What has Biotechnology done for you lately?

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This curriculum unit is recommended for:
Integrated Science grade 8

Keywords: biotechnology, agriculture, North Carolina, nutrition, economy, genetically modified, organic, stem careers, nitrogen, ecosystem, Haber-Bosch

Teaching Standards: See Appendix 1 for teaching standards addressed in this unit.

Synopsis: In this unit students will be able to make real world connections to biotechnology. The information published here goes from the basics of biotechnology which is an 8th grade standard but also dives deeper. Students will learn about the ethical issues that biotechnology creates as well as the lives that it supports. There will be some cross curricular learning as students learn about the history of North Carolina through agriculture. Many different cultures are included in this journey historically and present day. A lesson is included that allows students to talk about careers in the stem world that biotechnology has opened up and the significant implications to our everyday lives. This curriculum unit is meant to be taught across several standards which will then also assist students in understanding how multiple scientific disciplines lend themselves to one another. Scholars also get an introduction to agriculture and marketing as they build their own businesses to showcase local North Carolina agricultural products.

I plan to teach this unit during the coming year to 69 students in Integrated Science 8

Introduction

Rationale:

My topic idea is centered around eating and why we eat what we eat. I can tell that when we do our nutrition unit every year that my students know so little about the food that they eat. Helping students to understand where their food comes from and why, will give them a better understanding of themselves and their communities. This understanding will tie in to important discussions of genetically modified foods, food scarcity/deserts, and stem careers.

Since many of my students struggle to see themselves in stem careers, I will also peak their interest by talking about Food Science. My kids love to eat! The idea that they can be a scientist that helps develop products from Taki's to ice cream is something that I think can impact their career decisions. Many of my students strongly identify as loving southern food and I cannot wait to explore with them the path that their food took to get to what we know it as today.

I am creating this unit because a basic understanding of the way you interact with food is crucial to every human being. Unfortunately, many black and brown communities, like the one I serve, are riddled with food related diseases and disorders(for example: diabetes, obesity). I want my scholars to be able to make good food choices. It is important that they are doing it not because I said it was a good idea but because they have a true connection to how food has been used as a weapon against and a tool for them. The roots that anchor many people to food are often subconscious, deep seeded in years of tradition. I aim to open my students' eyes to the realities of how food has shaped our nation.

Demographics:

Our school is Wilson Stem Academy. We are in the Northwest Learning Community of Charlotte. This 2022-2023 school year will only be our 5th year open since being closed for several years. Wilson is a S.T.E.M. school that incorporates technology in several ways. Our scholars have several options for Project Lead The Way elective classes. They range from App Designing to Computer Science to Flight and Space courses. Our school also has a magnet component that allows students that are not zoned to attend Wilson to apply to participate in some of our technology courses.

Our current enrollment for this school year is 474 students. 335 or 70.7% are African American, 96 or 20.3% are Hispanic, 24 or 5.1% are Asian, 5 or 1.1% are two or more races and 1 student identifies as American Indian. Our school is split at 226 females and 248 males in attendance. We have 55 English learning students and 59 students with disabilities. We also have 10 McKinney-Vento students; these are students who are housing insecure, meaning they may be homeless. Our school enrollment has decreased about 10% since last year.

Goals:

The goals for this unit are to have scholars be able to answer each essential question to each standard correctly. The standards regarding biotechnology, molecular biology, and ecosystems are all interconnected. Essential questions such as "How have humans impacted competition among organisms?" lend itself to several topics, not just how food webs operate. An inquiry like this lends itself to the students understanding how food is used in human and animal populations as a means of control, whether purposeful or not. This is a connection I seek from my students while going through this curriculum unit. By completing the specific activities and vocabulary for the curriculum scholars will also be able to ascertain information about the way food is grown, through certain agricultural practices, affects them.

