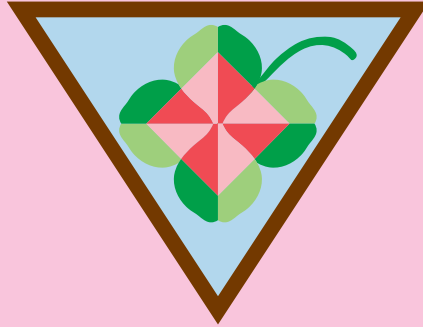




Brownie Shapes in Nature

Nature is full of colors and shapes. Imagine a leopard's spots or a butterfly's wings. Think of a bee's honeycomb or a turtle's shell.

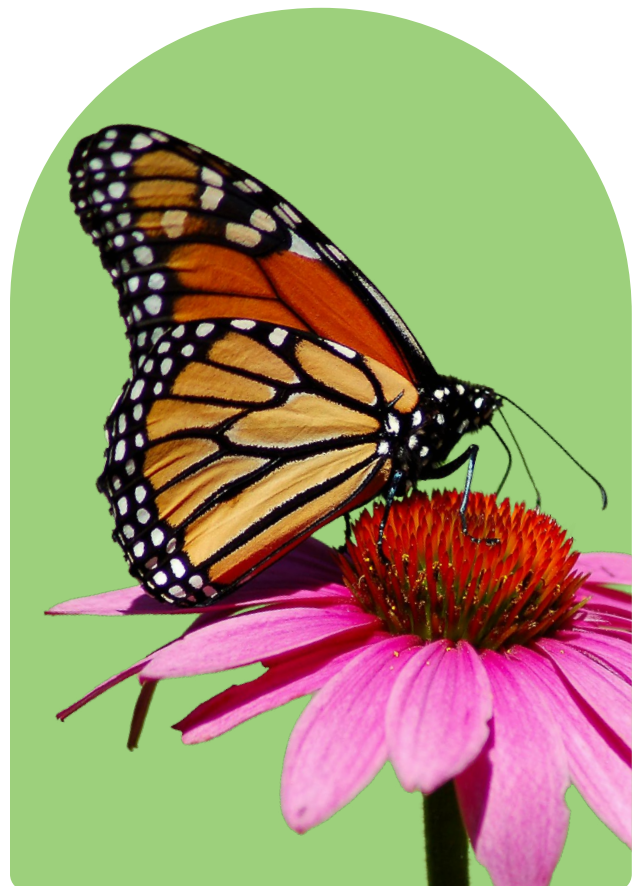
In this badge, you'll look carefully at nature. You'll track what you see. You'll create art about it. You'll share what you find.

Steps

1. Track natural objects
2. Graph natural objects
3. Make a spiderweb with symmetry
4. Explore tessellations
5. Collect data about birds

Purpose

When I've earned this badge, I'll know about counting, graphing, symmetry, and tessellations. I'll also know about spiders, birds, and other natural objects.



Words To Know

Bar graph: A chart that uses rectangles to show the number of things.

Category: A group of things that are alike in some way.

Columns: Lines that go up and down.

Data: Information gathered by observation, questioning, or measuring.

Data table: A chart that lists information in rows and columns.

Hexagon: A shape with six sides and six angles.

Horizontal: Going side to side.

Natural object: Things made by nature, like plants, animals, bugs, and rocks.

Observe: To look at something carefully using all of your senses and thinking about what you see.

Octagon: A shape with eight sides and eight angles.

Orb: Something shaped like a ball.

Pattern: When a design, color, shape, or sound repeats itself.

Radials: The long threads that go from the middle of a spiderweb to the outer edge.

Rows: Lines that go from side to side.

Spiral: A curve that circles around from a fixed point.

Symmetry: When one half of something is exactly the same as the other, like a heart or butterfly.

Tally mark: A line that means 1, to help you count things.

Tessellation: An arrangement of shapes that fit together in a pattern without any gaps or overlapping.

Vertical: Going up and down.

x-axis and y-axis: Two types of data shown on a bar graph. The x-axis is horizontal. The y-axis is vertical.

Step 1: Track natural objects

There are so many kinds of nature! There are animals. There are plants. There are insects. There are rocks. There are trees. There are lakes.

