



# OCEAN BIOGEOCHEMISTRY WITH PROFESSOR KATSUMI MATSUMOTO

## TALKING POINTS

### KNOWLEDGE

1. What are phytoplankton?
2. What is the global ocean carbon cycle?

### COMPREHENSION

3. Can you explain the importance of the biological pump in the context of global climate change?
4. Why are physical and chemical processes easier to model than biological processes?

### APPLICATION

5. Ocean temperatures are increasing under climate change. What effect do you think this might have on the biological pump?
6. Many scientists argue that the ocean is more important than trees for carbon sequestration. Why do you think this might be the case?

### ANALYSIS

7. Why do you think the Redfield ratio continues to be used in oceanographic models, given it is known to be an over-simplification?
8. How do you think zooplankton (which eat phytoplankton) might affect the phytoplankton C:N:P ratio?
9. Katsumi mentions using satellite data to complement his models. How do you think this information could improve his models?

### EVALUATION

10. Katsumi's research indicates that the biological pump may not weaken as much as previously thought. Do you think this means that the world can relax with regards to addressing climate change?

## ACTIVITIES YOU CAN DO AT HOME OR IN THE CLASSROOM

From your own knowledge and what you have learned from the article, draw a diagram of the global ocean carbon cycle. Make your diagram as clear and engaging as possible. Make sure to include:

- Photosynthesis
- Food chains
- Surface waters and deep waters
- Marine sediment
- Atmospheric carbon
- Carbon emissions

Once you have finished your diagram, look up some examples online. Have they included anything you haven't? Can you supplement your diagram with anything new you have learned?

If you have time, consider what other ocean nutrient cycles might look like. What might the global ocean nitrogen cycle involve? How might human activities affect it?

## MORE RESOURCES

- The University of Minnesota's Earth and Environmental Sciences Department runs a number of outreach initiatives, such as student symposiums, publicly available resources, and public-facing projects combining science and art. Find out more here: [cse.umn.edu/esci/initiatives](https://cse.umn.edu/esci/initiatives)
- This NASA article provides a background to phytoplankton and their importance, including how phytoplankton communities can be tracked using satellites: [earthobservatory.nasa.gov/features/Phytoplankton](https://earthobservatory.nasa.gov/features/Phytoplankton)
- This video provides a background to the concept of iron fertilisation, a controversial suggested technique for supplying phytoplankton with extra nutrients to encourage carbon sequestration: [www.youtube.com/watch?v=8ZO9M1\\_CJD0](https://www.youtube.com/watch?v=8ZO9M1_CJD0)