Microbes in the sea:
Demonstrations and Activity Session for the Marine Science Resource Kits

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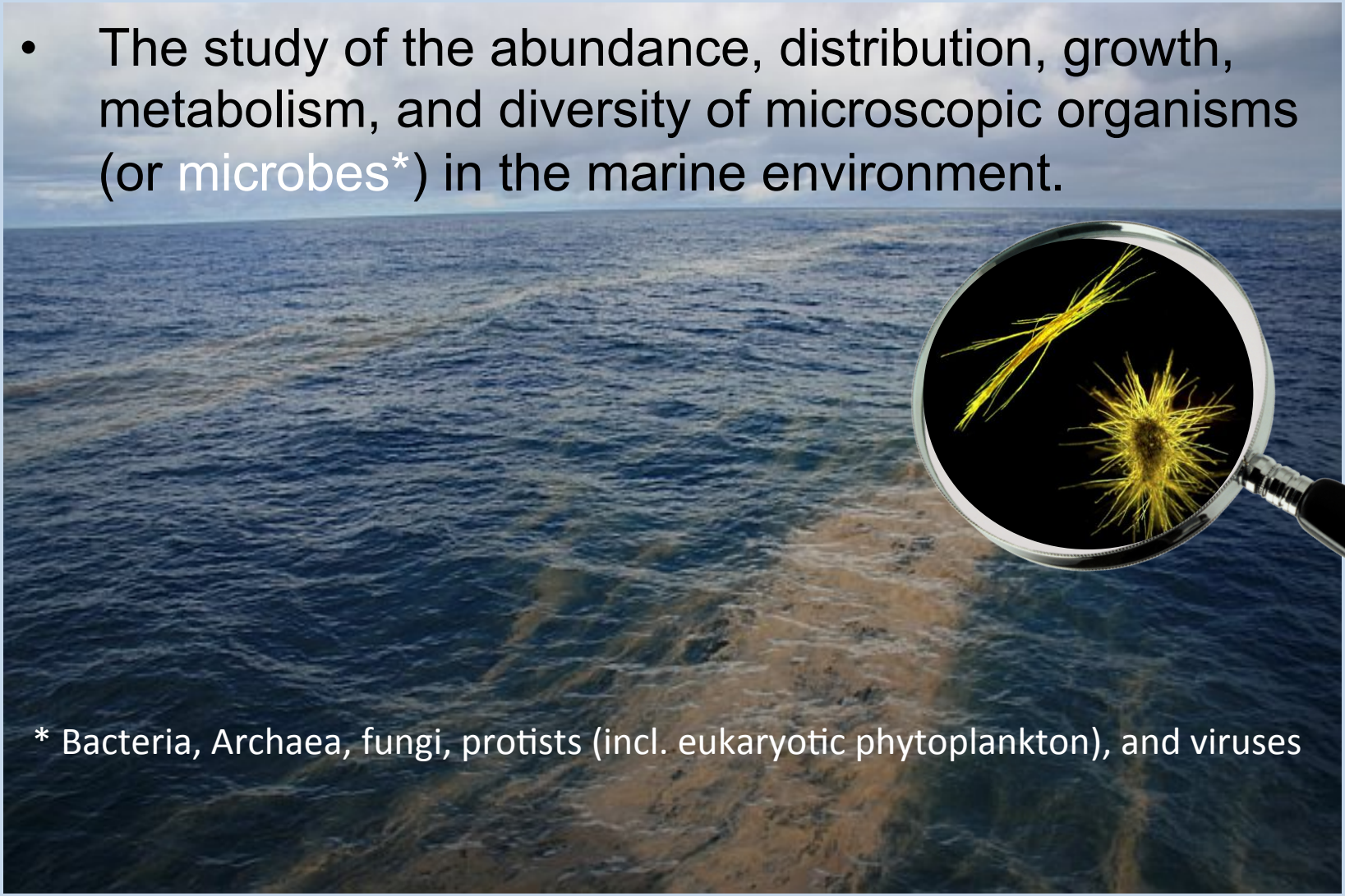
What is microbial oceanography?

- The study of the abundance, distribution, growth, metabolism, and diversity of microscopic organisms (or microbes*) in the marine environment.



