

Brownie Numbers in Nature

Do you like the feeling of sun or seawater on your skin? Do you like the smell of flowers or pine trees? Have you ever listened to the birds? Touch, taste, smell, sight, and hearing are all ways to **sense** or understand the world around us.

This badge is all about understanding nature. You'll use your senses to gather information. You'll use other tools to learn even more about nature.

Steps

1. Explore temperature
2. Measure the length of leaves
3. Graph your leaf data
4. Find space to grow
5. Plot and plant a garden

Purpose

When I've earned this badge, I'll know how to measure temperature and length. I'll know about square feet, diagrams, and grids. I'll have explored leaves and gardening.



Words To Know

Area: The space inside a flat shape.

Cricket: A small jumping insect. Male crickets make a chirping sound by rubbing their back legs together.

Degrees Fahrenheit and **degrees Celsius:** Standard units of measure for temperature.

Diagram: A drawing or plan that shows the parts of something and how those parts work together.

Grid: A network of horizontal (or sideways) and vertical (or up-and-down) lines that help us locate or organize things.

Length: The measurement from top to bottom.

Line plot: A graph that lets you show data as points on a number line.

One foot: 12 inches, the length of a standard ruler.

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

Senses: The way our body observes and understands the world around us. Our five senses are sight, touch, taste, sound, and smell.

Square foot: A unit of measure for area that is a square measuring one foot long on each side.

Temperature: How hot or cold something is.

Thermometer: A tool that measures the temperature.

Unit of measure: The words we use to describe how much of something there is. In time, we might use seconds, days, and years. In length, we might use inches or centimeters. These are “**standard**” units because lots of people use and agree on them.

Width: The measurement from side to side.

Step 1: Explore temperature

When you're getting dressed, how do you know what to wear? You can dress for what you have to do, like going to dance class or to soccer practice. You can dress for the weather, too.

The weather might be cloudy, sunny, raining, or snowing. The weather is how hot or cold out it is outside, too. This is called the **temperature**.

To find out what the weather is like outside, you can watch the news. You can go outdoors. You can find clues in nature, too! You can use a thermometer. A **thermometer** is a tool that measures the temperature.

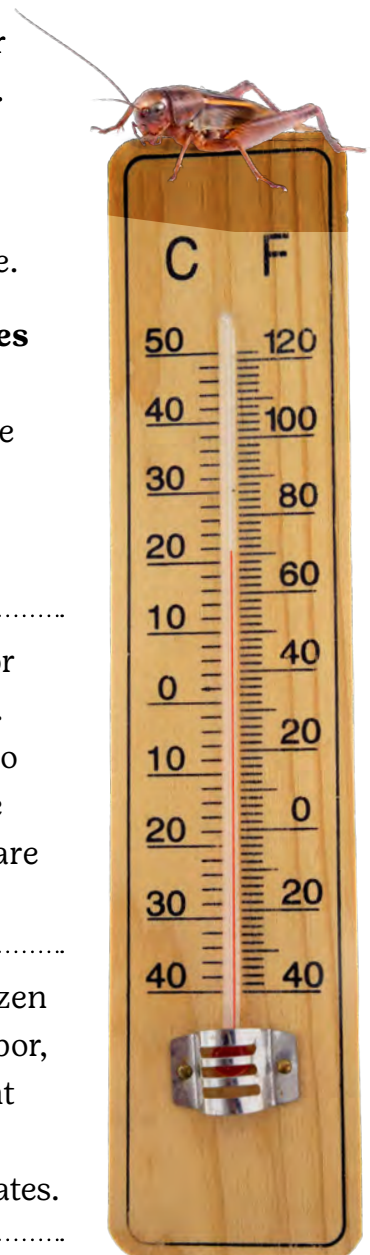
Many thermometers measure in both **degrees Fahrenheit** and **degrees Celsius**. They're two different **units of measure**. They cannot be combined with one another. In this badge, you'll focus on measuring the temperature in degrees Fahrenheit.

Choices—do one:

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Measure temperature with crickets. Crickets can tell you how hot or cold it is. They rub their back legs together. It makes a chirping sound. They chirp faster in hot weather. They chirp slower in the cold. Listen to crickets. Count the number of chirps in 15 seconds. Add 37. This is the temperature in degrees Fahrenheit! Check a thermometer. How close are the numbers?
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Experiment with water's states of matter. Have you ever seen a frozen lake? Water can be liquid. It can be solid, like snow or ice. It can be vapor, like steam, too. These are water's states of matter. Each is at a different temperature. When ice melts, it becomes water. When water boils, it becomes steam. Do experiments with water to explore how it changes states.
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Create a calendar with nature's clues. Imagine you didn't have a thermometer or calendar. How would you know the season or weather? Nature gives us clues. Leaves change colors in the fall. Frost sits on windows in the winter. Plants bud in the spring. Find 1 or more natural clues for each season: fall, winter, spring, and summer. Then draw your calendar to share the clues with others.





