

An aerial photograph of a rugged, red-rock landscape. The terrain is characterized by deep red and orange hues, with a prominent central volcano or mountain peak. A large, irregularly shaped reservoir or lake is visible in the lower-middle section of the image, surrounded by a network of roads and smaller water bodies. The overall scene depicts a complex geological environment.

Earth Science Everywhere

Exploring Disaster Management

Learning about natural hazards to prepare
and prevent natural disasters

A Lesson for Middle School STEM

Developed by AmericaView

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Introduction: “An ounce of prevention is worth a pound of cure.” – Benjamin Franklin

This lesson seeks to engage students in learning about natural hazards in the environment, first by exploring the volcanic eruption of Mount St. Helens, and then looking at potential for natural hazards in their own community. This content provides opportunities for students to meet NGSS performance expectation **MS-ESS2-4**, see next page for details. This lesson is best suited for a STEM enrichment class or as an enrichment activity included as part of a larger science curriculum. It was written with a middle school audience in mind but could be adapted for high school students.

This lesson refers to electromagnetic spectrum and remote sensing topics. It is recommended that the “Exploring the Electromagnetic Spectrum” lesson is completed first.

Keywords: Earth Science; Meteorology; Life Science; Geography; History; Natural Hazards; Natural Disasters

Background Information:

On May 18, 1980, Mount St. Helens erupted, causing widespread devastation across the surrounding landscape. This infrared, false-color image, captured on August 26, 1986, by the Thematic Mapper sensor on Landsat 5, vividly illustrates the eruption's aftermath. The image reveals the extensive damage caused by the eruption, including the vast areas of barren land and the destruction of dense forests. Disaster mapping is crucial in understanding the long-term environmental impact of natural and human-made disasters. It also aids in monitoring the gradual environmental recovery process.

Time Frame: 45 - 75 minutes

Materials: In order to complete the activities in this Lesson, the following materials/resources are essential:

- Internet access
- One computer per pair of students (one-to-one is preferred)
- Google Earth
- Smartboard or other projection system
- Visit the FEMA Map to download a report for your county or census tract:
<https://hazards.fema.gov/nri/map>

Next Generation Science Standards addressed:

Performance Expectation	Disciplinary Core Ideas	Crosscutting Concepts
<p>MS-ESS-3-2: Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.</p>	<p>ESS3.B: Natural Hazards</p> <p>Natural processes can cause sudden or gradual changes to Earth’s systems, some of which may adversely affect humans. Through observations and knowledge of historical events, people know where certain of these hazards—such as earthquakes, tsunamis, volcanic eruptions, severe weather, floods, and coastal erosion—are likely to occur. Understanding these kinds of hazards helps us prepare for and respond to them.</p>	<p>Patterns Graphs, charts, and images can be used to identify patterns in data.</p> <p>Cause and Effect Cause and effect relationships are routinely identified, tested, and used to explain change.</p>
<p>Evidence Statements</p> <p>1. Organizing data</p> <p>a. Students organize given data that represent the type of natural hazard event and features associated with that type of event, including the location, magnitude, frequency, and any associated precursor event or geologic forces.</p> <p>b. Students organize data in a way that facilitates analysis and interpretation.</p> <p>c. Students describe* what each dataset represents.</p> <p>2. Identifying relationships</p> <p>a. Students analyze data to identify and describe* patterns in the datasets, including:</p> <p>i. The location of natural hazard events relative to geographic and/or geologic features.</p> <p>ii. Frequency of natural hazard events.</p> <p>iii. Severity of natural hazard events.</p> <p>iv. Types of damage caused by natural hazard events.</p> <p>v. Location or timing of features and phenomena (e.g., aftershocks, flash floods) associated with natural hazard events.</p> <p>b. Students describe* similarities and differences among identified patterns.</p>		

3. Interpreting data

a. Students use the analyzed data to describe*:

i. Areas that are susceptible to the natural hazard events, including areas designated as at the greatest and least risk for severe events.

ii. How frequently areas, including areas experiencing the highest and lowest frequency of events, are at risk.

iii. What type of damage each area is at risk of during a given natural hazard event.

iv. What features, if any, occur before a given natural hazard event that can be used to predict the occurrence of the natural hazard event and when and where they can be observed.

b Using patterns in the data, students make a forecast for the potential of a natural hazard event to affect an area in the future, including information on frequency and/or probability of event occurrence; how severe the event is likely to be; where the event is most likely to cause the most damage; and what events, if any, are likely to precede the event.

