TEACHING CONSERVATION AND NATURAL RESOURCES TO GIFTED AND TALENTED STUDENTS

By

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TALENTED STUDENTS

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INTRODUCTION

Introduction

The natural resources of the earth are in jeopardy. There may not be enough good quality air, food, water, shelter, or space for the human population on the earth in the future. This problem is large and complex. To deal with the overall problem, smaller segments must be addressed and analyzed and a liberal dose of optimism and creativity applied to solutions.

Students at Dale Consolidated School who are in the gifted and talented program are identified in two ways: achievement test scores; and, Intelligence Quotient (IQ) scores. Such a student has the ability to think abstractly, deductively, inductively, creatively and optimistically. Sometimes they do this all at once, which is a wonder to see.

This study was of the science segment of The Dale School's gifted and talented program. The plan is to present the larger problems, give methods of seeking solutions and allow a lot of creativity to occur. Awareness plays a large part in these objectives.

A student who becomes aware of relationships of planet Earth, air, water, community, parks, schools, and classes and who thinks of ways to help make things better will be a successful citizen of tomorrow.

A gifted and talented student is highly motivated in problem solving. This student handles the immensity of problems in conservation of natural resources well. These students present few disciplinary problems, especially if their minds are busy on vital issues. In gifted and talented education we strive to stimulate without pressuring the student. Problems of natural resources are complex and contain many trade-off issues so the student's interest can be stimulated and many solutions can be identified.

The small class size allows for good teacher-student interaction. Library searches and water experiments were conducted with assistance of the teacher. If you help a student to study and think under supervision, the student will be better able to study and think on his or her own. Grades are not a factor. This class operates on learning free of competition and grade evaluation. The best evaluation is whether the students and the teacher feel the classes have been worthwhile. In the case of Dale's primary, intermediate and secondary gifted and talented classes, the teachers have a strong sense of satisfaction about the two years' accomplishments in analyzing issues in the conservation of natural resources.

Importance of the Problem

Conservation of natural resources promotes an optimistic view of life. Although a balanced approach also presents the pessimistic view, young people usually prefer the optimistic model which gives them a chance to do something to change their futures.

Teen problems often involve a too pessimistic point of view. Alcohol and drugs are ways to quit trying or to give up. Teen suicide is the ultimate statement of "I choose not to live in <u>this</u> world any longer." Immorality and teen pregnancy show unwillingness to wait for an orderly maturity, but rush into immediate pleasures.

The Nuclear Age picture is one of death, disaster and disease. The movie "The Day After" very graphically showed results of a nuclear holocost in Kansas, very near to Dale, Oklahoma. The show had a disclaimer that "parents should use discretion" before letting children watch this very potent program. The implication was that the program could have a negative impact on young minds.

Instead of adding to excuses not to live productive lives, teachers want to counteract these influences. Teachers want to teach about the future; emphasis should be on cures for diseases, preventive medicine rather than cures for chemical abuse, clean ocean water for human use, irrigation deserts, and preserving of wild animals in wildlife refuges. Teachers and parents want to see teens become tobacco free, drug free, alcohol free, and into exercise and intellectual experiences.

Specific Problem

My master's thesis concerns the study of water quality in Dale, Oklahoma by students of three age groups of Gifted and Talented students: Primary, 2nd and 3rd grades; Intermediate, 4th, 5th, and 6th grades; and, Secondary, 7th, 8th, 9th, 10th, 11th, and 12th grades.

Typical classes at Dale School have twenty to thirty students. The teacher makes a good effort each year to complete the material in the required textbook. Students in the classes have an IQ from 130+ to 60. Classes are fifty-five minutes long. However, continuity of teaching is lost for many reasons. Extracurricular activities such as ball games and local and state fairs often interrupt class. The students have dental or eye appointments, which take them away class Because of these and other reasons, gifted and talented students need a time, a place and a teacher to help them learn in a special way. These gifted and talented students are allowed to meet together two times a week to discuss special science topics. The students are encouraged not to be absent during these special classes.

Conservation of natural resources is included as a part of several classes, including geography, science, and other courses covering nature topics. The students however, do not have an opportunity to work for answers to questions, solutions to problems, and to obtain a balanced view of trade-offs necessary to deal with these issues.

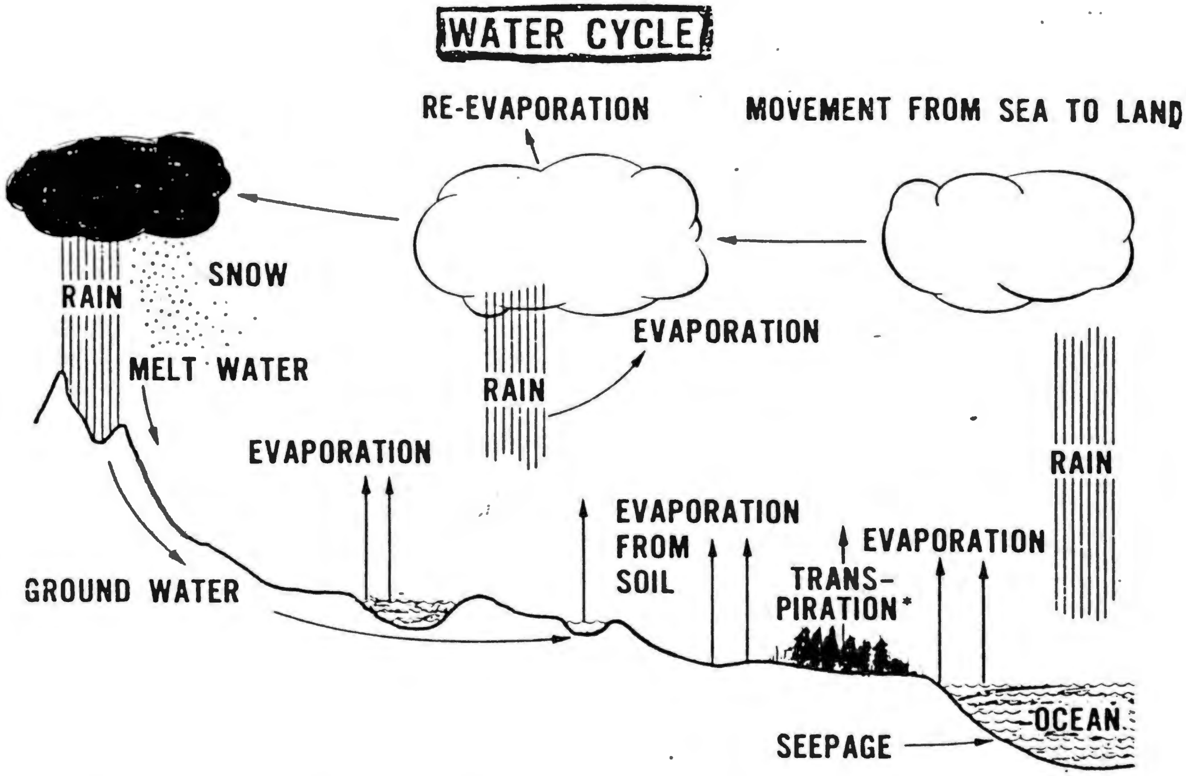
In the science segment of the gifted and talented program, conservation of natural resources can be approached with discussion techniques, creative material, individual instruction and particpation. The students can more directly deal with the problem. The major aim is to help each of the gifted and talented students attain an awareness and preparedness toward problems of saving air, water, fuels, soil, wildlife and forests. A basic issue is the ability of the student to grasp the interactions involved in conservation and the water cycle (Figure 1).

Objectives

The overall objective of this study is to describe a particular public school science education program for gifted and talented students. Specific objectives are to:

1. Present detailed information on the program in conservation and natural resources for the students, particularly water quality; and,

2. Present case studies on the aspects of the science program that has been developed at the Dale School over the last two years.



— WATER CYCLE GREATLY ALTERED BY HUMAN CONSUMPTION —

— *TRANSPIRATION CONTRIBUTES MORE WATER TO ATMOSPHERE THAN EVAPORATION FROM SOIL.

Figure 1. Conservation and the Water Cycle

Geography of Area of Study

Dale is a very small town in Pottawatomie County. Oklahoma City is 35 miles west of Dale. Shawnee is 8 miles southeast of Dale. Dale has a school of about 650 students in grades K-12. There are about 1500 homes in the rural school district of Dale. Dale has a Post Ofice and two gas stations.

The North Canadian River flows through the Dale community. This river often floods our land and can be quite destructive, as it was in 1983 when we missed a day of school because of floods. Many homes had flood damage, many crops were destroyed, extensive damage was done to roads, highways and bridges. The river is good to the community by providing the rich river bottom crop land valued at $4,000 per acre, and for the irrigation of the crops of alfalfa, corn, milo, and wheat raised around Dale.

Deer Creek also flows through the Dale community and also flooded during 1983. There is an old one way bridge over Deer Creek at highway 102 near Interstate 40. This bridge was covered with water during this flood and the 102 exit from I-40 was impassable for several days. Deer Creek is used for irrigation and also builds rich farm lands through frequent flooding (Figure 2).

I have studied water from the North Canadian River and Deer Creek as part of the requirements for my Microbiology Special Problems class at Oklahoma State University. Oklahoma City, Harrah and McLoud use the North Canadian River for dumping treated sewage effluent. My studies were to determine the pollution levels of the water and presence of coliforms and fecal coliforms. The North Canadian River and Deer Creek both had heavy microbial populations of aerobic and anaerobic organisms. However these micro-organisms were not harmful to human health or the ecology of the river. In fact the micro-organisms were busy using the sewage as food and the

