Curriculum Units by Fellows of the Yale-New Haven Teachers Institute
1999 Volume VI: Human-Environment Relations: International Perspectives from History, Science, Politics, and Ethics

Problem Solving Using Mathematics Spatially to Interpret Environmental Issues

Curriculum Unit 99.06.04
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Teaching must be creative, flexible and objective in the area of subject content. Creativity must be utilized as a tool to get the student's attention. Once the teacher has the student's attention, then it is important that the lesson is meaningful to the student. This unit incorporates the use of multiple intelligence, learning across the curriculum and interdisciplinary lessons. It utilizes problem solving, ecology, ecosystems as the topics to generate spatial assessment to mathematical data.

Many students do not have confidence in their academic ability to succeed. Through presenting the content in a multiple approach, with different assessment tools they will work and gradually build their confidence through success. Meaningful lessons are those that utilize real world problems, applications and solutions, as a means of satisfying the curriculum. The unit addresses the curriculum in the mathematical content area through problem solving, measurement, graphing, percents and probability. This also helps the student answer the question how will I use this? The lessons are from different content areas, yet sharing a common theme. They will address the when, how and why for the student through exploration. The lessons are created for the mathematical and science content areas through interdisciplinary units with the science teacher. The students learn how to make decisions from the environmental, economical, and social aspects. They will use statistics as a barometer and try to determine the effects of the complete decision process. They will begin to understand how decisions big and small impact the community, and the community at large. Environment

What are the components of environment?

Land Air Water Humans

The lesson's objectives are to provide an understanding of the relationship of individuals and their environment. The method being used is first from the science background of research concerning a public issue. The issue to be discussed is air quality. Students will have an opportunity to understand the cause and effect of decisions made on an economical basis. Economical and environmental trade-off are an essential part of how our resources are used . From these lessons they should become more empowered to help effect changes, regardless of how small.

Students will explore land use through literature, magazines, newspapers, and computers for current information. Determine the land boundaries of New Haven. Collect data concerning; population, land usage:

recreational, residential, commercial; watershed location, air quality.

The aspect of air is through data collection and interpretation of Federal and State guidelines; the Clean Air Act. Learn the allowable emissions and guidelines to determine clear air. Determine what are some of the dangerous toxins that travel through air. Understanding how toxins can effect water quality and uses. Ultimately providing the student with information, skills and the ability to make informed decisions and act accordingly.

Air is the part of the environment the student will study. The idea is to understand the importance of air and it's relationship to life on earth. The major focus will be understanding problem solving through researching the environment and the importance of limited resource utilization.

The student should formulate opinions through hypothesis they can test by themselves and/or by groups. The conjectures allow the student a methodical tool for proving or disproving their work. Once the students learn this method they can employ it in any content area. A method of learning is through hands on activities; The students will collect data on different topics to compare and form a collaborative work. They will have an opportunity to play the computer game SIM CITY, which allows them to control the needs and development of a community. Making graphs and using the graphs as visual representation to help understand the information. The student should develop a better understanding of their environment, and how many things in it are interrelated.

The science teacher will provide the student with an understanding of the nitrogen cycle and various experiments with plants and conditions needed to grow (refer to Maureen Taylor's paper). That will allow addition opportunities to utilize multiple exposure to the topic and related topics.

The language emphasis is logical written and oral expressions. However, it must provide enough diversity of comprehension for the majority to succeed. Possibilities are posters, booklet, fact sheets that include graphs, survey of school and the community at large input. The survey topics, questions, methods of completing are to be designed by the student. The assessment tool for this unit is limitless.

One form of assessment is an end of the unit project that incorporates an interdisciplinary theme. That project shows the student as a land developer, who had just received 100 acres of land to develop a new community. This land has a fresh water stream which runs completely down the center of the property. At the northwestern edge is an osprey nesting ground. The student must decide how to build the community determine the environmental issues to be must addressed and find solutions. The class or teacher can decide what type of zoning and environmental issues should be addressed.

