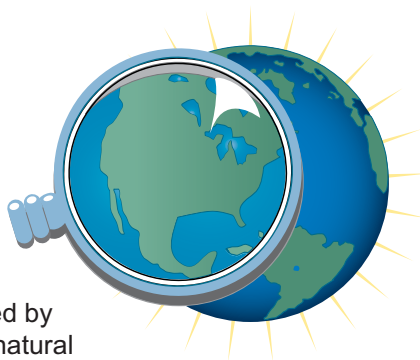




## How do disaster paths affect people's lives?



### Investigation Overview

Four scenarios illustrate paths produced by natural disasters. Students learn that natural disasters can be observed and analyzed using remotely sensed images. Working in groups, students read letters from imaginary pen pals describing specific natural disasters, examine NASA images of the locations of these events, report on the events, and write a response to pen pals.

Time required: One 45-minute session

### Materials/Resources

- Atlases or world wall map
- NASA images (one copy for each group of students)
  - Figure 1: Hawaii
  - Figure 2: Russia
  - Figure 3: Hurricane Georges
  - Figure 4: Mississippi River flood path
- Log 1: Pen pal letters

### Content Preview

Events such as hurricanes, volcanic eruptions, and floods are aspects of physical systems that have immediate and disastrous effects on human systems as well as physical systems. Remotely sensed images can be used to assist reducing social and economic disruptions from such natural disasters by contributing to the scientific understanding of Earth processes. The effects of a lava flow, aerosols and smoke from a volcano, a hurricane, and a flood can be seen on images.

### Classroom Procedures

#### Beginning the Investigation

- Write *Natural Disasters* on the chalkboard. Ask students to brainstorm different types of disasters. List each in a column under this heading. Write *Effects on the Environment* and *Effects on People* as additional headings. Go down the list of natural disasters and talk about how people and natural environments are affected by each disaster. A table can be made on the chalkboard that resembles the following:

Natural Disaster	Effects on the Environment	Effects on People
Hurricanes		
Earthquakes		
Tornadoes		
Floods		
...		

### Geography Standards

#### Standard 15: Environment and Society

*How physical systems affect human systems*

- Describe and locate natural hazards in the physical environment.

#### Standard 18: The Uses of Geography

*How to apply geography to interpret the present and plan for the future*

- Identify ways in which geographic conditions change.

### Geography Skills

#### Skill Set 3: Organizing Geographic Information

- Prepare maps to display geographic information.

#### Skill Set 4: Analyzing Geographic Information

- Use texts, photographs, and documents to observe and interpret geographic trends and relationships.

#### Skill Set 5: Answering Geographic Questions

- Present geographic information in the form of both oral and written reports accompanied by maps and graphics.

### Developing the Investigation

2. Tell students that they will see pathways that can best be seen from above Earth. Talk about ways to view natural disasters from different levels and the advantages and disadvantages of each (airplane, Space Shuttle, satellites). (*Refer back to the list of natural disasters and talk about why it is important to see the disasters from above:*
  - *helps to see how large an area the disaster is affecting.*
  - *helps to predict the direction of the disaster or the pathway that it is taking.*
  - *helps to warn people before the disaster reaches them.*)
3. Talk about NASA's mission in studying natural disasters. (See **Background**.)
4. Share with students that they will see four images of disaster pathways. Project transparencies of **Figures 1-4** (or distribute copies) and ask students to try to identify what they are seeing. Spend time on the images; talk about possible locations for the images, any outstanding features in the landscape that they see, and any other observations that students want to share.
5. Tell students that they will read letters from imaginary students in other parts of the world who have experienced a natural disaster that was shown in one of the images. Tell students that the imaginary letter writers would like to have a response from students in this class.
6. Have the students work in groups and give each group a page from **Log 1** (letter) and a **copy of the image** that goes with their letter, and an atlas (or use a wall map). In a small class, this can be done with four groups of students, each group with a different image and letter. A larger class would require eight groups, with two groups receiving the same pen pal letter and image. Ask students to read their letters and to use both the image and their atlases (or a wall map) to respond to their pen pal with one letter from the group (or individual letters from the groups' members). Encourage students to be sure that each member of the group contributes to the project.
8. Project **Figure 3: Hurricane Georges** and talk about possible paths that could be used for evacuation. Look at the other images and have students talk about possible ways to escape the disaster. If students are in a geographic area that experiences natural disasters, locate regional maps showing pathways for evacuation purposes.
9. Review how images from space can help people deal with natural disasters.