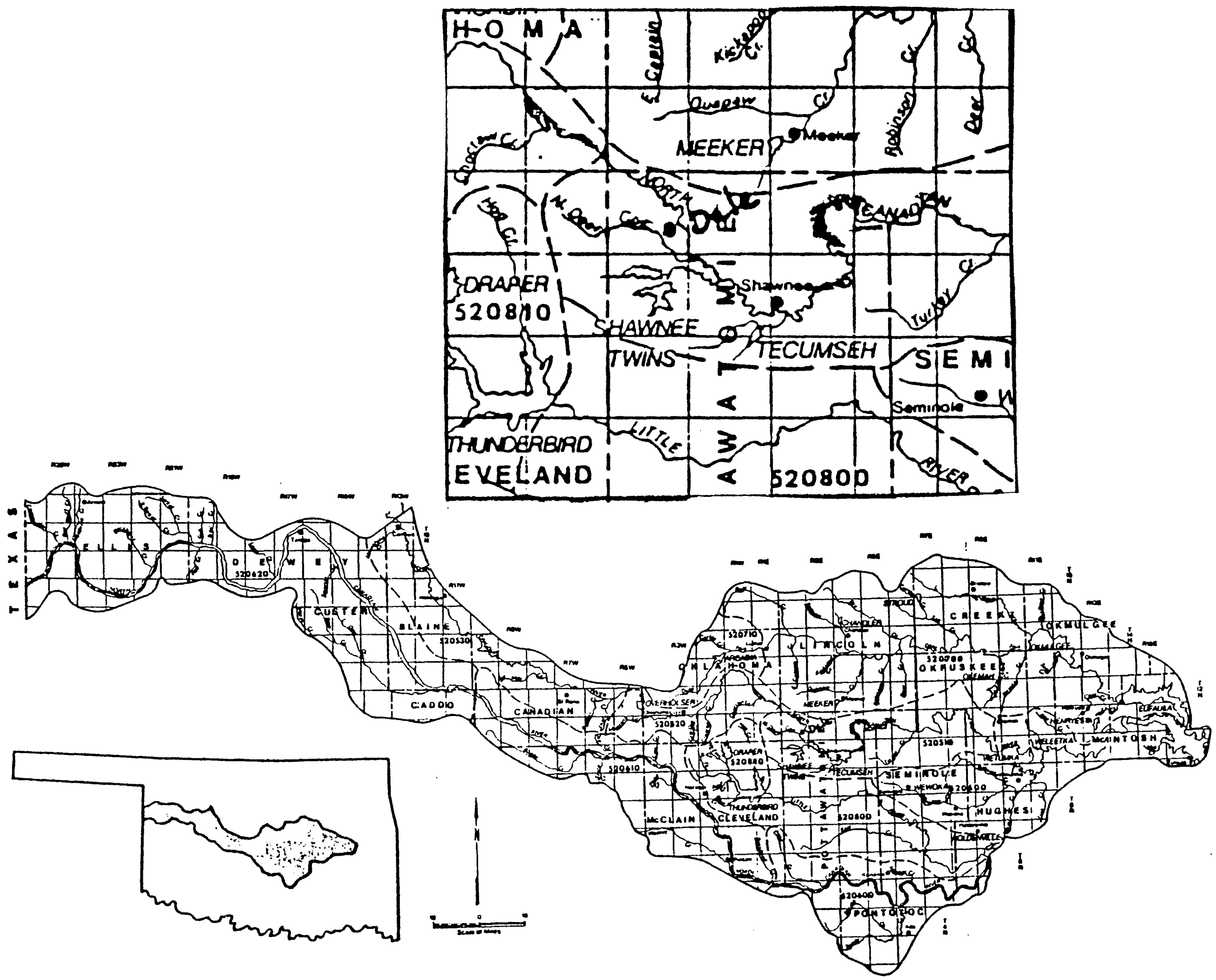


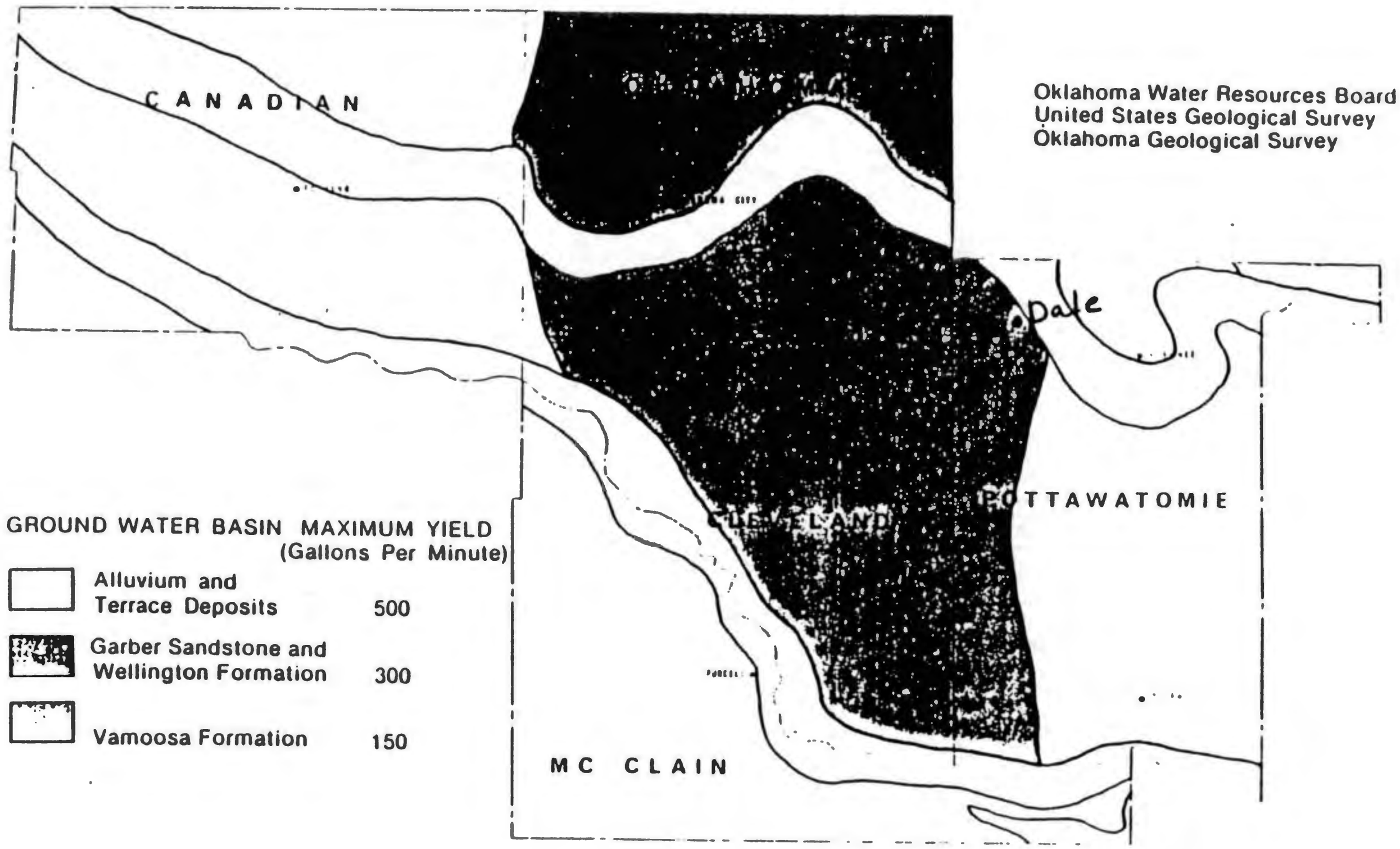
Figure 2. Planning Basin - Canadian River

flowing water was diluting and cleansing itself of this pollutant. Coliform bacteria were found but within acceptable limits for a river which receives sewage effluent. Fecal coliforms were not found in the river or the creek. Fecal coliforms are human pathogens.

The Dale homes, school, and businesses get their water supplies from ground water. This water is found in the Garber-Wellington Aquifer (Figure 3). I tested water from the Dale School well of 147 feet depth, my home well of 150 feet depth, and the Exxon station well of 100 feet depth; all of the microbiological tests were negative. No bacteria, aerobic or anaerobic were growing in the underground aquifer water of Dale. It is very good to know our water is so pure but we must be vigilant to see that this precious resource remains pure.

As a teacher, I want gifted and talented student's knowledge to be oriented to our community "Dale, Oklahoma." This thesis will discuss one area; "Water Quality in Dale, Oklahoma." To pursue this thesis I have investigated the problem of water quality in Dale, OK in my two years of academic work. For example, I wrote a paper for a graduate course at OSU, Agricultural Economics 5503, about disposing of poultry waste in such a way as to leave both surface and ground water uncontaminated. My husband owns and operates a 12,000 bird chicken house on our farm in Dale, Oklahoma. That study was designed to determine "if" our chicken farm could contaminate "our" water.

I wrote another paper for an OSU graduate course, Political Science 5100, about the "Politics of Water" in Pottawatomie County (Appendix 4). Various communities such as Dale, Oklahoma send representatives to a "Pottowatomie County Huddle" meeting. The community representatives are joined by state and local governmental officials to review common community needs such as water quality and solid waste disposal. My husband, Richard



Oklahoma Water Resources Board Publication 60

Figure 3. Central Region Ground Water Basins

Tarpey, represents Dale Service Club, the only civic club in Dale, Oklahoma. Richard attends the county Huddle Meetings and reports about Dale and then returns to Dale Service Club meetings and Dale School Board meetings and reports to them about the County Huddle.

Dale's water needs are discussed as well as the water needs of other communities in the county. The Deer Creek Reservoir project is currently being considered in the U.S. Congress. The Deer Creek Reservoir Project will complete a multi-purpose lake about two miles from Dale School.

Finally, in my OSU graduate course Microbiology 5990, "Special Problems: Microbial Ecology," last summer I concentrated my water experiments in the North Canadian River in Dale, Oklahoma, Deer Creek in Dale, farm water wells in Dale, and service station water in Dale. Students helped me collect these water samples and we tested the water quality for aerobes, sulphate-reducing anaerobes, and coliform organisms. The students found that the well water from the Garber-Wellington aquifer to be very clean and free of harmful organisms. The North Canadian and Deer Creek were typical of "wild" water sources and had a normal flora of organisms. Fortunately, there were no coliforms indicating low human fecal contamination. We found the quality of water in Dale, Oklahoma is very high.

My students need to embrace our common human problems, expecting no quick fix technological cures. Although the problems overlap and intertwine, my thesis will isolate "Water Quality" and a few case studies that were presented to gifted and talented students about conserving "our Dale water quality." Water was the natural resource issue chosen for this thesis because water is recognized by all people as a life necessity.

Procedures

Teaching conservation and natural resources to gifted and talented students has been a special project for two years so far. Classes are to continue this focus. During 1985-86 and 1986-87 school years I have taught gifted and talented science classes to three groups of students:

Primary	2nd & 3rd Grade	40 Minutes	Tuesday & Thursday
Intermediate	4th, 5th, & 6th Grade	40 Minutes	Monday & Wednesday
Secondary	7th, 8th, 9th, 10th, 11th, & 12th Grades	2 or 3 times with guest speakers and one field trip	

The budget is very limited with a small stipend for me as a teacher and the speakers invited. Special materials or equipment are out of the question so, we use science room equipment, books and magazines from my own personal collection. We also find natural free materials outdoors, use the school library and interview adults to supplement our materials.

The students are excused from their regular classes to attend the gifted and talented science class. Therefore when students return to their regular classes, they must make-up any class work they have missed. My gifted and talented students range in age from seven to eighteen, from second grade to the twelfth grade.

Organization of Thesis

The review of literature is presented in Chapter II. The case studies of teaching are presented in Chapter III. Other aspects of my gifted and talented program are presented in Chapter IV. Finally, the summary and conclusions are presented in Chapter V.

CHAPTER II

REVIEW OF LITERATURE

Anna Stotts in 1934 wrote a master's thesis, "Educational Problems of Mentally Exceptional Children," at Oklahoma Agricultural and Mechanical College. She did case studies of twenty-five gifted children, fifth grade, from a school in a "good" residential district. The parents of these gifted children were mostly professional upper income people. Anna reported that little had been done for mentally gifted children. She urged that these gifted children be given an opportunity for education better suited to their nature. Stotts noted that the occupation of parents, economic status of parents and education of parents have a direct bearing on the school progress of children.

Stotts loosely defined a gifted child as one with an IQ of 120 or more and endowed with intelligence. She pleaded for constitutional rights of gifted children. For a gifted child who is not allowed to develop as fully as his natural ability demands is not being given an equal opportunity of life, liberty and the pursuit of happiness. Liberty is denied him; he must remain imprisoned in the school room, hours each day after he has done all the curriculum requires. The pursuit of happiness is denied him; the deadly routine betrays happiness for the child whose ability prompts him to original discoveries and creative activity.

Stotts pointed out that delinquincy may offer a greater adventure in satisfying the gifted child's normal craving for new experience. She stated that most schools are doing more for the training of the subnormal child than the gifted child. Only about thirty U.S. cities had special classes for the gifted at that time (1934). She concluded that teachers of the gifted child could train them to be leaders of science, medicine, government and education.

A report to the Congress of the United States in 1971 was entitled "Education of the Gifted and Talented". The report concluded that intellectual and creative talent cannot survive educational neglect and apathy. The law, Elementary and Secondary Amendments of 1969, Section 809, defines "gifted and talented" as children who have outstanding intellectual ability and creative talent.