Molecular biology can be affected by the biotechnology field. Once these foundations are established, scholars can link this knowledge into second tier learning to explore and understand biotechnology and how genetic modifications of food evolved as a result of the changes that people in our area and others were subject to. I aim to have students debate with their peers using the knowledge gained from this Curriculum Unit to decide for themselves if altering the DNA of the plants they eat is beneficial or detrimental to their own bodies.

The end goal is for students to be able to use something that they are already invested in to reel them in to a love of science. The more engaging the material and the more relevant the material, the better the retention of the information. Many students ask the question, "When are we ever going to use this?" I aim to give them options to use science beyond 8th grade or even college but helping them to understand the fun in stem careers. For those that will not enter stem careers they will at least have a firm foundation in making the right food choices for them based on the research and evidence that they have completed.

Content Research

Biotechnology

Biotechnology for most people seems like a pretty modern term. But in actuality what we call biotechnology has been happening for thousands of years. "Humans have used biotechnology since the dawn of civilization"(1). The problem is this: most people associate the word technology with computers, electronics, and the 20th century. The truth is something as simple as cross-breeding dogs could fall into this category. Discoveries revolutionized the biotechnology field for sure but scientists were taking advantage of DNA years before Watson, Crick, Wilkins, Creeth and Franklin brought it to light(2). "Egyptians used yeasts to bake leavened bread, the Chinese developed fermentation techniques for brewing and cheese making, and the Aztecs used Spirulina algae to make cakes."(1) Food has traditionally been a staple of biotechnology.

Biotechnology is the study of using living organisms to create or alter how we live. In North Carolina, like many slavery imbued states, agriculture set the tone for life. Let's start with a North Carolina staple, sweet potatoes;

> "The sweet potato first found success in Europe and later in America due to the trans-Atlantic slave trade, which forced the migration of countless human-beings and relocated them primarily in the South. The popularity that sweet potatoes ultimately found within the black community was due to convenience. Though it wasn't the yam that was so popular back home, it was close enough.

'West Africa is a yam based culture,' said Miller. 'Even though we call dark-fleshed sweet potatoes yams, they're not the same thing as the tropical root plant. [P]eople were dissing the sweet potato as the 'white man's yam,' but on this side of the Atlantic, sweet potatoes were embraced because [enslaved people] couldn't get the true tropical yams."(3) In transplanting the sweet potato to the America's, colonists used biotechnology prowess to plant a crop they knew to be successful in warm climates. This was a more traditional form of biotechnology whereby plants were just moved with farming know-how.

Ethical Issues in Biotechnology: Organic and Genetically Modified Food

In the last 20-30 years, Americans have drifted more steadily towards a trend of organic foods. But do people really know what the term organic means? According to the USDA, "USDA certified organic foods are grown and processed according to federal guidelines addressing, among many factors, soil quality, animal raising practices, pest and weed control, and use of additives. Organic producers rely on natural substances and physical, mechanical, or biologically based farming methods to the fullest extent possible. (4)" The question remains, what are the natural substances that organic farmers are able to use? According to CTI instructor Jeff Gillman, organic fruits are subject to more frequent spraying as natural pesticides do not last as long(5). He goes on to state that the problem with organics is not just the amount of pesticides applied, but the environmental impact that some of these pesticides have.

Copper Sulfate and Pyrethrum can be detrimental to plants and honeybees respectively. Moreover, the testing for organics is certified through a third party and does not have the same stringent regulations of traditional foods. Organic foods are not tested for organic pesticide residue. This leaves organic consumers with some level of uncertainty about the amount of "all natural" pest repellants that they are actually ingesting. In studies, a comparison EIQ that quantifies toxicity, organic produce has scored 700 versus a mere 30 for traditional produce. While it takes 3 years of organic farmers not using traditional pesticides before they may be certified as organic, there is still room for unscrupulous companies to skirt regulations.

