Level A reading coming soon.

Where on Earth Are Earthquakes, Volcanoes, and Mountains Found?
Science Vocabulary

earthquake
elevation
lava
magma
physical map
volcano

When a volcano erupts, it can seem like a random event. People used to think so. But there is actually order and patterns in the features and events at Earth's surface. Scientists go about explaining the world by finding these patterns. They use patterns as evidence to explain what causes volcano eruptions, earthquakes, and other natural events. Maps are one of the best tools for finding these patterns.
1. Maps Show Patterns on Earth's Surface

Think about the last time you visited a new place. To get there, you may have used a map or GPS unit that gave you directions. People have been making maps for a long time. Some of the earliest known maps were made on clay tablets over 4,000 years ago. As people learned more about Earth's surface, maps improved. People still use many kinds of maps today.

Maps use symbols, colors and patterns to show locations. They can show different kinds of information. Some show what kinds of plants grow in an area or how many people live there. Maps usually have a key that shows what the different colors and symbols represent.

There are many kinds of maps, but all fall into two basic categories. Political maps show political boundaries, like those between countries. Physical maps show the physical features of an area, like its climate or elevation. Elevation is the height of an area above sea level. Physical maps can also show where bodies of water and deserts are. Some help you see patterns like how the ground slopes in an area.
Scientists create and study many kinds of maps to find patterns. The patterns that maps reveal can give clues about what causes earthquakes, what makes volcanoes, and how mountains form.

2. Earthquakes Occur in Patterns

Suppose that you are in class when, suddenly, the floor sways and shakes. Your teacher tells you to crawl under the desk for protection. Everyone is safe, but what caused the ground to shake? It was a small earthquake.
An **earthquake** is a shaking of the ground caused by the sudden movement of rock underground. An earthquake's movement is similar to that of a rubber band. Picture a rubber band stretched between two pegs that you pull on and then let go. When the rubber band slips, it vibrates. Similarly, rock underground moves. Vibrations move out through the ground from where the rock moved. This is an earthquake. On average, an earthquake happens on Earth about once every 10 minutes. Most of these are small and do not cause any damage. Many are not even large enough to feel.

If you mark places where earthquakes have occurred on a map, you will notice patterns. Some parts of the world almost never get earthquakes while other parts of the world have them often. About 4 out of every 5 of the strongest earthquakes happen in an area around the edge of the Pacific Ocean. One region between the Mediterranean and Asia also has many earthquakes.
An earthquake occurs when rock underground suddenly moves. If you study a map that shows where earthquakes occur, you will notice patterns. Most of the world’s earthquakes happen in an area around the Pacific Ocean.

3. Volcanoes Occur in Patterns
It is so hot deep inside the Earth that the rock is a liquid called magma. This picture shows the surface of a volcano at night. Once the glowing liquid rock reaches the surface, it is called lava.

Many of the areas that have earthquakes are also areas with volcanoes. A volcano is a place where melted rock and other material erupts from deep inside Earth.

If you dig a hole, you will find that the ground is cool. But if you kept digging, after about 100 m (330 ft) you would notice the warmth of Earth underground. It gets hotter the deeper you go. Deep underground, it is so hot that some rock melts. The heat makes the melted rock move and churn. Melted rock under Earth's surface is called magma. In some places, this magma rises to the surface and breaks through during volcanic eruptions. Once magma reaches the surface, it is called lava.

There are many kinds of volcanoes. Some have steep slopes, while others have gentle slopes. As magma comes
toward the surface, gases come out. Sometimes, the gases build up pressure and cause an explosion.

If you look at the map, you can see that there is a pattern of where volcanoes are. Most volcanoes are along the edges of the Pacific Ocean. There are so many volcanoes here that it is called the *Ring of Fire*. A map can show that volcanoes and earthquakes happen in many of the same areas. This is because they both occur at places where there are cracks in the Earth's crust.

Like earthquakes, volcanoes also occur in patterns. Both are found along the edges of the Pacific Ocean. This area is called the Ring of Fire because there are so many volcanoes.
4. Mountain Ranges Occur in Patterns

A mountain is an area with high elevation rising abruptly to a peak. Some mountains are volcanoes, but many are not. Like volcanoes, mountains are formed from movements inside the Earth.

You might notice different colors, shapes, and lines on a physical map. Some areas might look like small bumps sticking out. They represent mountains.

A mountain is an area of land with high elevation that rises to a sharp peak. Some are very tall. The tallest is Mount Everest, which is almost 9 km (5.5 mi) above sea level. Mountainous areas have many steep slopes. A group of many mountains is called a mountain range.

Some mountains are volcanoes or old volcanoes that do
not erupt anymore. In other places, the solid rocks at Earth's surface are pushing up against each other. Very, very slowly, the rocks fold and pile up into mountains.

One type of physical map that shows where mountains are is a *topographic map*. Topographic maps use symbols called *contour lines* to show the elevation of an area. Each line represents a certain elevation. When the lines are far apart, the land is not very steep. The closer together the lines are, the steeper the land.

Like volcanoes and earthquakes, mountains are found in patterns. Most are along the Ring of Fire or in a line between Asia and the Mediterranean Sea. Before people made detailed maps, no one understood the patterns of earthquakes, volcanoes, and mountains. Maps helped scientists discover these patterns.
The Earth’s surface shows a lot of variation, like mountains and valleys. These differences in elevation can be shown using a topographic map, like this one. The contour lines each follow a certain elevation, showing patterns of steepness.

**LESSON SUMMARY**

Where on Earth Are Earthquakes, Volcanoes, and Mountains Found?
1. Maps Show Patterns on Earth's Surface

Maps have been important to people for a long time. There are two main kinds of maps. One kind is a physical map, which shows the features and elevation of an area. Scientists study maps to look for patterns.

