

Introducing 9th Grade Students to the Biology of Food

Sue George

John Bartram High School

Problem

Rationale

Objectives

Background

Standards

Strategies

Classroom Activities

Bibliography

Appendix

Problem

Teaching health to ninth graders continues to reinforce my commitment to try to influence and help change the eating patterns of our students. The daily ritual of watching them enter the building with black plastic bags overflowing with bags of EMPTY CALORIES is very disheartening!! They walk right by the breakfast cart where the cafeteria is offering a government “balanced” school breakfast, which to them is not worthy of a second look. I understand that warm, not hot waffles or pancakes are not enticing to eat, but the breakfast parfaits of yogurt and fruit at least looks appealing even though I have gotten mixed reviews on how they taste! Attention needs to be focused not only on what they are eating at school, but also on what they are eating at home. Students need to evaluate what they eat at home and understand the impact or lack of impact that it has on their food choices and eating patterns throughout the day.

Rationale

As educators, we need to continually reinforce the positive results of eating nutritiously. We also need to make students aware of what junk food does to them as kids and now as teens and where this can lead as they get older. It is of course very difficult to communicate these ideas with to students who only are concerned about the present and maybe tomorrow. They do not consider the effects of their current eating habits on their health and weight in ten years, and beyond. This unit is designed to approach the topic of food and nutrition through an entirely different avenue.

We are also aware that the family structure has changed over the years and now many parental responsibilities are being transferred to children due to job responsibilities of the parent or guardian. Many of our students are responsible for preparing or purchasing their own meals. They need to understand the importance of healthy eating and the results of eating too much of what we call “junk food” and what they see as their meals.

If they can be taught to objectively look at the eating habits and food choices of adults in their family, they may be able to understand why certain health conditions have occurred. For example, if an older sibling or parent snacks on junk food, or substitutes chips and Cheetos and sodas for breakfast, this may be why the student is doing the same thing. Students need to be made aware of the repercussions of this pattern of food consumption and how to change this pattern for healthier living.

It is easier and more convenient to stop at McDonalds, Popeye, Wendy's or the local corner store to for breakfast, lunch or dinner. Dollar menus make many of the items very reasonable and an easy substitute for a meal. In April of 1999, there was a summit meeting of the CEO's of the major food companies. The C.E.O. of Pillsbury's organized the meeting in collaboration with a several other high-ranking officials of other companies, who wanted to address the growing problem of obesity. Even though these top officials acknowledged the growing obesity problem, they did not want to change their research or the techniques they use to prepare food so that it is enjoyable to eat, but does not cause the consumer to consume too much. The average person is not aware of the research, planning and chemical manipulation that occurs to make their favorite snack or beverage appealing. Food companies, unfortunately are more concerned about the bottom line, their profit and not the health of the consumer. (1)

Several studies published in **Nature Neuroscience** have tested the preference of rats for high calorie food over nutritious food. Both articles presented evidence showing that high calorie food created a type of brain response and the production of chemicals typically associated with addiction. These studies raise the question of whether our students are becoming "addicted" to high calorie foods, and make it essential to examine, and perhaps try to change the nutrition choices and eating habits of our students? (2)

This then led me to realize that students do not have a strong understanding of the biology of food and what is involved. Why are some ears of corn all yellow or white? How did we get an ear that is yellow and white? This opens an investigation into how scientists create a "yellow and white kernel" ear of corn. Plant cells have DNA just as an animal cell has DNA. The DNA in both cells operate the same way. Certain traits in plants can be isolated and genetically modified to become more nutritious, tastier and increase the supply of food and extend its shelf life. Other modifications also include using medicinal foods for vaccines or other medications, creating faster growing plants and animals. There are always potential risks such as genetic changes that are unexpected and harmful. Modified organisms may interbreed with natural organisms and out-compete them, leading to extinction of the original organism or to other unpredictable environmental effects. Plants may be less resistant to some pests and more susceptible to others. (3) If we research the foods that we buy and eat, one will find that a very large percentage has been genetically or chemically modified.

Organic foods are showing up on the shelves and the produce areas. These foods are becoming more popular especially with those consumers who are trying to avoid artificial ingredients or the use of pesticides. The first noticeable difference is the higher cost of the item. The consumer then needs to weigh the cost vs. the manner of production. The

question is then reduced to what is the difference and are these foods more nutritious and safer to consume? “Organic” farming is how the fruits, vegetables and meats are grown and processed. Organic farming practices are designed to encourage soil and water conservation and reduce pollution. Farmers who grow organic produce and meat don't use conventional methods to fertilize, control weeds or prevent livestock disease. For example, rather than using chemical weed killers, organic farmers may rotate crops and spread mulch or manure to keep weeds at bay. What this means to the average consumer is that conventional farming will use chemical fertilizers, synthetic insecticides and herbicides and antibiotics for the livestock. The organic farmer will use compost for fertilizer, use natural means to remove insects and allow animals to roam outside and maintain the living space of the animals. (4)

There are also requirements that need to be met to use the label “organic” as well as the USDA seal. There are various levels of “organic” starting with 100% organic. To be able to use the 100% organic label with the USDA seal, everything about the product must be all organic. If the product is certified 95% organic, the product may use the term “organic” as well as the USDA seal. Anything that is at least made with 70% ingredients, the label can read “made with organic ingredients. (4).