As much as organic foods have been glorified as of late, genetically modified foods have recently been villainized. Many people have no idea that genetic engineering of food is almost as old as agriculture itself. Gregor Mendel started a foundation of selective breeding in plants some 200 years ago. There are instances of plant modification that are not perpetrated in the lab per se but are simple gardening techniques. For years, scientists and farmers have used techniques like cross pollination to mix plants with favorable traits with one another. Not different from cross breeding dogs or other animals, two plants with characteristics like insect resistance or added nutrition are combined with plants with other traits like high yield. But for some reason, the public now thinks of GMO's as something that a mad scientist is cooking up in a lab with more variables than it actually has.

> "Most scientists would say that almost all the food we eat has been 'genetically modified' by man and that genetic modification includes not only conventional breeding, but simple selections man has made over millennia. Carrots were not orange until the 1700's and tomatoes used to be the size of marbles. Corn used to have very small ears and kernels with hard seed coats and low digestibility."(6)

Here recently, labeling has started to be required as consumers demand more transparency in their food. In 2016, Congress passed a law requiring it for some foods produced through genetic engineering. While the public is more aware than ever of things that may have altered DNA, most people have never heard of instances where traditionally farmed produce has been to our detriment. One example of this is the Lenape potato. This chip was discovered to be the perfect potato chip chip. The size was ideal for making uniform bites. After a certain amount of time, it was found that this traditional crop had high levels of solanine. Solanine has been found to be toxic in humans causing vomiting. A traditionally bred variety of celery that was hailed for its natural pest resistance, caused issues as well. Workers of this plant ended up with phytophotodermatitis, a disorder which causes skin blistering in the sun.

Stem Careers

North Carolina has more than 80 biotechnology companies. Here biotechnology careers are focused on the research and development of new drugs.(7) However, there are 30 companies doing agricultural biotechnology as well.(7) Biotechnology careers can include food scientists, genetic engineers, farmers using biotechnology practices, and pharmaceutical companies that create new drug therapies.

According to U.S. News, Biomedical engineers can make up to $118,930 dollars and have a median annual salary of $92.620. This position only requires a Bachelor's degree.(8) Biomedical engineers combine biology and medicine to create new medicines and medical equipment.

Biochemists, also in the top 30 stem careers according to U.S. News, make an average starting salary of $94,270. (8) This stem path allows employees to combine their love of biology and chemistry to create new medical treatments. Biochemists use their chemistry to address biological or body issues.

Food scientists can cover a wide range of career paths. They can do anything from researching how to grow the best food crops to how to pack a bag of chips effectively for production. Food scientists find new ways to use science to make our food ways more efficient. While they may not gross as much as our first two careers, many students will find the hands-on aspects of this career more interesting.

How the Nitrogen Cycle feeds the whole Ecosystem

One of the most important things in life is the exchange between plants and animals. We have come to understand that in a process called cellular respiration we give off the carbon dioxide that is vital to plant energy production. Photosynthesis allows plants to create glucose on their