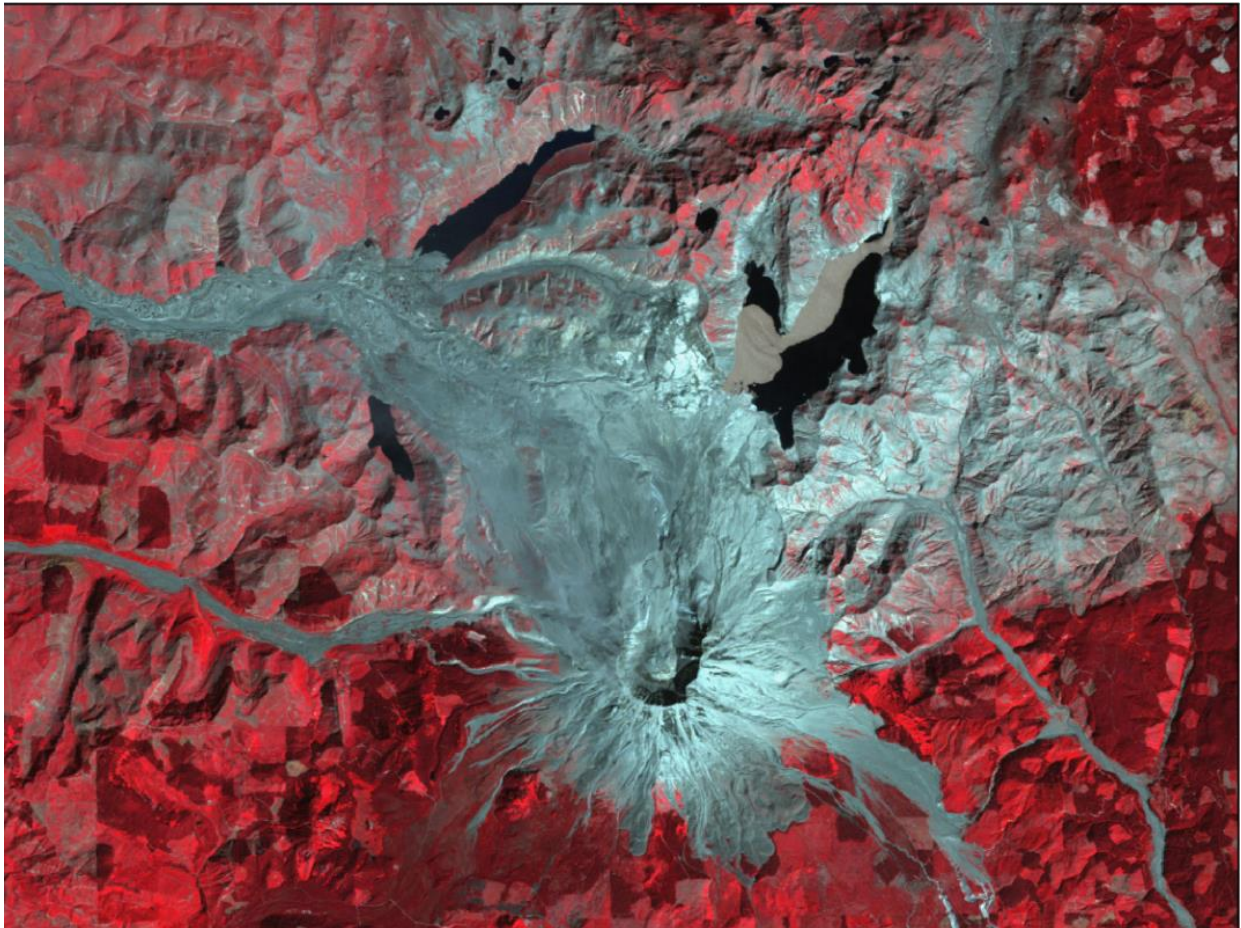
c Students give at least three examples of the technologies that engineers have developed to mitigate the effects of natural hazards (e.g., the design of buildings and bridges to resist earthquakes, warning sirens for tsunamis, storm shelters for tornados, levees along rivers to prevent flooding).

