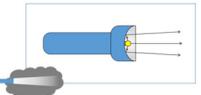
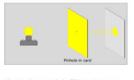
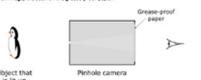


Physics > Big idea PSL: Sound, light and waves > Topic PSL3: Making images

Progression toolkit: Explaining images made by a pinhole

Learning focus	Only some light rays from each point of an illuminated object can pass through a pinhole, hitting a screen at distinct points to make an inverted image.				
As students' conceptual understanding progresses they can:					
	Describe what a light ray represents.	Describe the direction in which light travels from a light source.	Describe how light rays are emitted from each point on an extended light source.	Describe how light rays pass through a pinhole.	Explain how an image is formed on a screen behind a pinhole.
Diagnostic questions	Light ray	Light direction	Light bulb moment	Pinhole laser Pinhole lamp	Pinhole penguin
Response activities				Light through a hole	Pinhole camera

<p style="text-align: center;">Light ray</p> <p style="text-align: center;">BEST STUDENT WORKSHEET</p> <p>Light ray</p> <p>Janis has bought a new torch. On the picture there is a picture It shows how the torch makes a powerful beam.</p>  <p>What do you know about the light rays shown in the picture?</p> <p>For each statement, tick (✓) or cross (✗) to show what you think.</p> <table border="1"> <thead> <tr> <th></th> <th>I am sure this is right</th> <th>I think this is right</th> <th>I think this is wrong</th> <th>I am sure this is wrong</th> </tr> </thead> <tbody> <tr> <td>A Light ray is a long thin piece of light</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>B Light is made of light rays added together</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>C Light rays show the direction light moves</td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table> <p style="font-size: small;">Developed by the University of York Science Education Group and the Salters' Institute. This document may have been edited. Download the original from www.BestEvidenceScienceTeaching.org © University of York Science Education Group. Distributed under a Creative Commons Attribution-NonCommercial (CC BY-NC) license.</p>		I am sure this is right	I think this is right	I think this is wrong	I am sure this is wrong	A Light ray is a long thin piece of light					B Light is made of light rays added together					C Light rays show the direction light moves					<p style="text-align: center;">Light direction</p> <p style="text-align: center;">BEST STUDENT WORKSHEET</p> <p>Light direction</p> <p>Jada uses a lamp to light the table at a hole. She is thinking about how light moves from the lamp.</p>  <p>How does light move from the lamp?</p> <p>A  All towards the hole</p> <p>B  Equally in all directions</p> <p>C  Mostly towards the hole</p> <p style="font-size: small;">Developed by the University of York Science Education Group and the Salters' Institute. This document may have been edited. Download the original from www.BestEvidenceScienceTeaching.org © University of York Science Education Group. Distributed under a Creative Commons Attribution-NonCommercial (CC BY-NC) license.</p>	<p style="text-align: center;">Light bulb moment</p> <p style="text-align: center;">BEST STUDENT WORKSHEET</p> <p>Light bulb moment</p> <p>Henry and Emily have drawn pictures of a glowing bulb. They have added rays to show how light comes from the bulb.</p> <p>a. Which drawing best shows how light moves from the bulb?</p> <p>A  B </p> <p>b. What is the best reason for your answer? Put a tick (✓) in the box next to the best answer.</p> <table border="1"> <tbody> <tr> <td>A Light from the bulb can make shadows.</td> <td><input type="checkbox"/></td> </tr> <tr> <td>B The bulb can be seen from all directions.</td> <td><input type="checkbox"/></td> </tr> <tr> <td>C Light moves away from the bulb.</td> <td><input type="checkbox"/></td> </tr> </tbody> </table> <p style="font-size: small;">Developed by the University of York Science Education Group and the Salters' Institute. This document may have been edited. Download the original from www.BestEvidenceScienceTeaching.org © University of York Science Education Group. Distributed under a Creative Commons Attribution-NonCommercial (CC BY-NC) license.</p>	A Light from the bulb can make shadows.	<input type="checkbox"/>	B The bulb can be seen from all directions.	<input type="checkbox"/>	C Light moves away from the bulb.	<input type="checkbox"/>	<p style="text-align: center;">Pinhole laser</p> <p style="text-align: center;">BEST STUDENT WORKSHEET</p> <p>Pinhole laser</p> <p>Ms Teacher is shining a laser beam at a very small hole. Ms Teacher opens the laser beam with a thin sheet of card so it can be seen.</p>  <p>Do you think these diagrams show correctly how a laser beam passes through the hole?</p> <p>For each statement, tick (✓) or cross (✗) to show what you think.