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AUTHOR	Helms, J. Christopher; Corbett, .obert J.
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ABSTRACT

This activity guide, developed to provide hands-on environmental education activities geared to Jones Lake State Park in North Carolina, is targeted for grades 6, 7, and 8 and meets curriculum objectives in the standard course of study established by the North Carolina Department of Public Instruction. Three types of activities are included: pre-visit, on-site, and post-visit. The on-site activity is conducted at the park, while pre- and post-visit activities are designed for the classroom. Major concepts included are: water quality, data collection, pH, animal adaptations, and geomorphology of a Carolina bay lake. Includes an introduction to the water cycle, a vocabulary list, scheduling worksheet, parental permission form, North Carolina Parks and Recreation program evaluation, sources of information on water resources, and information about Jones Lake State Park and Carolina bays. (MKR)

CLOSE ENCOUNTER

WITH A CAROLINA BAY

Jones Lake State Park

An Environmental Educ... ...ing Experience

Designed ...

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An Environmental Education Learning Experience

Designed for Gr[illegible]

"The bay lakes region of North Carolina is among the few of the state's unique natural features to receive worldwide attention."

- NC Division of Parks and Recreation
State Lakes Master Plan

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CP&L

This Environmental Education Learning Experience
was developed by

J. Christopher Helms and Robert J. Corbett,
Lead Interpretation & Education Ranger and Park Ranger II
Jones Lake State Park

N.C. Division of Parks and Recreation
Department of Environment, Health and Natural Resources

DEHNR

James B. Hunt, Jr.
Governor

Jonathan B. Howes
Secretary

Other Contributors . . .

Park volunteers;

The N.C. Department of Public Instruction;

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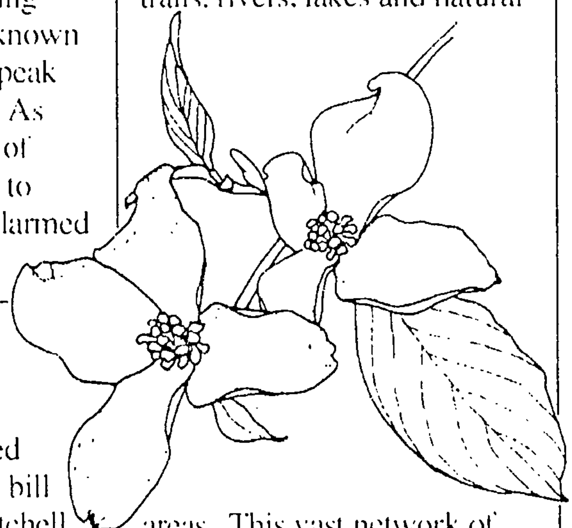
Introduction to the North Carolina State Parks System

Preserving and protecting North Carolina's natural resources is actually a relatively new idea. The seeds of the conservation movement were planted early in the 20th century when citizens were alerted to the devastation of Mount Mitchell. Logging was destroying a well-known landmark - the highest peak east of the Mississippi. As the magnificent forests of this mile-high peak fell to the lumbermen's axe, alarmed citizens began to voice their objections. Governor Locke Craig joined them in their efforts to save Mount Mitchell. Together they convinced the legislature to pass a bill establishing Mount Mitchell as the first state park of North Carolina. That was in 1915.

The North Carolina State Parks System has now been established for more than three quarters of a century. What started out as one small plot of public land has grown into 59 properties across the state, including parks, recreation areas, trails, rivers, lakes and natural



areas. This vast network of land boasts some of the most beautiful scenery in the world and offers endless recreation opportunities. But our state parks system offers much more than scenery and recreation. Our lands and waters contain unique and valuable archaeological, geological and biological resources that are important parts of our natural heritage.

As one of North Carolina's principal conservation agencies, the Division of Parks and Recreation is responsible for the more than 125,000 acres that make up our state parks system. The Division manages these resources for the safe enjoyment of the public and protects and preserves them as a part of the heritage we will pass on to generations to come.

An important component of our stewardship of these lands is education. Through our interpretation and environmental education services, the Division of Parks and Recreation strives to offer enlightening programs which lead to an understanding and appreciation of our natural resources. The goal of our environmental education program is to generate an awareness in all individuals which cultivates responsible stewardship of the earth.

For more information contact:

N.C. Division of Parks and Recreation
P.O. Box 27687
Raleigh, NC 27611-7687
919/ 733-4181

Introduction to Jones Lake State Park

Jones Lake State Park in Bladen County covers 2,208 acres, including two natural lakes. Jones Lake, the park's namesake, is about 224 acres and Salters Lake is 315 acres. Jones Lake State Park is located four (4) miles north of Elizabethtown on NC Highway 242.

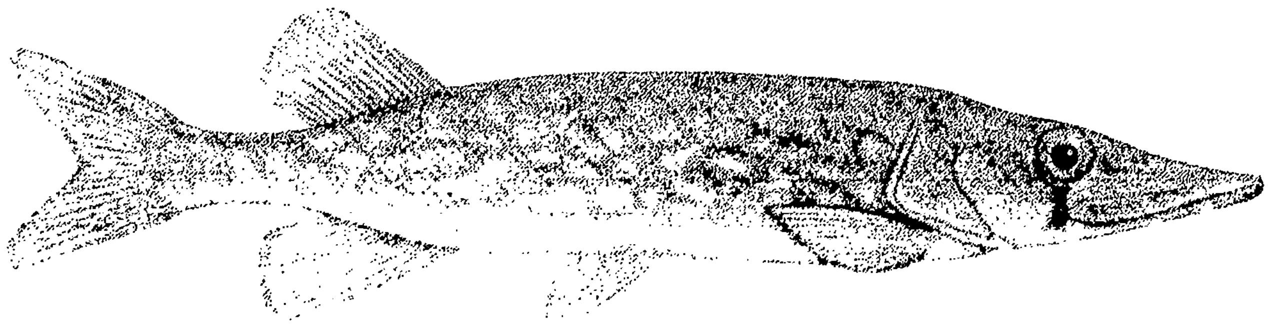
Jones Lake was once known as Woodward's Lake, for Samuel Woodward, a Justice of the Peace in the mid-1700's. It was renamed for Isaac Jones, a landowner who donated a tract of land on which Elizabethtown was established in 1773. Salters Lake got its name from Sallie Salter, a Revolutionary War heroine who spied on the Tories encamped in town.

Statewide interest in the bay lakes emerged in 1827-28 and 1911 when legislation prohibited private ownership of land covered by lake waters and further established that any lake in Bladen, Columbus and Cumberland counties of 500 acres or more become property of the state of North Carolina for the use and benefit of all its people. Additional legislation in 1929 designated lakes of 50 acres or more as state property.

The depressed economic times of the thirties provided the impetus for many state parks. In order to create jobs, the federal government poured millions of dollars into the field of conservation. For state parks, this assistance created a tremendous amount of development and land acquisition. The federal government purchased submarginal farm lands in the area, which were managed from 1936-39 by the Resettlement Administration. On this land, using local talents and materials, the Resettlement Administration developed a recreation center at Jones Lake. A large bathhouse, beach, picnic grounds and refreshment stand were constructed. All of these buildings have since been replaced.

This property was turned over to the state of North Carolina July 1, 1939, for operation under a lease agreement. Jones Lake opened in the summer of 1939 as the first state park for blacks in North Carolina. The park achieved immediate popularity and in later years, like all other North Carolina State Parks, was desegregated. In October, 1954, the land was given to the state by the federal government.

Today, the park's recreational activities center around Jones Lake, while Salters Lake is maintained as a natural area and used for educational and scientific study. Permits for entry to Salters Lake Natural Area may be obtained at the Jones Lake State Park office. Facilities at Jones Lake include: a 20-site family campground with a modern bathhouse; a day-use area with picnic tables; a protected swimming area which is open from Memorial Day to Labor Day; changing areas and



Chain pickerel

10

showers; and an interpretive stand where you may learn more about the Carolina bay lakes and flora and fauna of the area. A hiking trail follows the lakeshore about three miles around Jones Lake, while a shorter self-guided nature loop is also adjacent to the day-use area.

Jones Lake State Park contains a number of plant communities. Evergreens, such as sweet bay, loblolly bay and red bay, are predominant in the park and are the origin for the name Carolina bay. A bay forest surrounds the lake and has poor drainage. Around the edge of the bay forest and in other areas with moist soils, a pocosin plant community contains sheep laurel, blueberry and fetterbush. Pond pine and Atlantic white cedar are common in the bay forest and pocosin, thanks to past natural fires that burned underbrush allowing their establishment. Today, controlled burning is essential for the perpetuation of these communities. Without such fires, the character of these vegetative communities would eventually change.

On higher ground, the well-drained sandy soils support plant communities dominated by longleaf pine and turkey oak. The use of controlled burns is also essential to protect the ecological integrity of these communities.

Due to the acidity of both Jones and Salters lakes, few species of fish are present. The most abundant fish are yellow perch, with chain pickerel, catfish, lake chubsuckers and bluespotted sunfish also present.

Program Options

Jones Lake State Park is an excellent place to teach ecology, environmental issues, biology, conservation and earth science, as well as a fun place to enjoy recreational activities. The area is rich with natural resources and provides a wonderful outdoor classroom to have a close encounter with a Carolina bay.

Groups are encouraged to visit the park during all seasons of the year for hikes, exploration, nature study and other activities. Group leaders may choose to design and conduct their own activities or use the Environmental Education Learning Experience activity. Park staff will be glad to assist you with your programming needs. Every effort will be made to accommodate persons with disabilities. To make arrangements, please contact the park office at least two weeks before your visit.

Illustration by Ruth T. Brunstetter

Scheduling a Trip

1. To make a reservation, contact the park at least two weeks in advance.

2. Complete the Scheduling Worksheet, located at the back of this activity packet on page 8.1, and return it to the park as soon as possible.

3. Research activity permits may be required for sampling activities. If your group plans to collect any plant, animal or mineral within the park, please contact the park office at least 30 days in advance to obtain a permit application.

Before the Trip

1. Complete the pre-visit activity in the Environmental Education Learning Experience packet.

2. Group leaders should visit the park without the participants prior to the group trip. This will enable you to become familiar with the facilities and park staff, identify themes and to work out any potential problems.

3. Group coordinators should discuss park rules and behavior expectations with adult leaders and participants. Safety should be stressed.

4. Activities that take place outdoors may expose participants to insects and seasonal weather conditions. Be prepared to dress accordingly and wear sunscreen or insect repellent, if necessary. Comfortable walking shoes should also be worn.

5. Prior to the park visit, the group should be divided into four smaller testing groups. These groups will work together during the on-site testing.

6. Group leaders or teachers are responsible for obtaining a parental permission form from each participant, including a listing of any health considerations and medical needs. An example of this form is located after the reference list at the back of this packet on page 8.2.

7. *If you will be late or need to cancel your trip, please notify the park as far ahead as possible.*

While at the Park

Please obey the following rules:

1. To help you get the most out of the experience and increase the chance of observing wildlife, be as quiet as possible while in the park.

2. On hikes, walk behind the leader at all times.

3. The water quality tests will be conducted on the pier at Jones Lake. Horseplay and misconduct will not be allowed.

4. All plants and animals within the park are protected. Breaking plants or harming animals is prohibited in all state parks. This allows future visitors the same opportunity to enjoy our natural resources.

5. Picnic only in designated picnic areas. Help keep the park clean and natural; put litter in the nearest trash can.

6. In case of accident or emergency, contact park staff immediately.

Following the Trip

1. Complete the post-visit activity in the Environmental Education Learning Experience packet.

2. Build upon the field experience and encourage participants to seek answers to questions and problems encountered at the park.

3. Relate the experience to classroom activities and curriculum through reports, projects, demonstrations, displays and presentations. Ask park staff for additional ideas.

4. Give tests or evaluations, if appropriate, to determine if students have gained desired information from the experience.

5. File a written evaluation of the experience with the park. Evaluation forms are available at the back of the packet on page 8.3.

Park Information

Jones Lake State Park
Rt. 2, Box 945
Elizabethtown, NC 28337
Tel: (910) 588-4550

Hours of Operation

Nov-Feb	8:00 am - 6:00 pm
Mar,Oct	8:00 am - 7:00 pm
Apr,May,Sep	8:00 am - 8:00 pm
Jun-Aug	8:00 am - 9:00 pm

Other Attractions in the Area:

Singletary Lake State Park
Rt. 1, Box 63
Kelly, NC 28448

Bladen Lakes Educational State Forest
Rt. 2, Box 942-A
Elizabethtown, NC 28337

Moores Creek National Battlefield
Highway 210
P.O. Box 69
Currie, NC 28435

Lake Waccamaw State Park
Rt. 1, Box 147
Lake Waccamaw, NC 28450

Illustration by Ruth T. Brunstetter

Introduction to the Activity Packet for Jones Lake State Park

The Environmental Education Learning Experience, *Close Encounter with a Carolina Bay*, was developed to provide hands-on environmental educational activities for the classroom in the outdoor setting of Jones Lake State Park. This activity packet, designed to be implemented in the middle school grades, meets curriculum objectives of standard course of study established by the North Carolina Department of Public Instruction. It includes three types of activities:

1) pre-visit activity
2) on-site activity
3) post-visit activity

The on-site activity will be conducted at the park, while pre-visit and post-visit activities are designed for the classroom. The pre-visit activity should be done prior to the park visit to prepare students for the on-site activity, giving them the necessary background and vocabulary. We encourage you to use the post-visit activity to reinforce concepts, skills and vocabulary learned in the pre-visit and on-site activities. These activities may be performed independently or in a series to build upon the students' newly gained knowledge and experiences.

The Environmental Education Learning Experience, *Close Encounter with a Carolina Bay*, will expose the student to the following major concepts:

- **Water quality**
- **Data collection**
- **pH**
- **Animal adaptations**
- **Geomorphology of a Carolina bay lake**

Vocabulary words used throughout this Environmental Education Learning Experience appear in **bold type** the first time they are used in each activity. These words and their definitions may be found in the vocabulary at the back of the activity packet. A list of the reference materials used in developing the activities follows the vocabulary.

