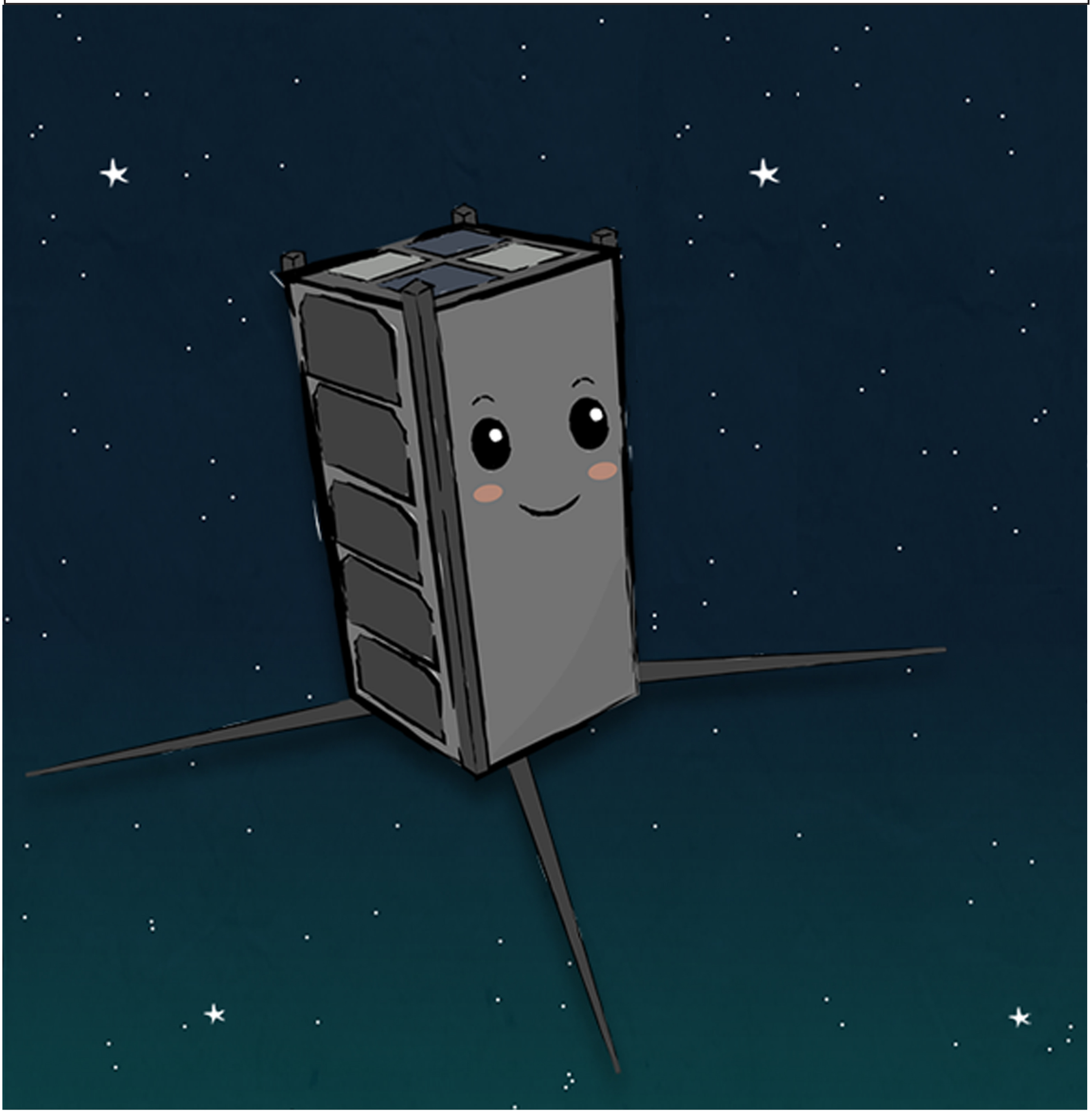


EIRSAT-1: A Satellite from Ireland

SPACE WEEK

Our Planet • Our Space • Our Time

Introduction

Satellites are a great topic to introduce elements of science, maths and geography. Communication and earth observation satellites are a huge part of how we learn about the Earth, how we monitor weather and natural disasters. They help us measure sea and ice temperatures, to check land use change and vegetation cover of the Earth. We can monitor phytoplankton blooms in the sea and even track huge shoals of fish. Farmers can use satellites to plot fertiliser schedules for individual fields and of course we use them every day for our communication and GPS.

A common misconception is that all satellites are made by humans – this is incorrect, any object that orbits another can be considered a satellite. Therefore, the Moon is a satellite of Earth, Earth a satellite of the Sun. These are natural satellites.

An artificial satellite is an object that people have made and launched into Earth orbit or beyond using rockets. There are currently over 4 thousand active satellites orbiting the Earth. The size, altitude and design of a satellite depend on its purpose. Satellites vary in size. Some cube satellites are as small as a Rubik's cube (10 cm by 10 cm by 10 cm!). Some communication satellites are about 7 m long and have solar panels that extend another 50 m. The largest artificial satellite is the International Space Station (ISS). The main part of this is as big as a large five-bedroom house, but including solar panels, it is as large as a rugby field.

