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What Is She Eating?

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Introduction

The purpose of my curriculum unit is three-fold, first to provide the basis for understanding the major biomolecules needed for growth and second, to explore the effects of chemicals in food and food packaging on health and the environment and third, to awaken students, my fellow teachers and readers in general, to the dangers of using plastics and their components. Lessons, discussions, student activities and projects will be directed towards learning the different chemicals in food and the adverse effects of plasticized packaging that contains many harmful chemicals, like Bisphenol A (BPA) and Diethylhexylphthalate (DEHP).

This unit aims at helping the readers realize the insufficient government guidelines and directives in safeguarding foods and food sources. The reason is that there are not enough data or studies on humans focusing on the harmful effects of the food chemicals in them. Various concerned scientists and experts have shown a direct link between diseases and plastics in food and drink containers. The findings are not publicly available.

I was taught that we have a special responsibilty to care for nature using its resources wisely and effectively. Yet, we have developed landfills and allowed plastics to accumulate in huge bodies of water. Human beings and other living organisms are little by little being deprived of safe land, air and water. In our country alone, 1/6 of the population lives within four miles of a chemical dump or other potentially hazardous site.[1] It is therefore most necessary that education in the classroom be holistic in its approach. I strongly believe that I have to build awareness among my students so they will learn to be responsible individuals who have respect for the welfare of people and nature. Education is necessary to develop critical thinking skills for stewardship of the environment.

This five-week curriculum unit is intended for my tenth grade chemistry students. The lessons included here fit the section on the chemistry of life. There are two major projects in this unit: a three-day food and packaging survey and research project, and a preparation of a one-week school lunch program plan. Completed projects will be presented to other students, teachers, parents, and school administrators. This curriculum unit is aligned to three Illinois State Standards, State Goals 11, 12, and 13.

Rationale

Dunbar Vocational Career Academy is one of many public schools in Chicago. Chicago has a total population of almost 3 million in 2000.[2] From this population, about 395, 907 school-aged children (below 18) enrolled in 600 schools of CPS participate in the food service program on a daily basis. $88.6 million worth of donated prepackaged foods are a great part of meals served in 2003.[3] Looking at the national mean consumption of packaged meals and drinks, the same scenario can be seen. Children soda intake is at 12 ounces/day and this means less milk and fruit juices are consumed.[4] In 1997, the National Academy of Sciences did a huge study on 12,000 people and determined that they consumed up to an average 317 mg of food dyes per day.[5] These were consumed from toothpaste, shampoo, hand and body lotion, cereal, and juice drinks. From 1965 to 1966, concurrent increases occurred in the consumption of higher fat potatoes and mixed dishes (pizza, macaroni cheese). This increase is accompanied by greater fluid non-citrus juice intake that are below the recommended daily allowance.[6]

I teach science courses to all levels of the Medical Career Academy at Dunbar High School in Chicago, Illinois. At the beginning of every school year, it is part of my class protocol as a science teacher to ask my students complete lab safety agreements where they indicate any form of illness. I find it alarming that at least three out of my 20 to 24 students have allergies and at least two have asthma. I start my class everyday at eight o'clock in the morning and I see that about five out of my twenty students eat hot chips with even hotter sauce. Majority of them have colored fruit drinks or soda hidden in their book bags. When the bell rings and I leave the classroom for a short break (this happens regularly everyday), I see them stopping momentarily to get some other food items in their lockers, and again, they are either chips, chocolates, or candies. My big garbage bin is full at the end of each day mostly with paper, food wrappers, and plastic containers. During classes, I have to issue passes to the nurse's office because one or two of my students need immediate help. Stomach upset, attacks of asthma, and headaches are some common complaints. I, as a health science teacher, tell them to eat nutritious foods yet, they pay little attention. Hence, I have this curriculum unit.

