

Lesson 3 - Plankton and Biodiversity

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Grade Level: 5-8th

Lesson Time: 45-60 minutes

Suggested Class Structure: Small groups

Subject Areas: Science

BACKGROUND



The word *plankton* refers to microscopic organisms that live in the pond. Plankton cannot swim; they float!

There are two kinds of plankton, plant and animal plankton. Plant plankton is

called *phytoplankton* and animal plankton is called *zooplankton*.

Although they are small and either barely visible or invisible to the naked eye, plankton are critical strands of the aquatic food web. Phytoplankton are the primary producers in the system, converting sunlight energy to usable sugars and carbohydrates through the process of photosynthesis. Other plankton and many small fishes eat the phytoplankton. Some zooplankton feed on even tinier microscopic bacteria, which are important recyclers of nutrients in the aquatic ecosystem. There are even some plankton that exhibit characteristics that we think of as belonging to both plants and animals, such as *chlamydomonas*, with its green pigment for photosynthesis and long flagellum for movement.

The number of different types of organisms that live in a community is called *bio-diversity*. Some scientists think that the number of different kinds of plankton in an aquatic community is an important indicator of environmental quality. The greater the biodiversity, the more likely it is that the community will recover from a disturbance

such as pollution, or drought. In some circumstances, more biodiversity means a more stable community. It is important to note however, that the plankton community often goes through dramatic rises and drops in population numbers as seasonal conditions change in ponds and streams.

In this part of the field trip, students will be taking a look at plankton biodiversity. They will look at samples of pond water under a microscope. They can also sample plankton two different ponds and compare the samples.

The pond water will contain plankton that has been collected using a specialized plankton-net. The net has very tiny holes, and will filter a large volume of water, concentrating the plankton in the collecting jar at the bottom of the net.



GOAL

Students will develop skills using the microscope and improve their powers of observation by drawing and identifying pond plankton. They will also explore the role of plankton in the aquatic food web, and look for evidence of biodiversity in their samples.

OBJECTIVES

The students shall:

1. Correctly use the plankton tow net to collect a sample of pond or stream plankton.
2. Correctly prepare a microscope slide with a plankton sample.
3. Draw, identify and label the plankton in their sample.
4. Use reference books to look up and summarize the feeding habits of their plankton.
5. Diagram an aquatic food web using examples of plankton they have sampled.

VOCABULARY

Plankton – microscopic, free floating aquatic organisms

Phytoplankton – plankton that contain chlorophyll and carry on photosynthesis

Zooplankton – plankton that are classified as animals or protists.

Flagellum – long, whip-like appendages that are used for locomotion by certain zooplankton .

Protista – One of the five kingdoms of life. Members of this kingdom are usually tiny one-celled organisms or multi-cellular colonies. They are sometimes called protists. Certain members of this kingdom have the ability to carry on photosynthesis and are commonly referred to as algae. Some protists have the ability to move via flagellum or tiny hair-like cilia.

MATERIALS

--Plankton Data sheets from the field study log book

--Collection jar
--Field microscopes
--Lens wipes
--Microscope slides
--Pencils
--Pipettes
--Plankton field guides
--Plankton net
--Protoslo
--Plankton net
--Sample bottle
--Slide covers

ADVANCE PREPARATION

- ✓ Run off copies of aquatic field study log books
- ✓ Gather plankton field guides (see “Resources” section of this lesson for suggested guides)
- ✓ Gather field collection and lab materials
- ✓ Make sure all materials are clean and ready to go.

PROCEDURES – Outline and Narrative

1. Explain how to use the plankton net.

There are several important points to keep in mind when using the plankton net. First, the net has a very fine mesh and is quite expensive, so care must be taken to avoid puncturing or tearing it. Second, the net has a long rope/line attached to it so that it can be thrown or lowered into the water and then retrieved. Care must be taken so that the line does not become tangled. Also, make sure students hold onto the end of the line while throwing the plankton net so that they don't lose it in the water.

