

## ***2009 Aquatics Station***

### **ESSENTIAL TOPICS**

- 1. Understanding Water**
  - a) Chemical and physical properties
  - b) Water cycle/Watershed
  - c) Uses and importance of water (recreational, economic, etc.)
  
- 2. Understanding Aquatic Habitats**
  - a) Living; identification and natural history of fish, amphibians, invertebrates and plants
  - b) Non-living; chemical and physical properties; geology
  - c) Interactions between and among living and nonliving
  - d) Uses of aquatic habitats
  
- 3. Protection of Water Resources**
  - a) Department of Environmental Protection, Department of Inland Fisheries and Wildlife, Dept. of Marine Resources, EPA & U.S. Fish and Wildlife Service
  - b) Management
  - c) Regulations concerning aquatic resources, reptiles and amphibians
  
- 4. Threats To Water Resources**
  - a) Water quality/pollution/quantity
  - b) Endangered/Threatened Species
  - c) Human health issues relating to water quality

### **LEARNING OBJECTIVES**

#### ***Understanding Water***

Envirothon students will be able to:

- describe properties of water resulting from its chemical structure, such as surface tension, density at freezing/4C, solubility, phases (solid, liquid, gas) and boiling and freezing points.
- identify the processes and phases for each part of the water cycle (evaporation, transpiration, condensation, precipitation, surface runoff, percolation).
- analyze the interacting of the competing uses of water for water supply, hydropower, wildlife, navigation, recreation, waste assimilation, and others.
- rank human use of water according to clean water needs and frequency of use.
- delineate a watershed boundary for a small water body.

#### ***Understanding Aquatic Habitats***

Envirothon students will be able to:

- identify common fishes, reptiles, amphibians and common aquatic macro-invertebrates and aquatic plants found in Maine. Specific or unusual organisms will be identified through use of a key.
- describe the characteristics of Maine's aquatic habitats (headwaters, streams, creeks, rivers, lakes, ponds, wetlands (marsh, bog, swamp), estuary, amount of plant life/food in the water, topography, geology, temperature/dissolved oxygen content, pH level, types of organisms found there.
- when given a description of a type of aquatic habitat, identify the organisms most likely to live there.
- describe the benefits of wetlands.
- describe the changes that could be expected with the destruction of a wetland area.

### ***Protection of Water Resources***

Envirothon students will be able to:

- identify the agencies for providing the protection and management of water resources
- describe the three types of fisheries management waters (cold water, cool water, warm water) and identify examples of fish in each type.
- when given a scenario of an aquatic resource use or misuse, correctly identify the regulation(s) violated.
- describe what individuals can do to protect, enhance and conserve Maine's aquatic resources.
- study methods used to manage aquatic environments. This includes sampling techniques, water quality testing, point and non-point pollution control.
- use the hydrologic cycle to discuss issues that effect water quantity and quality (including ground water).

### ***Threats to Water Resources***

Envirothon students will be able to:

- describe the major threats, sources, and damage done to water quality in Maine, including point and non-point source pollution.
- identify the most common threat to aquatic populations in Maine.
- recognize which animals are endangered/threatened species and identify the main causes of their depleted numbers.
- describe how biomagnification and bioaccumulation affect aquatic life and humans.

## REFERENCE MATERIALS LIST FOR WATER

**Contact Person(s):** Valerie Whittier, Environmental Specialist  
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### Reference Materials

For references listed below, please contact Valerie Whittier.

