DOCUMENT RESUME

ED 429 810 SE 062 101

AUTHOR	Lewis, Jim
TITLE	Classroom and Field Experiments for Florida's Environmental Resources.
INSTITUTION	Florida State Dept. of Environmental Protection, Tallahassee.
PUB DATE	1993-00-00
NOTE	26p.
AVAILABLE FROM	Florida Department of Environmental Protection, Office of Environmental Education, 3900 Commonwealth Blvd., MS-30, Tallahassee, FL 32399-3000.
PUB TYPE	Guides - Classroom - Teacher (052)
EDRS PRICE	MF01/PC02 Plus Postage.
DESCRIPTORS	Air Pollution; *Conservation Education; *Demonstrations (Science); *Environmental Education; Field Studies; Groundwater; Instructional Materials; *Natural Resources; Science Education; Secondary Education; Waste Disposal; *Water Pollution; Water Treatment
IDENTIFIERS	*Florida

ABSTRACT

This booklet is intended to help teachers in Florida manage the growing interest in environmental education. Fourteen experiments are grouped into the environmental areas of the water cycle, groundwater, water pollution, waste and water treatment, air pollution, and field experiments. Experiments include demonstrations of the water cycle, the interrelationship between ground and surface water, water pollution principles, and water treatment processes; laboratory experiments such as construction and use of air pollution detectors; and field experiments to measure the clarity of different bodies of water, study the plankton that make up the base of the food chain for marine organisms, and assess plant cover in land plots. Each experiment is organized to show educational level (junior and/or senior high) objective, tools needed, procedure, and results and discussion. One experiment for high school that assesses air pollution substitutes a section on quantitative evaluation for results. A resource list is also included. (PVD)

Classroom and Field Experiments for Florida's Environmental Resources

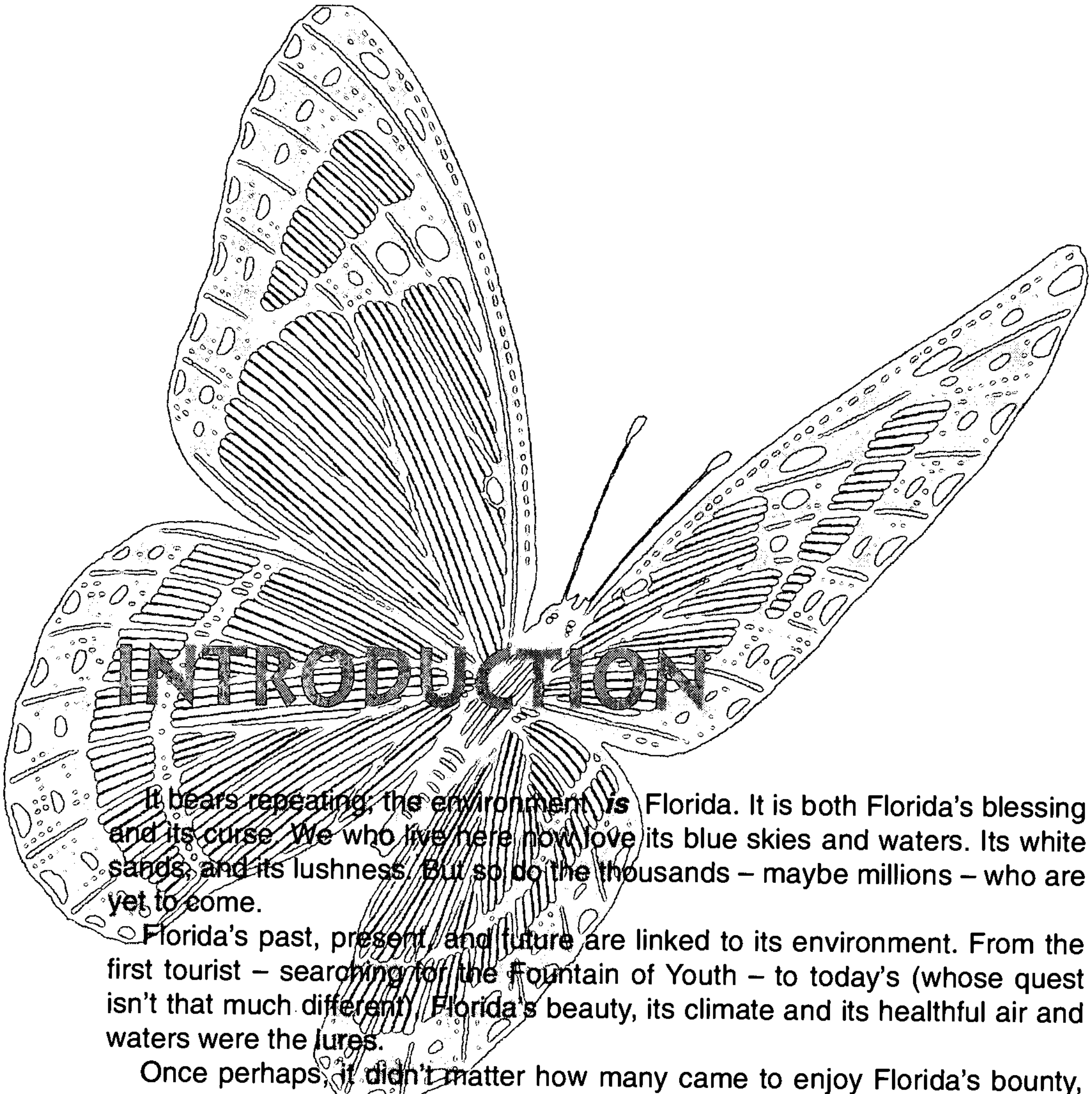
Florida
Department of Environmental Protection

ACKNOWLEDGEMENTS

Special thanks for the help of the Staff of the Department of Environmental Protection, especially to Anita Moon, Pam Houmere, Max Linn, Fred Calder, Roxane Dow, Mike Batts, Walter Starnes, and Geof Mansfield. Thanks, too, to Jim Phillips and Roy King, Florida Department of Education; the Air and Waste Management Association for permission to use several of the air pollution experiments in its workbook. *Air Pollution Experiments for Junior and Senior High School Students,* Second ed., 1972. Other experiments were adapted form *The Water Book,* (1982) published by the Pasco County School Board. We have borrowed and adapted freely from these and other sources. We thank them all.

Jim Lewis, Office of Environmental Education

TABLE OF CONTENTS



INTRODUCTION

It bears repeating; the environment *is* Florida. It is both Florida's blessing and its curse. We who live here now love its blue skies and waters. Its white sands, and its lushness. But so do the thousands – maybe millions – who are yet to come.

Florida's past, present, and future are linked to its environment. From the first tourist – searching for the Fountain of Youth – to today's (whose quest isn't that much different) Florida's beauty, its climate and its healthful air and waters were the lures.

Once perhaps, it didn't matter how many came to enjoy Florida's bounty, then stayed here. There seemed to be so much of Florida to go around. It is different today.

Once we thought our water supplies would last forever. They won't. We thought our swamps were vast wastelands which had to be conquered. They aren't. Our water supplies would always be pure and clear, we thought. But they won't be – without our help. Our blue skies, we said, would last forever – but we didn't reckon on the ubiquitous family automobile.

Today, we know how vulnerable Florida really is. We know that it is up to us to protect it. With 14 million people living here now – and more coming every day, week, month, and year – we have learned just how finite Florida is.

One of the many ways we can help Florida is by teaching our children about the environment they live in, how it is threatened, and how we – including each of them – affect it merely by marching along our daily paths.

That is the purpose of this booklet.