### Background

Natural hazards are inevitable manifestations of Earth processes but need not be inevitable disasters. Images from space can assist society in reducing social and economic disruptions from future natural disasters by contributing to the scientific understanding of Earth processes and conditions that lead to natural disasters.

**Figure 1: Hawaii** <[http://hvo.wr.usgs.gov/gallery/kilauea/erupt/2553002\\_caption.html](http://hvo.wr.usgs.gov/gallery/kilauea/erupt/2553002_caption.html)> In this radar image, produced by a sensor on the Space Shuttle, the city of Hilo is seen at the top. Different types of lava flows around the crater Pu'u O'o are evident. Ash deposits which erupted in 1790 from the summit of Kilauea volcano show up as dark in this image, and fine details associated with lava flows which erupted in 1919 and 1974 can be seen to the south of the summit in an area called the Ka'u Desert. In addition, the other historic lava flows created in 1881 and 1984 from Mauna Loa volcano (out of view to the left of this image) can be easily seen despite the fact that the surrounding area is covered by forest. This information is used to map the extent of the lava flows which can pose a hazard to the subdivisions of Hilo. Highway 11 is the linear feature running from Hilo to the Kilauea volcano. The Kilauea volcano has been almost continuously active for more than 11 years. Field teams that were on the ground specifically to support these radar observations report that there was vigorous surface activity about 400 meters inland from the coast. A moving lava flow about 200 meters in length was observed at the time of the shuttle overflight, raising the possibility that subsequent images will show changes in the landscape.

### Concluding the Activity

7. Bring the class back together and have each group
  - read the original pen pal letter,
  - show their image,

**Figure 2: Russia** <<http://images.jsc.nasa.gov/images/pao/STS68/10117628.jpg>> Shortly after the launch of the Space Shuttle on September 30, 1994, the crew reported thick black smoke over the Kamchatka Peninsula in northeast Russia. On the next orbital pass, the crew took photographs of the eruption of Klyuchevskaya. This is the most active volcano on the peninsula, and this eruption has been its largest in 40 years. The eruption cloud reached 19,000 meters above sea level, and the winds carried the volcanic ash as far as 1025 kilometers southeast from the volcano. The ash cloud interfered with the heavily traveled north Pacific air routes for 48 hours, diverting up to 70 flights carrying about 10,000 passengers per day.

**Figure 3: Hurricane Georges** <[http://rsd.gsfc.nasa.gov/rsd/images/Georges/GeorgesThree\\_md.jpg](http://rsd.gsfc.nasa.gov/rsd/images/Georges/GeorgesThree_md.jpg)> This satellite image shows Hurricane Georges at three different times on its path toward the Gulf of Mexico. During late September 1998, Hurricane Georges cut a path of destruction through Puerto Rico. Its strong winds, heavy rains, storm surge, and tornadoes resulted in an estimated \$2 billion in damage on the island. The hurricane's powerful thunderstorms spawned tornadoes, flooded hotels, and exploded shop and car windows. Georges forced tens of thousands of people into shelters and left hundreds of thousands without water or power. The hurricane prevented rescuers from immediately responding to calls for help. The center of the storm passed just south of the Puerto Rican capital of San Juan. Georges unleashed a landslide in Tao Alta, near San Juan, that killed three people. As it moved westward across southern Puerto Rico, Georges spawned tornadoes. Wind gusts reached 287 kph. More than 80 percent of Puerto Rico's 3.8 million people lost electricity, and more than 70 percent had no water. Countless roads and highways were choked by fallen trees and poles, dangling power lines, antennas, awnings, tin roofs, and other debris.

More than 20,000 people huddled in shelters in San Juan, Arecibo, Mayaguez, and other Puerto Rican cities, and President Clinton declared Puerto Rico and the U.S. Virgin Islands disaster areas, authorizing immediate release of federal recovery aid.

**Figure 4: Mississippi River flood path** <[http://observe.ivv.nasa.gov/nasa/exhibits/flood/flood\\_2.html](http://observe.ivv.nasa.gov/nasa/exhibits/flood/flood_2.html)> <[http://observe.ivv.nasa.gov/nasa/exhibits/flood/flood\\_3.html](http://observe.ivv.nasa.gov/nasa/exhibits/flood/flood_3.html)> These Space Shuttle photographs, with river and state boundaries overlaid, show the Midwestern United States during the flood of 1993. The Mississippi, Illinois, and Missouri Rivers converge just north of St. Louis. For over a month torrential rains, which had begun in the spring of 1993, began again in June and continued to fall on the already saturated fields. The waters of the Mississippi, Missouri, and Illinois Rivers and their tributaries soon spilled over once-protective levees, causing billions of dollars in damage and destruction. Tens of thousands of acres of farmland and crops were destroyed, water treatment plants were closed, roads and bridges were severely damaged or destroyed, and entire communities were inundated, leaving many thousands homeless.

