

Where in the World? The Next Generation of GPS Technology



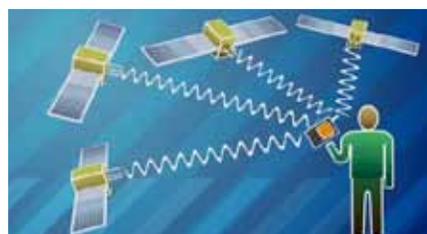
San Diego, CA (SPAWAR Systems Center - Navy) -- The Global Positioning System (GPS), which uses satellites, radio waves, and receivers, helps people determine their location anywhere on Earth. Navy engineers use their math skills and creativity to GPS improve devices and to make portable receivers with atomic clocks.

"GPS is really cool because you can be anywhere on the Earth and know exactly where you are, potentially down to meter or sub-meter accuracies. That's pretty amazing." **Edward Agunos, engineer**

Framework	Standards
Middle School	<ul style="list-style-type: none"> NSES - B.ii.1 ➤ Motion can be described. STL - 2.N ➤ Systems thinking involves how parts relate. STL - 3.E ➤ Systems developed for one setting may be applied to another. STL - 10.G ➤ Invention and innovation play a role. STL - 17.I ➤ Encoding, transmitting, and decoding.

Content Illustrated

- Communication technologies: transmission and reception of signals.



Content



Physical Science

- The radio waves from GPS satellites move at the speed of light (300,000 km/sec).

Earth & Space Science

- Satellites orbit the Earth. They send and receive signals to and from the Earth's surface.

Technology

- GPS is used for navigation in cars, ships, airplanes, and when hiking.
- GPS receivers use the radio wave signals sent from four different satellites to locate position. The calculations are based on the amount of time it takes for the signals to travel.
- An atomic clock is a clock derived from the oscillation frequencies of certain atoms in a crystal. GPS clocks use Rubidium crystals.

Engineering

- Engineers develop and test receivers, making sure they are accurate and can't be jammed by interference.
- Engineers are developing a tiny GPS receiver called a "navigation nugget," which uses a chip-scale atomic clock.

Math

- GPS uses the velocity of light to calculate location by using the formula: distance = time x velocity.

Guiding Questions

To think about as you watch:

- How long does it take light to travel from the moon to the Earth?
- How does a GPS system calculate distance using time and the speed of light?

Suggested Activities

- Calculate distance, given the velocity and time.
- Link this webisode to a unit on maps.
- Research how clocks have been used in navigation.
- Find out how satellites are used other than for GPS.

Keywords

atomic clock
global position-
ing system (GPS)
interference
oscillation
radio waves
receiver
Rubidium
satellite
velocity

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