High School Science Unit:
Interdependence of Organisms

Page references are for *Instruction for All Students* by Paula Rutherford

Unit Title: Interdependence of Organisms

Grade Level/Subject: High School Biology

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1st Oval: What should students know and be able to do?

On which content standard(s) will the students be working?

Standard 1: Achieve a solid base of scientific knowledge to make determinations about how the world works.

- **Benchmark** Students investigate and understand that atoms and molecules on Earth cycle among the living and non living parts of the biosphere.
  - Illustrate concepts of matter and nutrient cycling.
  - Explain how photosynthesis and cellular respiration are connected.
- **Benchmark** Students investigate and understand that energy flows through ecosystems in one direction from producers to consumers to decomposers.
  Illustrate food chains, food webs, and energy pyramids.
- **Benchmark** Students investigate and understand that organisms both cooperate and compete in ecosystems. This generates stable ecosystems.
  - Relate individuals, populations, communities, and ecosystems to each other.
  - Illustrate carrying capacities, limiting factors, and growth curves.
  - Give examples of predation, parasitism, commensalism, mutualism, and competition.
  - Compare biotic and abiotic features of terrestrial and aquatic biomes.
- **Benchmark** Students investigate and understand that human beings live in the world's ecosystems. Humans may change these ecosystems because of population growth and technology. Human destruction of habitats may make the world unsafe and cause permanent damage to ecosystems.
  - Identify with ways to deal with environmental problems like air pollution and overpopulation.
  - Describe how humans affect and disrupt ecosystems.

Standard 2: Apply science knowledge and processes to make informed decisions and to solve problems.

Benchmark Students use information about biology to generate possible solutions to real problems.

- Identify a problem or issue in a story or media article.

- Identify resources that could be applied to a situation.

Standard 3: Communicate scientific information effectively in several formats through a variety of resources.

- **Benchmark** Students access scientific information through a variety of media.
  - Locate and use information from paper and electronic references and the web.
  - Interpret graphs, charts, diagrams, and tables.
  - Read and interpret instructions to conduct experiments.
  - Use laboratory equipment to collect data.
- **Benchmark** Students express science knowledge and ideas orally, in writing and with computers.
  - Discuss information and points of view orally with peers and the teacher.
  - Construct graphs, tables, models, and charts to express information.
- **Benchmark** Students use speaking and listening skills in group collaboration.
  - Participate in group discussions on scientific topics.
  - Work collaboratively with a group to present scientific knowledge to peers.
  - Self assess to analyze effectiveness of group interactions.

Standard 4: Design and conduct a scientific investigation to test a hypothesis

- **Benchmark** Students define a problem to investigate.
  - Generate ideas from experimental study.
  - Make predictions based on prior knowledge.
  - Develop a hypothesis.
- **Benchmark** Students collect, organize and describe information to investigate problems.
  - Use experimental design to develop a model to investigate a problem.
  - Design a clear set of experimental procedures.
  - Select and use appropriate tools to collect, analyze, and display data.
- **Benchmark** Students analyze data, make inferences, and evaluate hypotheses
  - Determine trends and relationships from data.
  - Develop conclusions and further predictions from study.
  - Suggest improvements in the design of the study.

Standard 5: Make connections within science disciplines and with other disciplines.

- **Benchmark** Students understand the effect of chemical and physical principal on living things.
  - Explore the role of chemical principles in living things.
  - Discuss how biotic and abiotic factors influence living systems on Earth.
- **Benchmark** Students develop an awareness of the connections between science and math, social studies, and language arts.
  - Use principles of math to explore and understand principles of biology.
  - Use language arts to effectively communicate biological concepts
- **Benchmark** Students develop an awareness of the connections between science, technology, and society.

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- Explore technology to collect samples, take measurements, and communicate and retrieve data.
- Discuss the impact of scientific developments on the social and economic needs of society.

What are the big ideas, major themes, key concepts or essential understandings embedded in, or which transcend, the standards listed above? See pages 43-45.

Essential Understandings: Humans have developed incredible technologies that have allowed us to prosper more than any other species. However, even humans are part of the ecosystem in which they live and are thus a strand in the web of life. An ecosystem is fragile like a house of cards. If a card is removed, the system collapses. Our technological advancement has come at a great cost to the environment; we have removed many "cards." We cannot continue to damage our environment at the current rate and prosper as a species at the same time. We are reaching a critical "mass" of humanity and are beginning to exceed the supply of resources available to us.