This booklet is intended to help teachers manage the growing interest in environmental education. Copies may be obtained from the Office of Environmental Education, Florida Department of Environmental Protection, 3900 Commonwealth Blvd., MS-30, Tallahassee, FL 32399-3000. Permission is granted to use and copy it freely. We welcome suggestions for future editions.

Experiment 1: Water – the Water Cycle

Level: Junior High School

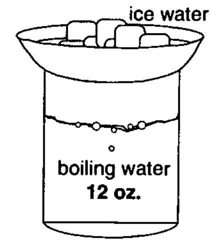
Objective: A partial demonstration of how water recycles itself.

Tools:

- A 12-ounce glass beaker or drinking glass.
- A round-bottomed glass flask large enough to fit just inside, or to seal off the top of the beaker or glass.
- Enough nearly boiling water to three-quarters fill the beaker.
- Ice water for the flask.

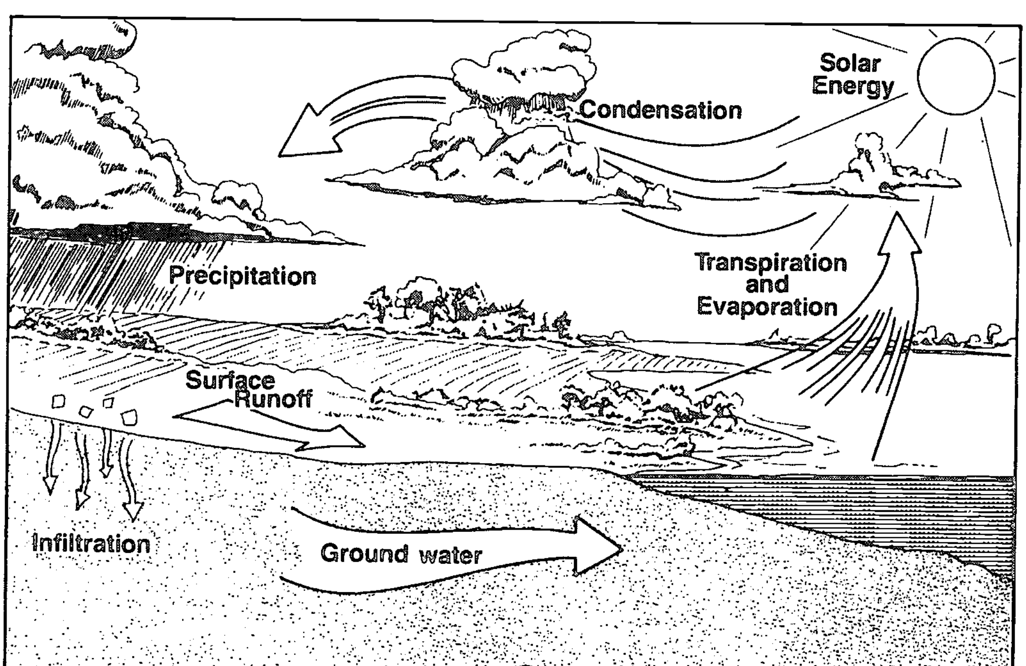
Procedure:

- Pour the hot water into the beaker or glass, ***making certain that the sides are thoroughly wetted.***
- Place the flask, filled with ice water, inside or across the mouth of the beaker or glass. There should be a reasonably tight fit,although it need not seal.
- Observe what happens.



Results & Discussion

Describe what you see. Even though this is an artificial situation, can you compare it to something that happens in nature? What do the terms ***evaporation***, ***condensation***, and ***precipitation*** suggest? How do ***they*** occur in nature? Describe what the warm water in the beaker or glass might represent. How about the cold water in the flask? And the drops that formed on the bottom of the flask?



Experiment 2: Ground Water

Level: Junior and Senior High School

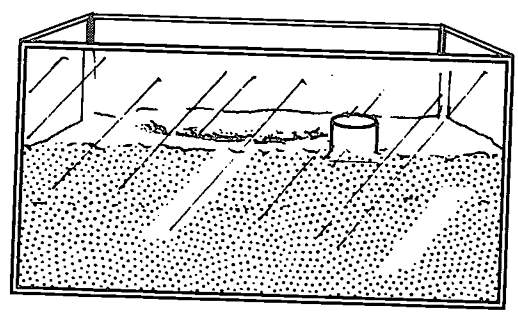
Objectives: To demonstrate the close interrelationship between ground and surface water and the effects of a lowered water table on a pond or wetland.

Tools:

- Five- or ten-gallon aquarium
- Large diameter glass tube
- Lift pump (a large syringe will do)
- ***Clean*** sand (wash it if necessary)
- Bucket

Procedure:

- Cover the bottom of the aquarium with about an inch of sand.
- Place the glass tube in the corner of the aquarium, against the glass. Hold it upright while the aquarium is half to three-quarters filled with sand. (Take care not to get sand in the tube, which should protrude no more than half an inch or an inch from the sand.)
- Add water to the aquarium until the water level reaches half to two-thirds of the depth of the sand.
- At some distance from the glass tube, dig out some of the sand until a pond appears.
- Using the lift pump or a syringe with a long tip, remove water through the glass tube, dumping it into the bucket.
- Observe the water level in the pond.



Results & Discussion

More than 90 percent of Florida's drinking water comes from the ground, where it is stored in underground formations called ***aquifers*** which are recharged by rain. Water table aquifers are shallow. Artesian aquifers are deeper and are confined under pressure by an impervious layer of rock, or soil, such as clay.

What kind of an aquifer have you created in the aquarium?

Ground water is pumped through wells to municipal water treatment facilities, or in many cases, directly to our homes. In this experiment, the glass tube represents a well or a wellfield. When water was pumped from your aquifer, what happened in the pond?

As Florida's population increases, it demands more and more water. Discuss the implications of this experiment for Florida's surface waters and wetlands. What does the experiment tell you about shallow ground water, and about surface water in Florida? What happens in your pond when you pour water back down the well? Does that give you any ideas about how ground water might be replenished? Discuss the implications of "artificial recharge." Where would we find the water? What problems might we have?

EXPERIMENT 3: GROUND WATER

LEVEL: Junior and Senior High School

OBJECTIVES: To demonstrate how easily ground water can become contaminated and the difficulty of cleaning it up.

TOOLS:

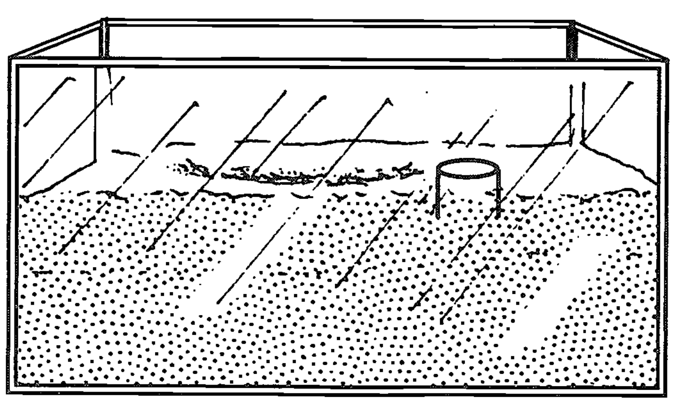
- Use the same setup as the previous experiment.
- Watercolor paints (a bright color; or mix several colors in a pail of water until you have created a suitably ugly wash.)
- A second syringe.

PROCEDURE:

- Refill the aquarium with clean water to two-thirds the depth of the sand. Be certain there is water in the "pond."
- Using the second syringe, pollute the ground water by pouring in a sizeable amount of the paint or paint mixture into the pond (or onto the surface of the sand on the side of the pond away from the "well." Observe what happens in the pond).
- With the pump or the first syringe, draw water from the well. Continue. Observe what happens.