Plankton live in the part of the water column that can be penetrated by light. The object is to pull the plankton net through as large an area of surface water as



possible. When students throw the net, they should be careful not to hit anyone with it or bash the net against a nearby bush. Also, watch out for sticks and rocks protruding from the pond or stream bottom that can snag and tear the net.

The plankton will collect in the sample bottle at the end of the net. You can empty the bottle into a collection jar in order to take additional samples.

Here are step-by-step instructions for using the plankton net:

1. Coil the rope that is attached to the net into a few loose coils.
2. Hold the plankton net in one hand, and the looped end of the rope and your coils of rope in the other.
3. Toss the net and rope coils out across the water so that the coils of rope uncoil smoothly (this may take some practice throws).
4. Wait a few seconds to let the net sink just below the surface, then gently pull the net towards you.
5. Before you pull the net up out of the water, hold it vertically in the water, then shake it gently as you pull it up out of the water, to shake the plankton down into the collecting jar.

2. Familiarize students with plankton types

Prior to observing actual plankton, students should take a moment to

familiarize themselves with the various types of plankton they might find. They should look through the field guides and sample posters available at the arboretum. Students can also do research on plankton prior to the field study and bring sample pictures along with them. (See the “Resources” section of this lesson for research references.)

3. Create plankton sample slides

- a) Use a pipette to collect a drop of water from the collection jar containing some of the plankton. Taking the sample from the top, middle or bottom of the jar will result in getting different types of organisms. Students can use a hand lens or just look to see where there might be a collection of organisms in the jar. Many of the organisms are translucent and can be observed moving about if the jar is examined under good light.
- b) Place the water drop on a microscope slide. At Graver Arboretum students will use special deep well plastic slides with plastic covers. Students can also use slides with concave depressions or flat slides with a small ribbon of clay or Vaseline on the sides used to create a well for the water drop. Students may want to use a drop of “protoslo” mixed in with the sample, to slow the organisms down and make them easier to observe. Cover the drop gently with a cover slip so as not to create bubbles in the sample.
- c) At Graver Arboretum, students will use field microscopes with 10X magnification. Students may also bring the water sample back to the lab and use the compound microscopes. In this case, the 10x and 40x lenses will

be used only, since the concave slides do not lend themselves to the higher power magnification. In either case, strong light is necessary for clear viewing of the details of the plankton. Make sure students have the light switched on and focused when using the scopes in the lab. Outside, the prism on the field microscope should be directed towards the light. Students should not stand in front of the prism or they will block the light.

- d) Students should begin by bringing the slide contents into focus using the 10x magnification. Once the slide is in focus, they should very slowly move the slide along the microscope stage in order to search for plankton. The microscopes in the laboratory have a pointer on the stage that serves as a “landmark” to help students identify the location of the plankton they are seeking to observe.

4. Draw and identify plankton

- a) Students should draw as many types of plankton as they can observe. The phytoplankton are usually easier to spot, since they can't move out of focus. Because they contain chlorophyll and other color pigments, phytoplankton have characteristic green or olive brown coloring. Many of the zooplankton will appear translucent. Zooplankton will often hide behind pieces of detritus—(decaying pieces of vegetation).
- b) Students should use field guides to help them identify the plankton and determine what it eats. Field guides are available on loan from Muhlenberg College. Check the “Resources” section of this lesson for

additional field guide suggestions and references.

5. Clean up microscope area and slides

Students should be careful not to break or scratch the microscope slides. They should be rinsed with warm soapy water and dried with Kim wipes, not paper towels! Students should also wipe off any spills on the microscopes, taking care not to scratch the lenses.

