# Message in a Bottle

**Overview**

Students will construct a model of an ecosystem in a plastic soda bottle. Extended inquiry and observations will increase knowledge of and appreciation for ecosystems.

**Concepts**

1. Ecosystems provide people with a sense of wonder and excitement.
2. Students practice scientific inquiry. Science as inquiry emphasizes questioning, hypothesizing, and observing.

**Time**

- 45 minutes with subsequent 15 minutes
- Constructing the ecosystem: 40 minutes
- Four observation lessons: 15 minutes each (one per week for four weeks)
- Closure: 5 minutes

**Materials**

For each team of four students:

- 1 two-liter, clear plastic soda bottle
- 1 pair of scissors
- about 4 cups of soil
- about ¼ cup gravel
- small plant
- insect (or other arthropod) for third week observation
- seeds (radish, bean, pea, etc.)

For each student:

- Ecosystem Explorations Journal

**Teacher Preparation**

1. Gather materials and photocopy observation sheets for each student.
2. Students may be able to do the following steps if properly supervised. Please refer to the last page of this lesson for illustrations of bottle preparation.
   a. Clean and remove labels from the soda bottles.
   b. Cut the soda bottles in half with a sharp knife or scissors. The cut needs to be about one inch below the narrow part at the top of the bottle.

c. Make five one-inch long cuts into the bottom portion of the bottle. This will help fit the two pieces together after the terrarium has been constructed.

d. Locate source for soil and plants (e.g., the schoolyard or students' homes).

**Background**

This activity is intended to provide students with the opportunity to closely observe and discover interactions within a created ecosystem. During this activity students are actively engaged in doing science by being investigators and observers. "Science as inquiry" encourages students to formulate and ask their own scientific questions and devise experiments that will test their hypotheses. A hypothesis is an educated guess that attempts to answer a question. A hypothesis is then tested in an experiment or through observation. The data collected is analyzed, and eventually a conclusion is made regarding the initial question.

For example:

**Question**: What does a grass seed need to germinate (start growing)?

**Hypothesis**: A grass seed needs water, soil, sun, and air to germinate.

Conduct experiment: Put grass seeds in different conditions: give the first group of seeds sun, soil, water, and air. Give the second group of seeds soil, water, and air (but leave them in the dark). For a third group of seeds have water, air, and sun available but no soil. The fourth group of seeds needs to have sun, soil, and air available but no water. For the last group of seeds have sun, soil, and water available but no air. Keep all other factors the same for all grass seeds. Observe and record what happens.

Collect and analyze data: The only seeds that germinated were the ones with sun, soil, water, and air available to them.

Conclusion: A grass seed needs sun, soil, water, and air to germinate.

Students can apply the observation and inquiry skills learned in this lesson to future scientific activities.

It is important that your students understand that the ecosystem that they create in the bottle is only a simplified **model** of a complete ecosystem. Scientists use models to increase understanding of the way things work on a large scale. Because these bottles cannot function as self-sustaining ecosystems on their own, after a few weeks this created ecosystem will not provide enough light, space, food, and water to keep the living components alive. Have your students return the living components to their proper environment after finishing the fourth observation. Encourage students to think through the needs of each component in their bottles during the experiment, so that the class, as a whole, will have success in keeping things alive. For example, if a student adds a cricket to his/her bottle, he/she should also make sure that the proper food is available for the cricket to eat (cornmeal can be used to feed crickets). For an ongoing model ecosystem, please refer to the extension section of this lesson.

## Procedure

Constructing the Ecosystem

1. Review the concept of ecosystems with your students. Explain that each team will construct their own ecosystem.
2. Give each team two soda bottle pieces. Ask them to practice putting the bottle together.
3. Lead students to an outside area where they are able to find soil, small plants, and gravel. If you are doing this project inside, show the class where they can find potting soil, plants, and seeds (or have them bring plants from home).
4. Instruct each team to put a handful of gravel into the bottom half of their bottle (for drainage).
5. Instruct each team to find a small plant that will fit comfortably in their closed bottle. There should be some room for this plant to grow inside the bottle.
6. Instruct students to add about two inches of soil to the bottle to cover the roots of the plant.
7. Provide students with seeds to plant in the bottle. Students may also plant seeds they find in their schoolyard.
8. Add water to the soil until it is moist.
9. Put the top half of the bottle over the bottom portion to finish the ecosystem in a bottle.