Step 2: Measure the length of leaves

Have you ever wondered how tall a tree is? How do you find how tall you are? **Length** is how long something is from top to bottom. **Width** is how long it is from side to side.

You can measure length and width with a ruler. You can measure in inches. You can measure in centimeters. Everyone agrees how big an inch and a centimeter are. They're **standard units of measure**. Inches are often divided into 16 equal parts. Centimeters are divided into 10.

Even though both are found on a ruler, inches and centimeters are on different sides. They're different units of measure. They cannot be combined with one another.

Did you know?

The length and size of a leaf affect how much food it makes and how much water goes into the air.

Choices—do one:

Measure with a ruler. Use a ruler to measure 3 leaves in inches and centimeters. Compare the measurements. Which leaf was the longest? Which was the shortest? Were any close to the same length but very different shapes?

Measure with your body. Your finger and toe will be your two units of measure. Find 3 leaves to measure with each body part. Make sure to use the same finger or toe to measure the leaves—that way you'll have the same standard unit of measure for each leaf. Then compare the measurements. Which leaf was the longest? Which was the shortest? Would others be able to use your unit of measure?

Measure with an object. Find a natural object, like a rock, flower petal, or stick. This will be your first unit of measure. Choose another object made by people, like a paper clip or barrette. This is your other unit of measure. Find 3 leaves to measure with each object. Then compare the measurements. Which leaf was the longest? Which was the shortest? Would others be able to use your unit of measure?

► **For more fun: Create a leaf rubbing.** Place your leaves under a sheet of paper. Gently rub crayons on top of the paper.

My Leaf Measurements

My first unit of measure is _____.

My second unit of measure is _____.

Trace each leaf here.	Length of leaf
1	Unit 1:
	Unit 2:
2	Unit 1:
	Unit 2:
3	Unit 1:
	Unit 2:



Step 3: Graph your leaf data

Scientists and mathematicians collect data. Data is another word for information. After collecting the data, they analyze it. They look at it carefully. They think about what it might tell them. They use data to learn new things and ask other questions.

Scientists and mathematicians use graphs and charts to show their data. A **line plot** lets you show data as points on a number line. It helps to compare the pieces of data.

Choices—do one:

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Draw a line plot. A simple line plot on a piece of paper can help you see your data more easily. It can help you notice different patterns or surprising things. Make line plots showing your leaf data. Make one line plot for each unit of measure. Use graph paper and a ruler to help.

Make a line plot with natural objects.

Usually line plots are made on paper or a computer. Can you make one with natural objects? Find sticks to be your lines. Find rocks to be your data points. Place your sticks in a line. Add the rocks. Make line plots showing your leaf data. Make one line plot for each unit of measure.

► **For more fun:** Take a photo of your line plots to share with others.

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Create a human line plot. Make a life-sized line plot! Use your troop or family as the data points. What can you use to make your line? Maybe chalk or long pieces of tape? How can you create a standard unit of measure for the line? How can people be the data points? Try different ideas. Which one worked best? Use it to make a line plot for each unit of measure.