6. Diagram a plankton food web.

- a) Show students a copy of the Pond Food Web diagram. Explain that the food web of the pond depends on the energy inputs from the sun, and the nutrients from the land that get washed into the pond. Other factors that influence the pond food web include the availability of oxygen and the temperature of the water. Different plankton flourish during different seasons, just as different plants and animals on land can be observed during different seasons.
- b) Ask the students to create a similar food web diagram in their log books, depicting the plankton and zooplankton that they have just observed, with lines showing the connections between the parts of the web. Students may have to further use the field guides to determine the role that the various plankton plays in the food web—which ones are predators or omnivores, or decomposers. They may also include in their food web small fish or macro-invertebrates that they have observed during other parts of their field study.

- c) If there is time at the end, ask the students what would happen if large amounts of nutrients entered the pond from land areas in the pond watershed? What effects would more nutrients have on algae growth? How could that affect the other members of the food web?

Note: Although students may think lots of algae would be good for the food web, often times excessive algae growth causes ponds to be depleted of oxygen. The decaying algae is preyed upon by large numbers of bacteria, which use up lots of oxygen to carry out their respiration. Furthermore, during times when there is no light, plants also carry on respiration, further depleting the pond of its oxygen, which in turn causes more death and decay, and more oxygen depletion.

copy of this publication, go to [<http://www.fish.state.pa.us>] and click on “Education/Educational Resources Catalog.” Click on “Critters” and scroll to “Phytoplankton.”

Richardson, Carl. *Zooplankton*. Pennsylvania Fish and Boat Commission. To obtain a PDF copy of this publication, go to [<http://www.fish.state.pa.us>] and click on “Education/Educational Resources Catalog.” Click on “Critters” and scroll to “Zooplankton.”

There is a materials order form on the PA Fish and Boat Commission’s Web site that can be copied and sent in to the main office in Harrisburg, or you can call your local Aquatic Resources Program Specialist for the Southeast Region, 717-626-9081 to obtain advance color copies of these publications.

Optional Extension

Teachers can do the activity “Sinking Slowly” found in the *Living in Water* curriculum. See “Books for the teacher” section of the lesson for details.

Books for the teacher:



Council for Environmental Education. *Project WILD Aquatic: K-12 Curriculum and Activity Guide*, “Micro Odyssey,” 2000.

ASSESSMENT

- Aquatic field study log book--plankton pages
- “Create a Plankton” worksheet

National Aquarium of Baltimore. *Living in Water*, “Sinking Slowly.” Kendall/Hunt Publishing Co.: Dubuque, Iowa, 1997.

Books for the teacher and students:

RESOURCES



Flyers:

Richardson, Carl.
Phytoplankton. Pennsylvania

Fish and Boat Commission. To obtain a PDF

Loewer, Peter. *Pond Water Zoo*. New York: Atheneum Books for Young Readers, 1996.

Needham, James G. and Paul R. Needham. *A Guide to the Study of Fresh-Water Biology*. New York: WCB McGraw-Hill, 1962.

Books for the teacher & students continued:

Rainis, Kenneth G., and Bruce J. Russell. *Guide to Microlife*. Danbury, CT: Franklin Watts, 1996.

Reid, George K, and Zim, Herbert S. *Pond Life: A Guide to Common Plants and Animals of North American Ponds and Lakes (Golden Guide)*. New York: St. Martin's Press, 2001.



Web sites: Since the Web is constantly changing, check Muhlenberg's Outreach Web site for updated listings. [<http://www.muhlenberg.edu/cultural/graver/>]

4.3.7 Environmental Health

C. Explain biological diversity.

4.6.7 Ecosystems and their Interactions

A. Explain the flows of energy and matter from organism to organism within an ecosystem.

4.7.7 Threatened, Endangered and Extinct Species

A. Describe diversity of plants and animals in ecosystems.

Web sites for the teacher and students:

Microscopy UK – Main Menu

[http://www.microscopy-uk.net/full_menu.html]

This is one amazing Web site! A nonprofit entity, run by microscopy enthusiast dedicated to the study of the very small world. Among the many free resources available here include: a monthly magazine called "Micscape" with an index to all past issues, the "Micropolitan Museum," microscope tutorials and microscopy primers, videos, pictures galore, a "Pond Life Identification Kit," a "Virtual Pond Dip," biology information, cells, recent discoveries, and much more!