Observation Lessons

Remind the students that they will be creating simplified models of ecosystems, and that it is important to return the plants and animals to the environment at the end of the fourth lesson. Give each student the four observation sheets. The observations are to be done one week apart. Each observation is meant to take fifteen minutes. Since scientific inquiry is being learned and practiced here, it is necessary for students to take their time with these lessons. We suggest that you ask each group to observe their ecosystem for five minutes before completing the exercise. Each exercise will use the format on the observation sheets. Tell students to be specific with their hypothesis of how the ecosystem will change in a week. Avoid broad hypotheses such as, “It will die.” (A good hypothesis would be “The plant will get too big for the container.”)

## Closure

Give students the opportunity to share their observations with the class. Make a list of observations on the different ecosystem bottles.

- Did anyone see anything that they didn’t expect to see?
- Was anyone surprised with what they observed?
- This lesson is called “Message in a Bottle.” Why? What is the “message?”

### Adaptations for Students with Limited English Proficiency

Pair LEP students with bilingual students who are strong English readers. Preview observation lessons with students in their primary language. Allow students to write in their primary language when doing the observation lessons.

**Key Words**: hypotheses: las hypotheses o la hipótesis

### Journal Exercise

Each week's observation can be added to the Ecosystem Explorations Journal.

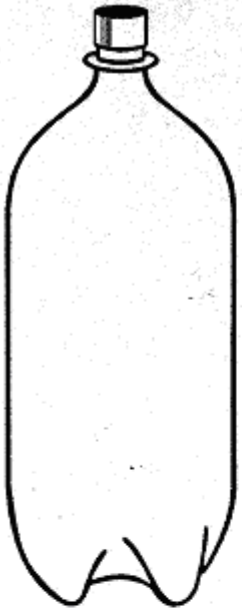
### Assessment

Participation in the observation lessons and the quality of journal entries (lots of details, good hypothesis, etc.) will provide a means of assessing the students' understanding of scientific inquiry and ecosystem processes.

### Extensions

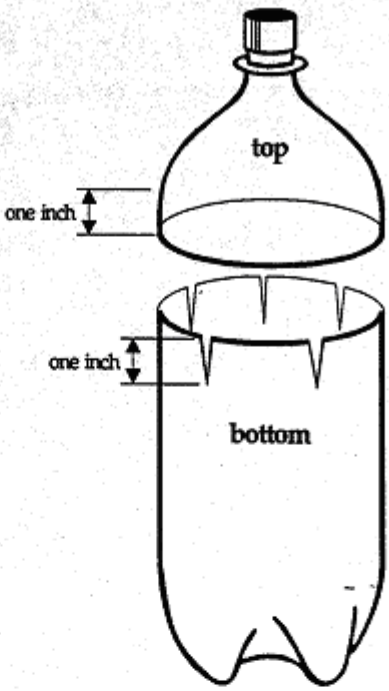
Use different variables (type of soil, amount of sunlight, type of plants used) to make the ecosystems different from one another. Design a terrarium for your classroom or construct more advanced ecosystems by familiarizing yourself with Bottle Biology, Ingram, Mrill. Flynn Scientific Inc., Batavia, IL.

# Message in a Bottle



**1.**

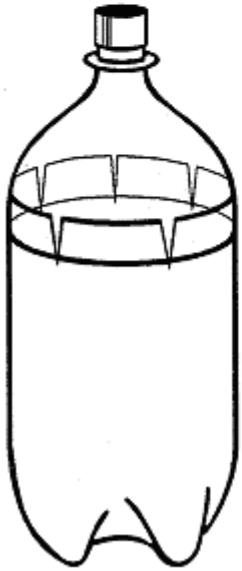
Clean and remove the label of a clear two liter soda bottle.