RESULTS & DISCUSSION

Discuss the implications of discharging untreated water into surface waters or on the land. How quickly did the pollution migrate from the pond to the well? Consider how you might clean up this ground water. Try pumping more water out of the well. (You probably will have to add clean water to replenish the ground water. Sprinkle it over the surface of the sand to imitate rainfall.) Keep track of how much water you add before the water pumped from the well **appears** to be clean again. Was it a larger volume than the polluted water you added at first? Discuss your clean up options if there had been no rainfall to replenish the ground water.



EXPERIMENT 4: WATER POLLUTION

LEVEL: Junior and Senior High School

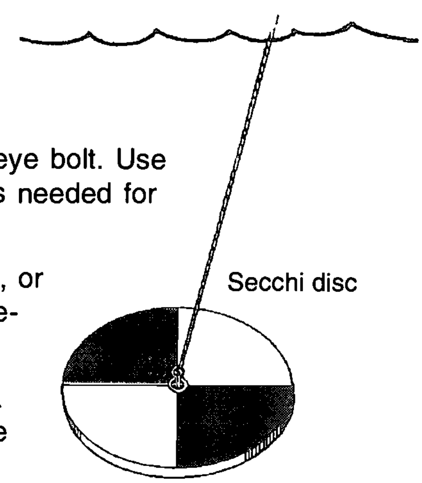
OBJECTIVES: To measure the clarity of several different bodies of water and to theorize about causes of unclear water.

TOOLS:

- Metal disc, such as a tin can lid (be careful of sharp edges. A disc also can be cut in a school shop from a lightweight metal, such as aluminum.)
- A small amount of black paint.
- A small amount of white paint.
- An eye bolt, nuts, and washers.
- Heavy string.

PROCEDURE:

- After the disc is cut, paint it in black and white quadrants. (see illustration.) This is known as a ***Secchi disc***.



- Drill or punch a hole in the center for the eye bolt. Use extra washers on each side of the eye bolt as needed for weight.
- Tie the string to the eye bolt. Mark one-foot, or for greater accuracy, 10-centimeter measurements on the string (knots or paint).
- From a dock or boat, lower the disc into a stream or pond until it disappears. Make a note of the depth.
- Lower the disc a foot or two, then raise it slowly until it reappears. Note the depth. Average the two depth readings to find your **limit of visibility**.

RESULTS & DISCUSSION

The limit of visibility is approximately the depth where photosynthesis and respiration are balanced – where about 5 percent of the light that penetrates the surface is transmitted. The light that reflects back to your eye from the disc has traveled from the surface, to the disc and back, indicating that the absolute limit of light penetration is about twice your limit of visibility.

Take readings from several different bodies of water – fast and sluggishly moving streams, salt water, fresh water, swamps, lakes, etc. Discuss what might influence the depth that light will penetrate in each. Sediment in moving water is an obvious cause. If you have a brown-water stream that drains a swamp in your area, you will note that the swamp itself can be clear, but that light penetration still is limited. Why? Is there a relationship between the limit of visibility, plant growth, or animal life? Are there more or fewer plants and animals in highly turbid waters than in clear waters? Note how the Secchi disc seems to change color at different depths. Why?

Experiment 5: Water Pollution

Level: Junior and Senior High School

Objectives: To see the effect of excess nutrients on water quality.

Tools:

- Five glass or plastic containers (the large, clear plastic soft drink bottles, with tops cut off). Each should hold about 2 liters.
- Fresh water from a clean pond or lake. (Tap water may be used, but it should stand in an open container for a day or two so it will lose any chlorine added in the water treatment process.)
- Assorted fresh water plants and small animals (algae, water lettuce, Elodea, Daphnia, freshwater shrimp, etc. obtained from the pond or lake or from a tropical fish store or laboratory supply house.)
- Plant fertilizer (liquid house plant fertilizer.)
- A hand lens or low-power microscope.

Procedure:

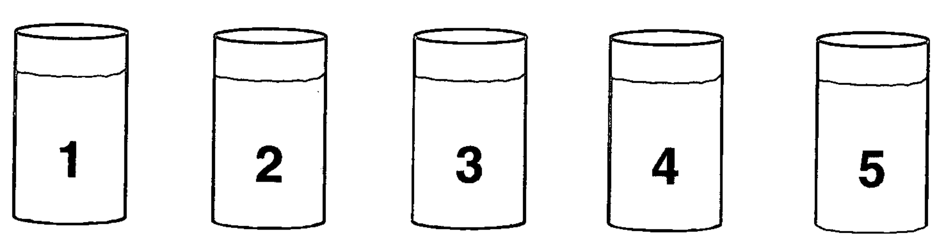
- Fill each container with an equal amount of water. Number the containers 1 to 5.
- Set container 1 aside. Add the Daphnia or freshwater shrimp to containers 2 and 3; put the algae, water lettuce or Elodea into containers 4 and 5. Label the containers with the material they contain.
- Put equal amounts of the liquid fertilizer (diluted to the strength recommended on the label for house plants) into containers 2 and 4. (A tablespoon should be enough.) Stir.
- Set all the containers on a window sill and examine them daily for 3 or 4 days.

Results & Discussion

After the first 24 hours, what happened to the Daphnia or the shrimp in container 2? After 3 or 4 days, what happened in container 4. Describe it in detail. Has anything happened in container 1? Describe. Examine containers 3 and 5. Has anything changed? Describe. The experiment may be continued for a week or more. Describe what happens as time goes on.

How would fertilizers get into our waterways in the "real" world?

Examine the label on the container of house plant fertilizer. Which of the ingredients are nutrients? What could happen to our streams and rivers if large amounts of nitrogen and phosphorus escape into them? List several sources of these materials and how they might reach a stream or lake. How can we keep this from happening?



Experiment 6: Water Pollution

Level: Junior High School

Objectives: To demonstrate how easily water can be contaminated by common materials.

Tools:

- A supply of small, clean, wide-mouth jars or pill vials with watertight tops (the number depends upon the number of "contaminants" you choose).
- A larger jar.
- The "contaminants": moderate amounts of such materials as oil (any kind, from motor oil to cod liver oil), ink, fine sawdust (the residue from a pencil sharpener, including powdered graphite), hard candy, sugar, coarse gravel, powdered chalk, soap, some dried beans, etc.

Procedure:

- Fill each of your containers with water. Set one of them aside as a **control**.
- To each of the remaining containers, add one of the contaminants. Cover and label each.
- Shake each container and observe the results.
- Set the containers aside and observe them for a few days.
- After three or four days, shake them up again, then open the containers and examine them. Dip your fingers in each and rub them together. *(Do not **taste** any of the concoctions.)*
- Mix the contents of all the containers. See what you have now!

Results & Discussion

Describe what happens to the material in each container. Some will dissolve into the water right away. Some will float. Some will appear to mix, then will separate after setting for a while. Some will settle out. Before the containers are mixed together, each should be compared with the control that was set aside at the beginning. The mixture, too, should be compared.

The experiment shows what can happen when material that is not meant to be in water is placed in it. Think of your contaminants as materials discharged as wastes by a community or industry.

Experiments 7, 8 and 9 show how pollutants can be removed from water. But, isn't it better to keep them out of the water in the first place? (When you have finished with those experiments, you might try the concoction that was formed when these containers were poured together to see whether or how much it can be cleaned.)

Experiment 7: Waste & Water Treatment

Level: Junior High School

Objectives: Demonstrate a simple way that polluted water can be cleaned – through filtration.