The objective for this curriculum unit, is to develop the skills necessary to make informed decisions about the environment using problem solving techniques. Once the student begins to understand the environment, they will learn to control their environment. Each student must be taught how contamination of air, water and land can lead to environmental exposures.

First I intend to discuss the Clean Air Act is a Federal regulation that requires each state to meet or exceed the government standard for allowable toxins and allowable amounts of said toxins. Each state is responsible to meet or exceed the federal government's recommendations for clean air. This is done through State Implementation Plans (SIPs) that explain how each state will do its job under the Clean Air Act. SIPs are a collection of the regulations state will use to clean up polluted areas.

Second I will consider energy deregulation. Connecticut has adopted the strongest environmental protection provisions of any state energy deregulation law. The new law includes the following measures and were recommended by Council on Environmental Quality:

> -- within the next ten years, at least six percent of electricity sold in Connecticut will be derived from renewable sources and fuel cells (not counting new hydroelectric, or water-powered, plants).
> --Customers will be charged 0.3 cents per kilowatt-hour to fund energy efficiency improvements, fund will be used to help develop renewable energy businesses in Connecticut
> --The General Assembly tied future electric sales to specific air pollution emission levels that will take effect if a significant number of other northeastern states adopt similar provisions.

The effect of deregulation in the public electric utility industry was immediate, with companies proposing to build new gas-fueled power plants. Some have designs that would consume several million gallons of water daily, which they propose to buy from water utilities. Some proposals involve transfer of water between watersheds. This has highlighted Connecticut's deficiencies in water allocation policy.

Connecticut's proposed action for 1999 deals with Fuel Cell production and utilization, the Department of Public Utility Control's vision of public interests, so that utilities are not required to sell undeveloped land. Many of the parcels of land are waterfront lands that are critical open spaces in their communities. The state should look at awarding double credit toward renewable energy requirements to fuel cells that consume methane from landfill. Fuel cells, that produce electricity with minimal emissions.

What is Air?

Air is made up of nitrogen (N) 78%, oxygen (O) 21%, nearly 1% is all argon , the remainder is carbon dioxide (CO2) 0.02% and other rare gases make up 0.08%. Air is transparent and has (density) body. It has weight and takes up space. Air possesses physical qualities which makes air matter.

Air is essential for life on earth to exist. Nitrogen and oxygen, each provide a different ingredient for the existence of life. Nitrogen is the essential in the formation of amino acids, the main ingredient of protein molecules. All living things are made up of amino acids. The nitrogen in the air must be converted to compounds that can then be used by living things to help make amino acids. Nitrogen (N) gas in the air is converted into nitrogen compound through the nitrogen cycle.

Oxygen is an extremely active gas, it is readily transferable for use by organisms. Almost all living things need oxygen to exist. The exception is anaerobic bacteria, bacteria that can function without oxygen. Oxygen is added to the air through photosynthesis. Photosynthesis is the process by which green plants make their food.

There are four types of gases in the air that are of major concern to public health issues. Carbon based gases are found naturally in the air, man adds by burning fossil fuel, (coal, oil, and natural gas). With increased incidence it upsets the temperature balance of earth and adds to the greenhouse effect. Carbon gases are

colorless, odorless and tasteless. They cut off the oxygen supply to the brain when its added to hemoglobin. Sulfur dioxide (SO_2) is colorless, tasteless, foul-smelling, and it's heavier than air. It occurs naturally, from volcanoes, and the decomposition of organic materials in swamps. When sulfur dioxide is combined with water vapors it forms sulfurous acid (H_2SO_3) a component of acid rain. Ozone (O_3) is a form of oxygen. This form of oxygen is a very harsh irritant to the lungs, and dangerous for people with lung disorders. Nitric oxide and nitrogen are produced by the incomplete combustion of gasoline. They combine with oxygen and, in the presence of light energy and hydrocarbons, form PAN, or peroxyacetyl nitrate.

Ozone Layer

From ten to forty miles above the earth's surface is the stratosphere. The stratosphere contains the protective ozone layer that surrounds the earth. Ozone is a form of oxygen which in the stratosphere blocks the sun's harmful rays form reaching earth.

