Seeds to Schools Curriculum Guide
2nd Edition

An integrated hands-on teaching curriculum for kindergarten through sixth grade, incorporating outdoor and science education into the garden environment while exploring children's senses and wonder of nature.

Developed by Classroom in Bloom, January 2022

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Classroom in Bloom is a non-profit 501c3 farm to school program in existence for 16 years. The garden is on campus at the Methow Valley School District. Staff teach K-12 garden and science education throughout the school year and garden kids camps during the summer months. Elementary school classrooms visit the garden for one hour per week throughout the school year. Children explore science activities and lessons taught by garden staff, participate in garden work activities, and eat Harvest snacks. Classroom in Bloom developed their own science curriculum in conjunction with Methow Valley Elementary School teachers and coaches, based on NGSS and integrated with each classroom's International Baccalaureate Units of Study.

Okanogan Conservation District works collaboratively with individuals and organizations to conserve natural resources in Okanogan County. They provide resource stewardship planning, conservation incentives, and adult and youth education. Okanogan Conservation District provides quality standard-based education for students K-12 in all of Okanogan County. Through this work, District employees form and strengthen relationships with teachers at each school and have built a diversified network of educators.

Okanogan Conservation District

Classroom in Bloom

National Association of Conservation Districts

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Overview and Welcome

The goal of these hour-long lessons is to provide hands-on experiential learning in the outdoor garden environment for students. The lessons within this curriculum engage students' senses and awareness of the natural world and align with the current Next Generation Science Standards (NGSS). Instruction is given through direct teaching, group discussion, hands-on experience, and garden projects.

Introductions to each lesson outline the structure of the day and focus the students' awareness on the natural world around them. Recording the date, time, temperature, and weather observation begins the process of paying attention to their surroundings. Asking questions and using small group discussions sets the expectation of active participation in the garden. Worksheets are tools for students who learn best through reading and writing. Hands-on activities provide learning through movement and listening.

Materials needed for <u>each</u> garden lesson:

- White board and markers
- Garden Journals/notebooks and pencils (optional)
- Thermometer for recording outside temperature
- Observation Worksheet (1 per student), found in the Appendix
- Any other worksheets and materials described in each specific lesson

Activities and Garden Work Projects work best when students are split into groups of up to 8 students with adequate adult supervision. Small group sizes allow every student to actively participate in games, activities, and garden work groups. These smaller groups facilitated by a parent or community volunteer are dramatically more manageable.

Reflection is critical for retention of new information. Include open-ended questions to challenge students to make connections between the activities and concepts. Reflections allow teachers to understand students' interests, encourage curiosity, and supply questions for future exploration in your classroom.

Harvest is one of the best parts of having a garden! Kids love to eat what they grow. Garden education inspires children to try new foods and develops a passion for growing healthy meals. During our Harvest Circle at the end of each lesson, students taste what they grow in the garden. Allow students to pick one pea, one strawberry, and one sorrel leaf or have a chaperone slice a variety of veggies to create a sampling platter so students can taste the results of their work.

Kindergarten: Lesson 1
Nature Scavenger Hunt

Learning objectives: Students will investigate the living and nonliving world using their senses to explore new shapes, patterns, colors, textures and more. Students will practice the skill of observation to expand awareness of their surroundings.

State Standards: K-1 INQA Question and Investigate; K-1 INQD Communicate; K-1 INQF Intellectual Honesty; K-1 ES2A; K-1 ES2B; K-ESS2-2 Earth Systems; K-ESS2-1 Earth Systems

Materials Needed

- Egg cartons, cups, buckets, or any receptacles for gathering found materials
- Pen or Marker for labels
- Attention and imagination!

Weather Worksheet: Record date, time, temperature, and weather observations.

Question of the day: What are our five senses and how can they help us pay attention to our surroundings?

Introduction

Go over the five senses as a class as a gateway to exploration in the garden. Give students a chance to practice using their senses, one at a time while walking around the garden as a class. Use this time as an opportunity to point out examples that may be used in the activity.

<u>Activity: Scavenger Hunt</u>

- Decide on an area in or around the garden to explore and gather materials for this activity.
- Pair up students and give each group an egg carton, cup, or bucket.
- Have each group choose a pair of words from the list below. These will be the categories that define the items you will be hunting for. Feel free to come up with your own pairs of words as well!

SMOOTH / ROUGH	FLAT / ROUND	LIVING (BIOTIC) / NON-LIVING (ABIOTIC)	SWEET FRAGRANT / STINKY
COLORFUL / DULL IN COLOR	TASTY / YUCKY	GREEN / BROWN	NEW GROWTH / LAST YEAR DEAD
LONG / SHORT	SPIKEY / BLUNT	CRUNCHY/ SOFT	LEAVES / ROCKS

- Gather egg cartons (or cups/buckets) for collecting materials. Write one word on one side of the carton, and the other word on the opposite side. For example: label one row of the egg carton “smooth” and the other “rough”.
- Give each child the labeled egg carton. Challenge them to find 6 examples of something from nature that represents each of their words. Allow at least 10 minutes for collecting items.
- Gather as a group and take turns sharing your found items. Encourage each student to describe why they chose certain items, making a case for their item as a representation of their category. Talk through what senses they used to make their decision (seeing, feeling, smelling, tasting, hearing).
- Switch to a new category, and have students find a new set of items in the same or a different area to represent this new category. See if you can get through the entire list together as a class.

*If you’d like to add a layer of challenge and fun, cross out or cover labels and have each child come up with their own categories and work secretly to gather materials. When everyone gathers back together to share, each person will take turns presenting their items, and the other participants must guess what their word or category might be!

Reflection
How does using our senses help us connect with the natural world? Did you notice anything new that you have never noticed before? What was the smelliest thing you found today? Softest?

Work Projects
Spend time in the garden working on various projects.

Harvest
Let all kids eat something from the garden environment.


Rough
Smooth

Kindergarten: Lesson 2
Soil Exploration

Learning objectives: Students will learn about soil and who lives there.

State Standards: K-1 ES2B - Properties and Change; K-1 LS1C Plants and Animal Parts; K-1 LS1E Plants and Animal Parts; K-LS1-1 Molecules to Organisms; K-ESS2-1 Earth Systems

Materials Needed
- Cups or buckets
- Trowels or spoons

Weather Worksheet: Record date, time, temperature, and weather observations.

Question of the day: What is soil and who lives there? What roles do these creatures have in keeping the garden healthy?

Introduction
Soil is alive! When we take the time to dig around and explore the soil in the garden, it's amazing how much we can discover. Bugs, worms, and other insects are responsible for creating a happy and healthy environment for our plants to grow in the garden. Some are decomposers while others are predators that maintain balance in the garden ecosystem.

<u>Activity: Meet Your Local Decomposers</u>
- Ask the class, "What is soil?". Share ideas aloud together.
- Playing off their ideas, share a bit about the living and nonliving components of soil and how they are all important. Use examples such as worms, bugs, and bacteria (those we cannot see!) to explain that there is a whole world of creatures working hard below the soil.
- Introduce the word *decomposers*. These are our friends in the soil!
- Ask the class what they think decomposers eat. Give them a minute or two to share aloud.
- Guide their minds to the soil and explain that the critters who live in the soil eat plant and animal materials to help plants grow.
- Give each student a tool for collecting samples and a cup or bucket to put it in.
- Walk in the garden together, or have children spread out to collect their own soil samples.
- After filling their cups or buckets, find an area where they can spread out their soil to search for living things. Students should demonstrate care for the critters that they find.
- Come back together as a group to share discoveries and discuss the role that soil organisms play in the garden.

Reflection
How is soil different from dirt? What do you notice about the parts of a soil - are they the same or different?

Work Projects
Spend time in the garden working on various projects. Notice how humans can help ensure plants are getting the right amount of light, air, water, and soil.

Harvest
Let all kids eat something from the garden environment.

Kindergarten: Lesson 3
Parts of a Plant

Learning objectives: Students will learn the five parts of a plant and begin to understand their functions. Students will identify the part of at least one plant that we eat. Students will make a piece of art with found leaves from the garden.

State Standards: K-1 SYSA - Part-whole relationships; K-1 INQA - Questions and Investigate; K-1 INQE; K-1 LS1B - Plant and Animal Parts; K-1 LS1F - Plant and Animal Parts; K-PS3-1 Energy; K-LS1-1 Molecules to Organisms

Materials Needed

- White board & markers
- Clipboards
- Scratch paper
- Crayons

Weather Worksheet: Record date, time, temperature, and weather observations.

Question of the day: What are the parts of a plant and which part of each plant do we like to eat?

Introduction

Parts of a plant and their functions

- Roots: hold the plant in place, transport water and nutrients from soil to the rest of the plant, like our veins!
- Stems: hold the plant upright, like a spine!
- Leaves: turn sunlight into food and energy; help the plant grow!
- Flowers: attract and feed pollinators; all flowers become fruits!
- Fruits**:** each plant has its own dispersal/distribution method; house of the Seeds!

Activity #1: Observe Plant Parts

- Draw a basic picture of a plant, including all five parts, unlabeled.
- Ask students to name any parts of a plant that they know. Go over the five main parts and briefly mention their function.
- Go into the garden and observe each part of different plants. Notice how they are the same or different from one another. For example, look closely at mint leaves and kale leaves. How do they feel? Which part do we eat?
- Ask students to find their favorite garden food and share what part of the plant it is.

Activity #2: Leaf Rubbings

- Collect leaf samples from different plants and bring them back to the table to begin "rubbings".

- Demonstrate using the leaf "bottom side up" and placing the paper over the leaf. Take the long side of a crayon and rub over the leaf.
- Assist students in their rubbings.
- Have students write their name on their paper and collect it in a pile for the classroom teacher.

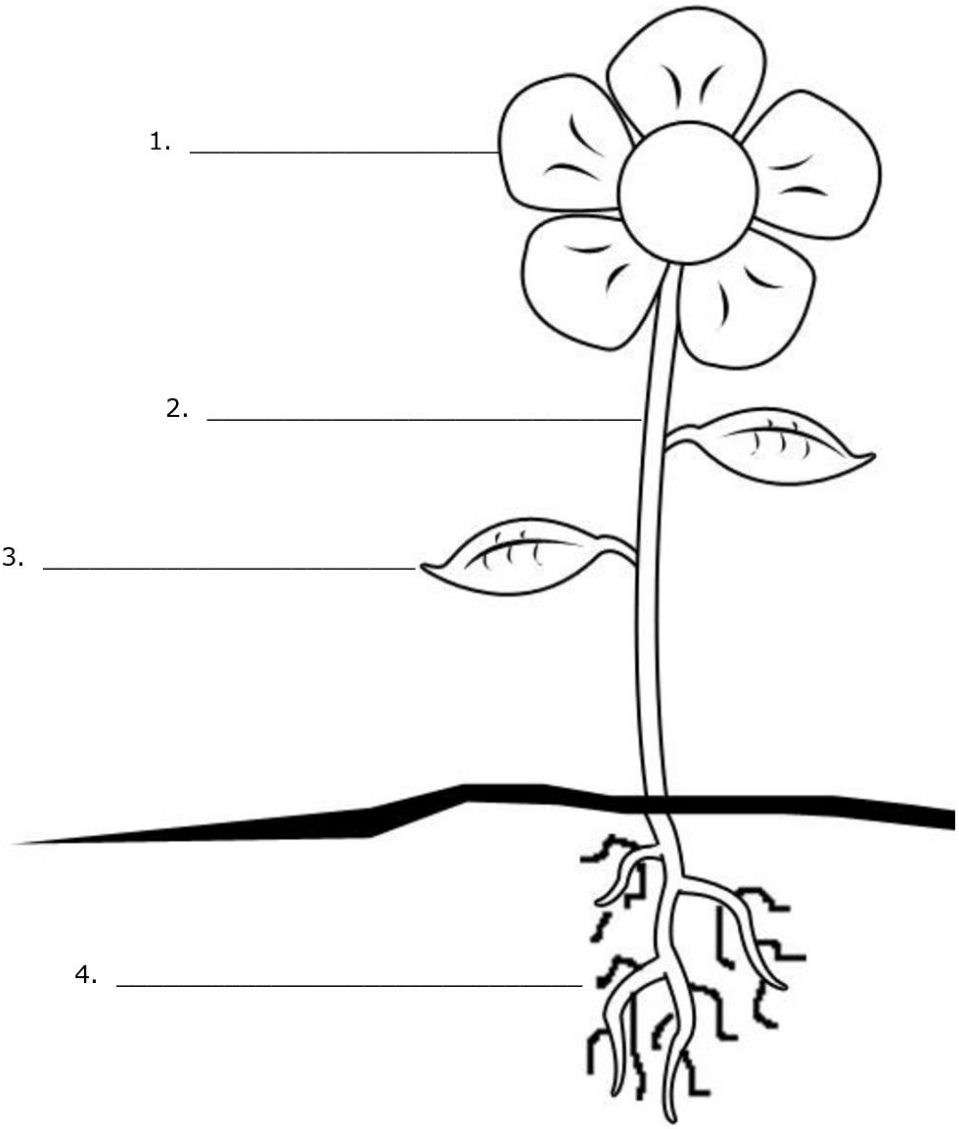
Reflection
As a class, review each part of a plant and its function. Can they give an example? Have students share their favorite part of the day with a person next to them.

Work Projects
Spend time in the garden working on various projects.

Harvest
Let all kids eat something from the garden environment. Have them name the part of the plant they are eating!

Name: _____

Parts of a Plant



Super Teacher Worksheets - www.superteacherworksheets.com

Kindergarten: Lesson 4
Harvest Time and Song

Learning Objectives: Students will learn about seasons in the garden and what is ready to harvest in the fall. Students will learn how to harvest and wash root crops.

State Standards: K-1 ES1B Earth and Space Science; K-1 LS2A Life Science, Habitats
K-PS3-1 Energy; K-ESS2-1 Earth's Systems

Materials Needed

- Pitchforks, shovels, or trowels
- Wheelbarrows or buckets

Weather Worksheet: Record date, time, temperature, and weather observations.

Question of the day: What are some foods that we harvest in the fall?

Introduction

Before going out into the garden to harvest, have a brief discussion about the seasons as a class. Have students describe what they notice about the weather and plants, and how they know it is fall. What veggies can grow during the winter where we live? What fresh veggies can we eat during the winter? Spend a few minutes discussing how the seasons affect what we grow and eat.

Activity 1: Harvest and Sing

- Have students brainstorm what vegetables are ready to harvest in the garden.
- Review or briefly introduce the five parts of a plant. Today, we will be focusing on roots. (Note: you may choose any part of the plant to focus on).
- Harvest roots as a class. Demonstrate how to harvest each crop. Make sure to sample!
- Introduce the "Harvest Time" song.

"Harvest Time" (tune: Twinkle, Twinkle Little Star)
Harvest Time is here again
In the garden we must dig
Carrots, beets, onions too
All so fresh and good for you.
Harvest time is here again
Won't be long till you know when!

Activity 2: Season in the Garden Worksheet

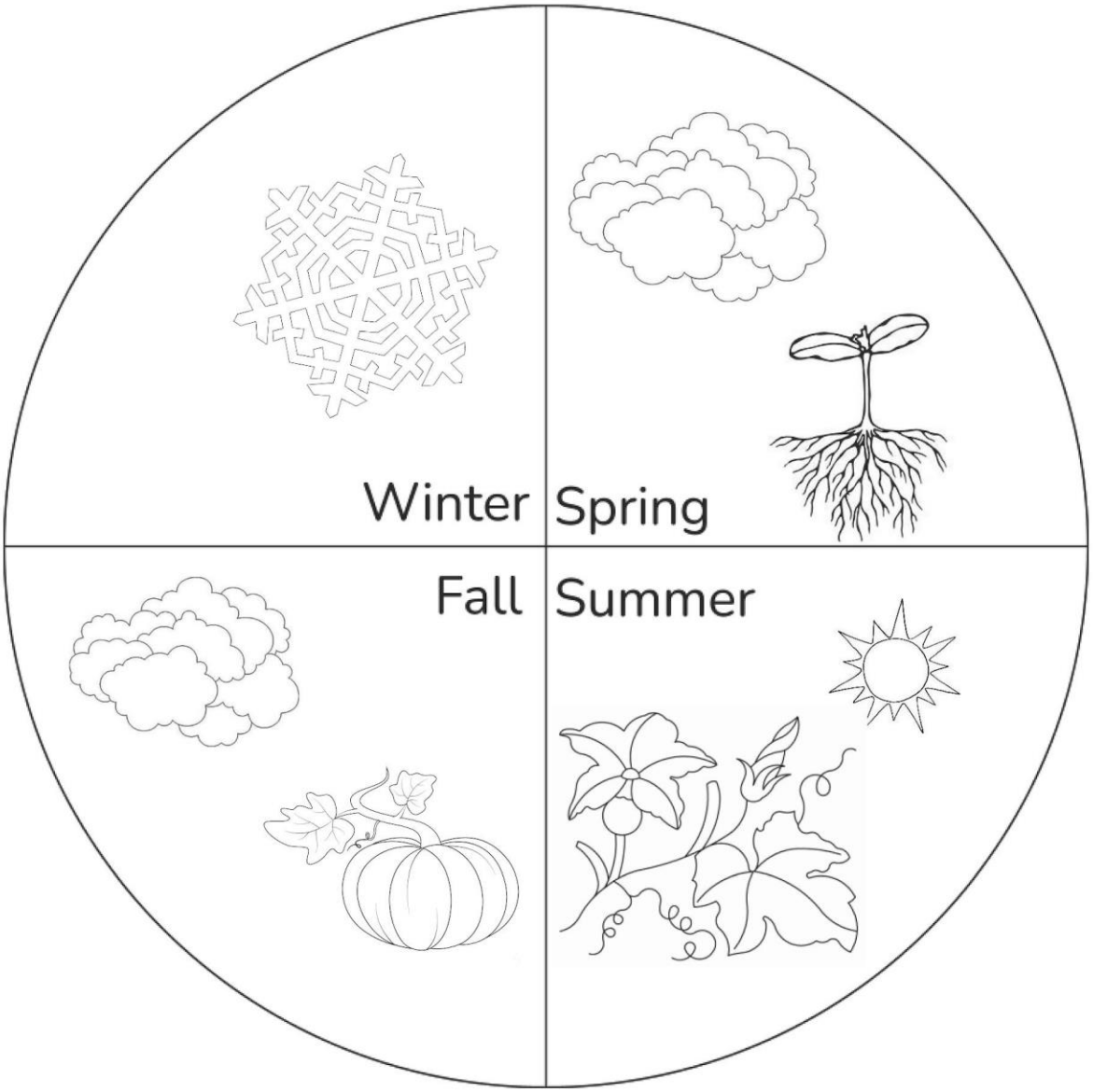
- Give students time to color the images in the season wheel while noticing the differences between the weather and the stages of plant growth in each season.

Reflection
Review the parts of a plant and the four seasons. Give each student a chance to share their favorite part of the day.

Work Projects
Spend time in the garden working on various projects.

Harvest
Let all kids pull up a harvestable veggie from the ground and eat! If you don't have carrots or beets in the ground in your garden, purchase a couple from the store and slice up in the garden for the students to try a bite each (or more if they enjoy them).

Seasons in the Garden



1st Grade: Lesson 1
Seeds & Spring

Learning Objectives: Students will understand when we plant most seeds and what the seeds need to grow. Students will learn the challenges seeds face in nature and how humans can increase the likelihood of survival in a garden environment.

State Standards: 1-ESS1 Earth's Place in the Universe (1-ESS1-2)

Materials Needed

- Seed Cards (3-4 sets)
- Large bag of small sprouting seeds (such as alfalfa, broccoli, mustard greens, mung beans, clover, wheat, radish)
- Paper plates
- Paper towels
- Water spritzer
- Markers

Weather Worksheet: Record date, time, temperature, and weather observations.

Questions of the Day: Why do we plant seeds in the spring? What do they need to grow into healthy plants?

Introduction

Here in north central Washington, we plant in the spring because seeds and plants need LAWS to grow and survive (Light, Air, Water, Soil). In the spring, the days are longer, which allows more light to reach our earth. With the increased light, we also increase heat needed in the soil and the air for seed germination and plant growth. In northern climates, water is frozen during the winter season as snow and ice, but with the spring thaw, water is available for our plants to grow and survive.

