GEORGIA MIDDLE SCHOOL Instructional Resources

CAREER, TECHNICAL, & AGRICULTURAL EDUCATION

AGRICULTURE

COURSE: Agriculture Education

UNIT 4: Agriscience Pre-Pathway

INTRODUCTION

Annotation:

Agriculture is a science. Science plays an essential role in every aspect of agriculture. Students will be introduced to Agriscience and how it relates to the various areas of agriculture and plant science.

Grade(s):

	6th
	7th
X	8th

Time:

Five 50 minute class periods

Author:

Todd Dobson

Students with Disabilities:

For students with disabilities, the instructor should refer to the student's IEP to be sure that the accommodations specified are being provided appropriately. Instructors should also familiarize themselves with the provisions of Behavior Intervention Plans that may be part of a student's IEP. Frequent consultation with a student's special education instructor will be beneficial in providing appropriate differentiation. Many students (both with and without disabilities) who struggle with reading may benefit from the use of text reading software or other technological aids to provide access to printed materials. Many of these are available at little or no cost on the internet.

FOCUS STANDARDS

GPS Focus Standards:

MSAGED8-15 **The students will identify the role of agriscience in meeting human needs.**
a) Define Agriscience and Biotechnology.
b) Give examples of how agriscience meets basic human needs (food, clothing, shelter).
c) Compare and contrast US and world agricultural practices.
d) Discuss how the skills needed for agricultural work have evolved.

MSAGED8-16 **The student will identify current trends and issues relating to Agriscience.**
a) Explain the role of agriscience and technology in society.
b) Describe the role of technology in agriculture and identify major technological advances.
c) Compare past agricultural methods to current production methods.
d) Evaluate the use of the scientific method to supply the world with needed agricultural products.
e) Identify issues associated with biotechnology.

MSAGED8-18 **The student will demonstrate the application of agriscience in agricultural plant research and production.**
a) Analyze how plant research has benefited the consumer.
b) List products and byproducts that are derived from plants and their uses.
c) Compares traditional plant breeding and genetic engineering of plants.
d) Explain genetically modified organisms and their importance.

GPS Academic Standards:

M6M1 **Students will convert from one unit to another within one system of measurement (customary or metric) by using proportional relationships.**

S8CS1 **Students will explore the importance of curiosity, honesty, openness, and skepticism in science and will exhibit these traits in their own efforts to understand how the world works.**

S8CS2 **Students will use standard safety practices for all classroom laboratory and field investigations.**

S8CS3 **Students will have the computation and estimation skills necessary for analyzing data and following scientific explanations.**

S8CS4 **Students will use tools and instruments for observing, measuring, and manipulating equipment and materials in scientific activities utilizing safe laboratory procedures.**

S8CS6 **Students will communicate scientific ideas and activities clearly.**

S8CS9 **Students will understand the features of the process of scientific inquiry.**

UNDERSTANDING & GOALS

Enduring Understandings:

- Agriscience affects the development, existence, and improvement of living things. Agriscience has and continues to play a major role in our lives.

Essential Questions:

- How does Agriscience affect your life?
- When do you experience the benefits of agriscience?
- What are the basic functions of plants and animals?
- What are the differences between US agricultural practices and the rest of the world?
- How have the skills needed for agricultural work evolved?

Knowledge from this Unit:

Students will be able to:

- Identify the role of agriscience in meeting human needs.
- Identify current trends and issues relating to Agriscience.
- Identify the application of Agriscience in agricultural animal and plant research and production.
- Identify various career clusters in the field of Agriscience.

Skills from this Unit:

Students will be able to:

- Interpret Plant and Animal Research

ASSESSMENTS

Assessment Method Type:

_____ Pre-test
_____ Objective assessment - multiple-choice, true- false, etc.
__ Quizzes/Tests
__ Unit test
_X_ Group project
_X_ Individual project
_____ Self-assessment - May include practice quizzes, games, simulations, checklists, etc.
__ Self-check rubrics
__ Self-check during writing/planning process
__ Journal reflections on concepts, personal experiences and impact on one's life
__ Reflect on evaluations of work from teachers, business partners, and competition judges
__ Academic prompts
__ Practice quizzes/tests
_X_ Subjective assessment/Informal observations
__ Essay tests
_X_ Observe students working with partners
__ Observe students role playing
_____ Peer-assessment
__ Peer editing & commentary of products/projects/presentations using rubrics
__ Peer editing and/or critiquing
_X_ Dialogue and Discussion
__ Student/teacher conferences
_X_ Partner and small group discussions
__ Whole group discussions
__ Interaction with/feedback from community members/speakers and business partners
_____ Constructed Responses
__ Chart good reading/writing/listening/speaking habits
__ Application of skills to real-life situations/scenarios
_____ Post-test

