

Indiana Volunteer Lake Monitoring Program

Expanded Monitoring Handbook

April 2001

Background

Indiana has over 1,100 lakes. These lakes offer Hoosiers tremendous recreational opportunities, whether they are used for boating, fishing, swimming, or quiet enjoyment. The lakes also offer habitat for waterfowl and other wildlife. Many lakes are used for drinking water supplies and flood control. In short, Indiana lakes are an integral part of our lives.

Because they are so important, we all must insure that our lakes maintain their beauty and water quality. Unfortunately, keeping close track of the water quality of each lake would be a costly and difficult undertaking.

The time and expense of monitoring the water quality of all our publicly owned lakes has encouraged the Indiana Department of Environmental Management (IDEM) to sponsor the Volunteer Lake Monitoring Program as a part of its Clean Lakes Program. Through this program, you can learn more about your lake and other lakes in Indiana while helping to monitor your lake's water quality. The Volunteer Lake Monitoring Program is modeled closely after the successful citizen monitoring program in Wisconsin. Other states, including Illinois, Minnesota, Ohio, and New York, have similar citizen programs.

Who Runs the Program?

The Volunteer Lake Monitoring Program is a cooperative effort by three groups: the volunteers, IDEM, and Indiana University's School of Public and Environmental Affairs (SPEA).

You, as a representative of the volunteers, are the crucial link in the operation of the Volunteer Lake Monitoring Program. You probably know your lake better than either of the other two groups. You know where the best fishing is, what birds visit the lake, and where the weeds are causing problems. You volunteered because of your concern for the lake. By collecting the data for your lake, you can help IDEM and SPEA understand more about your lake and we can help you increase your understanding how your lake "works."

SPEA will assemble the data that you collect and will enter it into a computer data base. At the end of the sampling season, SPEA will send you a summary of your measurements and a summary of other volunteers' lakes. The statewide summary will allow you to compare the water quality of your lake to others. It will be presented in easy-to-understand graphs and written comments. The annual summaries will allow IDEM to closely monitor water quality changes and identify management needs at the participating lakes.

What is the Lake Monitoring Program All About?

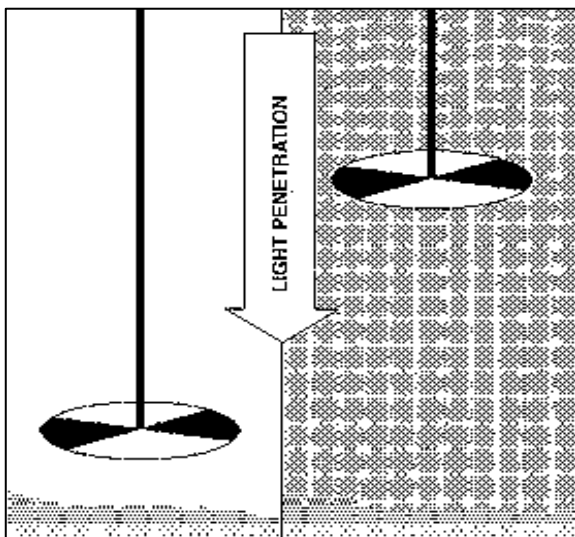
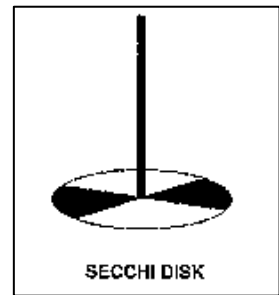
Begun in 1989, the Volunteer Lake Monitoring Program now includes over 100 Indiana lakes. More lakes are added to the program each year. Citizen volunteers like you donate about one hour of their time every two weeks to collect the necessary data. Your efforts provide a number of benefits not only for IDEM, but also for you. Here's how:

- 1) As a volunteer you will learn more about lake science (*limnology*).

- 2) You will learn not only about taking Secchi disk transparency readings, and possibly collecting total phosphorus and chlorophyll *a* samples, but also about other water quality tests. However, the data you collect will be valuable *only* if you take the readings carefully and according to set procedures.
- 3) By analyzing your samples and summarizing the information that you collect, we will be able to assess the changes in water quality at your lake. This is particularly important for lakes where little information has been gathered in the past.
- 4) After we have summarized the data, we will be able to compare the water quality of lakes around the state. This information will allow us to better understand our Indiana lakes.
- 5) Once we have several seasons' worth of data for a particular lake, we can begin to assess the long-term trends in the lake's water quality. Five years' worth of Secchi disk data will provide an indication if the lake is being degraded, is improving, or staying the same. One season of sampling is not enough to establish long-term trends.
- 6) This assessment can identify which lakes should receive more intensive management and/or monitoring.

What Do These Measurements Say About Water Quality?

The Secchi disk that you received as part of your volunteer package is used to measure water clarity or transparency. It is one of the oldest and most basic tools used by limnologists around the world. The Secchi disk is an eight-inch diameter disk painted black and white in alternating quarters. It is attached to a fiberglass measuring tape marked in **tenths** of feet. Look at the tape carefully to see that the markings are NOT in inches! (Earlier Secchi disks used in this program were attached to nylon cords marked in one-foot intervals.)

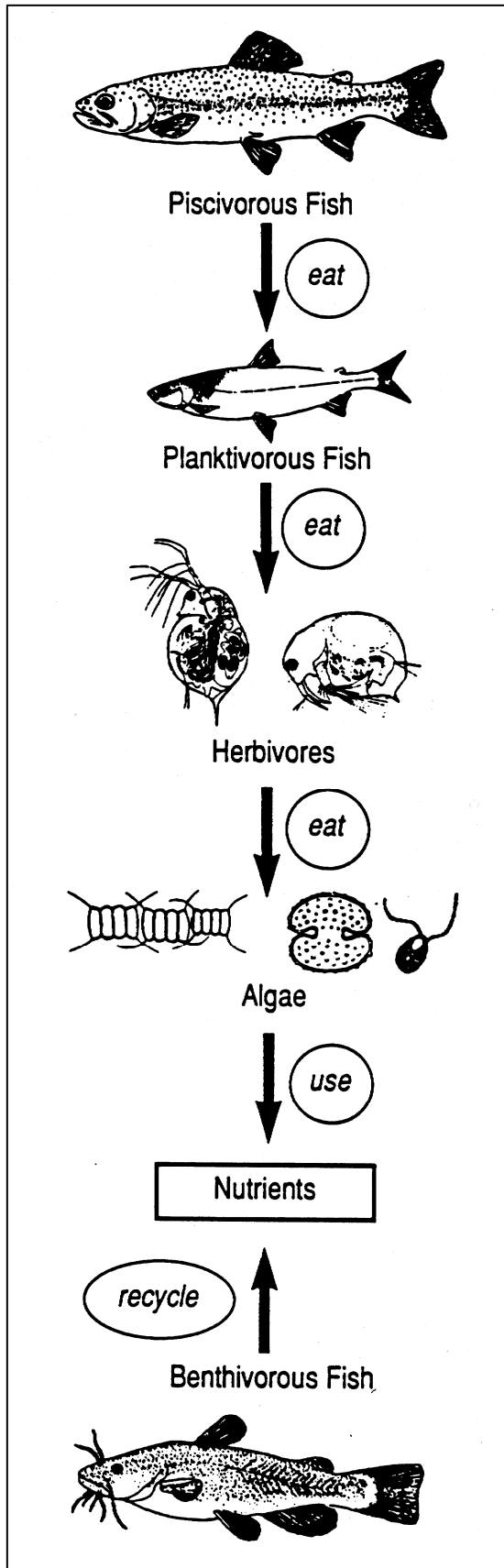


Clear Lake

Turbid Lake

Secchi disk measurements of water clarity can tell a great deal about the water quality of lakes. Water clarity is affected by two factors: algae and suspended sediments. Sediments may be introduced into the water by either runoff from the land or from sediments already on the bottom of the lake. Many activities may introduce sediments to lakes via runoff: examples include erosion from construction sites, agricultural lands, and riverbanks. Bottom-feeding fish such as carp may resuspend bottom sediments, or in shallow lakes, sediments may be suspended by motor boats or strong winds.