<u>Activity #1: Seed Game</u>

- Split the class into 3 or 4 groups.
- Pass out 1-2 cards to every student face down (no peeking). Each card will have a picture of **Light, Air, Water, Soil, Seed, or Squirrel.**
- When you say go, every student will walk around the group trading cards randomly to other students while everyone is chanting MINGLE, MINGLE, MINGLE. Students should be trading constantly but nobody knows what they're trading for as the cards are face down in their hand.
- After 15-30 seconds the instructor yells "SPROUT!" everyone goes back to their group and flips over their cards. To grow a sprout, the group must have at least one of each seed, light, air, water, and soil WITHOUT a squirrel (some animals like squirrels eat seeds before they can sprout).

- Ask which group sprouted. If done properly there should be very few sprouts. Play multiple times.
- Ask the group, "Why is it so hard to make a seed sprout?". In nature, it can be difficult, so plants make many seeds. In the garden, we can help increase the odds of seed survival by giving them the right amount of light, air, water, and soil and try to keep animals out that eat seeds

Activity #2: Sprouting Seeds

- Students each get two paper plates. Have them write their names on each of them. Have each student write Light on one plate and Dark on the second plate.
- Each student should place a paper towel on each plate and add 20 or so seeds to each plate.
- Spritz each plate with water until moist (not saturated). You may want to measure out 20 water sprays to see if this is enough to moisten their seeds and paper towels.
- Place half of the plates with seeds in a sunny location (outside, window sill, in your classroom, etc.) and place the other half in a dark location (the closet of your classroom for example).
- Ask the question, "Will there be any difference between the two locations? If so, what will the difference be?"
- Have a student helper spritz water on seeds every day to keep the seeds and paper towels moist. Monitor the plants to look for sprouting.
- After 3-5 days, seeds will have germinated. Compare what you see.

Activity #3: Learn the Song "Little Seed"

"Little Seed" (Tune: I'm a Little Tea Pot)
Here's a little seed in the dark, dark ground.
Out comes the warm sun, yellow and round.
Down comes the rain, wet and slow.
Up comes the little seed, grow, grow, grow!

Reflection

What do seeds need to sprout? What happened to the seeds in the light and in the dark? When and how does this happen in nature (summer/winter, night/day)? How can we plant seeds and grow plants when it is not spring or summer (indoors in a sunny warm window, cold frame, greenhouse)?

Work Projects

Spend time in the garden working on various projects. Notice how humans can help ensure plants are getting the right amount of light, air, water, and soil.

Harvest

Let all kids eat something from the garden environment.

Squirrel

Water

Light

Soil

Air

1st Grade: Lesson 2
Mystery Plant Project

Learning Objectives: Students will learn and describe how baby plants are similar to but not exactly like their parent plants. Students will recognize that plants change throughout their life cycle just like humans and animals.

State Standards: 1-LS3 Heredity: Inheritance and Variation of Traits (1-LS3-1)

Materials Needed

- Seeds: 3 seed packets total from any of these varieties - squash, marigold, kale, bean, pea, sunflower
- Individual Pots
- Potting Soil
- Sticks & markers
- Tables
- Magnifying glasses
- Laminated pictures of seeds, young plants, and adult plants listed above (referenced at the end of this lesson)

Weather Worksheet: Record date, time, temperature, and weather observations.

Question of the Day: How can we figure out what our mystery seed is?

<u>Activity #1: Mystery Plant Project (2-4 weeks long)</u>

- Give your students this scenario: when you were preparing for this lesson, a big gust of wind knocked over all the seed packets, scattering the seeds all over the ground. You picked up the seeds and sorted them by looks, but you do not know which seeds will grow into which plants! How can we figure out what these mystery seeds are? What resources do we need? Brainstorm ideas and record them on the whiteboard.
- Split the class up into groups. The number of groups should equal the number of seed varieties you have.
- Pass out one type of seed to each group and hand them magnifying glasses. Have students observe texture, color, and size. Ask students to describe and draw their seed.
- Pass out pots, potting soil, sticks for labeling, and permanent markers. Have each student fill their pot with soil and label their stick with their name. Place their stick in their pot. Have each student plant 2-3 seeds per container at the appropriate depth for the seed variety to ensure some seeds sprout.
- Water the seeds when everyone is finished. Place the labeled seed pots somewhere safe in the garden or on a sunny window sill in the classroom.

Activity #2: Mystery Plant (continued)

- Once the plants start to grow and the "true leaves" start to sprout, use the resources brainstormed earlier to try to identify their plant. Use pictures of fully mature adult plants to compare to baby plants. How do they look different? How do they look the same? Use this as an example of how baby plants and animals are similar to but not exactly like their parents.
- Pair students and have them share at least two differences they observe in each of their different seed sprouts. How did their plants change?
- Discuss germination and introduce the basics of how seeds change from seeds into baby plants.
- Bring attention back to potted plants and pass out their pieces of paper with seed drawings. Have students draw an update of their plants. Explain that everyone will have the chance to track the growth of their plants each week and continue comparing to the parent plant.
- Take 10-20 minutes per week to check on plants, update drawings, and discuss growth habits further.
- Can the children tell which type of "mystery plant" they planted based on the pictures of the adult plants? Compare weekly to see if they know what type of seeds they planted.

Reflection

How are baby plants similar to but not exactly like their parent plant? Are humans and animals similar?

Work Projects

Spend time in the garden working on various projects.

Harvest

Let all kids eat something from the garden environment.

Squash (pumpkin)

Marigold

Kale

Bean

Pea

Sunflower

1st Grade: Lesson 3
Parts of a Plant

Learning objectives: Students will identify six parts of a plant and begin to understand their functions.

State Standards: 1-LS1 Molecules to Organisms: Structures and Processes (1-LS1-1); 1-LS3 Heredity (1-LS3-1)

Materials Needed
- Digging trowels
- Paper
- Pencils or crayons

Weather Worksheet: Record date, time, temperature, and weather observations.

Question of the Day: What are the six parts of a plant?

Introduction
Plants have six different parts: Roots, leaves, stem, flowers, fruits, and seeds. When we look closely, we can find each one of these parts! Notice how the parts of different plants look the same or different. Let's explore our flowers and garden veggies and see how their plant parts differ.

Parts of a plant and their functions:
- Roots: hold the plant in place, transport water and nutrients from soil to the rest of the plant, like our veins!
- Stems: holds the plant upright, like a spine!
- Leaves: turn sunlight into food and energy; help the plant grow!
- Flowers: attract and feed pollinators; all flowers become fruits!
- Fruits: house of the seeds! Each plant has its own dispersal/distribution method
- Seeds: a packet of information that can grow into a new plant

<u>Activity: Dig and Draw a Plant</u>
- Draw plant diagram on white board.
- Ask students if they can name any plant parts and what each part might be used for. Allow discussion to 2-3 minutes for discussion. Do not label parts on the board yet.
- Divide the class into as many groups as there are adults. Have each group go into the garden and dig up one plant, making sure to include the roots.
- Return to the circle and examine the plant as a group.
- Pair & Share: Have students name the different parts of a plant that they know within their groups. Allow 1-2 groups to share their findings.
- Draw: Pass out pieces of paper and have students choose one plant to draw in detail. Ask students to label what parts they do know. Can they think of one possible

function for each of the parts?

- Draw & Label: On the board, draw a plant and label each of its parts. Have students fill in what they missed on their own drawings or draw a new labeled drawing next to their original.

Reflection

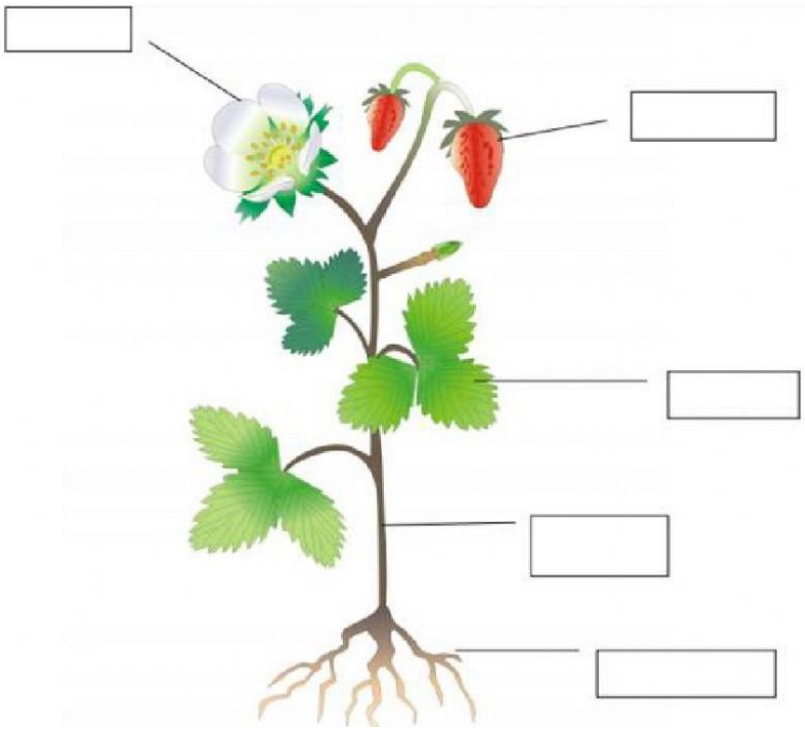
What can we learn when we dig a little deeper into the form and function of a plant? Do all plants look the same? Could it be beneficial to have lots of different plants around? Why do some plants grow above our heads, while others only grow one foot off the ground? Why are some flowers red and others white? Do all plants have fruits? Why do some plants crawl across the ground while others stay in place?

Work Projects

Spend time in the garden working on various projects.

Harvest

Let all kids eat something from the garden environment. Have them name the part of the plant they are eating!



1st Grade: Lesson 4
Friends in the Soil: F-B-I's!

Learning objectives: Students will know that healthy soil is teeming with life. They will understand that without living soil, plants and animals would cease to exist. Students will become familiar with the three main groups of living organisms in the soil.

State Standards: 1-ESS1 Earth's Place in the Universe (1-ESS1-2)

Materials Needed
- Digging trowels
- Magnifying glasses or dishes
- Photos of insects
- Spoons
- Buckets of soil
- Jars or other containers

Weather Worksheet: Record date, time, temperature, and weather observations.

Questions of the day: What is life like in the soil? Who are the soil F-B-I's and what do they do?

Introduction
Who are the F-B-I's? **F**ungi**, B**acteria**, I**nsects/invertebrates

We feed our FBI's things like animal manure and compost, their favorites! They are skilled at turning our waste into nutritious food for our plants to thrive year after year.

<u>Activity 1: The Soil is Alive! Relay Race</u>
- Demonstrate how a relay race works while very carefully carrying spoonfuls of precious soil to a jar at the end of the race track.
- In teams of 4-6, have students line up behind a bucket of soil. Give the first student in each line a spoon and place a small jar some distance away.
- Try to get as many spoonfuls of soil into the team jar in a given time.
- Have each group count how many teaspoons they transport.

Come back as a group and ask, "Is there anything alive in the soil that is in your jars?", "How many living things do you think are in there?", "Did you know there could be more living organisms in one teaspoon of healthy soil than there are PEOPLE LIVING ON THE EARTH?!"

<u>Optional Math Activity:</u>
There are not hundreds, not thousands, not millions, but billions of people living today. That means that there could be billions of living things in each teaspoon of soil.
- Write 1 billion out on the board.

- If each teaspoon has 1 billion living organisms, how many living things are in your jar? Write their answers on the board under 1 billion.
- Now start a new column with 2 billion on the top. Can the students double their number? If each teaspoon had 2 billion living things, how many creatures would there be in your jar?
- If your class is ready for it, challenge them to triple their answer.

Have students carefully pour out their jars of soil in a place that they think the organisms would like to live.

Activity 2: Life Beneath Our Feet

- What are all these living things in the soil? Can you see them?
- Introduce the F-B-I acronym. Ask the class what they think each letter stands for. Give a hint: these are groups of friends that live in the soil!
- For each letter, give an example. Fungi = mushrooms and mycelium. Bacteria = tiny, microscopic organisms! Insects/Invertebrates = beetles, flies, ants, worms, etc.
- Show the class pictures of different organisms, one at a time, and have them decide which group each one belongs to (F, B, or I). For each picture, challenge the students to think about what the organism eats.
- Spend the remainder of the class exploring different soils in the garden. Can you find an example of each group? How many different insects or invertebrates can you find?

Reflection

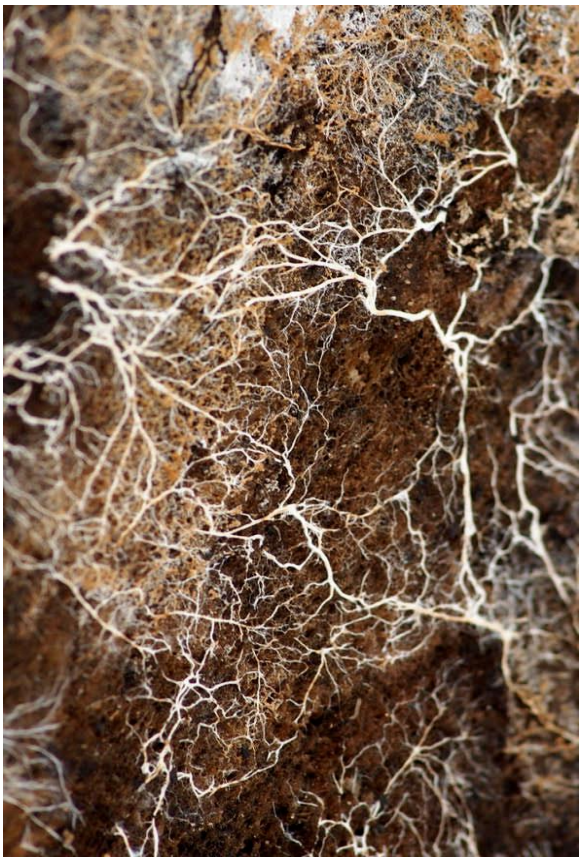
Did you know there were always so many billions of organisms beneath your feet? What can we do to feed these organisms so that our plants can be happier and healthier?

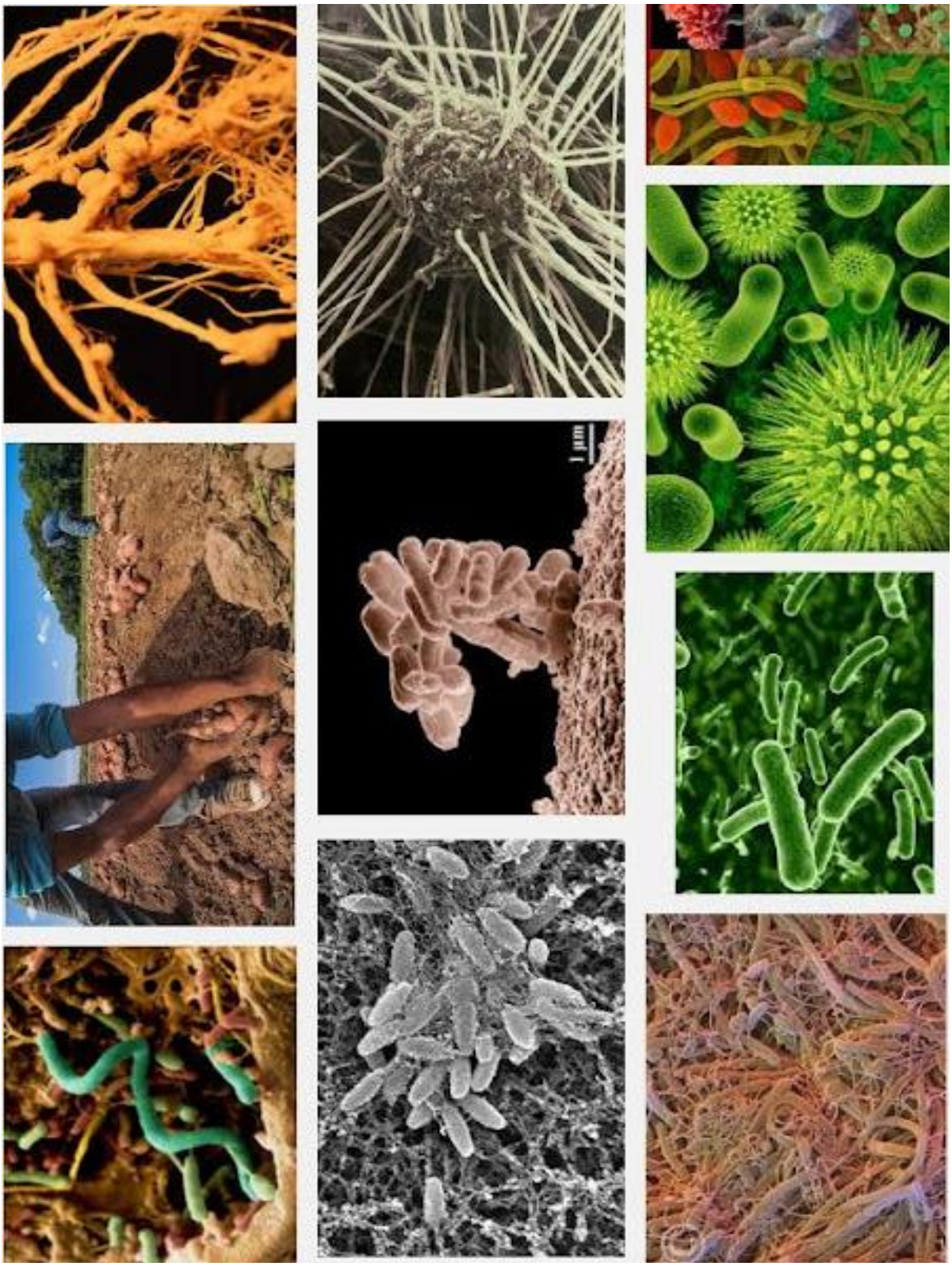
Work Projects

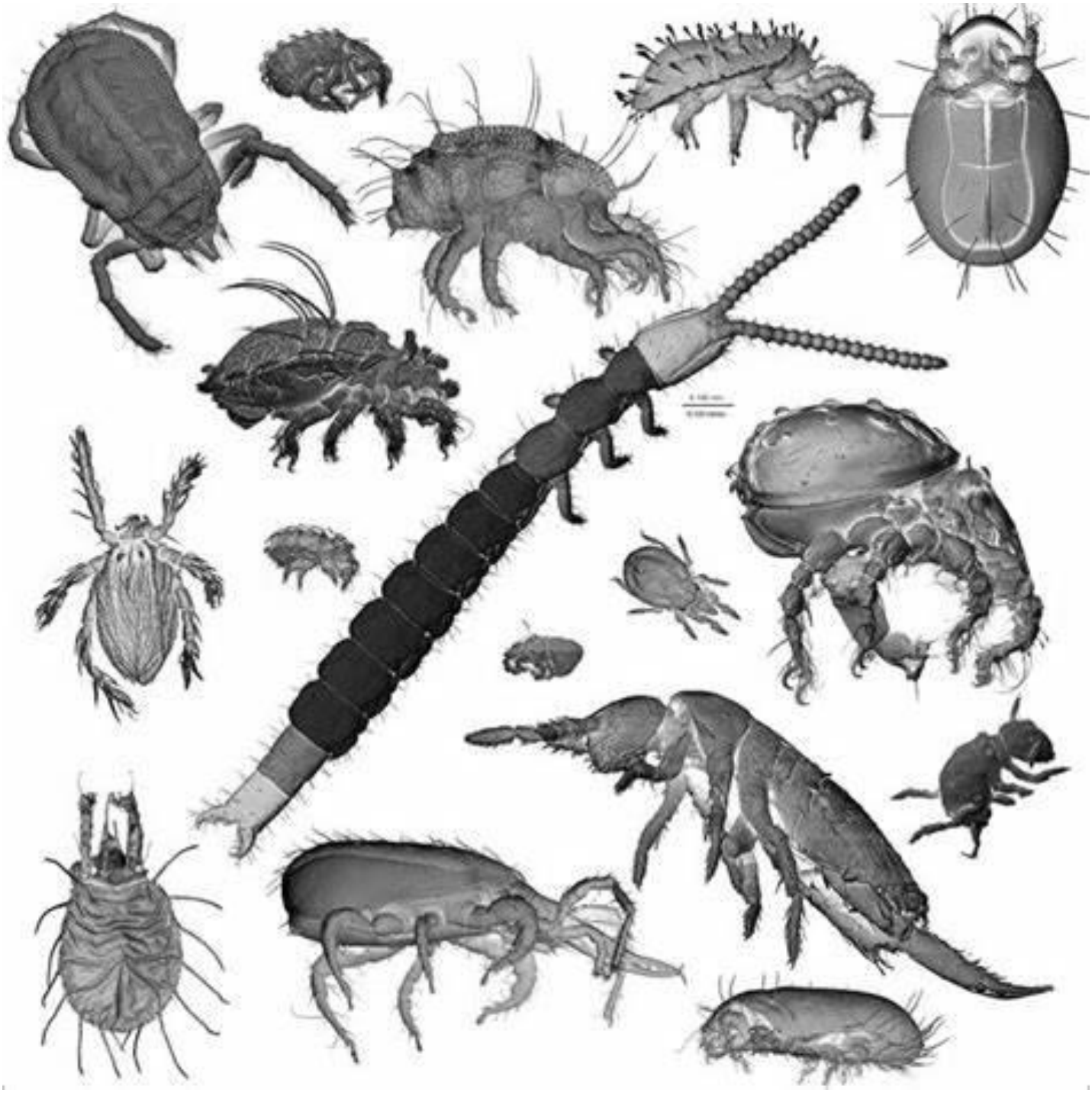
Spend time in the garden working on various projects.

