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Processed Food for Thought: Exploring Chemical Additives in Processed Foods

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Introduction

"I got ninety-nine problems but junk food ain't one. If you're having food problems, I feel bad for you son; I got ninety-nine problems but junk food ain't one. Feed me."

Although this quote is an obvious play on a popular song, my goal is that students who complete the lessons in my unit will have the confidence to believe that these words apply to them. When students are given the knowledge about the foods they take into their bodies, they become empowered to take control of over their immediate and future health. Unfortunately, health issues stemming from obesity and malnutrition are quite prevalent amongst today's American youth. Indeed, many of my students suffer from both obesity and malnutrition simultaneously. This unit addresses these nutritional health issues head on by having students investigate what is really in their food, and teaching them to utilize various research methods to examine the health effects of the ingredients they discover. A knowledge-is-power approach that empowers children to improve their health through dietary consumption choices can affect other non-food choices they make as well, by creating informed young consumers who are conscious of their health, the environment, and fair labor practices.

Depending on one's socioeconomic background, access to healthy, affordable food can vary dramatically. Access to information about diet is a social justice issue, one that involves a number of factors: access to supermarkets with fresh produce versus convenient stores with processed food, corporate marketing strategies that target children, misinformation that makes certain foods appear healthier than they actually are, the inclusion of unhealthy processed foods on school campuses, an absence of knowledge concerning nutrition on behalf of the general public and corporate refusal to inform the general public by properly labeling their food products. These issues are especially relevant to the lives of students from disadvantaged backgrounds, like those who attend schools in a part of San Jose, California known as the "East Side."

Demographic Information

Yerba Buena High School rests in the heart of East San Jose, within a larger area that is often referred to by outsiders as Silicon Valley. While the dot.com tech-companies of Silicon Valley make it one of the richest areas in the country, East San Jose is known locally for its ethnic, low-income population. A grade 9-12 high school, Yerba Buena has achieved an academic performance index (API) score of 685 ¹, a relatively low performance in comparison to target number of 800 or above for academic proficiency. The most recent information collected on our school shows a majority of the population is socioeconomically disadvantaged ². Sixty-five percent of the student population qualifies for the free or reduced lunch program, but this number may actually be higher ³.

Because of the current emphasis on standardized test scores, most on-campus programs focus solely on academics, and there is little time or funds leftover to allocate to nutrition education. When students are given a choice over what to eat, most prefer to pay for bagged chips from the vending machine than accept a "healthy" school lunch, which for most of the students on campus, as stated before, is provided for free.

Rationale

Importance of a Healthy Diet in Adolescent Years

There is currently a growing obesity epidemic in the United States, as the number of Americans diagnosed as obese has increased by 70% in the last decade ⁴. Chronic diseases such as type 2 (adult-onset) diabetes, cardiovascular disease, and certain cancers are linked to obesity. Expenditures in the United States on the health care of obese individuals is 36% higher annually than those who are not overweight under the age of sixty-five ⁵. It is estimated that 34% of adolescents between 12-19 years old were overweight or obese in 2010 ⁶.

According to the National Health and Nutrition Examination Survey, the prevalence of prediabetes and diabetes has increased two-fold in the past decade. The highest documented rates of incidence of type 2 diabetes in children is among minority groups aged 15-19 years. The number of physician-diagnosed adolescents aged 15-19 years old for non-Hispanic Whites was only 6%, while the prevalence of T2DM in Hispanics is 17%, 23% for Asian/Pacific Islanders, and 20% for blacks ⁷. This holds particular importance for the student population in East San Jose, which is primarily Hispanic and Southeast Asian.

Increased obesity in American adolescents has led to other even more severe health problems such as cardiovascular disease. Cardiovascular disease is the number one killer in the United States. It is responsible for one out of every three deaths that occur in the country ⁸. The health care costs associated with cardiovascular diseases are approximately \$149 billion annually, or about 17% of all medical expenses in the United States ⁹. The simplest and most effective strategy to lower these costs would be to involve the population in preventative measures, such as creating a change in the diet.

How Advertising to Youth Affects Food Preferences

One major factor in consumer choice amongst teens is how they are marketed to in today's media. On average, adults spend 5.2 hours watching TV, 3 hours surfing the Internet, 1.4 hours listening to the radio and 0.7 hours with mobile phones ¹⁰ . Television plays a significant role in consumer engagement, as consumers attribute advertisements seen on television as the most influential factor of all media types in deciding to purchase a product or service ¹¹ . In 2009, teens spent an average of 3.5 hours per day watching television ¹² . During this time, 21.3 commercials air per hour, and 47.5% of these are advertisements for food, a majority of which are promoting foods high in fat, sugar, and salt ¹³ .

Commercials that target today's youth take advantage of the viewing time and age of the consumer. Children under the age of 8 cannot discriminate between commercial and non-commercial programming nor do they have the skills necessary to critique advertisements for their content ¹⁴ . When children are bombarded with over 200,000 commercials a year, several of which advertise foods high in fats, oils, and sweets, it is no surprise that students prefer vending machine snacks over fresh produce, especially when the nearest farmer's market may be over a mile away and open for business only once a week. Advertisers will spend a substantial amount of money to capture some of the \$330 billion of parental spending, particularly when three quarters of teenagers influence family food purchases. It is also no mistake that non-nutritious foods are aired more frequently during prime time television hours than at other times.

Television and other forms of advertisement have a dramatic effect on the pathway to consumption. Children remember slogans, advertising jingles, and company mascots from commercials as short as 30 seconds in length. Branding also plays a key role in triggering memories associated with specific products. When children who have been exposed repeatedly to these commercials are given consumer choice for which products to purchase, the memory triggers become far more effective. Unfortunately, if a product is a calorie-dense, processed food with a low nutritional value, then the child will choose and consume the product without serious consideration of its effect on his or her health.

