Curriculum Units by Fellows of the Yale-New Haven Teachers Institute
1997 Volume VI: Global Change, Humans and the Coastal Ocean

The Connecticut Watershed and Its Impact On The Water Quality of Long Island Sound—A Curriculum Adapted for Use with Blind and Visually Impaired Students

Curriculum Unit 97.06.02
by Joanne Pompano

OBJECTIVES OF CURRICULUM

This curriculum has several objectives: l. To help students understand the importance of watersheds 2. To teach about the Long Island Sound watershed and its impact on the water quality of Long Island Sound 3. To help students understand the impact of a local problem on global change 4. To help teachers understand how science lessons can be modified for visually impaired or blind students.

Designed for students in grades 6-10, this curriculum examines the geological formation of Long Island Sound and the watershed system. It also investigates the importance of watershed management for the water quality in the Sound. It traces how pollutants released in neighborhoods throughout Connecticut end up, often untreated, in Long Island Sound. It also helps students understand what they can do to prevent pollutants from entering Long Island Sound. For example, it explores how motor oil flushed down a sewer drain in Hartford or New Haven ends up adding to the pollution and destruction of this precious waterway.

This curriculum is also designed to help students understand the types, causes, and consequences of pollution in Long Island Sound. It inspects the water quality of Long Island Sound and studies the affect pollutants have on the shellfish living in its waters. In addition, it explores how pollutants enter the water and what problems these pollutants cause when they find their way into the Sound.

PART I. LONG ISLAND SOUND

THE FORMATION OF LONG ISLAND SOUND

Long Island Sound was formed through a series of events during the last Ice Age. Geologists estimate that the last Ice Age began 85,000 years ago and lasted for more than 60,000 years. Glaciers which originated in northern Canada moved south to what is now Connecticut and Long Island Sound. The advancing ice radically altered the landscape. The sea levels were approximately 450 feet lower than the are today due to the water frozen in the ice sheet. Dry land extended several hundred miles east of the present shoreline. (1)

Geologists tell us that 21,000 years ago, what is known as the Wisconsin glacier, reached its maximum southern position. At the point of its southern-most advance, Long Island Sound was formed. The glacier then began to slowly retreat. As it did so it paused occasionally and dropped of piles of debris, known as recessional moraines.

As the glacier melted the moraines trapped the melting waters from the glaciers and prevented them from flowing into the Atlantic ocean. Thus a freshwater lake was created where Long Island Sound is located today. This glacial lake existed until 8.000 years ago when the rising sea levels caused water to enter the Sound through a drainage gap in the moraine. This mixing of salt and freshwater is called an estuary.(2)

LONG ISLAND SOUND

Today Long Island Sound is a body of salt water bounded on the north by Connecticut and the south by Long Island, New York. The eastern end of the sound is connected with the Atlantic Ocean by Block Island Sound and Gardiners Bay. On the western end the East River connects the sound with New York Bay. Long Island Sound is 110 miles long, 21 miles wide and covers 1299 square miles. There are many rivers flowing into Long Island Sound including the Connecticut, Thames, and Housatonic.

There is a complex system of bays, estuaries and marshland that contribute to the quality of water in the Sound. This delicate balance is often upset by human activity due to commercial, recreational, and individual usage.

The coastal environments represent a highly productive and unique ecosystem with a diverse array of living creatures. Many types of wildlife live on shores and in watershed. Wetlands are breeding areas for wildlife and help to filter pollutants from land runoff. (3)

WATERSHEDS

A watershed is the land and water area that drains into a stream, river, lake, estuary, or ocean. One watershed is separated from another by a drainage divide that causes runoff water to move in opposite directions towards adjacent watersheds. A watershed is usually named for the dominant water source it drains into such as the the Housatonic that eventually drains into Long Island Sound in New Haven. A watershed can be large or small. The Long Island Sound watershed drains over ten million acres.

Watersheds are enormously important to the environment and quality of life for the citizens. Watersheds are complex and fragile ecosystems and are especially vulnerable to human activities. Conditions within watersheds greatly affect the quality of rivers and streams flowing through them. The EPA estimates that “approximately 180 million gallons” of used motor oil are poured into storm sewers or dumped on the ground by do-it-yourself mechanics every year. A single quart of used motor oil poured down a storm drain can contaminate 250,000 gallons of water. Other things that may affect a watershed ‘s health include erosion from development sites or stream banks, trash, over-fertilized lawns and failed septic systems. (4)

LONG ISLAND WATERSHEDS

The Connecticut landscape is composed of many interconnected watersheds and basins. The water flows to the lowest point and eventually ends up in Long Island Sound. As it flows to the downward it passes through farms, forests, industrial complexes, and city streets. Along the way the water picks up contaminants and carries them along to the Sound. Thus human activities far inland contribute to marine pollution.

Along the way it carries debris and pollutants that are in its path. This complex system of rivers, streams, bays, estuaries and marshland directly contributes to the water quality in Long Island Sound. Pollution enters watersheds from landfill , sewer systems, urban and agricultural activities and depositions of heavy metals from current and past manufacturing.