**2.**

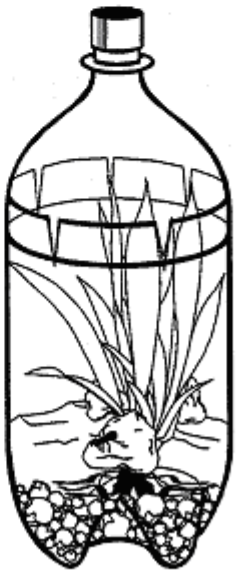
Cut the bottle in two. Cut about one inch below the narrow section at the top of the bottle.

Make five one inch cuts into the bottom section.



**3.**

Practice fitting the two pieces together.



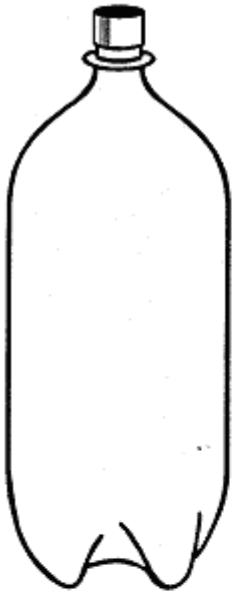
**4.**

Fill with one inch of gravel, small plant and seeds, soil, and consumers.

Add water.

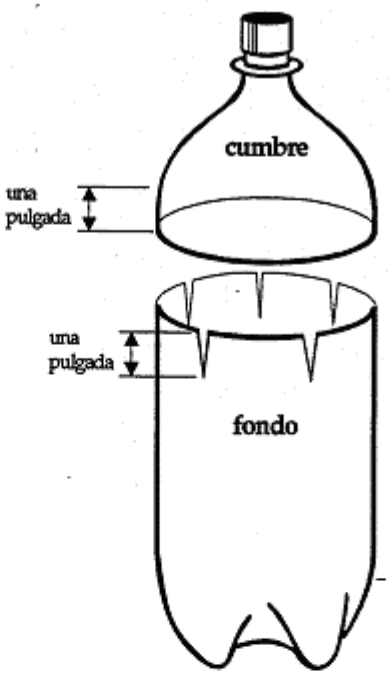
Fit the top onto the bottom.

# Mensasje en un Botella



**1.**

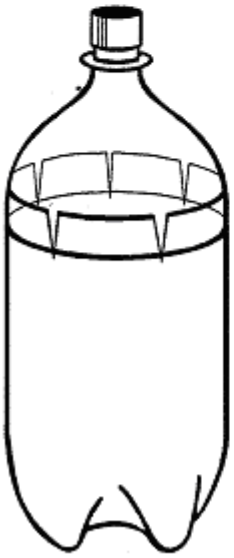
Limpia y quita el rótulo de una botella de dos litros refresco, transparente.




**2.**

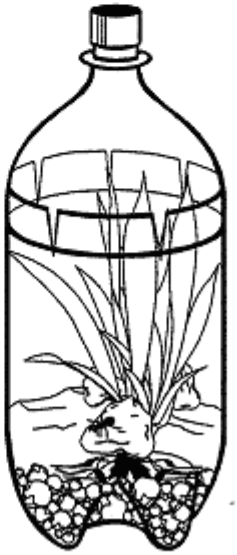
Corta la botella en dos. Corta aproximadamente una pulgada abajo del cuello de la botella.

Haz cinco cortes de una pulgada en la parte inferior de la botella.



**3.**

Practica uniendo y ajustando las dos piezas.



**4.**

Pon una pulgada de grava, una planta pequeña, semillas, tierra, y consumidores.

Agrega agua.

Ajusta la parte superior con la parte inferior de la botella.

# Message in a Bottle

**Observation 1**

Name _____

Date _____

Directions: Observe your ecosystem carefully and then answer:

A. What are the different living and nonliving parts of your ecosystem?

B. Make an accurate drawing of one part of your ecosystem and write down one other part of the ecosystem that connects to the item you drew.

