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"Where are Environmental Hazards?"

Curriculum Unit 97.07.01
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The goal that I, as a science teacher, expect to accomplish with "Where are Environmental Hazards?" curriculum is to have students develop an understanding of the following: toxicity, exposure, and precautions of certain chemicals including pesticides such as DDT, heavy metals, lead poisoning, radon, sulfur dioxide, nitrogen dioxide, carbon monoxide, water pollution, drinking water quality, and air pollution. Some emphases in this curriculum will be on conducting: hands-on activities such as testing water quality from tap water, classroom testing of radon and carbon monoxide in the air, debates and analyses of various environmental issues, field trips, and mock environmental investigations of homes / buildings in order to identify agents that do or do not meet standards for pollutants. These mock investigations will require students to understand scientific measurement units such as ppb (parts per billion), ppm (parts per million), mcg (microgram), pCi (picocurie), dL (deciliter), and L (liter), and to determine if the given numerical values of concentration and time pose an environmental threat. The curriculum is designed to integrate the following: readings of texts and current scientific journals, writings based on students' opinions of environmental issues, and cooperation activities for groups of students. The approach for this curriculum is interdisciplinary, combining science, mathematics, and language arts. Upon reading this unit, it will become apparent how knowledge from many academic subjects plays a critical role in developing answers for the questions that can be addressed in environmental science. Some of these questions can be: What threats do pesticides in your food pose? What are ways to get pesticides out of your food? What are some possible contaminants in our drinking water? How can you find out if your water is safe? What are some possible contaminants in our air? How do we pollute indoor air? What can you do about your indoor air quality? How should toxic waste disposal be handled?

The student population that I will be targeting for this curriculum will be my Chemistry and Earth Science classes. These students might already have a minimal basis of environmental science, but through this unit they can extend their knowledge of specific environmental pollutants, causes, effects, and solutions. At my school, the student / teacher ratio for these classes is approximately 10:1, therefore; a considerable amount of individual attention may be given for each student. This concentrated focus on each student's comprehension and performance of discussions, labs, essays, and investigations will allow me to expand on certain topics that are of special interest to the student. Also, each student's working pace can vary depending on the activity she is doing. This will permit some students to stay on one topic for an extended period of time, or to move ahead to another topic of particular choice.

The following represent environmental topics to be discussed:

DAY 1: PESTICIDES (DISCUSSION AND REVIEW OF WHAT PESTICIDES ARE AND HOW TO GET PESTICIDES OUT OF YOUR FOOD)

Each year, nearly 6 billion pounds of pesticides are sold in the global marketplace - 2.5 to 3 billion pounds of which are purchased in the United States. Pesticides are chemicals that are used to control or kill off pests. These compounds are applied to crops, forests, lawns, gardens, parks, highways, lakes, ponds, office buildings, aircrafts, ships, hospitals, schools, and day-care centers. Affected raw and processed foods are grapes, raisins, apples, apple juice, tomatoes, catsup, tea, citrus, wheat, bran, sugarcane, molasses, mints, oils, plums, and prunes. Pesticides are also deliberate components of some clothing, shampoos, drugs, paints, wallpaper, shower curtains, rugs, blankets, and mattresses. (Wargo, 1996)

The full extent of environmental contamination by pesticides is not known. Yet what we are finding out is alarming. Between 1982 and 1985 the FDA detected pesticide residues in 48 percent of the fresh vegetables and fruits we eat most frequently. In addition, according to the EPA estimates, pesticides have contaminated ground water in approximately 38 states, fouling the drinking water of half of all Americans. Estimates of some 6,000 cases of cancer a year are thought to be caused by most of the one-third approved pesticides in use today that have been tested. Most of the 50,000 pesticides on the market have never been tested for long-term effects. Finally, there is mounting evidence that farmers, farmworkers, and their families who are exposed to pesticides and herbicides have a far greater risk than the general population of developing leukemia and other cancers, birth defects, and diseases of the central nervous system. (Naar, 1990)