THE CONNECTICUT RIVER WATERSHED

The Connecticut River is 410 miles long and originates in Canada. The river travels through the states of Vermont , New Hampshire, Massachusetts and then Connecticut to the the Sound. It is the source of 70% of Long Island Sound's fresh water. (5)

The Connecticut River watershed ecosystem includes 11,260 square miles and 148 tributaries. In addition, the basins of the Housatonic and Thames Rivers basins add 3,500 more square miles of area. There are also many small creeks and streams from the North Shore of Long Island that empty into the Sound. The lands of the Connecticut River watershed include sparsely populated wilderness as well as urban areas. The rivershed supports wildlife including black bears, coyotes, moose, beavers, osprey and lynx. Two million residents live in this area. (6)

Before the 1972 Clean Water Act, the Connecticut River was heavily polluted by farm waste, and contaminants and,at one time, was known as "the nation's most beautifully landscaped sewer." The cleanup of this river resulted in less pollution being carried to The Sound and has allowed the river to again be used for recreational use. (7)

QUINNIPIAC WATERSHED

The Quinnipiac flows through the southern portion of the Central Lowland in Connecticut and through three medium sized industrial towns. The Quinnipiac empties into Long Island Sound at the City of New Haven. The Quinnipiac watershed includes a wide variety of biogeochemical environments ranging from pristine headwaters to heavily industrialized and populated stretches. The Quinnipiac is a typical ecosystem subjected to multiple stresses from point and non-point sources including discharges from steel manufacturing, electronics production and chemical firms that are permitted to be released into the river. There are five sewage treatment plants on the watershed of the Quinnipiac and two municipal landfills directionally on the main channel of the river. (8)

TYPES OF POLLUTANTS

It is important for students to understand the types of pollutants that are found in Long Island Sound.

HYPOXIA

This condition results from too much nitrogen entering the Sound. The ability to sustain animal life is determined by the level of dissolved oxygen of the water. It is also an excellent indicator of the estuary's health.

When there is a lack of oxygen in the water fish and other marine organisms die or become impaired. A condition called hypoxia occurs when the dissolved oxygen level falls below 3mg/L. Water temperature, geographical size and duration of hypoxia determine how low the level of dissolved oxygen fall. Also on a yearly basis the air temperature, precipitation and other weather variables influence the extent and duration of the hypoxia. (11)

When the hypoxic condition is severe animals and plants die or leave. There is a condition known as anoxia which results from the total depletion of dissolved oxygen. The result is that organisms are killed because of the lack of oxygen.

TOXIC SUBSTANCES

Manufacturing has been an important part of Connecticut history. For many years industries dumped chemicals and toxic substances into the rivers and The Sound. These chemicals continue to be found in the sediments of many harbors of the Sound.

Toxic substances have negative effects on the ecosystem and the health of humans, plants and marine life. Heavy metals, PCBs and other organic compounds are examples of toxic substances. Input include the following point sources: l. sewage treatment plants (STPs) and industrial discharges 2. non-point sources such as urban runoff, sediments and bank erosion. (12)

The major rivers that flow into the Sound are the largest source of toxins. The second largest source of toxins are the sewage treatment plants in both Connecticut and New York. Urban runoff and atmospheric deposition also add to toxic substances in the Sound.

FLOATABLE DEBRIS

Trash that floats in coastal waters and eventually washes up on beaches is called floatable debris. This debris harms wildlife and has other adverse effects on the environment. The majority of this garbage come from storm drains. Rain washes the litter from neighborhoods into the storm drains and it end up in the Sound. A major source of marine pollution is the non-biodegradable plastic such as soda can packs.

PATHOGENS

Pathogens are microorganisms that cause disease such as gastroenteritis, salmonellosis, and hepatitis A. Bacteria, viruses and protozoans enter the Sound through improperly treated sewage and the dumping sewage from boats.

There are several ways for pathogens to enter the body including swimming in polluted waters and eating raw or partially cooked shellfish harvested from contaminated waters.

Beaches and shellfish beds have often been closed due to sewer overflows, treatment plant malfunctions, as well as, other sources of runoff that are difficult to trace.

NON-POINT SOURCE POLLUTION

The source of pollution is not always clear. Long Island Sound is polluted by many sources that originate over a large area. Rain mixes with fertilizer from our lawns, farms, golf courses. Grease from roadways and airborne pollutants combine with rainwater and enter the Sound through storm sewers.

SEWAGE MANAGEMENT PLANTS

Most pollution comes from sewage treatment plants that are on the coast. The shellfish beds located in the area where streams and river flow into the Sound often have pollution problems that result in closures of beaches and shell fishing beds. These result from septic systems failures and upstream discharges, and the natural flow of the water to the lowest lever.

POLLUTANTS AND SHELLFISH

The shell fish harvested from Long Island Sound provide an important commercial benefit to Connecticut. This $50 million a year industry has suffered in recent years as many of the shellfish beds in Connecticut have been closed due to the pollution in Long Island Sound and to over-harvesting.

Water quality is an essential factor in the healthy development of shellfish. Long Island Sound is the unwilling recipient of the many pollutants caused on shore including: ground water runoff from cities, oil spills, sewage, litter, industrial wastes, sedimentation from erosion, and pesticides, fertilizer or chemical contamination. These pollutants, for the most part, remain near coastal areas changing the habitats of marine plants and animals including shellfish.