Tools:

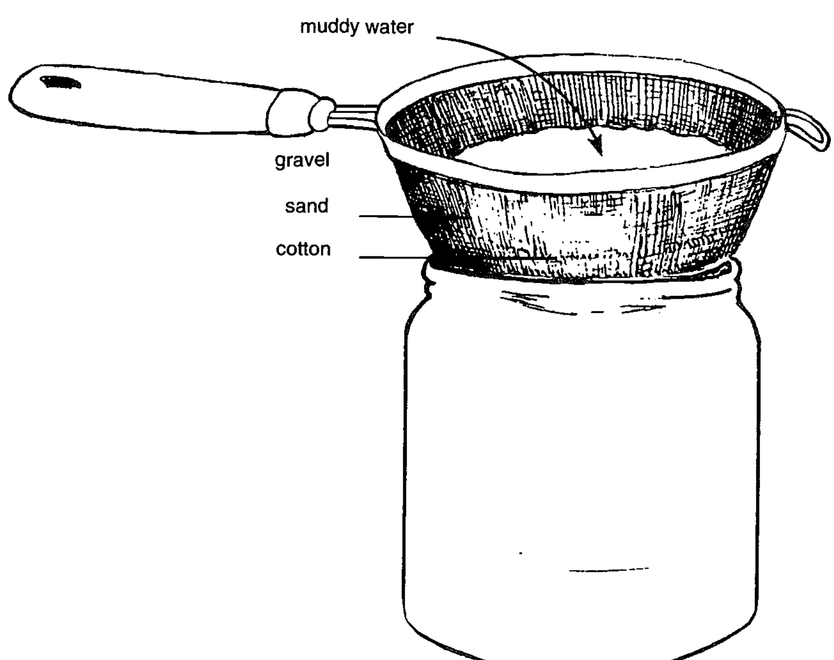
- A kitchen sieve, a kitchen flour sifter, or an empty can with fine window screen in place of the bottom.
- Absorbent cotton
- Coarse sand
- Gravel
- A good-sized jar
- Some muddy water

Procedure:

- Cover the screen with a thick layer of cotton.
- Add an inch-thick layer of the coarse sand.
- Add an inch of gravel.
- Place your just-built filter over the jar. Stir, and slowly pour the muddy water through the filter.

Results & Discussion

Watch what happens. Is the water still muddy after it has passed through your filter? Is it completely clean? What situations in your community might be might be analogous to your small filter? Perhaps your city offers tours of the water treatment or sewage treatment plants. Can you spot where these huge facilities do what you just did but on a much larger scale? For this and the next two experiments, you also might experiment with some of the "contaminants" from Experiment 6.



Experiment 8: Waste & Water Treatment

Level: Junior and Senior High School

Objectives: To demonstrate another step in the waste or water treatment process – coagulation.

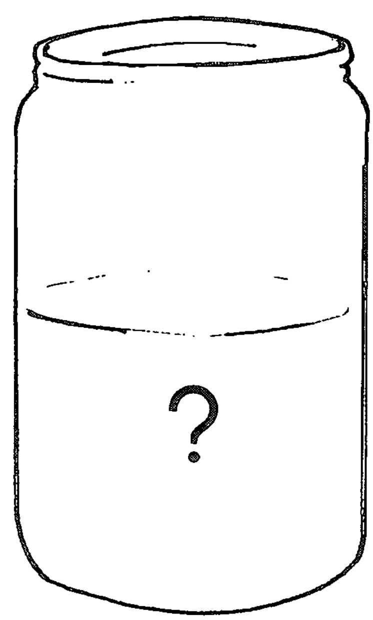
Tools:

- The jar of filtered water (still slightly muddy). (If there was no sediment left after filtration, add a small amount of mud – enough to add a brown tinge to the water).
- Alum
- Clean water
- A cup

Procedure:

- Grind ten or twelve crystals of the alum and dissolve them in the clean water in the cup.
- Shake the muddy water in the jar, and stir in the alum solution.
- Rinse the cup and add the rinse water. Continue to stir for a few minutes
- After about five minutes, let the jar stand.

Results & Discussion Describe what happened after the alum was added to the water. What was formed, and what was its purpose? How long did it take for the material to settle? Was the water above the settled floc clear? If you wish and if there still is some color in the water after coagulation, you might try pouring it through another (clean) filter as in Experiment 7.



Experiment 9: Waste & Water Treatment

Level: Junior and Senior High School

Objectives: Observe the ability of activated carbon to remove contaminants which pass through a "traditional" sand filter.

Tools:

- Two one-inch diameter plastic tubes, 18 inches long. (Golf club separator tubes or PVC pipe.)
- Activated carbon (used in fish tanks), enough to fill one tube.
- Clean coarse sand (from experiment 7), enough to fill the other tube.
- Two small squares of cloth (2x2) and two rubber bands.
- A stand, or something that will hold the tubes upright.
- Two beakers or small pans to catch the water after it passes through the tubes.
- Cotton balls.
- Food coloring.

Procedure:

- Place two or three cotton balls in one end of the plastic tubes. The cotton will separate the sand or charcoal from the cloth caps.

- Using the rubber bands, attach the cloth squares over the end of the tube below the cotton balls. These cap the tubes so the filtering material cannot fall out.

- Fill one tube to within two inches of the top with coarse sand. Tap on the sides of the tube to ensure that the sand settles.

- Fill the second tube to within two inches of the top with activated charcoal. Tap the tube several times to ensure that the charcoal settles.

- Set the tubes over a beaker or small pan.

- Mix food coloring into one pint (400-500 milliliters) of water, then divide the mixture into two containers.

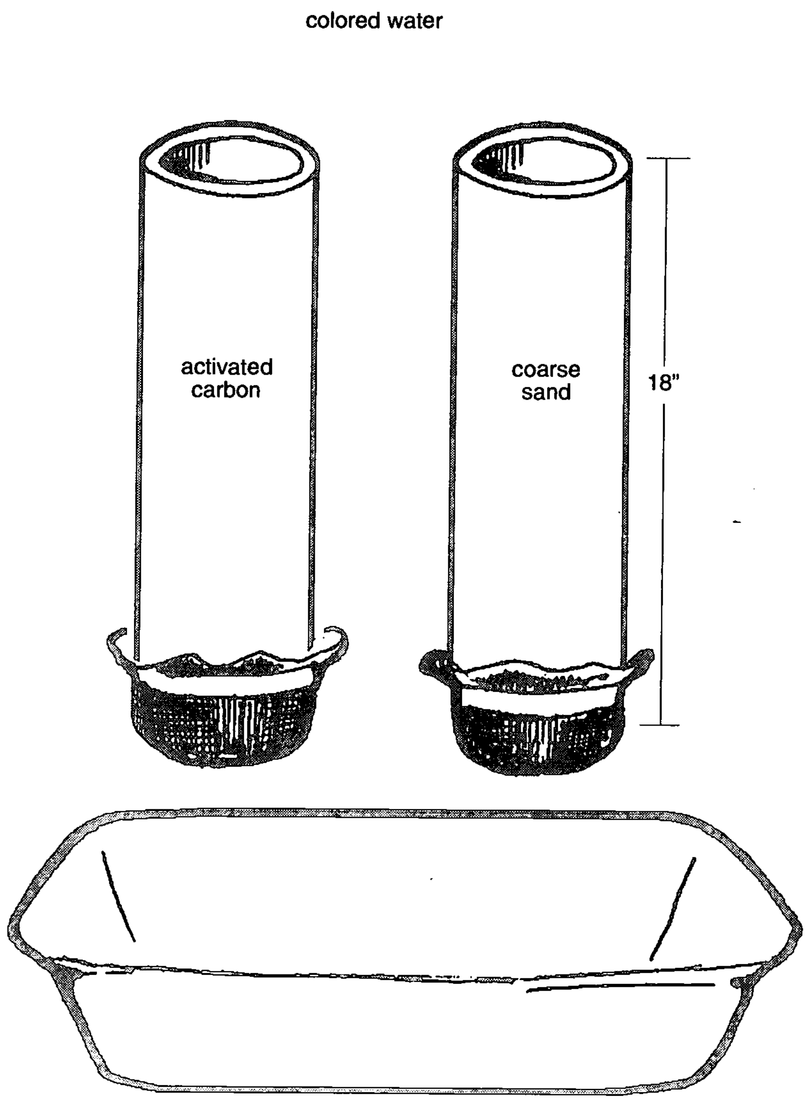
- Pour colored water into each tube.

