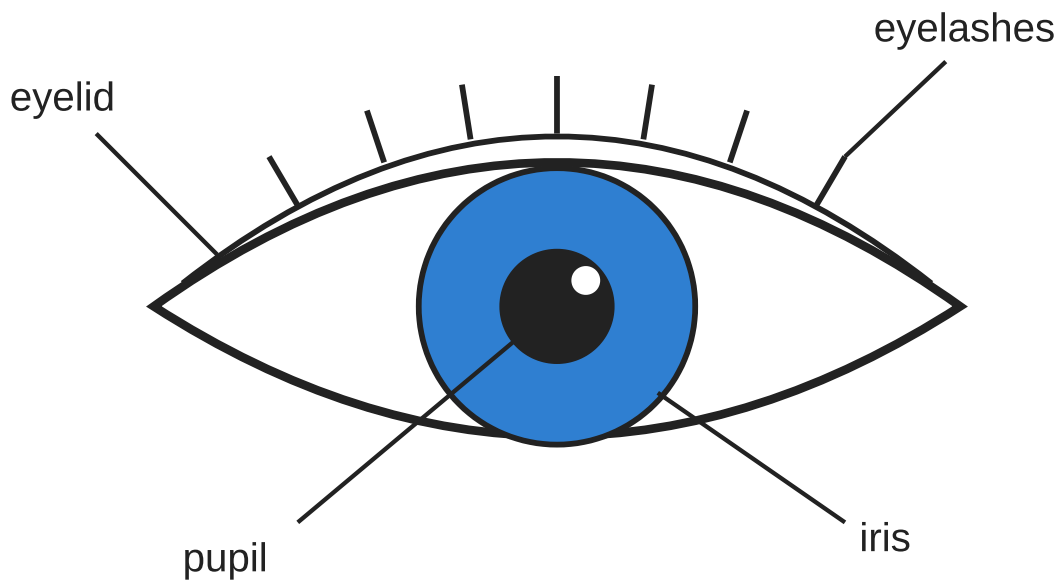
The story. Long ago, in the town of Delft in Holland, lived a man named Antonie van Leeuwenhoek. He sold cloth for his work. But he loved to look at things. He made tiny glass lenses, smaller than a pea, that made things look much bigger. One day in the 1670s he looked at a drop of water through his lens. He saw tiny living things swimming all around! No one had ever seen them before. His eyes, with a little help, found a whole new world.

How they figured it out. Your eyes work by letting in **light**. Light bounces off a ball, a tree or your mother's face and comes into your eye. Look in a mirror. The black dot in the middle is the **pupil**. It is a little opening, like a window. The colored ring around it is the **iris**. The iris makes the pupil bigger or smaller. In bright light the pupil gets small, so not too much

light gets in. In a dim room the pupil gets big, to catch all the light it can. Even so, in the dark we cannot see colors well.

The big idea. God made your eyes with helpers to keep them safe. Your **eyelids** blink many times each minute. Each blink spreads tears over your eye to keep it wet and clean. Your eyelashes catch dust. Your eyebrows keep sweat from running into your eyes. Two eyes working together help you tell how near or far something is. That is how you catch a ball!

God's handiwork. Animals have eyes made just right for their lives. An owl has huge eyes for seeing at night. A fly has eyes made of many tiny parts, so it can see a swatter coming. A horse has eyes on the sides of its head and can see almost all the way around. The Bible says, "he that formed the eye, shall he not see?" (Psalm 94:9). The God who made eyes sees everything, and He gave you eyes to enjoy His world.



The parts of the eye you can see in a mirror.

PICTURE STUDY



Young Hare, Albrecht Dürer, 1502 · Watercolor and gouache on paper · Albertina, Vienna

Albrecht Dürer was a German artist who looked at the world very, very carefully. He painted this hare so closely that you can almost count the hairs. Some people think the hare sat in his workshop while he painted it.

Look closely at the hare's eye. Dürer painted a tiny window shining in it! He saw the light of the window bouncing off the hare's eye, and he painted what he saw.

Look closely

- Find the hare's eye. Can you see the little bright window in it?
- Look at the whiskers. Are they long or short? Do they point up or down?
- Find the ears. Is one ear turned a different way from the other?
- Look at the fur. Is it all one color, or many browns, tans and white?

Talk about it

1. Where are the hare's eyes on its head? Why might that help a hare watch for a fox?
2. How did Dürer use his own eyes to make this picture?
3. What is one thing you see in this picture that you did not see at first?

Safety first. Never look straight at the sun, even for a moment, and never look at it through a magnifying glass, binoculars or a lens. It can hurt your eyes for good. Do not touch or poke your eyes.

MAKE AND DO: WATCH YOUR PUPILS CHANGE

You will be a scientist who looks at eyes. You will see the pupil get bigger and smaller with your own eyes, and then make a paper eye to show what you learned.

You will need

- A hand mirror
- A room you can make dim, and a lamp or sunny window
- A paper plate
- Crayons, including the color of your own iris
- A black paper circle about the size of a coin, and glue

Steps

1. Sit by a bright lamp or window, but do not look into the light. Look at your eye in the mirror. Is your pupil big or small?
2. Now go into a dim room, or have a parent turn off the lights. Wait while you count slowly to twenty. Look in the mirror again, near a little light from the door. Is your pupil big or small now?
3. Turn the light back on and watch closely. Do you see the pupil shrink fast?
4. Look at a parent's eye the same way. Do their pupils change too?
5. Make a paper eye. Color a big ring in the middle of the paper plate the same color as your iris.
6. Glue the black circle in the middle for the pupil. Draw eyelashes around the edge.
7. Tell a parent: "In bright light my pupil gets small. In dim light my pupil gets big."

Tips

- It helps to have a partner. One person looks, and the other person turns the light on and off.
- Make a second black circle that is smaller. Switch them to show bright light and dim light.

Check your work

- I can point to my iris and my pupil.
- I can tell what my pupil does in bright light and in dim light.

NATURE NOTEBOOK

1. Look in a mirror and draw one of your eyes. Color your iris. Label the pupil, iris, eyelid and eyelashes with a parent's help.
2. Draw a picture of something far away and something close up that you saw today.
3. Look at a leaf or a coin with a magnifying glass. Draw what you see.

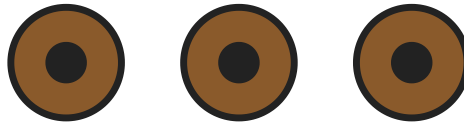
From history. Antonie van Leeuwenhoek wrote many letters about what he saw to the Royal Society in London, a group of men who loved science. At first some of them did not believe him. Later others looked through good lenses and saw the tiny living things too. Leeuwenhoek kept looking and writing for the rest of his long life, and he is remembered as one of the first people to see living things too small for our eyes alone.

WORKED EXAMPLES

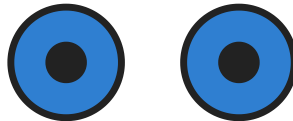
Example 1. Our family made a picture chart of eye colors. It shows 3 people with brown eyes, 2 with blue eyes and 1 with gray eyes. Which eye color do the most people have? How many people are in the chart in all?

Our Family's Eye Colors

brown



blue



gray



Our family's eye colors.

1. Count the brown eyes in the chart: 1, 2, 3. That is 3.
2. Count the blue eyes: 1, 2. That is 2.
3. Count the gray eyes: 1. That is 1.
4. The biggest number is 3, so brown has the most.
5. Count everyone: 3 and 2 make 5, and 1 more makes 6.

Answer: Brown eyes are the most. There are 6 people in all.

PRACTICE

1. **EASY** Point to your pupil in the mirror. Then point to your iris. What color is your iris?
2. **EASY** What does your pupil do when you go into a dark room?
3. **MEDIUM** Name two things that keep your eyes safe.

4. **MEDIUM** Count the eyes in the room right now. Count every person and pet. Each one has 2 eyes. How many eyes are there?
5. **HARD** Why do you think an owl has such big eyes? Tell your answer out loud.

COMMON MISTAKES

- Thinking the pupil is a black spot painted on the eye. It is really an opening that lets light into the eye.
- Thinking our eyes send out beams to see things. Light comes *into* our eyes from the things we look at.
- Thinking it is safe to look at the sun for just a second, or through sunglasses. Never look at the sun.

Make it a game • I Spy Like a Scientist. Take turns saying, “I spy with my little eye something that is...” and give a color, a shape or a size. The other players look around and guess. For a harder game, give two clues, such as “something round and red.” Then play it again with one eye covered, and talk about whether it was harder.

Scripture. “He that planted the ear, shall he not hear? he that formed the eye, shall he not see?” (Psalm 94:9, KJV)

God made our eyes, so He knows how to see. Nothing is hidden from Him. Every time we look at a flower or a hare, we can thank Him for our eyes.

Practice answers

1. The pupil is the black dot in the middle. The iris is the colored ring around it. The color is the child’s own eye color, such as brown, blue, green or gray.
2. It gets bigger to let in more light.
3. Any two: eyelids, eyelashes, eyebrows, tears, blinking.
4. Count by twos for each person or pet. For example, 3 people make 6 eyes; 3 people and a dog make 8 eyes.
5. An owl hunts at night, when there is very little light. Big eyes with big pupils catch more light so it can see in the dark.

8.2 HEARING

OBJECTIVES

- Tell that sound is made when something shakes back and forth, called vibrating.
- Tell how the outer ear catches sound and the eardrum inside feels it shake.
- Sort sounds as loud or soft and high or low.

Warm-up. Put your hand flat on the front of your neck and hum a song. What do you feel? Now stop humming. Is your neck still buzzing? That buzz is the shaking that makes sound. Now be very quiet for a little while with your eyes closed and count how many sounds you can hear.

Video. Coming soon. How we hear for young children: sound as vibration, the outer ear and eardrum, loud and soft and high and low sounds, a paper cup telephone, and animals with big ears such as rabbits, foxes and owls (search SciShow Kids, Homeschool Pop (Alternate), Science Max, Moody Science classics and nature footage).

KEY TERMS

sound

What you hear when something shakes back and forth and the shaking travels to your ears.

vibrate

To shake back and forth very fast. A drum, a guitar string and your throat vibrate when they make sound.

ear

The part of your body God made for hearing. The outside part catches sound and the inside part feels it.

eardrum

A thin, tight skin deep inside your ear. It shakes when sound reaches it, like the top of a little drum.