All of these things are **categories** or groups of things made by nature. They're **natural objects**. You can have categories within a group, too. You can have land snails, sea snails, big snails, and small snails.

When you're in nature, you can make **tally marks** or lines to track what you observe. **Observation** is looking at something very carefully. It's also thinking about what you see. Observation helps us learn how nature and the world work.

Choices—do one:

.....
Go on a scavenger hunt. Make a foldable with 4 categories, like animals, plants, bugs, and rocks. Search for objects in each category around your neighborhood, the beach, park, or a botanical garden. When you find a natural object from a category, add a tally mark to your foldable.
.....

Follow the instructions on page 4 to make a foldable to track and tally what you find in nature.

.....
Search for many kinds of a natural object. Choose one kind of natural object, like leaves, seashells, or rocks. What are some ways to describe it? Maybe size, color, shape, or texture? For example, there are spiky seashells and smooth seashells. There are pink seashells and white seashells. There are tiny seashells and big seashells. Make a foldable with 4 categories for the natural object. Then, search for the object and add a tally mark when you find one from a category.
.....

.....
Find nature beyond your neighborhood. In the Galapagos Islands, you'd see a blue-footed booby bird. You might never see a blue jay, though. Explore what nature looks like someplace else. Make a foldable with 4 categories, like animals, plants, bugs, and rocks. Then search for those objects in a book, video, or online. When you find a natural object from one of the categories, add a tally mark to your foldable.



1



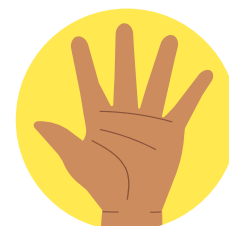
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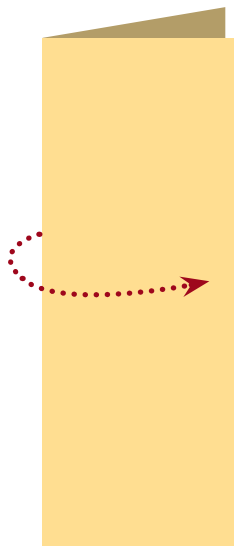


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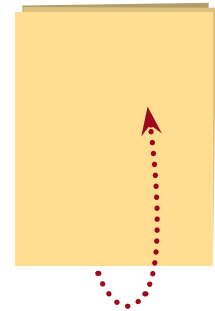
How To Make a Foldable



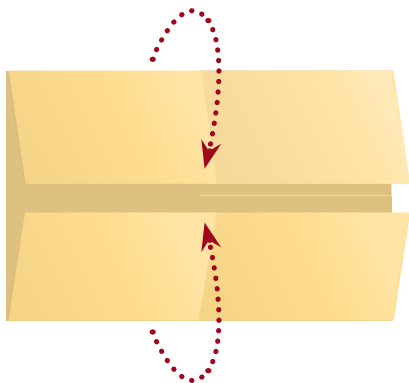
You'll need paper, scissors, and a marker.



1 Fold your paper once the long way (hot dog length).



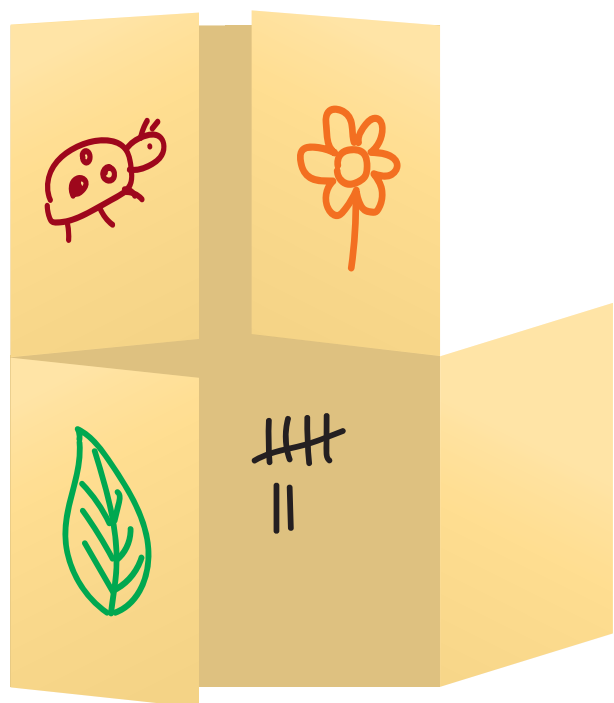
2 Fold it again in half (hamburger length). Unfold the paper.