C. List the things you can do to keep this ecosystem healthy:

D. Write a hypothesis in response to the following question: How will this ecosystem change in one week?

E. Write your own question and hypothesis.

## Observation 2

Name _____

Date _____

Directions: Observe your ecosystem carefully and then answer:

A. What do plants need to survive?

B. Make an accurate drawing of another part of your ecosystem and write down one other part of the ecosystem that connects to the item you drew.

C. Were last week's hypotheses supported by this week's observation? Why or why not?

D. Write a hypothesis in response to the following question: How will this ecosystem change in one week?

E. Write your own question and hypothesis.

## Observation 3

Name _____

Date _____

Directions: Observe your ecosystem carefully and then answer:

A. Add a consumer (spider, cricket, worm, roly-poly) to your ecosystem. What does this consumers need to survive in this ecosystem? Remember to provide a proper source of food for this consumer!

B. Make an accurate drawing of another part of your ecosystem and write down one other part of the ecosystem that connects to the item you drew.

C. Were last week's hypotheses supported by this week's observations? Why or why not?

D. Write a hypothesis in response to the following question: How will this ecosystem change in one week?

E. Write your own question and hypothesis.

## Observation 4

Name _____

Date _____

Directions: Observe your ecosystem carefully and then answer:

A. What will happen to the organisms in the ecosystem when they die?

B. Make an accurate drawing of another part of your ecosystem and write one other part of the ecosystem that connects to the item you drew.

C. Were last week's hypotheses supported by this week's observation? Why or why not?

D. Write your hypothesis in response to the following question: How will this ecosystem change if you no longer add water or provide light for it?

E: Summarize your observations over the last three weeks and describe what you learned about ecosystems.

# Mensaje en una Botella

**Observación 1**

Nombre_____

Feche _____

A. ¿Cuáles son las diferentes partes vivas y no vivas de tu ecosistema?

B. Haz un dibujo preciso de un área de tu ecosistema y escribe otra parte del ecosistema que se relacione conlo que dibujaste.

C. Haz una lista de cosas necesarias y que puedes hacer para mantener sano el ecosistema.

D. Escribe una hipótesis en respuesta a la siguente pregunta: ¿Cómo cambiará este ecosistema en una semana?

E. Escribe tu propia pregunta e hipótesis.

## Observación 2

Nombre _____

Feche _____

A. ¿Qué necesitan las plantas para sobrevivir?

B. Haz un dibujo preciso de un área de tu ecosistema y escribe otra parte del ecosistema que se relacione conlo que dibujaste.

C. ¿Fué apoyada la hipótesis de las semana pasada por las observacion es de esta semana? ¿Porqué o porqué no?

D. Escribe una hipótesis en respuesta a la siguente pregunta: ¿Cómo cambiará este ecosistema en una semana?

E. Escribe tu propia pregunta e hipótesis.

## Observación 3

Nombre _____

Feche _____

A. Añadir un consumidor (araña, grillo, lombriz, cochinilla) a tu ecosistema. ¿Qué necesitan estos consumidores para sobrevivir en este ecosistema? ¡Recuerda proveer una fuente de alimento propicia para este consumidor!

B. Haz un dibujo preciso de un área de tu ecosistema y escribe otra parte del ecosistema que se relacione conlo que dibujaste.

C. ¿Fueron apoyadas las hipotesis de la semana pasada por las observaciones de esta semana? ¿Porqué o porqué no?

D. Escribe una hipótesis en respuesta a la siguente pregunta: ¿Cómo cambiará este ecosistema en una semana?

E. Escribe tu propia pregunta e hipótesis.

## Observación 4

Nombre _____

Feche _____

A. ¿Qué les pasará a los organismos en el ecosistema cuando ellos mueran?

B. Haz un dibujo preciso de un área de tu ecosistema y escribe otra parte del ecosistema que se relacione conlo que dibujaste.

C. ¿Fueron apoyadas las hipotesis de la semana pasada por las observaciones de esta semana? ¿Porqué o porqué no?

D. Escribe una hipótesis en respuesta a la siguente pregunta: ¿Cómo cambiará este ecosistema si ya no le agregas agua o lo proves de luz?

E. Resume tus observaciones durante las tres últimas semanas u describe lo que aprendiste sobre ecosistemas.