Objectives

This unit is being created for students in Grade 9 but is applicable to students in grades 9 through 12. Their day starts at 7:55 with classes running through 1:30 pm when they go to lunch for thirty minutes. School is dismissed at 3:00 pm, one hour after lunch. For most of the students, classes are all within a classroom, with little or no opportunity for physical activity. Students have the freedom to decide what they want to eat for most of their meals and many have the money to purchase the food they eat. They have access to stores en route to and from school and are able to take public transportation or walk to neighborhood shopping centers where they can purchase food. Accepting this daily routine, this unit will provide the students the opportunity to study the biology of food starting with the basic cell unit and the role of DNA. From here, the students will study genetically modified foods: how they came to be as well as the role in our food supply. Organic foods will also be compared to genetically modified and “home grown” foods (ones that are grown in a personal garden). After gaining an understanding of these types of foods, the students will analyze high calorie and high carbohydrate foods and their effects on the body.

The Objectives of this unit are to:

- Introduce the students to the biology of food
- Analyze plant DNA as a preview to genetically modified foods
- Analyze genetically modified foods and identify characteristics of these foods.
- Understanding the concept of organic foods and analyze the characteristics of organic food.
- Understand how large food corporations create foods that are not necessarily healthy.

- Analyze the impact of large amount of carbohydrates on their brain and the possibility of becoming a “junk food” addict.

Background

The research for this unit will include topics that are related to food biology. The foods that are now available for consumption have changed over time. We no longer eat the types foods that were readily available sixty and seventy years ago. Today’s food choices include genetically modified foods, organic foods and a large amount of prepared and “fast food” choices. Standards that will be included in this unit:

Standards

Science

- 3.1.10.A1 Explain the characteristics off life common to all organisms.

Health

- 10.1.12 B Evaluate factors that impact the body systems and apply/preventative systems

- 10.1.12 C Analyze factors that impact nutritional choices of adults

- 10.1.6 C Analyze the nutritional concepts that impact health

- Nutrition requirements
- Healthful food selection

Strategies

This unit will start by accessing prior knowledge, use small group work, differentiated instruction, and technology (computers and internet).

Classroom Activities

Lesson 1

Students will be able to (SWBAT): analyze the plant cell and DNA and compare it to a human cell and DNA in order to gain an understanding of the common structure in all living cells.

(The level of instruction should be based on the students’ knowledge of cells and DNA. For those students who have not had a previous Biology class, you may have to take a very basic approach. For students who have had Biology, a more in-depth comparison can be used. I will be taking the approach that the students have not had Biology and have little or no prior knowledge about the cell and DNA. This lesson may need to be extended depending on student understanding and the need to review basic information.)

DO NOW: Consider a plant cell and a human cell: Do you think that the cells are the same? Please explain why you do or do not think that they are the same.

Lesson 1

1. Introduce the structure of a plant cell and compare it to a human cell. Identify shared features and discuss the function of the different parts.
2. Describe the structure of DNA and its role in inheritance. Use drawings of DNA strands, separating them, and identifying the same components on each strand.
3. Discuss what will happen if DNA is changed.
4. Resources for this lesson:
<http://gslc.genetics.utah.edu><http://gslc.genetics.utah.edu>. This web site is very informative and useful, especially for health teachers who do not have a strong science background. There are activities to help students better understand DNA structure. It includes a teacher guide with common misconceptions. If necessary this may need to be extended into two lessons.

Lesson 2

SWBAT: analyze the effect of changing DNA in order to gain an understanding of hybrid plants.

DO NOW: What is the main role of DNA? Is it the same in plants and humans?

Lesson:

1. Introduce the concept of hybrids. What is a hybrid, how are genes manipulated or changed to create different varieties of a plant? Good example is showing a yellow ear of corn and a white ear of corn. The product of the hybrid (the F₂) is the ear of corn that has both types of kernels.
Explain the process involved to produce the hybrid ear of corn.
2. Working in pairs: Students make a list of fruits and vegetables that are hybrids. Set a timer for three minutes to create the list. If possible, provide each group a computer so that they can search for examples if they are having a difficult time identifying the fruits and vegetables. (I am anticipating this problem.) If you don't have computers available provide a list of fruits and vegetables and have the students select the ones that are hybrids. (If you are going to provide a list, shorten the time to identify the hybrids.) You can also extend this to include trees and flowers if so desired.
3. Activity: Students can either draw or find pictures of the hybrids, describing the process. If access to Internet, students can find colorful pictures to show the relationships.