Background

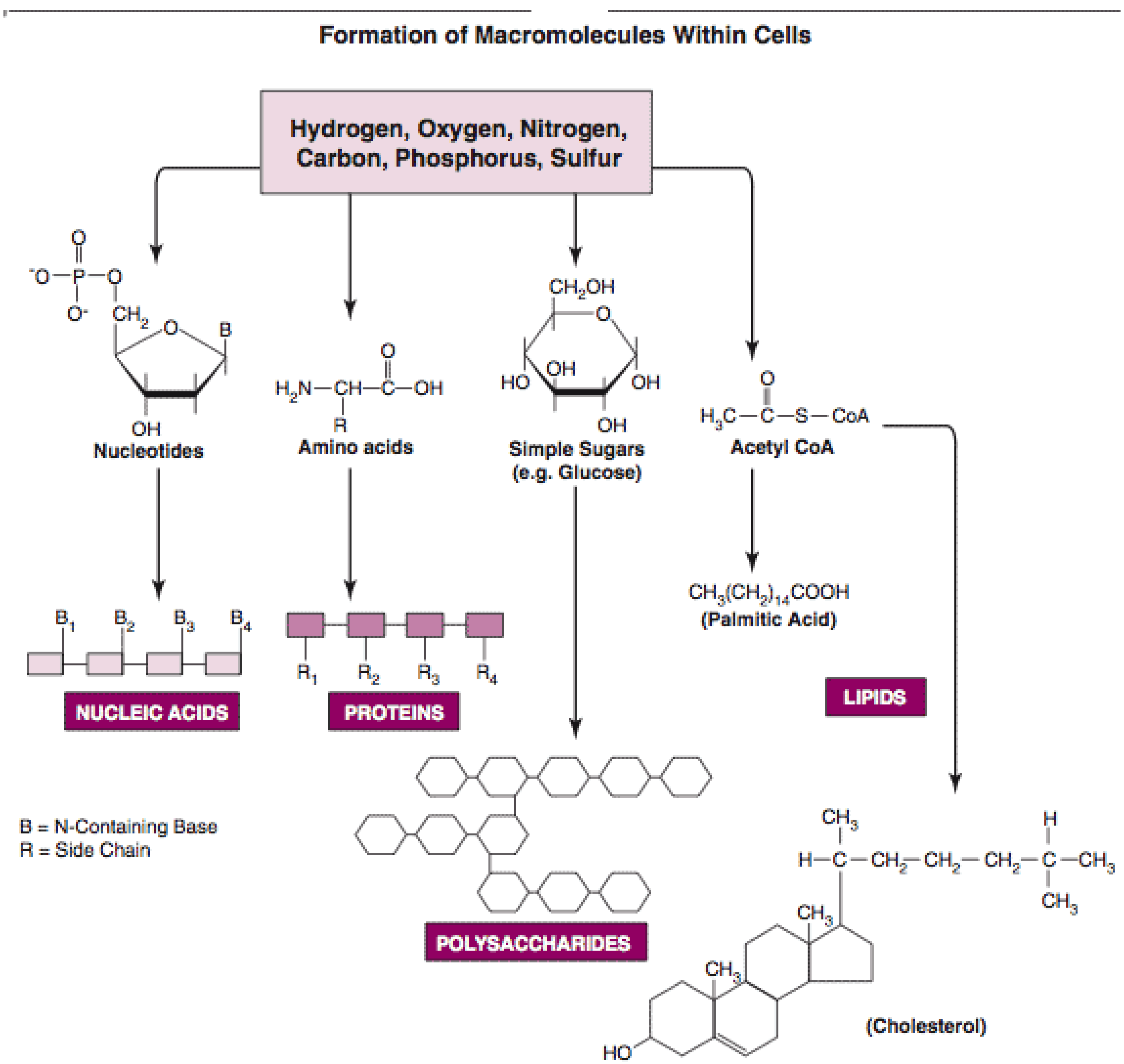
Food is a complex of natural and synthesized molecules often carrying a diverse set of deliberate chemical additives including flavors, coloring agents, preservatives, stabilizers, emulsifiers, fragrances, drug residues, and plastics that migrate from packaging materials.[7] Food is always a great part of our lives. In the human body, it provides nutrients for energy, growth, repair, and regulation of body processes. But because of its complexity, it sometimes becomes a subject of concern. Numerous research studies have shown that cancer and other forms of diseases are related to different chemicals found in food. Disorders are perceived to be caused by chemical exposures from changing environment conditions brought about by nearly 100,000 molecules traded in the world market.[8] These chemical exposures can virtually affect every cell in the body. They can affect enzymes, the proteins that regulate many important chemical reactions. These can also lead to harmful substances binding directly to the cells, or to molecules within the cell like carbon monoxide binding to blood hemoglobin. Food chemicals like carbon tetrachloride (CCl_4) can stimulate large release of epinephrine from the nerve cell that can cause liver damage. These harmful substances can have delayed or long-term effects. Effects are not only shown in humans. They can also be seen in our environment.

Food chemicals and packages have adverse effects to the environment. They proliferate in wild life-encroaching landfills scattered around the country. In Chicago alone, there are 10 major landfills. 23% of 2.5 million tons of trash collected from these landfills in 2003 were mostly from foods and plastics that cannot be recycled.[9] Toxic substances from plastics leach to fresh and marine water sources. Aquatic animals also eat plastic materials. This leads to disturbance of ecological balance. This directly or indirectly harms the food chain when toxic substances accumulate in living organisms and increase contamination levels on different kinds of species.

Polymers

Food molecules exist in the form of polymers. Polymers are made up of many molecules all strung together to form long chains. These long chains are made up of smaller units referred to as monomers. Various kinds of monomers form the two kinds of polymers, natural and synthetic. Natural polymers include proteins, lipids, and polysaccharides (the biomolecules in food). Synthetic polymers include silicone, plastics, nylon and epoxies. Polymers are very interesting because it is the kinds of molecules that dictate the properties. Adding "stick-in molecules" can alter the strength of the polymer. Plastics, for instance, become stronger by adding plasticizers.

How are natural polymers formed? In living cells, polymerization starts with elements carbon, oxygen, hydrogen, nitrogen, and sulfur. These elements are initially utilized to form small number of building blocks (amino acids, glucose, acetyl co-A and nucleotides). These building blocks are in turn used in the construction of a vast array of vital organic biomolecules (nucleic acids, polysaccharides, proteins and fats). Figure 1 shows how biomolecules are formed in living cells.



(Polymerization in Cells)[10]

Figure 1

Synthetic polymers can be formed just like natural polymers. Polymerization is done in two ways: by addition or by condensation.

Addition polymerization is a polymer reaction where the entire monomer becomes part of the polymer:

Addition Polymerization: $CH_2=CH_2 + CH_2=CH_2 \rightarrow CH_2=CH-CH_2-CH_3$

Condensation polymerization is when a small molecule is given off as the monomers combine. In the example below, the small molecule is water.

O

R - C - OH + H - OR" -> R - C - OR" + H_2O

Carboxylic acid Alcohol Ester Water

Biomolecules

Carbohydrates are the major sources of energy. These include sugars, starch, and cellulose. These are made up of carbon ©, hydrogen (H), and oxygen (O) in the ratio of 1:2:1. Carbohydrates may be monosaccharides, or simple sugars, such as glucose and fructose; they may be disaccharides or polysaccharides where two or more monosaccharides form chains. Monosaccharide contains one basic sugar unit, glucose. It is the major carbohydrate found in plants and animals. Glucose is represented by a cyclic structure with the molecular formula $C_6H_{12}O_6$. Below are the two different isomers of glucose: fructose and galactose.