Algae are a natural component of the food chain in lakes. They are food for microscopic animals (zooplankton), which are, in turn eaten by fish. We



AQUATIC FOOD CHAIN

are usually only aware of algae when they become overly abundant. Algae are microscopic plants, which grow like plants do; they need sufficient light and nutrients to survive. When there are too many nutrients in the lake, the algae multiply enough to cause a decrease in water clarity. The decrease will be seen when you take the Secchi disk transparency reading.

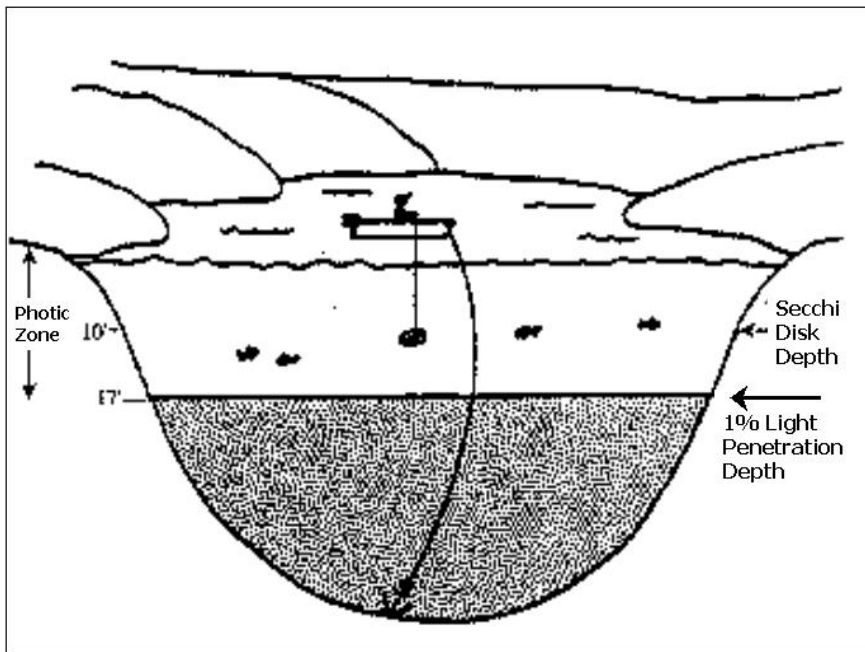
Of course, algae and suspended sediments are not the only factors that will affect your Secchi disk reading. Other factors that may affect your reading will be the color of the water, wind, waves, sunlight, and even your eyesight. Some lakes have a natural brown color. The color is not an indication of pollution or suspended sediments, but of tannic acids produced by decaying plants. Light does not penetrate as deeply in these darkened waters, so these brown lakes will generally have fewer algae than clear lakes.

Secchi disk transparency readings can also give a rough estimate of the depth to which oxygen can support fish and other aquatic life. Generally the Secchi disk depth times 1.7 is the depth to which light can penetrate. For example, if your Secchi disk reading was 10 feet, then light can penetrate to a depth of approximately 17 feet. If light can penetrate this far, then there is enough light to support an algal population. The *photic zone* is defined as the vertical depth of a lake that has enough light to support plant growth. Algae use the light to produce energy through a process called photosynthesis. Oxygen is released by the algae as a by-product of photosynthesis. The oxygen is in turn used by the fish that live in the deeper waters of the lake.

When to Take a Reading

The weather is another factor that will affect your ability to read the Secchi disk. Try to take your readings on days when the lake is calm and the sky is clear. The angle of the sun will affect your ability to see the disk, so take readings between 10 a.m. and 4 p.m. Winds creating high waves will adversely affect your ability to read the disk.

The goal of our program is to have transparency monitored *once every two weeks*. Try to make the sampling a regular part of your activities. If you are



able to take a reading every week, great! Total phosphorus and chlorophyll samples should be taken *once per month during the summer months*.

Water transparency following intense rainstorms or heavy boating activity is often lower than other times. This is to be expected. For example, many of our volunteers report worse transparencies on Saturdays, Sundays, and

Mondays than on other days of the week. We encourage you to vary the day of the week that you make your Secchi disk transparency measurement. This will help cover the entire range of conditions common on your lake. We especially encourage you to make a measurement after a heavy storm runoff. Use the comment section of the data card to indicate if there was a recent heavy rain or other event that could affect your reading. We analyze your data according to day of the week measured and according to any special conditions you note.

If you are unable to take your scheduled reading, do not worry about it. Take it as soon as you are able. If for some reason you are unable to continue to sample during the sampling season, please do not hesitate to contact SPEA. In this event, it would be extremely helpful to the program if you could provide us with the name of another lake resident interested in volunteering to take the readings.

Other Information to Collect

After you make each Secchi disk transparency measurement, we'd like you to also record the (a) water color, (b) recreation potential of the lake, and (c) physical appearance of the water.

Water Color

A lake's water color can give us insight into whether transparency is affected by algae (green color) or suspended sediments (brownish color) or even what kind of algae (green, blue-green, yellow-brown...). Water color can be determined by lowering your Secchi disk into the water to about one-half the Secchi disk depth. Look at the water color against the white background of the disk. Compare the water color to one of the 19 colors represented on your color chart. Record this color number on the data card.

Recreational Potential

We would also like to get your opinion of your lake's "recreational potential" and "physical appearance" at the time you take your Secchi disk measurement. This helps us relate Secchi disk transparency to the use and appearance of your lake. Remember, this should be your

opinion on the condition of your lake. For the “recreational potential”, if everything looks great, circle “beautiful” on the date card. If the water looks really scummy and you personally wouldn’t want to swim in the lake, circle “no swimming”. If swimming isn’t allowed in your lake, we’d still like you to consider “recreational potential” as if swimming was allowed.

Similarly, circle the condition that you feel best represents the lake’s physical appearance.

Expanded Monitoring

Total Phosphorus: A Measure of Nutrient Enrichment

Phosphorus is often the key nutrient in determining the amount of phytoplankton (algae) in a lake. In comparison to other nutrients, phosphorus is usually the first element to limit biological productivity. Most of the phosphorus in lakes occurs in two forms: dissolved phosphorus and particulate phosphorus. The determination of dissolved phosphorus is a measure of the inorganic form of phosphorus *available* to algae. The determination of total phosphorus is a measure of all forms of phosphorus *potentially available* to algae.

Phosphorus enters a lake from rainfall, incoming streams, overland runoff, groundwater, and direct discharges. Phosphorus is also contributed to lakes from decomposition of organic matter and the erosion of soils. Phosphorus in the lake sediments may be released into the water under anoxic (no oxygen) conditions. Phosphorus is contributed to a lake by human activity in the watershed, direct discharge of wastes, runoff from agriculture, or poorly maintained septic systems.

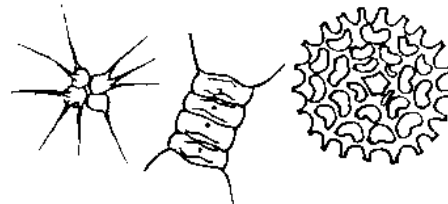
Phosphorus is often the *limiting nutrient* in freshwater systems because it is unavailable from the atmosphere and rapidly recycled and converted to forms unavailable to algae. As the limiting nutrient, any addition of phosphorus can stimulate more algae growth.

