Science Week Classroom Resource

Investigating Light

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DPSM/ESERO
Framework for Inquiry

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THEME	Overall theme	
CURRICULUM	Strand:	
	Maths:	
	Strand Unit:	
	Curriculum Objectives:	
	Skills Development:	

ENGAGE		
THE TRIGGER	WONDERING	EXPLORING

INVESTIGATE			
STARTER QUESTION	PREDICTING	CONDUCTING THE INVESTIGATION	SHARING: INTERPRETING THE DATA / RESULTS

TAKE THE NEXT STEP		
APPLYING LEARNING	MAKING CONNECTIONS	THOUGHTFUL ACTIONS

Considerations for inclusion

REFLECTION	

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THEME	SCIENCE RISING: LIGHT
CURRICULUM	**Strand: SESE:** Energy and Forces, Magnetism and Electricity, Science and the Environment. **Maths:** Shape and Space, Number, Measures, Data. **Strand Unit:** Light, Operations, Lines and Angles, 2D Shapes, Length, Area, Representing and Interpreting Data. **Curriculum Objectives:** Learn that light is a form of energy. Investigate the splitting and mixing of light - effects of flat shiny surface, curved shiny surface. Investigate current electricity. Use wires, bulbs, motors and batteries. Appreciate the application of science and technology in familiar contexts - information and communication technologies. Investigate the refraction of light. Explore how objects may be magnified using simple lens or magnifier. Estimate, measure and construct angles in degrees. **Skills Development:** Questioning, Observing, Predicting, Analysing, Investigating and Experimenting, Recording and Communicating, Designing and Making.

ENGAGE

THE TRIGGER	WONDERING	EXPLORING
Hang a glass prism in the window. See how it forms rainbows on the walls.	• Where do the different colours come from? How does a rainbow form? • If we can split light into different colours, could we combine those colours to make white light? • Does light always travel in straight lines? • Can light be made to change direction? • Are there any devices that help us to see further away – binoculars, telescopes, the zoom function on a camera. • What is it about these devices that help us to see objects that are far away? What do they contain? • What is a lens?	**Investigating Mirrors** • Explore with plane mirrors - mirror images, mirror writing, paired mirrors. • Explore with concave and convex mirrors. **Investigating Refraction** • Explore a selection of magnifying glasses, telescopes, binoculars, cameras. What do we notice about them? • Maybe look at reading glasses and also get the children who wear glasses to examine their own. • What do they notice about the lenses? Are they the same in both types of glasses? Why are they different? • Explore with the pencil / straw in water. • Hand out convex and concave lenses and explore with them.

INVESTIGATION 1 – RAINBOW SPINNER

STARTER QUESTION	PREDICTING	CONDUCTING THE INVESTIGATION	SHARING: INTERPRETING THE DATA / RESULTS
• If we combine the seven colours of the rainbow by spinning the disc very fast what will happen?	• Will the colours combine if we spin the disc? • What will happen if we try different size sections for the different colours? • What will happen if we use different colour combinations?	• Divide the disc into seven equal sections and colour them the different colours of the rainbow. • Spin the disc using string, a pencil or by using an electric motor and making a circuit.	• What colour was the disc when it was spun? • Did it make a difference what colours were used?

INVESTIGATION 2 – 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?	• Start by bouncing the ball. What do we notice about angle at which it bounces back? Will light behave in the same way? • Will the light be reflected back in the same direction? • Will the light go in a different direction? • How will we record our prediction?	• Place a slit in a sheet of card and shine the torch light though. • Change the direction of the card. • Mark the angles and measure. • Draw a table of measurements.	• How did we reassure the angles? • What did we notice about the angles?

Considerations for inclusion

Consider potential area of difficulty for students with Special Educational Needs.

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INVESTIGATION 3 – INVESTIGATING REFRACTION (MAKE A MODEL TELESCOPE)

STARTER QUESTION	PREDICTING	CONDUCTING THE INVESTIGATION	SHARING: INTERPRETING THE DATA / RESULTS
• Can we use what we have learned about lenses to design our own telescope?	• What could we use for the tubes of our telescope? • Could we experiment with the placing of lenses without using tubes? How could we secure them in place?	• Provide materials for the children to make a telescope.	• Did our telescope work? • Why did we use 2 different lenses? • Why was the image up-side down?

Considerations for inclusion

Consider potential area of difficulty for students with Special Educational Needs.

