Weather
Exhibit Guide
Grades 4-8
Dear Educator,

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

Students will explore weather with three Imagination Station exhibits: The Hurricane Chamber, the Tornado and the Cloud Machine.

**Your Weather Exhibit Guide contains:**
- Introduction- suggestions for using the guide with key concepts included
- State Standards Alignment for both Ohio and Michigan
- Chaperone Page(s)- tips for facilitating exhibit explorations with students
- Student Data Recording Pages that guide your students through exhibit-based explorations
- Post-Visit Activity 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 Page 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.

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Ohio Academic Content Standards

Grade 4:
Earth Systems:
1. Explain that air surrounds us, takes up space, moves around us as wind, and may be measured using barometric pressure.
2. Identify how water exists in the air in different forms (e.g. in clouds, fog, rain, snow and hail).
3. Investigate how water changes from one state to another (e.g. freezing, melting, condensation and evaporation).
4. Describe weather by measurable quantities such as temperature, wind direction, wind speed, precipitation and barometric pressure.

Doing Science Inquiry:
2. Analyze a series of events and/or simple daily or seasonal cycles, describe the patterns and infer the next likely occurrence.
3. Develop, design and conduct safe, simple investigations or experiments to answer questions.

Nature of Science:
2. Record the results and data from an investigation and make a reasonable explanation.

Grade 5:
Doing Science Inquiry:
3. Use evidence and observations to explain and communicate the results of investigations.

Grade 7:
8. Describe how temperature and precipitation determine climatic zones (biomes) (e.g. desert, grassland, forests, tundra and alpine).
9. Describe the connection between the water cycle and weather-related phenomenon (e.g. tornadoes, floods, droughts and hurricanes).

Doing Scientific Inquiry:
3. Formulate and identify questions to guide scientific investigations that connect to science concepts and can be answered through scientific investigations.
7. Use graphs, tables and charts to study physical phenomena and infer mathematical relationships between variables (e.g. speed and density).

Grade 8:
Doing Science 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).

Michigan Curriculum Framework

Middle School
Strand I. Constructing New Scientific Knowledge
Standard I. 1 Constructing New Scientific Knowledge

Strand IV. Using Scientific Knowledge in Physical Science
Standard IV.2. Changes in Matter
1. Describe common physical changes in materials: evaporation, condensation, thermal expansion and contraction.
Standard IV.3 Motion of Objects
1. Qualitatively describe and compare motions in three dimensions.

Strand V. Using Scientific Knowledge in Earth and Space Sciences
Standards V.2 Hydrosphere
1. Describe various forms that water takes on the earth's surface and conditions under which they exist.
Standard V.3 Atmosphere and Weather
1. Describe the composition and characteristics of the atmosphere.
2. Describe patterns of changing weather and how they are measured.
3. Explain the water cycle and its relationship to weather patterns.
Weather

Grades 4-8

Stroboscope
Create your own stroboscope to observe the effects of gravity on water drops. You can construct your own stroboscope to ‘freeze’ moving water.

Materials:
Heavy stock paper
Pencil with an eraser
Pushpin
Flashlight (battery powered)
Access to sink and cold water faucet

Procedure:
1. Using heavy paper, copy and cut out the disk using the template provided on the next page.
2. Insert a pushpin through the middle of the disk and push the pin into the center of the pencil eraser. Make sure your disk will spin easily.
3. Divide students into groups.
4. Giving each group a turn at the water faucet, start a slow steady stream of water droplets from the faucet. Aim the beam of the flashlight at the droplets. While one student adjusts the flashlight beam to get the correct angle, another practices spinning the slotted disk with a constant and continuous motion. Once a uniform speed is maintained, close one eye and peer through the rotating slotted rim.
5. It may take a few minutes to be able to get your stroboscope working for you. In order to ‘freeze’ the drops, you must spin the disk at a speed that is in sync with the falling droplets. Try changing the rate that your faucet is dripping or the rotational speed of the disk until you observe the ‘frozen’ droplets.

What’s the Science:
The actual shape of a water droplet (when gravity is not acting upon it) is round, not a teardrop, due to surface tension. When we watch water drip from the faucet, the water appears to form an elongated shape as gravity pulls it toward the sink basin. Surface tension causes the top to stick to the faucet as long as possible. The pull of gravity combined with the drop’s surface tension with the faucet gives the drop its long shape.

A stroboscopic disc can create the illusion of frozen motion. It does this by offering a quick ‘gated’ look at the moving scene. If the gate is timed correctly, you can see the same part of the event (but with a new subject) again and again.
Stroboscope
# Hurricane Chamber

What activity did you do in the Hurricane Chamber? _________________________________________

<table>
<thead>
<tr>
<th></th>
<th>Type of Wind</th>
<th>Wind Speed</th>
<th>Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trial 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trial 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trial 3</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Back in the Classroom:**

1. Hurricanes gather energy from the warm ocean waters at the equator. Why do you think hurricanes slow down and lose energy when they reach land? _________________________________________

2. How do meteorologists measure wind speed? _________________________________________

3. Why do hurricanes tend to occur most often at the equator? ____________________________

4. What is the Coriolis Effect? How does it help meteorologists to predict where a hurricane will travel? _________________________________________

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Tornado

1. Observe the movement of air in the tornado exhibit. Draw a picture of that air movement. Make sure to draw arrows indicating the direction that the air is moving.