CORE IDEAS

The story. On March 10, 1876, in Boston, a teacher named Alexander Graham Bell was working on a new machine. His helper, Thomas Watson, was in another room. Bell spoke into the machine: “Mr. Watson, come here, I want to see you.” Watson heard the words come out of his own machine, in the other room! He ran to tell him. It was the very first telephone call. Bell spent much of his life helping deaf people learn to speak, and he loved to study how we hear.

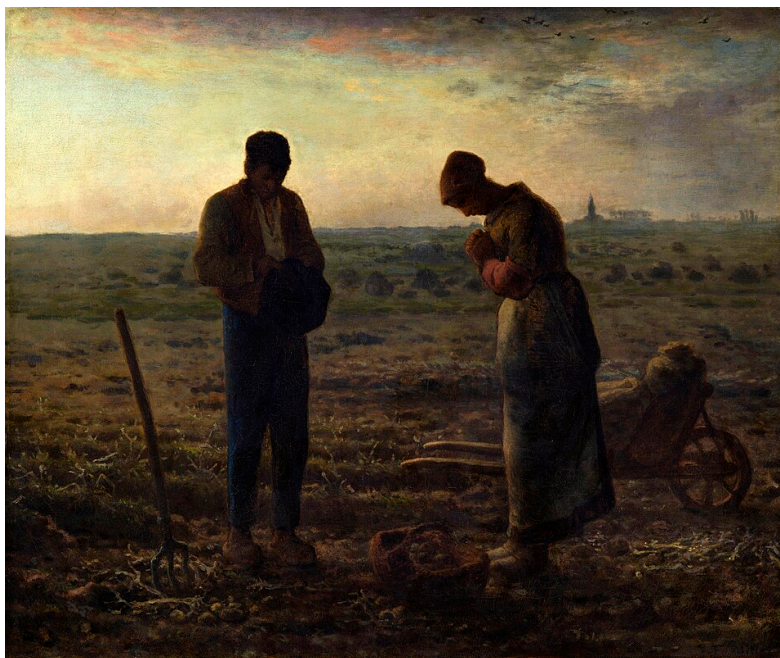
How they figured it out. Every sound starts with something that shakes. Pluck a rubber band and watch it **vibrate**. Tap a drum and it buzzes. When you talk, parts of your throat

shake. The shaking pushes the air, and the air carries the shaking to your ear, like ripples moving across a pond. Fast shaking makes a high sound, like a bird's chirp. Slow shaking makes a low sound, like a cow's moo. A big push makes a loud sound. A little push makes a soft sound.

The big idea. Your outer **ear** is shaped like a funnel to catch sound. The sound goes down a little tunnel to your **eardrum**. The eardrum shakes. Behind it are three tiny bones, the smallest bones in your whole body. They pass the shaking on, and your brain tells you, "That is my dog barking!" You have two ears, one on each side, so you can tell which way a sound is coming from.

God's handiwork. A rabbit can turn its long ears toward a sound to listen for danger. A fox can hear a mouse moving under the snow. A bat makes little squeaks and listens for the echoes to find bugs in the dark. The Bible says, "The hearing ear, and the seeing eye, the LORD hath made even both of them" (Proverbs 20:12). God made ears for each animal, and He made your ears so you can hear music, birds and the voices of the people who love you.

PICTURE STUDY



The Angelus, Jean-François Millet, 1857–1859 · Oil on canvas · Musée d'Orsay, Paris

Jean-François Millet grew up on a farm in France, and he loved to paint farm families at work. In this painting a man and his wife have been digging potatoes all afternoon. Far away, the church bell begins to ring. They hear it, and they stop their work to pray.

You cannot hear a painting. But Millet wanted us to feel the quiet of the evening and the sound of the faraway bell.

Look closely

- Find the church far away on the edge of the field. That is where the bell is ringing.

- Look at the man and the woman. What are they doing with their heads and hands?
- Find the basket, the wheelbarrow and the pitchfork. What work were they doing?
- Look at the sky. What time of day is it?

Talk about it

1. What sound do you think the man and woman heard? Was it loud or soft from so far away?
2. What other sounds might you hear in this field in the evening?
3. What sounds call your family to stop and do something, like a dinner bell or a doorbell?

Safety first. Never put anything inside your ear, not even a cotton swab or a pencil. Cover your ears or move away from very loud sounds. Do not shout into someone's ear or into the cup telephone.

MAKE AND DO: MAKE A CUP TELEPHONE

Bell sent a voice through a wire. You can send your voice through a string! You will see that sound travels by shaking.

You will need

- Two paper cups
- A long piece of string, about as long as your bed or longer
- A sharp pencil (a parent pokes the holes)
- Two paper clips

Steps

1. A parent pokes a small hole in the bottom of each cup with the pencil.
2. Push one end of the string through the hole into the first cup. Tie it to a paper clip inside so it cannot pull out. Do the same with the other cup.
3. You take one cup and your helper takes the other. Walk apart until the string is pulled tight and straight.
4. Your helper holds the cup over their ear. Talk softly into your cup.
5. Switch: you listen while your helper talks. Can you hear?
6. Now let the string hang loose and droop. Talk again. Can you still hear well?
7. Pinch the string with your fingers while your helper talks. What happens to the sound?

Tips

- The string must be tight and must not touch anything. The shaking travels along the string.
- Talk in a normal or soft voice. Shouting does not help and can hurt your helper's ear.

Check your work

- I can tell that the string shakes to carry my voice.
- I can tell why a loose or pinched string does not work as well.

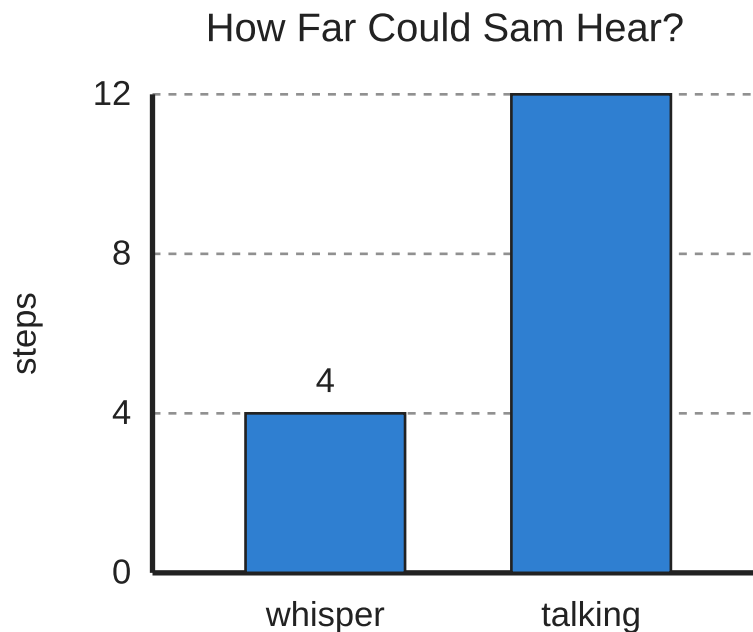
NATURE NOTEBOOK

1. Draw your cup telephone with a person at each end. Draw little wavy lines along the string to show the sound shaking.
2. Sit outside and close your eyes. Draw or list three sounds you hear. Circle the loudest one.
3. Draw an animal with big ears, such as a rabbit or a fox. Draw arrows to show where its ears are pointing.

From history. In 1816, a French doctor named René Laennec wanted to listen to a sick woman's heart. He remembered children who scratched one end of a long log and listened at the other end. So he rolled some paper into a tight tube, put one end on her chest and the other end to his ear. He could hear her heart better than ever! This was the first stethoscope, the tool your doctor still uses to listen to your heart.

WORKED EXAMPLES

Example 1. Mom whispered while Sam walked away one step at a time. Sam could hear the whisper for 4 steps. Then Mom talked in her normal voice. Sam could hear it for 12 steps. Which sound could Sam hear farther away? How many more steps is that?



How many steps away Sam could hear each voice.

1. Look at the chart. The whisper bar goes up to 4. The talking bar goes up to 12.
2. 12 is bigger than 4, so the talking voice could be heard farther away.
3. To find how many more, count up from 4 to 12: 5, 6, 7, 8, 9, 10, 11, 12. That is 8 counts.
4. So the talking voice was heard 8 more steps away.

Answer: The talking voice could be heard farther, 8 more steps than the whisper.

PRACTICE

1. **EASY** Close your eyes. A parent makes three sounds, such as a clap, a spoon tapping a cup and a jingle of keys. Name each sound.
2. **EASY** Sort these sounds into loud or soft: a fire truck siren, a cat purring, a drum, a whisper.
3. **MEDIUM** Which is a high sound and which is a low sound: a bird chirping or a cow mooing?
4. **MEDIUM** A parent claps a number of times while you keep your eyes closed. Count the claps. Try it three times.

5. **HARD** Pluck a rubber band stretched over an open box. What do you see and hear? Tell what makes the sound.

COMMON MISTAKES

- Thinking sound comes only from mouths and machines. Any thing that shakes can make sound, like a door, a drum or the wind in leaves.
- Thinking the part of the ear on the outside of your head does the hearing. It only catches sound. The hearing happens deep inside, at the eardrum and beyond.
- Thinking loud and high mean the same thing. A loud sound is strong. A high sound is like a squeak. A whistle can be high and soft, and a big drum can be low and loud.

Make it a game · Clap It Back. A parent claps a short pattern, such as clap, clap, pause, clap. The child listens and claps it back exactly. Then the child makes a pattern for the parent to copy. Make the patterns longer each round. For a harder game, play it with eyes closed, or use soft claps and loud claps.

Scripture. “The hearing ear, and the seeing eye, the LORD hath made even both of them.” (Proverbs 20:12, KJV)

Our ears are not an accident. The Lord made them. We can use them well by listening to our parents and to God’s Word.

Practice answers

1. The child names the sounds the parent made, for example: a clap, a spoon on a cup, keys jingling.
2. Loud: fire truck siren, drum. Soft: cat purring, whisper.
3. The bird chirping is high. The cow mooing is low.
4. The child counts the claps correctly each time (for example, 5 claps, 8 claps, 11 claps).
5. The rubber band shakes back and forth very fast (it vibrates) and makes a twang sound. The shaking makes the sound. When it stops shaking, the sound stops.

8.3 SMELLING AND TASTING

OBJECTIVES

- Tell that we smell with our nose and taste with taste buds on our tongue.
- Name the main tastes: sweet, salty, sour and bitter.
- Show by a test that the nose helps us taste our food.