Altitudes of satellites above the Earth's surface also vary. There are three common orbits:

Orbit Type	
Low Earth orbit (LEO)	from 200 to 2,000 km, for example, the ISS orbits at 400 km with a speed of 28,000 km/hour, and the time for one orbit is about 90 minutes.
Medium Earth orbit (MEO)	most MEO satellites are at an altitude of 20,000 km, and the time for one orbit is 12 hours.
Geostationary orbit (GEO)	36,000 km above the Earth. Time for one orbit is 24 hours. This is to match the rotation of the Earth so that the satellite appears to stay above the same point above the Earth's surface. This is used for many communications and weather satellites.

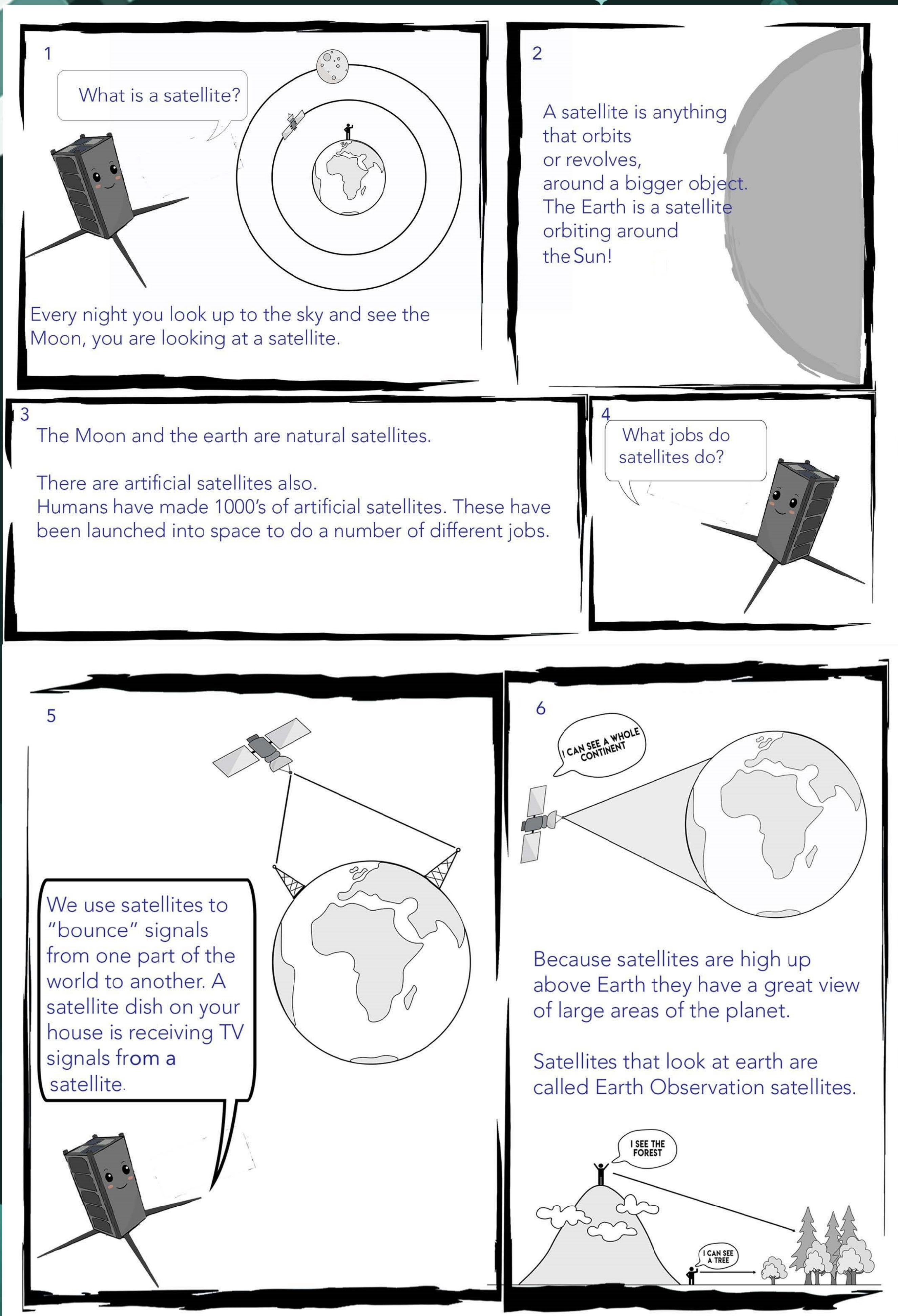
Types of Satellites

Navigation	Global Positioning (GPS).
Communication	TV, phone and internet. These are often geostationary satellites.
Weather	Used to image clouds and measure temperature and rainfall. Geostationary weather satellites allow the same area to be view continuously from a very high orbit. Low Earth polar orbiting satellites allow complete Earth coverage.
Earth Observation Satellites	These are used to photograph and image the Earth. Low Earth orbits are can be used so that a more detailed image can be produced.
Astronomical satellites	These are used to monitor and image space.
The International Space Station (ISS)	The ISS is a habitable artificial satellite that has been placed in a low Earth orbit. It completes 15.7 orbits per day and is maintained at an orbital altitude of between 330 km and 410 km. This is a habitable space laboratory. Scientists inside the ISS can perform many valuable experiments in a microgravity environment.