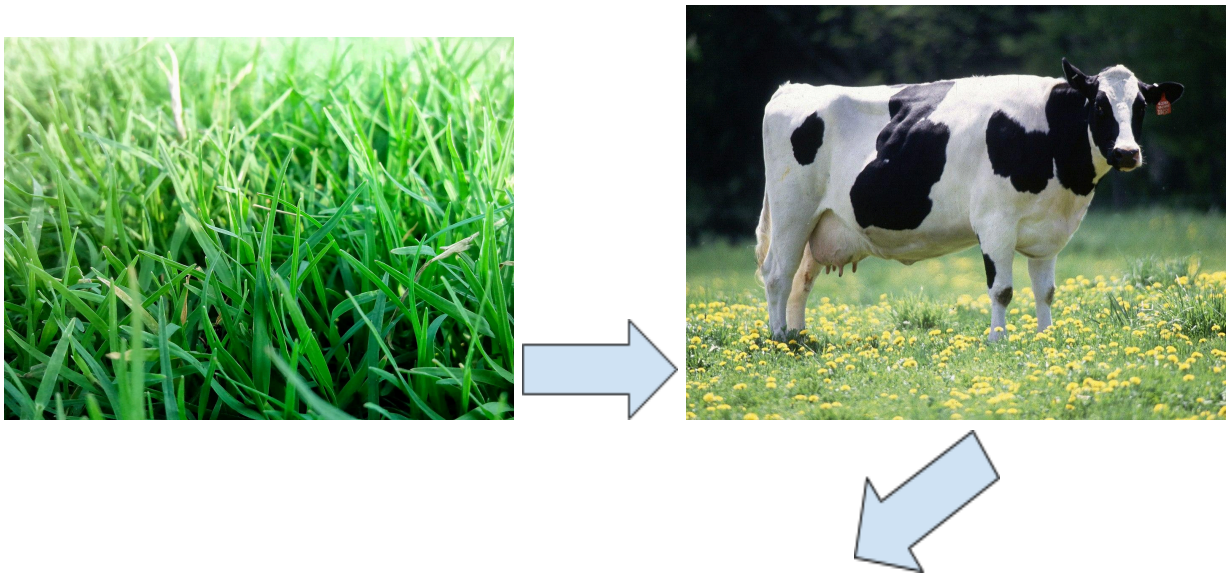
own and not only provide themselves energy but the rest of the living world as well. An input of CO2 and H2O along with sunlight is what we know drives this chemical reaction. However, another element is also extremely important to plant growth. Nitrogen! "When plants do not get enough nitrogen, they are unable to produce amino acids (substances that contain nitrogen and hydrogen and make up many of living cells, muscles and tissue). Without amino acids, plants cannot make the special proteins that the plant cells need to grow. Without enough nitrogen, plant growth is affected negatively."(9) So it stands to reason that just like our bodies need these protein building blocks to prosper, so does a plant. Just as when a human is trying to get bigger and build additional muscle, they consume protein shakes and powders. Nitrogen added soil is like a protein shake for a plant. It gives the plant a boost of nutrition and provides for additional crop yields. While this can be a good thing for plants, it can sometimes be a drawback for the environment.

Nitrogen in fertilizer is essential but can be a game changer in our environment. When it rains runoff from farmlands and residential properties washes the nitrogen into bodies of water. Once there it can cause something called eutrophication. The nitrogen then causes the plant growth in the water to swell, sometimes out of control. The additional plant growth affects the temperature of the water, causing it to increase. Water that is warmer then holds less dissolved oxygen. Then it is a chain reaction. Animals that live in the water are less healthy because of the decreased oxygen and change in water temperature. In addition other plants suffer because of the decrease in animal life that is essential for the photosynthesis cellular respiration exchange. Moreover, it affects the ability for animals to find food as the visibility in the water then decreases. If we can control the runoff, then the increase in nitrogen in our soil is a wonderful thing that scientists painstakingly researched and developed.

The Haber-Bosch process is a process that scientists Fritz Haber created to synthesize ammonia in an economically feasible way. Carl Bosch was able to use a catalyst and high pressure methods to make this possible on a large scale.(10) Using this process, large scale fertilizer was able to be mass produced for farming operations all over the world. According to Rae-Dupree, the process takes nitrogen from the air and hydrogen from natural gas to synthesize ammonia. There is then a high temperature catalyst of iron or ruthenium and a high pressure situation that forces the nitrogen and hydrogen together eventually creating liquid ammonia. (10) This process is still used today to create nitrogen rich fertilizers for agricultural purposes in every country, moreso in those that are developed.

The Haber-Bosch process is believed to be responsible for the population boom that happened in the 1900's. Countries have a Haber-Bosch machine (or several) that complete this process continually. Countries of high populations like the United States, China, Russia, and India especially count on their Haber-Bosch machines to ensure that their ever expanding populations are able to have increased food crops year after year. What would happen if a country did not have this technology? One such example of this catastrophe is Cuba. After political issues transpired, Cuba was unable to maintain their Haber-Bosch machine. As a result in the early 90's Cubans began to rely on imported fertilizer more heavily. Because of already stressed foreign relations, this too became difficult. Agriculture fell by 51.9%. (12) To this day, Cuba is experiencing food shortages as a result of not being able to adequately produce enough food crops for their people.

