Cotton Science and Sustainability

Dear Educator,

Take your students on a surprising journey from fashion to science! This free, standards-based teaching kit, made possible by Cotton Incorporated, the not-for-profit U.S. cotton research and promotion company, starts with something literally close to students' hearts — their clothing — and ends with a look at farming and recycling practices that help to sustain our environment and make our world a better place.

Designed for students in middle school, ***Cotton Science and Sustainability*** engages students in hands-on classroom lessons that will enhance your curriculum, and includes a fun video whiteboard activity that introduces students to some interesting and perhaps surprising facts about cotton — the most popular fabric on the planet.

We hope that you will share this program with other teachers in your school. Please return the enclosed reply card or comment online at ymiclassroom.com/feedback-cotton to provide your feedback. We look forward to hearing from you.

Sincerely,
Dr. Dominic Kinsley
Editor in Chief
Young Minds Inspired

Questions? Contact YMI toll-free at 1-800-859-8005 or by e-mail at feedback@ymiclassroom.com.

Target Audience

Students in grades 5 to 8 and their families

Program Objectives

- Help students learn about and evaluate the properties and benefits of cotton
- Teach students about cotton's value to the environment as a natural fiber
- Raise student awareness of sustainable practices adopted by cotton farmers
- Explore the versatility of cotton

Program Components

- This one-page teacher's guide
- Three reproducible activity sheets
- A colorful classroom poster
- A whiteboard activity available at ymiclassroom.com/cotton
- A reply card for your comments, or comment online at ymiclassroom.com/feedback-cotton

How to Use This Program

Photocopy the teacher's guide and the three activity sheets before displaying the poster. Review the websites and videos for use with each activity in advance. To review alignment with Common Core and Next Generation Science Standards, visit ymiclassroom.com/cotton.

How to Use the Poster

Display the poster and have students use the facts to create math word problems, e.g., If one bale of cotton can make 215 pairs of jeans, how many pairs can 4.5 bales make? Collect students' word problems to create a class quiz. Also, have students calculate what fraction or percentage of a bale of cotton produced the number of pairs of jeans worn by students in the classroom.

How to Use the Whiteboard Activity

Cotton: From Farm to Fashion to Food, available at ymiclassroom.com/cotton, is an interactive video-based quiz that takes students on an amazing journey to find out how cotton is used beyond clothing — from providing insulation for homes to feeding people. Share the activity on your whiteboard, or have students explore the activity on a home computer or mobile device.

Activity 1

The Fiber Factor

Ask students if they're familiar with ingredient labels on foods. Did they realize clothing also has a similar label? Just as the ingredients in food can determine how tasty or nutritious something is, the ingredients on a clothing label can determine how it feels, how to care for it, and how it will wear. Do the "ingredients" they are wearing help or hinder their fashion style or comfort?

Introduce the idea that cotton, found in many types of clothing, is a natural fiber grown by farmers, not synthesized from chemicals or made from crude oil. Ask students to watch the *All the Reasons Why Damsel in Dior Loves Cotton* video at youtube.com/watch?v=vKtE5qyROgw (1:19 minutes) and consider: What properties or characteristics of cotton would influence someone to choose clothing made from it?

Then have students share their thoughts, e.g., cotton is natural, breathable, durable, and comfortable, and can be rugged, yet still soft — like their favorite pair of jeans. Cotton also absorbs water and sweat. ***Answers:*** Part 2. C – 1, 3, 4, 6; S – 2, 5.

Give students time to work together on Part 3 and create new products made from cotton, and point out the activity to be done at home.

Activity 2

Break It Down!

Have students recap the characteristics of cotton that they learned in Activity 1. Then explain that our clothes can shed microfibers when we wear and wash them. These tiny microfibers get into water through the washing machine and can accumulate in wastewater treatment plants, freshwater, and even seawater environments, potentially harming the ecosystem. Once in the water system, these microfibers biodegrade or break down at different rates depending on the material type and the environment they are in (i.e., sea versus fresh water). For cotton, this process is called *biodegradation*.

Explain that the cotton industry worked with North Carolina State University to determine how quickly microfibers of cotton, rayon (a manufactured fiber made from wood), polyester (a synthetic fiber made from crude oil), and cotton/polyester blends biodegrade in aquatic environments. Can students predict the results?

