SPACE WEEK

Our Planet • Our Space • Our Time

Resource Book for Teachers

TOPIC: **Satellites**

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Satellites Improve Life

Background Information

Satellite information collected by remote sensing is used in a wide range of fields. Weather forecasting, climate, air and water quality measurements, and mapping and monitoring changes in land use can all use satellite data. Satellite TV, data relay and GPS make use of satellites.

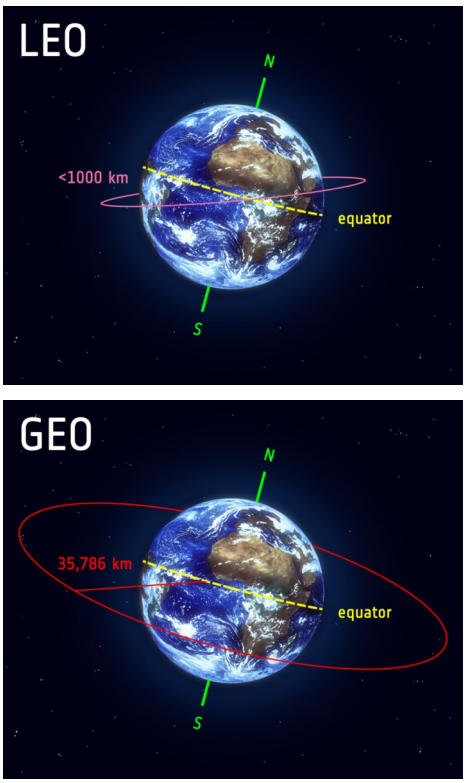
A 2020 project has taken earth observation data from ESA, NASA and JAXA to produce https://eodashboard.org/. This looks at the impacts of COVID-19 lockdown on economic indicators and includes case studies.

Google Earth and Google Maps use satellite imagery and aerial photography. Google Earth contains historical images, so can be used to access past images of a place.

Satellites can be described by their orbital distance (low Earth orbit— LEO vs geostationary orbit— GEO) and by the orientation of their orbit to the Earth's equator and poles.

GEO satellites (as used for satellite TV or for whole hemisphere images used in weather forecasting) are located above the equator and orbit exactly in time with the daily rotation of the Earth. This keeps them 'fixed' over a spot on the Earth.

LEO satellites pass over the Earth as they orbit, and are used for GPS, communications and for remote sensing. They can be aligned at different angles to the equator. Sun-synchronous orbits are designed to permit a satellite to repeatedly pass over a point on the Earth at roughly the same local time of day, so keeping the same illumination from the Sun.



Credit: ESA – L. Boldt-Christmas

Satellites can be observed in the night sky. They don't have external lights so need to be looked for after sunset / before sunrise. This is when they are still illuminated, yet the surface of the Earth is dark. The International Space Station (ISS) is one of the easier satellites to see and there are many websites (including https://heavens-above.com/) that can be used to find its position.

Students and teachers can take part in numerous learning activities that use satellite data. Notable among these are:

The GLOBE Program: Global Learning and Observations to Benefit the Environment. In particular: Cloud measurements protocol. Students can report on the appearance of clouds from the ground and compare to a satellite image taken within 15 minutes of their observations. Requires the teacher to register and complete an online training programme and to register an observing location. Uses either the GLOBE website or the GLOBE Observer app.

EarthKam—a programme that runs at certain times of the year, students can request their own image of the Earth, taken from a camera aboard the ISS. Supports learning about the Earth and the orbit of the ISS. Wide range of classroom resources here https://www.earthkam.org/activities

DPSM/ESERO Framework for Inquiry

Theme	Satellites Improve Life
Curriculum	**Science Strand: Strand Unit:** **Living things: Myself** use all the senses (**hearing**) to become aware of and explore environments **Energy and Forces: Sound** identify and differentiate between high and low sounds, loud and soft sounds **Environmental Awareness and Care: Caring for my locality; Science and the Environment** identify, discuss and appreciate the natural and human features of the local environment; identify some ways in which science and technology contributes positively to society **Skills Development**: Working Scientifically: Questioning; Investigating & Experimenting; Analysing. Designing and Making: Exploring; Planning; Making; Evaluating.

