Resources / Waste: Toxicity

Introduction

Chemical Use and Safety

Humans have used chemicals for a long time. The ancient Egyptians used chemicals for dyeing, soldering and coloring metal, and making jewelry. The Industrial Revolution, which began in the middle of the 18th century, spawned the development of many new chemicals and chemical processes. Since World War II, the global chemical industry has boomed. Global production of chemicals was 1 million tons in 1930 and is now over 400 million tons.

Environmental scientists study chemicals to determine if they are harmful to human health and the environment. Pretty much every chemical can harm you if you ingest too much of it. Take in too much water, for example, and you'll drown. Inhaling too much oxygen can lead to oxygen toxicity, a condition that can damage lung tissue as well as death. At the other end of the harmful spectrum is botulinum toxin, a single gram of which could kill upwards of a million people. Needless to say, it's classified as a bioweapon. In between oxygen and botulinum toxin are thousands of chemicals used every day to wash your hair, keep insects off your vegetables, and make you smell good.

The amount of harm a chemical can cause is known as toxicity. The word toxic comes from the Greek word "toxon" meaning a bow. Arrows were sometimes tipped with poison and the association between bows, arrows and poisons became our word "toxic". Harm from chemicals can be acute or chronic, or a combination. Acute effects are those that happen immediately. Chronic effects are those that are generally less harmful but over a longer time period. A severe cold, for example with a high fever, would be considered acute. A less bothersome one that you can't get rid of would be considered chronic. Some chemicals can kill you in a very short period of time. Others can affect you in ways which may not be detectable for decades.

There is the increasing concern about the risks through which humans are exposed by toxic substances in the environment. Toxic substances can cause cancer which may appear decades after exposure and be indistinguishable from cancer caused by other means. Exposure to toxic substances can also result in effects on reproductive systems and immune system degradation. Plants and wildlife can also be affected by toxic substances.

A number of factors can affect the potential for a chemical to be harmful to public health or the environment. These include persistence, bioaccumulation and toxicity. Persistence refers to how long a chemical remains in air, water, soil or sediment in an unchanged form. Bioaccumulation refers to the ability of a chemical to increase in concentration as it makes its way through living organisms. Some chemicals, mainly organic chemicals, breakdown and are released as waste in living organisms. Inorganic chemicals tend not to break down but rather stay within living organisms and accumulate. Toxicity is a function of the chemical nature of a chemical, as well as its concentration.

Both the Environmental Protection Agency (EPA) and the Food and Drug Administration (FDA) have the authority to regulate chemicals in the United States. The EPA, through the Toxic Substances Control Act, has the authority to both regulate existing chemicals as well screen new chemicals before they are used commercially. There are some 75,000 chemicals in EPA's TSCA inventory, though a proportion of these may not be currently manufactured or are produced in small volumes. Chemical companies claim that EPA requires too much testing, while environmental and health organizations maintain that EPA does not

go far enough to protect public health and the environment. Most Americans assume that basic toxicity testing data is readily available and that all chemicals used in commerce today are safe.

Activity

This week's activity is broken up into five different parts. In the first part, we will analyze websites to determine the safety of chemicals used in the United States. To begin with, go to http://www.epa.gov/chemrtk/hazchem.htm and answer the questions in Part One of the Activity Sheet. The term TRI chemical refers to Toxic Release Inventory chemicals. The Toxic Release Inventory is a program created by Congress that requires manufacturing facilities and waste handling and disposal sites to report annually on releases of nearly 600 toxic materials. In evaluating data availability for hazardous chemicals, EPA also looked at chemicals in consumer products used by children and families. To answer the last two questions in Part One, scroll down the page until you come to the "Major Conclusions" section of the EPA website. Go to the third "bullet" in the Major Conclusions section.