STATE STANDARDS FOR ENVIRONMENT AND ECOLOGY

4.1.7 Watersheds and Wetlands

C. Explain the effects of water on the life of organisms in a watershed.


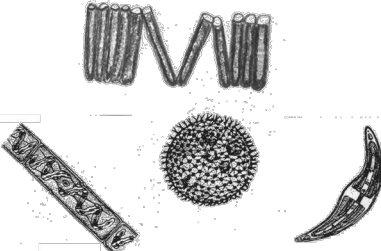
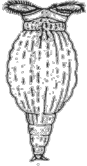

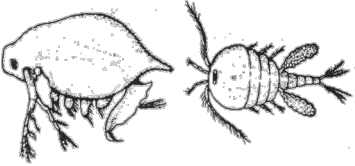

Lesson 3 – Appendix



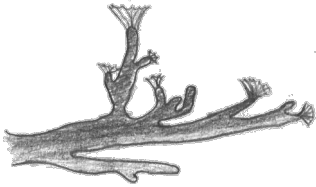

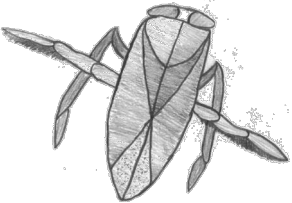
Copy Masters for:

Plankton Identification Guide
Pond Food Web Diagram
Create a Plankton

Plankton Identification Guide

Group	Picture	Key Features
Protozoa		single celled, with tiny hairs or pseudopodia
Algae		single celled, mostly green, sometimes yellow-brown
Rotifers		wheel-like, hairy appendages, transparent, free swimming or attached 0.2 - 1 mm
Worms		long thin body, many non related forms
Arthropods		jointed limbs; many groups e.g. crustaceans ('water fleas'), mites
Water bears (Tardigrades)		8 stumpy legs, slow moving <1 mm

Plankton Identification Guide-cont.

