(pix in this document are placeholders – to be replaced when we shoot 2011 pix)

ABOARD THE MELINDA ANN

Five Lake Stewardship Learning Activities

sponsored by the

Maine Congress of Lake Associations

ABOARD THE MELINDA ANN

MAINE CONGRESS OF LAKE ASSOCIATIONS

MAY 14, 2011

INTRODUCTION

For many years, a specially outfitted 30-foot pontoon boat, the Melinda Ann, has served as a floating classroom on lakes across the state of Maine. As the boat slowly heads towards deep water, Captain Phil Mulville introduces school-age children to a series of hands-on activities demonstrating that lakes are living ecosystems whose health students can measure. There are five activities in this series, each focusing on an observable feature of lake ecology that is also an indicator of lake health.

Just as a doctor measures temperature, blood pressure and heart rate to get a picture of a patient's state of health, so young lake stewards learn to assess lake characteristics such as water clarity, plant and animal abundance, and water temperature. Cumulatively, the activities lead students to understand that the health of a lake depends on the quality of stewardship present and future generations bring to it. To enhance the learning experience for teachers and students undertaking each of the five activities, please see

www.earlmorse.org/colaeducation/aboardmelindaann/aboard_the_melinda_ann.htm

and click on the links there, grouped according to each activity.

ACTIVITY ONE MEASURING WATER CLARITY WITH A SECCHI DISK

ACTIVITY TWO PLANKTON TOW: INTRODUCTION TO FOOD WEBS AND PHYTOPLANKTON

ACTIVITY THREE TAKING THE LAKE'S TEMPERATURE TO "SEE" LAKE STRATIFICATION

ACTIVITY FOUR USING A BENTHIC DREDGE TO IDENTIFY INSECTS IN THE SEDIMENTS

ACTIVITY FIVE EXAMINING LIFE IN THE DEPTHS WITH THE ROV

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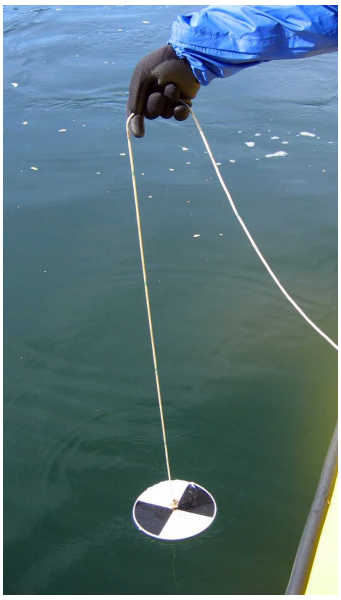
ACTIVITY ONE

MEASURING WATER CLARITY WITH A SECCHI DISK



Summary: At a deepwater station, the Secchi disc, a flat, round, black and white disk attached to a metered measuring tape, is lowered slowly down into the water. Students observe the disc through an Aqua Scope as it descends. The Aqua Scope is like a diver's face mask, enabling the viewer to see clearly through the reflections and waves on the water's surface. The pattern on the flat, round Secchi disk at first is clearly half white and half black. Students record the depth at which the pattern on the disk is no longer visible. That depth, known as the Secchi depth, is a measure of the transparency, or clarity, of the water.

Essential Question: What is the clarity of the water in this lake as measured by Secchi disk? How does this compare to readings in the same lake other times of the year, in past years, and to readings from other lakes? What causes the clarity (Secchi depth) of a lake to change?

Objectives:

- Students will learn that Secchi depth is a measurement of water clarity, which is a good indicator of water quality in most cases.
- Students will learn that a lake is a dynamic system affected by the land that surrounds it (its watershed).
- Students will learn that a major cause of poor water clarity is an overgrowth of microscopic plants, or phytoplankton, floating in the water.
- Phosphorus, a nutrient plants use to grow, is the limiting factor in plant growth and its overabundance can greatly accelerate the growth of phytoplankton. When this happens, it is called an algal bloom and the water quickly gets greener and greener.
- Phosphorus enters the lake from the surrounding watershed in silt-carrying stormwater runoff, in effluent from faulty septic systems, and as the result of such poor land management practices as the use of chemical fertilizers.
- Students will learn that the plants of the vegetative buffer at the edge of a lake or stream preserve water clarity by removing phosphorus from water before it drains into the lake. The phosphorus helps the buffer plants rather than the phytoplankton grow.
- They will be made aware of some of the effects of not having good water quality and some of the ways we can we manage our homes and the land in our watershed to prevent water quality degradation.

