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ENGINEERS WEEK 2026

Primary Activity Pack

Activities for learners at a primary school level

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Classroom Resource

Investigating Reflection: Mirrors, Satellites and Periscopes

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Research Ireland

Investigation

Investigating Reflection: Mirrors, Satellites and Periscopes

Class Level - Senior

Curriculum Links

Strand:	Energy and Forces.
Strand Unit:	Light.
Curriculum Objectives:	Investigate the relationship between light and materials; Recognise that light comes from different sources; Investigate how mirrors and other shiny surfaces are good reflectors of light.
Skills Development:	Questioning, Observing, Predicting, Investigating and experimenting, Estimating and Measuring, Analysing, Recording and Communicating.
New words:	Reflection, Mirror, Satellite.
Focail nua:	Frithchaitheamh (reflection), Reflector, Scáthán (mirror), Satailít (satellite), Angle of incidence, Angle of relection
Cross curricular links (General):	Maths – lines and angles, PE.
Equipment / materials:	• Plane (flat) mirrors • Small torches or light box, cardboard, protractors, A4 white paper, rulers • Balls – tennis balls, basketballs • For periscopes: Card, milk carton, plastic mirrors, tape, rulers, protractor

Engage

Prompt Questions / Wondering:

Reflection

- Can you name some sources of light? (the sun, fire, light bulbs, candles)
- Is the moon a source of light? (no the moon reflects the light of the sun)
- Can you name other reflectors of light? (mirrors, cat's eyes, reflector strips on hi-vis jackets, bicycle reflectors)
- 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?

Satellites

- 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)

Periscopes

- How would you use mirrors to see the back of your head?
- Can you use mirrors to see around corners?
- How would you turn a ray of light through 90 degrees?
- How do sailors see above the surface of the water?
- How do spectators see the golfers around the green at major golf tournaments?

Mirror Writing

- Why is the word ambulance written in a strange way on the front of the vehicle?

Background:

Light is a form of energy that makes it possible for us to see the world around us. Light comes from different sources called light sources and our main natural light source is the Sun. Other light sources include fire, stars, light torches, light bulbs, and candles.

We need light to see. Light hits the surface of an object and bounces off the object to our eyes allowing us to see. Shiny materials such as plane mirrors reflect images of objects. This is called reflection.

Light always travels in straight lines. When a ray of light hits a shiny surface like a plane mirror it is reflected. Scientists and engineers make use of mirrors and lenses to change the direction of light beams. The point at which the ray of light hits the mirror is called the point of incidence. A line drawn at this point and perpendicular to the mirror is called the normal. The angle at which a ray of light hits the mirror is called the angle of incidence. The angle at which the ray of light is reflected from the mirror is called the angle of reflection. The laws of reflection state that (1) the angle of incidence is equal to the angle of reflection and (2) the angle of incidence, the normal and the angle of reflection are all on the same plane which means in front of the mirror.

C

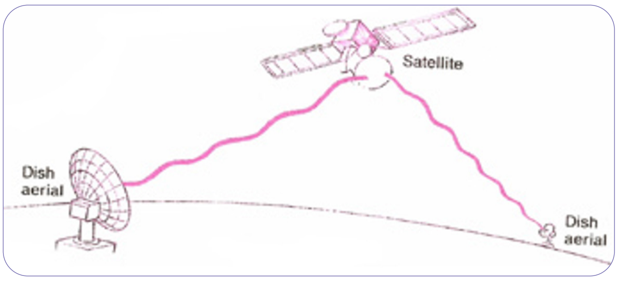
Real-world application:

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 synthetic 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 many different reasons. Earth Observation satellites gather and take images of all kinds of data about the Earth, satellites are used in weather forecasting, navigation and studying effects of climate change.

Communication satellites for TV, telephone and internet are essentially used to relay radio waves from one place on Earth to another. They catch signals that are sent up to them from a ground station (an Earth based satellite dish) amplify them so they have enough strength to continue and bounce them back down to a second ground station somewhere else. The signal is 'reflected off the satellite just as light is reflected off a mirror.

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!). 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.

Light is also used in the production of lasers. The word laser comes from a scientific description of what the laser does. Laser stands for light amplification by the stimulated emission of radiation. A laser involves a tube with mirrors at either end and a material such as a liquid or gas inside. The material and the mirrors help to increase the light and one of the mirrors is partly transparent to allow the light to escape. Most light that we see is white light which is a mixture of lots of colours of light. Although it travels in straight lines it can spread out or disperse over long distances. Laser light is a single colour and will travel over long distances as a concentrated beam.



Explore:

Ask the learners to list **light sources** such as the sun, fire, stars, torches, light bulbs, candles, stars, shiny things.

Ask them about **cat's eyes** that they see at night on the road. When does the Cat's Eye 'light up'? Does it produce light itself? What needs to happen for the cat's eye to emit light? What kind of clothing does one wear when out walking in the dark or while cycling at night? **The Moon,** the cat's eyes, mirrors, the reflector on the bike are what we call **reflectors.** They are not sourcing of light in themselves but rather bounce back (reflect) any light that hits them.

Have a **collection of items / pictures** and ask the learners to classify them as light sources or reflectors of light.

Standing in front of a wall, throw a ball at an angle against the floor, what happens? Where does the ball go? **It hits the wall at the same angle as you threw it.**

Throw a ball at an angle against the wall, what do you notice about the angle that the ball comes off the ground? **It bounces off the wall on to the ground and back to you at an angle in the opposite direction from you.**

It would be fun for learners to try this with a ball in the yard or hall and to describe what they observed.

What way does the ball bounce off the table in table tennis? What way does the ball bounce off the side of a pool table / snooker table? (there are lots of video clips online showing pool shots and table tennis shots) Ask the learners to observe and describe the bounce of the balls.

The learners could also engage in unstructured exploration with plane mirrors and torches bouncing beams of light from a torch off a mirror. Plane plastic mirrors are very safe and can be purchased from scientific suppliers.

Torch shone through a slit in card

Image reflected in water

Investigate: Is the angle of incidence equal to the angle of reflection in a plane mirror?

Starter question:

If we shine a beam of light at an angle to a plane mirror, what way will the light beam be reflected?

Prediction:

Learners can predict how the light will be reflected by sketching the beams of light on a piece of paper.