This report stated that all gifted and talented students do not come from a privileged environment. Blue collar parents have 20-30% gifted students. In fact, gifted and talented are out of the most versatile and complex of all human groups. Gifted students are vulnerable because they can conceal their gifts and talents; the results are tragic waste.

Contrary to widespread belief, gifted and talented students cannot ordinarily excel without assistance. Gifted and talented programs produce students with a sense of reality, wholesome humanity, self-respect and respect for others. Without a doubt those who will make the greatest contribution to society, and those who will provide the leadership and brainpower are the gifted.

Four states reported case studies to this Congressional report. California developed "Project Talent" to involve lay and professional people with gifted students. Connecticut used a mountain top as a site for gifted students to study earth and space sciences. The Georgia State Board of Education approved gifted as an area of teaching certification. Illinois found a considerable spill-over of techniques originating in gifted classes into regular classes.

In conclusion this congressional report stated educators can do so much for so very little with able children simply by freeing them under teachers who recognize and respect gifted students. The process requires concern, interest, and committment.

Educators define gifted and talented students in many ways. Renzulli (The Friad Enrichment Model, 1977) defines giftedness as the interaction of above average intelligence, above average creativity, and task commitment. Wohwill emphasizes that in the teaching of science and math to young children, the focus should be on the enrichment of their experiences aimed at generalization and transfer rather than on acceleration only.

Challenging the Gifted, by Corrine Clendening and Ruth Ann Davis lists practical implications for a teacher to use in developing creativity in gifted and talented students. First, provide non-threatening environment. Second, refrain from being the judge of the worth of all products in the classroom. Third, model creative thinking. Fourth, systematically reward novel production.

A prominent feature of modern society is its reliance on technology for both comfort and survival. Yet evidence exists American schools are not developing scientifically literate population or fostering achievement of its scientifically gifted students who will carry technology forward. The National Commission on Excellence in Education (1983) reports that in many industrialized countries, students begin biology, chemistry, and physics in grade six and that these subjects are required of all students. Moreover students in these countries spend three times more classroom hours on mathematics and science as do scientifically oriented American students.

In our gifted science programs we need to give our prospective scientists an opportunity to do what scientists really do: original research through problem finding, problem solving, problem reevaluation, and communication of results. Clendening and Davis include a model on "The Oceans: A Key To Our Future." Their model uses not a text but consists of a presentation of information about the ocean, a visit to the ocean, and a list of topics for independent study. This model was useful in designing my program for study of "Water Quality in Dale, Oklahoma."

At a recent Staff Development at Dale High School we studied the needs of the gifted and talented students. A classification of common characteristics of gifted and talented students was developed by the Oklahoma Education Department. These characteristics are presented in Table I.

My approach to teaching conservation and natural resources is to first give students a chance to express their own areas of interest within the science area. I ask the question "What would you really like to study in science?" After we decide on a few areas of interest, we select plans of independent study for the students to follow. Problem solving, and logical thinking skills are emphasized. A gifted and talented student needs to work with current problems and feel they are making progress toward responsible and valued changes in their world.

Project Wild has an activity book for primary level grades. After receiving 24 hours of outdoor classroom instruction in Project Wild at Camp Redlands in Stillwater, Oklahoma, I was certified to teach Project Wild. My second and third grade level students have really enjoyed and learned from our Project Wild activities such as: "Oh Deer"; "How Many Bears Can Live in This Forest?"; and, "Quick Frozen Critters."

All these activities are held outdoors. My fourth, fifth and sixth grade classes also used the same Project Wild activities as above. Project Wild is an interdisciplinary supplementary environmental and conservation education program for educators of kindergarten through high school age young people.

TABLE I

COMMON CHARACTERISTICS OF GIFTED AND TALENTED

FACILITATORS, DETRACTORS AND NEEDS			
Common Abilities of many gifted and talented	How can this facilitate learning?	How can this detract from learning?	What are some related learning needs?
Has high *energy* and motivation; desire to learn rapidly	Makes voluntary effort when interest is sparked	Frustrated with drill or slowing down for others	Exposure to much information and many ideas; individualized learning
Has good *memory*, ability to retain	Learns rapidly	Doesn't progress; is bored	Less rote learning
Has long & intense attention spans and periods of *concentration.*	Can learn greater amounts of material over a longer period	Has ability to effectively and cleverly tune out teachers or lessons	More involvement, more independent learning
Is *independent* in study and work	Takes direction independently; assumes more responsibility	Rejects, rebels, may prefer solitude	Independent study; less teacher direction; adaptation to working alone
Has *broad knowledge* and interest range; good vocabulary; high interest and abilities in reading.	Can tap own references; has many projects at home, broad comprehension of "life"	Occurs inappropriately at "expense" of lessons	Specialized vocabulary; appropriate and varied reading material
Has ease and clarity in *expression* (verbal, motor, numerical and affective)	Can communicate ideas to others effectively and successfully	Dominates conversation	Opportunity for self and creative expression

TABLE I. (Continued)

Has intellectual *curiosity* and a sense of questioning. Is observant, explores.	Cares about discovering why; often rejects norms unless the reason is clear; recognizes problems	May be stifled or discouraged in lesson, by the teacher and/or at home	(General Needs) "How to" skills; problem solving; critical and higher-level thinking; exposure across topics
Abstracts, conceptualizes and *processes* complex information	Likes problem solving, intellectual activities and inductive learning	Might resist direction and detail	(Specific Skills)
Has a logical *perspective*; sees relationships; applies concepts	Sees wholes, understands purposes, has goal-directed behavior; Learns across subjects	Needs order and consistency; has difficulty accepting illogical, the separation of school subjects	- classification - categorization - logical argument
Is *analytical*, thinks critically, evaluates and hypothesizes.	Analyzes problems and arguments sharply	Is critical toward others and/or self	- analysis
Is *creative*, original and inventive	Develops ideas and things because rejects the known	Rejects class content and convergent lessons; may stifled in school	Divergent and creative thinking or projects
Is *aware* and appreciative of environmental; has sense of justice and values	Comprehends mature, serious problems	Is frustrated with unaware peers	Exposure to and work with (current) problems, affective learning and values
Is *sensitive* and intuitive toward others; has good emotional development	Understands and cares about broad, human issues	Is sensitive to rejection and criticism	Affective and values learning

Source: Oklahoma Department of Education, Oklahoma City, OK, October 1986.

The goal of Project Wild is to assist learners of any age in developing awareness, knowledge, skills and commitment. In turn, this should result in informed decisions, responsible behavior and constructive actions concerning wildlife and the environment upon which all life depends.

Project Learning Tree is co-sponsored in Oklahoma by the Oklahoma Department of Agriculture, Forestry Division and the Oklahoma Conservation Commission. Project Learning Tree is a supplementary environmental education program designed for teachers and youth leaders working with students from kindergarten to twelfth grade using the forest as a window into the world of nature. We did a series of lessons on trees, leaf identification and use of trees to make paper and musical instruments.

From Critters and Concepts, a teaching guide to Oklahoma wildlife, I used the study of habitat and the students learned about Oklahoma's lakes, woods and grasslands. We learned Oklahoma has 13 million acres of woods, fifty lakes and our rich "sea of grass" in Oklahoma prairies. We devised our own food chains for wildlife.

Lab-aids is a good company for inexpensive laboratory activities. My class spent a week using the Lab-aids water pollution kit after gathering "wild water" samples from puddles, rivers, ponds and creeks in our flooded Dale community.

As I introduced "water quality" in Dale, Oklahoma to my combined junior and senior high group I reviewed some history. John Steinbeck's novel, The Grapes of Wrath, reminded us of Oklahoma's dust bowl in the 1930's and what the lack of water could mean to us. I reviewed the politics of water policies with the History of Federal Water Resources, and environmental policy in the 1980's.

Rachel Carson's Silent Spring enlightened us about water pollution. The 1960's brought great environmental concern about pollution. We learned that polluted water and hazardous wastes could ruin what we had accomplished in providing enough water "to drink, fish, and swim in" by 1985 as expressed in the Clean Water Act of 1977.

I found valuable textbook information in Conservation, an Ecological Approach. People writing in the 1960's and 1970's popularized the issues of natural resource conservation. Therefore in reviewing the literature I found a rich source of materials from these years.

One of the reasons for choosing conservation of natural resources was to retell the story of our treatment of the earth that these children's parents had heard when they were in school. Just because an issue is not "in vogue" at the moment doesn't mean the issue is not important. Conservation is vital, important and must be taught to each generation.

Garrett Hardin in Tragedy of the Commons points out that no one owns water; therefore, no one takes care of the water resources. This is why it is important for young people to learn the importance of taking care of our natural resources such as water.

In my science classes for talented and gifted students, I have attempted to synthesize many teaching points from the references discussed above. In addition, I have focused on specific water quality and quantity issues in and around the community of Dale, Oklahoma, since these are the water resources most familiar to my students.

CHAPTER III

CASE STUDIES FOR TEACHING WATER QUALITY TO TALENTED AND GIFTED STUDENTS

Case Study I

In the primary gifted and talented class at Dale School there were eight students, one girl and seven boys from second and third grades. During the school year these students receive special lessons in four areas: Science, Mathematics, Spanish, and Computers. These students were scheduled to study science 12:00 p.m. to 12:40 p.m. every Monday and Wednesday in the high school science classroom and laboratory for six weeks. In reality the students eagerly arrived at 11:55 p.m. and were coaxed back to class at 12:55 p.m.

The time scheduled for this class was the teacher's planning period. Therefore during the six weeks of this program all lesson plans, paper gradings, and test preparations were done before and after school hours. The classroom teacher is paid fifteen dollars an hour for this extra duty work.

This school year our library received a grant to enable the librarian to be full time. The library program was expanded to include the primary elementary grades. As part of our study of current science topics our primary gifted and talented class visited the Dale High School Library. The class was prepared for this trip by being assigned a word to find in the library and share the meaning of this wordk with the rest of the class. The word list came from current events so that words could only be found in magazines or very up-to-date reference books. The librarian and the gifted and talented science teacher assisted the students with the Reader's Guide to Periodic Literature and if the magazine was not in our library we helped the students to use the microviewers to read an article stored on microfilm. The word list included these words:

1. laser
2. maser
3. newest computer
4. newest plastic
5. Chernobyl nuclear accident
6. Gore, OK nuclear accident
7. Kingfisher, OK floods
8. acid rain

Each student found their word or phrase in a current magazine or reference source. The students sat at a round table in the library and told about their word or showed a magazine with their word in the article.

This session helped the students to become acquainted with the library, helped them to know how to use library reference materials, and helped the students to understand the current nature of science knowledge.

Case Study II

In the intermediate gifted and talented class at Dale School there were nine students, three girls and six boys from fourth, fifth and sixth grades. During the school year these students receive special lessons in four areas: Science, Mathematices, Spanish, and Computers. These students were scheduled to study science 12:00 p.m. to 12:40 p.m. every Tuesday and Thursday in the high school sciencee classroom and laboratory for six weeks. Most often our science class actually stretched from 11:55 p.m. to 12:55 p.m.

The time scheduled for this class was the teacher's planning period. Therefore, during the six weeks of the program all lesson plans, paper gradings, and test preparations were done before and after school hours. The classroom teacher is paid fifteen dollars an hour for this extra duty work.