(Note to Teacher: You might run through this experiment beforehand to determine the proper amount of food coloring to mix into the water. If too much color is used, the activated carbon may not remove all of it. Be certain the carbon is tightly packed into the tube.)

Results and Discussion

Is there a difference in the water that comes through the two tubes? Describe it. Why does the carbon do a better job of removing the color?* Is activated carbon treatment better suited for wastewater treatment, or treatment of drinking water before it reaches your faucets at home?

*Microscopic cracks and crannies in the activated carbon attract and hold the molecules of color in the solution. The sand, on the other hand, has a hard, relatively smooth surface which allows the color molecules to slide through.



Experiment 10: Air Pollution

Level: Junior High School

Objectives: Build and use simple air pollution (particulate) detectors.

Tools:

A.

- Several glass or plastic slides or small panes of glass.
- Flat stick (lath), 2 or 3 feet long. A yardstick is fine, too.
- Jaw-type clip
- Nut and bolt
- Vaseline

B.

- Yardstick
- Paper plate
- Thumbtack
- Vaseline

Procedure:

A.

- Bolt the jaw-type clip to the lath or yardstick.
- Smear an evenly thin layer of vaseline over the top of the slide or glass and place it in the jaws of the clip. (A separate slide might be covered with vaseline and put in a protected space as a "control.")
- Set the sampling tool outside. (If you made more than one sampler, set them in areas such as near a street, in a protected garden, etc. for comparative purposes.)
- After several hours, or a day of exposure (same time for all samplers), examine the slides through a microscope. Compare slides from different locations and from the protected space.

B.

- Tack a paper plate to the yardstick.
- Smear the plate evenly with vaseline.
- Hold the plate near the exhaust pipe of a car while it is running. (With different plates, sample several cars – old and new).

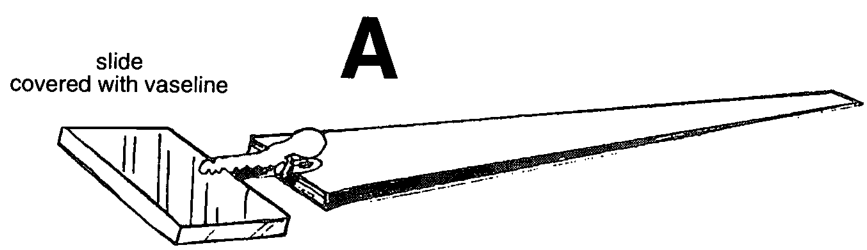
Results & Discussion

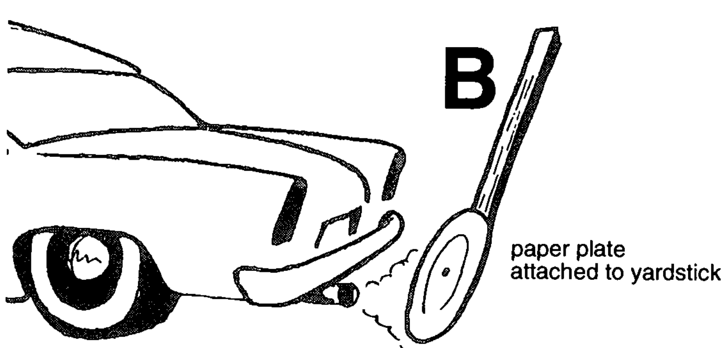
A.

Compare the slides that were exposed to the air with the one you had pro-protected. Was there a difference? Compare the amount of material trapped in the vaseline on slides exposed at different locations. Can you explain any differences you find? If you placed some slides near where construction was occurring, or near roads, what kinds of pollutants might be found on each slide?

B.

Is there any difference between old and new cars? If you know, is there a difference in cars that are burning different grades of fuel? You might run the experiment with a car as it starts after it has sat for a night, and compare it to a car that is idling after it has warmed up for a time. Can you explain any difference? Compare a gasoline powered car with one powered with diesel fuel.





17

Experiment 11: Air Pollution

Level: High School

Objectives: To determine whether the air you breathe contains suspended fine particles that may soil fabric or other material.

Tools:

- Small vacuum pump or water aspirator with an air volume capacity of about 3/4 cubic foot per minute.
- Two pieces of 28-mm outside diameter glass tubing, 50-75-mm long, with 1.2-mm wall thickness.

NOTE: Here, and elsewhere where glass tubing is required, observe proper safety measures by assuring that ends are cut square and are fine polished to avoid cut fingers.

- A 28-mm diameter disc of window screen.
- Two rubber stoppers to fit the glass tubing, each with an 8-mm hole in center.
- Two 75-mm pieces of 8-mm outside diameter glass tubing.
- Whatman #44 filter paper – 28-mm discs.
- One-inch wide rubber band to fit snugly around 28-mm tubing, or one-inch wide masking tape.
- Burette stand with a 3-finger clamp.
- Plastic or rubber tubing to connect filter to vacuum pump and to act as a probe to collect outside air.
- Flow meter (or rotameter) of appropriate range or a wet or dry gas meter if available. A critical orifice of proper size may be used to control air flow at the desired maximum rate.
- One-gallon glass bottle fitted with a two-hole rubber stopper containing one long and one short piece of 8-mm glass tubing. The bottle should be nested in a cardboard box for safety.
- Small metal or plastic funnel.

Procedure:

Assembly:

- Set the screen on top of one piece of 28-mm tubing (now called cylinder1)

- Place a filter paper disc on the screen.

- Place the other piece of 28-mm tubing (cylinder 2) on top of the filter paper, press the two cylinders together, and make an air tight seal with the rubber band or the masking tape.

- Place an 8-mm glass tube in a hole through each rubber stopper. Place one stopper in the lower end of cylinder 1 and the other in the upper end of cylinder 2. Mount the assembly in the burette stand, with cylinder 2 in the upper position.

- Using plastic or rubber tubing connect cylinder 1 to the lower tap on the rotameter or, if you are using one, to the inlet of the other type of flow measuring device. Connect the outlet of the rotameter or other flow meter to the inlet side (long glass tube) of the one-gallon bottle. (The bottle evens out any fluctuations caused by the vacuum pump. It is called a surge or buffer bottle.)

● Similarly connect the outlet tube from the surge bottle to the inlet tap of the vacuum pump or other source of vacuum.

● Connect a long piece of plastic or rubber tubing to the inlet end of cylinder 2, and pass the other end through a window. The stem of the funnel should be inserted in the tubing that is hanging outside. The funnel should hang upside down to prevent rainwater from entering the tubing.

Operation:

● Start the vacuum pump and record the time.

● Measure and record the rate of air flow.

● Allow air to pass through the filter for two hours, or as long as required to noticeably darken the filter paper.

● Measure and record the rate of air flow.

● Stop the vacuum pump and record the time.