Distribute the activity sheet, review the directions, and have students use the graphics to complete the activity. ***Answers:*** Part 1. 1. 44%; 35%; 2. freshwater; 3. They will continue to degrade; 4. See explanation in next paragraph; 5. Like plastics in the ocean, polyester resists biodegradation; 6. Answers will vary. Part 2. Graphs should reflect the data shown on the source graphics.

Explore the results between the microfibers of different fabrics. Ask students to think about why materials decompose. Explain that bacteria, enzymes, and marine fungi in water break down the cotton microfibers shed into water systems through washing machines. Since cotton is mostly made up of cellulose, a naturally occurring sugar-based compound, it is more easily broken down. Synthetic fibers, such as polyester, do not readily biodegrade and remain in the environment for longer periods of time.

Activity 3

Cotton and the Planet

Taking care of the environment is important to the cotton industry. Cotton farmers and producers adopt practices to increase cotton production sustainability, which means they farm and manufacture cotton in ways that help conserve our planet and its natural resources. Ask students how their families do this. For example, maybe they turn off the water when they brush their teeth, or compost or recycle.

Show students the *Cotton and the Planet* video at youtube.com/watch?v=zt2D8x1UtFo (1:17). Distribute the activity sheet and divide the class so that each group researches sustainable cotton farming practices in one of three areas — water, soil health, or land — and then creates a summary presentation. Examples: Water — Most cotton in the U.S. is grown with just rainwater; Soil health — Improved cotton varieties now defend against the boll weevil, which destroyed crops in the past in the U.S.; Land — In the U.S., twice the cotton is grown on the same amount of land as 40 years ago due to improved farming practices. Findings for question 5 can include cottonseed being used in cow feed as well as cottonseed oil being used in food preparation and production. Have the groups share their final presentations.

Resources

- thefabricofourlives.com
- ymiclassroom.com/cotton

ACTIVITY 1

The Fiber Factor

REPRODUCIBLE MASTER: G5-8

Food can be tasty or nutritious depending on the ingredients. Clothing has ingredients, too. Clothing ingredients can be natural, meaning they occur in nature, or synthetic, meaning they are manufactured from chemicals or other sources such as crude oil.

Part 1:

Look at these two clothing labels from different shirts. Each label lists the fiber ingredients in the shirt. Check out the link at https://thefabricofourlives.com/the-benefits-of-cotton. Then answer the questions.

Shirt #1

Shirt #2

1. Which shirt is made of all-natural fibers? What are the "ingredients" in that shirt?

_____

_____

_____

_____

2. Which shirt is made of synthetic fibers? What are the "ingredients" in that shirt?

_____

_____

_____

_____

3. On the back of this sheet, write a consumer reports blurb or an online shopping site customer review comparing the two shirts.

Part 2:

For each of the statements below, write a C for "cotton" or an S for "synthetic" to show which type of fabric best answers the question.

☐ 1. It's a hot, humid day. Which fabric breathes to help keep you cool?

☐ 2. You are performing on stage and want to avoid embarrassing static cling. Which fabric will you also want to avoid?

☐ 3. You've been up late doing homework, and you need a good night's sleep. Which sheet fabric will help you best catch some zzzz's?

☐ 4. There's no room in your budget for dry cleaning. Which fabric will last a long time even after repeated washings?

☐ 5. It's time to run the marathon! You grabbed some sweats, but can detect an aroma that never washes out. What type of fabric is in your clothing?

☐ 6. You are headed to the store to buy a durable pair of jeans. What fabric is the only *real* denim?

Now create two more questions to challenge your classmates!

_____

_____

Part 3:

Show your fiber savvy! Using the information you learned, create a new product made from cotton. Work with a partner to brainstorm your product, describe it, and explain how the properties of cotton benefit your new product.

What's your style?

Check your closets! Write down the different types of fibers you find on up to five of your clothing labels. Bring the list back to class and compare results. Which fibers were most common, and which were least common? Discuss the benefits and pitfalls of the fibers you found.