Essential Questions:
- Given that the human race is increasing in number and consuming more resources, how do we balance our need for a certain quality of life with the need to maintain a healthy ecosystem?
- How can we as individuals and a society be responsible stewards of the earth?

Unit Questions:
- How is an ecosystem like a house of cards?
- What causes ecosystems to become unbalanced and how can the problem be fixed?
- What are the necessary components for a healthy ecosystem?
- Why are all of the earth's biomes important to us?

Students Will Understand:
- What an ecosystem is and how it functions.
- How all earth biomes are important.
- How humans have damaged the earth, why we must fix it, and how we can do this.

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2nd Oval: How will the students and I know when they are successful?

Determine which tasks/products would best demonstrate student understanding. Decide whether to use a rubric or a performance task and the criteria to be included. See pages 175-180.

Performance Tasks and Projects:

- **Biology in a Bottle:** Students will make a mini ecosystem in a two liter bottle. They will monitor their ecosystems during the unit and observe firsthand the ideas discussed. At the end of the unit, students will hypothesize how their ecosystems could be improved to become self sustaining.
- **Biome Profile:** Students will select a specific biome and develop a profile of it. They will assume the role of someone who lives in that biome and try to convince the United Nations not to use their biome as a nuclear waste dump. Students will select the biome towards the beginning of the unit and continue work on it throughout. As each concept is introduced, students can complete that segment of the portfolio.

Academic Prompts:

I have the students write these in a **learning log** and allow them to use it on the unit test.

1. Explore our ecosystem and make a list of biotic and abiotic factors.
2. Make a list of every species you can think of that lives in our biome (don't forget plants, fungus, etc). Turn this list into a food web.
3. Use the food web previously constructed. Choose a species in one of the layers and hypothesize how other organisms would be affected if that specie's population declined, and then hypothesize the effects from an increase of that specie's population.
4. Explain how photosynthesis and cellular respiration relate to each other. Explain why ecosystems are dependent on plants.
5. Describe the 5 types of interspecies relationships and give an example for each from the biome in which we live.
6. Explain how predators are essential to ecosystems. Discuss the problem of animal overpopulation in your county and suggest long term solutions.
7. After viewing the video **The Lorax**, hypothesize how the Oncelor could have done things differently so that he could run his business without destroying the local habitat
8. Discuss what happened in your mini ecosystem. Describe how you could change the design of your ecosystem to make it self sustaining.
9. Why are all biomes essential to our existence? Write a personal pledge of three things you will do to help protect the environment and conserve resources.

Quizzes:

1. Food Webs
2. Populations and Communities
3. Humans and the Environment

Tests:

To prepare students for standards-based exams, administer an objective test with questions similar to what they will see on the end of course tests. A potential accommodation is to allow

students to prepare a page of notes to be used on the test. Writing the page of notes guides studying and relieves some of the pressure of objective tests. Another alternative is to have students keep **learning logs** or living notebooks of the unit and allow their use on the test. Emphasize with students that being able to use the information to solve problems is the objective.

Self Assessment:
Students will self assess their biome profiles after completing the rough draft. Peer review is also a useful tool to increase the quality of the profile before it is submitted for the final grade.

What does a task analysis reveal about the skills, the knowledge, and the level of understanding required by the task? Include the task analysis with your unit. See pages 46-47.

Students will need to know:
- Related vocabulary such as ecosystem, biome, food web, food pyramid, producers, consumers, etc.
- 5 types of interspecies relationships
- Location, climate patterns, and common species of the major biomes on the planet
- How the major biomes are important to the global economy
- Difference between food chains, webs, and pyramids
- Difference between biotic and abiotic factors
- How photosynthesis and cellular respiration relate to each other
- What causes fluctuations in populations
- Examples of ways humans have negatively impacted the environment
- Examples of how humans can repair damaged environments and lessen their impact on the planet

Students will be able to:
- Translate list of organisms and what they eat into food webs and pyramids
- Predict how changes in populations of one species will affect another
- Interpret data collected from their bottles and identify ways to improve ecosystem design
- Effectively research a selected biome
- Sort research to identify important information
- Organize the research for an effective presentation
- Defend a position with factual information

3rd Oval: What learning experiences will facilitate student success?