4 Fold the top toward the center. Fold the bottom toward the center.



5 Cut the short fold lines to make four doors.



6 Turn it around and add four categories to your foldable. Then keep your tallies!

Step 2: Graph natural objects

You made tally marks in Step 1. Each tally mark stood for a natural object. Each tally mark is also a piece of data.

Data is information. You can collect it in many different ways. You can observe. You can ask questions. You can measure.

Scientists also collect data. They think about what it might mean. They share it with other people. They might give a presentation or make a poster. Just like scientists, you can share your data with others.

Choices—do one:

Make a bar graph. A **bar graph** shows data with rectangles. It can show how much or how many of something. It's an easy way to compare categories. To make a bar graph with your data from Step 1, make a line across your paper. Draw a second line going up. Add numbers to that line, starting at 1 and going up. Add your categories to the bottom row. Draw a rectangle above each. Make each rectangle as tall as the number of objects in the category, going straight up.

Make a pie chart. A **pie chart** shows data in a circle. It has different “slices” for different categories. The bigger the “slice,” the more you have of something. It's a good way to show your data as a whole. It's also easy to compare categories. Each category from Step 1 would be a different slice. To make a pie chart with your data from Step 1, draw a circle. It shows all your data and the total number of natural objects you found. Make a slice for each category. How big should each slice be? The category you found the most of would be the biggest slice. The category you found the least of would be the smallest slice.

Make a word cloud. A **word cloud** shows data with words. If the word is written in big letters, there's a lot of that kind of data. If the word is in small letters, there is less of that data. It's a good way to compare categories. To make a word cloud with your data from Step 1, decide how big each category would be as a word. What category did you have the most of? That's the biggest word. What did you have the least of? That's the smallest word. Decide how big each word should be and write them in a cloud shape.

Step 3: Make a spiderweb with symmetry

Have you ever observed any patterns in nature? A **pattern** is when something repeats. Think of a ladybug's dots. Imagine snakeskin.

Spiderwebs can have patterns, too. Some have symmetry. Something is **symmetrical** when it is the same on both sides. They reflect each other. Think of butterfly wings or a set of eyes.

Orb spiders make round webs. **Orb** means circle or ball. The webs have radials. **Radials** come out from a center point. They're connected with a spiral. A **spiral** circles from the center. The center of the web is a spiral. It's made of silk.

Choices—do one:

Make a spiderweb with yarn and sticks. Put two or more sticks in a cross shape. This will make one center where all the radials cross. Wrap yarn around the radials. Go from one radial to the next in the circle. This makes a spiral of yarn from the center, just like a spiderweb.

Make a giant spiderweb. Stand or sit in a circle with friends or family. Hold the end of the ball of yarn. Toss the ball across the circle. Keep going so everyone has a chance to catch and throw the yarn. Look at your web. Is it symmetrical? Is there any kind of pattern? Brainstorm how to make radials. It may help to make the yarn always cross the same center point. Then try to make a spiral, weaving the yarn through the radials.

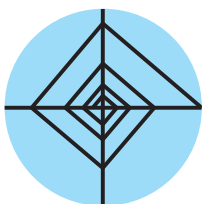
Make a spiderweb with glue. Use glue like a spider uses silk. Draw radials on a piece of paper. Have them connect in the center. Then, using the glue, make a spiral, starting at the center and touching each radial. When the glue dries, you'll be able to touch the ridges. Once dry, you can draw or paint a spider on top!

This American grass spider weaves a funnel web. Funnel webs have openings for the spider to hide, pounce, and bring in prey.



The Shape of Spiderwebs

What shape is your spiderweb?
Are there any patterns or symmetry?



If the web has 4 radials, it looks like a diamond or square.



If the web has 6 radials, it looks like a hexagon. A **hexagon** has 6 sides and angles.



If the web has 8 radials, it looks like an octagon. An **octagon** has 8 sides and angles.