Without this ozone layer in the stratosphere, too many harmful rays can reach the earth's surface, causing skin cancer in humans and damage to plant tissue. In 1988 National Aeronautics and Space Administration (NASA) conducted a study which showed the ozone layer had been depleted by 3 percent over the past twenty years. Halons used in increasingly high technological fire fighter equipment, chlorofluorocarbons (CFC's) group of compounds used as propellants for aerosol spray, plastic packaging, foam insulation, cleaning fluids, air conditioning and refrigeration are contributing factors to depletion.

These halons and CFCs, once released into the air rise slowly into the atmosphere, where they and methyl chloroform, an industrial solvent, are broken up by the sun's ultraviolet rays, releasing chlorine (Cl) and bromine (Br) atoms. The chlorine atoms from CFC's and bromine from halons disrupt the ozone molecules, breaking them up into molecular oxygen. Molecular oxygen depletes the ozone layer.

Every one percent loss of the ozone layer increases the potential for skin cancer by five to seven percent. The increase radiation from the sun also burn tissues of animals and plants, as well as causing eye problems for humans and other animals. The most dangerous might be changes to the human immune system. The increased ultraviolet radiation affected the food chain, by killing plankton. Plankton is the base of the food chain. The greatest ozone loss is at the Antarctica where sometimes it measures a fifty percent decrease, usually in the winter and early spring. If it happens there it can happen anywhere on earth.

Air Movement

Air moves in two ways wind and convection. Wind is caused by the sun, which creates weather systems in the troposphere. Convection is the manner which air rises and falls, depending upon air temperature. Cold air, is heavier than warm air; falls and it pushes the warmer, lighter air up.

Movement of air is an important factor in keeping the air free of pollutants. It is in stagnant air that pollution becomes isolated and localized. In temperature

inversion, a body of warm air moves over cooler surface air. When this happens convection can not take place

and the air easily becomes polluted.

Federal Clean Air Act

The passage of the Water Pollution Control Act of 1948, by the federal government began assisting local authorities in building sewage treatment plants, and it initiated a limited program for air pollution research in 1955. In 1950s - 1960s the federal government , was slowly beginning to formulate a policy to control industrial pollution and human waste. Air and water pollution was long considered strictly a local issue. That changed after 1962 when Rachel Carson wrote the Silent Spring.

Following the Clean Air Act of 1963 and amendments to the water pollution law, Washington began urging the states to set pollution abatement standards and to formulate implementation plans based on federal guidelines. On April 22, 1970 the first nationwide teach-in about the environment was organized to educate the public about the ecology. The event was named Earth Day, and it demonstrated ecology's new place on the nation's social and political agendas. The effect was a broadly based public demand for more vigorous and comprehensive federal action to prevent environmental degradation.

As a result, many environmental laws were quickly enacted and implemented throughout the 1970s, but with growing concern over their effect on the economy and increasing realization that administrative agencies lacked the resources and the capacity to assume their new responsibilities. The Clean Air Act of 1970 is really an amendment of earlier laws. The Clean Air Act has been amended several times each time the objective remained true to the original. However, methods of implementation, technology, economics, public opinion and politics were the driving force. The following is a list of the amendments to the Clean Act.

1970 Public Law 91-512, "Resource Recovery Act" set up programs of demonstration and construction grants for innovative solid waste management systems; provided technical and financial assistance to state and local agencies in developing resource recovery and waste disposal systems.

1970 Public Law 91-604, required environmental Protection Agency to set national primary and secondary air quality standards and certain emission limits; required states to develop implementation plans by specific dates; required reductions in automobile emissions.

1977 Public Law 95-95, postponed deadlines for compliance with automobile emission and air quality standards set new standard for " prevention of significant deterioration" in clean air areas. This bill was passed in response to non compliance by the stated time of the 1970 law. Review date was set for 1981.

The Clean Air Act of 1977 established clean air standards for all cities to meet by 1982. Again in 1981 the Environmental Protection Agency again provided and extension of compliance to December 1987.

On December 31, 1987 , many cities still failed to meet minimum standards set by the renewal of the Clean Air Act for six air pollutants. The six pollutants are: carbon monoxide, sulfur dioxide, nitrogen dioxide, ozone, lead, and volatile organic compounds (VOC).

1990 Public Law 101-549; set new requirements and deadlines of three to twenty years for major urban areas to meet federal clean air standards; imposed new stricter emission standards for motor vehicles and mandated cleaner fuels; required reductions in sulfur dioxide and nitrogen oxides by power plants to limit acid

deposition and created a market system of emission allowances; required regulation to set emission limits for all major sources of toxic or hazardous air pollutants and listed 189 chemicals to be regulated; prohibited the use of chlorofluorocarbons (CFC) by the year 2000 and set phase out of other ozone (O3) depleting chemicals.

Title One Air Pollution and Control divides air pollution into two categories: A.) Ozone standards were set as 0.12 parts per million, measured as a one hour average. It also divided the ozone levels as: marginal (0.121-0.138); moderate (0.138-0.160); serious (0.160-0.180); severe (0.180-0.280) and extreme (0.28 and higher). EPA then set guidelines and timetables accordingly to their ozone levels at the time of the amended "act". The timetable for each ozone level is as follows: marginal three years, moderate six years, serious nine years, severe fifteen years and an ozone level of 0.190-0.28 seventeen years; Los Angeles was the only city in the extreme level and they received twenty years to comply.

B.) Carbon monoxide, particulate matter and defined major sources as those which contribute 100 tons per year of ozone precursor, 50 tons as serious, 25 severe and 10 tons as extreme. Major sources are to install reasonably available control technology as defined by the EPA. SIP's plan must include enforceable emissions limitation, related control measures, schedules and timetable for compliance. It also established:

1. A system to monitor, compile and analyze data on air quality.
2. Enforcement procedures
3. Control on interstate air pollution
4. Procedure to ensure adequate personnel, funding and authorities
5. Monitoring systems
6. Fee schedule to cover the cost of reviewing or implementing permits.

Failure to comply would result in a reduction of the state's federal highway fund, and or that the state's industrial project off set emission by a 2:1 ratio.

1990 Clean Air Act provides economic incentives for cleaning up pollution. It has a market based approach designed to cleanup air pollution as efficiently and economically as possible. Businesses make choices of the best way to solve problems. Acid rain cleanups afford business's choice about how they research their pollution allowances. That allowance potential can be traded, bought and sold.

Senators from across the Northeast have united behind a plan they hope, will clean the air in their home states by cleaning up electric power plants across the nation. Mercury contamination in lakes are likely entered from the air - carried by easterly winds from the smoke stacks of Midwest coal-burning power plants. Though the northeast begun to improve their power plants, the effects are minimized. To halt this kind of pollution, Senator Joseph I. Lieberman, D-Conn., and Jim Jeffords, R-Vt., have introduced legislation that would require coal- and oil-burning power plants to reduce emissions of pollutants that damage human health and the environment.

The proposed Clean Energy Act of 1999: would regulate nitrogen oxides, sulfur, mercury, and carbon dioxides emissions from these power plants. Nitrogen oxides lead to smog. Sulfur emissions increase acid rain. Mercury can enter the food chain through fish. And carbon dioxide is a major contributor to global warning. Goals can and must be achieved regionally and nationally if every community is to be assured clean air and clean water.

The bill would for the first time, end pollution exemptions for old power plants currently grandfather under the Clean Air Act- including five in Connecticut.

The five plants - Bridgeport Harbor Station, New Haven Harbor Station, Middletown Station, Norwalk Harbor Station and Montville Station. They combine for more than 50% of the smog - and - soot - forming pollutants emitted by all industrial polluters in the state. The annual air pollution emitted from the plants are equivalent to 400,000 cars, according to Connecticut Public Interest Research Group (ConnPRIG). Smog and soot which are called ozone smog, and fine particulate matter; are the two most common and most dangerous air pollutants in Connecticut. Prolong exposure can significantly reduce lung function, increase asthma attacks, and cause premature deaths.