Teaching and learning experiences that will equip students to demonstrate understanding:

1. Conduct the House of Cards introduction and follow up (see attached).
2. Introduce essential and unit questions and benchmarks to be achieved.
3. Present lesson on biotic and abiotic factors.
4. Tour local ecosystem and identify components.
5. Students build mini ecosystems (see attached).
6. Present lesson on biomes (students will watch clips from several videos and discuss types of biomes).
7. Students select biome for biome profile and begin research.
8. Present lesson on food webs (including food web video) and food pyramids.
9. Have students do academic prompt on webs and biomes.
10. Present lesson on nutrient cycling (includes photosynthesis and respiration).
11. Have students do "marshmallow molecules" activity and complete academic prompt. (See **Resource Guide for Biology 1 Adaptive Strategies**.*****)
12. Students add animals to upper level of mini ecosystem and begin monitoring water quality.
13. Present lesson on populations and communities (including inter species relationships video).
14. Have students do academic prompt on inter species relationships.
15. Have students complete a predation lab and complete academic prompt. (See Supplemental Lab Manual from **Biology: An Everyday Experience** or Chapter 3 in **Biology: The Dynamics of Life**.[*])
16. Have students watch the video **The Lorax** and complete the academic prompt.
17. Discuss how humans impact the environment positively and negatively.
18. Have students complete a pollution lab. (See Supplemental Lab Manual from **Biology: An Everyday Experience** or the **Resource Guide for Biology 1 Adaptive Strategies**.***)**
19. Have students complete the rough drafts of their portfolios and self assess.
20. Have students exchange portfolios for peer review.
21. Have students present their cases to the United Nations (the class).
22. At the conclusion of the presentations, group students with similar biomes (i.e. rain forests, oceans, tundra) together and have them create a statement of how this type of biome is critical to the global ecology. Students should post their statements around the room. The class will then take a gallery walk to view the statements on all the biomes.
23. Discuss with students that all biomes are critical to the earth's health and none are disposable.
24. Wrap up the unit by having students complete the final academic prompt on biomes and their personal pledges.

[*] Possible sources for labs are provided but most district-adopted texts should have the types of labs listed.

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What else might I do to provide challenging and meaningful experiences for both struggling and advanced learners?

Differentiation /Accommodations:

1. Include individual, small group, and whole class instruction in the presentation of lessons. Possible small group activities include **Jigsaw** and **Think-Pair-Share**. **Jigsaw** is especially useful for students who have difficulty with reading comprehension as it allows students to get all necessary material without reading an entire section. **Think-Pair-Share** is especially helpful for students who need processing time before responding to questions orally.
2. Construction of bottles can be done individually or in small groups to meet student needs. If your classes are small, have each student build a bottle so you have several bottles per class.
3. Provide multiple opportunities for vocabulary review (computer games, bingo, making flash cards) to help students master important vocabulary. Select vocabulary carefully and do not overload. This is crucial for ESL students.
4. Academic prompts can be completed inside or outside of class depending on the writing ability of the learners and their comfort level with the material. Challenged learners may need to write several prompts in class to receive guidance as needed. Advanced students should be able to write or at least finish writing prompts outside of class. Extra time generated by this could be used to shorten the unit or do additional labs to further explore concepts.
5. For the Biome Profile, give students the opportunity to work individually or in small groups. Give students some choice in the product to be presented. Possible products are listed on the student directions for the assessment. Advanced students should be able to complete most of the research and preparation outside of class. Challenged learners will need more guidance in research and assembly of the Biome Profile. Provide these students more time in class for these activities or hold after school work sessions. Students may be concerned about presenting their arguments live to the class; give them the opportunity to videotape all or part of their presentations.
6. For the unit test, allow students to prepare a page of notes to use during the test. Writing the page of notes guides studying and relieves some of the pressure of objective tests. Another alternative is to have students keep **learning logs** or living notebooks of the unit and allow their use on the test. Emphasize with students that being able to use the information to solve problems is the objective.

The following pages are attachments further explaining the tasks/projects on pages 4-7. These include directions and resources for teachers who wish to duplicate the unit.