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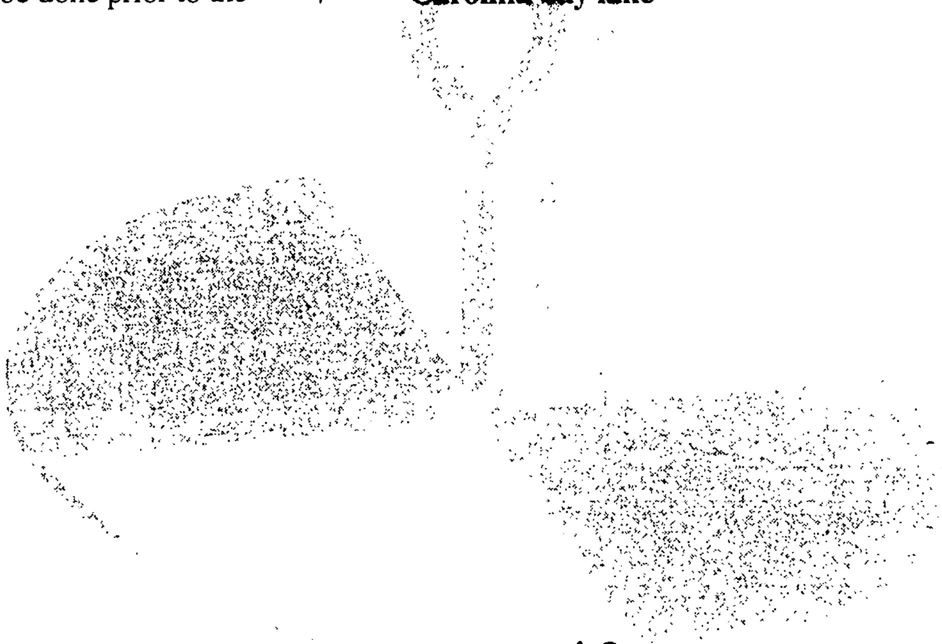


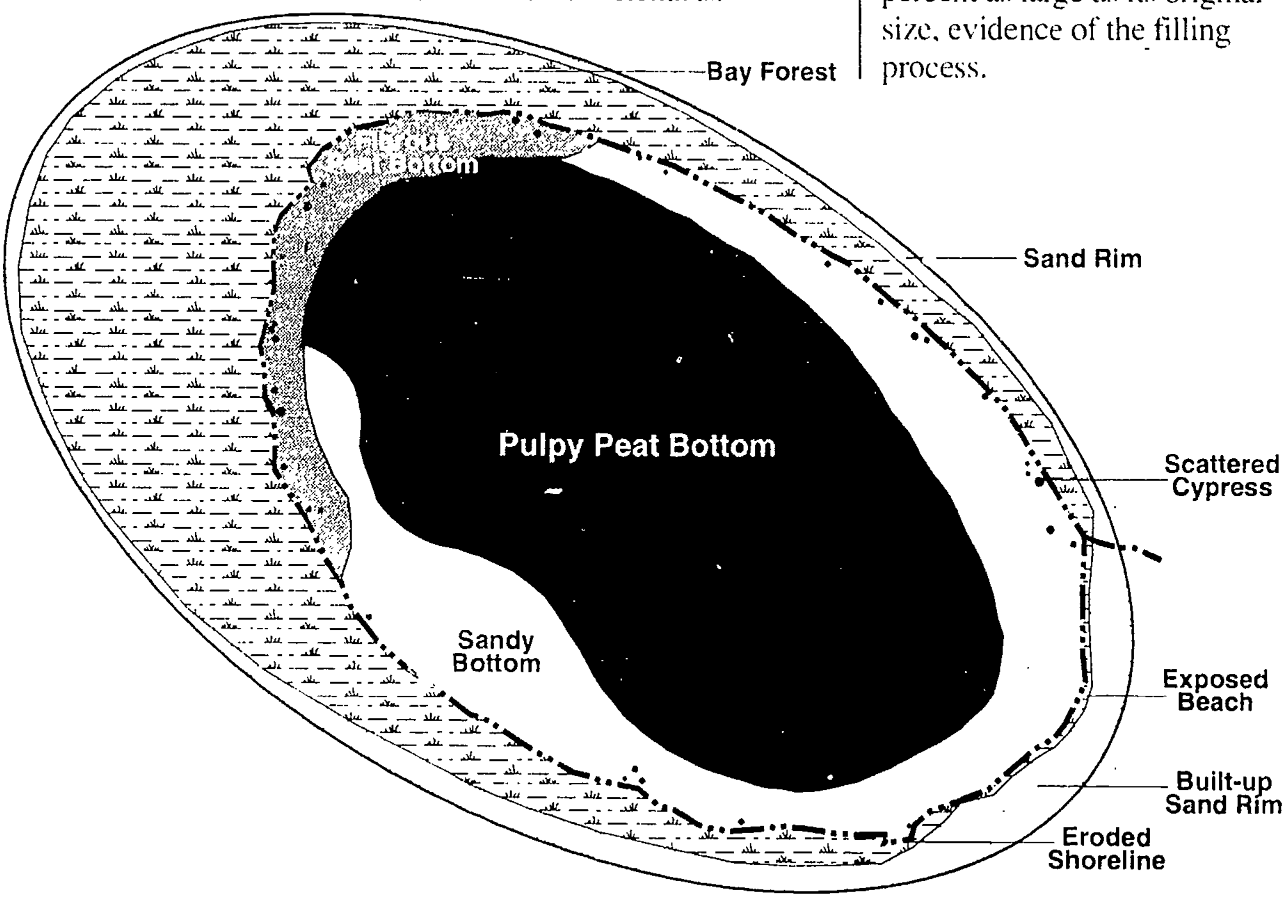
Introduction to Carolina Bays

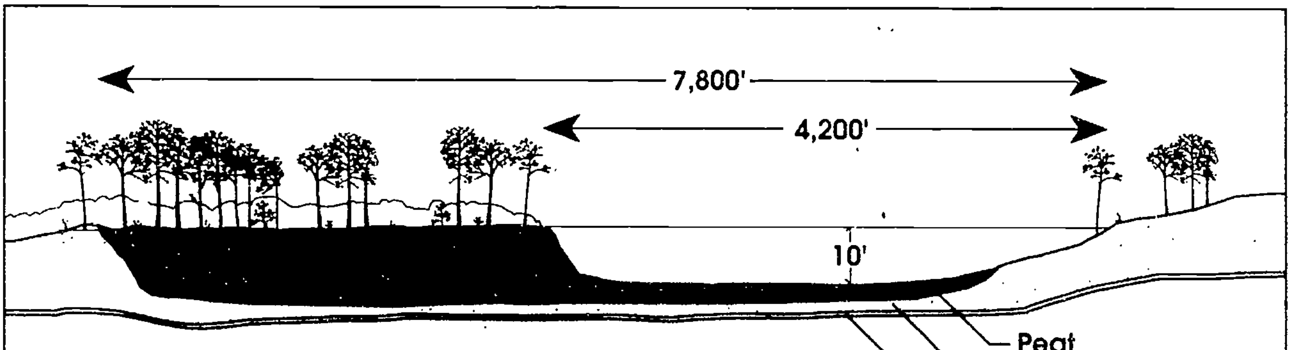
What is a **Carolina bay**? On the Atlantic Coastal Plain, from Florida to New Jersey, there were once over 500,000 bays. At one time, Bladen County contained some 1,200 bays covering almost 20 square miles. Many of these, however, have been destroyed to make way for agriculture and other uses. In general, bays are shallow, elliptical depressions in the earth that are oriented in a southeast - northwest direction. The size may range from less than 1 acre to 9,000 acres. The term bay can be confusing because it does not refer to a body of water. Most Carolina bays do not contain open water during the majority of the year. The name of these natural basins originated from the fact that there is a high concentration of them in the Carolinas and an abundance of three species of associated vegetation: red bay, sweet bay and loblolly bay.

Carolina bays were discovered in the early thirties, when aerial photographs were being used to lay out farms. Their similar shape, orientation and the presence of an elevated sand ridge on the southeast rim were obvious from the air and brought the Carolina bays to the immediate and on-going attention of scientists.

While sharing many similarities, Carolina bays also can differ in a number of ways. For example, the interior of Bushy Lake, despite its name, doesn't contain open water, but is dominated by **pocosin** vegetation growing on thick deposits of peat. On the other hand, Cotton Head Bay, just south of the park, is primarily bay forest. Given the large number of Carolina bays, only a very small percentage presently have open water.

It is likely that all bays were once bodies of water that over thousands of years became peat-filled bogs. Today, Jones Lake is only 34 percent as large as its original size, evidence of the filling process.





Jones Lake Geomorphology

Bladen County contains an unusually high number of bay lakes. Singletary, Bay Tree, White, and of course, Jones and Salters lakes are the most widely known.

Bay lakes depend on rainfall to maintain the water level. This results in a great deal of fluctuation from season to season. During periods of low water, pond cypress can become established on the exposed lake floor. The root system of mature cypress trees in open water traps floating vegetation. Over time, this allows the thick bay vegetation to creep further out into the lake.

Slow movement of rainwater through the peat soil of the bay forest dissolves chemicals, such as **tannic acid**, produced by the decaying vegetation. The tea-colored water found in most bay lakes is the result. This natural acidity is a determining factor in what types of fish and aquatic plants can live in this environment. White Lake, however, is different from the other water-filled Carolina bays. Its outlet stream exits the lake through the northwest rim where most of the peat soils occur. In this manner the dark-stained, acidic water flows away from, rather than into, the lake. The lake is therefore clear and less acidic.

Few geological phenomena are more mysterious to scientists than the origin of Carolina bays. Many theories have been proposed to explain their occurrence. These theories have generated much debate among the scientific community, but none has gained universal acceptance. Some of these theories include meteor impact, dissolution of limestone and streamlining of bays by the flow of groundwater, dissolution by artesian springs and streamlining of bays by wind and current action, the activity of giant prehistoric fish spawning, and the oriented lake theory. While there is no general acceptance of any one theory, the oriented lake theory is best supported by scientific evidence.

The meteor impact theory, one of the more popular, was proposed by Melton and Shreiver in 1934 and was later revised by Prouty in 1952. It suggests the Carolina bays were formed by a swarm of meteors that crashed into the earth at a low angle from the northwest. Air shock waves, generated by meteor impacts, created the shallow, elliptical depressions in the loose, unconsolidated sands of the coastal plain. While fascinating, this theory is not well-supported scientifically. No meteorite materials have been found in the bays and a sub-bottom profile of the bay lakes does not show the degree of disturbance a meteor impact should make.

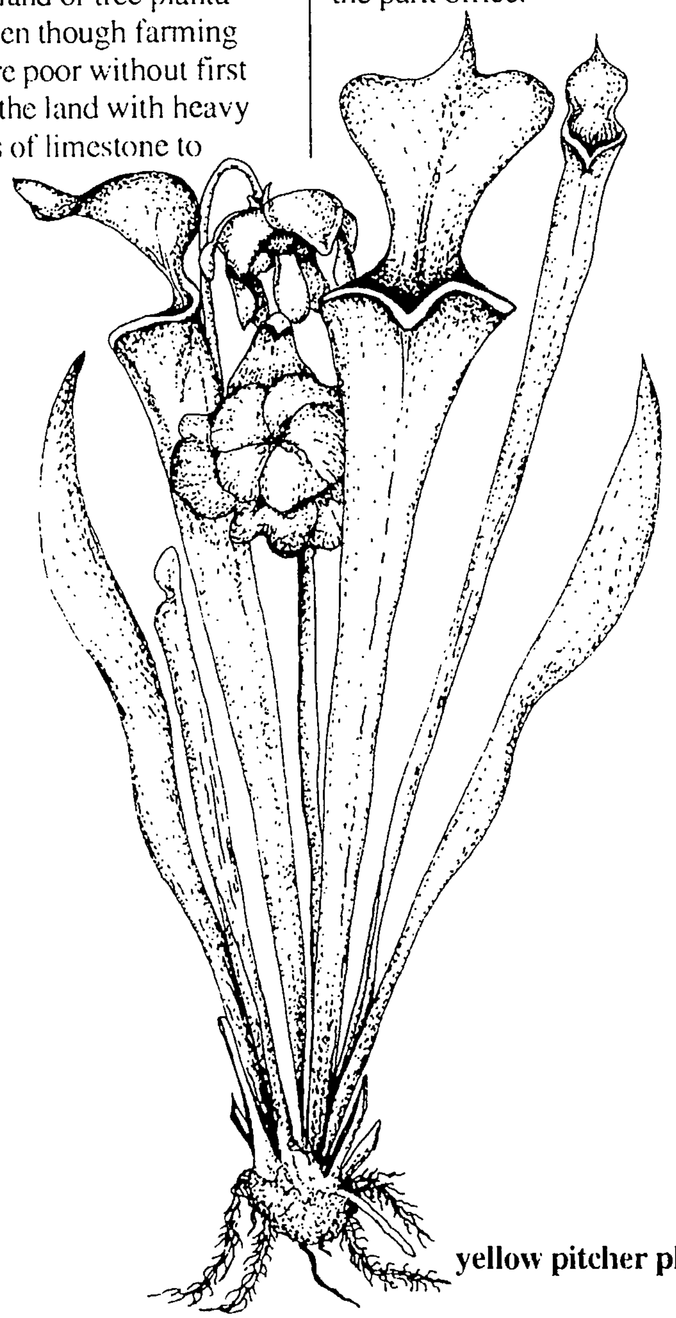
Recent research seems to indicate that the bays were formed during the last Ice Age when strong winds blew across ponds in what was then a sandy, barren landscape. Lake waves, generated by strong prevailing winds, eroded the shallow lakes and ponds into ellipses. In the area of the Carolinas, prevailing winds from the north-northeast created the southeast-northwest orientation of the Carolina bays. As the climate changed and warming began after the Wisconsin Ice Age, precipitation was reduced and vegetation began to overtake the bays. This is the oriented lake theory.

Geologists have determined from studying pollen grains that not all Carolina bays were formed at the same time. Ages range from 20,000 to 40,000 years, with Singletary Lake being one of the oldest ever recorded.

Carolina bays are ideal habitat for a number of rare plants and animals. Some small bays, while wet during the fall to spring months, dry up during the summer and therefore do not support fish. These fish-free bays are ideal **habitat** for many frogs and salamanders whose **larvae** and eggs are preyed on by fish. Nearly 50 reptile and amphibian **species** use North Carolina's bays, including the rare tiger salamander. Other rare species include the Venus fly-trap, white-wicky (a coastal plain relative of mountain laurel) and the black bear.