The proposed Clean Energy Act of 1999 would: Reduce emissions of a full range of pollutants- nitrogen oxides, sulfur, mercury and carbon dioxide. Require increased investments in renewable energy and energy efficiency programs from 2.5 percent in 2000 to 20 percent in 2020. Apply to every 15 megawatt or larger power plant in America. Require the Environmental Protection Agency to study the effect pollutants have on communities in instances when power plants exceed Clean Air Act standards by 25 percent or more. Provide consumers information to choose clean sources of power deregulated market.

Air Quality

Air quality in one region of the country, world may affect air quality somewhere else. This is explained through weather patterns and wind currents. National energy production from coal-burning plants jumped 16 percent from 1992 to 1998, discharging an additional 298 million tons of carbon dioxide into the atmosphere which is equivalent to annual pollution from 44 million cars.

The Northeast is affected by Midwestern coal-burning power plants because of prevailing easterly winds. Illinois, Indiana, Kentucky, Missouri and Ohio coal-burning plants have all seen sharp increases in production and carbon-burning emissions, a leading factor in global warming. The five states contributed an additional 85.5 million tons of carbon dioxide into the atmosphere in 1998 compared to 1992, or a 31 percent of the national increase. Though production at the five Connecticut plants decreased 22 percent from 1992 to 1998 and annual carbon dioxide emissions fell 723,566 ton, according to the U. S. PRIG study; the benefits are very small because of the midwest's increase production.

Toxic air pollutants are poisonous substances in the air that come from natural sources. An example is, radon gas which comes up from the ground. Synthetic sources are chemical compounds given off by factory smokestacks; and these for example harm the environment or your health. Benzene fumes are inhaled when you pump gas into your car. This can increase your chances of developing cancers associated with exposure to benzene, such as leukemia. Other pollutants that are a by-product of power production are hydrochloric acid, which is corrosive to skin, eyes and mucous membranes; nickel, which is known to cause lung and sinus cancer; and sulfuric acid which has been linked to reduced lung function.

Public health issues play an important role with decision making of environmental issues. Health risk, is a measure of chance that you will experience health problems. Exposure to toxic air pollutants can increase your health risk. An example would be, if you lived near a factory that releases cancer causing chemicals and inhaled contaminated air your risk of getting cancer can increase. Breathing air toxins could also increase your risk of non-cancer effects such as emphysema or reproductive disorders.

Many public health issues can be attributed to air pollution that then ties into water pollution. Virtually every lake and river in Connecticut is contaminated with mercury from air pollution. Another example is the unexpected place's people encounter pesticides, such as schools and public building, where the people applying the pesticides are not properly trained or licensed. How is it that people are permitted to drill new wells, into aquifers that are known to be contaminated?

The toxic air pollutants of greatest concerns are those that cause serious health problems or affect a large number of people. Health problem can include cancer, respiratory irritation, nervous system problems and birth defects. Some health problems occur very soon after a person inhales a toxic air pollutant. The immediate effects may be minor, such as watery eyes, or they may be serious, life threatening lung damage. The health problems may not occur for months or years after exposure. Cancer is an example of a delayed health problem.

Toxic chemical releases are very dangerous because of the active life of the contaminates and the manner it enters our ecology. Toxic chemicals are released through these sources: air, water, underground and land. Each source is regulated by the Environmental Protection Agency and the public citizen has the right to seek remedies if the regulations are broken by an individual, company or industry.

Sources of pollution that are power plants, factories or anything that releases pollutants into the air such as cars, trucks, other motor vehicles, consumer products and machines used in industry. Interstate pollution occurs when pollution travels from its source in one state to another state. Provision of the 1990 Clean Air Act was to form interstate commissions on air pollution control, which are charged to develop regional strategies for clean up and reduce interstate pollution.

