National Aeronautics and Space Administration

A Cupola of Art

Educator Notes

Learning Objectives

Students will

- Create a stained-glass art piece from the view out of the cupola depicting a weather event
- Observe and describe different weather conditions across different regions of the world

Challenge/Investigation Overview

Students will observe different weather events viewed from the International Space Station. This will include volcano eruptions, dust storms, and hurricanes. Students will analyze photos of the different weather events and determine the climate and part of the world these weather events occur. Students will choose a type of weather event and create a stained-glass art piece from the view out the cupola on the International Space Station.

Safety

- Practice safe cutting techniques when using scissors. Be sure to carefully support the piece being cut.
- Avoid moving around the room with scissors, cutting tools, or other sharp objects.

Investigation Preparation

The educator should:

- Read the NASA Context section and become familiar with the activity
- Prepare the materials listed

Introduce the Investigation

To activate prior knowledge, ask students the following question:

What do you know about the International Space Station? Write down in a journal what they know, and students will share responses with another student then in a whole group discussion.

Facilitate the Investigation

Engage

- Show the STEMonstration Space Art video
- Think-Pair-Share: If you could look out the windows on the International Space Station, what would you want to see? Then, share ideas in a whole class discussion.

Grades K-12

Suggested Pacing

45 to 60 minutes

Materials

- ☐ Scissors
- ☐ Glue
- ☐ Wax paper
- ☐ Variety of colors of tissue paper
- ☐ Heavy book
- ☐ NASA photos
- ☐ Paper plates

National STEM Standards

- K-ESS3-2
- 3-ESS2-1
- 5-ESS2-1
- MS-ESS2-5
- HS-ESS2-7

Cupola Observation Module on the International Space Station

A Cupola of Art

Explore

- Show photos of a volcano eruption, dust storm, and hurricane view from aboard the International Space Station.
- In groups, students will analyze the photos using the Weather Event Student Handout and then share responses in a whole group discussion.

Explain

- Ask students what they know about these weather events: volcanic eruptions, dust storms, hurricanes? Have students write what they know in their journals.
- Show each of the three videos below on each weather event. Students will use their journals, and take notes on the weather event they are most interested in. They will write down details about each one and draw a photo.
- Watch the video of the Volcano Eruption: NASA | Sarychev Volcano Eruption from the International Space Station - YouTube
  - Ask the following questions:
    - Looking at the images from the video, what impact do you believe volcanic eruptions have on local and global climate?
    - Volcanic eruptions can generate both cooling and warming effects in the environment how is this possible?
    - Share this link for more volcano eruption images: https://earthobservatory.nasa.gov/topic/volcanoes
- Watch the video of Hurricane Ian from International Space Station: Massive Hurricane Ian seen from International Space Station - YouTube
  - Ask the following questions:
    - What is the energy source for hurricanes?
    - How do hurricanes change once they reach land? What causes these changes?
    - Share this link for more hurricane images: https://www.nasa.gov/mission_pages/hurricanes/main/index.html
- Watch the video of Satellites See Saharan Dust from Space - YouTube
  - Ask the following questions:
    - How do the Saharan dust storms impact other regions of the world?
    - What would happen if the dust did not reach those areas?
    - Share this link for more dust photos: https://earthobservatory.nasa.gov/topic/dust-and-haze

Elaborate

- Students will create a stained-glass art piece of one of the three weather events discussed: hurricane, dust storm, volcano eruption
  - Use images from the student handout below or the nasa.gov website to find new images to create the stained-glass art piece
  - Cut out a 20-inch-long piece of wax paper, tear tissue into small pieces and recreate the image of the weather event the student chose.
  - Make two circular borders using the paper plate. Cut a small hole in the top plate and glue wax paper on top of the tissue art and then glue the other plate on top of that. Hang the artwork in the window so it's like looking out of a cupola.
  - Print directions for younger students: Make a Stained Glass Earth! | NASA Space Place – NASA Science for Kids

Evaluate

- Students can research more about one of the weather events and create a brochure about impacts on the environment and any weather patterns
- Older students can develop a meteorology news cast on one of the weather events

Share

Engage students in the following question:

- How does being able to view different weather events from space help in our understanding of these weather events better?
- Students will share their stained-glass art with their small group and then complete an art gallery walk around the classroom to see everyone's work.

Extensions

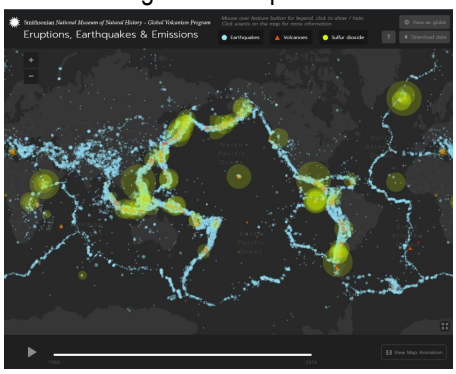
Art in space comes with its own set of challenges unique to the microgravity environment. Dive deeper into these scientific principles by exploring the following STEMonstrations.