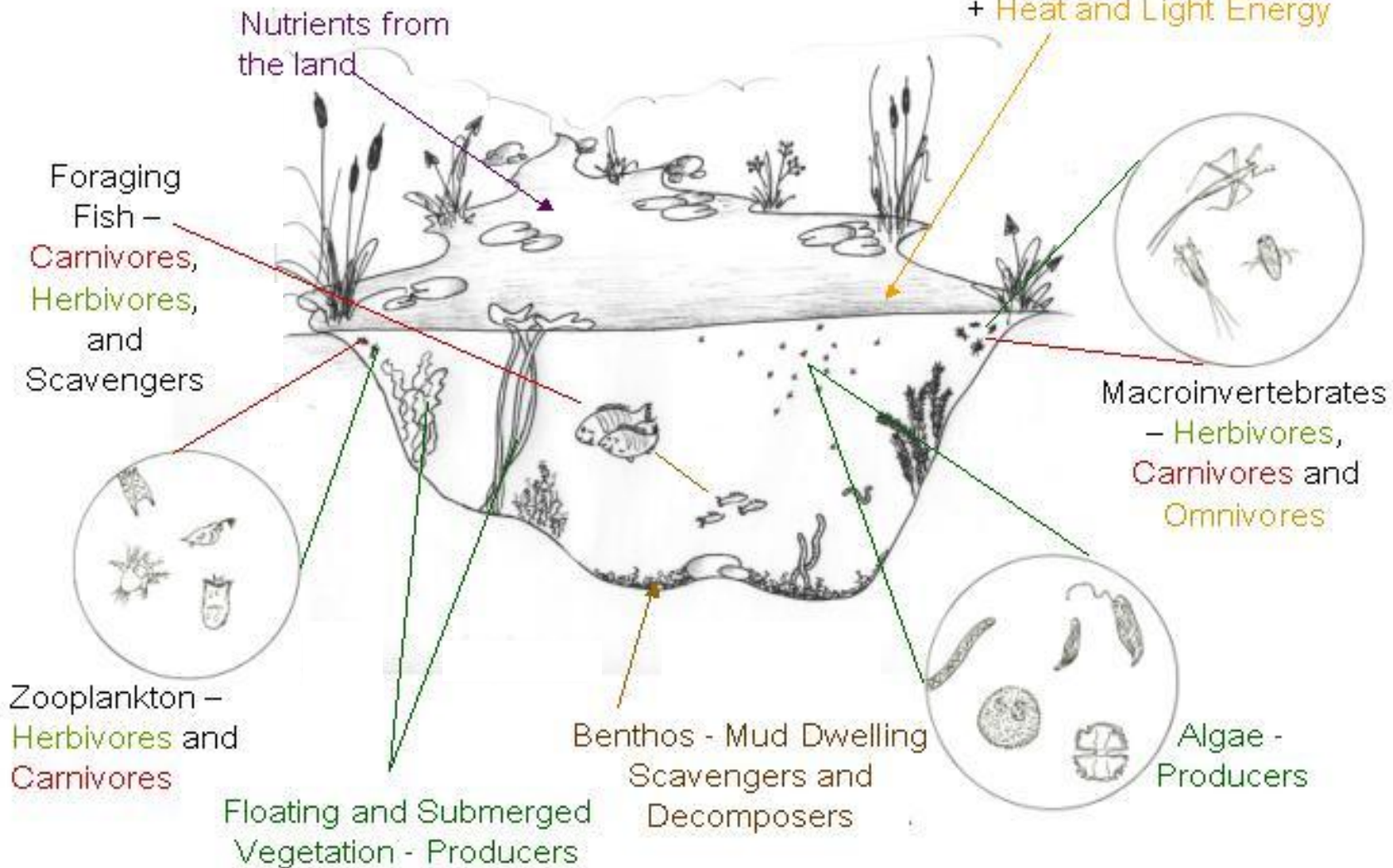
Group	Picture	Key Features
Bryozoa		plant-like or jelly-like colony, crown of tentacles individuals: 0.25 - 5 mm
Hydra		green brown or colorless, body and tentacles contract and stretch extended: 20 mm
Other Arthropods: <u>Insect stages</u>		wide variety of forms

This guide is adapted from “Pond Life Identification Kit,” *Microscopy UK*, by Wim van Egmond and Dave Walker found at [http://www.microscopy-uk.net/full_menu.html].

Note: This guide does not cover larger pond organisms. For a macroinvertebrates guide, refer to the Pennsylvania Fish and Boat Commission Web site – [<http://www.fish.state.pa.us>], click on “Publications,” category “Crittters.”

Aquatic Food Web

Oxygen, Carbon Dioxide,
+ Heat and Light Energy



Illustrations by *Jamie Bueschler*

Create a Plankton

Your name: _____



If it makes food from the sun—
Color your shape green.

Describe the chloroplasts of the plant cell.

Begin by drawing a shape inside the circle.

How will it eat?



If it catches other plankton—
Give your shape a mouth.

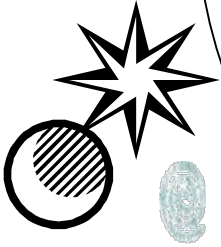
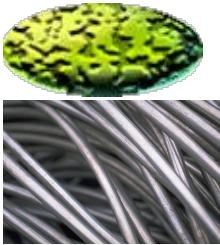
How will it catch them?

Draw chloroplast shape
Circular, crescent, blobs, oval, stringy, or fan-shaped.

How are they arranged?
Stacked, unstacked, spiral, scattered.

Entangles and engulfs them
Draw filaments, stinging & sticky hairs, bristles.

Chases and catches them
Draw eyes, claws, gills, antenna, limbs, mouth parts.



Will it Float?
Draw wings, filaments or shapes to help it.

OR

Will it Swim?
Draw cilia or flagella to help it.

Check one box

Your plankton's name is:
