Junior Numbers in Nature

How do you know what time it is or what the weather will be? Can you figure out how old a tree is by looking at it?

In this badge, you'll do all of these things! Math can be used to tell us all kinds of things about nature, from how tall or old a tree is to the weather, season, or time.

Steps

1. Tell time with nature
2. Track the weather
3. Explore the circumference of trees
4. Search for shadows
5. Find the area and perimeter of plants

Purpose

When I've earned this badge, I'll know how to use math to tell time, predict the weather, and learn about trees. I'll know how to measure shadows, perimeter, and area.

Words To Know

Anemometer: A scientific instrument used to measure wind speed.

Area: The space inside of a flat shape.

Barometer: A scientific instrument used to measure the air pressure.

Circumference: The distance around the outside edge of a circle.

Estimate: To guess a number close to the correct or actual answer using what you know.

Gauge: A scientific instrument that measures changes in amounts.

Instruments: Tools used by scientists during their research.

Irregular shapes: Shapes without equal sides or angles.

Level ground: Flat area that's not on a hill or slope.

Line of symmetry: An imaginary line where something could be folded and both sides would be reflections.

Meteorologist: A scientist who studies and forecasts the weather.

Neutral: Not high or low.

Perimeter: The distance around the outside of a two- or three-dimensional object.

Proportion: The relationship between the size, number, or amount of two things.

Quadrant: One of four equal parts created when a horizontal and vertical line cross.

Shadow: The dark shape created, or cast, when something blocks light.

Standard units of measure: A unit of measure that everyone agrees on and use to measure things, like inches, feet, and degrees Fahrenheit.

Sundial: An instrument that tells the time using the sun and shadows.

Thermometer: An instrument that measures the temperature or how hot or cold it is.

Tree pit: The area around the tree where roots can grow.

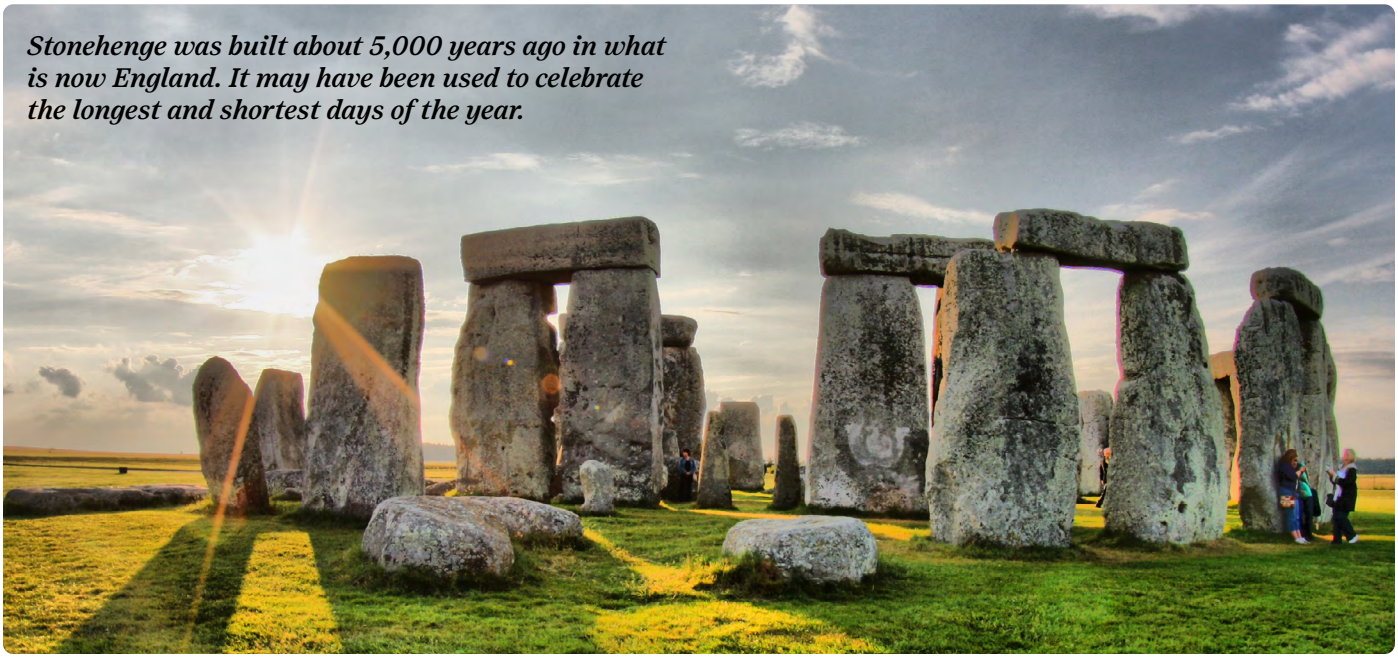
Weather station: A collection of instruments to track the weather.