During the time of our science segment, the Dale community experienced flooding of the North Canadian River. This river is about two blocks northeast of our school. As a class we walked to the river. Students were instructed about safety while walking on the highway and standing on the river bridge. Each student looked at the river. We saw the whirlpools, eddies and currents in the river. We dropped leaves in the water and watched them flow downriver. The students observed the following facts about the river. The water was greenish brown, flowing much faster than usual, the river water was about twenty feet wide, and the banks of the river still showed signs of the 1981 flood. The students remembered that river water covered the bridge in 1981, and Deer Creek also flooded over its bridge. The roads to Dale School were flooded so school was dismissed Friday and by Monday the water had receded so school could meet again.

People fishing showed us catfish they had caught. They told us catfish from the river was very good to eat. As we walked back to school we looked at the flood plains and the rich fields of alfalfa, wheat, and corn on either side of the river.

The next class meeting we decided to test water quality at Dale. Students were given brown 200 ml collecting bottles and white stick-on labels for the battles. The students choose a place to collect water. This is a list of their selections:

Boy's bathroom faucet

Science lab faucet

Lunchroom faucet

Home Economics room faucet

A pudddle on the playground

North Canadian River water

Grade School water fountain

Girl's bathroom faucet

Drainage ditch water

The students used a Lab-Aids kit for testing water pollution. This kit used chemplates and calibrated test tubes for mixing laboratory reagents to measured samples of water and reading colorimetric results. The students tested for metallic ions Fe^{++}, Ca^{++}, Zn^{++}, Mg^{++} and nonmetallic ions such as CN^-, NO_3^-, $SO_4^=$, $PO_4^=$, $SiO_4^=$. All students tested the pH of their water. Thekit provided a tally sheet for all results and a booklet that helped us understand what a water impurity might mean. For example some students had phosphate ions ($PO_4^=$) in their water which could mean soap contamination. Some students found nitrate ions (NO_3^-) which could mean fertilizer contamination of the water. All of the domestic water (from school building areas) showed only very small amounts of ion contamination. The raw water samples (outside - puddles, river) showed larger amounts of contamination.

The students showed their water test results to teachers or principals. For example one student took her test results to the home economics teacher while another student reported his test results of the boy's bathroom to the grade school principal. During this time we had open house for parents to visit school. Several students brought their parents by the science laboratory to show them where and how they had done their water testing.

The students were excited by the chemical testing. They cheerfully wore goggles to protect their eyes. They washed their own glasswear used in the testing. The students accepted the test results, but were surprized to find evidence of so many chemicals in clear drinkable water.

These students wrote evaluations of their work in the intermediate gifted and talented science program. Samples of these are in Appendix A.

Case Study III

In the secondary gifted and talented class at Dale School there were eighteen students, ten boys and eight girls, from seventh, eighth, ninth, tenth, eleventh, and twelfth grades. During the school year these students receive special lessons in four areas: Science, Mathematics, Spanish, and Computers. These students were scheduled to study science during three segments extending over a six weeks period of time.

A speaker, Dr. Jeff Black from Oklahoma Baptist University, came and instructed the students about Oklahoma wildlife in Oklahoma rivers, lakes, and ponds. The students saw and handled an adult and baby snapping turtle. The students saw and handled several snakes, none of them poisonous. The students were in the science classroom and laboratory for three hours, an entire afternoon of one school day.

Another speaker, Dr. Daniel Badger from Oklahoma State University came and presented Oklahoma Water Quality and Quantity Issues. Students were given an outline (Appendix B) and then presented the material by speaking, using transparency material on overhead projector. Supplemental material was handed out, such as a lake data sheet (Table II). Questions and answers were part of the presentation. Books and pamphlets were presented at the end to stimulate the student's own interests about water.

This presentation enabled the students to conduct an intelligent debate: "Should we build a dam across the Glover River in southeastern Oklahoma?" The major arguments presented were:

<u>YES</u>

Dam would provide flood control.

Provide jobs.

Lake would be good recreational site.

New wildlife-stock lake with fish.

Electrical power for the area.

<u>NO</u>

Dam would destroy wildlife.

Dam would destroy a wild river.

Canoe rides would be impossible.

Water stays cleaner, less chance of pollution without a dam.

Students did not resolve the issue, but they learned to think about such trade-off issues of natural resources. The students were in the science classroom and laboratory for three hours, an entire morning of one school day.

The third activity of the secondary gifted and talented class was a trip to Sulphur, OK to visit Chickasaw National Recreation Area and Arbuckle Lake.

Our objective was to experience a beautiful natural water and wildlife environment and see how humans and wildlife share the environment.

TABLE II

LARGE WATER LAKES IN OKLAHOMA AS OF OCTOBER 1985 (GREATER THAN 500 ACRES)

Name of Lake	Location of Dam	Surface Area* Acres	Acre-Feet Conser-vation Storage	Height of Dam Above Stream Bed (in feet)	Shore Line Miles	Purpose	Built by	Date Completed
Completed								
Altus	North Fork, Red River	6,260	134.549	98	49	I,WS,FC	Bureau of Reclamation	1948
Arbuckle	Rock Creek, Tributary Washita River	2,350	62,570	142	36	FC,WS,R	Bureau of Reclamation	1966
Arcadia	Deep Fork River, Oklahoma County	1,820	27,570	104	26	FC,WS,R	Corps of Engineers	1985
Atoka	North Boggy Creek	5,700	125,000		80	WS	City of Oklahoma City	1964
Birch	Birch Creek, Osage County	1,137	15,840	97	27	FC,WS,R	Corps of Engineers	1977
Bluestem	Middle Bird Creek	800	17,000		18	WS	City of Pawhuska	1958
Broken Bow	Mountain Fork River, McCurtain County	14,200	918,800	225	180	WS,P,R,FC	Corps of Engineers	1970
Brown	Bull Creek	550	4,525		11	R	Private	1970
Canton	North Canadian River	7,900	116,000	73	45	FC,R,WS	Corps of Engineers	1948
Carl Blackwell	Stillwater Creek, Trib. Cimarron River	3,380	61,500		55	WC,R	Dept. of Agriculture	1940
Choteau	Verdigris River, Wagoner County	2,270	Run of River		65	N	Corps of Engineers	1970
Chickasha	Spring Creek	1,950	41,080		38	WS	City of Chickasha	
Clear Creek	Wild Horse Creek, Stephens County	560	7,710		11	FC,WS,R	City of Duncan	
Copan	Little Caney Creek, Washington County	4,850	43,400	70	30	FC,WS,R	Corps of Engineers	1983
Cushing	Big Creek	600	3,044	39	12	WS	City of Cushing	1927
Ellsworth	Cache Creek	5,600	94,475		26	WS,R	City of Lawton	1962
Eucha	Spavinaw Creek	2,880	79,567	85	50	WS,R	City of Tulsa	1952
Eufaula	Canadian River	102,500	2,330,000	114	600	P,FC,N,WS	Corps of Engineers	1965
Ft. Cobb	Cobb Creek, Tributary Washita River	4,100	80,000	101	45	I,FC,WS	Bureau of Reclamation	1959
Ft. Gibson	Grand (Neosho) River	19,900	365,200	110	225	P,FC,WS	Corps of Engineers	1953
Ft. Supply	Wolf Creek, Tributary	1,820	13,900	85	26	FC,R,WS	Corps of Engineers	1942
Foss	Washita River	8,800	203,700	134	63	I,WS,FC,R	Bureau of Reclamation	1961
Francis	Illinois River	570	2,700		6	WS,R	Siloam Springs, Arkansas	
Fuqua	Wild Horse Creek, Stephens County	1,500	8,520	0	19	WS,FC,R	Soil Conservation Service	1963
Frederick	Deep Red Run Creek, Tillman County	925	9,526			S,FC,R	Soil Conservation Service	
Grand	Grand (Neosho) River	57,400	1,872,300	147	824	P,FC,WS	Grand River Dam Authority	1940
Great Salt Plains	Salt Fork, Arkansas River	8,690	31,420	68	41	FC,R	Corps of Engineers	1941

TABLE II (Continued)

Name of Lake	Location of Dam	Surface Area, Acres	Acre-Feet Conser-vation Storage	Height of Dam Above Stream Bed (in feet)	Shore Line Miles	Purpose	Built by	Date Completed
<u>Completed</u>								
Greenleaf	Greenleaf Creek	920	14,720		15	R	State of Oklahoma	1936
Hefner	Bluff Creek	2,580	75,000	120	18	WS,R	City of Oklahoma City	1945
Henryetta	Wolf Creek	616	6,660		11	WS	City of Henryetta	
Heyburn	Polecat Creek, Trib. Arkansas River	920	6,620	89	40	FC,WS	Corps of Engineers	1950
Holdenville	Canadian River Tributary	550	11,000		13	WS	City of Holdenville	
Hudson	Grand (Neosho) River	10,900	200,300	90	200	P,FC,WS	Grand River Dam Authority	1964
Hugo	Kiamichi, Choctaw County	13,250	157.600	101	110	FC,WS,R	Corps of Engineers	1974
Humphreys	Wild Horse Creek, Stephens County	882	3,360		19	WS,FC	Soil Conservation Service	1957
Hulah	Caney River	3,570	31,100	94	62	FC,WS	Corps of Engineers	1951
Kaw	Arkansas River, Kay County	17,000	428,600	125	168	FC,WS,R	Corps of Engineers	1975
Keystone	Arkansas & Cimarron Rivers	23,610	557,600	121	330	FC,N,P	Corps of Engineers	1965
Konawa	Jumper Creek	1,350	24,000		18	Cooling	OG&E	
Lawtonka	Medicine Creek	2,398	63,000		19	WS,R	City of Lawton	1905
McAlester	Bull Creek	1,240	11,470				City of McAlester	1923
McGee Creek	McGee Creek, Atoka County	3,580	109,800	186	64	FC,WS,R	Bureau of Reclamation	1985
McMurtry	Stillwater Creek	1,155	13,530	64	26	WS,FC,R	Soil Conservation Service	1971
Murray	Anadarche Creek	5,728	25,600		150		State of Oklahoma	
Newt Graham	Verdigris River, Wagoner County	1,490	Run of River		77		Corps of Engineers	1970
Nichols Park		600						
Oolagah	Verdigris River	29,500	553,400	137	209	FC,P,N,WS	Corps of Engineers	1963
Okemah	Buckeye Creek	720	13,100		18			
Okmulgee	Salt Creek	720	14,170		20	WS,FC	Soil Conservation Service	
Optima	North Canadian River, Texas County	5,340	129,000	120	38	FC,WS	Corps of Engineers	1977
Overholster	River mile 281.5 N. Canadian	1,700	16,620		7	WS,R	City of Oklahoma City	1919
Pauls Valley	Washington Creek	750	8,730	39	8	WS,FC	City of Pauls Valley	1954
Perry	Cow Creek	614	7,096	62	11	WS,R	City of Perry	1937
Pine Creek	Little River, McCurtain County	3,800	53,800	124	74	FC,WS	Corps of Engineers	1969
Ponca	Big & Little Turkey Creeks	805	15,000	70	15		Department of Agriculture	1935
Red Run & Coffin Cr.	Red Run & Coffin Creeks, Tillman County	925	1,857	65		WS	Soil Conservation Service	1974

TABLE II (Continued)

