

AGRICULTURE AND CLIMATE CHANGE

TEACHER GUIDE

SYNOPSIS

In this exercise, students interact with the National Climate Assessment chapter on agriculture to learn about the multiple ways that agricultural crops and products are affected by climate change.

LEARNING OUTCOMES

- Students will be able to analyze and interpret graphical data on a map.
 - Bloom's Taxonomy: Analyze
- Students will be able to analyze data from a line graph.
 - Bloom's Taxonomy: Analyze
- Students will be able to draw conclusions on the relationship between climate change and agriculture.
 - Bloom's Taxonomy: Understand, Evaluate

TOTAL TIME

45 minutes

MATERIALS

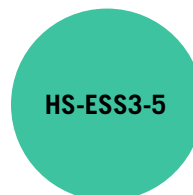
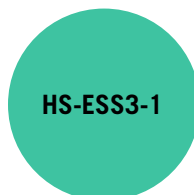
- For students: Agriculture and Climate Change Student Worksheet
- For teachers: Agriculture and Climate Change Answer Key

CONTEXT VIDEO

[Our Climate Our Future: Drought and Flooding in Georgia](#) (2:00 min)



STANDARDS



Common Core State Standards



Next Generation Science Standards

SOURCES AND REFERENCES

[National Climate Assessment Report, 2015: Climate Change Impacts in the United States](#)

Contact reb@acespace.org for questions and comments. Text TEACH to 64336 for more resources.

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TEACHING-LEARNING PLAN: THE INQUIRY 5E INSTRUCTIONAL MODEL

TIME	TEACHER DOES	STUDENT DOES
ENGAGE (5 MIN)	<p>Short debrief (1 min): Engage the class by explaining that they'll watch a short video on a young person's experience with flooding and drought on his farm in Georgia. While students are watching, have them consider the question, "How is climate change affecting farming in Georgia?"</p> <p>Play video (2:00 min): Our Climate Our Future: Drought and Flooding in Georgia</p>	<p>Jot down ideas: As students watch the video, consider having them take notes on how climate change is affecting Brandon and how he is taking action.</p>
EXPLORE (5 MIN)	<p>Observations from the video (5 min): Ask students what they observed from the video about how climate change impacts agriculture.</p> <ul style="list-style-type: none"> Share that climate change can make weather more extreme. Two analogies you can use: Climate change loads the dice, increasing the odds of more intense weather. Or, climate change puts weather on steroids. 	<p>Initial reactions: Allow students to share any initial reactions or emotional responses to the video.</p>
EXPLAIN (10 MIN)	<p>National Climate Assessment: Explain that you will be learning about how climate change affects agriculture by exploring the chapter on agriculture in the National Climate Assessment (NCA).</p> <ul style="list-style-type: none"> The NCA was produced by the US Global Change Research Program in 2014 by a team of more than 300 experts to summarize the impacts of climate change on the US, now and in the future. The report is entirely online and is mobile-friendly, so students can read and interact with graphics on tablets, computers or their phones. <p>Read: Read aloud as a class the Introduction of the NCA chapter on agriculture (3 paragraphs long).</p>	<p>Popcorn: Students navigate to the agriculture chapter in the National Climate Assessment (nca2104.globalchange.gov) >Explore the Report>Sectors>Agriculture</p> <p>One student begins reading the introduction, then calls on another student to continue. Students continue to "popcorn" read through the Introduction. Students can read the NCA on a computer, tablet, or phone or the chapter can be downloaded and printed.</p>
ELABORATE (20 MIN)	<p>Climate Change and Agriculture worksheet: Hand out the student worksheet to accompany the NCA agriculture chapter.</p> <ul style="list-style-type: none"> Explain that students will be exploring only the Introduction, Key Message 1 and an excerpt from Key Message 3. Students can work in small groups or pairs to explore the chapter and complete the worksheet. Note that although you can download and print the chapter, there are two interactive graphics that require online access to use. 	<p>Work in pairs or small groups: Students answer the worksheet questions by reading the Introduction, Key Message 1 and the blue excerpt box in Key Message 3 and interacting with the graphics in Figures 6.2 and 6.5.</p>
EVALUATE (5 MIN)	<p>Discussion Questions: After students have completed the worksheet, reconvene as a class to discuss the final three discussion questions on the worksheet:</p> <ul style="list-style-type: none"> How do we use these agricultural products and crops in our daily lives? Not only is agriculture impacted by climate change, but it also affects climate change. What are some ways in which agriculture as an industry contributes to climate change? What are some ways in which we as consumers of agricultural products can work to reduce the impact of agriculture on climate change (and therefore, in turn, the impact of climate change on agriculture!)? 	<p>Class discussion: Students contribute to class discussion about how the interaction between climate change and agriculture affects their daily lives and what they can do about it.</p> <p>Students record their ideas in their worksheet.</p>

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TEACHER GUIDE: STUDENT WORKSHEET ANSWER KEY

INTRODUCTION

Climate change has many different impacts on agriculture in the U.S. through temperature, precipitation, extreme weather, disease and more.