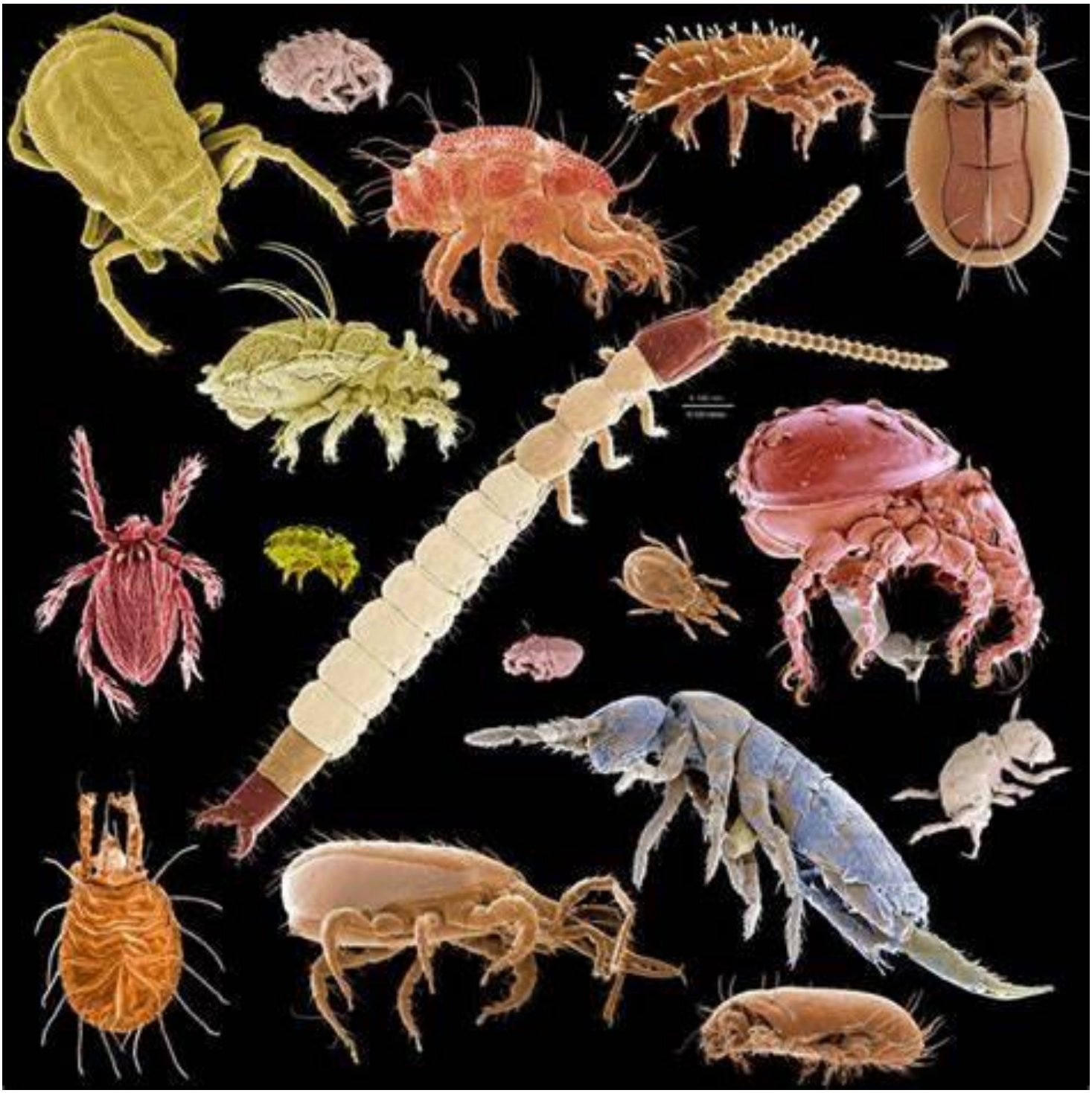
Harvest

Let all kids eat something from the garden environment.









2nd Grade: Lesson 1
The Water Cycle

Learning objective: Students will be able to describe how water moves in a cycle through the Earth.

State standards: 2-ESS2 Earth's Systems (2-ESS2-2, 2-ESS2-3); K-2-ETS1 Engineering Design (K-2-ETS1-2)

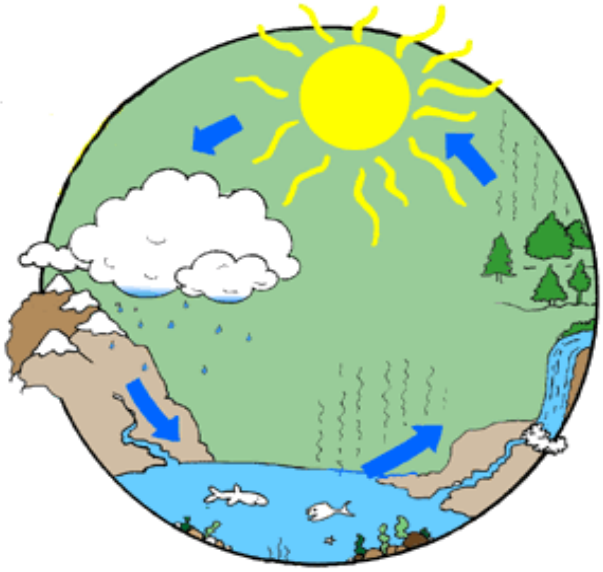
Materials needed

- a large metal or plastic bowl, or quart-sized canning jar
- a pitcher or bucket
- a sheet of clear plastic wrap
- a dry ceramic mug (like a coffee mug) or pint-sized canning jar
- a long piece of string or large rubber band
- water

Weather Worksheet: Record date, time, temperature, and weather observations.

Question of the day: How does water move through the earth?

Introduction: Use your white board to draw a visual and label the water cycle in front of the class. You may have students copy your drawing in their journals.



Explain that the Earth has a fixed amount of water in a closed system. This means the planet does not add more water or lose water, but moves water in a continuous cycle, constantly recycling itself.

The sun's heat causes water to **evaporate** from streams, lakes, oceans, rivers, irrigation ditches, and sprinklers. The water vapor rises. When it reaches cooler air, it **condenses** to form clouds. When the clouds are full of water or saturated, they release some of the water as **precipitation**. Rain water trickles down from the hills in creeks, streams to lakes and rivers headed for the ocean. The water cycle is important to all organisms as it provides the foundation for all life on the planet.

In our garden, irrigation systems divert water from the rivers or a pump brings water from underground wells through pipes.

Activity #1: Water Cycle Song

Sing this song (slowly) to the tune of *She'll Be Comin' Round the Mountain*. Write the words out on a chart so students can read it while singing and making the motions to engage all learning styles.

Water travels in a cycle yes it does,
Water travels in a cycle yes it does.
(move hands around in circle)
It goes up as evaporation.
(palms up, rise hands up to head)
It forms clouds as condensation.
(form cloud-like shape overhead)
It falls down as precipitation, yes it does!
(wiggle fingers and make hands go down like it's raining)

Activity #2: Make an Evaporation Chamber

- Put the mixing bowl in a sunny place outside.
- Using a pitcher or bucket to pour water into the bowl until it is about ¼ full.
- Place an empty mug in the center of the bowl. Be careful not to splash any water into it.
- Cover the top of the bowl tightly with plastic wrap.
- Tie a rubber band or string around the bowl to hold the plastic wrap in place.
- Watch the bowl to see what happens.

*Note: The time it takes for this lesson is dependent on weather, temperature, and sunlight. It is a good idea to have a completed bowl that was set up the day before to show students what the completed activity looks like.

The "mist" that forms on the plastic wrap will change into larger drops of water that will begin to drip. (You can speed up the dripping by carefully moving the bowl – don't splash! – into the shade.) When this happens, continue watching for a few minutes, then carefully peel back the plastic. Is the coffee mug still empty? Water from the "ocean" of water in the bowl evaporated. It condensed to form misty "clouds" on the plastic wrap. When the clouds became saturated it "rained" into the mug!

Reflection

Where else do you see examples of the water cycle in your everyday life? (Shower steam, kettle steam, morning dew on grass, breath on cold mornings). (If time allows, you can tie in how polluted water travels through the earth and the importance of clean water.)

Work Projects

Spend time in the garden working on various projects and find an example of the water cycle in your space.

Harvest

Let kids eat something in the garden that fresh, clean water helped grow.

2nd Grade: Lesson 2
How Plants Transport Water and Food

Learning objective: Students will understand that plants need water and food and be able to explain how water and food are transported through a plant.

State Standards: 2-PS1 Matter and its Interactions (2-PS1-2); 2-LS2 Ecosystems: Interactions, Energy, and Dynamics (2-LS2-1); K-2-ETS1 Engineering Design (K-2-ETS1-2)

Materials needed

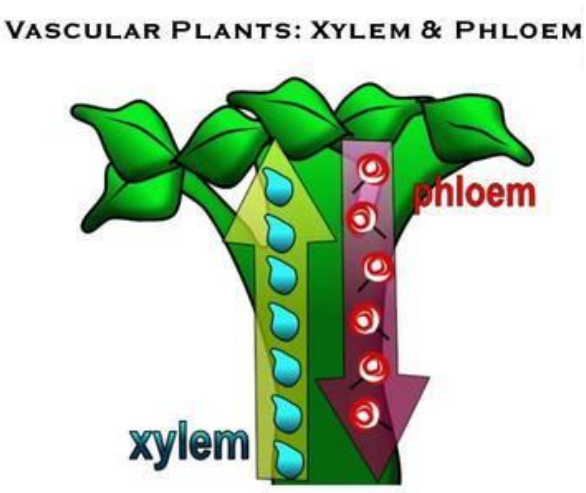
- Cup
- Water
- Knife
- Celery
- Rulers
- Red Food Coloring

Weather Worksheet: Record date, time, temperature, and weather observations.

Question of the Day: How does a plant drink water? How does water and food move through a plant?

Introduction

- Plants do not have a heart, blood, or circulation, but they still need to move food, water, and minerals from their roots to their leaves to grow and survive.
- Remind students about the water cycle chamber activity and refer to the water cycle chart created during that lesson.
- Use your white board to draw the visual to the right. You may have students copy your drawing in their journals.
- Introduce new vocabulary: *xylem* (tubes for water), *phloem* (tubes for sugars)



- Plants move water from their roots to their leaves through tubes in the stem called xylem. Plants move sugar from their leaves to the roots through tubes called phloem.

<u>Activity #1: Celery Experiment</u>

*Important: Do this the night before or follow up the next day

- Fill a glass about halfway with water.
- Add a few drops of red food coloring to the water and stir.
- Have an adult cut the bottom of the celery stalk straight across leaving the leaves attached to the stalk.
- Place the celery stalk in the glass, cut end first. Set the glass somewhere where it will not be disturbed.
- With a ruler, measure how far the colored water travels through the celery in 10 minutes and again in an hour. If time allows, leave the celery overnight and write down observations the next day.

Activity #2: Build a Plant

Explain to the students that every part of a plant has a specific and unique role. Together, the class will build a plant using their bodies. Go over these 5 important parts:

- **Heartwood**: Found in the center of large plants like trees, provides support.
  Motion: A hand beating over your heart as you say "Heartwood".
- **Xylem**: tissues and tubes that transport water from the roots to the leaves.
  Motion: Hands low to ground, as they raise their hands to the sky, say "Xy goes high".
- **Phloem**: Tissues and tubes that send sugars from the leaves to the roots.
  Motion: Hands high in the air, as they lower them to the ground, say "Phlo goes low".
- **Bark**: Protective layer on larger plants to protect from insects and disease.
  Motion: Arms crossed over the chest saying "Protector".
- **Roots**: Anchor the plant to the ground and absorb water and nutrients from soil.
  Motion: Fingers to your mouth like you're drinking from a straw, make a "slurping" sound.

Once you go over the parts of a plant and the hand/sound motion, ask for volunteers to help you build a "human" plant. Start with one or two students in the middle for heartwood. Then, add four or five students for the xylem and phloem to surround the heartwood. Remaining students can be bark and roots, with the bark students around the heartwood, xylem, and phloem and the roots sitting or lying on the ground. On the count of three, have everyone do their motion and speak at the same time.

Reflection

What are the differences between how plants get their water and food and how humans get their water and food?

Work Projects

Spend time in the garden working on various projects. Identify the parts of the plants around you.

Harvest

Let the kids eat something from the garden environment.

2nd Grade: Lesson 3
Soil Explorers from Space
***adapted from The Growing Classroom by LifeLab**

Learning objectives: Students will explore different soil compositions. Students will discover the different layers of soil.

State Standards: 2-PS1 Matter and its Interactions (2-PS1-1, 2-PS1-2)

Materials Needed
- Trowels or spoons for digging
- Cups or buckets for collecting samples

Weather Worksheet: Record date, time, temperature, and weather observations.

Question of the day: What is our soil made of? How does it support life on Earth?

Introduction
From topsoil, to humus, to rocks, soil composition can be quite diverse. It takes more than 100 years for just one inch of topsoil to be created, through weathering and decomposition. Soil is made of both inorganic and organic materials. The inorganic parts are things like rocks and minerals that have eroded into smaller particles through time. Fungi, bacteria, invertebrates, and decomposing plant and animal matter make up the organic parts.

Activity: Soil Explorers
Have the students sit quietly in a circle with their eyes closed while you read the following story:

"Imagine that we are scientists from the planet Zog, journeying to planet Earth on the Star Ship Life Lab. We have been chosen to make a most important journey. The future of our beloved planet is in danger as it has become so polluted that we are no longer able to grow our own food. Our astronomers have detected a very faraway planet called Earth. It appears to be green, lush, and fertile. Our computers have analyzed the reason for this and it appears to be a brownish-gray substance called "soil." It is difficult for us to believe that all their food comes from this substance. Our mission as scientists is to find this material called "soil," dissect it, and record every ingredient. This will allow us to learn the secret of this material so we can make soil back on planet Zog. Upon landing we will break into groups of 3-4 scientists. Each team will use the specially designed tools that our engineers have created just for this purpose. Remember: it is crucial to the success of our mission that each substance found in the soil be recorded. Good Luck to all of you. Long Live Planet Zog!"

- Divide students into groups of three or four. Tell each group that they will be researching the soil from a different part of the planet (garden).

- Demonstrate folding the newspaper into quarters and show how they can use one of the pockets created by the folds as a special place to store their soil sample as they carry it back to their work area.
- Show them how to dig up a sample of soil by inserting the trowel into the ground and lifting a "pie slice" of soil. Remind them not to disturb planted areas.
- Send each small group to a different area of the garden.
- When they return with their soil, have them use the tweezers to gently pick up the different items in the soil. Use the egg cartons to sort their finds into different categories. Have them record the different things they find in their journals.
- Allow the groups to share their lists of soil ingredients. *Are they all the same? If not, how do they differ?*
- Challenge the alien scientists to make some soil from the listed ingredients. *Can they take rocks and bark and bits of leaves and make soil? Allow them to try until they get frustrated. Why can't they make soil in a few minutes?*
- Explain that each inch of topsoil takes 100 years to form in nature. Bacteria, fungi, and other living things slowly decompose nutrients, recycling them into soil. Over 100 billion microorganisms live in a pound of soil. Our hands and tools cannot equal the power of the bacteria and fungi.

Reflection
What is soil made of? Will the super computer on planet Zog be able to make soil? How is soil important to Earthlings' lives? Is soil alive? Do all materials in soil break down at the same rate? What would happen if all our soil washed away?

Work Projects
Spend time in the garden working on various projects.

Harvest
Let all kids eat something from the garden environment.

2nd Grade: Lesson 4
Winter Plant Adaptations

Learning objectives: Students will learn how some plants survive the winter season's freezing temperatures and decreased amount of sunlight by using creative thinking skills to create their own plant and describe how it will survive the winter.

State Standards: 2-LS4 Biological Evolution: Unity and Diversity (2-LS4-1)

Materials Needed

- Scratch paper
- Colored pencils

Weather Worksheet: Record date, time, temperature, and weather observations.

Question of the day: How do plants survive the winter?

Activity 1: How Will You Survive the Winter?

There are a myriad of superpowers (adaptations) that plants have developed to survive below freezing temperatures and decreasing sunlight in the winter season.

Have students find one plant in the garden and ask it how it will survive the winter. After a few minutes, bring everyone back together and discuss their ideas. Then list some of the ways plants have adapted to cold winters.

- Dormancy: The plant goes into a state of temporary metabolic activity. They are not dead but rather in a state of suspended animation.
- Antifreeze Proteins: Some plants have antifreeze proteins to inhibit the growth of ice crystals inside their cells. These antifreeze proteins are inside of their stems where they convert starches to sugars to inhibit the growth of ice crystals and to keep from freezing. This makes them taste much sweeter during the cold season!
- Underground Storage: Some plants "go to sleep" in their own way, and survive by putting all their energy into underground storage organs such as tubers and roots (potatoes and carrots)
- Rhizomes: Some plants survive as an underground stem called a rhizome. New shoots will come up in the spring.
- Annual plants will die but will spread thousands of seeds to ensure the species continues.

Activity 2: Creating Plant Superpowers

- Discuss "adaptations" or plant superpowers. Brainstorm as a class and come up with some concrete examples of plant adaptations.

- Share with students that they will have a chance to create their own garden plant and they need to figure out how they will survive the harsh winter that is coming.
- Have each student draw their plant and come up with a creative way to survive the winter. Note: students can be super creative with they're responses.
- Encourage students to name their plant. Allow time for students to share their plant and describe its super power!

Reflection
Share one example of a plant that will survive over winter in your garden or area. How? Can you think of any ways plants are adapting to our changing climate?

Work Projects
Spend time in the garden working on various projects.

Harvest
Let all kids eat something from the garden environment.

3rd Grade: Lesson 1
Parts of a Flower

Learning objective: Students will be able to label and describe the functions of at least three parts of a flower.

State Standards: 3-LS1 From Molecules to Organisms: Structures and Processes (3-LS1-1); 3-LS4 Biological Evolution: Unity and Diversity (3-LS4-2, 3-LS4-3)

Materials needed

- Hand lenses or magnifying glass (optional)
- Scissors
- Flowers in bloom
- Clipboards (optional)
- Journals/pencils
- Diagram 1. Parts of a Flower
- Appendix Worksheet 1. Observation Worksheet
- Appendix Worksheet 2. Student Labeling Parts of a Flower

Weather Worksheet: Record date, time, temperature, and weather observations.

Question of the Day: What does a flower look like, and can you name the parts of a flower?

Introduction

When students know the parts of the plant, they can understand the bigger pictures of plant reproduction and the intentionality of the natural world. We admire flowers for their beauty, but flowers also hold an important role in producing seeds, food, and new plants.