Deregulation of the Power Industry

Deregulation of the Power Industry was to allow for competition across communities and states. With a focus on cleaner, renewable sources. This is not achieved with reinvest and research and development, all which are expensive. Companies are not told how to achieve goal, rather they understand the goal, their business and implement what they determine feasible measures to achieve compliance. Companies would receive credits for meeting or exceeding state and federal goals according to the SIPs plan. Through competition it is hope that the cost of production and regional cost of electricity would equalize.

Deregulation has led to an increased reliance on old dirty power plants. It shows a need for deregulation to be accomplished with basic environmental protections. "Unless you make allowances, industry would be engaged in a contest to produce the cheapest energy, which will have terrible effect on our environment." Plants are much cleaner in the Northeast.

Connecticut's electricity prices are doubled that in the Midwest. Connecticut's SIP plan calls to decrease

electricity from fossil fuel sources. Fossil fuel sources are less costly to generate, but the by-products are more dangerous for the environment. Connecticut has chosen to encourage utilization of renewable energy sources. This is a new development that is apart of the electricity deregulation, it is expensive.

Allowances are given to companies who are on goal with the federal and state guidelines for clean air. Companies may save, trade or use credit for times when they have not met standard. Some companies who have a good to excellent compliance records, trade their credits for cash or other goods. The purchasing companies, then use the credit to offset penalties for non-compliance of the Clean Air Act. Theoretically, a plant that is in non compliance can purchase enough credits to either off-set or eliminated possible fines due to the non compliance, without correcting the problem of pollution.

LESSON 1 Making a Circle Graph of Air Components

Objective: The student will demonstrate the gases and amount that combine to form air by constructing a circle graph which represents air.

Materials: plain white paper, pencil, color pencils, protractor and ruler.

Teach: Air is made of gases that include oxygen, nitrogen and other gases which is argon. The percentages for each are oxygen 21%, nitrogen 78%, carbon dioxide 0.02%, the remainder is argon and other rare gases 0.08%. When making a circle graph the circle represents the whole. When trying to decide the correct representation first determine the degrees of the circle that each percentage represents.

This is accomplished by mathematical calculations. A circle has 360 degrees, which is our total. Then set up your conversion chart to formulate the degrees for each gas.

Percentage Decimal Degrees
What is given Percentage divided by 100 Decimal multiplied by 360

Locate the number in the degree column and graph. Remember that a circle graph does overlap information. Therefore, once you have graph one gas you must begin the next gas at the end position of the previous gas. When using a circle graph all positions are determined by degrees, which takes 360 degrees for the complete units.

All graphs must include certain information such as: a title; some indication of amount, relationship to the whole; and the data sheet, which verifies your work.

Guided Practice: Complete the following problem as a class. Teacher should walk around class to verify student are grasping the idea of circle graphs.

Example:

45% = 45/100 fraction , calculations yields 0.45 as a decimal, 0.45 x 360 degrees = 165 degrees. 25% = 25/100 ; 0.25 as a decimal; 0.25 x 360 degrees = 90 degrees.

Using a protractor make a circle, with the protractor find the center point of the circle and mark it. Then locate

0 degrees, and mark that position. Next find 165 degrees and label that point. Using a straight edge connect the points, first draw a line from zero to the center, the draw a line from 165 degrees to the center. Label inside the area you just made as 45%. Next, starting from 165 add 90 = 255, this give you the ending point for the second equation.

Independent Work: Students are to construct a circle graph which represent Air.

Closure: The student will write a letter to an absent classmate explaining the assignment and instructions to make a circle graph.

Mathematical skills that are reinforced are fractions, decimals, percents, ratio and graphing. Also, data interpretation and understanding the relation of one complete unit as a whole.

LESSON 2 Does Air Have Weight?

Objective: The student will determine through an experiment that air has weight.

Materials: Yard stick, tape, two balloons, tape, string and a pin.

(Students are grouped 2-3), scientific method write up sheet.

