ACTIVITY 1— TAKING A RIDE ON A LITHOSPHERIC PLATE

Background Information

The theory of plate tectonics developed in earnest beginning in the early 1960s. Up until that time most geoscientists had rejected the idea that continents "drifted" through the ocean basins and around the planet, a hypothesis put forth in 1912 by the German meteorologist Alfred Wegener. As evidence amassed in the 1950s and 1960s, it became clear that Wegener had initiated the seeds of a unifying theory of geology — the theory of plate tectonics. Given the difficulty that geologists had accepting the idea of moving continents, it should be no surprise that getting students to understand the details of plate tectonics is not an easy task.

This activity has students find their location using latitude and longitude. The easiest way is to use a topographic map of the area, but the accuracy using this method is quite poor. Use of the Global Positioning System (GPS) has allowed much more precise determination of one's location on the Earth's surface, allowing for errors of less than 25 m. More accurate measurements can be made with large, permanently located GPS instruments over long periods of time. Military instrumentation, which has now been made available to nonmilitary users, allows even closer determinations of exact location.

Absolute motion (motion relative to a fixed reference point, like a point in outer space or a point deep within the Earth that is fixed relative to outer space) can be used to show motion in general, but geologists use relative motion to determine how one plate is moving relative to another nearby plate. This kind of motion can be used to examine how plates probably moved relative to one another in the geologic past and are often used to predict future motions of plates.

The Global Positioning System consists of satellites, ground control stations, and GPS receivers (users). There are 24 GPS satellites that orbit the Earth at a height of 20,200 km. Each satellite takes about 12 hours to complete an orbit. The satellites are spaced so that at least four satellites are always in view of an observer at any point on the Earth, provided that the line of sight is not obstructed by local mountain and valley topography. The satellites are powered by solar cells, and contain computers and extremely accurate clocks. GPS receivers on the ground, at sea, in the air, or in space can lock onto the timing signals from at least four satellites to determine the latitude, longitude, and elevation of the receiver.

GPS uses triangulation from a constellation of satellites to determine four-dimensional (x, y, z, t) space–time locations of "targets" on the Earth's surface. The "target" is the GPS instrument (receiver). The GPS receiver picks up a signal from four satellites. Simply put, a distance from the receiver to each satellite is computed from the arrival times of the signal to each satellite. Then, an exact position in three dimensions and time of measurement can be calculated because the four distance values are known. A calculation of this kind is known as triangulation.

For additional information on GPS technology, visit the *EarthComm* web site.