



# Telescopes

## Science Objectives:

- To know that some telescopes use lenses, others use mirrors too;
- To know that mirrors reflect light whereas lenses refract it;
- To know that light is focussed by a concave mirror;
- To know that differently shaped concave mirrors have different focal lengths.

## Science Skills:

- Observing the effects of concave mirrors and magnifying lenses.

## Resources:

- Pots of water – enough to share
- Pipettes – one per child
- Clear acetate or piece of Sellotape folded back on itself – one per child
- Small piece of foil 10cm x10cm – one per child
- Copies of The Tiny Words Worksheet
- A selection of lenses
- Caroline Herschel PowerPoint

## WARM UP

Tell the children:

Caroline Herschel was a famous astronomer who was the first woman to discover a comet. She was also very skilled in making parts for telescopes. One of the main parts of the telescope she used was a mirror. It had to be really shiny and really smooth and just a tiny bit curved.

Give out a small piece of foil to each child (10cm squared).

Tell the children:

Scrunch up the foil a little bit so it is creased.

Hold up the foil in front of your face.

Ask:

- Can you see your face in the foil? (No)

Tell the children:

The foil is shiny and can act like a mirror but the surface is not flat so it is bouncing the light in a disorganised way. We cannot see the image as it is all over the place. To make the light bounce off the foil in an organised way the foil must be flat. You have 3 minutes to smooth the foil out as much as you can.

Ask:

- Can you see your face in the foil now? (Not clearly but a blurred image is usually visible)

Tell the children:

It often took the Herschels a really long time, even over a year, to grind and polish a mirror to exactly the right shape and shininess. The smoother the mirror, the more light it would accurately reflect. The more light it reflected the clearer the image seen in the telescope. The mirror was perfectly smooth and dipped in the middle just a tiny amount. It was a concave mirror. Let's look at the effect of using a concave mirror.

Hand out a spoon to each child.

Ask :

- Look into the back of the spoon. What does the curve do to your reflection? (stretches it out)
- Look into the front of the spoon – the concave part. What does the curve do to your reflection? (turns it upside down)
- Move one finger towards the concave surface of the spoon very slowly. Can you find the spot where the image flips over? (quite close to the spoon)

Show *Slide 1* on the *Caroline Herschel PowerPoint*.

Watch:

<https://www.youtube.com/watch?v=5v7bNI3PjZ8>

It shows how the refracting telescope (using lenses) differs from a reflecting (using mirrors) telescope.

## INTRODUCTION

Watch:

<https://www.youtube.com/watch?v=0yIEhUSrGCM>

Tell the children:

History remembers Caroline as the sister and supporter of William Herschel, the famous astronomer but Caroline has the right to be considered as an astronomer herself, being equally skilled and knowledgeable as her brother. When Caroline was ten, she had typhus and stopped growing. Her family thought she would never find a husband and decided to keep her at home as a maid. It was her brother who took her from the family home in Hanover, Germany to Bath in England. William, a musician himself, engaged Caroline in music too, with singing lessons. She became very accomplished and well known as a singer. When William became interested in astronomy, Caroline did too and she often recorded observations that William shouted out as he kept his eye trained on the telescope. She even received payment from the Royal Astronomical Society as his assistant and William built her a telescope of her own. She used it constantly as she made detailed records of what she observed as she was 'minding the heavens' (as she called it).

Watch:

[https://www.youtube.com/watch?v=ocGHWfIsX\\_Q](https://www.youtube.com/watch?v=ocGHWfIsX_Q)

Ask:

- What do you think of the fact that a female scientist couldn't present her own paper at the Royal Astronomical Society?

Watch:

<https://www.youtube.com/watch?v=k5QSZkIZA5U>

Rewind this last video to 4:42 and look again at the Herschel's 40-foot telescope or show *Slide 2* on the *Caroline Herschel PowerPoint*.

Ask:

- What do you think it was like for Caroline as an astronomer?
- What were conditions like when she was 'sweeping the heavens'?

## MAIN ACTIVITY

Tell the children:

Another essential part of a telescope is the lens in the eye piece which magnifies the image so you can see in more detail.

Give out a selection of lenses (magnifying glasses, old glasses lenses – whatever you can find) and allow the children to explore what they can see through a lens.

Tell the children:

We can make a lens.

Give out small pieces of acetate (like the ones used on an overhead projector), pots of water, pipettes and the Tiny Text Worksheet. There are instructions to follow on the worksheet to investigate these lenses.

Discuss what happens.

Watch:

[https://www.youtube.com/watch?v=fDI544bM\\_c4](https://www.youtube.com/watch?v=fDI544bM_c4)

## FINALE:

Making fire with a magnifying glass is something that fascinates children but you may think it is unsafe to raise this topic with your particular group. Some children are able to assess risk whilst others have not developed this skill yet. You know your children best so you must make the decision. However, children in the last few years of primary school may well have a make-up mirror which is concave and magnifies their image. These mirrors can cause a fire in the same way as a magnifying glass by focusing the reflected light onto a small point. If the focal point lands on a curtain or other flammable material, it may ignite. So, there is an argument for teaching children about this topic so they can avoid fires. The same thing can happen with round glassware as it can act like a lens.

Watch:

<https://www.youtube.com/watch?v=7s0sKbKgGY0>

and

<https://www.ctvnews.ca/canada/makeup-mirrors-can-cause-fires-toronto-woman-warns-1.3611827>

Discuss what the children have seen on the videos and begin a discussion on fire safety with respect to lenses and mirrors.

## REVIEW

**ALL:** Children will know that some telescopes use lenses, others use mirrors too. They will also know that mirrors reflect light whereas lenses refract it

**MOST:** Children will understand that light is focussed by a concave mirror.

**SOME:** Children will understand that differently shaped concave mirrors have different focal lengths.

