Lesson Title	Cotton Industry Innovations
Timeline	1-2 45-minute class periods

STANDARDS

Social Studies:

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.

Economic Understandings

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

a. Describe opportunity cost and its relationship to decision-making across time (e.g., decisions to settle in the west).

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.

e. Describe how trade promotes economic activity (e.g., trade between the U.S. and Europe).

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).

Science: (ability to align based on student choice)

S4L1. Obtain, evaluate, and communicate information about the roles of organisms and the flow of energy within an ecosystem.

a. Develop a model to describe the roles of producers, consumers, and decomposers in a community.

b. Develop simple models to illustrate the flow of energy through a food web/food chain beginning with sunlight and including producers, consumers, and decomposers.

c. Design a scenario to demonstrate the effect of a change on an ecosystem.

d. Use printed and digital data to develop a model illustrating and describing changes to the flow of energy in an ecosystem when plants or animals become scarce, extinct or overabundant.

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.

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.

Speaking and Listening

ELAGSE5SL1: Engage effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on topics and texts, building on others' ideas and expressing their own clearly.
a. Come to discussions prepared, having read or studied required material; explicitly draw on that preparation and other information known about the topic to explore ideas under discussion.

b. Follow agreed-upon rules for discussions and carry out assigned roles.

c. Pose and respond to specific questions by making comments that contribute to the discussion and elaborate on the remarks of others.

d. Review the key ideas expressed and draw conclusions in light of information and knowledge gained from the discussions.

ELAGSE5SL2: Summarize a written text read aloud or information presented in diverse media and formats, including visually, quantitatively, and orally.

ELAGSE5SL3: Summarize the points a speaker makes and explain how each claim is supported by reasons and evidence.

MATERIALS LIST

- Pen or pencil
- Student Guide
- Science and Engineering Scenarios
- Engineer Graphic Organizer with Rubric
- Scientist Graphic Organizer with Rubric
- Speaking and Listening Rubic with Self-Reflections
- Access to Resources (e.g., GPB's Georgia Cotton Live Exploration)

INTRODUCTION

Historically after European settlement, cotton farming was successful only in the coastal plains of Georgia and South Carolina. In the United States, Georgia was the first colony to produce cotton commercially, with its first farm near Savannah in the 1730s. Innovations in technology and agricultural practices resulted in the expansion of cotton farming further inland, specifically across Southern states known as the Cotton Belt. Georgia was also part of the Cotton Belt, the region of the United States where railroads ran through areas where cotton was the predominate crop.

The success of cotton farming in Georgia has experienced ebbs and flows. Overall, innovations have improved the success of cotton farming in Georgia. The more notable historical innovations include the cotton gin, boll weevil trap, and introduction of crop rotation practices. Modern innovations that continue to support Georgia cotton farming include genetic engineering and selective breeding, precision planting and spraying, variable rate irrigation systems, and larger, more advanced equipment.

Today Georgia is ranked third in cotton production for the United States, supporting more than 50,000 jobs and contributing approximately $3 billion dollars to the economy.
For more detailed information about cotton in Georgia, visit GPB Live Exploration for videos and support resources.

In this performance task, students will obtain, gather, and evaluate multiple sources of information to construct an explanation about the role of both scientific and engineering innovations in Georgia's cotton industry. This performance task aligns to the Georgia Standards of Excellence.

ENGAGE

Prior to the engage phase, prepare copies of the Science and Engineering Scenarios for each group of students. In addition, use data to inform and determine student groups of 3-4. Within these teams, explain roles and responsibilities for team members. Either allow students to choose their role, or you pre-determine. Note: While all students are responsible for obtaining, gathering, and evaluating information, there are specific opportunities where the roles of speaker, writer, and (proof)reader could support better student growth and alignment to standards.

To begin the engage phase, project the image below (also included in the student guide) to elicit student thinking about similarities and differences in the practices of scientists and engineers. Encourage thinking by asking questions like What do you think engineers do? What about scientists? Do you think they ever work together? What kind of skills do you think an engineer needs? …a scientist?

Transition students to the Science and Engineering Scenarios. Provide each team member in each group a different scenario (e.g., boll weevil, irrigation systems, crop rotation, cotton engine). Provide 5-10 minutes for each student to individually read each prompt on their scenario to identify what they consider represents work of scientists, engineers, or both. Then provide another 10-15 minutes for each team member to share (speak) and listen to each other's' scenarios. While sharing, students listen for patterns that might support an explanation for how all scientists' and engineers' work.

Students record their thoughts in the table on the student guide:

As a team: *Listen* to each team member's scenario. *Listen* for patterns, *discuss* these patterns, and then *come to an agreement* for which practices best compare the work of scientists and engineers. Organize your team thinking in the table:

Science	BOTH	Engineering

As you monitor active speaking/listening, guide thinking by asking questions like What are some things you can see both scientists and engineers doing? How do you think an engineer might plan an investigation? What might they test? Why do you think they test these ideas? What if it doesn't work? Do scientists do this same thing? Why might a scientist want to plan an investigation into the relationship between ...(varies based on student scenario)?