Assessment(s) Title:

• LESSON 1: INTRODUCTION TO AGRISCIENCE AND BIOTECHNOLOGY

1. Identify the standards. Standards should be posted in the classroom for each lesson.

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S8CS9 **Students will understand the features of the process of scientific inquiry.**

2. Review Essential Questions. Post Essential Questions in the classroom.

    - What are the differences between US agricultural practices and the rest of the world?
    - How have the skills needed for agricultural work evolved?

3. Identify and review the unit vocabulary.

Agricultural Engineering	Cloning	Genetic Engineering	Replication
Agriscience	Codons	Herbicides	Rhizobium
Agriscientist	Diploids	Hybrids	Scientific Method
Agronomy	DNA	Industrial Technology	Soil Science
Amino Acid	Ethanol	Integrated Pest Management	Tetraploids
Angiosperms	Fence Rows	Mutation	Triploids
Artificial Insemination	Fermentation	Nitrogen	
Biotechnology	Gene Mapping	Nucleotides	
Chromosomes	Genes	Plant Breeding	

4. Lead a discussion about the process of turning a raw material into a product.
    - Ask students, "What is a raw material?"
    - What are some examples of raw materials?
    - How can raw materials become finished products?
    - What does it mean for a product to become value added?
    - What are some examples of value added products?

5. From the Field to the Shelves
    - Show students the **Agriscience Lesson on Tea** PowerPoint presentation and explain that all agriscience is at the molecular level.
        - See attached supplementary files
    - After viewing the PowerPoint, have students complete the tea quiz at the end of the presentation.
    - Split the class into several groups, and give each group a different brand of tea.
    - Using the steps outlined in the PowerPoint, have the groups create the sweet tea using their teabags.
    - Use a blind taste-test to determine which tea is most palatable.

• LESSON 2: AGRISCIENCE IN TODAY'S WORLD

1. Review Essential Questions. Post Essential Questions in the classroom.

    - What are today's trends in agriculture relating to agriscience?
    - What role does technology play in today's agriculture?

2. Lead a brief discussion about agricultural trends.
    - Ask students, "What are some trends in agriculture?"
        - **Examples:** Genetically modified crops, GPS on tractors, organic production
    - How do these trends make today's agriculture different from agriculture in the early 1900s?

3. Agriculture Over the Years
    - Allow each student to choose a historical agricultural production method to research.
        - **Examples**: Hand picked cotton vs. the cotton gin, mules vs. machinery
    - Students must match the historical method to its modern counterpart.
    - Instruct students to include the following in their research:
        - When the historical method was first discovered
        - Why the method was modernized
        - How the historical method compares to the modern method in terms of efficiency and cost
        - What industries use the modern technology today
    - Have students present their projects to the class.

LESSON 3: BIOTECHNOLOGY

1. Review Essential Questions. Post Essential Questions in the classroom.

    - What role does biotechnology play in the success of today's agriculture?

4. Discussion

- *Introduction*

  Biotechnology is the management of biological systems for the benefit of humanity. It is used in molecular biology and genetics. Another example of biotechnology seen in the news recently is cloning. In this lesson, we will learn the basics of biotechnology so we can apply them to the later lessons in this unit.
- *Motivation*
    1. Learn about biotechnology and its uses.
    2. Perform lab activity where students construct sentences using the DNA codes given to them.
    3. Compare and contrast genetic engineering and biotechnology.

- *Discussion Questions*

  1. Question: What is DNA?

  Answer: DNA is hereditary information for organisms stored in chromosomes. It is stored as a sequence of nucleotides, which are composed of a five-carbon sugar, phosphate group, and nitrogenous base. DNA is a recipe for making an organism because it contains the necessary items to make that organism just like a recipe contains the ingredients to make a cake.

  2. Question: What is biotechnology?

  Answer: The management of biological systems for the benefit of humanity. It is used in a wide array of other science disciplines.

  3. Question: What are some uses of biotechnology in plant and animal science?

  Answer: Cloning is used in both animal and plant sciences. Plant science used herbicides and now scientists are working on developing a plant that can withstand the herbicide. In animals, genetic engineering allows us to check who is the father of a child as well as cracking the genetic code for humans.

