Molecular genetics

with Associate Professor Dr Lynn Kee and Dr Anil Challa

Talking *points*

Knowledge & Comprehension
1. What is gene editing?
2. What is the difference between an organism's genotype and phenotype?
3. How does CRISPR-Cas9 technology work?
4. Why is CRISPR revolutionising the field of molecular genetics?

Application
5. Rapid technological and scientific advances are often exciting. To what extent do you think such advances come with risks and downsides? Use CRISPR as a first example, and another rapidly advancing technology or field that you know of as a second example.
6. What ethical considerations do you think Anil and Lynn take into account when performing experiments on model organisms?

Analysis
7. Why do you think Anil and Lynn chose to use different model organisms? What do you think are some advantages of using zebrafish over butterflies, and vice versa?

Evaluation
8. Many of the undergraduates in Anil's and Lynn's classes will choose careers that do not include working with gene editing technologies, and some will choose careers that do not involve lab-based work at all. To what extent do you think the CRISPR courses remain useful for them? What sorts of lessons might they learn that are beneficial within other career paths?
9. Think about the bioethics of gene editing in humans. At the moment, clinical trials are using gene editing technologies to cure harmful diseases. It is theoretically possible to use these technologies to also change other traits – perhaps gene editing could reduce a person's vulnerability to diseases such as diabetes or obesity, or even improve traits like intelligence or athleticism. Where do you think we should draw the line, and why? How could this be regulated or enforced?

Activities

Discuss
In pairs or small groups, discuss:
• How CRISPR-Cas9 works
• The potential applications of CRISPR technology and the key benefits of CRISPR technology mentioned in the article
• The ethical concerns surrounding CRISPR gene editing and the real world examples mentioned in the article
• Your thoughts about the topic, including any ethical considerations

Join another pair or larger group and discuss these points further. Ask questions, challenge each other's viewpoints, and explore the complexity of CRISPR technology and its implications.

Reflect
• What did you know about CRISPR technology before reading Anil and Challa's article?
• What do you find most interesting about the work they are doing?
• What interests you the most about the concept of CRISPR technology?
• If you were a student in one of Anil or Lynn's classes, what would you like to study? How would you like to use CRISPR technology?
• Having read the article and discussed the topic, what have you learnt about CRISPR that you did not know before?
• What issues related to CRISPR technology would you like to learn more about?

Design a scientific poster that explores one of the following:
• The key points raised in your class discussion
• The history of the science of gene editing
• How CRISPR-Cas9 technology works at the molecular level
• The lab-based techniques involved in doing a CRISPR-based experiment
• Current and possible future uses of CRISPR in society

More *resources*

• Visit the CRISPR in the Classroom Network's website: www.qubeshub.org/community/groups/crispr_classroom_network

• DNA From the Beginning introduces the fundamental concepts and history behind modern genetics through digestible articles, animations, videos and other resources: www.dnaftb.org

• The Innovative Genomics Institute provides many educational resources, including plenty of information, videos and games exploring CRISPR technology: www.innovativegenomics.org

• iBiology contains over 500 videos, talks and animations exploring biological concepts and advances (such as CRISPR) at a typically more advanced – but still accessible – level: www.ibiology.org/explore

• Anil recommends this article about recent CRISPR news: www.fiercebiotech.com/biotech/landmark-approval-vertexs-crispr-drug-two-steps-closer-after-trial-wins-pdufa-date-granted