LIFE IN A DROP OF WATER

By: Adrienne Steele

There are many forms of life you can see in a single drop of pond water. Examining water from a pond, lake, or ditch with the **Scope-On-A-Rope (SOAR)** can be a great introduction to the classification of organisms and is sure to generate an appreciation of the diversity of life! These activities can be modified for most grades and ability levels.

Objective

To introduce students to the myriad of life forms on Earth. This lesson can be used in conjunction with a unit on ecosystems, adaptations, or classification of organisms.

The following **National Science Education Standards** are just a few that are addressed by using SOAR with these activities.

SCIENCE AS INQUIRY: CONTENT STANDARD A

K-4:

- Ask a question about objects, organisms, and events in the environment
- Employ simple equipment and tools to gather data and extend the senses
- Understandings about scientific inquiry (simple instruments, such as magnifiers, provide more information than scientists obtain using only their senses)

LOUISIANA GRADE LEVEL EXPECTATIONS

SCIENCE AS INQUIRY

Gr. Pre-K: 3, 8	Gr. K: 4, 10	Gr. 1: 1, 5, 11
Gr. 2: 1, 6, 8, 12	Gr. 3: 1, 6, 8, 15	Gr. 4: 1, 7, 9, 17

LIFE SCIENCE

Gr. Pre-K: 24	Gr. K: 24, 25	Gr. 1: 26, 32, 34
Gr. 2: 27, 30, 35	Gr. 3: 35, 38, 39	Gr. 4: 41, 48, 53

References

1. Annenberg/CPB Website. Life Science, Session 2: “Classifying Living Things” http://www.learner.org/channel/courses/essential/life/session2
2. Reid, George K. *Pond Life*. St. Martin Press. New York: 2001.
3. www.microscopy-uk.org.uk/index.html (click on the “Pond” tab at the top of the page)

This work is supported in part by a grant to Louisiana State University from the Howard Hughes Medical Institute through the Precollege and Undergraduate Science Education Program.

A Little History: The "Discovery" of Microorganisms

Before the invention of the microscope, people did not know the diversity of life that existed hidden from view. Protozoans, bacteria, viruses were just some of the organisms that affect people (for better and for worse), but cannot be seen with the naked eye. Although many scientists built compound microscopes as early as the 16th-17th Century, one stands out as the "Father of Microbiology" – Anton van Leeuwenhoek. He was unschooled in science, but he was a keen observer and taught himself how to grind lenses that could magnify items over 200 times! (The compound microscopes used by Hooke and Galileo did not achieve magnifications nearly this great.) Leeuwenhoek's simple microscopes allowed him to see the first single-celled animals, which he dubbed "animalcules". He discovered protozoans, bacteria, blood cells, and much more!

In order to explain what he was seeing to other scientists and people at the time, he had to come up with a frame of reference. The smallest thing he could think of that a person could see with the naked eye, and that would be familiar to most everyone in the 1600's, was the eye of a body louse. He used this measurement to tell people how small his organisms were. Some microorganisms he observed were more than 1,000 times less in size than a louse eye!

Leeuwenhoek introduced a whole new idea in science – that unseen critters could be the cause of disease and other maladies. He paved the way for modern medicine. This is a great example of how the development of a technological tool has altered the way we interact with the world.

Check out these websites for more information on Anton van Leeuwenhoek:
www.microscope.org/micro/sm101.htm
www.ucmp.berkeley.edu/history/Leeuwenhoek.html

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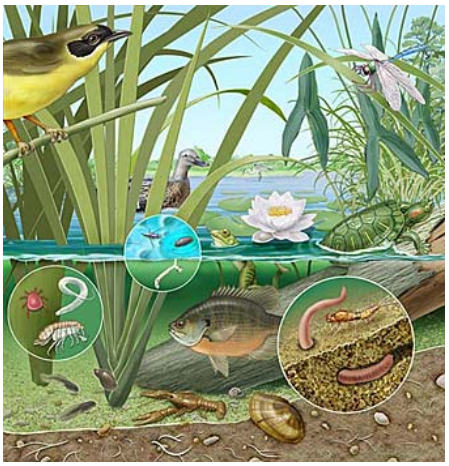
Water Collecting Tips



Locate a body of water that you would like to sample; this can be a pond, lake, ditch, stream, or large puddle. For comparison studies, collecting water from several locations is ideal. You may want your students to bring in their own water samples.

Look for signs of life, such as algae, plants, and animals. Use a scooper (such as a large soup ladle) to collect a sample of water. Make sure to collect plants (tongs work great for this purpose), especially algae, and get a couple of scoops off the bottom. A good water sample has lots of green (plants) and some brown (dirt/substrate). This is because different organisms live in different microhabitats in the pond.

Water samples can be stored in any type of container; I recycle plastic food tubs. **Be sure not to leave a lid on your container for very long!** Organisms need oxygen to survive. You can keep this water sample for a few weeks or more if there are enough plants to produce oxygen and it gets some light. You will find that the array of organisms found in the sample will change over time.