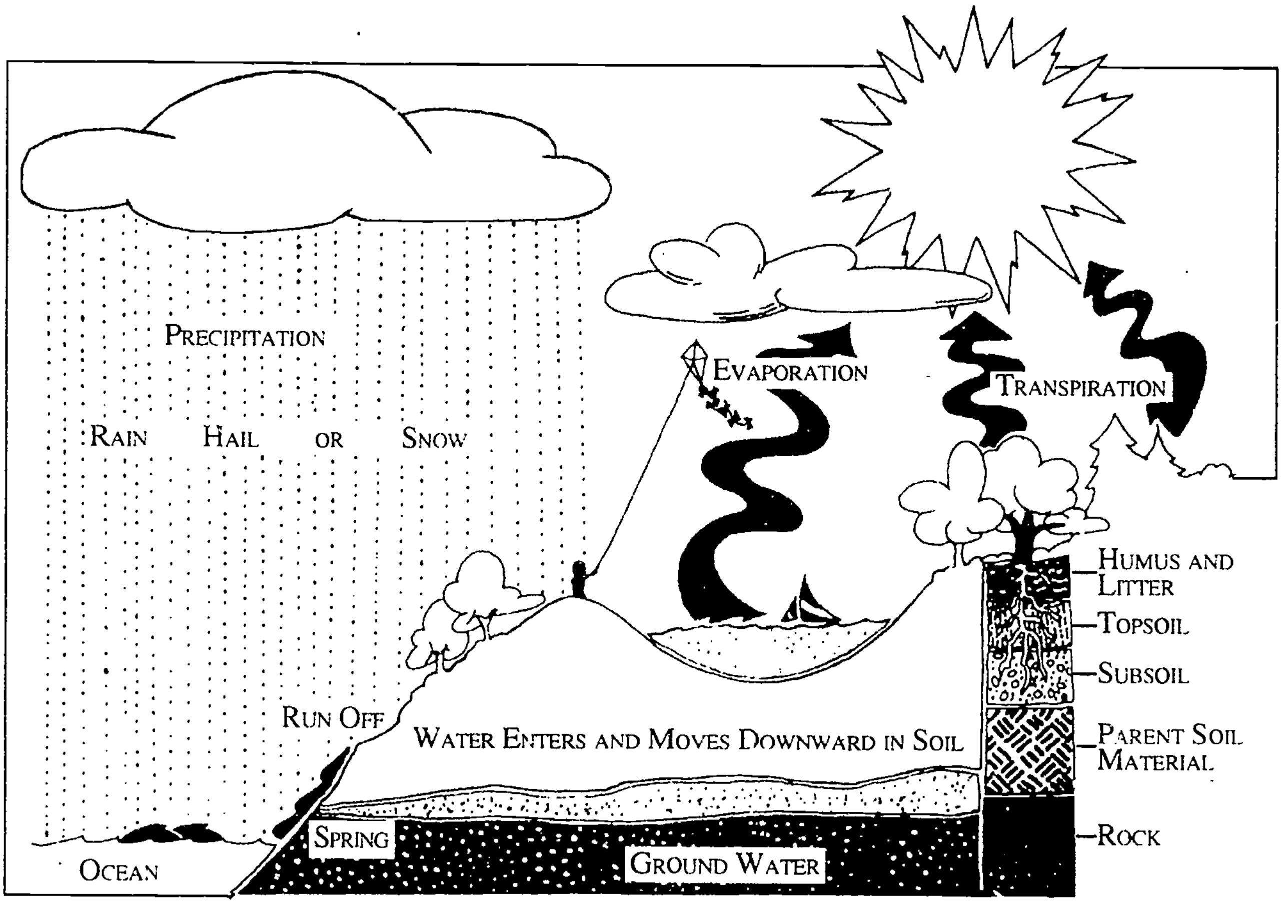
Since European settlement, over half of all Carolina bays have been logged and drained for farmland or tree plantations, even though farming yields are poor without first treating the land with heavy amounts of limestone to neutralize the acidity of the soil. These land uses have caused the loss of valuable habitat for some of the state's rarest plants and animals.

The Salters Lake Natural Area at Jones Lake State Park encompasses one of the finest examples in the state of an undisturbed bay lake community. Guided hikes in this area are available by contacting the park office.



yellow pitcher plant

Introduction to the Water Cycle



Evaporation – The changing of water into water vapor.

Groundwater – Water found below the surface of the Earth.

Hydrologic cycle (Water cycle) – Process involving the circulation and distribution of the water on Earth.

Infiltration – The process by which water seeps into the soil.

Precipitation – Forms of condensed water vapor that are heavy enough to fall to the Earth's surface, such as rain, snow, sleet, hail and fog.

"The water cycle is the system by which Earth's fixed amount of water is collected, purified and distributed from the environment to living things and back to the environment. Plants play a large part in the cycle by absorbing water with their roots and transpiring it as vapor through their leaves. All living things are connected through the water cycle."
(from "Water Wonders", *Project Learning Tree*)

The water cycle shows us that the Earth's water can be found in many different places.

Atmosphere **0.001%**
Water held in the air as water vapor.

Surface water **0.019%**
Fresh water found in lakes, rivers and reservoirs.

Subsurface water **0.630%**
Fresh water found beneath the ground, usually brought up by pumps.

Glaciers & ice caps **2.150%**
Fresh water frozen into ice, found in the Arctic and Antarctic oceans.

Oceans **97.200%**
Large bodies of salt water such as the Atlantic and Pacific, that cover about 71% of the Earth.

Activity Summary

The following outline provides a brief summary of each activity, the major concepts introduced and the objectives met by completion of the activity.

I. Pre-Visit Activity

#1 Water Quality Testing Procedures (page 3.1.1)

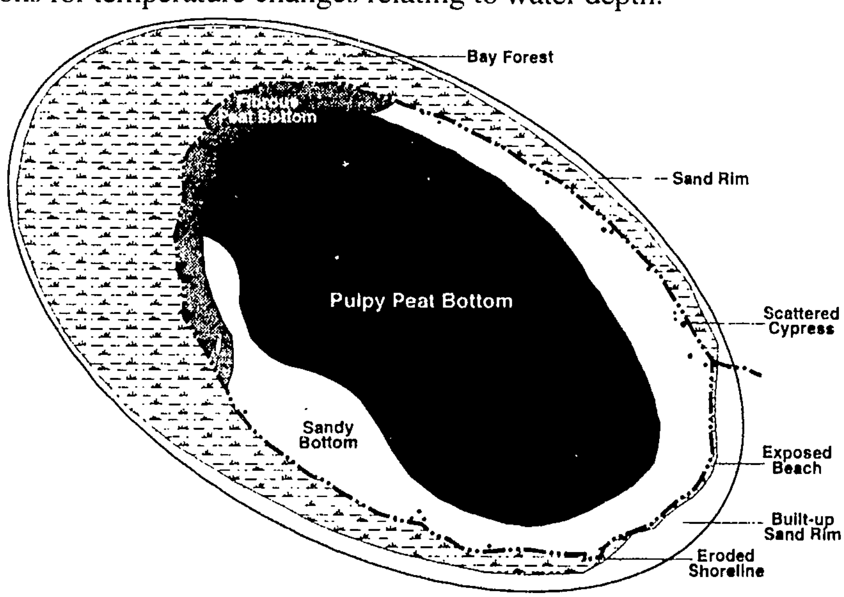
Instruct students in the use of various pieces of water testing equipment such as: litmus paper for pH testing; thermometer; calibrated depth marker and a Secchi disk for measuring water clarity. The use of these tools will be demonstrated.

Major concepts:

- Water quality
- Scientific testing procedures
- Bay lake ecology
- Data collection

Objectives:

- Identify the four main factors that influence water quality in Carolina bay lakes and learn methods to monitor and test for them.
- Name the two natural acids that affect the pH of Carolina bay lakes.
- Discuss the two zones relating to the amount of sunlight penetration and explain which area is most productive and why.
- List two natural influences that affect productivity in a Carolina bay lake.
- Explain how the amount of light penetration dictates the type of aquatic life present.
- State the environmental temperature range that must be maintained for the survival of most aquatic life.
- Convert temperature readings from the Fahrenheit scale to the Celsius scale and from Celsius to Fahrenheit.
- Name the layers of a lake during stratification and give the characteristics of each.
- Explain reasons for temperature changes relating to water depth.



II. On-Site Activity

#1 Water Quality Testing (page 4.1.1)

In this hands-on activity, students will perform various water quality tests to determine the pH, temperature, water clarity and depth of Jones Lake.

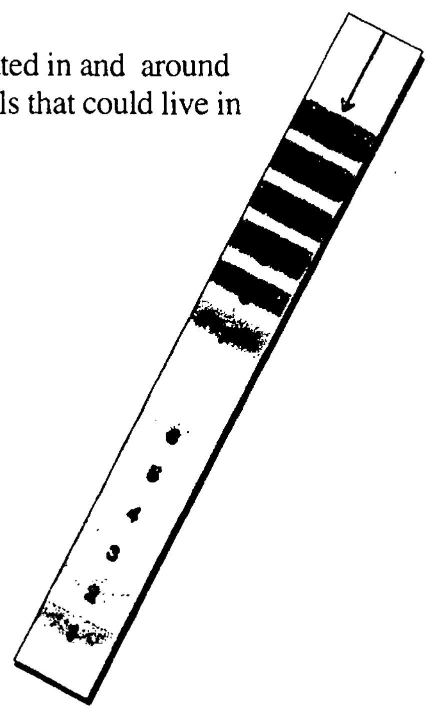
Major Concepts:
- Water quality
- pH
- pH range best suited for aquatic life
- Clarity
- Temperature ranges
- Reading a calibrated scale
- Bay lake geomorphology

Objectives:
- Work as a scientific testing group to gather data on the water quality of a Carolina bay lake.
- Use litmus paper to measure pH.
- Demonstrate how to use a Secchi disk to measure clarity.
- Measure temperature.
- Determine temperature ranges that best support aquatic life.
- Learn the average depth of most Carolina bay lakes.
- Demonstrate the use of a calibrated depth scale to measure lake depth.
- Present and explain the data collected in the water quality tests.
- Based on the pH of Jones Lake and Lake Waccamaw, explain the difference in aquatic life of the two lakes.

III. Post-Visit Activity

#1 How's Your Water ? (page 5.1.1)

The class will discover the pH values of water sources located in and around their school and home, and determine typical plants and animals that could live in these habitats.



Major concepts:
- pH
- pH range best suited for aquatic life
- Water quality

Objectives:
- Use litmus paper to measure pH.
- Predict habitat suitability for select fish.

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Pre-Visit Activity #1 Water Quality Testing Procedures

Curriculum Objectives:
Grade 6
- Communication Skills: study skills using environmental sources, listening, reading, vocabulary and viewing comprehension
- Science: how science helps us
- Social Studies: gather, organize and analyze information

Grade 7
- Communication Skills: study skills using environmental sources, listening, reading, vocabulary and viewing comprehension
- Science: characteristics of plants and animals, plant and animal communities, natural phenomena
- Social Studies: know the importance of natural resources, gather, organize and analyze information

Grade 8
- Communication Skills: study skills using environmental sources, listening, reading, vocabulary and viewing comprehension
- Science: ecology, geomorphology, landform processes
- Social Studies: North Carolina geography, gather, organize and analyze information

Location: Classroom

Group Size:
30 students or less

Estimated Time:
45 minutes to 1 hour

Appropriate Season: Any

Materials:
Provided by park: litmus paper, pH range poster, clear liquids (one acid, one base), glass containers (vials), Secchi disk, calibrated depth marker, "Bay Lake Geomorphology" handout, mercury thermometers, thermometer poster
Provided by educator: orange juice, antacids (i.e., Rolaids™, Tums™), tap water, very dark colored water or tea, small bag of potting soil or other dirt, aquarium or other rectangular, transparent container, hair dryer, ice cubes
Per student: Student's Information sheets

Major Concepts:
- Water quality
- Scientific testing procedures
- Data collection
- Bay lake ecology

Objectives:
- Identify the four main factors that influence water quality in Carolina Bay lakes and learn methods to monitor and test for them.
- Name the two natural acids that affect the pH of Carolina bay lakes.
- Discuss the two zones relating to the amount of sunlight penetration and explain which area is most productive and why.
- List the two natural influences which affect productivity in a Carolina bay lake.
- Explain how the amount of light penetration dictates the type of aquatic life present.
- State the environmental temperature range that must be maintained for the survival of most aquatic life.
- Convert temperature readings from the Fahrenheit scale to the Celsius scale and from Celsius to Fahrenheit.
- Name the layers of a lake during stratification and give the characteristics of each.
- Explain reasons for temperature changes relating to water depth.

Educator's Information:

In this activity, the students will learn three ways to test water quality, and the instruments and procedures to be used during the On-Site Activities at Jones Lake. Review the testing and background information provided and be sure that the students have read this material before you begin the classroom discussion.

Instructions:

pH Testing

1. Review the Student's Information on **pH.** Discuss what the term pH means and how it is measured on the **pH scale**. To reinforce the concept of the pH scale, use an example such as a lake with a pH value of 5, which is 10 times more acidic than a lake with a pH reading of 6; 4 would be 100 times more acidic than 6.

2. Explain how just a small difference in pH values can drastically affect the types of **aquatic life** found there and which balancing mechanisms affect the pH of an aquatic system. **Photosynthesis**, productivity, **clarity**, rainfall and light are all factors which can influence the pH of a body of water. At Jones Lake, as in the other **Carolina bay** lakes, the most important factor affecting pH is **tannic acid**, which leaches into the lake from the surrounding bay bog following rainfall. Display the poster of pH ranges that may support aquatic life (provided by the park).

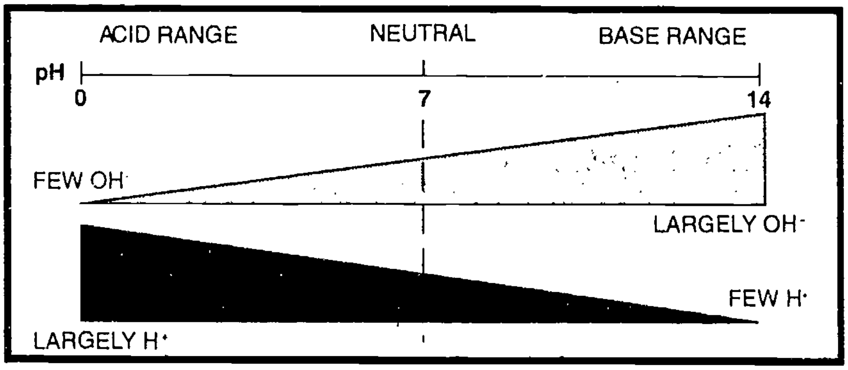
3. Discuss the method of pH testing that will be used at Jones Lake. Students will use **litmus paper**, a specially treated paper which changes color when it is moistened by a sample solution.

