WRAP-UP

To wrap-up the investigation, bring your students together for a group discussion to help them understand why and how they achieved their results. It is important to share results so that everyone has a clear picture of what happened. To help you facilitate the discussion, review the explanation in "The Why and The How" using the Group Discussion questions as a guide.

GROUP DISCUSSION
Explain to students that scientists learn from each other through discussion, and they build upon the work of others to make new discoveries. Just as scientists come to conclusions based on the findings of their experiments, students will now come together as a group to share their results and make conclusions about the investigations they've conducted. Have students record their final results and the explanation in their journals.

- What happened to your ecosystem?
- How did it change over time?
- How did your result compare to the results of other groups?
- What surprised you?

The "Why" and the "How"
Your students have created a small-scale aquatic ecosystem. If properly cared for, the ecosystem should last for some time. Every **element** plays a valuable role in the **ecosystem**.

Duckweed, also known as Lemna, is a green floating plant. Each individual plant looks like a miniature lily pad and only grows to be a few millimeters in length. Duckweed serves as a source of food and oxygen for organisms in the ecosystem.

L. catebeianus (Bullfrog) covered in duckweed

Elodea, also known as Waterweed, is a stalk-like freshwater plant. Elodea lives entirely underwater, except for small white flowers that grow at the surface. Elodea serves as a source of both food and oxygen within the ecosystem.

E. canadensis (Elodea)

References:
www.eduref.org/cgi-bin/printlessons.cgi/Virtual/Lessons/Science/Ecology/ECL0014.html
www.ucmp.berkeley.edu/glossary/gloss5/biome/aquatic.html
www.epa.gov/bioindicators/aquatic/freshwater.html
www.lawrencehallofscience.org/foss/fossweb/teachers/materials/plantanimal.html
www.fws.gov/pantherswamp/images/BULLFROG%20IN%20DUCKWEED.jpg
www.epa.gov/owow/invasive_species/invasives_management/images/brazilian-waterweed.jpg
www.fws.gov/pantherswamp/images/BULLFROG%20IN%20DUCKWEED.jpg
www.epa.gov/owow/invasive_species/invasives_management/images/brazilian-waterweed.jpg

Water snails are **gastropods** which have spiral shaped shells that grow with them. They have soft muscular bodies. The part of the snail's body that sticks out of the shell is known as the foot. The snails eat algae as they crawl.

Guppies are small fish that give birth to live young. Females are typically gray or brown in color and are larger than the males. Males are smaller, have longer tails, and are usually more colorful than the females. Guppies breed frequently, and may give birth in the bottled ecosystems. The parents may eat their young after they are born, so it is important to have Elodea in the bottled ecosystems for the babies to hide.

Care Tip:
When you receive your guppies, place the unopened bag into an aquarium of dechlorinated or spring water for about 15 minutes to equalize the temperatures. Use a dipnet to transfer fish from the bag to the aquarium of dechlorinated/spring water containing Elodea and Duckweed. Feed the guppies a small pinch of fish food every day. If any of the guppies die, remove them from the ecobottle and dispose of them.

CAUTION:
Never release any organisms from the ecobottles into the environment, as they may disrupt the local ecosystem! If you cannot keep the ecobottles, try to find them a new home. If a suitable home cannot be identified, put the organisms in a plastic bag with a small amount of water and place them in the freezer. This will cause them to enter hibernation and then expire.

Curriculum Match-Up

- Take pictures of the ecosystems at each observation and create a book or webpage.
- Create a table for the data collected.
- Create line graphs for the changes in water clarity, water temperature, plant growth and animal populations.
- Make a double bar graph comparing the number of animal populations at the beginning and at the end of the activity.

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Freshwater Ecosystems

Learning Objectives

Students will:

1. Identify the biotic and abiotic elements of a freshwater ecosystem.
2. Build a freshwater ecosystem.
3. Students will describe how a freshwater ecosystem changes over time.

Vocabulary Ventures

abiotic
biome
biotic
duckweed
ecosystem
elodea
freshwater regions
guppy
marine regions
water snail

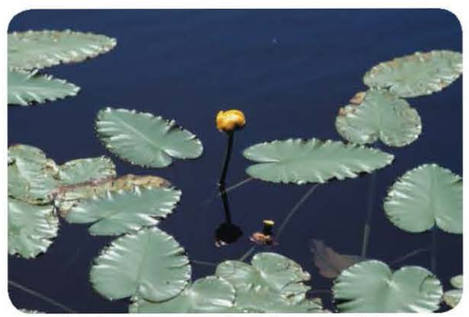
Have you ever wondered about all of the aquatic (water) habitats around our planet? How are they different? What do they have in common? How are they important to life on Earth?

The Earth's environments are organized into five **biomes**, which are areas of the planet that share a similar climate, plant life and animal life. These include the desert, tundra, forest, grassland and aquatic biomes. The aquatic **biome** is the Earth's largest, covering 75% of the planet.

