



Indoor versus Outdoor Air: What's the Difference?

Curriculum Unit 11.04.02
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Objective

In the curriculum unit, *Indoor versus Outdoor Air: What's the Difference*, students will develop an understanding of air pollution, both outdoors and indoors. Students will examine pollutants that exist in both areas through monitoring and make careful decisions of how their role can decrease such pollutants. They will become familiar with the emission of burning fossil fuels and also become aware of such hazards as to paints that we use in our homes, as well as caustic fibers in carpets. They will also be made aware of testing the quality of the air they breathe with monitoring devices and check out the circulation of the air within their school building.

Introduction

This unit will be taught to four sixth grade general science classes at Betsy Ross Arts Magnet School in New Haven, CT. Science is departmentalized at Betsy Ross and each class period is fifty-two minutes long, approximately. The sixth grade curriculum has four science standards that must be taught throughout the year and they are Ecosystems, Simple Machines, Weather, and the Human Impact on Our Water. The curriculum unit I plan to introduce is the Human Impact on Our Water. It was suggested to me by my science supervisor, Richard Therrien, that air pollution is ignored in our curriculum, but it shouldn't be because we are an inner-city school district and air pollution is a major problem. The reason why water is more emphasized is because the state standards believe this is more relevant due to the suburbs having well water and, thus, water quality is more important. I believe, due to the high rates of asthma and allergies amongst my students, they need to understand air pollution, both indoors and outdoors. The fact that our children spend more time indoors than I did in growing up, they need to know that there are as many dangers to indoor air, even more so, than outdoor air.

I plan to have students become more aware of using natural cleaning products and since New Haven Public Schools are using more natural cleaning products, students will have to realize that strong odors, such as chlorine bleach, doesn't make things any cleaner than products made from citrus products. Baking soda and

lemons can have just as much power as the bleaches and ammonia, which can lead to upper respiratory ailments. Some hands-on laboratory activities will be to create natural cleaners. Although I will not be able to enforce students to change the habits of their parents, my goal is to educate them in alternative practices for their adult lives. Just opening up a window can greatly decrease indoor air pollution. Our school is centrally heated and air-conditioned, but I plan on opening up a window in my classroom to make the point that pollutants are more diffused outdoors than indoors.

Background Information

Between our homes, our workplaces, our cars, or in stores, we spend about 90% of our time indoors. A lot of concern goes into outdoor air pollution, but we need to be just as concerned about the air we breathe indoors. We need to think about the amount of pollutants per unit of air and the number of times we are exposed to the pollutants. Whatever pollutants are outdoors will make its way indoors, but at a higher concentration. Then there are the pollutants we are exposed to from the furnishings we have in our homes, the cleaning products we use, and other lifestyle habits we have fostered that add to this pollution problem. Indoor air pollution falls into several categories, one being gases (including tobacco products), microbiologicals, particles (which can be from solids or liquids), and pesticides.

Gases

Gases, such as tobacco smoke, are extremely hazardous to humans and animals and are known to be carcinogenic. It contributes to higher rates of upper respiratory infection in children and it exacerbates asthma. Another harmful gas that has been found in homes is radon. Radon is a radioactive gas that seeps into homes from the soil. Radon can cause lung cancer. Mixing radon and tobacco together makes a potent cocktail that increases the chance of lung cancer even more.

Carbon monoxide is another harmful indoor gas that is formed from the burning of fossil fuels through heating and cooking and from cars running in garages. Carbon monoxide interferes with the blood's ability to carry oxygen, thus making this gas fatal if exposed to high doses. Nitrogen oxide is another gas that is a respiratory irritant and this is produced in the homes the same way as carbon monoxide by the burning of fossil fuels.

