Science

Light

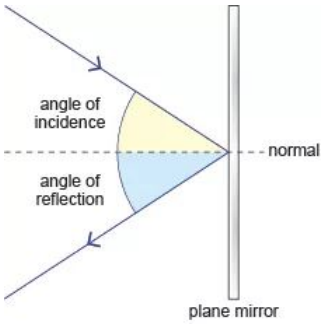
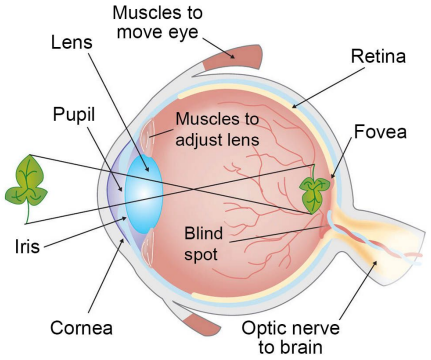
Atlantic Academy Portland
an Aspirations Academy

Year 6 - Spring 2

Name:_____

Class:_____

Year 6 Science Knowledge Organiser - Spring 2 - Light

1	**Light**	A natural agent that stimulates sight and makes things visible. Light travels in a straight line.
2	**Transparent**	Light completely passes through and you can see clearly through it.
3	**Translucent**	Some light passes through but the light is scattered so can't see clearly through it.
4	**Opaque**	No light can pass through. It blocks the light so it cannot be seen through.
5	**Shadow**	A shadow is made when an object blocks light. The object must be opaque or translucent to make a shadow. A transparent object will not make any shadow, as light will pass straight through it.
6	**Reflection**	For us to see objects, light rays from a light source must reflect off that object and into our eyes. Light gets reflected from a surface at the same angle it hits it. Angle of incidence = Angle of reflection
7		
8	**Cornea**	The transparent layer forming the front of the eye.
9	**Pupil**	The opening of the iris. The pupil may appear to open (dilate) and close (constrict) but really it's the iris that is the prime mover.
10	**Iris**	A flat, coloured, ring-shaped membrane behind the cornea of the eye, with an adjustable circular opening in the centre.
11	**Lens**	Light is bent by the lens in order to focus it.
12		
13	**Retina**	The light hits the retina at the back of the eye and forms an image, this is upside down!
14	**Optic Nerve**	The electrical signals are passed through the optic nerve and process by the brain.
15	**Speed of light**	Light travels at a speed of about 300,000 km/s
16	**Photosynthesis**	Plants use light energy to create chemical energy.
17	**Space**	Space is dark because light is only visible when it has an object of which to bounce off
18	**Dependent Variable**	The variable which is affected and measured in the experiment
19	**Independent Variable**	The variable that is changed on purpose to test the dependent variable
20	**Opinion**	A view about something
21	**Fact**	A thing that is known to be true
22	**Refraction**	The bending of light when passing from one medium to another
23	**Medium**	The substance through which physical forces are transmitted
24	**Dispersion**	The separation of white light into colours or of any radiation according to wavelength.
25	**Spectrum**	A band of colours, as seen in a rainbow, produced by separation of the components of light

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LESSON ONE: How we see

Retrieval Practice

What I already know about light.	Questions I still have about light.
•	•
•	•
•	•
•	•
•	•
•	•

Outcomes	Key Vocabulary
To recognise that light appears to travel in straight lines by creating a model of light travelling. To use the idea that light travels in straight lines to explain that objects are seen because they give out or reflect light into the eye by creating a model of light travelling. To explain that we see things because light travels from light sources to our eyes or from light sources to objects and then to our eyes by creating a documentary about light.	Light, source, travel, straight line, waves, ray, beam, wave, photon, energy, vacuum.
Knowledge needed	
Children will have learnt about light, reflective surfaces and shadows in Year 3.	

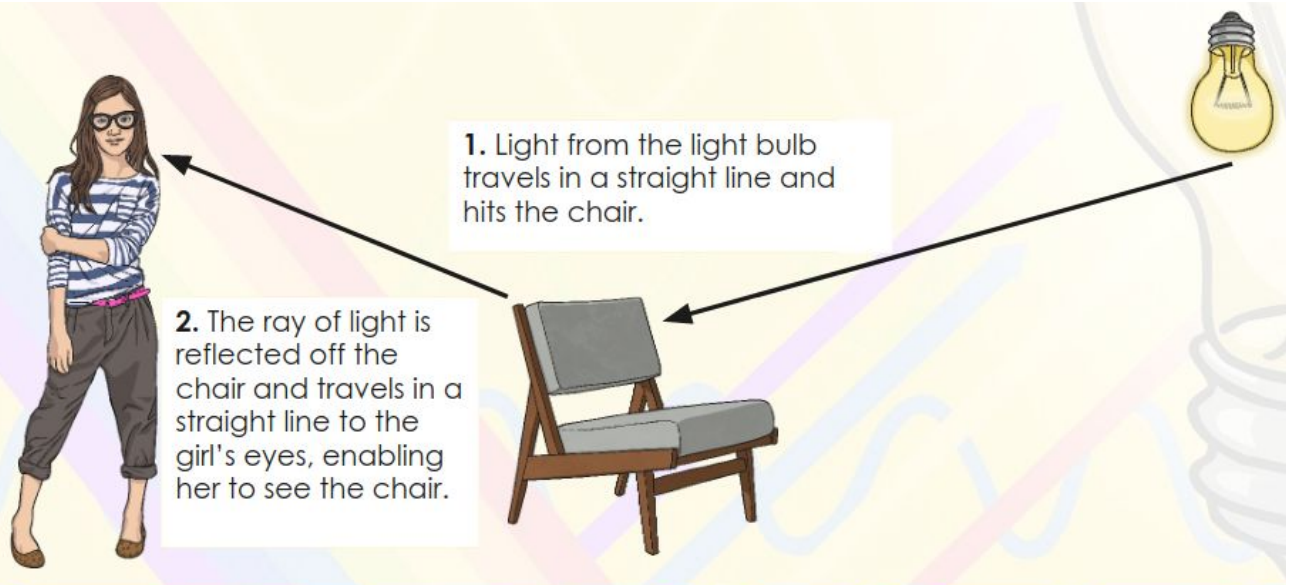
Talk Task

Where does light come from?
Light seems to be all around us. But where does it come from? Can you name some sources of light?

