

"Off the Hooke"



SCN 3.13a: Using a microscope, I have developed my understanding of the structure and variety of cells and of their functions.

Let's step back in time and find out how Robert Hooke observed some of the first "cells".

Materials

- Cork (e.g. a cork bung for a test tube)
- Coverslip
- Glass microscope slide
- Light microscope
- Scalpel
- Pipette
- Distilled water



The image here is only a guess of what Hooke looked like based on written documents; no recorded image exists. It is believed that this is because Newton despised Hooke and his work and had the only recognised portrait burnt as part of a much wider goal to wipe his record from history.



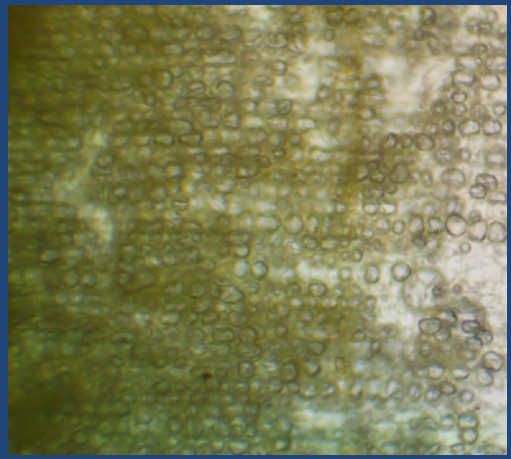
1 Using the razor blade, cut a cork slice that is thin enough for light to pass through. Be careful! This is tricky to achieve a very thin section.



2 Using a pipette, add a drop of water to a microscope slide. Place the thin section of cork onto the slide and carefully cover with a coverslip.

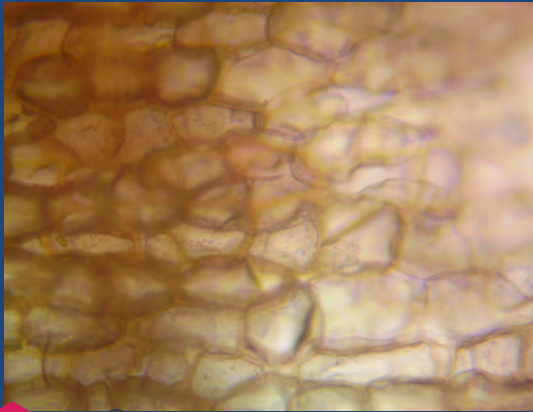
3

Position the slide so that the light passes through the thinnest section of the cork, towards the edge. View the cork using the x4 and then the x10 objective lens.



4

Once focused, increase the magnification by rotating the x40 objective lens above the specimen. Can you see the spaces between the cells now? Why might this be important?



Robert Hooke was the first person to observe "**cells**", back in 1665, using a 3-lens optical microscope that he invented himself. Interestingly, the first serious microscopes (invented by Hooke, Galileo, Newton etc) were created in part due to the scientist's interest in astronomy and optics in general, not necessarily biology (that, of course, they didn't yet understand). Unlike today, **interdisciplinary** science was the norm, lacking boundaries between "core sciences", and Hooke's work illustrates the huge impacts this can have on the world.

Hooke's first observations of cork cells from *Quercus suber*, commonly called the cork oak, remains one of his most famous observations:

I could exceedingly plainly perceive it to be all perforated and porous, much like a Honey-comb, but that the pores of it were not regular...these pores, or cells...were indeed the first microscopical pores I ever saw, and perhaps, that were ever seen.
Micrographia, Hooke (1665).

Hooke coined the term "cells" because his observation of the cork tissue reminded him of the cells within a monastery.



Calculating Total Magnification

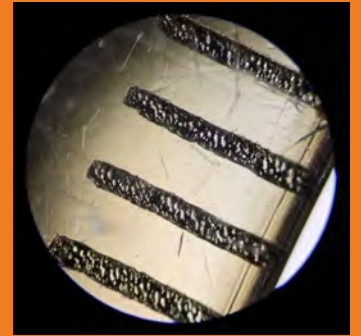
The microscope you are using to observe the cork cells is called a **compound microscope**. This is because it has two lens (oculars) to view the specimen. To determine the total magnification applied to your specimen, multiply the magnification achieved using the eyepiece lens (x10) by the magnification achieved using the objective lens (usually x4, x10 or x40).



