

## Lesson 1-Introductory Lesson-How is pH Determined?

### Objectives:

Students will be able to:

Estimate the pH based on the use of an unknown substance.

Determine whether an unknown substance is acid, base or neutral.

Evaluate, by the pH determination, which of the unknowns is the strongest acid or base.

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

### Materials:

Six unknown substances and a control substance with a known pH  
pH paper, LaMotte pH test kit, or red cabbage juice indicator solution

7 small beakers or paper cups

Paper towels

Pipettes

### Procedure:

#### Working with a partner:

1. Label the beakers or paper cups 1-7. Place approximately 2 milliliters of each substance to be tested in the appropriate container. For example, place substance 1 in the beaker or cup labeled 1. Continue with substances 2-7.

**Note:** If you are using a chemical test kit such as the LaMotte pH test kit, follow the directions found in the kit.

2. The beaker or cup labeled 7 is the control. The pH of this substance will be provided.

3. Based on the list provided of the uses of substances 1-7, estimate the pH of each unknown and record the number in the data table in the estimated pH column.
4. Test the pH of each substance, including 7, and record the actual pH number in the appropriate column in the data table.
5. Determine if each substance has an acid, base or a neutral pH.
6. Clean up and dispose of your unknown substances according to your teacher's instructions.

**Data Table:**

<b>Unknown</b>	<b>Estimated pH</b>	<b>Actual pH</b>	<b>Acid, Base or Neutral</b>
1			
2			
3			
4			
5			
6			
7			

Hypothesize about what will happen to the pH number if you mix an acid and a base together. In the hypothesis make a statement about how the pH will change.

**Hypothesis:****Conclusions:**

1. How accurate were the estimated pH determinations in comparison to the actual pH determinations?
2. Which of the substances is the strongest acid? How did you make this determination?

3. Which of the substances is the strongest base? How did you make this determination?
  
4. If a substance has a pH of 3, which of the unknowns could be added to it to obtain a substance with a pH of approximately 7?
  
5. Based on your answer to #4, if an aquatic ecosystem has an acid pH, what could be done to neutralize it? Would this be a long term solution? Why or why not?
  
- 6.. Describe the method used to determine pH. Compare it to the other two methods. Which method would be the most accurate? Why?

**Note:** If more than one of the methods for testing pH is available, make a comparison of the methods by testing the pH of the known substance using each method. Compare the accuracy of each of the pH determinations.

## **Lesson 2-Does a change in pH effect the growth and survival rate of aquatic plants?**

### **Objectives:**

Students will be able to:

determine if changes in pH effect the growth and survival rates of aquatic plants.

evaluate the optimal pH levels 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

3 250 ml beakers or containers

3 portions of duckweed or elodea

Dissecting microscope or hand lenses

Petri dishes for microscopic observations

1% NaOH in dropper bottles

1% HCl in dropper bottles

Wide range pH paper, pH test kit or pH probe

Pipettes

### **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 3 beakers or containers as follows:

Beaker 1-Control

Beaker 2-pH 3

Beaker 3-pH 12

3. Add approximately 200 milliliters of the fresh water sample to each beaker.

4. Beaker 1 is the control. Add a spig of plant material to beaker 1. **Do not add any additional materials to beaker 1.**

5. Beaker 2 should have a pH of 3. Add 1% HCl dropwise to beaker 2 until the water has a pH of

3. Test with pH paper after the addition of each drop. When a pH of 3 is reached, add a spig of plant material to the beaker.

6. Beaker 3 should have a pH of 12. Add 1% NaOH dropwise to beaker 3 until the water has a pH of 12. Test with pH paper after the addition of each drop. When a pH of 12 is reached, add a spig of plant material to the beaker.

7. Place the 3 beakers in an area where they will not be disturbed. Observe the containers every day for a ten day period.

8. On days 1-4 and 6-9, make visual observations of the plants and record the observations in the data table.

9. On days 5 and 10, make microscopic observations of the plant material and determine any changes which have taken place since the initial observations. Record your observations on the data table.

10. Based on the pH of each container, hypothesize about which plants will growth and survive or which plants will wither and die.

**Hypothesis:**

**Data Table:**

<b>Date</b>	<b>Day</b>	<b>Observations Beaker 1 Control</b>	<b>Observations Beaker 2 pH 3</b>	<b>Observations Beaker 3 pH 12</b>
	1			
	2			
	3			
	4			
	5 Microscopic Observations			
	6			
	7			
	8			
	9			
	10 Microscopic Observations			

After the observations are complete, answer the following questions.

**Conclusions:**

1. Based on your observations, what would be the optimal pH level for the growth and development of aquatic plants?
2. Based on your observations, what would happen to plants in an aquatic ecosystem if the pH decreased or increased?
3. How would this effect the aquatic ecosystem as a whole? (Consider other organisms such as macroinvertebrates and fish)
4. Research the cause behind the acidification of an aquatic ecosystem. Write a short paragraph explaining the causes, the effects, and the solutions.

### **Lesson 3-Determining the Effects of a pH Change on the Hatching and Development of Brine Shrimp Eggs**

#### **Objectives:**

Students will be able to:

Determine if brine shrimp eggs hatch and develop more readily in an environment which has an acid or a basic pH.

Evaluate the pH level which is optimal for the hatching and development of brine shrimp.

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

#### **Materials:**

brine shrimp egg culture

Salt water

1% NaOH

1% HCl

five test tubes

pH paper, pH meter or LaMotte pH test kit

beaker or test tube rack to hold test tubes

hand lens or dissecting microscope

Petri dishes

#### **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 five test tubes # 1-5. Fill each test tube half full with salt water.
3. Find the pH of the salt water in one of the test tubes.
4. Adjust the pH of the salt water in test tubes # 1-4 by adding 1% NaOH or 1% HCL dropwise until the pH of the solutions correspond to the following:

Test tube #1    pH 12    1% NaOH

Test tube #2    pH 8      1% NaOH

Test tube #3    pH 4      1% HCl

Test tube #4    pH 1      1% HCl

Test tube # 5      Control-do not change the pH

5. Test the pH with pH paper after adding each drop of the solutions to the test tubes. Continue adding the appropriate solution dropwise until the necessary pH has been reached.
6. When the appropriate pH has been reached, add one drop of brine shrimp culture to each test tube.
7. Place the five test tubes in a test tube rack or a beaker and place in an area where they will be undisturbed for a 24 hour period.
8. Based on your knowledge of pH and aquatic ecosystems, hypothesize how the cultures will change over a 24 hour period.

### **Hypothesis:**

9. 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.
10. Record your observations in the data table.

### **Data Table:**

Test tube	Observations
1 pH 12	
2 pH 8	
3 pH 4	
4 pH 1	
5 Control	

**Conclusions:**

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