Engage

The Trigger	Wondering	Exploring	Considerations for inclusion
What does the Earth look like from Space? https://www.ustream.tv/channel/live-iss-stream or One familiar use of satellites is in weather monitoring. Show students the images from https://www.met.ie/latest-reports/satellites/world-visible	Discuss looking at the Earth from a viewpoint located in space, such as the ISS. Ask pupils whether they have seen any photos taken from space by astronauts or satellites. What do they think about these photos? How does changing our point of view change the photo? How does the information from a satellite reach us on Earth? What do satellites do for us? See https://www.esa.int/kids/en/learn/Technology/Useful_space/Satellites	Photos taken by astronauts. Use https://www.flickr.com/people/astrosamantha/ Infants: ESERO 16 *How do you make contact?* Explore how to communicate with a tin-can telephone. Each pair of children takes one of the prepared tin-can telephones. Ask them to talk to each other by speaking into the tin can. ESERO 36 *Send Your Message via Satellite* 1st & 2nd class children can explore this activity; older children can try to communicate their drawing *without* showing it. ESERO 56 *Looking at Earth* For 3rd and 4th class, using google maps to explore satellite imagery. DPSM *Satellites and Reflection* maths and science activity for 5th and 5th class.	Use 'new words' with children's own definitions This resource uses a 10 by 15 grid, modify the size of the grid as needed.

Investigate: How Do You Make Contact? For Infants

Starter Question	Predicting	Conducting the Investigation	Sharing: Interpreting the data / results	
What affects how well a tin-can telephone works?	Children could refer to their prior experience with communicating through air. *"It's harder to hear when you are far away, so it'll be harder with a long string tin-can telephone."*	Encourage the pairs of children to swap telephones to find out if they can still understand each other if the string is longer or shorter. Does it matter if the string is loose or taut?	Children should order the telephones by string length, then compare how easy it was to hear each other. How did they measure how well they could understand each other?	Use diagrams as needed – for children's predictions and for summaries of learning

DPSM/ESERO Framework for Inquiry

Investigate: Send Your Message by Satellite

Starter Question	Predicting	Conducting the Investigation	Sharing: Interpreting the data / results	Considerations for inclusion
What if we couldn't *show* our diagram to another child? Can we develop a method of sending signals like a satellite? ... *use sounds for different colours – eee, ooo, eee (see this video from ESA, at 3m55s)*	Procedural writing could be used to describe their method. *Children should agree the procedure and then test it.*	Children should try out their suggested method. How will they measure the success of their technique? *They might compare the before and after images.*	Children could compare the before and after images, then see how different methods of sending signals affects their results. *Count the number of 0s and 1s in their image and compare it to the original. Look for 2d shapes and symmetry.*	

Investigate: Satellites and Reflection

Starter Question	Predicting	Conducting the Investigation	Sharing: Interpreting the data / results	
If a ball is bounced off the ground or wall at an angle what way will it bounce away? If light hits a mirror at an angle (the angle of incidence) what way will the light be reflected?	Children might refer to their understanding of how the ball behaves to predict how light will reflects from a plane mirror.	Place a slit in a sheet of card and shine the torch light through to a mirror. Change the direction of the card. Mark the angles and measure. Draw a table of measurements.	How did we measure the angles? What did we notice about the angles?	

Take the Next Step

Applying Learning	Making Connections	Thoughtful Actions

Analysing Images from Space: FROM THE GROUND AND FROM THE SKY
https://esamultimedia.esa.int/docs/edu/PR10a_From_the_ground_and_from_the_sky.pdf
https://esamultimedia.esa.int/docs/edu/PR10b_From_the_ground_and_from_the_sky.pdf
Complete the following sentences:
Photos of the Earth taken by Earth Observation satellites show us... A photo taken from the ground is better if you want to ... But a photo taken from space is better if you want to ...
Maths activity on locations of different satellites, for 5th and 6th class children: ESERO 76 Communication Satellites
Take part in **EarthKam** https://www.earthkam.org
Monitor a Volcano with Satellite https://www.sfi.ie/engagement/discover-primary-science-and-maths/resources/teacher-created-resources/teachers_monitoring_a_volcano.pdf
Weather instruments: http://esamultimedia.esa.int/docs/edu/PR48_Nose_up_high_in_the_sky.pdf
Take part in **Climate Detectives**, a school project from the European Space Agency. https://www.esa.int/Education/Climate_detectives

Reflection	
	Did I meet my learning objectives? What went well, what would I change? Are the children moving on with their science skills? What questions worked very well? What questions didn't work well? Ask the children would they change anything or do anything differently. Are there cross curriculum opportunities here? What further questions did students have?