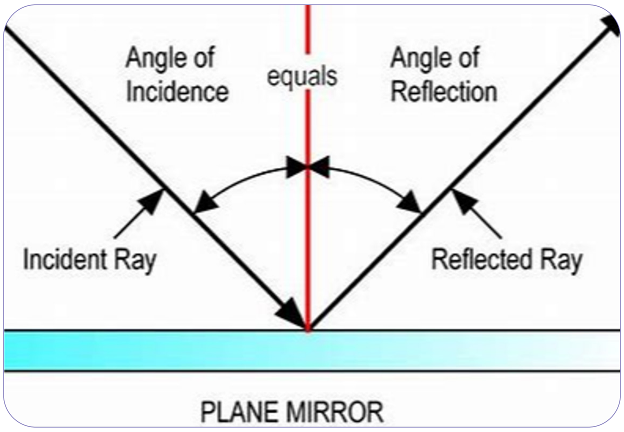
Conducting the investigation:

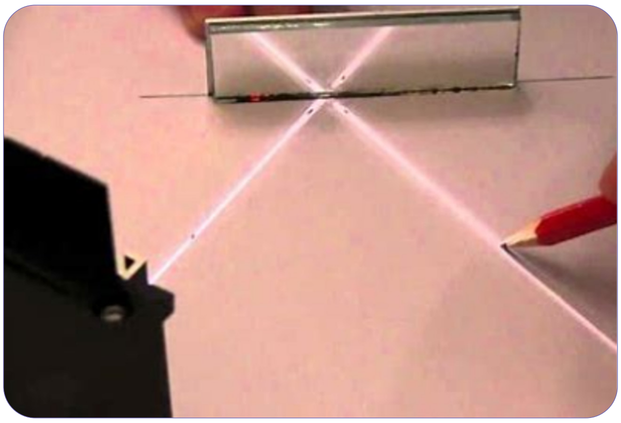
Note: For this investigation to work well, you will need to make the classroom as dark as possible. Chose a dull / rainy day, switch off lights and pull down classroom blinds.

Ideally a light box which can produce a single ray of light is need for this investigation but if not available cut a very narrow slit in a piece of card to get a single ray of light from the torch behind it. Learners could explore with a comb and torch and 'play 'with the rays of light bouncing off the mirror. Can they see the way the angles are hitting the mirror and the way the angle is being reflected? Could they think of how to measure the angles? You might give them some help, and encouragement as follows:

- Put a sheet of white paper on the table
- Place the plane mirror in a vertical position (use a book to hold it upright)
- Draw a line along the back of the mirror.
- Shine the torch through the narrow slit in the card to give a narrow ray of light.
- Direct the ray towards the mirror.
- Draw along the incident ray and the reflected ray
- Draw a right angle where the light rays hit the mirror.
- Use the protractor to measure the angles of incidence and reflection.
- Repeat with different angles of incidence and record results.

Angle of Incidence	Angle of Reflection





Sharing data / results:

Groups should share their findings with each other.

- Were you able to shine a narrow beam of light at the mirror? (Sometimes a little experimentation with making the slit in the cardboard is needed).
- Could you see the reflected ray of light on the page? (some groups might succeed better if they are in a darker part of the classroom. They might need to create barriers to darken their space).
- Were you able to draw along the two beams of light?
- Was the angle of incidence always equal to the angle of reflection?
- How could we use this knowledge?
- If you were to try this investigation again, would you do anything differently?

Take the Next Step

Adapt for home:

In some cases, it may be difficult to lower the light levels enough in the classroom to get this investigation to work well. In this case, learners may be asked to repeat the investigation at home in a darkened room using a torch and small mirror to see if they can get a better result.

Adapt for Junior/Senior level:

Junior classes might do some of the exploration with mirrors and torches and might try the mirror writing activity below.

Design challenge: Design and make a simple periscope

Explore

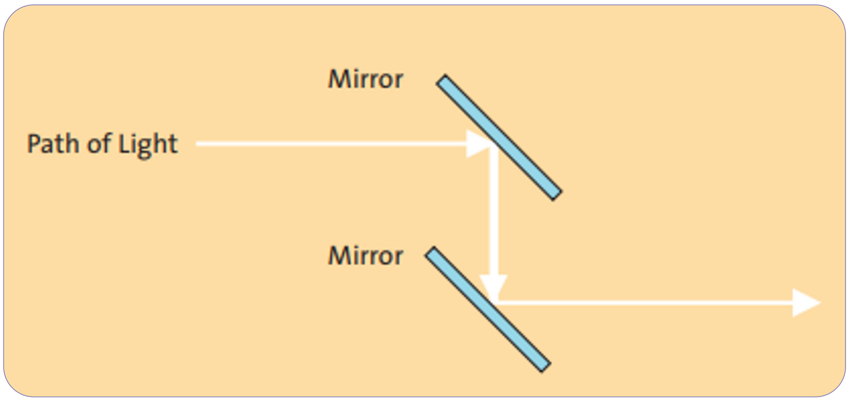
Give the learners plane mirrors and let them explore seeing around corners. Learners are asked to think about what they know about reflection in mirrors and how they might position mirrors to see what is on the table from below. It will allow them to apply skills in problem solving.

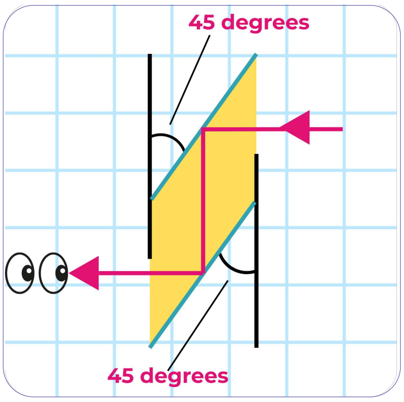
Plan

Learners are encouraged to use the materials provided to design the periscope. They could look up periscope designs to get inspiration. How will they construct their periscope? How will they angle the mirrors? How will they hold the mirrors in place?

Make

Mirrors can be used to help see around corners. When light falls on a mirror at an angle it is reflected off the mirror at the same angle. Therefore, light falling on a mirror at an angle of 45 degrees will bounce off it at 45 degrees. So, the total angle through which the light is turned is 90 degrees. A periscope uses two parallel mirrors facing each other to bounce light between them so that people can see round corners or look at things that are too high for them to see.





