Dear Educator,

Welcome to Imagination Station’s field trip resource! With the assistance of area K-12 educators, Imagination Station has created learning guides to help structure a field trip that aligns directly to the concepts you are teaching in the classroom.

Your Grow U Exhibit Guide contains:
- Introduction- suggestions for using the guide including key concepts
- Alignment to the state standards for Ohio and Michigan
- Chaperone Pages with tips for facilitating exhibit explorations with students
- Student Data Recording Pages to guide your students through exhibit-based explorations
- Extension Activities to do back in the classroom

How to Use This Guide:
- Review the guide.
- Customize the guide for your needs. You can have your students complete the entire guide or just a particular component, depending on your field trip objectives.
- Print off sufficient copies of the Student Data Recording Pages for each student.
- Print off copies of the Chaperone Pages for each of the chaperones. Divide your class into groups of 5-7 students and assign a chaperone to each group.
- Review the guide and your expectations with your students and prepare for a day of fun science learning at Imagination Station!
- Science Suggestion: Use this guide in combination with a science notebook so students can record observations and data throughout the day.
- Teacher Tip: Divide the guide into sections and have different groups complete different components. Each group can then report their findings to the class back at school.
Ohio Academic Content Standards

GRADE 6 ES:
Igneous, metamorphic and sedimentary rocks form in different ways.
Soil is unconsolidated material that contains nutrient matter and weathered rock.
Soil formation occurs at different rates and is based on environmental conditions, types of existing bedrock and rates of weathering. Soil forms in layers known as horizons. Soil horizons can be distinguished from one another based on properties that can be measured.
Rocks, minerals and soils have common and practical uses.
Nearly all manufactured material requires some kind of geologic resource. Most geologic resources are considered nonrenewable. Rocks, minerals and soil are examples of geologic resources that are nonrenewable.

GRADE 7 LS:
In any particular biome, the number, growth and survival of organisms and populations depend on biotic and abiotic factors.
Ecosystems are dynamic in nature; the number and types of species fluctuate over time. Disruptions, deliberate or inadvertent, to the physical (abiotic) or biological (biotic) components of an ecosystem impact the composition of an ecosystem.

GRADE 8 LS:
Reproduction is necessary for the continuation of every species.
Every organism alive today comes from a long line of ancestors who reproduced successfully every generation. Reproduction is the transfer of genetic information from one generation to the next. It can occur with mixing of genes from two individuals (sexual reproduction). It can occur with the transfer of genes from one individual to the next generation (asexual reproduction). The ability to reproduce defines living things.
The characteristics of an organism are a result of inherited traits received from parent(s).
Expression of all traits is determined by genes and environmental factors to varying degrees. Many genes influence more than one trait, and many traits are influenced by more than one gene.

INQUIRY 5-8
Identify questions that can be answered through scientific investigations;
• Design and conduct a scientific investigation;
• Use appropriate mathematics, tools and techniques to gather data and information;
• Analyze and interpret data;
• Develop descriptions, models, explanations and predictions;
• Think critically and logically to connect evidence and explanations;
• Recognize and analyze alternative explanations and predictions; and
• Communicate scientific procedures and explanations.
Michigan Curriculum Framework

Strand I. Constructing New Scientific Knowledge
Middle School
1. Generate scientific questions about the world based on observation.
2. Design and conduct scientific investigations.

Strand II.1 Reflecting on Scientific Knowledge
Middle School
5. Develop an awareness of and sensitivity to the natural world.

Strand III. Using Scientific Knowledge in Life Science
Middle School
Standard III.1 Cells
1. Demonstrate evidence that all parts of living things are made of cells.
2. Explain why and how selected specialized cells are needed by plants and animals.

Standard III.2 The Organization of Living Things
2. Describe the life cycle of a flowering plant.
3. Describe evidence that plants make and store food.

Standard III.3 Heredity
2. Describe how organisms acquire energy directly or indirectly from sunlight.
5. Explain how humans use and benefit from plant and animal materials.