Warm-up. Close your eyes. A parent holds something under your nose, such as an orange peel, a cinnamon stick or a cut onion. What is it? You did not see it or touch it, but your nose knew! Then lick your lips and look at your tongue in a mirror. Do you see tiny bumps?

Video. Coming soon. How smell and taste work for young children: taste buds on the tongue, sweet, salty, sour and bitter, the hold-your-nose jelly bean test, and animals with keen noses such as bloodhounds and bears (search SciShow Kids, Homeschool Pop (Alternate), Science Max, Moody Science classics and nature footage).

KEY TERMS

smell

The sense you use with your nose. Your nose catches tiny bits that float in the air from things like flowers and bread.

taste

The sense you use with your tongue to tell if food is sweet, salty, sour or bitter.

taste buds

Tiny parts on your tongue that do the tasting. You have thousands of them.

CORE IDEAS

The story. Hold an orange in your hand. Before you peel it, sniff it. A little smell. Now scratch the peel with your fingernail and sniff again. Wow! The smell jumps out. When you scratch the peel, tiny drops of orange oil fly into the air. They float up into your nose, and you smell orange. Now taste a piece. It is sweet and a little sour. Your nose and your tongue work together to tell you, “This is a good orange.”

How they figured it out. Your tongue has tiny bumps all over it. Hidden in the bumps are **taste buds**. They can tell **sweet** like honey, **salty** like a pretzel, **sour** like a lemon and **bitter** like strong coffee. There is also a rich, meaty taste called savory, like soup broth. But here is a surprise: much of what we call taste really comes from the nose! Hold your nose and eat a jelly bean. It tastes only sweet. Let go of your nose, and the flavor rushes in. That is also why food tastes plain when you have a stuffy cold.

The big idea. Smelling and tasting help you enjoy food, and they help keep you safe. Smoke smells like danger. Old milk smells sour, so you do not drink it. Many bad things taste bitter, so you want to spit them out. Your nose and tongue are like guards at the door of your body.

God's handiwork. Many animals smell much better than we do. A bloodhound can follow the smell of a lost person's footsteps. A bear can smell food from very far away. A salmon uses smell to find the very stream where it hatched. God gave each one the nose it needs. He also gave us good food to enjoy. The Bible says, "O taste and see that the LORD is good" (Psalm 34:8).

PICTURE STUDY



The Milkmaid, Johannes Vermeer, about 1657–1658 · Oil on canvas · Rijksmuseum, Amsterdam

Johannes Vermeer lived in Delft, the same Dutch town as Antonie van Leeuwenhoek from Lesson 8.1. Vermeer painted quiet rooms filled with soft light from a window. Here a kitchen maid pours milk very slowly into a bowl. She may be making a bread pudding.

Vermeer painted the bread so carefully that the crust looks crunchy. You can almost smell it!

Look closely

- Find the milk. Follow the thin white stream from the jug to the bowl.
- Look at the bread on the table. Find the bright little dots of light on the crust.
- Find the window. Where is the light coming from?
- Look at the maid's face. Is she in a hurry, or careful and calm?

Talk about it

1. What do you think this kitchen smelled like?
2. Which food in the picture would taste salty? Which might taste sweet?

3. What is your favorite smell in your own kitchen?

Safety first. Only taste foods a parent gives you. Check for food allergies before the taste test. Never taste or sniff things you do not know, like cleaners, berries outside or things in bottles. To smell something new, hold it away from your face and wave the air toward your nose with your hand.

MAKE AND DO: SMELL JARS AND THE HOLD-YOUR-NOSE TEST

First you will be a smell detective and name smells with your eyes closed. Then you will do a real test to find out if your nose helps you taste.

You will need

- Five small cups or jars, and paper or foil to cover them
- Five cotton balls
- Five smells, such as vanilla, lemon juice, cinnamon, peppermint and a little coffee
- A small bag of mixed jelly beans (or small pieces of apple and pear)
- A blindfold or scarf

Steps

1. A parent puts a few drops or a pinch of each smell on a cotton ball and puts each one in its own cup. Cover each cup and poke a few holes in the top.
2. Sniff each cup. Name the smell if you can. Did you get them right? Which smell did you like best?
3. Now the taste test. Put on the blindfold.
4. Hold your nose tight. A parent puts a jelly bean in your mouth. Chew it and guess the flavor. Then let go of your nose. Does the flavor change?
5. Try 6 jelly beans with your nose held, and 6 with your nose open. A parent makes a check for each right guess.
6. Count the checks. Which way did you guess right more times?
7. Tell what you found: "My nose helps me taste."

Tips

- If you use apple and pear, cut them into pieces the same size so you cannot tell them apart by touch.
- Keep the jelly beans for the test only. A few are plenty.

Check your work

- I can name a smell with my eyes closed.
- I can tell what happened when I held my nose and why.

NATURE NOTEBOOK

1. Draw your tongue and put tiny dots all over it for the taste buds.
2. Draw four foods in four boxes: one sweet, one salty, one sour and one bitter. Label each box.
3. Draw a smell that is a “warning smell,” like smoke, and a smell you love, like fresh bread.

From history. For many years, schoolbooks showed a “tongue map” with sweet at the tip, sour on the sides and bitter at the back. It came from a German science paper from 1901 that was misunderstood when it was retold. When scientists tested real tongues carefully, they found that every part with taste buds can taste sweet, salty, sour and bitter. Good scientists test things for themselves, and so can you: put a tiny bit of sugar on the side of your tongue and see if you can taste it.

WORKED EXAMPLES

Example 1. Anna tried 6 jelly beans with her nose held. She guessed 2 flavors right. Then she tried 6 jelly beans with her nose open. She guessed 5 right. Which way did she guess more right? How many more?

Right Guesses

nose held

✓	✓				
---	---	--	--	--	--

nose open

✓	✓	✓	✓	✓	
---	---	---	---	---	--

Anna’s jelly bean test.

1. Look at the chart. Count the checks in the “nose held” row: 1, 2. That is 2.
2. Count the checks in the “nose open” row: 1, 2, 3, 4, 5. That is 5.
3. 5 is more than 2, so she guessed more right with her nose open.
4. Count up from 2 to 5: 3, 4, 5. That is 3 more.

Answer: Anna guessed more right with her nose open, 3 more. Her nose helped her taste.

PRACTICE

1. **EASY** Point to the part of your body you smell with. Then point to the part you taste with.
2. **EASY** Match each food to its taste: lemon, honey, pretzel. Tastes: sweet, salty, sour.
3. **MEDIUM** Sort these smells into “I like it” and “warning!”: smoke, cookies baking, spoiled milk, flowers.
4. **MEDIUM** Why does food taste plain when you have a stuffy nose from a cold?
5. **HARD** Name an animal that uses its nose to do its job. Tell what it smells for.

COMMON MISTAKES

- Thinking each part of the tongue tastes only one taste, like sweet only at the tip. All the parts of the tongue with taste buds can taste every taste.
- Thinking flavor comes only from the tongue. The nose does much of the work.
- Thinking it is fine to sniff or taste anything to find out what it is. Only taste what a parent gives you, and wave smells toward your nose.

Make it a game • Smell Detective. One player hides a kitchen smell, like a banana, a pickle, soap or an orange, inside a paper bag. The other player closes their eyes, sniffs the top of the bag and guesses. Give one hint if needed: “It is sweet” or “It is a fruit.” Take turns. Score a point for each right guess.

Scripture. “O taste and see that the LORD is good: blessed is the man that trusteth in him.” (Psalm 34:8, KJV)

When we taste good food, we know it is good. The psalm says that when we trust God, we learn that He is good in the same sure way.

Practice answers

1. The nose for smelling. The tongue for tasting.
2. Lemon is sour. Honey is sweet. A pretzel is salty.
3. I like it: cookies baking, flowers. Warning: smoke, spoiled milk.
4. Much of the flavor of food comes from smell. When the nose is stuffed up, the smell cannot get in, so food tastes plain.
5. Many answers: a bloodhound smells to find lost people, a bear smells for food, a salmon smells to find its home stream, a dog sniffs to know who has been in the yard.

8.4 TOUCHING

OBJECTIVES

- Tell that we feel with our skin, and that fingertips feel things best.
- Describe things by touch with words like rough, smooth, soft, hard, hot, cold, wet and dry.
- Tell how Helen Keller learned words by touch and how Braille lets people read with their fingers.

Warm-up. Close your eyes. A parent gives you three things to hold, one at a time, such as a spoon, a sock and an apple. Can you name each one just by feeling it? Then rub your fingertips on your jeans, then on a smooth table. How are they different?

Video. Coming soon. The sense of touch for young children: skin and fingertips, rough and smooth and hot and cold, reading Braille with the fingers, the story of Helen Keller and the water pump, and animals that feel with whiskers such as cats and seals (search SciShow Kids, Homeschool Pop (Alternate), Science Max, Moody Science classics, Perkins School for the Blind and nature footage).

KEY TERMS

touch

The sense you use to feel things with your skin.

skin

The soft cover over your whole body. It keeps you safe and feels what touches you.

texture

How something feels when you touch it, like rough, smooth, bumpy or fuzzy.

Braille

A way of reading with your fingers by feeling little raised dots on paper.

CORE IDEAS

The story. Helen Keller was a little girl in Tuscumbia, Alabama. When she was a baby, a sickness took away her seeing and her hearing. She could not see words or hear them. Then a teacher named Anne Sullivan came to live with her family. In April 1887, Anne took Helen to the water pump. She held one of Helen’s hands under the cold, splashing water. Into Helen’s other hand she spelled with her fingers: w-a-t-e-r. Suddenly Helen understood! That wonderful cool something was called “water.” By touch, Helen learned many words that very day.

How they figured it out. You feel with your **skin**, and you have skin all over your body. Under your skin are many tiny feelers. They send messages to your brain: “This is soft,” “This is hot,” “Ouch, that is sharp!” Your fingertips and your lips have the most feelers

packed close together. That is why you use your fingers to feel the **texture** of things, and why a baby puts things in its mouth.

The big idea. Touch tells you rough or smooth, soft or hard, hot or cold, wet or dry. It also tells you when something hurts. Pain is not fun, but it is a helper. If you touch a hot pan, pain makes you pull your hand away fast, before you get badly burned. Touch also lets people who cannot see read! They read **Braille**, rows of little raised dots, by gently sliding their fingertips over them.