Each of these problems pollute our waters and degrade the shellfish habitat resulting in the loss of recreational and commercial harvesting of shellfish. In addition. these problems increase the risk to human health because diseases such as hepatitis and cholera are spread by eating contaminated shellfish. Despite the pollution problems affecting Long Island Sound, the commercial oyster industry is an important industry.(13)

PART III: ADAPTATIONS FOR BLIND AND VISUALLY IMPAIRED STUDENTS

SCIENCE

Science is an important but often difficult and challenging subject for blind and visually impaired students to master. Ideally the best situation is one in which all students have access to the the same materials and participate in the same activities as their sighted peers. However, often visually handicapped students will need and benefit from adaptations in equipment, teaching procedures, lessons and activities. Such adaptations will ensure that visually impaired students will acquire the skills necessary to complete assignments and gain scientific knowledge. Often specialized tools and materials are needed to provide access such as talking scales, compass, and voltmeters.

VISUALLY IMPAIRED STUDENTS

Visually impaired and blind students have individual needs. They may be print, braille, or audio users. Their vision may fluctuate due to many factors or may be influenced by factors such as lighting, glare, fatigue, or health issues.

Teaching this population requires unique and individual strategies based on the students’ needs, the project at hand, and the skills they possess (such as computer or braille skills and speed listening) that will allow them to participant and gain understanding of the material.

There is an overwhelming amount of visual material in an educational environment. To complicate matters science courses often require the reading of charts, measurements, observations, and other tasks that are made more difficult without the benefit of sight. Also, blind and visually impaired students often have have limited access to materials. Translations of books and other materials into braille, large print, or audio tapes are often difficult or impossible to obtain. The materials that are of concern include: textbooks, class notes, chalkboard lectures, videotapes, computers, journal articles, supplementary reading materials, and handouts.

CONCEPT DEVELOPMENT

Understanding science concepts depends on: observation, data collection, recording, and analysis. The challenge of science is not just learning the facts or content but it is the process. For the visually impaired to understand science the process must utilize direct sensory experience with a variety of hands-on activities. Students need to touch objects, materials, and organisms in order to observe size, shape, texture, patterns and change. They should not limit their experiences to reading from texts or lectures on science facts but instead must be encouraged to find things out for themselves by exploring, manipulating, investigating , and experiment.

The most effective science activities are those that include numerous tactile and auditory interactions, and extensive manipulation of equipment, materials, and organisms. Students need to explore concepts via tactile methods whenever possible and encouraged to relate to acquired skills and knowledge to her own sensory environment

MULTI-SENSORY APPROACH

Students with normal vision learn a great deal through incidental and planned observation of activities. For the visually handicapped, instruction in science should be based on a multisensory approach directed toward the acquisition of information from other sources of sensory input. This multisensory approach will help to compensate for the reduced visual functioning.

Understanding science depends on the ability of the students to make observations and to quantify those observations. Visually handicapped do not learn effectively from distance visual observations. Instead they must have direct access to objects, materials, organism, procedures, and operations. This multi-sensory approach which integrates input from auditory, tactile, and olfactory, as well as, visual sources allows students to gain knowledge and integrate information into concepts.

To derive maximum benefit from the science visually impaired students must be presented with a multisensory approach that is diverse and active to compensate for reduced vision. This approach can help to open new avenues for expression and creativity and serve to motive students by helping to stimulate interest and realize potential.

STRUCTURED ENVIRONMENTS

It is imperative to have a very structured and controlled work space. It is essential to label all materials, supplies, and equipment in regular or large print or Braille. Labels need to be prepared a print size that is appropriate for the visual acuity and perception of the individual. Some use standard size print while others benefit from enlarged print. Blind students may be braille or audio users or use a computer with adaptations to translate the written text to speech and produce a braille translator with a braille embosser.

Familiarize the student with the classroom, laboratory, equipment supplies, materials, field sites by allowing the student to explore these areas factually. A verbal description is also helpful.

Science lessons should be taught under uniform, diffuse lighting, with no glare, no shadows, and no strong back lighting. Contrast between objects and backgrounds should be bright rather than being pastel shades.

Each student should be encouraged to be involved in every step of lesson. It is important to that the visually impaired student to play an active not passive role in the team. For instance, they should not merely act as the recorder in experiments with sighted partners but should be encouraged to take part in each part of the activity.

TEACHER OF THE VISUALLY IMPAIRED / BLIND

The teacher of visually impaired serves as consultant to the science teacher and helps to select appropriate methods and materials and deal with instructional problems related to the teaching of specific lessons and concepts.

The teacher of the visually impaired should assist the science teacher by explaining the types of objects and actions students are able to see and under what conditions. This vision specialist should provide specific examples relative to the individual, rather than merely interpret the clinical information about the degree of vision. In addition, other sensory losses should be noted such as reduced tactile sense in diabetic children. Teachers should be sensitive to each student's cognitive learning style and provide science experiences that match that style.

MATERIALS

Real objects, organisms, and materials for classroom and experiments need to be provided and should include sturdy objects and organisms of appropriate size for tactile examination.

Descriptions of visual activities and an alternative to chalkboard work, printed diagrams, photographs will allow the visually impaired to have the information they need to be a part of the class. For the low vision student clear, high contrast printed materials are necessary.