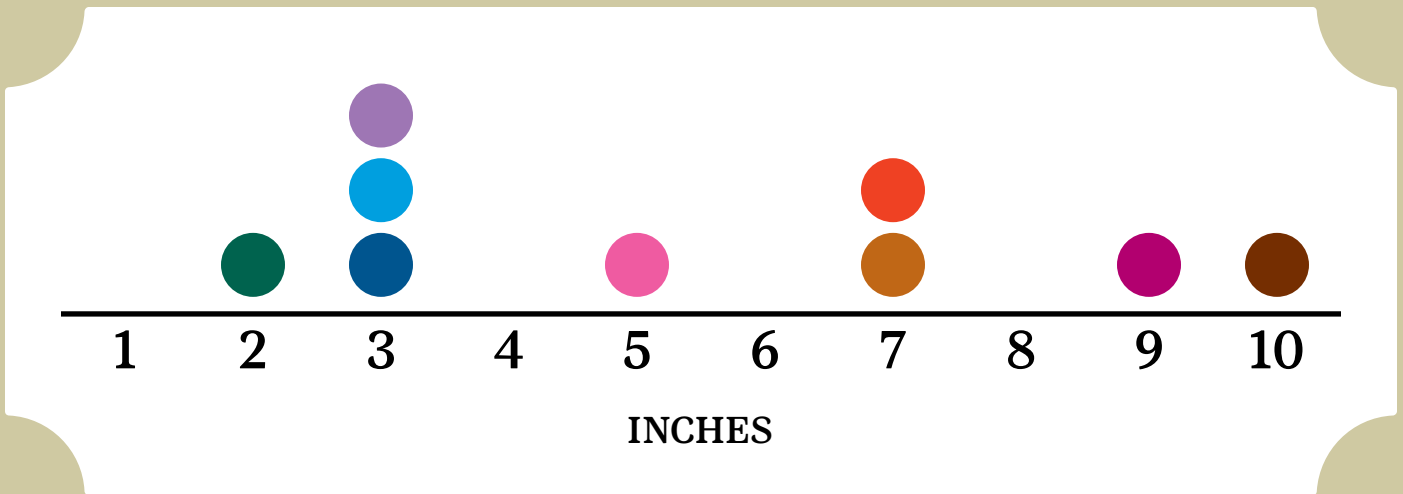
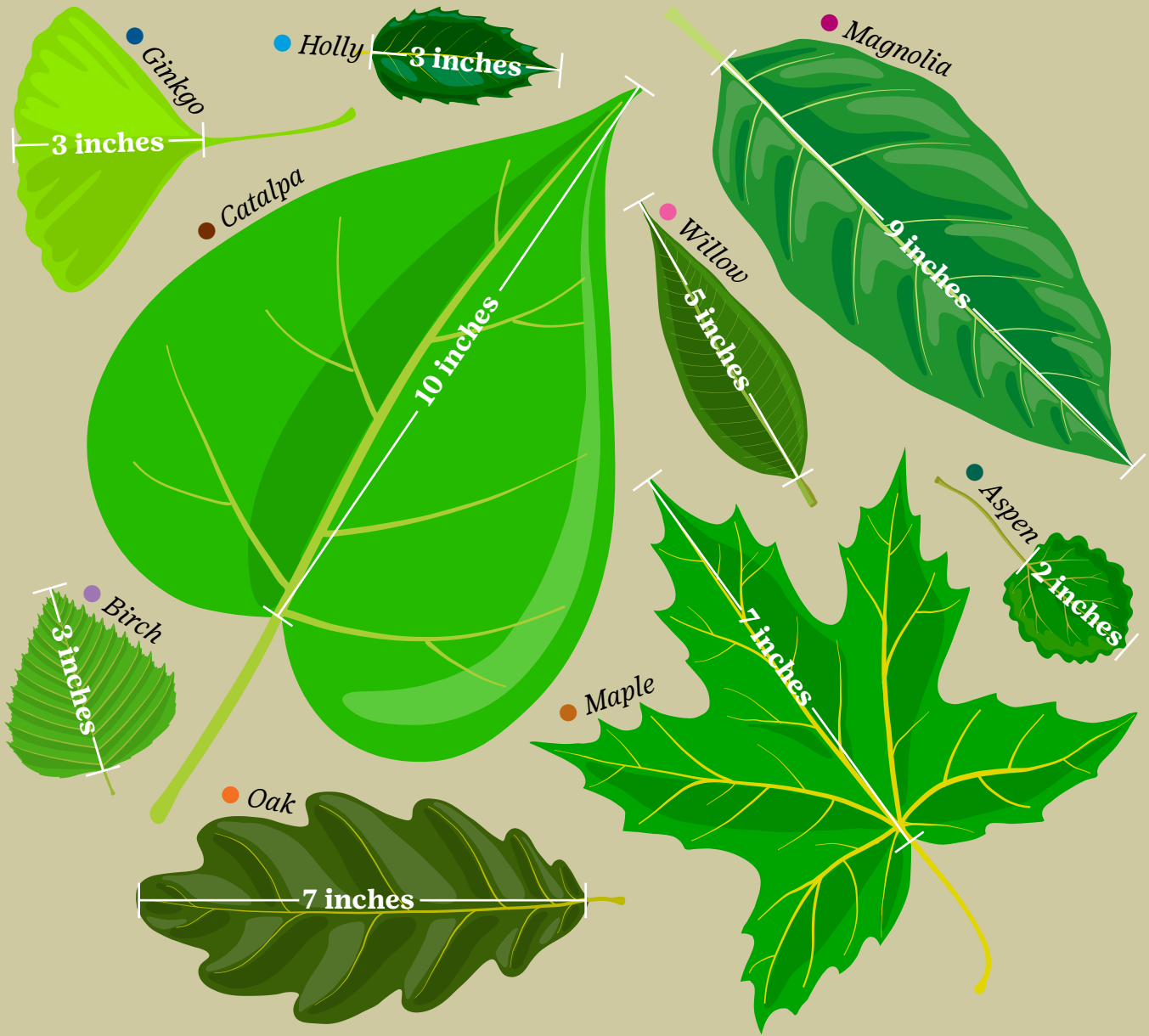
► **For more fun:** Take a photo of your line plots to share with others.

