Notes for teachers

At a glance

With the population estimated to reach 9-10 billion and with 50% of arable land expected to be salinized by the year 2050, there are serious concerns about food security in the future. The University of Oxford are examining the potential function of specific proteins involved in drought and salt resistance.

Understanding the function of such proteins may result in the production of genetically engineered crops that remain photosynthetically active throughout times of drought and in salinized soil and so may result in more reliable harvests. To understand the function of these proteins, scientists must study them in living organisms. For this, scientists use simple and well understood organisms, usually with short life spans and with minimal care requirements.

This lesson introduces students to the concept of using model organisms in biological research. Students will be introduced to the reasons for their use and will explore the ethical and logistical concerns that scientists consider when selecting a model organism.

With an increasing number of exam questions requiring students to have an appreciation of context and experimental design, understanding the considerations surrounding the appropriate use of model organisms may give students increased contextual understanding in experimental questions.

Learning Outcomes

- Students understand and can give reasons for the use of model organisms in biological research
- Students appreciate the logistical and ethical considerations when using model organisms
- Students can choose appropriate model organisms for given research objectives and can explain their decisions

www.oxfordsparks.ox.ac.uk/content/hardy-crops-tackle-food-insecurity
Each student will need

- A copy of the student worksheet

Possible Lesson Activities

1. Starter activity

- Introduce the idea of using model organisms in biological research and the associated ethics. For given exams encourage debate about the ethics of using living organisms in research. Examples may include;
  - Gregor Mendel’s use of pea plants in genetic cross experiments (these worked because the heritable traits he examined were controlled by a single gene);
  - The use of mice in research into the study of tumour development and its genetic causes;
  - The use of mice to study the effects of disease and the immune system. This includes experiments on mice which have had their immune system ‘disabled’;
  - The use of rhesus macaque in the development of the polio vaccine and in deep brain surgical stimulation.
- Finish by showing the Oxford Sparks animation (https://www.oxfordsparks.ox.ac.uk/content/hardy-crops-tackle-food-insecurity) which demonstrates an active research project using model organisms.

2. Main activity: Think, pair, share – reasons for using model organisms in research

- Think, pair, share activity. Pose the question ‘Why do scientists need to use model organisms in research and what qualities do they tend to share?’

Encourage students to produce a list or mind map independently, then encourage them to share their ideas with a partner or group before taking ideas from the class to produce a model mind map on the board.

Teachers should attempt to elicit ideas of;

- Simple and cheap to maintain in study (laboratory) conditions;
- Often unethical to study complex organisms with developed nervous systems;
- Study organisms often simpler and easier to manipulate and study;
- Allows for large sample sizes which is important in producing valid data;
- Simple structures that make it easy to identify any changes as a result of manipulation;
- Easily observable characteristics;
- Easy and quick to breed new generations (short generation time);
- Breed in large numbers;
- Similar genetics to the organism that the research will eventually be applied to;
- Similar biochemistry to the organism that the research will eventually be applied to;
3. **Main activity: Model organisms in research – context and choice**

- Students read through the information about model organism on the student handout. From this information they rank the three most appropriate model organisms for the research scenarios provided. For each, they write a short paragraph explaining their decision. Good answers will reference the information provided and the mind map the class produced in the preceding think, pair, share activity.

4. **Plenary**

- Pose the question, ‘Suggest a likely order/sequence of model organisms that might be used in the early development of a drug before trials on humans begin’. Students should bullet point a list and the teacher can ask a sample of students to explain their choices, getting other students to critique or agree?

**Web links**

- Oxford sparks animation on Hardy Crops: [https://www.oxfordsparks.ox.ac.uk/content/hardy-crops-tackle-food-insecurity](https://www.oxfordsparks.ox.ac.uk/content/hardy-crops-tackle-food-insecurity).

- Information for further reading and extension on model organisms: [https://www.yourgenome.org/facts/what-are-model-organisms](https://www.yourgenome.org/facts/what-are-model-organisms).