

Answer Key Activity 1

Next Generation Science Standards:

The following NGSS standards are addressed through the use of the GOES-R activities as they were integrated into our environmental units. The NGSS Science and Engineering Practices and Crosscutting Concepts are also included for the GOES-R activities.

We have offered suggestions on the Next Generation Science Standards that we feel fit in with the GOES-R activities. These activities were included within a much larger environmental unit. We have also included the NGSS Science and Engineering practice and Crosscutting Concepts that we feel apply to the GOES-R activities.

ESS2.D: Weather and Climate

- Weather and climate are influenced by interactions involving sunlight, the ocean, the atmosphere, ice, landforms, and living things. These interactions vary with latitude, altitude, and local and regional geography, all of which can affect oceanic and atmospheric flow patterns.
- Because these patterns are so complex, weather can only be predicted probabilistically.
- The ocean exerts a major influence on weather and climate by absorbing energy from the sun, releasing it over time, and globally redistributing it through ocean currents.

ESS3.D: Global Climate Change

- Human activities, such as the release of greenhouse gases from burning fossil fuels, are major factors in the current rise in Earth's mean surface temperature (global warming). Reducing the level of climate change and reducing human vulnerability to whatever climate changes do occur depend on the understanding of climate science, engineering capabilities, and other kinds of knowledge, such as understanding of human behavior and on applying that knowledge wisely in decisions and activities.

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Science and Engineering Practices - NGSS:

The eight practices of science and engineering that the Framework identifies as essential for all students to learn and describes in detail are listed below:

1. Asking questions (for science) and defining problems (for engineering)
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations (for science) and designing solutions (for engineering)
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information

Crosscutting Concepts - NGSS:

1. Patterns. Observed patterns of forms and events guide organization and classification, and they prompt questions about relationships and the factors that influence them.
2. Cause and effect: Mechanism and explanation. Events have causes, sometimes simple, sometimes multifaceted. A major activity of science is investigating and explaining causal relationships and the mechanisms by which they are mediated. Such mechanisms can then be tested across given contexts and used to predict and explain events in new contexts.
3. Scale, proportion, and quantity. In considering phenomena, it is critical to recognize what is relevant at different measures of size, time, and energy and to recognize how changes in scale, proportion, or quantity affect a system's structure or performance.
6. Structure and function. The way in which an object or living thing is shaped and its substructure determine many of its properties and functions.
7. Stability and change. For natural and built systems alike, conditions of stability and determinants of rates of change or evolution of a system are critical elements of study.

Understanding Satellite Orbits

In this activity you will be exploring satellite orbits.

Time: Activity 1:	Introduction	15 minutes
	Activity 1.1 with discussion	15 minutes
	Activity 1.2 with discussion	20-25 minutes
	Activity 1.3 with discussion	20-25 minutes

Activity 1.1 Satellites

1. Define satellite in your own words.

A satellite is an object that orbits around another object. A satellite may be artificial, GPS, Weather, Communications, etc... or natural like the moon. We are going to focus on artificial satellites.

2. Explain how satellites may aid us on a daily basis.

Satellites help provide us with weather forecasts, music choices, television, navigation, communications and research.

Activity 1.2 Orbits

Use the [Why do satellites have different orbits?](#) link to help complete the following:

1. Compare and contrast polar satellite orbits to geostationary satellite orbits.

Comparison:

Both polar and geostationary satellites travel around the Earth in paths called orbits. Their orbit height is dependent upon their purpose. They both can be used to monitor weather, climate and the environment.

Contrasting:

Polar orbit satellites orbit the Earth quickly and pass over each of the poles many times in one day. These satellites are about 850 kilometers (500 hundred miles) above the ground. Polar orbit satellites allow us to view a lot of the Earth for short periods of time.

Geostationary satellites orbit the Earth at the same speed the Earth rotates. It is about 36,000 kilometers (22,300 miles) above the ground. Geostationary satellites allow us to view part of the Earth for long periods of time.

2. Explain why there is a need for both polar and geostationary orbiting satellites.

Polar satellites, such as Polar Operational Environmental Satellites (POES), see as much of the world as possible. The Earth rotates under polar satellites as they move from pole to pole. These satellites have very low orbits, about 850 kilometers (500 hundred miles), allowing them to travel around the world in as little as 102 minutes. The combination of the fast speed and the rotating Earth make it possible for POES satellites to see the weather around our planet every day.

Geostationary satellites, such as Geostationary Operational Environmental Satellite

(GOES), stay over one place on the Earth by orbiting at the same speed the Earth rotates. This is called a geosynchronous orbit. GOES need to be about 36,000 kilometers (22,300 miles) above the ground and above the equator to rotate in this kind of orbit. This orbit will allow GOES to constantly scan an area of the Earth for severe weather or weather changes as they develop.

One reason we need them both is because polar orbiting satellites can not track weather systems and Geostationary satellites can not view weather systems at the poles.

3. GOES is an acronym for what device?

GOES is an acronym for Geostationary Operational Environmental Satellite. The GOES satellite will be able to constantly scan the Earth to monitor weather, climate and the environment.

Activity 1.3 GOES Satellite

Use the [How does a satellite's job dictate its orbit?](#) link to complete the following:

(Remind students to read the slides.)

1. Explain the relationship between the altitude of a satellite above the surface of the Earth and the rate at which it travels around the Earth.

Satellites with a lower altitude orbit can circle the Earth in a much shorter time than satellites at a higher altitude orbit. Therefore, a lower orbiting satellite is travelling faster around the Earth than a higher orbiting satellite is travelling around the Earth. Lower altitude satellites may travel around the Earth in as little as an hour and a half while higher altitude satellites may appear to not move around the Earth at all. These higher altitude satellites are said to have a geostationary orbit. A geostationary orbit must be so high because it has to go out far enough so it can travel slowly enough to go around Earth only once per day.

2. Describe the type of orbit the GOES has.

The GOES environmental satellites appear to be "parked" in geostationary orbits over North America. They orbit exactly over Earth's equator and make one orbit per day. Since Earth rotates once on its axis per day, the GOES seems to hover over the same spot on Earth all the time. A geostationary orbit must be very high, 35,680 kilometers or 22,300 miles, because it has to go out far enough so it can travel slowly enough to go around Earth only once per day.

3. How often does the GOES orbit the Earth?

The GOES makes one orbit per day.

4. Compare the rate of the GOES orbit to the rate at which the Earth rotates.

The GOES orbit and the Earth rotation are the same time period, one day. The GOES satellite orbit makes one orbit per day. Since Earth rotates on its axis once per day, the GOES seems to hover over the same spot on Earth all the time.

Additional Activities:

Visit the [CIMSS](http://cimss.ssec.wisc.edu/satmet/) website to learn more about satellites and to play educational games.

<http://cimss.ssec.wisc.edu/satmet/>

Resources for Activities:

Activity 1.2 [Why do satellites have different orbits?](#)

http://cimss.ssec.wisc.edu/satmet/modules/2_weather_satellites/ws-1.html

Activity 1.3 [How does a satellite's job dictate its orbit?](#)

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[CIMSS](http://cimss.ssec.wisc.edu/satmet/)

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