What about some reflectors of light?
These can look like light sources, but are really reflecting light.
How does light travel from a light source?

Everybody Reads
Light is a type of energy known as electromagnetic radiation.
It is made up of photons, little particles of energy.
Light travels as a wave. But unlike waves of water, or sound waves, it does not need any medium to travel through. This means light can travel through a vacuum - a completely airless space.
Light waves travel out from sources of light in straight lines. These lines are often called rays or beams of light.

Rays of light travel from a light source and hit objects around us.
The rays of light reflect, or bounce off an object, and then travel into our eyes.
This reflection of light allows us to see the object.



Can you describe how you can see some objects right now?
Draw a ray diagram on your whiteboard.

Group Task

Can you work with your group to create a human model to show how light enables us to see things?
Use your yellow wool as the ray of light - remember, it should always go in a straight line!
With one member of your group acting as the light source, and one member acting as an object, show how the ray of light travels to the other group members' eyes.
Show your models to the rest of the class. Do they agree with the way you have demonstrated how we see?

You have been asked to create an educational programme for children all about how light enables us to see.

Work with your group to plan the episode. All members of your group should take part equally. Make sure your explanations of how we see are clear and easy to understand. You may choose to use pictures or diagrams to support your explanations. Get into character as scientists and have fun!

1. Introduce yourselves and tell the audience what the programme will be about.

2. Explain how light travels.

3. Explain how light hits an object then bounces off it into our eyes, enabling us to see.

4. Give your audience any more information you think they need to know, then thank them for watching.

You might want to use some of these words to help you.			
light	source	straight	energy
beam	bounce	reflect	ray

Exit Ticket

Write down a **WWW** (**W**hat **W**ent **W**ell) comment given to you by your audience about your model and an **EBI** (**E**ven **B**etter **I**f) comment to improve on next time.

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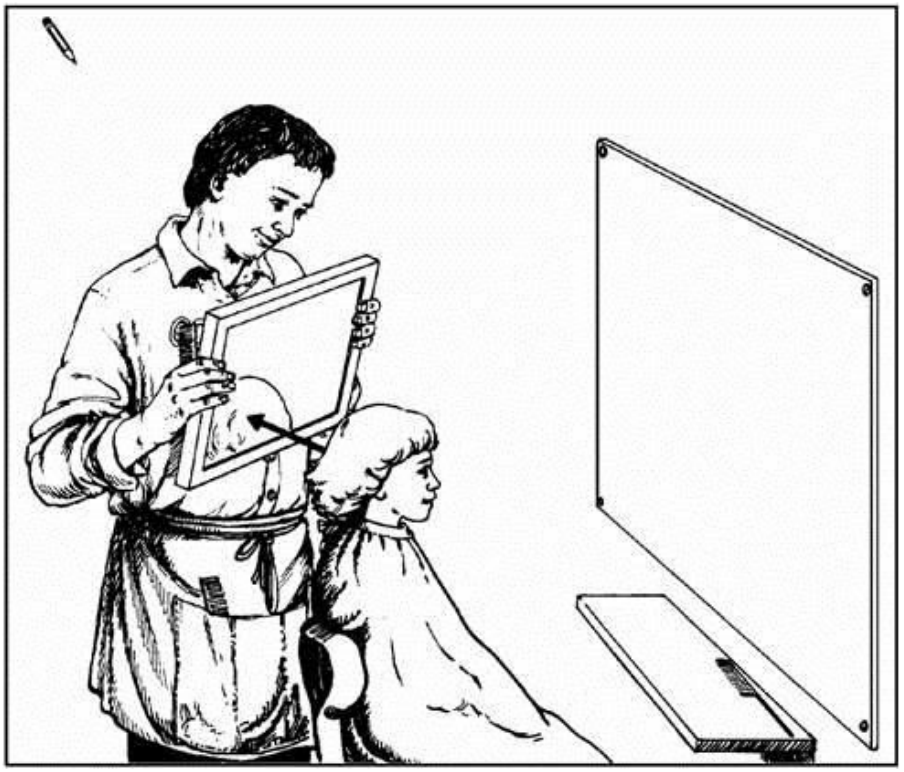
LESSON TWO: Reflecting Light

Retrieval Practice: Light



(a) The girl is looking at the large mirror in front of her. She can see the reflection of the back of her head.

The hairdresser is holding a small mirror. An arrow has been drawn to show the direction of some light.

Draw TWO more arrows to show how the girl can see the reflection of the back of her head.

2 marks

(b) The scissors look shiny. Why do scissors look shiny?
Tick ONE box.

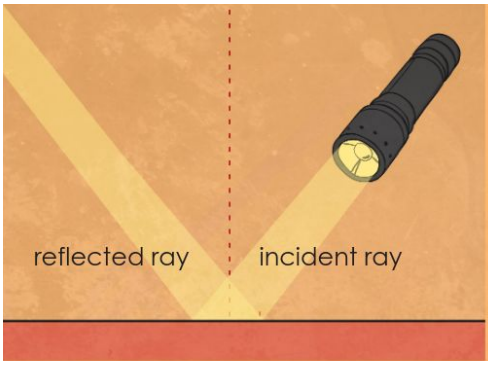
Light passes through them.	☐
They are sharp.	☐
They reflect light.	☐
They give out light.	☐

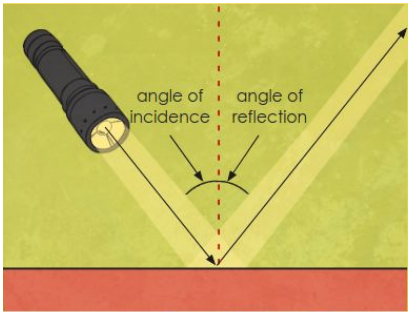
1 mark

Outcomes	Key Vocabulary
To recognise that light appears to travel in straight lines by investigating the angles of incidence and reflection. To use the idea that light travels in straight lines to explain that objects are seen because they give out or reflect light into the eye by creating a periscope and explaining how it works. To explain that we see things because light travels from light sources to our eyes or from light sources to objects and then to our eyes by creating a periscope and explaining how it works.	Reflection, angle, incidence, normal, periscope.
Knowledge needed	
Children will have learnt that we see things because light travels from light sources to objects and then to our eyes in Lesson 1.	

