

**TEACHING KATE
TEACHING KIDS ABOUT THE ENVIRONMENT**

THE EFFECTS OF POLLUTION ON OUR RIVERS, LAKES AND WETLANDS

Grade Level: 11-12

Time Required: 12 class periods of 90 minutes each

SC Science Standards

This lesson plan was correlated with only the grade level specified unless otherwise noted.

- 9-12th: I. B. 1, 2
 I. C. 1
 I. D. 1
 II. D. 1. a
 II. D. 4. b
 II. D. 5. a

Purpose

Students will learn how our rivers and lakes have been devastated by pollution in our recent past. They will learn about the causes and effects of this pollution. They will also learn about current pollution trends and what is being or can be done about them in the present and future. They will gain an awareness of the wetlands around them and how they may be endangered by destruction. They will learn about the contribution of wetlands to the amount of pollution an aquatic system is able to filter out.

Skills

Analysis, appreciation, comparison, description, discussion, evaluation, interpretation.

Concepts

Understanding what pollution is and what it can do to our water and the surrounding lands; the hydro-logic cycle and how water is cleaned and recycled- via the soil and changes in form; even natural systems can cause pollution by the addition of substances to the water; why pollution is so flagrant; why the public is often indifferent to pollution; what students can do about pollution; the economic effects of cleaning up pollution and its sources.

Materials Needed

overhead projector	transparencies
video tapes	empty Tide boxes
software disks	poster boards
colored magic markers	television
VCR	water test kits (such as Hach kit)
collection bottles	computers
thermometer	

Definition of Terms

<u>Biodegradable</u>	A substance that will break down or decompose naturally.
<u>Biomass</u>	The weight of living material, usually expressed as dry weight per unit area.
<u>Eutrophication</u>	Nutrient enrichment of an aquatic system.
<u>Heavy Metals</u>	Metals, such as mercury, cadmium, chromium, selenium and lead which are toxic to life in varying amounts.
<u>Hypertrophication or Cultural Eutrophication</u>	A body of water with excessive nutrient content. Results in chemical and environmental changes due to accelerated enrichment and causes major changes in plant and animal life. The excessive nutrient content is a result of a heavy influx of wastes, raw sewage, run off from urban areas, run off from agricultural lands and burning of fossil fuels.
<u>Pollutant</u>	Any agent causing harm or damage by introducing a chemical or physical substance to the environment.
<u>Potable Water</u>	Water that is safe to drink.
<u>Wetlands</u>	Land areas, either fresh or saltwater that are covered or saturated with water to within 18 inches of the surface for seven or more days.

Before the Session

Gather needed materials. Make arrangements for a short field trip to a local stream. Arrange for a guest speaker from the Department of Natural Resources or Department of Health and Environmental Control to make a presentation to the class. Schedule time in the laboratory, computer lab and library.

Background Information

We have abused our waters and destroyed our wetlands in the past. In many instances, too much abuse still exists today. One form of abuse is pollution. Three sources of pollution are the addition of excess quantities of nitrogen, phosphorous and heavy metals into our waters.

Excessive nitrogen in a body of water is often caused by human intrusion into the natural cycle of rivers and lakes. Excessive nutrient content, results in chemical and environmental changes due to accelerated enrichment and causes major changes in plant and animal life. Aquatic weeds and vegetation become overgrown. As organic remains of overabundant plants add to the organic sediments at the bottom of a lake, decomposers deplete the oxygen supply to the point where aerobic life forms cannot be supported in that region of the lake. Major human sources of this nitrogen pollution are agriculture and industry. Heavy forest burning for agriculture, heavy application of fertilizer to croplands, animal wastes from livestock, sewage from municipal sewage plants (although regulated, leaks occur) and wastes from fertilizer plants all cause streams to become over-fertile.

Human activities have also altered the phosphorous cycle. Phosphate fertilizers do not decompose readily. They often react with other ions, such as calcium, iron and aluminum and become insoluble salts. These eventually end up in our water systems. Excesses also occur in wastes from food-processing plants and feedlots. Sewage treatment only removes 30% of the phosphorous present in sewage. In aquatic ecosystems, this phosphorous is taken up rapidly by vegetation, resulting in great increase in biomass.