The type of litmus paper we will use covers the pH's of solutions in the ranges of to 12 and has a different shade of color corresponding with each pH.

A testing square in the center of the paper will turn to the shade of the pH value when placed in the testing solution. Inform the students the pH testing station will be on Jones Lake pier and no horseplay will be tolerated. On the pier, a small bucket with an attached string will be lowered over the side to get a water sample. Group members will pour some of the water in a small specimen jar and then dip their litmus paper in the water and record the value.

4. In the classroom, test two clear liquids, one **base** and one **acid**. These will be provided by the park. This test will show that two substances can look the same and have totally opposite pH values. Also, at this time, ask the students if and how pH may affect humans in our daily life. Use examples such as pH-balanced shampoos, acidic or spicy foods that cause indigestion, such as pizza, tacos, spaghetti and orange juice (citric acid). Also mention substances that can be taken to neutralize indigestion, like Rolaids™, Tums™ or Alka Seltzer™. As humans, we are also living **organisms** and cannot tolerate drastic changes in pH. In later activities, students will have an opportunity to test themselves.

Household items will be tested at the park and compared to the water of Jones Lake, but as a preview you may want to test orange juice and Rolaids™ or baking soda to show how an antacid works. Solids such as Rolaids™ must be dissolved in water before testing. If the water used to dissolve the solids is acidic, then the pH of the Rolaids™ will not test as basic as it would if water with a neutral pH had been used.



Clarity Testing

1. Review the Student's Information on clarity. Briefly discuss why the clarity of a body of water is important in determining the existence and types of aquatic life which may be present. If the students have read the provided information, they should be able to describe the importance of sunlight in photosynthesis of plants, even for underwater plants.

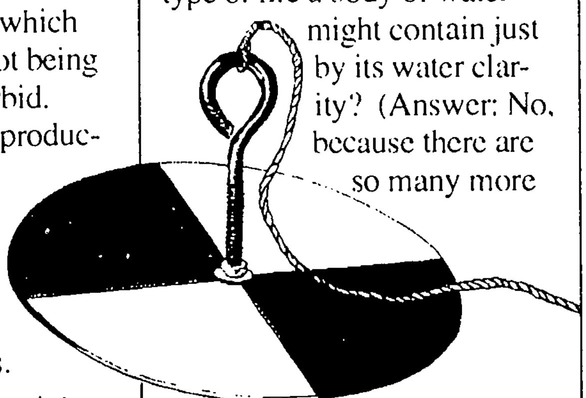
2. Make sure the students realize that the tea-coloring of Jones Lake is the most important factor affecting clarity, but in other water sources **turbidity** is a major concern. Turbidity is soil, algae or other particles or pollutants settling to the bottom through the lake water. These particles may be stirred up by wind, waves or human activity in the lake itself or may run off into the lake from nearby farms, construction sites or parking lots. Fortunately, Jones Lake is surrounded by Bladen Lakes State Forest, so runoff and pollution is not as large a concern as in bodies of water where there is more activity around the lake. Most Carolina bays lack an overland input of water (i.e. river or streams) which means that water is not being stirred up or made turbid. From a standpoint of productivity this means that nutrients essential for the growth of aquatic plants are scarce, because they are not flowing into the lakes.

3. For the classroom activity show the **Secchi disk** that is described in the Student's Information and remind the students of the Italian admiral who invented it by lowering an ordinary dinner plate into the water from his boat.

4. In order to demonstrate the concept of clarity in the classroom, start with two large aquariums (buckets or trash cans could work if aquariums are not available). One should be filled with clear, tap water and one with very dark tea-colored water, like that of Jones Lake.

5. Have a student lower the Secchi disk into the clear water and then into the tea-colored water. Explain to them that this is the same procedure they will be using at Jones Lake. Be aware that the disk may still be visible in the tea-colored water because light can penetrate through the shallow water in the container. Show the students that the disk is less visible in the darker water than the clear water.

6. Ask the students what effects the darker water would have on aquatic life found in the water. Could they tell what type of life a body of water might contain just by its water clarity? (Answer: No, because there are so many more factors such as pH, temperature and nutrient concentration that are just as important as clarity.)

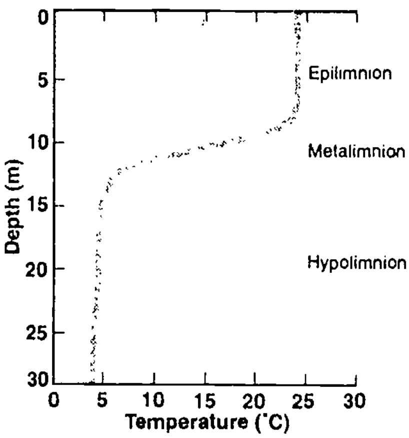


7. Stir soil and organic material into the clear water. This will demonstrate how the clarity of water can become turbid from the introduction of material, or from sediments in the bottom being stirred up. Soon after adding this material, check the clarity again, using the Secchi disk. What problems would a fish living in such muddied conditions encounter?

Depth Testing:

1. Review the the Student's Information and lead a discussion with the class on the depth of the Carolina bay lakes. At this time, hand out copies of the "Bay Lake **Geomorphology**." Point out to students that this type of lakes only averages about 9 ft. in depth and have different characteristics from deeper lakes.

2. The measure of depth as an activity is done because it so closely relates to the clarity and temperature of a Carolina bay lake. To introduce the process of **stratification**, focus on the fact that this is a transition that occurs on the basis of temperature. Increased periods of sunlight in spring heat the surface of the lake and cause it to be several degrees warmer than the rest of the lake water that is not being radiated by the sun. In the summer, the lake will have definite layers due to this solar heating. The **epilimnion** is the top layer and is well mixed by surface winds and wave action. The epilimnion, therefore, keeps a uniform temperature throughout. The layer closest to the bottom is much colder and darker and is called the **hypolimnion**. Naturally, sunlight penetration decreases the deeper you go in the water, so this cool, dark region has less productivity. The two layers are separated by a layer of transition called the **metalimnion**. Location of this layer depends on temperature and oxygen levels. (The metalimnion is sometimes called the thermocline, though this term refers strictly to temperature differences, and does not measure changes in dissolved oxygen).



3. Explain to the students that stratification works this way in most deep water lakes, but in the oval-shaped depressions called Carolina bay lakes the process is different. Because these lakes are so shallow, the entire water column becomes much like the epilimnion layer, having a quite uniform temperature throughout. Prevailing winds and winds associated with thunderstorms also play a part in mixing the lake water and making it roughly one temperature. This is not to say that Carolina bay lakes never stratify at all. During late spring a cool water hypolimnion may in some years be detected at the very bottom of the Carolina bay lakes.

4. At the park, students will be using a calibrated depth marker to check the depth in two locations from the pier at Jones Lake. Show the depth marker to the students.

5. Another activity you may want to perform in the classroom further demonstrates the concept of stratification.

A. First, get a transparent container at least 24 inches long. (An aquarium or shallow, rectangular baking dish works well).

B. Fill the container with cold tea to a depth of about 2 to 3 inches, depending on the size of the container.

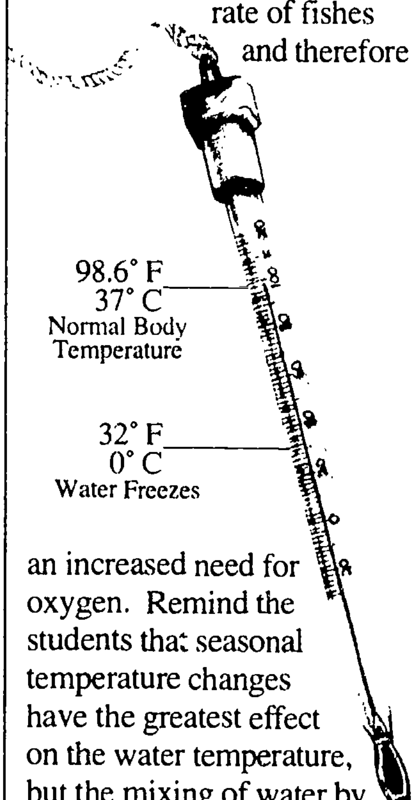
C. Add about an inch of very warm water, carefully pouring the water over the back of a spoon to avoid mixing it with the tea. You should be able to observe the two distinct layers with the metalimnion, or thermocline, between them.

D. Try different things, like blowing warm air across the surface of the water from a hair dryer and observing what takes place. Does the thermocline move? Add a couple of ice cubes to float in the warm water and see what happens.

Temperature Testing:

1. Review the Student's Information on temperature.

2. Discuss with students the reason temperature is measured (because of the role it plays in determining the amount of **dissolved oxygen** present in water). Cooler water has the capability to hold more dissolved oxygen than does warm water. Explain that this is one reason many species of fish are found in deeper waters during the summer. Warm water also causes a rise in the metabolic rate of fishes and therefore an increased need for oxygen. Remind the students that seasonal temperature changes have the greatest effect on the water temperature, but the mixing of water by wind will also cause the temperature and presence of oxygen to fluctuate.



3. Pass the **thermometer** around for the class to see. While the thermometer should remain in its plastic case today, it will be removed from it to get accurate readings at Jones Lake. Inform students that this is a mercury thermometer, like those used to measure human body temperature. The readings taken at the lake will be on the **Fahrenheit** scale that we use in the United States. This scale is named for Gabriel Daniel Fahrenheit (1686-1736), the same man who perfected a way of purifying mercury so that it could be used in this type of instrument.

4. Make the students aware that on the Fahrenheit scale, 32° F is the freezing point and 212° F is the boiling point. To illustrate the scale in use, the educator may use the thermometer to take a few of the students' temperatures. They should read around 98.6° F. Use the thermometer poster to compare the Fahrenheit and Celsius scales.

5. Most of the world uses the Celsius scale to measure temperature. The Celsius scale, like the rest of the metric system, is based on tens, with 0° C for its freezing point and 100° C for the boiling or steam point. Numbers in between go up in increments of ten. Using the following formulas you can easily convert a Fahrenheit temperature to Celsius or vice versa. Please explain these formulas to your class and have them do the sample problems at the end of the section.

Fahrenheit to Celsius

$°C = (F - 32°)\ 5 \div 9$

1. Replace the F in the formula with the Fahrenheit temperature.
2. Subtract 32° from the Fahrenheit temperature.
3. Multiply the result by five.
4. Divide that result by nine.
5. This is the temperature in Celsius.

Example (°F = 98.6°)

$°C = (98.6° - 32)\ 5 \div 9$

$°C = (66.6° \times 5) \div 9$

$°C = 333° \div 9$

$°C = 37°$

Celsius to Fahrenheit

$°F = \{(9 \times °C) \div 5\} + 32$

1. Replace the °C in the formula with the Celsius temperature.
2. Multiply the Celsius temperature by 9.
3. Divide that result by 5.
4. Add 32.
5. This is the temperature in Fahrenheit.

Example (°C = 100°)

$°F = \{(9 \times 100°) \div 5\} + 32$

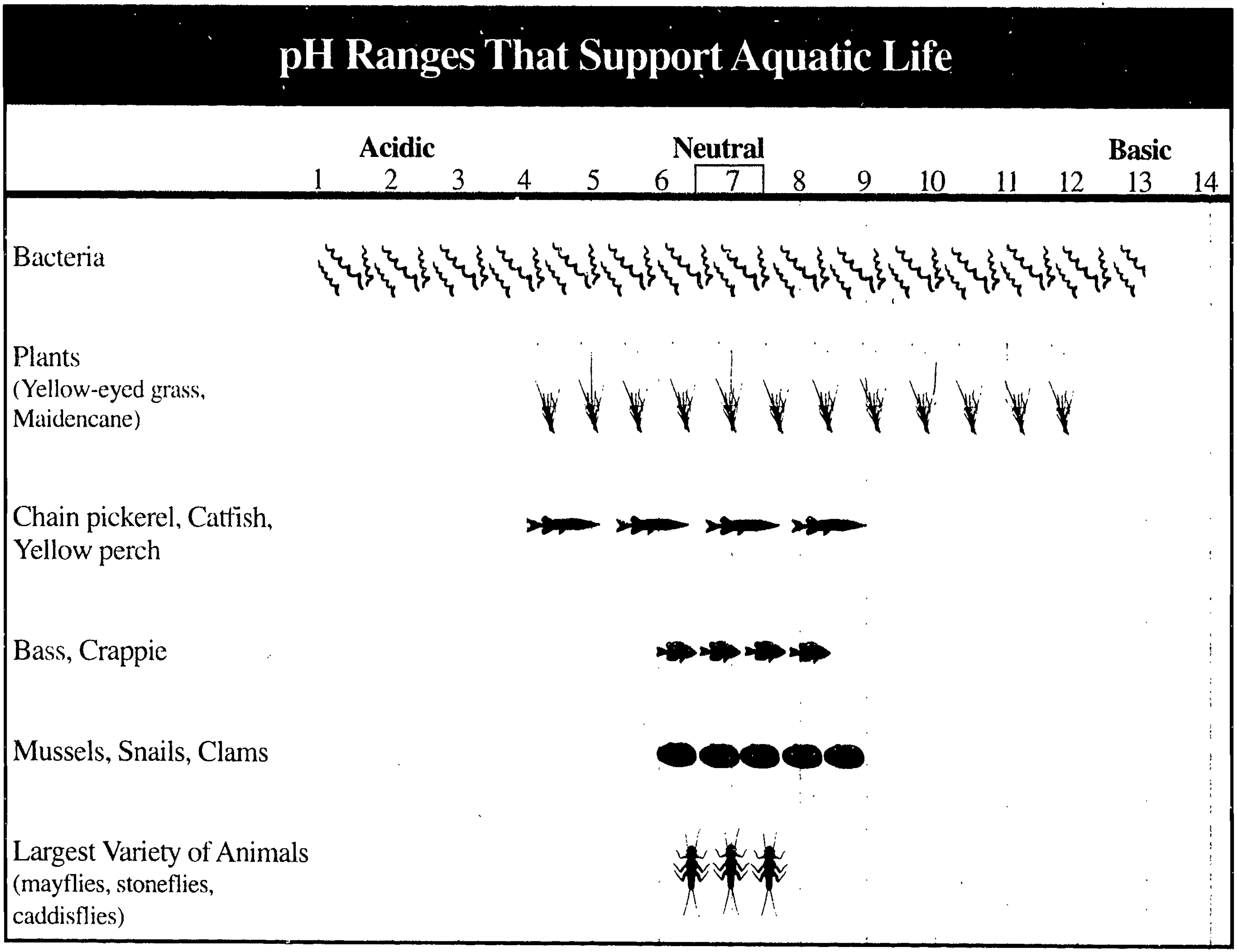
$°F = (900° \div 5) + 32$

$°F = 180° + 32$

$°F = 212°$

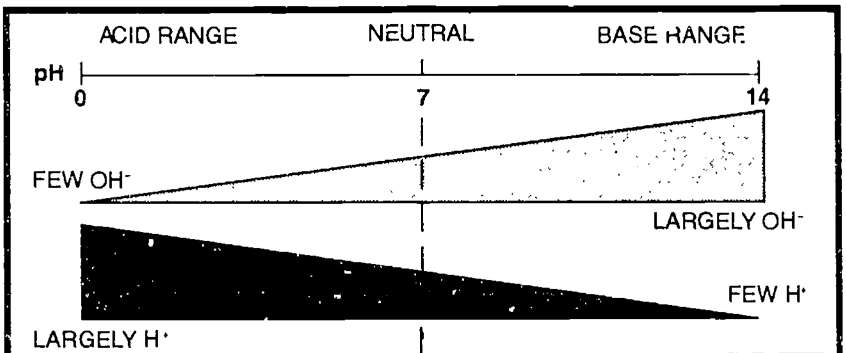
Have students convert the following temperatures to Fahrenheit or Celsius:

70° F	(21° C)
12° C	(54° F)
57° C	(135° F)
129° F	(54° C)
204° C	(399° F)


pH Ranges That Support Aquatic Life
Acidic
Neutral
Basic
1 2 3 4 5 6 7 8 9 10 11 12 13 14
Bacteria
Plants
(Yellow-eyed grass,
Maidencane)
Chain pickerel, Catfish,
Yellow perch
Bass, Crappie
Mussels, Snails, Clams
Largest Variety of Animals
(mayflies, stoneflies,
caddisflies)

pH

The term **pH** means (p)ower of (H)ydrogen ion activity. Scientists use the **pH scale** to show levels of acidity in soil and water. At one end of the scale, a pH of 0 is extremely acidic, having more hydrogen ions (H+). A pH of 14 is very basic, or **alkaline**, with more hydroxide ions (OH-). A substance with equal numbers of hydrogen (H+) and hydroxide (OH-) ions is neutral and carries a value of 7 on the pH scale. Pure water has a value of 7, being neither acidic nor basic.



pH is measured on a **logarithmic scale** with each number representing a factor of ten. Therefore, a pH reading of 5 is ten times more acidic than a reading of 6.

The level of acidity is very important in ponds and lakes because it affects what **aquatic life** can live there. Different animals can tolerate varying ranges of pH. Any changes in the pH ranges can be harmful to the aquatic life. (See the "pH Ranges That Support Aquatic Life" chart) Factors such as productivity, turbulence or **clarity**, rainfall and light are all balancing mechanisms that help keep a pH range constant. The pH of rainfall is naturally acidic, normally registering around 5 to 5.5, but may be "buffered" or neutralized when coming in contact with many types of soils.

The soils of **Carolina bays**, such as Jones Lake, contain large amounts of peat, partially decayed plant material, which is naturally acidic. Therefore, when rain falls on a Carolina bay peat bog and leaches or runs off into the lake, it is tea-colored and acidic, as you will discover during your On-Site testing. This natural acid is called **tannic acid** and is not harmful to humans or to the aquatic plants and animals which have adapted to live here. Peat, as it decomposes, releases carbon dioxide (CO_2) which also makes the pH of water decrease when it forms a weak carbonic acid.

The water quality of Jones Lake and other Carolina bay lakes is monitored several times a year by the North Carolina Division of Environmental Management to ensure that the pH range and other water quality factors remain within the appropriate range for aquatic life and human enjoyment.

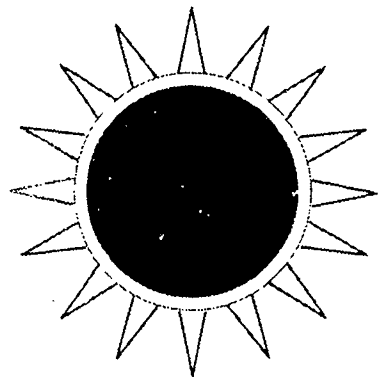
Clarity

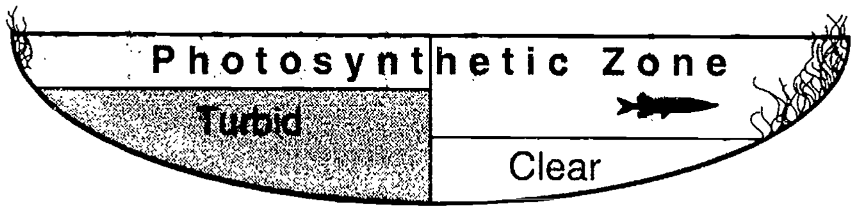
The energy source of a lake or pond **ecosystem** is the same for our entire planet, sunlight. The intensity or degree of solar penetration in an aquatic system decreases with depth due to the absorptive characteristics of water, microorganisms living in the water and other suspended or dissolved materials. Clarity is a measure of the clearness or visibility of water. Color and water chemistry have the biggest effect on the clarity and, therefore, the **biology** and productivity of the Carolina bay lakes.

The clarity of a lake or pond is important because it allows sunlight to penetrate and allow photosynthetic activity. In this area, called the photic or photosynthetic zone, green plants and phytoplankton thrive. These **organisms** contain chlorophyll, which uses energy from sunlight, along with water and carbon dioxide, to make food that plants need in order to grow. The **decomposition** zone is located near the bottom, where very little or no sunlight can reach. In this area, oxygen given off from **photosynthesis** is used in the break down of organic material. In the Carolina bays, however, the rate of decomposition is quite slow, due to high acidity and a limited supply of oxygen. Because of the slow rate of decomposition, scientists have been able to study pollen grains, preserved for thousands of years in the peat at the bottom of these lakes. This information enables researchers to understand more about what the environment was like when the Carolina bays were formed.

Jones, Salters and Singletary lakes are classic examples of these natural basins and associated ecosystems. Like most Carolina bays, these lakes receive almost no overland inputs of water, relying instead on rainfall and groundwater leaching from the surrounding bay-forest bog. These bogs are the cause of the characteristic tea-colored water of Carolina bays. Bogs normally form where little water flows in or out of a watershed. As plants die, their leaves, stems, roots and other parts fall into the water. These partially decay, forming peat. The peat is rich in tannic acid which, after rainfall, is released like tea from a tea bag.

In order to test the clarity of the water of Jones Lake you will be using a simple device called a Secchi (pronounced Seck-key) disk. This measuring device was invented by an Italian admiral, Pietro Angelo Secchi (1818-1879), who lowered an ordinary dinner plate over the side of a boat





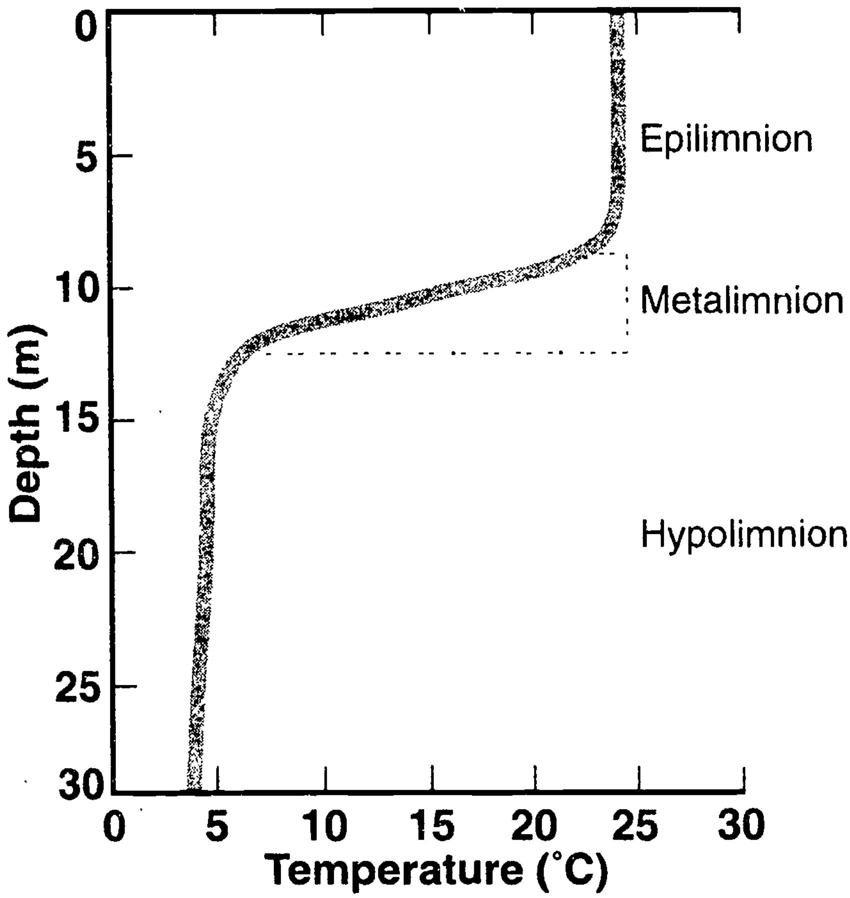
until it disappeared from view. He took a reading of the depth, and then raised the plate until it reappeared and then took the mean of the two readings to obtain the clarity. The Secchi disk you will use is 20mm in diameter and is divided into sections of black and white, and no, you can't eat lunch on it.

Depth

The Carolina bay lakes, while different in such aspects as clarity and pH, have a number of common characteristics. One of these similarities is depth. These shallow depressions average only around nine feet in depth and therefore have different characteristics from deeper lakes, such as Jordan Lake in the Piedmont region.

Deeper lakes go through a process called **stratification**. This transition occurs in the spring, when increased periods of sunlight begin to heat the surface of the lake. The first few feet of water may be several degrees warmer than the deep water, which is receiving less solar radiation.

Because the warm water is less dense, it will float on top of the cooler water. In the summertime, the lake will be much like a layer cake. The top layer, which scientists call the **epilimnion**, consists of warmer water that is continuously mixed and has a fairly uniform temperature. The bottom layer, called the **hypolimnion**, is colder, darker, denser and at certain times



contains little oxygen. These two layers are separated by a zone of transition called the **metalimnion**, also known as the thermocline, where the temperature and oxygen levels vary by depth.

In comparison, Carolina bay lakes are normally under fourteen feet in depth. Most, like Jones Lake, only average between eight and nine feet in maximum depth. Such a shallow depth means that nearly the entire water column can be mixed by constant winds and have a uniform temperature like the epilimnion of a deeper lake. Imagine a shallow saucer or dish and you can picture the bottom of a Carolina bay lake. Ideally, the lack of depth of these lakes should allow sunlight to penetrate to the lake bottom and allow aquatic plant life to photosynthesize. As you will recall from the clarity test, the tea-coloring of the lake absorbs much of the light before it reaches bottom. As a result, aquatic plant life is sparse in most Carolina bay lakes.

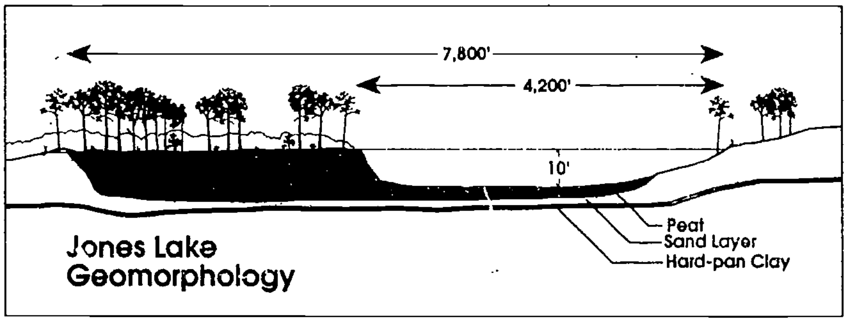
Generally, the deepest water is in the southeast end of Carolina bay lakes. In our state parks, visitor access and recreational opportunities are usually located on this side of the lake. Within 50 feet of the southeast shore, there is an initial drop of 1.1 to 2.0 feet in all of the lakes. This is a result of wind and wave action. A shallow wave-built terrace is usually several hundred feet into the lake, normally with a width the length of the lake.

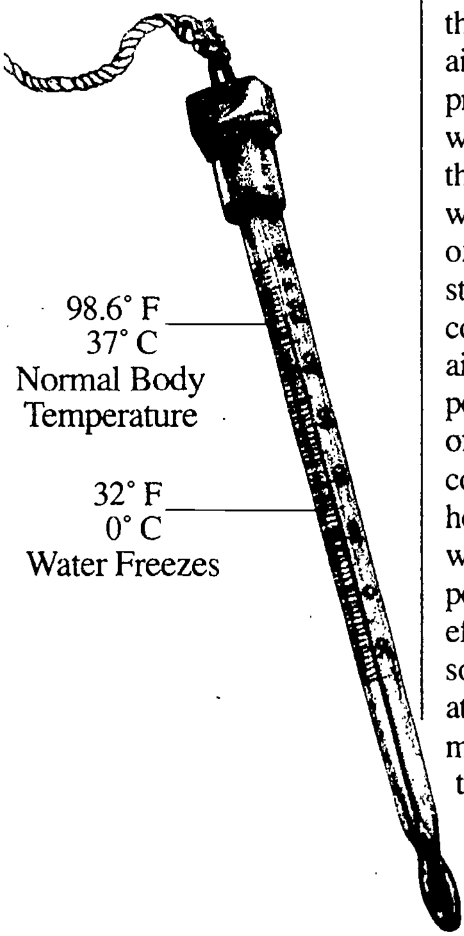
Jones Lake, however, has no such terrace and gradually slopes to its deepest point near the geographic center of the lake. The northwest shore of Carolina bay lakes have no terraces, and depths in this area may reach five feet at the water's edge. There is little or no wind influence on this side of the lake, which allows vegetation such as bay trees and cypresses to become more established around these margins of the lake. While reducing the wind and wave action, this also permits sediments to accumulate and new plants to establish themselves. Thus, peat is produced gradually from dead organic matter and the bay forest slowly grows into the lake. This process slowly reduces the size of the lake. Jones Lake, for example, is presently only about 34 percent of its original size. Ultimately, bay lakes will be reduced to moist bogs. Bushy Lake, a state natural area in southern Cumberland County, is a good example of a Carolina bay lake in the advanced bay-bog stage.

