Name

SCHOLASTIC

Lights on display

● This sheet shows you four pairs of images that will give you some ideas for creating an animated light display. Using these images to help you, draw your own designs and write a list of items you will need to complete your work.

Image 1 Image 2

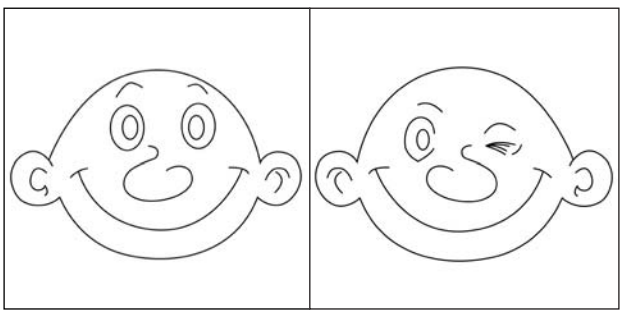


Image 1 Image 2

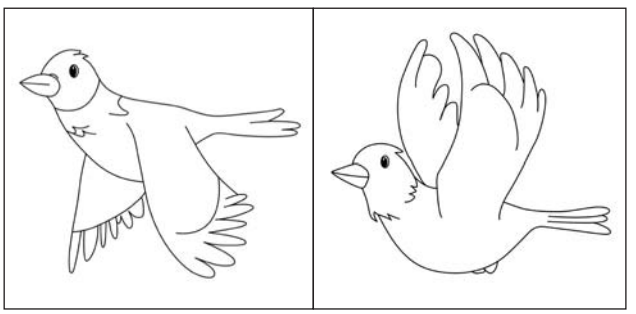


Image 1 Image 2

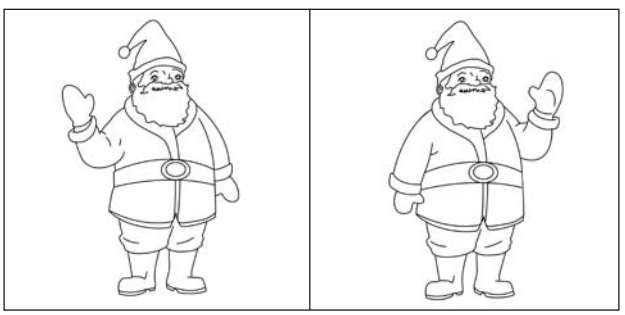
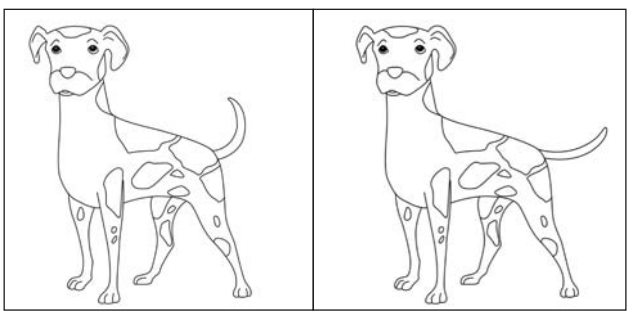


Image 1 Image 2



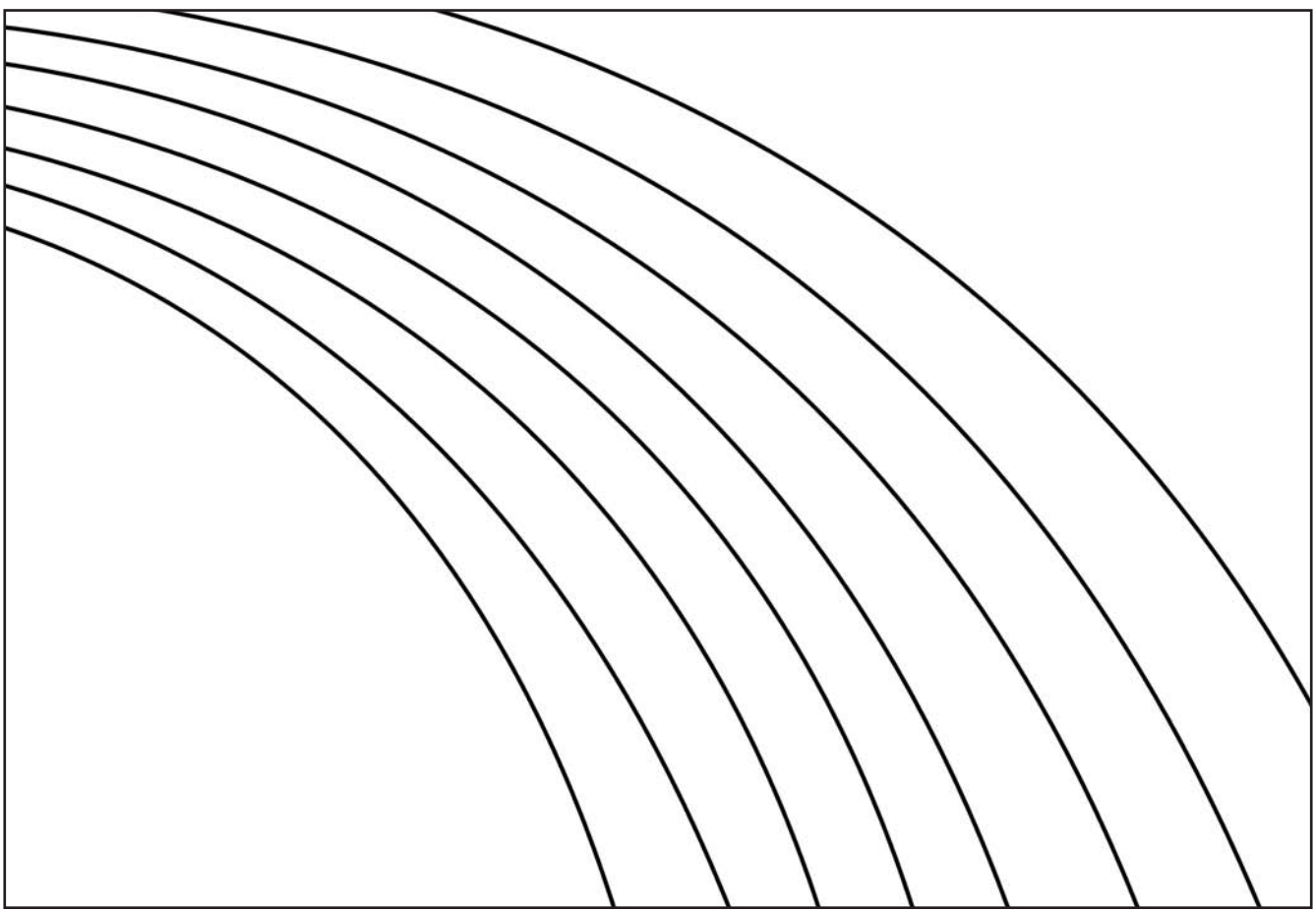
Our animated light design will use two images:

Image 1	Image 2

We will need....

Rainbow colours

- Make a spectrum by shading in the colours of the rainbow in this diagram below.



- Make up your own mnemonic to help you remember the colours in the correct order.

_____

_____

- What are the primary colours of light?

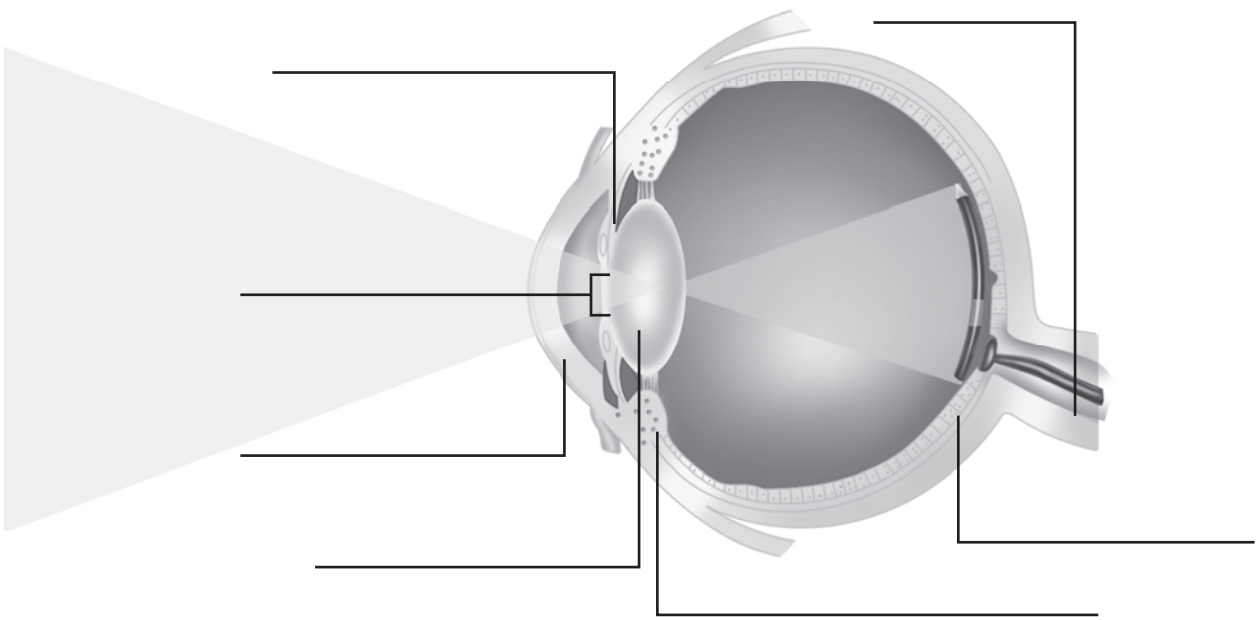
_____

- Think of ways you could use objects or surfaces in the classroom to show how white light is actually made up of these colours.

Human eye

● Put the correct labels on the parts of the human eye shown in this cross-section diagram below.

pupil **muscle** **retina** **iris** **optic nerve** **lens** **cornea**



● Now complete these sentences that explain the function of seven parts of the eye.

cornea **lens** **muscle** **iris** **optic nerve** **retina** **pupil**

The ..... is the transparent outer covering of the eye.

The ..... allows light into the eye.

The ..... is the coloured part of the eye.

The ..... focuses light rays on the back of the eye.

The ..... is covered with light sensitive cells and forms an image.

The ..... takes images to the brain for interpretation.

The ..... allows the eye to swivel in its socket.

Name

SCHOLASTIC

Light pioneers

● Find out more about two famous pioneers in the study of light by putting the correct missing words into the spaces provided below.