What if the web had more radials? Could it ever be a perfect circle?

Circles do not have angles or sides, like squares, triangles, or any other polygons do. The more sides a polygon has, the more it looks like a circle. This is why an octagon looks more like a circle than a diamond does.

▲ How many radials does this spiderweb have?

Step 4: Explore tessellations

Have you ever seen a shape repeat over and over, like on a rug or tile flooring? Have you seen a pattern without any space in between? They're all around us in nature. Think of a pineapple or honeycomb. These are tessellations.

A **tessellation** is when shapes fit together. The pattern repeats without any gaps. It never overlaps. It's like a puzzle with pieces that are all the same shape.

Think of a shape you know. Do you think it will tessellate? Some shapes don't. A pattern of circles would have gaps. Circles don't tessellate.

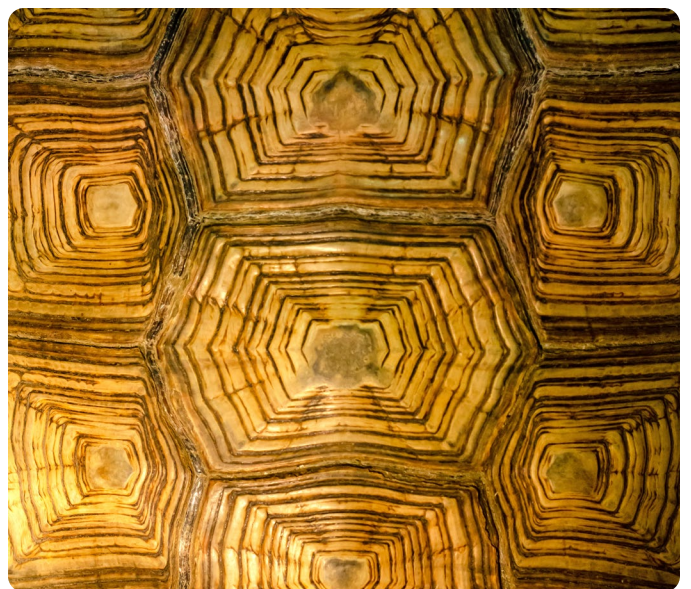
Choices—do one:

Draw a leaf tessellation. Leaves can tessellate. Choose a leaf with symmetry. Leaves with straight or curved edges work best. Put it in the center of a sheet of paper. Trace around it. Move the leaf so that the edges fit in with the leaf you drew. Remember, there are no gaps or overlaps in a tessellation! Trace the leaf again. Keep going. When you trace your leaf over and over, a tessellation will appear.

Find tessellations in your kitchen. Many foods have tessellations, like an orange slice or a raspberry. Can you find foods that tessellate? What other tessellations can you find? A floor might have tiles that tessellate. Wallpaper, a cushion, or a tablecloth might, too. Draw each tessellation. Which are natural objects? Which are made by people?

Make a tessellation quilt. Quilts are made from pieces of cloth. They're sewn together without any gaps. Many quilts have tessellations. To make your own tessellation quilt, choose a shape. Draw it on different colors of paper or fabric. Cut the shapes out. Fit them together in a tessellation. Sew the fabric pieces together or glue the shapes onto a bigger piece of paper.

**Make sure
to return any
leaves or other
natural objects
to the place you
found them.**



Step 5: Collect data about birds

Birds can be identified by their shape, color, sound, and what they're doing. You can find birds in your neighborhood, the woods, the park, or the zoo. You can even watch videos and livestreams of birds in nature.