TAKE THE NEXT STEP

APPLYING LEARNING	MAKING CONNECTIONS	THOUGHTFUL ACTIONS

- Find out about the work of Irish Scientist John Tyndall. What contribution did he make to our understanding of light?
- Electricity flows in the circuit because of the movement of tiny particles called electrons. Electrons were first named by an Irish scientist called George Johnstone Stoney. Can we find out more about him and his work?
- What else can we do with electricity?
- How do satellites work and what are they used for?
- Try using water as a magnifying glass and magic coin activity.
- Much of our present day understanding of astronomy comes from the work of William Parsons, the third Earl of Rosse who built a giant reflecting telescope at Birr Castle and used it to study the stars. What can we find out about him?
- Try out DPSM activities 'Mirror Writing", "Creepy Reflections and Floating Finger", "Make a Periscope" and "Solar Energy" which all relate to light.

REFLECTION

- Did I meet my learning objectives?
- What went well, what would I change?
- Are there cross curriculum opportunities here?
- 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.

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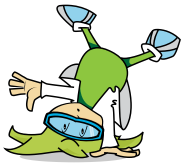
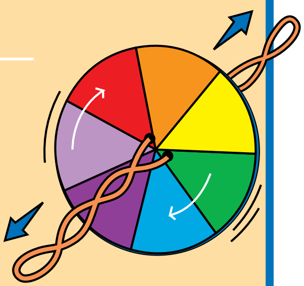
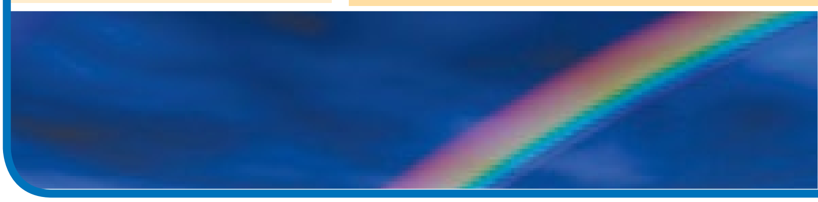
RAINBOW SPINNER



Preparation

CLASS LEVEL	**Third – sixth class**
OBJECTIVES	**Content strand and strand unit** **Energy & forces, Light** Through investigation the child should be enabled to investigate the splitting and mixing of light, SESE: Science Curriculum page 85. In this activity children learn that not only can white light be broken up into the rainbow colours, but also that the rainbow colours can be brought together to produce white light. They also learn about persistence of vision (i.e. that if things move fast enough the eye cannot distinguish between them and they merge). **Skill development** Making; observing
CURRICULUM LINKS	**Geography** Natural environment/weather phenomena **Visual arts** Paint and colour/painting
BACKGROUND	A previous activity, perhaps a demonstration, of white light being broken into the seven rainbow colours by a prism would be helpful. Working with bubbles is another way of introducing some ideas about colours.
MATERIALS/EQUIPMENT	White cardboard, Scissors, Cup or jam jar, Strong string (120 cm works well), Pencil, Coloured pencils or markers, Small electric fan, Protractor (for older children only).
PREPARATION	Collection of materials and equipment
BACKGROUND INFORMATION	Ordinary light consists of the seven rainbow colours, viz. Red, orange, yellow, green, blue, indigo, violet. Isaac Newton was the first person to show that light could be split up into seven different colours. Just as raindrops, prism, etc. can split white light into these seven colours so can white light be made by mixing the seven colours together. By spinning the disc quickly the eye sees all the colours together (persistence of vision) and so the disc appears white (in practice the disc appears off-white, as most colours are not pure).