Sir Isaac Newton

plague white prism Cambridge wall colours spectrum hole

It was in 1666 while Newton was away from ..... University escaping from an outbreak of the ..... that he first realised that, although light appears to be ....., it is in fact made up of a spectrum of ..... . He allowed a shaft of light into his darkened room through a tiny ..... in his window shutters. After he had passed it through a glass ..... he had specially cut, the ..... could be observed on the ..... opposite.

Thomas Edison

wire gas bulb American glows electricity glass laboratory

One of the inventors who worked on the development of the electric light ..... was Thomas Alva Edison. He was an ..... who lived between 1857 and 1931. Edison had his first ..... by the time he was ten years old and during his lifetime is said to have patented over a thousand different inventions. The bulb is made of ..... . Inside there is a very thin ..... When ..... passes through this thin wire it becomes very hot. It is so hot that it ..... The bulb is filled with ..... and this stops the wire from burning away too quickly.

English National Curriculum – Light and sound

Common objectives for all activities in this issue

Programme of study: science

Sc1 Scientific enquiry

1a) that science is about thinking creatively to explain how living and non-living things work
b) that it is important to test ideas using evidence from observation and measurement
2a) to ask questions that can be investigated scientifically
b) to consider what information they will use to answer questions
d) make a fair test by changing one factor and keeping other factors the same.

Sc4 Physical processes

3a) that light travels from a source
b) that light cannot pass through some materials and this leads to shadows
c) that light is reflected from surfaces
d) that we see things only when light from them enters our eyes
e) that sounds are made when objects vibrate
f) how to change the pitch and loudness of sounds
g) that vibrations travel through metal, wood, glass, air and water.

Additional objectives for specific activities

Pages 2-3 Everyday energy

Programme of study: science

Sc4 Physical processes – Breadth of study

1b) look at the part science has played in the development of many useful things
c) use a range of sources of information, including ICT-based sources
d) use first-hand and secondary data to sscarry out investigations.

QCA Science

Unit 6F – How we see things

Pages 4-5 Bright lights

Programme of study: design and technology

1a) think about who will use the product and what it will be used for
b) explain what they want their design to achieve
c) plan what they have to do
d) communicate design ideas.

Programme of study: science

Sc4 Physical processes

1a) construct circuits with a battery and a range of switches
b) change the components to make bulbs brighter or dimmer.

QCA Science

Unit 4F – Circuits and conductors

Pages 6-7 Shadows and shapes

Programme of study: ICT

Breadth of study

5b) explore a variety of information sources and ICT tools
c) compare the uses of ICT inside and outside school.

QCA Science

Unit 3F – Light and shadows

Pages 9-11 The orchestra

Programme of study: music

3a) analyse and compare sounds
4a) recall sounds and develop aural memory
c) how music is produced in different ways.

Programme of study: design and technology

1b) explain what they want their design to achieve
c) plan what they have to do
2a) select tools and techniques for making their product
c) explore the sensory qualities of materials used
d) measure, cut out and assemble a range of materials.

QCA Science

Unit 11 – The class orchestra

Pages 12-13 Good vibrations

Programme of study: science

Sc4 Physical processes – Breadth of study

1b) look at the part science has played in the

English National Curriculum – Light and sound (continued)

development of many useful things
c) use a range of sources of information, including ICT-based sources
d) use first-hand and secondary data to carry out investigations.

QCA Science
Unit 5F – Changing sounds

Pages 14-15 Controlling light
Programme of study: science
Sc4 Physical processes
1a) construct circuits with a battery and a range of switches.

Programme of study: design and technology
1b) explain what they want their design to achieve
c) plan what they have to do
2a) select tools and techniques for making their product.

Programme of study: ICT
2b) create, test and improve sequences of instructions to make things happen and respond to events
5b) working with others to explore a variety of information sources and ICT tools.

QCA ICT
Unit 5E – Controlling devices; Unit 6C – Control and monitoring

Page 16 Sending messages
Programme of study: English
En1 Speaking and listening
6a) how language varies according to context and purpose
c) be aware of spoken and other forms of language and communication.

Walking about

- Mark and Sunita are finding out about the effect that distance has on sound.

- Sunita bangs a pair of cymbals and Mark walks and stands different distances away from her.

- The sound is measured using a sound meter.

- What do you think the results might have been? Complete this table by matching the distances to the sound descriptions below and drawing on the correct sound meter reading.

Distance (paces)

1 pace 20 paces 10 paces 5 paces

Sound description

loud very quiet very loud quiet

Distance (paces)	Sound description	Sound meter reading
		Quiet Loud
		Quiet Loud
		Quiet Loud
		Quiet Loud

- Now write some sentences to explain what you think the two children might have found out.