Then there are the organic gases that come in many household products such as paints, varnishes, cleaning solutions, cosmetics, deodorants, carpeting, and disinfectants. These gases can irritate eyes, noses, and throats, causes headaches, and coordination loss, nausea, dizziness; damage to kidney, liver, and central nervous system. These gases are also named *volatile organic compounds* (VOC's). which are gases that are emitted from solids or liquids. VOC's have been found in furnishings, office equipment such as copiers and printers, pesticides, correction fluids, aerosol sprays, moth repellents, air fresheners, stored fuels, automotive products, and building materials. One of the major building materials used for the last forty years has been polyvinyl chloride plastic or PVC.

Polyvinyl chloride plastic is used, not only in building materials, but in furnishings and electronics. Globally, PVC production totals over 30 million tons per year and since PVC production leads to the production of chlorine, PVC production accounts for a huge energy issue, as well. Chlorine production is one of the most energy-intensive processes, globally. Chlorine production also causes mercury pollution to the environment.

Another major issue is that PVC is very difficult to recycle. It does not biodegrade.

The potential hazard in using PVC is the by-product it produces which is organochlorine. This by-product begins with the production of chlorine gas. Flexible vinyl products are found in many homes like roof tiles and vinyl wall coverings. The potential dangers are that it releases phthalates and it also promotes harmful mold growth. Because it is impermeable to moisture, toxic mold may grow beneath the vinyl causing severe health issues.

Microbiologicals

Not all mold growth comes from flexible vinyl. Mold falls under the category of microbiologicals. This also includes bacteria, mildew, viruses, animal dander, dust mites, and pollen from both indoor and outdoor plants. Moisture and humidity make for a nice setting for these microbiologicals room to thrive. These biologicals cause diseases and infections, exacerbate asthma, allergic reactions, and irritate eyes and respiratory tract.

Particles

The three main particles that are of the greatest concern are asbestos, lead and respirable particles. Asbestos is found in insulation, soundproofing, fireproofing, floor and ceiling tiles. Asbestos causes lung cancer called mesothelioma or to asbestosis, which is a permanent scarring of the lungs. Asbestos is found, more commonly, in schools and workplaces.

Lead was used in paint because it covered surfaces well and wore well. As of 1978, lead was removed from paint, but any home or building built prior to 1978 may still have lead paint. Lead paint dust can be breathed in and it impairs the central nervous system. Lead particles inhaled by children can interfere with their cognitive ability.

Then there are respirable particles that enter our homes principally through the combustion of stoves, fireplaces, hot water heaters, and boilers. Cleaning stirs up these particles. Car exhaust and particles from power plants also enter indoors. These fine particles increase the incidence of asthma attacks, respiratory irritation and can lead to heart problems.

Pesticides

Pesticides include herbicides, insecticides, and disinfectants. Although these levels are usually low, it is one more ingredient to be added to the mix of indoor pollutants that can account for our ill-health. One study indicates that 80 % of our exposure to pesticides occurs indoors.

Health Impacts

Besides the general health impacts outlined above, there are specific diseases that have been directly correlated to indoor air pollution. One such disease is Legionnaires' disease, which first broke out in 1976 and killed 39 American Legion members at a convention. Legionnaires' disease is a pneumonia caused by breathing in Legionella bacteria. This bacterium can come from contaminated water in ventilation systems, or any other moisture-producing system.

Another specific disease is hypersensitivity pneumonitis, which is a rare lung disease caused by bacteria and mold resulting from air conditioning and humidifying systems. The symptoms of this disease are very similar to viral and bacterial pneumonia. Still another specific disease is humidifier fever with symptoms such as

fever, aches, and fatigue. It may be caused by toxic byproducts of bacteria.

Then there are two well-known syndromes associated with indoor air pollution and they are "sick building syndrome" and "multiple chemical sensitivity." Sick building syndrome symptoms are fatigue, lack of concentration, nausea, and respiratory irritation, dry or itchy skin and sensitivity to odors. Multiple chemical sensitivity is more controversial. Most medical associations don't believe it exist at all, but theorists speculate that since it occurs more in women than men, it could be a dysfunction in the immunological or neurological systems brought on by being expose to chemical spills, or low-dose exposures to chemicals from soaps, cosmetics, or newspaper inks. The symptoms are headaches, fatigue, asthma, depression, rashes and muscles and joint pain.

