



Introduction to Satellites: K-5 Script

Objective

By the end of the lesson students will be able to: (1) define and understand the types of satellites; (2) understand the parts of satellites; (3) define and understand the uses of satellite imagery; (3) define and discuss the history of aerial mapping; (4) understand what GPS is.

Prepare for Lift Off!

Welcome to the crew of the USGIF Explorer! We're on a mission to fly to space and learn all about satellites. Before we lift off, you need to learn some basics and prove you've earned your spot aboard our ship.

USGIF

The United States Geospatial Intelligence Foundation, also known as the USGIF, is an educational nonprofit dedicated to promoting geospatial intelligence (GEOINT).

GEOINT

GEOINT, short for Geospatial Intelligence, is using maps, satellites, drones, and sensors to gather and visualize data in order to make a decision. GEOINT can be applied to most career fields.

1, 2, 3... Lift Off!

Spectacular! Because you learned your basics, we can now blast off into space.

Satellite Basics

Our mission is to gather as much intelligence (or information) on satellites as we can while we are in space. Wait... we probably should have checked to see if you knew anything about satellites before we brought you aboard. Oh well, it's too late now. Let's get you up to speed!

What is a Satellite?

What is a satellite? A satellite is something that orbits, or travels around, a planet or other object.

Natural Satellites

The Earth is considered a satellite, because it orbits the sun. The moon orbits the Earth, making it a satellite as well. These are examples of natural satellites. Today, we will be

learning about artificial, or manmade, satellites. That means that they were built by a person, rather than found in nature.

Artificial Satellites

Artificial satellites are launched into space aboard a rocket. They are then placed into orbit, meaning they follow a specific path around a planet or other point, in order to collect information.

Artificial Satellites

Some of these satellites have big cameras in them to take pictures of the Earth. Satellites provide us with a birds-eye view, or view from above, so we can learn new information we cannot see from the ground with our eyes.

Artificial Satellites

Because satellites orbit above clouds, they show us space more clearly than telescopes on Earth can.

Satellite Launch

Let's watch a video of a satellite being launched into orbit

Sputnik 1

In 1957, Russia launched Sputnik 1, the first satellite sent into space.

Sputnik 2

Russia then launched Sputnik 2, a satellite carrying Laika the dog, into space. Laika was the first living thing to orbit the Earth.

Explorer 1

The United States launched their first satellite, Explorer 1, in 1958.

Parts of a Satellite

Sputnik was a very simple satellite. It was about the size of a beach ball, made of aluminum, battery powered, and just had a few antennae and radio transmitters. Today, satellites look very different. The goal when building a satellite today is to make it as strong and light as possible. It needs to be able to withstand space travel, but still be light and easy to fly. Let's spend some time discussing the different parts of a satellite. The parts of a satellite include the satellite body, antennae, special equipment, solar arrays, and protective shielding.

Satellite Body

The body of a satellite houses all of the computer parts that make the satellite work.

Antennae

Attached to the satellite body are antennae. Antennae are wires that give and take radio or television signals.

Special Equipment

Also attached to the satellite body are whatever special equipment the designer has included, like cameras or telescopes.

Solar Arrays

As we said earlier, Sputnik was battery powered. Today, satellites rely on solar power. Solar power draws energy from the Sun. The solar panels attached to the satellite are called arrays and resemble wings.

Protective Shielding

Space is a very harsh environment, and over time can do a lot of damage to objects moving around there. Satellites have some sort of protective shielding to protect them from their dangerous surroundings.

How Big Are Satellites?

Satellites come in many different sizes. The biggest satellites are as big as a small school bus. As technology advances, satellites can be made faster, cheaper, and smaller.

Small Sats

Today, we have more and more small satellites, called “small sats”, being launched into space. These satellites are similar to the size of a shoebox. While the pictures taken by small sats are not as good as those taken by larger satellites, they can send information back to us much faster.

Cube Sats

Cube satellites or “cube sats” are even smaller than small sats. These are about the size of a tissue box and can be held in one hand.

Doves Launch

Let’s watch a video of Planet’s CubeSats “Doves” being launched from the International Space Station.

How Many Satellites are There?

There are thousands of satellites in space. There isn’t an exact number because satellites are always being sent into space and others are being turned off. As of now, there are almost 3,000 satellites in orbit.

