# LESSON 5: How are rising temperatures changing water stories in these communities?

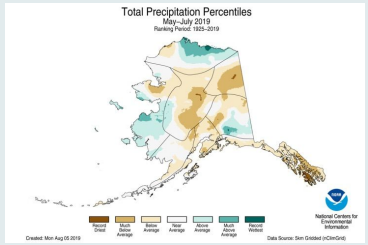
**PREVIOUS LESSON**

*We obtained additional scientific and technical information about other components of Earth's water system and how those components are changing as temperatures increase. We concluded that all components and processes in the system have been affected. We updated our model and added an entry to our Progress Tracker. We thought we could explain how warmer temperatures cause droughts and floods.*

**THIS LESSON**

PUTTING PIECES TOGETHER, PROBLEMATIZING

3 days




In this lesson, we use our key model ideas from previous lessons to construct explanations, using evidence, about how changes in temperature are having impacts on the water stories in our case site communities. We peer review our explanations and revise them using the feedback from our peers. We then learn about another community in Alaska and apply our key model ideas in an assessment transfer task to explain what is happening in that community as well. Finally, we notice that some other indicators are also changing in our atmosphere, and we are curious if that is related to the temperature changes, too.

**NEXT LESSON**

*We will build on our understanding of the composition of air to determine if changes happening in the air are related to the rising temperatures. We will discuss and analyze data and develop a better understanding of parts per million. Using this understanding, we will find the percent change in the concentration of these gases over a 100-year period. We will compare any increases or decreases in the concentration of these gases over time. We will notice that some gases remain stable, some change very little, while other gases change a lot.*

**BUILDING TOWARD NGSS**

MS-ESS3-1, MS-ESS3-3, MS-ESS3-4, MS-ESS3-5, MS-ETS1-2

## WHAT STUDENTS WILL DO

5.A Construct a scientific explanation based on valid and reliable evidence that changes in temperature can have impacts on the water sources available for communities.

5.B Compare graphs and charts depicting a changing climate in Alaska looking for similarities and differences to determine that trend lines and patterns across Alaskan claims are caused by increasing temperatures.

5.C Compare graphs and charts from multiple claims to identify patterns in the similarities and differences to determine that changes in the environments are caused by increasing temperatures.

## WHAT STUDENTS WILL FIGURE OUT

- Small changes in one part of Earth's system can have big impacts on another part.
- Changes in atmospheric temperature are related to changes in the components and processes of Earth's water system.

## Lesson 5 • Learning Plan Snapshot

| Part | Duration | Summary | Slide | Materials |
|---|---|---|---|---|
| 1 | 10 min | **NAVIGATION**<br>Consider the audience, purpose, and key ideas we want to include in our explanation. | A-C | Earth's Water System Model, Model Ideas list |
| 2 | 15 min | **CONSTRUCT AN EXPLANATION**<br>Construct an explanation to explain how and why the water story in one community is changing. | D | *Initial Water Story Explanation*, *Peer Feedback Instructions*, *Data for All Case Sites*, assorted colored pencils, blank paper |
| 3 | 10 min | **PEER REVIEW FEEDBACK**<br>Explanations are traded with two different peers to receive feedback. | E-F | *Initial Water Story Explanation*, *Peer Feedback Instructions*, *Peer Feedback Guidelines*, assorted colored pencils |
| 4 | 10 min | **REVISE EXPLANATION**<br>Revise explanation based on peer feedback. | G-H | *Explaining Water Stories* |
| | | | | *End of day 1* |
| 5 | 6 min | **NAVIGATION AND CELEBRATION**<br>Celebrate progress made on explaining the case sites and navigate to the transfer task. | I | |
| 6 | 3 min | **LOOK BACK AT ALASKA HEADLINE**<br>Look back at the headline from Lesson 1 about Alaska. Determine what we would need to to figure out if the Alaska case site is related to increases in temperature. | J-K | |
| 7 | 17 min | **INTRODUCE AND LISTEN TO ELDER CLAIMS**<br>Introduce the oral account of the Alaskan elder. Watch the video. Record claims and data we need to determine if this change is related to temperature and precipitation changes. | L-M | *Alaskan Elder Claims Transcript* (optional), Alaska Elder Claims video, Claims and Data We Might Need T-chart |
| 8 | 16 min | **INVESTIGATE NEW GRAPHS FROM ALASKA**<br>Read about wildfires and look at new Alaskan graphs in groups. Use *Alaska Graph Notes* to record any connections between the graphs and the claims. | N-O | *Alaska Graph Notes*, *What Causes Wildfires?*, *Alaska Graphs* |
| 9 | 3 min | **COLLECT THE ALASKA GRAPH NOTES HANDOUT**<br>Collect *Alaska Graph Notes*, *What Causes Wildfires?*, and *Alaska Graphs* from students. | | *Alaska Graph Notes*, *What Causes Wildfires?*, *Alaska Graphs* |
| | | | | *End of day 2* |
| 10 | 25 min | **BEGIN ASSESSMENT**<br>Use *Explaining Water Stories* and *Alaska Graph Notes* to complete *Alaska Wildfires and Sea Ice*. | P | *Explaining Water Stories*, *Alaska Graph Notes*, *Alaska Wildfires and Sea Ice*, *What Causes Wildfires?*, *Alaska Graphs* |
| 11 | 5 min | **COLLECT ASSESSMENT AND DISCUSS FUTURE PROJECTIONS**<br>Collect all documents from students. Discuss future projections of the data based on trends. | Q | *Alaska Wildfires and Sea Ice* |
| 12 | 15 min | **REVISIT DRIVING QUESTION BOARD**<br>Look back at the DQB. Brainstorm what may be causing temperatures to rise. | | *DQB Check-in*, initial consensus model (Lesson 1), Earth's Water System Model, DQB, Ideas for Investigation chart |
| | | | | *End of day 3* |