God's handiwork. Animals feel with special parts. A cat's whiskers feel if a space is wide enough to squeeze through. A seal's whiskers can feel the water move when a fish swims by. A raccoon feels for food with its clever front paws. God made us to touch too: to hold, to help and to hug. Jesus took the little children "up in his arms, put his hands upon them, and blessed them" (Mark 10:16).

PICTURE STUDY



Praying Hands (Study of the Hands of an Apostle), Albrecht Dürer, 1508 · Brush and ink with white highlights on blue-colored paper · Albertina, Vienna

Albrecht Dürer drew these hands as a study, a practice drawing, for a large painting of the apostles in a church. The painting was later lost in a fire, but this drawing of the hands was saved. Today it is one of the most famous drawings in the world.

Dürer looked so closely that you can see the wrinkles on the knuckles and the shape of each fingernail. Hands are how we touch the world.

Look closely

- Find the fingertips. Are they touching each other?
- Look at the knuckles. Can you see the little wrinkles in the skin?

- Find the white lines. Dürer used white to show where light shines on the hands.
- Find the sleeves at the bottom. What do you think the person is wearing?

Talk about it

1. Put your own hands together like this. What do your fingertips feel?
2. Do these hands look young and smooth, or older and hard-working? What makes you think so?
3. What are some good things our hands can do for other people?

Safety first. Do not put anything sharp, hot or breakable in the feely bag. Never touch a stove, an iron or a hot pan to “test” your sense of touch. Do not touch wild animals.

MAKE AND DO: THE MYSTERY FEELY BAG

You will be a touch detective. With no peeking, you will name things only by how they feel. Then you will make a touch card with bumpy dots, like Braille.

You will need

- A cloth bag or a pillowcase
- About eight safe things with different textures, such as a cotton ball, a pine cone, a smooth stone, a sponge, a feather, a block, a piece of sandpaper and a spoon
- An index card or piece of cardboard
- White glue, and a handful of dried beans or dried split peas

Steps

1. A parent puts the things in the bag while you look away.
2. Reach in with one hand. Feel one thing. Say how it feels: rough or smooth? Soft or hard? Bumpy, fuzzy or prickly?
3. Guess what it is. Then pull it out and see if you were right.
4. Do this for every thing in the bag. Count how many you guessed right.
5. Now sort the things into two piles: rough and smooth. Then sort them again: soft and hard.
6. Make a touch card. Glue beans on a card in the shape of the first letter of your name. Let it dry.
7. Close your eyes and feel your card. Can you tell what letter it is with your fingers?

Tips

- Try feeling with the back of your hand or your elbow, then with your fingertips. Which part feels better?
- Let a parent have a turn too. Grown-ups like to be touch detectives!

Check your work

- I can use touch words like rough, smooth, soft and hard.
- I can tell which part of my body feels things best.

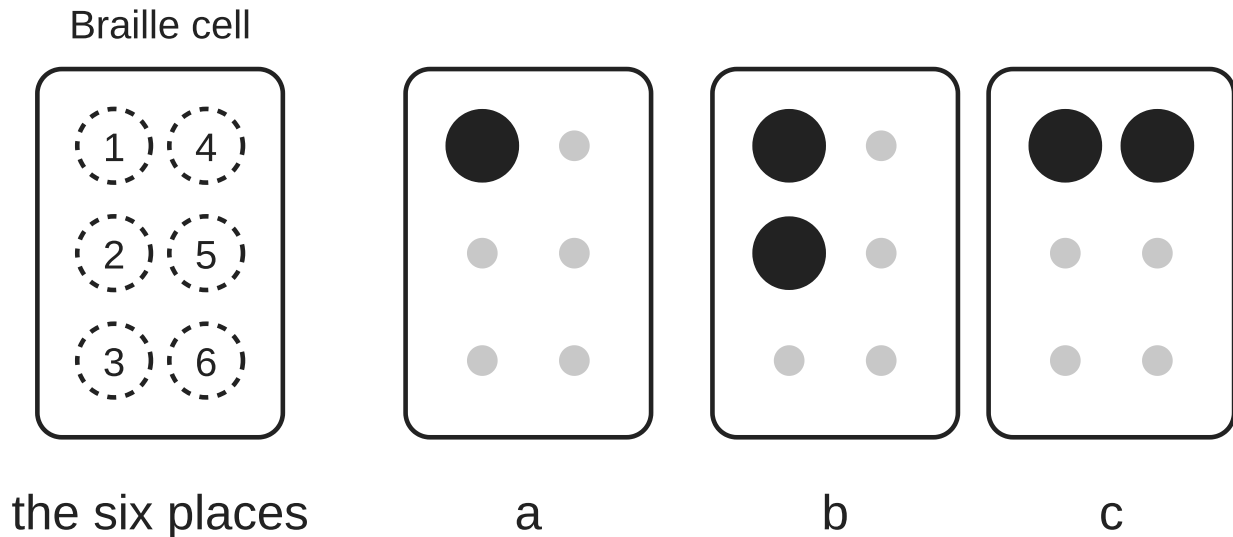
NATURE NOTEBOOK

1. Make a texture page. Lay your paper on a rough thing, like a coin, a leaf or a screen, and rub over it with the side of a crayon. Label each rubbing.
2. Trace your hand. On each finger, write or draw one thing that feels good to touch.
3. Draw a cat and its whiskers. Tell what the whiskers help the cat feel.

From history. Louis Braille was a French boy who lost his sight after an accident in his father's workshop when he was very young. At a school for blind children in Paris, he worked for years to make a better way to read. He used raised dots that a fingertip could feel all at once, and he printed his system in 1829. Helen Keller learned to read Braille too. Today Braille is used all over the world, on books, signs and even elevator buttons. Look for Braille dots the next time you ride an elevator!

WORKED EXAMPLES

Example 1. In Braille, each letter is made of raised dots. The letter “a” has 1 dot. The letter “b” has 2 dots. The letter “c” has 2 dots. How many dots do you feel in the word “cab”?



A Braille cell has six places for dots. Here are the letters a, b and c.

1. Look at the picture of the letters. Find “c.” Count its dots: 1, 2. That is 2.
2. Find “a.” Count its dots: 1. That is 1.
3. Find “b.” Count its dots: 1, 2. That is 2.
4. Add them: 2 and 1 make 3, and 2 more make 5.

Answer: The word “cab” has 5 dots.

PRACTICE

1. **EASY** Sort these by touch into rough and smooth: sandpaper, a glass window, tree bark, a ribbon.
2. **EASY** Point to the part of your body that you use to feel. Where does it cover you?
3. **MEDIUM** Say whether each one feels hot or cold: an ice cube, a cup of cocoa, snow, a sunny sidewalk in summer.
4. **MEDIUM** The Braille letter “l” has 3 dots. The letter “a” has 1 dot. How many dots are in the word “all”?
5. **HARD** Pain does not feel good. How can pain help you? Tell your answer out loud.

COMMON MISTAKES

- Thinking we feel only with our hands. Our skin covers the whole body, and all of it can feel, though fingertips and lips feel best.
- Thinking pain is always bad. Pain is a warning that helps keep the body safe.
- Thinking people who cannot see cannot read. Many read Braille quickly with their fingertips.

Make it a game · What Did I Draw on Your Back?. One player draws a simple shape or a number with one finger on the other player's back: a circle, a square, a heart or a number under 10. The other player guesses by feeling alone. Take turns. For a harder game, draw a letter. Talk about it: is the back as good at feeling as the fingertips?

Scripture. "And he took them up in his arms, put his hands upon them, and blessed them." (Mark 10:16, KJV)

Jesus did not just talk to the children. He held them and put His hands on them. A gentle touch can show love, and we can use our hands to help and bless others.

Practice answers

1. Rough: sandpaper, tree bark. Smooth: a glass window, a ribbon.
2. The skin. It covers the whole body.
3. Hot: a cup of cocoa, a sunny sidewalk in summer. Cold: an ice cube, snow.
4. $1 + 3 + 3 = 7$ dots.
5. Pain is a warning. It tells you to pull away from something hot or sharp so you do not get hurt worse, and it tells you when a part of your body needs care.

UNIT 8 REVIEW

This is an oral review. A parent asks each question aloud, and the child answers by telling, pointing or showing. Give full points for a clear answer in the child's own words. The review is worth 20 points.

1. (3 pts) Name your five senses. Point to the part of your body you use for each one.
2. (3 pts) Point to your pupil in a mirror. What does it do in bright light? What does it do in the dark?
3. (3 pts) What makes a sound? Show me with a rubber band or by humming with your hand on your neck.
4. (2 pts) Tell about the cup telephone. Why did the string need to be tight?
5. (3 pts) Name a food that is sweet, one that is salty and one that is sour.
6. (2 pts) What happened when you held your nose and ate a jelly bean? What does that show?
7. (2 pts) How did Helen Keller learn the word "water"?
8. (2 pts) Close your eyes and feel two things a parent gives you. Tell me one is rough or smooth, and one is soft or hard.

UNIT PROJECT: MY FIVE SENSES BOOK

Make a little book with five pages, one for each sense. On each page, draw the body part you use for that sense, label it, and draw or glue in things that go with it: your paper eye or an eye drawing, a picture of your cup telephone, a smell you love and a taste chart, and a touch page with crayon rubbings or glued-on bits of sandpaper, cotton and foil. On the last page, draw one animal from this year and tell which sense it uses best.

Read your book aloud to your family. For each sense, tell one thing you found out by testing it yourself, and one way that sense helps keep you safe.

- **Five senses:** All five senses have a page with the right body part drawn and labeled.
- **Tests I did:** The book shows at least three of the unit's tests, such as the pupil watch, cup telephone, jelly bean test or feely bag, and tells what happened.
- **Telling:** The child tells about each page clearly in their own words, including one way a sense keeps us safe.
- **Care:** The pages are neat and colorful, and the animal page connects a sense to an animal studied this year.

Answer key

1. Seeing (eyes), hearing (ears), smelling (nose), tasting (tongue), touching (skin, especially the fingertips).
2. The pupil is the black dot in the middle of the eye. It gets smaller in bright light and bigger in the dark.

3. Something shaking back and forth, called vibrating, makes sound. The child shows a plucked rubber band or feels the throat buzz while humming.
4. The voice made the string shake, and the shaking traveled along the string to the other cup. A loose or pinched string does not carry the shaking well.
5. Many answers. For example: sweet, honey; salty, a pretzel; sour, a lemon.
6. It tasted only sweet, and the flavor was hard to tell. When I let go, the flavor came back. It shows the nose helps us taste.
7. Her teacher, Anne Sullivan, held one of Helen's hands under the water at the pump and spelled w-a-t-e-r with her fingers into Helen's other hand.
8. The child uses touch words correctly, for example: sandpaper is rough, a stone is smooth and hard, a cotton ball is soft.