</p> <table border="1"> <thead> <tr> <th></th> <th>I am sure this is right</th> <th>I think this is right</th> <th>I think this is wrong</th> <th>I am sure this is wrong</th> </tr> </thead> <tbody> <tr> <td>A </td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>B </td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>C </td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>D </td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table> <p style="font-size: small;">Developed by the University of York Science Education Group and the Salters' Institute. This document may have been edited. Download the original from www.BestEvidenceScienceTeaching.org © University of York Science Education Group. Distributed under a Creative Commons Attribution-NonCommercial (CC BY-NC) license.</p>		I am sure this is right	I think this is right	I think this is wrong	I am sure this is wrong	A 					B 					C 					D 					<p style="text-align: center;">Pinhole lamp</p> <p style="text-align: center;">BEST STUDENT WORKSHEET</p> <p>Pinhole lamp</p> <p>Kay Teacher places a bright lamp in front of a very small hole.</p>  <p>Which diagram best shows how light passes through the pinhole?</p> <p>A  B </p> <p>C  D </p> <p style="font-size: small;">Developed by the University of York Science Education Group and the Salters' Institute. This document may have been edited. Download the original from www.BestEvidenceScienceTeaching.org © University of York Science Education Group. Distributed under a Creative Commons Attribution-NonCommercial (CC BY-NC) license.</p>
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<p style="text-align: center;">Pinhole penguin</p> <p style="text-align: center;">BEST STUDENT WORKSHEET</p> <p>Pinhole penguin</p> <p>A bright lamp that is the shape of a penguin is turned on. It is put in front of a thin crescent-shaped hole.</p>  <p>a. What would you expect to see on the screen?</p> <p>A  B </p> <p>C  D </p> <p style="font-size: small;">Developed by the University of York Science Education Group and the Salters' Institute. This document may have been edited. Download the original from www.BestEvidenceScienceTeaching.org © University of York Science Education Group. Distributed under a Creative Commons Attribution-NonCommercial (CC BY-NC) license.</p>	<p style="text-align: center;">Light through a hole</p> <p style="text-align: center;">BEST STUDENT WORKSHEET</p> <p>Light through a hole</p> <p>A bright yellow lamp is placed in front of a pinhole. There is a screen behind the hole.</p>  <p>Some students are discussing why they see a circle of light on the screen.</p> <p>Freddie: Light from each part of the bulb goes through the pinhole at different angles.</p> <p>George: Light spreads through the pinhole and spreads out after it.</p> <p>Jessica: Light from the top of the bulb moves in a straight line towards the bottom half of the screen.</p> <p>Hannah: When the hole is lit up the hole is like a lamp. Light moves from it in all directions.</p> <p>Isabella: Most of the light from the lamp does not go through the pinhole.</p> <p>To answer:</p> <ol style="list-style-type: none"> who is right about the light? who is wrong about the light? what would you say to help them understand? <p style="font-size: small;">Developed by the University of York Science Education Group and the Salters' Institute. This document may have been edited. Download the original from www.BestEvidenceScienceTeaching.org © University of York Science Education Group. Distributed under a Creative Commons Attribution-NonCommercial (CC BY-NC) license.</p>	<p style="text-align: center;">Pinhole camera</p> <p style="text-align: center;">BEST STUDENT WORKSHEET</p> <p>Pinhole camera</p> <p>A pinhole camera is a box with a tiny hole in the front. On the back is a piece of grease proof paper. When there is an image, it is seen on the grease proof paper.</p>  <p>Object that is lit up</p> <p>Pinhole camera</p> <p>Apparatus and materials:</p> <ul style="list-style-type: none"> insect camera grease proof paper (cut into a hole) Carbon filament lamp (to light up) <p>Procedure:</p> <ol style="list-style-type: none"> Make one pinhole in the front of the camera. Make the camera in a dark room or box. Look at the image on the grease proof paper. Describe the shape and brightness of the image. Draw which way up the image is. <p style="font-size: small;">Developed by the University of York Science Education Group and the Salters' Institute. This document may have been edited. Download the original from www.BestEvidenceScienceTeaching.org © University of York Science Education Group. Distributed under a Creative Commons Attribution-NonCommercial (CC BY-NC) license.</p>																																																					
<p style="text-align: center;">Two-tier multiple choice with a confidence grid</p>	<p style="text-align: center;">Talking heads</p>	<p style="text-align: center;">Predict, explain; observe, explain</p>																																																					

