Biological physics

with Dr Hanna Salman and Dr Andrew Mugler

Talking *points*

Knowledge

1. What is non-genetic memory?
2. What is antibiotic resistance?

Comprehension

3. Why do Hanna and Andrew combine experimental and theoretical approaches within their work?
4. What has their collaborative team discovered that appears to go against current understanding of non-genetic memory?

Application

5. What sorts of challenges do you think might arise when an experiment-focused team and a theory-focused team work together? How might Hanna and Andrew overcome these challenges?
6. How do you think the team's findings might help fight cancer? What biological processes might be disrupted to do so?

Analysis

7. Hanna says that theoretical models are needed to make experimental models "plausible, precise and predictive". What do you think he means by each of these adjectives, and why is each important to science?
8. Why do you think the team's discoveries about multi-generational non-genetic memory were not made earlier? Why might they have been missed by other scientists?

Evaluation

9. Antibiotic resistance is a growing problem; bacteria appear to be gaining resistance to antibiotics faster than we are discovering new antibiotics. What measures do you think that individuals, healthcare systems, scientists and the food industry should take to prevent this becoming a crisis? Do some online research if you are unsure of how to answer.
10. Why do you think that the growth of biological physics has accelerated in the last couple of decades? What do you think might have limited its emergence before then?
11. Where do you see biological physics leading in the future? What do you think future biological physicists will research?

Activity

Take some time to research the field of biological physics, in particular some of the big societal issues that it is attempting to tackle. Choose one such issue that captures your attention. There are many issues to choose from, including:

- Solutions to antibiotic resistance
- Personalised medicine
- Tracking sources of pollution
- Developing biology-based renewable energy sources
- Genetic screening (e.g., to understand individuals' vulnerabilities to certain diseases)

Now, imagine a future where research in this area has reached a milestone and is ready for application in the real world. Design a presentation to promote this research output. Your presentation should include:

- An introduction to the problem
- An overview of relevant research (including both real research to date, and imagined future research)
- Key findings and how they led to this major output
- How the research output works to solve this problem, and what benefits it can be expected to bring
- Next steps for rolling out this output into the world – to include any controls or regulations it might need.

Present to your class and take any questions raised. Was your audience enthused about your imagined output? How likely do you think the future will see this scenario become a reality? What related research areas would you like to learn more about?

More *resources*

- The Biophysical Society provides a quick introduction to biological physics and its applications: **www.biophysics.org/what-is-biophysics**
- The Physics of Life review examines the accomplishments of biological physics to date and how its unique traits are helping answer some fundamental questions: **nap.nationalacademies.org/catalog/26403/physics-of-life**
- This video from SciShow explains antibiotic resistance and why it is such a complex issue: **www.youtube.com/watch?v=pkTalaQsRIw**