Lesson Title	Teacher Guide: Design a Cotton Farm Guide
Timeline	1-2 45-minute class periods

STANDARDS

Social Studies:

Economic Understandings

SS4E1. Use the basic economic concepts of trade, opportunity cost, specialization, voluntary exchange, productivity, and price incentives to illustrate historical events.

b. Explain how price incentives affect people's behavior and choices: decisions about what crops (e.g., cotton and tobacco) to grow and products (e.g., textiles) to produce.

f. Give examples of technological advancements and their impact on business productivity during the development of the United States (e.g., cotton gin, steamboat, steam locomotive, and telegraph).

Geographic Understandings

SS5G2. Explain the reasons for the spatial patterns of economic activities.

a. Locate primary agricultural and industrial locations between the end of the Civil War and 1900 and explain how factors such as population, transportation, and resources have influenced these areas.

b. Locate primary agricultural and industrial locations since the turn of the 20th century and explain how factors such as population, transportation, and resources have influenced these areas.

Science:

S5L1. Obtain, evaluate, and communicate information to group organisms using scientific classification procedures.

a. Develop a model that illustrates how animals are sorted into groups (vertebrate and invertebrate) and how vertebrates are sorted into groups (fish, amphibian, reptile, bird, and mammal) using data from multiple sources.

b. Develop a model that illustrates how plants are sorted into groups (seed producers, non-seed producers) using data from multiple sources.

S5L2. Obtain, evaluate, and communicate information showing that some characteristics of organisms are inherited and other characteristics are acquired.

a. Ask questions to compare and contrast instincts and learned behaviors.

b. Ask questions to compare and contrast inherited and acquired physical traits. (Clarification statement: Punnett squares and genetics are taught in future grades.)

Math:

5.NR.2. Multiply and divide multi-digit whole numbers to solve relevant, mathematical problems.

5.NR.3. Describe fractions and perform operations with fractions to solve relevant, mathematical problems using part-whole strategies and visual models.

English Language Arts:

Reading (Informational)

ELAGSE5RI7. Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently.

ELAGSE5RI9. Integrate information from several texts on the same topic to write or speak about the subject knowledgeably.

Writing

ELAGSE5W2. Write informative/explanatory texts to examine a topic and convey ideas and information clearly.

a. Introduce a topic clearly, provide a general observation and focus, and group related information logically; include formatting (e.g., headings), illustrations, and multimedia when useful to aiding comprehension.

b. Develop the topic with facts, definitions, concrete details, quotations, or other information and examples related to the topic.

c. Link ideas within and across categories of information using words, phrases, and clauses (e.g., in contrast, especially).

d. Use precise language and domain-specific vocabulary to inform about or explain the topic.

e. Provide a concluding statement or section related to the information or explanation presented.

MATERIALS LIST

- Pen or pencil
- Species Recommendation Form (option with Sentence Starters)
- Recommendation for Space
- Harvest Predictions
- Animal/Plant Sorting Cards
- Pima and Upland Cotton Plants Information Sheet

INTRODUCTION

Wild cotton's earliest ancestor originated in Africa 5-10 million years ago, with seeds spreading the next millions of years into what is now Mexico, Australia, and Saudi Arabia. These cotton species still live in the wild today, covering significantly more geography. They thrive in warm, dry places and possess the classic cotton characteristics of pods filled with seeds and long fluffy fibers.

When wild cotton was discovered by earlier humans, its fibers were used for rope, yarn, and and thread that was woven. Cotton farming emerged as farming became a more common practice. This resulted in early farmers taking advantage of natural variations in desired traits. For example, some plants might possess more fibers than others or the fibers in one plant may be longer and stronger than others. Early farmers knew that these traits were passed down through seeds, and thus saved and planted seeds from cotton with those desired traits. This practice is what we now call selective breeding. Thanks to these ancient farmers, we now have the domesticated cotton we are familiar with today.