Name of Lake	Location of Dam	Surface Area* Acres	Acre-Feet Conservation Storage	Height of Dam Above Stream Bed (in feet)	Shore Line Miles	Purpose	Built by	Date Completed
Completed								
Robert S. Kerr	Arkansas River	42,000	525,700	75	250	N,P,R	Corps of Engineers	1970
Shawnee No.1	South Deer Creek	1.336	22,600		14.8	WS,R	City of Shawnee	1935
Shawnee No. 2	South Deer Creek	1,100	11,400		9.2	WSR	City of Shawnee	1960
Shell Creek	Shell Creek	640	9,500		13			
Skiatook	Hominy Creek	10,190	3,227	143	160	FC,WS	Corps of Engineers	1985
Sooner	Greasy Creek, Noble & Payne Counties	5,400	236,500		56	Cooling	OG&E	1978
Spring Creek	Spring Creek, Grady County	2,192	36,985			WS,FC	City of Chickasha	
Spavinaw	Spavinaw Creek	1,638	31,686	67	20	WS	City of Tulsa	1924
Stanley Draper	East Elm Creek	2,800	100,000		34	WS,R	City of Oklahoma City	1964
Stroud	Salt Creek	586	8,800		12			
Tenkiller	Illinois River	12,900	654,100	197	130	FC,P,WS	Corps of Engineers	1952
Texoma	Red River	88,750	2,643,300	165	580	FC,P,WS	Corps of Engineers	1944
Thunderbird	Little River, Cleveland County	6,070	119,600	101	86	FC,WS,R	Bureau of Reclamation	1965
Tom Steed	Otter Creek	6,400	97,500	60	31	FC,WS	Bureau of Reclamation	1975
Waurika	Beaver Creek	10,100	203,100	106	80	FC,WS	Corps of Engineers	1977
W.D. Mayo	Arkansas River	1,600	Run of River		50	N	Corps of Engineers	1970
Webber Falls	Arkansas River	10,900	170,000	84	157	N,P,R	Corps of Engineers	1970
Wewoka	Coon Creek	365	3,301		11			
Wild Horse	Wild Horse Creek, Stephens County	550	3,510	51			Soil Conservation Service	1963
Wister	Poteau River	5,400	46,100	99	115	FC	Corps of Engineers	1949
Under Construction								
Clayton	Jackfork Creek, Latimer County	14,360	128,200	100	117	FC,WS,R	Corps of Engineers	

TABLE II (Continued)

Name of Lake	Location of Dam	Surface Area* Acres	Acre-Feet Conser-vation Storage	Height of Dam Above Stream Bed (in feet)	Shore Line Miles	Purpose	Built by	Date Completed
Authorized but Construction Not Started								
Black Bear	Black Bear Creek, Pawnee County	550				FC	SCS	
Boswell	Boggy Creek, Choctaw County	5,540	35,800	95	40	FC,WS	Corps of Engineers	
Candy	Candy Creek, Osage County	2,170	44,160	102	23	FC,WS,WC	Corps of Engineers	
Clayton	Jackfork Creek, Latimer County	14,360	128,200	100	117	FC,WS,R	Corps of Engineers	
Lukfata	Glover Creek	1,680	43,500	176	44	FC,WS	Corps of Engineers	
Sand	Sand Creek, Osage County	1,940	39,300	114	53	FC,WS	Corps of Engineers	
Shidler	Salt Creek, Osage County	2,450	58,200	117	35	FC	Corps of Engineers	
Tuskahoma	Kiamichi River, LeFlore County	11,600	235,400	96	72	FC,WS,R	Corps of Engineers	

P-Power, FC-Flood Control, WS-Water Supply (Municipal & Industrial), R_Recreation, N-Navigation, I-Irrigation, WS-Water Conservation

Source: Oklahoma's Water Atlas, 1984 by Oklahoma Water Resources Board, and Oklahoma Water Resource Development, U.S. Corps of Enginners, Jan. 1981

*Measured at top of power pool or conservation pool

Compiled by Dr. Dan Badger, Department of Agricultural Economics, Oklahoma State University, Stillwater, Oklahoma 74078

Students wore outdoor clothing, backpacks and brought natural food picnic lunches. We rode a school bus to the Nature Center. We watched a film on keeping the beauty of America. We went on a short instructed nature hike with the park ranger. Then we hiked to Antelope Springs, waded in the stream and hiked back to the nature center. We stopped to see buffalo on our way to Arbuckle Lake. The students had free time after our lunch at the lake. They skipped rocks, waded and found shells and fossils.

This trip was planned to enhance the lessons learned from Dr. Badger's seminar of Oklahoma Water Quality and Dr. Black's seminar of Oklahoma wildlife. The way to preserve water and wildlife is to experience the beauty, the quiet, realize why the Chickasaw Indians called these "holy waters." The students saw the dam and lake that Dr. Badger told them was constructed by the Bureau of Reclamation of 1966. They learned Arbuckle Lake was used for city water supply, irrigation by farmers, and flood control for people in Murray County.

CHAPTER IV

OTHER ASPECTS OF DALE SCHOOL'S GIFTED AND TALENTED PROGRAM

1986 to 1987

Dr. Daniel Badger from Oklahoma State University spent one morning (3 class periods) with my 18 Junior High and High School students. He discussed water resource issues with the students. The finale of his presentation was a debate on the issue: "Should we Dam the Glover River?"

Thanks to the fund of knowledge he had given the students they were able to intelligently debate this issue. Everyone got to stretch their intelligence and speak their minds. Of course we did not resolve the issue, but we learned that an issue has many sides and that facts help us back up our opinions. Our school has no debate team; therefore this activity was special to the students.

Students from my Biology classes in the secondary gifted and talented group, including two students from Gifted and Talented, are making speeches this year at the annual Conservation Speech Contest sponsored by the Soil Conservation Service. These students used facts, figures and references furnished during Dr. Badger's presentation. The speeches emphasize soil and water conservation. The students volunteered to work on the speeches. They showed an amazing grasp and original thought to the subject of soil and water conservation. This shows a spill-over from a gifted and talented class to the regular classroom.

I am especially pleased by the way the students related to their own situations. One student pointed out the practices of sod farmers who live on either side of her and what they're doing to the soil. One student pointed out that 100 to 150 gallons of water are used per person per day in the home. She further states anything over 5 minutes of shower time wastes water excessively. This is an important lesson for a teenage student to grasp and apply to living.

During the time we have studied water in the Dale Community, we have heard both Dr. Badger and Ron Treat, Soil Conservation Service, tell us of flooding of the North Canadian River. During the week of September 29 to October 3, 1986 we had a flood on the North Canadian River in our community and experienced these lessons first hand. Water covered farms, homes, roads and some bridges. The school, although almost surrounded by water, did not flood so classes were held as scheduled. This gave me an excellent opportunity to let the students take samples of flooded river water, deposited river silt and analyze them as to pH, appearance and growth of microbes.

During the summer of 1985, I took a Microbial Ecology Class and at that time I analyzed North Canadian River water, Deer Creek water, Exxon drinking water, Dale School drinking water, Tarpey farm drinking water and Tarpey chicken barn water. The results showed that normal aerobic organisms were present in the river, creek and chicken barn water. All the drinking water sources were free of any organisms. The organisms were tested for anaerobic growth (none found) and coliforms (fecal) organisms (none found).

The chicken barn water did contain anaerobics and coliforms. We later concluded that the water had been setting in a tank several months after the last flock of chickens. Therefore water from a well that sets, and without the flow and flush of a pump, can easily become dangerously contaminated.

To help the OSU Geology Department, I also tested some well water tubing for anaerobic (+) and coliform (+) organisms. The tubing had a yellow and black biomass that I cultured. We concluded that contamination was due to only intermittent water flow through the tubes. Continuous flow or flushing would probably diminish or eliminate the problem.

Also this summer in an Advanced Problems in Public Policy of Natural Resources course I wrote a 30 page paper on the Politics and Policies of Water Quality (Appendix C). During my research for this paper I studied the Dale School and Dale, Oklahoma water situation. The Deer Creek Reservoir construction project was before the Congress and we read late October 1986 that the project has passed the House Committee and goes to the Senate. It was interesting to find how political pressures control the destiny of meeting our needs such as water. As I pass these ideas on to the students in my class, I stress the need to be informed, write letters, make phone calls, campaign and vote for good representation in all stages of government.

In the elementary groups both primary and intermediate of Gifted and Talented, I specifically introduce good conservation periodicals. Last year I used National Geographic World. We saw a squirrel in a story on water skis. We then made up our own stories of how the squirrel was tamed, trained and what his future might be. We used a picture of plants in a swamp as the earth might have looked during the Age of Dinosaurs. We discussed dinosaurs and various theories of how they might have died, how weather has changed, how oceans have receded, why a comet fell. Then the students came up with their own ideas: carnivores ate all herbivores and finally ate each other, the water receded, and dinosaurs were too heavy to walk to their food.

This year I am introducing the magazine, Ranger Rick, from the National Wildlife Federation. One story in two parts is titled "The Best Present of All" about energy. The king declares "Everything costs, even things that are free and once they are gone, they can no longer be." Later the king says "Burning and spitting poisons and pollution, oil on the beaches and death on the land. There must be a better way to make light and heat for my children." At the end of the story he says "I will give them heat and light from the earth and the sun."

Sometimes I select topics from the fun page. Tongue twisters are fun and we learn environmental facts about wildlife. We laughed a lot as we tried these.

"How many flies can a frog flick fast?"

"Does a little legged lizard or a large legged lizard leap longer?"

"Ranger Ricks raft ran the rapids rapidly."

CHAPTER V

SUMMARY AND CONCLUSIONS

In conducting my master's thesis study of Conservation and Natural Resource to Gifted and Talented students at Dale High School, I found that it was possible to teach water quality to all four age groups: primary - second and third grade; intermediate - fourth, fifth, and sixth grade; secondary - junior high (grades seven, eight and nine); and, senior high (grades ten, eleven and twelve). The water quality of their own area, Dale, Oklahoma, was of great interest to them.

The program had limitations of time. Many times as my primary or intermediate groups were extremely involved in our learning, the "bell rang" and our time was gone for that day. In working with my junior high and senior high school groups there were only three meetings so our time together was a total of about 12 hours.

Our money was limited. We had no money for new books, equipment or films. We took our own lunches on our field trip, used a school bus and visited a "free" park facility.

In this study, there was the ability of young minds to grasp and apply new ideas. I saw this program benefit the gifted and talented students of Dale School. As they become tomorrow's citizens of Spaceship Earth, I think "water quality" is an issue they will remember as they travel from Dale, Oklahoma to any new environment.

A summary of the conservation and natural resources program for Gifted and Talented Students at Dale School is presented in Table III. As indicated, many disciplines are included during this period of study.

TABLE III

SUMMARY OF CONSERVATION AND NATURAL RESOURCES TO GIFTED AND TALENTED STUDENTS AT DALE SCHOOL

Field	Level	Unit	Sample Concept
Library Science	Primary	Current Events	To use magazines, to find new science events in Chernobyl USSR and Gore, OK
Physics	Primary	Current Words	To find the meaning of laser, maser, computer, nuclear accident
Chemistry	Primary	Current Events	To find the meaning of acid rain and its causes. To find the chemical composition of plastics
Meteorology	Intermediate	North Canadian River Flood	Correlation between heavy rains both in Dale and NW part of state resulting in floods
Botany	Intermediate	Crops of Flood Plan	To observe correlation between river floods and rich farmland for alfalfa wheat and corn
Ecology	Intermediate	Pollution	To test water in Dale, OK for pollutants
Chemistry	Intermediate	Pollution	Chemical tests of Dale, OK water for cations and anions
Sociology	Intermediate	Communication	To report water test results to school officials

TABLE III (Continued)

Field	Level	Unit	Sample Concept
Zoology	Secondary	Live Animal Handling	To learn to appreciate and experience snakes and turtles
Natural Resources Economics	Secondary	Water Resources in Oklahoma	To study water quality and water quantity in Oklahoma
Politics	Secondary	Trade-Offs	To study and debate the Glover River dam project
Ecology	Secondary	Chickasaw National Recreation Area	To wade in streams and visit an Oklahoma lake
Nutrition	Secondary	Nutritious Picnic Lunches	To make and eat a lunch with no junk foods

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APPENDIX A

STUDENT EVALUATIONS

All letters dated September 30, 1986

I really enjoyed the time in here. I enjoyed making the terrarium the best. The leaf hunt was fun to.