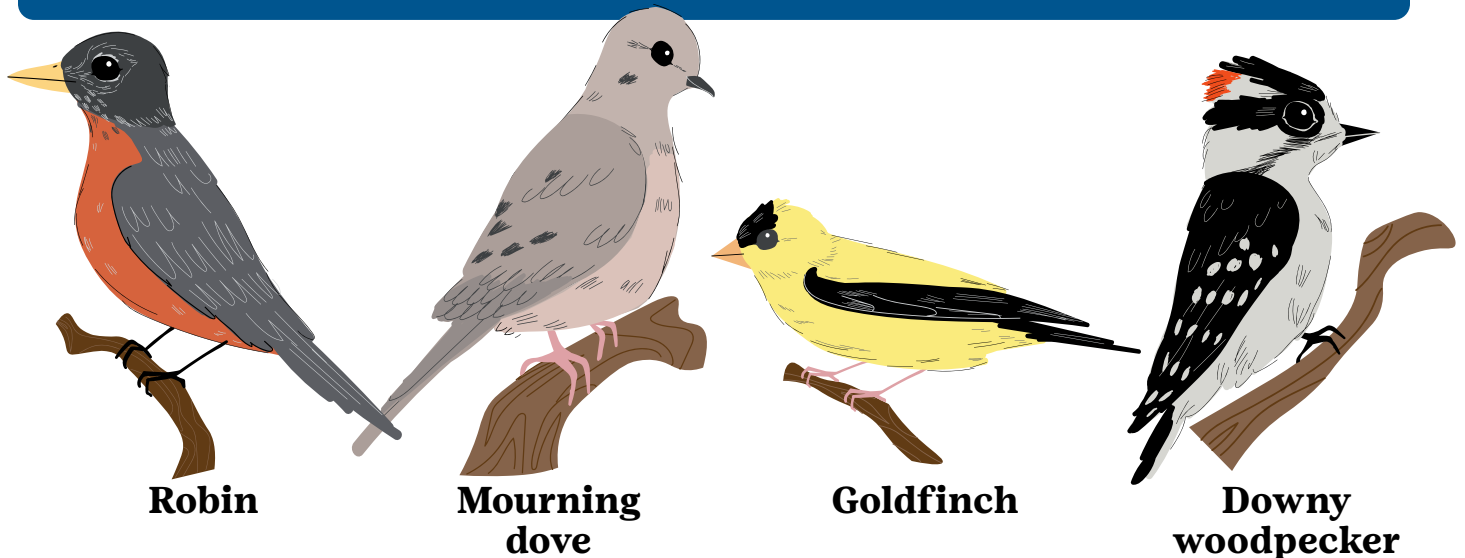
Choices—do one:

Create a data table. A **data table** is a chart. It lists information in **rows** (lines that go side to side) and **columns** (lines that go up and down). To make your own table, go bird-watching. Make a column to tally and total each type of bird you see. Add the numbers in the row. This is the total number of birds you saw. Show your data table to someone else. Tell them about the birds and how many you saw.

Act out your observations. Go bird-watching and track the kinds of birds you see. After you've gathered data, share it with others in a fun way. Create a puppet show, skit, or song about the birds you saw. What kinds of birds did you see? How many did you see? What were they doing? Perform for others to tell them about the birds you observed.

Count birds for citizen science. Citizen science is when regular people collect data for scientists. Scientists might want to know the number of squirrels, clouds, or even birds! Find a citizen science project and follow their rules to gather data about birds. Tally the birds you see. Which bird did you see the most? Which did you see the least? Share your data with the scientists.

Want to learn more about citizen science and data collection? Check out the Think Like a Citizen Scientist Journey!



How To Collect Data About Birds

Just like you observed natural objects, you can also collect and share data about birds.

Here's how:

Date

Time

Location

- 1. Learn about the local birds.** Where are you going? What kinds of birds normally live there?
- 2. Look for birds!** Be very quiet, so you don't miss any birds. Sometimes you'll hear a bird before you see it, so look and listen very closely. If you see a bird but aren't sure which kind it is, try to identify it using a field guide.
- 3. Tally the birds you see.** For example, if you see 3 cardinals, write the bird's name or draw it. Then make 3 tally marks.
- 4. Count your tally marks.** When you're done, add your tally marks to find the total number for each kind of bird. Add these numbers together to find the total number of birds you saw.
- 5. Share your data.** Think about what your data means. How can you share it with other people?



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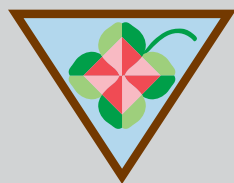
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Volunteer's Guide to Brownie Shapes in Nature*

Tips and ideas to help guide your troop through this badge. *This is the first badge in the Math in Nature badge series. The order of the Math in Nature badges is: 1) Shapes in Nature, 2) Numbers in Nature, and 3) Design with Nature.*

STEP 1: Track natural objects •

35–45 minutes

Ask: What do you like to do in nature? What would you like to see and explore outdoors?