**For
more fun:
Identify your
leaves.**

What trees did the leaves come from? What tree produced the longest leaf? What leaf produced the shortest leaf?



Leaf Line Plot



Step 4: Find space to grow

Different plants need different amounts of space to grow well. Some need a lot more space than others.

Growing plants takes planning and math. You'd need to know how much space each plant needs to grow. You'd also need to know the area of the space you are using. **Area** is how much room there is inside the space.

People often use the unit of measure of **one foot**—12 inches—to measure distance or size. Area is measured in square feet. A **square foot** measures one foot long on each side of the square.

So, what would you grow in a garden? How much space would each plant need? You can use a diagram to figure out where to put things. A **diagram** is a plan that shows the parts of something. It also shows how those parts work together.

Choices—do one:

Use
pages 10
and 11 to
plot your
gardens
in Steps
4 and 5.

Plot an edible garden. Decide what to grow. Look at the seed packets or online for spacing information. Compare the different plants and create a diagram. How many of each plant can you grow? Which would require a lot of land? Which could you plant the most of?

Plot a forest. Trees are nature's superheroes. They clean the air, provide homes for animals, and are beautiful to look at. They give us shade, food, wood, and paper. Trees need space aboveground to grow tall and wide. They also need space belowground for the roots. Find out what kinds of trees grow best in your area and how much space each needs to grow. Compare the different trees and create a diagram. What trees will you plant? How many can you plant?

Plot a flower garden. Find out what kinds of flowers and plants grow best in your area. How much space does each need to grow? Compare the different plants and create a diagram. What will you plant? How many can you plant? Will you add anything else, like a bench? Make sure to include the area of each object on your diagram!

Step 5: Plot and plant a garden

Planning is an important part of growing anything. You need to know what grows well in your area. You need to know how much space you have. You can make a **grid** to organize your garden. Your grid will have one horizontal (or sideways) line and one vertical (or up-and-down) line.

Each box in the grid is called a **quadrant**. Quadrants can help you make sure each plant has the room it needs to grow. Seeds need soil, or dirt, to grow in. All plants need water and sunshine.

Choices—do one:

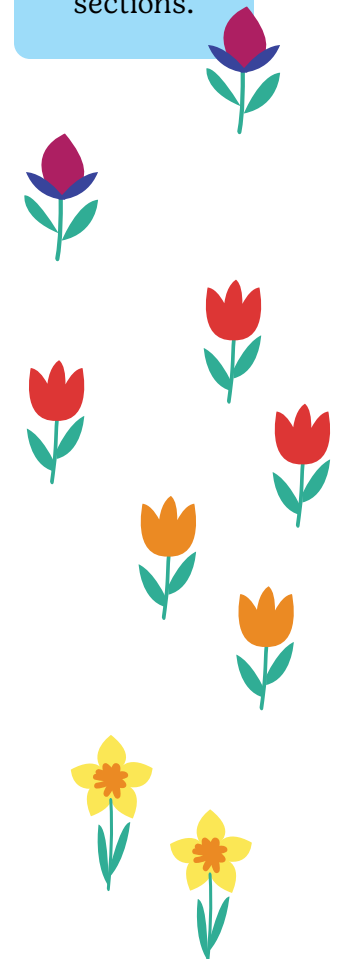
Plant an herb garden. An **herb** is a plant used in foods. Parsley and basil are herbs. Chives and peppermint are herbs, too. Make a small indoor herb garden with four quadrants. This will help the plants have enough room to grow. Use tape to make a grid with quadrants in a pan. Choose a different herb for each quadrant. Then plant your garden with soil and seeds.

Plant an outdoor garden. If you have space and permission, you can plant a garden outside. Measure the area you have for your garden. How many square feet do you have? Does the space get enough sunshine? Look up flowers, herbs, fruits, or veggies that would grow best in your space. Use a grid with quadrants to plan your garden. Then plant your garden and watch it grow.