In 1962 Rachel Carson alerted the world of the devastating effects of DDT on birds, fish and other animals. Although banned in the United States, DDT is still shipped here after being manufactured in Western Europe. It is also exported to many countries such as Mexico and Columbia from whom we import large quantities of food and coffee. DDT residues were first found in human tisues including blood and the liver, kidney, heart, and central nervous system in 1944. Although 80% of pesticides are used in the industrialized nations, 99% or more of the deaths from pesticides occur in low-income nations, where safety precautions such as label instructions, protective clothing, and field reentry intervals are less likely to be employed. (Wargo, 1996) Additionally, DDT and other pesticides are very persistent and mobile in the environment, having been found in animals in the Antarctic and other areas never sprayed. Another consequence of the widespread and long-term use of pesticides, herbicides, and fungicides is that pests, weeds, and fungi are becoming resistant to the chemicals. This calls for even greater amounts being used in a never-ending cycle of poison. (Naar, 1990)

Some ways to get pesticides out of your food or to prevent extensive use of pesticides are as follows:

a. Apply bugs that act as pest killers for harmful insects.

b. Grow your own food organically based on the principles of using compost to create a fertile soil.

c. Buy organic food at health food stores and farmers’ markets.

d. Wash all produce in clean water or a weak solution of hydrogen peroxide.

e. Peel, scrape, or remove skins from fruits and vegetables.

f. Buy local, buy in season to get fresher and less irradiated food.

g. Beware the perfect apples that can contain harmful pesticides. This example of a cosmetic standard normally encourages pesticide use for other fruits and vegetables. (Naar, 1990)

DAY 2: PESTICIDES (DISCUSSION OF FOOD CHAINS, STUDENT- CREATED EXAMPLE FOOD CHAINS, DISCUSSION OF BIOACCUMULATION-BIOMAGNIFICATION OF PESTICIDES IN THE FOOD CHAINS)

DAY 3: PESTICIDES (WORKSHEET SHOWING THE CONCENTRATION OF PESTICIDES FOUND IN THE CELLS OF LIVING THINGS IN AN ECOSYSTEM)

Worksheet: For years pesticides have been used to control or kill pests. Unfortunately, many pesticides remain in the environment for years after being applied, contaminating not only the environment of the area, but also the organisms living there. Table 1 shows the concentrations of pesticides found in the cells of living things in an ecoystem. Questions relating to the Table follow.

Table 1

Organism	Pesticide concentration *(parts per million)*
Blue-green algae	0.0001
Water crustaceans	0.001
Small fish	0.01
Trout	0.1
Polar bears	?

Each of the organisms listed above is part of a naturally occurring food chain. Figure 1 shows this food chain.

blue-green algae ——> water crustaceans ——> small fish ——> trout —> polar bears

Figure 1

Questions:

1. What can one conclude about the concentration of pesticides in the organisms as one moves up the food chain?

a. Pesticide concentration decreases.

b. Pesticide concentration remains fairly constant.

c. Pesticide concentration increases about ten times between each link.

d. Pesticide concentration initially increases but then decreases.

2. If the pattern of change in the concentration of the pesticide seen in earlier links continues, what would most likely be the concentration of the pesticide in polar bears?

a. 0.01 ppm

b. 0.1 ppm

c. 1.0 ppm

d. 10.0 ppm

3. Which organism serves as the primary producer in the food chain shown in Figure 1?

a. Blue-green algae

b. Water crustaceans

c. Small fish

d. Trout

4. Some pesticides are not as effective against insects as they were in the past. Which of the following best explains why this is true?

a. The pesticides killed off the insects food supply in the past.

b. The pesticides were used in lower concentrations in the past.

c. Individual insects became tolerant to the pesticides and survived.

d. Some of the insects were tolerant to the pesticide and survived to produce offspring.

5. Suppose the small fish population was killed off by the pesticides. Describe what would happen to the rest of the organisms in the food chain shown in Figure 1. Explain your answer fully.