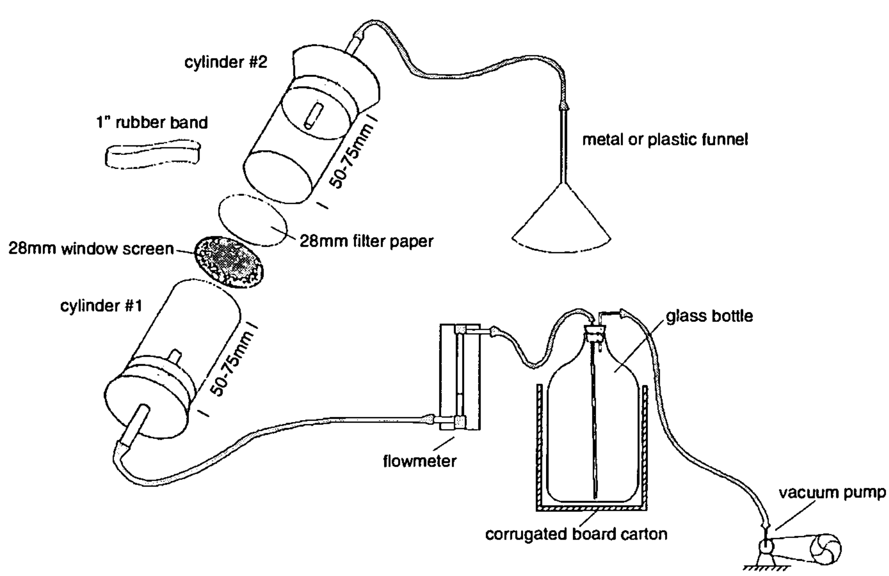
● Dismantle. Observe the soiling of the filter.

● **Optional:** If a photometer to measure the transmittance of light through the soiled filter paper is available, a quantitative evaluation (see below) of the amount of soiling can be made.

Quantitative Evaluation:

The amount of discoloration on the filter paper is about proportional to the quantity of solid particles suspended in the air. This makes it possible to relate the decrease in light transmittal through the paper to the amount of dirt particles collected on it. The transmittal of light through the paper will be measured before and after filtering the air by placing the clean filter disc and later the soiled discs against the photometer window and noting the intensity of light transmitted in each test.

From these measurements, the optical density of the soiled filter paper can be computed in terms of COHs (Coefficient of Haze – one COH represents an optical density of 0.01). The optical density of the deposit or soiling is the logarithm to the base 10 of the ratio of the intensity of light transmitted



through the clean filter paper to the intensity of the light transmitted through the soiled filter paper. In terms of percentage, it can also be the ratio of percent transmittance through the clean paper (100%) to the percent transmittance through the soiled paper.

Therefore: Io It = $\log_{10}$ 100% %T

Where:
Io = average light intensity transmitted through clean filter paper
It = light intensity transmitted through the soiled paper, and
%T = percent light transmitted through the soiled paper when the light transmittance through clean paper is considered as 100%
Since $\log_{10}$ of 100 = 2.0, we have: O.D. = 2.0 – log %T

By definition, one COH unit equals an optical density of 0.01. Thus, the number of COHs represented by the actual O.D. found equals
O.D./0.01 = 100 x (2.0 – log %T).

COH unit measurements are usually represented as COHs per 1,000 linear feet of air passed through the filter paper. The concept of linear flow, upon which the expression of COHs per 1,000 feet is based, considers that through each point on the surface of the filter a long stream of air passes and deposits its load of dirt particles. One might think of the sample as a long column of air the same diameter as the diameter of the exposed filter paper and with a volume equal to the measured volume of the air sample.

Computations:
- Volume of air = $R_2 - R_1$ (for dry or wet gas meter)

Where:
- R_2 = final reading in cubic feet
- R_1 = original reading in cubic feet

or, (for rotameter or critical orifice): Volume of air = $t(F_1 + F_2)$ 2

Where:
F_1 = initial flow rate in cubic feet per minute
F_2 = final flow rate in cubic feet per minute
t = sampling time in minutes

- Area: 3.14 x d_2

where d is the inside diameter of the cylinder in feet

$$\text{feet} = \text{mm.} \times \frac{\text{cm.}}{\text{mm.}} \times \frac{\text{in.}}{\text{cm.}} \times \frac{\text{ft.}}{\text{in.}}$$

- Linear feet of air:

volume
area = L

- COHs per 1,000 feet

$$\frac{(2.0 - \log \%T) \times 100}{L/1000} = \frac{(2.0 - \log \%T) \times 100 \times 1000}{L}$$

$$= \frac{(2.0 - \log \%T) \times 10^3}{L}$$

EXPERIMENT 12: AIR POLLUTION

LEVEL: Junior and Senior High School

OBJECTIVES: To show one way to keep odors out of the air.

TOOLS:

- Oilless gas pump (approximately 2 liters per minute capacity.)
- Pyrex U-tube, packed with Raschig rings or glass beads.
- Beaker to hold U-tube.
- Two fritted bubblers, or equivalent.
- Rotameter or other means of measuring gas flow.
- Glass or plastic tubing.
- Stopcocks or pinchcocks.
- pH indicator.
- Rubber stoppers for U-tube and bubbler flasks.
- Reagents:
  - Odorous material (hydrogen sulfide or mercaptans are suggested.
  - Potassium permanganate
  - Buffer material, such as borax, sodium carbonate or bicarbonate.

PROCEDURE:

- Assemble materials: see illustration (next page). If fritted discs are not available, improvise to break up the gas into very small bubbles. (The smaller the bubbles, the greater the surface area for contact with the solution for a given volume of gas and the greater the efficiency of oxidation.)

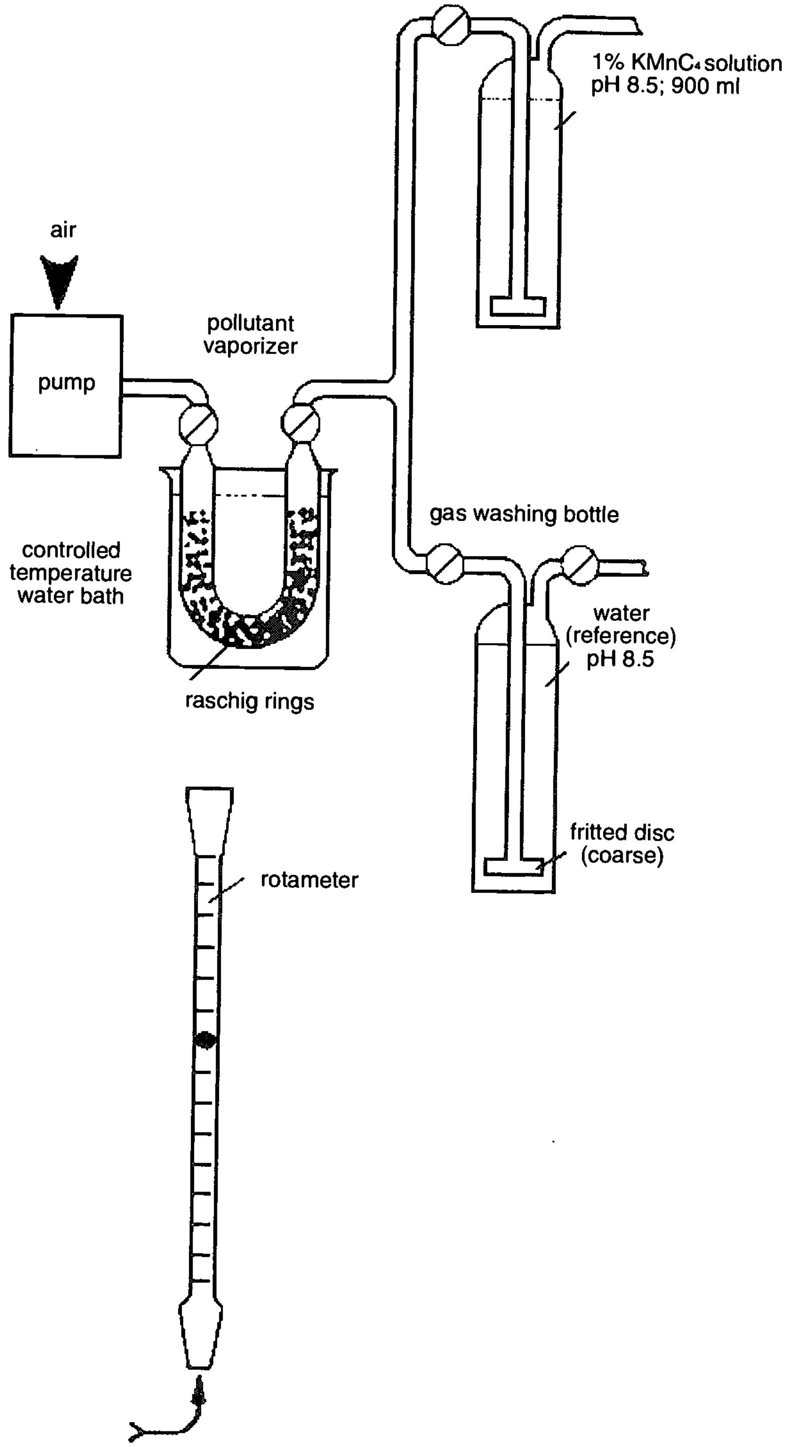
- Place the liquid that contains the odorous vapor or gas in the U-tube so the Raschig rings or glass beads are thoroughly wetted.