Step 1: Tell time with nature

Clocks help us know what time it is. We have clocks in our homes, cars, and public buildings, like schools and airports. Many of these are modern clocks that need electricity to work.

Other clocks use water, sand, weights and springs, or even the sun and moon. **Sundials** are one of the oldest tools used to tell time. They're a circle with each hour of the day marked. As the sun travels across the daytime sky, a **shadow** is cast which marks the time. The shadow is like the hand on the clock.

Most sundials are made out of stone, metal, or pottery. Cultures all over the world have used sundials to tell time. The Maya and Inca peoples had buildings with sundial features. Like people from long ago, you can make a sundial. You can even measure the passage of time with just your hands!



Stonehenge was built about 5,000 years ago in what is now England. It may have been used to celebrate the longest and shortest days of the year.

Choices—do one:

Make a sundial. First, draw a straight line down the center of a paper plate and another to create **quadrants**, or four equal parts of the circle. Write, 3, 6, 9, and 12 at the top of the lines, like the face of a clock, and add in the remaining numbers. Then poke a hole in the center for a straw or chopstick so it's standing up. Then find a sunny area or flashlight to test your sundial. Use a clock to check the actual time and rotate your sundial so the shadow matches the current time. Then wait a few minutes to observe how the shadow moves. What is the new time on your sundial and the actual time? How accurate is your sundial?

Sundials

You can tell time by tracking the sun.

Make a life-sized sundial. If you have a sunny day, a friend, some rocks, and ribbon, you can make a sundial with people! First, place a rock in the center of an imaginary circle on the ground. Stand by it and cast a shadow. Have your partner extend a piece of ribbon from your foot to the end of your shadow, cut it, and pin it down with another rock. Check the actual time and write it down. Repeat several times throughout the day. Each time, look at the shadow: is it long or short? Wide or narrow? How did it move or change? How does the time of day affect the shadow? Can you use your sundial to tell time without a clock?

Use the sun and your hands to tell time. You can measure how much time is left before the sun goes down with just your hands and a clear view of the sun, without any trees or tall objects blocking the horizon (be careful when looking at the sun!). Put your arms out in front of you with your palms facing in. Line your index finger up to the bottom of the sun. If your pinky is below the horizon, the sun will set within the hour. If you still have space, place the index finger from your other hand below your pinky. Continue moving and counting how many times you move your hands down until you reach the horizon. That's about the number of daylight hours until the sun sets.

▶ **For more fun:** Count the number of fingers between the bottom of the sun and the horizon. How many did you count? Each finger is about 15 minutes of daylight. How much time is left before the sun sets?

Step 2: Track the weather

Have you ever forgotten to wear a coat on a rainy day? Or gone outside without boots when it's snowing? Knowing what the weather is like can help you dress for the outdoors. This can help whether you're walking to school or wondering if it's a good day for a hike!

Meteorologists are scientists who study weather. They use tools, or **instruments**, to help them measure, track, and predict the weather.

Find out more about weather instruments on page 6!

Choices—do one:

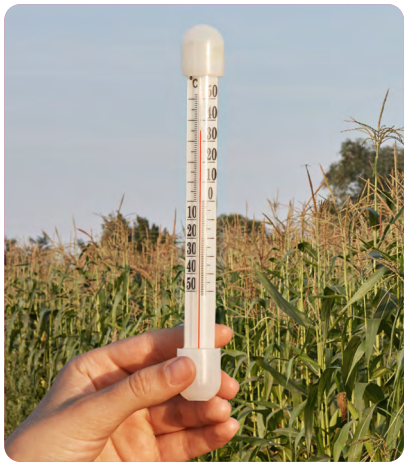
Make your own weather station. A **weather station** is a collection of instruments to track the weather. Set up your own weather station with a jar to collect rainwater. Add streamers and windmills to see how fast and in what direction the wind blows. Then track what you see in a weather journal. What do you observe each day? What do you think the weather will be later in the day or tomorrow? Then, compare the weather conditions you tracked with an app, a newspaper, or a TV or online weather report.

