



What is GPS?

Objective:

Students will learn the history of navigation as well as the basics of the GPS system.

Background:

GPS stands for **G**lobal **P**ositioning **S**ystem. It is a network of 24 satellites with some spares placed into orbit by the Department of Defense (DOD). It works anywhere in the world, 24 hours a day, in all weather conditions, and on land, air or sea. It is based on the coordinate system and the best part is that it is FREE to use!

How did we navigate before GPS? Early sailors and travelers used the sun, stars and landmarks to navigate. They used sextants to make precise observation of the sun, stars, and planets to chart their course. In the 18th century clockmaker John Harrison invented the chronometer. It allowed navigators to know what time it was in two places at once, which helped to determine longitude. In the 1930s radio beacons were used to navigate. Their accuracy level was several miles. The space race in the 1950s and 1960s was the beginning of the GPS navigation system. In 1957 the Russians launched Sputnik, which became the world's first artificial satellite. The radio waves emitting from Sputnik allowed researchers to determine Sputnik's location. This caused them to think they could determine a location on earth from a satellite in space.

The Navy therefore developed TRANSIT in the 1960s to track their fleet of nuclear submarines. This system consisted of three satellites. The problem with TRANSIT was it had low accuracy and was not available 24 hours a day. During this time the Air Force also created their own system to accurately locate vehicles on land or in the air.

In 1973, the Navy and Air Force systems combined and formed NAVSTAR. **NAV**igation **S**atellite **T**iming **A**nd **R**anging (NAVSTAR) is the official DOD name for GPS. The first GPS satellite was launched in 1978. Other satellites have been slowly added since then to complete the constellation. The NAVSTAR system reached full operational capability on April 27, 1995. However, it was first used in combat during Operation Desert Storm in 1991 which also increased public awareness of the system.

The GPS system consists of three segments – Space, Control and User. The Space segment consists of the satellite constellation in space. The Control segment consists of the master control station located at Schriever Air Force Base in Colorado as well as four stations that monitor the satellites and three ground antennas. The User segment consists of the receivers and antennas on Earth that receive the GPS signal.

GPS satellites weigh approximately 2,000 lbs (1 Ton), travel 7,000 mph, last approximately ten years, and are 17 feet across when the solar panels are extended. They are powered by solar energy but do have backup batteries for emergencies. Satellites are orbiting 12,500 miles above the Earth. Each satellite circles the Earth twice daily. The number of satellites in orbit changes, the following website gives information concerning the status of each satellite: <http://tycho.usno.navy.mil/gpscurre.html>.

For more information:

<http://tycho.usno.navy.mil/gps.html>
www.navcen.uscg.gov/gps/default.htm
<http://gpshome.ssc.nasa.gov>

www.4-H.org
www.trimble.com
www.garmin.com

What is GPS? Activity

RECAP:

Ask students the following questions concerning the information provided.

- What difficulties do you think navigators had in using the sun, stars and landmarks to navigate their vessels?
- List three characteristics of a satellite.
- What are the three segments of the GPS system and what do they do?
- Tell about the most interesting thing you learned today about GPS and why.

ACTIVITY:

- Have the students use a compass to navigate around a park or obstacle course you set up.
- At night, have the students attempt to locate the North Star and discuss how easy/hard it would be to navigate with. (Can also discuss the Underground Railroad and how slaves used the Drinking Gourd song and North Star to navigate to freedom)
- The students can do research or write short reports about prior ways people navigated (compass, North Star, sextants, chronometer, etc.) The reports could include the history, positive and negative aspects, who used this method and why, and anything interesting about it. These reports can then be shared with the group.
- Lead a discussion on other ways people can navigate, whether crazy and impossible to realistic.
- Discuss how the students think animals “navigate.” (Sight, smell, hearing, touch, etc.) Students can do research on specific animals if they wanted to.