For Part Two of the exercise, let's visit at a website that looks at pollution, most of which is chemical, in communities across the United States. To begin, go to http://www.scorecard.org/ and click on the "Toxic Chemical Releases" in the top left hand corner. Answer the questions in Part Two. To answer the last 3 questions in this part, click on the "Provide your Zip code" link on the main page of the website and type in your zip code. From there, click on the "Rank counties in YOUR STATE" link at the lower left.

So far we've determined that there lots of chemicals we use everyday in our houses, that there's little information about the potential harmfulness of these chemicals and that there's also significant releases of chemicals into the nations air, land and water. So what? Let's take a look…

For Part Three, we will look at three major studies of concentrations of chemical pollutants in the human body that have recently been completed. One was conducted by the Center for Disease Control (CDC) and one by the Mount Sinai School of Medicine in collaboration with two non-profit environmental organizations, The Environmental Working Group and Commonwealth. The third study was conducted by the World Wildlife Fund. For the CDC study, click on the "Second Report" link on the right hand side of the page. On the bottom left side of the "Second National Report on Human Exposure to Environmental Chemicals" page, click on the selected findings link. Scroll down the selected findings page until you come to the section on lead.

Generally, chemicals have been developed without much thought given to public or environmental considerations. Generations of chemical engineers, who design chemicals, have been trained without coursework in either public health or environmental science. It has only been after the chemical is developed and manufactured, that a public health or environmental problem has been discovered. It doesn't have to be this way.

For Part Four of the activity, let's look at a chemical problem involving a small Swiss textile manufacturer, one of the largest chemical manufacturers in the world, and two visionary "eco-thinkers", one a German chemist and former Greenpeace activist, the other an architect from Virginia. Go to http://www.google.com/search?hl=en&lr=&q=Rohner+Textil&btnG=Search and you'll come up on a website maintained by the World Business Council for Sustainable Development, a coalition of 170 international companies united by a shared commitment to economic growth, ecological balance and social progress. Begin by reading the article "The Eco Industrial Revolution". Answer the questions in Part Four of the Activity Sheet.

For the last part, let us go back to the work that we did in the Home Chemicals activity. In this activity, you were asked to identify three products around your home that were potentially hazardous. List each of the products below and describe the "service" that you get from each product. For example, there are many pesticides available that eliminate ants inside a house. So, in this case, you would simply list the name of the pesticide and the service would be that it "kills ants".

Your "home work" is to conduct research to identify less hazardous alternatives for each of the three products you've listed. There are lots of ways to do this. You could go to a library and find a home

ecology book or catalog that has alternatives listed or search the web. For example, the author of this website conducted an Internet search for an alternative for pesticides used to eliminate ants and found that instant grits can be used to kill ants. The ants eat the grits and, because the grits are dried out, expand when they come in contact with the ant's stomach fluids, and kills the ants. There are all kinds of information available for just about, if not, every chemical you use in your home. Try Google (http://www.google.com/) or any of the other popular websites. Once you have identified alternatives, record what you have found out below and complete the questions at the end. Good luck!

References

http://chemistry.about.com/cs/5/f/blpoison.htm
http://jama.ama-assn.org/cgi/content/full/285/8/1059
http://dl.clackamas.cc.or.us/ch104-10/(1).htm
http://www.cleaningpro.com/toxic.cfm
http://www.chem-tox.com/
http://www.healthychildrenproject.org/exposures/chemicals.html
http://www.safe2use.com/ca-ipm/01-11-14a.htm
http://www.scorecard.org/
http://www.chennaionline.com/science/Environment/harm.asp
http://www.worldwildlife.org/toxics/basic.cfm
http://www.wwf.pl/0406281352_newsen.php
http://chemistry.about.com/cs/5/f/blpoison.htm
http://www.mamashealth.com/doc/cleanprod.asp
http://www.touregypt.net/chemicals.htm
http://es.epa.gov/techinfo/facts/safe-fs.html
http://www.chemicalindustryarchives.org/factfiction/testing.asp
http://www.scorecard.org/chemical-profiles/def/hpv.html

ESA21: Environmental Science Activities

Activity Sheet
Toxic Chemicals

Name:

Part One – Are Chemicals Safe?