Track nature's clues. From animals and plants to changing seasons and even coming storms, you can track the weather just by looking around. Search for changes in plants, how animals act, or what is happening in the sky. Write down and tally what you see. Research what each clue might mean, make a guess of your own, and then wait to see what happens with the weather. Were you right?

Build a barometer. A **barometer** traps air in a container and measures the outside air pressure pushing against it. If the air pressure outside and inside is different, the gauge will move up (if the pressure is high) or down (if the air pressure is low). High air pressure means the weather will be clear and sunny. Low air pressure means it will be rainy or snowy. To make your own, stretch a balloon over the mouth of a jar (like the top of a drum) and secure it with a rubber band. Tape a straw to the center of the balloon. Stand a piece of cardboard next to it and mark the spot where the straw points. This is your barometer's home position. It's **neutral**—it's not high or low. Then draw a picture of sunshine and good weather above the neutral line and rain, snow, and storms below. Place your barometer in a sheltered outdoor space. Wait a minute or two. What happens? Mark your gauge and write the date, time, and weather.

Your Weather Toolbox

There are all kinds of instruments that help us measure and understand the weather.



A **thermometer** measures the temperature or how hot or cold it is.

A **barometer** measures changes in air pressure.

An **anemometer** measures wind speed.

A **rain gauge** measures the amount of rain.

A **windsock** or **weathervane** measures wind direction.

Natural changes can tell you about the season, time, and weather.

Step 3: Explore the circumference of trees

Trees are nature's superheroes! They take out pollution and carbon dioxide from the air we breathe and release oxygen. They keep our drinking water clean and protect our homes from the heat and cold. They protect soil and provide us fruit and nuts. They lower our stress, make us happy, and create space for wildlife to live, eat, and play.

So what can a tree tell you about itself? Well, by measuring just around the outside of a tree trunk, you can find out a lot about the tree. **Circumference** is the distance around the outside edge of a circle. For the most accurate measurement, wrap a string or tape measure around the tree about 4.5 feet from the ground.

Choices—do one:

Measure circumference to find the age of a tree. You can find out how old a tree was by looking at the number of rings in its trunk. But if the tree is still alive, you can estimate its age by measuring its circumference in inches. If the tree's circumference in inches is its approximate age in years, how old is the tree? Measure the circumference and estimate the age of other trees in the area.

Measure circumference to understand tree health. Sometimes you can look at a tree and know it isn't healthy, like if it's missing leaves or even rotting. The tree's trunk circumference can also tell you how healthy a tree is—a big trunk can more easily move water and nutrients than a small trunk. To find out how healthy a tree is, measure its circumference in inches. Then, measure the **tree pit** or area where the roots grow. Most trees need about 5x5 feet to properly grow. How big is the tree trunk? How big is the tree pit? Measure different trees to compare how healthy they are.

Measure circumference to find the amount of carbon stored by a tree. How much carbon a tree can store depends on its size, age, and species. Over the course of its life, a single tree can capture and store one ton of carbon dioxide. This helps clean our air! To find out how much carbon a tree has stored, measure the circumference of its trunk in centimeters. Then use the table to convert the circumference to dry weight in kilograms. Divide this by 2 to find the amount of carbon stored by the tree. Measure different trees to explore which trees have stored the most carbon.

Circumference (cm)	Tree dry weight (kg)
50	106
100	668
150	1,964
200	4,221
225	5,771
250	7,641
275	9,842
300	12,410
325	15,350
350	18,700
400	26,674

Step 4: Search for shadows

Shadows are mysterious. They move, change, and disappear. A shadow is created, or cast, when something blocks light. If you understand how shadows change with the sun, you can tell time or figure out how tall a tree or an object is.