Kelli

Chemistry I liked because we use different chemicals. They were different colors, put them together and you'll have different colors, but that was last year.

Zoology was fun because we saw a whole lot of different animals. Reptiles were neat because of the snakes.

Microscopes were fun because we saw a lot of different kinds of things. We made slides mine was blood, but that was last year.

When Mr. Black came I really enjoyed it because of all the snakes and the real big snapping turtles.

Peter Sweger

I liked the animals that were in the cabinets. I liked the skeleton and the field trip. Mr. Black was really neat. I liked holding the snake and seeing a real snapping turtle. Thanks for having us this year.

Stephanie Garrett

I liked the leaf hunt. I liked it because I learned a lot about how to identify different trees by there leaves. I also liked the time we had to make our terrariums. It was fun.

Lara Whittington

I liked everything we did. I liked the leaf walk best though. I hope we are here next year.

Justin

I liked everything we did. What I liked best was collecting the leaves. I hope we can do it next year.

Chuck

I liked everything we did and I really had fun. I especially liked to make my terrarium because it taught me about the earth.

Billy

I liked everything that we did even when we looked at the things in the case.

Jeffrey

APPENDIX B

OUTLINE OF WATER QUALITY AND QUANTITY ISSUES

WATER RESOURCES IN OKLAHOMA

WHAT IS H_2O

WHERE IT COMES FROM

HYDROLOGIC CYCLE

COVERS 3/4's OF EARTH'S SURFACE

WATER CAN BE BENEFICIAL

PLANTS AND ANIMALS NEED IT

INDUSTRIAL PRODUCTION PROCESSES - FROM WATER WHEEL AND TRANSPORTATION TO CLEANSING AGENT

ESTHETICS OR BEAUTY OF WATER: IT ATTRACTS PEOPLE LIKE A MAGNET -- HOMES ON SEASHORES, BARRIER ISLANDS, OVERLOOKING RIVERS AND LAKES

RECREATION

FISH AND WILDLIFE

WATER CAN BE DESTRUCTIVE

HURRICANES, TYPHOONS, TORRENTIAL RAINS

DESTRUCTION OF PHYSICAL PROPERTY -- LAND AND BUILDINGS

SOIL EROSION -- SHEET, RILL, AND GULLY: LOSS OF PRODUCTIVE LANDS

CLOGGING OF RIVERS AND LAKES WITH SILT OR SEDIMENT

IT CAN MOVE MOUNTAINS AND MAKE CANYONS -- GRAND CANYON IS EXAMPLE OF EROSIVE FORCE OF WATER

IT CAN BE DEADLY -- DROWNINGS TO POISONINGS WHAT WE MIX IN IT OR SOMETIMES WHAT NATURE ADDS

WHAT AND WHERE ARE OUR OKLAHOMA WATER RESOURCES

GROUND WATER -- OGALLAGA FORMATION AND OTHERS

SURFACE WATER -- RIVERS AND LAKES

IMPACT OF TOPOGRAPHY, RAINFALL AND EVAPOTRANSPIRATION

INTERRELATIONS OR CONNECTING LINKS BETWEEN SURFACE AND GROUND WATER

SURFACE WATER RESOURCES

RIVERS AND STREAMS -- CONTINUAL FLOWING OR INTERMITTENT

NATURAL LAKES -- THANKS TO BEAVERS! (OR NATURE)

ARTIFICIAL OR MANMADE LAKES

SINGLE PURPOSE VERSUS MULTIPLE PURPOSE DEVELOPMENT

MAJOR WATER RESOURCE DEVELOPMENT OR CONSTRUCTION AGENCIES IN OKLAHOMA: CORPS OF ENGINEERS, BUREAU OF RECLAMATION, SOIL CONSERVATION SERVICE

DEVELOPMENT PURPOSES

CHANGE IN LANDSCAPE OF OKLAHOMA -- FROM DUST BOWL TO INLAND SEAPORT AND RECREATION PARADISE

WHO HAS RIGHT TO USE WATER

RIPARIAN DOCTRINE -- 31 EASTERN STATES

PRIOR APPROPRIATION DOCTRINE - 19 WESTERN STATES

ROLE OF OKLAHOMA WATER RESOURCES BOARD

TRADEOFFS IN WATER RESOURCES DEVELOPMENT

WHO PAYS THE COSTS

WHO RECEIVES THE BENEFITS

IMPACTS ON AGRICULTURAL PRODUCTION

CONFLICTS AMONG USERS

CONFLICTS AMONG VARIOUS PUBLICS -- CONSERVATION AND ENVIRONMENTAL GROUPS VERSUS DEVELOPMENT OR GROWTH GROUPS

SOME CRITICAL ISSUES

FREE FLOWING STREAMS

STATE AND FEDERAL SCENIC RIVERS: ROLE OF OKLAHOMA SCENIC RIVERS COMMISSION

WATER QUALITY CONCERNS -- FROM SEDIMENT TO HAZARDOUS OR TOXIC WASTES

WATER QUANTITY CONCERNS -- DISTRIBUTION OF WATER AND RELOCATION (TRANSPORTATION) OF WATER

INTERBASIN TRANSFERS -- GOODS AND BADS

FUTURE OF DEVELOPMENT PROJECTS -- FOR MUNICIPAL AND INDUSTRIAL PURPOSES TO NAVIGATION AND RECREATION

LOSS OF FLOODPLAINS DUE TO FILLING IN BY DEVELOPMENT -- WATER MUST GO SOMEWHERE!

WE MUST CONSERVE AND PROTECT THIS WONDERFUL RESOURCE

APPENDIX C

POLITICS OF WATER QUALITY

APPENDIX C

POLITICS OF WATER

Past generations have had to define the optimum value and use of environmental resources for themselves and their property, so do we today. For the early colonist, environmental values were dominated by the need for survival. Human labor for them was more scarce than natural resources. Therefore it is understandable that they valued their natural resources less than we do today. They responded in a resourceful way to a seemingly endless wilderness.

Vast areas of land were added to the United States during the century after 1776. The Louisiana Purchase (1803), the Oregon Compromise (1846), and Alaska Purchase (1867) were some of the purchases adding 1.8 billion acres to the United States of America. This abundance of land and natural resources created a unique time in history. Slow planned growth was favored by the established eastern politicans but sprawling, brawling expansionism was the mood of the western frontier. In the west land was given to settlers, transcontinental railroads, and to states to promote higher education.

The settlement of our lands in the west and the development of their resources created a wealth in our new United States of America. Next our natural resources became part of the great struggle between the North and the South. After this was ended, slavery was abolished, the union once more established, the United States of America became the home of a very large middle class of society. People began to think maybe we were being shortsighted about our use of natural resources and we should begin to conserve.

By 1867 all the land area that is today the continental United States of America had been acquired. Two million acres were withdrawn by the United States government in 1871 to create Yellowstone National Park. In 1891, the Forest Reserve Acts established national forests. In 1902 the Reclamation Acts were passed to use money from western land sales to finance the construction of dams and reservoirs to irrigate arid western lands.

This new movement for conservation was led by President Theodore Roosevelt. In 1908 he held a White House Conference on conservation. On that occasion President Theodore Roosevelt said, "The wise use of all of our natural resources, which are our national resources as well, is the great material question of today. I have asked you to come together now because of the enormous consumption of these resources, and the threat of imminent exhaustion of some of them, due to reckless and wasteful use, . . ." Even though this threat did not come to pass during his lifetime, we can be thankful that Theodore Roosevelt was able to establish management and concern for our natural resources.

From 1911-1932 was a time for debate between conservationists and preservationists. John Muir, founder of the Sierra Club led the preservationists. They believed in the value of wilderness as wilderness. Natural resources found in untouched natural surroundings give beauty, health, and enrichment to our spirits.

One famous controversy was a proposal to dam the Hetch-Hetchy Valley in Yosemite National Park. The conservationists argued that a water reservoir was needed for San Francisco. The preservationists argued that the valley was more valuable in its primitive state, especially since water was available in several other locations for San Fransisco. In 1914 the conservationists prevailed and Congress authorized funding for the reservoir.

The use of the nation's waterways was also debated during this period of time. Should inland waterways be used primarily for navigation? Should inland waterways be used for multiple purposes such as water reservoirs and electrical prodution? The United States Army Corps of Engineers believed that navigation and commercial transportation were the most efficient use of inland waterways. The Forest Service and the Department of Interior argued to multi-purpose development. The Water Power Act of 1920 was passed by Congress and provided for public control of hydroelectric development and navigation.

After World War I there was a popular settlement to reduce the hold of the federal government. During the presidencies of Calvin Coolidge and Herbert Hoover federal conservation policies were strengthened. New laws created federal-state cooperative programs in fire protection, reforestation, water resources, and soil conservation. The giant Hoover Dam project was begun. Progress was made but questions remained. Should the states or the federal government control water in the West? Should the public or private sector control mining on public lands?

The Depression changed dramatically the politics and economies of natural resources as well as every other part of the United States of America in the 1930's. The federal government became dominant in managing public natural resources. President Franklin D. Roosevelt initiated the CCC (Civilian Conservation Corps) and the TVA (Tennessee Valley Authority). The CCC hired two million people to work in camps for park development, planting trees, flood control, waterways improvement, and reclamation projects. The efforts of the CCC to control soil erosion led to the Soil Conservation Service established in 1935. The TVA sought to use regional government to respond to both economic and natural resource issues. TVA gave jobs, hydroelectric power, flood control and navigation to a depressed area.

The 1940's were years for the construction of dam and large water lakes throughout our country. Flood control was the main objective at the time these projects were conceived but later multiple purposes of water supply, recreation, navigation, irrigation and water conservation became important to the people served by these lakes. Lakes in Oklahoma completed in the 1940's were Altus Lake by the Bureau of Reclamation in 1948, Canton Lake by the Corps of Engineers in 1948, Carl Blackwell Lake in Stillwater by the Department of Agriculture in 1940, Fort Supply Lake by the Corps of Engineers in 1942, Grand Lake by the Grand River Dam Authority in 1940, Great Salt Plains Lake by the Corps of Engineers in 1941, Lake Hefner by the City of Oklahoma City in 1945, Lake Texoma by the Corps of Engineers in 1944 and Lake Wister by the Corps of Engineers, 1949.

The 1950's continued the building of large dams and lakes. Oklahoma lakes built in the 1950's were Bluestem Lake by the Department of Agriculture in 1950, Fort Cobb Lake by the Bureau of Reclamation in 1959, Fort Gibson Lake by the Corps of Engineers in 1953, Kaw Lake by Corps of Engineers in 1951, Hulah Lake by the Soil Conservation Service in 1957, Pauls Valley Lake by the City of Pauls Valley in 1953, and Tenkiller Lake by the Corps of Engineers in 1952. Criticism of these structural solutions to water resource problems has decreased severely the number of new lakes under construction now. Senator Robert S. Kerr was very instrumental in the "pork barrel politics" which brought so many of these large water projects to Oklahoma. Robert S. Kerr was a co-founder of Kerr-McGee Corporation and has a channel in the Arkansas River Navigation System and a lake named for him. The State of Oklahoma has 6,327 miles of shoreline.