Biome Profile

Activity Time: Quarter Project

Comments:

- This project is designed to be used as a performance assessment for Unit 5: Interdependence of Organisms.
- You may wish to have students work individually or in groups.
- Students will need time for research in and outside of class. Internet access can provide up to date information, especially for environmental threats.
- Provide students with a list of biomes from which to choose. Be sure to include terrestrial and aquatic biomes. You can specify location, for example, Atlantic Ocean, Amazon Rainforest, etc.
- To make sure a variety of biomes are covered, you may wish to provide students with a list and have them sign up for a biome or have them draw a biome out of a hat.
- World Studies teachers may be a good source of a blank world map.

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Biome Profile

Biomes are habitats with specific set climates and geographical features. There are terrestrial and aquatic biomes.

The United Nations has decided to choose one large biome area to bury all radioactive waste. The biome where you live and work is on a list of suggested sites. What do you tell the UN to keep them from choosing your site?

For this assessment, you are to research your biome and prepare a profile to be presented to the UN. Your profile can be in a notebook, on video, on a computer slide show, or on transparencies. You will turn in the profile the day you do your presentation.

Your profile should include the following items:

A. Geographical location colored in on a world map (5 pts)

B. Description of the climate including average rainfall and average seasonal temperatures (5 pts)

C. Description of abiotic features (5 pts)

D. Energy Pyramid with at least 3 levels and 10 species (10 pts)

E. 3 Examples of the 5 types of interspecies relationships (3 pts)

F. One or more color pictures representative of the biome (5 pts)

G. Discussion of the major environmental threats already existing (5 pts)

H. Statement of how this biome is crucial to the global ecology and why it should not be destroyed (7 pts)

I. Neat and organized profile (5 pts). Remember you are trying to sell the biome so it will be saved

The Biome profile will be worth 50 points.

You will present your findings to the UN (class) on _____.

My biome is _____.

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Biome Sign-Up

Biome	Period	Period	Period	Period	Period
Arctic Circle					
Antarctic Circle					
Alaskan Tundra					
Canadian Taiga					
Asian Taiga					
U.S. Deciduous Forest					
U.S. Coniferous Forest					
Madagascar (Rain Forest)					
Hawaiian Rain Forest					
African Rain Forest					
Great Plains					
African Savannah					
Australian Outback					
Kalahari Desert					
Nevada Desert					
Chesapeake Bay					
Potomac River					
North Atlantic Ocean					
Great Barrier Reef					
Caribbean Sea					

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Biome Profile Assessment

A.	Map	/5
B.	Climate Description	/5
C.	Abiotic Factors	/5
D.	Energy Pyramid	/5
E.	Interspecies Relationships	/5
F.	Color Pictures	/5
G.	Environmental Threats	/5
H.	Defense Statement	/5
I.	Appearance/Organization	/5

Total: _____/50

Biome Profile Assessment

A.	Map	/5
B.	Climate Description	/5
C.	Abiotic Factors	/5
D.	Energy Pyramid	/5
E.	Interspecies Relationships	/5
F.	Color Pictures	/5
G.	Environmental Threats	/5
H.	Defense Statement	/5
I.	Appearance/Organization	/5

Total: _____/50

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House of Cards

Activity Time: 15-20 minutes

Comments:

- This activity is designed to be used as the opening hook for Unit 5. A house of cards only stands when cards can lean up against each other. This parallels an ecosystem. Ecosystems only function properly when all parts are present and in working order.
- For this activity give each student 10 playing cards. (You could also have students work in pairs.) Tell the students that they are to build a house of cards. You may need to demonstrate first. There are two rules for the house. All cards must touch at least one other card and they cannot fold or crease the cards to make them stand. If the cards are brand new, students may need to bend them just a little or they won't stand.
- Sometimes it is helpful to build the house on a piece of paper on the desk. The black topped lab tables are sometimes slick for the cards to stand.
- When the students houses are built or after about 5 minutes, (some students may not be finished by then- that's okay), ask them to pull out a card from the center of the house or the bottom level if they have built two levels. The house should then collapse. If they can pull out a card without the house collapsing, ask them to pull out a second card. That should cause the house to collapse.
- Ask the students to write for two minutes about the activity. Use focus questions such as "Why is it so hard to build a house of cards?" "What happens when you pull a supporting card out of the house?"
- Introduce the students to the definition of an ecosystem; ask them to name some ecosystems they can think of. Then explain that ecosystems are like houses of cards. They are made of many parts that rely on each other. If you start to remove the parts, the ecosystem may eventually collapse because ecosystems can be fragile. This allows you to lead in to learning about ecosystems and human impact on them.