To sample for total phosphorus, a water sample is collected every month throughout the growing season in a specially cleaned bottle and then analyzed in the laboratory.

Chlorophyll *a*: A Measure of Lake Productivity

Chlorophyll *a* is the photosynthetic pigment that causes the green color in algae and plants. The concentration of chlorophyll *a* present in the water is directly related to the amount of algae living in the water. Excessive concentrations of algae give lakes an undesirable “pea soup” appearance.

Some representative algae



The water quality characteristics of a lake largely determine which types of algae will be present. Lakes with high nutrient enrichment will tend to support larger numbers of algae than lakes with low nutrient enrichment. Other factors such as water temperature, depth, pH, and alkalinity also influence the species and numbers of algae found in a lake.

To measure chlorophyll *a* concentration, you will take an integrated water sample from the lake every month throughout the growing season. The water sample is “integrated” because it represents a sample of the water column from the surface to a depth of 6 feet. The integrated sample allows us to examine the water column where phytoplankton live (i.e. the part of the water column with enough sunlight for photosynthesis to occur). Then, a certain volume of this integrated sample is filtered. All of the algae (and other suspended particles) in the water will collect on the filter paper, which is then analyzed in the laboratory for chlorophyll *a* concentration.

Sampling Checklist

Before going out on the lake to make your Secchi disk reading and/or collect your water samples, make sure that you have everything you need and the weather conditions are okay for sampling!! Please confirm everything on this checklist and, if you are collecting water samples, make certain that you have all the equipment pictured at the top of the next page as well.

Weather:

- Sunny/partly sunny/partly cloudy
- Winds calm to breezy (NO WHITECAPS!!)

Date and time of day:

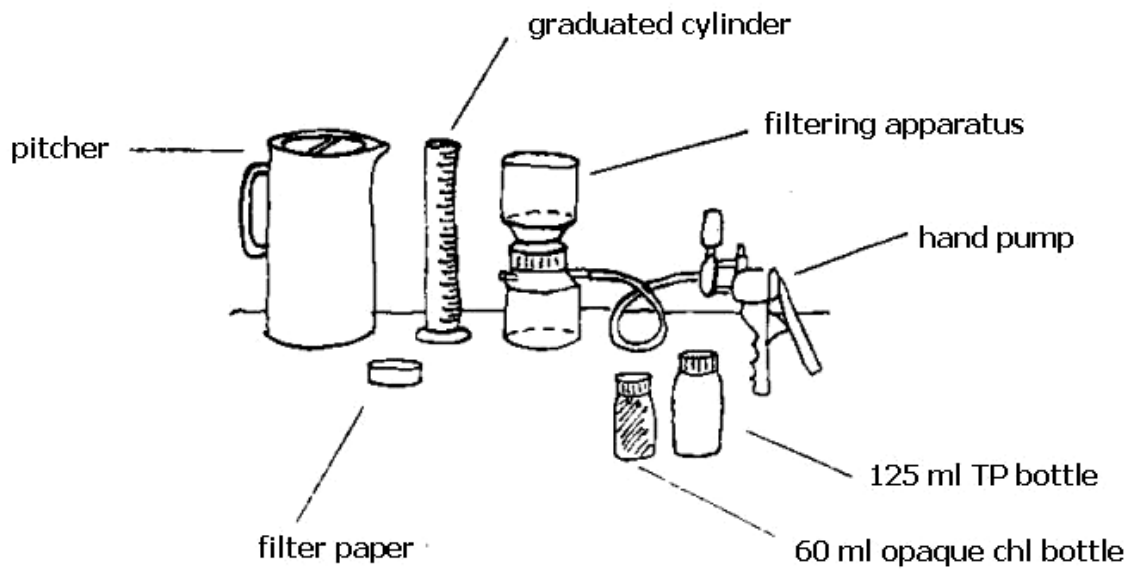
- Between 10 a.m. and 4 p.m.

Do you have:

- Secchi disk?
- Boat anchor?
- Color chart?
- Sampling instructions?
- Data forms?
- Something to write with?

Equipment for Chlorophyll *a* and Total Phosphorus Sample Collection:

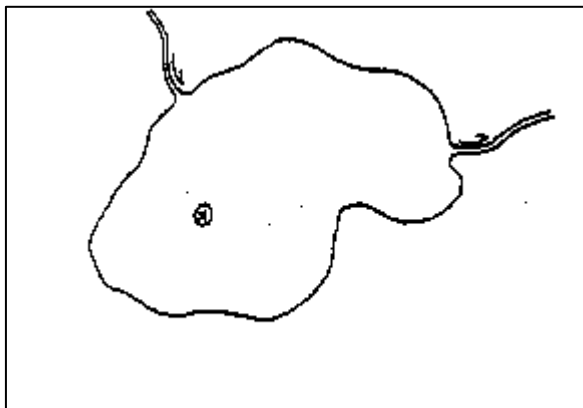
- Filtering apparatus ~ cap, upper chamber, filter support plate & receiver
- Pitcher
- 250 milliliter graduated cylinder
- 4.7 cm filter paper (in plastic case) with Tweezers
- Hand-operated pump with clear tubing
- PVC pipe (for sample collection)
- Sample bottles ~ 1--6 ml opaque (chlorophyll *a*) & 1-- 125 ml clear (total phosphorus)
- Styrofoam mailer



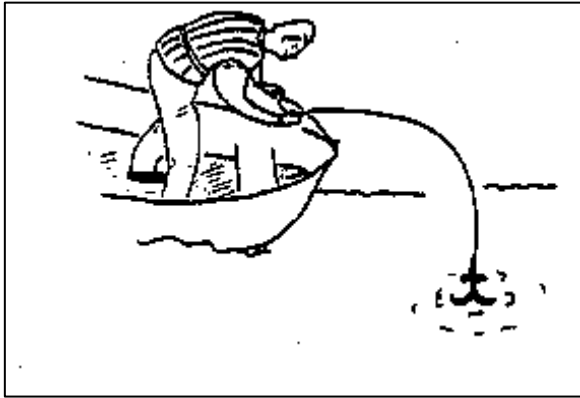
Chlorophyll a sampling gear

HOW TO TAKE A SECCHI DISK READING

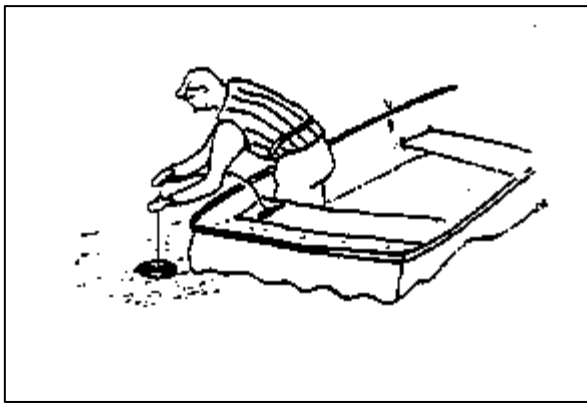
When taking the Secchi disk readings and water samples be sure to follow the instructions. Remember, do not feel guilty about missing a scheduled reading, do it when you have the time. **NEVER** make up data. We would rather have no data than invalid data. Most of all enjoy your time in the boat and on the lake.



1. Use the map of your lake and its marked sampling site and proceed to the site. Always take your Secchi disk measurements from this same general location.



2. Anchor the boat at the sampling site. Remove your sunglasses.



3. Lean over the **shady** side of the boat and slowly lower the Secchi disk into the water until it can no longer be seen.