- In space, the combination of water's surface tension and microgravity made mixing water and paint challenging. Try the Properties of Water and Surface Tension STEMonstrations to explore surface tension: STEMonstrations Classroom Connections Surface Tension (nasa.gov)
- The small air current produced when playing the flute is enough to propel an astronaut across the station in the microgravity environment. To remedy this, astronaut Ellen Ochoa used foot restraints while playing the flute. Explore Newton's Third Law of Motion STEMonstration to learn more about force and motion in space.
- Photographs help astronauts capture images of the Earth. Checkout the Earth Observations STEMonstration to learn more about how these observations are used to aid in our understanding of climate change and natural disasters.

NASA Context

Every NASA mission starts with a creative idea about how to explore something in a new way. As we look forward to Artemis missions to the Moon and beyond, space exploration kindles our imaginations. Many astronauts living and working on the International Space Station have found creative ways to integrate artistic expression into their lives while in space. Photos of the Earth captured from the station help to inspire us and increase our understanding of Earth's processes like climate change and major weather events.

NASA astronaut Christina Koch looking out of the ISS Cupola



Smithsonian National Museum of Natural History Global Volcanism Program- Eruptions, Earthquakes and Emissions

A NASA Scientist made a footprint in the dust, not on the moon, but in the Great Gobi Desert surrounding the Dunhuang Oasis, China.

In Crew Earth Observations (CEO), crew members on the International Space Station (ISS) photograph the Earth using digital handheld cameras from their unique point of view located 250 miles above the surface. Photographs record how the planet is changing over time, from human-caused events, such as urban growth and reservoir construction, to dynamic natural events, such as hurricanes, floods, and volcanic eruptions. The International Space Station orbits the Earth every 90-minutes or about 16 times a day. It travels in low Earth orbit at a vantage point about 250 miles above Earth's surface.

Volcanoes

Explosive volcano eruptions pose both short-term and long-term hazards. Lava flows and lahars can wipe out the flanks of mountainsides. Volcanic ash can blanket the landscapes for miles and ash clouds can disrupt aircraft travel. On longer time scales, eruptions can inject massive quantities of ash into the atmosphere, greatly reducing the solar heating of the Earth and potentially interrupting the global food supply for years.

Dust Storms

What is dust? On Earth, dust forms when rocks are broken down into sand and smaller particles. These particles, called mineral dust, can be blown by the wind, and suspended in the atmosphere. The deserts on Earth are huge sources of dust with the Sahara and Gobi Deserts as the main sources. Desert dust is one of many types of particles found in our atmosphere, which are also called aerosols. Every spring, dust from deserts in Mongolia and China invades heavily populated cities in Eastern Asia, such as Beijing, China.

Hurricanes

Hurricanes are large, swirling storms with winds of 199 kilometers per hour (74mph) or higher. That's faster than a cheetah, the fastest animal on land. The storms form over warm ocean waters and sometimes strike land. When a hurricane reaches land, it pushes a wall of ocean water ashore. This wall of water is called a storm surge, which along with heavy rain, cause flooding, especially near the coast. Once a hurricane forms, weather forecasters predict its path and how strong it will get. This information helps people prepare for the storm before it arrives. Warm ocean waters provide the energy needed for a storm to become a hurricane. Usually, the surface water temperature must be 26 degrees Celsius (79 degrees Fahrenheit) or higher for a hurricane to form.

The rate at which wind speed or direction changes with height is called vertical wind shear. Low vertical wind shear, or winds that change very little going up through the atmosphere, is needed for hurricane development.

Assessment

Rubric for 5E Instructional Model

5E Step	Novice (0)	Apprentice (1)	Journeyperson (2)	Expert (3)	Level of student knowledge (Score)
Engage	Student does not identify any prior knowledge or connections to previous learning experiences	Student identifies irrelevant or inaccurate prior knowledge or connections to previous learning experiences	Student identifies one example of relevant and accurate prior knowledge or connection to previous learning experience	Student identifies two or more examples of relevant and accurate prior knowledge or connections to previous learning experiences	
Explore	Student does not participate in brainstorming discussion	Student participates in brainstorming discussion (asks questions, for example) but does not contribute possible hypotheses, solutions, or tests	Student contributes at least one possible hypothesis, solution, or test to brainstorming	Student contributes at least one possible hypothesis, solution, or test to brainstorming and an alternative or improvement to another student's idea	
Explain	Student does not provide explanation of observations	Student provides an explanation of observations that is inaccurate, incomplete, or lacks evidence	Student provides an accurate, complete explanation of observations based on evidence	Student provides an accurate, complete explanation of observations based on evidence and supplements their reasoning with either evidence or evidence-based explanations from others	
Elaborate	Student does not draw reasonable conclusions based on evidence	Student draws reasonable conclusions but does not utilize scientific terminology or evidence	Student draws reasonable conclusions utilizing scientific terminology and evidence	Student draws reasonable conclusions utilizing scientific terminology as well as evidence and can make reasonable predictions based on those conclusions	
Evaluate	Student does not demonstrate understanding of concept or can only repeat provided definitions	Student demonstrates an understanding of concept by providing definitions or explanations in their own words, drawings, models, etc.	Student demonstrates an understanding of concept by applying it to new questions or by analyzing new evidence	Student demonstrates an understanding of concept by explaining how evidence caused their knowledge to progress over time or by proposing new ways to use their new knowledge (such as follow-up experiments)	
				Total	