Plant a container garden. If you don't have space in the ground to grow plants, you can use a container on a windowsill, patio, balcony, or stoop. You can recycle a milk carton, yogurt cup, and any other container. Make sure it has holes for water to drain out. Then measure the bottom of the container. Create a grid with quadrants. Now, what will you grow? Look for flowers, herbs, fruits, or veggies that would grow well in your space. Then plant your garden and watch it grow.

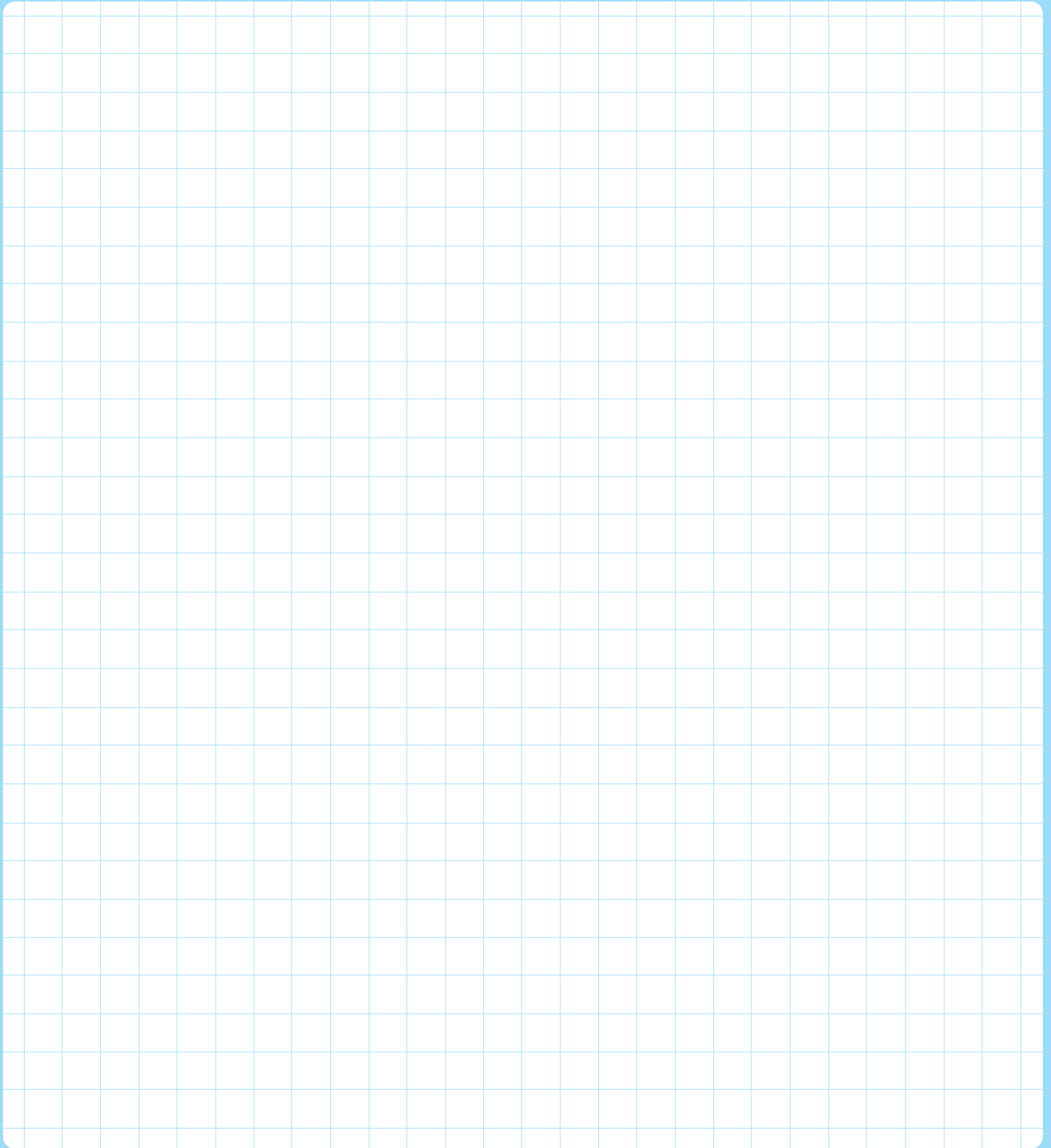


For more fun:
Divide each quadrant in half to make 8 smaller garden sections.



My Garden Diagram

This page can be used for Steps 4 and 5. You can remake it on paper as many times as you'd like!