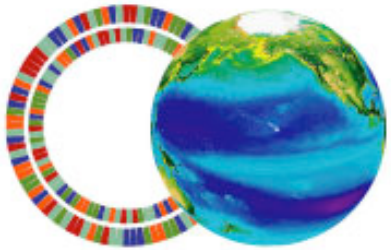
* Bacteria, Archaea, fungi, protists (incl. eukaryotic phytoplankton), and viruses

Marine Microbes: Why do we care?

- Abundant and diverse, found everywhere
- Remove CO_2, produce about 50% of the oxygen we breathe
- Form the base of the marine food web

C-MORE

- NSF-sponsored Science & Technology Center (STC)
- Goal = facilitate a more comprehensive understanding of microorganisms in the sea
- Design and conduct novel research, broker partnerships, increase diversity of human resources, implement education and outreach programs
  - education programs focus on preparing the next generation of microbial oceanographers
- Activities dispersed among partner institutions



center for microbial oceanography: research and education

C·more *linking genomes to biomes*

C-MORE: Education & Outreach

- K-12 Resources and Opportunities
  1. C-MORE website
  2. Science Teachers Aboard Research Ships (STARS)
  3. Grants for Education in Microbial Science (GEMS)
  4. Free Hands-on Science Kits

C-MORE: Education & Outreach

C-MORE: Science Kits

- Offer lesson plans and materials for hands-on science activities in a self-contained format
- For use with a range of grade levels
- Each kit provides the information and supplies necessary for educators to teach their students about a particular topic in oceanography
- Links to state science standards

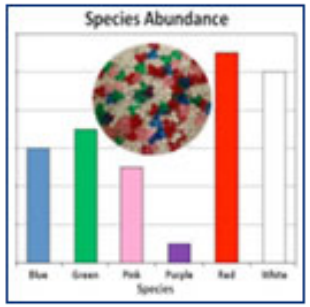
C-MORE: Science Kits

C-MORE Science Kits

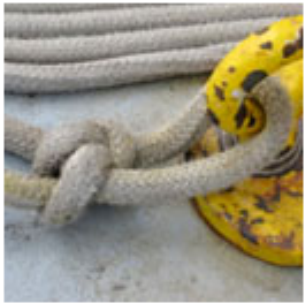
Marine Mystery

Marine Debris

Ocean Acidification

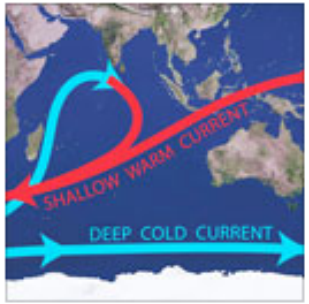


Random Sampling



Nautical Knots & Maritime Careers

Plankton



Ocean Conveyor Belt

Science Kit Discussion Forums!

Plankton Kit

- Grades 3–12*
- Explores plankton and their global importance through 4 lessons (30-45 min.)

  Lesson 1: students learn about plankton through a narrated PowerPoint presentation

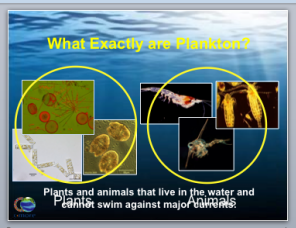
  Lesson 2: students design their own phytoplankton

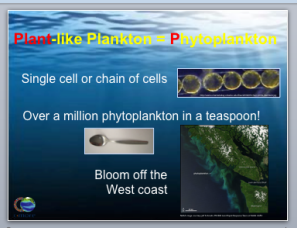
  Lesson 3: students investigate zooplankton with a microscope

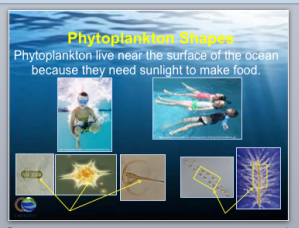
  Lesson 4*: Phytopia CD (Grades 6-12)

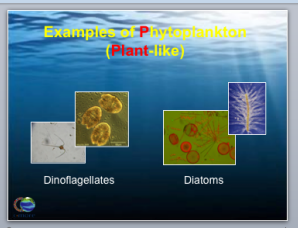
Plankton Kit

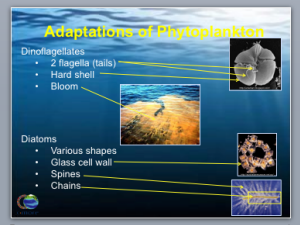
Lesson 1: students learn about plankton through a narrated PowerPoint presentation