Time requirements: 15 plus minutes minimum per student rotation (students divide into groups and rotate through the activities).

Pre Information:

- Students will need a simple understanding that plants require sunlight, water and nutrients like phosphorus, nitrogen, and potassium in order to grow and reproduce.
- They will understand why phosphorus is called a limiting factor in phytoplankton growth.
- They will understand that phytoplankton can reproduce very quickly and cause rapid deterioration of water quality.

This activity's web resources are located on the COLA website at:

Key Vocabulary: phosphorus, stormwater runoff, septic system, sediment, silt, algae, algal bloom, turbidity, clarity, water quality, vegetative buffer, plankton

Materials: Secchi disk, Aqua Scope, Ken-A-Vision, paper and pencil to record findings

ACTIVITY TWO

PLANKTON TOW: INTRODUCTION TO FOOD WEBS AND PHYTOPLANKTON

Summary: In deep water, a fine mesh sieve called a plankton net is dropped off the bow and towed behind the boat at a specific depth. Zooplankton (microscopic floating animals) get caught in the mesh. Phytoplankton (microscopic floating plants) do not because they are typically smaller and can pass through the mesh. The contents of the sieve are emptied and identified using a Ken-a-Vision microscope projector.

Essential Question:

How can we estimate the capacity of this lake to support animal life with food?

Objectives:

- Students will capture and examine zooplankton, the microscopic animal plankton that feeds on the phytoplankton that is found near the surface during the day and uses sunlight to grow.
- Students will learn about the role of microscopic floating plants and animals (plankton) as a part of food chains that support fish life.
- They will learn that the abundance of zooplankton depends on phytoplankton availability.

- Time requirements:15 minutes minimum per student group

Key Vocabulary: zooplankton, phytoplankton

Materials: Plankton net (a fine-mesh sieve); Ken-a-Vision projection microscope through which all aboard can view the “catch” at the same time

ACTIVITY THREE

TAKING THE LAKE'S TEMPERATURE TO "SEE" LAKE STRATIFICATION

Summary: In deep water, students drop a temperature probe on a line to measure water temperature at various levels of lake depth. They record and discuss the data.

Essential Question: Does this lake provide oxygen to support fish life at all depths?

Objectives:

- Students will learn that oxygen gets mixed or dissolved into water by wind at the lake's surface. Wind and wave action can oxygenate a whole shallow lake from top to bottom.
- Maine's seasonal variations in air temperature cause water on the surface to freeze in winter and melt in spring.
- The density of water varies with its temperature. At 39 degrees Fahrenheit, water is its densest and heaviest.

- Lakes “turn over” when the temperature of the lake is the same from top to bottom, typically around 39 degrees. At this time, wind blowing across the surface will cause a mixing of the entire lake, driving oxygenated surface water to all depths and distributing materials found on the lake bottom throughout the water. This often makes lake water darker and less transparent during this “over turn” period. Turn-over happens twice a year: spring (after ice out) and fall (before ice in).
- Cold-water fish that can only survive hot weather by going to the deepest parts of the lake (refugia) depend on those waters getting oxygenated twice a year during “turn over.” At this time, the oxygen content of the water is the same throughout.
- Lakes with deep holes may become stratified in the summer and develop three layers. On top is a sun-warmed layer, with uniformly warm, well mixed and oxygenated water that gets its oxygen by wind, wave action and photosynthesis. In the middle is a layer, called a thermocline, marked by a distinct temperature gradient. This layer separates warmer water in the layer above from colder water layer below. Since water temperature influences water density, and layers of widely differing density do not easily mix, thermoclines mark a barrier to mixing the oxygenated, uniformly warm upper layer’s water with the uniformly cold lowest lake bottom water layer. Because oxygen is locked into this cold bottom layer and can’t be easily replenished, this bottom layer can lose much or all of its dissolved oxygen when dead materials on the lake bottom decay.
- Phytoplankton blooms can cause this oxygen depletion.
- When phytoplankton die and sink to the bottom of the lake below the thermocline, the process of their decomposition uses up oxygen from