Share: There are so many kinds of nature, like animals, plants, insects, rocks, trees, and lakes. All of these things are **categories** or groups of things made by nature. They're **natural objects**. **Observation** is looking at things carefully and thinking about what you see. You can make **tally marks** or lines to count what you observe. Try not to disturb anything that you observe when you are out in nature.

Do: Brainstorm different categories of natural objects with Brownies. Then help Brownies to use “How To Make a Foldable” in the Brownie Booklet to each make their own foldable with a sheet of paper and safety scissors.

Materials: Paper; scissors

Choices—do one:

- **Go on a scavenger hunt.** Generate a list of the Brownies' ideas that were sparked by the “ASK” prompt on chart paper or a whiteboard. Have Brownies vote on four categories of natural objects for the scavenger hunt by making a tally chart for their votes. Help them total each to determine which are the most popular. If there's a tie, vote again. Have Brownies write or draw each category on a door of their foldable. Go outside and show any boundaries for the scavenger hunt. Give Brownies 10–15 minutes for the scavenger hunt, tallying their foldable every time they see a natural object from one of the four categories.

Materials: Access to an outdoor area; pencils; chart paper or whiteboard and marker

- **Search for many kinds of a natural object.** Generate a list of the Brownies' ideas that were sparked by the “ASK” prompt. Have Brownies vote on a natural object for the scavenger hunt by making a tally chart for their votes. Help them total each to determine which is the most popular. If there's a tie, vote again. Next, ask, “What

are four different ways to describe this natural object?”

Have Brownies choose four characteristics, like size, color, shape, etc., to write or draw a picture of on each door of their foldable. Give Brownies 10–15 minutes to search outdoors, online, in a video, or in a book, adding tally marks every time they see a natural object with one of the four characteristics.

Materials: Access to an outdoor area, nature book, nature video, livestream, or animal website; pencils; chart paper or whiteboard and marker

- **Find nature beyond your neighborhood.** Ask Brownies, “Have you ever seen nature that looks different from what you have nearby? What did you see?” Explain that nature changes, depending where you are. Have them vote on (or choose) a place to explore, like across the country, around the globe, or under the sea, and brainstorm natural objects they might observe. Make a list. Have Brownies vote on four kinds of natural objects to be the categories for the scavenger hunt by making a tally chart for their votes. Help them total each natural object to determine which four are the most popular. If there's a tie, vote again. Then have them write or draw each category on a door of their foldable. Give Brownies 10–15 minutes to search online, in a video, or in a book, adding tally marks to their foldable every time they see something from one of the four categories.

Materials: Nature book, nature video, livestream, or animal website; pencils; chart paper or whiteboard and marker

STEP 2: Graph natural objects •

20–30 minutes

Ask: How do scientists share their observations?

Share: In Step 1, you made a tally mark for each natural object you observed. Each tally mark is a piece of data.

Data is information gathered by observation, questioning, or measuring. Scientists share their data in a way other people can understand, sometimes giving a speech, making a poster, or presenting at a meeting.

*Detailed choice activities, meeting tools, and additional resources and materials can be found within the Volunteer Toolkit on my.girlscouts.org.

Do: Show Brownies how to add their tally marks for each category on their foldable from Step 1, using an example, like $5+5+5+2=17$. Have them count each line they drew (or if they grouped them in fives, count by fives) and write the total number next to each set of tally marks.

Materials: *Chart paper or whiteboard and marker; foldables from Step 1; pencils; paper (graph paper optional); markers, crayons, or colored pencils*

Choices—do one:

- **Make a bar graph.** Explain that a **bar graph** compares how much or how many there are of something with rectangles. Show Brownies how to make a bar graph with their data from Step 1, putting numbers going up and down on the y-axis and the four categories from their foldable along the bottom, side to side, on the x-axis. Point out that the x-axis and y-axis are just names for the two types of data on the graph: the categories (x-axis) and how many of each category (y-axis). Help Brownies draw and label their axes and add their data for each category as a bar. After, have Brownies compare graphs. Ask questions like, “Which category did you find most often? Which did you find least often? If we changed locations, how would this affect your count?” Discuss how geography affects what nature the group observes.
- **Make a pie chart.** Explain that a **pie chart** can compare “slices” of pie for different categories, with larger slices representing more and smaller slices representing less. Point out that it’s a good way to show data and its parts as a whole. Have Brownies draw a circle (try tracing around a bowl!) and create slices for each category from Step 1. Help them estimate how large each slice should be. After, have Brownies compare results. Ask questions like, “Which category did you find most often (the biggest slice)? Which did you find least often (the smallest slice)? If we changed locations, how would this affect your count?” Discuss how geography affects what nature the group observes.
- **Make a word cloud.** Explain that a **word cloud** compares data as words of different sizes, with a word in a big font representing more of that data than a word in a small font. Have them: 1) look at their totals for each category, 2) decide how big the word should be, and 3) write all the words in a cloud shape. Have Brownies compare. Ask questions like, “Which category did you find most often (the biggest word)? Which did you find least often (the smallest word)? If we changed locations, how would this affect your count?” Discuss how geography affects what nature the group observes.

STEP 3: Make a spiderweb with symmetry • 20–30 minutes

Ask: Did you find any patterns or symmetry in nature in Step 1?

Share: A **pattern** repeats, like a ladybug’s spots or

snakeskin. Something is **symmetrical** when it is similar on both sides, like butterfly wings or a set of eyes. Orb spiders make round webs out of silk. The webs have **radials** that come out from a center point and are connected with a **spiral** that circles from the center.

Do: Show Brownies the spiderweb photo on page 7 of the Brownie Booklet. Ask, “Why do spiders build their webs using this design?” Explain that many scientists think that orb spider webs are built for strength. The symmetry of the radials evenly distributes force when prey hits the web. It prevents tears in the thread.

Choices—do one:

- **Make a spiderweb with yarn and sticks.** Assign each Brownie 2–4 skewers for their web’s radials so that someone will do each kind and be able to compare. Help Brownies: 1) put their skewers together, crossing them in the center, 2) weave yarn in a figure-eight around the center until the skewers are sturdy, 3) count the number of sections and ask if they notice a pattern (the number of sections is two times the number of skewers and equal to the number of radials), 4) weave yarn around the radials to create a spiral, and 5) compare their webs. After, go over “The Shape of Spiderwebs” in the Brownie Booklet and have Brownies identify their webs’ shapes and patterns. Then invite them to compare the shapes of webs with different numbers of radials.
- **Make a giant spiderweb.** Have Brownies stand or sit in a circle. Hold the end of a ball of yarn and toss it across the circle to a Brownie. Have them hold the string and toss the ball to someone else. Keep going so everyone has a chance to catch and throw. Ask, “Is our web symmetrical? Is there any kind of pattern to it?” Remind Brownies of radials and brainstorm how they can make radials. If they need help, suggest they make the yarn always cross the same center point, cutting it if needed. Have Brownies count the number of sections made from their radials and ask if they notice a pattern (the number of sections is equal to the number of radials). Then help them to weave the yarn through the radials around the web to make a spiral. After, go over “The Shape of Spiderwebs” in the Brownie Booklet and ask Brownies to identify what shape and any patterns they see in the web the troop created.

Materials: *Ball of yarn; safety scissors*

- **Make a spiderweb with glue.** Assign each Brownie 2–4 radials so that someone will do each kind and be able to compare. Have them: 1) make a line of glue for each radial on paper, 2) count the number of sections and ask them if they notice a pattern (the number of sections is equal to the number of radials), 3) make a spiral with their glue, starting in the center and moving from radial to radial, and 4) compare their webs. After, go over “The Shape of Spiderwebs” in the Brownie Booklet and have Brownies

identify the shapes and patterns in their webs. Once the glue is dry, have Brownies make a spider on top.

Materials: Paper; white glue; paint and brush OR markers

STEP 4: Explore tessellations • 20–30 minutes

Ask: Have you ever seen a rug or tile where a shape repeats over and over?

Share: A **tessellation** is when shapes fit together in a structurally strong pattern without any gaps or overlaps. In nature, you can find tessellations like a pineapple or honeycomb. Some shapes tessellate while others don't—think of a pattern with squares and one with circles. Circles don't tessellate, but squares do.