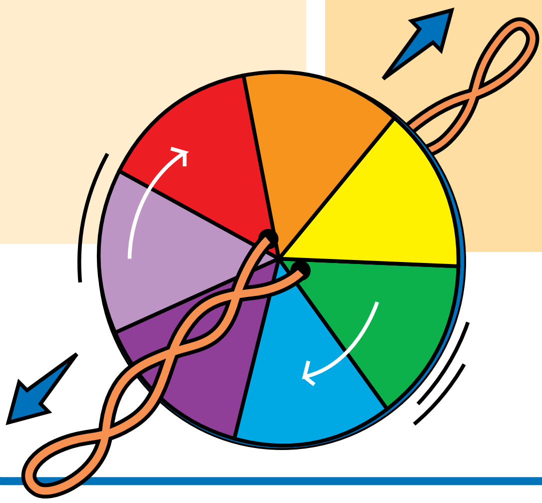


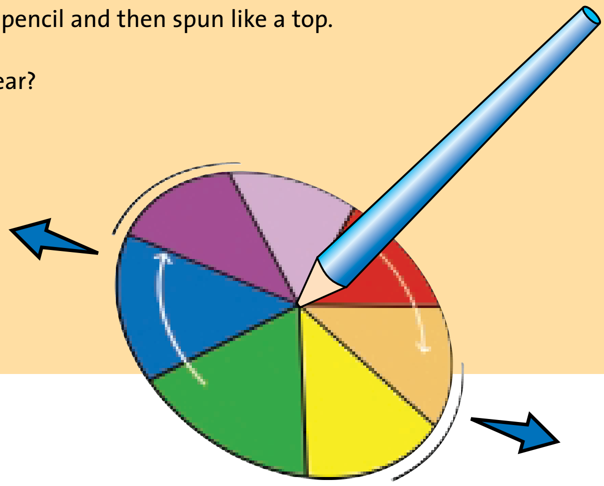


RAINBOW SPINNER

Activity

SETTING THE SCENE	Discussion on colour – what would the world be like without it, e.g. clothes, weather, gardens, organising city traffic, etc. Not all creatures see colours in the same way, e.g. guinea pigs and squirrels are colour blind. Colour is really the way our eyes see different kinds of light.
TRIGGER QUESTIONS	When/where do you see rainbow colours? Where do you think that the colours that you see in rainbows, in bubbles, on CDs, oil, etc. come from? What are the rainbow colours? If you can split light up into rainbow colours (by raindrops, prism, CD, etc.) can you make white light by bringing the rainbow colours together? TRY AND SEE! If we switch off the light will we see the colour?
DEVELOPMENT OF ACTIVITY	You can bring the colours together by making a cardboard disc with all the colours and then spinning – a rainbow spinner.
SAFETY	General care with scissors
ACTIVITY	Cut out a cardboard disc and divide it into seven equal segments (the older children may like to do this with a protractor). Colour the segments the seven colours of the rainbow. Make two holes in the centre of the card 1 cm. apart and thread the string through them making a loop at each end. Put a finger through the end of each loop and flip the disc over the string several times until the string is well twisted. Pull your hands apart and let the string go slack. The disc should now spin. OR The card can be placed on a pencil and then spun like a top. What colour does the card appear?





RAINBOW SPINNER

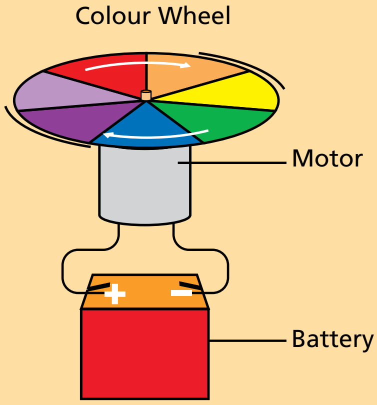
Review

REVIEW	Is there any difference between coloured pencils and markers in this activity? Does it matter what order the colours are arranged on the disc?
ASSESSMENT	The children could display their rainbow spinner and use diagrams and text to explain how they work. They could film their spinners and add a voice-over explaining how they work.
FOLLOW-UP ACTIVITIES	The coloured card can be placed on the spindle of a motor. When the motor is connected to a battery the spindle will turn and the card rotates. Reverse the connections between the motor and the battery. Is there any difference?

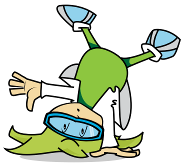
The children could be asked:

- What else would you like to find out?
- How would you find it out?

This would encourage them to design their own investigation.



SATELLITES AND REFLECTIONS

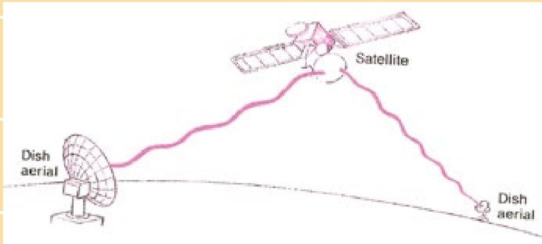


Equipment:

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.