Heavy metals, such as mercury, cadmium, chromium, selenium and lead, which are toxic to life in varying amounts, enter biogeochemical cycles. These come from industrial pollution, runoff from agricultural fields, toxic dumps and landfills. As they discharge into waterways, they contaminate water supplies or build up in food chains. Consumption of fish from these contaminated waters can result in birth defects, deaths and impaired lives. This causes serious economic effects on fishing and recreation activities, as well as serious ecological effects on fish-eating birds.

Other forms of pollution include heat pollution, other chemical wastes and pH levels. Water that is heated in the process of cooling in industrial processes and power plants must be allowed to cool back down before being returned to a river, stream or lake. Warm water holds less oxygen than cold water, therefore, when thermal pollution occurs animal life is often killed by suffocation. Some chemical wastes which are released into a system may be relatively innocuous by themselves but when mixed with other chemicals released from another site may create highly toxic conditions. Water that is too acidic is also toxic to aquatic life. Acidic water released from coal mines can destroy an aquatic system.

Wetlands act as nature's treatment plant, filtering out sediments and pollutants and allowing warm waters to cool down. Eventually, however, if pollution is not regulated more strictly, a point may be reached where even a wetland cannot filter out all the pollutants.

Suggested Lesson Plan

Day 1

1. Show a five minute video tape segment from the local evening news about the importation of 50,000 sterile grass-carp into the waters of Santee. Their purpose is to eat the choking grasses that are taking over that lake as a result of too many nitrates and phosphates polluting our streams, lakes and rivers. The high levels of these ions are contributed to by inadequately treated sewage waters. Until recently, in South Carolina, one source was the high levels of phosphates contained in some detergents. Allow students to discuss this video segment after viewing. If students do not know where the Santee River is show them the river system on a map.
2. Review the chemical properties of nitrogen and phosphorous compounds, stressing the way their ions combine into compounds and their respective reactivities. Then explore the meanings of such terms as biodegradable, potable water, eutrophication and cultural eutrophication, as well as other key terms for this unit.
3. View selected segments of Earth Day 1990 video (25 minutes) that concern the pollution of various bodies of water by nitrates, phosphates and heavy metals. After viewing, have students write a short essay on their reaction to the two tapes. Have students, who volunteer, read their essays in class.

Day 2

1. Have several more students read their essays from the previous day. Allow students to discuss these essays.
2. Place students into cooperative learning groups. Have them draw posters that express their feelings about pollution in our waters and wetlands. Display these posters around the room.
3. Explain and give requirements for students' essays on some aspect of water pollution that they are to research using Internet and the school library. Ask that one or more students research and write about laws which have been passed to control water pollution and strides which have been made since the laws were passed. A couple of students could also research and write their essays about the history of a specific river or lake that was or is polluted, including how the problem was, is being or could be solved.
4. Students may wish to write to the Department of Health and Environmental Control (DHEC) and/or the South Carolina Department of Natural Resources (SCDNR) and/or the Environmental Protection Agency (EPA) for information on their subject.
5. Review students on key terms using vocabulary "BINGO." These cards are blank spaced BINGO cards which have been xeroxed then laminated so that they can be reused for each new unit. Students use washable markers to randomly fill in the card with the key terms of the unit.

6. Remind students to come prepared for their field trip to the stream the following day. They will procure samples of stream water and observe any effects of pollution that they find.

Day 3

1. Students visit the stream to collect samples of water and to record water temperature. They also check for signs of pollution.
2. Students take notes on their observations at the park.

Day 4

1. In the chemistry lab, students use water test kits to test samples collected from the stream for nitrates, phosphates, heavy metals, dissolved oxygen and pH.
2. Students discuss their findings and their reactions to them.
3. Students write a short explanation about why they either did or did not find any pollutants.
4. Explain to students that these test kits do not prove the water safe since they test only for a very limited number of chemical compounds and no organic compounds or pathogenic organisms.

Day 5

1. Students visit the computer lab to work on Internet for information on water pollution.
2. Students work cooperatively, in groups of three, on computers to search for related topics. If there are enough computers they may work alone or in pairs instead.

Days 6-7

1. Students visit the media center to work on their essays on water pollution or some related topic of their choosing.
2. Students use computers in the media center to research current and historical information on water pollution.
3. Students who are using Internet as a source use the media center's computers to access their information. Students should be cautioned that most information on Internet is not subject to peer review and can be misleading, truthful or false.
4. Students may also choose to use books as their sources. Caution them that most books are out-of-date, but that they are a good source from the historical standpoint.