How do you make contact?

Looking at the Earth

time
55 minutes.

learning outcomes
To:
- learn that you need something to help you make contact over a long distance
- learn that there are different ways to communicate with each other

materials needed
- photograph of parrot (Appendix)
- 2 tin cans per pair of children
- 3 torches
- string
- nail
- hammer

Preparation

For the activity **Contact!** use the hammer and nail to make a hole in the bottom of each tin can. Join the tins together in 12 pairs using the string. Make sure that each tin-can telephone has a different length of string.
Set up a room divider in one corner of the classroom and put a chair on each side of this wall, so that the children cannot see each other during the activity.
You will need the photograph of the parrot from the Appendix.

Can you still hear me? 15 min.

Take the children outside to the playground. Ask the children to stand facing each other in pairs and encourage them to talk to each other. One child from each pair (always the same child) moves backwards one step at a time. The children stop when they can no longer understand what the other child is saying. See how far apart they are. Explain that this is quite a distance, but not very far.
Go back inside and sit in a circle with the children. Discuss the results. Could they stand father apart if they shouted to each other? Did they think it was a long distance or not? How can you talk to your mother at home if you are in the school playground? Shouting is not loud enough. Come to the conclusion that you cannot communicate very far without something to help you.

The children investigate different ways to make contact with each other.

Contact! 30 min.

Organise the children into pairs. Explain the activities before you start.

Hello. Who's there?

Each pair of children takes one of the pre-prepared tin-can telephones. Ask them to talk to each other by speaking into the tin can. Explain that they must keep the string taut. Can they understand each other if they whisper? Encourage the pairs of children to swap telephones to find out if they can still understand each other if the string is longer or shorter.

Parrots

Organise the class into two groups. Each group stands on the opposite side of a movable room divider. One child from each group sits on a chair. Ask one other child to stand by the room divider to pass on the signal (a facial expression or a code of flashes). Explain to the class that this child is the parrot. He or she is the only one who can see both groups of children at once. Ask the children if they know what a parrot is. Show the photograph of the parrot from the Appendix. Explain that a parrot is good at repeating what it hears. Give the parrot and the two seated children a torch. One of the seated children begins. This child is the transmitter. Explain that a transmitter sends a signal. You can send a picture as an image (a facial expression) or in code (using a flashing light). The transmitter flashes the torch a number of times, or shows a facial expression to the parrot. The parrot passes this on to the child on the other side of the room divider; this is the receiver. The group on the receiver side counts how many times the parrot flashed his torch, or copies the facial expression of the parrot. Let the group take it in turns to be transmitter and receiver.

Sit in a circle with the children and discuss both activities. Explain that using the tin cans means you don't have to talk very loudly to hear each other over a long distance.

What did the children learn during the *Parrot* activity? Was it difficult to guess what the other group did? Would they have been able to guess without the parrot? Explain that using a 'parrot' enables you to communicate over longer distances without using a string like the one in the tin-can telephone.

Is a satellite a handy invention? 10 min.

Summarise the conclusions from the activities. You need something to help you if you want to talk with other people over a longer distance. A piece of string on its own is not enough. A fixed-line telephone works rather like the tin cans, except that the string is a cable buried in the ground.

The parrot method was used frequently long ago. Then you had a messenger. The king or queen in one country told something to the messenger and they had to give the message to the king or queen in the other country. The only trouble was it could take weeks for the message to arrive. Nowadays you can talk to people all over the world via a satellite. A satellite is also a sort of parrot. It hangs in space and picks up messages and sends them on to someone somewhere else in the world. This enables you to talk to someone who is a long way away, for example on the other side of the ocean, or high in the mountains.