It may be necessary to acquire specialized tools, data recording materials and other materials such as braille rulers, thermometers, and talking calculators, and scales. In addition, teacher-made materials such as organizational containers include common objects such as muffin tins or egg cartons to help structure the activity for the student. Often equipment and materials can be easily modified to assist the student in their work. For example, a physical stop fixed to a syringe so the plunger can be pulled out at preset measurements or tactile notches cut in the edges of the plunger of a syringe to determine a variety of volumes.

ADAPTATIONS

Some of the strategies suggested will assist some but not all visually impaired students.The student's background and training and the degree of the visual impairment are all factors in whether these strategies and suggestions will be helpful to any one individual with a visual impairment.

Students with vision impairments will need assistance in areas such as accessing instructional materials, taking notes, and tests. A means for the acquisition and recording of data must be provided in the mode most familiar and appropriate to the student. It is necessary to provide accessible description for pictures, graphics, or displays. Verbal descriptions of diagrams and photographs,demonstrations and visual observations of experimental outcomes are also required. Low vision students should be encouraged to incorporate the use of their vision whenever possible.

There is a wide selection of magnifying devices available including stand mounted and hand held models. These may be helpful of some students to assist them in reading or working with items or equipment that need to be observed

GUIDELINES FOR MODIFICATIONS

There are many adaptations in equipment and teaching procedures that are helpful in teaching science to blind and visually impaired. In addition, computers are playing an important role in enabling visually handicapped to study and work in science. The following guide may be helpful.

1. Spell new or technical words
2. Use enlarged directions or a 3D models
3. An overhead projector or closed circuit television can be used to show step-by-step instructions or to enlarge a text or manual. It is helpful to mask tall the items except the one you are stressing at the moment
4. Provide braille labels for colored objects used for identification in a lesson or experiment
5. Describe visual occurrences, visual media and directions of pertinent aspects that involve sight in detail
6. Use a sighted narrator or descriptive video to describe aspects of videos or laser disks
7. All pertinent visual occurrences or chalkboard writing should be described in detail even when a note taker is available
8. Lessons, class handouts or directions should be provided in Braille, enlarged print, or on tape
9. Tactile 3D models, raised line drawings or thermoforms should be made available to supplement drawings or graphic
10. Use actual objects for three dimensional representations whenever possible
11. Raised line drawings can be used for temporary tactile presentations
12. Overhead projects, chalkboard talks, graphs or slides should not be avoided but must include more detailed in the oral descriptions, supplemented with themoforms where appropriate
13. The student should be allowed to use a tape recorder to record lectures and class presentations
14. Handouts and assignments must be available in appropriate form: regular print, large print, Braille, cassette this will depend on students optimal mode of communication and training
15. A monocular may be useful for long range observations of chalkboard or demonstrations
16. Call student by name to gain attention
17. Use descriptive words. Provide specific directions. Avoid vague terms and unusable information.
18. Describe pertinent visual occurrences of the the learning activities in detail
19. Changes in assignments and meeting sites should be given verbally.
20.It is helpful to offer to read information in some situations
21. At times an auditory signal may be helpful where a visual signal normally is used
22. Use stable and non breakable materials
23.Containers and materials should be labeled in braille and large print.

24.Use high contrast between material and work surfaces whenever possible
25. Be certain written materials are accessible to student including textbooks, journal articles, teacher handouts
26. Make use of braille, audio tapes, large print and sighted readers

LABORATORY MODIFICATIONS

Laboratory exercises can be accessible to students if equipment is available that allows them to access, interpret and understand the results of laboratory exercise. Such devices include audible readout voltmeters, calculators, talking thermometers, talking compass and scales, and magnifiers.

Additions suggestions for laboratory exercises include:

1. Team the student with a sighted student or provide a tutor to describe the activities and outcomes as they are observed.
2. A hot plate can be used instead of a Bunsen burner

3. A micro projector can be used to help a visually impaired student examine images from a microscope
4. Allow more time for laboratory activities
5. Describe and factually and spatially familiarize student with lab and equipment
6. Location of materials, supplies, equipment and how it is used

They should be kept in the places and a braille or large print label should be used. Braille or large print tags can be used on containers

7. Overhead projector or opaque projector is helpful for some to show step-by-step instructions. A low vision closed circuit television can be use to magnify images up to 720 times.
8. Taking a trial run on the equipment will help the student to become familiar
9. Use tag shapes for showing relationships (such as distance comparison) buttons, or other markers on a “layout” board
10. Portable communication board can be used to provide auditory scanning of laboratory materials such as : pictographic symbols, letters or words

Obtain laboratory equipment that have adaptive outputs such as : a large screen, print materials, various audio output devices, Braille and large print translations of books prior to enrollment

11. Allow more time for laboratory activities

FIELD EXPERIENCE MODIFICATIONS

1. Provide handouts, safety information and assignments available in appropriate e form including regular or large print, Braille, audio cassette.
2. Provide a detailed description and narration of objects seen in science centers, museums and field activities
3. Ask a classmate to act as a sighted guide
4. A laser cane or Mowatt sensor are electronic travel aid that can be helpful in assisting the student in unfamiliar surroundings
5. Provide a tape recorder for use by the student.