EIRSAT-1 is an astronomical satellite that will conduct three experiments in space. It is built by a team in UCD under the European Space Agency ‘Fly your Satellite!’ program.
Students can learn about satellites and EIRSAT-1 with accompanying print outs.
Students can cut out and assemble their own EIRSAT-1 satellite or complete a colouring-in page of EIRSAT-1.

Further Activity and Links
Classroom based inquiry from Discover Primary Science and Maths : See Satellites and Reflections or http://www.sfi.ie/site-files/primary-science/media/pdfs/col/satellites_and_reflections_activity.pdf
EIRSAT-1 Website here or www.eirsat1.ie

Satellites, what do they do?



Satellites, what do they do?

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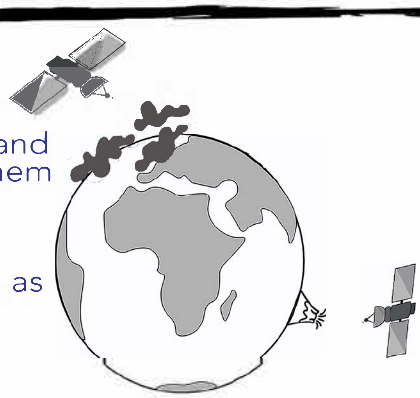
Satellites can observe our atmosphere, oceans, land and ice. We use them to predict weather and track natural disasters such as fires and volcanoes.



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Satellites can find our location on Earth. When we use a map on a computer or our phone, it is communicating with at least three satellites to tell us our location. These satellites are called Global Positioning Satellites or GPS.

SatNav uses GPS.

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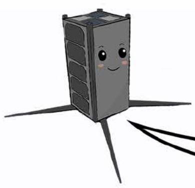

Satellites are used to look out into space too.
Satellites like the Hubble Space Telescope observe our solar system, our galaxy, other galaxies and beyond into the universe!

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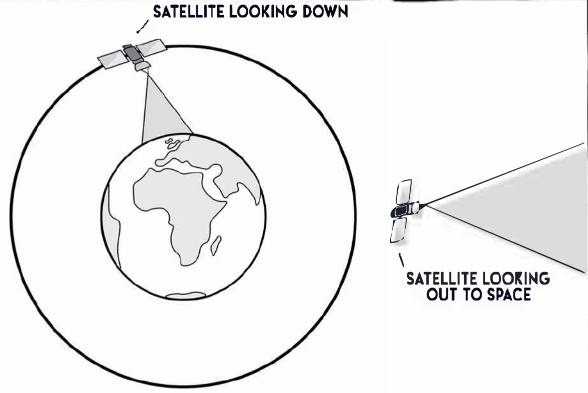
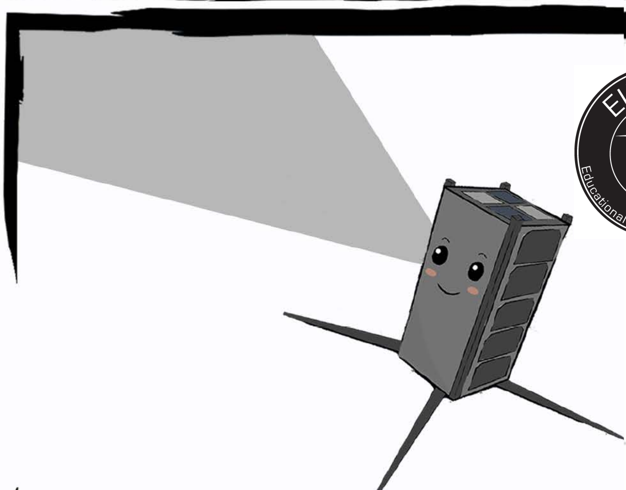
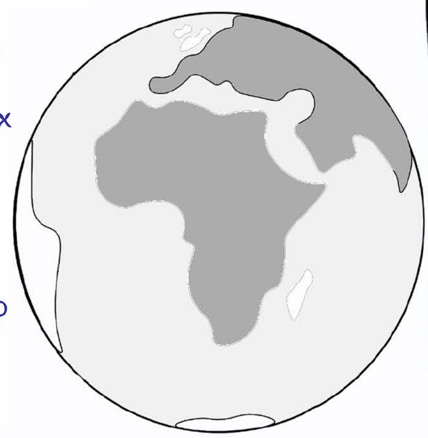