BONUS: NATURE LAB

This bonus unit takes everything you learned about animal homes and habits and carries it outdoors. You will walk slowly with a nature journal like the painter Albert Bierstadt, count the living things in your own yard like the bird counters who began the Christmas Bird Count, visit a zoo, a farm or a museum like the animal painter Rosa Bonheur, and build a small labeled collection like the young John James Audubon.

The lessons are short, playful and meant for fresh air. Each one has a picture to study, something to make or do, and a few simple counts and comparisons. Along the way you will hear how God gave every creature a home (Psalm 104:17-18), how the animals “shall teach thee” when we watch them (Job 12:7), and why Jesus told us to “consider the lilies of the field” (Matthew 6:28).

BEFORE YOU BEGIN

- Can count objects to 12 and add small numbers
- Can make simple drawings and say a sentence about them
- Knows a few animals and their homes from earlier units
- Can follow simple safety rules outdoors with a grown-up

MASTERY CHECKLIST

- I can keep a nature journal page with the date, the place, the weather, a drawing and labels.
- I can count living things with tally marks and read a picture chart.
- I can watch one animal closely and tell its covering, legs, food and sound.
- I can collect only fallen, non-living things with permission, and sort and label them.
- I can tell one way God made a home for His creatures.

OPTIONAL BOOKS AND RESOURCES

- **Great Backyard Bird Count** (<https://www.birdcount.org/>): Free. Every February, families count the birds they see for at least fifteen minutes and send in their lists. A perfect follow-up to Lesson 9.2.
- **All About Birds, from the Cornell Lab of Ornithology** (<https://www.allaboutbirds.org/>): Free. Photos, songs and facts for North American birds. Use it to name the birds in your nature journal and survey.
- **Smithsonian’s National Zoo** (<https://nationalzoo.si.edu/>): Free. Animal pages and live animal cameras for families who cannot visit a zoo in person (Lesson 9.3).

9.1 NATURE JOURNAL WALK

OBJECTIVES

- Take a slow, quiet nature walk and notice living things with your eyes, ears and nose.
- Draw one plant or thing from real life and label it with the date, the place and the weather.
- Measure a leaf or a twig with a ruler or with finger-widths.

Warm-up. Put one apple or one leaf from a houseplant on the table. Look at it for one whole minute without talking. Then tell three things you noticed. Now look again. Can you find one more thing you missed the first time?

Video. Coming soon. Nature journaling for children and how artists sketch outdoors: search Cornell Lab of Ornithology, John Muir Laws nature journal lessons, SciShow Kids, Homeschool Pop (Alternate) and calm nature footage of meadows, woods and mountains.

KEY TERMS

observe

To look, listen and notice carefully, the way a scientist does.

nature journal

A notebook where you draw and write about the things you find outdoors.

sketch

A quick drawing made while you look at the real thing.

label

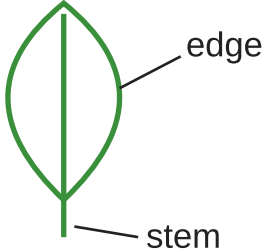
A word written next to a drawing to name it or one of its parts.

CORE IDEAS

The story. In 1859 a painter named Albert Bierstadt rode west with a group of men led by Frederick Lander. The men were marking out a wagon road. Bierstadt went to see the Rocky Mountains in the land we now call Wyoming. Every day he sat outside with paper and paints. He made quick sketches of mountains, rivers, trees and animals. Back east, in his New York studio, he used those small sketches to paint very big pictures. His little outdoor drawings were his nature journal.

The big idea. Artists and scientists start the same way: they **observe**. Walk slowly. Stop and stand still. Listen for birds and wind. Smell the pine needles or the wet dirt. Then pick one thing that holds still, like a leaf, a flower or a rock. **Sketch** what you really see, not what you think a leaf looks like. Count its points. Measure it. Write **labels**. At the top of the page, write the date, the place and the weather. Now your drawing is a real science record. You can come back in a month and see what changed.

God's handiwork. Jesus told the people to "consider the lilies of the field" (Matthew 6:28). To consider means to look closely and think about it. A nature journal helps you do just that. Look at two leaves from the same tree. They are alike, but they are not exactly the same. God made each one with care, and He made you able to notice it.

Date: _____ Place: _____	
Weather: ☉ ☁	
My drawing 	Size: 9 cm long
I notice... _____	
I wonder... _____	

A nature journal page: date, place and weather on top, a big drawing with labels, a size, and one "I notice" and one "I wonder."

PICTURE STUDY



The Rocky Mountains, Lander's Peak, Albert Bierstadt, 1863 · Oil on canvas · The Metropolitan Museum of Art, New York

Albert Bierstadt painted this huge picture in his studio after his trip west with Frederick Lander in 1859. He used the sketches and photographs he made outdoors to remember the mountains, the trees and the light. He named one of the peaks Lander's Peak to honor the leader of the trip.

Our unit also names Bierstadt's elk paintings of the Wind River country. If you can find one in a book, look at it beside this one. He drew the animals from life, just as you will.

Look closely

- Find the waterfall. Follow the water down with your finger.
- Find the snow at the tops of the mountains. Where is the sunlight brightest?
- Look at the camp in the front. Can you find the horses and the tents?
- Look at the tall trees. Are they pointy evergreens or round leafy trees?

Talk about it

1. If you sat in this valley with your nature journal, what would you draw first?
2. What sounds do you think you would hear in this place?
3. Bierstadt made a giant painting from small sketches. How do sketches help you remember?

Safety first. Walk with a grown-up and stay on the path. Look at wild animals, mushrooms and berries, but do not touch or taste them. Learn to spot poison ivy: "leaves of three, let it be." Never look straight at the sun. Wash your hands when you get home.

MAKE AND DO: MY FIRST NATURE JOURNAL PAGE

Today you will start a nature journal, just like a real naturalist. You will walk slowly, choose one thing, draw it from life, measure it and label it.

You will need

- A small notebook, or a few sheets of paper folded and stapled into a booklet
- A pencil and colored pencils or crayons
- A small ruler
- A clipboard or a piece of stiff cardboard to draw on

Steps

1. Make a cover. Write "My Nature Journal" and your name. Draw a leaf or a bird on it.
2. At the top of the first page, write the date and the place. Draw a little sun, cloud or raindrop to show the weather.
3. Go outside with your grown-up. Walk slowly. Stop three times. Each time, stand very still for one minute and listen.
4. Choose one thing that holds still: a leaf, a flower, a pinecone or a rock. If it is a mushroom, look only.

5. Draw it big, so it fills most of the page. Look back at the real thing again and again while you draw.
6. Measure it with the ruler, or count how many of your finger-widths long it is. Write the size beside your drawing.
7. Add color. Write two labels, such as “stem” and “edge.”
8. At the bottom, say one “I notice...” and one “I wonder...” Your grown-up can write your words for you.

Tips

- A scientist’s drawing does not need to be pretty. It needs to be true.
- Parents: let the child talk while you write. Narration counts just as much as the drawing.

Check your work

- I wrote the date, the place and the weather.
- I drew one thing from real life and gave it two labels.
- I measured my thing and wrote the size.

NATURE NOTEBOOK

1. Draw one leaf from your walk big enough to fill the page. Label the stem and the edge.
2. Make a sound map. Put an X in the middle of the page for you. Draw a tiny picture for each sound you hear, in the direction it came from: a bird, a dog, the wind.
3. Draw the sky today and color it. Write one weather word under it, such as sunny, cloudy, windy or rainy.

From history. In 1911 Anna Botsford Comstock of Cornell University wrote the *Handbook of Nature Study*, a thick book to help teachers and parents take children outdoors to watch birds, bugs, trees, rocks and stars. She was also an artist who made careful pictures of insects. Many homeschool families still use her book for nature walks today.

WORKED EXAMPLES

Example 1. You measured two leaves with a ruler. The oak leaf is 12 centimeters long. The maple leaf is 9 centimeters long. Which leaf is longer, and by how much?

1. Line up the end of each leaf with the 0 on the ruler.
2. Read the numbers: oak 12, maple 9. 12 is bigger than 9, so the oak leaf is longer.
3. Count up from 9 to 12: 10, 11, 12. That is 3 more.

Answer: The oak leaf is longer, by 3 centimeters.

PRACTICE

1. **EASY** Name the three things you write at the top of every nature journal page.
2. **EASY** Point to your eyes, ears and nose. Tell one thing you could notice on a walk with each one.
3. **MEDIUM** On your walk you stopped 3 times. Each time you heard 2 birds. Count by twos: how many bird songs did you hear?
4. **MEDIUM** Your stick is 4 hand-widths long. Your friend's stick is 6 hand-widths long. Whose stick is longer, and by how many hand-widths?
5. **HARD** Tell your grown-up: why does a scientist write the date and the place on a journal page?

COMMON MISTAKES

- Thinking a good nature drawing must be pretty. A scientist's drawing must be true: it shows what you really saw, even if the lines are wobbly.
- Thinking you will see more animals if you walk fast and far. Animals hide from noisy people. Sitting still and quiet shows you more.
- Thinking all the leaves on one tree are exactly the same. Look closely: each leaf is a little different in size and shape.

Make it a game • Nature Bingo. Before the walk, your grown-up draws a grid of nine boxes with a small picture in each: a leaf, a bird, an ant, a cloud, a rock, a flower, a spider web, a seed and a feather. Look only, do not pick up. When you spot one, put a check in its box. Three checks in a row is a bingo!

Scripture. "And why take ye thought for raiment? Consider the lilies of the field, how they grow; they toil not, neither do they spin:" (Matthew 6:28, KJV)

Jesus taught by pointing to flowers. To consider is to look closely and think. A nature journal is a way to consider what God has made.

Practice answers

1. The date, the place and the weather.
2. Answers will vary. Eyes: a bird or a flower. Ears: a bird song or the wind. Nose: pine needles, flowers or wet dirt.
3. 2, 4, 6. You heard 6 bird songs.
4. Your friend's stick is longer, by 2 hand-widths.
5. So they can remember when and where they saw it, come back later to see what changed, and so other people can check it too.

