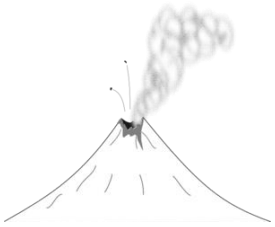
Name_____



Volcanic Decisions

Purpose: to investigate the effects of volcanoes

Events in Earth systems are often disruptive. They affect people, places, and things. Planning ahead and being prepared for the disruptions can save money and lives.

A major volcanic event occurred in Washington in 1980. The eruption of Mount St. Helen's in May of that year caused widespread damage. In this activity, you will explore the damage that occurred during the eruption and plan for a possible, future eruption.

Part 1 – Read the story of Mount St. Helens –

A Slumbering Volcanic Giant

Mount St. Helens was once one of the most beautiful mountains in the entire Cascade Range of the American Northwest. In 1805, William Clark in the Lewis and Clark expedition described Mount St. Helens as "perhaps the greatest pinnacle in America."
The serenity of the mountain and its surroundings was misleading. One of the Indian names for Mount St. Helens was "fire mountain." Local Indians were reluctant to approach the mountain despite the abundant game in the area.

To the experienced observer, the cone shape and composition of rocks on the mountain boldly proclaimed Mount St. Helens' true nature–it was a volcano. Lava flows and multiple layers of ash (powdered volcanic rock) lay everywhere under the carpet of trees–abundant evidence of many prior eruptions. Volcanic deposits had reshaped the region around the mountain. Even beautiful Spirit Lake was a volcanic accident created by a giant mudflow that rolled down the mountain 3,000 years ago and backed up a stream.

Mount St. Helens was active between 1832 and 1857 during the early settlement of the area by Easterners. But the eruptions were small, and the mountain then "dozed off" for the next century. Small settlements became towns, and towns became cities like Portland and Seattle. These new neighbors of Mount St. Helens knew the mountain only as a sleeping giant. Its violent past was largely ignored.

The Awakening

The quiet ended abruptly in March 1980, with a series of steam explosions and bursts of ash. The following story of the eruption of Mount St. Helens illustrates the potential dangers of an eruption from Mount Ranier–a volcano about 120 kilometers southwest of Seattle, Washington. During the months following the initial outbursts, vulcanologists and seismologists watched the mountain closely. Small earthquakes accompanied the bursts and indicated the movement of fresh lava into the heart of the mountain. Enormous cracks appeared in the summit and sides of the mountain, and the entire northern face expanded outward some 137 meters. Locals perceived this initial activity as minor, so in spite of warnings and the designation of the mountain and its surroundings as a dangerous "Red Zone," tourists flocked to the area to get a close view of the fireworks. Residents were strongly advised to move away, but some refused to go. Likewise, logging companies working in the area refused to shut down, claiming to "know the mountain."
Vulcanologists established several camps around the mountain to monitor its activity. Some of the camps had to be dangerously close to the mountain to provide the necessary data. The scientists who manned the camps in shifts knew they were at risk.

The Main Eruption

On May 18, a quiet Sunday morning, a few observers were at their stations, watching Mount St. Helens. Tourists and loggers were also nearby. At 8:32 a.m. a small aircraft with two geologists aboard flew directly over the central cone.

Eleven seconds later, a strong earthquake shook Mount St. Helens. The whole north face of the mountain broke free and slid downward as a giant rock avalanche. In seconds, pressure in the mass of hot lava inside the mountain dropped; water that had been dissolved in the lava turned into superheated steam, fragmenting the lava into a fine powder ash. This mass of superheated steam and ash blasted upward and outward over the top of the avalanche, roaring to the north and west at speeds reaching hundreds of miles an hour. The pilot of the small aircraft narrowly avoided disaster by putting the "plane into a steep dive to gain speed" and turning sharply south, away from the expanding ash cloud.

Every living thing within about 16 kilometers of the volcano on the north side–tree or bush, human or animal, scientist or layman–was destroyed. Some of the people took a few quick pictures.
Then, realizing their situation most ran or tried to drive away from the approaching cloud of dust and steam. The near-supersonic blast of rock, ash, and hot gas engulfed the area with enough force to uproot trees. The temperature within the cloud reached 260C (500F), more than enough to start fires or burn exposed skin. The rock avalanche roared over Spirit Lake and the valley of the North Fork of the Toutle River, burying them under layers of rock up to several hundred feet thick.

Moments after the rush of the avalanche and ash cloud, enormous mudflows–formed when glacial ice and snow that had capped the mountain were melted by the intense heat–surged down the mountain. Masses of mud poured down the nearby river valleys, sweeping away buildings, vehicles, trees, and bridges. One flow even blocked the shipping channel of the Columbia River, 88 kilometers downstream.