4. *Question: Compare and contrast genetic engineering and biotechnology.*

Answer: Biotechnology encompasses all subjects of science, but genetic engineering deals with genes. Genetic engineering involves gene splicing, replication, and transfer of genes to other organisms. Biotechnology handles the bigger picture and genetic engineering focuses more on smaller areas. Genetic engineering is an example of a biotechnology. Using a wide array of methods, genetic engineering accomplishes the task of multiplying the number of genes.

5. *Question: List the historical uses of biotechnology.*

Answer: The earliest biotechnology was used to make cheese and wine. Through the use of bacteria, spoiled milk can be fermented to form cheese and grape juice fermented to form wine. Yeast can be fermented to make bread as well (see attached lab activity). Highly spoilable foods can now be kept for long periods of time thanks to certain bacteria. Legend has it that Arabs were the first to use artificial insemination. Arabs would sneak into enemy camps and collect the semen of the stallions. This semen would then be used to impregnate the mares.

6. *Question: How does biotechnology increase production?*

Answer: Developing and using new forms of plants and animals, modifying to improve their life processes, and improving the quality of food. Thanks to biotechnology foods have a longer shelf life. A good example is the tomato because tomato pickers pick tomatoes that are green so that as the tomatoes travel to stores…they ripen along the way!

5. Lab Activity

This lab allows the students to practice their copying and replication of DNA. They need a basic understanding of what is involved in biotechnology before moving on to future lessons.
In order for students to understand how DNA replicates they need to understand how to copy DNA.

- Before class, create at least six DNA codes, containing six triplet codes in one DNA code.
  Examples of genetic codes: GTA ACT TGC TAG GGG ATT , CCC ATG CAT AAA GCT CGT , and TTT ATC GTC TGA ATC AAA
- Then, copy the DNA and put each triplet code on a piece of construction paper.
  Example of copied genetic code: CAT TGA ACG ATC CCC TAA
- On the back of each piece, put a word for the students to construct a sentence. Place each piece of paper around the room, on tables or walls.
  Example: CAT triplet code will have the word "the". TGA have "goat", ACG be "likes", ATC be "the", CCC be "purple", and TAA be "flowers." So the sentence the students will construct will be "The goat likes the purple flowers." You can make the sentence longer by adding more triplet codes.
- When the students come in give each pair of students a DNA code. If one or more groups has the same code that is fine. Instruct the students to first copy their DNA and then find the appropriate answers around the room. When they are done with their DNA code, one student from each group will report their answer to the teacher to see if their answer is correct.
- After this exercise, have the students do this activity with RNA. Students keep the same DNA sequence but now they are looking for the corresponding RNA strand. Before class, put up the corresponding RNA codons.
  From this they can find the t-RNA sequence. *Hint*: this is the same as their original sequence except instead of thymine it will be uracil.

6. Other Activities

1. Video: "Nova Cracking the Code of Life" The video explains the structure and function of DNA, what a gene is and what it does, and how proteins are produced. Item # ER-49-2212A in Carolina Catalog.

2. Teacher Activity:

   DNA Mutations – on PowerPoint

   Print the following sentence on the board: THE OLD RED DOG WAS TOO BIG FOR HIS BED. Each word consists of three letters like the triplet code of DNA. If a mutation were to cause a deletion of the D in OLD, the sentence would now read: THE OLR EDD OGW AST OOB IGF ORH ISB ED. Obviously this is nonsense. If it were a DNA molecule, the resulting protein would probably be ineffective. If the mutation caused an inversion of the word DOG, the sentence would now read: THE OLD RED GOD WAS TOO BIG FOR HIS BED. In this case, the sentence still makes sense, but the meaning is completely changed. A protein resulting from such a mutation would have a different amino acid in one position of its sequence which could have profound implications. This analogy could be extended by making other mutations, such as reversing the sentence, inserting a new word or letter, substituting a different word somewhere along the chain.

   ***Simple mutations, such as deletions, can affect the animal only slightly such as a color change or lack of a certain color pigment. Inversion and larger deletions or additions can change the animal by a birth defect or worse things.

3. Extra Assignment – Bread and Yeast Fermentation provided as set of worksheets. One set is for the teacher and the other for the student.

4. Optional Lab Activity
   - What kinds of food do we get from cows? Steaks, hamburger meat, milk, etc. Milk goes into the formation of cheese and ice cream. Yogurt also is made from milk. In this lab, students will make their own yogurt using whole milk.

   - Incorporating Mathematics: Students complete worksheet **Kitchen Measurements** which involves converting between standard and metric units.