2. What do you notice when you blow on the tornado? What happens to the movement of air?

3. What happens when you cover the holes at the base of the tornado exhibit? What happens to the movement of air?

4. Look carefully at how the air is moving in the center of the tornado and at the outer rim. Compare the speed of air movement you have observed.

Back in the Classroom:

1. The Tornado Exhibit at the Imagination Station uses a machine that creates fog to help you see the funnel of air. During a real tornado, you can also see the movement of air. Why do you think this is?

2. Find out about the Fujita Scale that rates the strength of a tornado. According to the scale what category of tornado would cause a car to overturn?

3. What is an updraft? Why do you think that type of air movement is especially dangerous for things like animals and small buildings on the ground?
Cloud Machine

Try the three activities below with the Cloud Machine. Write in the box about how your hands felt after each activity. Good descriptions include hot or cold, wet or dry.

<table>
<thead>
<tr>
<th>What I Did</th>
<th>How it Felt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trial 1: When I put my hand in the cloud for 30 seconds, it felt…</td>
<td></td>
</tr>
<tr>
<td>Trial 2: When I put my hand in the cloud for 60 seconds, it felt…</td>
<td></td>
</tr>
<tr>
<td>Trial 3: After Trial 2, if I hold my hand in the air for 30 seconds, it felt…</td>
<td></td>
</tr>
</tbody>
</table>

Back in the Classroom:

1. Think about how your hand felt when you put it into the cloud. What do you think clouds are made of?

2. When you took your hand out of the cloud, it probably felt dry. Where do you think the water went?

3. Clouds are formed by the condensation of warm, humid air as it rises in the atmosphere. Why does water vapor condense as it rises in the atmosphere?

4. Draw a cloud shape. Take a gray marker and dot your cloud a few times. Each dot represents a droplet of water. Keep adding water droplets with your marker. What do you notice is happening to your cloud?
Dear Chaperone,

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

The Imagination Station requires students and chaperones to remain together at all times. Group size should be 7 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 the their Data Recording pages while at the science center. The ‘Back in the Classroom’ section of the Data Recording pages can be completed when the students return to school.
- It should take about 1 hour to complete the activities.
- For older students, remind them to return their Data Recording pages to their teacher.
- For younger students, collect the Data Recording pages and hand them to the teacher at the end of the day.
- 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. You don’t have to be the science expert! Tell students to look up information when they return to the classroom or ask an Imagination Station Team Member about a specific exhibit.
- If a student is struggling with a portion of the Data Recording Sheet, ask questions like ‘What have you done so far?’ or ‘What were you thinking about doing next?’ These types of questions can help a student work through challenges and find their own solutions. Remember, your job is not to provide the answers!
High Wire Cycle - This thrill ride hovers over 20 feet above the ground, suspended on a 2 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.
• You must have a token to ride. Available at the Simulator entrance or Visitor Service. Tokens: $1/Members ride FREE!
• You must be 42” to ride.
• Elevator available, contact a Team Member.

Extreme Science Theater - Daily Interactive Demonstrations with an exciting EXTREME twist. Check monitors located at Visitor Service or Elevators for demonstration times.

Science Studio - Featuring hands-on activities for kids of all ages. Learn about biology, physics and chemistry in a fun and exciting way!

Mind Zone - Home to the Gravity Room, discover how the mind processes, interprets and creates illusions and perceptions. You won’t believe what you see!

Water Works - Discover the slippery science of water with an entire Learning World dedicated to exploring nature’s most powerful resource.

Little KIDSSPACE™ - Our littlest adventurers (kindergarten and under) can hop aboard our fire truck, shop in the grocery store or climb on our favorite Treehouse while learning science fundamentals.

Flex Space - This ever-changing space will feature some of the best exhibitions from North America and some great experiences that we’ve created right here at Imagination Station.

Science2 GO! - Offering unusual and unique gifts, toys, books and activities.

Atomic Cafe/Exploration Center - Eating is only half the fun! Exploration Center is reserved for school groups.

WEATHER Exhibits
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.
Hurricane Chamber
Student Data Recording Page Questions:

This room offers visitors the opportunity to feel the strength of hurricane force winds without all the dangerous effects.

1. First, have your group observe a person inside the Hurricane Chamber.

2. Students should pick an action to test in the Hurricane Chamber. Good actions would have students jumping in the air, lifting their arms to their sides, etc. Have each student enter the room at the lowest wind speed. Record their results on their Data Recording Sheet.