DAY 4: WATER POLLUTION (DISCUSSION)

If all the earth's water - an estimated 325 trillion gallons - were squeezed into a gallon jug and you poured of what was not drinkable (too salty, frozen or polluted) you would be left with one drop. And even that might not pass United States water quality standards. Some causes for this pollution include acid rain, wind-borne pesticides, oil spills, garbage, raw sewage, radioactive wastes, ash, medical debris, agricultural runoff, excessive chlorination, and corrosion of lead pipes. (Naar, 1990)

How can you find out if your water is safe? Here is how you can find out what your own situation may be at home:

> a. Look for the signs of orange-red or brown color in water or the sink resulting from iron by rusting pipes. A greenish stain could mean copper rust.
> b. A foamy appearance could be detergent residue.
> c. Cloudy water might indicate minerals, heavy metals, or other contaminants.
> d. Sniff the water to detect an odor of rotten eggs indicating sulfur or decaying bacteria. Candylike aroma might be vinyl chloride or other chemicals. Gasoline or oil smell could be caused by a defective water pump. Swimming pool odor is probably pointing to too much chlorine.
> e. Get the water tested for drinking-water quality including criteria of coliform bacteria count, hardness / softness, heavy metals, pesticides, herbicides, fungicides, and other chemicals. (Naar, 1990)

What can you do to reduce contaminants in your drinking water? Here are some easy tips to help. First, let cold water run for at least three minutes before using. Even for hot beverages and infant formulas, draw cold water because hot water dissolves lead and copper more readily. Second, use cold water primarily and let it boil for 20 minutes or whip the water for 15 minutes in a blender with the top off to get rid of bacteria and chemicals. Third, add a pinch of powdered vitamin C to a glass of water just before drinking to lower chlorine's effects. Fourth, buy a purifier to disinfect water. And lastly, use a filter to screen water. (Naar, 1990)

DAY 5-7: WATER POLLUTION (TAP WATER TOUR: HANDS-ON TEST KIT AND MINI CURRICULUM AND DISCUSSION OF WATER TESTING LAB REPORTS)

One activity that the students will do here is a Water Testing Lab. This lab consists of two parts. It entails students to test tap water from each of their homes and from the school. The tap water is tested for chlorine, copper, iron, salts, zinc, pH, and hardness / softness. Students will learn why water can appear brownish-red, why rings can form in a tub or in a sink with a brown or green color, and why water can taste bitter. They will learn about acid rain, how it forms, and how it has effects on our environment. A series of tests with colored indicators (tablets and paper) will allow the class to make interpretations from their results in their experiments. They can also make comparisons of the various tap water samples and can do further tests with ocean water or distilled water. Here also the students will be reinforced with the steps of the scientific method: What is the problem they are trying to solve? What is their hypothesis? What initial observations can they make from current and previous knowledge? How will they conduct their experiments to obtain their data? How will they present their data? How will they analyze their data? How valid are their conclusions? These steps of the scientific method are repeated throughout the school year in my classes in order to demonstrate the route of obtaining answers brought on by scientific inquiry. My students enjoy this method of experimentation and tend to use high-level thinking skills throughout it.

DAY 8: AIR POLLUTION (DISCUSSION)

Fossil-fuel pollution from plants, factories, cars, buses, trucks, airplanes, and even lawn mowers produce toxic air pollutants that endanger public health, wildlife, vegetation, buildings, statues, gravestones, and all they touch. Common fossil fuels include coal, natural gas, and petroleum oil. They are formed from the remains of plants and animals that lived millions of years ago. These remains were covered over and trapped below the earth's surface. These fuels are being consumed today far more rapidly than they can be replaced. For this reason, fossil fuels are considered nonrenewable resources. The current energy sources in the United States are oil 42%, gas 24%, coal 23%, and other 11%. (Globe, 1993) Causing the damage are the substances these fuels produce when burned: sulfur dioxide, carbon monoxide, nitrogen dioxide, particulate matter, hydrocarbons, ozone, lead, and other metals. Among other risks from this pollution, cancer reigns high on the list. (Naar, 1990)

Energy sources that are not fossil fuels are called alternative energy sources. Wind, water, and sunlight are nonpolluting renewable energy sources. Windmills and waterwheels played important roles in early industries. Currently, in the United States, these energy sources account for only about 4% of the electricity produced. (Globe, 1993) Many scientists hope that technology will lend itself to us to be able to use renewable energy sources more frequently and more efficiently, so that we are not without alternatives as our nonrenewable resources become depleted.