Garden Care Tips

- **Cover your seeds until they sprout.** This will protect them from direct sunlight. It will give them time to grow.
- **Many flowers and vegetables grow best with lots of sunlight.** Try to find a place for your garden where plants can get 6–8 hours of sun per day (once sprouted). If you need extra light indoors, use grow lights from a garden store.
- **Don't overwater.** Water plants near their base. Try not to water the leaves. Wait until the soil is dry (from the last time you watered them) to water your plants again.
- **Harvest your crop.** When they're ready, collect your herbs, flowers, fruits, or veggies.

My Plants

Kind of plant	Diameter (width)	Height	Does it like sun or shade?

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



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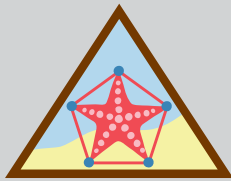
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Volunteer's Guide to Brownie Numbers in Nature*

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: Explore temperature •

15–25 minutes

Ask: When you're getting dressed, how do you know what to wear?

Share: You can dress for what you have to do, like going to dance class or to soccer practice. You can dress for the weather, too, like if it's cloudy, sunny, raining, or snowing. The **temperature** is how hot or cold it is outside. A **thermometer** is a tool that measures the temperature.

Choices—do one:

- **Measure temperature with crickets.** Have Brownies sit quietly with their eyes closed and listen to their surroundings. If indoors, play a recording with cricket chirps. Ask, "What sounds did you hear? Do you know what is making each sound? Can you describe it?" Explain that scientists have found a **formula**, or mathematical rule, to convert how fast the crickets chirp into temperature. Write, "**(The number of chirps a cricket makes in 15 seconds) + 37 = the temperature in degrees Fahrenheit**" on chart paper or the whiteboard. Then, using a stopwatch and giving "Stop" and "Go" cues, have Brownies: 1) count how many cricket chirps they hear in 15 seconds, 2) convert the number of cricket chirps they heard to degrees Fahrenheit, 3) compare their answers, and 4) use a thermometer to compare their results to the actual temperature (or estimate the temperature in the recording).

Materials: *If you're outdoors, a temperature between 55 and 100 degrees Fahrenheit, and crickets (in nature or from a pet store) or a recording of cricket chirps; thermometer; timer; paper; pencils*

- **Experiment with water's states of matter.** Before the meeting, prepare hot water and ice. Ask Brownies, "Have you ever seen a frozen lake? Or steam above hot water?" Explain that water has different **states of matter** depending on its temperature: liquid, solid (snow or ice), or vapor (steam). Have Brownies measure the

temperature of a glass of room-temperature water and write it down. Show Brownies the different materials and, if you have a freezer or the ability to melt ice, how that works. Then they can add hot water or ice to the glass of water, checking the temperature of the water before and after each experiment. Ask, "What did you learn about water's states of matter? How can you change its temperature or state of matter?"

Materials: *Thermometer; water; glasses, bowls, or jars; ice; hot water; paper; pencils; freezer (optional); microwave or stove (optional)*

- **Create a calendar with nature's clues.** Ask, "If you didn't have a thermometer or calendar, how would you know the weather or time of year?" Brainstorm with Brownies and suggest that nature can give us clues, like leaves in the fall, frost and snow in the winter, or plants budding in the spring. Have Brownies explore natural clues for their local area using a book, field guide, online research, or videos to create their own "natural calendar" with one or more clues for each season. Brownies can then draw a picture to share their natural calendar with others.

Materials: *Local field guide or technology to research; paper; pencils; markers, crayons, or colored pencils*

STEP 2: Measure the length of leaves •

20–30 minutes

Ask: Have you ever wondered how tall a tree is? How do you find how tall you are?

Share: **Length** is how long something is from top to bottom. **Width** is how long it is from side to side.

Do: Point out inches and centimeters on the rulers on pages 4 and 5 of the Brownie Booklet. Explain that they're two different standard units of measure. Let them practice measuring with each ruler. Then show the leaves or go outside for Brownies to collect them from the ground. After, have them sort the leaves into categories according to their shape.