OBJECTIVE

Understand the impacts of climate change on agriculture through exploring the National Climate Assessment report online.

PROCEDURE

- Go to the National Climate Assessment at nca2014.globalchange.gov.
- Click on **Explore the Report** > **Sectors** > **Agriculture** to get to the chapter on agriculture.
- As a class, read the Introduction to the chapter.
- In small groups, answer the questions below from the Introduction, Key Message 1 and Key Message 3.

QUESTIONS

1. In what ways is agriculture directly impacted by climate change? In what ways is it indirectly impacted?

Direct impacts include changes in temperature and precipitation, as well as extreme weather events like floods and droughts. Indirect impacts include increasing pests, weeds and disease from changes in climate.

FIGURE 6.2

2. Use Figure 6.2 to identify what agricultural products are grown in your state. What are they?

Answers will vary.

3. Is your state at the southern or northern range of that product, compared to other states?

Answers will vary.

4. What shifts do you predict might occur in agricultural products in your state in the next 100 years if climate change continues? What crops or products might you lose and what ones might you gain?

Answers will vary.

5. What climate variable affects crop production more than temperature? How might climate change affect this variable as well?

Water in the soil is a bigger impact on crops than temperature. Climate change also affects soil moisture through changes in precipitation (some regions get wetter, some get drier) as well as more extremes in both heavy rain and drought.

6. Based on Figure 6.4, which crops in California's Central Valley will adapt best to higher temperatures? Which will adapt worst?

Wheat, cotton and sunflowers will adapt the worst to high temperatures. Alfalfa, safflower and, depending on the scenario, tomatoes, will adapt best.

AGRICULTURE AND CLIMATE CHANGE

TEACHER GUIDE: STUDENT WORKSHEET ANSWER KEY

FIGURE 6.5

7. Which states will see the greatest decrease in number of frost days?

West: Oregon, Nevada, northern California, (Idaho, WA, UT)

8. Which states will see the greatest increase in number of consecutive dry days?

Southwest: CA, AZ, WA, NM, TX

9. Which states will see the greatest increase in number of hot nights?

Southern states: TX, LA, MS, AL, GA, FL, SC

10. What do the gray areas mean in the frost-free map?

Gray areas mean areas that are projected to experience more than 10 frost-free years between 2070-2099.

11. What's the biggest change you see of these four factors for your area?

Answers will vary.

USE FIGURES 6.2 AND 6.5 TO ANSWER THE FOLLOWING QUESTIONS:

12. Which crops do you think the change in frost-free season length may affect the most?

Tomatoes and apples are both grown in the western US (Central Valley of CA for tomatoes and Washington for apples) where the frost-free season length will be most affected. Tomatoes appear to do well in a warming world, however (according to Figure 6.4), so changes in frost-free season length may not affect them as much as apples.

13. Which crops and products do you think the change in number of consecutive dry days may affect the most?

Cattle, corn and wheat come from Texas, Oklahoma, Nebraska (as well as Missouri and Arkansas) which will experience a greater number of consecutive dry days from climate change.

14. Which crops and products do you think the change in number of hot nights may affect the most?

Cattle, egg layers, cotton, soybeans (as well as tomatoes, wheat, and corn to a lesser extent) are all grown or raised in the South where the increase in number of hot nights will be greatest.

15. How do hot nights impact agricultural animals?

Hot nights increase stress on animals, leading to less milk, meat and egg production.

16. What are chilling requirements for crops and how does climate change affect them?

Chilling requirements are the number of hours with temperatures between 32-50°F that a perennial crop (like fruit or nut tree) needs to grow. As climate change makes winters warmer, these crops like almonds, apples and cherries won't meet their needed number of chilling hours.

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TEACHER GUIDE: STUDENT WORKSHEET ANSWER KEY

KEY MESSAGE 3 CALL-OUT BOX: IT IS ALL ABOUT THE WATER!

17. How does climate change lead to soil erosion?

More intense downpours from climate change happen too quickly for the soil to absorb the water, leading to soil erosion.

18. How much have heavy downpours increased in Iowa since 1880 on average?

Heavy downpours have gone from an average of just less than 4 days per year to 5 days per year.

DISCUSSION QUESTIONS

19. How do we use these agricultural products and crops in our daily lives?

In our food, but also in food to make food (ie, corn to feed cattle) and to produce materials, such as clothing and textiles.

20. Not only is agriculture impacted by climate change, but it also affects climate change. What are some ways in which agriculture as an industry contributes to climate change?

Fertilizers used in agriculture use nitrous oxide, which is a greenhouse gas. Carbon dioxide is released from the soil through tilling, which is why some farmers are paid to practice no-till farming. And animal agriculture releases methane, particularly from cow burps, as well as manure.

21. Which crops and products do you think the change in number of consecutive dry days may affect the most?

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STUDENT WORKSHEET

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13. Which crops and products do you think the change in number of consecutive dry days may affect the most?
14. Which crops and products do you think the change in number of hot nights may affect the most?
15. How do hot nights impact agricultural animals?
16. What are chilling requirements for crops and how does climate change affect them?

AGRICULTURE AND CLIMATE CHANGE

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