### Related Resources

Students as scientists  
<http://dns.kilauea.k12.hi.us/sas/>  
 Images and information on hurricanes  
<http://rsd.gsfc.nasa.gov/rsd/images/>  
 Hurricane and extreme weather impact studies  
<http://coastal.er.usgs.gov/hurricanes/>  
 Hurricane and other storms information  
[http://www.aomi.noaa.gov/hrd/Storm\\_pages/](http://www.aomi.noaa.gov/hrd/Storm_pages/)  
 Japan, good images of lava flows  
[http://observe.ivv.nasa.gov/nasa/ootw/1999/ootw\\_990512/ob990512\\_more7.html](http://observe.ivv.nasa.gov/nasa/ootw/1999/ootw_990512/ob990512_more7.html)  
 The Weather Dude, The Weather Channel  
<http://www.wxduke.com>  
 Hurricane basins  
<http://www.usatoday.com/weather/whurbasn.htm>



## Module 4, Investigation 4: Log 1a

### Pen pal letters

Dear students in the United States,

I am so glad that I will be your pen pal. I would like to learn more about your country, and I will tell you more about mine. My name is Olga, and I am 10 years old. I know that you are studying about pathways, so I wanted to share an experience with you.

I live on a peninsula in northeast Russia. Do you know what a peninsula is? It is a stretch of land that juts out into water and is nearly surrounded by water. Do you have any peninsulas in the United States? In September of 1994, a volcano erupted near my town. The name of the volcano was Klyuchevskaya. This volcano is our peninsula's most active volcano. This was the **biggest** eruption in 40 years. I am very glad that I live to the west of the volcano and farther north on the peninsula.

A huge amount of volcanic ash erupted from the top of the volcano. The snow on the volcano and on the nearby mountains turned blackish brown. Winds were blowing toward the southeast, and the volcanic ash covered the ground from the volcano to places over 960 kilometers (600 miles) to the southeast. We are very lucky that the winds blew the ash away from us.

Write back and tell me more about yourself and your country. Do you have any active volcanoes in the United States?

Your friend,  
Olga from Russia

P.S. You can find out more about what happened in my country by visiting <<http://www.earthkam.ucsd.edu>>, <<http://earth.jsc.nasa.gov>>, or <<http://spacelink.nasa.gov>>.

Your jobs:

1. Write back to Olga and answer her questions about peninsulas and active volcanoes.
2. Send her a map of the United States, labeling the peninsulas and active volcanoes.
3. Visit the web sites that Olga mentioned and let her know what you found out about the eruption. Mention at least three facts.
4. Draw a map of the Kamchatka peninsula, locate the volcano, and draw a picture of the path that the ash clouds took.



## Module 4, Investigation 4: Log 1b

### Pen pal letters

Dear students on the “mainland,”

I am so glad that I will be your pen pal. My name is Kuloo, and I am 10 years old. I would like to learn more about the U.S. mainland. The mainland, as my family calls the continental United States, seems so far away.

I heard that you are studying about pathways, and I want to share an experience with you. It is an experience that my family and I had. It was very frightening. But we are all OK. We just had to move.

My family and I live in the state of Hawaii. All of our islands have their own names, beautiful Hawaiian names. My island is called Hawaii. So I really live on the island of Hawaii in the state of Hawaii. People often call our island The Big Island, and that makes it less confusing.

We live on the newest island of all the islands here, on the slopes of the Kilauea volcano. Our island sometimes shakes, rattles, and pours out lava. We lived in a place called Royal Gardens, but we had to move. In 1998, the volcano began pouring out lava from its side. The lava came down the slopes in a path toward Royal Gardens. We had plenty of time to pack up and leave our homes. It was sad to watch our houses burn. This path was called a flow from Pu’u O’o. (The Hawaiian language only has 13 letters in it.)

Write and tell me about the place where you live.

Your pen pal,  
Kuloo from Hawaii

P.S. You can find out more about the lava path on <http://earth.jsc.nasa.gov/Images> or <http://southport.jpl.nasa.gov/imagemaps/html/srl-kilauea.html>.