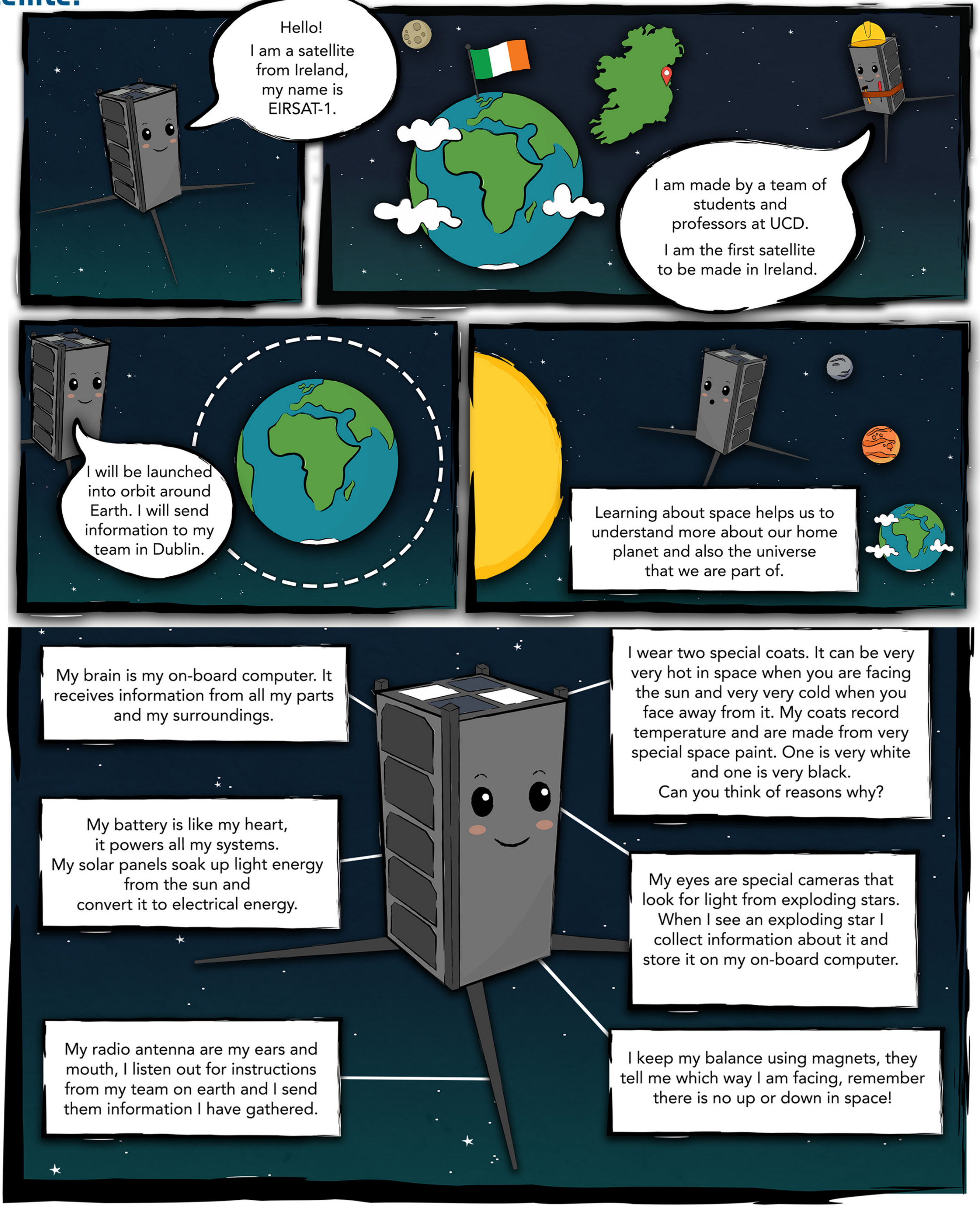
fly your satellite!

In Dublin there is a team of students building a satellite.
It is called EIRSAT-1.
EIRSAT-1 is a 'CubeSat' satellite . It is 20cm long and 10 x 10cm wide!
EIRSAT-1s job is to test technology and to gather information to help us learn about the Universe.