Strand V. Using Scientific Knowledge in Earth Science
Middle School
Geosphere V.1
2. Explain how rocks are formed.
3. Explain how rocks are broken down, how soil is formed and how surface features change.
5. Explain how technology changes the surface of the earth.
Seed Germination

**Supplies:** (amount will vary by class size)
Various types of seeds  
Cotton balls  
Clear plastic gloves  
Water  
Permanent marker

**Procedure:**
1. Provide each student with a clear plastic glove and have them label the palm of the glove with their name and the fingers of the glove with the names of the seeds.
2. Students should then wet five cotton balls and wring out excess water.
3. Place 3 to 4 seeds on each cotton ball or dip the damp cotton ball in the seeds then place one in each finger of the glove.
4. Finally, have students puff some air into the glove, tie it off and tape their gloves to a window for warmth from the sun or place in a warm area of the room.
5. Check seed packets for germination period. Have students observe seeds for the appropriate time until germination is complete.
6. Once seeds have germinated, students should transplant them into soil and provide them with the things they need to grow into strong plants!
7. Make observations as the plant progresses through its various life cycle phases.

**What’s Happening:**
Germination is when a seed sprouts and begins to grow. It is important for students to know that germination starts right when a bud is present from the seed. Explain to your students that their sprout will need a while to grow and that every plant is different in the amount of time it takes for them to get to maturity. Ask them what their plant will need to grow. Most plants need water, light, proper temperature, time, soil (nutrients), oxygen and ample space to grow to full maturity, which is something you can show your students. A typical plant cycle includes sprout, growth, flower and fruit. The basic parts of the plant to point out are roots, leaves, stem, flower, seeds and fruit. Make sure to point out that not all plants have every part.

**Additional activities:**
- Have students keep a journal of the day to day changes with the plants.
- Experiment with different types of gloves.
- Do the seeds germinate at the same rate in the dark as they do in the light?
- Have students review information on the seed packet for growing habits of plants. What zone does Ohio fall in?
- Have students discuss the crops grown in Ohio today. How has transportation changed the variety of foods available to consumers?
- Keep records of the classroom and outdoor temperatures. Is there an optimum temperature for germination?
Web of Life

This activity will help your students to better understand the interdependence of different organisms in the environment and how the food we eat depends on other organisms in the food web.

**Supplies:** (amount will vary by class size)
Ball of string

**Procedure:**
1. Have everyone form a circle. Challenge your class to try to make the food web as long as possible. Encourage them to include organisms such as bacteria, insects and decomposers (cockroaches).
2. Start by having a student be the sun and wrap the end of a string loosely around their hand.
3. Have a second student name a type of plant that will benefit from the sun. The first student (the sun) tosses the the string to this student who then wraps the string loosely around their hand.
4. Have another student name a living organism that may benefit from the plant (ex: a mouse). The second student (the plant) tosses the ball of string to them and the third student wraps the string loosely around their hand.
5. Students continue naming living organisms and passing the string around the circle.

**Questions to Ask:**
- How many living organisms did you have in your web? Does the cycle ever get back to plants? How many cycles can you connect together?
- Together everyone makes a stable web. Have one student tug on their string. The tug represents something happening to that organism (ex: a tree is cut down, an animal goes extinct). Everyone that feels the tug would be affected by the absence of that organism. Can you name other ways the web may be affected? (temperature, deforestation, poaching, extinction, etc)

Have students try the activity again (always starting with the sun) and continue your web of life!
Soil Study

Supplies:
- Three clear, plastic 12oz bottles
- Potting soil
- Local soil
- Sand (coarse grained)
- Magnifying glasses
- Plastic trays
- Pencils

Preparation:
1. Fill three plastic bottles 2/3 full with each of the different types of soil.
2. Label the bottles so that you know what sample is contained in each.
3. Add water to the bottle, fill to near the top and cap. Shake the bottles and allow them to sit for 24 hours. Soils are best observed with as little disruption as possible, so place these bottles at stations a day in advance of your lesson. Students will record their observations in the “Samples in Water” section of their worksheet.
4. In addition, set up stations where students can observe the different soils on a plastic tray or container with a magnifying glass. Students will record their observations in the “Dry Samples” section of their worksheet.

Discussion:
Begin with a discussion. Ask your students:
- What do you find in soil?
  Write all responses for students to view. Possible responses include water, air, worms, rocks, clay, sand, bacteria, nutrients and insects.

- How would you categorize the different components of soil?
  This is a more difficult question. Guide your students to create two categories: inorganic and organic. Inorganic items include clay, silt and sand. These items will all be non-living. Organic materials can include both living and non-living items- bacteria, insects and wood chips.

