Cells

Background, National Curriculum links and suggested aims

This lesson is intended for use when teaching cells to Years 7-9. It has been written for use in a Biology lesson.

Teacher background knowledge

No special background knowledge required for a Biology teacher. If a Science teacher with a specialism in Physics teaches the lesson, there are opportunities to make additional links with rays of light (optical microscopes) and electrons (electron microscopes).

Cross-curricular links

There are links to History, specifically the importance of developments in Technology for advancements in Science.

Student background knowledge

None required, though useful if they have already been introduced to cells.

Resources and timing

No special resources.

One lesson of 50 minutes should suffice.

Activities

1. Give students a standard account of cells:
    - Cells vary in size but the great majority cannot be seen with the naked eye.
    - All organisms are made up of cells; unicellular organisms have just a single cell; multicellular organisms typically are made up of a number of different cell types.
    - Every cell comes from another cell as a result of cell division.
    - You might want to show students photographs or video clips of unicellular organisms or get them to look at them under a light microscope.
    - Similarly, students might look at simple slides to see cells – e.g. a blood smear or a slice through a leaf.

2. Explain to students that in the 1600s, a number of countries in Europe had people inventing what we now call microscopes. We don't know for sure who 'got there first' but one of the early scientists who devised a microscope was the Italian scientist, Galileo. This was the same Galileo who championed the idea of Copernicus that the Earth goes round the Sun (not vice versa), did early work on pendula (after realising that the period of a pendulum depends on its length but not on how far it swings in each direction) and was one of the first to make telescopes (which he used for making observations of various celestial bodies including the Moon).

3. Explain to students two ideas:

    a. Sometimes, advances in science about what we know about the world come about largely as a result of advances in technology. The invention of the microscope is a case in point. Once people had microscopes, their knowledge of the natural world increased greatly.

    b. It isn't always important, or even very meaningful, to talk about 'who got there first' in science. Sometimes, several teams are all working on much the same problem at about the same time. Microscopes are an example of this. Even if Galileo hadn't thought of the idea of a microscope, others would have.

4. Soon, lots of scientists were using microscopes. One such person was the British scientist, Robert Hooke. In 1665, Hooke coined the word 'cell' after looking at the cell walls of cork under the microscope. Show students a projection of Hooke's drawing of these cells, e.g. https://www.sciencephoto.com/media/230814/view/drawing-of-cork-under-microscope-by-robert-hooke.

5. The first person to see live cells under a microscope was the Dutch scientist Antony van Leeuwenhoek in 1674. Leeuwenhoek used a *simple* microscope – i.e. one that only has one lens whereas both Galileo and Hooke used *compound* microscopes with two lenses. The great advantage of a compound microscope is that it can magnify more than a simple microscope; however, there are more things that can go wrong! Show students a labelled example of one of Leeuwenhoek's microscopes, e.g. https://www.timetoast.com/timelines/microscopes--38. Help them to appreciate the functions of the various parts and how different it is from one of today's microscopes. One of the living cells that Leeuwenhoek saw was *Vorticella, e.g.* https://www.youtube.com/watch?v=fcQrzdnQADY.

6. The best contemporary light microscopes magnify up to about 1000 times. Advances in light microscopes continue to this day but it is impossible for a light microscope to usefully magnify more than about 1500 times, owing to the wavelength of light.

7. Electrons have much shorter wavelengths than the photons that make up light. In the 1930s, people began to build what we now call 'transmission electron microscopes' and 'scanning electron microscopes'.
8. In a transmission electron microscope, electrons are fired at a very thin section (a slice of an object). Some electrons pass through the section, others don't. The resulting image reveals much of the internal structure of the object. Transmission electron microscopes can usefully magnify hundreds of thousands of times, even more than a million times. There are many images on the internet. For example, http://rachithscellanalogy.weebly.com/chloroplast.html shows a single chloroplast.
9. In a scanning electron microscope, electrons bounce off a sample rather than passing through it. The resulting image therefore reveals much of the external structure (the surface) of the object. Scanning electron microscopes can usefully magnify up to about 30,000 times. Again, there are many images on the internet. For example, https://www.reddit.com/r/Damnthatsinteresting/comments/8f8z2s/scanning_electron_microscope_sem_image_of_red/ shows red blood cells at the tip of a hypodermic needle. Note that the images produced by both transmission electron microscopes and scanning electron microscopes are black and white. This image is therefore a 'false colour image' – red has been added by the person responsible for producing the image.
10. Get the students to think about whether electron microscopes are better than light microscopes because they magnify more and whether transmission electron microscopes are better than scanning electron microscopes for the same reason. The answer is 'no' – each is a tool with advantages and disadvantages. As stated above, transmission electron microscopes provide information about what is inside objects, scanning electron microscopes on the surfaces of objects. However, both types of electron microscopes can only be used with non-living objects. Light microscopes can be used with both living and non-living objects. We can imagine that if we wanted to understand how an organism was able to move, both light and electron microscopes would have a part to play.

Extension activities

- What is the relationship between a telescope and a light microscope?
- What is 'chromatic aberration' and how do high-quality light microscopes minimise the problem?
- Is the image produced by a microscope any less 'real' than the image produced by our brain as a result of what we see directly with our eyes?

Resource links

- There are loads of videos on the internet showing unicellular organisms – e.g. *Paramecium* (https://www.youtube.com/watch?v=WFpBRfLtblo), *Amoeba* (https://www.youtube.com/watch?v=ZpAbk__xaew), *Euglena* (https://www.youtube.com/watch?v=sYupCQT46cI).
- For a good introduction to the history of the light microscope see: https://brunelleschi.imss.fi.it/esplora/microscopio/dswmedia/storia/estoria1.html.
- For a timeline of microscopes, see: https://www.timetoast.com/timelines/microscopes--38.
- Science museums quite often have microscopes from a range of periods.