Temperature

Most creatures living in aquatic environments, such as fish, are cold-blooded. Because of the close relationship between body temperature and environmental temperature, most aquatic life is maintained within a narrow range of temperatures, from about 32° F to 122° F (0° C to 50° C). Few organisms, with the exception of some types of bacteria, can live very long at temperatures above or below these limits. This sensitivity to the temperature is a result of the effect temperature has upon enzymes, the proteins that control the rates of life-supporting reactions. When an organism's temperature decreases, the rates of such reactions decrease. In high temperatures, the complex enzyme molecules become unstable and reactions will cease.

The heat-holding capacity of water is great. It absorbs and releases heat much more slowly than does air. For this reason, plants and animals of most ponds and lakes are not usually subjected to suddenly varied temperatures. In a shallow pond or lake such as Jones Lake, the water temperature varies with air temperature.





Oxygen, which is necessary for the survival of nearly all plants and animals, is quite soluble in water, but the amount dissolved in fresh water is much lower than in the atmosphere. Oxygen from air is absorbed slowly, but the process is speeded when wind, waves and currents disturb the water surface. Moving water usually contains more oxygen because it is constantly being stirred up and comes into more contact with air than does still water. Temperature enters the equation of **dissolved oxygen** because cold water has the ability to hold more oxygen than warm water. Water at higher temperatures can have a harmful effect, because it has less dissolved oxygen available while at the same time it raises the metabolic rate of fish and therefore their need for oxygen.

Depending on the species of fish, maximum temperatures from 75° F to 92° F (24° C to 33° C) may result in thermal death. This is a result of the failure of one or more of the vital processes: respiration, circulation or nervous response. At Jones Lake, such high water temperatures have been recorded, usually around late July to early August, and occasionally fish have been found dead along the shore. On July 10, 1992, a temperature 90° F (32° C) was recorded at a depth of 3.5 feet.

Temperature is easily recorded with a **thermometer**, thanks to its invention by Gabriel Daniel **Fahrenheit** (1686-1736). He perfected a method of purifying mercury, and figured out that it would expand or contract uniformly with changes in temperature. The mercury thermometer is probably the most widely used way of measuring temperature today, and Fahrenheit's name lives on in the form of the temperature scale that we still use in the United States.

On-Site Activity #1 — Water Quality Testing

Curriculum Objectives:

Grade 6
- Communication Skills: listening, reading, vocabulary and viewing comprehension
- Guidance: competency and skill for interacting with others
- Healthful Living: recreational safety
- Mathematics: solve problems in temperature and measurement
- Science: ecology
- Social Studies: gather, organize and analyze information, draw conclusions

Grade 7
- Communication Skills: listening, reading, vocabulary and viewing comprehension
- Guidance: being responsible in a group
- Healthful Living: recreational safety
- Mathematics: solve problems in measurement and temperature
- Science: characteristics of plants and animals, earth science, natural phenomena
- Social Studies: know the importance of natural resources, gather, organize and analyze information, draw conclusions

Grade 8
- Communication Skills: listening, reading, vocabulary and viewing comprehension
- Healthful Living: recreational safety
- Mathematics: solve problems in measurement and temperature
- Science: ecology, geomorphology, landform processes
- Social Studies: North Carolina geography

Location:
Jones Lake State Park

Group Size:
30 or less; minimum of 1 leader per 10 students

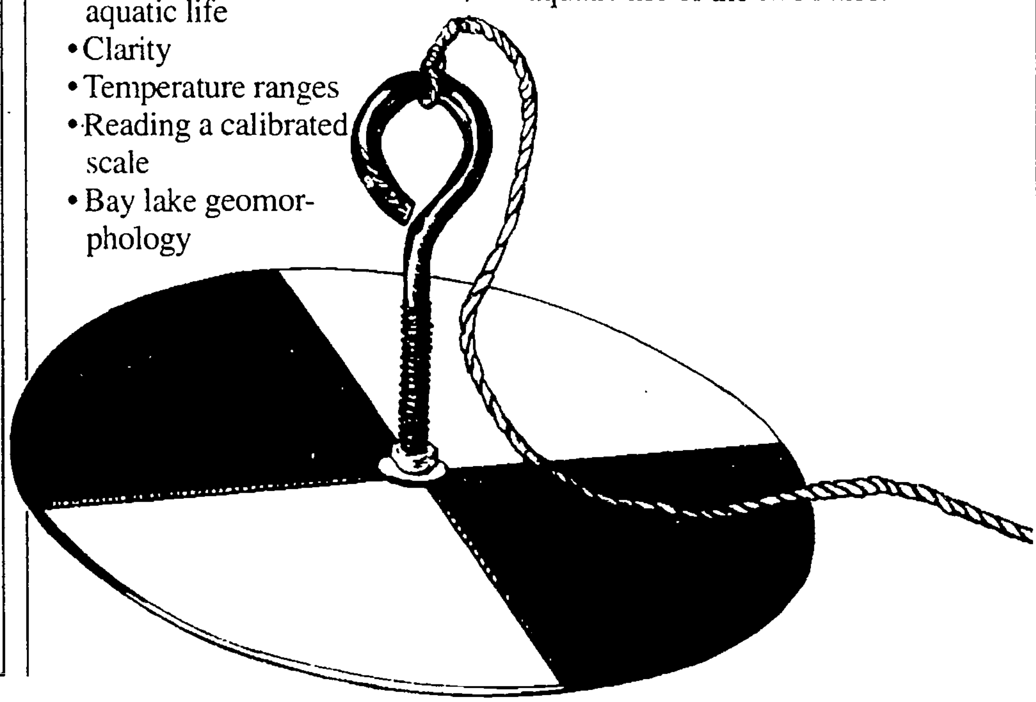
Estimated Time:
Approximately 60 minutes

Appropriate Season:
Early spring to late fall

Materials:
Provided by the educator:
Per student: "Close Encounter with a Carolina Bay Worksheets," pencil
Provided by park: litmus paper, small plastic bucket, small glass specimen jars, pH testing meter, Secchi disk, mercury thermometer, calibrated depth marker

Major Concepts:
- Water quality
- pH
- pH range best suited for aquatic life
- Clarity
- Temperature ranges
- Reading a calibrated scale
- Bay lake geomorphology

Objectives:
- Work as a scientific testing group to gather data on the water quality of a Carolina bay lake.
- Use litmus paper to measure pH.
- Use a Secchi disk to measure clarity.
- Measure temperature.
- Determine temperature ranges that best support aquatic life.
- Learn the average depth of most Carolina bay lakes.
- Demonstrate the use of a calibrated depth scale to determine the depth of a body of water.
- Be able to present and explain the data collected in the water quality tests.
- Based on the pH of Jones Lake and Lake Waccamaw, explain the difference in aquatic life of the two lakes.



Educator's Information:

This activity takes place on and around the pier at Jones Lake, so it is very important to emphasize safety before and during the visit to the park. Horseplay and misconduct will not be allowed. A member of the park staff or an educator will be the station leader at each testing site.

1. Prior to the park visit the students should be divided into four groups.

2. The bus will be met in the main parking area by a park staff member, who will lead the group to the Interpretive Stand located in the picnic area. At the Interpretive Stand, students will take part in a brief introduction to the park and learn important information concerning the location of testing stations on the pier. Each group will take turns visiting each of the water quality testing stations. When a group completes a water quality test, they should wait quietly until the word is given to move to the next station.

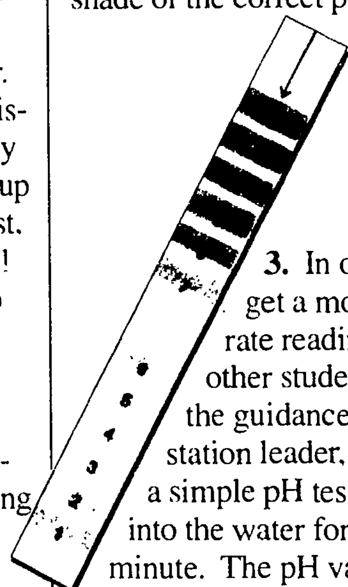
3. Distribute the materials, testing equipment and data sheets to the students and answer any questions concerning the day's events.

Instructions:

Part A
pH Testing:

1. The **pH** testing will be located near the boat stalls of Jones Lake pier. Students should be especially careful at this testing station as there is no railing in this area.

2. When the group has arrived at the station, the station leader or a group member will lower a bucket into the water and bring up a sample of water. Have one student stick the **litmus paper** into the water while the others observe what color the testing block turns. Students should remember from the Pre-Visit activities that the shade the test block turns will correspond with the shade of the correct pH value.

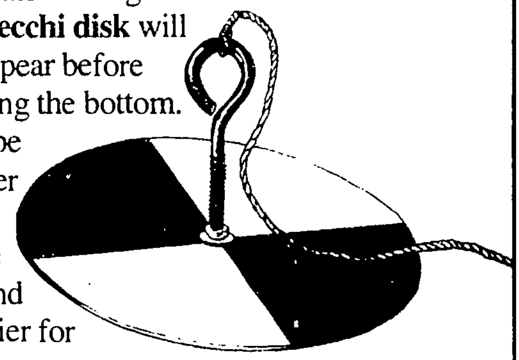


3. In order to get a more accurate reading, another student, under the guidance of the station leader, will dip a simple pH test meter into the water for about a minute. The pH value will then be displayed on the small digital screen.

4. Both readings should be recorded on the worksheet and the water sample returned to the water. Please be good park stewards and place used litmus paper in the nearest trash can.

Part B
Clarity Testing:

1. The **clarity** testing will be done near the end of the pier where the water is deeper. Students should get a fairly accurate reading here since the **Secchi disk** will disappear before striking the bottom. A rope barrier is in place around the pier for safety.



2. The station leader or a group member will slowly lower the disk into the water as the students carefully watch the disk to determine when it fades from view in the tea-colored water.

3. The disk should then be raised slightly until it can just barely be seen again, almost to the point of no longer being visible. This is the mark or reading which should be recorded on the worksheet. The line on the Secchi disk is calibrated in inches. The leader will assist the students in reading the measurement.

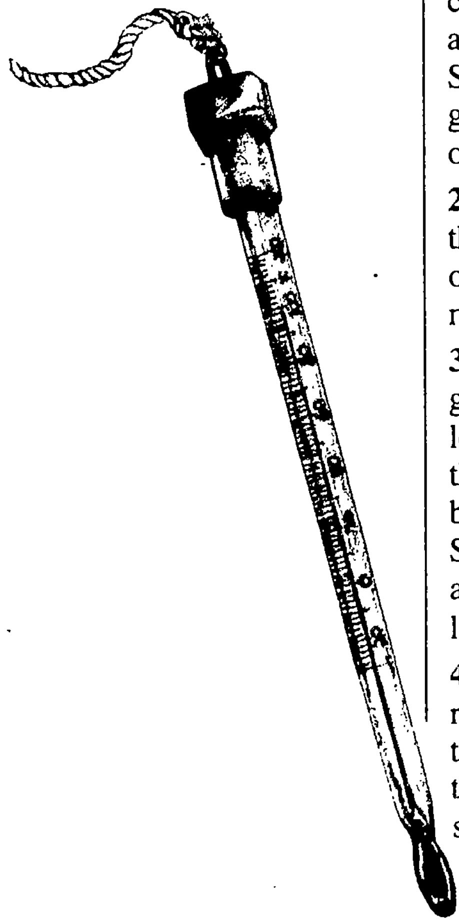
Part C
Temperature Testing:

1. In this part students will record the temperature of Jones Lake at two locations on the pier. The first station is located near the end of the pier. After testing the temperature in this location, students will move down the pier to test the temperature in shallower water.

2. Students should remember to keep the **thermometer** in the plastic case before the test begins. Have one student remove the thermometer from the case, being careful to not hold the bulb end, as this may affect the test accuracy.

3. The student will lower the thermometer into the water at the station until it reaches the bottom. The thermometer should be left in the water for at least two minutes.

4. After the allotted time, the student should pull the thermometer to the surface and quickly take the reading, in order to get an accurate reading not influenced by air temperature. Each student should record this reading on his or her worksheet.



5. Follow the station leader to the second station near the start of the pier, to test the temperature in shallow water. This water should be slightly warmer because of more thorough heating from solar penetration. The same procedure should be used as in the previous temperature test and everyone should record this temperature on his or her worksheet.

6. Next, leave the thermometer out of its case for a few minutes and record the air temperature, once again remembering not to hold onto the bulb.

Part D
Depth Testing:

1. In this part, students will check the depth of Jones Lake at two locations on the pier. Students will discover the gradual slope of the bottom of a **Carolina bay** lake.

2. Students will first meet at the depth station near the end of the pier, where a measurement will be taken.

3. The station leader or a group member will slowly lower the depth marker into the lake. The marker is calibrated in inches and feet. Students will record the level after the marker has touched lake bottom.

4. Once this reading has been recorded on the worksheet, the station leader will lead the group to the second depth station near the start of the pier. Here the students will take another reading using the same instructions as before.

Part E
Testing Summary:

1. Once every group has visited each of the stations and recorded data on the water quality tests, they will be led back to the interpretive stand.

2. Here, students will present their findings for all of the water quality tests and see if they correspond with expected results and those recorded by other groups.

3. Group members will be asked to come forward and record their group's readings on a poster in front of the rest of the class. Also on this poster will be pictures of actual fish and aquatic plants commonly found in Carolina bay lakes.

4. Another poster will show pH ranges that support **aquatic life** in Jones Lake in relation to ranges that support life at Lake Waccamaw. How is it possible that more life may be present in Lake Waccamaw although it, too, is a Carolina bay lake?

5. At this time students will test a few items from everyday life. Bleach, lemon juice and tap water are among items to be tested in order to define the limits or boundaries of the pH scale. Ask students to compare the pH of Jones Lake water to these other substances. Based on pH, which of the fluids would be more likely to support aquatic life?