Making scientific drawings to scale

Collect a small ruler and place on the microscope stage (as shown in the image opposite). Place the x4 objective lens over the stage and note the diameter of the field of view (in millimetres). The image opposite shows 1mm markers - the microscope field of view diameter at x40 magnification was 4mm. To determine the diameter of the field of view with the x40 objective lens (x400 total magnification), do the follow calculation:

$(40 / 400) \times (\text{diameter of the field of view at x40 magnification})$

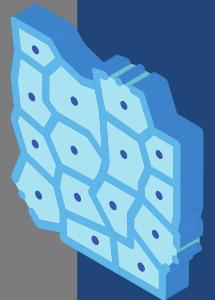


For this microscope:
 $(40/400) \times 4 =$
0.4mm diameter at x400 magnification

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Now you have determined your field of view at x400 total magnification, draw a scientific diagram of the cork cells. Draw a circle to represent the field of view. Make a scale drawing of 3 cells. Beside each, record:

- the total magnification
- diameter of the field of view
- number of cells that will stretch across the field of view
- the estimated length of an individual cork cell.





Push Yourself Further - Conversion between units
In step 5, you estimated the length of an individual cell. This is achieved by dividing the field of view by the estimated number of cells that stretch across the field of view.

However, this can give a very small number when recorded in millimetres.

How can we solve this?

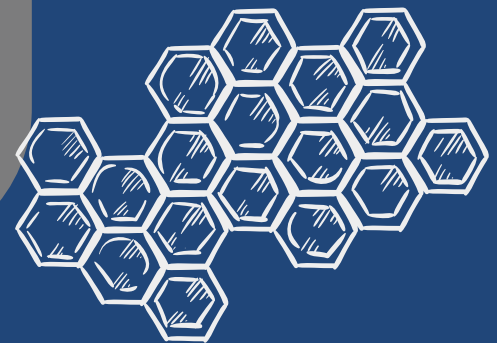
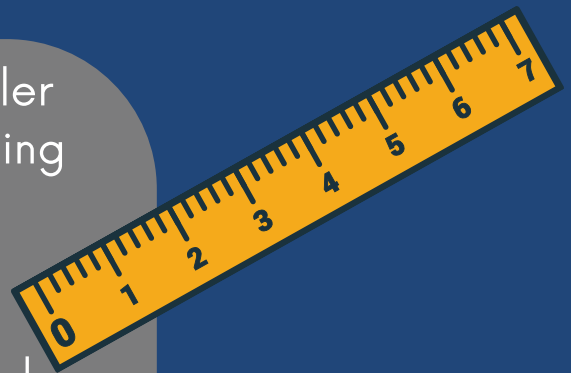


6

1 micron (μm) is 1000 times smaller than 1 mm; another way of wording this is that there are $1000\mu\text{m}$ in 1mm.

To convert from mm to μm , multiply by 1000.

For example, $5\text{mm} = 5000\mu\text{m}$.



What can you see?

A cork cell is non-living with cell walls made up of suberin, which is impermeable to water and gases. Using lower magnifications, the closely-packed, radial arrangement of cells can be observed. However, a total magnification of $\times 400$ should reveal the small gaps between cells. This is due to structures called lenticels that arise from the cork cambium, which allow gas exchange between the environment and the plant stem.



Microscopes in the world of work

In this short film, meet Dr Amanda Berg. She is studying medical science and uses microscopes to observe zebrafish embryos.



STEM AMBASSADOR
SPOTLIGHT:

AMANDA BERG
PhD Student (Medical Sciences) at the University of Aberdeen



Keywords: biology, chemistry, maths, French, biomedical



Microscopes in the world of work

Forensic services for Police Scotland use microscopes to analyse crime scene objects, e.g. the microscopic analysis of clothing or weapons, paint or glass fragments, and even marks/striations made by tools.



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