Your jobs:

1. Visit the web sites that Kuloo mentioned.
2. Write back to Kuloo and let him know what you found out about the lava flow on the web site.
3. Draw a map of the island of Hawaii that shows the Kilauea volcano. If you can find the location of Royal Gardens, show it on your map, and draw the laval flow that reached the town.



## Module 4, Investigation 4: Log 1c

### Pen pal letters

Dear pen pals,

I am so glad that I will be your pen pal. My name is Elizabeth, and I am 10 years old. I would like to learn more about your part of the United States.

I heard that you were studying about pathways. Did you know that some paths change a lot? In my state, Missouri, we talk a lot about the paths of the rivers around us. Sometimes the paths get **very wide** because of heavy rain. And that is when we have floods. Do you have floods where you live? Please write and tell me if you have streams, rivers, or lakes where you live. I like to find out about other places. I want to be a geographer when I grow up.

Back to my story . . . My family and I had to move from our house in St. Louis when the River Des Peres began to overflow its banks. I was only four years old then. We waited until the last minute to leave. The water was already covering the living room floor. When we returned, after the waters went down, our house was filled with mud. My family is very lucky because no one was hurt. Our pets are fine too. But cleaning up that mud was TERRIBLE.

Goodbye for now.

Your pen pal,  
Elizabeth from Missouri

P.S. You can find out more about the flooded river path at [http://observe.ivv.nasa.gov/nasa/exhibits/flood/flood\\_2.html](http://observe.ivv.nasa.gov/nasa/exhibits/flood/flood_2.html) and [http://observe.ivv.nasa.gov/nasa/exhibits/flood/flood\\_3.html](http://observe.ivv.nasa.gov/nasa/exhibits/flood/flood_3.html).

Your jobs:

1. Visit the web sites that Elizabeth mentioned.
2. Write back to Elizabeth. Let her know what you found out about the flood of 1993 from the web site.
3. Send her a map of your state. Label any rivers, lakes, and waterways, and tell her about them.
4. Draw a map of Missouri and the river system, and label the rivers.





## Module 4, Investigation 4: Log 1d

### Pen pal letters

Dear pen pals,

I am so glad that I will be your pen pal. My name is José, and I am 10 years old. I would like to learn more about your part of the United States since I have never visited there.

I heard that you were studying about pathways. Did you know that some paths are **huge**? The path of a hurricane can start off the western coast of Africa and continue across the Atlantic Ocean and north along the coast of the United States. There are many islands that can be in the hurricane path, and my island is sometimes one of them. I live in Puerto Rico. It is a beautiful island.

My family and I watch the weather on television very closely when a hurricane is coming. If it is heading toward Puerto Rico, we cover our windows with boards. We take our bikes, swings, and porch furniture inside so that they won't get blown away. The winds can get very strong. In 1998, a hurricane hit my island, and our house was flooded. The winds were very strong. It was very scary. The hurricane was called "Georges." Most of us lost our electricity. The president said that the U.S. government would send help to the people in Puerto Rico because of the damage.

Have you ever tracked a hurricane's pathway? Do you get hurricanes where you live? If you don't get hurricanes, do you get other strong winds?

Goodbye for now.