Follow up challenge: Mirror Writing: Lateral inversion

Lateral inversion is the effect produced by a plane mirror in reversing images from left to right. This is the reason **AMBULANCE** is written laterally inverted so that when a person sees the word in their rear-view mirror in a car, they see it aligned properly. Take the letter **b** when it is laterally inverted it becomes **d**. Letters that have an axis of symmetry look the same for example A, H, T have an axis of symmetry.

Challenge

Learners try to draw over a shape (a star) by looking at the image in the plane mirror only. They write their name in capitals and see how many letters are laterally inverted.

They look at LOVELY JELLLIES -70C and CHOICE DICE-80C in the mirror and explain the difference.

LOVELY JELLIES – 70C

CHOICE DICE – 80C

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Classroom Resource

Investigating Current Electricity

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Investigation

Investigating Current Electricity

Class Level - Senior

Curriculum Links

Strand:	Energy and Forces
Strand Unit:	Magnetism and electricity
Curriculum Objectives:	Become aware of the uses of electricity in school and at home; Identify some household appliances that use electricity; Become aware of the dangers of electricity; Learn about electrical energy; Investigate current electricity by constructing simple circuits using wire, bulbs and batteries and experiment with simple switches; Examine and group materials as conductors (those that conduct electricity) and insulators (those that do not allow electricity to pass through); Become aware of the dangers of electricity; Investigate current electricity by constructing simple circuits with more than one bulb and more than one battery; Become aware of how some common electrical appliances work.
Skills Development:	Predicting, Investigating, Observing, Analysing, Designing and Making
New words / vocabulary:	Electric current; Battery
Focail nua:	Sruth leictreach (electric current), Leictreachas (electricity), Fuinneamh (energy), Cadhnra (battery).
Cross curricular links:	Geography – renewable and non-renewable sources of electricity, climate change
Equipment / materials	• Batteries, bulbs and bulb holders, LEDs, wires with crocodile clips or magnetic connectors. • Lemons / potatoes, copper coins / nails, zinc coated nails / washers. For optional follow on activity: • Recycled materials for design projects.

Lightbulbs

Kitchen appliances

Engage

Prompt questions:

- What is electricity?
- Where do we get electricity from?
- What do we need for electricity to flow?
- What other forms of energy can we get when we use electricity – light, heat, movement, etc.

Power lines

Background information:

An electric current is a flow of a charged particles (usually electrons) through a material called an electrical conductor. Energy is needed to get the electrons in the material to move and this is supplied by the battery. A battery is a source of energy used to move electrons in a conductor. Voltage is the push a battery gives a circuit to enable electric current to flow. As the electrons move, their energy can be converted into other forms of energy such as heat and light. This depends on the nature of the material through which they are travelling.

Materials which have electrons that are free to move are called conductors. These materials can carry an electric current. Some materials do not have any electrons free to move and so they cannot carry an electric current. These materials are called insulators. The human body conducts electricity.

Electric current can flow in a conductor. Electric current cannot flow in an insulator. The greater the amount of electrons flowing per second, the greater the current.

Real-world application:

For an electric current to flow there must be a complete circuit – a complete loop from one terminal of the battery back to the other terminal. By convention, electric current flows from the positive (+) terminal of the battery to the negative (-) terminal.

Any break or insertion of an insulator at any point in the circuit will prevent current flow at all points. This can be shown by using a simple circuit with a battery and a bulb. Connect the bulb to the battery and see the bulb light. Disconnect at different points in the circuit – the bulb always goes off. Put an insulator into the circuit at different points. The bulb always goes off. The current either flows in all of the circuit or does not flow at all.

Electrical cables and plugs are covered with insulating materials to protect users from the electric current.

Electric currents produce heat. This is seen in kettles, irons and electric heaters. The greater the current, the greater the heat produced. If a battery's terminals are directly connected by a wire, then a lot of current will flow through the wire, which can make it and the battery dangerously hot. To avoid this "short circuit" always include a lamp or motor in a circuit.

We make use of electrical circuits every day. When we plug in a TV or other electrical appliance and switch it on, the circuit will be completed and electricity will flow through the appliance allowing it to work. We can also make a circuit using stored energy in a battery as shown in the investigations below. Some devices like phones, laptops or electric cars use rechargeable batteries. When the battery has run down, plugging the device in causes electricity to flow through the battery in the opposite direction to when the device is being used.

Explore:

Identify things that use electricity in school, at home, on the farm, etc. What uses mains electricity? What uses batteries? What uses both? (e.g., a phone battery charged using mains electricity).

Discuss examples of electricity producing heat, light, movement. Discuss the main sources of energy - burning of fossil fuels versus renewable energy. Why do we need to limit our use of electricity?

Investigation 1: Making simple circuits

All investigation and work on electric current should be done using batteries. Mains electricity should never be used by learners when doing investigations.

Class Level - 3rd and 4th class

Testable question:

- What is needed to get the bulb to light?

After completing their first circuit and getting the bulb to light, learners should come up with their own starter questions for simple changes to the circuit. Examples might include:

- Will a higher voltage battery make a difference to the light from the bulb?
- Will the length of the wire make a difference?
- Will it make a difference which side of the bulb is attached to the + of the battery?

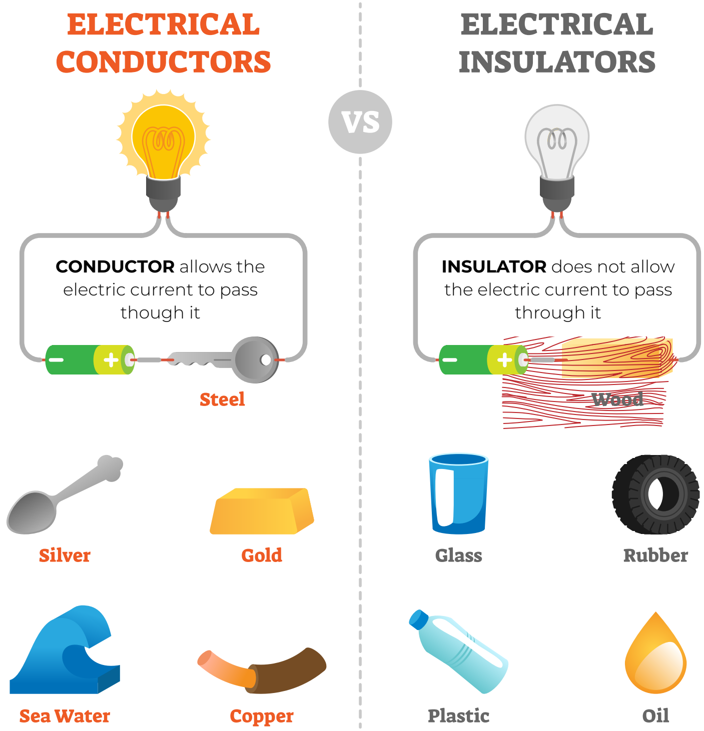
Predicting:

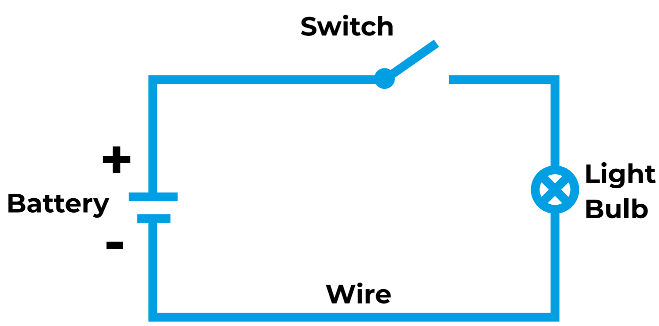
Groups should make a prediction for each question they choose to investigate.

Conducting the investigation:

Let the learners 'play' with the components to get the bulb to light so that they recognise the necessity for a complete circuit. Once they have completed their circuit, they can carry out a number of simple investigations as follows:

- Change connections to + and -. Does it make any difference?
- Make a simple switch to include in your circuit as follows: Insert two paper fasteners into cardboard and join them with a paper-clip on top, so that the latter can swivel. Join the wires from the circuit to each paper fastener at the back of the cardboard.
- Connect materials/objects into the circuit and see the effect on the bulb. Use plastic, wood, different pieces of metal, paper, water, salt water, etc. Classify materials/objects as conductors or insulators.





Investigation 2: Circuits – series and parallel

Class Level - 5th and 6th class

Testable question:

- What happens when a second bulb is put into the circuit?

Predicting:

Learners should predict whether the first bulb will get brighter, dimmer or stay the same.

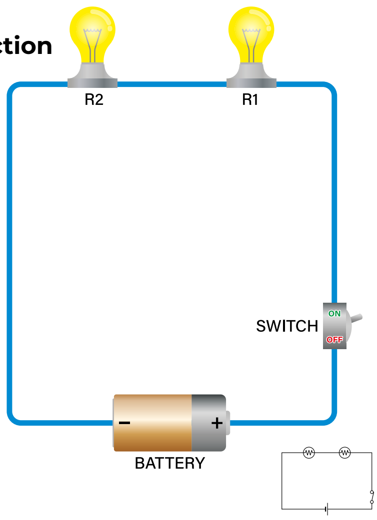
Conducting the investigation:

Learners set up a simple circuit with battery and bulb and then add a second bulb into the circuit. What happens to the first bulb? Is there more than one way to add a second bulb to the circuit? Could they arrange their circuit in a way that ensures both bulbs stay lighting? Encourage learners to try different ways of arranging their circuit.

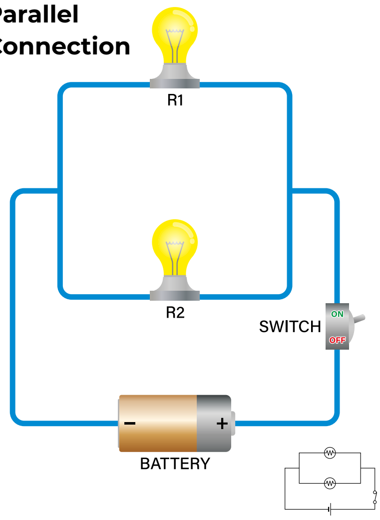
There are two different ways to add extra bulbs into a circuit. When the bulbs are in series, the electricity passes through each bulb in turn. The battery is trying to power both bulbs in turn so both will be dimmer.

When the bulbs are arranged in parallel to each other, the brightness stays the same no matter how many bulbs are added in parallel. The battery will be used much faster as there is only a finite amount of energy in it.

Series Connection



Parallel Connection



Further investigations:

When bulbs are in series, what happens when one bulb is removed from its holder - all the bulbs go out. When bulbs are in parallel, what happens when one bulb is removed - other bulbs remain lighting. Which way do you think bulbs in Christmas tree lights are wired: in series or in parallel? Why? How are the lights in your house wired: in series or in parallel? (See Primary School Curriculum Science Teacher Guidelines Pages 100-101).

Explore what happens in simple bulb circuits when batteries of different voltages are used. Do not exceed the voltage stamped on the bulb.

Come to recognise that the voltage of a battery is a measure of the energy stored in it. The greater the voltage, the greater the energy available to push the electrons in the circuit. This creates a bigger current and the bulb will be brighter.

Sharing data / results:

Groups should decide how to display their results and present their findings to the rest of the class. Different groups may have investigated different things with their circuits.

Take the Next Step

Adapt for home:

It is safer that investigations on electric circuits, etc. are done in school under supervised conditions.

Adapt for junior level:

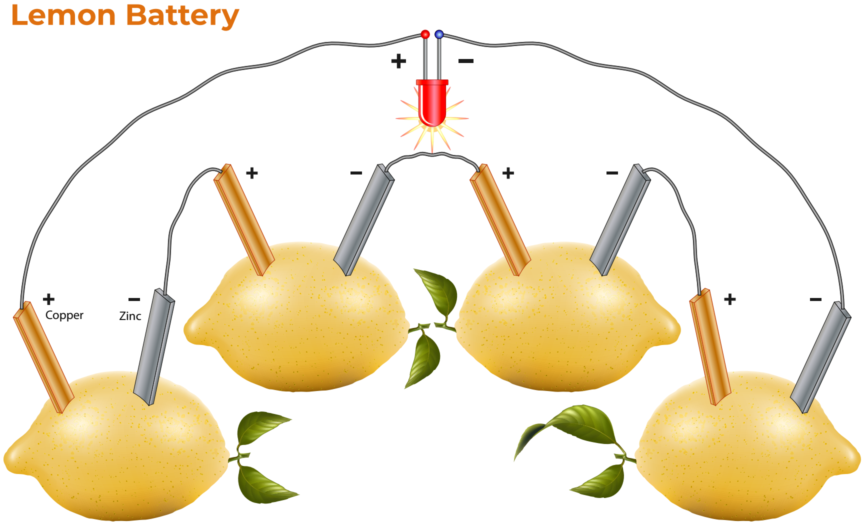
Infants, 1st and 2nd class are introduced to electricity through questioning, observation and exploration. Emphasis should be placed on the necessity to take great care with electricity and electrical appliances. Take care with bare wires. Do not have your hands wet when dealing with electricity. Never put anything other than a plug into an electrical socket. Never go near overhead wires.