Preference of Youth to Hot Cheetos and Other "Junk" Food

Junk food is defined by the Columbia Encyclopedia of Nutrition as "foods that are high in calories but low in, or sometimes devoid of, other nutrients ¹⁵ ." These are often popular with urban youth because these snacks are convenient and appeal to taste, despite being low in nutritional value. These foods also tend to be prepared en-mass and processed in factories. Although there is this general understanding of what constitutes "junk food," there are no specific guidelines for determining or labeling food as such.

When it comes to food access, junk foods are readily available in urban environments. The physical location of a group of students has a great impact on their food choices, and therefore their lifestyle choices and risk for becoming overweight. One study found that the presence of large chain supermarkets, which tend to carry healthy foods at a lower cost, varies by socioeconomic barriers such as race, ethnicity, and income ¹⁶ . Simply put, in low-income areas, there are more convenient stores and less supermarkets. This trend is statistically significant across the United States, with 1.3 times as many convenience stores in low-income zip codes as compared to middle-income urban neighborhoods ¹⁷ . This is noteworthy because the lack of access to healthy foods has shown a significant correlation to lower diet quality. Furthermore, the difference in the average price of food sold in convenient stores and supermarkets reveals an economic barrier to eating healthy. The prevalence of low-priced, high sugar snacks in convenience foods stems from government subsidization of certain commodities (e.g. corn subsidies make domestic corn more affordable to use as an ingredient in many

popular snack foods) ¹⁸ . It is for these reasons that studies show socioeconomic status and ethnic background significantly affect obesity rates.

Branding and product recognition is so strong in adolescent populations that the popular snack distributed by the Frito-Lay corporation, Flamin' Hot Cheetos, is a strong example of processed food ideal for study. Flamin' Hot Cheetos are affordable snack that are sweet and calorie-dense, and are readily available in urban environments. Known in schools as the "red menace," schools in San Jose and across the country have banned the original version of the snack. Frito-Lay now distributes a baked version, which prepares food by baking rather than frying; this version is now available in vending machines around the East Side Union High School District. Most of the ingredients in this snack have chemical additives to make the cheese puff appeal to school-age children. One expert claims that spicy food that elicits a burning feeling causes the body to release comforting chemicals (endorphins) to cope with the pain ¹⁹ .

The Frito-Lay website allows consumers to enter in the desired product and find local stores that sell the desired product. A search for Flamin' Hot Cheetos revealed twenty six registered vendors that sell this snack under a one mile radius of the school. When the zip code of a more affluent school of the same district was entered, this search rendered only ten registered vendors within a mile ²⁰ . While this may simply be an indicator of food preference of students, it may also be an indication of a link between diet and academic performance, as my school performs lower on standardized tests than the more affluent comparison school. Indeed, Red 40, a dye used in Flamin' Hot Cheetos, is linked to impaired academic performance ²¹ .

Background Information for Teachers

How Foods Can Be Processed (Processing of Foods)

Food processing began with American colonists, who used to rely on various food preservation methods to be able to eat fruits and vegetables out of season. These often included drying (using the sun, air, heat, or vacuums to take out moisture to prevent mold, bacteria, and yeast growth), salting (brining foods to slow mold, bacteria, and yeast growth), canning (packing, sealing, then heating food to sterilization temperatures in a container), pasteurization (heating liquids such as milk to reduce disease-causing bacteria), and refrigeration (keeping foods at low temperatures to slow or prevent bacterial, mold, and yeast growth). Today, processing methods help foods keep the nutritional value loss at a minimum. Examples of commonly processed foods and techniques used to preserve these are raisins and beef jerky (drying), ham and pickles (salting), canned fruit and ketchup (canning), milk (pasteurization), and lettuce (refrigeration).

Chemical additives, purposes, and health effects

While food processing has preservation benefits, these methods also have drawbacks. Certain processing methods lower the nutrient density of the foods. For example, food processing methods that utilize removing water from the food can have the effect of drawing out water soluble vitamins (e.g. B and C vitamins). In addition, fresh fruits and vegetables lose their nutrients over time, so refrigeration methods can have the effect of lowering the nutrient density of the food over time (and also the flavor), though the calories will be similar. Therefore, the food is considered to be full of empty calories (calories that do not include essential vitamins, minerals, and nutrients that your body needs). To combat the loss of flavor that preservation

methods cause, food manufacturers often add chemical additives. For example, hydrogenated fats (trans-fats) are commonly found in margarine, peanut butter, and shortening. Trans-fats help give foods a longer shelf life by altering a product chemically to make a food originally found as a liquid into a solid. However, this preservative is known to increase LDL cholesterol (bad cholesterol as it is known due to the increase in risk for heart disease) and decrease HDL (good cholesterol). Sodium compounds also have the effect of preserving foods and adding flavor, but can contribute to high blood pressure. Nitrites are also added to prevent bacterial growth in foods such as hot dogs and salami, but these chemicals are also associated with increased cancer risk. Some dyes are added to foods solely to make the food products look more attractive; these include Red 40 (found in M&M candies) and Yellow 5 (found in Dorritos), but these dyes are also associated with cancer. These are just some of the negative effects that processed foods can cause on human health.

Ingredients in Hot Cheetos (note the majority of chemical additives)

The ingredients list of Flamin' Hot Cheetos includes several chemical additives ²². The definitions and known health effects for specific chosen ingredients are discussed below.