RESEARCH MODIFICATIONS

1. Tape record, computer, various braille devices to assist in reading and note taking
2. Use of appropriate lab and field strategies according to the nature of the research
3. Make arrangements for tactile examination if allowed by the museum or research center

TESTING ADAPTATIONS

1. Allow addition time for testing.
2. Testing should be present in a form that will be unbiased for visually impaired
3. The student may be able to help you understand which method is most accessible
4. Talking and large print display calculators should be available.
5. Record test questions on tape and allow students to record their answers on tape
6. The activity script, directions or readings can be taped
7. 3D tactile models can be used
8. Modifications may be made or specialized equipment such as talking thermometers, talking scales, etc.

READING

There are a number of devices that can be used to assist vision impaired students when reading including closed circuit televisions which enlarge pages of written material. They can be very portable and provide the student with instant enlargement of pages.

Tutors or volunteer readers or writers can assist student with tests,materials, research by reading materials for students.

The teacher of the visually impaired should arrange with Talking Book Service or Recording for the Blind for audio books to be produced of textbooks or other reading materials.

THE SCIENCE ACCESS PROJECT

The Science Access Project at the University of Oregon was developed to ensure full accessibility of electronic information by individuals with visual difficulties. This project promotes the development of technologies that will allow full access of electronic information to individuals with print disabilities. Their philosophy is that information should be created and transmitted in a form that is display-independent as possible with the user having maximum freedom over how information is displayed. This, it is believed, will lead to maximum usability by everybody and will assure equal access. Ideally information should be made accessible by controlling the display, not the information itself.

Science Access Project concentrates on accessibility of non-textual information including:

1. new and improved paradigms for tactile and audio-/visual information display
2. hardware for tactile information display
3. software that utilizes display-independent information and multi-modal access (14)

TACTILE INFORMATION DISPLAY

Science Access Project (SAP) actively promotes reforms in Braille and development of DotsPlus paradigm used to represent more general text and graphics. Braille is a tactile method of representing words by dot patterns. Fewer than 15% of American who are legally blind and read braille. Even few er of those readers can read the special braille codes needed to represent math, science, and computer programs. Therefore there is a movement to develop a more useful method of braille. This new unified braille code would allow readers to represent math and science in a more simple fashion. (15)

DOTSPLUS

Dotsplus is a tactile font set developed by SAP. Dotsplus permits straightforward tactile hard-copy representation with the same format used in print. Signs such as plus, equals, times, parentheses, fraction bar, etc. are represented by tactile images with the same shape as the print symbol. Although it is not easy to distinguish the shapes of letters and numbers factually. SAP developed the TIGER (Tactile Graphics EmbosseR) which is a high-resolution embosser that can print DotsPlus. In addition, to is a major improvement in making graphics accessible. (16)

AUDIO/VISUAL DISPLAYS

A wide range of software applications that utile audio display is being developed by SAP:

1. The TRIANGLE program is able to display x-y graphics and bar-charts through tone displays. To display formatted text, tables and math equations a variety of speech enhancements and non-speech audio are used in TRIANGLE.
2. The Audio System for Technical Reading (AsTeR) is a reader program that presents scientific expressions compactly in speech and other audio. Audio formatting use a higher pitch for superscripts and lower pitch for subscripts. They also group symbols by changing tone or rate and by using strategic pauses. Different words may also be used depending on context

3. EmacSpeak is a self-voicing system that has expanded the accessibility of blind users to the UNIX operating systems

TACTILE HARDWARE

Methods and hardware for making tactile graphics materials for blind users including:

1. Swell paper is the only practical methods for making tactile graphic materials from computer applications. To do this a black image is transferred to this special paper. It is then passed through an infrared heater that makes the black areas swell. The images however are soft and not very pleasant to read. The process is also expensive at a cost of dollar plus per sheet to produce. Also the process is cumbersome.
2. A new embossing technology has been developed and patented by Oregon State University that produces a high-resolution tactile graphics (20 dots per inch) to be embossed on standard braille paper and plastic media. It is able to produce smooth lines in vertical and horizontal directions. The company that purchased the license for this technique is working on a commercial embosser.
3. In 1997 a prototype personal embosser called TIGER was exhibited at the March of 1997 at the International Conference on Technology and Persons with Disabilities, in Los Angeles. TIGER automatically converts fonts to a user-selectable computer braille representation using Windows 95 and a printer driver. (17)

TRIANGLE

The Science Access Project wrote a computer program that permits blind people to read, write, and calculate math and science problems. Written in DOS it requires a DOS screen reader and includes a math/science word processor, graphing calculator, a viewer for y versus x plots, a table viewer. It also Touch-and-Tell, a computer-assisted reading program of tactile figures that uses an external digitizing pad.

Triangle allows a keyboard or any specialized device that emulate a keyboard to be used to provide input. The output is transmitted in several ways:

1. Visually—with text on the DOS screen
2. Audibly—with the assistance of a screen-reading program, external voice synthesizer and PC speaker
3. Factually—with use of a braille screen access program and external refreshable braille display

Triangle also can provide the user with visual, audible, and tactile output simultaneously. (18)

GRAPHIC ACCESS

Often graphical information is available only in printed hard copy or as electronic bit-mapped images and must be make accessible to blind or visually impaired individual.

Several programs including the Objectif and Boxer programs support access to graphical information.