To summarize, facilitate a clarifying discussion with questions like *How are science and engineering similar? Which practices are the most clearly different between the two?* During discussion guide students toward the following, encouraging them to erase and replace as needed for accuracy:

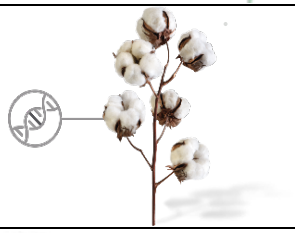
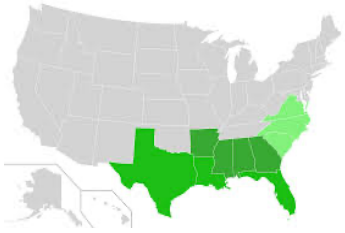
<table>
<tr><th>Science</th><th>BOTH</th><th>Engineering</th></tr>
<tr><td>Ask Questions</td><td>Develop and use models</td><td>Identify problems</td></tr>
<tr><td>Construct explanations</td><td>Plan and carry out investigations</td><td>Design solutions</td></tr>
<tr><td rowspan="4"></td><td>Analyze and interpret data</td><td rowspan="4"></td></tr>
<tr><td>Use mathematics and computational thinking</td></tr>
<tr><td>Engage in arguments from evidence</td></tr>
<tr><td>Obtain, evaluate and communicate information</td></tr>
</table>

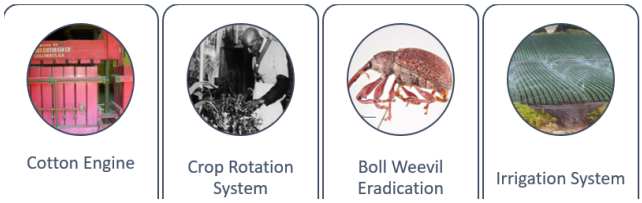
EXPLORE

To transition, ask students, *What did all these scenarios have in common? (cotton) What do you know about cotton? (answers will vary) How do you think scientists and engineers have affected cotton farming practices and production? (answers will vary)*

To pique student interest, begin by telling a historical narrative of cotton's expansion over time. As you tell the story, students will use the map in their student guides to color code the Cotton Belt and the areas of Georgia where upland cotton and sea island cotton historically grew. Consider displaying representative images as you share the story.

Suggestions for Historical Narrative of Cotton's Expansion:

	About 500 years ago, cottonseed was first introduced to the United States by European settlers. However, the United States is not where our story of cotton begins.
	Cotton plants evolved about 7000 years ago. Its natural habitat consists of a warmer climate with long, sunny growing seasons. Cotton plants grow and develop from seeds in soil. These seeds, once germinated, will sprout, bud, and bloom white flowers. These white flowers are unique because they can self-pollinate, meaning they have both male and female reproductive parts. After fertilization, the white flower turns slightly pink and then red. After the flowers fall off, tiny cotton bolls begin to emerge. These bolls continue to grow and develop into fluffy cotton lint with new seeds inside. It is that fluffy cotton lint that we are likely most familiar with – as that is what is used to make fiber and fabric.
	When cotton was first introduced to the United States, it was first grown in areas that had perfect growing conditions. In Georgia, this was the Coastal Plain region where soil was sandier, and climate was warmer to support a longer growing season.
	Through selective breeding practices, a new species of cotton evolved. This new species was commonly referred to as upland cotton. It could successfully grow in more areas of southeastern United States.
	As farmers began to experiment with its success across more states, cotton eventually became a commercial crop in all states highlighted in green on this map. (Note: Students shade their maps and create a key.)



Cotton farming has faced many challenges over the years. Some of the earlier challenges were trying to figure out ways to get the seed out of the boll so that fabric could be spun. This led to the innovation of the cotton gin. Then, as farmers continued to have successful crops, they also came to realize that nutrients from the soil and the amount of water the crops received were important factors to the crop success. Scientists and engineers tested ideas like rotating crops and irrigation systems to create better growing environments for cotton.
There was also a boll weevil invasion! Boll weevils take in and use energy from cotton buds and flowers – and, as you can imagine, if cotton cannot flower then it would not be able to produce that white fluffy boll!

Through all this, people have worked together to support the success of cotton farming. Not only is cotton fiber the most widely used fiber across the globe, but scientists and engineers have figured out how to use every part of the plant so that nothing goes to waste!
Aside from being spun into fabrics and threads, cottonseed is pressed into oil for cooking, cosmetics, soaps, and plastics. Sometimes the cottonseed is even used as part of cow feed! Farmers also mulch down stems to go back into the soil, recycling nutrients to keep the soil healthy for more crops.