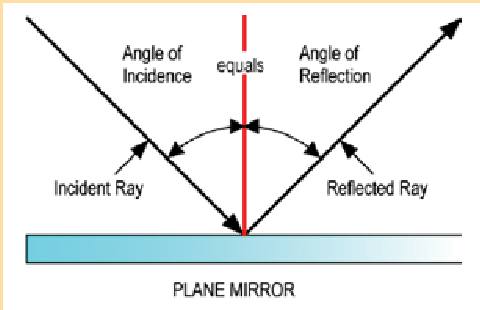
Background information:

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 DPSM 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.

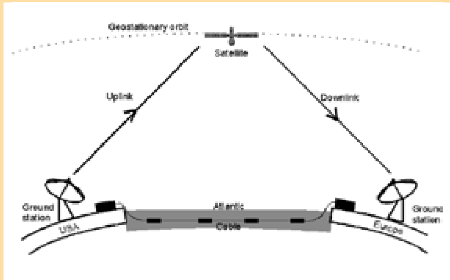
Since then thousands of satellites have been launched into space for lots of different reasons: for communications (*TV, radio, telephone and Internet - the signals are sent up to the satellites, they are 'reflected' off the satellites at a different angle like light off a mirror or a ball off a wall, 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 REFLECTIONS

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 REFLECTIONS

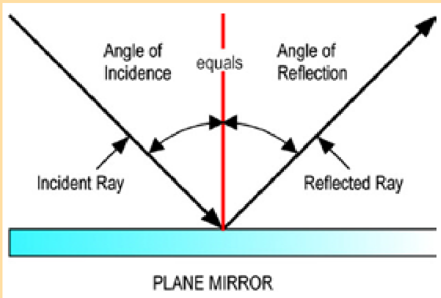
Activity:

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*).

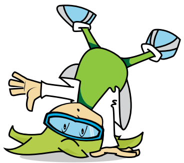


Record these angles. Are they acute or obtuse?

- 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

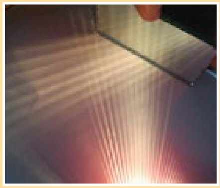
SATELLITES AND REFLECTIONS



Safety:

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

Follow-up activities:



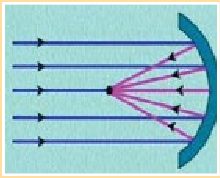
1.

- 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: spacemath.gsfc.nasa.gov

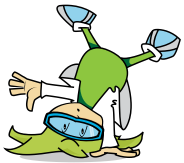
"The Declining Arctic Ice Cap during September"

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

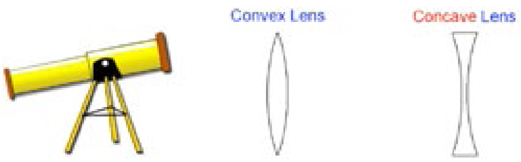
- Draw a graph from this data, using a suitable scale.
- Can you give a rough prediction of the area of ice in 2020 and 2030 if the present trend continues?
- Why do you think the area of ice is getting smaller?
- What do you think will be the effect on the environment if this global warming continues?

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

INVESTIGATING REFRACTION



(Lenses and Telescopes)



Strand/Strand unit

Energy and Forces: Light

Class level

5th/6th

Learning objectives

The child shall be enabled to:

- investigate the refraction of light
- explore how objects may be magnified using simple lens or magnifier

investigate use of lens
design and make model telescopes

(SESE: Science Curriculum, p.85)

Equipment

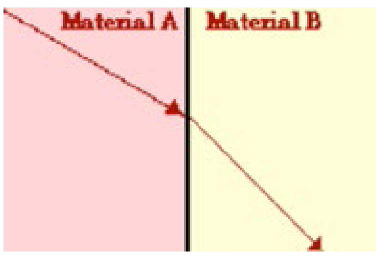
1. Jampot, water, pencil or straw
2. Small convex lenses (1 per child if possible), sheet of white paper
3. Small concave lenses (1 per child if possible), sheet of white paper

   (LENSES WITH 5 cm. DIAMETER AND FOCAL LENGTH 20 cm. ARE CHEAP AND SUITABLE FOR CLASSROOM USE)
4. For model telescope: 2 cardboard tubes (e.g. empty kitchen rolls) – one to slide up and down inside the other; 2 convex lenses – one short focal length (say 5cm) and one long focal length (say 20 cm), sellotape.

Preparation

- Collection of materials.
- Children will probably have carried out an activity in a younger class about ***shadows,*** in which they learn that light normally travels in straight lines. If they have not, then this should be done beforehand. Otherwise it may be more difficult to understand the concept of refraction of light.