While many of these outdoor contaminants may seem to be minor irritants, they become a real and present danger when added together and concentrated within four walls over a long period of time we spend indoor. Some specific causes of indoor air pollution are as follows:

a. Burning of wood, coal, and kerosene in such places as stoves, furnaces, and heaters.
b. Use of aerosol cleaners and disinfectants.
c. Ammonia.
d. Air fresheners.
e. Insect sprays.
f. Cigarette smoke.
g. Asbestos, lead, and radon in many building materials, finishes, and furnishings. (Naar, 1990)

What can you do about indoor air pollution? You can significantly lower the concentrations of air pollution in your own home by increasing the circulation between outdoors and indoors. Opening windows and doors increases the natural ventilation rate. Turning on kitchen, bathroom or workshop exhaust fans is a simple way to remove contaminants from those areas. Buying a heat-recovery ventilator or air cleaner could also exchange and clean air in your home. Although air conditioners and humidifiers often harbor harmful bacteria, mold, fungi, and viruses that are spread into the air, cleaning these instruments can help. Air conditioners should be professionally changed or cleaned at least once a year, depending on how much use they get. Humidifiers should be cleaned every day with a strong solution of white vinegar and very hot water. One added hint to keeping air clean is to buy common houseplants. Some houseplants have a natural ability to rid the air of harmful pollutants. To clean the air in a typical 1,500-square foot house 15 to 20 plants would probably be adequate. (Naar, 1990)

DAY 9-10: AIR POLLUTION (FOSSIL FUEL DENSITY COMPARISON LAB AND DISCUSSION OF FOSSIL FUEL DENSITY COMPARISON LAB REPORTS)

Here the students will determine the densities of coal and petroleum oil, compared to that of water, by determining each mass in gram units with a balance beam, by determining the liquid volume in milliliter units with a graduated cylinder, or by determining the solid volume in milliliter units by water displacement in a graduated cylinder. After the measurements are taken, the students can then use the formula D=M/V to calculate their densities. Next, the students can calculate their percentage error by using the formula PE=(OBSERVED VALUE - EXPECTED VALUE) / EXPECTED VALUE. Students will need to write a lab report also.

DAY 11: AIR POLLUTION (DISCUSSION OF ALTERNATE ENERGY SOURCES COMPARED TO FOSSIL FUELS AND A WRITTEN ESSAY DESCRIBING THE PROS AND CONS OF EACH ENERGY SOURCE)

DAY 12: AIR POLLUTION (SHARE YOUR RIDE: ACTIVITY WHERE STUDENTS ARE GIVEN INFORMATION TO DEBATE THE PROS AND CONS OF RIDING IN A CAR ALONE, CARPOOLING, RIDING A BUS, OR RIDING A TRAIN)

Students will learn that the average Connecticut commuter has a daily round trip commute of 60 miles. The IRS calculates the cost of operating a car at 29 cents per mile. Based on these facts, with 21 working days per month, the monthly cost to commute alone is $365.40. Sharing the ride and splitting the cost with others will reduce this cost. The students can calculate how much money can be saved monthly and yearly. Part two of this activity approaches the idea of reducing the amount of pollutants that we send into the atmosphere. It offers given information and requires students to calculate quantities of pollutants given off. The given information tells students that for each gallon of gasoline burned, approximately .403 pounds of carbon monoxide, .075 pounds of nitrogen dioxide, and .032 pounds of other chemicals enter the atmosphere. All of these substances upset our delicate environmental balance. Knowing that a car travels approximately 1200 miles / month, the typical car gets 20 mpg, and the average van gets 15 mpg, students can calculate the pounds of pollutants released per person per year by traveling in a vehicle. (Burns, 1995)

Below is a list of questions that can be answered after “Share Your Ride” activity:

1. When your ride is shared with two others at 9.7 cents / mile / person, what is the savings monthly? yearly?
2. When your ride is on a bus after you purchased a monthly bus ticket for $100.00, what is the savings monthly? yearly?
3. When your ride is on a train after you purchased a monthly train ticked for $79.00, what is the savings monthly? yearly?
4. What are the following pounds of pollutant / person / year created by a car with a single occupant at 1200 miles / month:
    a. carbon monoxide
    b. nitrogen dioxide
    c. other chemicals
    d. total
5. What are the following pounds of pollutant / person / year created by a car with a three occupants at 1200 miles / month:
    a. carbon monoxide
    b. nitrogen dioxide
    c. other chemicals
    d. total
6. What are the following pounds of pollutant / person / year created by a van with eight occupants at 1200 miles / month:
    a. carbon monoxide
    b. nitrogen dioxide
    c. other chemicals
    d. total
7. What have your calculations shown?
8. Imagine a situation twenty years into the future, where 50% of the population uses mass transit. Describe how this dramatic reduction in pollutants entering the atmosphere would affect the environment.

DAY 13: CARBON MONOXIDE (DISCUSSION AND DETECTION IN THE CLASSROOM WITH A CARBON MONOXIDE DETECTOR DEVICE)

Along with generally lowering air pollution, some specific measures can be taken to lower and monitor carbon monoxide levels. Carbon monoxide is a gas that is dangerous to humans as it is absorbed into our red blood cells two-hundred times more than oxygen. Therefore, carbon monoxide enters our red blood cells more readily, preventing an adequate amount of oxygen in our blood. People may then die of lack of oxygen to their tissues and brain. The term complete anoxia is used when the oxygen stores of the brain are exhausted within a few seconds. Here the body temperature, blood pressure, and pH fall rapidly and unconsciousness occurs as oxygen consumption of the brain is diminished. (Bokonjic, 1963)

Although carbon monoxide travels to the blood via the lungs, only about one half of it is absorbed by the blood, but the amounts which cause severe poisoning are of the order .1-.3%, therefore only a very small quantity is needed for damage. Studies have been conducted to determine human's revival and recovery time after exposure to high levels carbon monoxide. These studies have shown that in a matter of minutes, carbon monoxide poisoning can occur. (Bokonjic, 1963)

It has been estimated that the concentrations of carbon monoxide in parking garages are very high, usually exceeding the federal standard level of 35 ppm / 30 minutes. (Duan, 1988) Some ways to protect ourselves against carbon monoxide poisoning are by the following: Do not use gas-powered small devices or tools indoors. Try to use tools with electricity or compressed air. Check your oven for blue shaped flames, not irregular, lazy and yellow flames. Do not use an unvented gas heater in a bedroom. Check fireplace drafts, gas appliances, and chimney vents for defects yearly. Patch all vent pipes with gum or tape. Have the cooling unit of a gas refrigerator checked if it gives off an odor. Do not used charcoal grills or portable gas camp stoves indoors. Check your exhaust system of your car periodically. Do not run your automobile in the garage with the doors shut. (Center for Disease Control & National Center for Environmental Health, 1997)

DAY 14: RADON (DISCUSSION AND DETECTION IN THE CLASSROOM WITH A RADON DETECTOR DEVICE)

Radon-222, a nobel gas, is odorless, colorless, water soluble, radioactive, and is the heaviest known gas. Its solubility in water is inversely proportional to water temperature. (Cross, 1990) Radon gas has a half-life of 3.8 days and is a decay product of radium, that begins with uranium-238. Uranium is abundant in granite, shale, and certain phosphates that are found in small amounts dispersed throughout the earth's crust. Radon therefore may be found everywhere. Since it is a gas, radon filters through cracks in the bedrock and soil before it finally escapes into the atmosphere. When inhaled, radon gas flows quickly in and out of the lungs, but the formation of solid particles by radon poses the most serious problem as these tend to lodge in the bronchial tree. The particles can also damage the DNA which is found in all cells, and that damage can lead to uncontrollable cell reproduction which can cause the growth of a cancerous tumor. (Cole, 1993)

Studies have shown that the most significant factor in determining radon concentration was the geographical region, followed by the soil type, year of building construction, and type of building foundation. The lower figure represents a house with a basement, built in 1950's on clay soil. The higher figure represents a house with a concrete slab in contact with the ground, built in the 1980's on gravel. (Makelainen, 1990) This study shows that certain geographical regions and soil types with abundant granite, shale, and certain phosphates can have a high radon concentration. It also shows that houses built in 1950's were usually less air tight which allowed a higher air exchange rate to get rid of radon gas. Additionally, a concrete slab foundation in contact with the ground will allow for more detrimental filtering of the radon gas.