The aquatic biome can be divided into two regions, **freshwater** and **marine** (saltwater). The freshwater regions include ponds, lakes, rivers, streams, wetlands, reservoirs and groundwater. Freshwater regions make up less than 1% of all the water on Earth. Most of the freshwater on the Earth can be found in the polar ice caps. Freshwater regions provide most of our drinking water supply.

freshwater lake

Freshwater regions are host to very unique ecosystems. An **ecosystem** is a community of living organisms and the nonliving things in an environment. The living elements are known as **biotic** and the nonliving elements are known as **abiotic**. Plants and animals living in freshwater habitats have adapted (adjusted) to these environments and would usually not be able to survive in water with higher salinity. Almost half the fish on Earth live in freshwater ecosystems.



freshwater pond with water lillies

Time Needed to Conduct Investigation
This investigation has three parts.
Organize and set up materials: 20 – 30 minutes
Introduce the lesson: 10 minutes
Conduct the investigation: 30 minutes
Student journaling/group reflection: 10 – 15 minutes
Total estimated time: 70 – 85 minutes

Investigation:
Freshwater Ecosystem in a Bottle

Materials

For groups of three or four
Student journals and writing tools

- Dip net
- Dechlorinated or spring water
- Large aquarium containing guppies, snails, Elodea and Duckweed
- Small containers for offspring
- Hammer
- Nail

Part 1
- Colorless, rinsed 2-liter soda bottle (label removed)
- Colorless, rinsed 2-liter soda bottle with air holes poked in the bottom (label removed)
- Dechlorinated tap or spring water
- Markers
- Scissors
- Masking tape
- Sand (rinsed with plain water)
- Three Elodea plants
- A scoop of Duckweed
- Thermometers

NOTE: Rinse soda bottles and sand with plain water.
Use a hammer and nail to create holes in the bottom of one of the two soda bottles that will be given to each group.

Part 2
- Two Water snails in a 16 oz clear plastic cup of dechlorinated water
- Two Guppies in a 16 oz clear plastic cup of dechlorinated water
- Fish food

Part 3
- Magnifying lenses
- Thermometers

TIP
To dechlorinate tap water, pour water into a bucket or container with a large opening and let sit for at least 24 hours.

NOTE: Background information and care instructions for each organism are found at the end of this lesson. Upon receipt, rinse all living materials with dechlorinated tap or spring water and place immediately into an aquarium away from direct sunlight. The aquarium serves as a storage and observation tank until students make their own ecosystems.

Part 1
Setting the Stage

GET READY!

BRAINSTORM
Share with students that the aquatic biome is divided into freshwater and saltwater regions. Ask students to brainstorm and list some different bodies of water that they know. Record their responses on a flipchart or chalkboard. Ask students to identify which of these are freshwater.

Next, ask students if they know what an ecosystem is. If not, provide students with the definition. *Answer: An ecosystem is a community of living organisms and the nonliving things in an environment.* Ask students to brainstorm what they know about freshwater ecosystems:
- What is the water like in a freshwater ecosystem?
- What types of animals would you find?
- What kinds of plants exist in a freshwater ecosystem?

PROCEDURE

Inform students that they will be making a small freshwater ecosystem in a bottle. Ask students to share some of the elements they think would need to be included in a freshwater ecosystem (e.g. animals, plants, water, oxygen, sunlight etc.).

1. Have students use their markers to draw a line around the circumference of the soda bottle without holes two or three centimeters from the curved top end of the bottle.
2. Next, have students draw a line around the circumference of the bottle with holes two or three inches from the curved bottom end of the bottle.
3. Students should then cut along each line with a scissor.

TIP
If students are having difficulty cutting the bottles, help them create the initial puncture with the pointed tips of the scissors. The cut-off top of the bottle can also be used as a funnel

4. Students should use the masking tape and marker to put their names on the bottle without holes. Explain to students that the bottom portion of the other soda bottle (with the holes) will serve as the lid to their freshwater ecosystem.
5. Students should fill the bottle without holes with 6 cm (2.5 inches) of sand.

6. Then, they should slowly fill the bottle two thirds of the way with dechlorinated or spring water, trying not to disturb the sand.
7. Students should plant their three Elodea plants securely in the sand at the bottom of the soda bottle.
8. They should then sprinkle their scoop of Duckweed on the surface of the water.

OBSERVE

Students should record the biotic and abiotic elements they added to their freshwater ecosystems in their journals.

Have students make observations about the Elodea plants and the Duckweed. Students should describe and draw each of these elements in their journals. Discuss a bit more about each of these plants with students. (See "The Why and The How" section.) Have students measure and record the water temperature of the ecosystem.

TIP
The bottles should be allowed to sit overnight to allow the sand to settle before proceeding to Part 2.


ecobottle set-up

Part 2
Adding Some Key Players

TIP
Students should always wash their hands before and after handling live organisms.

GET READY!

Students will add some additional biotic elements to their freshwater ecosystems. Remind students to use the student journal to document their predictions, observations and findings.

Ask students to observe their freshwater ecosystem bottles after they have been allowed to settle and record these observations in their journals. Have students measure and record the water temperature of the ecosystem.

OBSERVE

Distribute prepared cups of guppies and snails to students. Ask students to make the following observations about the water snails and the guppies in their cups:
- How does each organism look?
- How does each move?

Have students draw each of these organisms in their journals. Discuss a bit more about each of these organisms with students. (See "The Why and The How" section.)

PROCEDURE

1. Have students first add the two snails to the ecosystem using the nets, or by gently pouring them from the cups.
2. They should then add the guppies to the ecosystem using the nets, or by gently pouring them from the cups.
3. Ask students to observe how the snails and guppies behave when added to the bottled ecosystems and also record their observations in their field journals.
4. Next, have students place their bottled ecosystems in a well lit area, but not in direct sunlight.
5. Feed the guppies with a very small pinch of fish food every day.

Ask students to make and record the following predictions:
- What do you think will happen to your freshwater ecosystem over time?
- How do you think it will change?
- What do you think will stay the same?

Part 3
Watch What Happens

OBSERVE

Explain to students that they will be making the following observations about their ecosystems over the next few weeks:
- Has the color of the water changed? If so, how? Why do you think these changes occurred?
- Did you notice any change in water temperature? If so, how?
- Has there been any plant growth or changes?
- How did the organisms behave?
- Did any of the populations change?

Students should record and draw each observation in their journals.