Name: _____ Date: _____

How GPS Finds You

Circle group

A phone can show your spot as a blue dot on a map. It does this with satellites that orbit high above Earth. The system is called GPS, which stands for Global Positioning System. More than thirty satellites circle the planet. Each one sends out a radio signal. The signal holds the exact time it was sent.

Your phone does not send anything to the satellites. It only listens. A radio signal moves at the speed of light. The phone checks when the signal was sent and when it arrived. This tells the phone how far away that satellite is. The delay is tiny, only a fraction of a second. So the clocks must be very exact. Each satellite has atomic clocks for this reason.

One distance is not enough. One satellite only says the phone is somewhere on a huge imaginary sphere around it. A second satellite shrinks the spots to a circle where two spheres overlap. A third leaves just two points, and one is usually far out in space. A fourth signal helps the phone fix its own clock, which is less exact. Then it can find its spot and even its height above the ground.

Tall buildings, deep canyons, and tunnels can block or bounce the signals. That is why the blue dot sometimes drifts in a big city. Still, GPS usually puts a phone within a few meters. Drivers, pilots, farmers, and hikers use it. The same timing signals help keep cell networks in step.

Questions

1. What does each GPS satellite send out?

_____

_____

2. Does the phone send signals to the satellites?

_____

_____

3. How does the phone learn how far away a satellite is?

_____

_____

4. Why must the clocks be very exact?

_____

_____

5. Why might the blue dot drift near tall buildings?

_____

_____

Words to know

satellite: an object that circles a planet in space
orbit: to travel in a curved path around something
signal: a message sent by waves, such as radio
sphere: a perfectly round ball shape

Talk together (every group has these)

1. Find one fact that every group read. How did your sheet say it?
2. What did your sheet tell you that you think another group's did not? Ask them.
3. What is one question about this topic that none of the sheets answered?

Name: _____ Date: _____

How GPS Finds You

Triangle group

When a phone shows your position as a blue dot on a map, it is using a system of satellites that orbit high above Earth. The system is called GPS, short for Global Positioning System. More than thirty satellites circle the planet, and each one constantly broadcasts a radio signal that includes the exact time the signal was sent.

Your phone does not send anything to the satellites. It only listens. A radio signal travels at the speed of light, so by comparing the time a signal was sent with the time it arrived, the phone can work out how far away that satellite is. The delay is tiny, only a fraction of a second, so the clocks involved must be extremely accurate. Each satellite carries atomic clocks for exactly this reason.

One distance by itself is not enough. A single satellite only tells the phone that it is somewhere on a huge imaginary sphere around that satellite. With a second satellite, the possible locations shrink to a circle where two spheres overlap. A third narrows it to just two points, and one of those is usually far out in space. A fourth signal helps the phone correct its own less precise clock, so it can fix its position and even its height above the ground.

Tall buildings, deep canyons, and tunnels can block or bounce the signals, which is why the blue dot sometimes drifts in a big city. Even so, GPS usually places a phone within a few meters. Delivery drivers, pilots, farmers, and hikers all depend on it, and the same timing signals help keep cell networks in step.

Questions

1. What does each GPS satellite broadcast?

_____

_____

2. Does the phone send signals to the satellites?

_____

_____

3. How does a phone work out its distance from a satellite?

_____

_____

4. Why must the clocks used in GPS be extremely accurate?

_____

_____

5. Why might the blue dot drift among tall buildings?

_____

_____

Words to know

satellite: an object that circles a planet in space
orbit: to travel in a curved path around something
signal: a message sent by waves, such as radio
accurate: exactly correct, with very few mistakes
sphere: a perfectly round ball shape

Talk together (every group has these)

1. Find one fact that every group read. How did your sheet say it?
2. What did your sheet tell you that you think another group's did not? Ask them.
3. What is one question about this topic that none of the sheets answered?

Name: _____ Date: _____

How GPS Finds You

Square group

When a phone displays your position as a blue dot on a digital map, it is relying on a constellation of satellites that orbit far above Earth. This arrangement is known as GPS, which is short for Global Positioning System. More than thirty satellites circle the planet, and each one continuously broadcasts a radio signal that contains the precise moment at which that signal was transmitted.

Your phone never transmits anything to the satellites; it merely listens. Because a radio signal travels at the speed of light, the phone can compare the time a signal was sent with the time it was received and thereby calculate how far away that satellite is. The delay is minuscule, only a fraction of a second, so the clocks involved must be extraordinarily accurate. For exactly this reason, each satellite carries atomic clocks.

A single distance, however, is not sufficient. One satellite can only reveal that the phone lies somewhere on an enormous imaginary sphere centered on that satellite. A second satellite narrows the possible locations to a circle where the two spheres overlap. A third reduces the candidates to just two points, one of which is usually located far out in space. A fourth signal allows the phone to correct its own less precise clock, so that it can determine both its position and its height above the ground.

Tall buildings, deep canyons, and tunnels can block or reflect the signals, which explains why the blue dot occasionally wanders in a crowded city. Nevertheless, GPS typically places a phone within a few meters of its true location. Delivery drivers, pilots, farmers, and hikers all depend on it, and the same timing signals also help keep cell networks synchronized.

Questions

1. What information does each GPS satellite include in the signal it broadcasts?

_____

_____

2. Does a phone send any signals to the satellites?

_____

_____

3. How can a phone calculate its distance from a satellite?

_____

_____

4. Why do the clocks in the GPS system need to be extraordinarily accurate?

_____

_____

5. What could explain the blue dot wandering in a crowded city?

_____

_____

Words to know

satellite: an object that circles a planet in space
orbit: to travel in a curved path around something
signal: a message sent by waves, such as radio
accurate: exactly correct, with very few mistakes
sphere: a perfectly round ball shape

Talk together (every group has these)

1. Find one fact that every group read. How did your sheet say it?
2. What did your sheet tell you that you think another group's did not? Ask them.
3. What is one question about this topic that none of the sheets answered?

For the teacher: How GPS Finds You

Each student sheet carries a shape, not a level. The same topic and facts, written three ways.

Circle: How GPS Finds You

Easier · 250 words · Flesch-Kincaid grade 4.4

1. A radio signal that holds the exact time it was sent.
2. No. It only listens.
3. It checks when the signal was sent and when it arrived.
4. The delay is only a fraction of a second, so a small mistake would give a wrong distance.
5. The buildings can block or bounce the signals.

Triangle: How GPS Finds You

This passage · 272 words · Flesch-Kincaid grade 8.3

1. A radio signal that includes the exact time it was sent.
2. No. It only listens.
3. It compares the time the signal was sent with the time it arrived.
4. The signal's delay is only a fraction of a second, so a tiny clock error would give a wrong distance.
5. The buildings can block or bounce the satellite signals.

Square: How GPS Finds You

Harder · 285 words · Flesch-Kincaid grade 10.9

1. The precise time at which the signal was sent.
2. No. It merely listens.
3. By comparing the time the signal was sent with the time it was received.
4. The signal's delay is only a fraction of a second, so even a tiny clock error would produce a wrong distance.
5. Tall buildings can block or reflect the satellite signals.