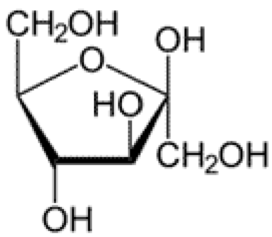


Figure 2: Structural Formula of Fructose [11]

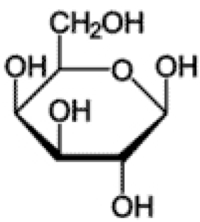


Figure 3: Structural Formula of Galactose [12]

Starch and cellulose are examples of carbohydrates with many sugar units called polysaccharides. While starch can be digested into glucose, which serves as a source of energy, cellulose cannot be digested. Both starch and sugar are natural polymers of glucose. Starch is stored in fruits, roots, and seeds of plants. Glycogen, an animal starch, is stored in the liver and muscles. Cellulose, on the other hand, is the principal structure of plant cells and fibers. The building material in cellulose cannot be consumed for energy due to its different structural arrangements as compared to starch.

The presence of sugar in food can be tested with Benedict's solution. The color changes from blue to reddish orange, the latter indicating greater amount of sugar. Staining by Iodine solution distinguishes starch from sugars. The basis of this test is that starch is a coiled polymer of glucose and that iodine interacts with these coiled molecules and becomes bluish black. A yellowish brown color is a negative test for starch.

Whenever we eat meat, fish, cheese, or eggs, and drink milk, we supply ourselves of proteins. Proteins are remarkably versatile molecules for growth and development and are found in all life forms. Proteins are composed of monomers of amino acids with amino and carboxyl groups. The amino group (NH_2) on one amino acid is linked to the carboxyl group (COOH) on an adjacent amino acid by a peptide bond.

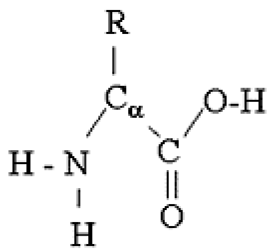


Figure 4: Amino Acid Structure [13]

The peptide bond forms through dehydration synthesis. Dehydration synthesis involves two monomers (amino acids) of proteins that join together and one of the products released is water. This peptide bond is the site of action for the Biuret test for proteins. The Biuret solution is light blue, but in the presence of proteins, it turns violet, the intensity of the color relates to the number of peptide bonds that react. Long chains of polypeptides (which is also a polymer of proteins) have many peptide bonds and produce the most positive reaction. Free amino acids and very short chains may result in a pinkish color.

Lipids are groups of molecules including fats and oils, waxes, phospholipids, steroids and some other related compounds. All lipids are hydrophobic(water-hating). Fats and oils are made from two different kinds of molecules: glycerol and fatty acids. The Sudan IV test is a useful laboratory test for fats. If fats and oils are present, these will appear as floating red droplets or as a floating red layer colored by Sudan IV. Fats are present in almost every food.[14] Milk, eggs, meat, and other animal products contain fats. Whole grain cereals and oatmeal range in fat content from 1% to 7%. All types of nuts contain about 70% fats. Fats are also considered sources of energy. They can sustain life for about five weeks provided water is available.[15] However, excess fats are not good for the heart. The extra load causes strain on the heart as it pumps blood to different parts of the body. The smallest unit of fats is fatty acids. The structure is given below:

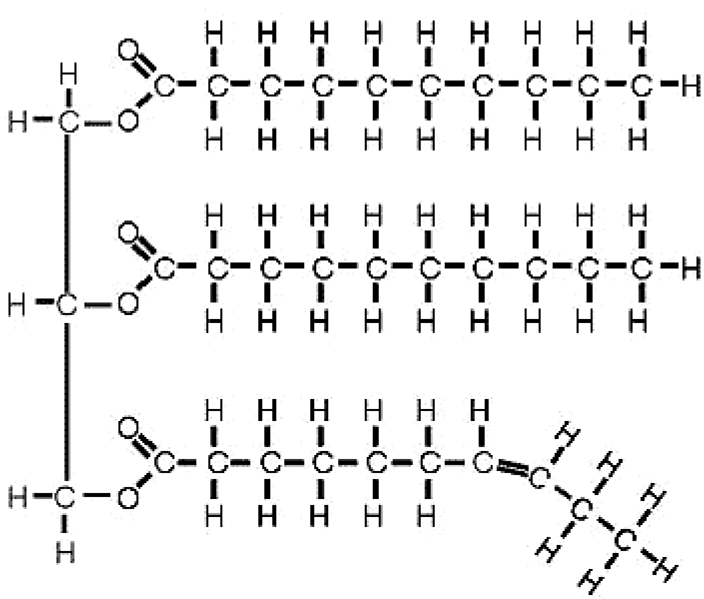


Figure 5: Fatty Acid Structure [16]

Food Additives

A food additive is any substance that is used to condition food as a dietary supplement and to affect some useful purpose in the food. It may also be any substance that affects the characteristics of foods.[17] The use of food additives has been practiced for thousands of years. The common household additives are vinegar, salt, spices, and sugars. Some additives are used to retard spoilage, some to retain freshness, enhance flavor and increase the attractiveness and acceptability of foods. In food processing, additives are used to sanitize, bleach, and improve food texture. Almost all instant foods contain a variety of food additives.