Talk Task
Look at the four explanations of how light is reflected, which one is
four explanations of how light is reflected.
Three of the explanations are false; only one of them is accurate!
Write down the one you think is true.

Everybody Reads
Reflection is when light bounces off a surface, changing the direction of a ray of light. All objects reflect light; smooth and shiny surface reflect all the rays of light at the same angle, rather than scattering the rays of light like rough or dull surfaces.
The light ray that hits the mirror or other object is described as the incident ray, and the ray of light that bounces off is known as the reflected ray.





When rays of light reflect, they obey the law of reflection: The angle of incidence always equals the angle of reflection.
The red dashed line is called the 'normal' line. It is drawn at a right angle, or perpendicular to the reflector.

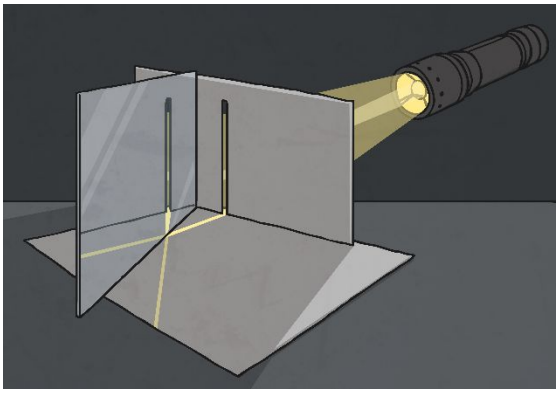
The angle of incidence is the angle between the normal line and the incident ray of light.

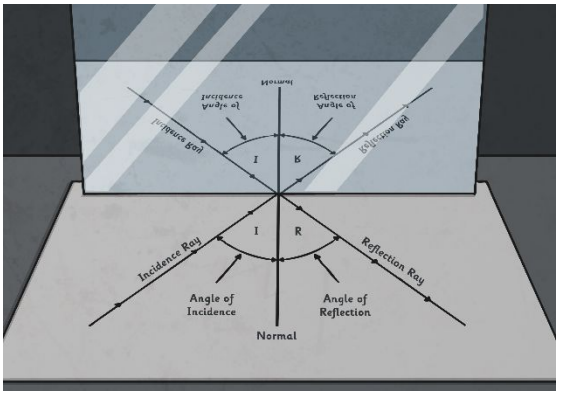
The angle of reflection is the angle between the normal line and the reflected ray of light.

Group Task
Let's prove the law of reflection.

Method

- Use modelling clay to stand a mirror up on a piece of white paper.
- Make a very narrow slit in a piece of card.
- Dim the lights and shine a torch through the slit towards the mirror.
- On the white paper, look for the incident ray and the reflected ray of light. You may have to play around with the angle of the torch and the distance you hold it from the mirror.

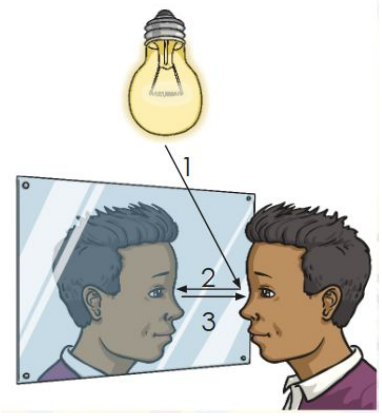




- Use a pencil and ruler to draw the incident and reflected rays on the paper.
- Draw a dashed line perpendicular to the mirror, from the point where the incident and reflected rays meet. This is the normal line.
- Use a protractor to measure the angle formed between the incident ray and the normal line.
- On the white paper, look for the incident ray and the reflected ray of light. You may have to play around with the angle of the torch and the distance you hold it from the mirror.

They should be equal.
Whenever light is reflected from a surface, it obeys this law.