Enriched corn meal

Corn meal is a coarse flour product from corn that is ground to different consistencies. Depending on the way it is processed (whole versus milled, whole being the healthier option), it can contain varying amounts of beneficial nutrients. Vitamins such as niacin, thiamine, riboflavin, pantothenic acid, folate and vitamins B-6, E and K can be found in corn meal. Minerals that can be found in corn meal include iron, magnesium, phosphorus, potassium, zinc, copper, manganese, and selenium. It has a medium load on the glycemic index (GI). The glycemic index is based on a scale of 0 to 100; each food is scored based on the rate at which it raises blood sugar level after eating. Diets with foods containing low glycemic indices are good for people with Type 1 and 2 diabetes because they can improve glucose and lipid levels, reducing insulin and insulin resistance ²³. Cornmeal has a GI score of 69. One serving of cornmeal is a quarter of a cup, which has 10% total carbohydrates (32 g) and 6% of the daily recommended value of dietary fiber (2 g). It also includes 3 g of protein and 0.5 g total fat ²⁴.

Ferrous sulfate is an additive that improves iron levels in the blood. Iron helps hemoglobin found in blood to carry oxygen to body tissues. Ferrous sulfate is good for people with anemia, but can be harmful for people with iron overload syndrome, hemolytic anemia (lowered red blood cells), porphyria (a genetic disorder that affects the skin or nervous system), thalassemia (a disorder of red blood cells caused by genetics), alcoholics, or people who receive blood transfusions on a regular basis. Ingesting too much ferrous sulfate can cause nausea, severe stomach pain, bloody diarrhea, shallow breathing, pale skin, blue lips, and seizures ²⁵. The food label of Flamin' Hot Cheetos claims that each serving contains 2% of the daily recommended value of iron, and an analysis of the ingredients indicate that the source of this iron comes from ferrous sulfate used to enrich the corn meal. In a clinical laboratory study, patients given a 100 mg supplement of ferrous sulfate showed increased free-radical levels in fecal material ²⁶. Another study, this time on rats, showed that ferrous sulfate absorption varied significantly according to the acidity of the diet ²⁷. The main concern for students consuming too much ferrous sulfate would be constipation, darkened or green stools, diarrhea, nausea, and upset stomach.

Oils

The vegetable oils that can be found in Hot Cheetos include corn oil, soybean oil, and sunflower oil. Corn oil is

a polyunsaturated vegetable oil that is steamed, milled, and sifted to separate the germ from the starchy endosperm. Then it is heated and pressed, and this process gives the oil its texture. Due to the prevalence of genetically modified corn, there is a high probability that the corn oil used by Frito-Lay comes from genetically modified corn. A recent study found a positive relationship (depending on consumption level) of genetically modified corn and the toxicity of the liver, kidneys, and spleen of rats ²⁸ .

Flamin' Hot Seasoning

Maltodextrin is a sweetener derived from treating starch from corn or potatoes with enzymes, alkali or acid. It is most likely used in Cheetos as a thickening or flavoring agent. Because it is high in calories, it can increase blood cholesterol levels (1 cup of maltodextrin contains 190 calories and 49 g of carbohydrates); this has the effect of increasing LDL cholesterol, or the "bad" type. If taken in excess, this can lead to cardiovascular diseases such as hypertension, heart attack, or stroke. In addition, increased consumption of maltodextrin upsets the balance of insulin and glucagon (hormones that regulate blood sugar levels), which can lead to hypoglycemia (which can cause dizziness, fatigue, headache, confusion, seizures, coma, and eventually death) ²⁹ .

Monosodium glutamate (MSG) is a flavor enhancer that is a form of the amino acid glutamic acid. It has been linked to weight gain. Overconsumption can cause MSG related syndrome (also known as Chinese restaurant syndrome), which includes symptoms such as numbness of chest, back, and neck, worsening of asthma, tingling or burning sensations, heart palpitations, anxiety, frequent urination, thirst, excessive urination and thirst, migraines, depression, and stomach ache or vomiting ³⁰ .

The food coloring used in Flamin' Hot Cheetos is of particular concern, as the popular food dyes in this snack are allowed in the United States by the Food and Drug Administration, but are banned in other countries due to effects on health. Red 40 Lake (the "lake" term indicating that it is a water-soluble dye that contains more than 85% pure dye and is stable when exposed to heat, and is easily incorporated into products in its dry state) was approved for food use in 1971. However, it is currently banned in the United Kingdom, Switzerland, Sweden, The Netherlands, and other countries of the European Economic Community due to its links with behavioral problems in children ³¹ . Yellow 5, also known as tartrazine, is known to cause allergic reactions and is linked to the induction of asthma and the immune response. When ingesting Yellow 5, some people may experience itching, hives, and tissue swelling. Yellow 6 is also known to cause allergic reactions. In a study involving rats and a high level of consumption of this dye, the rats developed lesions on their kidneys, which may explain the ban of Yellow 6 in some countries ³² .

Other additives

Sodium diacetate is used as an antifungal agent and helps to retard mold growth in cheese and bread as well as bacteria. Because skin contact is necessary for ingestion of Cheetos, it should be noted that, while the EPA lists the consumption of sodium diacetate as safe ³³ , it is a known skin irritant than may result in inflammation (itching, scaling, reddening, or blistering) and an eye irritant (redness, watering, or itching). It is considered very hazardous in the case of skin contact ³⁴ .

Disodium inosinate is a flavor enhancer that is a sodium salt from a phosphoric acid. It decreases the cooking time of food and can serve as a leavening agent that has the added benefit of slowing bacterial growth. It is a known irritant to the respiratory tract, inducing coughing and shortness of breath. Ingestion can cause vomiting, diarrhea, lethargy, heart disturbances, blood chemistry effects and central nervous system effects,

as well as calcium depletion. It is also known to irritate the skin and eyes ³⁵ .