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Bottle Ecosystems

Activity Time: 90 minutes-2 hours to make the bottle

30 minutes to demonstrate the water tests

10-15 minutes per day to monitor the ecosystem
(This includes doing water tests and making observations.)

Advanced Planning:

- Order the materials for the bottle project.
- Fish, snails, Elodea (known as Anacharasis), crickets, sand, and gravel can usually be found in pet stores. Earthworms can be obtained from a place that sells bait, or at Wal-Mart or K-Mart in their fishing section. Soil and plants or seeds can be gotten at a garden center or hardware store.
- The Didinium and Paramecium will need to be ordered from a Biological Supply company. Try to have them arrive no more than a day or two before making the bottles, otherwise they may not last.
- Tap water can be dechlorinated by allowing it to sit in an open container for 24 hours before use. You can also purchase dechlorinator from a pet store.
- Pond water can be obtained from any healthy pond. Stay away from places used specifically for drainage. Well-season aquarium water can also be used. These types of water will contain bacteria necessary for the health of the ecosystem.
- Make a bottle yourself before having the class do it. This gives them an example to follow and will make it easier for you to answer questions about construction.
- Gather good scissors and a few utility knives. Monitor student use of these for safety reasons.
- I recommend purchasing some inexpensive tea light candles if you have a lot of students. That will prevent waiting lines for the candles.
- If you don't have dissecting probes you can use nails to make the air holes. You will need to make a handle for the nail that does not conduct heat so the students can hold the handle to heat the nail in the flame.

Comments:

- Assembling the bottles is messy! If you teach in a room with a carpeted floor or without water you may want to look for another place to build the bottles. At least put down a sheet under the preparation area so you can clean up more easily.
- There are lots of things you can do with the bottles not mentioned here. This activity is adapted from ***Bottle Biology*** (Kendall/Hunt Publishing Company.) The book is full of great ideas for things you can do with this project and others.
- If you have CBL's there are lots of ways to use them in this project. You could monitor PH with them instead of the paper or do both and compare. If you have a dissolved oxygen

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probe you can monitor dissolved oxygen levels in the water. This is an important indicator of water quality. Experiment!

- You can use protists other than the ones listed (Didinium, Paramecium). These were chosen to allow you to use the bottles with the Population Lab in Chapter 3 of Glencoe's **Biology: Dynamics of Life**. Most healthy pond water will have protists in it.
- Depending on the time of year, you may be able to get duckweed or other aquatic plants out of a local pond or lake rather than buying them.
- Alright- you've finished with the lab. What do you do with all the bottles? You can let the students take them home. You can have them take the ecosystems apart to take a closer look. If you do this you can return the water stuff to an aquarium. You can set up a compost bin with the worms and the dirt. It's amazing how much they can decompose. Use a closed container with holes just small enough for air circulation otherwise you'll attract fruit flies. If it's spring, add the worms to your garden.
- Since this is a unit on Ecology, try to be environmentally responsible with the waste created. Recycle your plastic scraps from bottle construction. If you take the bottles apart, clean out the bottles and recycle them. If you have space, you may try saving the bottles and using them again next year. Remember the plastic caps and rings around the bottle necks cannot be recycled. Remove them and throw them away.

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Bottle Ecosystems

Introduction:
Ecosystems are self sustaining, interdependent groups of organisms and their physical environment. Established ecosystems (ones that have been around for while) can stay in balance for thousands, even millions of years. Ecosystems have many parts, both living and nonliving that are necessary for their survival. In this lab you will build and monitor a micro ecosystem. You will observe how the living and nonliving parts depend on each other. You can also observe human impact on ecosystems.

Purpose: To construct and monitor a micro ecosystem.
To design experiments to test the effect of species interactions on the health of ecosystems.
To design experiments that tests the effect of human impact on the health of ecosystems.

Materials for Building the Ecosystem:
2 two liter soda bottles (preferably clear) with plastic caps

Scissors or Exacto knife

Dissecting probe (for making holes in the plastic bottles and caps)

Candle

Metric ruler

40 cm clear, waterproof tape (2 inches wide)

Wax pencil or crayon

100 ml sand

150 ml gravel

1 liter dechlorinated water

150 ml pond water

2 sprigs Elodea (Anacharasis)

2 small aquatic animals (snails, guppies)

1 pipette Didinium

1 pipette Paramecium

250 ml potting soil

1 handful dirt (from outside)

3-4 large pieces (2 cm wide) dead organic matter such as old fruit, vegetables, bread crusts, leaves, etc.