Simply put, every food chain starts with plants. Take the image below as an example. If not enough grass grows, the population of cows will decrease. If the cow population decreases the supply of food for humans goes down and the general health of the population also decreases. Any decrease in the energy supplier which is the plant or producer, will cause a chain reaction amongst the entire food supply. There are of course the food crops that we eat directly. The less we have of those such as corn, rice, and potatoes, the harder it is to feed a growing population.



Food and the North Carolina Economy

Interestingly enough, feeding their population seemed to be something Native peoples had under control. According to Marcie Ferris, an American Studies professor at UNC, the Tuscarora and the Cherokee tribes have inhabited North Carolina for 10,000 years. They went from hunter gatherers, to farmers during their time here. While maize or corn was their staple with which we are very familiar, native women also controlled the economy with tobacco, sunflowers, beans, and squash. (13) Sunflowers were especially useful because of the oil that they produce. Additional native tribes that exist within our state include the Lumbee and the Sara. The Sara tribes and other "Indigenous peoples in the region in this era [ate a diet of] maize, grains, beans,

squashes, nuts, persimmons, grapes, other fruits, small game, and fish." (13) As settlers came in and adopted Native practices, it provided for a different kind of life in the "New World". Farming allows for people to grow a large amount of food at once to possibly stored for later without the everyday commitment of hunting and foraging.

Fast forward and native Africans were brought to the Americas.While their primary workload was the financially profitable crops of cotton and tobacco, there were food crops that were also important to the North Carolina economy. Hogs, fields of corn, vegetable gardens, and a variety of greens including collards were all farmed by enslaved people. African American pit masters even developed sauces for slow cooked hogs. (13) Enslaved Africans grew this food but were not always permitted to eat that which they grew for their masters. Some meat was available but slaves primarily ate table scraps and corn derived foods. Rice and okra were also important owing to their transport from African nations and the knowledge of the slaves in cooking and growing these items. (14)

Even today, many of the same foods are still popular in North Carolina today. Soul food places are exceedingly popular and common among people of different cultures. Greens, cornbread and pork have been carried down from previous generations. Although the highest quality and nutrition content was not available for the slaves, new establishments have aimed to turn that around in the wake of the health food craze.

Making good food choices for your body and why?

Macronutrients help us classify the things that we eat. The macronutrients include carbohydrates, protein, and lipids or fats. They all play a particular role in our bodies. Carbohydrates give our bodies quick energy and come from foods like fruits and vegetables. Starches like bread and pasta are also under the category of carbohydrates. Because carbs are so closely linked with sugar, this is a macro that most people have to be observant of not to eat too much of it. Proteins are the building blocks of your body. Most of us get more than enough protein through meat. Another way to get protein is through beans and nuts. This is a healthier way to obtain this food source.

Fats often get a bad wrap but are just as essential in your body as the other two macronutrients. Fat serves as energy storage and insulation for our bodies. Too much fat can lead to obesity and heart disease through clogged arteries. Much of our fat comes from the same place as protein. Animals! Animal fat can cause a slew of health concerns that we are more prone to because of our large portion sizes in the United States. Those most affected tend to be the minorities. For example diseases such as diabetes disproportionately hit communities of Indigenous people and African Americans. Food desserts or areas where there is poor access to nutritious foods lead low income populations to be stuck in a rut of poor food choices. How do they escape?

Whether it is Indigenous people or Africans relocated here, food and agriculture has been long used as a medicine. Things people can grow in their own backyards have been proven by our forefathers to "cure what ails ya". Leafy green vegetables, often grown by Native North Carolinians and later passed on to enslaved-and free Blacks, have vitamins and minerals which are known to be anti-inflammatory immunity boosters. (15) Berries, nuts, and seeds are also ways to get antioxidants in your body and fight infection and disease.(15)

Teaching Strategies

Vocabulary

Allowing students to explore a list of familiar and unfamiliar vocabulary words will make this curriculum less daunting. A combination will be used of Quizlet and taking notes on vocabulary in their science notebooks. When each standard has begun students will be given the list of vocabulary to make their own flashcards in Quizlet. The program allows them to select the best definition as well as add a picture that will allow the students to remember the context of the information much better. They can also play games with this program in order to familiarize themselves easily with the language of biotechnology, agricultural practices and historical food practices.