Teach: Ask students if they think air has weight. Then ask using the materials if they can prove or disprove the statement. Materials are those items needed to perform the experiment. Hypothesis is what you think will happen. Purpose is why you are completing the experiment. Procedure is the steps taken during the experiment. Results are what actually occurred. Conclusion is what you learned from the experiment.

Guided Practice: Conducting the experiment-- blow up two balloons equally, tie a knot to keep air in the balloons. Attach a string to the balloons, position one balloon at each end of the yard stick. Find the center spot and attach a string, position yard stick so the stick is suspended and level. Take a pin and pop one balloon, and have each student describe what happened. Can this experiment help determine if air has weight? What is weight? Prove your answer by using the experiment as your guide.

Independent Practice: Each student will complete the experiment and scientific method sheet.

Closure: Class discussion concerning what was learned from this experiment. Discuss the molecules in air, parts of a molecule, how contaminates attach and may be nuclei for contaminants.

Mathematical standards to be addressed are problem solving, reasoning skills, organizing data, testing a hypothesis and decision making skills.

LESSON 3 Developing a Neighborhood Map of TRI Companies

Using the data from the EPA's Toxic Release Inventory (TRI) determine the school's location and the TRI for the Hill neighborhood of New Haven , Connecticut.

Objective: The student will develop a map using the TRI information for a specific area. They will compile a list of toxic release inventory for the school's neighborhood. The student will also include the necessary information to read map, verify information and clearly understand their written interpretation of the map.

Materials: Graph paper, pencils, rulers, color pencils, compass and line paper. Student group will research the Internet for Environmental Website, search by zip code of the school. The toxic release inventory will provide a list of companies in the zip code area that is registered to handle different types of toxins. It also provide information if a company has ever been listed or is listed as a Superfund site. A Superfund site is one that requires massive cleanup effort due to incorrect waste handling.

Once this information is collected and shared with the class the students are to categorize it by the type of permits each company listed has, and color code the permits. Using graph paper with Roberto as the center point, the scale is one square equals one block; plot each company one the map they are developing. Color code each company by permit. Using the completed map write four observations. One observation should include what in close proximity of the school. Close proximity is a four block radius.

Teach: Collection of data is useful to decision making and problem solving. However, in order for it to be effective the purpose must be clear. What is the problem? What information is needed to help solve the problem? What process is needed to prove or disprove the problem? Where to begin, develop a strategy. List the information that is given. The key to problem solving is to develop a plan. Also understanding that a plan is just a starting point. If it does not work, develop another and test; until a successful solution is found or enough trails to prove there is no solution.

Guided Practice: Using the compass determine Roberto's location by cardinal directions, using Columbus Avenue as the front of the building for location on the map. The students must label map as North, South, East and West. Using data locate the first company.

Independent Practice: The students will continue until the map is completed.

Closure: The students will write one paragraph discussing the toxic release in the school's neighborhood.

The mathematical objectives to be addressed are problem solving, data collection and interpretation, organization of data, and application of information as a tool of decision making.

LESSON 4 Measuring Dispersion

Dispersion means to break up, spread over a wide distance, to scatter. To determine a dispersion rate is to find out how fast the substance travels over a certain distance.

Materials: perfume, cologne, four student volunteers, stop watch and chart, blind fold.

Objective: The students will determine through an experiment the dispersion rate of certain solutions such as: perfume, cologne, ammonia, and alcohol.

Teach: To determine distance use the formula; distance (d) = rate(r) multiplied by time (t); d = rt. Using the classroom and students to determine the distance traveled and speed, for each solution. Does it matter if the room has ventilation concerning the experiment? How can the experiment be setup in the classroom? What is needed to solve the problem?

Place students in the corners of the room, with blind fold on. Mark the distance from spray to student. Time keeper write time of spray and records when each student smells the spray. Conduct experiment two more times once with the classroom closed, then open (door and window), record student's time. Determine the answers to questions and any observation not mentioned.

Guided Practice: As a class complete the first experiment, set up the data chart

Room Distance Spray Smell Elapsed Travel

Student Condition from source Time Time Time distance/time

Independent Practice: using the data from the chart complete calculations. Peer correct with discussion. Must show calculations for distance traveled per unit of time formula for each trail in chart. Correct each other's work through proof theories

Closure: Write one paragraph concerning what you learned from this lesson.

