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
- 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.

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Ohio Academic Content Standards

Grade 3:
Earth and Space Sciences
4. Observe and describe the composition of soil (e.g., small pieces of rock and decomposed pieces of plants and animals, and products of plants and animals).

Grade 6:
Life Sciences
3. Identify how plant cells differ from animal cells (e.g., cell wall and chloroplasts).

Science and Technology
1. Explain how technology influences the quality of life.

Grade 7:
Life Sciences
7. Explain that photosynthetic cells convert solar energy into chemical energy that is used to carry on life functions or is transferred to consumers and used to carry on their life functions.

Scientific Inquiry
3. Formulate and identify questions to guide scientific investigations that connect to science concepts and can be answered through scientific investigations.

Grade 8:
Science and Technology
1. Examine how science and technology have advanced through the contributions of many different people, cultures and times in history.

Scientific Inquiry
3. Read, construct and interpret data in various forms produced by self and others in both written and oral form (e.g., tables, charts, maps, graphs, diagrams and symbols).
Soil Study

Supplies:
Three clear, plastic 12oz bottle
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 of 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.
4. In addition, set up stations where students can observe the different soils on a plastic tray or container with a magnifying glass.

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 support for root systems, provide nutrients for plants, hold water and control 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 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 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.

Some important points to note about soil:
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>
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<tbody>
<tr>
<td>Potting soil</td>
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<tr>
<td>Local soil</td>
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<td>Sand</td>
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Dry Samples: Observe the different types of soil. What differences do you observe between them?

<table>
<thead>
<tr>
<th>Potting soil Observations</th>
<th>Organic Material</th>
<th>Inorganic Material</th>
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<tbody>
<tr>
<td>Local soil Observations</td>
<td>Organic Material</td>
<td>Inorganic Material</td>
</tr>
<tr>
<td>Sand Observations</td>
<td>Organic Material</td>
<td>Inorganic Material</td>
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</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. Some may notice a bee doing the waggle or round dance, worker bees feeding drones, some bees cleaning the hive, others with pollen on their legs from a recent trip to a flower, while others will tend to the queen.

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<table>
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<tr>
<th>What do you see?</th>
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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 the time of day had 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)

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<thead>
<tr>
<th>Area of Farm</th>
<th>Type of Crop to Plant</th>
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<tr>
<td>Northern</td>
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<td>Southern</td>
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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.
**Attractions**

**High Wire Cycle** - This thrill ride hovers over 18 feet above the ground, suspended on a 1 inch cable with a 275 pound counterweight that enables any person to defy gravity.
- You must be 54” to ride.

**BOYO** - Using science similar to that of the classic yo-yo, a rider is propelled up to 13 feet in the air using his or her own strength and some basic science principles.
- You must be 54” to ride.

**Simulator Theater** - It'll bounce you forward and backward, sideways, up and down. The virtual reality video makes your stomach drop and takes your breath away.
- Tokens: $1/Members ride FREE!
- You must be 42” to ride.

**Demonstrations**

**Extreme Science Theater**
Interactive Demonstrations with an exciting EXTREME twist.

**Learning Worlds**

**Eat It Up!** - Eat Smart. Play Hard. Have Fun. The choice is yours!

**Energy Factory** - Get a glimpse into the abstract world of oil refining and solar energy.

**Engineer It!** - Think it. Build it. Test it. There’s no right or wrong, just a lot of open-ended discovery.

**Flex Space** - This ever-changing space will feature some traveling exhibitions and some great experiences that we've created.

**Grow U** - Let Mother Nature and Tork be your guide as you take on FARM 101: know it to grow it.

**Little KIDSPACE™** - Our littlest adventurers (kindergarten and under) can hop aboard our fire truck, shop in the grocery store or climb on our favorite treehouse.

**Mind Zone** - Home to the Gravity Room, discover how the mind processes, interprets and creates illusions and perceptions.

**Science Studio** - Featuring hands-on activities for kids of all ages.

**Water Works** - Discover the slippery science of water and exploring nature's most powerful resource.

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**Information**
Lost Persons/First Aid
Wheelchair Accessible
Elevator
Demonstration
Restaurant/Vending
Food & beverages permitted only in Atomic/H2O Cafe.
Men's & Women's Restroom
Family Restroom
Special needs accessible & baby changing facilities.

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**Imagination Station**
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: 
Responses will vary for students. Encourage your group to try to answer their questions using the other exhibits in Grow U or researching the question when they return to school or at home.

Be A Bee Scientist

Much of what we know about the animal kingdom has been learned from observation. Oftentimes, scientists will tag bees and track their movements and behavior over time. Where do you see most of the bees? Select a bee in the hive to observe, What do you see this bee doing? Record your observations.

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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 will feed 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 had 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.

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
Carrots- most root vegetables do well with soil that drains quickly; these plants can tolerate a drier soil
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Soil types on the Farm

Northern

Eastern

Southern

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