LABORATORY INVESTIGATION

14 DIATOMS AS WATER-QUALITY INDICATORS

Problem: *How can the diversity of a population of diatoms be measured and used to assess water quality?*

INTRODUCTION

Background *Diatoms* are a large and diverse group of one-celled golden-brown algae. The cell wall of all diatoms is made up mainly of silica and is much like glass in composition. The wall has two parts of slightly different size. The larger half fits just over the smaller one, like the lid on a box. Different species of diatoms are generally easy to distinguish because of differences in the shapes of their shells and in the markings on their cell walls.

Goals In this investigation, you will collect and **observe** a sample of diatoms and **compare** them to tell various species apart. You will then **classify** the sample in terms of its diversity and **infer** the quality of the water from which the sample was taken.

LAB WARMUP

Concepts Diatoms exist in large numbers in almost all naturally occurring water. They are very sensitive to pollution and other factors harmful to water quality. These characteristics make diatoms good indicator organisms in the study of water quality. In general, the smaller the number of kinds of diatoms—in other words, the lower the diversity—the poorer the water quality. Another factor that must also be taken into account is the density. This is the total number of diatoms per unit volume in a sample. A calculation called the *diversity index* (DI) can then be used to determine the health and pollution level of the water ecosystem.

In the case of diatoms, the DI is calculated by first counting the number of times different kinds of diatoms are found next to each other on a microscope slide. The resulting number is then divided by the total number of diatoms observed, to arrive at the DI. The DI scale ranges from 0 to 1.0. A DI that is greater than 0.8 indicates high organism diversity and good water quality. A DI of 0.5 to 0.8 indicates only moderate diversity and suggests some problem with water quality. A DI that is less than 0.5 indicates low diversity and suggests serious problems with water quality.

Review Section 10.3, Flowing-Water Ecosystems, should be completed before beginning this investigation. You should also understand the following terms before you perform this investigation.

diversity **diatom** **cell wall** **pollution** **ecosystem**

Make a **prediction** about the outcome of this experiment and write it in the Lab Notebook.

MATERIALS (PER GROUP)

- wooden popsicle stick
- water sample containing diatoms
- collection bottle
- dropper
- coverslip
- mounting medium
- glass slide
- compound microscope

PROCEDURE

1. Go to one of the collection sites suggested by your teacher. **CAUTION: Have an adult accompany you to the collection site. Be careful not to go near areas of deep water.** Scrape some brown-diatom coating from wet rocks, leaves, and twigs, and place it in a collection bottle. Then skim some nearby surface water into the bottle. Record information on the collection site, date of collection, and any other details, in the Lab Notebook.
2. At the beginning of one classroom investigation period, shake the collection bottle to break up any material that has settled to the bottom. Use a dropper to place a drop from the bottle onto a microscope coverslip. Give the slip to your teacher, who will dry it in an oven.
3. During the next class period, obtain the dried, cooled coverslip from your teacher. Put 1 drop of mounting medium onto a glass slide, and place the side of the coverslip with the dried diatom sample onto the medium.
4. Place the slide under a compound microscope set at 40X. Position the slide such that the upper left-hand corner of the coverslip is in the field of vision. Observe the diatom in the upper left-most position. Place a *d* (for "different") in the first box of the table in the Lab Notebook, to indicate that this is the first of the different kinds of diatoms you observe.
5. Look at the diatom directly to the right of the one you just observed. If it is different from the first one, place a *d* in the second box of the table. If it is the same type, place an *s* (for "same") in the box.
6. Continue observing the diatoms in the row. Each time a diatom is different from the one observed just before, record a *d*. Each time it is the same type as the preceding one, record an *s*. If there are not at least 20 diatoms in the row within the field, move the slide very slightly to view the next field. After you have observed a row of 20, return to the left edge and observe another row. If the first diatom in the row is different from the last in the preceding row, write *d*; otherwise, write *s*.
7. Continue until you have observed 5 rows of 20 diatoms each.
8. In the Lab Notebook, sketch the three most common diatom species.
9. Compare your results with those of a group of students who collected from a different site.

Name: _____ Class: _____ Date: _____

LAB NOTEBOOK: INVESTIGATION 14

PREDICTION

_____

_____

_____

OBSERVATIONS

Collection site: _____

Description of site and its surroundings: _____

_____

_____

Collection date: _____ Collection time: _____

COMPARISON OF DIATOMS

d = different from preceding diatom; *s* = same type as preceding diatom

ROW	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1.																				
2.																				
3.																				
4.																				
5.																				

SKETCHES OF MOST COMMON DIATOMS

Diatoms sketched will vary, depending on the individual samples.

DATA ANALYSIS

1. Calculate the diversity index (DI) for your sample by counting the number of *d*'s you recorded in the table and dividing this number by 100, the total number of diatoms you observed. The number you obtain will be a decimal between 0 and 1.

2. Given what you learned about the DI scale in the Concepts section above, how would you rate the diversity of the diatom sample you collected?

3. How would you rate the quality of the water from which you collected the sample?

4. What was the DI value of the sample collected by other groups of students whose results you studied? How would you rate the diatom diversity and water quality of their sample?

CONCLUSION

1. **Interpret data** Given what you observed directly about your collection site and its surroundings, what environmental factors do you think may have contributed to the level of diatom diversity and water quality?

2. **Interpret data** What environmental factors do you think may have contributed to the diatom diversity and water quality of the source from which the other group of students obtained their results?

3. **Integrate** What changes might be made to increase water quality in the areas studied by you or other students? What difficulties might be encountered in attempting to make such changes?

EXTENSION

Predict What level of diversity do you predict for other kinds of algae, such as green algae, in the sites you studied? Design and carry out an experiment to test your prediction. Obtain your teacher's permission before proceeding.