ASTROEDU

Peer-reviewed Astronomy Education Activities

Build Your Own Artificial Satellite

Build a satellite to learn what they are made of and their uses.

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KEYWORDS

Artificial Satellites

LOCATION

Small Indoor Setting (e.g. classroom)

AGE

8 - 10

LEVEL

Primary, Secondary

TIME

1h30

GROUP

Group

SUPERVISED

Yes

COST

Low Cost

SKILLS

Developing and using models, Communicating information

TYPE OF LEARNING

Interactive Lecture, Discussion Groups, Modelling

GOALS

Learn about artificial satellites and their appearance, orbits, functions, and importance in our daily life.

LEARNING OBJECTIVES

- Students will be able to explain what satellites are, what they look like, their function, and their importance in society.
- Students will build their own model satellite to recognise the components and engineering challenges of building satellites.
- Students will discuss the strengths and weaknesses of their model satellite and describe the importance of building models

BACKGROUND

What is a satellite?

A satellite is an object (e.g., Moon, planet or machine that orbits a planet or star). For example, Earth is a satellite because it orbits the Sun. Likewise, the Moon is a satellite because it orbits Earth.

The Earth and Moon are examples of natural satellites. In astronomy, the word 'satellite' usually refers to a machine launched into space to orbit the Earth or another space object. Thousands of artificial satellites orbit Earth. Some take pictures of Earth to help meteorologists predict weather and track hurricanes, while others take pictures of other planets, the Sun, black holes or faraway galaxies. These pictures help scientists better understand our Solar System and universe.

Most satellites orbiting Earth, however, are used for communication, such as beaming TV signals and phone calls around the world. The Global Positioning System (GPS), a key navigation tool, is a group of more than 20 satellites. If you have a GPS receiver, these satellites can determine your exact location.

Why Are Satellites Important?

Satellites can see large areas of Earth at a time. This enables them to collect more data quicker than instruments on the ground.

Satellites also can see into space better than telescopes on Earth's surface. This is because they fly above the clouds, dust and molecules in the atmosphere, which block certain wavelengths of light from reaching the ground.

TV signals didn't go very far before the advent of satellites. They travel in relatively straight lines and quickly trail off into space rather than following Earth's curve. Sometimes mountains or tall buildings would block them. Making phone calls to faraway places were also a problem. Setting up telephone wires over long distances or underwater is difficult and expensive.

With satellites, TV signals and phone calls can be sent up toward a satellite and almost instantly bounced back to different locations on Earth.

What Are the Parts of a Satellite?

Satellites come in many shapes and sizes. Most have at least two parts in common, an antenna and a power source. The antenna sends and receives information, often to and from Earth. The power source can be a solar panel or battery. Solar panels make power by turning sunlight into electricity.

Many satellites carry cameras and scientific sensors. Sometimes these instruments point toward Earth to gather information about our land, air and water. At other times, they face towards space to collect data from our Solar System and universe beyond.

How Do Satellites Orbit Earth?

Most satellites are launched into space on rockets. A satellite orbits Earth when its speed is balanced by the pull of Earth's gravity. Without this balance, the satellite would fly in a relatively straight line off into space or fall back to Earth. Satellites orbit Earth at different heights, different speeds and along different paths. The two most common types of orbit are 'geostationary' (jee-oh-STAY-shun-air-ee) and 'polar'.

A geostationary satellite travels from west to east over the equator. It moves in the same direction and at the same rate as Earth's spin. From Earth, a geostationary satellite looks like it is standing still since it is always above the same location.

Polar-orbiting satellites travel in a north-south direction, from pole to pole. As Earth spins underneath, these satellites can scan the entire globe, one strip at a time.

Why Don't Satellites Crash Into Each Other?

Actually, they can. NASA and other international organizations keep track of satellites in space. Collisions are rare because when a satellite is launched, it is placed into an orbit designed to avoid other satellites. But orbits can change over time. And the chances of a crash increase as more and more satellites are launched into space.