4. Note the depth that the Secchi disk disappears from site. **Remember:** the marks on the measuring tape are in tenths ($1/10$) of a foot NOT inches.
5. Lower the disk a few more feet into the water. Slowly raise the disk. When the disk reappears, note this depth. Record the mean depth between where the disk disappeared and reappeared as the Secchi disk transparency depth.

Measuring Tape Markings



6. *Tape Measure:* Carefully read off the depth to the nearest **tenth** of a foot.
7. Record the measurement on the date card and/or data log (see pages 9 & 10 for examples).

Secchi Disk/Expanded Data Log

Volunteer Name: _____

Lake Name: _____ County: _____

| <i>Date/Time</i> | <i>Secchi Depth (feet)</i> | <i>Water Color (number)</i> | <i>Recreation Potential (number)</i> | <i>Physical Appearance (number)</i> | <i>Amount Filtered (mls)</i> |
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Your Name: _____
 Lake Name: _____
 County: _____
 Sample Date: _____ Sample Time: _____
 SECCHI DISK TRANSPARENCY: (Record to nearest 1/10 foot)
 Depth: _____ Did it hit bottom? (circle one) NO YES
 WATER COLOR: (select one from color chart) _____

| | |
|------------------------------|-----------------------------|
| RECREATION POTENTIAL: | PHYSICAL APPEARANCE: |
| 1. Beautiful | 1. Crystal Clear |
| 2. Minor Aesthetic Problems | 2. Some Algae |
| 3. Swimming Impaired | 3. Definite Algae |
| 4. No Swimming | 4. High Algae |
| 5. No Recreation | 5. Severe Algae |

(Circle the condition that most applies in each category.)
 OTHER COMMENTS: _____

Sample Data Card

8. To determine the water color, lower the Secchi disk into the water to about 1/2 the Secchi disk depth and observe the water color against the white background. Record your observation.
9. Consider the water quality condition of the lake and circle one answer for "Recreation Potential" and one answer for "Physical Appearance."



No postage stamp necessary. Postage has been prepaid by:

**Bill Jones
 Clean Lakes Program
 SPEA 347
 Indiana University
 Bloomington, IN 47405**

10. If you are taking water samples, proceed with the expanded program directions. If you are monitoring more than one site or lake, proceed to the next location and repeat steps 1-9.

11. Once on shore, check to see that the data card is completely filled out. Mail it as soon as you can.

- OR -

12. Log onto the Indiana Clean Lakes Program web site and enter your data **on line!** See page 11.

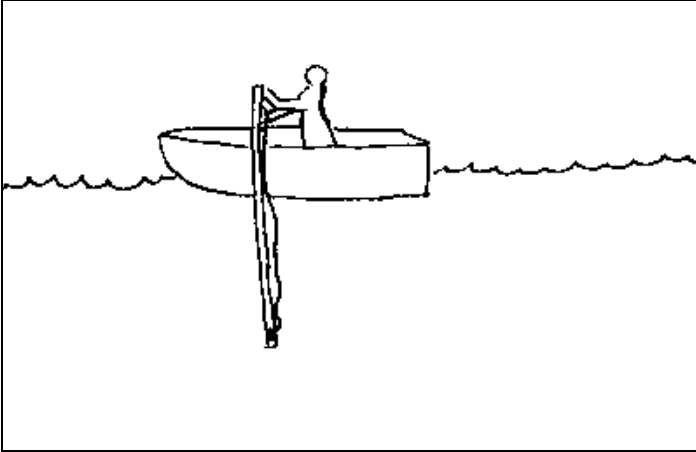
After taking your Secchi disk reading, be sure to:

- ❑ Store your Secchi disk, color chart and equipment in a dry place.
- ❑ Go over the data form and make sure it's complete.
- ❑ Carefully copy the data onto the SPEA postcard. Make sure all the blanks are filled.
Mail the postcard to SPEA in Bloomington.
 - **-OR-**
- ❑ Log onto the Indiana Clean Lakes Program web site at: <http://www.spea.indiana.edu/clp/> and enter your data onto our electronic data entry form.

Instructions for Entering Data Using the Clean Lakes Program Web Page

1. Log onto the Internet using your web browser.
2. Type in our web site address: <http://www.spea.indiana.edu/clp/> (save this address in your 'Favorites')
3. From the CLP home page, click on the link that reads **Volunteer Monitoring**
4. Click on the link that reads **Data Entry Form**
5. Now just enter information requested in all the blanks. Use the **TAB** key to advance to the next box. Do **NOT** use the 'Return' or 'Enter' key. We have drop-down menus from which you can select your county, lake name, recreational potential and physical appearance.
6. **IMPORTANT!** Check your data entries very carefully. Once you are satisfied that everything is correct, click on the button reading **Submit Form**
7. This transmits your data to us in Bloomington and automatically enters it into our volunteer monitoring database. This saves us from having to re-enter your data from the data cards.
8. If you wish to delete all your data from the form and not submit it, click on the button that reads: **Reset Form** will bring up another blank form for you to use.

HOW TO COLLECT CHLOROPHYLL *a* AND TOTAL PHOSPHORUS SAMPLES



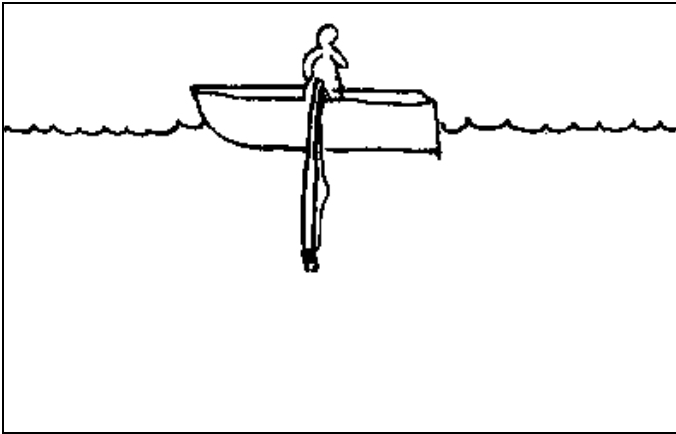
1. Rinse the pitcher with lake water twice by simply dipping the pitcher into the lake.
2. Rinse the pipe by slowly lowering the end of the pipe into the water so that the 6 foot mark on the pipe is 2 feet below the lake surface. The ball valve needs to be open during this step.
3. Slowly pull the sampling pipe back up and into the boat. Repeat.

**Don't have an integrated pipe sampler?? Contact us or see Appendix A (page 26) for instructions on making one.

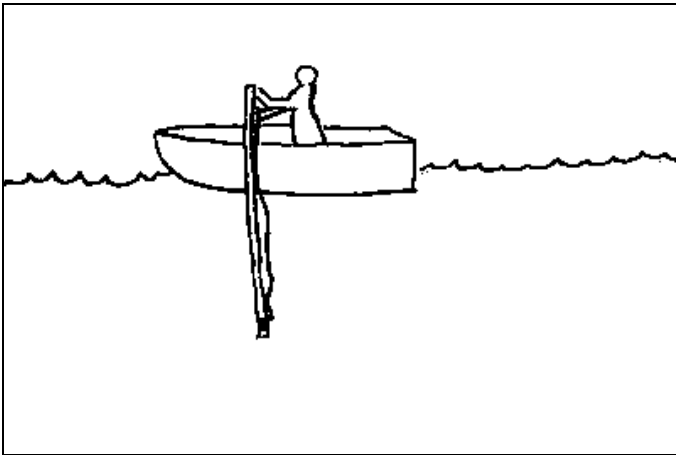
TABLE 1

| Secchi Depth | Vol of Water to Filter |
|--------------------------|------------------------|
| < 1 ft | 50 mls |
| 1 – 1.5 ft | 100 mls |
| >1.5 – 2.5 ft | 200 mls |
| >2.5 – 3.5 ft | 300 mls |
| >3.5 – 6 ft | 500 mls |
| >5 ft – 9 ft | 800 mls |
| >9 ft – 16 ft | 1000 mls |
| >16 ft | 1500 mls |
| “>” means “greater than” | |