Unique to the modern history of cotton is that its domestication processes occurred simultaneously and independently in four different areas across the globe. These four independent efforts resulted in four domesticated*Gossypium* species: two of these species were in the Americas (Mexico and northern sections of South America), one from Africa, and one from southwest Asia. Cotton grouped in the *Gossypium* genus share common traits in their leaves, branching patterns, flowers, and fruits. Each of these *Gossypium* species has its own unique history of domestication, and with each generational set of outcomes (annual crop), the economic impact is also well established. Cotton, now cultivated across 70 countries, is the leading textile fiber plant and is an important source of seed oil and protein meal. As a result, it is also of great scientific interest to a range of specialty backgrounds, like agricultural scientists, taxonomists, geneticists, and evolutionary biologists.

The work of these specialized scientists has led to a new understanding of the evolution of the specific upland cotton (*Gossypium hirsutum*) that is now grown in Georgia. For more detailed information, visit Learn.Genetics or Polyploidy and the Evolutionary History of Cotton (Wendel, J and Cronn, R. 2003).

The objectives for this set of performance tasks focus on the science of naming cotton species (taxonomy), the role of humans in the inherited traits of cotton, and both economic and geographic understandings for making agriculture related decisions. For this interdisciplinary lesson students obtain, gather, and evaluate multiple sources of information to eventually take on the role of a scientist hired to construct a growing plan for a new cotton farmer.

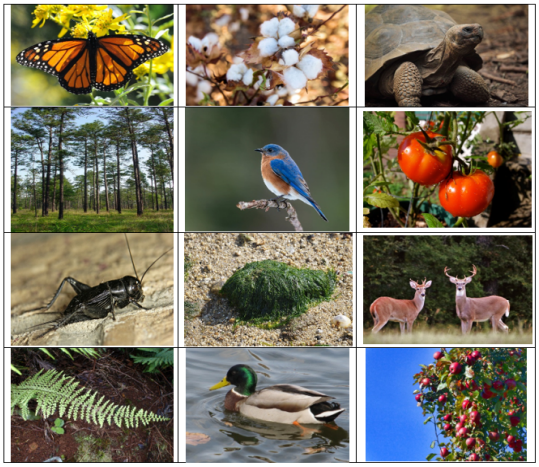
Students will:

- analyze and interpret growth and development data of different
- cotton species develop and use models of inherited traits of different cotton species
- locate primary growing locations for the desired cotton species
- calculate an anticipated profit from the harvest
- construct a growing plan (explanation) for a new cotton farmer

ENGAGE

Prior to starting this lesson, make copies and cut the animal/plant sorting cards. Quantity of copies is based on how you choose to group students (e.g., partnerships, individual).

Start the lesson by projecting the images of the plants and animals. Elicit student prior knowledge by asking students to identify (name) anything they recognize. If time permits, allow students an opportunity to elaborate on their experiences with these living things.



Provide students the sorting cards. Ask students to sort the species into two categories and prepare to share their reasons for their organization.

NOTE:

Monarch butterfly *Danaus plexippus* animal/invertebrate	Upland cotton *Gossypium hirsutum* plant/seed producer	Gopher tortoise *Gopherus polyphemus* animal/vertebrate/reptile
Longleaf pine *Pinus palustris* plant/seed producer	Eastern bluebird *Sialia sialisi* animal/vertebrate/bird	Tomato *Solanum lycoperscium* plant/seed producer
Black field cricket *Teleogryllus commodus* animal/invertebrate	Green algae *Chlorophyta sensu stricto* plant/non-seed producer	White tailed deer *Odocoileus virginiaus* animal/vertebrate/mammal
Shining spleenwort *Asplenium trichomanes* plant/non-seed producer	Mallard *Anas platyrhychos* animal/vertebrate/bird	Red Rome apple tree *Malus domestica* plant/seed producer

After some time to sort, ask volunteers to share group names and their reasons. Note: Sharing can occur with partners, small groups, or whole class. Anticipate students to sort as plants and animals. If students do not sort into these categories, commend them for their way of thinking, and then encourage them to rearrange before transitioning to the next chunk of instruction.

Once sorted as plants and animals, guide discussion about characteristics of these living things:

- How do plants grow?
- How do animals grow?
- How do plants get food?
- How do animals get food?
- How do plants reproduce?
- How do animals reproduce?
- How might we further sort the animals?
- How might we further sort the plants?

Transition to the next part of the sorting exercise by asking students to stack the animals to the side and concentrate on the plants. Ask students to sort the plants *again* just two ways and *again* prepare to share their reasons for their new categories.

After some time to sort, ask volunteers to share their group names and reasons. Anticipate students to sort several ways: fruits/flowers, grows tall/short, edible/not. Complement students on their ways of thinking and communicating their ideas. Explain that one way the plants could be sorted is by their seeds.

Ask students to hold up cards of plants they know have seeds. Based on student response, add to their understanding by asking them to hold up other examples from their sort. Then ask students to group all the seed plants together and observe the two remaining. Ask students to observe other characteristics of these non-seed plants that seem to make them different than the plants in the seed stack.

Redirect student observations to the seed plants. Ask students, "What do you already know about any of these seed plants?" Anticipate for student volunteers to provide names (e.g., pine tree, apple tree, tomato), characteristics (e.g., tall, short, flowers, roots, make their own food), or role they play in a food chain (transfer energy to animals – e.g., deer, squirrel, birds).

Direct student observations to the cotton plant. Ask students, "What do you already know about this plant – cotton?" Anticipate for student volunteers to provide uses (e.g., clothing) and identify the role it plays in agriculture/economy (e.g., My grandpa grows cotton.)

Ask students if they know someone whose job is to work with plants. Guide thinking by asking things like, "Does anyone know someone that works as a landscaper? …cuts grass? Does anyone know a farmer? What about a tree trimmer?"

EXPLORE

Introduce students to Georgia cotton farming families.

EXPLAIN

Prior to the explain phase, prepare copies or access to the recommended student farm guides. You may also want to consider projecting a map of Georgia and pre-determining different plots of land that you want students to use as their "client's farm."

Explain the performance task. *You are going to think like an agricultural scientist for the next couple of days. You have been hired by a new Georgia farmer to provide advice on what type of cotton to grow, how to effectively use all your land, and predict the amount of cotton that can be harvested at the end of the growing season.*

To be successful in your new role, you need to apply understanding of the following core cotton ideas:

- best cotton species for where your client has purchased land
- cotton life cycle (growing season) and needs during life cycle to provide recommendations for when to plant and how to take care of the cotton plants
- amount of cotton that could be harvested based on amount planted

Provide students with the following *student farm guides* to support them as they gather and evaluate information to use in drawing conclusions about their farm recommendations:

- Pima and Upland Cotton Information Sheets
  Note: Consider additional resources such as those found (GPB's Live Exploration: Georgia Cotton)
- Species Recommendation Form (Differentiation Option: with Sentence Starters)
- Recommendation for Space when Planting Cottonseeds
  Note: Students may prefer to work from a piece of graph paper.
  Note: Encourage students to start practicing the model by isolating a single acre. If additional resources are needed to support visualization, try TheCalculatorSite.
- Harvest Predictions

OTHER POSSIBLE DIFFERENTIATION

Differentiate by process with teams of three working together to make recommendations. Identify group roles based on student data (readiness, prior knowledge, areas where more practice is needed, etc.).

To differentiate by product, provide structured supports for creating final draft of recommendations.

To provide additional choice, consider identifying different areas on a Georgia map where the "farmer" is requesting the recommendation (e.g., south Georgia, middle Georgia, north Georgia).

SUMMARIZE

Students compile all recommendation forms to turn in like they are providing them to the new cotton farmer. After completion, time to reflect on the processes and specific tasks of being a cotton farmer and an agricultural scientists should be provided. Part of this reflection should also include opportunity to ask new questions/ wonderings. Questions that could structure this reflection might include:

- What do you think cotton farmers find to be the most challenging?
- What do you think gets easier for cotton farmers as they work from year to year?
- Would you ever consider being a cotton farmer?
- What did you like about the tasks in your role as an agricultural scientist?
- What did you find challenging in your role?
- Would you ever consider being an agricultural scientist?