An additive may have two functions. Spices and vinegar for example preserve the food and at the same time improve the flavor. Some household additives include sodium citrate, sodium phosphate, and monosodium glutamate (MSG). In using any food additive, its dose or quantity should be a great consideration due to the harmful effects it may cause. Monosodium glutamate (MSG), when used in large quantities, produces profuse sweating and dizziness. It also causes severe headaches even at small quantities among sensitive individuals. Food additives that are considered dangerous are those that are introduced in food through the use of insecticides like DDT and antibiotics such as streptomycin.[18] Carcinogenic additives are those that cause cancer. These carcinogens may come from cooking styles. Broiling with charcoal can give benzopyrene, a strong toxin, to the steak. Benzopyrene comes from the fumes of charcoal. Another example of carcinogenic additive is safrole. Safrole is commonly found in root beer.[19]

Foods contain preservatives. They prevent spoilage and give long life to products. They are widely used by food processing industries and they are mostly found in soft drinks. One example is sodium benzoate that is currently a subject of concern about cancer. If we mix this substance with vitamin C additive in soft drinks, benzene is formed. Benzene is a carcinogenic substance that causes decrease in red blood cells and damages the bone marrow and the immune system.[20] Studies show that benzene is also linked to some genetic diseases like Parkinson's Disease because this compound has the ability to destroy mitochondrial DNA in cells that triggers cells to malfunction.[21]

Table salt is one of the earliest food preservatives. It can retard the growth of microorganisms. It also regulates the growth of fermentation. It is widely used for cooking because salt is an excellent binder. It binds with meat, fish, and other foods and thus increases the solubility of these muscled substances in water. Adding salt also gives taste to food, and consequently, we get pleasure from eating. In addition, salt provides our body with minerals like sodium and chlorine. But increased amount of salt in food is not healthy.

Hypertension is directly linked to too much salt. It is also associated with other forms of health problems. Gastric cancer was found related to dietary factors like the intake of salt and salted foods. It does not only increase the risk of Helicobacter pylori infection, it also adds to the risk of gastric cancer.[22] Adverse effects of abnormal salt intake include risk of stroke, renal diseases, asthma, cirrhosis, heart failure, and stomach cancer. Since most salt consumed comes from processed foods, steps must be taken to decrease the amount of processed food intake.

Food coloring, stabilizers and flavors are also added to foods. Colorings are there for aesthetic reasons, to make food attractive and appealing. Stabilizers are thickeners that give food a firmer texture and viscosity. Flavors are not altogether safe. Adding artificial sweetener is associated to teeth decay and erosion, abnormal weight gain, depression, anxiety, sleep difficulties, headaches, increased appetite and seizures. Abnormal weight gain, for example, results from having the body crave for more food when sweetener signals the body to store carbohydrates and fats. Once glucose levels decrease, the person feels lethargic and the feeling of hunger kicks in.[23] This can lead to increased eating.

Pesticides

Pesticides grew with human population. More food was needed to feed the increasing number of people. Plants as sources of food need to be protected from pests. The use of pesticides became a popular means to control or eliminate pests. But pesticides when applied to plants often persist as residues. A recent analysis of non-organic food found that 73% of samples contained pesticide residues. Tests of a single vegetable found ten different pesticides while several single pieces of fruit contained eight.[24] Imported foods usually contain pesticide residues and are marketed without any warning to consumers or penalty to importers.[25]

Children often are more susceptible to pesticides; their diets are exposed to pesticide residue 10 to 20 times the average levels experienced by adults.[26] Food intake is highest during this growing stage. They are most likely to suffer because of their lower body masses. Moreover, their immune systems are not yet well developed. They get more pesticide exposures from homes, yards, schools, parks, or even from playgrounds. When they play, we let them drink from garden hose or spray them with water from it.

In consequence, the government thru the EPA reviews studies on pesticides so that its use will not pose unreasonable risks to human health and the environment. EPA sets a tolerance, or the residue level that triggers enforcement actions. If residues are found above that level, the commodity will be subject to seizure by the government. Tolerance levels are published in the Federal Register.[27]

Examples of commonly used pesticides include Boric Acid, Chlordane, Diazinon and Hydropene. These are proven effective against insects, spiders, algae, molds, fungi, weeds, and termites. Some pesticides are used as antimicrobial or antiviral agents. Examples of these are the Accel TB for Myobacterium tuberculosis, 25 RTU for Human HIV -1 Virus and the 65 Disinfecting Heavy Duty Acid Bathroom Cleaner for MRSA.[28] The National Pesticide Information Center gives a list of government-approved pesticides including their chemical ingredients, uses, and toxicity levels.[29]

Plasticizers

Polychlorinated biphenyls or PCBs are examples of poisonous compounds that have varied uses. These are used as components of adhesives, asphalt roofing material, dyes, fluorescent light ballasts, inks, lubricants, paints, carbonless copy paper, pesticides and rubberizers.[30] PCBs are also used in the manufacture of different plastic containers. In some countries, food contaminated with PCBs were found to cause hair loss, enlargement of the liver, and disorders of the intestinal and lymphatic systems.[31] They do not easily decompose and are suspected to be carcinogenic. They are found to be soluble in fats of animals and are stored in human tissues.[32]

Production of all kinds of commodities has increased exponentially and to preserve these materials, the use of plastics proliferated. Plastics have two components, Bisphenol A and DEHP. Both substances are believed to cause changes in growth and development of many species of animals. Bisphenol A is a white to light brown flakes or powder substance that has a chemical formula $C_{15}H_{16}O_2$ or $(CH_3)_2C(C_6H_4OH)_2$.[33] BPA is a chemical compound with high molecular weight, melting point, boiling point, and is water-insoluble.[34] It was invented about 120 years ago. This substance is used an important chemical building block to make polycarbonate plastics and epoxy raisins, both of which are believed to serve in a wide variety of applications that were intended to make our lives better and safer.[35] It has been utilized extensively. About 40 years later, its first evidence of toxicity was revealed. Now, it is known to contaminate 93% of the population.[36]