Background information

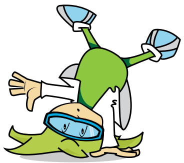


Light normally travels in straight lines (think of shadows as an absence of light). This only happens if the light is travelling in the same substance all the time, e.g. through air OR through glass OR through water.

However, if light goes from one medium to another (e.g. from air to glass, from water to air, etc.) it usually bends. This bending of light when it goes from one medium to another is called REFRACTION. It happens because light travels at different speeds in different materials.

INVESTIGATING REFRACTION

(Lenses and Telescopes)



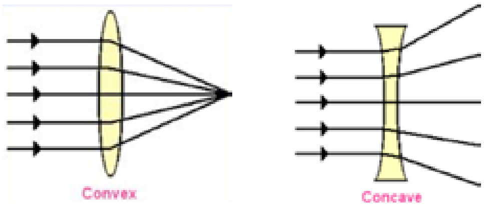
Background information

Lenses are specially shaped pieces of glass or transparent plastic that bend the light travelling through them.

Lenses which are thicker in the middle than at the edges are called CONVEX LENSES. Lenses which are thinner in the middle than at the edges are called CONCAVE LENSES (i.e. they cave in!). They both bend light as it passes through them.

Convex lenses *converge* light that passes through them.

Concave lenses *diverge* light that passes through them.



Telescopes gather up light from distant objects, e.g. stars. They come in all shapes and sizes, from a small plastic tube in a €2 shop to the very powerful giant Hubble Space Telescope which weighs several tons. Galileo made the first telescope in 1609, using a convex lens. This is called a *refracting telescope*. Galileo was able to see mountains and craters on the Moon through his telescope.

(Concave mirrors can also be used to collect distant light. Isaac Newton made the first *reflecting telescope* in 1688. *See DPSM activity 'Investigating Mirrors'*).

Both types are still in use

Our **eyes** contain convex lenses which gather up light coming into them and focus it on the retina, which sends messages to the brain via the optic nerve.

Skills

Experimenting, Observing, Analysing
Designing and Making

Cross –curricular links

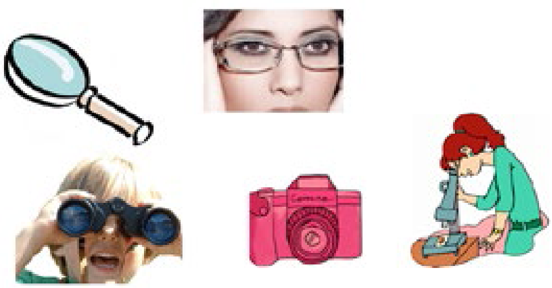
MATHS: Estimating, Measuring

Trigger questions

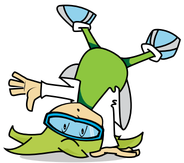
What is a lens?
(Possible response: A specially shaped piece of glass or transparent plastic that can make things look different when you look through them).

Tell me one important difference between a lens and a mirror. Can light pass through both?
(No, light does not pass through a mirror).

Where do you find lenses?
(Spectacles, cameras, telescopes, binoculars, microscopes etc.).



INVESTIGATING REFRACTION



(Lenses and Telescopes)

Activities

1. STRAW OR PENCIL IN WATER

Put a straw or pencil in a jampot or glass of water and let it go. Look at the straw from various angles. What do you notice? *(The straw seems to bend at the surface of the water. This effect is called refraction).*

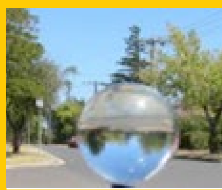
2. INVESTIGATING CONVEX LENSES

This is a magnifying glass or hand lens

A: **Near:** Hold the lens close to some print, e.g. a book or newspaper.
What do you see? *(The image is large and right way up).*

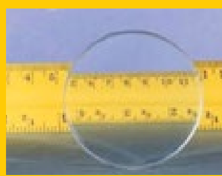
Now look at your friend's eye through the convex lens.
What do you notice?