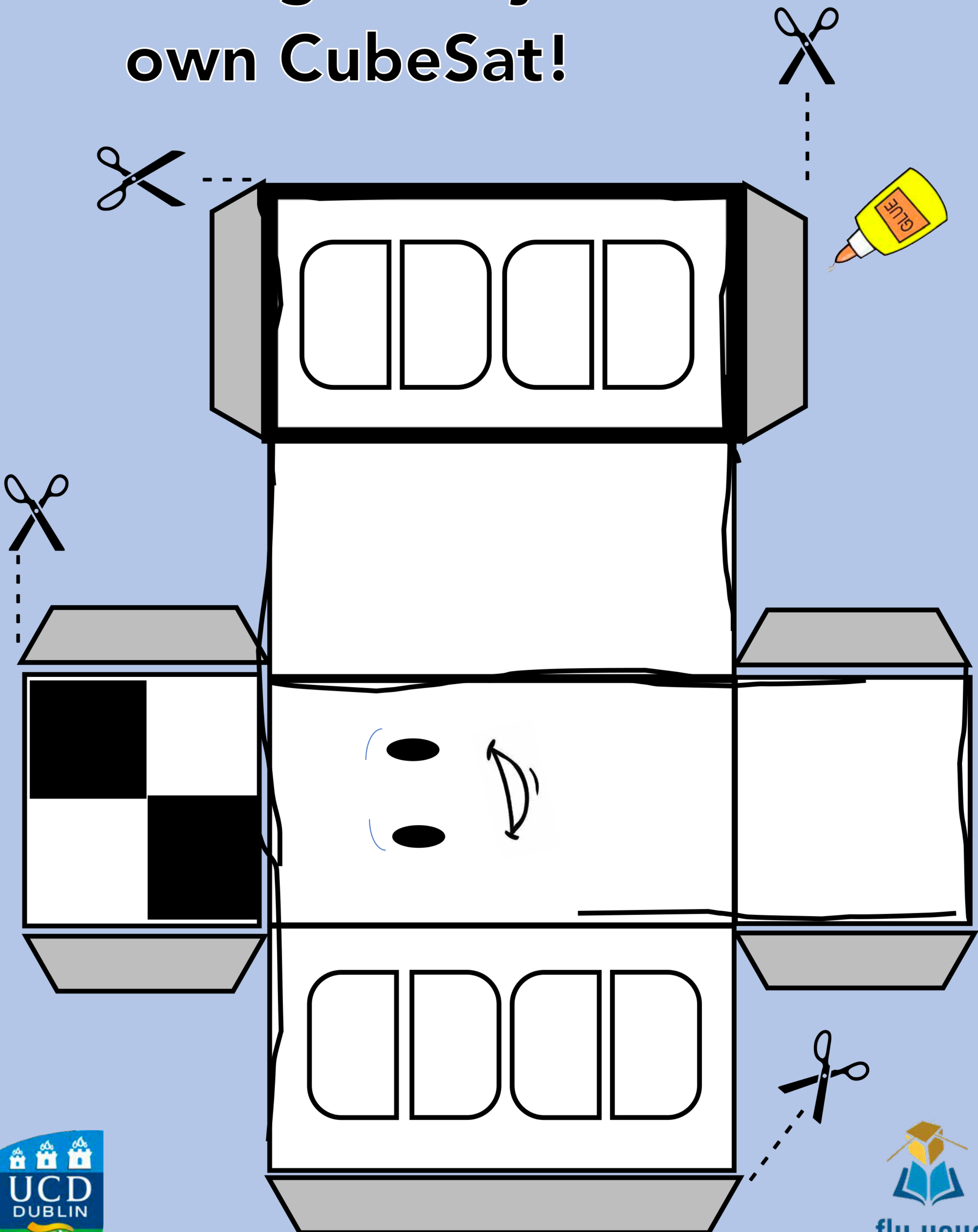
EIRSAT-1 will be the first ever satellite made in Ireland to go into orbit around Earth!