Let’s Get Orbital

Now that you are a satellite expert, we need your help! In order for us to get our rocket into orbit, we need to be going much faster. You’ve been challenged to a pop quiz, and every correct answer will give us a speed boost until we are safely in orbit.

Question #1

Is the moon a natural or artificial satellite?

Answer

The answer is natural satellite! The moon is a natural satellite because it travels around the Earth but is not manmade.

Question #2

Which was the first living thing to orbit the Earth?

- A. Chicken
- B. Dog
- C. Human
- D. Alien

Answer

The answer is B, Dog. Russia sent Laika the dog into orbit aboard Sputnik 2

Question #3

Where do the solar panels used to power satellites get their energy from?

- A. Batteries
- B. Space dust
- C. Wind
- D. The Sun

Answer

The answer is D. the Sun. Solar panels get their power from the Sun's energy.

Question #4

What do we call a satellite the size of a tissue box?

- A. Sneeze Sat
- B. Tissue Sat
- C. Cube Sat
- D. Rubik's Sat

Answer

The answer is C. Cube Sat. Cube sats are even smaller than small sats and can typically be held in one hand.

Mission Success

Stellar job. Thanks to you, we are moving fast enough to get into orbit. Now that we are here, let's learn about the different types of satellites we will see up here!

Types of Satellites

There are many different types of satellites that are used for a specific purpose, including weather, navigation, communications, earth observation, astronomical, manned space stations, and spy satellites.

Weather Satellites

Weather satellites track weather patterns and measure things like rain, temperature, and more extreme events like hurricanes and tornados.

Weather Satellites

We can track hurricanes using satellites to see where a hurricane will make landfall to help people prepare.

Navigation Satellites

Navigation satellites are used to find the exact location of a GPS receiver like your phone or your parent's phone on the Earth's surface.

What is GPS?

What is GPS? GPS is a navigation system that allows you to determine your exact location anywhere in the world

How GPS Works

Let's watch this video to learn more about how GPS works.

Flash Quiz

Can you think of some of your favorite apps that use GPS to work?

GPS Apps

So many of the apps we use and love require GPS. Social media platforms like Instagram and Snapchat, navigation apps like Google Maps, and games like Pokémon Go all rely on GPS to get the job done.

Communications Satellites

Communication satellites work so that we can get internet, telephone, radio, and television access

Earth Observation Satellites

Earth Observation Satellites are used to photograph and study the Earth. Earth observation satellites monitor the environment, our natural resources, and are used for projects that help people in need.

Astronomical Satellites

Astronomical satellites take pictures of space. The Hubble Space Telescope is an astronomical satellite that has taught us a lot about stars and space through its photos.

Manned Space stations

Manned Space Stations are a type of satellite that people can live on. The International Space Station is a space lab where scientists can perform experiments to better understand space.

Spy Satellites

Spy satellites are used to monitor things happening on the ground. Satellite images are used to see information that is usually invisible (or hidden), like the growth levels of a country's crops or the heat given off by certain buildings.

Houston, We Have a Problem

Oh no, we have an emergency! There is an asteroid barreling toward our ship. You need to answer these questions to change our orbit path and guide us to safety.

Question #1

What type of satellite helps you watch your favorite TV show?

- A. Spy satellite
- B. Communications satellite
- C. Earth Observation satellite
- D. Astronomical satellite

Answer

The answer is B, Communication satellites. Communication satellites give us television access.

Question #2

What kind of satellite can a person live on?

- A. Manned space station
- B. Weather satellite
- C. Spy satellite
- D. Communications satellite

Answer

The answer is A, a manned space station. The International Space Station is an example of a satellite that astronauts live on.

Questions #3

Can you name an app you use that relies on GPS, or navigation satellites?

Answer

There are lots of possible answers here.

- Google Maps
- Instagram
- Facebook
- Pokémon Go

Thank Our Lucky Stars

Awesome work! Because of your quick thinking, we were able to adjust our path and avoid collision. Now let's turn our attention to the flight paths of satellites.

How fast does a satellite travel?

How fast does a satellite travel? There is no exact number, but the best estimate is about 17,000 miles per hour. Satellites in lower orbit are going faster than 17,000 and satellites in higher orbit are going less than 17,000. For some perspective, a cheetah can run up to 58

miles per hour, some cars can go up to 250 miles per hour, a plane can go up to 575 miles per hour. Satellites are moving super-fast!