Day 8

1. Students participate in a lesson presented by a speaker from the South Carolina Department of Natural Resources or the Department of Health and Environmental Control, who will discuss water pollution in the state.
2. Students will view aerial photographs that show large amounts of green vegetation in the river north and south of Lake Marion (or choose a system closer to your area). Have the speaker discuss the geography of the river, the presence of sewage treatment plants along the river, the presence of power plants along the river and the presence of current and former industrial sites along the river.
3. Explain about the introduction of sterile grass carp as a treatment for a symptom of a “disease” rather than a “cure” for the “disease” of over-fertilization of our streams and lakes.
4. Have the speaker explain how the sterile grass carp were created in order to avoid overproduction that could cause a problem to the game fish environment.
5. Students participate in a question and answer session with the guest speaker.

Day 9

1. Explain how aquatic weeds can choke out entire open water areas of a river or lake. Discuss the fact that they could eventually cause the hypertrophication and death of a lake if left to grow rampant and that this could occur fairly rapidly in a warm state like South Carolina.
2. Discuss interactively with the students the impact of aquatic weeds on recreational activities. Also, discuss their economic effects on the surrounding areas. Refer often to the lake you chose for your example.
3. Allow students to relate their stories and express their feelings about this situation.
4. View a wetlands video that illustrates the beauty and necessity of preserving our wetlands and other aquatic systems.
5. In cooperative learning groups, students compile lists of ways that the problem of over-fertilization of our waters can be reduced.

Day 10

1. Review with students the properties of heavy metals.
2. Review with students the food chains of fish and waterfowl. Explain how these forms of life, as well as man, are being affected by these pollutants.

3. Students view the segment from Earth Day 1990 (30 minutes) on heavy metal contamination of the Great Lakes that occurred before the Clean Water Act. The video explains that the fish in some places on the lakes are unfit to eat - even today. It explains the risk to pregnant women. The video also explains how these contaminants move up the food chain. Several experts in the film say that they would never allow their daughters to consume fish caught in these waters. Teachers could bring this lesson home using Lake Hartwell and its PCB pollution problem as a local example. Another example is the near extinction of our national symbol, the Bald Eagle, and other fish eating birds due to DDT in the aquatic system.
4. Allow students to orally discuss their reactions to the day's lessons. Expect outrage, as well as some disbelief. The teacher should point out how bad the problem was from early 1900's to the mid 1960's and that tremendous improvements have been made since. To illustrate the tremendous improvements which have been achieved and which can continue to be improved upon, point out the continued growth and health of the Bald Eagle population.
5. Students complete a crossword puzzle on key terms of this unit.

Days 11-12

1. Students make oral presentations of their essays on water pollution.
2. After each presentation, students are allowed to ask questions and discuss each essay.

Application

Using problems of a local lake first as an “attention-getter” to “hook” the students on environmental concerns, the trip to the stream will bring water pollution problems right into the students’ backyards. This unit of study can be used to inform, motivate, stimulate and instruct students about our aquatic environments and how they impact all that surround them- even their own lives. Bringing the Bald Eagle back from near extinction is a classic example of what can be achieved with a lot of dedicated effort. DDT, a chemical pesticide used on crops for many years, was washed into the water systems and made its way up the food chain to fish and crustaceans. Birds which feed on fish built up high levels of this chemical. The chemical in their systems resulted in thinning of eggshells which could no longer hold the weight of an incubating parent. Eggs cracked and the number of young successfully raised decreased dramatically. After the use of DDT was banned, it eventually settled under the sediments of aquatic systems. As amounts of DDT in the system decreased, eggshells began to return to normal thickness and more young were successfully raised. Bald Eagles are now a true success story as their come back appears to be assured at this point. Pollution of aquatic systems must be stopped because we never know when another DDT type of situation might occur.

Extension

This portion of a unit on water pollution would continue on with such topics as ground water supplies and possible contamination, municipal water and sewage treatment, the hydrologic cycle and pollution of ocean waters. Continued emphasis will be placed on the effects to plants, animals and mankind.

If the students wish to further their knowledge on the Santee and its history suggest they read *River of the Carolinas: The Santee* by Henry Savage, Jr.

Recent news segments and programs are available on video tapes from local television stations provided they are for educational use. Consult your local station for details.

Biology, environmental science or wildlife departments of local universities often own or can help to find videos on aquatic pollution.

Other teachers in your own school can also be used as experts in related fields such as biology. This entire unit could be taught using team-teaching or by using an interdisciplinary approach. Possible partners for this unit might be English, Biology, History, Chemistry, Social Studies, Out-door Living, Computer and Keyboarding instructors.