the water. If this decomposition occurs in the cold lowest layer it will use oxygen that will not be replaced till the fall turn over. Oxygen in this lowest layer will be gone from the deep holes on some lakes by the end of the summer. This may cause the deaths of creatures that live in these depths. In many lakes these bottoms can become vast, lifeless deserts.

- Phosphorus below thermoclines can recycle from sediments and create phosphorus-rich water. If the summer is very warm and the thermocline keeps moving downwards, phosphorus-rich bottom waters can mix with the upper layer and can cause algae blooms.

Time requirements: 15 minutes per student group

Pre Information: Lake temperature and oxygen stratification is a difficult concept. We strongly suggest that the teacher/mentor review some of our web resources on the subject before the session and select a few resources to review the major concepts after the activity.

Key Vocabulary: thermocline, temperature probe, strata or layers, dissolved oxygen,
Materials: Temperature Probe

ACTIVITY FOUR

USING A BENTHIC DREDGE TO IDENTIFY INSECTS IN THE SEDIMENTS

Summary: In shallow water (3-4 feet) students use a benthic dredge to scoop a sample of lake bottom and bring it up. The sample is dumped into a bucket, water added, and then poured out through a strainer. Macro invertebrates (large animal life without spinal columns) remain in the strainer. Students can identify them using a provided key.

Essential Question: What invertebrate life does this lake support? Where do many of the insects we see above and around the lake come from?

Objectives:

- Students learn that floating plankton are not the only food sources a lake supports. The lake bottom is the nursery for its insect life.
- They learn the healthier the lake, the more aquatic insect diversity it supports, as they have an important place in the food chain of a lake. Insects feed on each other and fish feed on insects. The presence of

some invertebrates indicate that water quality is “good” while others may indicate “poor” water quality.

Time requirements: 15-20 minutes minimum per group of students.

Key Vocabulary: benthic dredge, macroinvertebrates, food web, biodiversity
Materials: benthic dredge, key (to identify critters), Ken-A-Vision (projection microscope)
Post Information: Students can access COLA’s web site to study the life histories of some of these fascinating creatures. They’ll find insects that spin underwater webs to catch passing plant pieces; insects that catch and eat fish and tadpoles; insects that walk on the surface of the water, some that walk upside down on the underside of the surface; and some that we see flying around in summer which spend most of their lives under water. Be sure to download “Wonderful, Wacky, Water Critters.”

ACTIVITY FIVE

EXAMINING LIFE IN THE DEPTHS WITH THE ROV

Summary: In this deep water activity, students operate the most high-tech instrument aboard the Melinda Ann, a Remote Operated Vehicle (ROV) equipped with 150 feet of tether, camera, thrusters, and lights. They take a diving, loon's-eye-view of the lake, and can navigate the ROV to see what they want to see.

Essential Question: If I could navigate underwater what would I see?

Does any of what I see give me an indication of lake health?

Objectives:

To directly see the underwater lake environment and encounter features of the lake ecosystem that can only be seen in that way. Students will readily see that most of the macro life can be found in the shallower areas nearer shore where animals can readily find food, cover, and spawning environments. Much that they see may relate to lake health, from a school of crayfish watching the ROV go by or a bed of mussels

on the lake floor; other things may indicate poor health, such as a depleted, lifeless deep hole in an oxygen-poor hypolimnion; an algal bloom that has sunk to the bottom of the lake.

Time requirements: 15 minutes per student group

Key Vocabulary: remote operated vehicle, hypolimnion

Materials: Remote Operated Vehicle