What Can We Do to Reduce Indoor Air Pollution?

With the push for constructing "green buildings," using materials made of PCV vinyl will be the antithesis to providing a cleaner environment. Thus, phasing out PCV building materials is the way to go in order to protect human health and the health of the environment.

As individual dwellers of homes, we can use more environmentally-friendly products that can reduce our exposure to harmful chemicals. Since we know that chlorine bleach is hazardous, oxygen bleach can be a healthier alternative. Oxygen bleach is non-polluting, non-toxic, biodegradable, and made with 100% natural ingredients. Another alternative to using chlorine bleach is hydrogen peroxide, which is a natural bleach alternative that is safe to use around the house. Another natural household cleanser is lemon juice. Lemon juice can also remove stains from white clothes. For stubborn stains, making a paste of lemon juice and cream of tartar will work and it also can remove rust stains. Milk can remove ink stains on clothes and borax removes stains from clothes, as well.

Instead of using commercial air fresheners, which contains formaldehyde, a known carcinogen, simmering natural ingredients on the stove will do the trick without the chemicals. Using ingredients such as lemons, or mint, or cloves and cinnamon sticks can be a better alternative.

To remove mold or mildew, conventional products contain bleach and other corrosive chemicals such as formaldehyde, a healthy alternative is tree oil (found in health food stores). It can be mixed with water and put in a spray bottle which can be sprayed on mold and mildew.

The traditional solution to unclogging drains is to use dangerous drain cleaners, which contains lye, hydrochloric acid, and trichloroethane. These chemicals are very hazardous. Lye is very caustic and hydrochloric acid and trichloroethane can cause kidney and liver damage. A healthier alternative is to use baking soda and boiling water. This application can be followed by a dose of vinegar. If this doesn't work, using a plumber's snake will work.

Furniture polish has toxins and is highly flammable. A safer alternative is mayonnaise, a soft cloth and some elbow grease. Cool tea is also a great polisher.

Oven cleaners have very caustic chemicals and the fumes are very difficult to breathe. An alternative is to use baking soda and hot water. A paste of baking soda and water can be applied to tough stains and left overnight.

Black tea kills dust mites, which contribute to allergy suffering. Borax cleans toilets, Vinegar, water and a little

liquid soap cleans windows and mirrors. Baking soda and dishwashing soap can be made as a soft scrub for tubs and sinks. There are a myriad of natural products that are available and have less health risks associated with them, but it is important to do some research on these products and always read the ingredients. Rule of thumb, if you can not pronounce the ingredient, it is a good idea to avoid using that product. Sometimes there is no choice but to use hazardous materials, therefore reading the labels and following the directions will make it safer to use. When forced to use toxic substances, proper ventilation is key to keeping indoor air pollution to a minimum.

More Facts about Indoor Air Pollution:

- Dishwashers, washing machines and showers strip chemicals from the water and emit these chemicals into the air.
- Permanent-press clothing and drapes release high levels of potentially toxic vapors.
- Wall-to-wall carpeting release a potentially toxic gas called 4-phenylchlorohexene, or 4-PC. Also carpeting serves as a reservoir for other toxics such as pesticides and chemicals used for dry-clean clothing.

Potential Hazards in the Work Place:

- According to the General Accounting Office, half of the schools in the United States have some sort of indoor air pollution. This is due to poor ventilation, crowded buildings, and inadequate cleaning of filters, poor maintenance of ventilation equipment.
- Younger populations in schools generally bring in biological pollutants such as pet dander, bacteria, and viruses.
- Schools also have the potential for other pollutants such as markers, paint, adhesives, art materials, chalk dust, floor wax, and emissions from copying and duplicating machines.
- Asbestos is still found in schools as a fire retardant for pipes, boilers, wall and ceiling tiles, as well as floor tiles.