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

Materials: *Leaves OR access to collect; pencils; paper; natural and non-natural objects (for Choice 3)*

Choices—do one:

- **Measure with a ruler.** Explain, “The length and size of a leaf affect how much food it makes and how much water goes into the air.” Trace a leaf and show Brownies how to measure it in inches and centimeters by counting the lines on the ruler and writing each as a fraction. Then have each Brownie draw three leaves on “My Leaf Measurements” in the Brownie Booklet and measure each in inches and centimeters. After, ask them to compare their measurements: Which leaf was the longest? Which was the shortest? Were any close to the same length but different shapes?
- **Measure with your body.** Explain, “The length and size of a leaf affect how much food it makes and how much water goes into the air.” Trace a leaf and show Brownies how to take measurements with their fingers and toes and write each as a fraction. Then have each Brownie draw three leaves on “My Leaf Measurements” in the Brownie Booklet and measure each with their finger and toe (remind them to use the same finger or toe each time). After, ask them to compare their measurements: Which leaf was the longest? Which was the shortest? Were any close to the same length but different shapes?
- **Measure with an object.** Explain, “The length and size of a leaf affect how much food it makes and how much water goes into the air.” Have Brownies choose a natural object and non-natural object as their two units of measure. Trace a leaf and show Brownies how to measure it with an object and write its length as a fraction. Then have each Brownie draw three leaves on “My Leaf Measurements” in the Brownie Booklet and measure each with their objects. After, ask them to compare their measurements: Which was the longest with one unit of measure? Which was the shortest in that same unit of measure? Would others be able to use their unit of measure?

For more fun: After Brownies measure the leaves, help them to place the leaves under paper and gently rub crayons on top of the paper.

STEP 3: Graph your leaf data • 20–30 minutes

Ask: How can you share your leaf measurements with others?

Share: Scientists and mathematicians collect **data** or information. They analyze, or think carefully about, what the data might mean. They use graphs and charts to show their data. A **line plot** helps to compare data as points on a number line.

Do: Show the “Leaf Line Plot” on page 7 of the Brownie Booklet to Brownies. Point out the “Inches” label under the line and how the measurement of each leaf is a data point above the line.

Choices—do one:

- **Draw a line plot.** Have Brownies pair up to create a simple line plot by: 1) drawing a horizontal line on a sheet of paper, 2) writing numbers along the line, 3) adding their first set of measurements from Step 2 as data points on the line, and 4) labeling the line plot “Leaf length in (unit of measure 1).” Then have them make another line point, “Leaf length in (unit of measure 2),” using their second set of measurements from Step 2 as data points. Have them compare their graphs: how does leaf length compare in the two units of measure?

Materials: *“My Leaf Measurements” charts from Step 2; graph paper; pencils; rulers (optional)*

- **Make a line plot with natural objects.** Have Brownies pair up and: 1) gather sticks and rocks or shells, 2) place their sticks in a line, 3) place small rocks below the line to mark the numbers, and 4) place larger rocks to show their leaf data in the first unit of measure from Step 2. Then have them make (or rearrange) another line plot to show their leaf data in the second unit of measure. Finally, ask them to compare their graphs: how does leaf length compare in the two units of measure? **For more fun:** Help Brownies take a photo of their line plots.

Materials: *“My Leaf Measurements” charts from Step 2; sticks OR access to collect; seashells or rocks OR access to collect; camera (optional).*

- **Create a human line plot.** Have Brownies team up to create a line plot using masking tape as a line and themselves as the data points. Ask, “What can you use for your line? How can you create a standard unit of measure? How can people be the data points?” Have teams try different ideas to plot their data from Step 2. Once they come up with a solution, have them create a line plot for each unit of measure in Step 2 and compare their graphs: how does leaf length compare in the two units of measure? **For more fun:** Help Brownies take a photo of their human line plots.

Materials: *“My Leaf Measurements” charts from Step 2; masking tape; camera (optional).*

For more fun: Help Brownies identify their leaves with a local field guide or tree identification app. What trees did the leaves come from? What tree produced the longest leaf? What tree produced the shortest leaf?

Did You Know? Scientists usually use the metric system. This is because metric units, like centimeters and meters, use fractions of 10 (tenths) and can be easily made into a decimal. For example, 2 and 1/10 is written as 2.1.

STEP 4: Find space to grow •

20–30 minutes

Ask: Have you ever wanted to create a garden? What would you grow? How much space would you need?

Share: Different plants need different amounts of space to grow. You'd need to know how much space each plant needs to grow and the area of the space you are using. **Area** is how much room there is inside the space. You can make a **diagram** to figure out where to put things.

Do: Show Brownies what a square foot looks like. Have them measure one foot on the floor, put down a piece of masking tape one foot long, and make a square with the tape that is one foot on each side. Explain that **square feet**, which measure one foot long on each side of the square, is the unit of measure for area.

Materials: *Pencils; masking tape; rulers or tape measures*

Choices—do one:

Make a life-sized diagram! For all of the options, Brownies can create life-size square-foot diagrams with masking tape. Then, they can tally or draw in and label each square foot on the grid.