## Lesson 5 • Materials List

| | per student | per group | per class |
|---|---|---|---|
| Lesson materials | • *Initial Water Story Explanation*<br>• *Peer Feedback Instructions*<br>• *Data for All Case Sites*<br>• *Peer Feedback Guidelines*<br>• *Explaining Water Stories*<br>• science notebook<br>• *Alaskan Elder Claims Transcript* (optional)<br>• *Alaska Graph Notes*<br>• *What Causes Wildfires?*<br>• *Alaska Wildfires and Sea Ice* | • *Alaska Graphs*<br>• *DQB Check-in* | • Earth's Water System Model<br>• Model Ideas list<br>• assorted colored pencils<br>• blank paper<br>• Alaska Elder Claims video<br>• Claims and Data We Might Need T-chart<br>• initial consensus model (Lesson 1)<br>• DQB<br>• Ideas for Investigation chart |

## Materials preparation (20 minutes)

Review teacher guide, slides, and teacher references or keys (if applicable).

Make copies of handouts and ensure sufficient copies of student references, readings, and procedures are available.

Have the Earth's Water System Model and Model Ideas list available for students to view.

For day 2:

- Make sure *Alaska Elder Claims* video is playable. It is located at www.teachersopensciedfieldtest.org/droughtsfloods (already cut for classroom use) or access the video directly from YouTube, playing only the clip from 7:48-13:12 (https://www.youtube.com/watch?v=iqAtI4ltl_Y).
- Create a T-chart. Label the left side of the T-chart "Claims" and the right side "Data we might need."

For day 3:

- Prior to day 3, type all questions from the DQB into *DQB Check-in*. Add additional rows as needed to the table.
- Confirm that the Driving Question Board, Earth's Water System Model, and the Ideas for Data and Information We Need chart are all easily accessible by students.

## Lesson 5 • Where We Are Going and NOT Going

### Where We Are Going

Students will first use their Model Ideas list and the entire Earth's Water System Model to write a scientific explanation of one case site introduced in Lesson 2. This task will require a synthesis across ideas and will also challenge students to put their thinking into a written explanation. Students will have an opportunity to review peer explanations, provide feedback, and revise their own.

Additionally, the lesson introduces students to another case site in Alaska. Students will apply these model ideas to this additional site. The additional case site serves as an assessment opportunity and transfer context. It will have students drawing upon ideas developed in Lessons 2-4 but with the addition of a new climate impact: wildfires. Students will use data over the Alaskan headline and elder claims to compare to their scientific explanation of one case site and determine if the events are all connected, even though they have seemingly different phenomena.

### Where We Are NOT Going

Even though wildfires may occur in other case site locations, that data will not be utilized for the assessment. This will allow students to make sense of the data already given in addition to only the Alaskan graphs and charts.