Mathematics standard: interpret data, distance formula, and solving equations using variables.

Lesson 5 Graphing the Five Connecticut Power Plant's Emission

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Objective: The student will develop a graph that represents the Connecticut power plants hazardous pollutants and emissions.

Materials: graph paper, Environmental Protection Agency Report of Connecticut's filthy five power plants.

Teach: The students are encouraged to view the data from The Toxics Action Center, federal Environmental Protection Agency 1998 Report. Determine what information to include and organizing the data. Students are to make a line or bar graphs to represent the information. Then they will discuss the data means and how the graph can help understand the information presented.

Guided Practice: As a class determine the labels for the axis, scale, and key.

Independent Practice: The student will use the information provided to complete the assignment. Students may work in groups of 2-3. The students will determine which of the plants are the worst and provide the criteria used to validate their answer.

Closure: Using the graph explain as briefly as possible what does this mean to you and the quality of air you breathe.

Lesson 6 Land Development Group

Objective: To develop a new community on 100 acres of land. The land is zoned for mix use of residential and light commercial properties. As a developer you have approve to make a community that does not harm your present environment. The location of your land is in the Northeast and it has a fresh water stream running north to south, down the center. Ten acres on the northwest portion of the stream is an osprey nesting area. Your community can not disturb them. Reminder to consider power, water, commercial and residential property, as well as open space.

Your community should include houses, businesses, church, school, land fill, transportation system, water, police, fire department, hospitals, and other items you want to include. Keep in mind your resources and the Clean Air Acts. Be creative and make it interesting using the information charts, graphs, organizers and research developed in class and independently.

Develop: A map of your town with buildings, open space, stream and osprey habitat. The scale of the map is one square equals one mile. You must determine how many miles are in an acre or vise versa. You will need to convert acres to feet, then find miles in feet or vice versa. Determine the ration and apply to your project. A circle graph representing the open space, and each use of the community, compared to the whole.

Rubric: * items must be included in the project

_____ pts * Clear stamen of the Task

_____ pts Each environmentally friendly decision

_____ pts * clear explanation that address osprey

_____ pts clear statement of community choice

_____ pts * location and labeling of buildings on map

_____ pts * map of community

_____ pts community's affect on resources, environment, waste production and technology impact

_____ pts * circle graph community land use

_____ pts use of cardinal directions on map

_____ pts * 5-7 paragraphs addressing Why your community's development is set in the manner it is. How it helps the environment and humans.

_____ pts * make a timeline of the Clean Air Act and its amendments

_____ pts * graphic organizers, Venn diagram, two column notes, web

_____ pts neatness

_____ pts parent comment

_____ pts student statement of what they learned from doing this project

Grading System A+ = 110%, A = 95-109% etc. Class can assign points and grades or teacher can. The grading is flexible and allows for student ownership.

It's in the Air **CONNECTICUT'S**

FIVE STATIONS	**HAZARDOUS POLLUTANTS**	**EMISSIONS (unit of measurement pounds)**
Bridgeport Harbor	Hydrochloric acid	340,000
(637 megawatts)	Sulfuric acid	179,000
	Total	519,000
New Haven Harbor	Nickel compounds	1,400
(447 megawatts)	Sulfuric acid	198,000
	Total	199,400
Norwalk Harbor	Ammonia	17,000
(330 megawatts)	Hydrochloric acid	34,000
	Sulfuric acid	94,000
	Total	148,700
Middletown	Hydrochloric acid	68,000
(819 megawatts)	Sulfuric acid	45,000
	Total	113,000
Montville	Hydrochloric acid	31,000
(483 megawatts)	Nickel compounds	15,000
	Sulfuric acid	83,000
	Totals	129,000
	FIVE PLANT TOTAL	1,109,100

SOURCES: The Toxics Action Center; federal Environmental Protection Agency

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