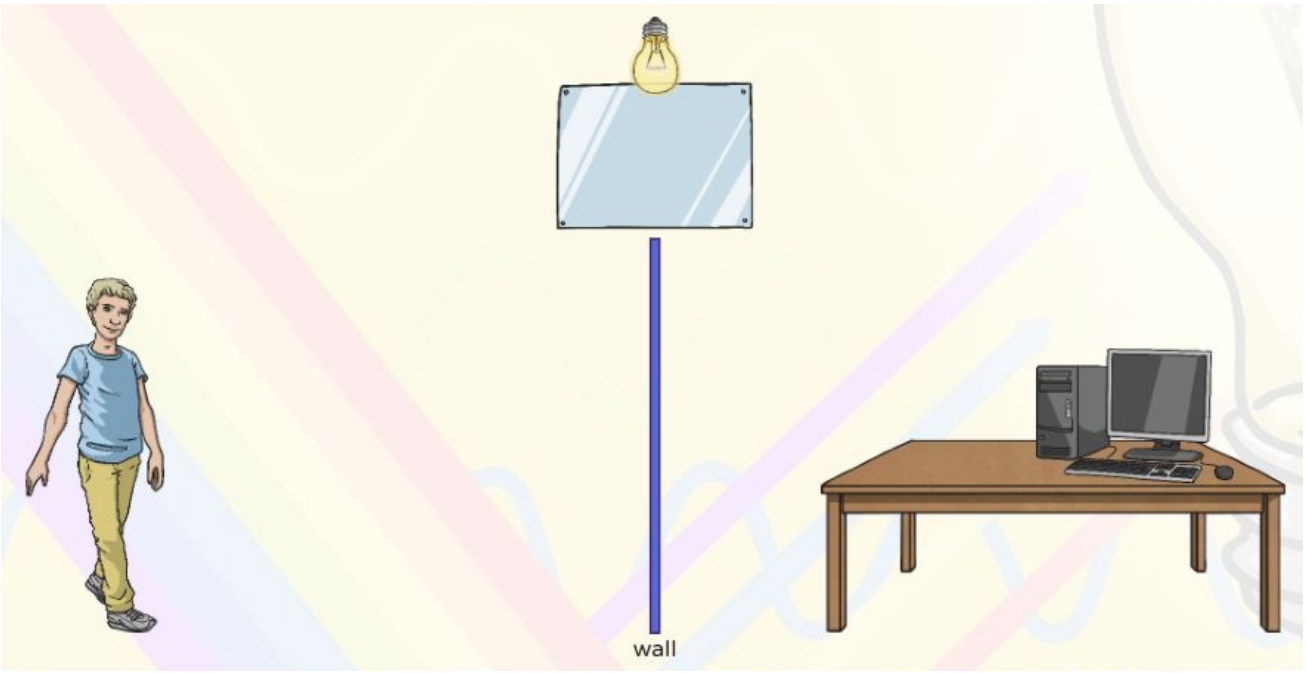
Everybody Reads
The law of reflection is what allows us to see an object reflected in a mirror.
Look at the way light travels to enable the boy to see his face reflected in the mirror:



1. Light from the bulb hits the boy's face and bounces off.
2. The light reflected from the boy's face hits the mirror.
3. The light reflected from the mirror travels to the boy's eyes, so he can see the image of his face reflected in the mirror.

Exit Ticket

How is light travelling to enable the boy to see the computer behind the wall? Draw lines and directional arrows on the image.



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LESSON THREE: Refraction

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t	r	e	t	l	i	f	n	o	m	c	r
e	h	z	y	w	i	o	b	e	b	o	e
v	q	g	f	d	t	u	c	e	x	l	f
a	z	n	i	o	q	n	a	s	e	o	r
w	j	e	h	a	e	m	m	h	n	u	a
j	y	p	l	d	r	s	z	a	e	r	c
q	z	a	i	g	i	t	a	d	r	h	t
e	e	c	r	r	n	p	s	o	g	f	j
m	n	x	p	c	u	a	s	w	y	p	j
i	k	k	j	m	u	r	t	c	e	p	s
h	b	u	t	h	g	i	l	n	f	w	q

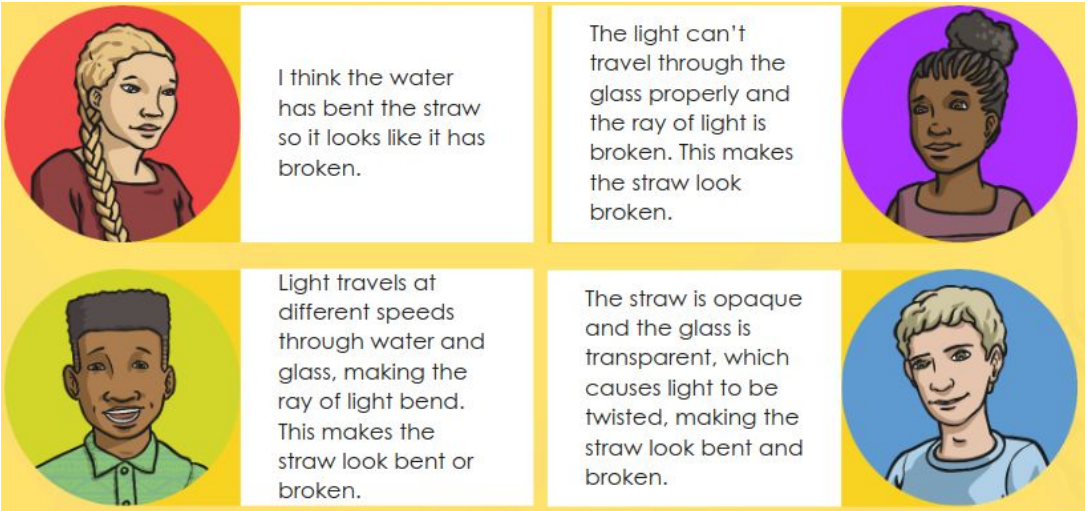
shadow	prism
light	beam
filter	energy
refract	angle
spectrum	ray
wavelength	straight
incidence	wave
photon	colour

Outcomes	**Key Vocabulary**
To recognise that light appears to travel in straight lines by investigating refraction.	Refraction, bend, lens, focus, focal point, transparent.
Knowledge needed	
The children will have learnt how light travels and how we see in lesson 1.	

Talk Task

This photo shows the effect created when light is refracted.
What is happening?

These children are talking about why the straw looks broken, when they know it isn't. Who do you agree with? Why?



Everybody Watches

Let's watch this short video about refraction (https://www.youtube.com/watch?v=95V-QJYZ2Dw)
While you are watching, think about:
What happens when light travels from air into another transparent material, such as glass, plastic or water? How does a lens focus light?

Everybody Reads

Light waves travel at a different speed when they go through other transparent materials, such as water or glass. This causes the rays of light to change direction and bend. This is known as refraction.
Refraction creates illusions. Because light bends when it travels between air and water or glass, objects seen through these materials look bent or distorted.

(Photo courtesy of indi.ca (@flickr.com) - granted under creative commons licence – attribution)

Group Task

You are going to work together to set up two investigations to explore refraction.
Have a look at each investigation and predict what you think will happen. Try to explain your prediction using your scientific knowledge and understanding.
Follow the instructions to set up each investigation.
Record what happens and say whether your prediction was accurate or not.
Come to a conclusion for each investigation, explaining what happened and why.

