**What turns round?**

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 (the observer) need to turn through 180o. The mirror reflects back what is in front of it.

**Apparatus and materials**

* Safety screen
* Large plane mirror
* White-board pen
* Clamp and stand that holds the mirror in front of the safety screen

**Procedure**

1. Write a word with the white-board pen on a clear safety screen so it is clearly visible.
2. Elicit what students think the word will look like in a plane mirror. (Back-to-front.)
3. Place the mirror directly in front of the writing on the screen and hold it in place with a stand and clamp.
4. Allow students to look first from behind the mirror at the writing on the screen, and then from behind the screen at the reflection of the writing in the mirror.
5. Elicit what physical thing has turned round between the two observations. (The observer.)
6. Allow students to look through the screen from behind so they can see both the writing and the reflection of the writing.
7. Elicit which way round each piece of writing is. Turning the screen so the writing is all the right-way-round makes this more evident. (Both are initially the same way round.)
8. 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.

If some students are still not convinced, then challenge them to explain why the reflection is not upside-down as well as back-to-front. Ask what direction they would need 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 at it from an upside-down position.)

**To answer**

(FIRE)

1. Write the word ‘FIRE’ as is appears in a flat mirror.
2. Describe how the reflection of ‘FIRE’ is different to ‘FIRE’ when it is written down.

(It is back-to-front)

1. What does a mirror do when it reflects the word ‘FIRE’?

(Reflects back what is in front of it)

1. What does a person reading the word ‘FIRE’ need to do to the paper it is written on in order to see its reflection in a mirror?

(Turn to fact the other way)

NB Mirrors can be place so as to give reflections that are upside-down and not back-to-front. This is the same effect, but rotated through 90o.

*Physics > Big idea PSL: Sound, light and waves > Topic PSL3: Making images > Key concept PSL3.1: The ray model of light to explain images*

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| --- |
| **Response activity** |
| **What turns round?** |

**Overview**

|  |  |
| --- | --- |
| 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. |
| Observable learning outcome: | Explain why an object appears back to front in a plane mirror. |
| Activity type: | Clarifying - demonstration |
| Key words: | Mirror, reflection, inverted |

This activity can help develop students’ understanding by addressing the sticking-points revealed by the following diagnostic question:

* Diagnostic question: Mirror writing

**What does the research say?**

Many textbooks talk about an ‘image’ that is ‘laterally inverted’, but this is not true (Gee, 1988). It does *appear* that the reflection is back-to-front, but this is because of the direction in which we observe the reflection, rather than something the mirror has done to it.

In ‘looking’ at an object, **an eye forms a real image** of the object on its back surface (the retina). When looking at a reflection of the same object in a plane mirror, the reflected light rays from the object enter the eye in exactly the same way as they would have if they had originated from the object placed in a position behind the mirror that corresponds to where it is in front of the mirror (but without the mirror there). The reflection however appears laterally inverted. This is because to turn from looking at the side of the object facing the mirror to looking at the reflection of the object in the mirror, *the observer* must rotate through 180o. Likewise, if the observer were to hang upside-down from the ceiling the image would appear to rotate in the vertical plane.

**Ways to use this activity**

This demonstration gives you the opportunity to re-teach why a reflected image appears flipped from left-to-right and not upside-down. It allows you to show your students how it build understanding from simpler ideas, using a structured teacher-led discussion.

You should use carefully selected questions to check your students’ understanding of each step, before progressing onto the next one. The steps you might follow in this demonstration are described in detail in the demonstration notes.

*Differentiation*

You could challenge different individuals by asking them follow-up questions to clarify or to extend their original answer. If a student is having difficulty with a particular question, it is often helpful to break it into smaller *chunks*, to lead them to a fuller answer. This technique models more thorough answers, and can be used to support an open classroom culture in which students are encouraged to ‘have a go’.

**Equipment**

For the demonstration:

* Safety screen
* Large plane mirror
* White-board pen
* Clamp and stand that holds the mirror in front of the safety screen

**Technician notes**

The mirror needs to be large enough to view writing on the safety screen. A mirror in a lightweight frame is ideal.

Students need to be able to walk around both the mirror and the safety screen, and to observe from all sides.

**Health and safety**

It may be sensible to allow one or two students to make observations and describe what they see to the class.

Practical work should be carried out in accordance with local health and safety requirements, guidance from manufacturers and suppliers, and guidance available from CLEAPSS.

**Expected answers**

These are given in brackets in the demonstration notes.

**Acknowledgments**

Developed by Peter Fairhurst (UYSEG).

**References**

Gee, J. K. (1988). The myth of lateral inversion. *Physics Education,* 23**,** 300-301.