The Transition from Corn to Flamin' Hot Cheetos

Corn is cereal grain that is high in carbohydrates. The life cycle of a typical corn on the cob starts with a seed, which comes from a kernel on an ear of corn. Sadly, it is most likely a genetically modified seed from Monsanto, ConAgra Foods, or Syngenta. Corn seed is usually planted in the spring by a machine called a row planter, and often accompanied with weed killer chemical spray. When the corn eventually grows tall and the corn silk turns from a light yellow to dark brown, the corn is ready to be picked. A machine harvester will remove the corn husks from the plant. The corn is then packaged and purchased by a produce broker to be sold at the store. The corn travels usually by diesel truck to the grocery store.

After being picked from a farm, corn is turned in to corn meal by cleaning, drying, then grinding corn kernels with oil to make it in to a paste. This paste is checked for moisture, temperature, and coarseness. Then, cornmeal is shipped by freight cars to silos at a Frito-Lay plant. When ready, water is added to the cornmeal and then it is heated under pressure and pushed through a hole to make a cylinder shape. When this mixture comes in to contact with air, it fills with air and takes the cheese puff shape. An oven dries the cheese puff and while it is drying, it is coated with oil and then seasoned with cheese powder. These cheese puffs are then baked or fried, depending on the snack. It is then packaged in plastic (with nitrogen blown in the bag to keep the chips fresher longer) and then inserted in cardboard boxes before being shipped to stores via diesel trucks.

What Constitutes Junk Food

There are several groups that are hoping to define a healthy snack versus an unhealthy snack. The California After School Resource Center has defined a healthy snack as one that is low in saturated fat, added sugars and sodium, yet high in vitamin and fiber. It can include foods such as fruits and vegetables, whole grains, beans, nuts, and low fat dairy products. It is suggested that each snack follows the 35/10/35 rule, which proposes that 35% or less of the total calories of that snack come from fat, 10% or less from saturated fat, 35% or less added sugar by total mass of the product ³⁶ . It is also recommended that the snack contains 250 total calories or less. There are some foods and beverages that are exempt from this rule, including eggs, individually packaged cheese, nuts, seeds, and dried fruits and vegetables, and 2% skim milk, non-dairy milk, and fruit and vegetable juices comprised of at least 50% juice without added sweeteners.

The New Haven Healthy Store Initiative, along with Yale's Community Alliance for Research and Engagement (CARE) and the New Haven Health Department, have established clearer, stricter standards for what constitutes a healthy snack. These are as follows ³⁷ :

Table 1: Nutritional standards for a healthy snack in New Haven.

Fat	Less than 35% total calories from fat. Nuts, seeds, eggs, and avocados are exempt Less than 10% of total calories from saturated fats Less than 0.5 grams of trans fats per serving
Sugar	Less than 35% total calories from total sugars OR Less than 10 g sugar per serving. Fruit products with no added sugar are exempt
Calories	Less than 200 calories per serving
Fiber	2 g or more of fiber per serving for grain-based products (applies to chips, granola bars, cookies, or other similar snacks)
Sodium	Less than 200 mg sodium per serving

Table 2: Comparison of Nutritional Values of Cooked Corn versus Flamin' Hot Cheetos Snack

	Cooked Yellow Corn, ½ cup, 82 g (1 serving size)	Hot Cheetos 82 g (2.9 serving sizes)*	FDA Recommended Daily Intake³⁸	EFSA Recommended Daily Intake³⁹
Calories	67	464	2,000	2,150**
Fat	0.1 g	31.9 g	44 g	84 g**
Saturated Fat	<0.1 g	4.4 g	22 g	26 g**
Cholesterol	0 mg	0 mg	300 mg	Not proposed
Carbohydrate	16.8 g	37.7 g	300 g	242 g
Protein	2.5 g	2.9 g	50 g	72 g
Dietary Fiber	3.9 g	1 g	25 g	25 g
Sodium	13 mg	725 mg	2,400 mg	2,500 mg
Vitamin C	5 mg	0 mg	60 mg	Not proposed
Folic Acid	41 mg	unknown	400 mg	< 400 mg
Niacin	2 mg	2.1 mg	20 mg	8 mg
Potassium	243 mg	0 mg	4,700 mg	5,000 mg

*According to the package, 1 serving size is 28 g, or 21 pieces of Cheetos. Serving sizes are estimates of what an average person eats in one sitting, but there is often more than one serving size in a typical \$0.99 bag of chips. Therefore, the numbers above are normalized to the nutritional value of the equivalent of 1 serving size of corn.

**Based on information from the Food Standards Agency UK FSA Nutrient and Food Based Guidelines for UK Institutions ³⁸

Comparison of Food Additive Standards in the United States Versus the European Union

There are different regulations that determine whether a food additive is safe, based upon parameters set by the government. There are two agencies that publish a Code of Federal Regulations for every chemical that is involved with food: the FDA and the EPA. The Food and Drug Administration (FDA) of the United States sets food additive regulations that food corporations must follow in order to market a product. In considering the safety of a food additive, the FDA analyzes the composition and properties of the additive, the typical consumption amount, any immediate and long-term health effects, and different safety factors ³⁹. The Environmental Protection Agency (EPA) dictates and tests for the use of pesticides in the United States. The European Union has also established an agency called the European Food Safety Administration (EFSA), which has the same role as the FDA and EPA, but historically has stricter testing standards and therefore approves less food additives than the United States. The requirements for approval of a food additive for the EFSA reads: "Food additives must be safe when used, there must be a technological necessity for their use, their use must not mislead the consumer and their use must bring a benefit to the consumer ⁴⁰ ." Below is a table that compares the food additives that are allowed in the United States versus the European Union that are found in Flamin' Hot Cheetos.