# LEARNING PLAN for LESSON 5

## 1 · NAVIGATION

10 min

MATERIALS: Earth's Water System Model, Model Ideas list

**Frame today's work around developing an explanation for one of the case sites.** Display **slide A**. Share the question we'll be answering today in a written format:

- How are rising temperatures changing water stories in these communities?

**Consider the audience with whom we should communicate.** Display **slide B**. Ask students, *Who might want to know why these communities are experiencing changes in their water stories?* Student ideas might include:

- people who live in the community,
- scientists who study climate,
- people who might be impacted because this community has changed (e.g., farmers can't grow crops so consumers might be impacted), and
- the general public.

Allow students choice in the audience they will target with their explanation.

**Set the purpose for writing.✱** Motivate students to establish the purpose for why they might write something for this audience. Ask students, *What do you think this audience would want to know or better understand about what is happening?*

- Is this normal or not normal for this place?
- What does the data say about how things are changing?
- How or why this is happening in this community?

**Consider the ideas needed to answer this question.** Give students a few minutes of quiet time to review the most important science ideas to answer just this question. As they review this work, ask, *What do we think we can explain right now? What resources do we have that we can use to help us?*

- Earth's Water System Model
- Model Ideas list
- students' individual Progress Trackers

**Share out a few key ideas and evidence to include in the explanation.** Have a few students share out important ideas to include in the explanation.

| Suggested prompts | Sample student responses | Follow-up questions |
|---|---|---|
| *What are some important ideas to include in our explanation?* | *Patterns the data shows.* | *Can you say more about the data and the patterns? Which data? What patterns?* |
| | *Temperature and precipitation, or how wet or dry it is.* | |
| | *What is happening with the snow/groundwater/sea levels.* | *So, it might be helpful to include information about which parts of the water system are impacted? Are they the same for the different sites?* |

### ✱ SUPPORTING STUDENTS IN DEVELOPING AND USING STABILITY AND CHANGE

It might be helpful to explicitly introduce Stability and Change here by saying something like, *It surprised us that a small rise in temperature was related to all of these big changes in precipitation and Earth's whole water system. The audience may find this surprising, too. Why don't we add, "How could a small change in one part of the system have a big impact on the community's water?" to our list. Explaining this may help the audience understand the problem better.*

When students cite evidence from their case site locations, encourage them to include ideas about how as one part of the "normal," or stable, system changes, it impacts other parts of the system.

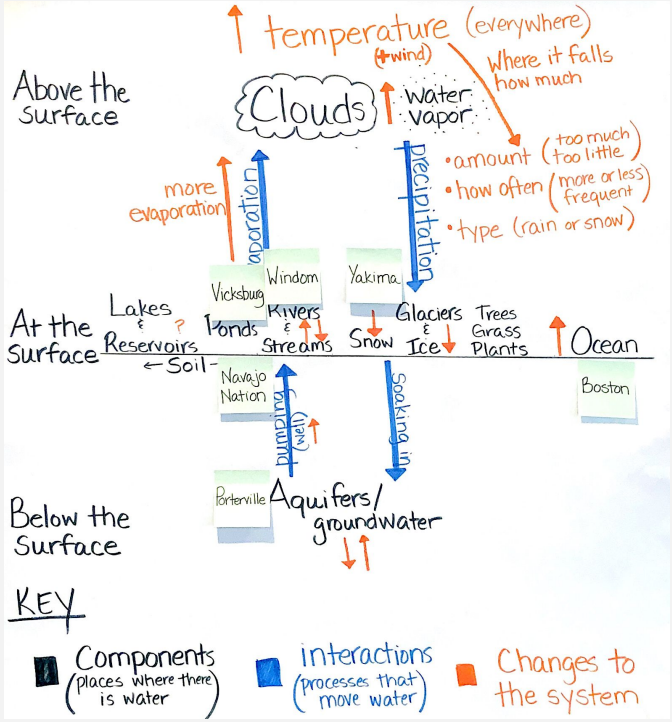
### ✱ ATTENDING TO EQUITY

**Supporting Universal Design for Learning:** Offer students a choice of modalities for communicating their explanations, such as written or oral news stories. Students can also choose to *represent* their ideas in written or pictorial form.

| Suggested prompts | Sample student responses | Follow-up questions |
|---|---|---|
| | *No, they are different.* | |
| *OK, we established that we need to include information about what the data shows. How about ideas about what is causing it to happen?* | *We should include ideas about how warmer temperatures affect evaporation in places.* | |

**Establish options for how to communicate with the audience.** Display **slide C**. Provide students with options they can choose for communicating their explanations.✱ These options are:

- Write a headline for the site and give a news story that includes a scientific explanation of what's happening.
- Create an infographic that communicates how and why water is changing in the community.
- Allow students to suggest additional options and a rationale for why that format is helpful.