3. Set the Hurricane Chamber to the second wind speed. Have students test the same activities at this wind speed. Make sure the students record their results!

4. Have your students enter the Hurricane Chamber at the highest speed. Again, have them test the same activities at this wind speed. Complete the chart.

IN THE KNOW

A hurricane, or tropical cyclone, is a large storm that forms near the equator. In the Northern Hemisphere, these large storms turn counter-clockwise and the center of the storm is called the ‘eye’ because it is typically calm.

Special conditions are needed to create a hurricane. First, very humid and warm air needs to be trapped between the earth and a layer of cooler air. Only near the equator is the air warm enough to create this condition. Additionally, fairly strong winds must be blowing in the same direction. If the winds are blowing at different speeds or in different directions, it will tear apart the hurricane. The warm air near the earth wants to rise, as warm air tends to do. As this warm air rises, it gains energy and heats up as the water vapor condenses. This causes the air to rise faster and faster. Cooler air pushes in on the warm, rising air causing this circular motion to become increasingly powerful.

The eye of the storm has little to no precipitation because it is a high-pressure zone. The winds spiral inward and rise up on the outside of the hurricane making the eye of the hurricane an area of high-pressure downdrafts.

Hurricanes are categorized by wind speed. Winds can vary between 64 mph-140 mph. When a hurricane reaches landfall, it typically loses power. This is because it can no longer draw that warm, moist air from the ocean that gives the hurricane its energy.
Tornado
Student Data Recording Page Questions:

The Tornado Exhibit provides students with the chance to experiment with the air movement of a tornado without the danger of the real thing.

1. Observe the movement of air in the tornado exhibit. Draw a picture of that air movement. Make sure to draw arrows indicating the direction that the air is moving.

2. What do you notice when you blow on the tornado? What happens to the movement of air?

3. What happens when you cover the holes at the base of the tornado exhibit? What happens to the movement of air?

4. Look carefully at how the air is moving in the center of the tornado and at the outer rim. Compare the speed of air movement you have observed.

IN THE KNOW

A tornado is a rotating column of air touching both the earth and the clouds. This dangerous rotation of air is typically shaped like a funnel that narrows as it comes closer to the earth.

Quick Tornado Facts:
- Wind speeds are typically between 40 mph and 110 mph.
- Tornadoes travel several miles before losing energy.
- Most tornadoes occur in the United States, approximately 750 per year.
- Tornado alley is where most US tornadoes occur and includes parts of Texas, Oklahoma, Kansas and Nebraska.
- The Fujita Scale ranks tornadoes on a scale 0 through 5 based on how much damage they cause.

A tornado occurs when warm, moist air meets cool, dry air and causes an unstable situation. The warm air begins to rise as it is displaced by heavier, cooler air. As the warm air rises, it meets varying wind speeds. If these winds behave in a certain way, they begin to spin the warm air like a top. This creates a vortex, a circular flow of fluid (in this case, air) around its center.

Activity
Make sure students include arrows in the drawing to show the flow of air in the Tornado exhibit.

Encourage students to blow on the tornado with different intensities. Does this make a difference in your results?

Talk a little with students about tornado safety. Good safety tips in the event of a tornado include:
- Go to the basement or lowest level of the building.
- Evacuate mobile homes for safer ground.
- Move to an interior room away from windows and doors.
- Cover head and neck with blankets or pillows.
Cloud Machine
Student Data Recording Page Questions:

The Cloud Exhibit offers visitors the chance to feel a cloud and think about what composes clouds.

1. Try the three activities below with the Cloud Machine. Write in the box about how your hands felt after each activity. Good descriptions include hot or cold, wet or dry.

2. When I put my hand in the cloud for 30 seconds, it felt…

3. When I put my hand in the cloud for 60 seconds, it felt…

4. After Trial 2, if I hold my hand in the air for 30 seconds, it felt…

IN THE KNOW

A cloud is composed of water and particulate matter. Particulate matter is tiny particles (dust, pollen, dander, salt, etc.) suspended in the air. A great way to explain particulate matter to young children is to have them think about the sun shining through a big window. They have likely seen the small little particles that are visible in the air when this occurs.

When the students place their hands in the cloud machine, their hands will get moist. This is because the cloud is composed of tiny droplets of water suspended in the air. When students take their hand out of the cloud exhibit, their hands will feel cool. The droplets of water that had formed on their hands will evaporate. This is because the warmth of their hands heated the water and caused it to evaporate. This results in a transfer of heat from the hand to the water and, as a result, the hand feels cool.

Clouds are formed when warm, humid air rises into the cooler atmosphere. This air condenses and forms tiny droplets that are suspended in clouds. These droplets tend to suspend themselves around the particulate matter such as dust, pollen, etc. There are many different types of clouds and the type formed depends on the environmental conditions when the cloud was created.

Activity
Make sure students fill out their charts. Encourage them to use good descriptive words to explain what they felt- wet, dry, warm and cold are all good descriptors.