They are designed to simplify the process for the sighted transcribed making tactile copes and the electronic label maps necessary for blind users to read complex figures.

These programs are available free of charge through SAP. They require use of the Nomad tablet (American Printing House for Blind), the TRIANGLE Touch and Tell view, and audio/tactile viewing programs. They are designed to assist sighted people in making tactile graphic materials for blind users. (19)

OBJECTIF

This is a programs that implies editing bit-mapping graphics. It prints using a braille graphics printer. Users are able to make an electronic label file for viewing with the Triangle. Objectif is a Windows program that intrinsically requires some sight for its use.

Boxer was designed to make trees and flow charts that can be printed on a standard braille text printer. Boxer can be used by a blind person. (20)

VRML VIEWER

It is important to assure that all electronic informational graphic is accessible. The VRML viewer is used in many world wide web applications and has been demonstrated to be fully accessible to graphics. For instance, the periodic table of chemical elements can be made accessible using a standard VRML browser that speaks object labels when you click either on-screen or on a tactile copy sitting on the external touch pad.

SCREEN

UNIX is an operating system originally used on mainframe computers. It now is also used on many stand-alone work stations. in companies and universities. UNIX was accessible only through DOS machines used as terminals. This lack of direct access prevented blind and visually impaired users from working with this system. Now, however, SAP has developed a direct braille access to UNIX text applications.

Screen is a full-screen window manager. It multiplexes a physical terminal between several processes such as interactive shells. Braille additions have been added to Screen to allow the user to view these directly with the display without having to log in through a DOS machine. (21)

TUTORS

Assistance from a paid tutor or volunteer can provide the following services:

l. Reading texts, lecture notes and other documents

2. Production of braille and tactile educational materials

3. Typing and proofreading of term papers and assignments

4. Assisting with laboratory work

PART II: GLOBAL CHANGES

Global changes in the environment can best be understood by exploring a local environmental problem. The knowledge and understanding gained from such a project will assist students as they attempt to comprehend problems on a wider or global scale.

The lessons learned about Long Island Sound's pollution problems will give the students the basis for understanding such problems on a larger scale. They will be provided with information that will help them understand the global implications of the changes they see on a local level.

CONCLUSION

Understanding the Connecticut watershed will assist students in understanding how their actions affect the environment By understanding the ecology, history, and geography of Connecticut and by interacting with the environment, students will gain an understanding and appreciation of Long Island Sound and take steps to protect this precious resource.

Modifications and hands-on projects can open new avenues for expression and creativity and serve to motivate students by helping to stimulate interest and realize potential. This curriculum will help students to participate in learning activities that develop scientific knowledge and skill. Such experiences will enable students to prepare for further study in science and be informed participants in modern society. It may also prepare students for further study in science-related areas.

This curriculum will allow visually impaired and blind students:

GOALS

1. To appreciation science
2. To understand the importance and beauty of our oceans
3. To create an awareness s of ecology and the environment
4. To understand the threats posed by human activities
5. To increase awareness of marine life
6. To provide a means for students to be active participants in conservation of the oceans such as beach clean-up activities

7. To acquire skills necessary for scientific and technological literacy
8. To increase the use of computers in the study science

LESSON PLANS:

LESSON 1: OIL SPILLS

OBJECTIVES:

1. To make a model of an oil spill

2. To evaluate the efficiency of oil spill cleanup methods.

MATERIALS:

For each group of students the following materials will be needed

l. A shallow pan or container (oblong)

2. Vegetable oil

3. Water

4. Cotton balls

5. Medicine dropper

6. Teaspoon

7. Timer

8. Plastic bucket

9. Wastepaper basket with plastic bag (to discard cotton balls)

10. Liquid detergent, brush, bird feather, wire whisk, pebbles

11. Paper towels

12. Wide-mouthed plastic containers (quart sized)—-two for each group

13. Toothbrush

14. Pebbles, small rocks

MODIFICATIONS FOR BLIND AND VISUALLY IMPAIRED STUDENTS

l. Magnifiers (stand and hand-held)
2. Small groups or teams (1 or 2 students)
3. Readings and handouts provided in braille or large print
4. A description of the visual parts of this lesson must be provided by the teacher, vision tutor, or class member

PROCEDURE

Materials provided at each workstation:

l. Divide the students into teams of 1-4 students. Each team will create a simulated oil spill and then work cooperatively in cleanup efforts.
2. Provide directions on how to make an oil spill and then clean it up. Encourage them to use their resources wisely, as they will be "charged" for each piece of equipment used and the disposal of the oil.
3. Instruct the students to collect the oil-soaked cotton balls and can count them when the oil spill is cleaned up. Remind them that they will be charged for each cotton ball used.

NOTE: A student , vision tutor, or the classroom teacher should be assigned to verbally describe the actions or visual parts of this lesson.

1. Demonstrate that "oil and water don't mix" by pouring some oil into a clear container of water. Have students observe how the oil forms a layer on top of the water.
2. Use a wire whisk to stir up the oil and water. Students should note that oil can be made into smaller and smaller droplets. Explain that these droplets will disperse in the open ocean where there is room to spread out. (This is similar to one of the techniques used in cleanup operations.)
3. Suggest that students use the whisk in their pans and discuss the fact that this will make skimming the oil much more difficult.
4. Dip a bird feather in oily water and have students try to clean the feather using liquid

detergent and a brush.
5. Suggest that one group to simulate an oil spill that hits a rocky coast by using pebbles at one end of the pan. Students should compare the amount of surface area for that cleanup with an oil spill on the ocean sea or in a body of water such as Long Island Sound.