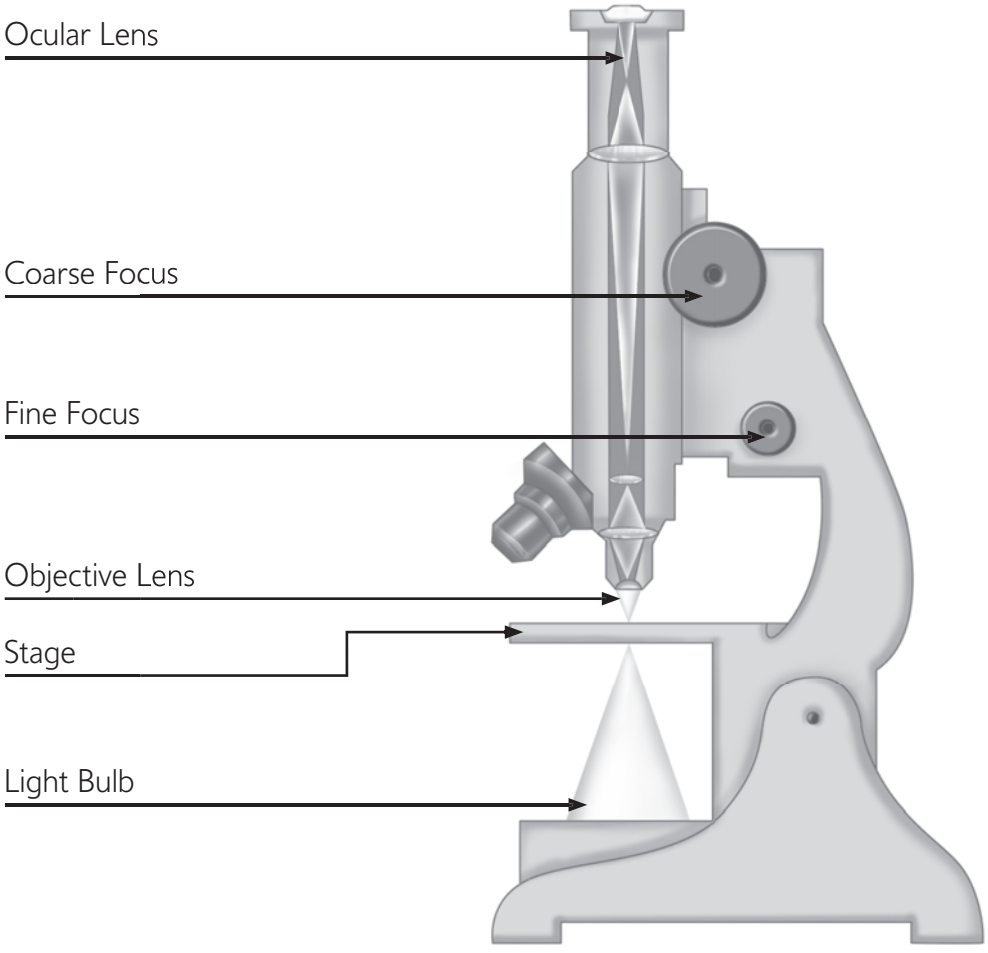
How the microscope works

- The Englishman Robert Hooke (1635–1703) and Antoni van Leeuwenhoek (1632–1723) from Holland were the pioneers of the microscope.

- Leeuwenhoek's microscope was a tiny metal device with a single lens while Hooke's had two lenses and was illuminated by an oil-lamp when sunlight was not good enough.

- Today's compound microscope needs two lenses – a small but powerful objective lens and a large eyepiece lens. Light from the specimen is focused by the objective lens so that it forms a magnified 'real' image. The eyepiece lens enlarges this just like a magnifying glass so that the observer's eye traces the light back to see a much bigger virtual image. A two-lens microscope produces an image that is inverted or back to front.

Many modern microscopes use prisms to give a two-way split. One group of light rays goes to the observer and the other group of rays goes to a camera that records the image on film.



Biography of Alexander Graham Bell

Alexander Graham Bell was one of the few people to successfully combine the roles of both teacher and scientist. He spent his working life teaching deaf people to speak while, in his spare time, his experiments with sound led to the development of the first working telephone.

Bell was born in Edinburgh in 1847, although he spent much of his later life living and working in Canada and the USA. For two generations his family were well-known for their work in elocution and speech correction, and Alexander and his two brothers were trained to continue the family tradition. Alexander was taught mainly at home. In 1868 he became his father's assistant in London, teaching speech to the deaf.

Following the death of his two brothers from tuberculosis, the Bell family moved to Canada, where Alexander began to experiment with sound during vacations at home. He opened his own school for training teachers of the deaf in 1872 and, the following year, was appointed Professor of Vocal Physiology at Boston University.

Alexander had never been skilled with his hands but at this point he met Thomas Watson, a young repair mechanic and model maker, who was able to assist him with his experiments and construct the equipment needed to put his theories into practice. In March 1876, Bell registered his telephone at the United States Patent Office – the place where licences are issued allowing inventions to be made, used and sold. The Bell Telephone Company was officially founded in 1877, the year Alexander married Mabel Hubbard, one of his deaf students.