Sources and Health Effects Related to BPA

BPA is now deeply embedded in the products of modern consumer society. It is used to form pesticides, antioxidants, flame retardants, rubber chemicals and polyvinyl stabilizers. We are also exposed to it through films, pipes, computers, refrigerator shelvings, microwave ovens, floorings, enamels, varnishes and adhesives, automobile parts, water bottles, baby bottles, and eating utensils. We can see BPA in plastics everywhere, from children's toys to our drinking cups, from cosmetic products to baby diapers.[37]

BPA is a hormone-disrupting chemical considered to be potentially harmful to health and the environment. In different studies, BPA was found to mimic the female hormone estrogen in test animals and some marine organisms that led to the discovery that female sex organs have sprouted in some male fish and seagulls. BPA is also very much present in ground and surface water. If pesticides travel from crops to drinking water supplies in two years, then BPA must be doing the same thing. The widespread use of BPA in consumer products and its presence in environmental media have lead to the detection of BPA in human urine, serum, breast milk, maternal and fetal plasma, amniotic fluid, and placental tissue at birth. Though BPA has no clear effects on humans, as as the American Chemical Council has found out, studies have shown adverse health effects on some test animals. These include meiotic failure, reduced sperm count, mammary gland development, prostate disease and cancer, diabetes and obesity, impaired human function, behavioral changes, and brain effects. BPA has been shown to have physiological effects in development of tissues of these organisms both in vitro and in vivo. In Japan, women with history of miscarriage were found to have high levels of BPA. With uncontrolled use of BPA, researchers, scientists, and educators started to study its effects on human health and environment.[38]

Government researchers and agencies are aware of BPA's persistence under normal conditions in the environment. It does not readily degrade. Yet, there are no laws set to regulate BPA in the market. BPA shows no matter how proofs of toxicity even at very low doses persist. Government agencies like EPA provides safety standards which are at odds with scientific results. Thus, people continue to use them. In the United States alone, the estimated consumption of BPA-containing plastic is 223 poinds/person/year. It is also estimated that consumption will increase to 300 pounds/person/year by 2010.[39]

Life is easier with plastics but we suffer some serious consequences. Marine and aquatic ecosystems are affected by having planktons and other organisms feed on plastic and its components. Therefore, we can say that we do not only get plastic-contaminated foods, we are also taking these toxic substances through the food chain.

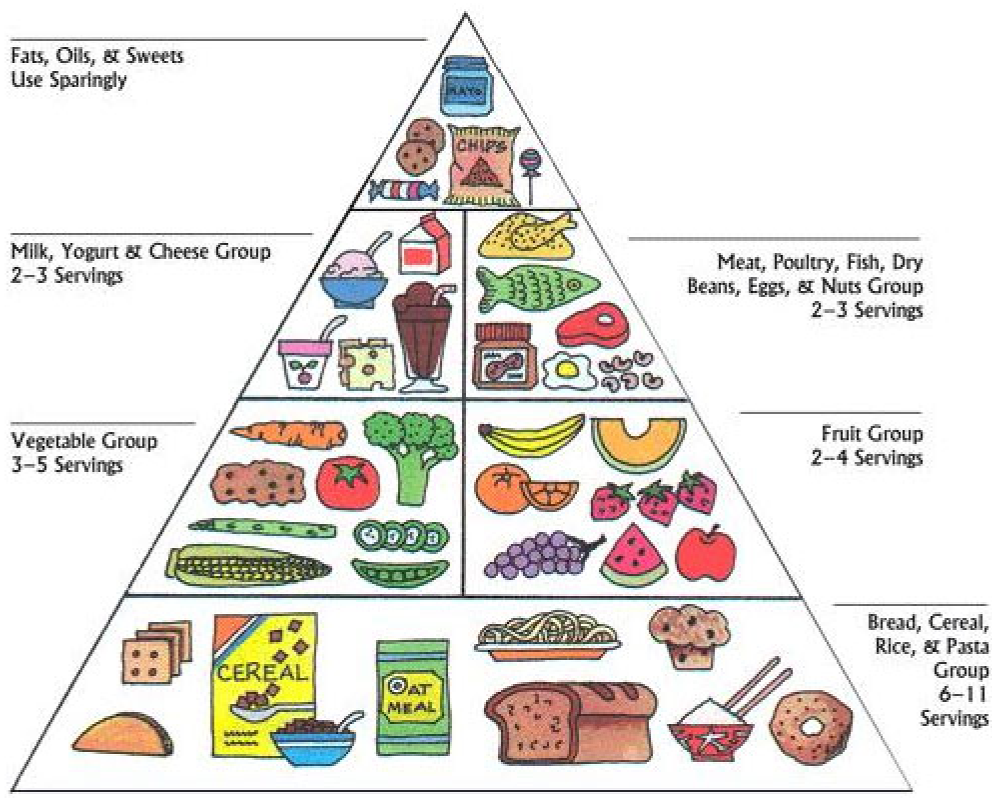
DEHP, Its Sources and Health Effects

Another component of plastic is diethylyhexylphthalate or DEHP. It is one of the most cost effective and widely used general purpose plasticizer. It is used mainly for making PVC soft and pliable.[40] It is a compound that can easily bind with anything. DEHP has a chemical formula of $C_{24}H_{38}O_4$.[41] It is a colorless almost odorless liquid that is insoluble in water, miscible with mineral oil, and soluble in most organic solvents. In the atmosphere, it is present as a gas or attached to solid paticles. During precipitation and rain, it can persist in the environment. If a DEHP-containing material is thrown as thrash and ended in landfills, this chemical can leach to grounwater. Contamination with DEHP can come from many different sources. Phthalates are present in all food and packaging materials, medical devices and products, flexible tubings, electrical conduits, building products, lubricants, perfumes, hairsprays, cosmetics,construction materials, wood-finishers, and adhesives. The probability of exposure especially among children is high because most PVC applications like teethers and toys contain DEHP.