How to Reduce Our Risk:

- Do not smoke indoors
- Make sure all heating appliances are running efficiently
- Install a hood over the stove
- Repair any leaky roofs, foundations or wall to avoid biological contaminants
- Remove any carpeting that has gotten wet
- Vacuum regularly
- Ventilate your attic
- Empty drip pans under the refrigerator

- If installing new carpet, roll in outdoors to air it out
- Keep food areas clean on order to not attract roaches
- Buy limited quantities of cleaners, disinfectants, and pesticides and use with proper ventilation
- Don't idle your vehicle in your garage

Strategies

This unit will begin with a brainstorming session on what students know about air pollution, what questions they want to ask about air pollution, in other words a KWL chart. Students throughout the unit will add to this chart of what they have learned about air pollution. Students will have hands-on learning experiences in testing air quality. This chart will be kept in their interactive notebooks.

An interactive notebook is a notebook that contains all the information that is given in each lesson. Hand outs are glued into the notebook and pages are based on the Cornell note-taking strategy which is a two-column page where questions are on the left side and notes are on the right side. An objective for the day is written at the top of the page and each page has a date. This is always on the right side of the notebook, which is the input. Students summarize what they have learned each day at the bottom of this page. A demonstration of the content knowledge is displayed on the left side page of the notebook. This demonstration is homework and laboratory data sheets. All pages are numbered and a Table of Contents is updated daily with new entries added every day. The purpose for this method is to help students retain what they have learned. This is vitally important since the units I teach will be on the eighth grade Connecticut Mastery Test and these units will not be revisited again until such time.

Students will be introduced to new vocabulary through a method called "matchbook foldable" which is a 3 x 6 inch piece of construction paper folded to resemble a matchbook. Students will draw a picture of the new word or concept on the front cover, the phonetic spelling will be on the inner top flap, the definition will be written on the inner bottom flap and the word, or concept will be written on the small flap in the front. What that helps students to do is to visualize new concepts in their minds in order for retention to take place. There are many other foldables that will enhance comprehension and retention of key concepts.

Activities

Activity # 1

Students will take a personal inventory of every day products they use to see how much indoor air pollution they are adding to their environment.

Personal Inventory of Potential Indoor Pollutants

1. Write a list of the personal care products you used today for work or school.

2. Were any of these products an aerosol spray? Yes _____ No _____

3. What type of fuel heats and/or cools your home? _____

4. Did you cook this morning and if so, what kind of fuel does your stove use? _____

5. Do you sleep with a window cracked, even in the winter? Yes _____ No _____

6. Does anyone in your home smokes inside? Yes _____ No _____

7. Do you use a humidifier in your home? Yes _____ No _____

8. Do you use a dehumidifier in your home? Yes _____ No _____

9. Would you say your home is energy efficient (insulated windows and doors keeping outside air out)? Yes _____ No _____

10. Does your family burn candles and/or incense, wood-burning stove, kerosene stove, and/or fireplace? If so, please list.

11. Do you know what kind of paint was used inside your home? If so, please list?

12. How often does your family paint the interior of your home?

13. Do you have potted plants in your home? Yes _____ No _____

14. Do you have wall-to-wall carpeting? Yes _____ No _____

15. Do you have pets and what kind do you have? _____

16. Do any of your family members suffer from asthma and/or allergies? If yes, how many people? _____

17. Choose the area you live near:

_____ Wooded area

_____ City Street

_____ Suburban Street

_____ Major Intersection

_____ Highway

_____ Cul-de-sac

18. Do you have a garage? If so, is it attached to your home, near your home, or underneath you home? _____

Rating scale:

Item #2: For every aerosol spray listed, deduct 1 point.