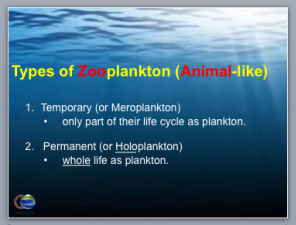


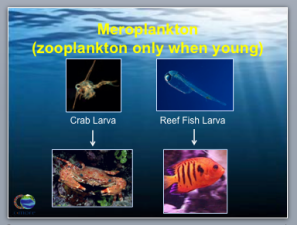


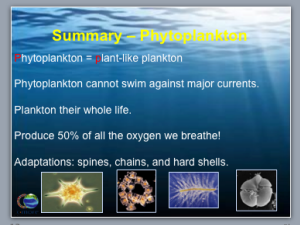


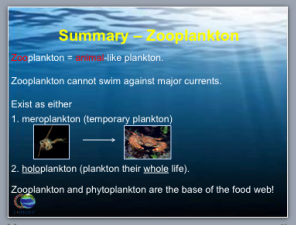






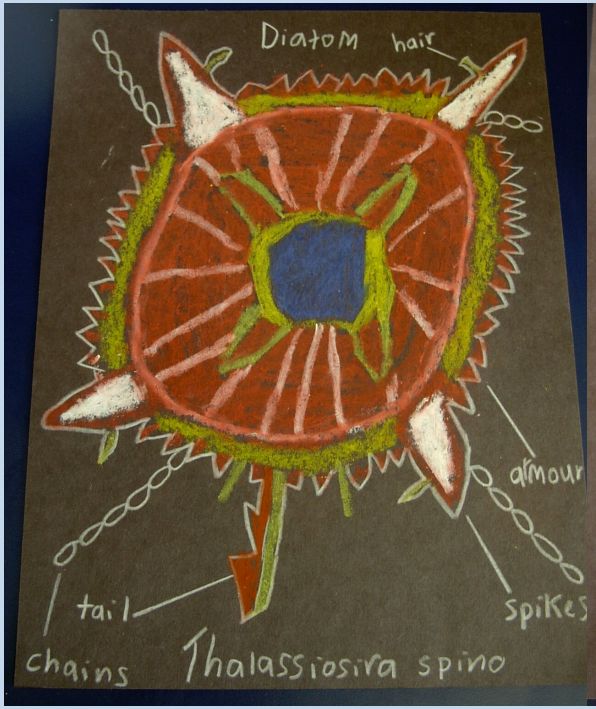


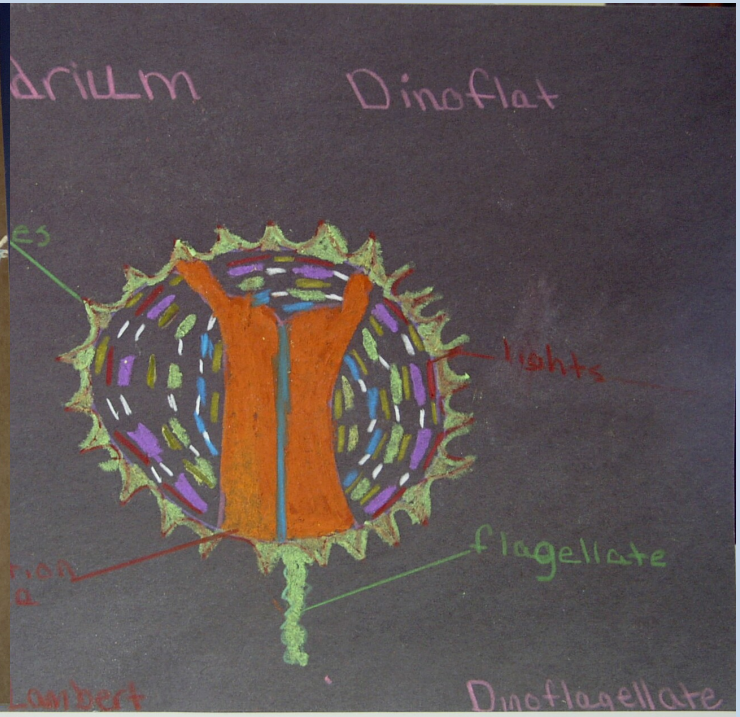




Plankton Kit

Lesson 2: design your own phytoplankton





Plankton Kit

Lesson 3: students investigate phytoplankton and zooplankton with a microscope

TEACHER GUIDE
Lesson 3: Zooplankton Microscopy Lab

Time Required: 50 minutes. Advance preparation requires another 1 to 2 hours.