1 small earthworm

1 small bedding plan or several seeds to plant

A few small rocks and sticks (optional decoration for the Bottle B)

2 small terrestrial animals (crickets, sow bugs, beetles)

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Materials for Monitoring the Bottle:

PH paper (2 cm long strip for each test)

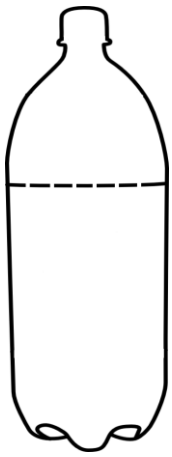
Small plastic cup

Pipette or eye dropper

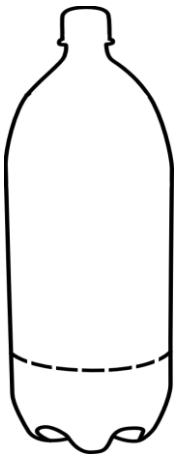
Bromothymol blue or phenol red

Procedure for Building the Ecosystem:

1. Remove the labels from your soda bottles.
2. Remove plastic base if present.
3. Remove the plastic caps from the bottles and save them.
4. Rinse your bottles thoroughly with tape water. Do not use soap to clean the bottles!
5. Cut the 2 bottles as follows:
   (This should give you 1 bottle without a top and 1 bottle without a bottom.) You may wish to mark a line to be cut with a crayon or wax pencil. Also mark the bottles A and B.

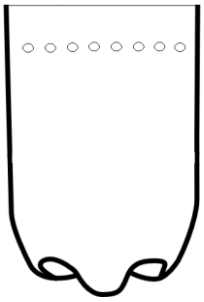


Bottle A



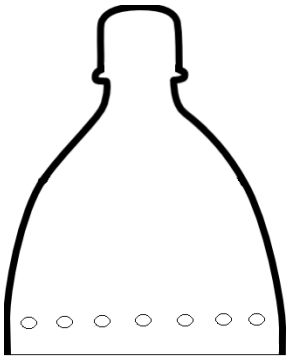
Bottle B

6. Save the pieces you have cut off the bottles. You will need them later.
7. About two thirds of the way up Bottle A you are going to cut a small door. Do this by cutting 3 sides of a square in the bottle.
8. Make the small air holes in a ring around Bottle A about 5 cm from the cut edge of the bottle as shown:



Bottle A

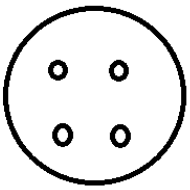
9. Make the small air holes in a ring around Bottle B about 5 cm from the cut edge of the bottle as shown.



Bottle B

The best way to make the air holes is to heat the metal tip of a dissecting probe in a candle flame for a few seconds then stick the tip of the probe into the bottle. The hot metal will easily go through the plastic.

10. Using the same procedure make 4 or 5 holes in the top of one of the plastic bottle caps. As shown:



11. You are now ready to fill the bottles. Start with Bottle A. This will be your water habitat.
12. Add the sand and gravel to the bottle and mix gently. The mixture should fill up the bottle about 5 cm. If necessary add more sand and gravel.
13. Add the pond water to Bottle A. Add enough dechlorinated water to Bottle A so the water line is just below the small door.
14. Add the Elodea. Bury the bottom of the sprig in the sand.
15. Add the Didinium and Paramecium to the water.
16. Gently add your aquatic animals to the water. Your water habitat is now complete.
17. Put the plastic cap with the holes on Bottle B.
18. Turn Bottle B upside down. While one partner holds Bottle B steady, the other person should put in the soil and dirt. Gently mix the soil and dirt together. The soil mixture should fill up the bottom one third of the bottle. Add more soil if necessary.
19. Add the dead organic matter to the soil and bury it towards the bottom of Bottle B.
20. Plant the small plant or the seeds in the soil mixture. If using seeds, they should be covered with soil but still close to the surface.
21. Add sticks or rocks if desired.

