9-12

TURBIDITY

OBJECTIVES

The student will do the following:

1. Define turbidity.
2. Describe the effects of turbidity on aquatic ecosystems.
3. Measure turbidity levels.
4. Compute average turbidity.

SUBJECTS:
Science (Environmental Science, Ecology, Earth Science, Chemistry)

TIME:
1 class period

MATERIALS:
white gallon milk containers
black markers
rulers
scissors
large petri dishes
Secchi disc
meter sticks
stapler
ball of string marked in 1cm units
4-5 light-colored small buckets
dirt
water
100 mL beakers

BACKGROUND INFORMATION

Turbidity is defined by the American Public Health Association as the "optical property of a water sample that causes light to be scattered and absorbed rather than transmitted in straight lines through the sample." In other words, "How cloudy is the water?"

The amount of suspended material present determines the ability of light to pass through water. Turbidity may be caused by large amounts of silt, microorganisms, plant fibers, sawdust, wood ashes, chemicals, coal dust, and plankton. Soil erosion from agriculture, mining, logging, dirt roads, construction, and dredging operations contribute to the silt problem.

The most accurate way to determine water's turbidity is with an electronic turbidimeter. The turbidimeter is a photoelectric cell that accurately measures the light scattered by suspended particles in a water sample. The results are reported in units called Nephelometric Turbidity Units or NTUs.

Turbidity can also be measured by filtering a water sample and comparing the filter's color to a standard turbidity color chart or by a device called a Secchi disc that determines turbidity from a sample's clarity.

Turbidity affects fish and aquatic life by:

1. Interfering with sunlight penetration that, in turn, results in lower oxygen concentration and large carbon dioxide concentrations.

2. Clogging the gills of fish and shellfish and killing them directly.

3. Providing a place for harmful microorganisms to grow.

4. Reducing the visibility for certain fish to find food but, on the other hand, helping protect some from predators.

The table below shows the amount of fish and plankton per acre that may be expected in ponds of different turbidities.

FACTOR MEASURED	CLEAR PONDS	INTERMEDIATE PONDS	MUDDY PONDS
Average turbidity units:	Less than 25	25-100	over 100
Amount of fish in ponds per acre:	162	94	29
Comparative amount of plankton:	12.8	1.6	1

Terms

plankton: microscopic plants and animals in water which are influenced in mobility by the movement of water (i.e., as opposed to nekton (fish) which can swim)

Secchi disc: a black and white circular plate that is used to determine water clarity

turbidity: the cloudy or muddy appearance of a naturally clear liquid caused by the suspension of particulate matter

ADVANCE PREPARATION

A. Discuss the use of Secchi disc with students. These discs are lowered into a pond or lake with a rope that has measurement markings on it. The disc is lowered to a point where it is no longer visible and then raised up through the water until it becomes visible. The depth of visibility is then measured and compared to a chart. The depth of visibility is determined by the degree of turbidity in the body of water.

B. Prepare 4-5 buckets of turbid water using tap water and local soil in various ratios. Mark the ratios on the buckets. Try the Secchi disc experiment on each bucket to make sure that some have no visibility.

C. Prepare a chart on the board for data from each group.

PROCEDURE

I. Setting the stage

A. Use the atmosphere and its particulate matter as an example to initiate discussion on turbidity.

B. Have students name/list particles in the air; then list particles in the water. Discuss similarities.

C. Discuss Background Information with students and review vocabulary.

II. Activity

A. Have the students work in 4-5 groups. Number the groups for chalkboard recording purposes.

B. Each group needs 1 white gallon milk container, black permanent marker, ruler, large petri dish, scissors.

C. Cut out one complete side of the milk jug and place it under the lid of the petri dish and draw a circle. Cut it out. Use the ruler to divide and mark the circle in quarters. Color 2 opposite quarters black. This will resemble a small Secchi disc that is used to measure the clarity of water. Attach a string ½ meter in length to the middle of the disc with a stapler and mark the string every centimeter.

D. Have students stir each turbidity bucket and then immediately lower the Secchi disc into the bucket.

E. The disc should be lowered until it is no longer visible.

F. Have one student record the distance from disc to water surface using the meter stick or by the centimeter marks on the string. Record data on Data Sheet.

G. Each group should repeat steps for each bucket and record data on Data Sheets and on the board.

H. Obtain measurements from the other groups that were recorded on the board and calculate an average for each sample. Record the values on the Data Sheet. The smaller the measurement, the greater the turbidity.

I. Have students compare the turbidity of a local river or stream during fair weather conditions and immediately after a storm. Ask how could one help prevent increases of turbidity resulting from farming or logging.

III. Follow-up

Have students bring in various water samples and align them by a visual observation in order of turbidity. Place each on the sheet of white paper and label the source of each. Discuss what caused turbidity in each sample by discussing the factors surrounding the body of water from which it was taken.

IV. Extensions

A. Try Secchi disc measurements on a field trip to various bodies of water.

B. Have a field biologist, hydrologist, or water quality expert discuss problems and sources of water turbidity. They may demonstrate various ways of measuring turbidity.

C. Demonstrate the removal of sediment by mixing in alum. This is done by water treatment plants.

RESOURCES

Arms, Karen, Environmental Science, Holt, Rinehart, and Winston, Inc., Austin, TX, 1996.

Chiras, Daniel D., Environmental Science, High School Edition, Addison-Wesley, Menlo Park, CA, 1989.

Cunningham, William P. and Barbara Woodworth Saigo, Environmental Science: A Global Concern, Wm. C. Brown Publishers, Dubuque, IA, 1997.

Enger, Eldon D. and Bradley F. Smith, Environmental Science: A Study of Interrelationships, 5th Edition, Wm. C. Brown Publishers, Dubuque, IA, 1983.

Jacobson, Cliff, "Water, Water Everywhere," (Student Reading Unit About Water Quality), Hach Company, Loveland, CO, Catalog Number 21975-00. 1-800-227-HACH.

Nebel, Bernard J. and Richard T. Wright, Environmental Science: The Way The World Works, 4th Edition, Prentice-Hall, Englewood Cliffs, NJ, 1993.

TURBIDITY DATA SHEET

GROUP:	SAMPLES: #1	#2	#3	#4	#5
1					
2					
3					
4					
5					
AVERAGE:					