- **Stem**: supports the flower and transports water and nutrients to the flower. Also, a landing pad for insects.
- **Petals**: protect the other parts inside the flower. The color, shape, and arrangement of the petals is usually designed to attract pollinators.
- **Pistil**: female reproductive part of a flower (Thick singular tube in the middle of the stamens).
- **Stigma**: receives the pollen, where the pollen germinates. It can be long and thin, or sticky, or feathery (like corn silks). AKA 'Sticky stigma'.
- **Stamen**: provides support for the anthers.
- **Anthers**: produces and stores pollen (part of the stamen, or the male reproductive system).
- **Ovary**: contains egg cells and produces a seed when fertilized.

<u>Activity #1: Parts of a Flower</u>

- Give students a sheet of paper folded in half and reopened or open their journals to 2 facing pages.
- **Memory Drawing:** On one side of the paper or on one side of their journal, have students draw a picture of a flower from their memory.

- **Group Diagram:** Hand out the "parts of a flower" worksheet. On the board, draw the simple diagram of a tulip and label the *stem, petals, pistil, stigma, stamen, anthers, and ovary***.** Have the students fill out the worksheet as you label your flower.
- Go over the purpose of each part in simple terms. See "Background" below for further definitions.
- **Observational Drawing:** Individually or in groups of two, have students find a flower in the garden. Have your students draw ALL parts they see on the second half of their sheet of paper or on the opposite page in the journals (next to their memory drawing). Encourage students to draw the details inside the middle of the flower.
- **Pair and share**: Return to the circle and have students "pair and share" what they think they know about each of their flower parts.

Reflection
Have students share one part of the flower and its purpose. What are these parts used for? Introduce the concept of pollination.

Work Projects
Spend time in the garden working on various projects. Look for different flower parts around the garden.

Harvest
Let kids eat something from the garden environment. If you can, show them edible flowers, such as pea flower, Johnny jump-up (violet), spring beauty, edible pansy, squash flower, rose petals, any herb flowers, mustard, sunflower seeds, borage, clover, chives, dandelions etc.

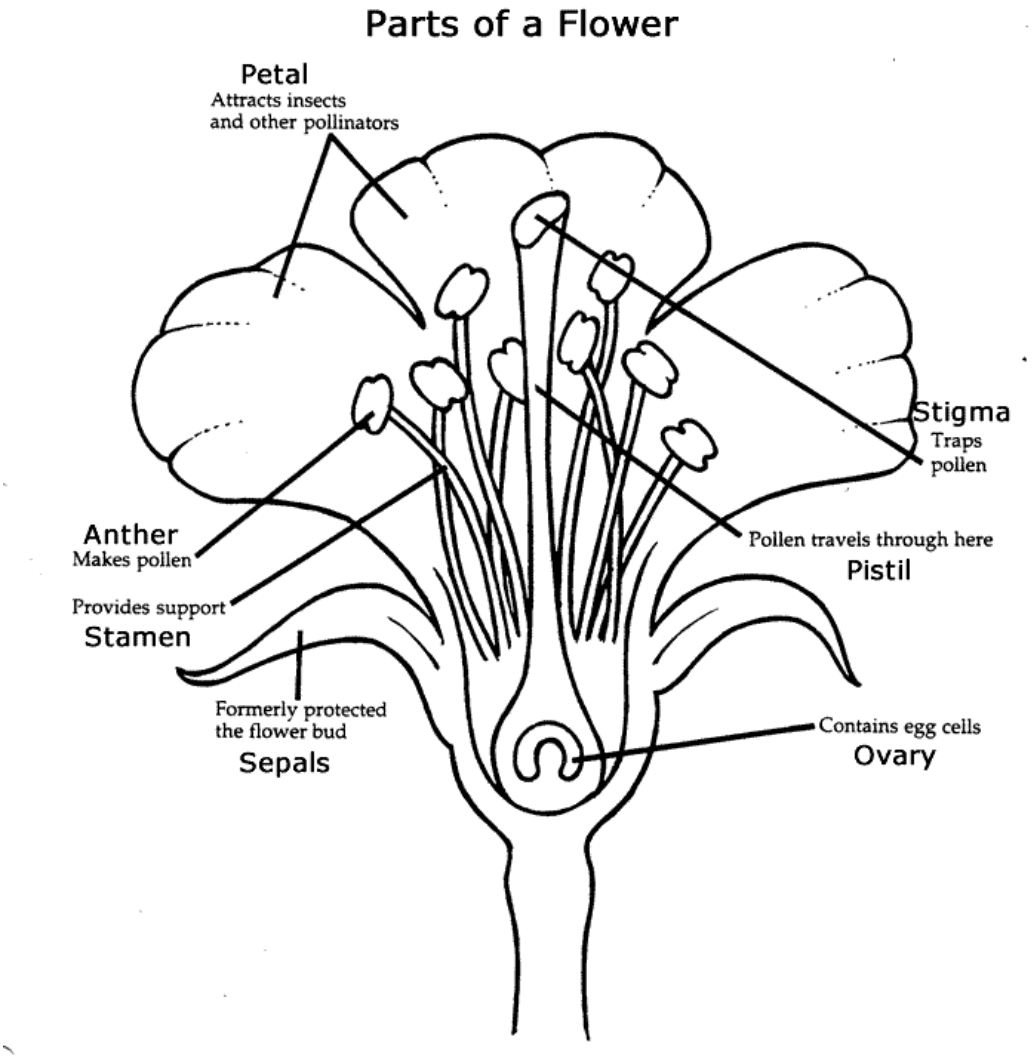
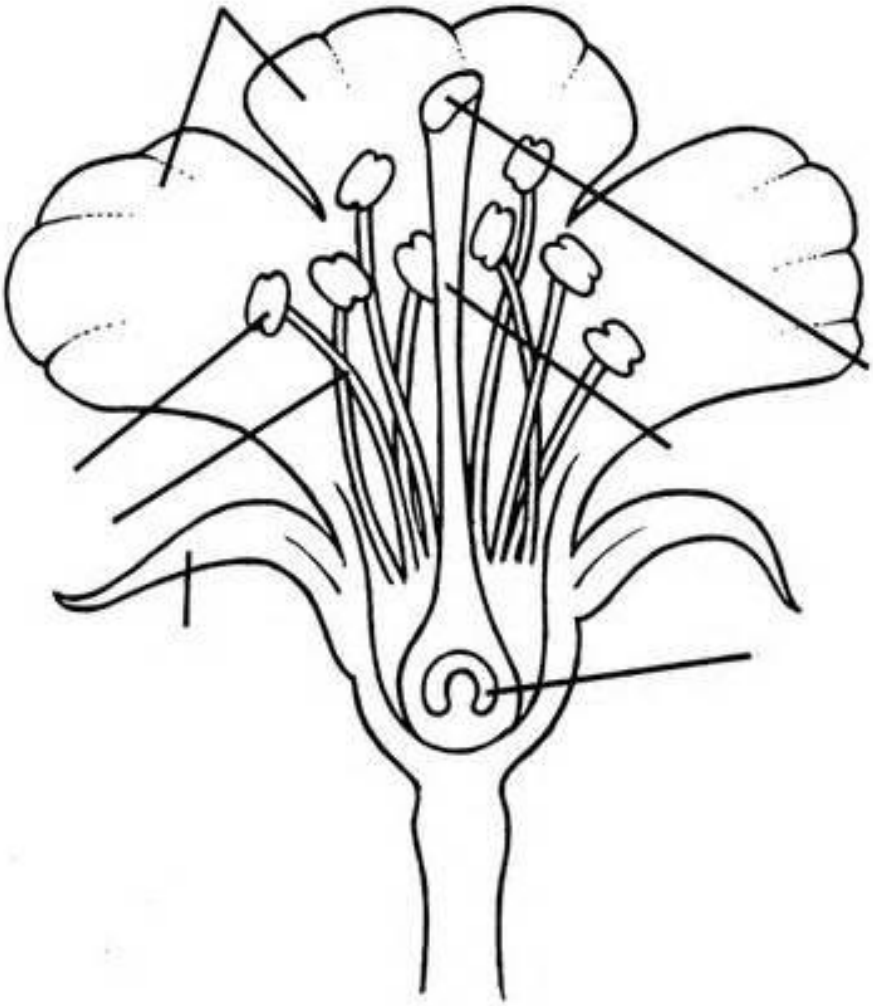


Diagram 1. Parts of a Flower
Teachers: Use the above diagram labeling the stem, petals, pistil, stigma, stamen, anther, and ovary.

Parts of a Flower



Worksheet 1. Parts of a Flower
Flower without parts labeled for students to fill in.

3rd Grade: Lesson 2
Pollinators

Learning objective: Students will learn about various pollinators and methods of pollination.

State Standards: 3-LS3 Heredity: Inheritance and Variation of Traits (3-LS3-2); 3-LS4 Biological Evolution: Unity and Diversity (3-LS4-2, 3-LS4-3)

Materials needed

- Journals/pencils
- Petri Dishes with lids (or other clear plastic lidded vessel to see insects inside)
- Plastic tweezers (optional)
- Hand Lenses (optional)

For Activity #3

- Dixie cups (1 per child)
- A short 1-inch straw (1 per child)
- Colored sugar (Kool-Aid)
- Sugar water to fill ¼ inch liquid in each Dixie cup (Kool-Aid or honey water)

Weather Worksheet: Record date, time, temperature, and weather observations

Question of the Day: How does pollination work and why is it important?

Introduction

- Review the last lesson's flower diagram.
- Explain how plants use powdery *pollen* to help them make seeds. Plants grow pollen in their flowers' anthers.
- Pollen sticks to the '*sticky stigma'* and travels down the *pistil* to fertilize the *ovary* and allow a seed to start to form. Some flowers use their own pollen to make seeds, but many flowers need pollen from a different flower of the same kind of plant. They need the pollen to travel to them, somehow...
- Once pollen sticks to the stigma and fertilization occurs, the ovary swells to form a fruit and seeds are produced to become new plants.

Have students turn to their neighbor and brainstorm one pollinator. As a group, share answers. Create a list of their answers on the white board and add pollinators they may not know. Examples of pollinators include bees, flies, moths, butterflies, bats, and wind. To explain wind, ask if the students have ever seen a green haze in the air. This is pollen from Ponderosa Pine trees that rely on wind to transport their pollen.

Activity #1: Flower Dissection

Have students pick one flower per person with simple flower parts such as a lily, a rose, or an iris (large flowers are easiest). Students gently break apart the petals and separate all

the reproductive parts you just learned about. See if they can isolate the pistil, stigma, stamen, anthers, and ovary.

*Note: If time allows, prepare examples of dissected flowers before the lesson begins. Have two or three different types of flowers dissected to show variations in flower anatomy.

Activity #2: Insect Hunt

Students will tour the garden in groups of two or three looking for insects on flowers. As they find insects, gently tap the plant so the insect falls into the petri dish. Close the lid and look at the insect with hand lenses to see the pollen. They will determine whether that insect is a pollinator and if so, how they pollinate.

Note: Know your student and their bee allergies. Teachers may want to remind students to be gentle with insects as some of them can bite or sting. Most insects are harmless to humans, so this may be a good opportunity to reduce any students' fears of insects.

Activity #3: Be the Bee

Explain to the students they are a hive of native bees and are looking for nectar to drink. The Dixie cups are the flowers; the straws are their proboscis (or insect tongue).

- Take one Dixie cup for each student and coat the rims with colored sugar (get the rim damp for the sugar to stick). The colored sugar acts as the flower's pollen for this activity.
- Add a small amount of sugar water (or honey water) to the bottom of the cup to act as the flower's nectar.
- Give each student a short straw that is the length of the cup. This acts as the bee's mouth part (proboscis).
- Without using their hands or tipping the cup over in any way, the students must try to drink the nectar through the straw. If done properly, the colored sugar (pollen) will stick to the students faces and demonstrate how pollen is accidentally captured by pollinators as they go from flower to flower.
- You can also set up multiple stations around the garden and have the busy bees run from station to station gathering pollen from different types of flowers.

Additional Information on Pollinators

Pollinating insects profoundly impact our world. The symbiotic (mutually beneficial) relationship between pollinators and flowers demonstrates that every organism has a role to play in this world.

Symbiosis is a relationship between two or more species, where both organisms benefit. Pollination is a symbiotic relationship in which both pollinators and plants benefit from each other. Pollinators receive food in the form of nectar and pollen from the flowers, while flowers get the help they need to move pollen from flower to flower to reproduce. It takes many flowers to feed a pollinator.

Fun Fact: A bee visits around 100 flowers per flight from the hive. With 10 flights per day, this equals 1,000 flowers pollinated per day! You can do the math with your students.

Remind students that a flower needs pollen from other flowers of the same kind. Ask students how they think a plant can get pollinators to take pollen to the same kind of plant, instead of visiting many different kinds. As students answer, guide them to understand that plants develop flowers with certain colors, shapes, smells, and tastes that appeal to certain pollinators. For example, hummingbirds are attracted to red, fuchsia, and pink flowers. Bees are often attracted to bright blue and violet flowers.

Reflection
Back in the circle, students share what pollinators or insects they found and why pollinators are important. Where did students see the pollen collecting on the insects they found? In pollen sacks on their legs, on their head and abdomen, other locations? Reiterate how insects help with pollination.

Work Projects
Spend time in the garden working on various projects. Continue noticing pollinators.

Harvest
Let the kids eat something from the garden environment.

3rd Grade: Lesson 3
Habitat Exploration
***Adapted from the Cornell Lab of Ornithology**

Learning objectives: Students will define what a habitat is, including needs for food, water, cover, and space.

State Standards: 3-LS2 Ecosystems: Interactions, Energy, and Dynamics (3-LS2-1); 3-LS3 Heredity: Inheritance and Variation of Traits (3-LS3-1, 3-LS3-2); 3-LS4 Biological Evolution: Unity and Diversity (3-LS4-2, 3-LS4-3)

Materials Needed
- Notebooks
- Pencils

Weather Worksheet: Record date, time, temperature, and weather observations.

Question of the Day: What is a habitat?

Introduction
Imagine life as a bird. Where do you live? What are you doing? What do you hear? Are you hungry? What do you eat? Where do you find water? How do you eat and drink water? Where do you sleep? Where might you hide? Who chases or hunts you? Where do you lay your eggs? How do you hide your babies? Do you travel alone or in groups?

Habitat is defined as the natural home or environment of an animal. Does the garden provide all that a bird might need to survive? Let's go find out!

Activity #1: Birds in the Garden Exploration
- Ask students to close their eyes as you read the prompt in the **Introduction** section, pausing between each question. Have them hold on to their imaginations for now.
- As a group, walk around the garden for two minutes in silence. Encourage students to listen and look for bird activity.
- Gather in a circle and ask students to share any evidence of birds. Did you notice anything new or different?
- Ask the class: What do birds need for survival? Have students think, pair, and share.

Activity #2: Habitat Hunt
- In their notebooks, ask students to draw a line down the middle of a piece of paper both horizontally and vertically, creating four quadrants on the page. Label each quadrant: Food, Cover, Water, Space.
- Send students into the garden to look for examples to fill in the quadrants with words and/or drawings.
- Allow for 5 minutes at the end for students to share observations.

Reflection
How does the shape of a bird's beak influence what they eat or where they live. Have students give you a few examples they can think of. For example, a hummingbird's long beak helps it drink nectar from a tube-shaped flower - they migrate to warm climates in the winter so they can find flowers for their food. A chickadee's tiny sharp beak helps it break open and eat seeds - they live in forested areas where seeds are present, year-round. A bald eagle's sharp, large, hook-shaped bill helps it tear meat from its prey. Bald eagles live near the water to hunt waterfowl and fish or scavenge on already dead larger animals.

Work Projects
Spend time in the garden working on various projects. Look for signs of birds or food that birds may eat.

Harvest
Let all kids eat something from the garden environment that a bird may enjoy eating (e.g.: seeds, nuts, or berries)

3rd Grade: Lesson 4
In Search of Cycles

Learning objectives: Students will observe cycles made of found materials in the garden. Students will create their own cycles using found materials to deepen their understanding of plant cycles.

State Standards: 3-LS1 From Molecules to Organisms (3-LS1-1)

Materials Needed

- Two sheets, bandanas, or napkins
- A handful of soil
- Samples of various life stages from a plant in the garden

Collect an example of various life stages of a plant and arrange them on a napkin on the ground in what will be the center of your circle of students; start and end with soil. You want to find as many samples as you can find from the same plant at different life stages, such as a tomato: leaf/stem, flower, green fruit, ripe fruit, overripe fruit, mushy fruit. Then, place another sheet or napkin over the arrangement.

Weather Worksheet: Record date, time, temperature, and weather observations.

Question of the Day: How do plants change over time?

Activity: A Plant's Story

- Gather in a circle around the sample you have created.
- Tell students you are going to show them the samples you've collected, but only for three seconds! Their job is to remember as many details as possible during those three seconds.
- Lift the top napkin for three seconds, and quickly cover it back up.
- Ask students to share, one at a time, anything they can remember from what they saw. Once everyone has had a chance to share, remove the top cover and explain that this is not just a random sample of items, but a *story*.
- Allow students to look at the example again while uncovered. Then, have them share any ideas they come up with about the story with a partner.
- Have one partner group at a time share what they came up with.
- Fill in the gaps of the story as each group shares. For example, we see a seed germinating in the soil, growing into a sprout, taking many weeks to produce leaves, and eventually producing flowers, which are pollinated to form fruit. The fruit continues ripening, even rotting, and sometimes falls off onto the soil. The cycle begins again! (unless we save the seed)
- If "decomposition" does not come up, introduce the concept. Explain how plants decompose into soil, which is where the cycle begins and ends.

- Send students out in teams of 2-4 to collect samples to create their own plant cycle. They may collect from different plants, including vegetables, shrubs, herbs, flowers, or even grasses, depending on what you have in your garden.

Reflection
How is a plant's life cycle different from an animal's life cycle? What does it make you wonder?

Work Projects
Spend time in the garden working on various projects.

Harvest
Let all kids eat something from the garden environment.

4th Grade: Lesson 1
Photosynthesis

Learning objective: Students will know where energy comes from in the garden and how it moves throughout the garden.

State Standards: 4-PS3 Energy (4-PS3-2); 4-LS1 From Molecules to Organisms: Structures and Processes (4-LS1-1)

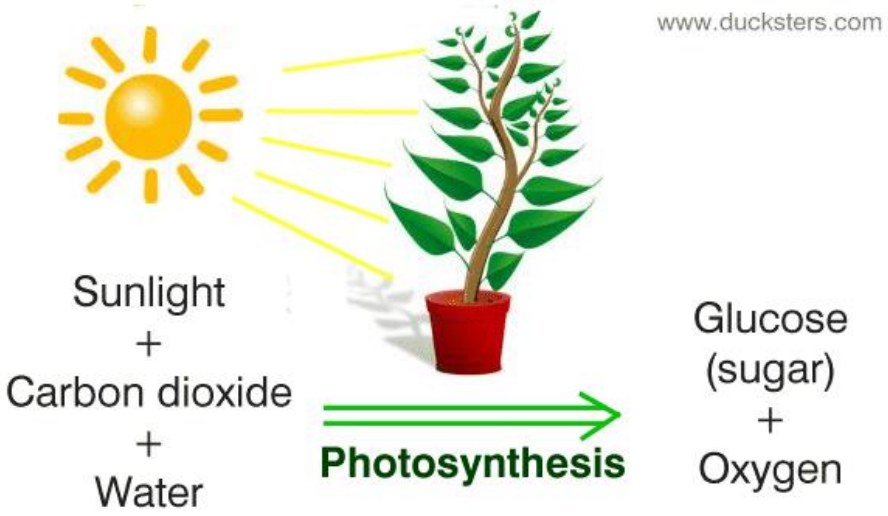
Materials needed
- Journals/pencil
- Refractometer

Weather Worksheet: Record date, time, temperature, and weather observations.

Question of the Day: Has anyone heard of photosynthesis? Have students write the word in their journal. Explain the meaning: Photo = Light. Synthesis = To put together, combine, or make something out of.

Introduction
Plants need three basic things to live: water, sunlight, and carbon dioxide. Plants absorb water through their roots, chlorophyll inside plants absorbs sunlight, and plants breathe in carbon dioxide. The process of taking these three key ingredients and making them into food (or sugar) is called *photosynthesis*.