Warm-Up: 10 - 15 minutes

Vocabulary Words to introduce during this activity

- Natural phenomena -events that occur in nature without human involvement. Some occur regularly (daily, seasonally, yearly) and others are irregular.
- Natural hazard - environmental phenomena that have the potential to impact societies and the human environment.
- Predictable – being able to be known, seen, or declared in advance.
- Natural disaster - is the negative impact following an actual occurrence of natural hazard in the event that it significantly harms a community.
- Avalanche - a mass of snow in swift motion traveling down a mountainside.

What's going on in this picture?



Instructions: Show students the image above (either project on a screen or print from page 10) and ask students to take a minute to look at it and write down “What’s going on in this picture?” Make sure to give them adequate thinking time. They will be answering the following questions:

- 1) *What’s going on in this picture?*
- 2) *What do you see that makes you say that?*

3) *What more can you find?*

Now have them turn to their neighbor and discuss what they wrote. Call on groups around the classroom to share their ideas with the class. Once you start getting similar answers ask if there are any different or additional new information that people would like to share. If not, it is time for the big reveal!

The Big Reveal! On May 18, 1980, Mount St. Helens erupted, causing widespread devastation across the surrounding landscape. This infrared, false-color image, captured on August 26, 1986, by the Thematic Mapper sensor on Landsat 5, vividly illustrates the eruption's aftermath. The infrared image shows high contrast between areas in red that represent healthy vegetation such as trees and grass and areas that were affected by the volcano's eruption areas covered in ash, mud and lava shown in gray.

Notable features in the image:

Volcano Crater: The areas covered in gray and brown are areas that were covered volcano debris from the eruption. Notice the extent of the damage for miles around the volcano.

Rivers: Several of the major rivers seen in gray were filled volcanic mudflows and avalanche debris (rocks, dirt, and trees).

Timber Patches: Much of the landscape is used to grow and harvest timber products. The patchy area to the right of the blast zone are areas that are timber stands in various stages of the timber harvest (plant, grow, harvest).

Spirit Lake: A large lake northeast of the volcano crater. The lake is brown due to large amount of mud and debris that flowed into it from the volcano eruption.

Assessment: to help reinforce these concepts have students play the Natural Hazards and Natural Disasters Match Up on Wordwall or print the hand out related activity on page 10:

<https://wordwall.net/resource/76265407>.

Reading Activity: World of Change Mt. St. Helens Reading -10- 15 minutes

Instructions: Once the warm-up discussion has ended, direct the students to the NASA Earth Observatory website (<https://earthobservatory.nasa.gov/>) and have them read the "[Devastation and Recovery at Mt. St. Helens](#)" article and view the time lapse video of images from 1979-2016 (click the play button to have images scroll) associated with the article.

Assessment: A short quiz over the reading either as a word wall quiz game:


<https://wordwall.net/resource/77490559> or print the handout on page 11

Google Earth Exploration: 10 -15 minutes

In this activity, students will get a chance to explore Mt. St. Helens with Google Earth. This will put the reading into greater context by allowing them to see where it is located and how the landscape has changed and recovered from the early days after the volcano's eruption through 2016. Discuss with students how the satellite imagery was a major technological breakthrough because it allowed scientists a new way to monitor changes and how this is helpful for monitoring hazards and disaster. Example: images before the eruption, in the aftermath (to assess the damage), as well as in the recovery phase. Share with students that the Landsat satellite has a new image every 16 days.

Instructions: Have the students navigate to Google Earth. Then have the students enter “Mount St Helens” into the search bar of Google Earth and zoom to the location. Give students a few minutes to explore the mountain. What do they notice? Even today, over 40 years after the eruption the lava ripples and flows are still visible all around the mountain.

Have them turn on the Time-lapse layer: Click Layers icon in the bottom left and scroll down to Time lapse. Turn it on. Discuss the changes that they notice taking place around the volcano (greening and reforestation). Also point out to the students that they will notice little patches on the surrounding mountain sides going from green to brown to green over time. The hillsides surrounded the volcano are used to grow trees for timber production so the hills are routinely being harvested and replanted.