During the decade of the 1960's water pollution control became the most important Federal water resources program. Silent Spring a best selling book by Rachel Carson in 1962 drew public attention to the chemical insecticides in our soil and water. These chemicals concentrate as they rise in the food chain damaging wildlife and even human life. Carson's message was the DDT, endrin, aldrin and others seriously threaten the balance of nature and should be eliminated from the environment. As a result, our federal government became more cautious about the use of pesticides and regulations about pesticide use were established in (USDA) United States Department of Agriculture and (HEW) Health, Education and Welfare Department. Mercury and other heavy metals were also discovered to be dangerous water pollutants from industrial sources that rise in the food chain and cause brain damage in humans.

In 1969 there was a blowout of an oil platform operated by the federal government near Santa Barbara, California. This oil spill covered several hundred miles of costal water and 13 miles of ocean frontage land. The oil spill damaged fish, wildlife, beaches, the tourist industry, and the morale of a community who prided themselves on the beauty of Santa Barbara. Public opinion was forever changed by this event and its aftermath. Secretary of the Interior Udall said Santa Barbara was "a sort of conservation Bay of Pigs and we should always err on the side of protection when a mistake can do great damage to other resources."

Presidential leadership during the 1960's was very important. President John F. Kennedy recommended $100 million a year to be spent on sewage treatment plants, initiated the Corps of Engineers flood plain studies, and emphasized desolination of ocean water research. Stewart Udall, Kennedy's Secretary of the Interior, wrote a book, The Quiet Crisis in 1963 about stewardship of natural resources. Three large national seashores were added to the National Park Service during Kennedy's administration. Hydroelectric projects were begun on the Columbia River and the Colorado Gorge by Kennedy. When President Johnson was elected President in his own right he made nature preservation an important domestic policy item. As part of his Great Society campaign speech of 1964, Johnson stated that preservation of the natural beauty of the countryside was second only to urban renewal. Johnson's administration established our National Wild River System including Oklahoma's Illinois River and Glover River. President Johnson also cleaned and beautified the Potomac River in Washington, D.C. Johnson said the solution to pollution was organization. The Water Resources Council, interstate water quality standards, clean river demonstration program, creation of a National Water Commission, and Clean Waters Restoration Act, were a few of the programs he organized. Money was the big problem. Viet Nam was costing a lost of money and Congress simply could not appropriate full funding of all these programs.

President Nixon early in his administration recognized the environment as an issue that will "bring us together again." Public concern for the environment as expressed by the Citizens Crusade for Clean Water was to see $800 million for pollution control authorized by the Clean Water Restoration Act of 1970. President Nixon requested only 37 new water projects for the Corps of Engineers and the Bureau of Reclamation and Congress sent a bill through with 102 new projects. President Nixon commented "many of these added starts are for projects which would benefit some particularly interested groups but would be of little value to the people generally. There is too much pork in this barrel."

President Nixon in 1969 created the Cabinet Committee on the Environment. In 1970 Congress passed the National Envronmental Policy Act which included the (CEQ) Council on Environmental Quality. But the most important policy change by president Nixon was the establishment of (EPA) the Environment Protection Agency in December, 1970. EPA brings together in one agency pollution control programs for water, air, solid wastes, pesticides and radiation.

The 1970's have become known as the environmental decade. Throughout our nation in industry, government and among the people at large there was a heightened consciousness of human and ecological interdependence. The federal government wrote, passed, and enforced laws which affected water quality, air quality, endangered species, drinking water, pesticides, toxic substances, hazardous wastes, ocean pollution, and the ozone layer. President Jimmy Carter in May, 1977 called for reform in the nation's water resource management process. President Carter supposedly had a water project "hit list". A year of hot debate followed this announcement. The nation's governors responded by adopting a statement of principles they believed for national water policy. This had an immediate impact. President Carter sent a message to Congress in which he called for "a new creative partnership between the states and the federal government." When the states get together and speak with one voice they can influence thinking in Washington. Due to the short time left in his term, little else happened in major national water policy organization.

President Ronald Reagan came riding in from the West bringing our environmental policies for the 1980's. Government spending was to be cut and that included water projects according to President Reagan. The Water Resources Council was abolished. The system of river basins was dismantled.

The concept of partnership was ignored by an administration of the "new federalism." Money again may tell the story. In 1976 the Corps of Engineers, Bureau of Reclamation, and Tennessee Valley Authority was budgeted $4 billion. In 1980 these groups had a budget of $2.5 billion. In 1984 they were budgeted $1.3 billion dollars. President Reagan wants to rely on a free market to allocate natural resources and shift protection of the environment from federal government to the state and local governments. The President's Council on Environmental Quality uses cost-benefits analysis to determine federal spending on governmental projects. President Reagan's administrative strategy seems to be largely to bypass Congress by changing rules and regulations in the beaurocracy. Many have raised the question of violation of the Constitution by President Reagan to "take care that the laws be faithfully executed." Environmental and conservation groups in the private sector have grown very strong during Reagan's term.

The 1980's show a contrast of success and failure of water policies. The clean up of the Erie Lake and other Great Lakes have been successful and the sight, smell, and fishing in the lakes has been dramatically improved. The Potomac River in Washington, D.C. has been restored to fish and greater beauty. However, the goal of the Clean Water Act of 1972 to make water everywhere in our country clean enough for drinking, swimming and fishing by 1985 has certainly not been met. The toxic waste pollution of our ground water supplies is a glaring failure. Water pollutions at Love Canal taught us just how vulnerable we are. Water is very scarce in Tucson, Arizona where 55 ground water wells were contaminated with (TCE) trichloroethylene.

President Reagan has experienced difficulty with staff who deal with environmental issues. James Watt, Secretary of the Interior, resigned under a cloud of controversy. Anne Gorsuch resigned from EPA (Environmental

Protection Agency) taking the blame for the failure of the EPA policies given her by President Reagan's administration. Gorsuch's policy agenda for EPA was better science, regulatory reform, elimination of backlogs, return to states the financial and regulatory responsibility for EPA, management improvement and budget reduction. Under Gorsuch's implementation of the Reagan/Stockman (David Stockman, Budget Director) air, water, hazardous wastes and toxics were cut during 1981-84 by 44%. By early 1983 environmental regulation had become President Reagan's most embarrassing policy failure. In the press, the public was concerned about real environmental hazards and toxic contaminations while EPA was having its credibility destroyed by scandal, mismanagement and unauthorized budget cuts.

William Ruckelshaus, EPA's first administrator in May, 1983 returned to head the agency. Ruckelshaus was to restore trust in EPA. Specifically he was to manage a Superfund program, develop an acid rain policy, vigorously enforce environmental laws, and help identify the states and federal governments' respective roles. He has made a real beginning by hiring "the best people" with "iron integrity." He has begun by deciding to clean up certain hazardous waste dumps now rather than wait for negotiation, he has reversed Gorsuch's weakened federal water quality standards and he has asked for a Superfund budget increase.

America has enjoyed an abundance of high quality water since its birth as a nation. Maybe the more dependent we are on something the more we take it for granted. Health. Breath. Water. Water is everywhere around us. All molecules of water are shared. Water is part of the commons of life. Ever try doing without water for a day? Drinking, washing, flushing, heating, cooling, cooking, and recreating are all water-based. The human body is about 70% water and would die without drinking water in about seven days. The average

U.S. Water Requirements sheet lists water uses in the home. You will notice each of us uses about 60 gallons of water per day.

Industry uses about 724 gallons of water per day per person to produce electricity, metals, fuels, and make paper. A simple copy of a favorite author's paper back book requires 100 gallons of water. Industry not only uses water but produces chemical-laden wastes as a by-product. Toxic and hazardous wastes are a problem for all water-drinkers to face in the immediate future.

Agriculture uses water to irrigate land that would not otherwise grow crops. In order to produce our food, farmers and ranchers use 693 gallons of water per day. The statistics are amazing: a pound of beef requires 2,500 gallons of water, an orange 100 gallons of water, and one egg 40 gallons of water. Agriculture too can be a careless steward of water. Tons of pesticides, herbicides, fertilizers and animal wastes leach into the soil every time crops are irrigated. This tainted water flows through to a ground water aquifer. Once contaminated we don't know how long or if we can clean up the ground water aquifer (Table 1, 2, and 3).

In 1982 a Lou Harris survey showed that 94 percent of all Americans wanted Congress to maintain or toughen the provisions of the decade-old Clean Water Act. The public seems ready for action. States have started their own toxic clean-up programs. The Justice Department has started prosecuting toxic polluters. U.S. Department of Agriculture's Soil Conservation Service states, "Economics is beginning to make conservationists of a lot of farmers around here." Arizona placed water meters on their wells and instead of free water the state charges $0.50 to $1.00 for each acre-foot of water drawn by farmers of two acres or larger.

All of the uses of water can not be listed on a per person basis. Religious ceremonies such as baptism are based on water. Political boundaries such as

Table 1. Average U.S. Water Requirements (Home Use)

	Average Amount Used	
Use of Product	Cubic Meters	Gallons
HOME USE		
Direct use per person (per day)	0.23	60
Drinking water (per day)	0.001	0.26
Toilet (per flush)	0.02	6
Bath	0.14	36
Shower (per minute)	0.01	5
Shaving, water running (per minute)	0.008	2
Cooking (per day)	0.03	8
Washing dishes, water running (per meal)	0.04	10
Automatic dishwasher (per load)	0.06	16
Washing machine (per load)	0.23	60
Watering lawn (per minute)	0.04	10
Leaky faucet (per hour)	0.008-0.04	2-10
Leaky toilet (per hour)	0.004-0.02	1-5

Table 2. Average U.S. Water Requirements (Industrial Use)

Use of Product	Average Amount Used: Cubic Meters	Gallons
INDUSTRIAL USE		
Indirect use per person (per day)	2.97	784
Cooling water for electric power plants per person (per day)	2.40	632
Industrial mining and manufacturing per person (per day)	0.70	183
Refine 0.004 cubic meter (1 gallon) of gasoline from crude oil	0.04	10
454 grams (1 pound) of steel	0.13	35
Refine 0.004 cubic meter (1 gallon) of synthetic fuel from coal	1.00	265
Sunday newspaper	1.06	280
454 grams (1 pound) of synthetic rubber	1.14	300
454 grams (1 pound) of aluminum	3.79	1,000
Automobile	379	100,000

Table 3. Average U.S. Water Requirements (Agricultural Use)

Use of Product	Cubic Meters	Average Amount Used Gallons
AGRICULTURAL USE (IRRIGATION)		
Indirect use per person (per day)	2.60	693
One egg	0.15	40
454 grams (1 pound) of flour	0.28	75
Ear of corn	0.30	80
Orange	0.38	100
Glass of milk	0.38	100
454 grams (1 pound) of sugar	0.47	125
Loaf of bread	0.57	150
454 grams (1 pound) of rice	1.89	500
454 grams (1 pound) of beef	9.47	2,500

the Red River between Texas and Oklahoma are formed by water. Just as human life is inseparably dependent on water, so too is wildlife. An Oklahoma pond is home to ducks, water lillies, frogs, blue gill, and algae who all depend on that pond's water quality.

Water issues that are politically hot right now are: acid rain, waste reduction, toxic cleanup, and the Superfund. All of these issues will be discussed separately.