DEHP, just like BPA, is known to have greatest potential among phthalates to cause diseases and this is more potent at low doses. Effects on animals were on male reproduction, brain development, early onset of puberty in males, delayed/advanced puberty in females, and allergies.[42] Studies show that it is found in human blood, seminal fluid, breast milk, and saliva. Human studies were also conducted and phthalate exposures also resulted to male reproductive malformation, sperm damage, asthma, early puberty in girls, female reproductive tract diseases, premature delivery and thyroid effects.[43]

The Food Pyramid Guide

The pyramid in Figure 7 is composed of six food groups. Although it is important to eat foods from all the food groups, the pyramid also gives information on the number of servings per day. For good health, fats, oils, and sweets at the very top should represent only a small portion of a diet. It is recommended that daily food choices must come from the bottom section (6 to 11 servings) and the middle groups (3 to 5 servings).



The Food Pyramid Guide [44]

Figure 7

Label Statements on Foods

FDA states that required label information must be conspicuously displayed in terms that ordinary consumers like us can easily read and understand. Package labels should include the manufacturer's name, address, packer, and distributor. It should state an accurate statement of net amount of food in terms of weight, measure, or numerical count.[45] The ingredients in food should be listed by their common names in decreasing order by weight. Food additives are required to be listed as ingredients. Artificial colors and flavors should be named specifically. Nutrition requirement should be provided. If the food labels bear representations in a foreign laguage, they should be translated into english. The government, along with its agencies, is trying its best to assure safety and proper labeling for human consumption, but because of limited federal funding, these agencies like Centers for Disease and Control (CDC), Food and Drug administration (FDA), and United States Department of Agriculture (USDA) can only do as much.

Reported occurrences of outbreaks of food-borne diseases have been increasing, and current safety efforts are not providing the confidence in the food supply that U.S. consumers demand.[46] Another concern that we have to think about is that usually, foods are only labeled if they meet certification standards. Some organic products sold in the market are properly labelled but majority are not.

It is important that students and readers understand the most common names and symbols often used for labeling plastics especially for classifying and recycling purposes. The following is a list of plastic symbols, numbers, names, and sources:[47]

1. PETE (Polyethylene Terephthalate) - is a thermoplastic resin used in synthetic fibers, beverage, food, and other liquid containers.
2. HDPE (High Density Polyethylene)-is made from petroleum and used in milk jugs, trash bags, ice cube trays, andstorage containers.
3. PVC or V poly (Polyvinyl Chloride, DEHP)- is a thermoplastic polymer widely used in construction materials, cooking oil bottles, baby bottle nipples, and packaging around meat.
4. LDPE (Low Density Polyethylene)- is thermoplastic made from oil and used widely in manufacturing containers, dispensing bottles, wash bottles, tubings, plastic bags for computer components and various molded lab equipments. The most common term is plastic bag.
5. PP (Polypropylene)-used as margarine tubs, yogurt containers, straws, spice containers, and trays for microwaveable meals.
6. PS (Polysterene)-is a thermoplastic made from petroleum. This is used in styrofoam cups and containers, take-home boxes, egg cartons, meat trays, plastic model kits, license plate numbers, plastic cutlery, and CD containers.
7. Others (Bisphenol A) -which means the plastic is not made up of the initial six or some unique combination of the initial six. These are found in polycarbonate baby bottles, water cooler bottles, and toodler fruit cups.

Strategies and Class Activities

At the end of the lessons, students will be able to identify food substances that are excellent sources of required food nutrients. They should be able to explain why biomolecules are classifed as polymers. They should be able to compare and contrast natural and artificial polymers. After doing the hands-on activities on making polymers, they should be able to explain the unique properties and characteristics of polymers. Using the plastic symbols, students should be able to identify food packaging that contains BPA and DEHP. As a culminating activity, each group should be able to report about their projects using power point presentations.

Learning Scenario

I love using a school-based scenario to introduce a unit. I believe students will become engage by the lessons and learning will become easy. Below is my learning scenario.

Dunbar High School is in great need of new uniforms for all sporting events. The President of Pop Cola Corporation announced that he would pay for everything, in fact, they are willing to donate two sets of uniform to every player, whatever event he is involved. School administrators, teachers, students, parents, and the whole community is ecstatic about the news. Afterall, everyone is waiting for developments like this. However, there is a catch. The school will have to sell all Pop Cola products in the school's vending machines and in all sporting events for the next five years. This will create a problem. The previous year, all pop cola products were ordered removed by the School System as part of healthy nutrition campaign. School officials ask for students' unified decision. As a student member of Dunbar, what will you do?

Bell Ringers and Scaffolding Activities for Review

To effectively make a connection between what my students already know and what my curriculum unit is all about, I will start with bell ringers and scaffolding activities. Bell ringers are generally questions about or related to concepts already learned while scaffoldings are prepared checklists used to reflect on what they previously studied. The main purpose of scaffolding is to keep students on track and simplify the task to make it more meaningful and achievable. Bell ringers and scaffolding will be my strategies to review topics covered. These will take the first five minutes of class. Table 1 summarizes the topics that students need to understand to prepare them for my unit.

Table 1: Scaffolding Worksheet

Indicate with a check mark how you feel about the following topics:

Topics	I Know a lot	I know little	I don't know
Parts of the animal cell			
Functions of each part of the animal cell			
The role of mitochondrion in cells			
How the cell membrane works			
Diffusion and Osmosis			
Organs and functions of parts of the digestive system			
Photosynthesis			
Respiration			

To enhance vocabulary development, I will use context clues. Context clues are words or phrases in a sentence which help us figure out the meaning of an unfamiliar word. We can oftentimes determine the meaning of an unknown vocabulary word by paying attention to other words in the sentence.