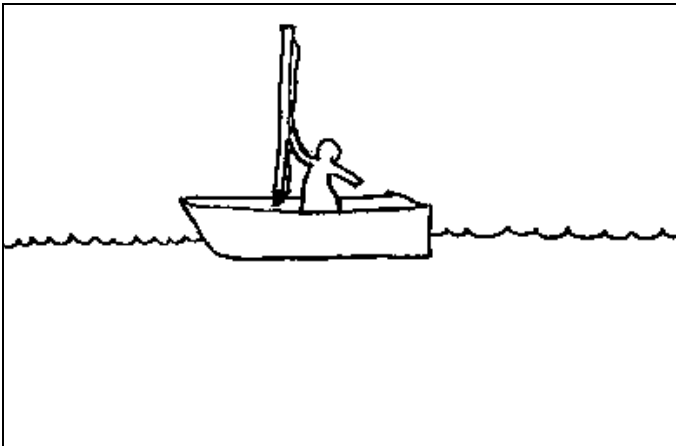
4. Take a Secchi disk reading if you have not done so already. Refer to Table 1 and determine the amount of water required for chlorophyll-a filtration. For example, if your Secchi depth was 10 feet you would need to filter at least 1000 ml of water for chlorophyll *a*, plus collect 125 ml for your total phosphorus bottle. Each integrated sample delivers about 1000 ml so you would need to collect 2 samples of lake water in the pitcher before filtering or filling any bottles.



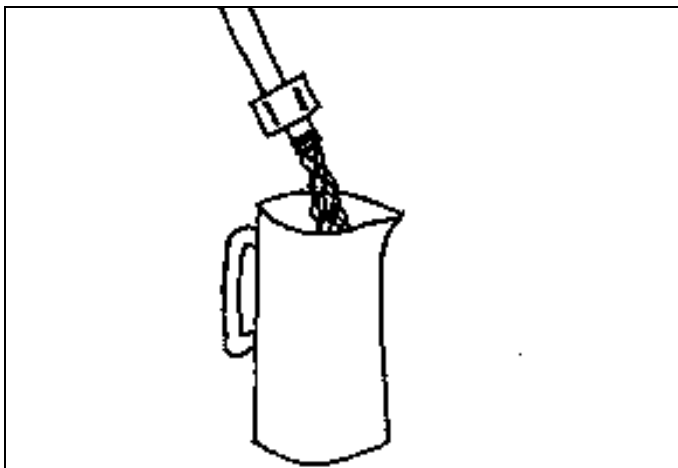
5. Your goal is to filter enough water to make the filter green (like #1 on your color chart). This will give us enough pigment to analyze in the lab. Table 1 above provides a starting point – **you will likely have to filter more than what the chart indicates.** Be certain to keep track of all the water you filter.



6. To take the integrated water sample, slowly and evenly lower the end of the pipe into the water until the 6-foot mark on the pipe is even with the surface of the water.



7. Pull the rope on the pipe to close off the valve at the bottom of the sampler. Hold the open end out of the water, keeping the pipe perpendicular to the water's surface

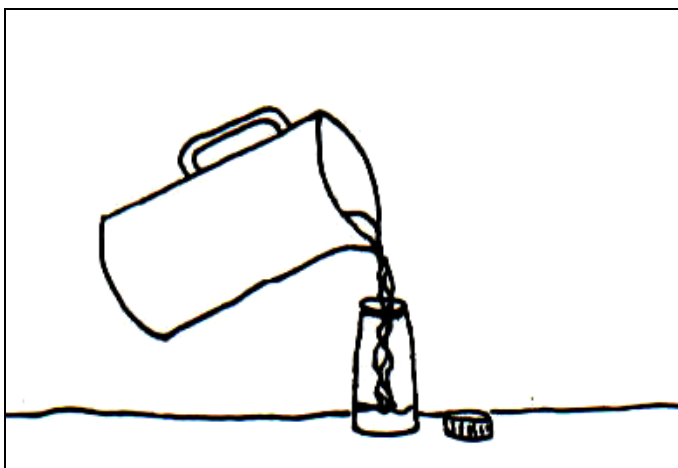


8. Hold the end of the pipe over the pitcher. In order to prevent contamination, be careful not to let the coupling on the end of the pipe touch anything (your hands, the pitcher, the water that you will empty into the pitcher).

9. Slowly release the valve in the pipe.

10. Allow the entire sample to drain from the pipe before continuing.

11. Once the pipe is empty, check to see if you need to take another sample (see step 4). If you do, repeat the procedure again in steps (4) to (10) until you have the correct amount of water.



12. Swirl the pitcher to thoroughly mix the water.

13. Carefully pour the water from the pitcher into the Total Phosphorus bottle (clear bottle). (The bottle has been specially washed so do not rinse it out prior to filling). Be careful not to let the mouth of the Total Phosphorus bottle touch the pitcher or anything else.



14. Fill the bottle up to the bottom of the neck in order to allow for expansion of the water when you freeze it.

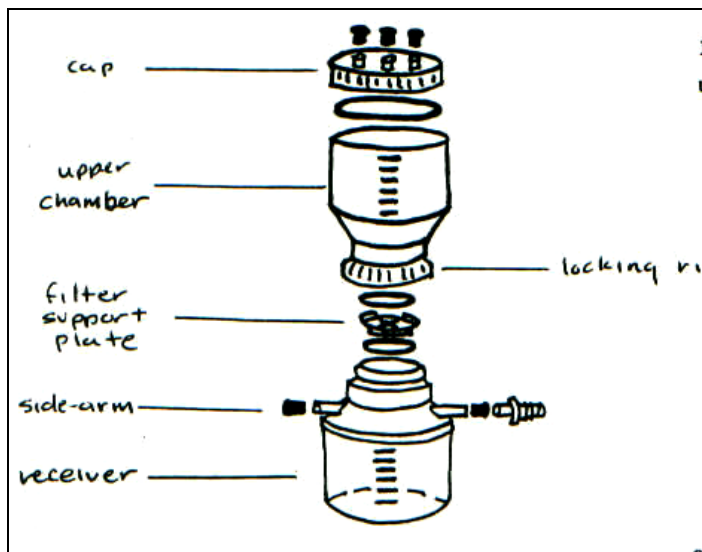
15. Securely screw the cap onto the bottle.



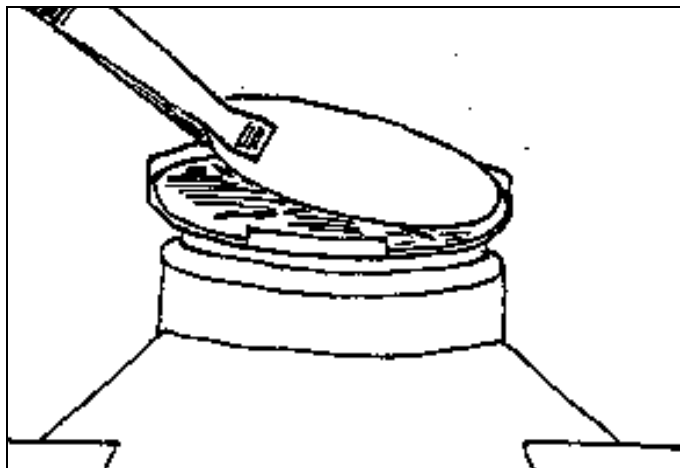
16. Label the Total Phosphorus bottle on the tape with the "Sharpie" pen. Be sure to include lake name and the date sampled.