Table 3: Comparison of Regulatory Limits on Food Additives Found in Hot Cheetos

Food Additive	FDA	EFSA
Ferrous Sulfate	Approved (no levels specified)	Approved (no levels specified)
Maltodextrin	Approved (no levels specified)	Approved (no levels specified)
Monosodium glutamate	Approved (no levels specified)	Approved (no levels specified)
Red 40	Approved (depending on diluent; up to 500 ppm in castor oil)	Not Approved for use in food for human consumption
Yellow 5	Approved (depending on diluent; up to 500 ppm in castor oil)	Not Approved for use in food for human consumption
Yellow 6	Approved (depending on diluent; up to 500 ppm in castor oil)	Not Approved for use in food for human consumption
Sodium Diacetate	Approved (no levels specified)	Approved (no levels specified)
Disodium Inosinate	Approved (150 ppm in soluble barium)	Not found on the approved list of food additive

The approval by the FDA of the color additives Red 40, Yellow 5, and Yellow 6 for use in food for human consumption versus the EFSA disapproval brings into question whether or not these additives are actually safe for human consumption, and whether the standard for proof of food safety is high enough in the U.S. The EFSA seems to be more precautionary in their risk assessment. When comparing the published reports of the EPA versus the EFSA, it appears that the United States requires a quantitative risk assessment in units of excess damage. For example, the FDA allows Red 40 to be used at specific levels depending on food and diluent type despite numerous bulletins concerning its safety from other countries which can be searched for and found on

the FDA's own website.

A Healthy Alternative to the American Diet

Studies show that there are health benefits to altering the typical American diet to a Mediterranean diet. The Mediterranean diet is easier to adhere to than other plant-based diets and still shows the health benefits of other whole-foods, plant-based diets ⁴¹. This could be due to incorporating olive oil as the primary source of lipids, but also, the diet emphasizes daily consumption of a high amount of fruits and vegetables, unrefined cereals and legumes, moderate consumption of fish and dairy products, and a less frequent intake of red meat, refined grains, and sweets. The chart below summarizes the difference between a typical American diet and a Mediterranean diet.

Table 4: Comparison of Typical American Diet Macromolecules to Mediterranean Diet Guidelines⁴²

Macromolecule	American Diet (%)	Mediterranean Diet (%)
Carbohydrate	42	47
Protein	20	15
Saturated Fat	17	10
Monounsaturated Fat	14	22
Polyunsaturated Fat	7	6

As one can see, the Mediterranean diet does not cut fats out drastically as compared to the traditional American diet, but the fat type varies considerably. There is a low level of saturated fats and a high level of monounsaturated fats, which is from the olive oil prevalence in the Mediterranean diet (mainly oleic acid). The saturated fatty acids from a typical Mediterranean diet come from cheese and yogurt from goat and sheep milk, as compared with the American source of saturated fatty acids from cow's milk and meat. Goat and sheep milk is primarily medium chain fatty acids, which do not negatively affect plasma cholesterol levels as longer chain fatty acids. Most of the cheese that Greek people consume is feta, which is derived from ewe's and goat's milk. This could account for the lower prevalence of cardiovascular disease when following a Mediterranean diet.

Content Objectives

This unit is designed to engage students through activities that give them an opportunity to analyze their food choices using scientific investigations, communicate their findings, and to apply their knowledge of macromolecules to their dietary intake. This unit will address specific science inquiry skills including researching, comparing, observing, measuring, classifying, inferring, calculating, graphing, communicating, and collecting and interpreting data.

Teaching Strategies and Classroom Activities with List of Teaching Materials

The following table outlines the recommended timeline for each activity, activity objective, materials required, timeframe, and notes. Detailed explanations follow Table 5.

Table 5: Unit Overview

Subunit 1: Food Processing			
Activity	Objective	Materials Required	Time
1. Corn versus Hot Cheetos	SWBAT* compare natural and processed forms of food	Corn Hot Cheetos	15 minutes
1a. Processing of Foods	SWBAT contrast different food processing types.	Matching cards Reading Reading questions Exit ticket	35 minutes
1b. Life Cycle Assessment	SWBAT compare how three different potatoes are processed.	Readings Graphic organizer	50 minutes
2. Ingredient breakdown	SWBAT identify the harmful health effects of food additives.	Powerpoint	10 minutes
2a. Macromolecule Lab	SWBAT use indicators to identify the presence of macronutrients in food.	Macromolecule lab (including lab setup and indicators) Food samples	120 minutes
2b. Processed Food Taste Test	SWBAT explain why chemical additives are used in food.	Food samples (corn flour, corn meal, salt, sugar, food coloring, cheddar cheese flavor, Flamin' Hot Cheetos) Taste test rubric	35 minutes
3. Student research and presentation	SWBAT research and present the health effects of five food additives found in unhealthy snacks.	Teacher-generated list of unhealthy snacks Computer lab access	160 minutes
4. Class discussion	SWBAT explain why certain foods are marketed, even if these foods are not healthy.	Whiteboard	20 minutes
5. Survey	SWBAT identify the prevalence of knowledge, or lack thereof, about food additives in their local community	Survey	60 minutes of homework time
6. Written assessment	SWBAT create solutions to educate their community about unhealthy foods.	Teacher-generated prompt	30 minutes

Subunit 2: Marketing and the American Diet			
1. A Look at Advertising	SWBAT analyze marketing techniques used to target specific populations of consumers.	4 sample commercials Graphic organizer	40 minutes
2a. Questioning advertisements: Vitamin and Mineral Reading	SWBAT identify the health benefits of vitamins and minerals and also be aware of toxicity if these phytonutrients are consumed in excess.	Reading packet on vitamins and minerals Reading questions	60 minutes
2b. Healthy Food Commercial	SWBAT present the health benefits of consuming healthy snacks in an engaging manner.	Computer lab with Internet access (for research)	80 minutes
Subunit 3: Comparing Local Student Diets to Global Diets			
1. Comparing Global Resources	SWBAT compare how GDP and calorie supply relate per country.	Map with GDP per country Map with calorie supply per country	15 minutes
2. What I Eat	SWBAT compare the diets of people from different countries.	Powerpoint (including 1 slide with teacher meal and nutritional breakdown) Notetaker 4 excerpts from book <i>What I Eat</i> and worksheet	95 minutes
3. Student Diet Presentation	SWBAT outline their diets and present these to the class.	Computer lab access Cameras	120 minutes

* SWBAT is an abbreviated form for "Students will be able to..."