9.2 BACKYARD SURVEY

OBJECTIVES

- Count the plants and animals in one small patch of yard using tally marks.
- Make and read a picture chart of what you found.
- Find and name the homes animals make in a yard: nests, webs, holes and hills.

Warm-up. Sit by a window for five minutes with a pencil and paper. Each time you see a living thing move outside, such as a bird, a bug, a squirrel or a cat, make one short line on the paper. When the time is up, count your lines together.

Video. Coming soon. Backyard bird counts and backyard bugs for kids: search Cornell Lab of Ornithology (Great Backyard Bird Count), National Audubon Society, SciShow Kids, Homeschool Pop (Alternate) and close-up nature footage of ants, worms and garden birds.

KEY TERMS

survey

A careful count of the living things in one place.

tally mark

A short line you make for each thing you count. The fifth line goes across the first four, so you can count by fives.

picture chart

A chart that uses little pictures or dots to show how many of each thing there are.

shelter

A safe place where an animal rests and hides, like a nest, a web, a hole or a hollow tree.

CORE IDEAS

The story. Long ago, some people went out on Christmas Day to see how many birds they could shoot. A bird scientist named Frank Chapman had a better idea. On Christmas Day in 1900, he asked friends in different towns to go out and *count* birds instead. Each person walked, looked, wrote down every bird, and mailed the list to Chapman. People have done that Christmas Bird Count every winter since. It is one of the biggest bird **surveys** in the world, and families still help.

How they figured it out. A survey is a careful count. You pick one place. You look for the same amount of time. You make a **tally mark** for each thing you find. When you do it again next week, in the same spot, for the same time, you can compare. When many people send in their counts, scientists learn which birds live where, and whether there are more or fewer than before.

God's handiwork. Your yard is full of homes. Psalm 104 says God made places for every creature: the birds make nests, the stork lives in the fir trees, the wild goats live on high hills, and small furry conies (rock hyraxes) hide in the rocks. Look for nests in trees, webs on bushes, holes in the ground and little hills of sand where ants live. Ants, worms, beetles and spiders are animals too. Look low and close, and you will find many neighbors.

PICTURE STUDY



The Large Piece of Turf, Albrecht Dürer, 1503 · Watercolor and gouache on paper · Albertina, Vienna

More than five hundred years ago, the German artist Albrecht Dürer painted a little patch of ground: just grass and weeds, the kind you could find at the edge of any yard. He painted it as if he were kneeling down with his nose close to the dirt. You can tell one kind of plant from another, and almost count the blades of grass.

This is just what a backyard survey asks you to do. Choose one small patch, get down low and look at every living thing in it.

Look closely

- Find a dandelion. Can you find its jagged leaves and its tall, thin stems?
- Count how many different kinds of plants you can find. Are some leaves wide and some thin like grass?
- Look at the bottom of the picture. What color is the dirt? Does it look dry or damp?
- Look closely between the stems. What small animals might hide in a patch like this?

Talk about it

1. Why do you think Dürer chose to paint plain weeds instead of fancy flowers?
2. If you laid your hoop over this patch, what would you count?

3. What would you find if you painted a patch of your own yard this closely?

Safety first. Stay in your own yard or a place your grown-up chooses. Look at bees, wasps, ants and spiders, but do not touch them. Turn over a log or a stone only with a grown-up: roll it toward you so anything under it runs away from you, and then put it back gently so the animals keep their home. Wash your hands when you come in.

MAKE AND DO: THE HOOP SURVEY

Scientists cannot count every bug in a whole field, so they count in one small square or circle. You will do the same thing with a hoop or a loop of string.

You will need

- A hula hoop, or a long piece of string or yarn tied into a loop
- A magnifying glass if you have one
- Paper, a pencil and crayons
- A clipboard or cardboard
- A kitchen timer

Steps

1. Lay the hoop on the grass, or on a patch of garden or weeds.
2. On your paper, make three rows: Plants, Bugs and Crawlers, Other Animals.
3. Set the timer for ten minutes. Kneel down and look inside the hoop.
4. Each time you find something new, make a tally mark in its row. Count clover, grass, dandelions, ants, worms and beetles.
5. Look for a home: an ant hill, a worm hole or a tiny web. Draw it.
6. Next, sit near a tree for ten more minutes and tally every bird and squirrel you see.
7. Back inside, count your tally marks. Make a picture chart: draw one dot for each animal, in a row for each kind.
8. Tell your grown-up which row had the most and which had the fewest.

Tips

- Count only what is inside the hoop. That keeps your survey fair.
- Do the same survey again in another season, in the same spot, and compare.

Check your work

- I counted with tally marks inside my hoop.
- I made a picture chart and told which row had the most.
- I found and drew one animal home.

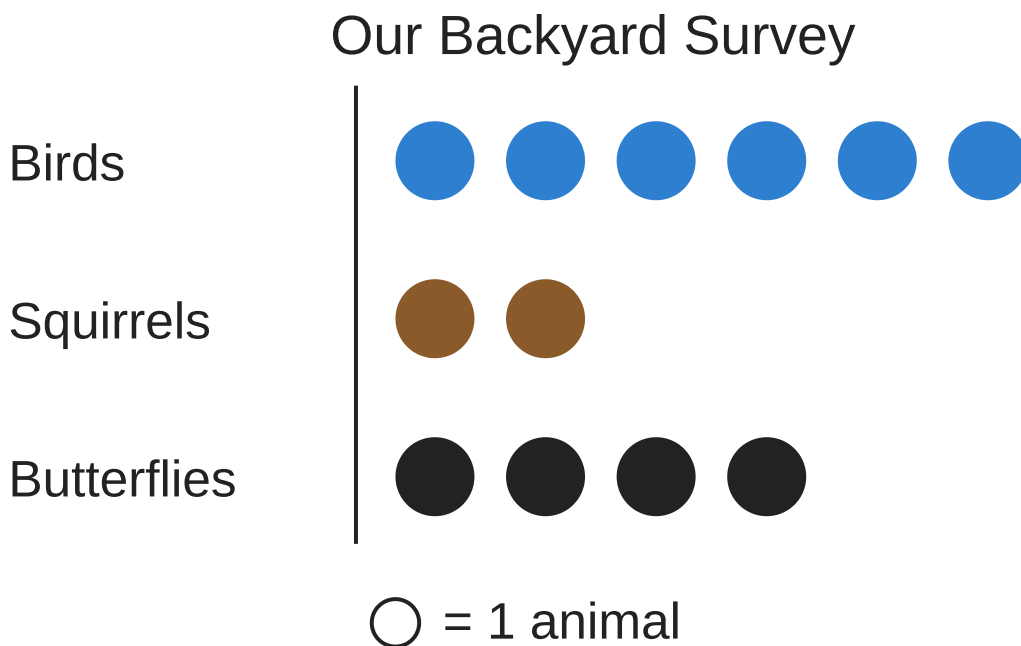
NATURE NOTEBOOK

1. Draw a map of your yard from above, like a bird would see it. Mark where you found a nest, a web or an ant hill.
2. Draw the tiniest animal you found in your hoop, as big as you can, and count its legs.
3. Draw one tree and all the animals that might live in it, under it and on it.

From history. In 1998 the Cornell Lab of Ornithology and the National Audubon Society began the Great Backyard Bird Count. Every February, families all over the world count the birds they see for at least fifteen minutes and send in their lists. Children can be real helpers to bird scientists, right from their own windows.

WORKED EXAMPLES

Example 1. Look at the picture chart of a backyard survey. How many birds, squirrels and butterflies were seen? Which animal was seen the most? How many more birds than squirrels? How many animals in all?



Our backyard survey. Each dot stands for 1 animal.

1. Count the dots in each row: Birds 6, Squirrels 2, Butterflies 4.
2. The longest row is Birds, so birds were seen the most.
3. Compare Birds and Squirrels: count up from 2 to 6: 3, 4, 5, 6. That is 4 more.
4. Add them all: $6 + 2 = 8$, and $8 + 4 = 12$.

Answer: 6 birds, 2 squirrels, 4 butterflies. Birds were seen the most, 4 more birds than squirrels, and 12 animals in all.

PRACTICE

1. **EASY** Show the number 7 with tally marks on paper.
2. **EASY** Sort these into two groups, animals and plants: robin, ant, dandelion, worm, oak tree.
3. **MEDIUM** In your hoop you counted 5 ants, 3 worms and 1 beetle. How many animals did you count?
4. **MEDIUM** Match each animal to its home: bird, spider, ant, squirrel. Homes: web, ant hill, nest of sticks, ball-shaped nest of leaves high in a tree.
5. **HARD** Tell your grown-up: why should you count in the same spot, for the same amount of time, when you do your survey again next week?

COMMON MISTAKES

- Thinking bugs and worms are not animals. Ants, worms, beetles and spiders are all animals.
- Thinking a spider is an insect. Insects have six legs. Spiders have eight legs, so they are not insects.
- Thinking a plain-looking yard has nothing living in it. Look low and close: grass, soil and dead leaves are full of tiny animals.

Make it a game • Who Lives Here?. Your grown-up names a home: a nest, a web, an ant hill, a hole in a tree, a pond. You act out the animal that lives there, and your grown-up guesses. Then switch. Score a point for every correct match.

Scripture. “Where the birds make their nests: as for the stork, the fir trees are her house. The high hills are a refuge for the wild goats; and the rocks for the conies.” (Psalm 104:17-18, KJV)

God gave every creature a home that fits it. When you survey your yard, you are finding the homes He has made for your animal neighbors.

Practice answers

1. Four straight lines with a fifth line across them (that is 5), then 2 more lines.
2. Animals: robin, ant, worm. Plants: dandelion, oak tree.
3. $5 + 3 = 8$, and $8 + 1 = 9$ animals.
4. Bird: nest of sticks. Spider: web. Ant: ant hill. Squirrel: ball-shaped nest of leaves high in a tree.
5. So the two counts are fair to compare. If you counted a bigger place or for a longer time, you would find more just because you looked more, not because more animals came.

9.3 ZOO, FARM OR MUSEUM VISIT

OBJECTIVES

- Visit a zoo, a farm or a natural history museum and observe one animal closely.
- Compare two animals by size, body covering, legs and food.
- Tell how people care for the animals in their keeping.

Warm-up. Gather three toy animals or stuffed animals. Sort them by what covers their bodies: fur, feathers, or scales and skin. Then tell which one might live on a farm and which one might live in a zoo.