- Put 900 milliliters of 1% potassium permanganate solution, buffered to pH 8.5 with borax, sodium carbonate or sodium bicarbonate, into one of the flasks.

- Put the same amount of distilled water, buffered to pH 8.5, into the other bubbler flask.

- Start the gas pump and adjust the rate of flow to 2 liters per minute passing through the U-tube; flow through each bubbler flask will be at 1 liter per minute. By using water or ice in the U-tube beaker, heat or cool the liquid in the U-tube according to its vapor pressure so the air stream will be loaded to the maximum with the odorous gas or vapor.

- Observe and record the nature and intensity of the odor emitted from each bubbler flask.



Results & Discussion

This experiment demonstrates just one of a number of ways odors can be removed. Activated carbon also can be used for some odors, and others can be removed by direct exposure to a flame.

Discuss local factories or other activities such as dairy farms, sewage treatment, etc. which might need to control odors.

Experiment 13: Field Experiment

Level: Junior and Senior High School

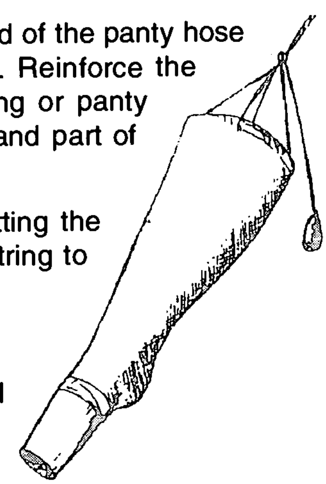
Objectives: Collect and study the plankton that make up the base of the food chain for marine and aquatic organisms.
Note: This experiment can be done in either fresh or salt water.

Tools:

- One leg of a nylon panty hose or a nylon stocking.
- A wire coat hanger or a plastic milk jug.
- Needle and thread.
- Duct tape.
- A vial or small bottle, plastic or glass (one with a lip).
- Strong cord.
- A small fishing sinker.
- A boat and motor (not necessary, but recommended. A rowboat may be used if you have a strong rower.)

Procedure:

- Twist the coat hanger into a ring. Attach the wide end of the panty hose leg to the coat hanger, using the needle and thread. Reinforce the stitching with the duct tape. Alternatively, the stocking or panty hose can be stitched to the milk jug after its bottom and part of the top have been cut out.
- Attach strong cord to three places of the ring, knotting the string together a foot or so in front of the net, or tie string to the handle of the jug.
- Add cord for a towing line.
- Cut open the toe of the stocking, and tie on the small catch bottle, making certain that the string is tight around the lip.



Results & Discussion

Using the net: Plankton nets can be towed by hand through the water or can be pulled behind a boat, either one with a motor or rowed. The net should be pulled fairly fast to keep it off the bottom or you will collect more than plankton. Smaller nets can be attached to a fishing rod and reel, cast out over the water, and reeled in.

As you pull the net through the water, tiny drifting organisms are trapped by the net and wash down the side into the catch bottle.

You can study your catch back at school. How many of the organisms you collected can you identify? What is the proportion of plants to animals? Can you suggest a reason why this might be?

Discuss the position of the plants (phytoplankton) and the animals (zooplankton) in the food chain. Discuss the importance of phytoplankton in the food chain and in maintaining air quality. What happens to the plankton if a pond dries up? How do plankton reach a new body of water?

EXPERIMENT 14: FIELD EXPERIMENT

LEVEL: Junior and Senior High School

PURPOSE: After marking off a plot of land for detailed field study, to assess its plant cover and determine if it is dominated by upland or wetland plants. (Note: A, B, and C may be done individually or one following the other.)

TOOLS:

A. Line Transect
- Heavy string (50-100 feet or so)
- Two wooden pegs
- Fluorescent plastic surveyor's tape

B. Belt Transect
- Heavy string (at least twice the amount used in A)
- Four wooden pegs
- Paper, pencil and clipboard

C. A Plot Grid
- Four pieces of 1" x 1" x 1 meter lathe (note: 1x2 lathe will do)
- Heavy string
- Nails
- Glue
- Small drill

D. All
- Field guides to help identify plants and animals

PROCEDURE: Note: for each of these activities, it will be more interesting if the area to be sampled extends inland from a lake, pond, or stream.

A. Line Transect
- Stretch the string between two pegs at the selected site.
- At regular intervals, tie the surveyor's tape to the string.
- Count the number of each type of plant that touches the string to determine the dominant vegetation at the area.
- At each ribbon, collect samples of the plants, or the soil for later study and identification in the classroom.
- You could run several parallel transects to obtain a more accurate assessment of the plant cover at a site. Or, you could use experiment B.

B. Belt Transect
- Mark out a narrow strip with pegs placed to form a rectangle.
- Tie and run a string from each peg, enclosing the rectangle.
- Draw a map of the area, using different symbols to indicate dominant vegetation, and vegetation zones.
- Inside the belt transect, follow the procedure in experiment C for a detailed assessment of the plant cover.

C. Plot Grid

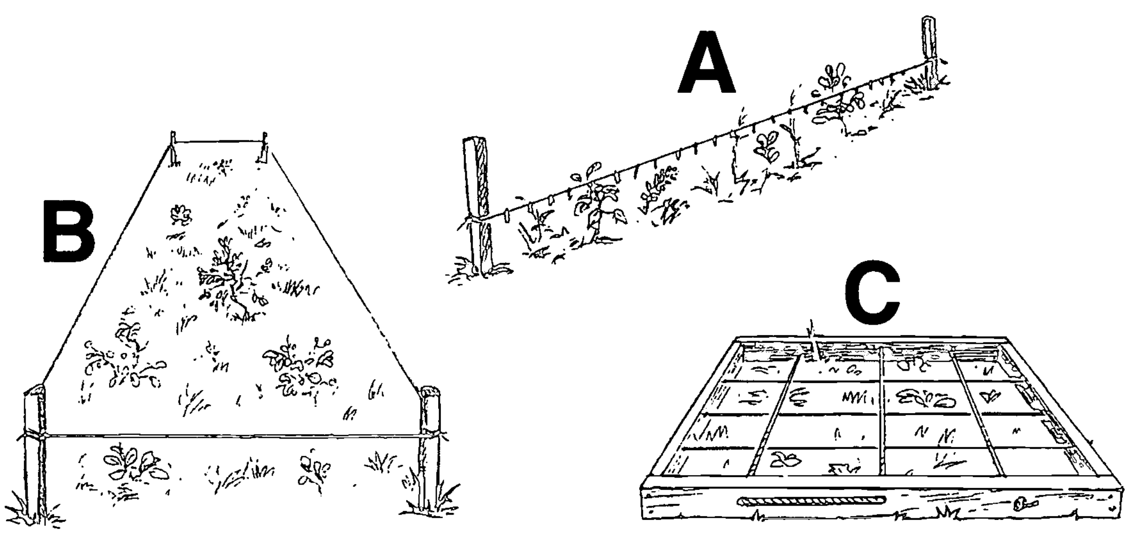
- Build a one-meter square frame from the pieces of lathe, nailing and glueing the corners securely.
- Drill three holes spaced evenly along each side of the frame.
- Weave the string through the holes (see illustration). Within your belt transect (see B) or on another plot, lay the grid on the ground. Count the total number of each kind of plant in each square and determine the relative dominance of each.
- Move the frame to an adjoining plot and repeat. Do this until you have completely sampled the chosen plot.