Your pen pal,  
José from Puerto Rico

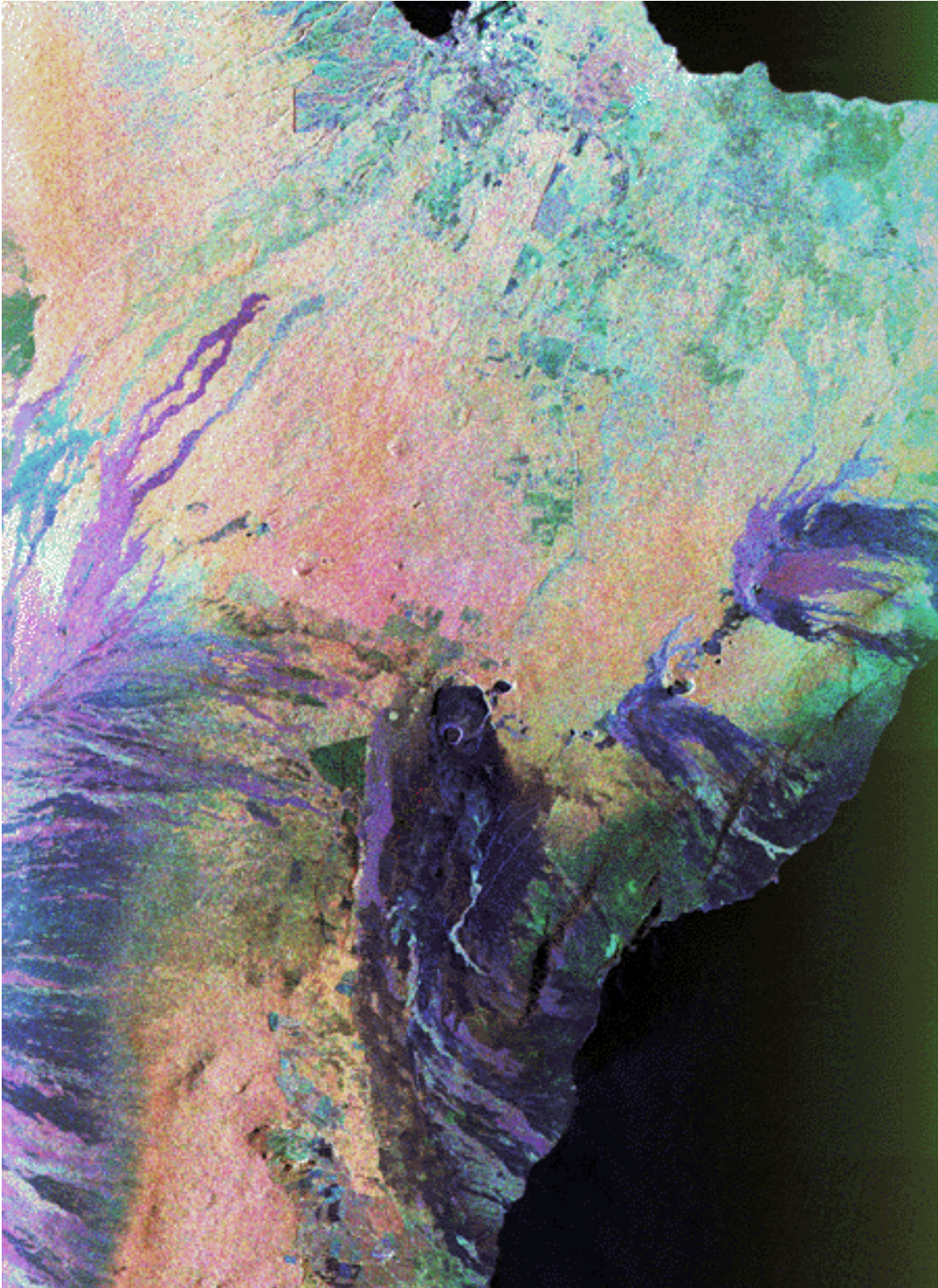
P.S. You can find out more about hurricanes at [http://rsd.gsfc.nasa.gov/rsd/images/Georges/Georges19980921\\_lg.jpg](http://rsd.gsfc.nasa.gov/rsd/images/Georges/Georges19980921_lg.jpg) and <http://dprsj35.er.usgs.gov/public/hurricane.html>.

Your jobs:

1. Visit the web sites that José mentioned.
2. Write back to José and let him know what you found out about hurricanes. Answer his questions about your state.
3. Send him a map of your state labeling important features or places.
4. Draw a map of Puerto Rico and label the water around it.
5. Research the definitions of "hurricanes."
6. Search for more images of hurricanes in other places.



## Module 4, Investigation 4: Figure 1 Hawaii



Source: <http://southport.jpl.nasa.gov/imagemaps/html/srl-kilauea.html>





## Module 4, Investigation 4: Figure 2

### Russia



Source: <http://images.jsc.nasa.gov/images/pao/STS68/10117628.jpg>



## Module 4, Investigation 4: Figure 3 Hurricane Georges



Source: [http://rsd.gsfc.nasa.gov/rsd/images/Georges/GeorgesThree\\_md.jpg](http://rsd.gsfc.nasa.gov/rsd/images/Georges/GeorgesThree_md.jpg)



## Module 4, Investigation 4: Figure 4 Mississippi River flood path



**Before**



**After**

Source: [http://observe.ivv.nasa.gov/nasa/exhibits/flood/flood\\_2.html](http://observe.ivv.nasa.gov/nasa/exhibits/flood/flood_2.html) (before)  
[http://observe.ivv.nasa.gov/nasa/exhibits/flood/flood\\_3.html](http://observe.ivv.nasa.gov/nasa/exhibits/flood/flood_3.html) (after)