Subunit 1: Food Processing

The following components will be a vital part in developing a relevant, effective unit to teach about nutrition and how junk food contains mostly two macromolecules (carbohydrates and lipids in a processed form) and how they can take action to educate others about the harmful effects of processed foods.

1. Engage Activity: Corn versus Hot Cheetos. One of my students' favorite snacks is this spicy cheese puff called Flamin' Hot Cheetos. I would like to start the unit by asking the students when is the last time they had an ear of corn versus a Hot Cheetos. I will ask the students to compare how each one is made. Using realia is one strategy that helps English Language Learners process the information presented to them. The four modes of language acquisition include reading, writing, listening, and speaking. In this lesson, students will be listening to me and each other, and speaking about how the process is made. Then, they will write their ideas down on a white board and share it out with the class. By working in groups, the affective filter is lowered to encourage class participation.

- a. *Processing of Foods*: Students will do a matching activity (given the fresh form and the processed form of common foods, such as beef/beef jerky, pork/bacon, grapes/raisins) and then try to explain how the food gets from fresh to processed form. I will then present a reading with questions that students must answer on the processing of foods. An exit ticket will be used as an evaluation to assess if students learned the material. These materials are based on the lesson *Food for Keeps*⁴⁰.
- b. *Life Cycle Assessment*: Using readings and graphic organizers, students will expert-base jigsaw to compare the life cycles of potatoes produced three ways: French fries, a Peruvian grown potato, and a locally grown, organic potato. This lesson is part of a unit from the Creative Change Energy Solutions ⁴². To evaluate students' understandings of the life cycle comparison, an exit ticket with sentence frames to aide English Language Learners will be provided. Students must be able to communicate at the end of the lesson which potato type requires more energy.

2. *Ingredient breakdown: Cause and effect*. To model for the students the assessment they will be responsible for after this unit, I will use a Powerpoint presentation entitled *Processed Food for Thought* (see Appendix B for text) showing chemicals added to a bag of Hot Cheetos and the health effects of each (ex. "high fructose corn syrup => diabetes"). After presenting the ingredients, I will ask the students why people eat Hot Cheetos (examples can include the cost, marketing, taste, convenience); I can pose the question what would happen if we took out the corporation's ability to market on television, etc. This discussion would lead to the reasoning behind why it is essential to understand food labels.

- a. *Macromolecule lab*: Students will be given a lecture and a reading of the four basic macromolecules and their subunits. Then, students will use indicators to first identify a specific macromolecule (e.g. iodine turns black in the presence of carbohydrates, Biuret reagent turns purple in the presence of protein, and lipids will turn brown paper transparent). Then students will test different foods to determine which macromolecules are present in different foods. Students will need to write a conclusion paragraph to indicate learning about different foods. A variety of processed and fresh foods will be presented (potato chips, apples, cereals, rice) in order to prepare the students for Step 3, Student Research.
- b. *Processed Food Taste Test*: Students will perform a taste test to determine for themselves why companies process foods. As noted earlier, food additives are used for a variety of reasons (texture, visual appeal, taste, nutritional supplements, etc.) but hopefully students will come up with their own reasons why companies would put additives in food products. Students will be given the following foods, in order: corn flour, corn meal, corn meal with salt*, sugar*, food coloring*, cheddar cheese flavor* (*each one added in combination with the previous ingredient), and finally Flamin' Hot Cheetos. Students will evaluate each based on visual appeal, texture, aroma, and taste (salty, sweet, sour, or bitter).

3. *Student Research and Powerpoint*. Students will be given a choice of one product from a list of processed foods to research. Students will look at the ingredients, and then describe the health effects of five of those ingredients (one per slide). Then, they will have to present three healthy alternatives to their chosen snack. For their conclusion to their presentation, students must present why junk food is bad.

4. *Class discussion*. After hearing all of the harmful chemical additives found in popular processed foods, students will discuss why people eat junk foods, why are corporations allowed to sell these harmful products to the general population when they know their products are bad, and who do these corporations sell their junk food to? The main idea is to show that junk food is harmful to human health.

5. *Survey*. Students will find at least five people who have eaten their product of research. Included in the

survey will be a question that asks if the person was aware of the health effects caused by the chemicals found in their food.

6. *Written assessment.* Students will write about what they can do to better educate people about what they are eating.

Subunit 2: Marketing and the American Diet

The following activities will help students explore why so many Americans are obese and undernourished at the same time.

1. *A Look at Advertising:* Students will view commercials for junk foods. Students will determine the target audience for each commercial and provide evidence that the commercial is advertising to that audience. Students will then discuss why the corporation would market to that particular audience (commercials include advertisements for McDonald's, Burger King, Coca-Cola, and 3 Musketeers Light). We will conclude the discussion with a quote from Marion Nestle, "Food companies will make and market any product that sells, regardless of its nutritional value or its effect on health. In this regard, food companies hardly differ from cigarette companies. ⁴³ "

2. *Questioning Advertisements:* Students will notice that there are not health food advertisements by farmers ("Strawberries aren't labeled as having ten percent of a daily recommended vitamin. Real food doesn't need decorations or high-pressure advertising. ⁴⁴ ").