DAY 15: LEAD (DISCUSSION AND REVIEW OF WHAT LEAD IS, WHERE IT IS FOUND, AND HOW TO PREVENT LEAD POISONING)

The Childhood Lead Poisoning Program supported by the Center for Disease Control and the National Center of Environmental Health inspects 20,000 homes annually for lead poisoning. They specifically check paint, ceramics, dishes, walls, window sills, leaded gas, and lead solders. Lead exposure attributable to automobile air emissions was a major exposure source prior to 1976. Between 1976 and 1990, lead used in gasoline declined by 99.8% in the United States, but not in some other countries where lead is permitted in gasoline. (N.A.P.E., 1993)

Blood tests on individuals may be done in order to detect lead poisoning. If a blood level of an individual ranges from 10-19 micrograms of lead per 1 deciliter of blood, follow-up and repeat screening will need to be done. A blood level at approximately 20 micrograms of lead per 1 deciliter of blood indicates lead poisoning and requires treatment. A blood level at approximately 70 micrograms of lead per 1 deciliter of blood indicates a serious case of lead poisoning and requires chelation. (Childhood Lead Poisoning Program, 1997)

The symptoms of lead poisoning may appear in various forms. Acute lead encephalopathy may result in coma, seizures, apathy, incoordination, alternate states of consciousness, or loss of skills. Severe and permanent brain damage may result in 70-80% of children infected. Symptomatic lead poisoning may result in decreasing in play activities, lethargy, anorexia, vomiting, intermittent abdominal pain, or constipation. These two forms of lead poisoning require a blood test to determine the exact concentration of lead in the blood. (Childhood Lead Poisoning Program, 1997)

Some agents to treat lead poisoning are Bal in Oil, Curpimine, Chemet, and CaNa EDTA. The CaNa EDTA Chelation Test requires the patient to empty his / her bladder and be infused with this chemical at 500 mg/m in 5% dextrose over 1 hour. If caught early enough, these cases of poisoning can be treated sufficiently. (Childhood Lead Poisoning Program, 1997)

What can you do to prevent or decrease lead poisoning in your home? First of all, one common mistake in ridding of lead paint in the home is to chip away at it and dispose of all pieces. This is not as easy as it seems. As you begin to chip at the paint, small lead dust particles enter the air and can make their way to your airways and lungs. This can cause a worse scenario than before. In order to properly get rid of lead paint, trained professionals need to do the job with ventilated masks and technical equipment. Other approaches you can take in your home include using a wet mop approximately twice a week. This prevents lead dust from accumulating. Also, you should use cleaners high in phosphates to prevent lead poisoning. Remember that most homes built prior to 1970 did use lead paints on walls and especially window sills. If you feel your house could have lead build-up, have it examined by a professional or call the LEAD HOTLINE at 1-800-424-LEAD.

DAY 16: TOXIC-WASTE (DISCUSSION)

In the United States there are some 75,000 chemicals in everyday use, mnay of which endanger the lives of millions of people who live near where they are produced, handled, transported, or dumped. Contained in pesticides, herbicides, food additives, drinking water, building materials, household goods, and many other carriers, toxic chemicals threaten every woman, man, child, and animal. We are literally poisoning ourselves to death. (Naar, 1990)

Toxic waste disposal is being implemented in most areas, but the methods contain flaws. The main disposal methods are as follows:

a. Dumping in pits, ponds, and lagoons. This is the cheapest and least regulated method, any many sites are illegal.
b. Landfills fitted with liners of clay and plastic. They have the potential of leaching toxic substances into ground, water, and sewers.
c. Above-ground storage by tanks or sheds. These present the danger of fire or explosion.
d. Incineration where combustion is used to destroy toxic materials. This produces air pollution and residual ash.
e. Underground deep wells. A concern of the impact of earthquakes. (Naar, 1990)