*Note: Plants breathe in carbon dioxide and breathe out oxygen, the opposite of us humans. They are the major source of oxygen on planet Earth and help keep us alive.



Activity #1: Photosynthesis Yoga

- After talking about the meaning of photosynthesis, walk to an outdoor location and feel the sun's rays. Have students stand up tall as a plant, stretch their arms as branches or leaves towards the sun and absorb all the light they can.
- Next, have students plant their feet strong into the ground - wiggle their toes and ground their roots into the soil. Talk them through collecting the water from the soil to absorb into the stem of their plant being.
- Now with feet/roots planted firmly in the soil, and arms/leaves in the air, take a deep breath of Carbon Dioxide from the air as they fold at the belly towards the ground (arms/leaves come to the ground as well). As they stand up and reach towards the sky, have them release a deep breath out to deliver oxygen to all the human beings in our world. Do this 3 times for a larger impact.
- These three activities from the sunlight absorbed on leaves, water absorbed into the roots, and intake of carbon dioxide are helping their plants produce the food that sustains them, sugar!

Activity #2: Plant Tag Game

- Gather in a circle for a game in which everyone is going to transform into a plant. Have everyone decide in their minds which plant they are going to be.
- Define boundaries, and have students line up on one end. Explain that you (or whoever is doing the chasing) are going to call out commands like "If your plant has bark!" or "If your plant grows in the garden, cross!" If that is true of their plant, they must try to make it to the other side without being tagged.
- If they do get tagged, they grow roots and can tag other plants by reaching their branches or leaves (arms), but they can't move their roots (feet).
- Play for a while, and towards the end make sure to include each component of photosynthesis. "If your plants need water… if your plant breathes in carbon dioxide… if your plant eats the sun!"
- Gather back together and decompose (collapse to the ground). Ask "As plants, how did you grow from a little seed? Did you open your mouth, eat food, and digest the energy to grow?" List what plants need to grow: water, carbon dioxide and sunlight. Out of these ingredients they make oxygen and sugar! It's called PHOTOSYNTHESIS!
- Ask students to stand up if they are wearing green. If they're not wearing green, have them point to something green. The green stuff in plants is called chlorophyll and is the substance that enables the plant to absorb energy from the sun! (In Greek, the word ckhoros means "pale green" and phyllon means "leaf".)
- Enter the garden looking for chlorophyll, photosynthesis, and/or exchanging our CO2 for a plant's oxygen (the fourth graders really liked doing this air exchange!).

Activity #3: Life Without Green

Read the students this scenario: "It is twenty years in the future, and everyone has children of their own. A news story says that the chlorophyll in plants all around the world is mysteriously breaking down and photosynthesis is coming to a halt. How will this affect us all?"

Would these items be gone without photosynthesis? Have students stand up and identify a 'yes' zone and a 'no' zone. Ask questions and have students go stand in the zone of their answer.

- **Carrots?** Yes, photosynthesis is necessary in the leaves of the carrot to create sugars that are stored in the root (carrot).
- **Ice cream?** Yes, cows need grass or other grains to eat and without food, the cows will not produce milk for our ice cream.
- **Bread?** Yes, wheat plants grow to maturity and produce seeds on their florets that are ground up for flour for our bread.
- **T-shirts?** Cotton plants produce cotton seeds needed for the fibers in clothes.

Activity #4: Hidden Sugar

"Since you cannot see photosynthesis happening, how do we know the plant is producing food?" Let the students brainstorm some ideas before introducing the refractometer.

Refractometers are scientific tools that measure the amount of light refraction through a substance (light refracts or "bends" as it travels through dissolved substances). For this demonstration, we can use this tool to measure the percentage of sugars found in a plant.

- Take out the refractometer and apply pure water on the daylight plate. Look through the scope towards the sky and read the measurement (pure water should have a 0% sugar density rating). Note: Dry off the plate before applying other things.
- Take a grape (or any juicy fruit) and squeeze that onto the daylight plate. Look through the scope toward the sky and read the measurement (grapes have between 14-20% sugar density).
- Take a plump leaf (such as a succulent) or plant stem and squeeze the juice out of it and apply to the daylight plate. You can now measure the density of sugars produced in that plant through photosynthesis!

Explain that this tool helps farmers know when their fruit crops are ready to harvest.

Reflection

Sunlight provides energy that flows through plants to all living things. Ask students what energy they have received today from photosynthesis.

Work Projects

Spend time in the garden working on various projects. Continue the photosynthesis discussion while working.

Harvest

Let the kids eat something from the garden environment. Fruit and vegetables are full of sugar, so let's have a natural sugary snack.

4th Grade: Lesson 2
Decomposition and the Nutrient Cycle

Learning objective: Students will understand that nutrients cycle through a natural ecosystem and through our garden ecosystem.

State Standards: 4-PS3 Energy (PS3-2); 4-ESS3 Earth and Human Activity (ESS3-2)

Materials needed

- Decomposed materials found from the garden
- Paper or field journals and pencils (optional)
- Food scraps
- Straw, wood chips, or used paper bags
- Water source (bucket, hose or watering can)
- Probing thermometer

Weather Worksheet: Record date, time, temperature, and weather observations.

Question of the Day: Why do we compost?

Introduction

Ask students, "why do we compost?", then have students "pair and share" ideas with each other. Students write in their journals one sentence detailing the reason we compost.

As a group, draw the nutrient cycle on the whiteboard and have students follow along on their printout (see diagram at the end of the lesson) or draw in their journals.

The cycle that nutrients follow in the garden is:

Soil -> Plant -> Dead Plant/Food Scraps -> Compost -> Soil

Include the food leaving the garden and then coming back again from the cafeteria or your home. The transfer of nutrients might go through many organisms but if they are composted, they always return to the soil to grow more plant life.

<u>Activity #1: Decomposition Timeline</u>

Tell the students they will be creating their own decomposition timelines from natural materials. Have the students go out in the garden (or just outside) to find at least five objects from the same type of plant that are in different stages of decomposition. For example, often leaves and pine cones are everywhere and in different stages of decomposition. Grab five leaves from the ground that fell from the same tree. In a straight line on the ground, order the leaves from most decomposed to least decomposed. This can also be done at the base of an apple tree or with squash plants during the fall season.

Make notes in field journals (optional). Share observations about color, texture, fragility amongst the different stages of decomposition. Connect this to the nutrients in the soil where the tree (plant) grows.

Activity #2: Build a Compost Pile

Build a compost pile to demonstrate how humans can return the nutrients from their food back to the soil. When we take things from the garden, we must return them to keep the balance of nutrients. To make a healthy compost pile you need four main ingredients:

- Green material (food scraps, grass clippings, garden trimmings, etc.)
- Brown material (Wood chips, straw, used paper bags)
- Air (turning it with a shovel or pitch fork once a week to allow air circulation)
- Water (damp but not soaking)

These compost ingredients will help create healthy garden soil and complete the nutrient cycle. You can create compost bins, however, a pile on the ground is just as effective as long as you are not attracting neighborhood animals.

Revisit your compost pile over several weeks to document the process of decomposition. Remember you must have the four ingredients, including air and water for it to decompose efficiently.

When visiting your compost pile, use a probing thermometer to measure the temperature as the heat is created during the decomposition process. Measure the internal temperature of the pile every day. Turn the pile to aerate and bring more oxygen to the compost. Observe how this changes the temperatures of the pile in the coming days.

Optional Math Activity

Record and graph the changing temperatures by the number of days after turning their compost pile. Discuss how this mathematical model helps us understand our compost pile and what we can learn from the data we collect.

Reflection

How does composting at home or in the garden help return nutrients to the soil?

Work Projects

Spend time in the garden working on various projects. Note decomposition taking place.

Harvest

Let the kids eat something from the garden environment.

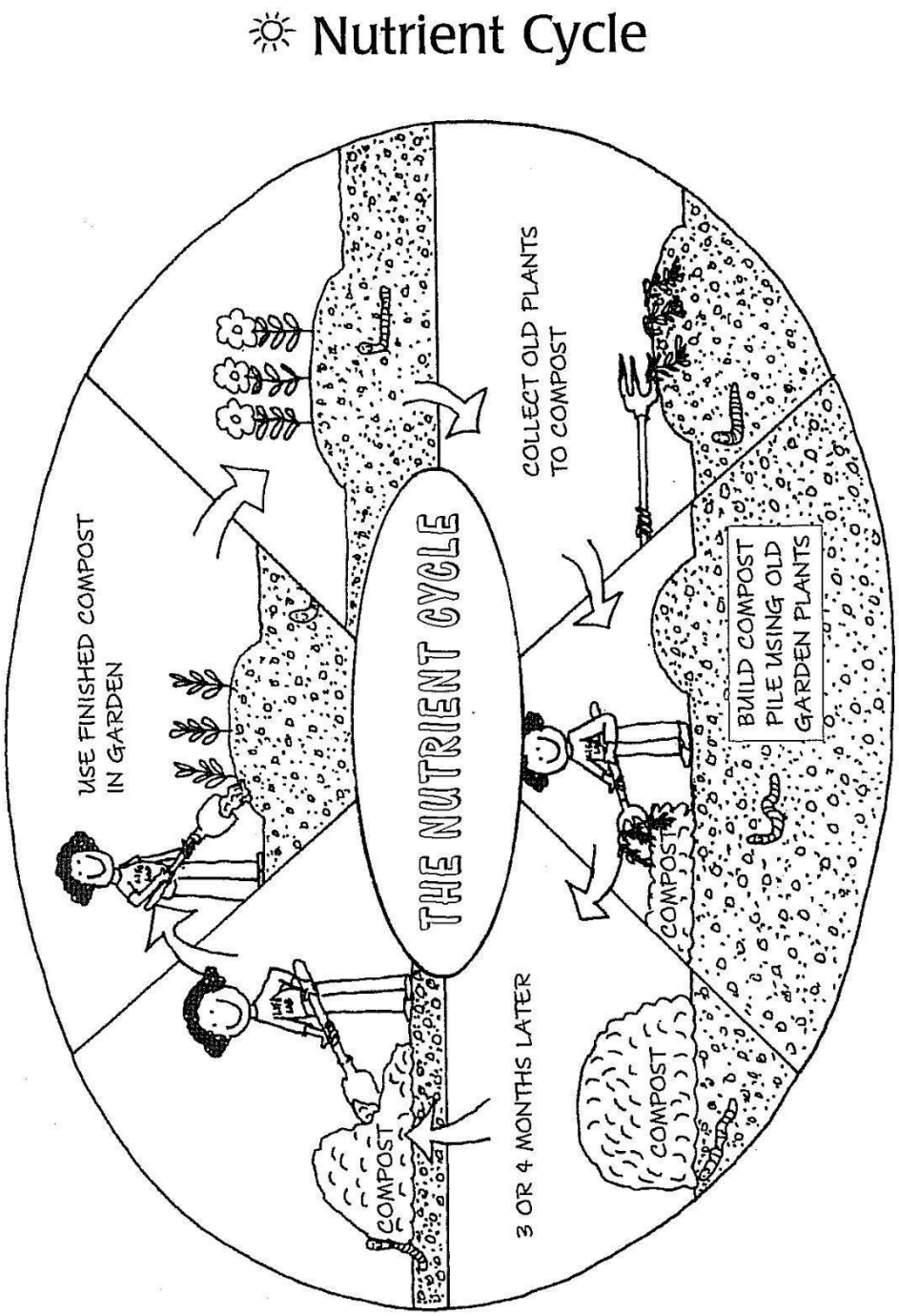


Diagram 2. The Nutrient Cycle Building Soil

4th Grade: Lesson 3
Nutrition Mission

Learning objectives: Students will discover where nutrients come from and how they help us grow.

State Standards: 4-LS1 From Molecules to Organisms: Structures and Processes (4-LS1-1)

Materials Needed
- Paper
- Pencil
- Coloring pencils, markers, or paints

Weather Worksheet: Record date, time, temperature, and weather observations.

Question of the Day: Why do we eat? Where do nutrients come from and why should we eat a variety of fresh foods?

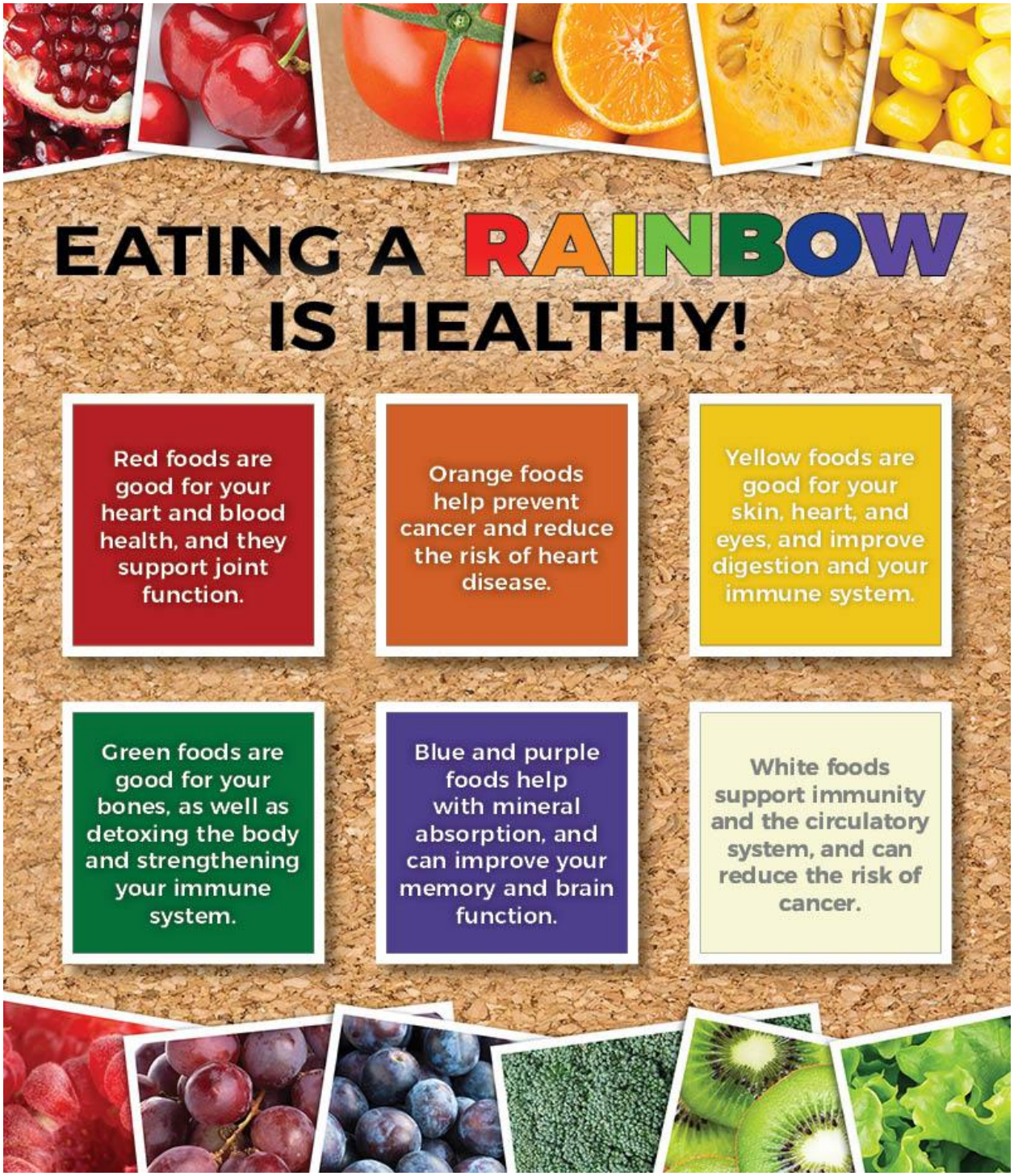
Introduction
Ask students why they think it is important to eat fresh fruits and vegetables.
Possible talking points include:
- Our bodies rely upon nutrients to grow and function properly. Just like we feed compost to the soil to feed the plants, we feed our bellies the plants that we grow.
- Different plants provide an array of nutrients that build our bones, clean our blood, and give us clear thoughts.

What nutrients are they already aware of? Possible answers:
- Carbohydrates - potatoes, wheat
- Fats - avocado, animal products
- Fiber - leafy greens, carrots
- Minerals -calcium, iron
- Protein- beans, meat, egg
- Vitamins- A, B, C, D, E K

Activity 1: Eat a Rainbow!
Here's a fun video you can use to introduce the fruit and vegetable rainbow:
https://ed.ted.com/best_of_web/uZoCUkl3

Eating colorful food is not only beautiful, but it is also nutritious! The colors in the fruits and vegetables from the garden can tell us something about the nutrients that they contain. To get all the nutrients we need, it is recommended that we eat every color every day!

Have the students pretend that they will be the featured chefs at a nutrition party. Their challenge is to plan a meal that contains every color of the rainbow from fruits and veggies. Give each group paper and colored pencils to draw their dish and describe it in writing. Have each group present their meal plan, including some of the health benefits that people will get from eating their nutritious meal. YUM!



Activity 2: Veggie Portraits

Have you ever heard people say, "you are what you eat?"

Check out this vegetable portrait by Guiseppe Arcimboldo, an Italian painter who lived in the 1500's.

Have students make their own veggie portraits. See if they can include a food for every color of the rainbow. Can they use fruits or vegetables for the body parts that they are good for?

Reflection

Why don't we just eat one thing every day? What would we look like? How would we feel?

Work Projects

Spend time in the garden working on various projects.

Harvest

Let all kids eat something from the garden environment. If possible, walk around the garden sampling different colors and reviewing their nutrient contents, or eat a colorful snack from the market.

4th Grade: Lesson 4
Traveling Seeds

Learning objectives: To recognize the mechanisms that seeds have developed to travel and identify how certain seeds travel.

State Standards: 4-LS1 From Molecules to Organisms: Structures and Processes (4-LS1-1)

Materials Needed:
- *The Seed is Sleepy* book by Dianna Aston
- Hand signs for Wind, Water, Animal and Explode
- Pictures of seeds that fit in each category

Weather Worksheet: Record date, time, temperature, and weather observations.

Question of the Day: How do seeds move to find the right space to grow? Can students name types of seeds that travel by wind, water, animals, or explode from their seed pods?

Activity 1: Read *The Seed is Sleepy* by Dianna Aston

Tell students to pay attention to the different ways that seeds travel. After the reading, make a list of ways that seeds travel:

1. Wind,
2. Water,
3. Animals, and
4. Explode!

Have students share with you what they learned about some features of seeds that can tell us how they travel (hairs for flying, hooks for sticking).

Activity 2: Seed Master Game

After making a list of the 4 types of seed travel, get moving by assigning a pose for each category. Ex: Extend arms in flight for wind, make waves for water, hold up hands like paws for animals, and throw arms up in the air to explode. Practice each motion several times. To play as a game, stand in front of the students as the "Seed Master." On the count of three, everyone strikes one of the 4 poses. If they are doing the same pose as the Seed Master, they may take one step back to "disperse." Play until satisfied. Bring students back and review poses and modes of transport. See how fast everyone can go through a sequence. Wind, Water, Wind, Explode, Water, Animal, Explode!!!

Activity 3: How Do Seeds Move?

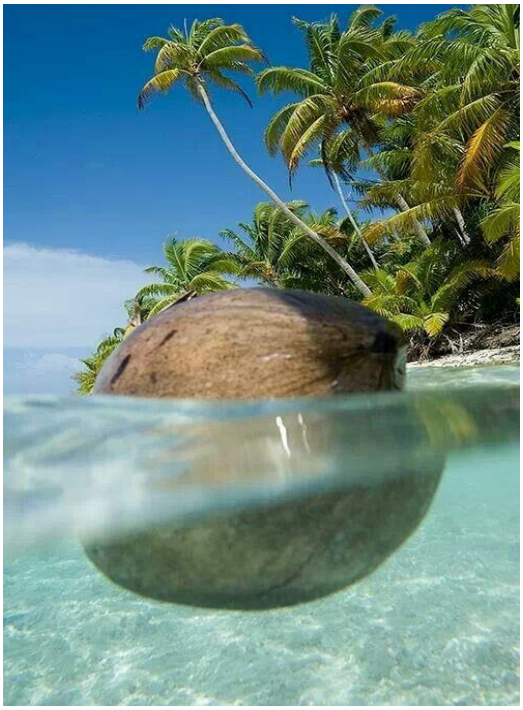
- Set out Wind, Water, Fire, Animal and Explode cards in a row
- Give each student or group of students a variety of seeds or pictures of seeds
- Using what they know about how seeds travel, the students will act as detectives to analyze the pictures and determine how the seeds travel based on their unique features. They will place these pictures or seeds below one of the four columns

- Optional: Make it more active by placing Wind, Water, Fire and Animal signs in a large square. Hold up a picture and students must run to which type of dispersal they think the seed uses.
- When everyone is finished, go through several examples and ask why they thought the seed belonged to the category they placed it in. What similarities or differences do they notice between the seed examples?