- How does soil help plants grow?
  Responses could include supports root systems, provides nutrients for plants, holds water and controls temperature.
Soil Study page 2

Procedure:
Divide students into groups and ask them to observe the different soil samples at different stations. Have them record their observations on the worksheet provided.

What you should expect to see:
The potting soil will show a thick layer of dark material on the bottom, a thick layer of cloudy water and a thinner layer of organic material on the top.

The local soil will depend on the location it was extracted from. Typically, the layering will be similar to potting soil, but will likely have less organic material on the top.

The sand will form a thick layer on the bottom. There should be a thick layer of clear water and a very thin layer of organic material on the surface. The local soil and potting soil will have cloudier water because the clay present in these soil will remain suspended in the water. This is because clay has a finer grain than sand.

All soil is different depending on where it comes from. Some soils contain lots of rocks, sand and clay, although all soils will contain some organic material, known as humus. Humus is the remains of dead and decayed plant and animal material found in tiny and fragments. Humus is usually located near to the surface of the soil. When you shake up your mixture of soil and water the ingredients separate. Because the organic material (humus) doesn’t weigh as much as the inorganic materials (rocks, sand, clay) the humus floats.

Conclusion:
Ask students: What properties of soil are important to support plant growth?

- Soil must be firm enough to support plant growth
- Soil must contain essential plant nutrients
- Soil must contain both organic and inorganic materials
- Soil allows water to percolate through it
- Soil contains space between the particles for air
Properties of Soil

**Samples in Water:** Observe the different types of soil. What differences do you observe between them?

<table>
<thead>
<tr>
<th>Type of Soil</th>
<th>Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potting Soil</td>
<td></td>
</tr>
<tr>
<td>Local Soil</td>
<td></td>
</tr>
<tr>
<td>Sand</td>
<td></td>
</tr>
</tbody>
</table>

**Dry Samples:** Observe the different types of soil. What differences do you observe between them? List the organic and inorganic materials you observe in the different types of soils.

<table>
<thead>
<tr>
<th>Type of Soil</th>
<th>Observations</th>
<th>Organic Material</th>
<th>Inorganic Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potting Soil</td>
<td></td>
<td></td>
<td></td>
</tr>
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</tr>
</tbody>
</table>
Which of the samples appears to be the best environment to grow plants? Why?

______________________________________________________________________________
______________________________________________________________________________

What properties of soil are important for plant growth?

______________________________________________________________________________
______________________________________________________________________________
Farm 101: know it to grow it

One thing I knew about agriculture and plants before playing the game show:
_______________________________________________________________________________

One thing I learned from playing the game show:
_______________________________________________________________________________

One thing that I would like to learn more about after playing the game show:
_______________________________________________________________________________

Be A Bee Scientist

Observe the bees in the hive. Where do you see most of the bees? Select a bee in the hive to observe. This can be tough work as they are moving around quickly! What do you see this bee doing?

Bees are diurnal which means they are awake during the day and asleep at night. Since Imagination Station is open during the day, you are seeing the bees when they are most active. You may notice a bee doing the waggle or round dance, worker bees feeding drones, bees cleaning the hive, bees with pollen on their legs from a recent trip to a flower or other bees tending to the queen.

Record your observations below.

<table>
<thead>
<tr>
<th>Date:</th>
<th>Time:</th>
<th>Approximate temperature:</th>
</tr>
</thead>
</table>

What do you see?
_______________________________________________________________________________

On the wall, you will find information about the roles of different types of bees in the colony. Based what you learned, what type of bee do you think you are observing?
_______________________________________________________________________________

Do you think that the temperature and time of day have any effect on the bees? Why or why not?
_______________________________________________________________________________

What role do bees play in pollination? Look at the signs for help!
_______________________________________________________________________________
Water Drainage

Turn the wheel and observe how water passes through the different types of soil.

When the water passes through the clay soil, I notice…

_______________________________________________________________________________

When the water passes through the silty soil, I notice…

_______________________________________________________________________________

When the water passes through the sandy soil, I notice…

_______________________________________________________________________________

A farmer has three different crops that she needs to plant. Over many acres of land, different types of soil conditions exist. Based on your observations, make recommendations about where the farmer should plant the crops.