36

Send your message via satellite!
Looking at the Earth

time
50 minutes

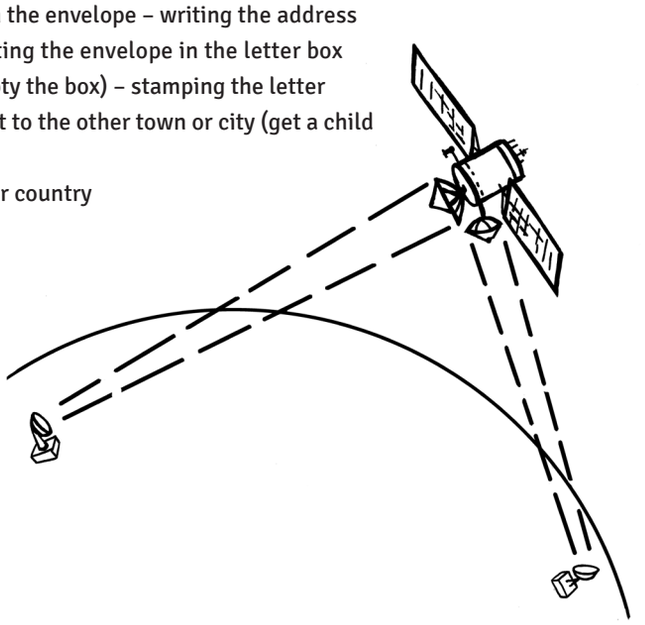
learning outcomes
To:
- learn that messages are sent via satellite in the form of zeros and ones

end product
- a drawing converted into 0s and 1s (code)

materials needed
- A5 squared paper or copies of worksheet
- A4 paper
- scissors
- envelope
- postage stamp
- stamp
- post bag
- a box with a slit opening

Preparation
For the activity **Sending a letter** you will need an envelope, a postage stamp, a stamp, and a post bag. Make a box with a slit opening; this will be the letter box. For the activity **What is your message?** make 2 copies of the worksheet per child.

Sending a letter 20 min.
Sit in a circle with the children. Together make a drawing for a friend who lives in another country. Give the drawing to one of the children. Ask him or her what needs to happen for the drawing to reach the friend. Pass the drawing to the next child. Ask them what needs to happen next. Go through all the steps in the process of posting a letter. The following steps should be covered: putting the letter or drawing into an envelope – sticking a postage stamp on the envelope – writing the address on the envelope (choose a real address) - posting the envelope in the letter box (this is the box) – emptying the letter box (empty the box) – stamping the letter (give a child a stamp to stamp with) – transport to the other town or city (get a child to take the letter and walk to the corridor) – sorting by the postman – transport to the other country (ask the child to return to the classroom) – the postman delivers the letter (ask a child to give the letter to another child).



Explain that it is possible to send other things, such as photographs. Take a photo in the class using a digital camera. Ask if anyone knows how you can send this photograph. Have they ever sent a digital photograph by e-mail? Explain that satellites can also send photographs. A satellite is a device that has been sent into space. Satellites orbit the Earth and can take photographs and films, among other things. The photographs made by the satellite are sent to computers on Earth. Of course this cannot be done in the same way as sending a drawing by post. So how do they do it?

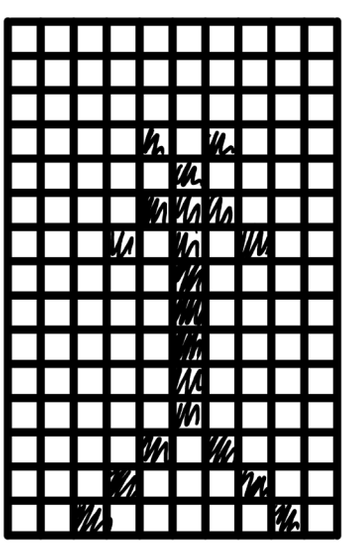
The children investigate how a satellite sends a message.

What is your message? 30 min.

Organise the children into pairs. The children complete Task 1 on the worksheet. Explain that they should make a drawing in the first rectangle by colouring in some of the squares and leaving other squares blank. In the second rectangle they can write a 0 in the blank squares and a 1 in the coloured squares. Show the drawing below as an example. Now each child should cut his or her rectangle showing the 0s and 1s from the worksheet and give it to another child. On a second worksheet each child then draws the other child's picture by reading the numbers and colouring in the appropriate squares and leaving the others blank. Repeat this activity so that every child gets to draw two codes (use one grid each time, but only colour-in according to the code - don't write out all the 0s and 1s).