*For detailed instructions on setting up your scope, download the *User's Guide* from the SOAR website: www.scopeonarope.lsu.edu

Setting Up SOAR to View Aquatic Samples

There can be a wide range of sizes of the organisms you collect. It's best to start by viewing and identifying the larger organisms first, then move on to the smaller, microscopic organisms. This will help your students gain an appreciation of magnification and scale.

A. "1x" Investigations

1. Look through your water sample(s). Can you see anything relatively large? Anything over a couple millimeters long can be spotted with the naked eye. Use magnifying lenses, if desired. Try pouring your sample into a larger, shallower dish if you need to get a better look. Examples of large organisms include fish, water insects and their larvae, and snails.
2. Try to capture a few of these animals and isolate them in smaller vials. You may be able to simply scoop them up into the vial, or you can use a small net or a spoon. Students may have fun doing this.
3. Put the SOAR in the **1x stand-and-view** set up. (See photo at right & the *SOAR User's Guide*.)
4. Have students try to identify each organism collected. Use the *Macroinvertebrate Key* (from the SOAR website) and the clues/websites listed below. This can be a good opportunity for older students to learn or to practice their knowledge of classification.
5. **Encourage and ask questions**: Is it a plant or animal? Does it have legs? How many? How does it move/swim?

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B. “200x” Investigations

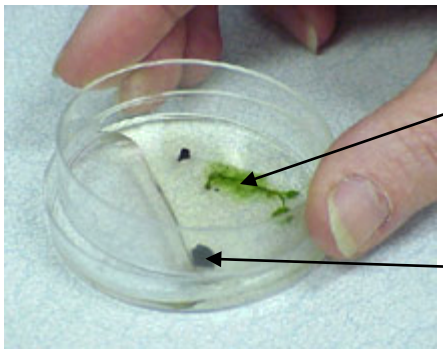
Now it’s time to investigate the tiny organisms that are not visible (or barely visible) with the naked eye. Before viewing a water sample, it’s important to make sure your students understand what the scale of things they are seeing at 200x by figuring out the field of view.

What is the field of view of the 200x lens?

1. Begin by asking students to visualize how big a millimeter is (or ask them what is the smallest unit they can measure). Magnify a ruler with the **30x lens** to see how many millimeters fit across the screen; this is the field of view of this lens.
2. Try scoping some common objects that students think may be a millimeter long/thick and measure them with the 30x of SOAR. You can press REC too take a picture of the ruler, then press REC again to take a picture of the item you want to measure. Press PLAY three times to see both items on a split screen. You can also make a millimeter grid using a transparency (see the *Measure Up* activity on the SOAR website). Examples of common objects that are about 1mm are the tip of a ballpoint pen and the width of a dime.
3. With the **200x lens** on the SOAR, scope this same millimeter ruler. What do you see now? The field of view with this lens should be about one millimeter! This means that everyone you see at one time with the 200x lens could fit on the tip of a ballpoint pen! Use this activity as a reminder when viewing water samples at 200x – the field of view is VERY SMALL and any critter that fits on the screen must be less than a millimeter long!

Preparing a 200x aquatic slide:

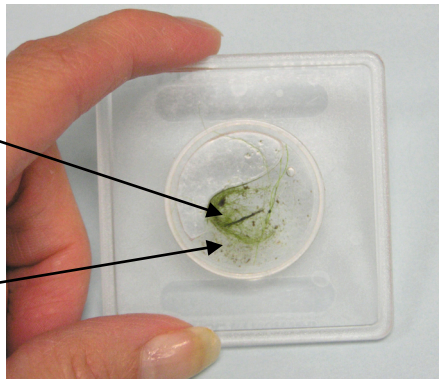
4. Remembering that you can only see about one square millimeter at a time with the 200x lens, you should only look at very small samples of water at this magnification. There are two good ways to prepare an aquatic sample for viewing with the 200x—you can use a **small Petri dish** or a **deep well slide**. If using the Petri dish, place the sample inside the lid of the dish, then “sandwich” the bottom on top to make a slide.



Petri dish “sandwich”

Include a little bit of “green stuff”

…and a little bit of “brown stuff” from the bottom



Deep well slide

5. Once you’ve prepared your sample, set up the SOAR in the **200x invert-and-view** configuration (see image below left with instructions) or use the **XYZ stage** (see image below right and refer to the *User’s Guide* available for download from the SOAR website).

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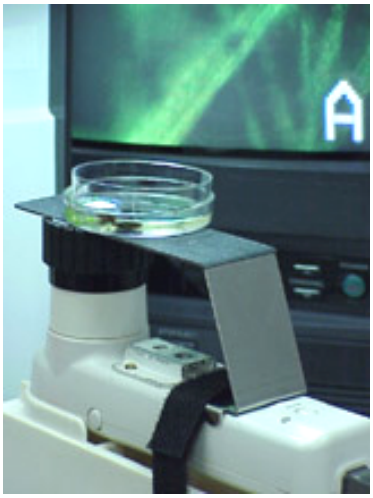
6. View samples by placing slides/dishes on the stage. You may have to focus the lens quite a bit to see through the plastic of the dish and into the water.
7. You will also need to use the **lamp** to give you more light. You can move the lamp closer to or farther away from the scope to give you the image that looks best (dark-field or bright-field).
8. Move the dish around until you see something that looks interesting. Leave it in one place for a while and watch closely as organisms swim on and off the screen.