Reflection
What are the different ways that seeds travel? Why do seeds travel? What features or structures helped the students discover how each seed travels?

Work Projects
Spend time in the garden working on various projects. Investigate seeds and their features.

Harvest
Let all kids eat something from the garden environment. Will they be carrying seeds when they leave the garden?!



Seed Dispersal Photo Key (in order from top):

- Douglas Maple- wind
- Dandelion- Wind
- Tumbleweed- Wind
- Water Lily- Water
- Coconut Palm- Water
- Cattail- Water and wind
- Lupine- Explode
- Witch Hazel- Explode
- Milkweed- Explode and wind
- Huckleberry- Animal
- Burdock- Animal, the seed's barbs attach to animal fur, it inspired the maker of Velcro
- Sunflower- Animal- bird (or human!)

5th Grade: Lesson 1
Producers, Consumers, and Decomposers

Learning objectives: Students will understand the roles of producers, consumers, and decomposers in the ecosystem and apply their understanding to the garden and their home ecosystem.

State Standards: 5-PS3 Energy (5-PS3-1); 5-LS1 From Molecules to Organisms: Structures and Processes (5-LS1-1); 5-LS2 Ecosystems: Interactions, Energy, and Dynamics (5-LS2-1); 5-ESS3 Earth and Human Activity (5-ESS3-1)

Materials needed

- String/rope 100 ft long
- Organism Cards with strings so they can be a necklace. The cards should be a variety of producers, consumers, and decomposers.

Weather Worksheet: Record date, time, temperature, and weather observations.

Question of the Day: What is the cycle of life and how does energy flow through organisms? Can you describe one full cycle?

Introduction:

- Divide the class into small groups. Give each group a set of three pictures representing a producer, a consumer, and a decomposer organism. Have each group describe to each other how these three organisms are related to each other. Use one group to detail how they just created a food web, a model that illustrates how food is produced (made), consumed (eaten), and then decomposed (eaten again & recycled) in an ecosystem.
- Write these keywords on the board and have students write them in their journal (optional).

Producers make their own food. They do not have to obtain energy from other organisms. They obtain their energy from the sun and make food with that energy through the process of photosynthesis. They are often plants (grass, shrubs, trees).

Consumers cannot make food. They must find food and eat it to obtain energy. There are *primary consumers* which are plant eating *herbivores*, (mice, deer) and *secondary consumers* that eat primary consumers (cougar, owl) otherwise known as meat eating *carnivores*. Omnivores consume either plants or meat (racoon, bear).

Decomposers eat dead things. They break down dead organisms and return the nutrients to the soil (worms, bacteria, mushrooms).

<u>Activity #1. Guess Your Creature Card Game:</u>

- Have the students line up facing away from you.

- Wrap a card around the neck of each student so the organism is on the students back. Tape will also work. Students should not be able to see their own card.
- The students must go around to their classmates and ask yes or no questions about their organism, gathering enough hints to guess their organism. Instead of guessing names of plants and animals, help them narrow the possibilities down by asking questions about their size, color, food source, are they a producer, consumer, etc.
- Once a student figures out their organism, they can turn their card around to the front of their bodies and help other students answer questions.

Activity #2. Web of Life

The group creates a circle with each person holding a picture of an organism in the ecosystem. Give one student a 100-foot roll of string. The student will pass the roll of string to a person who has a picture of something they eat or something that eats them (a producer, consumer, or decomposer). Student one continues holding onto their end of the string. Student two does the same thing. Continue until everyone has a chance to make connections and everyone is holding a part of the string.

Staying in their web, explain to students that they have created a food web, a model that illustrates how food is made (produced), eaten (consumed), and then recycled (decomposed) in an ecosystem. The more biodiversity, the stronger the web will be.

What would happen if we took one species out of the equation? Illustrate by removing one animal/plant/insect by having them drop the string they are holding. Speculate on the effects on the web of life. Discuss animals, plants, and insects in danger, possible extinctions, and the repercussions of losing biological diversity in the ecosystem. When we remove something from the web of life, it becomes unstable and everything in the ecosystem feels the effects, or even collapses.

Reflection

Have students reflect on their understanding of ecosystems in their local environment.

Work Projects

Spend time in the garden working on various projects while looking for producers, consumers, and decomposers.

Harvest

Let students eat some producers that help feed the web of life!

Decomposers:

Producers:

Primary Consumers:

Secondary Consumers:

Omnivore Consumers:

Scavenger Consumers:

5th Grade: Lesson 2
Plant Adaptations

Learning objectives: Students will understand plant adaptations, the difference between natural and artificial selection, and the parts of the plant.

State Standards: 5-PS3 Energy (5-PS3-1); 5-LS1 From Molecules to Organisms: Structures and Processes (5-LS1-1)

Materials needed
- Clipboard and paper or journals
- Bag of vegetables per group of students from the list below
- Copies of the brassica picture

Weather Worksheet: Record date, time, temperature, and weather observations.

Question of the Day: What is an adaptation?

Introduction
- Adaptation: special features that allow a plant or animal to live in a place or habitat. These adaptations might make it very difficult for the plant to survive in a different habitat.
- Natural Selection: the process where organisms better adapted to their environment tend to survive and produce more offspring
- Artificial Selection: the breeding of plants and animals to produce desirable traits. Organisms with the desired traits, such as size or taste, are artificially mated or cross-pollinated with organisms with similar desired traits.

<u>Activity #1. Vegetable Parts Game</u>
Plants have special adaptations to grow and humans have learned to cultivate the nutritious parts in different ways. In fact, we eat different parts of plants all the time. This game connects garden food items with the part of the plant - roots, tubes, stems, leaves, flowers, seeds, and fruit.
- Break students into four teams (5-10 kids per team).
- Write on the whiteboard six categories: roots, tubes, stems, leaves, flowers, fruit, and seeds
- Present one garden food item at a time.
- Each team guesses what part of the plant the food item is categorized as, using paper or journals to write their answers down. Once each team is ready, the teams reveal their answers.

Examples of garden food items and the part of the plant represented:
- Carrot (root)
- Beet or radish (root)

- Broccoli or cauliflower (flower and stem)
- Kale and lettuce (leaves)
- Onion (modified stem surrounded by modified leaves)
- Celery (stem and leaves)
- Raspberry (fruit)
- Zucchini (fruit)
- Pepper (fruit)
- Potato (tuber)
- Corn (seed)

Discussion:
Ask the question, "How do humans influence plant adaptations?". Hand out the Brassica picture below and distribute it to each team. Let students think together about what the diagram represents. Have students share questions about what is happening and write their comments on the board.

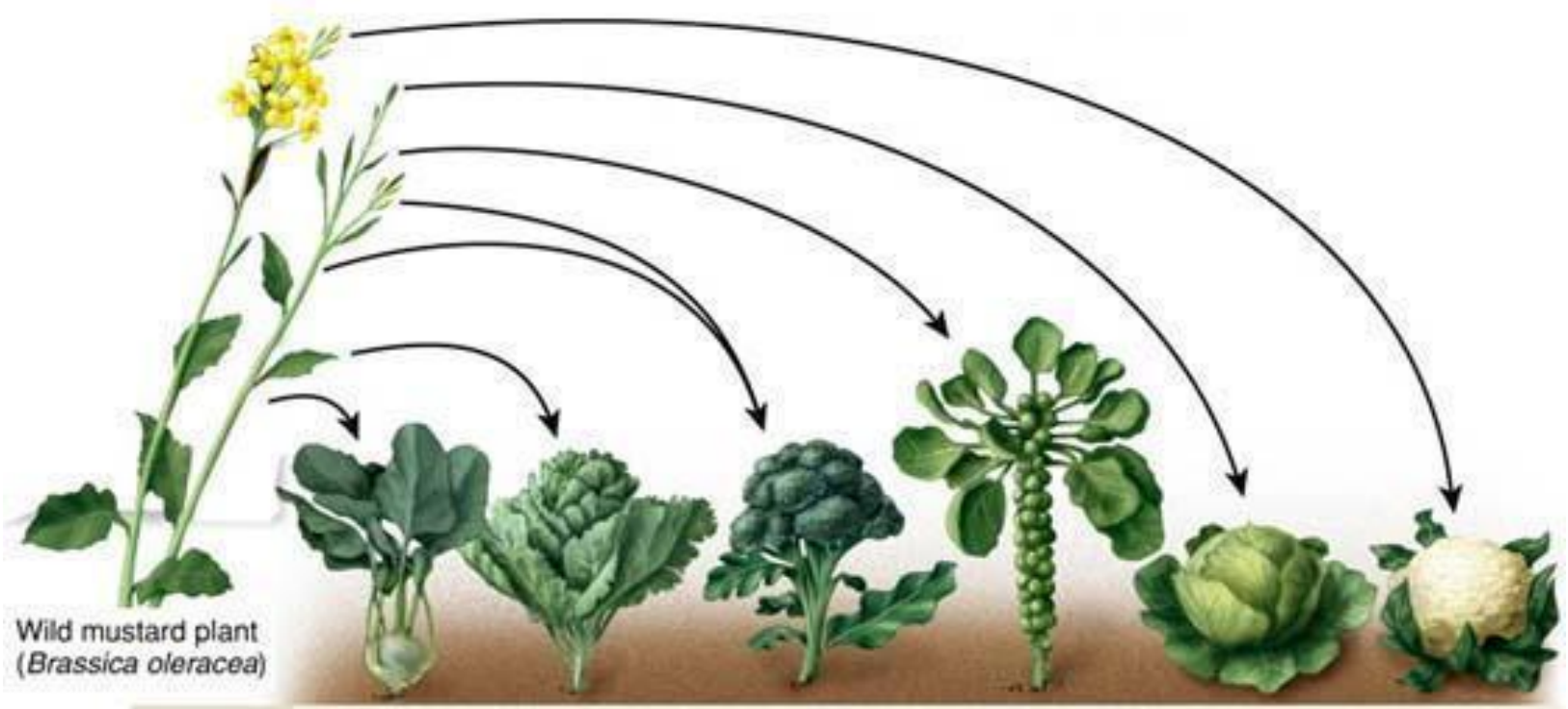
Write the word *adaptation* on the board and ask students to write it in their journals. Share examples of plant adaptations to specific habitats. For example, native plants in the carrot family are adapted to poor soils and low moisture in a desert environment. They obtain water and nutrients from their tap root that extends deep into the soils.

Write the words *artificial versus natural selection* on board and ask students to write it in their journals. *Artificial selection* occurs when adaptations are imposed by human actions. *Natural selection* occurs when adaptations are imposed by natural conditions. Discuss what this means based on the brassica picture below, food we eat from the garden, and food we harvest from the wild.

Reflection
Have students reflect on how humans use different parts of plants and how humans have created new foods through artificial selection.

Work Projects
Spend time in the garden working on various projects.

Harvest
Let kids eat a snack from the garden that includes one fruit, one vegetable, and one root.



Strain	Kohlrabi	Kale	Broccoli	Brussels sprouts	Cabbage	Cauliflower
Modified trait	Stem	Leaves	Flower buds and stem	Lateral leaf buds	Terminal leaf bud	Flower buds

5th Grade: Lesson 3
Orographic lift/Rain Shadow Effect

Learning objectives: Students will understand why it is dryer east of the Cascade Mountain range than west. Students will make connections between the water cycle, geology, and life in the garden.

State Standards: 5-ESS2 Earth's Systems (5-ESS2-1)

Materials Needed

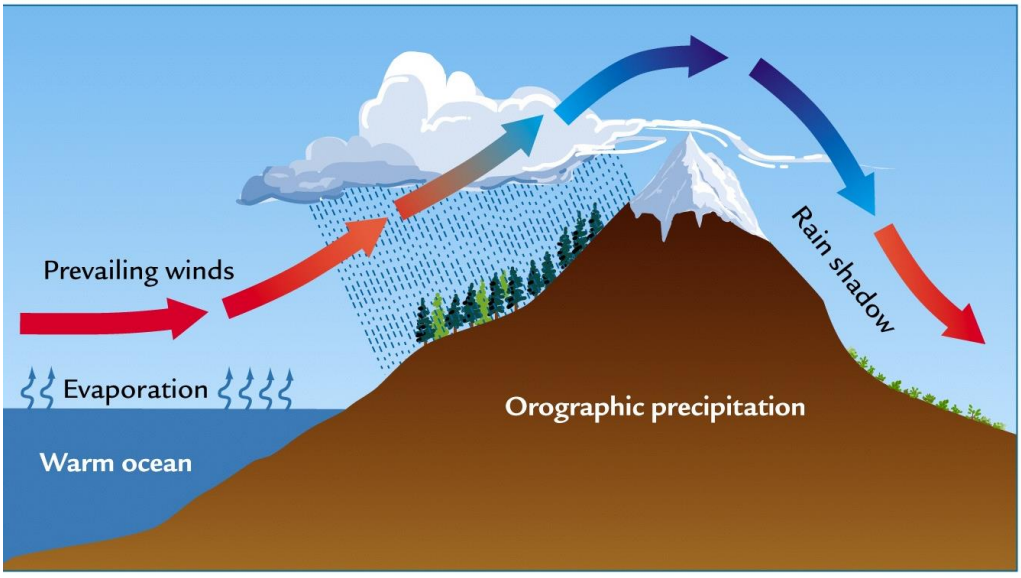
- Rocks
- Sponge
- Bucket of water

Weather Worksheet: Record date, time, temperature, and weather observations.

Question of the Day: Why does it rain so much in Seattle but not here in Eastern Washington? Have students respond with theories or ideas.

<u>Activity 1: Make a Model of Orographic Lift</u>

- With rocks already collected ahead of time, have students build a model mountain range going from north to south to represent the Cascade Mountain range.
- Once the range is built show the locations of California, Canada, the Pacific Ocean, and Seattle. Then, point and mark where the school is on the model.
- With a bucket of water and a sponge, explain the bucket is the ocean and the sponge represents the clouds. Explain that most clouds form through evaporation over large bodies of water such as the ocean (dunk the sponge in the bucket of water).



- When clouds move from west to east (because of jet streams) they often drizzle over the land and the communities near the shore.
- However, when clouds reach the mountains, they are forced into colder air causing the water vapor to condense, which results in precipitation. Demonstrate this by squeezing the sponge hard as it travels up and over the rocks.
- When the clouds reach the east side of the Cascades and travel down to warmer temperatures, most of the water is gone. This is known as orographic lift or the rain shadow effect. Demonstrate this a few more times with students moving the sponge from the ocean over the mountains.

Annual Precipitation Facts in Washington:

- Seattle- 37 inches per year
- Marblemount- 76 inches per year
- Mazama- 22 inches per year
- Winthrop- 14.76 inches per year
- Grand Coulee- 10.79 inches per year

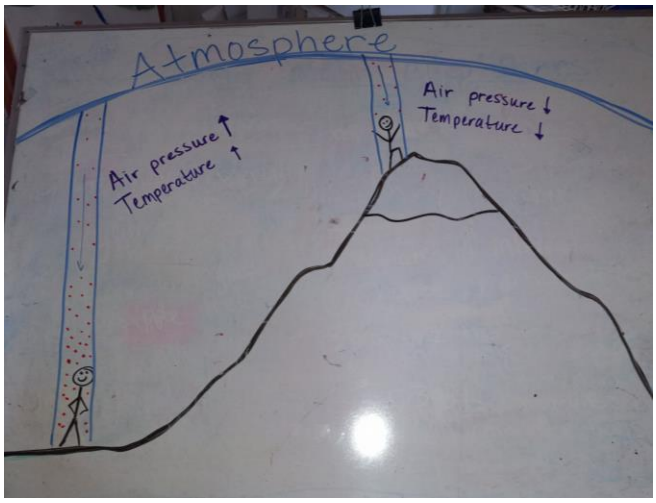
https://www.usclimatedata.com/climate/winthrop/washington/united-states/uswa0497

Activity 2: Why is it Colder in the Mountains?

Orographic lift is the condition where clouds are forced to rise over mountains, entering colder temperatures, precipitating. So, why is it colder in the mountains? Let the students speculate, then draw a mountain on the whiteboard with one person in the valley and one on the summit.

Ask the students, "What is heat?". Air molecules are always traveling and when they collide heat is produced. Have students travel randomly inside a designated space and when they collide, they say "heat". Ask the students, "If we expand the boundaries, will more or less heat be generated as you move around the larger space?".

Bring the students back to the whiteboard and draw a column of "pressure" over each person. Even though we may not feel it, the atmosphere is pushing down on the earth, a force called air pressure. Discuss these questions with the students: "Is there more or less air pressure at higher elevation?" and "How would differing air pressure impact the molecules?".



At higher elevations, less air pressure means the molecules are more spread out, causing the molecules to collide less often and generate less heat.

*Fun fact: at sea level, the amount of atmosphere pushing down on a person "weighs" as much as a car!

Reflection
How does orographic lift influence the way we grow our garden? Where does the water come from that we use? Where do the farms and orchards in our neighborhood get water?

Work Projects
Spend time in the garden working on various projects.

Harvest
Let all kids eat something from the garden environment.

5th Grade: Lesson 4
The Scientific Method

Learning objectives: Students will understand the scientific method for designing and implementing a new experiment. Students will make and test a hypothesis for how different soil types affect plant growth.

State Standards: 5-ESS2 Earth's Systems (5-ESS2-1); 5-ESS3 Earth and Human Activity (5-ESS3-1)

Materials Needed

- Scientific method cards (referenced at the end of this lesson)
- Soil percolation chart (referenced at the end of this lesson)
- Plastic water bottles
- Coffee filters
- 3 soil types
- Cups of water
- Rulers
- Stopwatch

Question of the Day: How can we use the scientific method in the garden?

Weather worksheet: Record date, time, temperature, and weather observations.

<u>Activity 1: Demonstrate the Scientific Method</u>

Ask the students what they think a scientist looks like? After hearing some responses, tell the students that a baby is a wonderful scientist. They are always observing and testing new things. Babies do the scientific method all the time without realizing it.

- Break the students into groups of nine students per group.
- Hand each group a set of nine cards all jumbled up. Have the kids order the cards in a logical order to make sense of the baby's scientific method. Here are the 9 steps:
    1. Look at that black and yellow flying thing. **Observation**
    2. Does it taste good? **Question**
    3. I think it will taste delicious. **Hypothesis**
    4. I am going to put it in my mouth. **Methods**
    5. I am going to reach out and grab it with my hands. **Gather Materials**
    6. Got it in my mouth. **Collect Data**
    7. Ouch. **Analyze Data**
    8. It is not tasty. **Conclusion**
    9. WAAAAA!!!! **Presentation**
- Write down the scientific method and talk about how scientists all over the world use this method to do science. This is not the only method to do science, but it is one that is universally recognized in the scientific community.

Activity 2: Soil Experiment

In the garden, classes can observe that plants grow differently and produce varying amounts of food in different soil types. This experiment will test which soil type (sandy, clay, or loam) grows the tallest plants. Teachers can provide the three types of soil or students can gather soil from different areas in or around the garden (compost pile, garden bed, forest, native ground, schoolyard).

Part 1:

Cut three water bottles in half and invert the top to create a funnel. Place a coffee filter in each funnel and fill each with a different type of soil, ensuring they are all three centimeters deep. Place each funnel over a cup. Measure 100 mL of water and pour it over the soil. Use a stopwatch to record how much time it takes for the water to finish percolating through the soil. Then, measure how much water is collected in the collection cup. Have students record the data.