1. What volume range of chemical production or importation was used for the EPA study?

2. What are these chemicals called?

3. How many chemicals fall into this category?

4. What percentage of these chemicals had no testing data on basic toxicity?

5. What percentage of these chemicals had a full set of basic test data?

6. What percentage of these chemicals had incomplete testing data? (take 100% minus % chemicals with no data and % chemicals with full date set).

7. How do you feel about the results of the EPA Chemical Hazard Data Availability Study?

8. How many basic tests have been internationally agreed to for screening chemicals?

9. What are they?

10. What are these tests referred to as (otherwise known as their official name)?

11. What percentage of TRI chemicals has had full SIDS testing?

12. How do you feel about what you've discovered about TRI chemicals?

13. How many chemicals used by children and families did EPA evaluate as part of it's' research?

14. What percentage of these chemicals has full screening data?

15. How do you feel about chemicals used in consumer products?

16. What does is say there?

17. Are you surprised by EPA's findings?

Part Two – Where You Live

1. How many pounds of toxic chemicals are released into the environment each year in the U.S.?

2. Of these, what amount are recognized carcinogens?

3. How do you feel about what you've discovered?

4. Click on the "states" link. What five states have the greatest annual releases?

5. Are you surprised by the ranking?

6. Where does your state rank?

7. How do you feel about your state's ranking?

8. Describe how your county compares to other counties in the U.S. Is it among the cleanest or dirtiest?

9. How does your county compare to other counties in your state?

10. How do you feel about your county's ranking?

Part Three – Public Health
CDC Study: http://www.cdc.gov/exposurereport/
1. What did the report find about lead blood levels in children? Has it increased or decreased and by how much?

2. Scroll down. In your own words, what did the report find out about dioxins, furans, and polychlorinated biphenyls (PCBs)?

3. Scroll down. In your own words, what did the report find out about environmental tobacco smoke?

4. Scroll down. In your own words, what did the report find out about dichlorodiphenyltrichloroethane, also known as DDT?

5. Scroll down. In your own words, what did the report find out about chlorpyrifos, a commonly used organophosphate pesticide?

Mount Sinai Study: http://www.ewg.org/reports/bodyburden/es.php
6. What was the total number of chemicals found?

7. Of that total, what % is linked to cancer (to calculate the percentage, divide the number of chemicals linked to cancer by the total number of chemicals)?

8. What percentage is toxic to the brain and nervous system?

9. What percentage is linked to birth defects or abnormal development?

WWF Study: http://www.worldwildlife.org/news/displayPR.cfm?prID=156
10. Who was tested?

11. What kind of consumer products are these chemicals found in?

12. How many chemicals were tested?

13. How many chemicals were found?

14. What was the average number of chemicals found?

15. How many chemicals were found in all of the individuals tested?

16. Now, based on what we found out in Part Two, we know that toxicity data does not exist for most chemicals. This being the case, how do you feel overall about the results of the three studies?

Part Four – Industrial Case Study
1. Who are the two visionary “eco-thinkers”?

2. What two major multinational companies have they been working with?

3. Further down the page, you’ll come across a story about a small Swiss textile mill. What is the name of the mill?

4. What problem did this company run into?

5. What did this company do to solve their problem?

6. Of the 1,600 dyes they analyzed, how many did they find were non-persistent or non-toxic?

7. What happened to the mill's waste fabric?

8. What happened to their product as a result of the changes they made?

Part Five – Home Work

Current products

1. Product Name:	Service:
2. Product Name:	Service:
3. Product Name:	Service:

Alternative products

4. Product Name:	Alternative:
5. Product Name:	Alternative:
6. Product Name:	Alternative:

7. Did you have difficulty finding out information about alternatives?

8. Has this exercise changed your perception about chemical use in your house? Why or why not?

9. What was most surprising about the information you uncovered while doing this exercise?