B: **Further away:** Now hold the convex lens further away from you (at arm's length) and look at something in the distance. What do you notice? *(The image is upside down).*



3. INVESTIGATING CONCAVE LENSES

A: **Near:** Hold the lens in front of some print. What do you see? *(The image is smaller and right way up)*



B: **Further away:** Now hold the concave lens further away from you and look at something in the distance. What do you see? *(The image is still smaller and right way up).*

4. DESIGN AND MAKE A MODEL TELESCOPE

Trigger Questions:

(i) What is a telescope?
(An instrument for making faraway things look much closer.)

(ii) What is the study of stars called?
(Astronomy. It is the oldest science).

Before Galileo invented the first telescope the only way people could study the stars and the Universe was to look at them with just their eyes.

(As telescopes are slightly tricky to make on account of the different focal lengths – which is a second level topic - it may be a good idea for children to follow a prototype first. They can then experiment with designing their own if the school has a variety of lenses of different focal length).

INVESTIGATING REFRACTION

(Lenses and Telescopes)

Activities

Slide the narrower tube inside the wider tube. Attach the convex lens with the longer focal length to the end of the wider tube, and the convex lens with the shorter focal length (the bulgier one, which is called the eyepiece because it is the end which you look through) to the end of the narrower tube.

While looking through the eyepiece, slide the inner tube back and forth slowly inside the outer tube until you see a sharp image in the distance. What do you notice about the image? *(It is upside down).*

Why is it upside down?
(Because the first lens which the light meets collects the light from far away and turns the image upside down - remember when you held your convex lens at a distance from you. Then the lens near your eye magnifies this image, without turning it the other way up – remember when you held the convex lens near you.)

N.B. There is quite a narrow field of view in this model telescope, but it is the principle on which a real telescope is based.

You can experiment with the principle of this activity , without using tubes, by holding convex lenses of different focal lengths in the air at different distances apart – with the shorter focal length lens nearer your eye, as above. *(suggested by Frances McCarthy, Blackrock Castle Observatory, Cork).*

Another simple tubeless method to illustrate the principle of the refracting telescope is to set up the following arrangement, using a ruler, plasticine and the two convex lenses (5 cm and 20 cm focal length) approximately 25 cm apart.

Analysis/Conclusion

What in general do you notice when you look at objects through lenses?
(The objects can look bigger or smaller, right way up or upside down, depending on the type of lens and the distance from it).

Safety

1. **Mind your eyes! Do not look directly, or through lenses, into the sun or bright lights.**
2. **Convex lenses can concentrate sunlight into one small area and could cause a fire on a hot day.**

Follow-up activities

WATER AS A MAGNIFYING GLASS

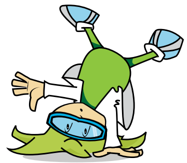
1a) **Drop of water**

Equipment: Small piece of clear plastic, a page of print, water, pencil or dropper.

Activity: Place a drop of water on clear plastic (using a pencil or dropper). What shape is the drop? Holding the plastic tight, place it over some writing. What do you notice?. Does this remind you of any type of lens you used? *(Convex).* What shape is a drop of water? *(Curved).*

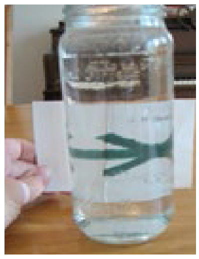
Move the plastic nearer to and then away from the print. What do you notice?

INVESTIGATING REFRACTION
(Lenses and Telescopes)



Follow-up activities

WATER AS A MAGNIFYING GLASS



1b) **Bottle of water**

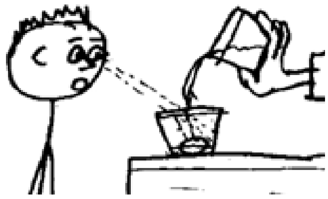
Equipment: clear bottle of water, page of print.

Look at a picture or writing through a clear bottle of water. What do you notice? Does this remind you of any particular type of lens? *(Convex).*

Question: What shape was the water in the above two activities, to produce the magnification? *(Curved: convex).*

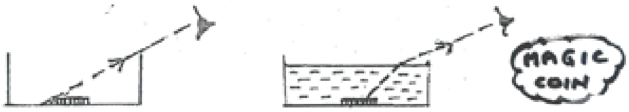
2. **"MAGIC COIN"** is a fun activity, based on refraction, for children working in pairs.

Equipment: Jug or jar of water, empty carton (butter cartons work well), coin, blutack.



Place a coin on the bottom of the butter carton and secure it with blutack. One child looks at the coin and moves his/her head back until the coin is JUST OUT OF VIEW. The other child pours water into the carton slowly. What does the first child see?