Video. Coming soon. Zoo keepers, farm animals and natural history museum halls for kids: search Smithsonian’s National Zoo, Smithsonian National Museum of Natural History, SciShow Kids, Homeschool Pop (Alternate) and farm footage of cows, sheep, hens and horses.

KEY TERMS

zoo

A park where wild animals are kept and cared for so people can see them and learn about them.

farm animal

An animal people raise for food, wool, eggs or work, such as a cow, a sheep, a hen or a horse.

specimen

A real animal, bone, shell or plant kept carefully in a museum so people can study it.

covering

What an animal has on the outside of its body: fur, feathers, scales or bare skin.

CORE IDEAS

The story. Long ago in France there lived a painter named Rosa Bonheur. She wanted her animal paintings to look just right. So she went where the animals were. She walked out to farms in the countryside. She sat at the busy horse market in Paris for hours with her sketchbook. She watched how a cow’s legs bend and how a horse’s muscles move when it walks. Later she kept many animals at her own home near a big forest, so she could watch them every day.

The big idea. You can learn like Rosa in three kinds of places. At a **zoo**, keepers care for wild animals from faraway lands. On a farm, families raise **farm animals** that give us milk, eggs, wool and help. God gave people the job of ruling over the animals and caring for them (Genesis 1:28). In a natural history museum, you can see **specimens**: real bones, shells, eggs and animals kept for study. Wherever you go, choose one animal and observe it for a

long time. What is its **covering**? How many legs? What does it eat? How does it move and sound? Then compare it with a second animal.

God's handiwork. Job said, "Ask now the beasts, and they shall teach thee" (Job 12:7). Animals cannot talk, but they teach us when we watch. In a museum dinosaur hall you may also see signs with big words like "Jurassic." Those are museum words. Read the box called Thinking About Time with your grown-up.

Thinking About Time

What the sign says. Museum signs say the dinosaurs lived a very, very long time ago, in times with museum names like Jurassic.

What we observe. What we can really see are bones and footprints that were buried in layers of rock.

How Christians read it. Many Christians believe God made the animals in the days of creation, and that many fossils were buried in Noah's Flood.

Try it. Find one fossil sign at the museum and read its museum word with your grown-up.

Genesis 7:11

PICTURE STUDY



Ploughing in the Nivernais, Rosa Bonheur, 1849 · Oil on canvas · Musée d'Orsay, Paris

Rosa Bonheur painted this picture of a farm in the middle of France. Teams of strong oxen are plowing a field to make the soil ready for planting. Bonheur spent many days on farms

drawing oxen from life, and you can see how carefully she painted their heavy bodies, their horns and their hair.

Our unit also names her painting *Monarchs of the Forest*. Bonheur painted wild deer and stags in the forest too. If you find one in a book, compare the farm animals and the forest animals.

Look closely

- Count the oxen in the team closest to you.
- Find the farmers. What are they holding, and where are they walking?
- Look at the dirt the plow has turned. How is it different from the grass?
- Find the sky. Is it a sunny day or a stormy day?

Talk about it

1. Why do you think the farmers used oxen to pull the plows?
2. How do the farmers take care of their oxen, do you think?
3. Which farm animal would you like to draw if you visited a farm?

Safety first. Stay beside your grown-up the whole visit. Never reach into a zoo pen or feed an animal unless a keeper or farmer says it is allowed. Stand away from the back legs of horses and cows, because they can kick. Wash your hands with soap after touching farm animals or their pens, and always before you eat. In a museum, look with your eyes and touch only where a sign says you may.

MAKE AND DO: ANIMAL DETECTIVE CARDS

A detective writes down clues. You will make two Animal Detective Cards and fill them in on your visit. If you cannot visit a zoo, farm or museum, use a pet, a neighbor's chickens, or an animal at a park.

You will need

- Two index cards or two half-sheets of stiff paper
- A pencil and crayons
- A clipboard or a small book to press on

Steps

1. Before the visit, draw a big box at the top of each card for a picture.
2. Under the box, write these words down the side: Name, Covering, Legs, Food, Sound.
3. At the zoo, farm or museum, choose one animal. Watch it for five whole minutes before you draw.
4. Draw it in the box. Fill in each line. Ask a keeper or farmer what it eats if you do not know.
5. Choose a second animal that is very different and fill in the second card.

6. At home, lay the two cards side by side. Tell your grown-up two ways the animals are alike and two ways they are different.
7. Draw a thank-you picture for the keeper, farmer or museum guide who helped you.

Tips

- Parents: many zoos and museums have quiet benches. A five-minute sit with one animal teaches more than a fast walk past fifty.
- If the animal moves too fast to draw, draw one part only: a foot, an ear or a tail.

Check your work

- I watched one animal for five minutes before I drew it.
- I filled in two cards: name, covering, legs, food and sound.
- I told how the two animals are alike and different.

NATURE NOTEBOOK

1. Draw the animal you liked best on your visit. Label its covering: fur, feathers, scales or skin.
2. Draw one way a keeper or farmer cares for an animal: giving food, giving water, cleaning a pen or brushing a coat.
3. Draw one bone or skeleton you saw in a museum, or one animal's footprint. Write what animal it came from.

From history. In 1889 the United States Congress created the National Zoo in Washington, D.C. One of the people who worked hardest for it was William Temple Hornaday. He kept a few live American bison near the Smithsonian building so people could see them, because wild bison had become very rare. Hornaday later helped lead the work that saved the American bison.

WORKED EXAMPLES

Example 1. In one farm pen there are 2 hens and 1 goat. How many legs are in the pen?

1. A hen has 2 legs. Two hens have $2 + 2 = 4$ legs.
2. A goat has 4 legs.
3. Add them: $4 + 4 = 8$.

Answer: There are 8 legs in the pen.

PRACTICE

1. **EASY** Sort these animals into farm animals and zoo animals: cow, lion, hen, giraffe, sheep, zebra.

2. **EASY** Match each animal to its covering: duck, sheep, snake. Coverings: wool, feathers, scales.
3. **MEDIUM** Three ducks walk by. Each duck has 2 legs. How many legs walk by?
4. **MEDIUM** Put these animals in order from smallest to biggest: horse, hen, goat.
5. **HARD** Tell your grown-up three things a farmer or zookeeper does to care for animals.

COMMON MISTAKES

- Thinking zoo animals are tame pets. Even a calm zoo animal is wild and can bite, scratch or kick.
- Thinking a museum animal is just a toy or a statue. Many museum specimens were real animals, kept with great care, and many bones are real or careful copies of real ones.
- Thinking milk, eggs and wool come from the store. They come from cows, hens and sheep that farmers feed and care for every day.

Make it a game · Who Am I? Your grown-up thinks of an animal you saw on your visit. You ask questions that can be answered yes or no: “Do you have feathers?” “Do you have four legs?” “Do you live on a farm?” Try to guess the animal in ten questions or fewer. Then switch places.

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

The animals cannot speak, but when we watch them closely they teach us about the wisdom of the God who made them.

Practice answers

1. Farm: cow, hen, sheep. Zoo: lion, giraffe, zebra.
2. Duck: feathers. Sheep: wool. Snake: scales.
3. 2, 4, 6. Six legs.
4. Hen, goat, horse.
5. Any three: gives them food, gives them clean water, gives them shelter from cold and rain, cleans their pens, brushes or trims them, and calls an animal doctor when they are sick.

9.4 SPECIMEN COLLECTION

OBJECTIVES

- Collect fallen, non-living nature treasures safely and with permission.
- Sort specimens by a rule you choose, such as kind, color or size, and say your rule.
- Label a small nature museum with what each thing is, where you found it and when.

Warm-up. Pour a handful of buttons, coins or dry beans onto the table. Sort them into groups. Tell your grown-up the rule you used, such as color or size. Then mix them up and sort them a new way.

Video. Coming soon. Nature collections and museum drawers for kids: search Smithsonian National Museum of Natural History (behind the scenes collections), SciShow Kids, Homeschool Pop (Alternate), and gentle nature footage of acorns, pinecones, seed pods and shells.

KEY TERMS

specimen

One real thing kept to study, like one leaf, one shell or one rock.

collection

A group of specimens kept together, sorted and labeled.

sort

To put things into groups that are alike in some way.

fallen

Dropped to the ground on its own, like a dry leaf, an acorn or a pinecone.

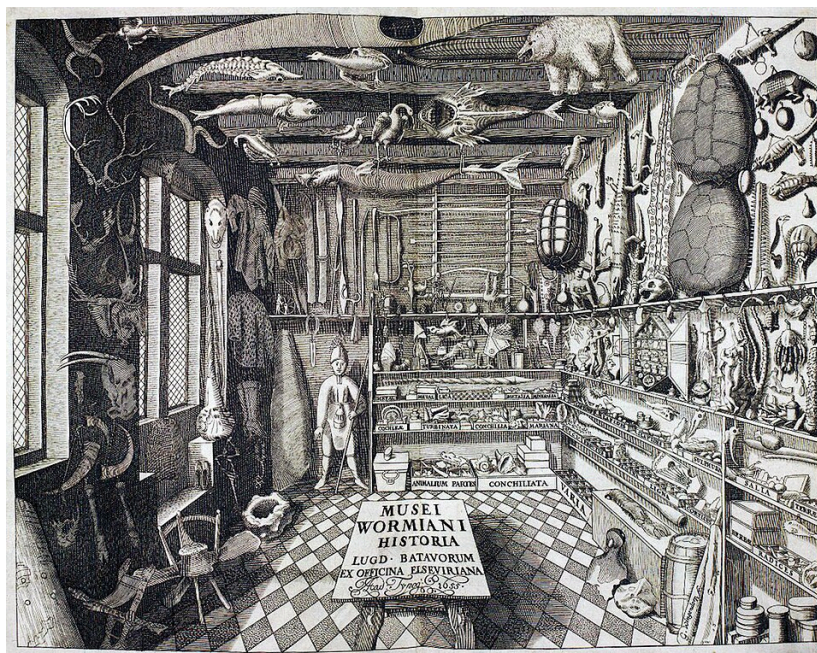
CORE IDEAS

The story. When John James Audubon was a boy in France, his room was full of treasures. He collected birds' nests, eggs, lichens, flowers and pebbles. Later he lived at Mill Grove, a farm in Pennsylvania, and he kept on collecting and drawing. He wanted to paint every bird at its real size, so he posed birds on thin wires on a board marked with squares. That way he could measure and draw them exactly. His great book, *The Birds of America*, shows each bird life-size. In his day, bird scientists studied birds that way. Today we use binoculars and cameras, and the law protects wild birds.