Reading

A list of articles that are on grade level will be provided to give students a deeper understanding of the material. Many websites have been identified that will give scholars easy to understand yet challenging articles to push the limits of learning this topic. Reading will be followed up by questions that support the essential question goals. Use of programs such as NEWSELA will allow built in scaffolding for different levels of learners.

Videos

This unit goes into a myriad of topics that are hard to perceive if you have never seen them. For some of those topics including some that we will encounter, hands on, videos are often a good hook to connect the knowledge for the students. National Geographic and other scientific researchers have published a great many videos that will lend themselves to capturing the attention of middle school students.

Class Discussion

Not every topic in this unit is set in stone. Using some of the more controversial topics like ethics in biotechnology, class discussion can be stimulated. Students will pick sides but will ultimately be responsible for knowing both opinions to validly defend their points.

Experiments/Labs

Hands-on experiments will help to bring this information to reality. Experiments that test the growth of food crops with increased nitrogen will be implemented. There will also be a marketing challenge where students can evaluate how companies target people and the effectiveness of different campaigns. Also labs stimulate inquiry. Scholars can begin asking questions like, “Can I taste the difference between organic and non-organic produce?” And then they can answer these questions using the scientific method.

Lesson One: Ethical Issues in Biotechnology

Learning Objective: Students will be able to understand the ethical issues that exist in biotechnology and will be able to explore their opinions on a few of these topics.

Materials: Articles from NEWSELA 1. For some, test tube meat probably beats eating insects 2. Recycling space pee and other waste is getting some serious studying 3. Fruits and vegetables used to look so different

Debate Worksheet

Introduction: Students will take key points from the Biotechnology Articles and use it to debate one another on controversial topics.

Explicit Instruction: Pick two competing topics with which your students are familiar. For example, McDonald's versus Burger King. Allow them to take 5 minutes to pick a side (or you assign it). Give 10 minutes for fact based research on why their side is better. Allow students to take turns debating their sides. Explain that knowing both sides assists a person in having a stronger argument and which side had that stronger argument.
Now, have students read the NEWSELA Articles above. Discuss with students the definition of biotechnology. Biotechnology is the manipulation of genetic material to make a change in agriculture, medicine, or forensic practices. Introduce samples of biotechnology such as insulin production, vitamin A enriched rice, and genetically modified corn, Allow students to select which article interests them the most or assign depending on your class dynamic. Have students use the debate sheet to map out their argument and repeat the earlier exercise.

Individual Practice: Have students prepare an argument for one particularly controversial issue. Use the debate worksheet to have students capture all information.

Assessment: Assess students' understanding of the material by creating a rubric for what you expect out of the debate. A sample one is provided. 80% or better would signify mastery of the topics

Lesson Two: Nutrition

Learning Objective: Students will understand which foods lend themselves to proper nutrition and why this is important to their everyday lives.
Materials: Powerpoint
Introduction: Introduction/Warm-Up: Introduce the idea of nutrition with this video. How the food you eat affects your brain - Mia Nacamulli
Explicit Instruction: See powerpoint
Individual Practice: : Have students create their own menu on blank paper with a day of foods on it. They should then research the meal that they chose. Have them write down their

macromolecules. Are they within the standard guidelines? If not, have scholars decide what they would need to change to make it fit the guidelines.

Assessment: Use an exit ticket to see if students can identify what items you would look for in a balanced meal.