The children then reverse roles. What happens? Why do you think this happens?

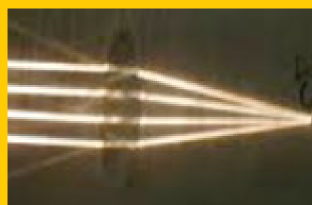


Children Can:

1. Investigate spectacles: do they bulge in or out in the middle, i.e. are they convex or concave? What happens to the print if they hold the spectacles close to some print?

2. Try to 'catch a light'!

(a) using a convex lens: hold a convex lens towards a light (sun or artificial) and, with a sheet of white paper in the other hand, try to focus the light (i.e. to where it is the smallest and brightest) to a sharp point onto the paper, by moving either the paper or lens.



Convex lens

MATHS: (i) Estimate the distance between the lens and the paper.

(ii) (working in pairs) measure the distance between the lens and the paper (this distance is called the 'focal length', which is in the second level curriculum).

Concave lens

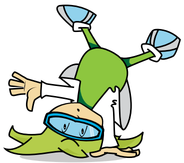
(b) using a concave lens *(This is not possible because a concave lens bends light in the other direction, i.e. it diverges the light).*

3. Try to predict which type of lens is contained in their eyes, to gather up light coming into them and focus it on the retina (the part of the eye which tells the brain what it sees).

Shut their eyes and gently feel the outside of their eyelids with their clean fingers (CAREFUL! GENTLY!). What type of lens do they feel?

INVESTIGATING REFRACTION

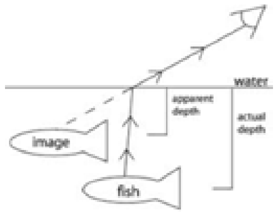
(Lenses and Telescopes)



Did You Know?

1. Short-sighted people wear spectacles which have lenses that are thinner in the middle, i.e. concave.

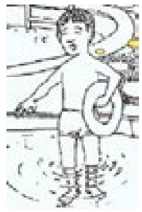
   Long-sighted people wear convex lenses. The lenses bend the light to form a sharp image on the retina (the part of the eye that sees).



2. Water can look a lot shallower than it actually is, because of refraction. Because light which is reflected off say a fish in water, bends when it reaches the surface, your eye assumes light travels in straight lines and sees the fish nearer the surface than it actually is.

   Have you noticed that when you paddle in water your legs appear to be shorter than their actual length? *(This is for the same reason).*

   SAFETY in the water! So refraction is important to think about before you jump into water – it might be much deeper than you think!



3. A fresnel lens (named after a Frenchman called Fresnel, who invented it) is a special type of convex lens – a very powerful one, which is used in lighthouses to send out extra strong beams. *(See DPSM activity 'Make a Lighthouse' – using an ordinary bulb in glass).*

Useful Websites:

For more about telescopes have a look at http://www.kidsastronomy.com/telescopes.htm

Another activity, using just one convex lens, can be found at https://www.exploratorium.edu/science_explorer/pictures_from_light.html

At www.bco.ie read about a partnership between Blackrock Castle Observatory, Cork and a primary school in the San Francisco Bay area, America, where the first robotic telescope project will be sited.

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**

Curriculum Links

Science Rising: Light

English / Irish

- Read about the work of Irish scientists and their contribution to scientific knowledge http://sciencerising.sfi.ie/
- Start a science blog for Science Week with pictures of your scientific investigations and reflections on your findings.
- Keep a Science Week diary.
- Write instructions for one of your investigations into light.

PE

- Apply what we learned about the effect of angles. Bouncing balls at different angles. How angles are important for different sports – basketball, tennis, football.

SPHE

- Myself and the wider world: Look at the contribution of scientists to our world. How have inventions for space exploration influenced our daily lives?

SESE Geography

- Planet Earth in Space: How does the light from the sun reach Earth? Night and day, seasons.
- Human Environments: Look at how the reflection of light and satellite technology contribute to transport and communications.
- People at Work: The work of scientists. Look at how scientists do their research, often when they do not know the answers to the questions they are asking. How do they confirm their findings?

SESE History

- Early People and Ancient Societies: Find out about the building of Newgrange and how the builders used their understanding of light to align the entrance of the tomb.
- Traders, explorers and colonisers from Europe: The invention of the telescope had a significant bearing on the age of exploration. What other scientific instruments help the early explorers to discover new lands?

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