Discuss the relationship between water permeability and nutrient retention. Pose the questions, "How do you think water percolating quickly or percolating slowly through the soil impacts the nutrients in the soil?" and "Do you think plants would rather have water drain through the soil slowly, quickly, or somewhere in the middle?".

Part 2:

After the students watch the soil demonstration, have them write a *hypothesis* in their journal about which soil type will produce the largest plant. Then, explain that the class will use the scientific method to create an experiment to test the hypothesis.

The general layout for the experiment should be planting three of the same type of plant in three containers with different soils. However, determine the exact *methods* of the experiment with the students. Describe the concept and importance of limiting variability in experiments. Ask them how they plan to address variability. Possible methods may be watering each plant the same, growing plants in the same beds or type of pot, and providing equal amounts of sunlight. *Gather the necessary materials* and set up the experiment. *Collect data* over the next few weeks as the plants grow.

Splitting into groups, ask students to *analyze their data*, make a *conclusion*, and *present* their work.

Work Projects

Spend time in the garden working on various projects.

Harvest

Let all kids eat something from the garden environment.

Look at that black and yellow flying thing.	**I wonder if it tastes good?**	**I think it will taste delicious.**
I am going to put it in my mouth.	**I am going to reach and grab it with my hands.**	**Got it in my mouth.**
OUCH!	**It is not tasty.**	**WAAAAAAA AAAA!!!!!!!!**

Soil Percolation Chart

	Soil #1 _____	Soil #2 _____	Soil #3 _____
Time for water to percolate (seconds)			
Starting amount of water	**100ml**	**100ml**	**100ml**
Ending amount of water			

6th Grade: Lesson 1
Germination and Plant Life Cycles

Learning objectives: Students will understand a life cycle and will be able to describe a plant's life cycle.

State Standards: MS-LS1 From Molecules to Organisms: Structures and Processes (MS-LS1-5); MS-LS2 Ecosystems: Interactions, Energy, and Dynamics (MS-LS2-3)

Materials needed

- White board & markers
- Notebooks
- Pencils and/or markers

Activity #3 Materials:

- Seeds- squash seeds work well since they are big and easy to observe
- Paper towel
- Small pots filled with soil

Weather Worksheet: Record date, time, temperature, and weather observations.

Question of the Day: What is the life cycle of a plant?

Introduction

What is a cycle? Allow students to share with the person next to them any examples of different cycles they are familiar with (e.g., water cycle, nutrient cycle, seasonal cycle). Next, ask students if they know of any life cycles. Allow a minute or two to brainstorm before introducing the question of the day.

Activity 1: "Be a Plant" Visualization

From "French Fries and the Food System" by Sara Coblyn

This is a great introduction to plant life cycles for a class that is willing to engage in a meditative activity. Invite students to find a comfortable position outside where they can hear you and, if they wish, close their eyes. Read the following meditation by Sara Coblyn. (5 min.)

> "Close your eyes and take three slow, deep breaths. With your eyes closed, continue breathing slowly, and feel what I read to you.
>
> You are a plant, rooted in the ground under you, reaching up into the air and light. You began in the soil as a seed. You sent out one long root straight down into the ground. From this root, you grew side roots, like an underground web. Your roots anchored you in place. They kept growing slowly, cell by cell, weaving through the tiny particles of the soil. On a warm day your small stem uncurled from under the surface of the soil and shot straight up. The sun shone down. Water came up

through your cells. Over the next few weeks, small, young leaves grew from your stem. The young leaves grew larger and branches grew off the stem and put out more leaves. Now you are a healthy plant with many leaves and small buds that are opening into flowers filled with pollen. Each morning as the light dawns dimly, you are simply standing here tall and cool. The early sun's rays touch you gently. The air warms gradually around you. The heat gains intensity as the sun rises higher, and you stand under it, not thinking, not waiting. A bee flies around you and finds your flower. It lands on a petal and crawls in to sip nectar. Its wings vibrate against the inside of your flower. Water is drawn into your roots and circulates through the channels of your stem and branches. and into your cells. It evaporates through the surface of your leaves. Feel the noonday sun on you and the water lifting from your leaves. As the day gets hotter, you close off your pores to keep from wilting. You are simply rooted there, not thinking, not waiting. The hot air moves around you. Small insects crawl over your leaves. Now a breeze blows gently. Your leaves flutter, and you bend slightly. A cloud comes over the sun, and the intense heat is interrupted. The breeze becomes a wind blowing steadily and pushing you with it. Then a summer rain starts falling. Drops tap your leaves. Feel the rain falling slowly and coolly. Now it gains strength, slapping at your leaves. It feels very wet and cold. You stand in it while it drenches you. The rain slows and then stops. The wind diminishes again to a gentle breeze. The sky clears, and late afternoon light spreads warmly over you. The cool rainwater dries off you. An earthworm curves slowly through the moist soil up near the base of your stem. Now the sun is going down. A shadow falls across you, and the air begins to cool around your leaves. You stand in the damp soil as the night comes on cool and quiet. Inside you, sugar is made in your leaves and moves slowly into the water in your cells, providing energy to your leaves and flowers. The earthworm returns to its hole, pulling a dead leaf into the ground past your roots. Insects fly past from time to time. The night continues. The darkness begins to lighten towards a new morning, and you are standing there, rooted, the air on you, not thinking, not waiting."

When the visualization is over, ask, "What other life stages of plants were not included?". Answers may include producing fruit, producing seed, dying, decomposing, being eaten.

Activity 2: In Search of the Life Cycle

Spring Seed Planting Variation:

- Introduce the life cycle of a plant by drawing pictures of each step on the white board. Encourage students to draw along in their notebooks as you describe each stage.
- Together as a class, describe each step from seed, germination, young plant, mature plant, flower/fruit, and back to seed.
- Have students spend 5-10 minutes in the garden looking for examples of each different stage of a plant's life cycle.
- While students are in the garden or beforehand, prepare seedling trays or containers with soil. When they come back, have them choose three seeds to plant into the soil.

Fall Seed Saving Variation:

- Begin the activity the same way as above, following steps 1-3. Instead of planting seeds, students will save seeds from plants in the garden.
- Walk around the garden as a class and have students find dried seeds from different plants in the garden: shuck beans from their pods, harvest dandelion-like lettuce seeds, shuck an ear of dried corn seed, cut open a cucumber or zucchini.
- After collecting, have students count how many seeds they found from just one fruit or vegetable

Activity 3: Germination Experiment

This is a good activity to take into the classroom as you explore what seeds need to germinate.

As a class, set up 4 sets of seeds to germinate.

1. 4 seeds on a paper towel set near a window
2. 4 seeds in pots set near a window
3. 4 seeds on a paper towel set in a dark place
4. 4 seeds in pots set in a dark place

Hypothesize: Ask the students what they think will happen. Will the seeds germinate/ sprout in the dark, or without soil? What do seeds need to grow?

Keep all the seeds moist and observe what happens in the following days. The students may be surprised to learn that seeds don't need light or soil to germinate!

Reflection

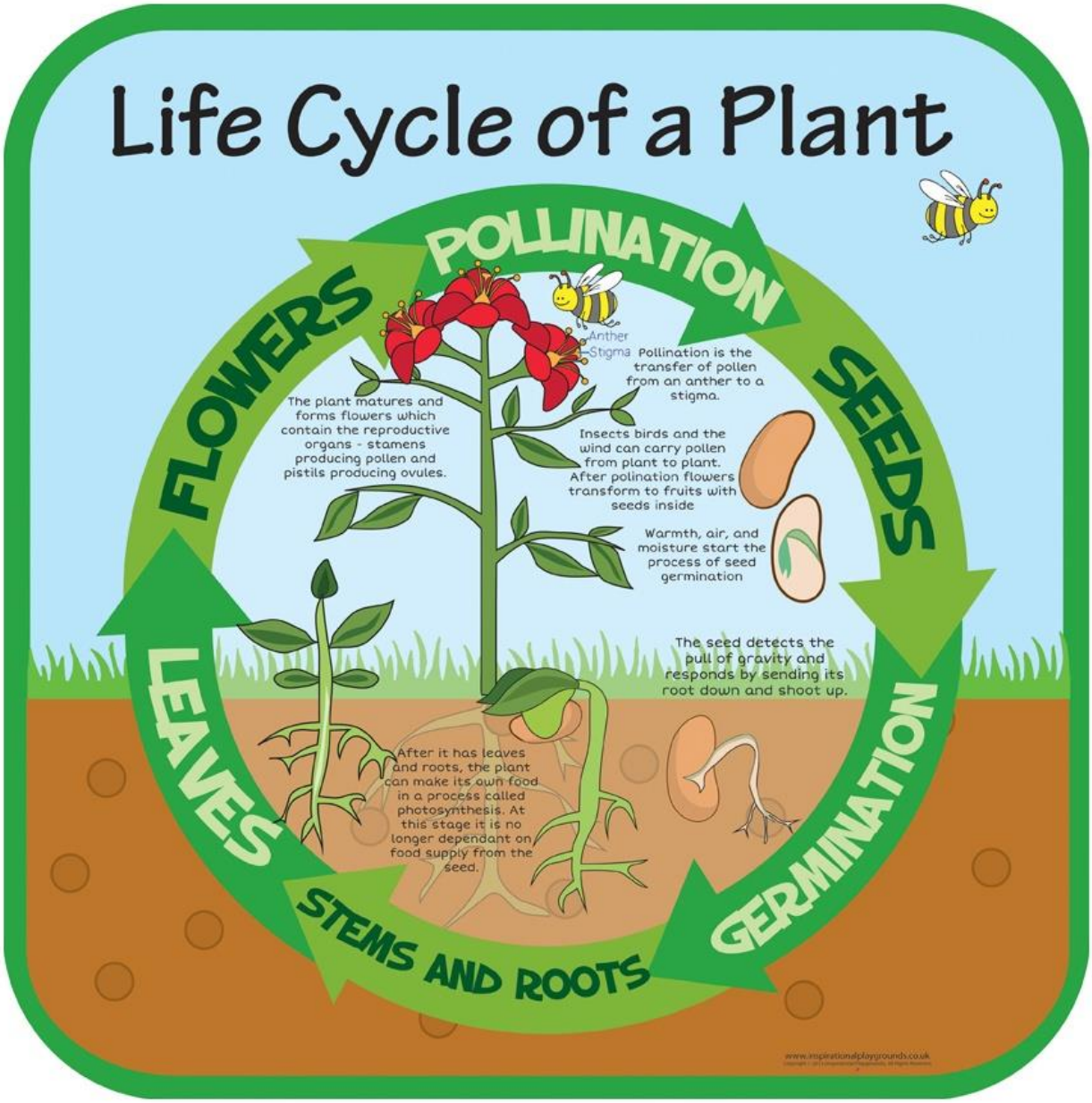
What are the main differences between plants and people? How do we each take care of our needs? Is germination the same as long term growth and health?

Work Projects

Spend time in the garden working on various projects.

Harvest

Let all kids eat something from the garden environment. Which part of the plant's life cycle is it in?


Life Cycle of a Plant
POLLINATION
SEEDS
GERMINATION
STEMS AND ROOTS
LEAVES
FLOWERS
Anther
Stigma
Pollination is the transfer of pollen from an anther to a stigma.
Insects birds and the wind can carry pollen from plant to plant. After polination flowers transform to fruits with seeds inside
Warmth, air, and moisture start the process of seed germination
The seed detects the pull of gravity and responds by sending its root down and shoot up.
After it has leaves and roots, the plant can make its own food in a process called photosynthesis. At this stage it is no longer dependant on food supply from the seed.
The plant matures and forms flowers which contain the reproductive organs - stamens producing pollen and pistils producing ovules.
www.inspirationalplaygrounds.co.uk

6th Grade: Lesson 2
Pests, Predators, Pollinators, and Recyclers

Learning objectives: Students will be able to identify different ecological functions of insects in the garden; predators, pollinators, recyclers. Students will understand the difference between a pest and a beneficial insect. Students will learn about insecticide and insecticide resistance

State Standards: 6-8 LS3B; 6-8 LS3C; 6-8 LS3D; MS-LS1 From Molecules to Organisms: Structures and Processes (MS-LS1-4, MS-LS1-5, MS-LS1-6); MS-LS2 Ecosystems: Interactions, Energy, and Dynamics (MS-LS2-1)

Materials Needed

- White board & markers
- Insect worksheet or notebooks
- Pencils and/or markers
- Magnifying lenses
- Clear containers for holding insects
- Beneficial insect worksheet (optional, referenced at the end of this lesson)

Weather Worksheet: Record date, time, temperature, and weather observations.

Question of the Day: How do various insects interact with the garden environment?

Introduction

Insects sometimes get a bad rep, but they are an important part of the ecosystem. As a class, define an ecosystem. On a whiteboard, list three of the roles of beneficial insects. Ask students for examples of each.

1. Pollinator - helps carry pollen from the male part of the flower (stamen) to the female part of the same or another flower (stigma). The movement of pollen must occur for the plant to become fertilized and produce fruits, seeds, and young plants
2. Recycler - Insects that feed on dead or dying plant tissues. There are many soil, and wood, inhabiting species that shred leaves or tunnel in dead wood. This helps plant materials to decay quickly. Over time, decay creates humus, a type of soil rich in organic matter.
3. Predator - Predatory insects eat many pest insects and are an important part of a natural control program for the garden.

<u>Activity 1: Insect Exploration</u>

Send students with notebooks and magnifying lenses to find an insect, either on their own or with a partner. If you want them to, have them gently and carefully collect their insect in a clear container (such as a plastic petri dish with a lid). Instruct them to draw the insect with as much detail as possible and use observations to hypothesize which role or roles the insect has in the ecosystem. Students can bring their insect or insects to show to the rest of the group at the end of the allotted time. Just be sure they bring the insects carefully back to

the place where they found them. Can they guess which role each of these insects play in the garden? Did any of the insects have multiple beneficial roles?

Activity 2: Pests!

Ask, "Are all insects beneficial?" One estimate says that only one tenth of one percent (0.1%) of insects could be considered serious pests. You may choose to point out that "pests" are not inherently good or bad, but they can make it hard for us to grow food!

Tell a story about the Colorado Potato Beetle:

"A farmer walks out into their potato field and sees a common sight: Colorado Potato Beetles (CPB) are munching away at the leaves. In the past she has seen how quickly these bugs will strip the entire field of leaves. She relies on this potato crop for income security, so she immediately goes to the store and buys an insecticide off the shelf. She returns to the farm, puts on her biohazard suit, and goes out to spray the potatoes. 90% of the CPBs are killed by this insecticide. She is satisfied, but only a short while later she goes out to the potatoes and again sees CPBs munching away. She goes back to the store, sprays the insecticide, but this time it doesn't kill the CPBs! Those original survivors have all reproduced. The survivors of the first round were resistant to the insecticide and now all their offspring are too! This calls for stronger insecticides… or does it?"

Colorado Potato Beetle Larvae

CPB adult and eggs

Reflection

What effect will the insecticide have on the other insects? The ecosystem? What would you do if you had an enormous potato field infested with CPB's? How does diversity in an ecosystem lead to resiliency? How does that same thinking apply to the garden?

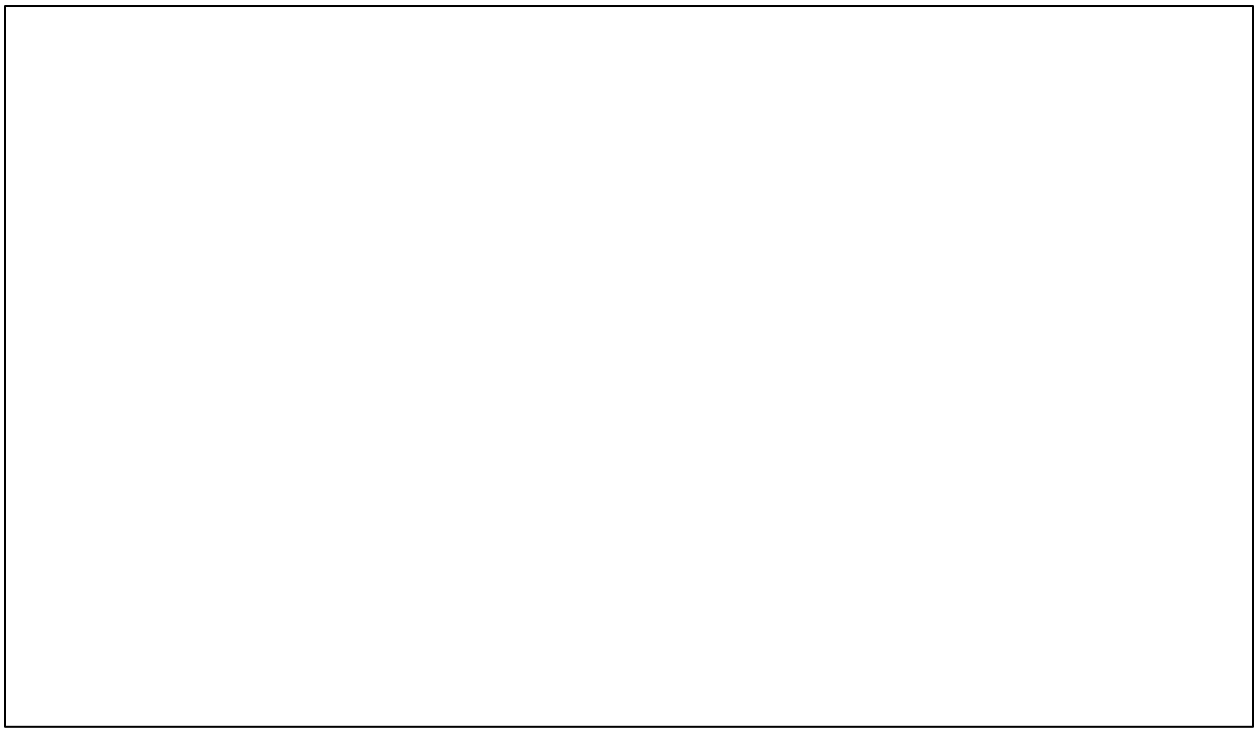
Work Projects

Spend time in the garden working on various projects. Look for any outbreak of beneficial or non-beneficial insects and discuss what to do with your garden coordinator or teacher.

Harvest

Let all kids eat something from the garden environment.

Beneficial Insect Worksheet



Find and draw an insect, include as many details as you can.

1.) What role does it have in the garden? Do you think it is a predator, pollinator, recycler, or all three?

2.) Why? What did you observe that helped you answer question #1?

6th Grade: Lesson 3
Water Journey

Learning objectives: Students will play a game that helps them learn where water exists on the Earth. Students will understand how water moves around the earth and be able to describe each step of the water cycle clearly.

State Standards: MS-LS2 Ecosystems: Interactions, Energy, and Dynamics (MS-LS2-3); MS-ESS2 Earth's Systems (MS-ESS2-4)

Materials Needed:
- 9 water station dice
- 9 water station cards
- Paper and pencils

Weather Worksheet: Record date, time, temperature, and weather observations.

Question of the Day: Where does water exist on earth and how does it travel?

Introduction
Briefly review the water cycle by asking 1 or 2 students to describe as many parts of the processes as they can remember.

<u>Activity: The Incredible Journey</u>
- Place the 9 station labels and dice in a wide circle. For the version with paper dice, each station has a specific die that always stays with that station.
- Tell students they are going to play a game in which they are individual water molecules moving through the water cycle.
- Every time they visit a station, write the name of that station, then roll the dice.
- If the die shows a new station, then move to a new station and write it down in your journal. If the die shows the same station, then the water molecule did not travel, and you stay at that station. Important: write the name of the station again. Students should write the name of a station with every roll.
- The game can last for either 15-20 rolls or approximately 5-10 minutes
- When finished, have the students look at their list. Can they describe how they moved between two places?
  Examples: Ocean —> Clouds = evaporation
  River —> Groundwater = pulled by gravity or filtered through soil.
- Challenge students to share their journey to the class, as a water droplet using as many details and vocabulary words as they can. Make it fun!