Follow-up challenge/project:

- Create a simple circuit and use it to design and make a Lighthouse (see Materials investigations).
- Learners could use their knowledge of colour, light and electric circuits to design and make a set of traffic lights.
- Examine the ways in that electricity can be generated. Describe or demonstrate basic principles of generation – relative motion of a coil of wire and a magnet. How can this motion be produced? (Steam, water, wind, waves).
- Learners could make a simple cell/battery using a lemon /potato with a copper nail and a galvanised (zinc) nail. Put the nails into the fruit / vegetable and connect the wires to make a circuit. LEDs work better than bulbs in these circuits. It usually takes 3 lemon / potato batteries in series to light one LED although it will sometimes work with only 2. Investigate which fruit / vegetable creates the biggest voltage. Watch the SEAI Potato Battery Experiment to learn more about this activity: https://www.youtube.com/watch?v=wZcQyTZJIzs. **Note:** there are two wire legs on the LED, the LED must be connected the right way around, if it doesn't work at first, swap which metal plate each leg is connected to (see image below). Also note that the zinc nails are only plated with zinc. Once the zinc coating wears off, the nail can no longer be used as part of the battery.

Battery

Lemon Battery



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Classroom Resource

Make a Rocket and Investigate its Flight Path

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Design Challenge

Make a Rocket and Investigate its Flight Path

Class Level – Senior

Curriculum Links

Strand:	Energy and Forces
Strand Unit:	Forces
Curriculum Objectives:	Identify and explore how objects and materials may be moved
Skills Development:	Design and Make - Explore, Plan, Make and Evaluate; Working Scientifically – Questioning, Observing, Predicting, Investigating and Experimenting, Estimating and Measuring, Analysing, Recording and Communicating
New words / vocabulary:	Angle of launch, force, trajectory, projectile
Focail nua:	Roicéad (Rocket), Lainseáil (Launch)
Cross curricular links:	Maths – 2D and 3D shapes, measurements, angles; History of flight; PE – throwing and kicking balls
Equipment / materials	• For foam rockets: foam pipe insulation, wide rubber band, duct tape, cardboard (for fins), scissors, ruler • Other materials such as cardboard tubes, plastic bottles etc. can be substituted for pipe insulation • For launching and measuring: metre stick (and launcher quadrant pattern provided), long tape measure / trundle wheel

Engage

Prompt questions / wondering:

- What are rockets? Cylinders full of materials which produce gases.
- How do they work? Gases going out the back of the rocket push it forward, like an untied blown-up balloon goes forward when you let it go and the air goes out the back.
- What are rockets used for? Sending objects into the air with great force to escape Earth's gravity.
- If you sent your rocket straight up into the air, where do you think it would land?
- If you want to throw or kick a ball a very long distance, how would you throw or kick it?
- Does the angle matter?
- What force will send our rocket up?
- What force will bring it down again? Gravity.

Background information:

This foam rocket is based on stored energy. When you pull back the elastic band, the elastic band stores this energy. When you let it go, it releases this energy as it returns to its original length. The foam rocket is stabilised by the fins, which keep it pointed in the desired direction.

Technically the foam rocket is a rocket in appearance only. Real rockets get their energy when burning fuels emit gases from the back, which, in turn, send the rocket in the opposite direction. Things that are sent into the air, and that have no energy source of their own (e.g., a ball, javelin) are called projectiles. Gravity gradually brings them down.

Real-world application:

The flight path or trajectory of the rocket depends on the angle of launch and the force applied (the amount of energy stored in the elastic by pulling it back). These same factors apply in the case of any object that is thrown or kicked, such as a ball.

ESA's rocket with Irish parts

Ariane 6 is the new European Space Agency (ESA) rocket. It can be used with either two or four boosters as well different lengths. The boosters are one of the most powerful one-piece motors in the world. Flying with four boosters takes Ariane 6 to a whole new class of rockets. With the extra thrust from two more boosters Ariane 6 can take around 21.6 tonnes to low Earth orbit, more than double the 10.3 tonnes it could bring to orbit with just two boosters.

In February 2026 the first Ariane 6 rocket with four boosters lifted off from Europe's Spaceport in French Guiana, taking satellites to orbit. There are many different parts and components needed to assemble the Ariane 6 rocket and two Irish companies, Nammo Ireland and Réaltra, contribute engine parts and video systems.

Design Challenge

Explore

Show the learners a foam rocket and demonstrate how it works. Either show them how to make the basic model as suggested below or provide some pre-made ones. One rocket per group should be enough for initial exploration.

Making the Rocket

- Using scissors, cut one 30 cm length of pipe insulation for each rocket.
- Cut four equally-spaced slits, each about 8 cm long, at one end of the tube. This will be the tail of the rocket. The fins will go into these slits.

Front of rocket

- Cut a 12 cm length of duct tape down the middle to make two pieces. Place one piece over the other, sticky to shiny side, to make the tape extra-strong.
- Place a single strand of a rubber band across the top of the foam tube.
- Tape the rubber band down to the tube, using the double strength duct tape at right angles to the rubber band.
- Press the tape down to the sides of the tube.
- Reinforce this tape with another length of tape wrapped around the top end of the side of the tube.

Back of rocket

- Cut four fins from cardboard. A suggested way is as follows: Cut a 10 cm square, draw a diagonal and cut along the diagonal (forming two isosceles triangles).
- Cut halfway down the height of one triangle and halfway up the other. Now nest the fins together and place them in the slit.
- Close off the slits with another piece of duct tape wrapped around the foam tube.

