

Teaching ideas for Topic 1: Cell biology

Students will need a sound knowledge of this topic before studying genetics and meiosis. The topic also provides a basic introduction for HL Topics 7 and 8.

Ideas for the lesson

- Supply students with a set of electron micrographs of cells at various magnifications. Ask them to work out the magnification of each image, or the actual sizes of organelles in the photographs given the magnification.
- Remind students that a cell membrane is made up of the passive phospholipid part (75–95%) and the active protein part (5–25%), and that cells that do more exchanging of materials have more protein channels. Ask them to draw analogies between the protein channels of a cell and the doors, windows, sewage system, phone lines, mailbox, electricity supply and chimney of a house to explain membrane functions.
- Lead a class discussion on the potential benefits and problems of stem cell research. Students should carry out their own investigation of the literature regarding therapies; new studies are reported regularly in the press.
- Ask students to compile a list of the different methods by which substances move into and out of cells, summarising whether they are active or passive and whether substances move with or against the concentration gradient. For each one, students can suggest an example of a substance that moves in that way.
- Mutagens and oncogenes are topics for which much up-to-date reference material is available (see, for example, www.news-medical.net and www.nature.com). A differentiated research assignment can be used to form the basis of class presentations by students and be linked to health issues such as smoking.

Practical activities

- Ask students to produce a ‘to scale’ model of a eukaryotic cell from coloured modelling clay, using textbooks and photographs for reference. This can be a group activity and, at the start of a new course, provides an opportunity for students who may not know one another well to become acquainted.
- Enable students to investigate surface area : volume ratio in simple practical work and relate this to the rate of diffusion into (and out of) a cell. A small-scale, individual experiment involving planning and evaluation can be done using different sized agar jelly cubes stained with DCPIP. Immersing the cubes in vitamin C solution will cause the cubes to clear and the diffusion distances can be compared.
- Provide students with the opportunity to observe osmosis and osmotic balance. This can be done using a wet mount of a small, thin-leaved plant such as *Elodea* or other suitable aquatic species. Observe the leaves firstly in distilled water and then in a 5% salt solution. Ask students to observe the proximity of chloroplasts to the cell membrane near the edge of the preparation in each case. As water enters the cells, the membrane and chloroplasts are pushed up tightly against the cell wall.
- The practical protocol for staining cells in mitosis from root tips of garlic or onion cells is described in the practical support material. Video clips can be used to support the practical work. Suitable clips can be viewed online, for example, at www.gettyimages.co.uk and www.corbismotion.com.
- Students can consider why these areas of plant tissue are particularly useful for observation of mitosis and form a link to additional HL Topic 9.

ICT

- Colorimeters and data loggers can be used to monitor the leakage of pigment from the membrane of samples of beetroot or other cells subjected to a range of different treatments. Changes in pH, temperature and the presence of alcohol will all disrupt the membrane. Leakage in alkaline solution produces an interesting colour change as the beetroot pigment acts as an indicator. Students can be asked to explain this. Alternatively, they can design their own investigation to determine the extent of membrane disruption when using different concentrations of acid or alkali.

Common problems

- Some students find the concept of wavelength of light and electrons difficult and the idea of resolution can cause problems for non-physical scientists. Diagrams, analogies and visual examples can assist in clarifying things.
- Calculation of magnifications of electron micrographs and photographs is another area of difficulty, which can be resolved with plenty of practice.

Theory of knowledge (TOK)

- Discuss the cell theory as an example of a theory that is generally accepted but for which exceptions can be found. This provokes useful discussion about the value of theories in advancing knowledge.
- Students can consider the ethical issues involved in stem cell research. False claims about untested treatments (for example, in treating multiple sclerosis) can be discussed as well as the factors that cause people to make decisions about seeking such treatments. News items on this topic are available at www.bbc.co.uk, for example. Stargardt's disease is one very recent example of the use of stem cells in medical treatments.
- The use of models and development of new theories based on previously held views can be discussed in relation to the evolution of the Davson–Danielli model to the current view of membrane structure.

International mindedness

- Discuss stem cell research in different countries and what influences governments as they legislate on what is permitted. Potentially useful video clips can be viewed at www.corbismotion.com, among others sites.
- Attitudes to health vary from country to country and the approaches of different governments to the promotion of anti-smoking campaigns is a useful example to discuss.