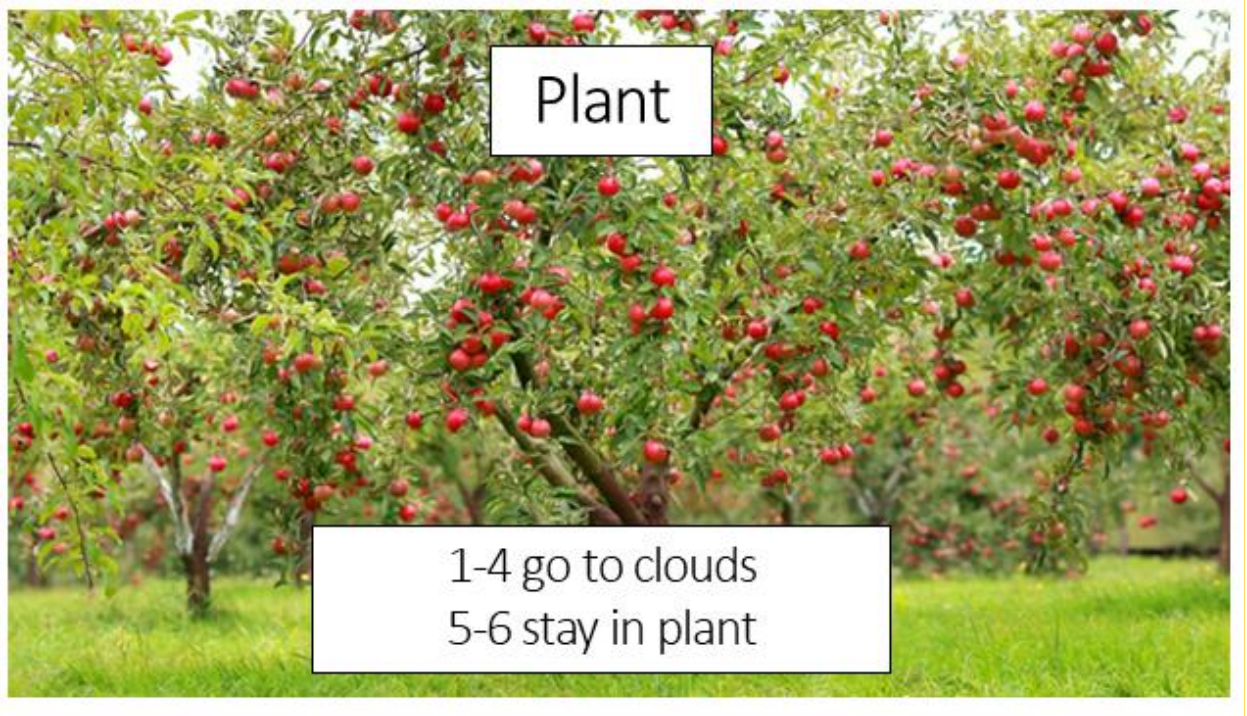
Reflection
How does water travel from each location (use water cycle vocabulary)? Does it make sense that water can stay in certain areas for long periods of time? Once a water droplet makes it to the ocean, how can it escape back to fresh water?

Work Projects
Spend time in the garden working on various projects.

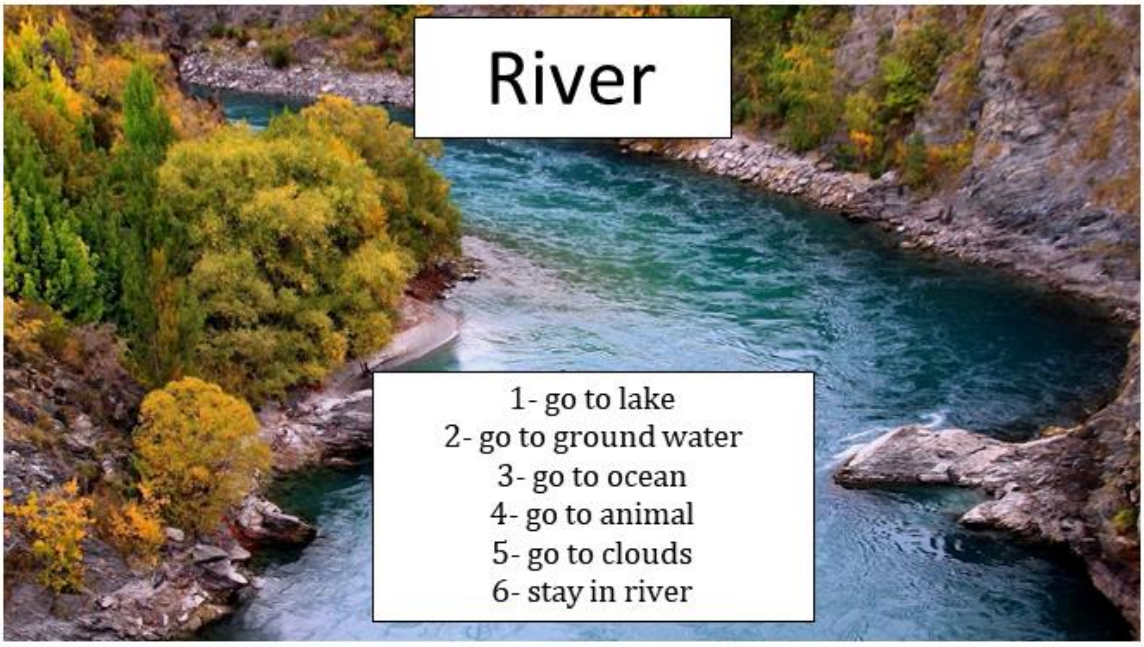
Harvest
Let all kids eat something from the garden environment while thinking about how water got to these fruits or vegetables.

Dice Templates
Download dice templates from Project WET's activity: The Incredible Journey for $5.00 or create your own template using theirs as a guide.
https://store.projectwet.org/incredible-journey-cubes.html

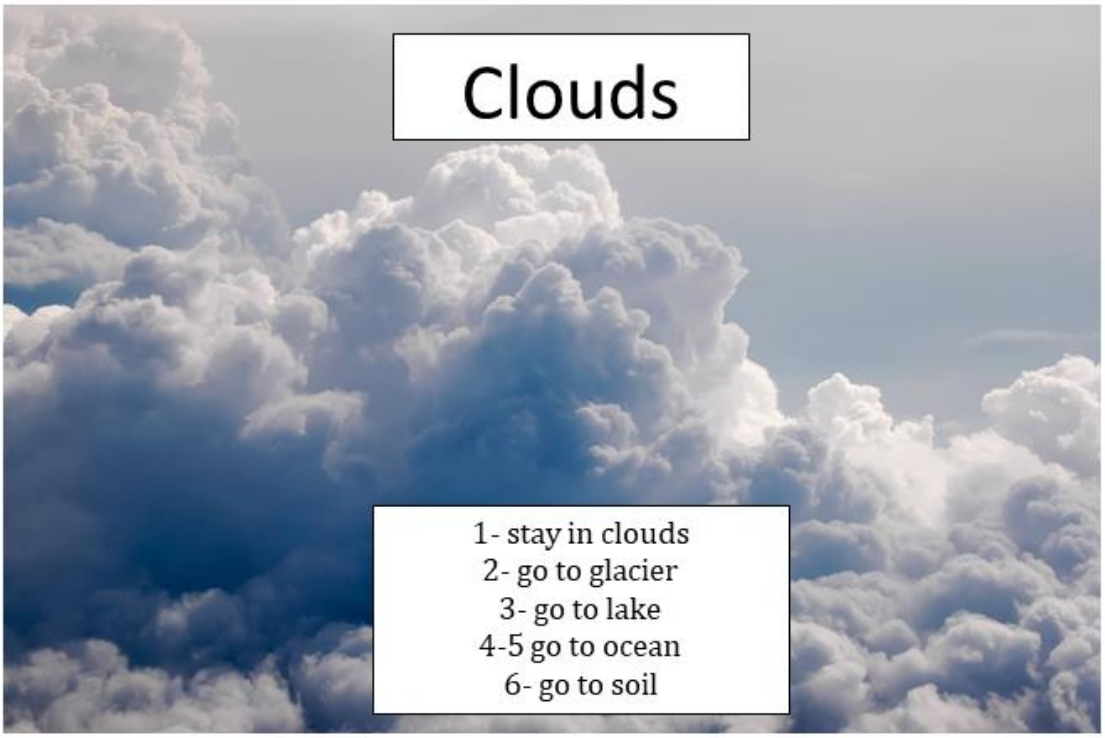
Station Cards

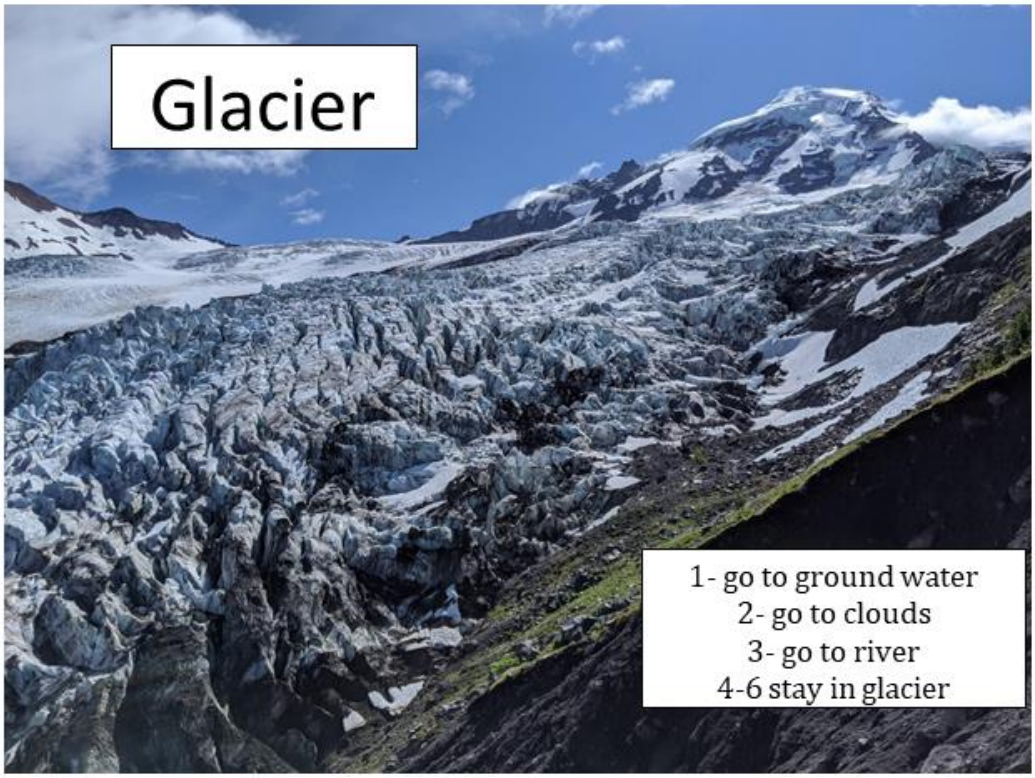


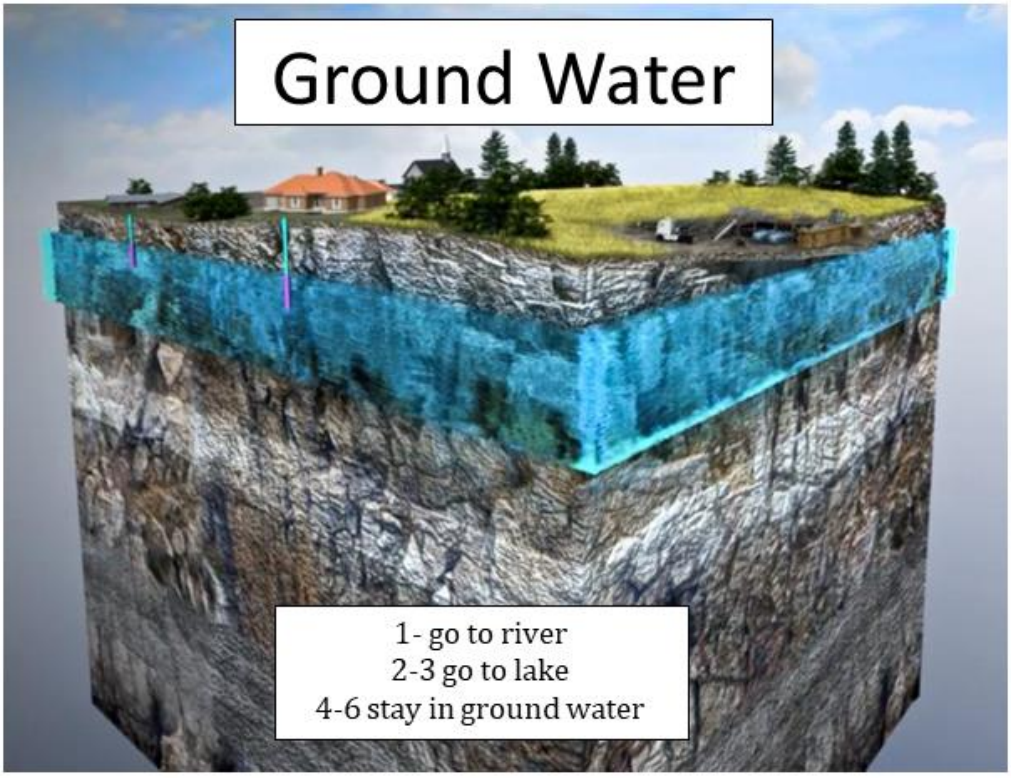

Ocean
1-4 stay in the ocean
5-6 go to clouds


River
1- go to lake
2- go to ground water
3- go to ocean
4- go to animal
5- go to clouds
6- stay in river

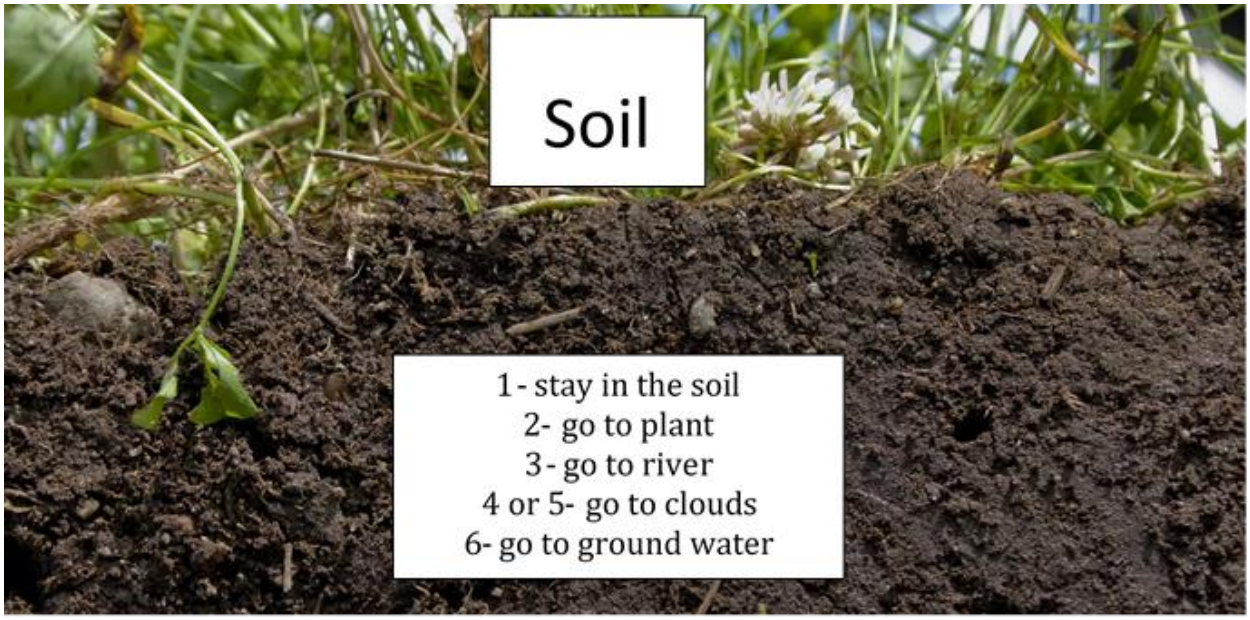

Animal
1-2 go to soil
3-5 go to clouds
6- stay in animal


Clouds
1- stay in clouds
2- go to glacier
3- go to lake
4-5 go to ocean
6- go to soil


Glacier
1- go to ground water
2- go to clouds
3- go to river
4-6 stay in glacier


Ground Water
1- go to river
2-3 go to lake
4-6 stay in ground water


Lake
1-2 stay in lake
3- go to ground water
4- go to animal
5- go to river
6- go to clouds


Soil
1- stay in the soil
2- go to plant
3- go to river
4 or 5- go to clouds
6- go to ground water

6th Grade: Lesson 4
Garden to River

Learning objectives: Students will understand how our practices in the garden impact the larger watershed. Students will learn about organic farming principles and their importance to ecological health.

State Standards: 6-8 LS2D; 6-8 LS2E; 6-8 SYSF; MS-ESS3 Earth and Human Activity (MS-ESS3-1, MS-ESS3-3, MS-ESS3-4)

Materials

- Paint trays
- Objects found in the garden
- Food coloring
- Sponges
- Watering can

Weather Worksheet: Record date, time, temperature, and weather observations.

Question of the Day: How do our gardening practices impact the watershed?

Introduction

Have everyone cup their hands together and ask, "If I sprayed water onto your hands, where would it go?". This is an example of a watershed. A watershed is an area of land that all drains to the same body of water. If available, show a map of your local watershed. The thumbs and pointer fingers are the mountain ridges and where the pinkies touch is the valley or river. Rain that falls within the watershed will run over your hands to join the river below.

<u>Activity 1: Create a Clean Watershed</u>

- This activity works best in groups of 5-8. Give each group a tray.
- Each group places their tray so water will flow into the bottom of the tray.
- Students have five minutes to create a town within their tray, using items found around the garden. The town should have:
    a. farms or gardens with animals, orchard trees, and vegetables
    b. houses,
    c. roads,
    d. schools,
    e. anything else they would like to have!
- Encourage students to name their towns.
- Go on a tour of the towns. Ask each group about their town. As they point out the roads, drop food coloring to represent pollution. Continue dropping food coloring on their town based on pollution sources. The animal farm may have a big cattle feedlot and the corn field may spray pesticides on their crops. Add food coloring to represent heaps of manure and pesticides.

- Pour “rain” from the watering can over the town. What happens?
- Call a city council meeting to discuss the poor water quality that has been killing the fish and making the water unhealthy for drinking and swimming. Students should suggest ways to help keep the watershed clean.
- After they have shared their ideas, hold up sponges and tell them that these sponges will represent plants. Plant roots hold soil in place, which slows the flow of water. Plants also absorb pollution. For example, sunflowers are known as “super absorbers”. For that reason, they have been planted at nuclear waste sites to speed up restoration.
- Give students the sponges to prepare their town for the next major storm. Where would they choose to plant trees or other plants if their goal is to keep the water clean?
- After five minutes, make it rain again to see if the plants help keep the water clean.
- Optional: place every tray next to the others, they all share a river. Pretend the town further upstream has been spraying thousands of gallons of insecticides. How will this impact everyone downstream? How will the other townspeople respond?

Note: If you do not have paint trays, you can use a table, a bucket, and a sheet of clear plastic. Students can put the table on a slight hill and create a watershed using a sunflower stock under the plastic to divert the rainwater into the bucket. The town can be built on top of the plastic.

Activity 2: Leaf-hopper Theater

- Present the challenge: the garden has become overtaken with leafhoppers! These little bugs are impossible to catch, and they multiply quickly. They feed on plants and spread a virus called “curly top” in many of the plant families in the garden. How should we address the take over?
- Have students think, pair, and share their ideas.
- Break into small groups of 2-4 students. Have students discuss ways to treat pests without chemicals. E.g., integrated pest management like beneficial insects that eat other insects (predators), companion planting, organic fertilizers, and compost to increase soil health.
- Ask students to come up with a skit or a song to explain how they would manage the garden issue. Bonus points for the inclusion of larger concepts like environmental impacts and key words such as “watershed”.

Reflection

How do farming practices impact the health of the watershed and ecosystem? How can cover-crops and planting trees alongside waterways protect the river?

Work Projects

Spend time in the garden working on various projects.

Harvest

Let all kids eat something from the garden environment.

Weather Worksheet

Date:_____ Time of Day:_____ Temperature:_____

Weather Observations

- _____
- _____
- _____

Notes and Drawings