A shadow's size is similar to the size of the actual person or object. It's a **proportion**. A proportion is the relationship between the size, number, or amount of two things. A shadow and the object that casts it are proportional.

To find the height of any object or its shadow, use the equation on page 9.

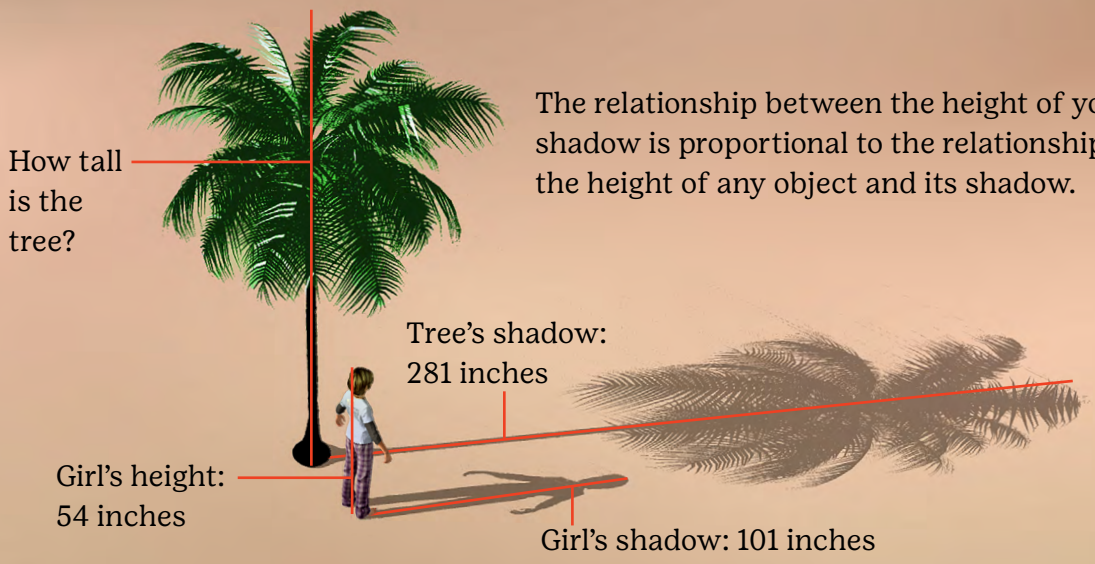
Choices—do one:

Find a tree's height using shadows. On a sunny day, you can use a tree's shadow and proportions to calculate its height. Choose a tree to measure that is on **level ground**—ground that's flat, not on a hill or slope. Then stand near the tree and have a partner measure your height and shadow height in inches. Then measure the tree's shadow in inches. Use proportions to find the approximate height of the tree in inches.

Go on a shadow adventure. Go outside and look for shadows. Notice where the light is coming from and how big each shadow is. Can you change its size or shape? Try to block or change the light and notice what happens. Trace and measure your own shadow. Trace and measure shadows you see. How do they compare to one another? If you can measure the objects, are they proportional to their shadows? If you can't measure the height of something (like a tree) you can find its approximate height with proportions.

Measure the power of shadows. When the sun moves, a shadow's size changes. It disappears completely at noon. Make shadow puppets to discover the relationship between the light source and size of the shadow. Use your hands or cast shadows with your body. Measure both the shadow and you. Do they have the same proportion? What light position casts the longest shadow? Which casts a short one without disappearing? Does the shadow keep its shape or get distorted? Try other objects and light positions.

Find the Height of Any Object



The relationship between the height of you and your shadow is proportional to the relationship between the height of any object and its shadow.

$$\frac{\textbf{Your height}}{\textbf{Your shadow length}} = \frac{\textbf{Object height}}{\textbf{Object shadow length}}$$

Did You Know?

You can measure the earth's circumference with a shadow for 2 weeks around when the season's change at the spring and fall equinoxes (March 20 and September 22)!

How do you measure the circumference of the earth?