Launching the rocket

- Loop the rubber band at the top of the rocket over the end of the metre stick.
- Pull on the bottom end of the rocket, holding it below the fins as you point it up into the air.
- Now let the rocket go.
- What happened to the rocket?

Allow the learners to explore with the rockets. The best place for launching is outdoors on a calm day as the rockets will travel quite far. Alternatively, a school hall can be used: the larger the better. Learners should explore how they can make their rocket travel as far as possible. Could they improve the design to make it travel further? Could they change something about the way it is launched?

Plan

Learners should look at the rocket they have been exploring with. How could they improve the rocket's design to make it travel further while still using the elastic band to launch it? In planning, they might consider:

- The materials used – they may decide to construct their rocket from recycled materials such as a toilet roll / kitchen towel tube, an empty plastic bottle or even an old sock.
- The fins – they may decide to use a different material for the fins, to make them a different size or different shape or to place them in a different position.
- The size – they may decide to make their rocket shorter or to use a different pipe insulation diameter.

Once they have decided on materials, the learners should draw a plan of their rocket with materials and measurements. This will be useful if they want to adapt their design.

Make

Groups make their rocket according to their plans.

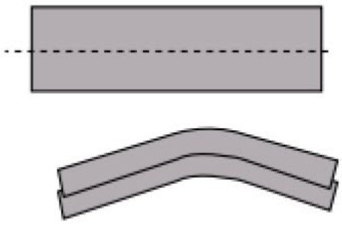
Evaluate

The following questions may help with rocket testing and evaluation:

- How far can your rocket travel? Can it travel further than the first foam rocket you tried?
- Is your rocket strong enough? Does it stay together when you pull back the elastic to launch it?
- Are you happy with your design? What do you think you could do to improve it?
- If you want to improve your rocket, use your initial plan to make a new rocket. Change one variable at a time and retest.

1 Cut four slits 12 cm long 90 degrees apart.

2 Cut 12 cm strip of duct tape in half lengthwise. Place one strip on top of other.



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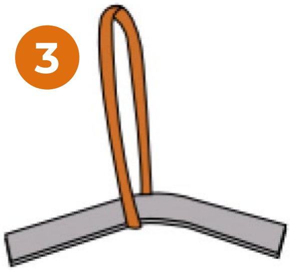
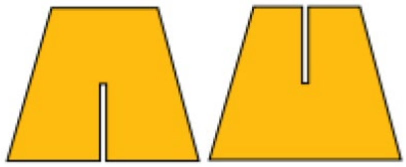


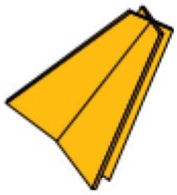
4 Tape launcher rubber band to nose end of rocket.

Add tape strip around the nose to strengthen the attachment.

5 Cut out fins with notches.

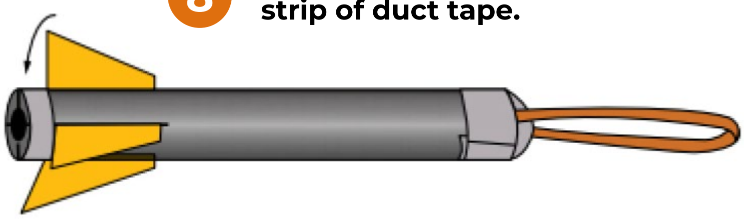


6 Slide fins together.



7 Slide fins into slits.

8 Close fin slits with narrow strip of duct tape.



Ready for flight!

Investigate

Use your rocket to design a fair test investigation. Each group should come up with a testable question and change one thing about the way their rocket is made or launched. Some possible testable questions are suggested below. For fair testing, remember to only change one variable at a time, e.g., if changing a design feature such as rocket length, all other design features and all launch conditions should be kept the same.

Testable questions

Launch conditions

- How does the angle of launch affect the distance travelled?
- How does the force (the amount of stretch on the elastic) affect the distance travelled?
- How does the wind direction affect the distance travelled (launched with the wind, against the wind, across the wind)?
- How does the position of launch (standing, sitting, kneeling) affect the distance travelled?

Design Features

- How does the size of the fins affect the distance travelled?
- How does the length of the rocket affect the distance travelled?
- How does the position of the fins affect the distance travelled?

Prediction

Groups should make a prediction based on their chosen question, e.g., "I predict that the rocket will travel furthest at an angle of 30°".

Conducting the investigation

- Groups should discuss how to carry out their investigation and how to make it a fair test. They should record their data in some way (tables, graphs, video).

The following is a suggested way to compare the launch angle to the distance the rocket travels:

- Print out the launcher quadrant pattern provided onto card.
- Cut out the pattern and fold it on the dashed line.
- Tape the quadrant to the metre stick so that the black dot lies directly over the 60 cm mark on the stick and the long arm points towards the 10 cm mark.
- Press a drawing pin into the black dot.
- Tie a string to the drawing pin and hang a small weight (e.g., plasticine) to the string. Make sure the string hangs freely.
- Loop the rubber band over the end of the metre stick. Pull on the fin end of the rocket until the nose is aligned with the 30 cm mark.
- Tilt the launcher up at the chosen angle as indicated with the string and weight on the quadrant.
- Release the rocket and measure the distance travelled. To help measure long distances, the learners can measure and place markers at 1 metre intervals, starting at 5 metres and going up to 20 metres.
- The launch should be repeated three times for each angle to determine an average distance.

How will you make this a fair test?

- What will you keep the same? – use the same rocket each time, stretch the rubber band the same distance each time, e.g., the nose is aligned with the 30 cm mark on the metre stick, start from the same position, launch in the same direction.
- What will you change? The angle of launch.
- What will you measure and record? The distance travelled (measured along the ground).

Sharing data/results

Groups should present their findings to the rest of the class.

Take the Next Step

Adapt for home:

The rocket could easily be constructed and tested at home using readily available materials such as toilet roll inserts.

Adapt for junior/senior level:

The rocket can be quite challenging to construct, especially the attachment of the elastic band and the cutting of evenly spaced slits in the foam. Younger classes may need help with construction or to be given pre-cut slits and/or fins.