Structure: Students will investigate and identify marine zooplankton using the digital dissecting microscope (45 minutes). We recommend students divide into small groups of 4–6 students. Materials are provided for five groups. Finally, they will complete a post-survey (5 minutes); the pre-survey was given at the beginning of Lesson 1.

Materials: (Paper materials contained in binder are shown in **BOLD CAPS**)
Materials are provided for 5 groups. We suggest 4–6 students per group.

1. **MATERIALS PHOTO GUIDE – Lesson 3: Zooplankton Microscopy Lab**
2. **STUDENT WORKSHEET – Lesson 3: Zooplankton Microscopy Lab**
3. **ZOOPLANKTON ID guide (Drifting Along) – Lesson 3: Zooplankton Microscopy Lab** (5 in Inner Box)
4. **PLANKTON SURVEY – Lessons 1, 2, and 3: Version 1 or 2**
5. **TEACHER ANSWER KEY to PLANKTON SURVEY – Lessons 1, 2, and 3: Version 1 or 2** } provided in Lesson 1
6. **GLOSSARY**
7. Plankton net with attached line
8. Plastic bottle to transport plankton to the classroom (1)
9. Squeeze bottle to rinse sample from net (1)
10. Plankton sieve (1)
11. Plastic beakers (5)
12. Plastic droppers (5)
13. Petri dishes (5)
14. Dissecting needles: straight (2) and curved (1)
15. Motic digital dissecting microscope (1) and cords (2) for microscope set-up
16. ThinkPad computer and power cord
17. Motic Images Plus CD
18. Motic Live Imaging Module: Quick Start Guide
19. Motic Instruction Manual SMZ-143
20. Extra microscope parts

Materials Not Included in this Kit but Needed for Lesson 3:

21. Projector

Advance Preparation:

1. Photocopy or print the **STUDENT WORKSHEET – Lesson 3: Zooplankton Microscopy Lab** (one per student).
2. Photocopy or print the appropriate version of the **PLANKTON SURVEY – Lessons 1, 2, and 3** (one per student; provided in Lesson 1) and the **GLOSSARY** (one per student; provided in the GLOSSARY tab).
3. Conduct a plankton tow to collect a zooplankton sample.
   a) You can either collect the sample on your own, or make this a class field trip. Grab the plankton net with attached line, plastic bottle, and squeeze bottle, and head down to the ocean. The plankton net has very small holes (80 µm), which are large enough to allow water to pass through but small enough to trap the zooplankton inside the collection cup (or cod end) at the end of the net.
   b) Fill the squeeze bottle with seawater.
   c) SLOWLY tow the plankton net through the water, either by attaching the line to the back of a kayak / boat or by walking along a pier. Best towing speed is about 2 knots (a slow walk). If the current is fast enough to stream the net (like a flag in the wind), you can just let the current flow through the net. *Caution: The net can tear easily so watch out for rocks, reefs, protrusions from piers, etc. Also, keep the net out of the shore break or you may get a net full of sand.*

MATERIALS PHOTO GUIDE
Lesson 3: Zooplankton Microscopy Lab

Plankton Net


Plastic Bottle


5 Plastic Beakers


Squeeze Bottle


Plankton Sieve


Digital Dissecting Microscope


5 Plastic Droppers


5 Petri Dishes with Covers


3 Dissecting Needles

Outreach Box

- Activities for all ages, cover a mix of subjects

  - Physics
    - Penny plop (surface tension)
    - Cartesian diver (density)
  - Climate
    - Air and Ocean pressure (pressure)
  - Nautical skills
    - Knot tying
  - Biology
    - What Microbe are You? (marine microbes)
  - Chemistry
    - Ocean acidification straw experiment (pH)

Kit Demos

- Plankton Kit: Microscopy lab to investigate and identify phytoplankton and zooplankton from local water sample (Hudson River)

- Outreach Box: Air and Ocean pressure lab

- Outreach Box: Ocean acidification straw experiment

Kit Reminders

- Kits are free to borrow, and can be loaned up to several weeks depending on scheduling
- We do not have a shipping budget
- Kits can be tailored to suit existing curricula and student needs