1. Check the weather and find a sunny day around those dates. Look up the time for sunrise and sunset. What time is exactly in between? That's called "solar noon."
2. At solar noon, hold a meterstick straight up from the ground. Mark the top of its shadow. Stretch some string from the top of the meterstick to the mark. Then use a protractor to measure the angle between the string and the meterstick. Write this down.
3. Research the distance between you and the equator.
4. Calculate the circumference of the Earth using this equation:

$$\textbf{Circumference} = \frac{\textbf{360} \times \textbf{(distance between you and the equator)}}{\textbf{Angle of shadow that you measured}}$$

If the true circumference of the earth is 24,901 miles, how close was your measurement?

Step 5: Find the area and perimeter of plants

Plants are lifesavers! They turn the sun's energy into food, fresh air, and other useful things. When they make food for themselves with their leaves, they make fresh air for us. They also provide food in gardens, farms, and orchards. So, how much fresh air can a plant produce? And how much space do you need for plants to grow in a garden?

You can find the answer to these questions using area and perimeter. **Perimeter** is the distance around the outside of a two-dimensional (2D) object. A 2D object is flat, like a leaf or sheet of paper. You can also find the **area**, or space inside, of a flat object. The area of **irregular shapes**, or shapes without equal sides or angles, like a leaf, can be hard to calculate, but you can **estimate** and guess a number close to the correct or actual answer using what you know.

Use the grid on page 11 to calculate area and perimeter.

Choices—do one:

Find the perimeter and area of leaves. First, trace around a leaf on graph paper. Then place some yarn along the outline and cut it to that length. Measure the yarn. How long is it? That's the leaf's perimeter! To calculate the area, count and write down the number of full squares inside the leaf outline. Then, count each partial square that is at least half covered by the leaf. Do not count the squares with the stem. Add the two numbers together to estimate the area of your leaf. Then measure other leaves. Which has the largest area?

Find the perimeter and area to plan a garden. Plants need different amounts of space and sunlight to grow. Gardeners and farmers plan their plantings carefully to make the most of their space. First, draw the shape of your garden on graph paper. Then imagine you want to add a fence. Can you find the garden's perimeter and area? Then decide what to grow. How much area does each plant need? Add in your plants. How many of each can you grow? Add in benches, paths, and anything else. Make sure to find the area and perimeter of each plant or object you add.

Find the perimeter and area of a natural landscape. How big is the nearby lake? How much tree canopy is there in the woods? How big is the climbing structure in the park? There's no tape measure big enough to check! Instead, use a map or aerial photos (pictures taken from above) to measure perimeter and area. Trace the outline of the area you want to measure with yarn and cut it to that length. Measure the yarn and use the scale to calculate the perimeter. For area, use the scale to create a grid on the landscape. Then, count and write down the number of full squares inside the outline. Next, count each partial square that is at least half covered. Add the two numbers together to estimate the area.

Find the area and perimeter of plants

Perimeter = _____

Estimated area = _____^{2}

How does the perimeter compare to the area? _____

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

Made possible by a generous grant from Johnson & Johnson.

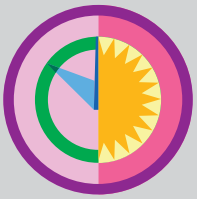
First published in 2021 by GSUSA | 420 Fifth Avenue, New York, NY 10018-2798 | www.girlscouts.org

Printed in the United States

UPC 64291

7 31955 64291 4

girl scouts



Volunteer's Guide to Junior Numbers in Nature*

Tips and ideas to help guide your troop through this badge. *This is the second 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: Tell time with nature • 25–35 minutes

Ask: How do clocks help us with our daily lives?

Share: Clocks help us know what time it is. Many clocks need electricity to work. Others use water, sand, weights and springs, or the sun or moon and rotation of the earth. **Sundials** are a circle with each hour of the day. As the sun travels across the sky, a shadow is cast to mark the hour of the day. The shadow is like the hand on the clock. Most sundials are made out of stone, metal, or pottery. Cultures all over the world have used sundials to tell time.

Do: Have Juniors look at the photos of sundials on page 4 of the Junior Booklet and tell the time on each sundial.