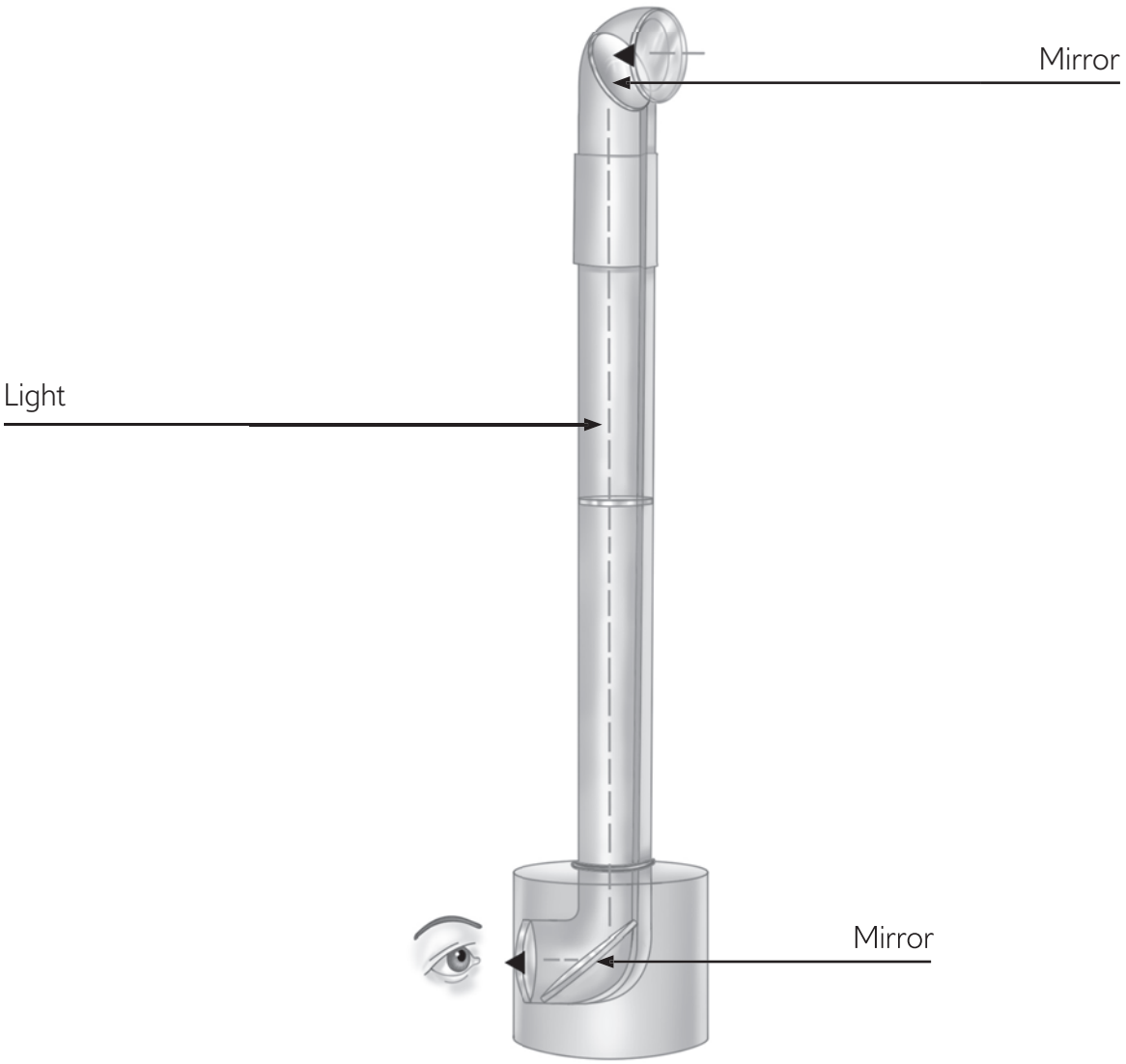
Despite the success, Bell was eager for fresh challenges. He invented the photophone – a device that transmitted sound over a short distance on a beam of light and, with the money awarded for winning the French Volta Prize in 1880, he established the Volta Laboratory. Here he developed the graphophone, a practical approach to sound recording and in many ways an early kind of record player. The Volta Bureau building still exists and is an international information centre concerned with oral education of the deaf.

In 1885, Bell acquired land on Cape Breton Island, Nova Scotia in Canada, where he established a summerhouse complete with fully-equipped research laboratories. From this base, until his death in 1922 at the age of 75, he continued to expand his scientific interests into many other fields.

How the periscope works

● Periscopes are well known to the crew of a submarine because they allow them to see what is happening on the surface of the water. But they can also prove useful in other situations. They could be used to help see over a high wall or round a corner, for example. They have also helped shorter people at the back of a large crowd see exactly what is happening in front of them, like at a sports event or a royal procession.

● Two mirrors are placed inside the periscope box or tube to reflect the light. You can see things over or round an obstruction because light from objects travel to the top mirror. From there it is reflected or bounces to the bottom mirror and into the eyes. Each mirror is set at an angle of 45 degrees but actually turns the light through 90 degrees. In a more powerful periscope, lenses can be set at intervals down the tube to magnify the image and make it even clearer.



Name

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Hearing sounds

- Try out these experiments in the classroom to see how sound is able to travel through different materials.

- Stand at one end of your table and ask your friend to quietly scratch the other end. Can you hear it easily? Is it louder with your ear to the table?

- Put different materials between your ear and the table. Which materials let the sound come through best? Record your results below.

- Now ask a friend to go into the room next door and make noises like banging a drum. Listen out for the sounds you hear.

- Put your head against the wall. Can you hear the sounds better now?

- Now try listening through a plastic cup. Does this help? Why do you think this might be?