Lesson Three: Haber Bosch Lab

Learning Objective: Students will be able to understand the importance of the Haber-Bosch process and the impact of the loss on countries.
Materials: Plant seeds (store bought), mini pots, low nitrogen fertilizer, high nitrogen fertilizer, soil, Haber-Bosch Lab Worksheet
Introduction: Use the video to give a quick visual understanding of the Haber-Bosch Process.
Explicit Instruction: Watch the video and have a turn in talk with the students about what they have learned. Be sure to emphasize how Nitrogen (quick periodic table review) is a key element in making things grow. Have students fill out lab sheets and make a hypothesis for what they think will happen specifically when the Haber-Bosch machine is "hindered or gone".
Individual Practice: Students will draw out a food chain that will include producers. They will hypothesize what percentage of the food source will be affected by the Haber-Bosch disruption. They will use the planting supplies to plant seeds with low and high nitrogen soil.
Assessment: Exit ticket on the back of the lab sheet that asks students to explain the direct correlation between Nitrogen and Tertiary Consumers.

Lesson Four: Carolina Cuisine Marketing Project

Learning Objective: Students will be able to create a business based on local North Carolina Agriculture. They will work on what their product will be and how they will price and market the product based on the money they are allotted.
Materials: Chromebooks and Poster Board
Introduction: Agriculture is and always has been an essential part of North Carolina's Economy. Now students will explore what part of the industry they deem to be the most profitable.
Explicit Instruction: Students will pick a local North Carolina item and use it to create a business. On their poster board they will explain what item they picked and why. The project will also have them display the following: Does it need to be processed? What is the final product for sale? How much will it cost to process it and how much will they sell it for? What will be the profit margin for their business? Will they have to hire employees?
Individual Practice: Students will create a poster to share and "advertise" their business. All criteria in the rubric must be met.
Assessment: When businesses are complete, students will circulate the room to shop at each other's businesses. This will allow other students to decide the value of each business and demonstrate the effects agriculture has on the economy.

Appendix 1: Teaching Standards

8.E.1.3 Predict the safety and potability of water supplies in North Carolina based on physical and biological factors, including: temperature, dissolved oxygen, pH, nitrates and phosphates, turbidity, bio-indicators.

- This curriculum unit will cover the fact that the addition of simulated nitrates for soil is responsible for the increase in the world's population. In the seminar the Haber-Bosch process was discussed and that knowledge is imparted here. While nitrates can be a detriment to the hydrosphere, for the soil it is essential. This unit will explain why it is good for one and bad for the other.

8.L.2 Understand how biotechnology is used to affect living organisms. 8.L.2.1 Summarize aspects of biotechnology including: specific genetic information available, careers, economic benefits to North Carolina, ethical issues, and implications for agriculture.

- This curriculum unit will detail biotechnology in North Carolina and in general. There will also be information regarding career opportunities in biotechnology and the implications of these careers on our local economy. Students will be able to connect agricultural specifics to their everyday lives.

8.L.3.3 Explain how the flow of energy within food webs is interconnected with the cycling of matter (including water, nitrogen, carbon dioxide, and oxygen)

- This curriculum unit will cover the fact that the addition of simulated nitrates for soil is responsible for the increase in the world's population. In the seminar the Haber-Bosch process was discussed and that knowledge is imparted here. While nitrates can be a detriment to the hydrosphere, for the soil it is essential. This unit will explain why it is good for one and bad for the other.

8.L.5.1 Summarize how food provides the energy and the molecules required for building materials, growth and survival of all organisms (to include plants).

- The curriculum unit will talk about the food chains/webs that the increase in agriculture was able to effect. Countries were able to increase their food supply, and as a result livestock was able to increase as well. This energy boom affected life as we know it and we will discuss how it has had some long standing effects on certain populations.

8.L.5.2 Explain the relationship among a healthy diet, exercise, and the general health of the body (emphasis on the relationship between respiration and digestion)

- The curriculum unit will discuss some healthy eating choices that are local to North Carolina. As discussed in the seminar, the way that different cultures eat now is often a result of a historical relationship with food. This can sometimes be to a cultures detriment causing disease and obesity. The curriculum here will be a broad overview of how students should take advantage of nutrition options available to them to make the best of their lives.