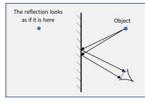
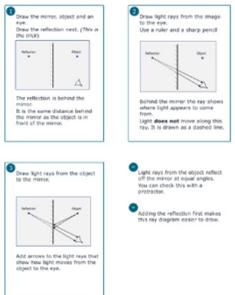
Progression toolkit: Explaining how an object is seen when reflected in a plane mirror

Learning focus	A plane mirror reflects light rays from each point of an object so they appear to come from distinct points behind the mirror and the reflection is seen as if it were behind the mirror.				
As students' conceptual understanding progresses they can:					
As students' conceptual understanding progresses they can:	<p>Compare the reflection of an object in a plane mirror to how the object looks.</p> <p>P</p>	<p>Describe where the reflection of an object appears to be in a plane mirror.</p>	<p>Explain why the reflection of an object in a plane mirror appears to be behind the mirror.</p>	<p>Explain why an object appears back to front in a plane mirror.</p>	<p>Draw a ray diagram to show how an object is seen when reflected in a plane mirror.</p> <p>B</p>
Diagnostic questions	Mirror reflection	Behind the mirror	Mirror writing		
Response activities		Reflection hunt	What turns round?	Drawing a reflection	

Key:

P Prior understanding from earlier stages of learning

B Bridge to later stages of learning

<p>Mirror reflection</p> <p>BEST STUDENT WORKSHEET</p> <p>Mirror reflection</p> <p>Henry the hedgehog looks at himself in a mirror.</p>  <p>How often does a pond have a castle because it is flat? It's called a plane mirror.</p> <p>How can you describe Henry's reflection?</p> <p>Put a tick (✓) in the box next to the best answer.</p> <table border="1"> <thead> <tr> <th></th> <th>I can name this as right</th> <th>I think this is right</th> <th>I don't know</th> <th>I can name this as wrong</th> </tr> </thead> <tbody> <tr> <td>A Henry's reflection is on the mirror</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>B Henry's reflection looks back at Henry</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>C Henry's reflection is the same size as Henry</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>D Everyone looking at the mirror sees the same reflection that Henry sees</td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table> <p>Confidence grid</p>		I can name this as right	I think this is right	I don't know	I can name this as wrong	A Henry's reflection is on the mirror					B Henry's reflection looks back at Henry					C Henry's reflection is the same size as Henry					D Everyone looking at the mirror sees the same reflection that Henry sees					<p>Behind the mirror</p> <p>BEST STUDENT WORKSHEET</p> <p>Behind the mirror</p> <p>In a flat mirror you can see the reflection of an object. The reflection looks as if it is behind the mirror.</p>  <p>Why does the reflection look as if it is behind the mirror?</p> <p>Put a tick (✓) in the box next to the best answer.</p> <table border="1"> <tbody> <tr> <td>A The object's image bounces (reflects) off the mirror</td> <td></td> </tr> <tr> <td>B The object's image reflects off the mirror at an equal angle</td> <td></td> </tr> <tr> <td>C Light appears to come from an object behind the mirror</td> <td></td> </tr> <tr> <td>D The mirror makes an image of what is in front of it</td> <td></td> </tr> </tbody> </table> <p>Simple multiple choice</p>	A The object's image bounces (reflects) off the mirror		B The object's image reflects off the mirror at an equal angle		C Light appears to come from an object behind the mirror		D The mirror makes an image of what is in front of it		<p>Mirror writing</p> <p>BEST STUDENT WORKSHEET</p> <p>Mirror writing</p> <p>In a mirror writing looks back to front.</p>  <p>What can you say about the reflection?</p> <p>For each statement, tick (✓) one column to show what you think.</p> <table border="1"> <thead> <tr> <th></th> <th>I am sure this is right</th> <th>I think this is right</th> <th>I don't know</th> <th>I am sure this is wrong</th> </tr> </thead> <tbody> <tr> <td>A The mirror turns the reflection round</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>B The mirror reflects back what is in front of it</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>C Looking through the back of the writing, we see the same as the reflection</td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table> <p>Confidence grid</p>		I am sure this is right	I think this is right	I don't know	I am sure this is wrong	A The mirror turns the reflection round					B The mirror reflects back what is in front of it					C Looking through the back of the writing, we see the same as the reflection					<p>Reflection hunt</p> <p>BEST STUDENT WORKSHEET</p> <p>Reflection hunt</p> <p>A candle flame reflects in a safety screen. You can see the reflection through the safety screen.