Choices—do one:

- **Make a sundial.** Show Juniors how to use a ruler to draw **quadrants**, or four equal parts, on a paper plate. Then ask Juniors to label the lines with 12, 3, 6, and 9 and add the remaining numbers (like a clock face). Then help them to poke a hole in the center of the plate where the lines cross and tape the straw or chopstick in the hole so it stands. Then find a sunny area or use a flashlight to test the sundials. Have Juniors: 1) check the actual time, 2) rotate their sundials so the shadow matches the time, and 3) wait a few minutes to see how the shadow moves. Ask, "What's the new time? What's the actual time? How accurate is your sundial? How does the sun make the shadow move?"

  Materials: *Access to sunny area OR flashlights; watch, clock, or cell phone with the correct time; paper plates; markers; plastic straws or chopsticks; pencils; rulers; scissors*

- **Make a life-sized sundial.** Go outside and have Juniors pair up to mark the center of an imaginary circle. Have one Junior stand in the circle and cast a shadow while the other extends a ribbon on the ground from the center stone, cuts it to the shadow's length, and pins it down with another rock. Have them check the time on a clock, write it on a piece of paper, and place the paper under the rock with the ribbon. Repeat several times throughout the meeting, marking the shadows with ribbon and labeling the time. Each time, ask, "Is the shadow long or short? Wide or narrow? Did it move or change? How does the time of day affect the shadow? How can you use your sundial to tell time?"

  Materials: *Access to outdoor sunny area with pavement; ribbon; scissors; rocks; paper; pencils; watch, clock, or cell phone with the correct time*

- **Use the sun and your hands to tell time.** Look up the time for sunset and go to a sunny place with a clear view of the sun and horizon. Caution Juniors about looking directly at the sun. Have Juniors put their arms in front of them with palms facing in, lining their index finger to the bottom of the sun. Explain, "If your pinky is below the horizon, the sun will set within the hour." If there's space, have them place the index finger from their other hand against their pinky, moving their hands down until they reach the horizon. Ask, "How many times did you move your hands? That's about the number of hours until the sun sets." Tell them the time for sunset and ask, "How accurate is our tool?" **For more fun:** Have Juniors count their fingers between the sun and horizon—each is about 15 minutes of daylight.

  Materials: *Access to outdoor sunny area with a clear view of the sun and nothing blocking the horizon; sunset time for the day*

STEP 2: Track the weather • 20–30 minutes

Ask: What tools can help you know the weather outside?

Share: Meteorologists study weather. They use all kinds of tools, or **instruments**, to measure, track, and better understand weather and other parts of nature.

Do: Go over "Your Weather Toolbox" in the Junior Booklet.

Choices—do one:

- **Make your own weather station.** Have Juniors make

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

weather stations with a rain gauge, windsock, and wind speed instrument (anemometer). For the rain gauge, cut the top off an empty bottle and mark inches on a piece of tape for the bottle's side. For the windsock, tape streamers to the top of a chopstick. For the anemometer, make a windmill by: 1) decorating a paper square, 2) folding it in half diagonally and repeating in the other direction (to create an X with the fold), 3) cutting each corner half-way to the center of each crease, 4) bending each corner to the center, creating loops, and 5) pushing a pin through the corners and into a pencil's eraser. Then, make stands for the windsock and windmill by filling two bottles with pebbles or sand. Have Juniors place their stations outside, check them 2–3 times a day, and make a prediction. Have them compare their predictions to a weather report in an app or newspaper, on TV, or online. Ask, "How accurate were your predictions? How accurate were your instruments?"

Materials: *3 empty plastic bottles for each Junior; masking tape; markers; rulers; dowels or chopsticks; streamers or ribbon; pebbles or sand; squares of card stock; scissors; pencils with erasers; pushpins*

- **Track nature's clues.** Have Juniors research natural changes and phenomena that indicate a change in weather or season. Then go outside and have them: 1) look for natural clues of changing weather, like plants, animals, or the sky, 2) note what they see, 3) predict what weather changes are coming based on the clues, 4) compare what they see to their research, and 5) create a natural calendar documenting the different clues they've found. At the next meeting, Juniors can share their calendars and discuss if their predictions were correct.