Do: Look at the photos of natural and non-natural tessellations on page 9 of the Brownie Booklet. Ask Brownies to identify the objects and shapes they see in each tessellation.

Choices—do one:

- **Draw a leaf tessellation.** Go outside for Brownies to find a fallen leaf. Leaves with straight or curved edges work best. If you're indoors, gather leaves for Brownies to choose from before the meeting or have them draw and cut out their own. Show them how to create a tessellation with a leaf, putting a leaf in the center of a sheet of paper, tracing around it, moving it so that its edges fit in with the outline of the leaf drawn before, and continuing to move and trace the leaf until you see a tessellation. Help Brownies create their tessellations and color them in. Have Brownies share their tessellation drawings with one another.

Materials: Leaf for each Brownie OR access to collect leaves; paper; pencils; markers, crayons, or colored pencils

- **Find tessellations in your kitchen.** Ask, "Have you ever seen food that tessellates?" Have Brownies brainstorm and offer examples like a raspberry or slice of orange. Share any boundaries or rules for the scavenger hunt, like don't go into drawers. Then Brownies can search for two kinds of tessellations: foods and objects made by people, like tiles, wallpaper, or tablecloths. Have them: 1) draw and color each tessellation, 2) share their finds and the shapes in each, and 3) sort their tessellations into natural objects and objects made by people.

Materials: Access to a kitchen or space with tessellations; paper; pencils; markers, crayons, or colored pencils

- **Make a tessellation quilt.** Show Brownies a quilt and explain that they're made from cloth shapes that sometimes tessellate. Have Brownies: 1) choose a shape (make sure it tessellates), 2) draw it over and over on paper or fabric, 3) cut out and fit the shapes together, and 4) sew the fabric or glue the shapes onto paper in a tessellation. Help if needed. If sewing, this activity may take additional time.

Materials: Quilt or photo of quilt; safety scissors; paper; pencils; for paper quilt: construction paper, large sheets of paper, markers, and glue; for fabric quilt: fabric and sewing supplies

STEP 5: Collect data about birds • 40–50 minutes

Ask: Have you ever gone bird-watching? What did you see? What did you hear?

Share: Birds can be identified by their shape, color, sound, and what they're doing. Tally marks can help you track any birds you see.

Do: Show any materials you prepared and talk about the different birds Brownies might see in your area, including their name, shape, color, and song or call. Review the steps in "How To Collect Data About Birds" in the Brownie Booklet so Brownies understand what to do for the activity.

Materials: Field guides or research on local birds; access to outdoor area or video player; paper; pencils; bird identification app and binoculars (optional)

Choices—do one:

- **Create a data table.** Before the meeting, make a sample data table with birds local to where you're going bird-watching (if you know). Show your table and explain to Brownies that a **data table** lists information in **rows** that go side to side and **columns** that go up and down. Have Brownies set up their own data tables with birds they expect to see and follow the steps in "How To Collect Data About Birds" in the Brownie Booklet. After, help Brownies: 1) organize their data, 2) add their tally marks for each kind of bird, and 3) compare data tables. Ask, "What bird did you see most and least often? Why do you think this is so? How would the bird count change if the season or location was different?"
- **Act out your observations.** Have Brownies follow the steps in "How To Collect Data About Birds" in the Brownie Booklet to go bird-watching. After, help Brownies: 1) organize their data, 2) add their tally marks for each kind of bird, and 3) compare data. Ask, "What bird did you see most and least often? Why do you think this is so? How would the bird count change if the season or location was different?" Then have Brownies work in pairs or small groups to present their data. They might create a puppet show, skit, or song. Give them time to plan and practice before sharing with the troop, family, or friends.
- **Count birds for citizen science.** Before the meeting, find a citizen science project about birds. Explain to Brownies that citizen science is when regular people help scientists with their research. Go over the project's instructions and have Brownies follow the steps in "How To Collect Data About Birds" in the Brownie Booklet. After, help Brownies: 1) organize their data, 2) add their tally marks for each kind of bird, and 3) compare data. Ask, "What bird did you see most and least often? Why

do you think this is so? How would the bird count change if the season or location was different?” Help them log and send their data to the project’s scientists.