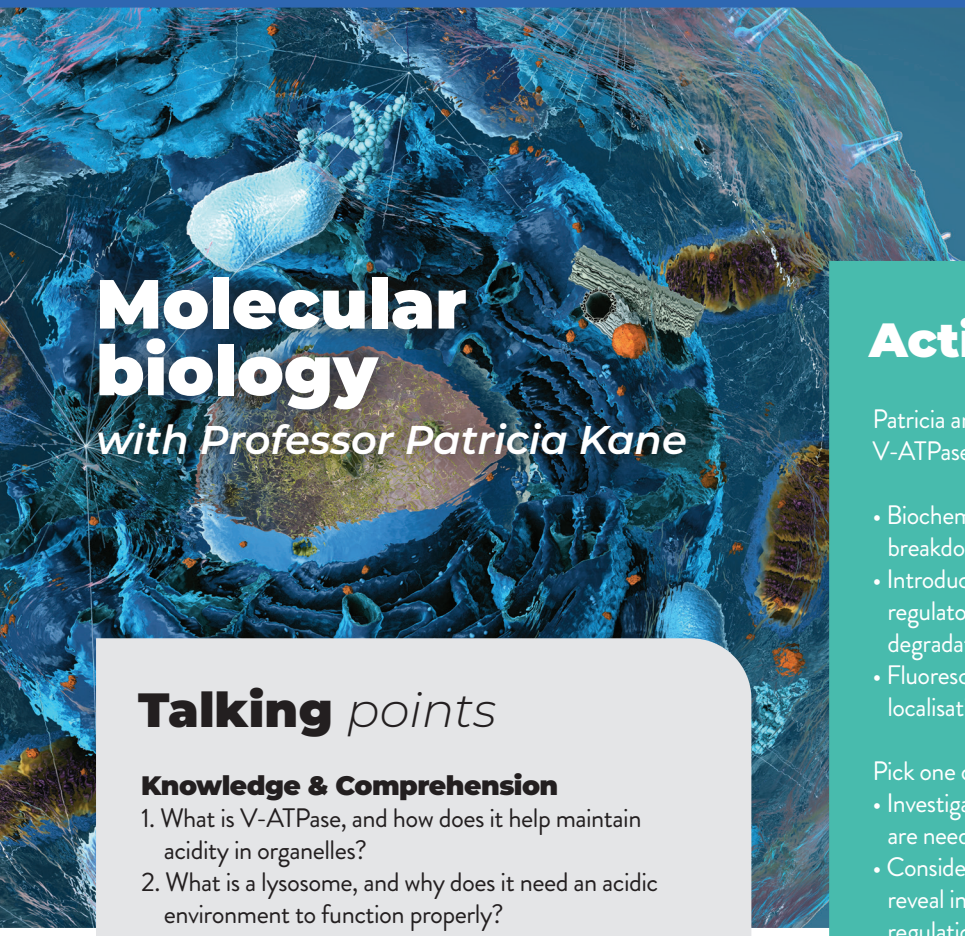

Molecular biology

with Professor Patricia Kane

Talking *points*

Knowledge & Comprehension

1. What is V-ATPase, and how does it help maintain acidity in organelles?
2. What is a lysosome, and why does it need an acidic environment to function properly?
3. What is reversible disassembly, and how does it regulate V-ATPase activity?
4. Why does Patricia use yeast cells to study V-ATPase function and regulation?
5. How can mutations in V-ATPase genes affect human health, including kidney function?
6. How does ageing affect V-ATPase activity and lysosome acidity, and what impact might this have on protein degradation and recycling?

Application

7. V-ATPase is essential for normal cell function but is also involved in diseases such as cancer, osteoporosis and Alzheimer's. Why is it important to carefully target these molecular pumps in therapies, and what strategies might scientists use to avoid harming healthy cells while treating disease?

Analysis

8. How does V-ATPase activity contribute differently to diseases such as Alzheimer's and osteoporosis?
9. Why is reversible disassembly important for cells to adapt to changes in nutrient availability or stress?

Evaluation

10. Patricia and her team found that V-ATPases in older yeast cells are more often disassembled, reducing lysosome acidity. How might understanding this process guide strategies to slow cellular ageing? What challenges could scientists face when trying to apply these findings to human cells?
11. What skills and attributes do you currently have that would help you succeed in a career in molecular biology? What further skills could you develop to help you succeed?

Activity

Patricia and her team use a range of techniques to study V-ATPase activity in yeast cells, including:

- Biochemical isolation of vacuoles to measure the breakdown of ATP and proton pumping
- Introducing mutations in yeast V-ATPase genes or regulators to observe effects on cell growth, protein degradation or vacuole pH
- Fluorescent labelling of V-ATPase to visualise its localisation under a fluorescence microscope.

Pick one of the techniques listed above and:

- Investigate how it works and what equipment or materials are needed
- Consider what kind of data it produces and how it can reveal information about V-ATPase activity, localisation or regulation
- Think of some questions about V-ATPase or lysosome function that it could help answer.

Use your chosen technique to create an experiment that investigates V-ATPase in yeast.

- Describe the experimental set-up and procedure
- Explain what results you would expect if V-ATPase is functioning normally versus if it is impaired
- Suggest how this approach could be applied to study age-related decline in lysosome acidity or V-ATPase regulation.

Reflection questions:

- How could the data from your experiment guide potential therapies for age-related diseases?
- What challenges might scientists face when translating findings from yeast experiments to human biology?
- How does combining multiple techniques, such as mutations and fluorescent labelling, give a more complete picture of V-ATPase function?

More *resources*

- Explore the American Society for Cell Biology's Cell Image Library: **cellimagelibrary.org/home**
- Explore V-ATPase Alliance, a community of scientists, patients and families working towards improving the lives of those suffering from rare genetic conditions affecting V-ATPase: **vatpasealliance.org/home**
- This YouTube playlist by Medicosis Perfectionalis is a great introduction to molecular biology: **youtube.com/playlist?list=PLYcLrRDaR8_cpMqa1bbUwD2T39RJA6_o3**