Meet EIRSAT-1, the first Irish Satellite

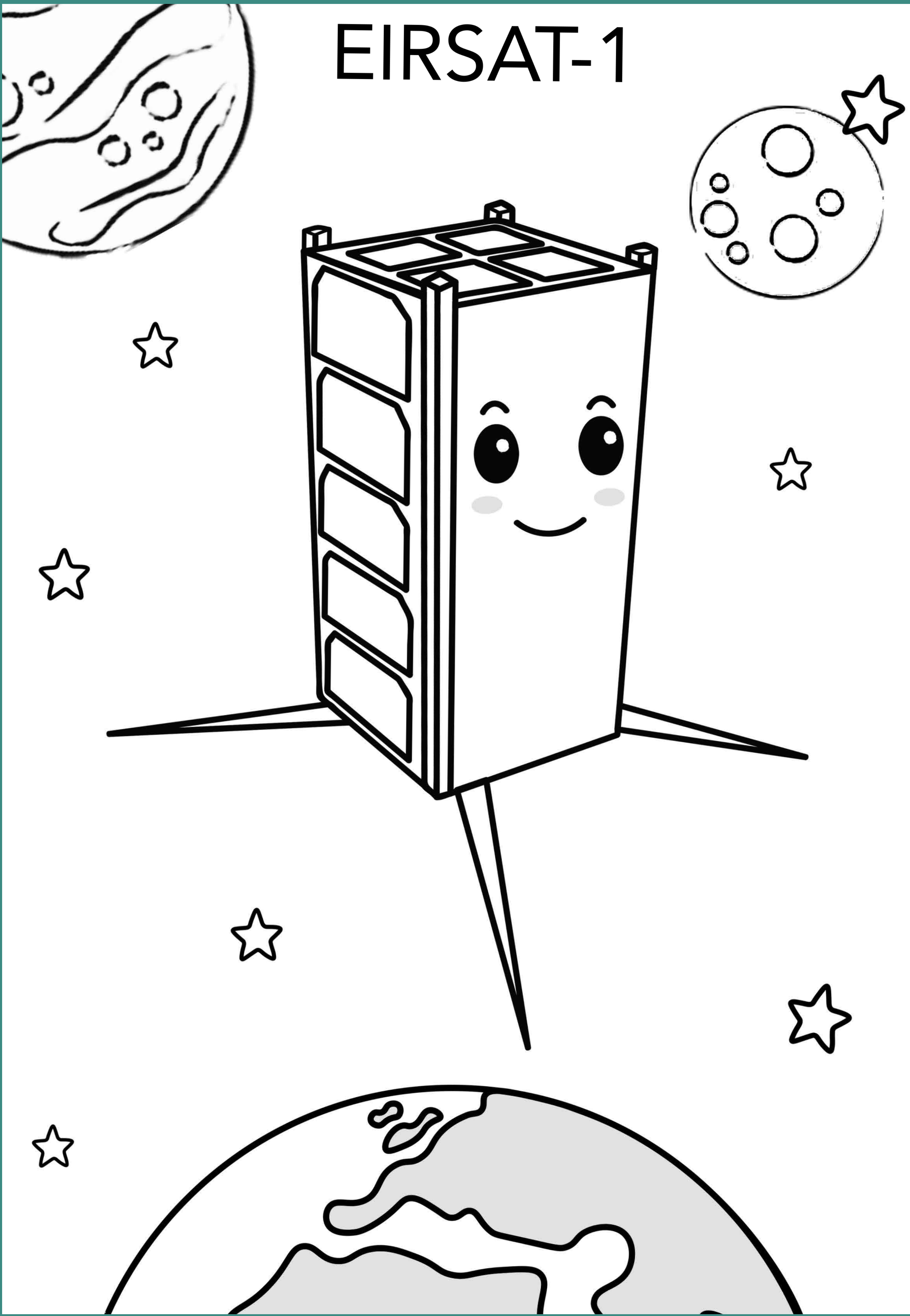


Colour in, cut out and stick together your own CubeSat!