NOTE: this is a little tricky because technically hybrids are controlled crosses between two different types of plants (e.g. yellow and white corn), but many crops are self-pollinated (e.g. soybeans, heirloom tomatoes, canola etc.). It might be interesting to get a seed catalogue and see that some varieties of the same crop (e.g. tomatoes) are described as F₁, and some varieties are described as OP (open pollinated). You could ask the students what they think this means. Do they think that one type is better than the other? What sorts of seeds will these plants produce? Note that the seeds that are produced by crossing yellow x white corn are yellow (because the yellow allele is dominant to the

white allele), and it is only the in progeny of these hybrids (the ear that they produce) that one sees the segregation of yellow and white seeds.

Lesson 3

SWBAT: Analyze “organic” food items in order to learn the pros and cons of consuming organic foods.

DO NOW: What does “organic” food mean? Do you eat foods that are labeled “organic”?

1. Introduce the concept of “organic” foods and vegetables.
2. Discuss the “rules” that identify organic foods, problems growing them and analyzing the cost of organic foods vs. “regular” foods.
3. In small groups: using computers and grocery store advertisements: students will identify foods that they eat on a regular basis and price the food out to see what it will cost them to buy the food and what it would cost to buy foods that are label “organic. Have groups list advantages or disadvantages of consuming organic food using a “T” chart. Groups will share out.

Using large poster paper: Create a list of pros and cons as students share out.
On another large poster paper: Develop list of GM foods and organic foods so that students can visualize the availability of the items. You can also include prices if that is available.

Lesson 4

SWBAT gain an understanding of genetically modified foods in order to appreciate the origin of foods they eat.

DO NOW: Define your understanding of genetically modified foods and animals. (Students may not have any knowledge regarding genetically modified foods.) Introduce the idea that all food has been genetically modified by humans since agriculture was invented 10,000 years ago, but now new techniques are available for introducing genes into plants and animals.

Lesson:

1. Introduce the concept of genetically modified foods: purpose, history and examples of foods; extend discussion to include animals that may have been genetically modified for particular traits or uses.
2. In small groups: students will identify examples of foods that they eat on a regular basis. Identify foods that are not GM. Use computers to help with examples.
3. Golden Rice: what it is, how it was created and what it was intended for, reasons it is not marketed?
4. In small groups: provide groups with information on Golden Rice. Designate groups to be either pro or con on the approval of the Golden Rice. Students will present and defend their reasons. Extension: Groups can create a GM product

that has been created for a particular reason. They will explain what plant was modified and how it was modified and for what purpose.

Lesson 5

SWBAT: analyze the role that large food companies play in manipulating the chemistry of foods to increase consumption in order to make healthy choices.

DO NOW: Do you think that foods, especially comfort foods such as snacks and drinks are chemically altered so that we are able to eat them without having our body send out a “stop” eating signal?

1. Role food companies play in ensuring that their products are attractive to consumers.
2. In small groups have students research chemical manipulation of foods to improve taste, create cravings, negative affects of chemical manipulation to include obesity, chemical effects to body, brain and digestive system. Research their favorite foods to see if or how they are chemically altered. or a Students share out their findings. To differentiate learning: students can assume roles of recorder, time manager (if a specific time is set to complete research), spokes person, etc. Have students prepare visual presentation so that class can compare and contrast findings.

Lesson 6

SWBAT: create a project in order to demonstrate knowledge learned from the Biology of Food.

DO NOW: What favorite food has been chemically manipulated? Will you continue eating it? Why or why not.

1. To demonstrate an understanding of this unit, students will complete a project of their choice. They may choose from one of the following suggestions or suggest one that is instructor approved. Topics may include but are not limited to: Hybrid plants, genetically modified plants, foods that have been chemically manipulated or altered, history of a particular vegetable or other topic of student’s choice.
2. Encourage students to create visual, written and other modes of presentation. Project will be presented to class.
3. Rubric is included in appendix.
4. An extension for differentiated instruction: Students will research the future of crop production for the year 2050. (It is estimated that the world population will reach nine billion people). Will crops be grown for human consumption or animal, or both? What are the threats to the environment from farming? What is the greater threat: farming or cars and industry.