Some health effects of toxic chemicals include swelling of tissues in the upper respiratory tract, depression of the central nervous system, irritation, and stripping naturally protective oils from skin, lung tissue, or eyes. Other effects are damaging cells, and chronic effects on the liver, kidneys, and heart. In addition, most of the chemicals mentioned are suspected of causing cancer. (Naar, 1990)

What can you do about toxic chemicals? First, realize that although it may not seem important if you pour a can of old bleach or turpentine down the sink or toilet, imagine our country’s total dumping. For example, if you mulitply your one can by 83 million other houseuholds in the United States, each one of which contains an estimated 3 to 8 gallons of hazardous waste, it certainly adds up. Therefore, clean up your own mess in the proper fashion. Also, contact the EPA and your local toxic waste facility for specific information on removal of toxic wastes. (Naar, 1990)

DAY 17: TOXIC-WASTE (LAB ON HOW CAN YOU CLEAN WITHOUT TOXIC CHEMICALS?)

Lab: “Cleaning your house many be hazardous to your health.” Although this statement may sound like a joke, it is not. Most household cleaning products —from furniture polishes to disinfectants to rug shampoos — contain toxic chemicals that can damage your health and pollute water supplies. Are there alternatives to toxic household cleaners? Try this lab and see.

Materials for each pair of students:

-3 buckets	-baking soda	-water
-cornstarch	-soap flakes	-white vinegar
-stirrer	-rags or paper towels	-all-purpose cleaning liquid

Procedure:

1. Make a nontoxic all-purpose cleaning liquid in a bucket. Add 1 tablespoon (15 mL) of baking soda and 1/4 cup (60 mL) of soap flakes to 1 gallon (3.8 L) of hot water. Stir well.
2. Wet the sponge with the homemade cleaning liquid, then clean a dirty desktop. Rinse the sponge thoroughly with clean tap water.
3. Use the store-bought cleaner to clean another dirty surface.
4. Make a nontoxic glass cleaner in another bucket. Add 2 tablespoons (30 mL) of cornstarch and 1/2 cup (120 mL) of white vinegar to 1 gallon (3.8 L) of warm water. Stir.
5. Moisten a rag or paper towel with the homemade glass cleaner. Clean a dirty window.
6. Use the store-bought cleaner to clean a dirty window.

Questions:

1. Which does a better job of cleaning a desktop, the homemade cleaner or the store-bought kind? Which does a better job of cleaning the window?
2. Do any of the cleaners have an unpleasant odor? Which cleaning fluid has the most unpleasant odor and which one has the least unpleasant odor?
3. Do any of the cleaners irritate your hands or eyes? Rate the cleaners for irritation.
4. Was it time consuming or inconvenient to mix up either of the homemade cleaners? Explain your answer.
5. Compare the ingredients in your homemade cleaners to the ingredients on the store-bought cleaners. What seems to be the biggest difference between them?

6. Which products do you think would be less harmful to the environment, the store-bought cleaners or the homemade kinds?
7. How do you think most people dispose of cleaning products after they have finished using them? What effect would disposing of cleaners in this way have on the environment?

DAY 18: TOXIC-WASTE (FIELD TRIP TO THE LOCAL SEWAGE TREATMENT PLANT)

DAY 19-21: MOCK ENVIRONMENTAL INVESTIGATIONS

Another activity for my class is to conduct mock environmental investigations of homes / buildings. Here students can use the following information on the U.S. EPA Standards Data Sheet in order to identify if an agent meets its standard. Students will work in groups of 2 or 3 and they will each be given EPA inspector buttons to wear. They can give their EPA inspector agency a specific name only for their group. First, they will need to familiarize themselves with the U.S. EPA Standards Data Sheet making sure they know each type of pollution and its correct unit. Next, they will be given different layouts for mock environmental investigations of homes / buildings. Each group needs to analyze the information given and compare it to the U.S. EPA Standards Data Sheet. After a comparison is made, the group can determine if the pollution pose a mild or serious threat, or no threat at all. They may then begin their lab report which entails: Problem, Hypothesis, Observations, Steps of Experiment, Data, Analysis of Data, Conclusion, and Criticism. Each group will work on their own mock investigations and may present their lab report in different ways. The lab report also needs to include: How did the pollution get to that area? Why were certain pollution levels higher than the standards? What can be done to stop this pollution? What can be done to prevent further pollution of this type? What detrimental effects could this type of pollution have on living things?