In February 2009, two communications satellites - one American and one Russian - collided in space. This, however, is believed to be the first time two artificial satellites have collided accidentally.

FULL DESCRIPTION

Billions of people around the globe watch television, surf the internet, use phones, and use maps or navigation systems. Satellites are often involved in all these cases and play an important role in daily life. At the end of the lesson, the students will know what artificial satellites are, how they look, about their orbits, their

functions, and how many there are. At the end of the activity, the students will make a satellite and explain the function of their satellite.

Step 1:

Show the video 'What are Satellites?' http://youtu.be/lUaxDI9CSB0 and discuss why they are important, how do they orbit Earth, why don't they crash into each other, etc. Please refer to the background information. Following the discussion, show the video 'How Do Satellites Work' http://youtu.be/54MSV2B399o

NOTE: If you don't have access to the videos, you can start the activity by discussing the topics from the background information.

Step 2:

Encourage students to ask their own questions about satellites, and share them with the class. The questions don't necessarily need to be answered. The teacher could explain that a way to help investigate the answers to such questions is to build a model.

Step 3:

Discuss the basics parts of a satellite and show the video 'Parts of a Satellite' http://sciencelearn.org.nz/Contexts/Satellites/Sci-Media/Video/Parts-of-a-satellite Highlight the most important parts: * Antennas and transceivers: to send and receive radio signals to and from the Earth or another satellite * Rocket motors: to move the satellite in space, to put it into orbit or course correction; * Fuel tanks: to store fuel for the rocket * Solar panels: to generate electricity * Batteries: to store the electricity generated * On-board processors: to provide processing capabilities to the satellite

Step 4:

Show the following examples of satellites: * Telecommunications, Artemis: An artist's impression of Artemis. Carrying three payloads plus a number of experiments, ARTEMIS (Advanced Relay and Technology Mission Satellite) tests and operates new telecommunications techniques. * Research, Hubble space telescope: This illustration shows the NASA/ESA Hubble Space Telescope in its high orbit, 600 kilometres above Earth. * Weather satellite, Metop: MetOp is a series of three polar orbiting meteorological satellites operated by the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT) * Navigation satellite, GPS: The Global Positioning System (GPS) is a space-based navigation system that provides location and time information in all weather conditions, anywhere on or near the earth where there is an unobstructed line of sight to four or more GPS satellites. The system provides critical capabilities to military, civil and commercial users around the world. The United States government created the system, maintains it, and makes it freely accessible to anyone with a GPS receiver.

Step 5:

Provide each student (or a group) with materials to build an artificial satellite. Encourage students to be creative. Explain that students need to decide the satellite function, how a satellite would need to look or be constructed, and what type of orbit it would need to serve its function.

Step 6:

When students are finished building their satellites, ask them to present it to the class explaining its components, functions, and use. Encourage classroom discussion by asking questions.

Suggested teacher questions to spark discussion: * Why is it useful to build models? * What are the strengths and limitations of this model satellite? * What aspects of a satellite does the model represent well, and what can be improved? * What can we learn from this model? * How could we improve the model? * How is it important to the society?

EVALUATION

- Students are asked to explain what satellites are, what they look like, their function, and importance in society.
- Students successfully build their model satellite, and are prompted to describe the different components of their satellite.
- Students are prompted to discuss why it is useful to build models.

CURRICULUM

Country	Level	Subject	Exam Board	Section
UK	KS2: Year 5	Science	-	Earth and Space: the idea of the Earth's rotation.
UK	KS2: Year 4	Science	-	Electricity: identify common appliances that run on electricity.

ADDITIONAL INFORMATION

What Is a Satellite? http://www.nasa.gov/audience/forstudents/5-8/features/nasa-knows/what-is-a-satellite-58.html

Satellite Facts for Kids: http://www.sciencekids.co.nz/sciencefacts/space/satellites.html

CONCLUSION

By building a satellite using household materials, students learn about artificial satellites, their functions and importance to society.

CITATION

Kolman, V., , *Build Your Own Artificial Satellite*, astroEDU, 1413 doi:10.11588/astroedu.2014.2.81343