EXPLAIN

After reading the narrative, direct students to the summary table in their student guide:

After listening to the explanation of what we know about cotton, summarize the information using images and a minimum of three key ideas. The beginning has been modeled for you.

About 7000 years ago				Now
				
-seeds germinate -flowers turn to bolls with new seeds -grow in warm climates				

After making the instructions explicit, highlight the completed model as a sample to follow. Provide time and supports to students as needed. Utilize group roles to support peer checking of standards aligned to the summaries and map.

Responsibilities might include:

- Speaker: Reads aloud each team member's summary. Repeats as many times as needed for the proof-reader and writer to provide constructive feedback. Provides at least one suggestion for improvement.
- Writer: Underlines key ideas that are in the accurate sequence. Writes constructive feedback as requested by the proofreader.
- (Proof) Reader: Listens for key ideas supported by details and accurate sequencing of ideas. Provides constructive feedback to the writer to record.
- Transition to the next explore/explain by providing time for students to individually make note of what they are now wondering (see student guide). After individual time, support team discussion of wonderings. Again, consider utilizing group responsibilities:
- Speaker: Reads aloud each team member's questions to the team. Shares most repeated questions with whole class during whole group sharing.
- Writer: Listens for similarities in questions to determine if it should be recorded. Makes note of any questions that are repeated.
- (Proof) Reader: Listens for questions that may need to be rephrased for improved comprehension. Listens for similarities in questions to determine if it should be recorded as a repeated question.

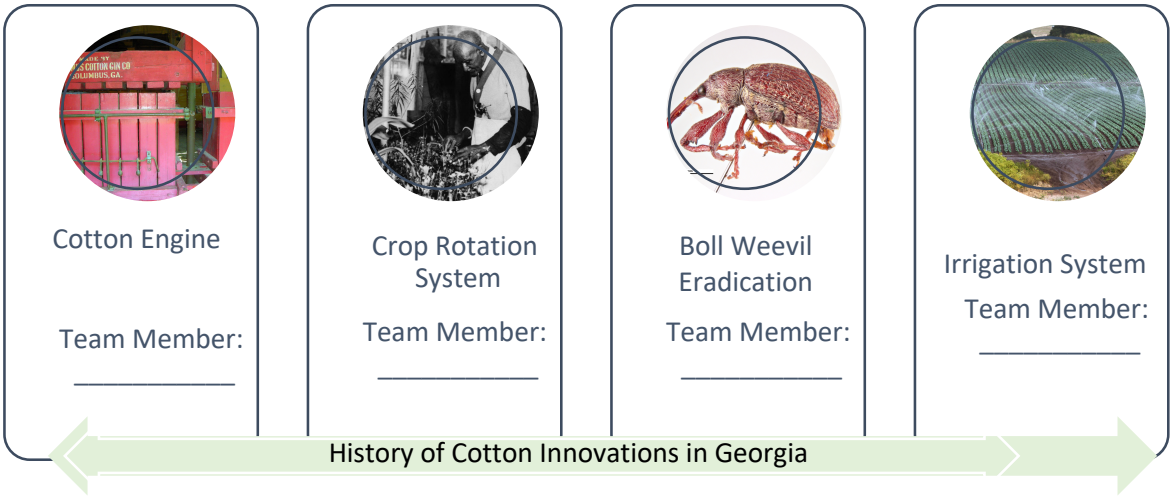
EXPLORE/EXPLAIN

Driving Question: How have scientists and engineers affected cotton farming and production practices?

OVERVIEW

Overview the project description as a choice of either a problem or phenomenon that scientists or engineers worked to explain or solve. Make explicit that the learning targets for this lesson will aim across disciplines so that students have opportunity to (a) obtain, gather, and evaluate information from multiple sources about the specific details of both this narrative and one of the cotton-related scenarios, (b) then organize the information as a flipbook, Sway, or other media onto a group timeline, and (c) prepare an elevator speech to present to the class.

Project the following image so that students have a clear idea of what their choices include:



Provide time for students in each team to decide which problem or phenomenon they want to learn more about for their performance task and record the responsible team member on their student guide. (Note: Each team member must choose a different problem or phenomenon.)

Review the graphic organizers and rubric(s) for each part of the performance task. Provide time, resources, and supports for students to obtain, gather, and evaluate information about their science phenomenon or engineering problem. Provide additional time for students to finalize the performance task and prepare for elevator pitches as a team.

EXPLAIN

Students prepare and practice elevator pitches to present to the class. As teams present their elevator pitches, the listening audience provides feedback that contributes to the discussion and elaborates on the key ideas of the presentation. Use the Speaking and Listening Rubric to support evaluation.

SUMMARIZE

Refer to the self-reflection portion of the Speaking and Listening Rubric to guide students in reflecting on their learning experiences. Provide additional time for students to identify and record any new wonderings.