1. *Environmental Management: A Guide for Town Officials, Best Management Practices to Control Nonpoint Source Pollution.*
2. *Watershed: An Action Guide To Improving Maine Waters*
3. *Understanding Maine's Lakes and Ponds, A Guide for the Volunteer Monitoring Program*
4. *River and Stream Volunteer Water Quality Monitoring, A Citizen Guide*
5. *Threats to Groundwater in Maine (poster, detailed information on ground water threats).*
6. *Protecting Maine Lakes, An Overview*
7. *Protecting Maine Lakes from Phosphorus Pollution*
8. *Acid Rain and Maine Lakes*
9. *For Your Lake's Sake*
10. *Septic Systems, How They Work and How to Keep Them Working*
11. *Ground Water Facts for Maine Residents*

12. *Ground Water Facts for Municipal Officers*
13. *How to Delineate a Watershed:*  
[http://www.nh.nrcs.usda.gov/technical/WS\\_delineation.html](http://www.nh.nrcs.usda.gov/technical/WS_delineation.html)

**Additional Resources:**

13. *A Catalog of Water Quality Information and Educational Materials (DEP)*
14. *State of Maine 1992 Water Quality Assessment (DEP)*
15. *Fishes of Maine, Inland Fisheries and Wildlife* (available at most book stores)
16. *Charting Our Course* (available from State Planning Office)
17. *The Estuary Book* (available from State Planning Office)
18. *Teacher's Guide To Marine Life of The Gulf of Maine, (Maine Department of Marine Resources, SHS # 21)*
19. "Paradise Under Pressure: Maine's Threatened Lakes. August 1989. *Maine Sunday Telegram, Special Report.*
20. *Maine Lakes. Geographical Digest Series.* University of Maine.  
Copies from: Water Resources Program, Sawyer Environmental Research  
Center University of Maine, Orono 00469-5764
21. Quest Show by Maine Public Television
22. *The Lake Book: Actions You Can Take To Protect Your Lake.* Maine Congress of  
Lake Associations. For additional copies, contact: Maine COLA,  
P.O. Box 38, Readfield, ME 04355 or 685-3591
23. Field Guides and keys, such as: *Peterson's Guide to Wildflowers; Newcomb's  
Wildflower Guide; Fern Finder by Anne & Barbara Hallowell; Amphibians and  
Reptiles of Maine by Mark McCullough*
24. *Federal Manual for Identifying and Delineating Jurisdictional Wetlands-(DEP)*
25. *Natural Resources Protection Act (DEP)*
26. *Protection and Improvement of Waters Act (DEP)*
27. Permit By Rule Standards, Chapter 305 (DEP)
28. *National List of Plant Species that occur in Wetlands (Region I - Northeast)*  
*(EPA/Army Corps of Engineers)*

29. Videos: *Maine's Polluted Water: We All Can Help* - Maine Public TV's Quest Series
30. View the Enviroscape Watershed Model located at all DEP Regional Offices
31. The Erosion and Sedimentation Control Law (DEP)
32. The Stormwater Law (DEP)
33. Wetlands Rules, Chapter 310 (DEP)
34. Shoreland Zoning Guidelines, Chapter 1000 (DEP)
35. Shoreland Citizens Guide (DEP)
36. Significant Wildlife Habitat – Chapter 335 (DEP)
37. *A Field Guide to the Animals of Vernal Pools* by Leo Kenney & Matthew Burne (available from Massachusetts Division of Fisheries & Wildlife); <http://www.state.ma.us/dfwele/dfw/dfwnhes.htm>
38. *Textbook of Limnology* by Gerald Cole
39. *Pond Life*, Golden Nature Series, edited by Zim (available at most book stores)

## **WATER AND WATERSHEDS**

The topic of water includes a potentially overwhelming amount of material, unless it is integrated into an understandable framework. The concept of a watershed can do that. A watershed is "A drainage area or basin in which all land and water areas drain or flow toward a central collector river, or lake at a lower elevation (1)." The ocean is also a collector. Consider the Penobscot River watershed: it feeds Penobscot Bay. All water systems: groundwater, wetlands, streams, rivers, ponds, lakes, estuaries, marine intertidal zones, and open ocean are all part of a watershed. They all transport water, the dissolved materials in the water, and particulate such as soil from their source to their destination - a lake or the ocean.

It is essential to emphasize in your teachings about water that the properties of surface water vary continuously as the water proceeds from a watershed's source through streams and ponds to the estuary and finally to the ocean. Examples of these properties are BOD (biological oxygen demand), nutrients, mineral content, temperature, salinity, density, DO (dissolved oxygen), TSS (total suspended solids), or pollutant load. A stream may begin from a groundwater spring surfacing or surface runoff from rains or snows. Both of which are fairly clean. Groundwater continues to feed surface water throughout its journey.