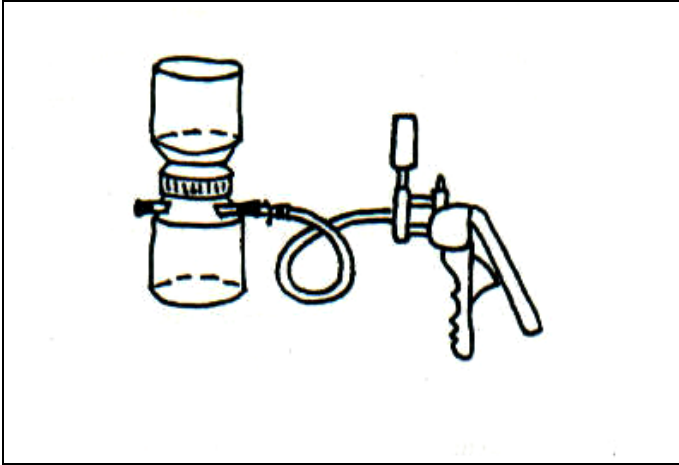
HOW TO FILTER CHLOROPHYLL *a*

NOTE: The chlorophyll *a* filtration procedure should be conducted out of direct sunlight. Exposure to direct sunlight promotes the degradation of chlorophyll *a*. Try to keep the filtration apparatus out of direct sunlight whenever possible.



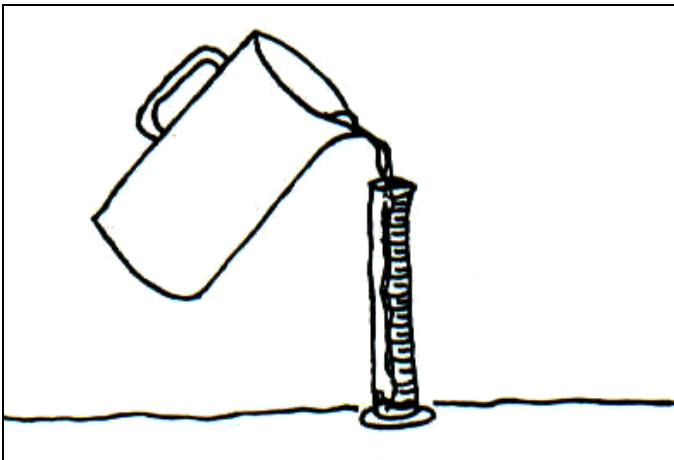
1. Separate the chlorophyll-*a* filtration apparatus by unscrewing the upper chamber from the receiver.
2. Pick up one of the 4.7 cm filters with tweezers and place the filter on the filter support plate on top of the receiver.
3. Carefully place the upper chamber back on top of the filter support and receiving flask.
4. While holding the upper chamber piece stationary, tighten the locking ring until the upper chamber is firmly seated on the receiver. (Do not over tighten the locking ring or allow the upper chamber to rotate while tightening because this may tear the filter paper.)



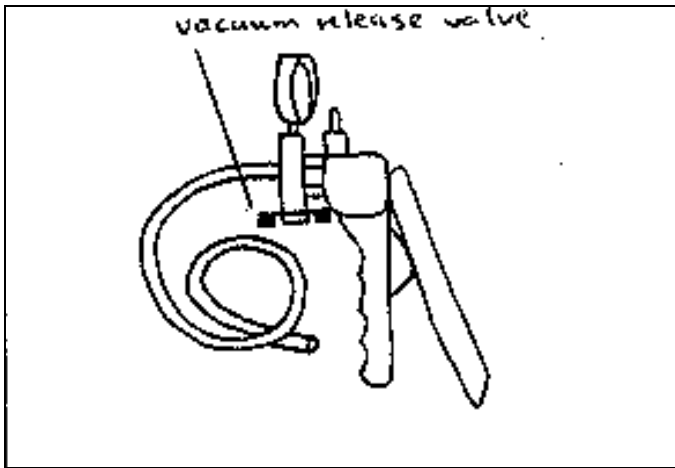


5. Connect the tubing from the hand pump to one of the two side-arms on the side of the receiver. (The other side-arm must have a black cap on it in order for a vacuum to form).
6. Using your previously measured Secchi depth, refer again to Table 1 to determine the amount of water to filter. [example: if the Secchi depth was 7 feet, then you would measure out 500 ml (2 x 250 ml contained in graduated cylinder) of water from the integrated sample in the pitcher].

**** Remember** – Table 1 gives you the amount of water to start with. If the filter is not green, then add more water, 100 ml at a time until the filter is a nice, green color. Be careful! Too much water will clog the filter and then you will have to start over.



7. Pour water from graduated cylinder into upper chamber. Squeeze the vacuum pump until the pressure on the dial reaches 15 on the outer scale of the dial. Do not exceed 15 psi or the pressure may damage the filter. Over time the pressure will decrease so you will need to periodically squeeze the hand pump to maintain pressure.
8. Note that the upper chamber and receiver only hold 500 ml each. If you are required to filter more than 500 ml, you must disassemble the filtering apparatus and empty out the receiver according to the following procedure outlined in steps (9) to (16). If you do not need to filter more than 500 ml, proceed to step (17).



9. Has all of the sample water passed through the filter? Squeeze the vacuum pump several extra times to remove as much water as possible from the filter.

10. Release the pressure of the vacuum pump by rotating the vacuum release valve to the right.

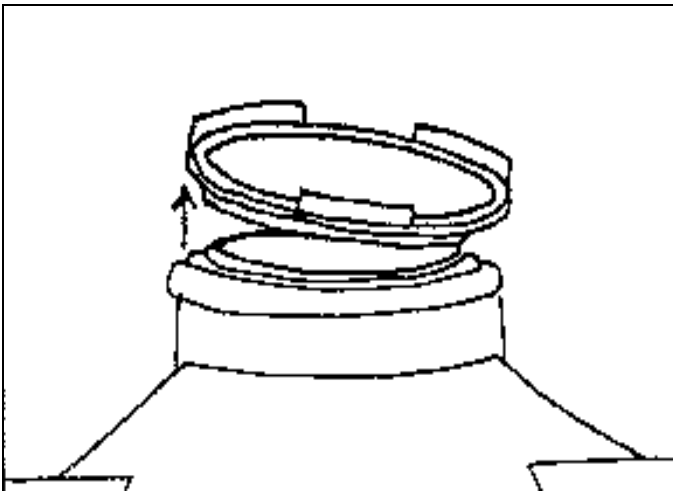
11. Hold the upper chamber stationary while unscrewing the locking ring.

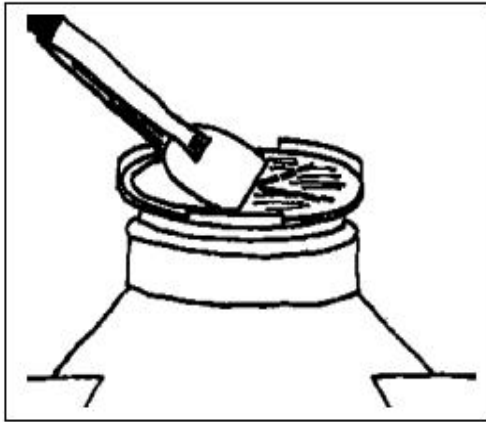
12. Carefully remove the upper chamber by lifting directly upwards. The filter support plate should now be exposed on the top of the receiver.