Reference

International Space Station Cupola Observational Module | NASA

Make a Stained Glass Earth! | NASA Space Place – NASA Science for Kids

Hurricane Ian is pictured from the International Space Station | NASA

Central Africa Dust Storm (nasa.gov)

International Space Station Imagery for Disaster Response (arcgis.com)

Sarychev Peak Eruption, Kuril Islands (nasa.gov)

Volcanic Eruptions | MyNASAData

Understanding Earth: The Journey of Dust (nasa.gov)

What Are Hurricanes? | NASA

How Scientists Are Using the ISS to Study Earth | NASA

STEMonstrations: Surface Tension - YouTube

A Cupola of Art

Your Investigation

Engage

Your educator will show you the Space Art STEMonstration video.

- Answer the following questions in your journal; then share your answers with a partner
  - What do you know about the International Space Station?
  - If you could look out the windows on the International Space Station, what would you want to see?

Explore

Your educator will show you photos of a volcanic eruption, dust storm, and hurricane taken from aboard the International Space Station.

- In groups, you will analyze the photos using the Weather Event Student Handout and then share your responses with the rest of the group

Explain

In your journals, write down what you know about these weather events: volcanic eruptions, dust storms, and hurricanes.

Your educator will show you this video on a Dust Storm: Satellites See Saharan Dust from Space - YouTube .

- Answer these questions in your groups
  - How do the Saharan dust storms impact other regions of the world?
  - What would happen if the dust did not reach those areas?

Your educator will show you this video on Hurricane Ian taken from aboard the International Space Station: Massive Hurricane Ian seen from International Space Station - YouTube .

- Answer these questions in your groups:
  - What is the energy source that drives hurricanes?
  - How can hurricanes change once they reach land? What causes these changes?

Your educator will show you this video on Volcano Eruption: NASA | Sarychev Volcano Eruption from the International Space Station - YouTube .

- Answer these questions in your groups:
  - Looking at the images from the video, what impact do you believe volcanic eruptions have on local and global weather patterns?
  - What long term impact might these eruptions have on Earth's climate?
  - Volcanic eruptions can generate both cooling and warming effects in the environment. How is this possible?

NASA astronaut Christina Koch looking out of the ISS Cupola Observation Module

Volcano Eruption from the ISS

Career Corner

NASA Astronaut Christina Koch was selected as a NASA astronaut in 2013. She has been assigned as Mission Specialist I of NASA's Artemis II mission.

Learn more: Christina Koch

Elaborate

- Create a stained-glass piece of art that represents one of the weather events: hurricane, dust storm, volcano eruption
  - Use images from the student handout below or use the nasa.gov website to find new images to create the stained-glass art piece
  - Cut out a 20-inch-long piece of wax paper, tear tissue into small pieces and recreate the image of the weather event you chose
  - Make two circular borders using the paper plate. Cut a small hole in the top plate and glue wax paper on top of the tissue art; then glue the other plate on top of that. Hang the artwork in the window so it's like looking out of your own cupola.

Evaluate

- Using the references your educator gives you, create a meteorology newscast or a brochure highlighting the different weather events and their impacts on the environment

Share

- Share your stained-glass art with your small group and then complete an art gallery walk around the classroom to see everyone's work
- Answer this question in your journal: How does being able to view different weather events from space help our understanding of them?
- Imagine you are an astronaut on the International Space Station. How would the process of creating a stained-glass piece of art on the station be different than creating one on Earth?

Extensions

Art in space comes with its own set of challenges unique to the microgravity environment. Pick one of the STEMonstrations below to dive a little deeper into the science behind art in space.

- In space, the combination of water's surface tension and microgravity make mixing water and paint challenging. Try the Properties of Water and Surface Tension STEMonstrations to explore surface tension. Then put it all together with this classroom connection: STEMonstrations Classroom Connections Surface Tension (nasa.gov) .
- The small air current produced when playing the flute is enough to propel an astronaut across the station in the microgravity environment. To remedy this, astronaut Ellen Ochoa used foot restraints while playing the flute. Explore Newton's Third Law of Motion STEMonstration to learn more about force and motion in space. Photographs help astronauts capture images of the Earth.
- Checkout the Earth Observations STEMonstration to learn more about how these observations are used to aid in our understanding of climate change and natural disasters.
- Think of a form of artistic expression you enjoy (painting, playing an instrument, crafts, etc.). How might engaging in that form of art be different in space than on Earth? How could you mitigate any challenges you might encounter in microgravity?

Weather Event Student Handout

Look at each photo and write down observations about each weather event. What details do you notice for each weather event?

Volcanic Eruption	Observations
	
Dust Storm	**Observations**
	
Hurricane	**Observations**