  Materials: *Papers; pencils; markers; weather reference books; laptops, smartphones, or tablets (optional)*

- **Build a barometer.** Have Juniors: 1) stretch a balloon over the mouth of the jar and secure it with a rubber band, 2) cut a straw into a point and tape the other end to the center of the balloon, 3) stand a piece of cardboard next to it, 4) mark the gauge's neutral line (where the straw points), 5) draw good weather above the line and stormy weather below, 6) place them in a sheltered outdoor space, 7) wait a minute or two, and 8) mark their gauge with the date, time, and weather. Later, check the barometers again. Ask, "Did your barometer accurately predict weather changes?" If you're meeting virtually, Juniors can bring their barometers outside (with a parent or guardian), wait, and mark their gauges before returning to the meeting.

  Materials: *Access to a sheltered outdoor area; glass jars; rubber balloons; thick rubber bands; plastic straws; 8 ½ x 11 card stock; tape; scissors; markers*

STEP 3: Explore the circumference of trees • 15–25 minutes

Ask: What do you think you can learn about a tree by measuring it?

Share: By measuring a tree trunk, you can learn a lot. **Circumference** is the distance around the outside of a circle. For a tree, it's the distance around the trunk.

Do: Have Juniors measure the circumference of their wrist, a partner's head, and a cup or bowl. Show how to get an accurate measurement of a tree's circumference by wrapping a tape measure or string (to measure) around the trunk about 4.5 ft (137 cm or 1.37 m) from the ground. Have them practice measuring 4.5 ft from the ground.

Choices—do one:

Materials: *Access to outdoor area with trees; flexible tape measure with inches OR string to then measure with a ruler; field guides or tree identification app; pencils; paper*

- **Measure circumference to find the age of a tree.** Explain, "You can find a tree's age by counting the tree rings or estimating its age by measuring its circumference. When you estimate, you guess based on the information you have." Go outside for Juniors to pair up. Have them choose a tree, identify it, measure its circumference in inches, and record the measurement. Ask, "If the circumference in inches is its approximate age in years, how old is the tree? What year was it planted?" Have Juniors write the age and year planted next to the measurement before estimating the age of other trees.

- **Measure circumference to understand tree health.** Explain, "Circumference can tell us something about the tree's health—a big trunk more easily moves water and nutrients than a small trunk." Go outside for Juniors to work in pairs to: 1) choose a tree, 2) identify it, 3) look for clues about the tree's health, 4) measure and record its circumference in inches, 5) measure and record the area of the tree pit (space around the tree) in inches, and 6) measure other trees.

- **Measure circumference to find the amount of carbon stored by a tree.** Discuss the benefits of trees, like shade, food, and clean air (taking carbon dioxide out and putting oxygen back in). Share that the amount of carbon a tree can store depends on its size, age, and type. Go outside for Juniors to work in pairs to: 1) choose a tree, 2) identify it, 3) measure and record its circumference in centimeters, 4) use the table in the Junior Booklet to convert the number of centimeters to dry weight in kilograms, 5) divide by 2 to find the amount of carbon stored in the tree, and 6) measure other trees to compare which trees have stored the most carbon.

STEP 4: Search for shadows • 20–30 minutes

Ask: Did you know you can use shadows to answer math and science questions?

Share: A shadow is **cast** when something blocks light. Its size is related to the size of the thing that casts it, so the shadow and the object that casts it are proportional. A **proportion** is the relationship between the size, number, or amount of two things, such as two ratios or equivalent fractions, like ½ and ⅜. If you know the relationship, then you can use one to find the other.

Do: Go over and demonstrate how to solve the equation under "Find the Height of Any Object" in the Junior Booklet. Show Juniors how to write an equation with equivalent fractions and multiply diagonally to solve for x.

Materials: *Chart paper or whiteboard and marker*

Choices—do one:

- **Find a tree's height using shadows.** Go outside to a place with bright sunlight, **level ground**, and trees. Have Juniors pair up to: 1) choose a tree to measure on level ground (flat area, not on a hill or slope), 2) measure and record each other's height in inches, 3) while standing near the tree, measure and record each other's shadow in inches, and 4) measure the tree's shadow from its base to the top of the shadow (in inches). Then ask them to calculate the approximate height of the tree in inches (tree shadow length multiplied by the Junior's height and divided by the Junior's shadow length) and share how tall their trees are. If you're meeting indoors or virtually, Juniors can use toys and flashlights to create shadows with a family member.