</p>  <p>You can put an upright candle on the reflection and measure where it is.</p> <p>What can you say about the reflection?</p> <p>For each statement, tick (✓) one column to show what you think.</p> <table border="1"> <thead> <tr> <th></th> <th>I am sure this is right</th> <th>I think this is right</th> <th>I don't know</th> <th>I am sure this is wrong</th> </tr> </thead> <tbody> <tr> <td>A The candle flame reflects in a safety screen</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>B The candle flame reflects in a safety screen</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>C The candle flame reflects in a safety screen</td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table> <p>Predict, explain; observe, explain</p>		I am sure this is right	I think this is right	I don't know	I am sure this is wrong	A The candle flame reflects in a safety screen					B The candle flame reflects in a safety screen					C The candle flame reflects in a safety screen					<p>What turns round?</p> <p>BEST DEMONSTRATION NOTES</p> <p>What turns round?</p> <p>This demonstration shows students that writing appears back to front in a plane mirror because when they look from the object to the reflection of the object in the mirror they are always 'seen' to turn through 180°. The mirror reflects back what is in front of it.</p> <p>Apparatus and materials</p> <ul style="list-style-type: none"> Safety screen Large plane mirror White board card Clamp and stand that holds the mirror in front of the safety screen <p>Procedure</p> <ol style="list-style-type: none"> Write a word with the white-board pen on a clear safety screen so it is clearly visible. Stick what students think the word will look like in a plane mirror (back-to-front). Place the mirror directly in front of the writing and the screen and hold it in place with a stand. Ask Q1. Allow students to look from behind the mirror at the writing on the screen, and then from behind the screen at the reflection of the writing on the mirror. Stick what physical object has turned round between the two observations. (The challenge.) Allow students to look through the screen from behind so they can see both the writing and the reflection of the writing. Check that you have seen each piece of writing in. Turning the screen so the writing is at the right-hand end makes this more obvious. (Each one initially the same way round.) Conclude that when we observe both the writing and the reflection of the writing in the same direction, both are the same way round and the mirror does not flip the reflection round. <p>If some students say they are not convinced, then challenge them to explain why the reflection is not upside-down and not back-to-front. Ask other questions they could use to observe the reflection from in order for it to appear upside down. (They need to stand on their heads. That is, the observer needs to look from an upside-down position.)</p> <p>To answer</p> <ol style="list-style-type: none"> Write the word 'PINK' as it appears in a flat mirror. (815) Discuss how the reflection of 'PINK' is different to 'PINK' when it is written down. (It is back-to-front) What does a mirror do when it reflects the word 'PINK'? (Reflects back what is in front of it.) What does a person reading the word 'PINK' need to do to the paper it is written on in order to see an reflection in a mirror? (Turn to face the other way.) <p>NB Mirrors can be plane as well as give reflections that are upside-down and not back-to-front. This is the same effect, but caused through refraction.</p> <p>Clarifying - demonstration</p>
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<p>Drawing a reflection</p> <p>BEST STUDENT WORKSHEET</p> <p>Drawing a reflection</p> <p>Ray diagrams show how light reflects in a mirror. These diagrams can be difficult to draw. The trick is to draw the reflection before the rays of light.</p>  <p>Application and practice</p>																																																																													