- a. *a. Vitamin and Mineral Readings:* Students will complete a reading with questions about the essential vitamins and minerals needed for optimal health. Readings include information on toxicity and deficiency for vitamins and minerals, in addition to the daily recommended values ⁴⁵ .
- b. *b. Healthy Food Commercial:* Individually, students will read "Snack Food can be Real Food. ⁴⁶ " Then, in groups, students will pick a healthy snack and create an advertisement that markets to their age group while advertising the vitamin and mineral benefits of this healthy snack.

Subunit 3: Comparing Local Student Diets to Global Diets

1. *Comparing Global Resources:* Students will be given a world map that demonstrates graphically Per Capita GDP printed in black and white, and then a colored transparency that overlays this map which shows calorie supply by country ⁴⁷ . Students will make the connection that there is a negative relationship between GDP and calorie supply. Students will then complete an anticipation/reaction guide based on ten posters that include pictures of a person's daily diet and statistics on that country to predict how these ten countries (Bangladesh, Canada, China, Israel, Japan, Kenya, Latvia, United States, Venezuela, and Yemen) rank in both life expectancy for females and national percentage of overweight males ⁴⁸ . Students will then take a closer look at the countries and record the actual ranking and statistical data. Students will receive a chart that includes statistical information on these countries and then they will be responsible for a bar graph that shows

a comparison by country of health expenditure per capita in U.S. dollars versus overweight females and males⁴⁹. Finally, students will be given a reading about each country from the book *What I Eat*⁵⁰ and fill out an inference chart that demonstrates their understanding of the text about that country. An inference chart answers a question on the left, and then students quote from the text to help them identify sources from the reading that prove their inference response on the left.

2. *What I Eat*: Students will take notes on a Powerpoint presentation based on Peter Menzel's book. Throughout the presentation, students will be asked what they notice about people's diets around the world. Then, students will be shown a meal that the teacher eats. The meal will be broken down by macronutrients (lipids, carbohydrates, and protein) and the mass of each food type and calorie intake will be shown. Students will choose one of four people from the book *What I Eat*. Students must fill out a graphic organizer in expert groups that include the person's statistics (name, age, height, weight and total calorie intake). Students will read about that person's country (the geographic setting and environment; the history and food; the foods of the country; food for religious celebrations; mealtime customs; and politics, economics and nutrition)⁵¹. Then, students will break down the foods in the meals of the chosen person, classify the food type by macronutrient⁵², and then the number of ounces that person consumed. Then, students will total up the number of ounces per macronutrient, then convert this to grams (1 ounce = 30 grams), then convert these numbers to calories (1 gram of fat = 9 calories, 1 gram of carbohydrates = 4 calories, 1 gram of protein = 4 calories). The students would then calculate the percent of each macronutrient, then graph these percents in a bar graph. Finally, students would give a written analysis of the health of their person's diet in comparison the FDA's daily recommended daily value of 29% lipids, 18% protein, and 53% carbohydrates⁵³.

3. *Student Diet Presentation*: In pairs, students will create a Powerpoint presentation of one meal and one snack that the student actually eats. Students will be responsible for taking a photograph of these foods (if students do not have access to a camera, a drawing would suffice). This photograph will be diagrammed similar to the one the teacher has created, including information about lipids, carbohydrates, and proteins, as well as food additives in their snacks. Caloric intake and macronutrient information can be obtained using the Internet for information not readily available⁵⁴. Students will then create a profile similar to the ones found in the posters viewed in class (*Student Name: The Football Player* followed by a paragraph about that student). Students will include statistical information about their state (prevalence of obesity, heart disease, percent of people reporting poor health, and physical activity). This pair of students will be responsible for presenting their final presentation to the class.

Following this outline, I am hoping that students will have a relevant, meaningful experience about what is being put in the foods that they favor.

Resources

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Statham, Bill. *Eat Safe The Truth about Additives from Aspartame to Xanthan Gum*. New York: Running Press, 2009. This resource provides an alphabetical list of additives and explains the function of the additive in food. It also codifies the additive on a rubric represented by smiley faces, gives possible health effects, tells the possible food use and other uses in a tabular form. This is a great

resource for the students' Powerpoints as well as for background information if you do not want to choose Hot Cheetos as your profile snack.

"Creative Change Education Solutions." Creative Change Education Solutions. <http://www.creativechange.net> (accessed July 17, 2012). This is a subscription-based site approved for use in the classroom for members with paid membership. The lesson used here is entitled "The Biography of Three Potatoes."

" Ultimate Factories Frito Lay - YouTube ." YouTube - Broadcast Yourself. . <http://www.youtube.com/watch?v=mUoQm93IyaM> (accessed July 16, 2012). This is a great episode on the Frito Lay factory in Georgia. At 27 minute in to the program, they show how chips are packaged at their factory. At 31 minutes, there is an animation that explains how Funions get their shape, similar to Cheetos.

Reading List for Students

Johanson, Paula. *Fake foods: fried, fast, and processed : the incredibly disgusting story*. New York: Rosen Central, 2011. pp. 32-34. This resource has great readings that are at the appropriate level for English Learners who are at least at CELDT level 3.

Menzel, Peter, and Faith Aluisio. *What I eat: around the world in 80 diets*. Napa, Calif.: Material World Books, 2010. For the worksheets, the four people I am choosing are 1. pp. 62-67: Ruma Akhter, The Factory Seamstress from Bangladesh, 1800 Calories. 2. Pp. 106-109: Atefeh Fotowat, The Miniaturist's Daughter from Iran, 2400 Calories. 3. Pp. 154-157: Jose Angel Galaviz Carrillo, The Rancher from Mexico, 2900 Calories. 4. Pp. 260-263: Oscar Higares, The Bullfighter from Spain, 4200 Calories.