  Materials: *Access to a bright, sunny area with trees on level ground OR flashlights; rulers or tape measures; paper; pencils*

- **Go on a shadow adventure.** Go outside for Juniors to pair up and: 1) trace, measure, and record the height of each other's shadows, 2) try to change the shadow's shape by blocking or changing the light, and 3) trace and measure other shadows and objects. Ask, "How do the measurements compare to one another? If you measure the objects, are they proportional to their shadows?" If Juniors aren't able to measure the height of the object (like a tree or building) or its shadow, help them to find its approximate height by multiplying the "Object shadow length" by "Your height" and dividing by "Your shadow length."

  Materials: *Access to a bright, sunny outdoor area OR flashlights; rulers or tape measures; paper; pencils; sidewalk chalk and permission from property owner OR butcher paper and markers; calculators (optional)*

- **Measure the power of shadows.** Have Juniors work in small teams to: 1) create shadows, either with their whole bodies or hands (shadow puppets), 2) measure and record their height or the length of their hand, 3) measure and record the shadows' lengths with the flashlight in three different locations, 4) calculate how the shadows change in size from one location to the next, and 5) write the relationship of the flashlight location to the shadow size as a proportion or ratio. Ask, "What location casts the longest shadow? Which casts a short shadow, without disappearing? Does the shadow keep its shape or does it get distorted?"

  Materials: *Flashlights; rulers or tape measures; paper; pencils*

STEP 5: Find the area and perimeter of plants • 20 minutes

Ask: What can we measure besides the height or length of something?

Share: Perimeter is the distance around the outside of a flat object. Circumference is the perimeter of a circle. **Area** is the space inside of a flat object. The area of **irregular shapes** without equal sides or angles can be hard to calculate, but you can **estimate** and find a number close to the actual answer.

Do: Demonstrate how to measure the perimeter of an irregular object, like a shoe or hand. Trace its outline with string, cut it, and measure the string. Have Juniors measure the perimeters of regular and irregular objects and calculate the area for the regular objects (length × width). Show them how to estimate the area of an irregular object (if it's small enough) by tracing around it on graph paper, counting the number of full squares, counting the number of more than half-full squares, and adding them together. Using the scale from the graph paper to write the area as area = x cm^2 (or other unit).

Materials: *String; rulers; graph paper; pencils*

Choices—do one:

- **Find the perimeter and area of leaves.** Go outside for Juniors to each gather a fallen leaf (do not pull leaves off of trees or other plants) or show Juniors the leaves you gathered for them to choose from. Have them follow "DO" to find the perimeter and area of their leaf. They can trace their leaf on "Find the area and perimeter of leaves" in the Junior Booklet. Remind them that the perimeter or edge of a leaf is called a **margin**. When calculating the area, tell Juniors not to count any squares with the stem. Have Juniors measure other leaves, guessing which has more area before comparing their calculations. Make sure to return any leaves or other natural objects to the place you or the Juniors found them.

  Materials: *Leaves OR access to collect leaves; yarn; scissors; pencils; rulers with centimeters*

- **Find the perimeter and area to plan a garden.** Have Juniors draw their garden on "Find the area and perimeter of leaves" in the Junior Booklet. Then help them to follow "DO" to calculate the perimeter for fencing

and area for planting. Next, have them: 1) decide what to grow, 2) find out how much space each plant needs to grow, 3) plot the plants in their garden, and 4) add in benches, paths, or anything else, finding the area and perimeter of each object they add. Once they're done, ask Juniors to share their gardens with the troop.

Materials: *Seed packets, gardening reference books, smartphones, laptops, or tablets; yarn; scissors; pencils; colored pencils; rulers with centimeters*

- **Find the perimeter and area of a natural landscape.** Show sample maps or aerial photos, and explain, "Scientists use scale and maps or aerial photos (taken from above) to measure and calculate the perimeter and area of natural landscapes like the Great Lakes or the Amazon rainforest." Using the process in "DO" and "Find the area and perimeter of leaves" in the Junior Booklet, have Juniors calculate the perimeter and area of a natural landscape on a map, like a forest, tree canopy, glacier, or lake.

  Materials: *Maps or aerial photos; yarn; scissors; pencils; rulers with centimeters*