Applicable standards

Next Generation Science Standards (NGSS)

High School Life Sciences

Element of the curriculum	Lessons 1	2	3	4	5	6	7
Ecosystems: Interactions, Energy, and Dynamics							
• **HS-LS2-1.** Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.	✓	✓	✓	✓	✓	✓	✓
• **HS-LS2-2.** Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.	✓	✓	✓	✓	✓	✓	✓
• **HS-LS2-3.** Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.	✓						
• **HS-LS2-4.** Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.	✓						
• **HS-LS2-5.** Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.	✓	✓	✓				
• **HS-LS2-6.** Evaluate claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.				✓	✓	✓	✓
• **HS-LS2-7.** Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.		✓	✓	✓	✓	✓	✓
• **HS-LS2-8.** Evaluate evidence for the role of group behavior on individual and species' chances to survive and reproduce.				✓	✓	✓	✓

SCHEME OF WORK

Lesson 1: Why should we care about zooplankton?

Overview

In this lesson, students learn the importance of zooplankton as primary consumers in the community and as part of the marine biological pump in the global carbon cycle. These zooplankton account for a staggering percentage of the Earth's biomass, and yet because they are microscopic and in the ocean, we hardly give them much thought.

Learning outcomes

- Say what zooplankton are (Foundation)
- Define and use a variety of ecological terms correctly to describe zooplankton (Developing)
- Draw food chains and pyramids of numbers with zooplankton (Developing)
- Explain the importance of zooplankton in a community (Competent)
- Explain the importance of zooplankton in the marine carbon cycle (Expert)

Resources

Slideshow 1:
Why should we care about zooplankton?

Student Sheet 1a:
The importance of zooplankton

Answer Sheet 1a:
Mark Scheme for Student Sheet 1a

Video Lesson 1:
Teacher Guidance

Video Lesson 1:
Student Sheet Video

Video Lesson 1:
Student Sheet Video reflection

Video:
Investigating the impact of microplastics

Subject Update:
Learn more: Copepods

Subject Update:
Learn more: Marine carbon cycle

Lesson 2 How can humans affect the marine environment?

Overview

The ocean is worth $49.7 trillion to the global economy and its beauty is priceless. People, every day, all over the world, use the ocean for a whole variety of purposes: but what impact does this human activity have on the ocean, the organisms that live there and on us?

Learning outcomes

- Give examples of human impacts (Foundation)
- Use the words 'overfishing' 'dose' and 'persistent' correctly (Developing)
- Describe what happens in a trophic cascade and apply this knowledge (Developing)
- Describe the process of bioaccumulation (Competent)
- Explain why it is difficult to predict the impact of population change (Expert)

Resources

Slideshow 2:
How can humans affect the marine environment?

Student Sheet 2a:
Scientist tweet sheet

Student Sheet 2b:
Blog post

Student Sheet 2c:
Storyboard template

Answer Sheet 2b

Answer Sheet 2c

Gallery:
Water sampling

Subject Update:
Learn more: Trophic cascades

Lesson 3: What are microplastics and where do they come from?

Overview

In this lesson, students develop their understanding of how human actions can have a negative impact on the marine environment. The context of this lesson is investigating the amount of microplastics that students use every day in personal hygiene products.

Learning outcomes

- Define microplastics (Foundation)
- Give sources of microplastics (Foundation)
- Define and use the term 'microplastic' correctly (Developing)
- Describe how to use sampling techniques (Competent)
- Apply sampling techniques (Competent)
- Switch between multiples of units (Expert)
- Use standard form (Expert)

Resources

Slideshow 3:
What are microplastics and where do they come from?

Activity Overview 3:
How much microplastic

Student Sheet 3a:
How much microplastic

Student Sheet 3b:
Microplastics summary worksheet

Student Sheet 3c:
Hunting microplastic home learning

Subject Update:
Learn more: Marine plastics

Subject Update:
Learn more: Marine plastics facts and figures

Lesson 4: Do zooplankton and microplastics occur together?

Overview

In this lesson students learn how to apply sampling techniques, using real field data collected by Dr Lewis's team. The context of this lesson is the voyage the team took to the Gulf of Maine to investigate if zooplankton and microplastics co-occur.

Learning outcomes

- Describe how to collect data at sea (Foundation)
- Define and use the key words correctly (Developing)
- Apply sampling techniques (Competent)
- Use standard form (Expert)
- Evaluate sampling techniques (Expert)

Resources

Slideshow 4:
Do zooplankton and microplastics occur together?

Student Sheet 4a:
Do zooplankton and microplastics occur together

Student Sheet 4a:
Do zooplankton and microplastics occur together higher

Answer Sheet 4a and 4b

Video:
Science under sail

Lesson 5: Do zooplankton eat microplastics? (Experiment set-up)

Overview

This lesson develops students' skills in data handling and presentation. Having learnt about microplastics and zooplankton separately, the next two lessons see students test the hypothesis that zooplankton eat microplastics. In this first lesson, students set up a classroom practical to collect primary data. They then process the secondary data collected by Dr Ceri Lewis and her team.

Learning outcomes

- Calculate differences and plot points on a graph accurately (Foundation)
- Calculate averages, choose appropriate graphs to draw, and draw your own scales on axes (Developing)
- Handle anomalies, draw lines of best fit, and range bars (Competent)
- Find linear equations (Expert)
- Calculate standard deviation (Advanced)

Resources

Slideshow 5:
Do zooplankton eat microplastics? Part 1

Activity Overview 5:
Do zooplankton eat microplastics

Student Sheet 5a:
Do zooplankton eat microplastics practical

Student Sheet 5b:
Do zooplankton eat microplastics data analysis

Answer Sheet 5b

Video:
Science in the lab

Lesson 6: Do zooplankton eat microplastics? (Conclusion)

Overview

In this lesson, students return to their experiments from Lesson 5, and observe the gut contents of the brine shrimp, applying model conclusions to what they can see. Students develop their ability to write scientific conclusions using the secondary data from the research team. The lesson ends with students considering the implications of microplastics being consumed by zooplankton on a wide scale.

Learning outcomes

- Say what results show (Foundation)
- Describe patterns in results (Developing)
- Describe how results support hypotheses (Developing)
- Explain your conclusion with science (Competent)
- Explain conclusions' wider impacts (Competent)
- Support conclusions with numerical values (Expert)
- Describe the limitations of conclusions (Expert)

Resources

Slideshow 6:
Do zooplankton eat microplastics? Part 2

Activity Overview 5:
Do zooplankton eat microplastics

Student Sheet 5a:
Do zooplankton eat microplastics practical

Student Sheet 6a:
Model conclusions

Student Sheet 6b:
Do zooplankton eat microplastics conclusions

Answer Sheet 6b

Video:
Investigating the impact of microplastics

SCHEME OF WORK

Lesson 7: How can you make sure your discoveries have an impact?

Overview

Having made their discovery that microplastics affect zooplankton feeding and that this could have devastating environmental consequences, the question is, what changes do they want to see, and who should make them?

Learning outcomes

- Give some ways scientific discoveries can have an impact (Foundation)
- Produce and implement a small-scale impact plan that reaches 1-2 people (Developing)
- Produce and implement an impact plan that reaches 2-50 people (Competent)
- Produce and implement a large-scale impact plan that reaches 50 or more people (Expert)

Resources

Slideshow 7:
How can you make sure your discoveries have an impact?

Student Sheet 7a:
Reducing the impacts of microplastics

Student Sheet 7b:
Communications ideas

Student Sheet 7c:
Impact plan

Student Sheet 7d:
SMART targets

Video:
Science and society