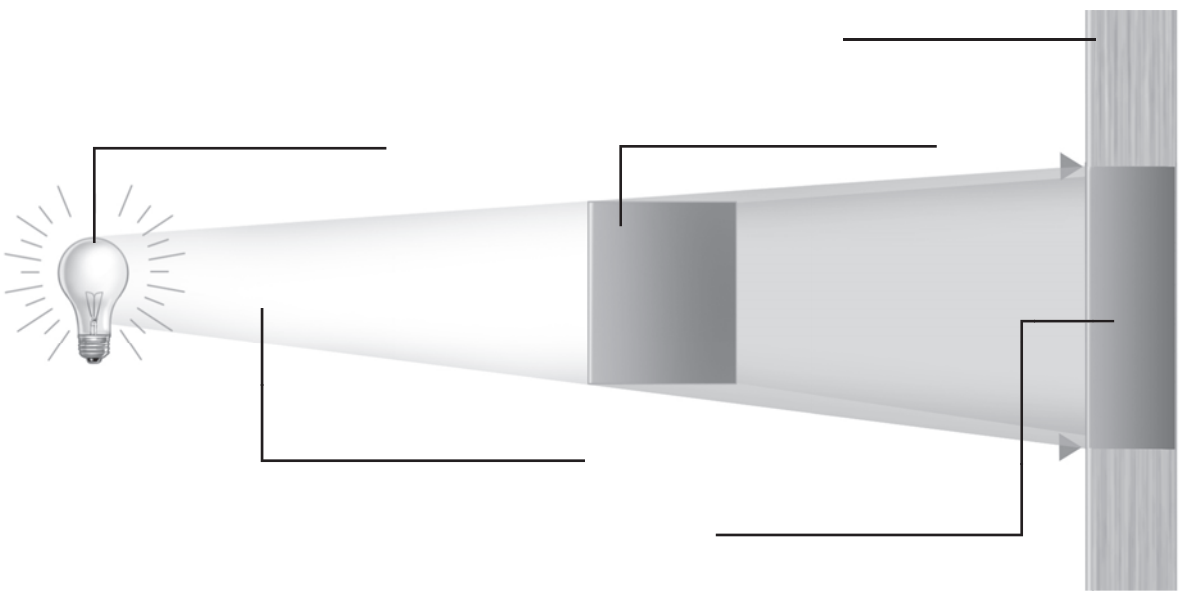
SCHOLASTIC

Shadow assessment

- This diagram shows how an object casts a shadow onto a surface.

Label each part of the diagram using the following words:

light rays light source object shadow surface



- Now, write an explanation to go with the diagram.

A shadow is formed...

Some useful words to use:

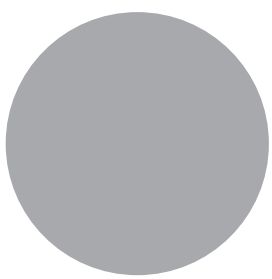
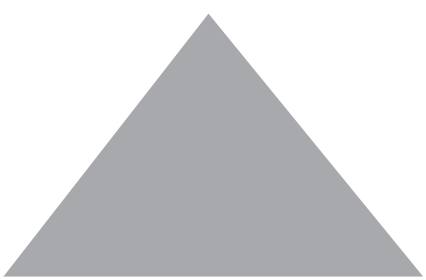
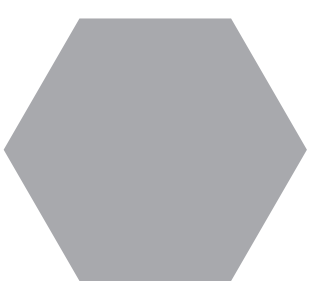
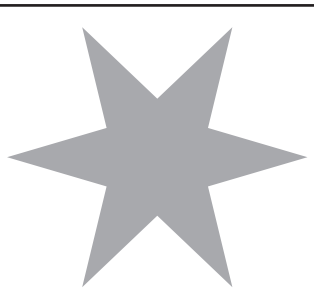
light, light source, light ray, object, block, travel, transparent, opaque, dark, shadow

Name

SCHOLASTIC

Shape shadows

Use this sheet to record the shadows made by these shapes.

Shape	Possible shadow
	
	
	
	
	

Northern Ireland Curriculum – Light and Sound

Common objectives for all activities in this issue

Programme of study: science and technology

Planning:

b) suggest which ideas can be investigated and make predictions

c) choose appropriate materials and components

d) design a fair test.

Making:

b) develop manipulative skills using a range of materials and tools

c) record what they have done or observed

e) use results to draw conclusions.

Sound:

a) investigate how sounds are produced when objects vibrate

b) investigate that sound travels through a variety of materials.

Light:

a) explore how light passes through some materials and not others

b) find out how when light doesn't pass through materials shadows are formed

c) investigate the reflection of light from mirrors and shiny surfaces.

Additional objectives for specific activities

Pages 2-3 Everyday energy

Programme of study: information technology

Application:

- select information technology tools appropriate to the context and task.

Pages 4-5 Bright lights

Programme of study: science and technology

Electricity:

b) construct simple circuits using switches, bulbs and batteries

c) investigate materials to find out whether they are insulators or conductors

d) investigate the effects of varying a current to make bulbs brighter.

Making:

i) construct working models using an energy source which can be controlled.

Pages 6-7 Shadows and shapes

Programme of study: information technology

Application:

- select information technology tools appropriate to the context and task.

Pages 9-11 The orchestra

Programme of study: music

Listening:

d) become familiar with the sounds of some common instruments.

Pages 12-13 Good vibrations

Programme of study: science and technology

Electricity:

b) construct simple circuits using switches, bulbs and batteries.

Pages 14-15 Controlling light

Programme of study: science and technology

Making:

i) construct working models using an energy source which can be controlled.