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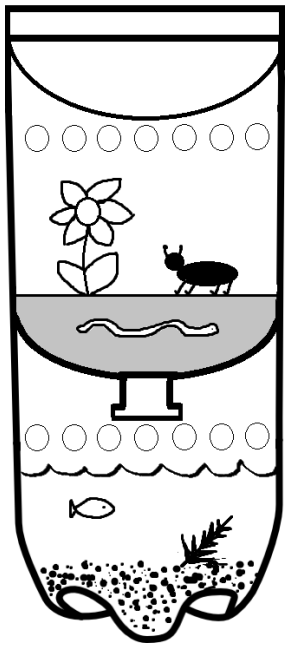
22. Water the soil mixture with some of the dechlorinated water. Add enough water to make the soil moist but not wet.
23. When the soil has absorbed all the water, add the worm.
24. If you planted a plant, you may add your terrestrial animals. If you planted seeds, you must wait for them to sprout before adding the terrestrial animals. Do you know why?
25. Carefully pick up Bottle B which is still upside down and place it cap first into the top of Bottle A.
26. Tape around the whole bottle where Bottles A and B meet.
27. Take the bottom that you cut off Bottle B and place the rounded end into the top of Bottle B. This is the lid for your system. Do not tape this shut. You will need to remove it occasionally to water your bottle.
28. Your finished product should look like this:



Hypothesize:
How long will your ecosystem stay balanced? _____

Procedure for Monitoring the Ecosystem:

1. Record today's date on your data chart.
2. Take a small plastic cup. Remove 1 or 2 pipettes full of water and place it in the plastic cup. You will use this water for your tests. Never add chemicals to your bottle unless instructed to do so.
3. Cut a piece of PH paper about 2 cm long from the roll. Place the tip of the paper in the water to be sampled.

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4. Remove the PH paper from the water and compare it to the PH color chart. Record your reading.
5. Add one drop of your indicator solution (Bromothymol Blue or Phenol Red) to the water to be sampled. Gently swirl the water to mix. Record the color of the water. Interpret the color. Does it indicate high, medium, or low level of carbon dioxide? Record this also.
6. Spend several minutes observing the activity level of the animals in your ecosystem. Record your observations.
7. Look at your plant. Is it healthy? Does it appear to be growing? Record your observations.

Data:

Date	**PH**	**CO_2 Levels**	**Animal Activity**	**Plant Activity**

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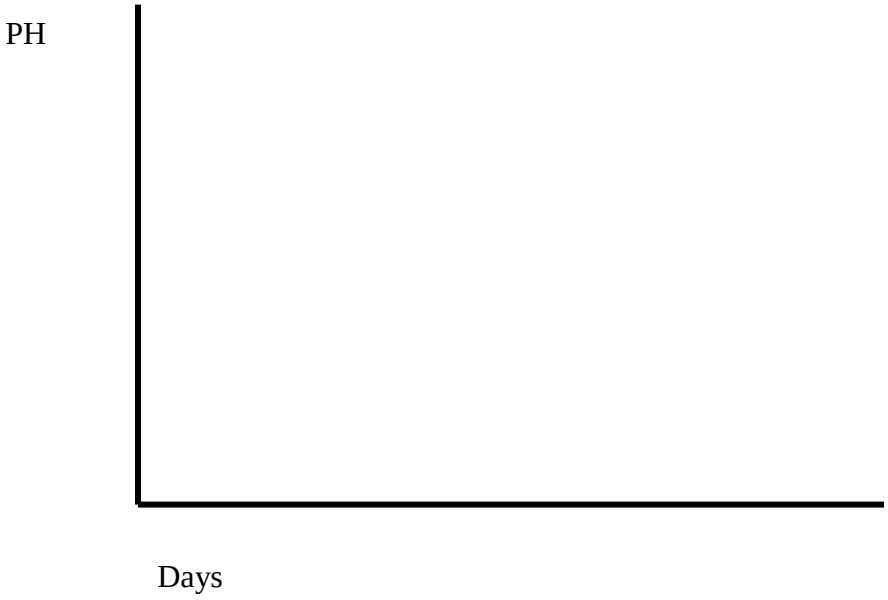
Analysis:

Graph your PH readings



Hypothesize why the readings did or did not change.

Describe how the carbon dioxide level changed during the time you were monitoring the bottle.

Hypothesize why the levels did or did not change.

Conclusion:

Be sure to address the following questions:
Was your hypothesis correct? Was it close? Why or why not?

What changes did you see in your bottle? What could account for them?

What could you do to improve your ecosystem to help it stay in balance longer?

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