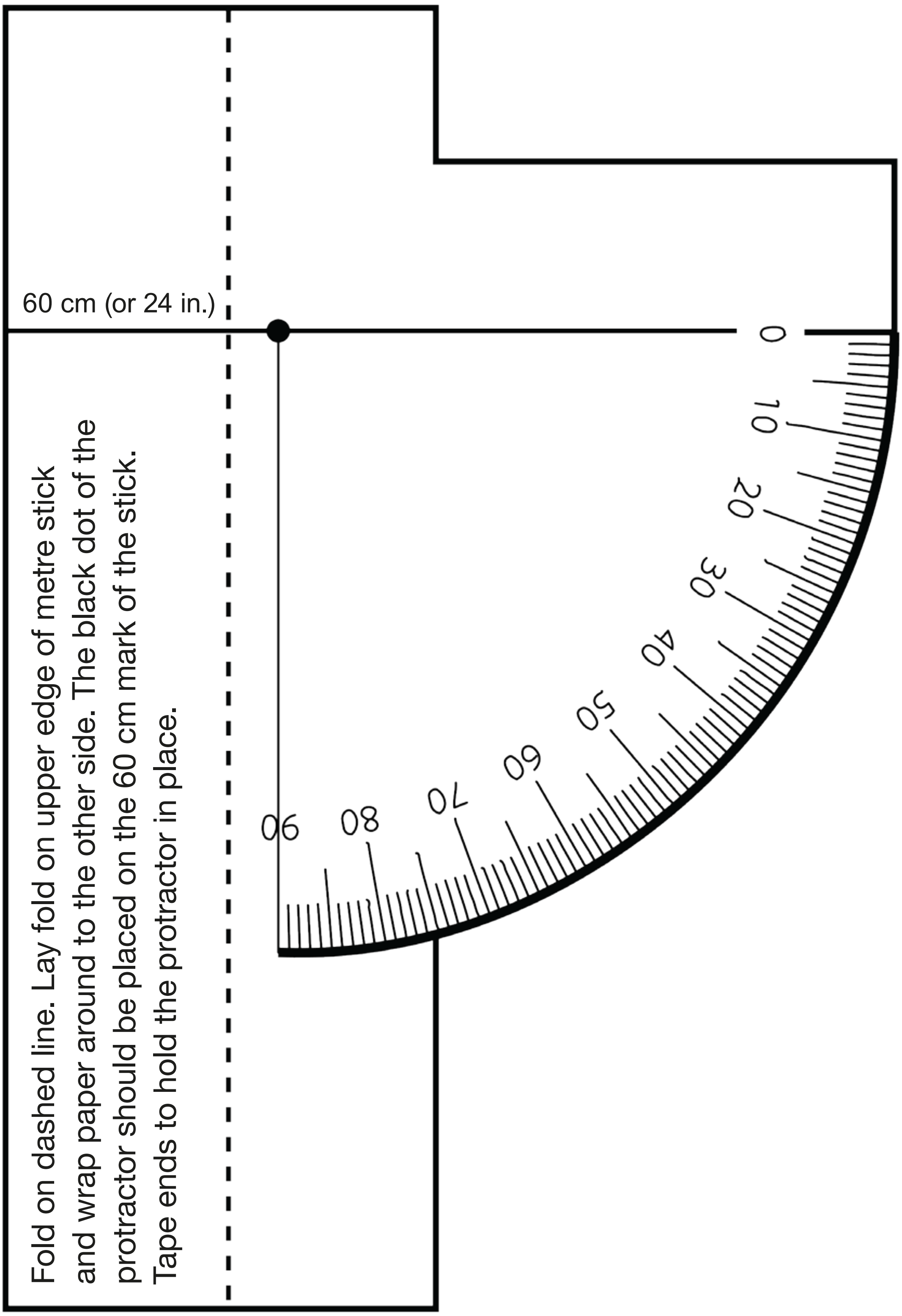
For testing, younger classes could be challenged to hit a particular target, such as a hula hoop on the ground, an empty bucket or a particular line on the basketball court. They could discuss pointing the metre stick in a different direction or pulling back the rocket further without having to measure. Leaning the metre stick against the seat and back of an infant chair can be a good way to keep the angle the same without having to measure.

Follow-up challenge/project/citizen science link:

- Look at people playing sports such as ball sports, such as archery, javelin, darts or watch videos. Look at the trajectory of the ball/arrow/dart. How does it compare to your rocket launch?
- Research how real rockets are launched. How much fuel is used? Where are they launched from and why? What are rockets used for?

Launch Quadrant Pattern

(Actual Size)



curious minds
Discover STEM

Classroom Resource

Investigating how to save energy

Taighde Éireann
Research Ireland

Investigation

Investigating how to save energy

Project carried on over a number of weeks with an initial discussion and set-up (one hour) followed by daily recording of meter readings to facilitate weekly calculation of energy use. It can be started at any time of year.

Class Level - Senior

Curriculum Links

Strand:	Energy and Forces; Environmental Awareness and Care
Strand Unit:	Heat; Environmental Awareness; Caring for the Environment; Science and the Environment
Curriculum Objectives:	Identify ways in which homes, buildings and materials are heated; Become aware of the importance of the Earth's renewable and non-renewable resources; Foster an appreciation of the ways in which people use the Earth's resources; Come to appreciate the need to conserve resources; Recognize and investigate aspects of human activities that may have positive or adverse effects on environment.
Skills Development:	Questioning; observing; predicting; investigating and experimenting; estimating and measuring; analysing; recording and communicating
New words / vocabulary:	Sustainable, Fossil Fuels, Renewable Energy, Audit
Focail nua:	Inbhuanaithe (Sustainable), Fuinneamh (Energy), Breoslaí iontaise (Fossil Fuels)
Cross curricular links:	(General) Geography: Use of the Earth's resources; History: Energy generation and use in the past; Maths: Data, weighing and measuring, ratios, percentages
Equipment / materials	• Copies of school energy bills, pencils, paper / recording sheets, calculator

Radiator in a house

Solar panels and wind turbines

Engage

Prompt questions:

- What is energy?
- What gives your body its energy? (Food).
- What gives a car its energy? (Petrol/diesel/electricity).
- What gives your kettle the energy to heat things? (Electricity).
- Where do the radiators in your school/house get heat energy from? (Usually oil or gas).
- What else in the school uses energy?
- Where do oil, coal, gas, and turf come from and how were they made? (from the compressed remains of plants and animals).
- Why do we need to use less energy? (Fossil fuels are running out; and also, burning them produces carbon dioxide and is giving rise to climate change which is having impacts in many parts of the world – weather extremes like floods, droughts, hurricanes).
- How do we measure the amount of electricity or gas we use in a building? (With meters). What is the unit of measurement called? (A kilowatt-hour, kWh for short).
- If you want to reduce the amount of energy the school uses, what is the first thing you need to do? (Measure the amount the school uses at present).
- How would we do this? (Look at the bills for electricity, gas, oil etc; or read the meters at intervals of one week, one month - do an energy audit of the school).
- How will we try to reduce the amount of energy that we use? (Use daylight when possible, switch off lights, appliances and equipment when not in use, turn the classroom thermostat down as per current guidance).
- How will we know if we have saved energy? (Read meters again, look at the next energy bill).

