

Lesson 1-Does a fluctuation in temperature effect the growth and survival rate of aquatic plants?

Objectives:

Students will be able to:

- determine if different temperatures effect the growth and survival rates of aquatic plants.
- evaluate the optimal temperature for the growth of aquatic plants.

Note: Safety goggles and aprons should be worn at all times during this lab activity.

Materials:

Fresh water sample from a local pond or aquarium

6 test tubes

6 portions of duckweed or elodea

3 thermometers

3 beakers or test tube racks to hold test tubes

hand lens or dissecting microscope

Petri dishes

Refrigerator (preferable) or ice bath

Incubator or light source

Procedure:

Working with a partner:

1. Using a hand lens or a dissecting microscope, examine a portion of the plant to be used in this experiment.

Describe the characteristics of a healthy plant.

2. Label 6 test tubes as follows:

2 Test tubes - 1 & 2

2 Test tubes - 3 & 4

2 Test tubes - 5 & 6

3. Fill each test tube approximately half full with the fresh or aquarium water sample.

4. Add a sprig of the plant to each test tube.

5. Place the test tubes in a rack or a beaker and place each group of two in the appropriate location.

Test tubes 1 & 2-Refrigerator or ice bath

Test tubes 3 & 4-Incubator or light source

Test tubes 5 & 6-Room temperature

6. Place a thermometer in each location as close as possible to the test tubes.

7. Take a temperature reading from each location after approximately 10 minutes. This will allow time for the temperature to stabilize.

8. Record the temperature readings in the data table under Day 1.

9. Based on your knowledge of aquatic ecosystems and temperature, hypothesize how the cultures will change over a 24 hour period.

Hypothesis:

10. Record the temperature readings and observations on the data table for the next four days.

Data Table:

Day	Observations Test tube 1 & 2 Refrigerator or Ice Bath	Temperature	Observations Test tube 3 & 4 Incubator or Light Source	Temperature	Observations Test tube 5 & 6 Room Temperature	Temperature
1						
2						
3						
4						
5						

After the observations are complete, answer the following questions.

Conclusions:

1. Based on your observations, what would be the optimal temperature for the growth and development of aquatic plants?
2. Based on your observations, what would happen to plants in an aquatic ecosystem if the temperature increased or decreased?
3. How would this effect the aquatic ecosystem as a whole? (Consider other organisms such as macroinvertebrates and fish.)

4. Research the effects of thermal pollution on aquatic plants. Write a short paragraph explaining what thermal pollution is and how it effects an aquatic ecosystem. In addition, include ideas on how this problem can be alleviated.

Lesson 2-How is the metabolic rate of clams effected by a change in temperature?

Objectives:

Students will be able to:

- determine the optimal temperature at which a clam's metabolic rate functions efficiently.
- evaluate the changes, if any, which a clam undergoes at various temperatures.

Note: Safety goggles and aprons should be worn at all times during this lab activity.

Materials:

Salt water

3 thermometers per group

3 500 milliliter beakers

Large pan to use as an ice bath

Petri dishes

Red or blue food coloring

3 clams per group

Hot plate

Procedure:

Working in Groups of Three:

1. Fill three 500 milliliter beakers approximately half full with salt water. Label the beakers in the following manner:
 - Beaker 1 - Room temperature
 - Beaker 2 - Ice bath
 - Beaker 3 - Hot plate
2. Place a thermometer and a clam in each of the three beakers.
3. Place beaker 1 on the lab table in an area where it will not be disturbed.

4. Make an ice bath using the large pan or container. Place beaker 2 in the large pan or container and place ice around the beaker. Add water so that the beaker is half way submerged in the ice bath.

5. Place beaker 3 on low heat on a hot plate.

Note: Do not allow the water to reach boiling.

6. Each member of the group should take a thermometer reading from beakers 1, 2 and 3, after the temperature stabilizes. (Approximately 10 minutes)

7. Record the temperature on the data table.

8. Hypothesize as to which temperature will allow the most efficient functioning of the clam's metabolic rate. The hypothesis should contain a statement about temperature.

Note: Wash hands thoroughly with soap and water after handling the clams.

Hypothesis:

Each member of the group should do the following simultaneously.

9. Place a drop of red or blue food coloring approximately 1 centimeter away from the pointed end of the clam. Note the time on the data table. This is Time 1.

10. Watch the clam and look for the colored water to be expelled or forced out of the clam. Record the time when the clam expels the colored water. This is Time 2.

11. To determine the differences in the time, subtract Time 1 from Time 2 and record the difference in the last column of the data table.

Data Table:

Beaker	Temperature	Time 1 Time Food Coloring Added	Time 2 Time Food Coloring Expelled	Time 1-Time 2 Difference in the Time Added and the Time Expelled
1 Room Temperature (Celsius)				
2 Ice Bath (Celsius)				
3 Hot Plate (Celsius)				

After the observations are complete, answer the following questions:

Conclusions:

1. Does the data collected support your hypothesis? Why or why not?
2. Based on your observations, what is the optimal temperature for the metabolic rate of a clam to function at an efficient level? How was this determination made?
3. Based on your observations, how does a temperature increase or decrease change the metabolic rate of aquatic organisms?

4. How do you think this would effect the aquatic ecosystem as a whole? (Consider other organisms such as macroinvertebrates and fish)

5. Research the effects of an increase or decrease in metabolic rates in aquatic organisms. Based on your research, write a short paragraph explaining how this will detrimentally effect the ecosystem as a whole.

Lesson 3-What is the Optimal Temperature for the Hatching and Development of Brine Shrimp Eggs?

Objectives:

Students will be able to:

- determine the optimal temperature at which brine shrimp eggs hatch and develop.
- evaluate the changes, if any, which occur in a brine shrimp culture at various temperatures.

Note: Safety goggles and aprons should be worn at all times during this lab activity.

Materials:

brine shrimp egg culture

Salt water

six test tubes

3 thermometers

3 beakers or test tube racks to hold test tubes

hand lens or dissecting microscope

Petri dishes

Refrigerator (preferably) or ice bath

Incubator or light source

Procedure:

Working with a partner:

1. Place a dropper of brine shrimp culture in a petri dish. Using a hand lens or a dissecting microscope, observe the culture and describe the characteristics of a healthy brine shrimp culture.
2. Label six test tubes # 1-6. Fill each test tube half full with salt water.

3. Add one drop of brine shrimp culture to each test tube.
4. Place the test tubes in the following locations:
 - Test tubes 1 & 2-Refrigerator or ice bath
 - Test tubes 3 & 4-Incubator or light source
 - Test tubes 5 & 6-Room temperature
5. Based on your knowledge of aquatic ecosystems and temperature, hypothesize how the cultures will change over a 24 hour period.

Hypothesis:

6. After a 24 hour period, pour the contents of each test tube into a petri dish and observe with a hand lens or dissecting microscope.
7. Record your observations in the data table.

Data Table:

Test tube	Temperature	Observations
1 & 2 Refrigerator or ice bath		
3 & 4 Incubator or light source		
5 & 6 Room temperature		

After the observations are complete, answer the following questions:

Conclusions:

1. Does the data collected support your hypothesis? Why or why not?
2. Based on your observations, what is the optimal temperature for the hatching and development of brine shrimp?
3. Based on your observations, what would happen to organisms in an aquatic ecosystem if the temperature increased or decreased?
4. How would this affect the aquatic ecosystem as a whole? (Consider other organisms such as macroinvertebrates and fish.)
5. Research the effects of thermal pollution on aquatic organisms. Write a short paragraph explaining the effects on an ecosystem as the water warms due to thermal pollution.