Millions of tons of fine ash were thrown high into the air and carried hundreds and thousands of miles downwind. These clouds, visible in satellite images, dropped several inches of ash over many communities and agricultural areas, ruining machines and crops.

The Toll

To the nation, and especially to those living nearby, the May 18 eruption was apocalyptic. The crown and heart of a whole mountain had been blasted away, and the surrounding countryside devastated. The energy released by the eruption was estimated at 10 megatons, an explosion thousands of times stronger than an atomic bomb.

- Thousands of deer, elk, bear, and smaller animals perished–in addition to 57 humans.
- Over 593 square kilometers of forest were destroyed, including three billion board feet of timber estimated at $400 million in value.
- Numerous buildings, bridges, roads, and machines were destroyed, and farms and communities up to 1,600 kilometers away were partially buried in ash.
- One hundred sixty-nine lakes and more than 4,800 kilometers of streams had either been marginally damaged or destroyed.
- Losses to property and crops were set at more than $1.8 billion.

Yet, the impact on human life could have been much greater if the main eruption had occurred on a workday or if the blast had been directed southwest toward the Portland/Vancouver metropolitan area (just 72 kilometers away) or if the wind had been blowing toward the southwest.

As large and destructive as the May 18 eruption appeared, it was a relatively small eruption when seen in context. Thick deposits of older volcanic rock around Mount St. Helens attest to much larger eruptions in its past. Mount St. Helens is also only one of many volcanoes that dot the Cascade Range. All of these volcanoes grew in the same geologic setting. Some eruptions at other Cascade volcanoes have been truly huge, such as the explosion nearly 7,000 years ago–100 times larger than the May 18 eruption–that reduced Mount Mazama to Crater Lake. Eruptions ranging in size from the May 18 eruption to the Mazama blast could occur at any time at any of the Cascade volcanoes. For the metropolitan centers of Portland, Seattle-Tacoma, and San Francisco that have grown up among the Cascade volcanoes, this is a serious concern.

Source: *NASA's Classroom of the Future*. http://www.cotf.edu/ete/modules/volcanoes/vnarrative1.html

For an extended discussion of Mount St. Helens, see http://vulcan.wr.usgs.gov/ljt_slideset.html

Define the following elements of Earth's physical systems:

Hydrosphere: _____

Geosphere: _____

Atmosphere: _____

Biosphere: _____

Part 2 - Use actual images of the Mount St. Helen's area to determine a buffer zone:

1. Look at Figure 1. This is a false color image, which means that the features in the figure do not have the same color as they do in real life. The volcano is in the lower left corner. In this image, the vegetation (plant life) appears reddish and the water appears dark blue or black. Locate the following:
   - Mount St. Helens volcano
   - Spirit lake
   - A river
   - Areas of vegetation

   Have your teacher check this.
2. Write down three changes that you expect to observe in an image taken after an eruption.

   _____

   _____
3. Place a transparency over Figure 1. Mark the corners of the image onto the transparency to line up the other images. With a transparency marker, outline the base of the volcano's cone. Create a key at the bottom of your transparency. Label the first colored line as **Volcano** on the key. *Have your teacher check this*.
4. With a different color transparency pen, draw a line representing the nearest point to the volcano where you think people could safely build houses and businesses. This creates a **buffer zone**.
5. Look at Figure 2, another false color image of Mount St. Helens. This was taken *after* the 1980 eruption. Compare Figure 1 and Figure 2. Write down three changes that occurred.

   _____

   _____
6. With another color transparency pen, trace the extent of the disruption caused by Mount St. Helens' 1980 eruption. Add this color to the key and label it **Damage.** (Figure 2) *Have your teacher check this.*
7. Do you think the area has recovered to the way it was before the eruption in 1980? What is the extent of damage today? Discuss with your team. Sketch your predicted area on the transparency using dashed lines. Add the dashed line to your key and label it **Estimate for Today**. *Have your teacher check this.*
8. How is Figure 4 different from Figures 1 and 2?

   _____

   _____

9. Where has the vegetation around the volcano begun to grow back? Where has it not?

_____

_____

10. Write one reason why some of the areas have recovered from the 1980 blast while other areas still have not.

_____

_____

11. Discuss with your team: Should the area be larger than your last prediction? How should you deal with the areas of regrowth and recovery? With a different color transparency pen, draw a second buffer zone line based on all three images. Record this color on your key and label it **Buffer 2**. *Have your teacher check this.*

12. Write a paragraph discussing both the importance and limitations that buffer zones have when dealing with Earth' s systems.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____