The big idea. A **collection** turns your walk into a little museum. Follow the collector's rules. Take only things that have **fallen** and are not alive: dry leaves, acorns, pinecones, seed pods, pebbles and empty shells. Ask before you take anything. Leave living animals, nests, eggs and wild bird feathers where they are, and draw them instead. At home, **sort** your **specimens** by a rule: things from plants and things not from plants, or big and small, or brown and not brown. Then label each one with what it is, where you found it and the date.

God's handiwork. In the garden of Eden, God brought the animals to Adam “to see what he would call them” (Genesis 2:19). Naming and sorting living things was one of the very first jobs God gave to people. When you label your collection, you are doing that same good work.

PICTURE STUDY



The Museum of Ole Worm, from Museum Wormianum, Engraving made for Ole Worm's book, 1655 · Engraving (the picture at the front of a printed book) · Printed in Museum Wormianum (Leiden, 1655); copies in many libraries, including the Smithsonian Libraries

Ole Worm was a doctor in Copenhagen, Denmark, who loved to collect. He gathered shells, stones, bones, horns, plants and stuffed animals, and he kept them in one room so he could study them and show them to his students. Each thing was sorted and put in its place.

After he died, this picture of his museum was printed at the front of a book about his collection. It is one of the most famous pictures of an early natural history museum. Your egg-carton museum is a small cousin of Ole Worm's room!

Look closely

- Find the animals hanging from the ceiling. What kinds can you name?
- Look at the boxes on the shelves. Can you see the little words written on them? Those are labels.
- Find the horns and antlers on the walls.
- Find the shells. Are they all on one shelf or mixed everywhere?

Talk about it

1. How did Ole Worm sort his things? What rule might he have used for each shelf?
2. Why do you think he wrote labels on his boxes?

3. Which part of this room is most like your egg-carton museum?

Safety first. Collect only things that have already fallen and are not alive. Never pick up wild mushrooms, berries, droppings, bones or dead animals. Leave nests, eggs and bird feathers where they are: in the United States the law protects most wild birds, even their feathers and empty nests, so draw them or take a photo. Ask before taking anything from a park or someone else's land, because many parks ask visitors to leave everything in place. Wash your hands when you finish.

MAKE AND DO: MY EGG-CARTON NATURE MUSEUM

An egg carton has twelve little cups. That makes it a perfect museum drawer for small specimens. You will fill it, sort it and label it like a real museum collector.

You will need

- One clean, empty egg carton (paper or plastic)
- A small bag or basket for collecting
- Small slips of paper, a pencil and tape or glue
- A magnifying glass if you have one

Steps

1. With your grown-up, walk in your yard or a place where collecting is allowed.
2. Gather up to twelve fallen treasures: dry leaves, acorns, a pinecone, a seed pod, a smooth pebble, a piece of bark from a fallen branch, an empty snail shell.
3. At home, spread them out. Look at each one with the magnifying glass.
4. Choose a sorting rule, such as "from a plant" and "not from a plant." Put one group in the top row of the carton and the other in the bottom row.
5. Write a tiny label for each cup: what it is. Tape it beside the cup.
6. On the lid, write: "Collected by," your name, the place and the date.
7. Show your museum to your family. Tell them your sorting rule and your favorite specimen.

Tips

- Small is best. A pinecone that does not fit can be drawn on the lid instead.
- Dry damp leaves between two paper towels under a heavy book for a few days before you put them in the carton.

Check your work

- I collected only fallen, non-living things, with permission.
- I sorted my specimens and can tell my sorting rule.
- My carton has labels and says who, where and when.

NATURE NOTEBOOK

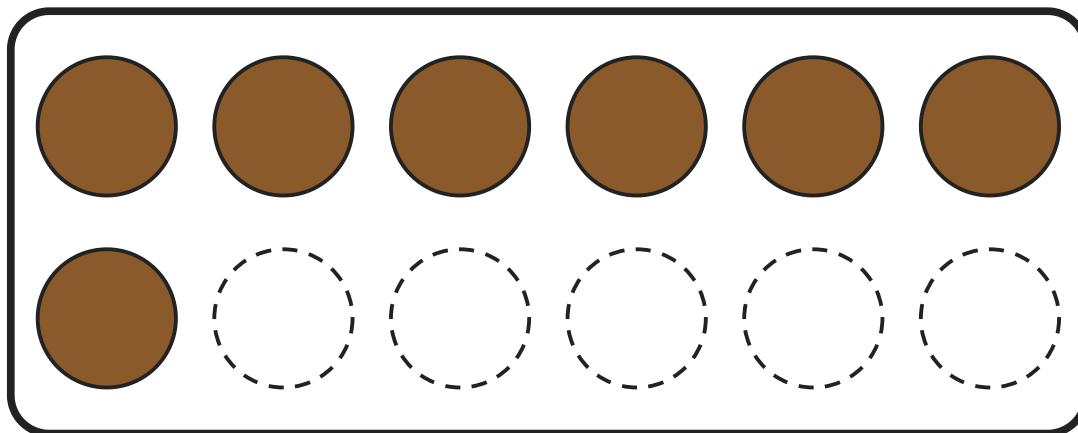
1. Draw your favorite specimen big. Write its label under it: what it is, where you found it and the date.
2. Draw something you saw but left behind, such as a nest, a feather or a beetle. Write "Left in place" beside it.
3. Draw two groups of your specimens and circle each group. Write your sorting rule at the top.

From history. In 1804, at Mill Grove in Pennsylvania, young Audubon found a family of phoebes nesting near a creek. He gently tied a thin silver thread around the legs of the baby birds. The next spring he found phoebes with threads on their legs back near the same place. It is often called the first bird banding in North America, and scientists still band birds today to learn where they travel.

WORKED EXAMPLES

Example 1. Your egg carton has 12 cups. You have filled 7 cups with specimens. How many cups are still empty?

My Egg-Carton Museum



● = a specimen

○ = an empty cup

An egg-carton museum with 7 filled cups and 5 empty cups.

1. Look at the picture. Count the filled cups: 7.
2. Count the empty cups: 1, 2, 3, 4, 5.
3. Check: $7 \text{ filled} + 5 \text{ empty} = 12 \text{ cups}$.

Answer: 5 cups are still empty.

PRACTICE

1. **EASY** Which of these may you collect, and which must you leave? A fallen acorn, a live caterpillar, a pinecone on the ground, a bird's nest, a smooth pebble.
2. **EASY** Sort these into "from a plant" and "not from a plant": a red leaf, a gray rock, an acorn, an empty snail shell.
3. **MEDIUM** You found 4 acorns and 3 pinecones. How many specimens is that?
4. **MEDIUM** One pebble is as long as your thumb. One rock is as long as your whole hand. Which is bigger? Which would fit in an egg-carton cup?
5. **HARD** Tell your grown-up the three things a good specimen label says, and why each one matters.

COMMON MISTAKES

- Thinking it is fine to take anything pretty. Living things, nests, eggs and wild bird feathers stay where they are.
- Thinking a shell or a pinecone was never part of a living thing. A shell was made by an animal, and a pinecone grew on a tree.
- Thinking there is only one right way to sort. You can sort by kind, color, size or shape. A scientist always says which rule was used.

Make it a game • Mystery Sock. Your grown-up hides one specimen from your museum inside a clean sock. Reach in without looking. Is it smooth or bumpy? Heavy or light? Round or flat? Guess what it is. Then hide one for your grown-up to guess.

Scripture. "And out of the ground the LORD God formed every beast of the field, and every fowl of the air; and brought them unto Adam to see what he would call them: and whatsoever Adam called every living creature, that was the name thereof." (Genesis 2:19, KJV)

Naming and sorting God's creatures is good, old work. When you label your collection, you follow in Adam's steps.

Practice answers

1. Collect (with permission): the acorn, the pinecone and the pebble. Leave: the caterpillar and the bird's nest.
2. From a plant: the red leaf and the acorn. Not from a plant: the gray rock and the snail shell (the shell was made by an animal).
3. $4 + 3 = 7$ specimens.
4. The rock as long as your hand is bigger. The thumb-sized pebble would fit in a cup.
5. What it is (so people know its name), where it was found (so people know where it lives or grows), and the date (so people know when, and can compare seasons).

UNIT 9 REVIEW

This is an oral review. The parent asks each question aloud and the child answers by telling, pointing, showing or drawing. Give full points for a clear answer in the child's own words. The review is worth 20 points.

1. (3 pts) What three things do you write at the top of a nature journal page? Show me one page from your journal.
2. (3 pts) Why do we walk slowly and sometimes sit still and quiet on a nature walk?
3. (4 pts) What is a survey? Show me the number 8 with tally marks.
4. (3 pts) Name three animal homes you could find in a yard, and the animal that lives in each.
5. (3 pts) Tell me about one animal you saw on your zoo, farm or museum visit. What is its covering, how many legs does it have, and what does it eat?
6. (4 pts) Show me your egg-carton museum. What may we collect, and what must we leave where it is? What is your sorting rule?

UNIT PROJECT: MY NATURE LAB BOOK

Gather your work from all four lessons into one book or folder: your nature journal pages, your hoop survey picture chart, your two Animal Detective Cards and a drawing or photo of your egg-carton museum. Make a cover with your name and a drawing of your favorite creature. Then show the book to your family and tell the story of one discovery you made.

- **Observation:** Drawings are made from real life and show true details, such as the number of legs or the shape of a leaf.
- **Records:** Pages have dates, places, labels, tally marks and a picture chart that is counted correctly.
- **Telling:** The child tells about one discovery clearly in their own words, with one "I notice" and one "I wonder."
- **Care:** The book is neat and colorful, and the child followed the rules for safe, kind collecting and watching.

Answer key

1. The date, the place and the weather. The page shows a drawing from real life with labels.
2. So we notice more, and so the animals are not scared away. Quiet watchers see and hear more.
3. A survey is a careful count of the living things in one place. Eight is four lines crossed by a fifth line (5), then 3 more lines.
4. Any three, such as: a nest (bird), a web (spider), an ant hill (ants), a leaf nest or hollow tree (squirrel), a hole in the ground (worm).
5. Answers will vary. Example: a sheep has wool, 4 legs and eats grass and hay.
6. Collect only fallen, non-living things with permission, such as dry leaves, acorns, pinecones and pebbles. Leave living animals, nests, eggs, wild bird feathers, mushrooms and berries.

The child names a sorting rule, such as from a plant or not from a plant.