Amazing Arrow

- You will draw a horizontal arrow on a small piece of paper.
- Then hold the piece of paper behind a glass filled with water.

What do you predict will happen?

_____

_____

_____

_____

_____

- Try it out and describe your observations.

Was your prediction accurate? Can you explain what happened and why, using your understanding of refraction?

Incredible images

- You will draw a small picture on a piece of paper - a smiley face or star are some examples of images you may draw.
- Then, place an empty glass over the top of the picture and look at your image through the side of the glass.
- As you watch your picture, slowly fill the glass with water.
- When the glass is full, you should cover the top of the glass with a saucer.

What do you predict will happen?

- Have a go! What do you observe?

What happened to the image you drew?

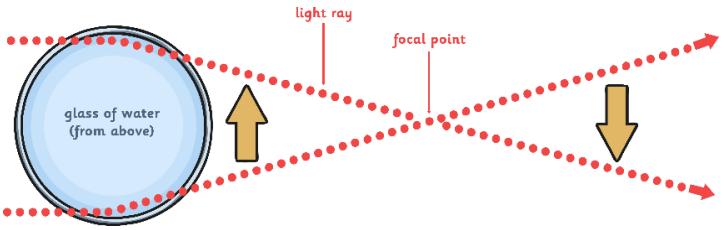
Explain why this happened in your conclusion, thinking about refraction.

Everybody Reads

Amazing Arrow - What happened?

In this investigation, when you place your arrow at a certain distance behind the glass of water, it appears to point in the opposite direction. The arrow turns because the light travelled from the air, through the glass, through the water, through the back of the glass, and then back through the air, before hitting the arrow. When light passes from air through a transparent material, it refracts, causing it to bend.

Because the glass is curved, it also acts as a lens, focusing the rays of light. Where the light all comes together is called the focal point, but beyond the focal point the image appears to reverse. The rays of light that were bent cross each other, so that the light from the left of the arrow is now on the right, and light from the right of the arrow is now on the left. This is what causes the arrow to appear reversed.

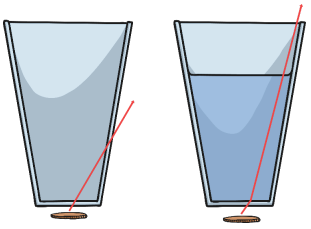


Incredible Images: What Happened?

When you filled the glass with water and placed a saucer on top, the image seemed to have disappeared. Light rays falling on the image are refracted through the glass, then the water, then back into the air. When the refracted rays are bent at different angles by adding the water, it means they can be blocked by the saucer on top of the glass.

Since the rays of light cannot get through the saucer, they cannot reach our eyes and we cannot see the image.

It seems to have disappeared!



Exit Ticket

What did you learn today?

What did you find tricky?

What can we do next time?

Today's Lesson Tweet.

Don't forget the hashtag # describes the lesson or something memorable from the lesson.

@

#

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LESSON FOUR: Spectacular Spectrum

Look through what you have completed in your booklet so far and complete any blank pages. If you were absent, read the **Everybody reads** sections and write **ABSENT BUT READ** in **purple pen** and sign your name.

If you **complete all** of your feedback, on your whiteboard write 5 questions about light for another person in the class to answer.

Outcomes	**Key Vocabulary**
To recognise that light appears to travel in straight lines by exploring prisms and creating colour wheels.	Refract, spectrum, wavelength, colour, prism, visible, transparent, rainbow.
Knowledge needed	
Children will have learned about refraction in lesson 3.	

Independent Task
Around the room you will see several pieces of coloured paper.
Have a look at the different colours, then write down the colour of the piece of paper that you think shows what colour light is.

_____

Do others agree with you?
Why have you chosen this colour?

_____

_____

At the end of this lesson, you will answer this question again, and see if your first thoughts were accurate or not!

Everybody Reads

Isaac Newton was an English scientist and mathematician. His ideas and discoveries are still considered to be important today.
In 1666, Newton made a discovery about light that led him to develop his Theory of Colour, a theory that still informs our understanding of light today. He placed a prism in front of ray of light, and his observations were incredible.

Prisms

A prism is a solid shape whose 2 ends are the same size and shape.
Isaac Newton used a transparent triangular prism in his investigation.
What can you remember about what happens to light when it travels between air and a transparent material?

When light travels from air through a transparent material, it refracts, or bends.
This is an important fact, as it is this refraction that caused the amazing effects that Newton observed.

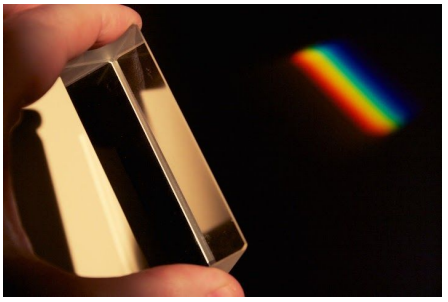
Group Task

Now it's your turn! Shine a torch through a transparent prism, and hold a piece of white card in front of the refracted ray of light as it leaves the prism.
Can you see what Newton observed?

You shone a ray of light through a prism. What happened? Draw or write about what you observed.

Everybody Reads

Rainbows
Did you see a rainbow of colours form on your white card?
These colours are known as the 'Visible Spectrum'.
This is what Isaac Newton observed, and it made him realise that although light looks white, it is actually made up of all the colours of the rainbow!
When these colours merge together, it looks white to our eyes. But we can use a prism to separate the different colours of the spectrum, as you have just demonstrated.



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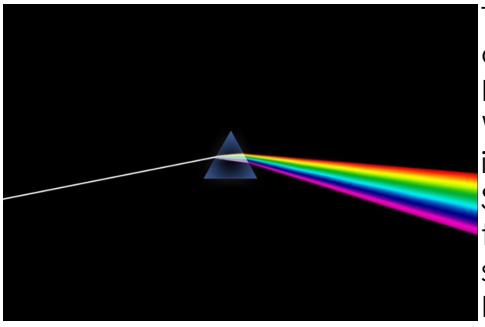

This happens because each colour within a ray of light has a different wavelength.
Red has the longest wavelength, and violet has the shortest.
When a ray of light travels from air through a transparent material, it refracts.
Since each colour's wavelength is slightly different, the colours in the ray of light bend slightly differently. This causes them to separate and become visible to our eyes.
Red bends the least, and violet bends the most.