Appendix 2: Other Documents

Vocabulary Needed:

Nitrogen	Biotechnology	Agriculture
Food Web	Ecosystem	Economy
Food Chain	Population	Food Scarcity
Genetically Modified	Ethical	Organic
Haber-Bosch Process	Nitrification	Breeding

Materials by lesson:

Lesson 1

Articles from NEWSELA 1. For some, test tube meat probably beats eating insects 2. Recycling space pee and other waste is getting some serious studying 3. Fruits and vegetables used to look so different (Used to have students formulate an opinion on one interesting biotechnology dilemma)

Debate Worksheet

Article Focused On:_____

Opinion (For or Against)_____
_____

1st round of arguments: (Support each argument with evidence from the text)

1.

2.

3.

Counter-Argument: (What could the other team say to discredit your argument?)

1.

2.

3.

Defense: (How will you defend against the counterargument?)

1.

2.

3.

Conclusion: (Do you still believe what you initially stated?)

_____
_____
_____

(Used to guide students through the process of a debate. Sentence starters may also be provided if necessary for differentiation.)

Debate Rubric

	Points Possible	Points Given	Comments
An opinion was	5		

stated: For or Against			
All 3 initial points were based on the text	10		
Counter Argument used key information to “debunk” the argument	10		
All 3 points to defend the counterargument were supported by evidence.	10		
Conclusion clearly states if the original opinion has remained the same and why	10		
Total	45		

(Used as a method of assessing if the students understood how to debate a topic while supporting their stance with text based evidence)

Lesson 2

Nutrition Powerpoint: Nutrition

Exit Ticket: Nutrition

How much of what should I eat everyday?

*Fat*_____
*Carbohydrates*_____
*Protein*_____

Lesson 3

Lab Sheet

Question	Research/Observations
Hypothesis	
Experiment	
Materials	Procedures
Results	
Conclusion	

1.An Introduction To Plant Breeding
This resource gives the teacher a background information about how plant breeding actually works. This may help with a more thorough understanding and therefore explanation if needed.

2. NEWSELA Articles: 1. For some, test tube meat probably beats eating insects 2. Recycling space pee and other waste is getting some serious studying 3. Fruits and vegetables used to look so different
These resources give your students an interesting place to start debates about biotechnology. NEWSELA has a plethora of biotechnology related articles to choose from and the service is free.

3. https://www.fda.gov/food/consumers/agricultural-biotechnology
A website that both student and teacher can explore to gather information that the Food and Drug Administration put out regarding Genetically Modified Organisms.

4.https://kids.frontiersin.org/articles/10.3389/frym.2019.00041
This website breaks down the Nitrogen Cycle in great detail. It makes it easier to understand for anyone with numerical steps and illustrations.

5. https://www.myplate.gov/
This resource allows people to explore the USDA guidelines for nutrition.

6. https://www.thoughtco.com/haber-bosch-process-604046
A quick article explaining the history of the Haber-Bosch process.

7. What Does "Organic" Mean, and Should You Buy Organic Foods?
A video that explains what classifies things as organic. Simple to understand and by the people who make Crash Course videos.

Notes

1. https://www.lonestar.edu/history-of-biotechnology.htm
2. https://theconversation.com/the-forgotten-scientist-who-paved-the-way-for-the-discovery-of-dnas-structure-86978
3. https://www.southernkitchen.com/story/eat/2021/07/25/african-american-history-sweet-potato-pie/8089134002/
4. https://www.usda.gov/media/blog/2012/03/22/organic-101-what-usda-organic-label-means
5. How the Government Got in Your Backyard: Superweeds, Frankenfoods, Lawn Wars, and the (Nonpartisan) Truth About Environmental Policies By Jeff Gillman, Eric Heberlig · 2011
6. https://agbiotech.ces.ncsu.edu/q1-what-is-the-difference-between-genetically-modified-organisms-and-genetically-engineered-organisms-we-seem-to-use-the-terms-interchangeably/
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