Crops to plant:
Cabbage - heartier plant; does well in variable soils; needs moist environment
Carrots - most root vegetables do well with soil that drains quickly; these plants can tolerate a drier soil
Tomatoes - needs a soft soil to support their root system; soil needs to retain moisture

Area of Farm:
primarily clay soil
very sandy
mixture of sand, silt and clay (also known as loamy soil)

<table>
<thead>
<tr>
<th>Area of Farm</th>
<th>Type of Crop to Plant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northern</td>
<td>______________________</td>
</tr>
<tr>
<td>Southern</td>
<td>______________________</td>
</tr>
<tr>
<td>Eastern</td>
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Soil types on the Farm
Dear Chaperone,

We’re glad you’re here! Thank you for volunteering to be a chaperone on your school’s visit to Imagination Station. This page explains field trip procedures and offers tips on how to facilitate an Imagination Station Exhibit Guide.

Imagination Station requires students and chaperones to remain together at all times. Group size should be seven students or less per one adult.

Student Names:
1. 
2. 
3. 
4. 
5. 
6. 
7. 

Schedule for the day:
Lunch Time:
Demonstration Time(s):
Departure Time:

Imagination Station Exhibit Guides:
- Students should fill out their Data Recording pages while at the science center. It should take about one hour to complete the activities.
- Have fun! A field trip is a great chance to interact with young people and see the wonder of science through their eyes.
- Ask open-ended questions that will elicit more than ‘yes’ or ‘no’ responses. Ask questions that begin “Tell me about...”, “What...” or “Why do you think...”.
- Encourage exploration! Students may ask “What will happen if...”. Encourage them to experiment and find out!
- Don’t worry about completing the guide in order! You can visit the different exhibits in a manner that is most convenient for your group.
Be A Bee Scientist

Observe the bees in the hive. Where do you see most of the bees? Select a bee in the hive to observe. This can be tough work as they are moving around quickly! What do you see this bee doing?

Bees are diurnal which means they are awake during the day and asleep at night. Since Imagination Station is open during the day, you are seeing the bees when they are most active. You may notice a bee doing the waggle or round dance, worker bees feeding drones, bees cleaning the hive, bees with pollen on their legs from a recent trip to a flower or other bees tending to the queen.

Record your observations below.

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What do you see?
Students will observe a variety of different things. Some may notice a bee doing the waggle or round dance, worker bees feeding drones, some bees will clean the hive, others will have pollen on their legs from a recent trip to a flower, while others will tend to the queen. It is unlikely that you will be able to view the queen as her hive keeps her well protected, however, she is larger than the other bees.

On the wall, you will find information about the roles of different types of bees in the colony. Based what you learned, what type of bee do you think you are observing?

**Workers:** These small female bees do it all—make honey, clean the hive, feed the larvae (baby bees) and build the wax cells where the bees live. There are 10,000 to 60,000 worker bees per colony.

**Drones:** These male bees usually number around 100 per colony. Their primary job is to mate with the queen. Drones can be so lazy that worker bees oftentimes have to feed them!

**The Queen:** Only one queen can rule a colony and her main responsibility is to lay eggs...lots of eggs! During the summer months, a queen will lay up to 1,500 eggs per day. Queens usually live around 4 years and can produce over one million eggs in that time.

Do you think the temperature and time of day have any effect on the bees? Why or why not?
Bees prefer temperatures above 54°F. During the winter months, worker bees stay in the hive and huddle around the queen. The bees vibrate against each other for warmth. Once temperatures are above 54°F, worker bees will leave the hive in search of food. Bees are typically diurnal which means they are awake during the day and asleep at night. Most likely students are observing the bees at their most active time of day.

What role do bees play in pollination? Look at the signs in the exhibit for help!
Some estimates indicate that without honeybees, farmers would produce a third less produce than they do! Pollen sticks to bees as they move from one plant blossom to another. As a bee travels from plant to plant, so does the pollen resulting in cross-pollination.
Water Drainage

Turn the wheel and observe how water passes through the different types of soil.

When the water passes through the clay soil, I notice…
Clay drains the slowest because it has the smallest particles and they are packed tightly together.

When the water passes through the silty soil, I notice…
Silt drains faster than clay, but slower than sand. This prevents the soil from drying out but also allows air to circulate through the soil.

When the water passes through the sandy soil, I notice…
Sand drains the faster than silt and clay because the particles are large and loosely packed. This type of soil dries out easily.

A farmer has three different crops that she needs to plant. Over her many acres of land, different types of soil conditions exist. Based on your observations, make recommendations about where the farmer should plant the crops.

Crops to plant:
Cabbage- heartier plant; does well in variable soils; needs moist environment
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