Encourage the children to look and see if the drawings made by their classmates are actually the same as their original drawing.

Discuss this activity with the children. Explain that they have just worked in the same way as a satellite. A satellite sends all its communication in the form of 0s and 1s and when they reach Earth all these 0s and 1s are converted back into a photograph.



0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	1	0	1	0	0	0
0	0	0	0	0	1	0	0	0	0
0	0	0	0	1	1	1	0	0	0
0	0	0	1	0	1	0	1	0	0
0	0	0	0	0	1	0	0	0	0
0	0	0	0	0	1	0	0	0	0
0	0	0	0	0	1	0	0	0	0
0	0	0	0	0	1	0	0	0	0
0	0	0	0	0	1	0	0	0	0
0	0	0	0	1	0	1	0	0	0
0	0	0	1	0	0	0	1	0	0
0	0	1	0	0	0	0	0	1	0

Tip. As a variation on this task, you can encourage the children to design their own drawings. Instead of colouring in the squares, they can begin by using 0s and 1s. What will be the result when they colour the appropriate squares?

Send your message by satellite!

What is your message?

write your name **HERE**

Name:

Task 2: make a second drawing **HERE** by colouring in the squares

Task 1: convert your drawing into code HERE

write your name **HERE**

Name:

make a drawing **HERE** by colouring in the squares

esero

DPSM/ESERO

Framework for Inquiry - Promoting Inclusion

SPECIAL EDUCATION SUPPORT SERVICE
building on ability

When planning science activities for students with Special Educational Needs (SEN), a number of issues need to be considered. Careful planning for inclusion using the framework for inquiry should aim to engage students in science with real purpose. Potential areas of difficulty are identified below along with suggested strategies. This list is not exhaustive, further strategies are available in the Guidelines for Teachers of Students with General Learning Disabilities (NCCA, 2007).

ENGAGE

POTENTIAL AREA OF DIFFICULTY	STRATEGIES
Delayed language development/poor vocabulary/concepts	• Teach the language of science demonstrating meaning and/or using visual aids (material, property, strong, weak, textured, dimpled, absorbent, force, gravity). • Have the student demonstrate scientific phenomena, for example gravity —using 'give me, show me, make me,' as much as possible. • Assist the student in expressing ideas through scaffolding, verbalising a demonstration, modelling. • Use outdoor play to develop concepts.

INVESTIGATE

POTENTIAL AREA OF DIFFICULTY	STRATEGIES
Fear of failure/poor self-esteem/fear of taking risks	• Model the speculation of a range of answers/ideas. • Repeat and record suggestions from the students and refer back to them.
Understanding Time and Chronology	• Practice recording the passing of time, establish classroom routines that draw the students' attention to the measurement of time. • Teach and practice the language of time.
Fine/Gross Motor Difficulties	• Allow time to practice handling new equipment. • Allow additional time for drawing diagrams, making models etc. • Give students the option to explain work orally or in another format.
Short Term Memory	• Provide the student with visual clues/symbols which can be used to remind him/her of various stages of the investigation.

TAKE THE NEXT STEP

POTENTIAL AREA OF DIFFICULTY	STRATEGIES
Developing Ideas	• Keep ideas as simple as possible, use visuals as a reminder of earlier ideas. • Discuss ideas with the whole group. • Repeat and record suggestions from students and refer back to them. • Encourage work in small group and in pairs.
Communicating Ideas	• Ask students to describe observations verbally or nonverbally using an increasing vocabulary. • Display findings from investigations; sing, do drawings or take pictures. • Use ICT: simple written or word-processed accounts taking photographs, making video recordings of an investigation.

REFLECTION

- Did I take into account the individual learning needs of my students with SEN? What differentiation strategies worked well?
- Did I ensure that the lesson content was clear and that the materials used were appropriate?
- Was I aware of the pace at which students worked and the physical effort required?
- Are there cross curriculum opportunities here?
- Are the students moving on with their skills? Did the students enjoy the activity?

More strategies, resources and support available at **www.sess.ie**

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www.primaryscience.ie

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