Programme of study: information technology

Application:

- select information technology tools appropriate to the context and task.

Page 16 Sending messages

Programme of study: talking and listening

Audience:

- interact with the wider school community.

Activities:

- respond to a range of visual and audio-visual materials.

Scottish National Guidelines 5-14 – Light and sound

Common objectives for all activities in this issue

Environmental studies – society, science and technology

Energy and forces, levels B-E:

- identify the sun as the main source of heat and light
- link light and sound to seeing and hearing
- link light to shadow formation
- give examples of light being reflected from surfaces
- link sound to sources of vibration.

Skills in science, levels B-E:

- suggest a question for exploration
- make predictions about possible outcomes
- suggest ways of making a test fair
- select appropriate measuring devices.

Additional objectives for specific activities

Pages 2-3 Everyday energy

Skills in technology, levels B-C:

- describe how everyday needs are met by familiar products
- give examples from the past of how specific needs have been met in different ways.

Pages 4-5 Bright lights

Skills in technology, levels B-C:

- use given and self-selected resources and processes to carry out a task
- offer suggestions for possible improvements in their solutions.

Energy and forces, levels B-E:

- construct simple battery-operated circuits
- construct a parallel circuit
- describe the effect of changing the components in a circuit.

Pages 6-7 Shadows and shapes

Skills in technology, levels B-E:

- describe how everyday needs are met by familiar products
- describe how tools, equipment and procedures in their own problem-solving tasks relate to those in the world outside school.

Developing ICT capability, level D:

- be aware that computers collect information about the environment through sensors, eg light and sound.

Pages 9-11 The orchestra

Energy and forces, levels D:

- use the terms 'pitch' and 'volume' to describe sound.

Music, levels B-C:

- become familiar with the ways in which sounds are made
- recognise the sounds of instruments that have a distinctive quality
- recognise the sounds of an orchestra.

Pages 12-13 Good vibrations

Energy and forces, levels D-E:

- use the terms 'pitch' and 'volume' to describe sound
- explain what happens when sound passes through different materials
- describe the relationship between pitch and frequency and loudness and amplitude.

Pages 14-15 Controlling light

Energy and forces, levels D-F:

- describe how electrical energy is distributed to our homes.

Developing ICT capability, level D:

- plan a sequence of instructions to be executed by a device.

Energy and forces, level D:

- construct simple battery-operated circuits.

Page 16 Sending messages

Listening, levels B-E

- be given opportunities to associate listening with other forms of communication.

National Curriculum Wales – Light and sound

Common objectives for all activities in this issue
Programme of study: science
Nature of science:
3. that scientific ideas can be tested.

Investigative skills:
2. to anticipate what might happen
3. to decide what information should be collected
4. that a fair test may be carried out when factors can be controlled.

Light:
1. that light travels from a source
2. that we see light sources
3. that we see objects because light is reflected
4. that most of the light falling on shiny surfaces is reflected
5. that light cannot pass through some materials.

Sound:
6. that sounds are made when objects vibrate
7. that the pitch and loudness of sounds can be changed
8. that vibrations from sound sources can travel through materials.

Additional objectives for specific activities
Pages 2-3 Everyday energy
Programme of study: science

Communication:
2. to use a range of methods to present information
5. to search for and access relevant scientific information using ICT.

Pages 4-5 Bright lights
Programme of study: design and technology
Knowledge and understanding:
1. to design and make products, matching the materials to the tasks.

Designing skills:
4. to communicate aspects of their design in a variety of ways.

Programme of study: science
Electricity:
1. that a complete circuit is needed for a current to flow
2. to investigate how switches can be used to control devices
3. that the brightness of bulbs can be controlled
5. to construct simple circuits.

Pages 6-7 Shadows and shapes
Programme of study: information technology
Communicating and handling information:
to use ICT equipment and software to analyse information and communicate ideas
to use ICT to explore and solve problems across a variety of subjects.

Pages 9-11 The orchestra
Programme of study: music
3. to explore and use a widening range of sound sources.

Programme of study: design and technology
Knowledge and understanding:
1. to design and make products, matching the materials to the tasks.

Designing skills:
4. to communicate aspects of their design in a variety of ways.

Pages 12-13 Good vibrations
Programme of study: science
Electricity:
2. to investigate how switches can be used to control devices
5. to construct simple circuits.

Pages 14-15 Controlling light
Programme of study: science
Investigative skills:
10. to use IT equipment and software to monitor changes.

National Curriculum Wales – Light and sound (continued)

Programme of study: design and technology
Knowledge and understanding:
4. to create, test, modify and store instructions to control events.

Page 16 Sending messages
Programme of study: English Range:
2. to communicate to different audiences.

Glossary

Light

- **Concave:** Of a lens surface, curving inwards.
- **Convex**: Of a lens surface, curving outwards.
- **Hologram**: An image produced by a laser on a flat surface that appears to have three-dimensions so that you can see all around it.
- **Iridescence**: The shimmering effect caused by light wave interference that is seen on the moving surfaces of shiny objects.
- **Laser**: A special kind of high energy light in which all the rays are the same colour and do not spread out from each other.
- **Mirage**: An optical illusion, that looks like a sheet of water on a road, caused by the refraction of light from the sky by heated air.
- **Reflection**: The way light bounces off a surface.
- **Refraction**: The way light rays bend as they move from one substance to another, especially from air to water.
- **Retina**: The thin lining at the rear of the eyeball where the energy of light rays is turned into nerve signals and sent to the brain.
- **Spectrum**: The range of colours produced by splitting up ordinary white light.