Have the groups work on their oil spills for twenty minutes and then have them tally the cost of their efforts for cleaning up their spill sites. Students can then answer the discussion questions and compare their results.

LESSON 2: "FOLLOW A RIVER"

OBJECTIVE:

To illustrate the fact that human activities far inland can cause marine pollution. Students, either individually or in small groups, should trace the path of a local river to Long Island Sound—-for example the Qunninipiac Rivers route to New Haven harbor.

MATERIALS NEEDED:

1. Maps of Connecticut and Long Island Sound

2. Closed circuit television for enlargements

MODIFICATIONS FOR VISUALLY IMPAIRED / BLIND STUDENTS

1. Magnifiers (hand-held and stand)
2. Large print maps
3. Tactical map of Connecticut and Long Island Sound
4. Allow students to move their seat to gain the best possible view of lessons
5. Conduct lectures using a portable whiteboard (erasable blackboard) for writing
   This will allow you to present lecture closer to students
6. Use wide tipped magic marker
7. Use black and white print for better contrast
8. Provide student with individual copy of materials written on blackboard or have tutor print materials in large print

LESSON:

Find the local watershed and streams that are closest to your school. Show major point and non-point sources of water pollution on the map. Locate additional watersheds and show major pollution sources such as factories, sewage plants, etc. Indicate the flow of the pollutants as they move toward The Sound.

Discuss the land uses, such industrial, urban agricultural, forest lands, around the river. What pollutants will likely be picked up on its way to The Sound?

Prepare a poster with a large map and explanatory notes to show the path and final destination of the pollutants that enter the storm drains in a cities and towns throughout Connecticut.

DISCUSSION QUESTIONS / EXERCISES:

1. Trace the path of pollutants that enter the water in your community and discuss where they are likely to end up.
2. Where are the reservoirs that provide drinking water for your community?
3. Are the watersheds protected?
4. If your water is drawn from a river, how many other communities upstream and downstream draw their drinking water from this river?
5. What changes are planned to meet future demands, such as building dams, reservoirs, aqueducts?

Present answers to these questions on a regional map.

If possible, go on a field trip to visit a water or sewage treatment plant.

LESSON 3: Analyze The Chemicals That Go Down The Drain At Home and In School

Students should determine what substances they add to the water.

1. Give the students a block of time to list everything they can think of that is poured down the drain in their household or at school.
2. Have them list all the products at school (and later for homework) that are flushed down the drain. Include items found in the kitchen, bathroom cabinets, workshop, or garbage, art room, janitorial room, science labs, etc. Types of products include: hair products, soaps, detergents, bleach, specialized cleaners (glass, toilet bowl, drain cleaners), ammonia, paint products, etc.
3. Read the labels to determine what types of chemicals these products. Compare the lists between groups.

Discuss the variety of substances found? What are the potential health and ecological effects of improper disposal of these substances. Discuss safe disposal methods for household products such as motor oil, pesticides, paint, and turpentine. Which of these substances not be dispose in the sewage system? Have students suggest alternatives to common household chemicals.

LESSON 4: ALTERNATIVE CLEANING PRODUCTS

Common cleaning products can be harmful to the environment and so many people are turning to alternatives cleaning products. Natural products such as vinegar, baking soda, table salt, lemon juice, and borax can be used to clean many items in the home. Students should research and try out these alternative cleaners.

Try using these home-made products to clean common items and areas. Discuss how effective the alternative cleaning products are compared to store-bought cleaners.

Compare the costs.

An example of an all-purpose cleaner:

1. Add 1/4 cup ammonia, 1/4 cup vinegar, and 1 tablespoon baking soda to 1 gallon of hot water.

MATERIALS:

1. Measuring cup

2. Cleaning rags and pail

3. Ammonia

4. Vinegar

5. Baking soda

6. Water

7. Several commercial cleaners

LESSON 5: WATERSHED SURFACES

OBJECTIVE:

To determine if different types of Earth surfaces absorb water at different rates?

MATERIALS NEEDED:

1. Metal can —16 oz. (both ends removed)

2. Liter bottles (cut flat on each end)

3. Watches with second hand or stopwatch or talking watch

4. Water

5. Centimeter ruler (large print or braille)

6. Masking tape

7. Black magic marker (thick tip)

PROCEDURE

l. Select several areas to study. They should have different surfaces such as a garden, a gravel area, a sandbox, a grassy area or a compact surface area
2. Mark the can about 5 cm from one end (use magic marker or masking tape).
3. Write or record a brief description of each surface. Note types of plants present, soil conditions and location and how long it's been since the last rainfall.
4. Put the marked end of the can on the ground. Twist can firmly in place, trying to push it down into the ground to the 5 cm line you drew and taped.
5. A. Pour l liter of water into the can. Mark the level of the water inside the can. Immediately record the time you poured the water into the can.
B. Measure the height of the column inside the can with a centimeter ruler
C. Record your ESTIMATE of the time you think it will take for all the water to soak into that surface area
D. Record the ACTUAL TIME by measuring the height of the water column after 5, 10, 30, 60 minutes. Calculate the distance between the starting height and surface of the water for each time interval. This will tell you how many centimeters of water are absorbed by the soil in that time period. Note: Some areas may not absorb the water.
6. Repeat steps 4 and 5 in your other study areas

BIBLIOGRAPHY

1. Sterling, Dorothy, "The Outer Lands: A Natural History Guide To Cape Cod, Martha's Vineyard, Nantucket, Block Island and Long Island," W.W. Norton & Company, Inc., New York, 1978, p. 10-15)

(Provides a comprehensive description of the shoreline from Cape Cod to Long Island.)