● **Plot an edible garden.** Ask, “If you wanted to plant fruits or vegetables, what would you plant? How much space would each plant need?” Help Brownies: 1) find out how much space each plant needs to grow (check the seed packets or online), 2) decide which plants to grow, 3) add labels and draw the plants on “My Garden Diagram” in the Brownie Booklet, and 4) share their diagrams. Ask, “Which plants grow tall and which grow low to the ground but are wide? How many of each can you grow? What would you plant if you wanted a large crop but had very little space? Which plant would require a lot of land?”

● **Plot a forest.** Share with Brownies some of the benefits of trees: they clean the air and provide homes for animals, shade, food, wood, and paper. Explain that trees need space aboveground to grow tall and wide and space belowground for roots. Help Brownies: 1) identify what trees grow best in your area, 2) figure out how much space they need to grow, 3) add labels and draw the trees on “My Garden Diagram” in the Brownie Booklet, and 4) share their diagrams. Ask, “What trees will you plant? How many can you plant?”

● **Plot a flower garden.** Help Brownies: 1) identify what kinds of plants and flowers grow best in the area, 2) find how much space they need to grow (check seed packets or online), 3) add labels and draw the plants and flowers on “My Garden Diagram” in the Brownie Booklet, and 4) share their diagrams. Ask, “What will you plant? How many can you plant? Will you add anything else, like a bench?”

For more fun: Help Brownies to get permission, create a troop diagram to plan, and get planting!

STEP 5: Plot and plant a garden •

30+ minutes

Ask: Have you ever planted a garden or taken care of a plant? What did it need to grow?

Share: Seeds need soil, or dirt, to grow in. All plants need water and sunshine. Some need lots of sun while others prefer shade. Planning is an important part of growing anything. You need to know what grows well in your area, how much space you have, and how much space each plant needs. You can make a **grid** with one horizontal (or sideways) and one vertical (or up-and-down) line to organize your garden into four boxes. Each box is a **quadrant**.

Choices—do one:

● **Plant an herb garden.** Ask Brownies, “Have you ever eaten an herb before?” Brainstorm different kinds of herbs with Brownies, like parsley, chives, basil, and peppermint. If you have samples of herbs, let Brownies look, touch, smell, and even taste them. Then help Brownies: 1) scoop soil into their foil pan until it comes up to just below the top edge, 2) create quadrants by measuring each side, dividing by 2 and taping pieces of string across the pan, 3) choose seeds, add spacing information, and draw the herbs on “My Garden Diagram” in the Brownie Booklet (they may need to redraw the grid on a blank sheet of paper!), 5) plant following the seed packet instructions, and 6) label each quadrant with a wooden craft stick. Then go over the “Garden Care Tips” in the Brownie Booklet.

Materials: *Foil baking trays; potting soil; scoops or paper cups; rulers; tape; string; wooden craft sticks; markers; variety of herb seeds; scissors; fresh herbs (optional); clear tray lids (optional)*

● **Plant an outdoor garden.** Ask Brownies, “What do you want to plant outside?” Help Brownies: 1) identify what grows best in your area, 2) figure out how much space the plants need to grow (check seed packets or online), 3) measure a rectangular space for their garden and find its area, 4) create quadrants by measuring each side of the garden, dividing it by 2 to find the midpoint, and taping a piece of string across the garden, 5) choose seeds, add spacing information, and draw the plants on “My Garden Diagram” in the Brownie Booklet (they may need to redraw the grid on a blank sheet of paper!), 6) plant the seeds (following the seed packet and making sure they're covered), and 7) label each quadrant with a wooden craft stick. Then go over the “Garden Care Tips” in the Brownie Booklet.

Materials: *Access to an outdoor space for a garden; rulers or tape measures; string; scissors; wooden craft sticks; markers; variety of seeds*

● **Plant a container garden.** Ask Brownies, “What do you want to plant? What can we plant in?” Help Brownies: 1) identify what grows best in your area, 2) figure out how

much space the plants need to grow (check seed packets or online), 3) choose a container, measure the bottom to find its area, and create quadrants, 4) choose seeds, add spacing information, and draw the plants on “My Garden Diagram” in the Brownie Booklet (they may need to redraw the grid on a blank sheet of paper!), 5) plant them in the soil (following the seed packet and making sure they’re covered), and 6) label each quadrant with a wooden craft stick. Then go over the “Garden Care Tips” in the Brownie Booklet.

Materials: *Variety of clean and empty containers with holes for drainage; potting soil; scoops or paper cups; rulers; wooden craft sticks; markers; variety of seeds*

For more fun: Help Brownies create 8 sections by dividing each quadrant in half to make 8 smaller garden sections.