Next, have the students zoom out to see this location as it relates to where they live. Have them use the measure or ruler tool  to find out how far away is it from their home. How far away is it from the closest city of Longview, Washington (southwest of Mt. St. Helens). How far is it from the Pacific Ocean; Seattle, Washington; and Portland, Oregon?

What are the greatest risks of natural disasters based on local natural hazards? 15 -20 minutes

Natural hazards can occur in any region of the country. The Federal Emergency Management Agency (FEMA) defines natural hazards as environmental phenomena that have the potential to impact societies and the human environment. While we can't stop natural hazards from occurring we can do our best to be prepared for them when they do occur. One way that we can be prepared for natural hazards is to know what are the greatest risks in our local community. FEMA has created a web map of the United States that scores every location based on their risk of natural hazards as well as their community's resiliency. The National Risk Index is designed to help communities understand their relative natural hazard risk and the impacts they could expect during or after a disaster.

- Natural hazard - environmental phenomena that have the potential to impact societies and the human environment.

Below are examples of 18 common natural hazards that are used in the FEMA Risk assessment tool:

- Avalanche - a mass of snow in swift motion traveling down a mountainside.
- Coastal Flooding - when water covers normally dry coastal land as a result of high or rising tides or storm surges.
- Cold Wave - a rapid fall in temperature within 24 hours and extreme low temperatures for an extended period.
- Drought - a lack of precipitation over an extended period of time resulting in a water shortage.
- Earthquake - a shaking of the earth's surface by energy waves emitted by slowly moving tectonic plates overcoming friction with one another underneath the earth's surface.
- Hail - a form of precipitation that occurs during thunderstorms when raindrops, in extremely cold areas of the atmosphere, freeze into balls of ice before falling towards the earth's surface.

- Heat Wave - a period of abnormally and uncomfortably hot and unusually humid weather typically lasting two or more days with temperatures outside the historical averages for a given area.
- Hurricane - a tropical cyclone or localized, low-pressure weather system that has organized thunderstorms but no front (a boundary separating two air masses of different densities) and maximum sustained winds of at least 74 mph.
- Ice Storm - a freezing rain situation (rain that freezes on surface contact) with significant ice accumulations of 0.25 inches or greater.
- Landslide - the movement of a mass of rock, debris, or earth down a slope.
- Lightning - a visible electrical discharge or spark of electricity in the atmosphere between clouds, the air and/or the ground often produced by a thunderstorm.
- Riverine Flooding - when streams and rivers exceed the capacity of their natural or constructed channels to accommodate water flow and water overflows the banks, spilling out into adjacent low-lying, dry land.
- Strong Wind - damaging winds, often originating from thunderstorms, that are classified as exceeding 58 mph.
- Tornado - a narrow, violently rotating column of air that extends from the base of a thunderstorm to the ground and is visible only if it forms a condensation funnel made up of water droplets, dust, and debris.
- Tsunami - a wave or series of waves generated by an Earthquake, Landslide, volcanic eruption, or even a large meteor hitting the ocean and causing a rise or mounding of water at the ocean surface. A Tsunami can travel across open ocean at about 500 mph and slow down to about 30 mph as it approaches land, causing it to grow significantly in height.
- Volcanic Activity - occurs via vents that act as a conduit between the Earth's surface and inner layers, and erupt gas, molten rock, and volcanic ash when gas pressure and buoyancy drive molten rock upward and through zones of weakness in the Earth's crust.
- Wildfire - an unplanned fire burning in natural or wildland areas such as forests, shrub lands, grasslands, or prairies.
- Winter Weather - winter storm events in which the main types of precipitation are snow, sleet, or freezing rain.

Instructions: Give students a moment to write down which hazards they think are most likely to happen where you are. Then have them discuss their answers with their neighbor. Then discuss the answers as a group. Introduce the FEMA National Risk Index website <https://hazards.fema.gov/nri/map> and pull up the report for your county or census block. Guide the students through learning about the risks in the county where the school is located. Discuss how geography, topography, and landscape can play a role in natural hazards. Also discuss which hazards are predicable and which are not. Have the students brainstorm at least three ways that we can prepare for natural hazards.