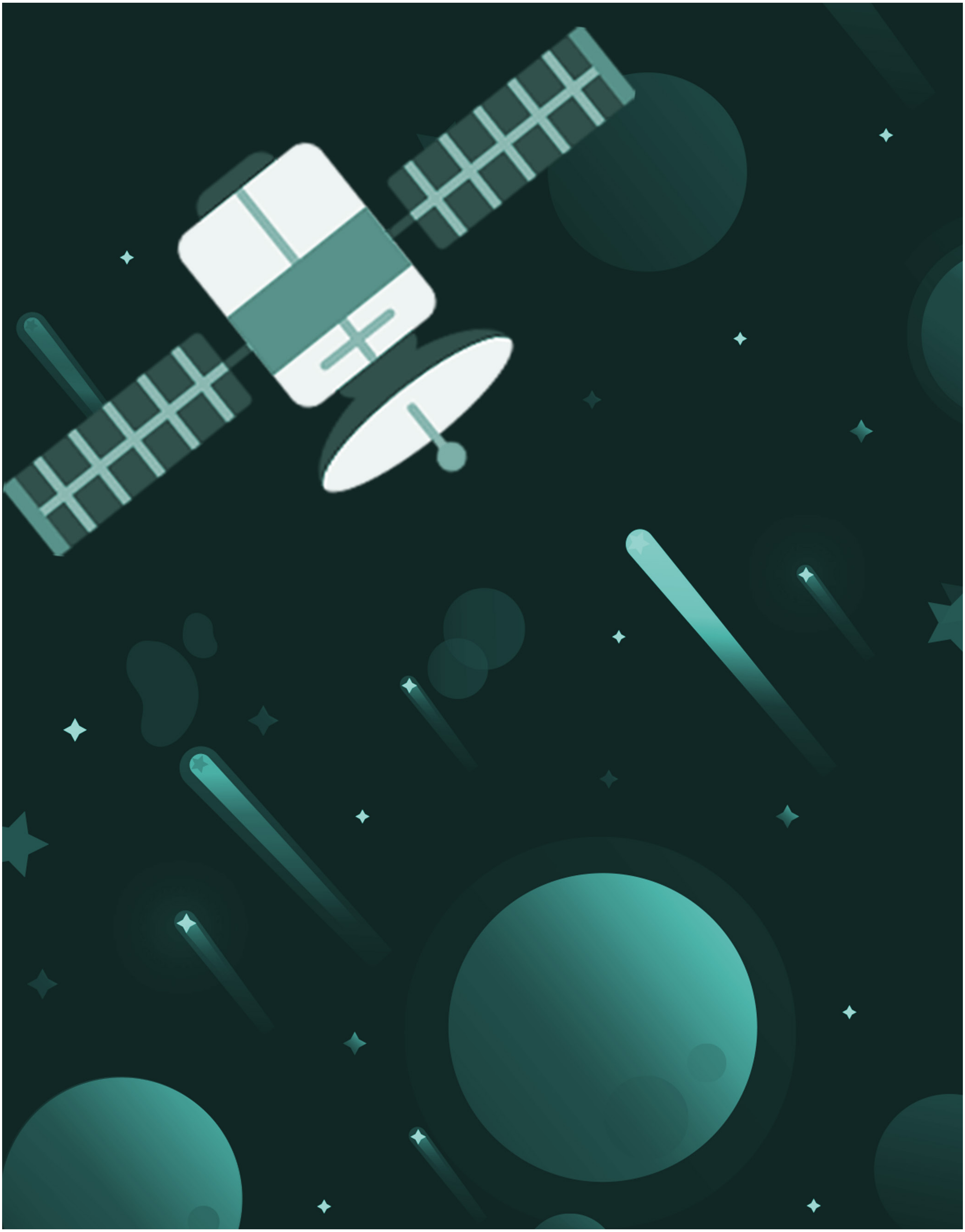


fly your satellite!

EIRSAT-1



SPACE WEEK
Our Planet • Our Space • Our Time



SATELLITES AND REFLECTION

SENDING SIGNALS (E.G. TV, TELEPHONE, INTERNET) ACROSS LONG DISTANCES

Equipment:

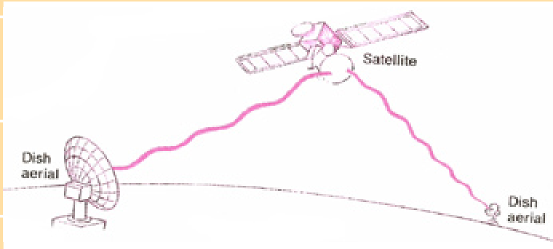
1. Ball, floor or wall on which a ball can bounce, another person
2. Plane (*i.e. flat*) mirror, white A4 paper, small torch (*one with single bulb gives a better single ray of light than halogen type with multiple bulbs*), cardboard, scissors, protractor, pencil, book or other object to prop up mirror.
3. For follow-up activity: Concave mirror, piece of plain A4 paper, sun or torch or light of any sort.

Suggested Class Level:

5th- 6th

Preparation:

Darkened room if possible for Activity 2.



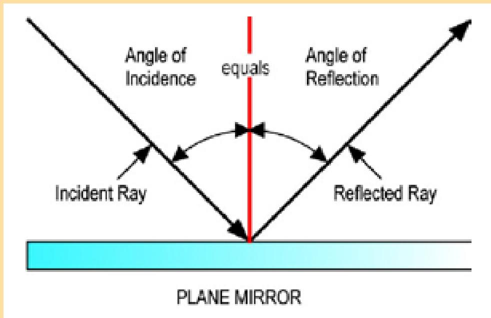
Background information:

REFLECTION OF LIGHT

Light bounces off a flat shiny surface in the same way a ball bounces off the ground.

When light hits a surface at a certain angle (*called the angle of incidence*) it bounces off the surface at the same angle (*called the angle of reflection*).

(*See DPS activity 'Make a Periscope' for similar concept*).



SATELLITES

A satellite is something which orbits a planet.
The Moon is a natural satellite of the Earth. There are now thousands of man-made satellites which orbit the Earth.

The first man-made satellite was launched by the Soviet Union in 1957. It was called Sputnik 1 and it studied the atmosphere.

Since then thousands of satellites have been launched into space for lots of different reasons: for communications (*TV, radio, telephone and Internet - the signals are sent up to the satellites, they are 'reflected' off the satellites at a different angle like light off a mirror or a ball off a wall, and are received back down in another part of the world*), weather forecast, studying the Earth itself, looking at plant cover and the effects of climate change, etc.

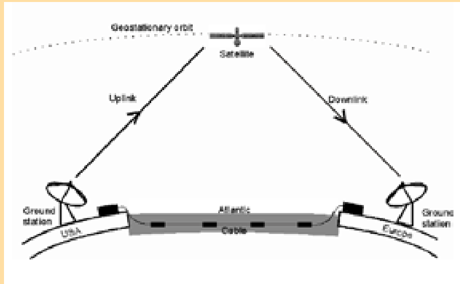
GEOSTATIONARY SATELLITES

Many signals (*e.g. from mobile phones*) are sent from one mast to another directly via waves in straight lines. But if the signals are to be sent over very long distances across the world, then the masts would have to be extremely high to allow for the curvature of the earth (*e.g. nearly 2 km high for transmission between Europe and the USA!*).

SATELLITES AND REFLECTION

SENDING SIGNALS (E.G. TV, TELEPHONE, INTERNET) ACROSS LONG DISTANCES

However, if a kind of mirror for the waves is put in a 'fixed' position well above the earth, large distances can be overcome (*a bit like seeing around a corner using a traffic mirror*). Because the Earth is rotating this' mirror' has to rotate also, and exactly in time with the earth. This is called a Geostationary satellite, i.e. it appears to be fixed but is actually rotating.



Very large amounts of communications (*telephone, Internet and TV*) are also sent long distances along very fine glass cables called **fibre optics.** These go along the ground and under the sea. They have largely replaced the old copper cables.