(Photo courtesy of iwannt (@flickr.com) - granted under creative commons licence – attribution)

Can you remember the colours of the rainbow?
They are **red**, **orange**, **yellow**, **green**, **blue**, **indigo** and **violet**.
Some people remember them using this mnemonic:

Richard **O**f **Y**ork **G**ained **B**attle **I**n **V**ain.
Others use the initial of each colour to spell a name:

ROY G BIV

A colour wheel can be used to show the colours of the spectrum that Newton discovered.

Independent Activity
Use the instructions on your sheet, to create your own colour wheel. What do you predict will happen when you spin it?

_____

_____

Try it! Make the colour wheel then use the string to spin it. What happens? Draw or write about it below. Was your prediction correct?

_____

_____

Exit Ticket
What colour is light?
At the start of the lesson, you answered this question.
Just like the famous Isaac Newton, you then used a prism to refract a ray of light to show the colours of the spectrum.
Was your initial answer correct? Explain why.

_____

_____

_____

_____

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LESSON FIVE: Seeing Colours

Retrieval Practice
In your own words, explain what refraction is? You can draw a diagram to help you explain in the box below.

_____

_____

_____

_____

Outcomes	**Key Vocabulary**
To use the idea that light travels in straight lines to explain that objects are seen because they give out or reflect light into the eye by investigating how we see colours. To explain that we see things because light travels from light sources to our eyes or from light sources to objects and then to our eyes by investigating how we see colours.	Filter, colour, light, see, reflect, absorb.
Knowledge needed	
The children will have learnt about the visible spectrum in lesson 4.	

Everybody Reads
Isaac Newton made many famous discoveries and had lots of important ideas.

Let's read the Fact Sheet about Isaac Newton and answer the questions to learn more about his work.

1. When was Isaac Newton born?

_____

2. Where was his home?

_____

3. Why did he conduct his experiment at home?

4. How did people in the 1660s believe colours were created?

5. What did Newton use to create a beam of light?

6. Why do you think his experiment is known as 'crucial'?

7. What did he prove about how we see an object's colour?

8. What was Newton's book called and what did it explain?

9. What do you think Newton means when he says he 'stands on the shoulders of giants'?

10. Can you think of a different caption for the sketch of Newton's crucial experiment?

Group Task
Newton's Discovery
An optical filter is a device that lets some colours of light through, but not others.
You will use the different coloured filters to look at some coloured objects.
What do you think they will look like through the different filters?

Colour of object	Colour of filter	What colour do you think it will look?	What colour do you see? What colour does it actually look?

Extension
Extend your thinking by using two overlapped filters. How will your predictions change, and what will you see?

Colour of object	Colour of filter	What colour do you think it will look?	What colour do you see? What colour does it actually look?

I think this is because?

_____

_____

_____

_____

Everybody Reads

Filtering Facts

Did you notice that when you look at a green object through a green filter, it still looks green?
But did you discover that a green object looks black through another colour of filter?
Why does this happen?
As you found out in the last lesson, white light is actually made up of all the colours of the rainbow.
This is called the 'visible spectrum'.
When a ray of white light shines on an object, the object absorbs some colours and reflects others.
A pear reflects the green light and absorbs the other colours of light.
It is only the green light that bounces back into our eye.
The pear looks green to our eyes!

Blue objects **absorb all** colours of light **but blue**, which they **reflect**.
Red objects **absorb all** colours of light **but red**, which they **reflect**.
White objects **reflect all** the colours of light.
Black objects **absorb all** the colours of light.

A filter only allows certain colours of light through. For example, a green filter allows green light through, but absorbs the other colours.
So if you look at a green pear through a green filter, it will still look green, because the green light will get through the filter to your eyes.
But if you look at it through a red filter, it will look black, because there is no red light reflecting off the pear, and the green light that is reflecting off it will be absorbed by the filter.

Exit Ticket

Talk to your partner:

Look again at your results and your conclusion.
Do they support these explanations?
Are any there any results that don't make sense?
Can you think of a reason for this?
How could you check your results to be sure they are reliable?

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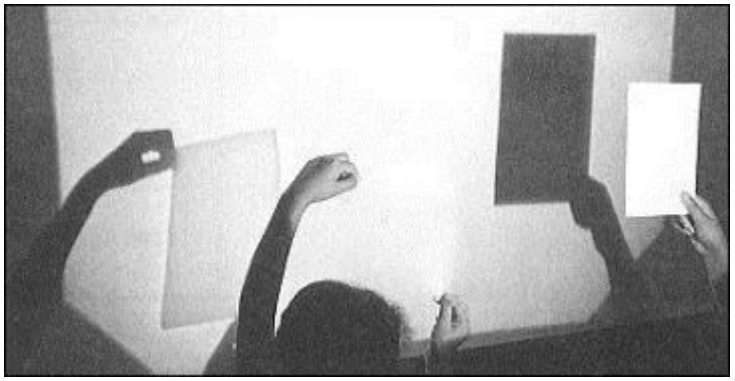
LESSON SIX: Shadow Theatre

Retrieval Practice

(a) Two children hold some objects between a lamp and the wall.



They see that cardboard makes a dark shadow and a plastic sheet makes a faint shadow.
Explain why the shadows are different.

.....

.....