Close Encounter with a Carolina Bay Worksheet

Lake or Water Source ______________________ Date ______________

Student's Name ______________________ Time ______________

pH TESTING

Litmus paper __________ pH meter __________

pH Scale

Acid												Base		
0	1	2	3	4	5	6	**7**	8	9	10	11	12	13	14
STRONG			MODERATE		WEAK		NEUTRAL	WEAK			MODERATE		STRONG	

pH is recorded on a logarithmic scale. Each number represents a change by a factor of 10. For example, water with a pH of 3 is 100 times more acidic than water with a pH of 5. How many times more acidic is the water of Jones Lake than Lake Waccamaw (pH = 7)?

answer: ______________

CLARITY TESTING

______________ inches

If one inch equals 2.5 centimeters, what is the clarity depth reading of Jones Lake in centimeters? ______________ cm

DEPTH TESTING

Location # 1 ______________ Location # 2 ______________

If one inch equals 2.5 centimeters, what are the depth readings of Jones Lake in centimeters?

Location # 1 ______________ Location # 2 ______________

TEMPERATURE TESTING

Location # 1 (deep) __________ Location # 2 (shallow) __________ Air __________

In what way does the air temperature of today compare to the water temperatures? Which of the three is warmer? Why? ______________________

____

____

General Observations:

Were any signs of animal life present? If so, what? ______________________

____

____

Were any signs of plant life present? If so, what? ______________________

____

Post-Visit Activity #1 How's Your Water?

Curriculum Objectives:
Grade 6
- Communication Skills: study skills using environmental sources, listening, reading, vocabulary and viewing comprehension
- Healthful Living: environmental health, how people affect the environment, recreational and home safety
- Science: how science helps us
- Social Studies: gather, organize and analyze information, draw conclusions

Grade 7
- Communication Skills: study skills using environmental sources, listening, reading, vocabulary and viewing comprehension
- Healthful Living: home, school and recreational safety
- Science: characteristics of plants and animals, organization and variety of living things, interaction of people and the environment
- Social Studies: know the importance of natural resources, gather, organize and analyze information, draw conclusions

Grade 8
- Communication Skills: study skills using environmental sources, listening, reading, vocabulary and viewing comprehension
- Healthful Living: home, school and recreational safety

Location:
Classroom, school property, home

Group Size:
30 students or less, class size

Estimated Time:
As much time as teacher deems necessary

Appropriate Season: Any

Materials:
Provided by park: litmus paper
Provided by educator: pencils, "How's Your Water?" data sheet, "Flashy Fish" fact sheet

Major Concepts:
- pH
- pH range best suited for aquatic life
- Water quality

Objectives:
- Use litmus paper to measure pH.
- Predict habitat suitability for select fish.

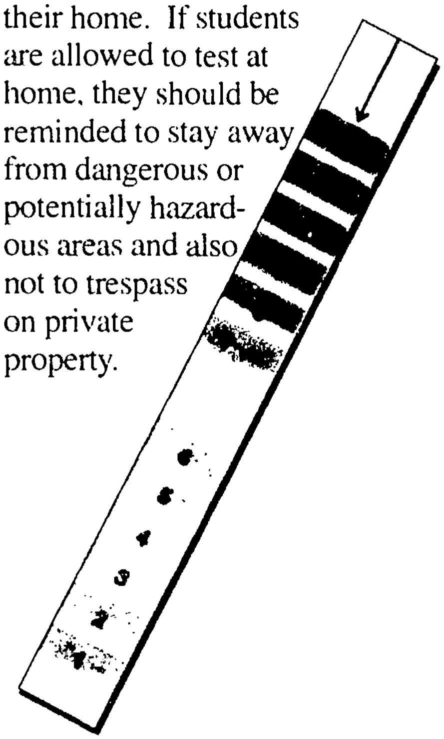
Educator's Information:

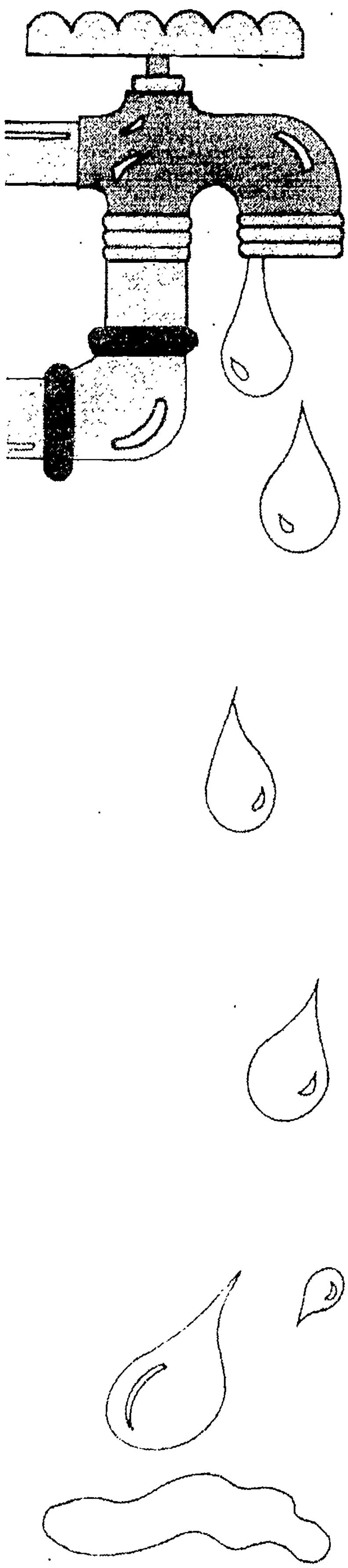
During their visit to Jones Lake State Park, students learned about the term **pH** and how it is an important aspect of measuring the quality of a water source. As students discovered, pH plays a very important part in determining the type and amount of **aquatic life** that may live in Jones Lake and the other **Carolina bay** lakes. By gathering pH readings, we can tell the acidity of a liquid, whether it is a mud puddle or a 224 acre lake.

In this activity, students will be testing the pH of different water sources in and around the school or home. In preparation for this testing, you may want to briefly refresh the students on the use of **litmus paper**. It may also be necessary for you to designate certain areas as "off-limits" to testing for safety purposes.

Examples of items or areas that could be tested may include mud puddles, a local creek, pond, road-side ditch, classroom aquarium, drinking fountain or even the student's own saliva. By recording the pH values, students will be able to determine if the "Flashy Fish" could live in the water they tested.

This activity could be done solely on the school grounds or as a take-home project to include water sources around their home. If students are allowed to test at home, they should be reminded to stay away from dangerous or potentially hazardous areas and also not to trespass on private property.





Instructions:

1. Once the testing areas have been defined, pass out the "How's Your Water?" data sheet and briefly review it with the class. Instruct the students to be sure to record the testing location, the type or use of the water source and the pH of the water source. You may find it necessary to set a time limit for testing around the school grounds.

2. After the testing has been completed, gather the class back together to discuss their findings.

3. Start by asking the class if they discovered any water source that was new to them. Is it permanent or temporary? What is the origin of the water?

4. Did any of the students observe anything alive in or near the water source they tested? If it was a natural **habitat**, have the student(s) describe the plant or animal life, if any.

5. Were there any signs of pollution at the test site? If so, what was the probable cause?

6. Draw the pH scale on the board. Have the students share the pH results of their test sites and note these on the board below the pH scale. Above the scale, mark what they recorded as the pH of Jones Lake and Lake Waccamaw.

7. Hand out the "Flashy Fish" fact sheets. Have the class read the biological sketch for each species. From these characteristics students should determine which fish species could live in the water sources they tested.

"How's Your Water?" Data Sheet

Find a water source and test it with a strip of litmus paper. Record your observations on this sheet for use in the second part of this activity. (Use the back of this sheet to answer the questions if additional space is needed.)

	Test Site	Location	Source of / or use of Water	pH
1.	*water fountain*	*hallway*	*drinking*	
2.				
3.				
4.				
5.				
6.				
7.				
8.				

- Does the test site have water permanently or on a temporary basis?

1.*permanently* 2.____ 3.____ 4.____
5.____ 6.____ 7.____ 8.____

- Is the water clear, moderately clear or turbid/muddy?

1.*clear* 2.____ 3.____ 4.____
5.____ 6.____ 7.____ 8.____

- List any living things in or near the water test site:

1.*people* 2.____
3.____ 4.____
5.____ 6.____
7.____ 8.____

- List any sign(s) of pollution at your test site:____

- Any additional comments or observations:____

- Which (if any) Flashy Fish could live in the water at the test site(s)?____

Largemouth Bass

Micropterus salmoides

The largemouth bass is the largest and probably the most important game fish within the sunfish family. It is a well-known fish that is usually only confused with its closest relatives, the smallmouth and spotted bass. As its name indicates, the upper jawbone of the largemouth extends farther back than the jawbone on the smallmouth. A more reliable indicator is the number of rows of scales on the cheek of the largemouth. The number of rows of scales is always less than 12 for a largemouth. The largemouth is black to deep bronze-green in color on the dorsal (top) side, blending through lighter green on the sides to a white belly.

Natural History

Largemouth bass spawn under a wide variety of water conditions. Most spawning takes place in the spring when water temperatures are between 62° to 68° F (16° - 20° C). As many as 26,000 eggs may be deposited in the nest by one or more females. After fertilization, the male bass guards the nest from predators and circulates water over the eggs through the movement of its fins. Young largemouth hatch in 7 to 10 days and feed on plankton and insect larvae while remaining schooled together. Once the young bass reaches about 2 inches it will eat almost anything it can swallow.

Distribution

The largemouth bass is a native to the eastern United States and is presently found in nearly every lake and reservoir in North Carolina. Warm rivers and streams also provide good largemouth habitat. This species is usually absent, however, from the extremely acid waters of the southeastern part of the state.

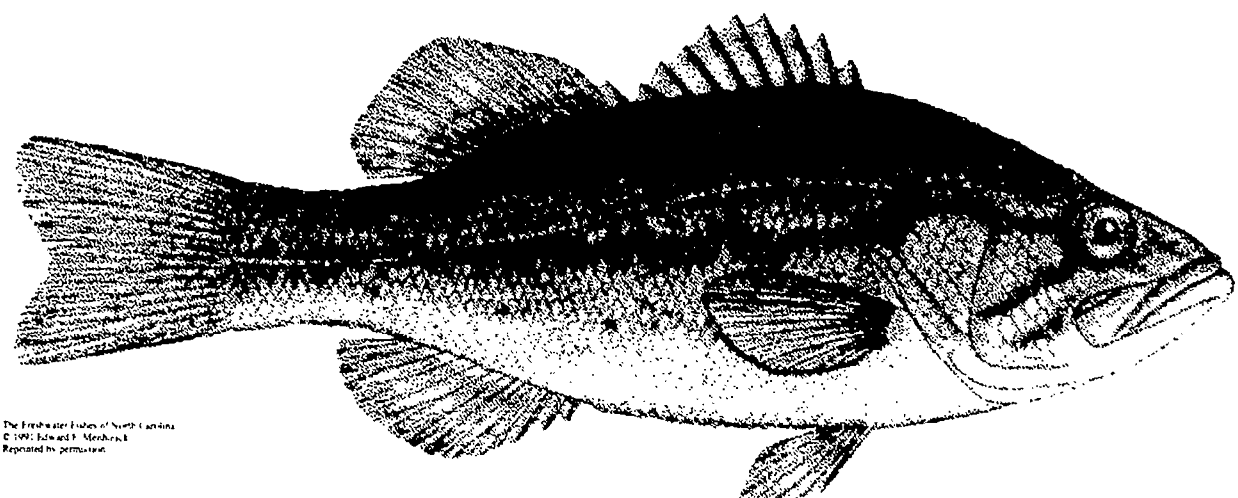
pH Tolerance

Largemouth bass, like all fish, and humans for that matter, has a blood pH of 7.4. While the air that we humans breathe does not have a pH, this value is all-important to the aquatic environment of the fish. Even slight changes or variations in pH may affect the fish's hemoglobin and its ability to take oxygen out of the water. If the pH of the water is adequate, the fish is able to acquire all the oxygen it needs, even from oxygen-starved water. If the pH value of the water is too high or too low, a sufficient oxygen supply might not be derived, even in oxygen-rich waters.

Largemouth bass prefer and are most active in a pH range from 7 to 8.5. Largemouth bass are not commonly found in water below 6 and above 9 on the pH scale.

Size Range

The average size of the largemouth bass ranges from 4.7" to 28" or 12 to 70 cm.



Flashy Fish Fact Sheet

Blackbanded Sunfish

Enneacanthus chaetodon

The "angelfish" of native fishes, blackbanded sunfish have a series of four to six intense black vertical bands crossing a round, silver body. The fins are clear except for the leading spines of the dorsal fin which may be black and orange.

Natural History

The blackbanded sunfish prefers to spawn in a sandy, heavily vegetated lake or on a river bottom with slow moving water. Most spawning takes place in early spring as the water temperature starts to rise. The male defends the shallow nesting depression, even against fish larger than himself. He also fans the nest to insure the developing eggs receive oxygenated water.

Distribution

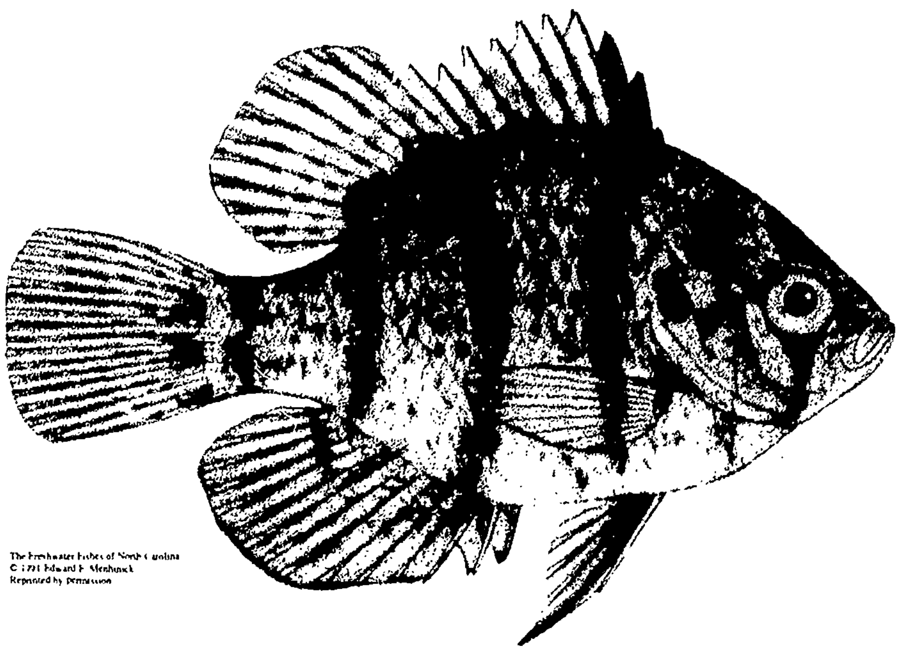
This species is found in the Atlantic coastal plain from the New Jersey Pine Barrens southward to northern Florida. In North Carolina it is more common in the blackwater streams in the southeastern section of the state.

pH Tolerance

Of all the native fish, the blackbanded sunfish probably has the greatest tolerance for existing in waters with a low pH (acidic). The species is routinely found in blackwater lakes and streams where the pH is in the low 4's. The fish has even been found living in waters where the pH was an exceptionally low 3.5.