As water runs toward the ocean, it accumulates substances from the natural and human-made environments through which it passes. Natural sources may include minerals, metals, and nutrients from soil decomposition and terrain change may cause oxygen addition as water bubbles over rocks. Terrain will also impact what organisms are able to grow in the water. For example, slow moving water or ponds allow plankton to grow, whereas fast moving sections of rivers do not. Human-made impacts include both point and non-point sources (NPS) of pollution. Point sources include direct discharges from municipal wastewater treatment facilities

(sewage treatment), and industrial wastewater facilities (i.e. paper companies, vegetable processing, starch manufacturing, etc.). Point sources tend to be licensed discharges. Nonpoint sources of pollution come from storm event runoff and tend not to be licensed. NPS contains nutrients (fertilizers, eroded soil, animal waste, etc.), chemicals (fertilizers, pesticides, petroleum products, landfill leachate, etc.), bacteria (failing septic systems, and livestock waste), and soil (construction sites, roads, agriculture forestry operations, etc.). Past uses, such as logging or now closed mills or factories can still be sources of pollution. All of these chemical and physical properties impact the biological composition of the water bodies. Increased nutrients, especially phosphorus in fresh water and nitrogen in salt water, can initiate phytoplankton blooms and through the decay action of bacteria, decrease oxygen concentrations.

Once the water enters an estuarine environment where the fresh water is mixed with the tidal salt water, the water habitat itself becomes stressful. The biological plants and animals who live in an estuary must be able to tolerate a wide range of properties to exist. Examples include chemical properties such as salinity, and physical properties such as turbidity and its impact on light penetration, current, and temperature.

The estuary runs into the ocean first through the intertidal zone and then into open ocean. Organisms living in the intertidal zone must tolerate desiccation and niche and food competition to exist. The rocky intertidal zone has both sheltered and exposed areas causing animal species to vary or animal size to vary. Muddy clamflats are a completely different habitat and are very sensitive to pollution. Many livelihoods are dependent on what people do upstream in the watershed. Open ocean provides much less food, so organisms in the ocean have different adaptations to exist there - such as groundfish versus the pelagic fish or jelly fish.

Wetlands can be both freshwater or marine. They are wet regions which "are often transition zones that lie between dry land and waterways, but some are more isolated. (2)" The three types of wetlands found in Maine are forested wetlands, bogs and marshes. "What these areas have in common is what defines them as wetlands: water, special soil, and specialized plants. The particular types and arrangement of these three characteristics is what makes one kind of wetland distinct from another. (2)"

Discussing why organisms and plants live where they do in terms of what they have to do to survive and what adaptations they have developed to survive is a good way to encourage thinking and the interconnectedness of the system. Also, again using the watershed concept, follow a pollutant - fertilizers or manure from an agricultural region or a chemical effluent from a factory, from its source to the sea (or a lake). Consider what benefits humans, fish and wildlife receive from clean water, and what impact the pollutants might cause. Discuss why we need to protect the water, what measures we can all take, and the link between land use and water quantity and quality. The DEP brochure "For Your Lake's Sake" and COLA's (Congress of Lake Associations) "The Lake Book: Actions you Can Take To Protect Your Lake" list lots of ways individuals can help. The above are just suggestions, and there are lots of other ways the issues can be integrated and discussed - whatever fits your teaching goals, but they are ways to put the whole system and its various properties into perspective.

1. EPA. February 1984. The Lake and Reservoir Restoration Guidance Manual, First Edition. p. 2-3. EPA 3440/5-88-002, Criteria and Standards Division, Nonpoint Sources Branch, WA, D.C. 20460
2. Slattery, Britt Eckhardt. 1991. WOW!: The Wonders of Wetlands, Third Edition. p. 7. Environmental Concern, Inc., P.O. Box P, St. Michaels, MD 21663.

\* Other resources are listed at the end of the water section.