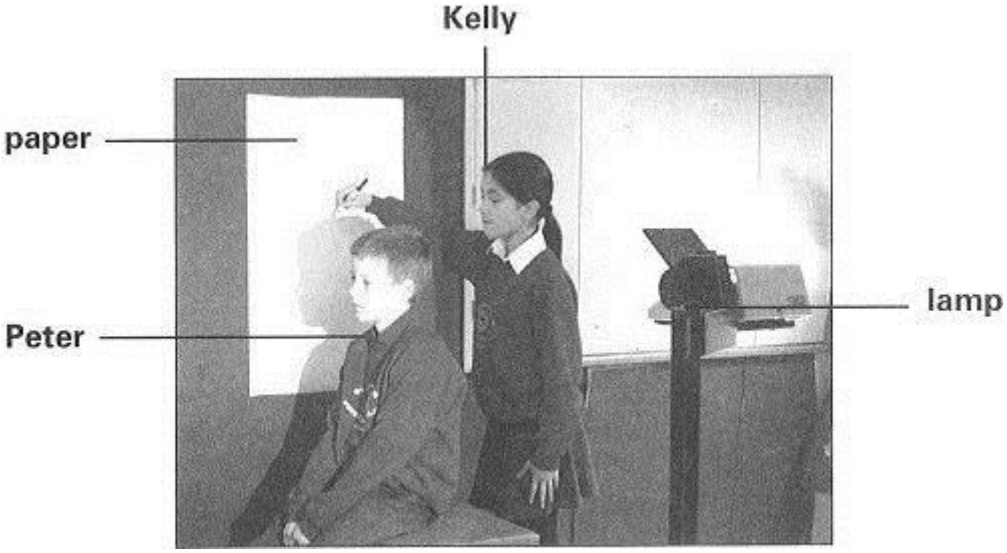
1 mark

(b) Tick TWO objects which make a faint shadow.

a wooden toy	☐
a piece of tracing paper	☐
a book	☐
a mirror	☐
a clear plastic cup	☐

1 mark

(c) Kelly is drawing around Peter's shadow.



How could Peter make the shadow of his head bigger?
Tick TWO boxes.

move closer to the paper	☐	move closer to the lamp	☐
use a bigger lamp	☐	use a brighter lamp	☐
move the lamp closer	☐	move the lamp further away	☐

1 mark

(d) Explain how Peter's shadow is formed on the paper.

.....

.....

1 mark

Outcomes	**Key Vocabulary**
To use the idea that light travels in straight lines to explain why shadows have the same shape as the objects that cast them by performing a shadow puppet show about Isaac Newton. To identify scientific evidence that has been used to support or refute ideas or arguments by performing a shadow puppet show about Isaac Newton.	Shadow, light, source, opaque, size, distance, change, tilt, cast.
Knowledge needed	
Children will have learnt about making and changing shadows in Year 3.	

You have an Interactive Bingo Activity Sheet with 12 questions about light and shadows on it.
The aim is to move around the classroom, finding a different person to answer each question.
Once you have answers to all 12 questions on your sheet, you should shout 'Bingo!' The first person to do so is the winner!
Make sure each person you ask writes their answer and signs their name or initials on your sheet.
Remember, you will also be asked to answer questions for others at the same time!

Q. Light travels in _____ lines.	**Q.** What is the process that causes a straw to look bent in a glass of water?	**Q.** Do opaque, translucent or transparent objects make the darkest shadows?
A.	**A.**	**A.**
Q. Do you make a shadow bigger by moving the object closer to or away from the light source?	**Q.** What is it called when a ray of light bounces off an object?	**Q.** What are all the colours of the rainbow called?
A.	**A.**	**A.**
Q. A red apple reflects _____ light and absorbs all the other colours.	**Q.** Are shadows shorter or longer at noon when the Sun is directly overhead?	**Q.** We see things when light from a light _____ hits an object then reflects off it into our eyes.
A.	**A.**	**A.**
Q. Shadows are formed when an object _____ light.	**Q.** How many colours are there in a rainbow?	**Q.** Light rays reflect off a mirror at the same _____ that they hit it at.
A.	**A.**	**A.**

Everybody Reads

Shadows are formed when an opaque object blocks a ray of light.
Is a shadow always the same shape as the object that casts it?
A shadow can change size depending on the distance the object casting it is from the light source.
Shadows can also be elongated or shortened depending on the angle of the light source.
However, a shadow is always the same shape as the object that casts it. This is because when an object is in the path of light travelling from a light source, it will block the light rays that hit it, while the rest of the light can continue travelling. Therefore, the shadow it casts is exactly the same shape.

Group Task

For this challenge, you will need to work in a group to produce a shadow puppet show.
You will perform a short scene involving the scientists Newton and Hooke using the Experiments and Enemies Script.

Isaac Newton made many important discoveries about light. However, some of his contemporaries, notably Robert Hooke, did not agree with his ideas. They were enemies and rivals.

You should make shadow puppets of the two scientists to perform a dramatisation of the dispute between them. You may also choose to create shadow puppet props of key objects - you could make a prism, or use coloured tissue paper to make a shadow of the visible spectrum.

Think about how you can use your shadow puppets creatively - moving them closer to the light source to make them look bigger, or tilting them to change the angle.

Use cardboard and straws or craft sticks to make your shadow puppets.
Remember, your puppets will not need to have features or detail as your audience will only see their shadows in the performance.
You will have the chance to perform your puppet show at the end of the lesson.

Experiments and Enemies Script

This short script is a dramatisation of the dispute between Isaac Newton and Robert Hooke over Newton's theory of light and colour.

Isaac Newton uses a prism to split a ray of light into the spectrum of colours.

Newton: Finally! I have solved the celebrated phenomenon of colours! This surely proves that colour is in light.

Robert Hooke writes a letter to Newton.

Hooke: You are wrong! I cannot see any evidence or argument here to convince me with any certainty that there are colours in light! My own theories that I made after carrying out hundreds of experiments still make more sense. The colours are simply formed because the glass is corrupted and taints the white ray of light.

Newton replies to Hooke.

Newton: How can you believe this still? Can you not see how the prism bends the ray of light and separates the colours? They are present within light!

Hooke: I do agree the light has been refracted, yes. But why you persist in thinking that this means the colours are originally within the white light I do not understand! This makes no more sense than thinking that sound is already stored within a musical instrument! I will not believe you until I see more proof.