Acid rain is an issue with very interesting political ramifications. Michael K. Deaver, deputy White House Chief of Staff from 1981-1985 is now a lobbyist who commands high fees for his access to President Reagan. Deaver's client is the county of Canada. Deaver as a White House aide in 1985 encouraged President Reagan to appoint a special envoy to Canada on the acid rain issue. After leaving the White House and accepting the job with Canada, Deaver promoted acceptance of the acid rain report. This report was released after a March of 1986 summit meeting between President Reagan and Canadian Prime Minister Brian Mulroney. Scientists agree that oxides of sulfur and nitrogen emitted from coal burning utilities in the Midwest are damaging lakes of the northeastern United States and Canada. Canada is also claiming damages from acid rain to their forests and the National Academy of Sciences has not drawn any conclusions about forest damage. The coal miners say the damage is local and limited and the control legislation would be expensive. The United Mine Workers of America say 38,000 coal miners would lose their jobs if acid rain legislation is enacted. Alliance for Clean Energy (ACE) a western low sulfur coal industry group wants to be sure Congress passes an acid rain bill that permits switching to low sulfur coal. Wisconsin utilities support a moderate acid rain bill. Nonpartisan organizations such as the League of

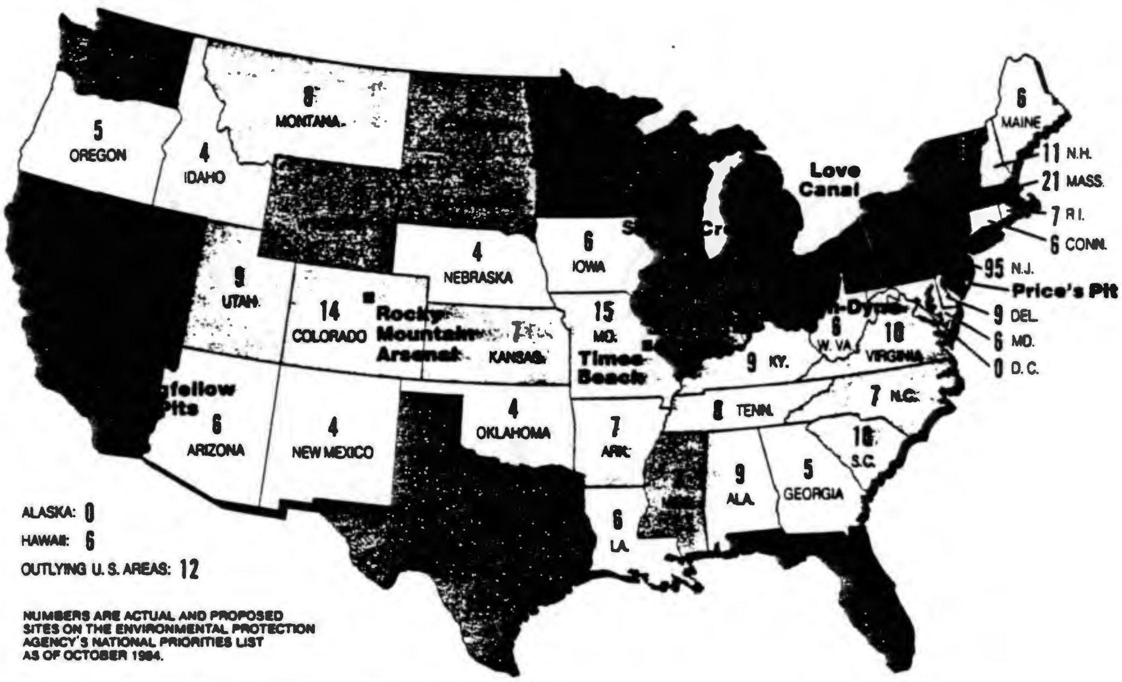
Women Voters are actively in favor of an acid rain bill. Acid rain is still a complex and evolving issue.

Waste reduction is seen as a solution to the problems of too much waste and costly waste disposal. Our throwaway society must learn to prevent waste and pollution, not just to control it. One corporate executive noted, "Waste is just a product no one has found a market for yet." It makes good economic sense to convert the maximum raw materials into useable finished products and find a good use for any by-products along the way. Some ink and paint manufacturers have switched from organic solvents to water-based to eliminate toxic waste. 3M substitutes water-based adhesives for those with organic solvents. DuPont plants have substituted a nonflammable petroleum-based cleaner for halogenated solvents used as degreasers. North Carolina's "Pollution Prevention Pays" slogan works with all sizes of companies making suggestions like "run out a batch in one color for a full week instead of mixing different collors each day" (to save waste water for washing out the equipment). And as a bonus, the firm usually saves money. An Exxon chemical plant in New York was forced by state air pollution regulation to install floating roofs on chemical tanks to reduce evaporation. The value of the chemical not lost was much higher than the cost of the roofs so Exxon installed floating roofs on tanks in several other states as well. Urvan R. Sternfels, President of the National Refiners Association, exhorted the research and development branch of refining to use "everything but the squeal." The most important incentive for waste reduction may be increasing liability costs. EPA collected $32 million in 1986 from companies who contaminated Superfund sites. The main way to attain waste reduction is to develop an attitude within the organization from top to bottom, so every member feels it is important to minimize waste.

Toxic cleanup reaches gigantic proportions as the EPA National Priorities List grew to 786 waste sites shown on this map of the United States (See Figure 1). The agencies estimate that the list may eventually contain a total of 2,500 sites. EPA regulated 264 million metric tons of waste in 1982 mostly from the chemical and petroleum industries. Various treatments such as biological, decomposition and incineration were used in 176.1 million metric tons. Storage in waste piles, impoundments and tanks was used for 135.8 million metric tons. Injection wells and landfills were used to dispose of 54.7 million metric tons of hazardous wastes. The EPA classifies wastes as toxic, ignitable, corrosive, or dangerously radioactive. Such waste is an "environmental tar baby no modern society can shake off" according to Allen Boraiko, National Geographic Society. This 264 million metric tons would fill the Superdome in New Orleans, Louisiana 1,500 times. These chemicals can cause cancer, birth defects, miscarriages, nervous disorders, blood diseases, and genetic mulations.

The private sector has joined the fight againt hazardous wastes. Clean Sites, Inc., was formed by environmental groups and chemical companies to aid in the cleanup of 20 dump sites. DuPont has developed waste-eating bacteria which cleanses water on its way back to the Delaware River. Dow Chemical's Louisiana Division burns toxic waste to generate steam heat and cut fuel bills. At 3M ammonium sulfate, a corrosive by-product of videotape manufacture, is sold to fertilizer companies, who convert it to harmless plant food.

Cities have a real problem with hazardous wastes. In Los Angeles, California where 80% of all toxic waste is improperly disposed City Attorney Barry Graveman leads an environmental SWAT team from state and county health departments, city police, fire and sanitation forces. Offenders risk jail,



Priority hazardous waste sites per state fines and the shame of repenting in full page newspaper ads. Dr. Alan Black, research director of New York's Select Committee on Crime, has found organized crime at every level of the toxic waste disposal industry. "Organized crime is besting disorganized government," he says.

EPA now allows you and me to discard like a banana peel all but the most deadly wastes. Our trash inlcudes an amazing array of toxic stuff: chlorine bleach, antifreeze, insecticides, nail polish, and PCB's in old TV sets. Most of our landfills are not built to capture and drain away these materials before rain flushes them into the soil and the water cycle. Other hazards to the water cycle are highway de-icing salts, seepage from gasoline lines and septic tanks.

Some succesful ways to deal with toxic cleanup do exist. A crater near Emelle, Alabama carved into chalk 700 feet thick promises safe containment of hazardous wastes for the next 10,000 years. Using tunnels created by salt mining near Heringen, West Germany solid wastes are stored in drums 2,300 feet below ground. Two million barrels are now stored there. Chemical Waste Management is the world's largest waste disposal company. Under high pressure treated waste shoots down a pipe clad in concrete past the Gulf of Mexico down through dense clay layers to the sand of an ancient sea nearly one mile down. Waste wells have been drilled in the well mapped geology of Texas and Louisiana petroleum fields. Monitoring wells stand watch that no waste enters drinkable water.

Superfund is a toxic cleanup program of the Environmental Protection Agency (EPA). Use of a 1.6 billion dollar industry financed Superfund for cleaning up hazardous waste dumps lies at the heart of the current EPA political whirlpool. Both sides in Congress seem to want the Superfund to continue and even tentatively agree on 8.5 billion dollars for five years, but they disagree on how to raise the money. Politics, personalities and complex parlimentary procedures have combined to create a lot of bitterness in the Superfund talks. At the center of this turmoil is House Energy and Commerce Committee chairman John D. Dingell. Many Congressman and Senators agree that if Dingell thinks enacting Superfund will suit his purpose it will go forward and if it doesn't he'll block it. Whatever happens will be on his terms. Meanwhile Environmental Protection Agency administrator Lee M. Thomas says he'll have to start terminating contracts and employees if Congress doesn't act.

A national water policy for the United States of America has been a theme running throughout the readings I have done to prepare these lectures. In 1968 Congress created a National Water Commission and after five years of study these themes emerged.

1. Water management planning is imperative.
2. Strategies must be developed to resolve conflicts among uses, particularly noncommercial use and users.
3. Federal water agencies should shift from construction to planning and management.
4. Decisions about water projects should be based on sound economic principles.
5. State water laws need comprehensive modernization particularly ground water laws.
6. Development, management, and protection of water resources should be controlled by that level of government nearest the problem and most capable of effectively representing the vital interest involved.
7. Conservation must become a priority.

The same basic themes dominated the 1975 and 1977 National Water Commission Reports. Our planning must begin to aim at census and cooperation.

Conservation could help solve our water woes by using one of our best assets - ordinary American citizens. Retirees in Florida on fixed funds have flocked to state conservation offices seeking tips to cut their monthly water bills. Northern Californians have had their consciousness raised by severe drought and through conservation alone have cut their water use in half. Conservation saves water, money and energy but it also cultivates an awareness of water. There is a list of new technology to help: lasers to check that fields are level so that irrigation water is evenly spread, computors that calculate when and how much to water crops, electron and neutron sensors measure water and salt in a field and in plant leaves, drip irrigation, new microsprinklers using 20 gallons of water per hour instead of 300 gallons per hour, plant varieties that tolerate waste water. Water conservation equipment for the consumer includes a solar blanket for the swimming pool to prevent evaporation, recycling of water in a home, short showers instead of baths, and watering the lawn and washing the car less often. Treat the water as though it costs as much as gasoline.

Other countries can teach us some things about conserving water. Desalination factories now supply Saudi Arabia and South Africa with fresh water but in limited amounts. Israeli scientists recently developed an experimental method of cloud seeding that uses substances from bacteria instead of silver iodide. This seeding agent promises to be more reliable and less expensive than silver iodide. Israel also has wells to trap fresh water before it drains into the sea, and Israeli people are persuaded by monthly water bills that rise steeply if a household uses more than a certain amount, to conserve household water.

Conservation can be taught and students motivated to learn through a series of environmentally oriented education programs. Project WILD has an overall purpose to motivate youngsters of elementary or secondary school age to take intelligent and constructive action to conserve wildlife and natural resources. The American Forest Foundation sponsors an educational program called Project Learning Tree using trees as a starting point. Teachers and students consider the interrelationships between living (oak tree) and non-living (water) things. In both of these educational programs the outdoor classroom is used and "hands-on" investigations are geared to learning concepts and developing attitudes.

Let us hope we never reach the time in our future when we see,

"Water, water, everywhere
Nor any drop to drink."

S.T. Coleridge
The Rime of the Ancient Mariner

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VITA

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