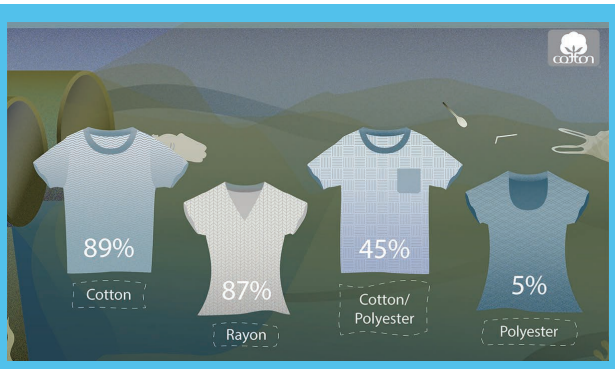
ACTIVITY 2

Break It Down!

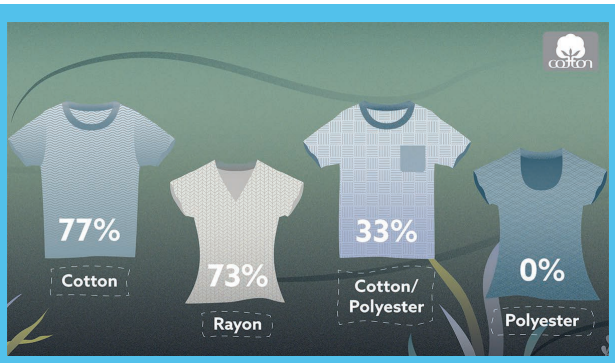
REPRODUCIBLE MASTER: G5-8

Our clothes can shed microfibers when we wear and wash them. These tiny fibers can find their way into our water systems through washing machine drains. If they build up in freshwater and seawater environments, they could even harm the ecosystem.

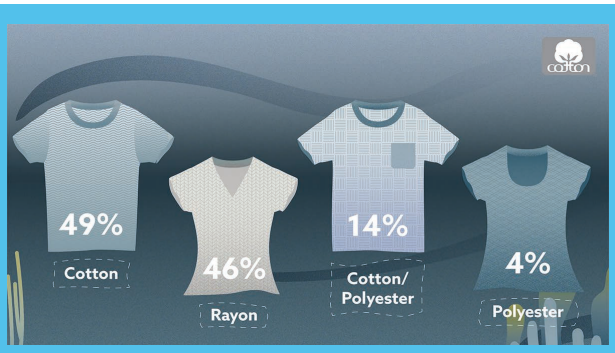
The cotton industry and North Carolina State University did a study to examine how textile microfibers break down or biodegrade in aquatic environments for more than 40 days. They compared cotton, rayon (a manufactured fiber made from wood), polyester (a synthetic fiber made from crude oil), and cotton/polyester blends. Learn more about the study by completing Part 1 below.



Wastewater Timeframe of over 40 days



Freshwater Timeframe of over 40 days



Seawater Timeframe of over 40 days

Part 1: Use the graphics at left to answer these questions.

1. What is the difference in the percentage rate of degradation between cotton and the cotton/polyester blend microfibers in freshwater? _____ In seawater? _____

2. In which aquatic environment — fresh water or seawater — did the cotton microfibers degrade the most? _____

3. Look at the wastewater treatment graph. What do you predict will happen to the cotton microfibers after 250 days, based on the data pattern? _____

4. Why do you think the cotton microfibers degraded more rapidly than the cotton/polyester microfibers?

   _____

   _____

5. Why could the accumulation of polyester microfibers become an issue in aquatic environments?

   _____

   _____

6. How can the choice of textiles used to make clothing help with the issue of degradation?

   _____

   _____

Part 2: Use the other side of this sheet to create a bar or line graph to represent and compare the results of the freshwater and seawater studies.

Source: Zambrano, M. C., Pawlak, J. J., Daystar, J., Ankeny, M., Goller, C. C., & Venditti, R. A. (2020). Aerobic biodegradation in freshwater and marine environments of textile microfibers generated in clothes laundering: Effects of cellulose and polyester-based microfibers on the microbiome. *Marine Pollution Bulletin, 151* (February). https://doi.org/10.1016/j.marpolbul.2019.110826

ACTIVITY 3

Cotton and the Planet

REPRODUCIBLE MASTER: G5-8

Become a cotton expert! Do some web research to find out what U.S. cotton farmers are doing to help take care of the environment. Then share what you find with your class.

