Q1: Describe some of the different types of volcanic eruptions.

Answer: A volcano can erupt in a variety of ways. Some volcanoes, like Mount Pinatubo in the Philippines, undergo violent eruptions. Gases, such as sulfur dioxide, are ejected into the air. Solid ash and/or molten rock also can be expelled into the atmosphere. Other volcanoes do not have violent eruptions. In those cases, molten rock, called lava, oozes out, as it does on Mauna Loa in Hawaii, because there is not enough gas to cause an explosive eruption.

Q2: Identify the sources of volcanic activity on Earth and elsewhere in the solar system that were discussed in the story.

Answer: The story discusses three sources of volcanic activity:

• Volcanoes on Earth result from the movement of Earth's tectonic plates, which are set in motion due to Earth's molten core.

• The volcanoes on Jupiter's moon Io are created when its interior is heated by tidal forces, produced by Jupiter's powerful gravity.

• Some volcanoes were active billions of years ago as the solar system bodies cooled after forming. The extinct volcanoes on Mars are an example of this ancient process.

Q3: Compare and contrast two volcanoes discussed in the story.

Answer: Student answers will vary, depending on their choices. Volcanoes on Earth result from the movement of Earth's tectonic plates. Most volcanoes on Earth are
found at the boundary between plates, where their movement causes friction (and heat). The Mount Pinatubo volcano in the Philippines, the Mount St. Helens volcano in Washington, and Novarupta in Alaska reside in the Pacific “Ring of Fire,” where two tectonic plates meet. Iceland’s Eyjafjallajökull volcano, part of a chain of volcanoes stretching across Iceland, derives its energy from its location along the Mid-Atlantic Ridge, another boundary between tectonic plates. Occasionally, volcanoes are located in the middle of plates where there is a “hot spot,” a place where magma can rise to the surface and erupt as a volcano. The movement of the tectonic plates causes volcanoes to form in a chain when the “hot spot” moves with the plate. The Hawaiian Islands are such an example.

On Io, the volcanoes are the result of gravitational forces exerted by Jupiter. These uneven forces cause Io’s interior to heat up, creating pressure. The pressure is released through volcanic activity. Because Io is small, the force of gravity is weak near its surface. Therefore, plumes of material ejected by Io’s volcanoes rise high into space.

Billions of years ago, as the newly formed Mars was cooling, the planet had many active volcanoes. Unlike Earth, Mars has no tectonic plates. Without moving plates, hot spots of magma remained stationary in one place. The erupting lava, therefore, piled up in one location, forming giant volcanoes such as Olympus Mons, the largest volcano in the solar system. The planet Mercury shows similar volcanic activity.

Q4:
**Identify ways in which volcanoes are both harmful and helpful for people.**

**Answer:**
Student answers will vary. Some of the harmful effects of volcanoes include falling ash, flowing lava, mudslides, and deadly gases that create a wasteland around the erupting volcano. They can be a danger to both life and property. The good effects of volcanoes include producing spectacular scenery and creating rich soils for farming.

**Vocabulary words**

**Active volcano**
A volcano that is either currently erupting or has erupted within the past 10,000 years.

**Astronomer(s)**
A scientist who studies the universe and the celestial bodies residing in it, including their composition, history, location, and motion. Many of the scientists at the Space Telescope Science Institute are astronomers. Astronomers from all over the world use the Hubble Space Telescope.
**Dormant volcano**
A volcano that is not erupting now and has not erupted within the past 10,000 years. However, it is expected to erupt again.

**Extinct volcano**
A volcano that is not expected to erupt ever again.

**Observatory**
A structure designed and equipped for making astronomical observations. Observatories are located on Earth and in space.

**Rocky planet**
A planet located in the inner solar system and made up mostly of rock. The rocky planets are Mercury, Venus, Earth, and Mars. Rocky planets are also known as terrestrial planets.

**Surface gravity**
The strength of the force of gravity at the surface of a celestial body. The more massive the object, the greater the surface gravity.

**Tidal forces**
Forces that are caused when the gravity tugging on one side of a celestial body is stronger than that on the other side, often causing the object to stretch or shift. This force can exist between any two celestial objects that orbit each other. Tidal forces are so named because of their effect on Earth’s oceans.

**Volcano**
A break or vent in the crust of a planet or moon that can spew extremely hot ash, scorching gases, and molten rock. The term volcano also refers to the mountain formed by volcanic material.

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**Education Standards**

**Common Core Standards for English Language Arts**
http://www.corestandards.org/ELA-Literacy/CCRA/R/

**College and Career Readiness Anchor Standard for Reading**

CCSS.ELA-Literacy.CCRA.R.10
Read and comprehend complex literary and informational texts independently and proficiently.
SEE MORE Hubble images and read more Star Witness news stories at **Amazing Space**, NASA’s award-winning educational website for K–12 students and teachers.

http://amazingspace.org/news