Size Range

The average size of the blackbanded sunfish ranges from 1.2" to 2.4" or 3 to 6 cm.

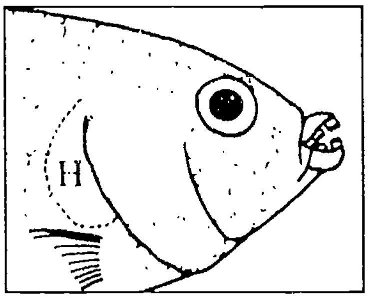


FLASHY FISH FACT SHEET

SHEEPSHEAD PUPFISH

CYPRINODON VARIEGATUS

The sheepshead pupfish can be identified by the enlarged scale (the humeral) just behind the gill cover. Also, under a magnifying lens you can see the presence of three projections on each tooth. Its body is short and thick with dark "Y"-marks on its silvery flanks. The male has a brilliant iridescent blue line running from the dorsal fin to the snout.



NATURAL HISTORY

Members of this fish genus appear to have originated from marine environments. They have the ability to exist in either freshwater or saltwater. Their pituitary gland controls their body's ability to adjust to changes in water salinity (salt content) that would be fatal to most other fish.

DISTRIBUTION

It occurs from Massachusetts to South America along the Atlantic coast.

HABITAT

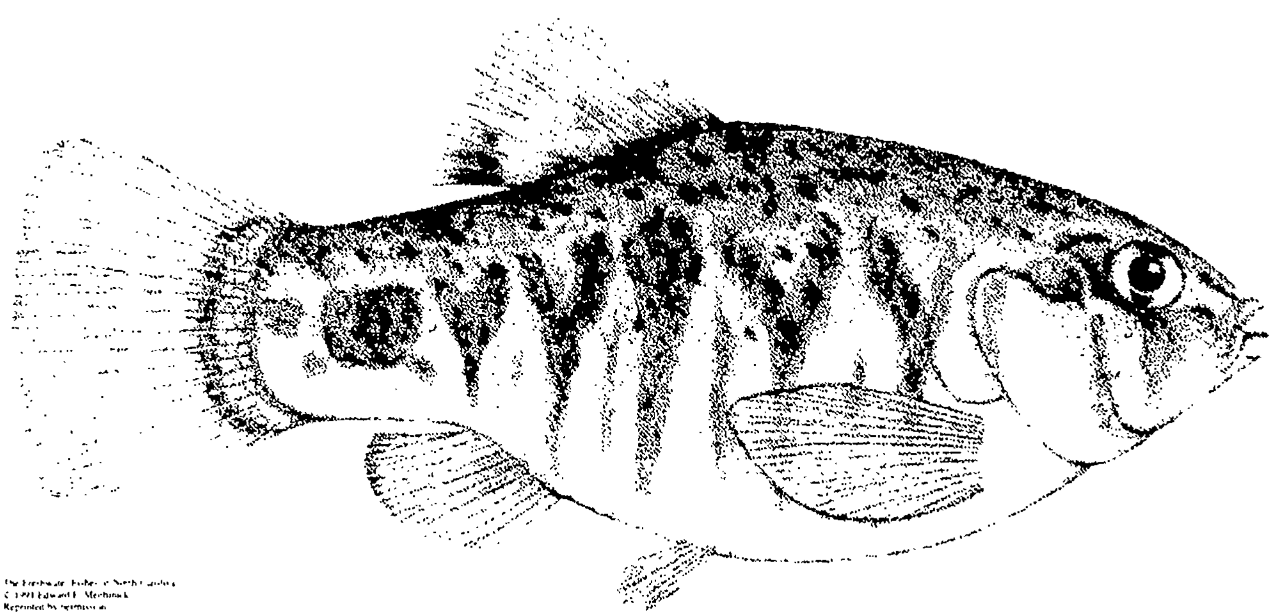
This fish is commonly found in coastal waters with low salinity. Most typically it is found in tidal pools or marsh channels with sand bottoms and well-developed shorelines of marsh grasses. It can also occur in full strength seawater. It is rarely found in freshwater mainly because of competition with other fish, primarily sunfish.

pH TOLERANCE

This species can exist in waters with a pH up to 9.

SIZE RANGE

The average size of the sheepshead pupfish ranges from 1.6" to 2" or 4 to 5 cm.



VOCABULARY

Acid - Having a pH less than 7; the chemical state of water or other substance in which the hydrogen (H+) ions exceed the hydroxyl (OH-) ions. For example, a car's battery acid has a pH of 1. See pH scale.

Adaptation - A change in the structure or activity of an organism that produces a better adjustment to its environment, thus enhancing its ability to survive and reproduce.

Alkaline - See Base.

Ammonia - A colorless, strong smelling gas composed of nitrogen and hydrogen. It has a pH of 12.

Aquatic Life - A plant or animal growing or living in or upon water.

Base - Having a pH greater than 7; the chemical state of water or other substance in which the hydroxyl (OH-) ions exceed the hydrogen (H+) ions.

Biology - The science that deals with the origin, history, physical characteristics, life processes and habits of plants and animals.

Carolina Bay - Elliptical or oval depressions in the surface of the coastal plain of the southeastern United States from northern Virginia to southern Georgia. They generally run parallel to each other in a northwest to southeast orientation. Most are filled with wet, organic soils and are overgrown with swamp-type vegetation. In the past, nearly all contained lakes. A few open-water bay lakes remain. Jones, Salters, Singletary, White and Waccamaw are all examples of Carolina bays in the lake form.

Clarity - The distance that sunlight is able to penetrate into a body of water.

Decomposition - The rotting or breaking apart into basic components. Decomposition makes nutrients, such as nitrogen and phosphorous, available for use by other organisms.

Dissolved Oxygen (DO) - The amount of oxygen gas molecules dissolve in water. Fish and other aquatic animals depend on DO for respiration.

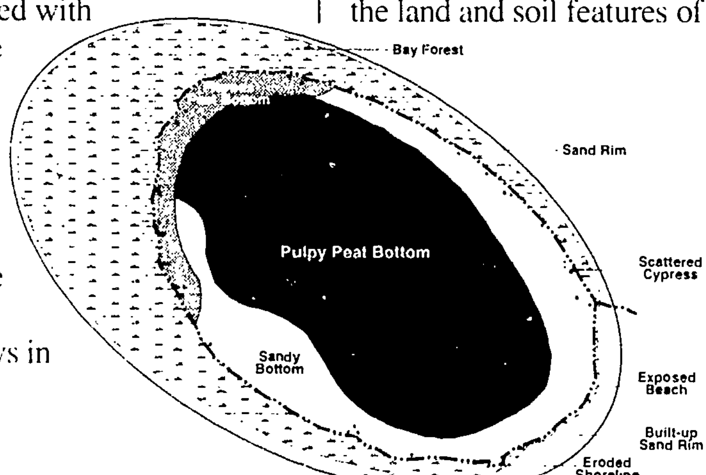
Ecosystem - Plants, animals and their physical surroundings which interact with environmental conditions, such as temperature and rainfall, forming an interdependent system.

Environment - All the living and non-living conditions, factors and influences which surround a plant or an animal.

Epilimnion - The uppermost, warmest, well-mixed layer of a lake during summertime thermal stratification. The epilimnion extends from the surface to the metalimnion (thermocline).

Fahrenheit - Denoting a thermometric scale in which water freezes at 32 F and boils at 212 F. Named for Daniel Gabriel Fahrenheit (1686-1736), the inventor of the thermometer.

Geomorphology - A science that deals with the land and soil features of the earth.



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Habitat - The environmental conditions of the area where a plant or animal naturally grows or lives. See Environment.

Hypolimnion - Lower, cooler layer of a lake during summer thermal stratification.

Larva (larvae, plural) - The immature form of an animal that changes structurally when it becomes an adult, usually by complex metamorphosis.

Limnology - The scientific study of the physical, chemical, geological and biological factors that affect aquatic productivity and water quality in freshwater ecosystems, lakes, reservoirs, rivers and streams.

Litmus Paper - Specially treated paper used as an acid-base indicator.

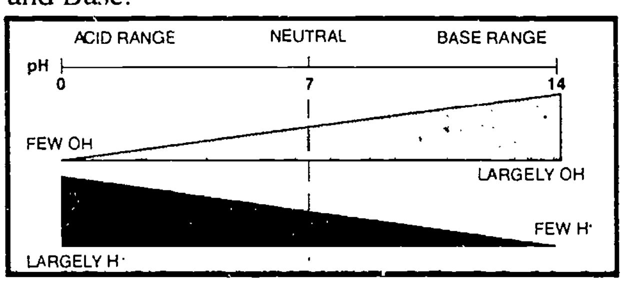
Logarithmic Scale - In relation to pH, each unit of pH on the scale represents a factor of ten. A lower pH number is more acidic, while a higher pH number is more alkaline. For example, a pH of 5 is ten times more acidic than a pH of 6, which is ten time more acidic than a pH of 7. Conversely, a pH of 7 is ten times more alkaline than 6, which is ten times more alkaline than 5.

Metalimnion - Layer of greatest temperature change in a stratified body of water; presents a barrier to mixing. See Thermocline.

Organism - A plant or animal; any living thing.

pH - A measure of the power of the hydrogen ion (H+) activity in a substance.

pH Scale - A range of 0 to 14 used to measure the degree of acidity or basicity (alkalinity) of a substance. A pH of 7 is neutral. See Acid and Base.



Photosynthesis - The chemical process carried on by green plants in which the cells that contain chlorophyll use light as energy to produce glucose (a plant food) from carbon dioxide and water; oxygen is released as a by-product.

Plankton - Collective term for the mostly microscopic plants and animals that float or drift in oceans and freshwaters. These plants and animals are a very important food source in aquatic environments.

Pocosin - A type of wetland which is dominated by dense stands of broad leaf evergreen shrubs or low bay trees.

Secchi Disk - Typically a black and white disk, generally 20 cm in diameter, used to measure water clarity. Named for its originator, Italian admiral Pietro Angelo Secchi (1818-1878).

Species - A biological classification of organisms. All organisms of a single distinct kind that have a high degree of similarity and can mate and produce fertile offspring.

Stratification - A division of an aquatic or terrestrial community into distinguishable layers on the basis of temperature, moisture, light, vegetative structure and other such factors creating zones for different plant and animal types.

Tannic Acid - Any of a group of pale-yellow to light-brown, shapeless, substances in the form of powder, flakes or a spongy mass widely distributed in plants. Tannins normally occur in the roots, bark, leaves and fruit of many plants. Tannins are responsible for the tea-color and low pH of Jones Lake.

Thermometer - An instrument for measuring temperature.

Turbidity - Cloudiness in water caused by particles suspended in the water.

Wetland - A low lying area, such as a swamp, marsh or pocosin, whose soils are waterlogged for at least part of the year.

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Illustration by Ruth F. Brunstetter

SCHEDULING WORKSHEET

For office use only:
Date request received______________ Request received by__________________________

1) Name of group (school) ____

2) Contact person _____________________ ______________________________
name phone (work) (home)

____
address

3) Day/date/time of requested program ______________________________________

4) Program desired and program length ______________________________________

5) Meeting place ____

6) Time of arrival at park ______________ Time of departure from park _____________

7) Number of students ________________ Age range (grade) ____________________
(Note: A maximum of 30 participants is recommended.)

8) Number of chaperones ______________
(Note: One adult for every 10 students is recommended.)

9) Areas of special emphasis ____

10) Special considerations of group (e.g. allergies, health concerns, physical limitations)________
____

11) Have you or your group participated in park programs before? If yes, please indicate previous programs attended: ____
____

12) Are parental permission forms required? ________ If yes, please use the Parental Permission form on page 8.2.

I, _______________________________, have read the entire Environmental Education Learning Experience and understand and agree to all the conditions within it.

Return to: Jones Lake State Park
Rt 2, Box 945
Elizabethtown, NC 28337

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PARENTAL PERMISSION FORM

Dear Parent:

Your child will soon be involved in an exciting learning adventure - an environmental education experience at **Jones Lake State Park**. Studies have shown that such "hands-on" learning programs improve children's attitudes and performance in a broad range of school subjects.

In order to make your child's visit to "nature's classroom" as safe as possible we ask that you provide the following information and sign at the bottom. Please note that insects, poison ivy and other potential risks are a natural part of any outdoor setting. We advise that children bring appropriate clothing (long pants, rain gear, sturdy shoes) for their planned activities.

Child's name ________________________________

Does your child:

- Have an allergy to bee stings or insect bites? ________________________________
  If so, please have them bring their medication and stress that they, or the group leader, be able to administer it.

- Have other allergies? ________________________________

- Have any other health problems we should be aware of? ________________________________
  ____

- In case of an emergency, I give permission for my child to be treated by the attending physician. I understand that I would be notified as soon as possible.

________________________________ ________________

Parent's signature date

Parent's name ________________________________ Home phone ________________
(please print) Work phone ________________

Family Physician's name ________________________________ phone ________________

Alternate Emergency Contact

Name________________________________ phone ________________

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NORTH CAROLINA PARKS & RECREATION
PROGRAM EVALUATION

Please take a few moments to evaluate the program(s) you received. This will help us improve our service to you in the future.

1. Program title(s) ______________________ Date __________

   Program leader(s) ______________________

2. What part of the program(s) did you find the most interesting and useful? ______________________

____

3. What part(s) did you find the least interesting and useful? ______________________

____

4. What can we do to improve the program(s)? ______________________

____

____

5. General comments ______________________

____

____

____

LEADERS OF SCHOOL GROUPS AND OTHER ORGANIZED YOUTH GROUPS PLEASE ANSWER THESE ADDITIONAL QUESTIONS:

6. Group (school) name ______________________

7. Did the program(s) meet the stated objectives or curriculum needs? __________

   If not, why? ______________________

____

Please return the completed form to park staff. Thank you.

Jones Lake State Park
Rt. 2, Box 945
Elizabethtown, NC 28337