Name: _____ Date: _____

Reading: How is movement measured at Mount Everest?

So what happened at Mount Everest?

Millions of years ago, there was not a Himalayan Mountain Range nor Mt. Everest. So, how was Mt. Everest formed? What are some of your initial ideas?

In recent years, earthquakes have been occurring in the Himalayas causing the mountains, and even cities, to move.

How scientists measure earthquakes today

We read about how scientists long ago collected evidence that an earthquake has occurred, but new advances in technology continue to be developed to better measure and predict earthquakes. Scientists want to be able to predict and study earthquake to better plan for and warn people for when they might occur. Today scientists use a global network of GPS data and underground sensors to monitor movement of Earth's surface.

What is GPS data?

GPS stands for Global Positioning System. There are many satellites above Earth that can "communicate" using digital light signals with devices on Earth and pinpoint the exact location of the device. Many people today use a smartphone for directions on how to get to different locations. The map application on a smartphone uses GPS to provide direction. Signals are sent between at least two, but usually three, satellites that are constantly sending signals towards Earth of the satellite's location and devices on Earth receive these signals.

How is GPS data used to measure movement on Earth's surface?

Today scientists use GPS data to keep track of how the Earth is moving. Instead of just three points of satellite data to measure movement, there are 24 satellites above Earth used for collecting this data, making the data very accurate. According to Incorporated Research Institutions for Seismology, each satellite consists of a computer, an atomic clock, and a radio

transmitter. As satellites orbit at approximately 20,000 kilometers (12,500 miles) above the surface, they constantly broadcast their positions through the radio signals. The receivers on Earth need to connect with at least three satellites to obtain a "triangulated" position. The more satellites the receiver can use to triangulate, the more accurate the calculation becomes. Receivers placed near plate boundaries are so precise in their measurements that they can obtain the location of a receiver with less error than the size of a grain of rice!

Below are the names of the 9 major plates (named after land that is on them) and some data about how the plates are moving.

Name of Plate	Average range of speed of movement (mm/yr)	Direction moving
African	215 mm	East
Antarctic	12-14 mm	Northwest
Australian	62-70 mm	Northeast
Euroasian	7-14 mm	South
Indian	26-36 mm	Northeast
Indo-Australian	37-56 mm	Northeast
North American	15-25 mm	West
Pacific	56-102 mm	Northwest
South American	27-34 mm	West

What are some things you notice about the movement of the different plates?

Scientists create large networks of GPS receivers mostly near plate boundaries. If you saw one of these receivers, you would probably not think much of it. They generally have a small fence for protection and a solar panel to power them. They can be wireless, so they would also have a small antenna. The modern GPS receivers are almost real-time, and movement can be seen in seconds

by scientists back at the lab. By using a network of receivers near plate boundaries, scientists can very accurately determine how the plates behave. Plates move about as fast as your fingernails grow.

What about Mount Everest?

In an effort to more accurately track how Mt. Everest is moving, scientists have placed 26 different GPS receivers that are secured into the rocks of the mountains along the Himalayan area. With 24 satellites circling Earth, each receiver can pick up 8 satellites and record the readings to more accurately pinpoint how the land under the receiver is moving. Scientists are also hoping that with more accurate data about Earth's movement, they may be able to more accurately predict when larger, more destructive earthquakes are going to happen, and then they can warn people to prepare ahead of time. One scientist shared, "The relative motion of these points is telling us how the Himalaya is deforming," or how the Himalaya is changing shape, location, and/or size. The result is clear: India is moving northward toward southern Tibet at 18 mm each year, and the high mountains are rising at about 5mm each year.

Use the space below to draw an image of what how this might look on a map:

Now, figure out which direction and speed the plates are moving at your assigned location. Use the reference, *Direction and Speed*, to help locate which plates are at that location.

Sources:

GPS information obtained from:
Incorporated Research Institutions for Seismology (IRIS). (no date). *GPS - Measuring plate motion*. Retrieved from:
https://www.iris.edu/hq/files/programs/education_and_outreach/aotm/14/1.GPS_Background.pdf

Relative plate motions obtained from:

- http://jersey.uoregon.edu/~mstrick/AskGeoMan/geoQuerry29.html
- http://academic.brooklyn.cuny.edu/geology/grocha/plates/platetec21.htm
- https://earthhow.com/indo-australian-plate/