Video Clips:

To set the tone for the lessons, I will show two video clips, "A New Year's Resolution: Use Less Plastics"[48] and "The Great Pacific Garbage Patch".[49] These videos talk about how hundreds of million tons of trash are brought to our oceans and how marine animals were affected by this global marine catastrophe. Students will discover that these man-made disaster affect even the most distant places in this planet. The clips will give important pieces of information that will be helpful for their projects.

Inquiry Labs:(Students wear goggles and gloves)

Biomolecules Lab

The foods we eat contain important organic compounds that our bodies need as nutrients. In this lab, a series of chemical tests are used to determine which compounds are present in different foods. Indicator solutions will identify the three major biological molecules, carbohydrates, fats, and proteins. Indicators are test solutions that change color for a specific substance only.

Materials:

Test tubes, test tube rack, test tube brush, 30 well well -plates, masking tape, marker, toothpicks, 10 medicine droppers, hot plate, 250 mL beakers, distilled water, food solutions A to I (apple juice, butter, cooking oil, diet soda, egg white, flour, green beans, ham, and ice cream, test indicators (Sudan IV, Biuret, Iodine and Benedict's solutions)

Procedure:

Label the three rows of the well-plates A to I, W is water which is the control. With clean medicine droppers, add solutions to each row following the letter codes. Complete food solutions in all three rows. Add ten (10) drops of distilled water to all test solutions. Mix thoroughly with clean toothpicks. On the first row (solutions A to W), add 10 drops of Sudan IV to each well. On the second row (also with solutions Ato W), add 10 drops of Biuret. On the third row, do the same for the third row. Mix all solutions with clean toothpicks for each well. Do not use toothpicks twice. Use white paper as background to observe color changes. Record the color of each reaction.

For the last test (Benedict), fill a 250 ml beaker with 150 ml of water. Place the beaker on a hot plate and heat the water to a low boil. Use clean medicine droppers to put 10 drops of each food solution into the appropriate labelled test tube. Add 10 drops of Benedict's solution. (This solution is poisonous!) Mix the shaking the test tube. Heat the test tubes in boiling water bath for 3 minutes. Use test tube holder in taking the test tubes out of the water bath. Observe color changes using white paper as background. Use Table 2 to compare results. Write results in lab journals.

Table 2: Color changes for positive results:

Indicators	Original Color	Color Changes for Positive Results
Sudan (Fats and Lipids)	Dark reddish brown	Red
Biuret (Proteins)	Blue	Pink to purple
Iodine (Starch)	Yellowish brown	Bluish black
Benedict's (Sugar)	Blue	Yellowish orange

After performing the lab, students will complete the following tasks:

1. Classify the foods tested in three groups based on similarities in color changes.
2. Identify the biomolecules present in all foods studied.
3. Answer analysis questions given below:
4. Some of the foods had a positive reaction to more than one indicator. What does that tell you about those foods?

5. Were there any food solution that did not react with any indicator? What does that tell you about those foods?

Polymer Lab

"Making Polymers" is the next activity. Here, students will be exposed to the properties and characteristics of polymers. They will see that increasing or decreasing one ingredient can change the polymer's properties.

Again, the class will be divided in five groups. Each group will be assigned to make a specific polymer. These are slime, super slurper and three kinds of gluep. Three kinds of gluep will be made using different combinations of glue, water, and borax. Students will share results.

Materials: 4% PVA solution, food coloring, 4% sodium borate, Elmer's glue, talcum powder, wooden sticks, sodium polyacrylate, table salt, sugar, baking soda, recipe cards

Group 1: Place 20 ml of 4% PVA solution into a cup. Add 1 drop of food coloring. Then add 20 ml of 4 % sodium borate. Mix thoroughly with wooden stick. Remove the blob and study the properties by stretching slowly and stretching it quickly.

Group 2: Mix 20 ml of water with 25 ml Elmer's glue in a cup. Add 1 tsp. of talcum powder. Mix thoroughly. Add 10 ml of saturated borax solution. Stir. Remove the blob from the cup and knead for a while to dry. Add talcum powder if there is difficulty in drying the blob. Study its characteristics.

Groups 3, 4, and 5: Prepare color-coded recipe cards shown in table 3 below:

Table 3: Color Coded Recipe for Making Gluep

Color	Glue (ml)	Water (ml)	Borax (ml)
Green	15	15	10
Blue	15	30	10
Pink	15	0	10

Each group selects a color and prepares the polymer following the same steps described above. Relate the properties observed with the characteristics of some known plastics (like the famous plastic bag)

Preparing Nylon [50] (Teacher Demonstration)

Note: Use fume hood, the vapors are hazardous), Disposal-Code A

Materials: 250 mL beaker, 50 ml petroleum ether, 1 ml sebacoyl chloride, stirring rod, 100 ml beaker, 1.1 gram of 1,6 hexanediamine, 10 ml 1 M NaOH, food coloring, forceps, graduated cylinder, paper towels

Procedure: In a 250 ml beaker, place 50 ml of petroleum ether. Add 1 ml of sebacoyl chloride. It is important to mix the solution. In a 100 ml beaker, mix 10 ml of 1 M NaOH in 15 ml water. Dissolve 1.1 gram of hexanediamine in the water solution. Add a drop of food coloring to help students see the water layer in the next step. Carefully pour the water solution down the side of the 250 ml beaker into the petroleum ether solution, without mixing the two. Using forceps, pick the center of one film that forms at the interface of the two liquids. Slowly pour the nylon fiber from the beakerand roll it up on a graduated cylinder that has a paper towel wrapped around it.