What is satellite imagery?

What is satellite imagery? Satellite imagery refers to photos of the Earth and other planets taken by satellites with cameras. These satellites are used by governments and businesses around the world. Let's learn about the history of aerial mapping.

Aerial Mapping

Aerial mapping allows us to get a better and more accurate view of the land, or a "birds eye view".

History of Aerial Mapping

During the Civil War, armies used hot air balloons to gather information on enemy troops. Can you think of some advantages (good things) and disadvantages (bad things) of using a hot air balloon to take aerial images?

Advantages:

- It provides a better view than what we can see standing on the ground
- This helped soldiers during the war learn new information about enemy groups

Can you think of some disadvantages of using a hot air balloon to gather intelligence?

Disadvantages:

- The time it takes to build the balloon and then take it apart could cost a lot of money
- If you've ever seen a hot air balloon before than you know they are easy to spot in the sky. This is bad in a war situation because your enemy can spot you from far away

Pigeon Photography - WWI

During WWI, the balloon was upgraded to carrier pigeons. People put cameras on the pigeons, sort of like how you wear your backpack to school. They then used the pigeons to fly over enemy areas, taking photographs from above. What are some advantages to using pigeons to take pictures?

Advantages:

- Pigeons are much smaller than hot air balloons. This means they cannot be as easily spotted by enemies
- Pigeons can fly further and higher than a balloon
- Cameras had become much more high-tech than those used during the Civil War, making better pictures

What are some disadvantages?

Disadvantages:

- Pigeons are animals with minds of their own. They may not fly back! For those of you with dogs, do they come every single time you call them? It takes a lot of training for animals to be reliable
- If the camera breaks, there is no human flying the pigeon to fix it. The pigeon could come back with no pictures, and the whole expedition was a waste!

U-2 Spy Planes – WWII

During WWII, pigeons were upgraded to spy planes. Cameras were attached to the planes and would fly over areas of interest. What are some advantages of a spy plane?

Advantages

- Spy planes are very hard to see from the ground, meaning they are stealthy.
- There are human pilots on the plane. This is great because they can make quick decisions as the photos are being taken.
- Technology advanced further by World War II, making the photos easier to see.

Can you think of any disadvantages?

- It costs a lot more money to fly a plane than it does to fly a pigeon.

Satellite Imagery

Like we discussed earlier, we now rely on satellites to take images of the Earth from space.

Uses of Satellite Imagery

What are some uses of satellite imagery, and how does it relate to geospatial intelligence? Satellite images are very important in solving real world problems as they collect information about a specific place on the Earth that you cannot see from the ground.

- **Natural Disasters:** Satellite imagery is very useful during dangerous weather events. For example, we can look at satellite images before and after Hurricane Harvey in Houston to see how the city changed after the hurricane. You can use the photos to see where people were trapped, where roads were blocked, and other ways to help save lives.
- **Climate Change:** Scientists look at satellite images of locations around the world over time in order to determine things like oceans rising, or ice melting.
- **Archaeology:** Archaeologists use satellite imagery to look for and analyze historic sites.
- **Natural Resources:** The forestry, mineral, and oil industries use satellite images to monitor and mine these resources.

Journey Home

Our time in space is coming to a close. To bring us back down to Earth, you'll need to answer these questions.

Question #1

Why did the United States begin using pigeons instead of hot air balloons during World War I to take aerial images?

- A. Pigeons are easier to control
- B. Pigeons are cuter than hot air balloons
- C. Pigeons are harder to see than hot air balloons
- D. Pigeons have a human pilot

Answer

The Answer is C, pigeons are harder to see than hot air balloons. They are much smaller and more difficult to spot.

Question #2

Can you name an example of a use for satellite imagery?

Answer

Studying hurricanes, oil mining, how many trees have been cut down in a specific area, and many other examples.

Intergalactic!

Fantastic job. Space has been fun, but I'm starting to miss gravity. It's time to begin our descent back to Earth.

The Eagle has Landed

Mission accomplished! Thank you for joining us on this intelligence gathering mission. You helped us narrowly avoid disaster multiple times, and hopefully learned a thing or two about satellites. Now it is time to use what we taught you and tackle some activities.