2. Earthquakes Occur in Patterns

An earthquake is the shaking of the ground that happens when underground rocks move suddenly. Some maps show where
3. Volcanoes Occur in Patterns Deep under Earth's surface, it is so hot that the rock there is liquid magma. A volcano is a place where lava erupts from deep inside of Earth. If you study a map, you will see that volcanoes also occur in patterns. They are mostly along the edges of the Pacific Ocean in the Ring of Fire.
4. Mountain Ranges Occur in Patterns

Mountains are areas with high elevation. They also form from movements inside Earth and occur in patterns. Many are found in the same areas as earthquakes and volcanoes. Topographic maps show an area's elevation and how quickly it changes. They show mountains and other surface features.

**SUPER SIMPLE SCIENCE**

Watching Vesuvius

Because they can erupt at any moment, active volcanoes can be dangerous. Mount Vesuvius is one found along the coast of Italy. It has been a long time since Vesuvius has caused any harm. But, almost two thousand years ago, its eruption buried cities.
People have lived all around the base of Mount Vesuvius for thousands of years.

In 79 CE, between 10,000 and 20,000 people lived in or near the city of Pompeii in Italy. At the time, many may have believed that volcanoes were active only in the distant past. They knew the story of the hero Heracles. In the story, he traveled along the coast of Italy. He came to a “plain of fire” and saw a hill that “vomited out fire.” This hill was known in Pompeii as Mount Vesuvius.

In 79 CE, Mount Vesuvius had been quiet for hundreds of years. That August, several strong earthquakes shook Pompeii and the nearby city of Herculaneum. But the people did not think this meant anything unusual. Small
earthquakes were common in the area. Also, both cities had survived a larger earthquake just seventeen years before. Scientists know now that earthquakes can be signs of volcanic activity.

Mount Vesuvius began to erupt on the morning of August 24. People could see a large cloud rising from the mountain. The cloud had a strange color and shape. Few had likely seen anything like it before. And many would not survive to tell about it.

This is how the view of Mount Vesuvius erupting may have looked to Pliny the Younger.
A young man named Pliny the Younger later wrote about that fateful morning in the cities surrounding the giant volcano. Pliny lived in a town near Mount Vesuvius. In letters, he wrote what it was like in the days after the volcano started erupting. Pliny's uncle was a commander of Roman ships. Soon after the ash clouds appeared, he learned of people trapped in villages near the volcano. He organized ships to rescue them by boat.

Vesuvius spat so much hot ash, gases, rocks, and lava into the sky that the day was as dark as night. Meanwhile, Pliny saw “broad sheets of fire and leaping flames” from the volcano. The strong earthquakes continued. Buildings shook so hard that people left the cities if they could.

Most people from Pliny's town went to the shore. They saw the sea sucked away and creatures stranded on the beach. As ash continued to fall, people had to stand up from time to time to shake it off and avoid being buried. Finally, Vesuvius quieted and people headed home. Pliny thought the land looked like it was covered in snow.

Many people closer to Vesuvius did not survive. Pliny's uncle and others died during the rescue effort. Pompeii was buried by about 9 m (30 ft) of ash and rock. Herculaneum was buried by mudflows caused by the volcano. And at least 2,000 people were dead.
Scientists have uncovered much of the city of Pompeii. You can see Mount Vesuvius in the distance.

Finding Whole Cities

Pompeii and Herculaneum stayed buried and untouched for nearly 1,700 years. People had not forgotten the cities, but they no longer knew exactly where they were. This changed in 1709, when people digging a well discovered the remains of Herculaneum. They found a wall, which was part of the city's theater. An organized digging of Herculaneum began in 1738. Work at Pompeii began five years later.

Since the 1700s, researchers have uncovered and studied other ancient cities and towns near Vesuvius. Because these places were so deeply buried, they were protected
from weathering and erosion. Also, no one could dig into the ruins to steal or break things. This has created a unique opportunity to learn how people lived so long ago.

Under the volcanic materials, Pompeii and Herculaneum were preserved nearly exactly as they had been in August of the year 79. Scientists have learned about the arts and culture from recovered statues, wall paintings, and tiled floors. The ruins have also told much about the people's daily lives. Scientists have mapped and studied streets, public gathering places, and homes in the cities. They have even found the remains of bread in ovens.

**Watching a Volcano**

While some scientists study the people of Pompeii and nearby cities, others study Mount Vesuvius itself. This deadly volcano has not stayed quiet. It is still active from time to time. A major eruption in 1631 killed 3,000 people. The most recent major event took place in 1944. And, while no eruptions since 79 have been so violent, you might wonder why people continue to live near a dangerous volcano.

One reason people still live in the area is that volcanic materials produce very rich soil. Many crops grow on and around the sloping sides of the mountain. Aside from the rich soil, the coast and surrounding areas are also very
beautiful and have pleasant weather.

This false-color image of Mount Vesuvius was taken from space. The cities surrounding Vesuvius are colored aqua in the image and may be affected when Vesuvius erupts again.

The population near Vesuvius has continued to grow over time. In the late 1700s, people recognized the need to learn more about Vesuvius. Local governments decided to build an observatory on the mountain. It was completed in 1845, and has been in use ever since. Scientists from around the world come to Vesuvius to study volcanoes.

Today, about 3 million people live within the area that Vesuvius could affect. So, it is now more important than ever to keep an eye on the volcano. A network of scientists and machines watch all of the volcanoes along Italy's southwest coast. They expect to be a lot more prepared than the people of long-ago Pompeii and Herculaneum.