In summary, with this activity, students will be given various statistics of buildings, concentrations of possible pollutants, and information on products or procedures in the building that could cause pollution. The class needs to identify the pollutants that are causing problems, where specifically in the building are the problems, can the pollutants spread, if so how and where, what are possible consequences of these pollutants, are they mild or serious, and what methodology would they use to remediate the problems? With this activity, students will be measuring and converting scientific measurements using ppm, ppb, mcg, pCi, and forms of area and volume, and they will get practice in an interdisciplinary activity requiring mathematics and scientific skills. Additionally, students will need to use problem-solving techniques in order to determine cause and effect and to develop solutions based on observation and experimentation. This allows the students to work at their own pace and to use their own knowledge to approach a problem from different angles. Furthermore, as the class writes up a lab report from their findings, they will need to present it professionally as they are acting as environmental inspectors. This written report and oral presentation combine the language arts skills and scientific skills to make another interdisciplinary activity.

U.S. EPA STANDARDS DATA SHEET FOR MOCK ENVIRONMENTAL INVESTIGATIONS

STANDARDS FOR MAJOR POLLUTION FOR AIR AND DRINKING WATER (SOURCE: U.S. EPA, 1993)

1. OZONE	220 ppb for 30 minutes
2. CARBON MONOXIDE	35 ppm for 30 minutes
	(levels as high as 50-100 ppm have been detected in traffic jams or on freeways during rush hours)
3. AIRBORNE PARTICULATES-	150 mcg / m for 24 hours

(10 microns = 1/1000 m in diameter)

4. NITROGEN DIOXIDE	53 ppm for 1 year
5. SULFUR DIOXIDE	330 ppm for 1 year
	140 ppm for 24 hours
6. LEAD	1.5 mcg / m for 3 months
	200 mcg / m for floors
	500 mcg / m for window sills
	.05 mg / L in primary drinking water
	10-19 mcg / dL in blood = caution and further screening
	20 mcg / dL in blood = lead poisoning
	above 70 mcg / dL in blood = serious lead poisoning requiring chelation treatment
7. CHLORIDE	250 mg / L
8. COPPER	1 mg / L
9. ZINC	5 mg / L
10. FLUORIDE	2 mg / L
11. IRON	0.3 mg / L
12. MANGANESE	0.05 mg / L
13. MERCURY	0.002 mg / L
14. ARSENIC	0.05 mg / L
15. BARIUM	1 mg / L
16. CADMIUM	0.01 mg / L
17. CHROMIUM	0.05 mg / L
18. TOTAL COLIFORMS	1 per 100 mm
19. RADON	4 pCi / L = guidance level which requires a thorough inspection
20. HYDROCARBONS	5 ppb in drinking water
21. DISSOLVED SOLIDS	0-60 mg / L = soft water

61-120 mg / L = average water

121-180 mg / L = hard water

(figure available in print form)

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Reading List for Students:

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2. Chemistry : A Modern Course (textbook for chemistry classes) 1990.

3. Chemistry : Visualizing Matter (textbook for chemistry classes) 1996.

4. Globe Book Company “Science, Technology, & Society : Impacts of Technology” 1993.

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List of Materials for Classroom Use:

1. LaMotte Company Tap Water Tour Test

2. motor oil

3. coal

4. graduated cylinders

5. beakers

6. calculators

7. balance beams

8. Carbon monoxide detector device

9. Radon detector device

10. buckets

11. baking soda

12. cornstarch

13. soap flakes

14. white vinegar

15. stirrers

16. rags or paper towels

17. all-purpose cleaning liquid