## Model Ideas List

- Normal precipitation = long-term trends in total amount, timing, intensity, and type of precipitation.
- Precipitation during individual years may be different from the long-term trend and this is normal.
- Not normal precipitation is a trend toward a change in precipitation that is outside of a typical range for a place.
- Climate is a measure of weather conditions for an area over a long period of time.
- ↑ temperatures = ↑ evaporation rates = ↑ water vapor in atmosphere.
- Wet areas = ↑ evaporation; dry areas = ↓ evaporation.
- ↑ temperature & wind affects where/how much precipitation falls.
- ↑ temperature the type of precipitation that falls.
- Changes to sources of water affect communities in different ways.
- A small change in temperature in the atmosphere has big changes in Earth's water system.

## 2 · CONSTRUCT AN EXPLANATION

15 min

MATERIALS: *Initial Water Story Explanation*, *Peer Feedback Instructions*, *Data for All Case Sites*, assorted colored pencils, blank paper

**Distribute *Initial Water Story Explanation* and *Peer Feedback Instructions*.** Acknowledge that students made important progress toward this explanation through developing their models and model ideas in Lessons 2-4 and that this activity will give them an opportunity to share their thinking by writing and/or drawing their explanation.

Remind students that their role is to use data and their model ideas to create a clear and convincing communication to others to (1) explain how or why something is happening and (2) support the how or why with evidence.✱ Display **slide D**. Students should review the first column of *Peer Feedback Instructions* to see how their peers will review their work.

Tell students they can (1) choose the case site they want to explain, (2) choose their intended audience, and (3) choose their format for communicating their explanation. However, all explanations need to focus on (1) how or why something is happening drawing upon the science ideas and (2) being supported by evidence.

Divide students to work on explanations for their case sites. Ideally students would be assigned to the same location as they did in Lesson 2, since they are familiar with those sites. However, students could explain a different case location if they want a challenge or need an extension opportunity. If students choose pictorial ways of representing their explanations, provide them with colored pencils and blank paper to do so. Give students about 15 minutes to work on their explanations.✱ Encourage students to look back at the data from Lessons 2-4, such as *Data for All Case Sites*.

### ALTERNATE ACTIVITY

**Building Prerequisite Understanding:** If your students need additional support for writing a scientific explanation before they engage in this activity independently, choose one of these two options:

- Option 1: Use column 1 from *Scoring Guidance for Case Site Explanations* and display a draft of an initial explanation for either Porterville or Vicksburg. As a class, practice providing peer feedback on the initial explanation. Then let students work independently on the other five case sites.
- Option 2: Co-construct an explanation for your local community together first. This would allow you to model how to write a good explanation by (1) deciding the main idea (or headline) for your local community's water story, and (2) co-constructing the explanation of your local precipitation and water source patterns supported by data. After co-constructing an explanation for your local community together, have students write an explanation for another case site.

### ✱ SUPPORTING STUDENTS IN ENGAGING IN CONSTRUCTING EXPLAINING AND DESIGNING SOLUTIONS

Students use the class model, model ideas, and Progress Trackers to construct a first draft of an explanation for one case site location. Each case site has a unique explanation. If students get stuck, encourage them to review the models and Progress Trackers since they are helpful sensemaking tools for explaining the phenomenon.

### ✱ ATTENDING TO EQUITY

**Supporting Emerging Multilingual Learners:** To support Emerging Multilingual Learners and/or other students who need additional support with writing in science, consider providing sentence starters. If the whole class needs support, consider posting a list of sentence starters on chart paper for everyone to use. If only some students need support, write sentence starters on strips and put them in an envelope that you can provide to students who would benefit from additional support.

Example sentence starters:

- The sources of water used by this community include...
- The temperature data shows a long-term pattern of...
- The precipitation data shows a long-term pattern of...
- The other data show...
- This means...
- When temperatures rise, evaporation is affected by...
- This community's water story is affected by...