Hanson, Karen. *Junior Worldmark encyclopedia of foods and recipes of the world*. Detroit, MI: U X L, 2002. These four volumes contain a wealth of information about each country, including an average of ten sample recipes that illustrate the typical food consumed. These volumes will be used for the background reading for each country.

Appendix A: Implementing District Standards

California Biology Standards Covered by the Unit

This unit will be taught after students have gained basic understanding of the following concepts: cells, enzymes, biochemistry, macromolecules and their subunits, the definition of calories, research methods, graphing, calculations, and the scientific method.

The Common Core Standards that will be addressed in this unit are as follows:

RST.9-10.1.Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions

RST.9-10.2.Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.

RST.9-10.3.Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.

RST.9-10.7. Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.

Appendix B: Resources for Curriculum Unit

Subunit 1, Activity 2: Powerpoint Text for Processed Food for Thought

Title Slide 1: Processed Food for Thought: Exploring Chemical Additives in Processed Foods

Slide 2: When is the last time you had one of these? (show picture of corn on the cob)

Slide 3: When is the last time you had one of these? (show picture of Flamin' Hot Cheetos)

Slide 4: How is each one made? (show side by side pictures of corn and Flamin' Hot Cheetos)

Slide 5: Let's look at what's going in to your body every time you eat one of these. . . (show pictures of food label and someone eating Hot Cheetos)

Slide 6: Do you suffer from: Constipation? Darkened or green stools? Diarrhea? Nausea? Upset stomach? Then you may be consuming too much. . .Ferrous Sulfate (show picture of food label with circle around this ingredient and arrow pointing at the ingredient from slide)

Slide 7: Do you want to risk getting: Prostate cancer? Bone cancer? Then don't eat too much. . .Folic Acid (show picture of food label with circle around this ingredient and arrow pointing at the ingredient from slide)

Slide 8: Do you want to get: Diabetes? Hypertension? Arthritis? Cancer? Auto-immune diseases? Then be sure to get enough. . .Vegetable Oil (show picture of food label with circle around this ingredient and arrow pointing at the ingredient from slide)

Slide 9: Do you suffer from: Numbness of chest or neck? Worsening of asthma? Tingling or burning? Anxiety? Frequent urination? Excessive thirst? Migraines? Depression? Stomach aches/vomiting? Then you may be consuming too much. . .MSG (show picture of food label with circle around this ingredient and arrow pointing at the ingredient from slide)

Slide 10: Do you have: Attention problems? Behavior problems? Asthma problems? Immune problems? Itching, swelling or hives? This may be caused by the dyes (banned in several countries, but not in ours. . .Red 40, Yellows 5 and 6 (show picture of food label with circle around this ingredient and arrow pointing at the ingredient from slide)

Slide 11: And in this snack there are pesticides known to cause. . .Skin irritation, Eye redness and irritation, Vomiting, Lethargy, Swelling of the brain in a bad way. But they help fight off bacteria! They are called. . .disodium inosinate and disodium guanylate (show picture of food label with circle around this ingredient and arrow pointing at the ingredient from slide)

Slide 12: So really, what are we eating?! You tell us! (include pictures of snacks that students eat with food labels: Twinkies, Chili Fritos, Cream Cheese dip, etc.)

Slide 13: What's in my lunch today? (show picture of my lunch with nutrient breakdown)

Subunit 1, Activity 2b: Processed Food Taste Test Rubric

Food Sample:	Texture (smooth, grainy): what feels appealing about this food?
Visual Appeal (how does it look?)	Aroma (how does it smell?)
Taste (salty, sweet, sour, or bitter?) Does it taste good?	
Overall Judgement: would you eat this food as is? Explain.	

Subunit 3, Activity 2: What I Eat Reading Worksheet

1. Personal Basics

a. Name of Person: b. Age: c. Height: d. Weight: e. Calories: f. Country:

2. Background Information about the Person's Country: Answer the following based on the provided reading.

a. Describe the geographic setting and environment of this country.

b. Describe the history of the country and how this history impacts the food.

c. What are typical foods you would find in this country?

d. Describe food people in this country eat for religious and holiday celebrations.

e. What are two mealtime customs?

f. What is the political and economic situations in this country that effect nutrition?

3. Look at the dietary intake of the person. For each meal (breakfast, lunch, dinner, and snack) write the name of the food in the first column, classify the food type in the second column (lipid, carbohydrate, or protein), and record the amount in ounces that the person consumed of this food product.

Meal	Name of Food	Food Type (L, C, or P)	Amount (Ounces)
Breakfast			
Lunch			
Dinner			
Other			

4. Fill in the following table to calculate the macronutrient intake of the person*.

Total Ounces	Lipids	Carbohydrates	Protein
Total in Grams (1 oz = 30 g)			
Total Calories	(g * 9 cal/g) =	(g * 4 cal/g) =	(g * 4 cal/g) =
Calories as Percent of Whole Daily Food Intake	(cal lipids/total calories)	(cal carbohydrates/total calories)	(cal protein/total calories)

5. Create a bar graph to show the person's caloric intake by macronutrient type.

6. What do these results tell you about how healthy the person's diet is? Remember, the FDA recommends 29% lipids, 18% protein, and 53% carbohydrates.

*Note: Since we classified the food type by what the majority of the food was (example, spaghetti is mostly carbohydrates, but it also contains lipids and protein), our numbers are not completely accurate so your calories may not add up to the total in the reading.

Endnotes

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<https://teachers.yale.edu>

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