Item # 4: Deduct 1 point if your answer was yes.

Item # 5: Add 1 point if your answer was yes.

Item # 6: Add a point if your answer was no.

Item # 7: Deduct 1 point if your answer was yes.

Item # 8: Add 1 point if your answer was yes.

Item 9: Add 1 point if your answer was yes.

Item # 10: Deduct 1 point for every item listed.

Item #11: If paint contained lead, deduct 1 point (usually in an older house).

Item # 12: Deduct 1 point for how often you paint.

Item # 13: Add a point for each potted plant.

Item # 14: Deduct 1 point if your answer was yes.

Item # 15: Deduct a point for every furry animal.

Item # 16: Deduct 1 point for each person.

After taking the personal inventory and rating their answers, students will compare results and see what ways they can change some of their habits in order to improve the air inside their homes.

Activity # 2

Students will research facts about indoor air pollution and outdoor air pollution in order to compare and contrast using a two-circle Venn diagram.

Indoor Air

- We spend 90% of our time indoors
- There is very little air exchange between indoor and outdoor air
- Children don't spend a lot of time playing outdoors
- Cleaning products, paint, carpeting, dust mites, fungi, and bacteria contribute to poor indoor air quality
- Carbon monoxide and radon seep in households from the Earth
- Asbestos
- Lead
- Respirable particles which are microscopic solid or liquid matter due to burning of fireplaces, stoves, etc.
-
- Outdoor Air
-
- Fumes from car exhaust and industry increases our exposure to pollutants
- Pollen and other allergens add to our pollution problems
- Acid rain due high levels of smog stacks which will cause an increase of sulfuric acid and nitrogen oxide
- We are adding more carbon dioxide to the air than the plants can convert to oxygen resulting to global warming
- Ozone depletion due to increase use of chlorofluorocarbons (CFC's)

Activity # 3

Students will prepare monitoring strips that will be placed in various locations within their homes, as well as in the school building.

Materials:

- 3x5 index cards
- Scissors
- Adhesive tape
- Hand lens

Procedure:

1. Fold cards in half.
2. Cut a hole one inch by three inches
3. Apply adhesive tape to the hole with the sticky side facing up to catch particulates

4. Set up cards at various locations where the cards will not be disturbed. After a few days, collect the cards and examine with hand lens.
5. Count the amount of particulates on each of the cards.
6. Create a bar graph from the data collected.
7. Students will write an explanation as to why certain areas had more particulates than others.

Activity # 4

Students will monitor air quality of the same various locations as outlined in Activity # 3 using an air quality monitoring system. Students will create a data table and compare the results from Activity # 3. Students will write an analytical essay with the comparison and its implications.

Activity # 5

Students will work in groups in order to complete a culminating argument of indoor air quality of their school building by creating a poster, brochures, commercial, newspaper article, or power point presentation.

Works Cited

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Appendix

6.2 - An ecosystem is composed of all the populations that are living in a certain space and the physical factors with which they interact.

Populations in ecosystems are affected by biotic factors, such as other populations, and abiotic factors, such as soil and water supply.

Populations in ecosystems can be categorized as producers, consumers and decomposers of organic matter.

C 4. Describe how abiotic factors, such as temperature, water and sunlight, affect the ability of plants to create their own food through photosynthesis.

C 5. Explain how populations are affected by predator-prey relationships.

C 6. Describe common food webs in different Connecticut ecosystems.

Science and Technology in Society - How do science and technology affect the quality of our lives? (EARTH)

6.4 - Water moving across and through earth materials carries with it the products of human activities.

Most precipitation that falls on Connecticut eventually reaches Long Island Sound.

C 10. Explain the role of septic and sewage systems on the quality of surface and ground water.

C 11. Explain how human activity may impact water resources in Connecticut, such as ponds, rivers and the Long Island Sound ecosystem.

REQUIRED CMT EMBEDDED TASK: DIG IN

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