Your teacher has assigned your group to research sustainable cotton farming practices in one of three areas: water, soil health, or land. What is your group's topic?

Part 1:

Do your research using these sources, then answer the questions below.

- Water Management: cottontoday.cottoninc.com/cotton-production/water
- Soil Health: cottontoday.cottoninc.com/our-sustainability-story/land/soil-health/
- Land Use: cottontoday.cottoninc.com/cotton-production/land

1. How is your topic important to cotton growth or production?

_____

_____

2. List five important facts about your topic:

a. _____

b. _____

c. _____

d. _____

e. _____

3. How do sustainable farming practices in your topic area help the environment?

_____

_____

4. What did you find most interesting or surprising?

_____

_____

5. In addition, research to learn how cotton by-products can be used in a sustainable way.

_____

_____

Part 2:

Now, with your group, create a presentation in your own choice of media to teach the other groups what you have learned. You might create a slide show, video, or poster, or choose some other format. Include the answer to each question in Part 1 in your presentation. Then, share your presentation with the rest of the class!

No lesson is complete without a quiz!

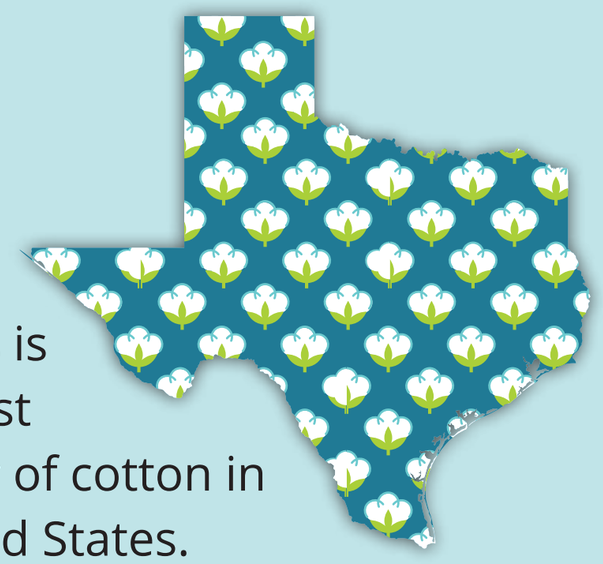
Using what you've learned, create a quiz to test your peers on their knowledge about cotton farming today. Consider taking your quiz home to challenge your parents, too!

Count on Cotton

Check out these fun facts to discover what makes cotton so unique!

1. Cotton is natural and grown from the Earth.

2. Cotton has been grown and used to make fabric for at least 7,000 years.



3. Texas is the largest producer of cotton in the United States.

4. In 2021, 17,500,000 bales of cotton were produced in the United States. One bale of cotton weighs approximately 480 pounds and can make 690 bath towels or 215 pairs of jeans.

5. In 2021, 537 million pairs of adult and kids' jeans were sold in the United States.

6. The U.S. dollar bill contains 75% cotton. One bale of cotton can make 313,600 $100 bills.

7. Cottonseed oil is used as an ingredient in bread, cereals, and snacks, including potato chips.

8. Scientists have found a way to make cottonseed edible for humans, which could make it an inexpensive food source for millions of people around the world.

SOURCES:
1. https://thefabricofourlives.com/blog/cotton-vs-polyester-rayon; 2. https://www.cotton.org/pubs/cottoncounts/story; 3. http://www.cotton.org/edu/faq/index.cfm; 4. https://www.nass.usda.gov/Publications/Todays_Reports/reports/cropan22.pdf, https://www.cottoninc.com/cotton-production/quality/us-cotton-fiber-chart/bale-sizes, and https://www.cotton.org/pubs/cottoncounts/what-can-you-make.cfm; 5. https://www.euromonitor.com; 6. https://www.cotton.org/pubs/cottoncounts/cotton-currency.cfm and https://www.cotton.org/pubs/cottoncounts/what-can-you-make.cfm; 7. https://cottontoday.cottoninc.com/cotton-byproducts/cottonseed and http://smartlabel.kelloggs.com/Product/Index/00038000138430#ingredients; 8. https://www.aphis.usda.gov/aphis/ourfocus/biotechnology/brs-news-and-information/2018_brs_news/texas_am_low_gossypol_cotton