Sound

- **Amplify:** To make something greater, like increasing the volume of sound.
- **Decibel**: A measurement of the amount of energy in a sound that is usually the same as its loudness or volume.
- **Doppler effect**: An increase (or decrease) in the frequency of sound as the source and an observer move towards (or away from) each other.
- **Echo**: A sound that bounces off a hard, smooth surface so that the ears hear it a little after the original sound but more faintly.
- **Infrasound**: A sound too low in pitch or frequency for our ears to detect.
- **Pitch**: The highness or lowness of a sound.
- **Resonance**: Vibrations in response to and at the same frequency as vibrations received from somewhere else.
- **Sonar**: Echo location used by ships to detect underwater objects like shipwrecks and shoals of fish.
- **Timbre**: The distinctive sound quality of a musical instrument.
- **Ultrasound**: A sound too high in pitch and frequency for our ears to detect.
- **Volume:** Refers to how loud a sound is.

Light source

- How many different sources of light can you find?

- Draw sketches in the boxes provided, one for light provided by non-electrical means and one is for electrically produced light. Label each item carefully.

Non-electrical light sources

Electrical light sources

SCHOLASTIC

Simplified bar codes

Measuring sound

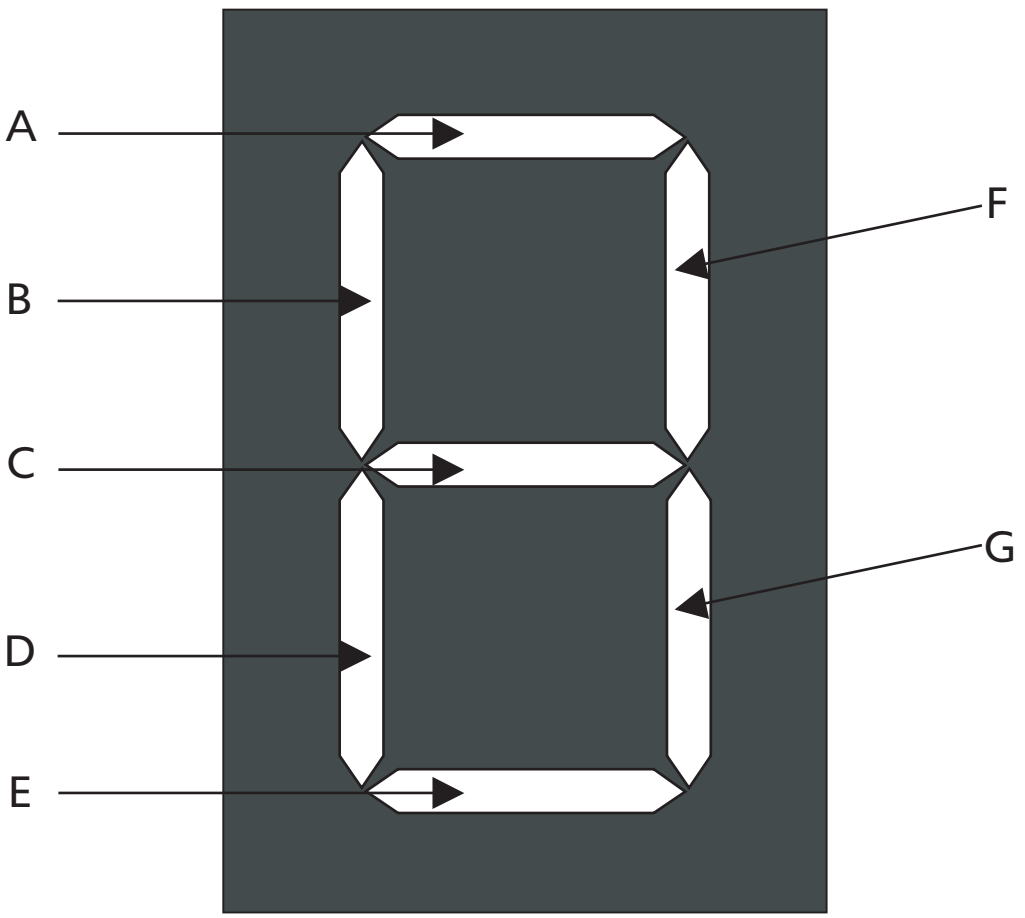
• Decibels are used to measure the level of sound. The louder the sound the higher the number of decibels. The abbreviation for the decibel is dB.

• Here are the decibel readings for some familiar sounds but they have got jumbled up. Can you join the correct decibel rating to each noise?

Noise	Decibel rating
Thunder and lightning	110dB
Normal conversation	160dB
High-speed train	90dB
Whispering	130dB
Jet aircraft taking off	15dB
Falling leaves	40db
Rock band	70dB
Street traffic	5dB

Answers: falling leaves (5dB); whispering (15dB); normal conversation (40dB); street traffic (70dB); thunder and lightning (90dB); high speed train (110dB); rock band (130dB); jet aircraft taking off (160dB)

Calculator display



- This diagram shows the eight light bars in a calculator display.

- Identify which light bars you would need to illuminate for each of the digits in this chart:

Digit	Light bars to illuminate
1	*F and G*
2	
3	
4	
5	
6	
7	
8	
9	
0	