Results & Discussion

For each experiment, prepare a list of the kinds of plants in the sampling area, using the fieldbook. After the plants have been identified, determine whether the area is a wetland, a transitional zone between wetlands and uplands, or an upland. (The plant identification guide may indicate the habitat preferred by each species, or you may wish to consult other references [see appendix.]) Which method of sampling provides the most detailed picture of the area being sampled?

Schedule a class period to consider the importance of wetlands, transitional zones, and uplands to such things as wildlife, water quality, water supply, flood and erosion control, and aesthetics. Discuss how these sampling procedures might be used by planners to plan land uses which will have the least adverse effects, or by regulators to ensure that valuable resources are protected.

This is an area which teachers may wish to bring in outside "experts" to help the class discussions. Sources include DEP District Offices, city and county planning and environmental offices, and local offices of any of the other agencies listed in the appendix.



APPENDIX

Sources of environmental education and information about environmental education.

Department of Environmental Protection
booklets, speakers
Office of Environmental Education
3900 Commonwealth Blvd.
Tallahassee, FL 32399-3000
904/488-9334

Division of Forestry
booklets, speakers
3125 Conner Blvd.
Tallahassee, FL 32301
904/488-7000

Water Management Districts
booklets, speakers

Northwest Florida WMD
Route 1, Box 3100
Havana, FL 32333
904/539-5999

Suwannee River WMD
Route 3, Box 64
Live Oak, FL 32060
904/362-1001

St. Johns River WMD
P.O. Box 1429
Palatka, FL 32078-1429
904/329-4500

Southwest Florida WMD
2379 Broad St.
Brooksville, FL 33512-9712
904/796-7211

South Florida WMD
P.O. Box 24680
West Palm Beach, FL 33416-4680
305/686-8800

Office of Environmental Education
1311 Paul Russell Rd.
Suite 201A
Tallahassee, FL 32301
904/487-7900

Game & Fresh Water Fish Commission
booklets, speakers
620 S. Meridian St.
Tallahassee, FL 32399-1600
904/488-4676

OTHER SOURCES OF INFORMATION

There are a number of organizations which may be able to provide help or suggestions with other environmental experiments. Some of these are:

American Institute of
Chemical Engineers
345 East 47th St.
New York, NY 10017

American Society of
Mechanical Engineers
345 East 47th St.
New York, NY 10017

Florida Engineering Society
125 S. Gadsden St.
Tallahassee, FL 32301

The Air and Waste Management
Association
P.O. Box 2861
Pittsburgh, PA 15230

Florida Audubon Society
480 E. Highway 436
Casselberry, FL 32707

Local nature museums or state and county parks

SE056210I

ERIC

U.S. Department of Education
Office of Educational Research and Improvement (OERI)
National Library of Education (NLE)
Educational Resources Information Center (ERIC)

REPRODUCTION RELEASE

(Specific Document)

I. DOCUMENT IDENTIFICATION:

Title: Classroom & Field Experiments for Fla's Environmental Resources

Author(s): Jim Lewis

Corporate Source: DEP - Dept of Environmental Protection

Publication Date: 1993

II. REPRODUCTION RELEASE:

In order to disseminate as widely as possible timely and significant materials of interest to the educational community, documents announced in the monthly abstract journal of the ERIC system, *Resources in Education* (RIE), are usually made available to users in microfiche, reproduced paper copy, and electronic media, and sold through the ERIC Document Reproduction Service (EDRS). Credit is given to the source of each document, and, if reproduction release is granted, one of the following notices is affixed to the document.

If permission is granted to reproduce and disseminate the identified document, please CHECK ONE of the following three options and sign at the bottom of the page.

The sample sticker shown below will be affixed to all Level 1 documents	The sample sticker shown below will be affixed to all Level 2A documents	The sample sticker shown below will be affixed to all Level 2B documents
PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL HAS BEEN GRANTED BY Sample TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC) 1	PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL IN MICROFICHE, AND IN ELECTRONIC MEDIA FOR ERIC COLLECTION SUBSCRIBERS ONLY, HAS BEEN GRANTED BY Sample TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC) 2A	PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL IN MICROFICHE ONLY HAS BEEN GRANTED BY Sample TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC) 2B
Level 1	Level 2A	Level 2B
[✓]	[ ]	[ ]
Check here for Level 1 release, permitting reproduction and dissemination in microfiche or other ERIC archival media (e.g., electronic) *and* paper copy.	Check here for Level 2A release, permitting reproduction and dissemination in microfiche and in electronic media for ERIC archival collection subscribers only	Check here for Level 2B release, permitting reproduction and dissemination in microfiche only

Documents will be processed as indicated provided reproduction quality permits.
If permission to reproduce is granted, but no box is checked, documents will be processed at Level 1.

I hereby grant to the Educational Resources Information Center (ERIC) nonexclusive permission to reproduce and disseminate this document as indicated above. Reproduction from the ERIC microfiche or electronic media by persons other than ERIC employees and its system contractors requires permission from the copyright holder. Exception is made for non-profit reproduction by libraries and other service agencies to satisfy information needs of educators in response to discrete inquiries.

Sign here, please

Signature: Teri Valente	Printed Name/Position/Title: Teri Valente AA II
Organization/Address: 3900 Commonwealth Blvd MS-30 Tallahassee FL 32399	Telephone: 850-488-9334 FAX: 850-922-6615
	E-Mail Address: Date: 12/8/98

(over)

III. DOCUMENT AVAILABILITY INFORMATION (FROM NON-ERIC SOURCE):

If permission to reproduce is not granted to ERIC, *or*, if you wish ERIC to cite the availability of the document from another source, please provide the following information regarding the availability of the document. (ERIC will not announce a document unless it is publicly available, and a dependable source can be specified. Contributors should also be aware that ERIC selection criteria are significantly more stringent for documents that cannot be made available through EDRS.)

Publisher/Distributor:
Address:
Price:

IV. REFERRAL OF ERIC TO COPYRIGHT/REPRODUCTION RIGHTS HOLDER:

If the right to grant this reproduction release is held by someone other than the addressee, please provide the appropriate name and address:

Name:
Address:

V. WHERE TO SEND THIS FORM:

Send this form to the following ERIC Clearinghouse:

However, if solicited by the ERIC Facility, or if making an unsolicited contribution to ERIC, return this form (and the document being contributed) to:

ERIC Processing and Reference Facility
1100 West Street, 2nd Floor
Laurel, Maryland 20707-3598

Telephone: 301-497-4080
Toll Free: 800-799-3742
FAX: 301-953-0263
e-mail: ericfac@inet.ed.gov
WWW: http://ericfac.piccard.csc.com