13. Grasp the filter support plate by its edges and lift directly upwards. The filter support plate should snap out of the receiver.

14. Carefully empty the water in the receiver into the lake. Remember, we are only interested in what is left on the filter paper, not the filtered water. Be sure not to dump water down the plastic tubing that connects the hand pump to the receiver.

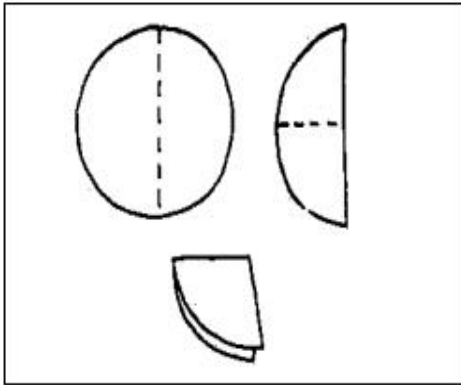
15. After emptying the flask, return the filter support plate with the “green” filter containing algae and particulate matter to the receiver by snapping it back on the top of the receiver. (Be sure not to touch the filter).



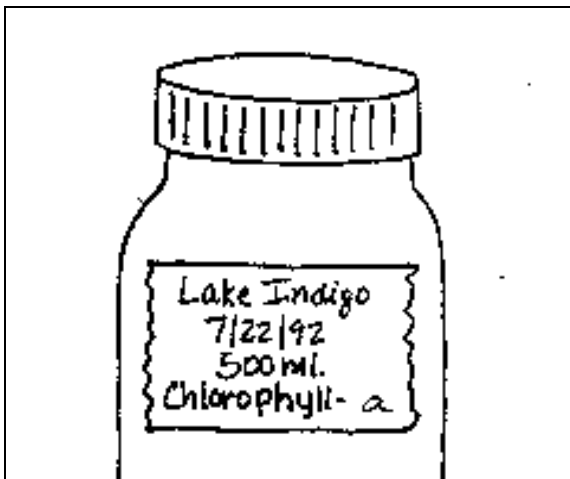


16. Reconnect the upper chamber as instructed in step (3) and (4) and proceed filtering the remainder of your sample as indicated by the Secchi depth. (Remember you already filtered 500 mls!)

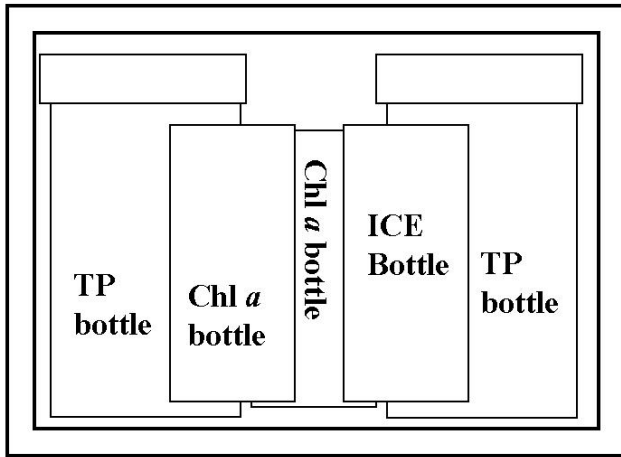
17. When you are done filtering the recommended amount of lake water, remove the upper chamber as directed in steps (9) through (12).



18. Using the tweezers, carefully pick up the edge of the filter and fold it in half on top of the filter support plate. (All of the algae and other particles are trapped on top of the filter paper, therefore this “green,” top side of the filter must always be on the inside of the fold). Make sure that all of your folds are crisp to ensure that the “green” stays inside and is not lost during transfer to or from the bottle.



19. Place the folded filter paper into the opaque amber chlorophyll sample bottle and label the bottle with a “Sharpie.” Include the lake name, date and number of milliliters of sample water filtered. Also record this information on your data log sheet.



20. Place both the chlorophyll and the total phosphorus bottles in the styrofoam mailer and put the mailer in the freezer. Samples must be frozen immediately. If the styrofoam mailer will not fit in your freezer, put the loose samples in freezer but be careful not to lose them!
21. Once you have collected two total phosphorus samples and two chlorophyll *a* samples, mail frozen samples.
22. Pack styrofoam cooler as shown to the left. Seal with tape. Place sealed cooler in mailing bag and affix the pre-printed and posted mailing label. Take package to the Post Office close to the time when packages go out so your sample doesn't sit in a warm room or truck for too long.

Clean-up and Storage of Equipment

1. Rinse all of the sampling equipment [pitcher, hose, filter apparatus (be sure to remove hand pump), graduated cylinder, tweezers] with tap water. **IN ORDER TO PREVENT CONTAMINATION, DO NOT USE ANY TYPE OF DETERGENT ON THE EQUIPMENT.**
2. Let the equipment air dry.
3. Once equipment is dry reassemble the filter apparatus and reconnect the hose ends in order to prevent any contamination from entering the hose.
4. Return the equipment to the storage bucket. Place the bucket in a safe, dry place until next month.

TEMPERATURE & DISSOLVED OXYGEN MONITORING

Beginning in 1999, all volunteers will be able to borrow an electronic instrument that measures water temperature and dissolved oxygen. The instrument includes a submersible probe and a digital readout with easy-to-use controls. Generally, temperature and dissolved oxygen are measured from just below the water surface down to just off the bottom in one-meter increments. The instrument's cable is marked in one-meter increments to facilitate this.

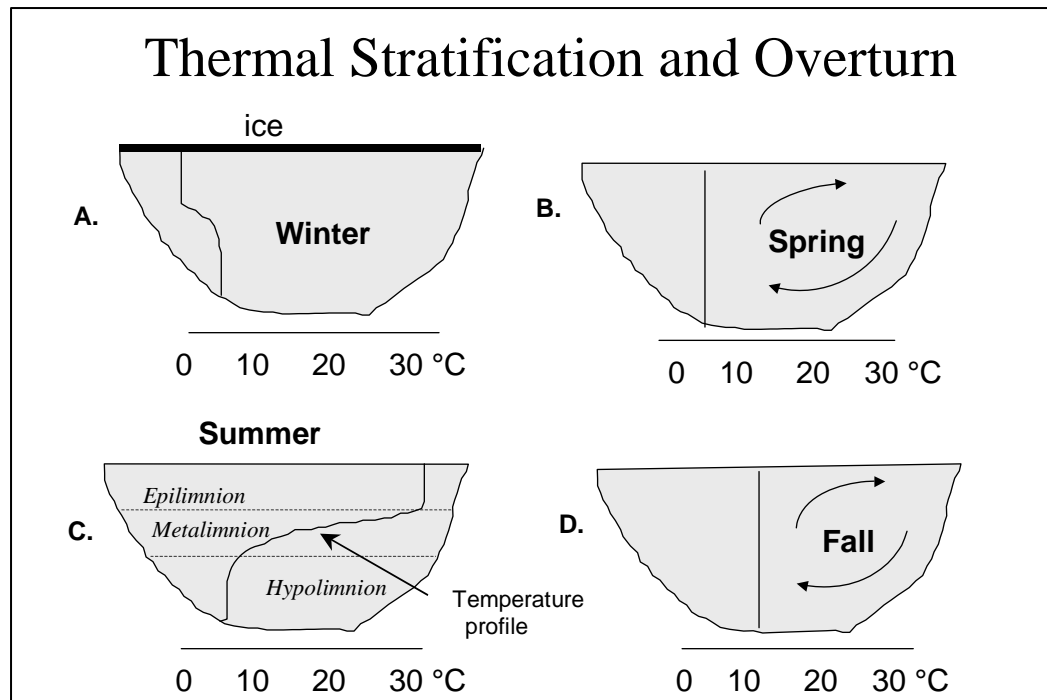
Temperature and oxygen profiles of lakes can yield very useful information. For example, the temperature profile indicates: a) if the lake is thermally stratified or unstratified (mixing), b) if stratified, the depth of the epilimnion or hypolimnion, c) the position of the metalimnion (fish often hang out at the top of the metalimnion). The dissolved oxygen profile indicates: a) how much of the lake has sufficient oxygen for fish, b) if the hypolimnion has no oxygen, and c) the potential for nutrient release from bottom sediments (this may occur when the hypolimnion is anoxic).