Extension: Give students time to explore the FEMA National Risk Index website. Have them change the geographic view from Counties to Census Tracts in the upper left-hand corner of the viewer. In many cases there will be areas of the county that are more at risk than other parts of the county, discuss these differences. Have students compare different areas of the state or country using the Create Report tool at the bottom right of the map (perhaps Mt. St. Helens or a rival school district to see how risks index

scores are similar or different.) Discuss how geography, topography, and landscape can play a role in natural hazards

Additional vocabulary Explain that natural hazards are grouped into categories depending on where the phenomena are taking place:

- Interior process (something that is generated from inside the earth) – earthquake, volcanic activity
- Surface process (these happen on surface of the earth) - Avalanche, coastal flooding, landslide, riverine flooding, tsunami, wildfire
- Severe weather event – cold wave, drought, hail, heat wave, hurricane, ice storm, lightning, strong wind, tornado, winter weather

Career Exploration: 5 minutes

Have the students navigate to the below website to explore emergency management careers within the U.S. Department of Interior. This page gives details about job qualifications and if they scroll towards the bottom of the page, they can explore more specific jobs within that category. <https://careers.doi.gov/occupational-series/emergency-management>

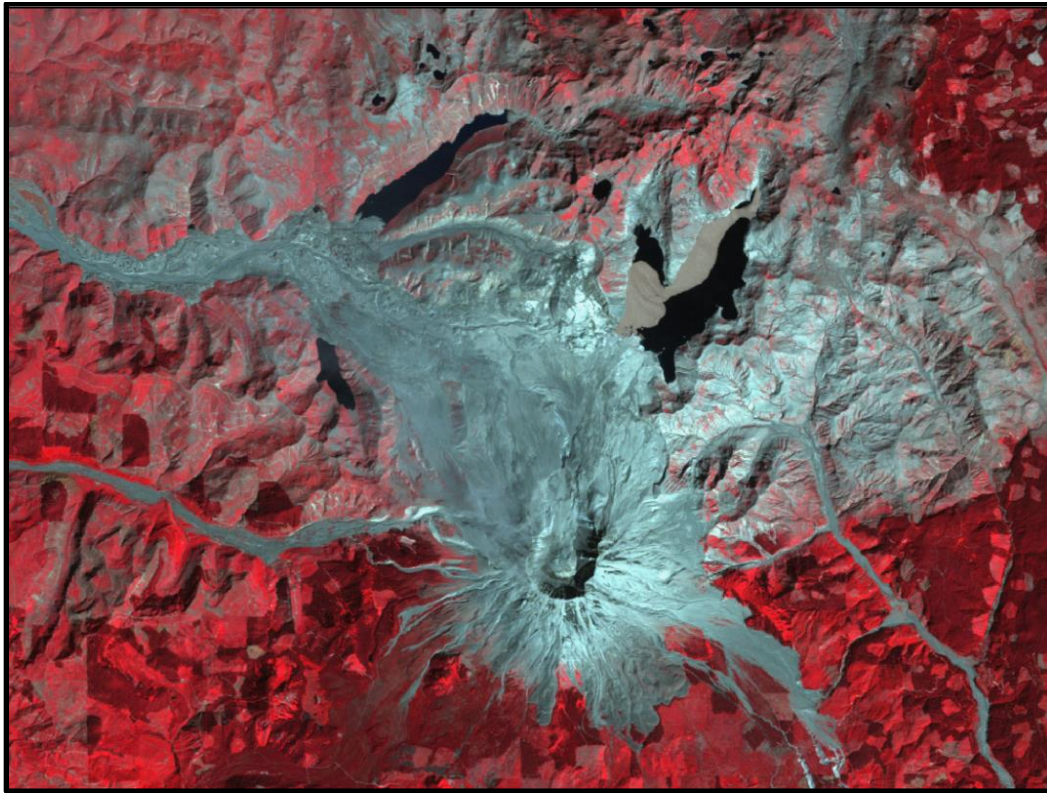
If there is additional time or if you want to make this a longer activity in the future, begin at the below link. Students can click on “Find Your Path” then “Get Started” to search careers based on their personal interests.

<https://careers.doi.gov/>

Wrap-up: 5 minutes

Have the students play the online game(<https://wordwall.net/resource/77491290>) to test their natural hazard knowledge from the lesson. The printable quiz is also provided on page 12.

Activity 1: What's Going on in This Picture?



View the image projected at the front of the classroom. Take a moment to really look and observe. Now answer the following questions. There are no right or wrong answers.