200x Invert-and-view Set Up (at left)

1. Place the scope, facing up, in its cradle.
2. Put the black collar over the 200x lens.
3. Place the metal stage over the scope, with the hole over the lens tip and the prongs fitting into the groove on the collar.
4. Velcro the stage in place so you have a stable working surface.
5. Place the sample on top the stage, and focus the lens by turning the collar.

XYZ Stage (at right)

1. Slide scope into the metal fitting and lower the stage over the lens.
2. Use the silver knobs to adjust the focus and to move the sample in an X-Y plane.

Identifying Organisms with SOAR

Refer to the ***Macroinvertebrate Key*** for assistance in identifying aquatic organisms (available on the SOAR website). There several good websites with identification keys, here a few examples:

http://www.microscopy-uk.org.uk/index.html
http://www.silkentent.com/gus1911/RonPond.htm
http://micro.magnet.fsu.edu/moviegallery/pondscum.html
http://microscope-microscope.org/applications/pond-critters/pond-critters.htm

Other good identification guides include:

1. Rainis, Kenneth G. and Bruce J. Russell. *Guide to Microlife*. Franklin Watts. Connecticut. 1996. (extensive guide to identifying everything, with keys)
2. Reid, George K. *Pond Life*. St. Martin Press. New York: 2001. (kid-friendly)
3. Voshell, J. Reese, Jr. *A Guide to Common Freshwater Invertebrates of North America*. McDonald & Woodward Publishing Co. Virginia: 2002. (for identifying different types of insect larvae and snails)

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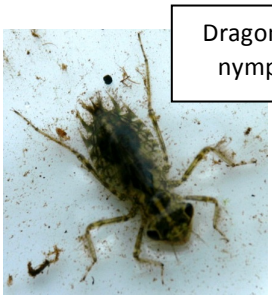
A. Common "large" aquatic organisms found in Louisiana include:


Dragonfly nymph

- Crawfish
- Snails
- Mosquito fish (*Gambusia spp.*, sometimes referred to as "minnows")
- Insect larvae (look for legs to distinguish from worms!)
  - **Dragonfly nymph** = spider-looking, stout body with six long legs
  - **Damselfly nymph** = long and slender with three feathery gills on tail
  - **Caddisfly larvae** = worm-like with tiny legs that live in mobile homes they build out of debris found in the pond
  - **Mosquito larvae** = worm-like with feathery gills; they hang upside down from the surface of the water and jet quickly to the bottom when the water is disturbed
- Worms – can be flat, round, or segmented
- Amphipods = called "scuds" (shrimp-like crustaceans that are flattened sideways with many legs; they swim very fast through the water and usually hang out near algae)
- Water bugs = e.g. water striders, water boatmen, backswimmers, and whirligigs

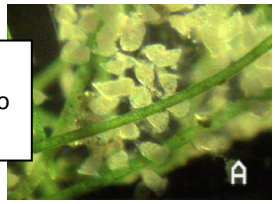

"Scud"

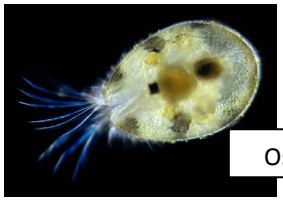
B. Common "small" organisms (best viewed with 200x) include:

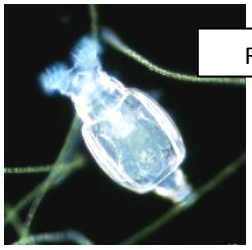
- Protists – can be plant-like (green) or animal-like (called protozoans)
  - **Algae** = long green strands of hair-like plants sometimes found clumped in mats
  - ***Stentor* and *Vorticella*** = tiny bell-shaped animals that attach to plant matter and filter feed using cilia around their body opening
  - ***Paramecium*** = oval-shaped ciliate that moves in a zig-zag pattern (backwards & forwards)

- Crustaceans
  - **Ostracods** (seed shrimp) = they move very fast and look like seeds with two halves
  - **Water fleas** (*Daphnia*) = look like little fleas with clear body, eye spot, and external gills
  - **Copepods** = small, one-eyed crustaceans that swim with jerky movements; females can have two egg sacks that hang off the body on either side

Vorticella attached to algae




Ostracod


Rotifer

- Other members of the Kingdom Animalia
  - **Hydra** = tubular, cylindrical animal with tentacles; usually attached to substrate
  - **Rotifers** = small, multicellular organisms with a ring of cilia around their mouth and a "foot"
- Bacteria = most bacteria are too small to view with 200x; the larger ones are the smallest organisms barely visible in the shape of dots, rods, or corkscrews

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Pond Water Observations

Date _____

Name _____ Class _____

Draw an animal or plant in each box and describe what it looks like, how it moves, and what you think it might be.

Organism #1

What does it look like? _____

_____

_____

Does it move? How? _____

_____

_____

What is it? _____

Organism #2

What does it look like? _____

_____

_____

Does it move? How? _____

_____

_____

What is it? _____

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