## 3 · PEER REVIEW FEEDBACK

10 min

MATERIALS: *Initial Water Story Explanation*, *Peer Feedback Instructions*, *Peer Feedback Guidelines*, assorted colored pencils

**Discuss the key elements on which to give peer feedback.** Display **slide E**. Review the "Peer feedback" column of *Peer Feedback Instructions*. Review the key elements of the explanation as a class. Share instructions for how to provide feedback:

- Underline places that explain how or why.
- Circle evidence that is used.
- Use colored pencils or pens to mark up peer work and write legibly.
- If students made an infographic or other visual representation, peers can use sticky notes to add comments and suggestions.
- If there is another protocol used in your classroom for providing feedback, substitute that protocol if desired.

**Discuss as a class how to provide useful feedback.** Display **slide F**. Review elements of quality peer feedback on *Peer Feedback Guidelines* in the student edition. Give examples of productive and unproductive feedback.

| Examples of productive feedback | Examples of unproductive feedback |
|---|---|
| "Your explanation said that less snow means less water for the community. I think you should add details about why snow matters to this community and how they use the water source." | "I like your explanation." |
| "Your explanation provides really clear patterns from the data for the community, but it doesn't explain how temperature and precipitation are related, and why that matters for this community." | "I agree with everything you said." |

**Provide peer feedback for the same case site.** Give students 3-4 minutes to provide feedback within the same case site group. These peers analyzed the same data. This will provide students with feedback from a similar perspective.

**Provide peer feedback for a different case site.** Rotate partners. Give students 3-4 minutes to provide feedback on a different case site. These peers analyzed the slightly different data and wrote a different explanation. They can provide feedback from a more neutral perspective.

**ALTERNATE ACTIVITY**

If time is short, complete only one round of peer feedback. Choose a peer from a different case site to provide feedback on a different place.

## 4 · REVISE EXPLANATION

10 min

MATERIALS: *Explaining Water Stories*

**Discuss how to respond to peer feedback.✱** Display **slide G**. Discuss how students take these steps when receiving feedback:

- Read the feedback carefully. Ask someone else to help you understand it, if necessary.
- Decide if you agree or disagree with the feedback and reflect on why you agree or disagree.
- Revise your work to address the feedback.

**Individually draft a revised explanation and reflection on what was revised and why.** Distribute a copy of *Explaining Water Stories* to each student. Give students time to write a new explanation, incorporating their own and the peer feedback.✱

**✱ SUPPORTING STUDENTS IN ENGAGING IN ARGUMENT FROM EVIDENCE**

As an extension, ask students to explain one piece of feedback they used, one piece of feedback they didn't use, and why.

Students receive critiques about their explanations and respond to peer feedback and questions by determining how to add elaboration and detail and revising their explanation accordingly.

**ASSESSMENT OPPORTUNITY**

**Building towards:** 5.A Construct a scientific explanation based on valid and reliable evidence that small changes in temperature can have big impacts on the water sources available for communities.

**What to look/listen for:**

- a "how" explanation that draws upon science ideas and is supported with evidence, including:
  - how temperature, precipitation, and water sources change in the communities,
  - how those changes are connected to one another in Earth's Water System Model, and
  - how changes in one or more components of the system can impact changes in another part of the system.
- Look for evidence that students have revised their explanation, based on peer feedback, by comparing the first draft and the revised explanation and reviewing their reflections on what feedback they used and didn't use.

**What to do:** Have students submit their revised explanation along with the first draft explanation that has their own revisions, as well as peer feedback. If students struggle to include model ideas, cue students to reference the class's Earth's Water System Model and their Progress Trackers. If students struggle to include all of the interactions among parts of the system, encourage them to review the blue and orange parts of the system model. If students struggle to include evidence from investigations, direct them to their science notebooks to remember the evidence that they gathered from Lessons 2, 3, and 4.

Use *Scoring Guidance for Case Site Explanations* to assess students and provide feedback to them on their explanations and revisions.

**ADDITIONAL GUIDANCE**

If time is short, assign home learning to complete the revised explanation. If possible, provide feedback on students' written explanations for their case site prior to day 3 of this lesson. Students will have the opportunity to use these written explanations and your feedback to inform their explanation for the Alaskan case.

