teachers guide

Satellites 1: Orbiting Earth

Components

	NAME	DESCRIPTION	AUDIENCE
	Orbiting Earth teacher guide	The guide shows how students can explore a range of satellites and their orbits.	teachers
	Satellite explorer learning object	Students use an interactive learning object to explore satellite orbits and consider their possible applications.	students
	Looking at satellites worksheet	Students explore satellite orbits and consider the value of different orbits to everyday life.	students

Purpose

To **Engage** students' interest in different types of satellites and enable them to **Explore** satellite orbits (including equatorial, polar, geosynchronous and geostationary orbits).

Outcomes

Students:

- learn about a number of currently-operating satellites and observe their orbits;
- describe different types of satellite orbits, and speculate on why they are used;
- explore some characteristics of satellite orbits; and
- speculate on how satellites might impact on everyday life.

Activity summary

ACTIVITY	POSSIBLE STRATEGY
Students launch *Satellite explorer* and observe the orbits of a number of satellites currently orbiting Earth. The worksheet, *Looking at satellites*, guides students' progression through Satellite explorer and prompts them to think about the physics of satellite orbits and the reasons for placing a satellite in its particular orbit. Questions draw students' attention to different types of satellites and orbits.	individually or in pairs Students explore the learning object while answering questions one to eight on the worksheet.
Students continue using *Satellite explorer*. In the second part of the learning object (Satellite tracks) they explore what Earth looks like from satellites in geostationary, geosynchronous, polar and inclined orbits. The worksheet guides them to explore geostationary and geosynchronous orbits and to speculate on the positioning of satellites to fulfil a particular purpose.	Students answer questions nine and ten on the worksheet.

Technical requirements

The learning object requires Adobe Flash (version 9 or later), which is a free download from adobe.com.

The guide and worksheet require Adobe Reader, which is a free download from adobe.com. The worksheet is also provided in Microsoft Word format.

Using the learning object, *Satellite explorer*

Part 1: Satellites in Earth-orbit

Students observe the orbit of satellites at different altitudes. In addition to viewing the orbit of a named satellite, they see paths of many other satellites in similar, nearby or intersecting orbits. Information is provided on the purpose of each featured satellite.

Part 2: Satellite tracks

Students are presented with a view of Earth from space. They select:

- animation speed (x1000 is recommended for most explorations),
- type of orbit (geostationary, polar, geosynchronous or inclined), and
- altitude (high, medium or low Earth orbit).

The view of Earth changes to what it would look like when observed from the satellite in its chosen orbit and altitude.

Possible strategies

Teachers may choose to use the information in a number of ways, including:

- Ask students to predict what the satellite orbit would look like when traced on an outline of Earth (either a rotating globe or a Mercator projection), and what Earth would look like from the satellite.
- Allow time for students to explore different orbits and discover what the satellite 'sees' as it completes several orbits of Earth.
- Direct students to view selected orbits.

The worksheet, *Looking at satellites*, guides students through the learning object, *Satellite explorer*. It includes questions on satellite orbits, the usefulness of a satellite in a particular orbit and physical principles that determine these orbits. Additional notes for teachers are included for some questions in the suggested answers for this worksheet.

Acknowledgements

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Image credits

Satellite explorer

- 'Hubble Space Telescope' by NASA. PD-USGOV, spaceflight.nasa.gov/gallery/images/shuttle/sts-82/hires/s82e5937.jpg
- 'Starshine 2' by NASA. PD-USGOV, spaceflight.nasa.gov/gallery/images/shuttle/sts-108/html/sts108-328-007.html
- 'Iridium satellite' by Cliff1066. CC-BY-2.0, www.flickr.com/photos/28567825@N03/3347077014
- 'LM-1 satellite' by Intersputnik, www.intersputnik.com/f/downloads/Lmi-1_photo.jpg
- 'Artist conception of NOAA-N Prime in orbit' by Lockheed Martin. www.nasa.gov/centers/goddard/news/topstory/2008/noaa_n.html
- 'Artist conception of a NAVSTAR GPS satellite in orbit' by U.S. Air Force. PD-USGOV, commons.wikimedia.org/wiki/File:Navstar-2.jpg
- 'Artist conception of the Double Star satellites' by European Space Agency. /object/index.cfm?fobjectid=37217&fareaid=70
- 'Artist conception of a satellite in the SIRIUS-FM fleet of satellites' by Space Systems LORAL, www.ssloral.com/html/satexp/sirius.html
- 'Artist conception of the Cluster spacecraft' by European Space Agency, sci.esa.int/science-e/www/object/index.cfm?fobjectid=39698
- 'Artist conception of the INTEGRAL spacecraft' by European Space Agency, sci.esa.int/science-e/www/object/index.cfm?fobjectid=38737

SPICE resources and copyright

All SPICE resources are available from the Centre for Learning Technology at The University of Western Australia ("UWA"). Selected SPICE resources are available through the websites of Australian State and Territory Education Authorities.

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Associated SPICE resources

Satellites 1: Orbiting Earth may be used in conjunction with related SPICE resources to address the broader topic of motion and forces in a gravitational field.

DESCRIPTION	LEARNING PURPOSE
Satellites The learning pathway shows how a number of SPICE resources can be combined to teach the topic of motion and forces in a gravitational field.	
Satellites 1: Orbiting Earth An interactive learning object engages students' interest in satellites and their impact on everyday life. It also allows students to explore a range of satellite orbits, and visualise Earth from the perspective of an orbiting satellite.	**Engage/Explore**
Satellites 2: Satellite motion Students integrate their knowledge of Newton's Law of Universal Gravitation with their understanding of forces and circular motion to explain satellite motion. The worksheet provides qualitative and quantitative problems related to satellites and the sensation of 'weightlessness' experienced by astronauts in orbiting spacecraft.	**Explain**
Satellites 3: Impact of satellites Students elaborate on their understanding of how satellites and their associated technologies impact on everyday life.	**Elaborate**