Bibliography

1. http://www.nytimes.com/2013/02/24/magazine/the-extraordinary-science-of-junk-food.html?_r=1&pagewanted=all&
2. http://www.nature.com/neuro/press_release/nn0510.html
3. <http://www.nlm.nih.gov/medlineplus/ency/article/002432.htm>
4. <http://www.mayoclinic.org/healthy-living/nutrition-and-healthy-eating/in-depth/org>

Teacher Bibliography:

1. <http://www.genome.gov/Glossary/> This site has a talking glossary of genetic terms. This would be useful for DNA explanations.
2. <http://www.genome.gov/25520880> DNA facts. I found it very useful for someone who is not strong regarding DNA. Very straight forward and simple.
3. National Geographic, May, 2014. The entire magazine is dedicated to food. A very good resource especially for current numbers, farming and food consumption. . It is not an article I would recommend for students to read, but is a good teacher resource
4. <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2620507/pdf/178.pdf> article provides a good understanding of genetically modify plants. Written so that a non-science person can understand.
5. <http://www.eufic.org/article/en/food-technology/gmos/artid/challenges-genetic-research-3/> This article addresses challenges of genetic research.
6. <http://www.eufic.org/article/en/food-technology/gmos/artid/viewpoints-> Technical article about world wide use of GMO foods.
7. <http://www.eufic.org/article/en/food-technology/gmos/artid/gmos-debate/> . This is a good article on GMO debate.

Teacher Bibliography on junk food related articles. (I am including these resources for use as an extension of the unit because of the relevance to eating habits of our teens.)

1. <http://healthyeating.sfgate.com/junk-food-affects-children-5985.html> This article discusses the effect of junk food on energy, ability to focus, obesity, chronic illness, self-esteem and depression.
2. <http://healthyeating.sfgate.com/reduce-intake-junk-food-children-5768.html>
3. <http://www.kidshealthclub.com/magazine/2012/02/13/junk-food-and-teens/>
4. <http://www.grandmagazine.com/news/2012/04/teens-and-junk-food-are-there-consequences/>
5. <http://www.fda.gov/animalveterinary/developmentapprovalprocess/geneticengineering/geneticallyengineeredanimals/ucm113672.htm> This has consumer questions and answers that are easily understood. Good resource for clarification of questions.
6. <http://www.nature.com/neuro/journal/v13/n5/full/nn.2519.html>
7. http://www.nytimes.com/2013/02/24/magazine/the-extraordinary-science-of-junk-food.html?_r=1&pagewanted=all&
8. <http://www.mbgnet.net/bioplants/food.html> This website deals with plants. I found this helpful for the information on the biology of plant. This is very helpful for teachers who are not biology majors.
9. McGuire, Michelle, Beerman, Kathy A. Nutritional Science From Fundamentals to Food (with Table of Food Composition Booklet). (Jan 1, 2012)
10. Fedoroff, Nina V., Brown, Nancy Marie. **Mendel in the Kitchen: A Scientist's View of Genetically Modified Food.** Joseph Henry Press, 2006. Book is about Scientist's view of genetically modified food.
11. Ronald, Pamela C., Adamchak, R.W. **Tomorrow's Table: Organic Farming, Genetics, and the Future of Food.** Oxford University Press. 2008. Authors are an organic farmer and plant genetic scientist.

Appendix

1. Word Scramble
2. Answers for word scramble
3. Rubric for Food Biology Project

Name _____

SuperKids Word Scrambler

	Scramble	Answer
1	etcigafe ldideminy lo	
2	ignacor	
3	e negfrera	
4	aatruln	
5	nriagco	
6	ogyloib	
7	NDA	
8	vsetsiceleritat	
9	ancfaeonrgtmo vilnin	

Answer sheet for word scramble:

Scramble	Answer
etcigafe ldideminy lo	genetically modified
ignacor	organic
e negfrera	free range
aatruln	natural
nriagco	organic
ogyloib	biology
NDA	DNA
vsetsiceleritat	selective traits
ancfaeonrgtmo vilnin	conventional farming

Rubric for Biology of Food Project

	3	2	1
Content	Project has accurate and rich levels of detail.	Project is detailed but contains some inaccurate information	Project lacks detail or accuracy.
Organization	Project is well organized and very easy to follow.	Project is fairly well organized.	Stu Project is unorganized and difficult to follow.
Relevance	Project is relevant and has excellent analysis of topic.	Project has some relevance and some analysis	Project is irrelevant and contains no analysis
Presentation	Project is neatly presented and includes no errors	Project is fairly neat but has some errors	Project is sloppy and full of errors
References	Project has a minimum of 5 references and they are correctly annotated.	Project has no less than 3 references and there are a few mistakes in annotation.	Project has less than 3 references and there are mistakes in the annotation.

GRADE

A = 13-15

B = 10-12

C = 8-9

D = 5-7

F<5