2. “Watershed Worlds,” Thames Science Center, New London, CT, 1997.

(This article helps students to understand watersheds and their affect on local environments.)

3. Feldman, Gene C. “Environmental Awareness”, Ocean Planet Environmental Awareness Program, Smithsonian Institution, Washington, D.C. (gene seawifs:gsfc.nasa.gov)

(A website that provides information on environmental issues concerning oceans and waterways)

4. “Connecticut Project WET”—(Water Education for Teachers), State of Connecticut Department of Environment Protection,79 Elm Street, Hartford, CT 06106

(Lessons and information for teachers on the environment and environmental issues)

5. “Environment 2000-Connecticut ‘s Environmental Plan 1992-97, Connecticut Department of Protection, Hartford, Connecticut

(A report on the Connecticut environment now and in the future)

6. “About Environmental Education,” World Resources Institutes Environmental Education Program, 1709 New York Ave, Washington, D.C., 1992

(A program that deals with environmental education and issues on the environment)

7. “Pollution Prevention Through Innovative Technologies,” Dec. 1995, Center for Environmental Risk Reduction and Pollution Prevention, UCLA, www.ccteseas.ucla.edu

(This website deals with issues of pollution and prevention)

8. “Global Rivers Environmental Education Network-GREEN,” 721 East Huron Street, Ann Arbor MI

(GREEN provides information on environmental education for students and teachers)

9. Sterling, Dorothy, “The Outer Lands,” p.16

10. Sterling, Dorothy, “The Outer Lands,” p.22

11. Feldman, Gene, “Environmental Awareness”

12. Connecticut Project Wet, p. 2

13. Dadd, Debra Lynn, “Non-toxic, Natural, Earthwise,” Jersey Tarcher, Inc., Los Angles, CA, 1990.

14. “Science Access Project” John Gardner, director, Oregon State University

(Oregon State University program for improving the availability of science literature for the blind)

15.. Barry, William and Gardner, John, “Accessibility to Scientific Information for Blind: Dotsplus and ASTER Could Make It Easy,” Oregon State University

(This book discusses two programs used to help blind and visually impaired individuals deal with science text and graphics)

16. Gardner, John, “Dotsplus,” http:/dots.physics. crst.edu/dotsplus.html

(Dotsplus is a method of producing hard copy of scientific literature for the blind)

17. Visions Lab at Purdue University (Visually Impaired Students’ Initiative ON Science) www.engagePurdue.edu, West Lafayette, IN 47906, Kevin Loeffler, Dept. of Computer Science

(Dedicated to the improvement of science education for visually impaired)

18. Barry, William and Gardner, John “Books for Blind Scientists,” Department of Physics, Oregon State University, Corvallis, Oregon, 1994. p.3

(Describes developments improving accessibility of science literature for visually impaired individuals)

19. Foundations of Education for Blind and Visually Handicapped Children and Youth. Geraldine T. Scholl, Editor, American Printing House for the Blind,15 West 16th Street, New York, NY 10011, 1986 p.375-381

(Dedicated to the improvement of science education for visually impaired)

20. “Science and Environment, Voyage Publishing,” www.voyagepub.com/publish

(A website dealing with science and the environment)

21. Ramon, T.V., “Demonstration of the ASTER computer program.” www.cs.cornell.edu/Info/People/raman/aster/demo.html

(The Audio System for Technical Reading-ASTER, is a software application that controls a voice synthesizer and audio soundboard)

22. “Screen” ftp://ftp.uni-erlangen.de/pub/utilities/scree/braille/screen-38.3.tar.gz

(A full screen window manager that multiplexes a physical terminal between several processes)

23. Cronon William, *Changes In the Land, Indians, Colonists, and the Ecology of New England,* l996, Hill and Wang, New York

(Describes the changes in the New England landscape since the colonists settled on these lands.)

24. Turekian Karl K., *Global Environmental Change Past, Present, and Future* , l996., Prentice Hall, New Jersey

(A study of the global changes in our environment. It deals with issues of natural and human induced environmental change)

25. “Household Hazardous Waste: What You Should and Shouldn’t Do”. Water Pollution Control Federation, 601 Wythe Street Alexandria, VA 22314

(A pamphlet that provides information on hazardous wastes found in the household)

26. “Household Hazardous Waste: What You Should and Shouldn’t Do,” Water Pollution Central Federation, 601 Wythe Street, Alexandria, VA 22314

(A pamphlet describing hazardous waste and what individuals should and shouldn’t do when dealing with them.)