Background information:

Nothing can happen without energy. Energy is what makes everything work, including ourselves. There are many different forms of energy. The main ones are light energy, heat energy, chemical energy (in food and fuels among other things), electrical energy, sound energy, kinetic energy (moving energy), and potential energy (stored energy). Energy can be changed from one form to another (e.g., the chemical energy in food and petrol can turn into kinetic energy in people and cars; electrical energy turns into light and/or heat energy in electric lights and cookers). Energy cannot be created (from nothing) so to get energy for heating our homes or running our cars we often use the chemical energy stored in fossil fuels and convert it to other forms of energy. Instead, we could use solar panels to convert light energy from the sun into heat energy or electrical energy or use turbines to convert kinetic energy from wind or moving water into electrical energy.

Real-world application:

We use electricity for lighting, heating, appliances and other equipment at home and in school. Up to now much of this electricity has been made by burning fossil fuels (oil, turf, coal, etc.) in power stations. We need to cut down on the use of fossil fuels for two reasons: a) they took thousands (peat) or millions (coal, gas, and oil) of years to form and they are running out; b) extraction and burning fossil fuels produces carbon dioxide and is giving rise to climate change, which is having impacts in many parts of the world – floods, droughts, hurricanes, etc.

To cut down on the use of fossil fuels we need to do two things.

1. Reduce our overall energy use.
2. Use more renewable energy sources instead of burning fossil fuels.

Learners should be encouraged to identify the need to monitor energy consumption in school and to be involved in the design of a survey. In this way learners can have a sense of ownership of the project. Measuring the energy used, and calculating the cost, reinforces the idea of looking at our energy use and finding ways to save energy. Learners can be involved in measuring energy use at present in the school and then measuring energy use after implementing energy saving measures.

For more information see The Story of Energy video on the SEAI (Sustainable Energy Authority of Ireland) website: https://www.seai.ie/community-energy/schools/primary-school/resources-for-teachers/.

Investigate

Testable question:

- How much electricity are we using in school and how can we reduce our energy use?

Predicting:

After reading the electricity meter to assess current energy use, learners can investigate where electricity is being used in the school (e.g., lighting, whiteboards, computers, photocopiers, other appliances, and possibly heaters) and come up with a list of electricity saving measures that can be implemented in school over a set time period. Learners can predict how much electricity they might save in that period.

Radiator in a house

Conducting the investigation:

Monitoring electricity use

- It's good to start by monitoring your electricity consumption for 2-3 weeks (when the school has normal opening hours). Design a table to record your data. Read your meter every morning and afternoon at the same time. Can you calculate how many units of electricity are being used per day? Can you tell if electricity is being used at night when the school is closed? If so, why is this? Can you calculate how many units were used each week? What is the average number of units used per week? The cost of electricity can be calculated, using the unit cost on your school's bill (or by looking online to find your suppliers unit cost).

Sample weekly table (alternatively learners can design their own)

Before implementing plan

Date and day	Meter reading morning - A	Meter reading afternoon - B	Units used per day (B minus A)	Multiplied by cost per unit
Monday				
Tuesday				
Wednesday				
Thursday				
Friday				
Total per week	-	-		

- Implement your electricity saving plan and take meter readings at similar intervals over the same period (2-3 weeks when the school has normal opening hours). Calculate the number of units used and the cost. Are things that use electricity being left on when not in use? Can you investigate which appliances or devices use the most electricity per hour? (look on the manufacturers label or website). Can you reduce the time these items are in use? Was there any difference in the amount of electricity used compared to the initial readings? If so, what was the difference in the number of units? How much money was saved?

After implementing plan

Date and day	Meter reading morning - A	Meter reading afternoon - B	Units used per day (B minus A)	Multiplied by cost per unit
Monday				
Tuesday				
Wednesday				
Thursday				
Friday				
Total per week	-	-		

- Learners may decide to measure the success of individual energy saving measures by implementing one new change each week. For suggestions on energy saving measures see the SEAI website.
- For a scientific survey, learners need to remember 'fair testing' and monitor over the same length of time for each test, (say one full week, with normal school hours). Discuss why strict fair testing may not be possible on account of the variability of the Irish weather, changes in daylight hours, and the need for different levels of heating or light.

Sharing data/results:

- Calculate the total amount of energy saved and the percentage of energy saved.
- Calculate the amount of money saved as a result of energy reductions.
- Display the results on a table and make posters or displays for school noticeboards.
- Investigate which appliances or devices use the most 'Watts' or power (look on the manufacturers label or website). Can you reduce the time the items that use most power are in use?

Take the Next Step

Adapt for home:

The same steps can be used at home to monitor energy use and calculate savings. SEAI's Home Energy Kit can be borrowed from participating libraries to help monitor energy use at home.

Adapt for junior level:

The actual monitoring and recording of energy use is best undertaken by senior classes but energy saving is best undertaken as a whole school project with all classes involved in measures to save energy.

Follow-up challenge/project/citizen science link:

- Investigate solar energy and the Greenhouse effect using the following ESERO resources at www.esero.ie
    - Hot and cold.
    - Earth under the lid.
    - What use is solar power?
- Use the primary school resources on the SEAI website to:
    - Learn more about sustainable energy and climate change.
    - Research renewable and non-renewable forms of energy.
    - Investigate solar energy by designing and making a greenhouse or making a pizza box solar oven.
    - Investigate wind energy by designing and making a model wind turbine or land yacht.
- For senior classes research more sustainable and efficient ways to heat buildings (heat pumps, photovoltaic panels). Calculate the costs and identify how long it would take for the new system to pay for itself.

Wind turbines in the countryside