What's going on in this picture?

What do you see that makes you say that?

What more can you find?


Natural Hazards and Natural Disasters Match Up

Date: _____

Name: _____


💡 Draw a path from each airplane to its answer - don't crash into other clouds along the way

natural phenomena that have the potential to impact humans and societies




natural hazard

events that occur in nature without human involvement



predictable

being able to be known, seen, or declared in advance




natural disaster

the negative impact to a community following an actual occurrence of a natural hazard



natural phenomena

a mass of snow in swift motion traveling down a mountainside.



avalanche

Reading Quiz - Recovery at Mt. St. Helens

Date: _____

Name: _____

1. What was the date of the Mt. St. Helens volcano eruption?
A May 30, 1979 B September 13, 1980
C May 18, 1980 D August 28, 1985
2. Which three natural hazards were mentioned in the article?
Select 3 answers
A Tornado B Earthquake C Avalanche
D Tsunami E Volcanic eruption F Winter Weather
3. Mount St. Helens was the first volcano eruption to happen in the continental United States since the launch of the earth observing satellites.
A True B False
4. The avalanche at Mt. St. Helens was the largest landslide in recorded history. How many miles was the avalanche?
A 150 miles B 8 miles
C 23 miles D 14 miles
5. Mt. St. Helens gave warning signs to help scientists predict that there was going to be eruption. Before Mount St. Helens exploded there were:
A Ghosts B Tornadoes
C Small Earthquakes D Wildfires
6. Years following the eruption when scientists did ground surveys of the area, which plants did they find were the first to return to the land affected by the volcano?
A Prairie Lupines B White Pine Trees
C Birch Trees D Dandelions

Natural Hazards Review Quiz

Date: _____

Name: _____

💡 Write the correct letter in each space.

- | | | |
|----------------------|--|-------|
| A. earthquake | 1. a rapid fall in temperature within 24 hours and extreme low temperatures for an extended period | _____ |
| B. hail | 2. storm events in which the main types of precipitation are snow, sleet, or freezing rain | _____ |
| C. tornado | 3. a wave or series of waves generated by an Earthquake, Landslide, volcanic eruption, or even a large meteor hitting the ocean and causing a rise of water at the ocean surface. | _____ |
| D. heat wave | 4. when water covers normally dry coastal land because of high or rising tides or storm surges | _____ |
| E. winter weather | 5. a rupture in the Earth's surface and inner layers, can include erupting gas, molten rock, and ash | _____ |
| F. lightning | 6. when streams and rivers exceed the capacity of their channels to for water flow and water overflows the banks, spilling out into nearby low-lying, dry land | _____ |
| G. landslide | 7. a visible electrical discharge or spark of electricity in the atmosphere between clouds, the air and/or the ground often produced by a thunderstorm | _____ |
| H. wildfire | 8. an unplanned fire burning in natural or wildland areas such as forests, shrub lands, grasslands, or prairies | _____ |
| I. avalanche | 9. the movement of a mass of rock, debris, or earth down a slope | _____ |
| J. strong wind | 10. a period of abnormally and uncomfortably hot and humid weather typically lasting two or more days with temperatures outside the averages for a given area | _____ |
| K. drought | 11. a freezing rain situation (rain that freezes on surface contact) with significant ice accumulations of 0.25 inches or greater | _____ |
| L. tsunami | 12. a lack of precipitation over an extended period of time that leads to water shortage | _____ |
| M. coastal flooding | 13. a tropical cyclone or localized, low-pressure weather system that has organized thunderstorms but no front and maximum sustained winds of at least 74 mph | _____ |
| N. volcanic activity | 14. a shaking of the earth's surface by energy released from moving tectonic plates underneath the earth's surface | _____ |
| O. ice storm | 15. a narrow, violently rotating column of air that extends from the base of a thunderstorm to the ground and is viable only if it forms a condensation funnel made up of water droplets, dust, and debris | _____ |
| P. cold wave | 16. damaging winds, often originating from thunderstorms, that are classified as exceeding 38 mph | _____ |
| Q. hurricane | 17. a mass of snow in swift motion traveling down a mountainside | _____ |
| R. riverine flooding | 18. a form of precipitation that occurs during thunderstorms when raindrops freeze into balls of ice before falling to the earth | _____ |