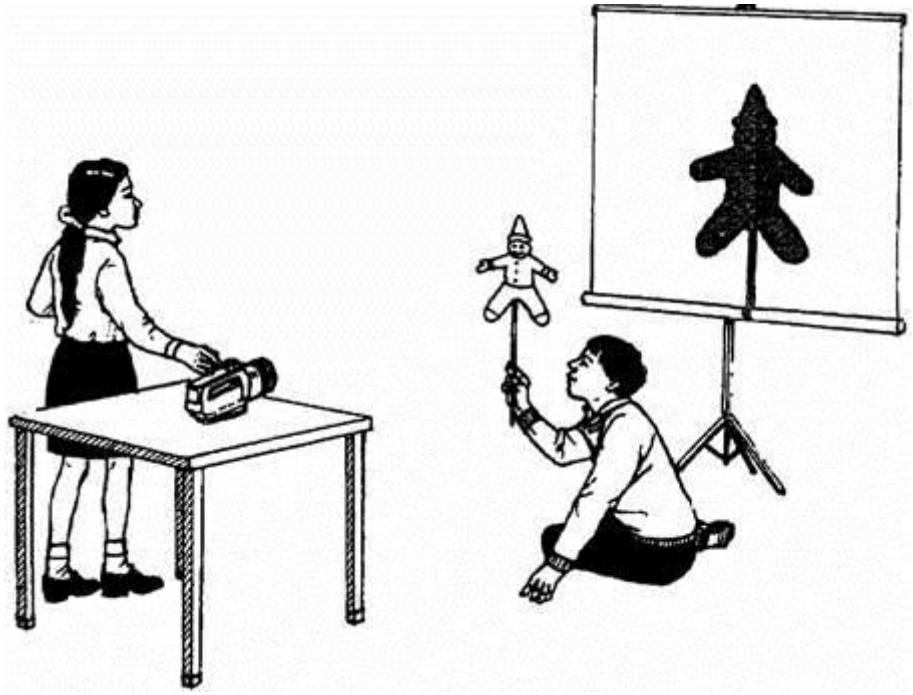
Newton uses two prisms to conduct his 'crucial experiment', using one prism to split the white light into the spectrum, then another prism to bring the refracted rays back together, making white light again.

Newton: This is the most considerable discovery that has ever been made! Because the colours can form white light once more, I have proven once and for all that white light is made up of the colours of the spectrum. Here is your proof!

Hooke later accused Newton of stealing his ideas, and Newton threatened to leave the Royal Society (the group of the world's most distinguished scientists) as a result. Newton only stayed on once the Society's Secretary reassured him about his theories.

Can you add some more lines to the script to this?

Exit Ticket



(a) Tim and Sue have a torch and a shadow puppet. What does the light from the torch shine on? Tick TWO boxes.

the front of the puppet	☐
the back of the puppet	☐
the shadow of the puppet	☐
the screen	☐

1 mark

(b) Explain how a shadow is formed.

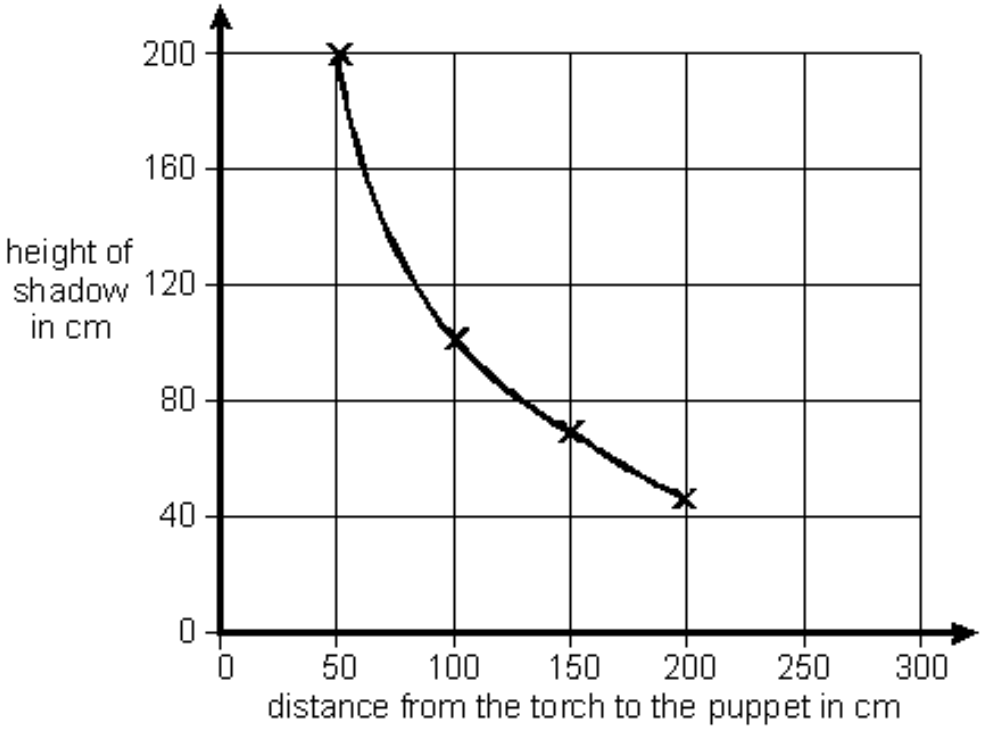
.....

.....

1 mark

(c) The height of the puppet is 20 cm.

The graph below shows how the height of the shadow on the screen changed when the puppet was moved away from the torch.



Continue the line graph to show what the height of the shadow will be when the puppet is 250 cm and 300 cm from the torch.

2 marks

(d) Look at the graph.

What was the height of the shadow when the puppet was 50 cm from the torch?

..... cm.

1 mark

(e) Describe how the height of the shadow changed as the distance from the torch to the puppet changed.

.....

.....

2 marks