   - **Yogurt Production**

     Society uses more from an animal than we think. Milk from cows is not only used for drinking but also for making cheese, ice cream and yogurt. In this lab, we will find out how people make yogurt from milk.

     Materials:
     Half-pint carton of milk
     500 ml beaker or Mason jar
     Ring stand (optional)
     Powdered milk
     Heat source (Bunsen burner, hot plate, etc)
     Thermometer (0-100° C)
     Starter Yogurt culture (any non-flavored yogurt available at grocery store)
     Incubator, yogurt maker, or heating pad and cooler
     Refrigerator
     Sugar
     Jams or fruit

- Procedure:
  1. Pour the half-pint carton of milk into a beaker. Place the beaker in a ring stand (or on a hot plate).
  2. Add 11 g of powdered milk to the beaker and stir. Heat to 96° C, stirring constantly. Do not boil, but scald it.
  3. Cool milk to 46° C while continuing to stir.
  4. Add 5 ml of starter yogurt culture to the empty milk carton. Pour the cooled milk into the carton and staple shut. Label the carton with date and student name.
  5. Place in an incubator at 39° C until it coagulates (6-8 hours). If you are using the heating pad and cooler as your incubator, be sure to keep the temperature consistent. To find out the temperature at each setting on the heating pad, tightly wrap the pad together and then stick a thermometer in the center. Check the temperature at each setting for accuracy. Usually the "low" setting is around 39° C.
  6. Remove the carton from the incubator and cool to 10° C in a refrigerator overnight.
  7. You may want the students to bring in their own jams to put into their yogurt. The teacher needs to have some sugar on hand because the yogurt is a little tart at first.

7. Assessment Activity.

Genetic Map

8. Attachments.

LESSON 4: AGRISCIENCE IN PLANT SCIENCE (50 MIN)

1. Identify the Standards. Standards should be posted in the classroom for each lesson.

MSAGED8-18- The student will demonstrate the application of agriscience in agricultural plant research and production.
a) Analyze how plant research has benefited the consumer.
b) List products and byproducts that are derived from plants and their uses.

2. Review Essential Questions.

How has plant research made an impact on today's consumer?

3. Identify and review the unit vocabulary.

Genetic Engineering	Nitrogen	Hybrids
Angiosperms	Fence Rows	Rhizobium
Diploids	Triploids	Tetraploids
Ethanol	Agriscientist	Agronomy
Scientific Method	Integrated Pest Management	

4. Discussion

- As a group, discuss the different ways plant research has changed today's agriculture in terms of productivity, quality, and efficiency of today's farmers.

A. Introduction

Plants do more than we think in the world today. Normally, when we study plants we study them in conjunction with photosynthesis and respiration, but now we can study plants effect on humans. Vegetables today are being grown with the help of genetic engineering. We are seeing more and more hybrid fruits and vegetables. Plants are being used as fence rows in fields and as ways to increase the fertility of soil for crops during turn-around. In this lesson, we will utilize various research materials to discover the technologies in the plant science field.

The number of chromosome matters in the composition of plants because the wrong number of chromosomes gives a different species. For example, the seedless watermelon has a different number of chromosomes than a watermelon with seeds. All this deals with diploids, triploids, and tetraploids.

Provided at the end of this lesson are two articles about biotechnology and plants. One is about the Corn T-Cytoplasm that has made corn sterile and the other is about tulips. Both of these can be found under Supplemental Worksheets in Disk 1 under Unit 17 Biotechnology.

B. Motivation

Provide students with newspapers, agricultural magazines, and Internet access to obtain information on plant science technologies. Each group of three students will then present their information to the class as a whole.

C. Assignment

Working in groups of three, research one biotechnology used in plant sciences. One student can research with the use of newspapers, another with journals, and another with the Internet. After research, the group will present their findings to the class.

D. Discussion Questions

1. Question: What are some biotechnologies used in plant science?

Answer: Answers are based on material students presented to the class. Suggested areas include genetic engineering, plant breeding, and hybrids (ambersweet orange). Also could discuss how the fermenting of sugar cane and corn produces ethanol, which in turn can be used to produce an alternative to gasoline. Genetic engineering is a recent topic because now we are seeing plants that are resistant to frost damage, insects, and herbicides.

2. Question: How will these new biotechnologies help plants?

Answer: Answers vary depending on group topics

3. Question: Identify some negative impacts of these new biotechnologies.

Answer: Answers should include environmental and consumer health.

4. Question: What will be the benefits to humanity?

Answer: Answers vary based on group topics.

5. Question: What are herbicides and what is the danger of using these?

Answer: Herbicides are chemicals that are used to kill weeds or unwanted plants. When the weeds are growing among a crop, herbicides kill the weeds and the crop. Many herbicides work by inhibiting a key enzyme or protein necessary for growth of the plant. Genetic engineers now are working on crops that are tolerant of herbicides. If this happens, then what keeps the weeds from picking up this tolerance?

6. Question: How can grain be produced more efficiently with the use of nitrogen?

Answer: Corn requires a lot of nitrogen to produce large yields. Legumes produce nitrogen through use of bacteria. If scientists could find a way for these two to work together then the corn yields would be great and farmers not have to pay a lot of money to get nitrogen fertilizer

7. Question: What is polyploidy?

Answer: Contain more than one haploid set of chromosomes. The number is some multiple of n (haploid). Explain to the students how humans have a diploid set of chromosomes so our haploid chromosome number is 23.

8. Question: How does polyploidy affect plants?

Answer: This phenomenon is very common in plants. About 30-70% of angiosperms may be polyploids. The peanut is 4n, banana and apple are 2n or 3n, and cotton is 4n. There has also been deliberate polyploidy in plants with marigolds, watermelons, and snapdragons.

9. Question: How will biotechnologies harm nature?

Answer: Crop plants, such as the tomato, are now engineered to produce a protein that kills certain insect pests, like the caterpillar. Advances like this can reduce the amount of insecticides farmers spray on crops. If these plants can produce this protein to kill the caterpillars, then what happens to our beautiful butterflies?

5. Lab Activity.

Say your boss asks you to take one plant and make at least ten copies of that exact same plant, how will you do it?

Cloning of plants has been done for many years but we just do not think of it. Cloning of animals is something that is new and it is hard to clone an animal in a classroom, so we will clone some plants.

Main methods of asexual propagation are cuttings, layering, and grafting. Stem tip cuttings are taken from the end of stem or branch. The stem is cut about 3 inches below terminal bud. Place the cutting deep enough into the medium so that at least one node is below the surface medium. Leaf cutting is a cutting from a leaf without a petiole and usually works well for indoor herbaceous plants. When new plants form at the base of the leaf, they can be removed and planted individually.

For the lab assignment, have the students divide into groups of four. Each group will be given a coleus, wandering jew, or other easy to root plant and will be told to make stem tip cuttings.
Materials:
2 coat hangers
4-inch pots
Potting soil
Coleus or wandering jew plants

- Other Activities
    1. A lab activity entitled “Rhizobium Inoculum with Clover Seeds” from the Carolina Science and Math catalog gives students the opportunity to see how Rhizobium helps plants. (#ER-15-4720). Instructions with the kit.

    2. Legume nodule – Carolina Math and Science Catalog ER 30-1976. Root of leguminous plant with nitrogen-fixing bacteria inside nodule

6. Attachments.

LESSON 5: AGRISCIENCE IN PLANT SCIENCE-PART 2 (50 MIN)

1. Identify the Standards. Standards should be posted in the classroom for each lesson.

MSAGED8-18- The student will demonstrate the application of agriscience in agricultural plant research and production.
c) Compares traditional plant breeding and genetic engineering of plants.
d) Explain genetically modified organisms and their importance.

2. Review Essential Questions.

Is plant breeding a beneficial part of today's agriculture?

3. Identify and review the unit vocabulary.

Plant breeding
Genetic engineering

4. Discussion

Talk about the new types of plants used in today's agriculture that were non existent before plant breeding and genetic engineering.

5. Assessment Activity.

"Design your Plant" Have students develop a plant that is non existent now but would be beneficial in the future.

6. Attachments.

- **NOTES & REFLECTION:**

CULMINATING PERFORMANCE TASK

Culminating Unit Performance Task Title:

Culminating Unit Performance Task Description/Directions/Differentiated Instruction:

Attachments for Culminating Performance Task:

UNIT RESOURCES

Web Resources:

-

Attachment(s): Supplemental files not listed in assessment, learning experiences, and performance task.

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Materials & Equipment:

-

21st Century Technology Used: Type an "X" in the boxes below to indicate what 21st century technology is used in this lesson.

☐ Slide Show Software	☐ Graphing Software	☐ Audio File(s)
☐ Interactive Whiteboard	☐ Calculator	☐ Graphic Organizer
☐ Student Response System	☐ Desktop Publishing	☐ Image File(s)
☐ Web Design Software	☐ Blog	☐ Video
☐ Animation Software	☐ Wiki	☐ Electronic Game or Puzzle Maker
☐ Email	☐ Website	