Trigger questions:

If you throw a ball straight against a wall or onto the ground, what happens?
(*It bounces back straight at you*).

If you throw a ball at an angle against the wall or on the ground, what happens?
(*It bounces off the wall or ground at an angle in the opposite direction from you*).

What way does the ball bounce off the table in table tennis, or off the side of a snooker table?

What are the different ways that radio, TV, telephone and Internet communications travel across various distances? (*Wires, fibre optic (i.e. very fine glass) cables, invisible waves through the air.*)

What is a SAT NAV?
(*A piece of electronic equipment in a car. It can tell you which way you need to go by using information received from a satellite*).

Content:

SCIENCE: Energy and Forces – Light

MATHS: Lines and Angles
Data: Representing and Interpreting Data
SPHE: Myself and the wider world – Environmental care

Skills:

Investigating and Experimenting, Observing, Measuring, Recording, Analysing

Cross-curricular Links:

Geography:

Human Environment – Transport and Communications
Natural Environment – Planet Earth in Space

SATELLITES AND REFLECTION

SENDING SIGNALS (E.G. TV, TELEPHONE, INTERNET) ACROSS LONG DISTANCES

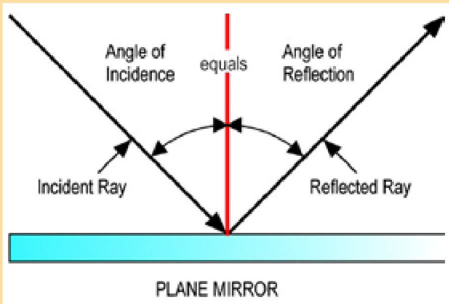
Activity:

1. Bouncing a ball at an angle to the ground.

- Stand some distance away from the other person.
- Can you throw the ball against a wall, or onto the ground, at an angle so that the ball reaches the other person exactly?
- What do you notice about the angle at which the ball hits the ground, and comes off the ground?

2. Reflecting light off a plane mirror.

- Make a very narrow slit from the edge, and at right angles, into a piece of cardboard.
- Put a sheet of plain white paper onto the table.
- Prop up the mirror into a vertical position (*against a book or something similar*) on the paper.
- Draw a line along the back of the mirror.
- Shine the torch through the vertical slit in the cardboard, to give a narrow beam of light coming through the cardboard. (*Does the distance between the torch and cardboard make any difference to the width of the beam of light?*).
- Direct the narrow beam at right angles to the mirror. What happens to the reflected beam?
- Now shine the narrow beam of light at an angle to the mirror. In what direction does the reflected beam go?
- Can you draw along the incident ray and the reflected ray? (*See diagram*).
- Take away the torch and draw a right angle where the light hit the mirror.
- With your protractor measure the angle between the incident ray and the perpendicular (*angle of incidence*).
- Then measure the angle between the reflected ray and the perpendicular (*angle of reflection*).



Record these angles. Are they acute or obtuse?

- Repeat this activity a number of times, with the light hitting the mirror at different angles.
- What conclusion do you come to? Is there any connection between the two angles?

ANGLE OF INCIDENCE	ANGLE OF REFLECTION

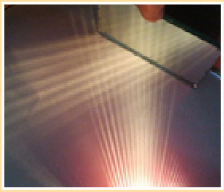
SATELLITES AND REFLECTION

SENDING SIGNALS (E.G. TV, TELEPHONE, INTERNET) ACROSS LONG DISTANCES

Safety:	**Do not shine torches into eyes, or look directly into the sun. It is very bad for eyes.**

Follow-up activities:

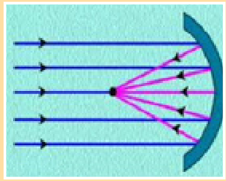
1.



- Shine a beam of light through the teeth of a comb, at an angle to a plane mirror.
- What do you notice about the pattern which is formed?

2.

- Hold a curved (*concave*) mirror towards the sun or a light, with the hollow shiny side facing the sun or light.
- With your other hand can you move the piece of paper to a position where you get a clear sharp image of the sun or light on the piece of paper?



- Can you think what the mirror is doing to the rays of light?

  (*The mirror brings them together to a point - called the focus. Small curved satellite dishes on many houses pick up TV signals from the air, focus them to a point from where they are sent into the houses*).

More Maths:

The following data was taken from the NASA (*American Space Agency*) website: www.spacemath.gsfc.nasa.gov

"The Declining Arctic Ice Cap during September"

The minimum ice cap area for the Arctic during the month of September was measured using satellites.
The results for the following years were:

- Draw a graph from this data, using a suitable scale.
- Can you give a rough prediction of the area of ice in 2020 and 2030 if the present trend continues?
- Why do you think the area of ice is getting smaller?
- What do you think will be the effect on the environment if this global warming continues?

Year	Ice area in millions of square kms
1980	7.9
1985	6.9
1990	6.2
1995	6.1
2000	6.3
2005	5.6
2010	4.9