Student Sheet

In this practical I will be:

- Carefully observing how the size of objects alters when water drops are placed over them.
- Testing how altering the distance between the object and the lens changes the object’s appearance.
- Using my scientific knowledge and understanding of shape of lenses, how we see objects, explain my observations of the water droplets.

Introduction:

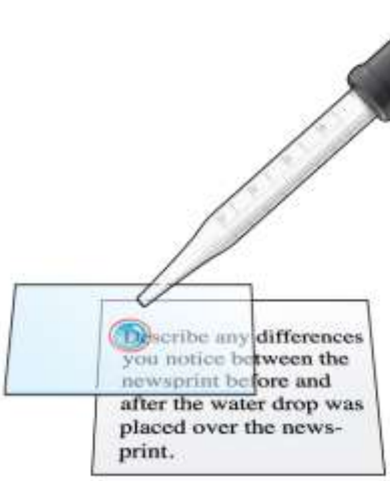
Recently, you have managed to trade one of your paintings for a jeweled bracelet. When you return to your workshop you place the bracelet in a box with some drachma. When you look at the bracelet again, in one of the gems you can see an image of letters on the coins. However, something unexpected has happened to the letters. Like all good ancient Greek science-artists, you decide to investigate further…

Equipment:

- 1 microscope slide or clear plastic ruler
- 1 sheet of newspaper
- 1 crayon or non-permanent marker pen
- Petroleum jelly
- 1 eyedropper or plastic pipette
- A small amount of water
- Diagram of the eye

Method:

1. Get a microscope slide or plastic ruler and put it on top of a piece of newspaper that has small print on it.
2. Use a crayon (or non-permanent marker pen) to draw a small circle on the slide. Look closely at the newsprint that is within the circle and try to measure the circle that would surround the letter.
3. With an eyedropper or plastic pipette, carefully put a drop of water (about 5–6 mm) across in the circle, so that it keeps its shape.



Peter Bull

4. If the drop flattens out completely get a clean microscope slide and make a circle of petroleum jelly on the slide. Make sure you keep the centre very clean. Put the water drop inside the circle as before.
5. Look down at the newsprint, through the top of the water drop. You might need to get quite close to the water drop to be able to see.
6. Experiment with carefully lifting the slide up or lowering it towards the newsprint.
   - What do you notice about the size of the newsprint beneath the water drop?
   - Describe any differences you notice between the newsprint before and after the water drop was placed over the newsprint.
   - What do you notice about the shape of the water drop on top of the glass?
   - What is the shape of magnifiers?
   - How do you think water and magnifiers bend light?
   - Do you think the shape is important?
   - How do you see the newsprint?

Going further:

As an extension activity examine salt, sugar, leaves, etc.

It may be easier to use a straw to place a few grains of salt or sugar onto the microscope slide or ruler. To do this, dip the end of the straw into the salt or sugar and scrape along the salt or sugar to get a few grains into it. Then carefully place the end of the straw onto the slide or ruler and tip them very gently onto it.

You could also experiment with different sized water drops and see if the magnification changes.

Explain why you think this is happening.

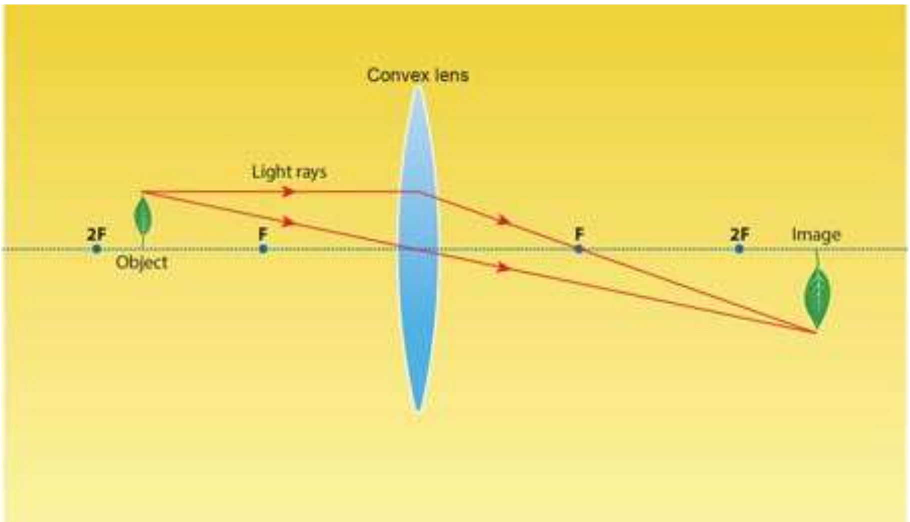
Research the life of the scientists Anton van Leeuwenhoek and Robert Hooke.

Theory:

Surface tension is the name for the **attractive forces** between the **particles** or **molecules** in water, which make the water drops, become ball shaped or **spherical**. This is because the molecules inside a drop are attracted to each other in all directions, from the surface inward.

The outward **curvature** of the water droplet is similar to the curved surface of a lens. The more outwardly curved the lens, the **stronger its magnification**. This is because it is bending or refracting more light in a shorter space. This type of outwardly curving lens is called a **convex lens**.

A convex lens bends the light rays to focus on a point in space somewhere beyond the lens as you can see in the diagram below:

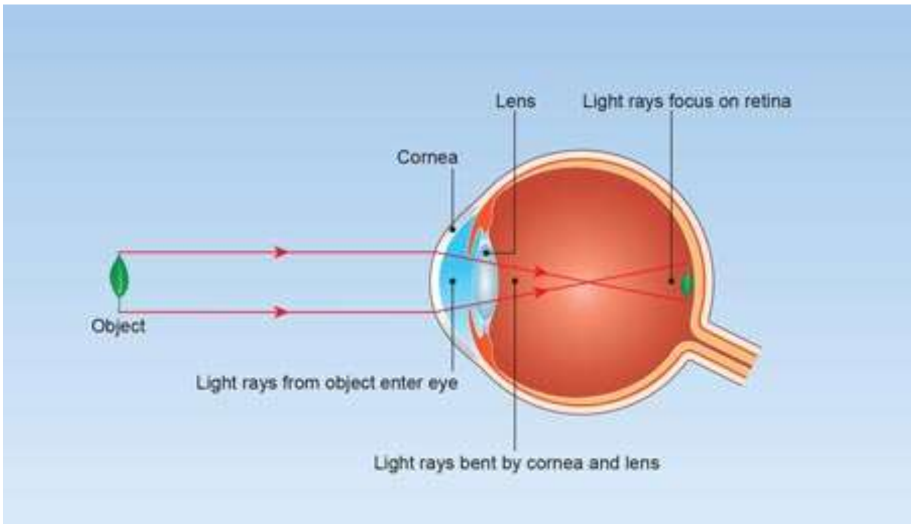


Peter Bull

By moving the lens toward and away from the object, you can adjust where the point of magnification strikes your eye.

ROYAL SOCIETY OF CHEMISTRY

When light strikes your eye, the cornea and lens project it onto your retina, as shown in the diagram below.



Peter Bull

You should find the water drop magnifies by a factor of 4 - 5 the smaller the droplet the more the magnification, but it is also harder to look through and focus.

This was the principle behind the early microscopes, such as that used by the 17th century Dutch trader and scientist Anton van Leeuwenhoek (1632-1723). He perfected these early microscopes by using carefully prepared glass beads, similar in shape to your water droplet. Although difficult to use, these microscopes were powerful, able to magnify up to 200x.

Anton van Leeuwenhoek.

ROYAL SOCIETY OF CHEMISTRY