After the polymer lab, students answer the questions given below:

1. How will you classify your slime, super slurper and gluep, a solid or a liquid? Justify your answer.
2. What words can you use to describe your polymer?
3. What is viscosity?
4. What is crosslinking? How does it affect the characteristics of a polymer?
5. In making nylon, why should the two liquids not mix?

The Projects

Three-Day Food and Food Packaging Inventory

This survey is to be written and completed in each student's science journal. Each one will keep track of foods eaten for three days. While completing their journals, they have to be careful not to miss any detail in the food label. I will ask them to include all recycling symbols and chemical names and formulas written on the packages. After three days, students will synthesize their results in groups. Only one food chart will be entered per group. In groups, they will evaluate the chart by comparing it with the "Food Pyramid Guide". Then they will compare the food label notes with the plastic symbols. Each group will proceed by classifying the foods listed according to the kinds of plastic they may contain. Research on the health effects of plastics seen in the survey will follow. As they move to the completion of their research, each group will prepare a "One-Week Lunch Program Plan." They will submit this plan as recommendations for other students, teachers, cafeteria personnel, and school administrators.

Field Trip to A Landfill

One of my goals is to awaken my students to the amount of plastics in trash. To add realism to my lessons, I will take my students to one of the landfills in the Chicago area. This activity will provide a community-based learning opportunity. This trip will expose them to what is actually happening in our environment. More importantly, this will make them look at themselves from two perspectives: that of a student and a contibutor to the problem.

I will divide the class into three groups: one will focus only on "how much, what kinds" of trash are collected on a daily basis; the second group will ask questions on "classifying/sorting" schemes and how do trash separators distinguish among plastic products, and the third group will expose recycling, composting, and incineration.

Final Presentation

On the last Wednesday of the fifth week, students will be ready with posters, power point presentations, and one- week meal plans. Posters will be prepared to inform other students on the curriculum unit's final project. Each group will present their food intake results and analyses, the diseases linked to common food chemicals, and their recommendations in the form of a one-week lunch plan.

This culminating activity will be done after classes. Parents, school administrators, teachers, and other students will be invited. The final presentation will be videotaped so I and other teachers can use this as a teaching resource.

Suggested Reading Lists

Annotated Teacher Resources

Carson, Rachel. "*Silent Spring*. Boston: Houghton Miffin, 1962 (An eye-opener to pollution and pesticides.)

Tennant, David R. "*Food Chemical Risk Analysis*." New York: Chapman and Hall, 1997 (Introduces readers to potential food hazards and how they can be assessed and managed.)

Vogt, Donna U. "Food Safety Issues in the 107 th Congress." Congressional Research Service (2001) (A guide to federal regulatory framework for food safety.)

Wargo, John. *Green Intelligence.* New Haven, Connecticut: Yale University Press, 2008. (Exciting book that analyzes how environment influences human health.)

Annotated Student Resources

Shapiro, Mark and Weir, David. *Circles of Poison.* San Francisco, California: Institute for Food and Development Policy, 1981 (An exciting book describing how chemicals like pesticides move in the market.)

Wargo, John, Cullen, Mark, and Taylor, Hugh. *Plastics That may Be Harmful To Children and Reproductive Health*. New Haven, Connecticut: Environment and Human Health, Inc. 2008 (Excellent book on sources and effects of plastics and plasticizers to human health.)

Others

Greyhalk, Sam. "Understanding Recycled Plastics - The Recycling Symbols." Ezine Articles. http://ezinearticles.com/?Understanding-Recycled-Plastics—The-Recycling-Symbols-and-Numbers&id=106748 (accessed July 10, 2008). (Good resource guide for understanding and doing recycling activities.)

Gore, Al. *An Inconvenient Truth, The Planetary Emergency of Global Warming and What We Can Do About It.* New York, NY: Rodale, 2006 (A book that will open our eyes to global warming.)

Houlihan, Jane. "Timeline: BPA from Invention to Phase Out." *Environmental Working Groups* (2007) www.ewg.org/reports/bpatimeline. (accessed July 10, 2008). (A great website for the history of BPA.)

Dabrowski, Elizabeth. "Polymer Project." www.lerc.nasa.gov/WWW/k-12/Summer_Training/Magnificat/Polymer_Project.html (accessed July 12, 2008).

(A great website for lab activities.)

United States Department of Agriculture, Food and Nutrition Information Guide. http://fnic.nal.usda.gov/nal_display/index.php?info_center=4&tax_level=1. (accessed July 12, 2008)

(A great resource for food intake analysis.)

Appendix A

Implementing District Standards

Illinois State Goals

State Goal 11: Understand the processes of scientific inquiry and technological design to investigate questions, conduct experiments, and solve problems.

The inquiry process prepares learners to engage in science and apply methods of technological design. This understanding will enable students to pose questions, use models to enhance understanding, make predictions, gather and work with data, use appropriate measurement methods, analyze results, draw conclusions based on evidence, communicate their methods and results, and think about the implications of scientific research and technological problem solving.

State Goal 12: Understand the fundamental concepts, principles, and interconnections of the life, physical, and earth/space sciences.

Knowing and applying key concepts in the given fields of science that includes; animal development and growth, body systems, cell structure and processes, ecology, chemical bonding and reactions, elements, compounds, mixtures, and properties of matter, help students understand what they observe in nature and through scientific experimentation. A working knowledge of these concepts and principles allows students to relate new subject matter to material previously learned and to create deeper and more meaningful levels of understanding.

State Goal 13: Understand the relationships among science, technology, and society in historical and contemporary contexts.

Understanding the nature and practices of science such as ensuring the validity and replicability of results, building upon the work of others and recognizing risks involved in experimentation gives learners a useful sense of the scientific enterprise. Understanding these relationships among science, technology, and society give humans the ability to change and improve their surroundings.

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