How Lakes Change With the Seasons

As the spring sun rises higher in the sky and air temperatures become warmer, the surface water of lakes warms as well. This warm water is less dense than the cold, heavy water on the lake bottom. The wind does not have enough energy to overcome these density differences and completely mix the lake, so only the surface water (*epilimnion*) is mixed during the summer in deeper lakes (5-7 meters deep). Thus, the bottom waters in the *hypolimnion* are isolated from the air at the surface. The narrow zone of water separating the epilimnion and hypolimnion is called the *metalimnion*. This temperature and density layering in lakes is called *thermal stratification*.

Dissolved oxygen in the hypolimnion is consumed by bacteria decomposing organic matter (dead algae, leaves, etc.) on the sediments. This lost oxygen is not replaced during stratification because the hypolimnion is not in contact with the atmosphere (the major source of oxygen to lake water) and photosynthesis (which produces oxygen as a by-product) cannot take place in the dark waters. As a result, oxygen concentrations are often lower in the hypolimnion of stratified lakes - the lower the hypolimnetic oxygen concentration, the more productive (*eutrophic*) the lake is. Low oxygen in the hypolimnion can prevent the use of the area by fish and aquatic macroinvertebrates. Fish need at least 3-5 ppm (mg/L) of dissolved oxygen to survive. If no oxygen is present in the hypolimnion, phosphorus can separate from compounds in the sediments and re-dissolve in the water. Ammonia can also accumulate in the hypolimnion as a result of bacterial decomposition of organic material in the sediments.

In the fall, cooler air temperatures gradually cool the lake's surface water until it is nearly the same temperature as the bottom water. Because all the water now has similar density, a light wind can cause the lake to mix completely down to the bottom. This is called *fall overturn*. Nutrients released into the hypolimnion from the sediments during summer stratification can now mix with the surface water and this may cause a fall algae bloom in some lakes.



Measuring Temperature and Dissolved Oxygen

Getting information about the characteristics and magnitude of the seasonal cycles described above provides limnologists with important information needed to diagnose the lake condition. We have placed five YSI Model 95 temperature and dissolved oxygen meters in Soil and Water Conservations District (SWCD) offices around Indiana for participants in the Volunteer Lake Monitoring Program to use on their lakes. Because both temperature and dissolved oxygen change with the seasons, volunteers are encouraged to take several of these profile measurements on their lake – ideally once per month.

Each meter is expensive (\$1,000) and fragile. Please use with care. You will be trained by SWCD or SPEA staff before you are allowed to borrow a meter. If you are uncertain about features of the meters or how to use them after you've been trained, please call for refresher instructions.

Here is the procedure for borrowing the meters:

1. Call the nearest SWCD office or SPEA to reserve the meter for a specific date (addresses and telephone numbers are given following). Arrange a time when you can pick up the meters.
2. The local SWCD or SPEA staff will train you on proper use and care of the meter during your first visit. This training will take approximately 30 minutes.
3. You will have to sign for the meter on a standard form.

4. Take the meter home and make the measurements on your lake (measurement instructions are on a separate sheet and enclosed in the meter case).
5. Return the meter to the SWCD office or SPEA the same or next day. We can only allow you 1-2 days at a time with the meter so that it is available for others to use.

Where to Sign Out a Meter

Kosciusko County SWCD
217 E. Bell Drive
Warsaw, IN 46582
(219) 267-7445 ext 3
Contact: Julie Harrold

Noble County SWCD
100 East Park Drive
Albion, IN 46701-9797
(219) 636-7682 ext 3
Contact: Kent Tracey

LaGrange County SWCD
910 South Detroit Street
LaGrange, IN 46761-2235
(219) 463-3166 ext 3
Contact: Mark Diehm

Steuben County SWCD
Peachtree Plaza 200
1220 N. 200W
Angola, IN 46703-8901
(219) 665-3211 ext 3
Contact: Mark Diehm

School of Public and Environmental Affairs
Indiana University
1315 East 10th Street
Bloomington, IN 47405-1701
(812) 855-4556
Contact: Bill Jones

INSTRUCTIONS FOR TAKING TEMPERATURE AND DISSOLVED OXYGEN MEASUREMENTS

Temperature and oxygen profiles should generally be made from the deepest water depths in your lake. You will have to anchor your boat – otherwise drift will cause inaccurate depth measurements.

1. Turn on meter and calibrate according to instructions. **The meter must be turned on for 20 minutes prior to calibration to allow the electronics to stabilize.
2. Once calibrated, remove probe from calibration/storage chamber.
3. Lower probe into water to desired depth.

(Always start measurements with the probe at just below the water's surface. Then make measurements at one-meter intervals, for example, 1m, 2m, 3m, 4m, etc. The cord is marked with tape at these intervals. Be careful to not let probe hit the bottom sediments.)

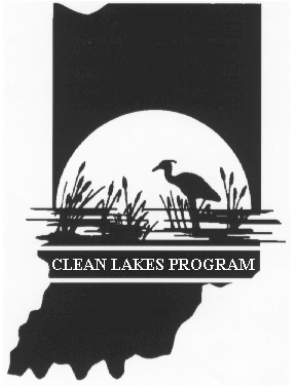
4. Press MODE button until meter is in “dissolved oxygen % air saturation” mode.
5. Allow temperature to stabilize (about 30 seconds).
6. Record temperature on data sheet (see example data sheet on page 14).
7. Raise and lower the probe gently (about 2 inches per second) until % air saturation stabilizes. Record this percentage.
8. Press UP ARROW button once so dissolved oxygen is displayed in “mg/L”. Again raise and lower the probe until stable. Record this value.
9. Lower probe to next depth.
10. Press the UP ARROW button to return to “% air saturation” mode. Repeat steps 5 – 9 as necessary.
11. When finished, rinse probe with distilled water from the squirt bottle. Place probe in storage chamber. Turn off meter.

REMEMBER: Never hold the meter over the water. Keep it securely inside the boat. Put **only** the probe over and into the water.

Send completed data sheet to:

Bill Jones, SPEA 347, Indiana University, Bloomington, IN 47405

Report any difficulties to SWCD staff.



VOLUNTEER LAKE MONITORING PROGRAM

- Temperature/D.O. Data Sheet -

Lake: _____ Date: _____

Volunteer: _____ **Time:** _____

| DEPTH (m) | TEMP. (°C) | D.O. (%) | D.O. (ppm) |
|-----------|------------|----------|------------|
| Surface | | | |
| 1 | | | |
| 2 | | | |
| 3 | | | |
| 4 | | | |
| 5 | | | |
| 6 | | | |
| 7 | | | |
| 8 | | | |
| 9 | | | |
| 10 | | | |
| 11 | | | |
| 12 | | | |
| 13 | | | |
| 14 | | | |
| 15 | | | |
| 16 | | | |
| 17 | | | |
| 18 | | | |
| 19 | | | |
| 20 | | | |

APPENDIX A

Construction of an integrated pipe sampler