This unit could also be adapted for conforming to South Carolina Act 135 by having speakers relate their job descriptions, qualifications and responsibilities to students. Video tapes could also be found to reinforce career possibilities. Additional speakers from the business world, whose jobs depend on clean water, could also be used as speakers.

Resources Available

Chemcom. 1988. American Chemical Society. (Available from State Library.)

Environmental Protection Agency.

Elements of Ecology. 1992. R. L. Smith. Harper Collins Publishers, NY.

Fabulous Wetlands. Washington State Department of Ecology, Wetlands Section, MS PV-11, Olympia, WA 98504. \$15.00 or borrow from State Library.

Internet. (If computers with modems are available to students.)

River of the Carolinas: The Santee. 1968. Henry Savage, Jr. The University of North Carolina Press, Chapel Hill.

South Carolina Department of Health and Environmental Control, Columbia, SC.

South Carolina Department of Natural Resources, Columbia, SC.

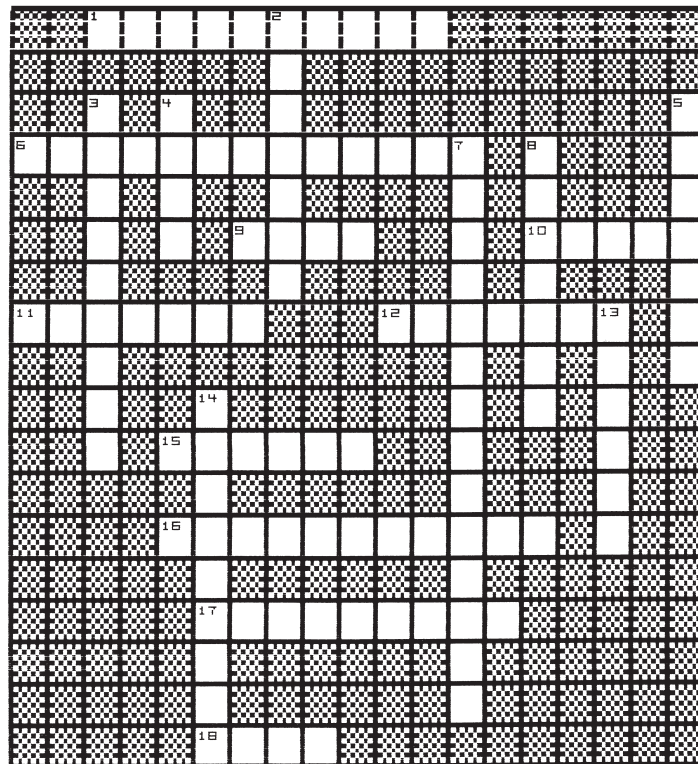
South Carolina Forestry Commission, Columbia SC.

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WATER POLLUTION CROSSWORD PUZZLE



Across Clues

1. Another name for Santee.
6. A substance that can decompose naturally is said to be ____.
9. One species that can be affected by pollution in water.
10. Harmful or poison to man or animals.
11. Water that is fit to drink is said to be ____.
12. The weight of organic matter.
15. Lake ____ has a problem with aquatic weeds.
16. Elements such as lead, mercury, and cadmium that accumulate in the food chain.
17. The consumption of lesser organisms by larger organisms, such as big fish eat little ones.
18. A heavy metal that can cause brain damage.

Down Clues

2. Having to do with water in some shape or form.
3. A substance that is out of place, usually caused by man, that is disturbing the balance of nature.
4. A plant that is undesirable in the habitat in which it is located.
5. The only liquid metal, it often becomes a pollutant.
7. Often causes the death of a lake or stream.
8. The area that is commonly referred to as a marsh or swamp.
13. Partially treated ____ adds nitrates to rivers and lakes.
14. Birds that live in and around water.

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WATER POLLUTION WORD LIST

AQUATIC	HEAVYMETALS	POLLUANT
BIODEGRADABLE	LAKEMARION	SEWAGE
BIOMASS	LEAD	TOXIC
EUTROPHICATION	MARION	WATERFOWL
FISH	MERCURY	WEED
FOODCHAIN	POTABLE	WETLAND

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THE EFFECTS OF POLLUTION ON OUR RIVERS, LAKES AND WETLANDS

WATER POLLUTION CROSSWORD PUZZLE - ANSWER KEY