**EXIT TICKET**

Take a moment to ask students how confident they feel about writing scientific explanations. Use **slide H** to present the question, *On a scale of 4 (totally independent) to 1 (need lots of help with this), how are you feeling right now about writing a scientific explanation? Briefly explain what makes you feel that way and what help you could use as you develop this practice.* Direct students to respond on the bottom or back of the page where they wrote their scientific explanation. Students will construct another explanation on day 3 of this lesson. Gathering information about students' comfort with the practice now can help you better scaffold their explanations later in this lesson.

## End of day 1

## 5 · NAVIGATION AND CELEBRATION

6 min

MATERIALS: None

Say, *We've made a lot of progress on our case sites! We have been able to explain why these changes in precipitation have been occurring and created headlines and explanations to help others understand what is happening in those locations. Let's consider what we have learned so far.*

**Turn and talk about progress on our ideas.** Project **slide I**. Ask students to turn and talk about the following questions:

- How has your understanding of the problems of droughts and floods changed?
- What are some big takeaways for you so far in our study of this problem?

Give students 2 minutes to discuss their ideas with a partner. After that time, ask students to share what their partners have said in regard to the questions. Below are some anticipated responses:

- There are normal short-term fluctuations in precipitation, but long-term there is a (decrease) or (increase) in extreme precipitation events. Long-term data shows that rising temperatures are changing how much and where we have freshwater on Earth.
- The rise in temperature is causing changes in the water cycle. It is causing more precipitation in some areas and less in others.
- Changing temperatures cause changing precipitation patterns.
- Changes in temperature affect many aspects of the water cycle, which varies in impact depending on where you are.
- These seem like different "events" that happen at random, but they are all really connected to each other. Even if one community is experiencing one kind of water problem, it is connected to the problems happening in other communities, and all caused by rising temperatures.

## 6 · LOOK BACK AT ALASKA HEADLINE

3 min

MATERIALS: None

**Revisit Alaska headline.** Project **slide J**. Say, *We have seen patterns with increasing temperatures and precipitation in the continental United States. But, if we think back to our headlines, we did have a headline in Alaska. This headline was focused around wildfires. Do you think this headline could also be related to what we have figured out about the other case sites?*

Give students a moment to read the headline and allow students to respond. Below are some anticipated student responses:

- It could be related to increasing temperatures because it mentions a heat wave.
- Wildfires might be related to the droughts because it says "dry," but we aren't sure.
- Alaska is normally cold, but wildfires up there don't make sense. It could possibly be related to the increase in temperature.

Project **slide K**. Say, *It sounds like these could be related, but we may need additional data to figure out if it is related to our increasing temperatures*.

Ask students to turn and talk to a partner about the following question:

- What data would we need to determine if the changes in Alaska are due to temperature increases and precipitation changes?

Students should respond that temperature data, precipitation data, and wildfire data would be needed to figure out if these changes are related. Students might also mention that we need to know more about what causes wildfires. Say, *OK, so it sounds like we need to look at data from Alaska to determine what is going on. Interestingly though, this is not the only change that is being reported in Alaska. Our headline is from the southern part of Alaska. Very different changes are being reported in the northern part of Alaska.*

| | |
|---|---|
| **ADDITIONAL GUIDANCE** | If your students were curious about wildfires in Lesson 1 and added questions to the DQB and ideas to the Ideas for Investigation chart, make sure to resurface those questions and ideas. Have students share their question again and the data or information they wanted to gather to learn more about the problem. |

## 7 · INTRODUCE AND LISTEN TO ELDER CLAIMS

17 min

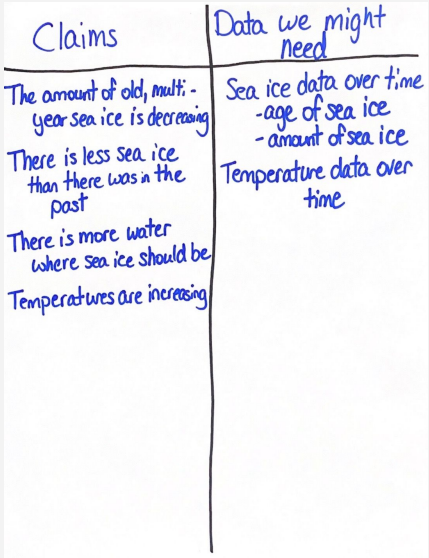
MATERIALS: science notebook, *Alaskan Elder Claims Transcript* (optional), Alaska Elder Claims video, Claims and Data We Might Need T-chart

**Introduce the Alaskan oral account.** Say, *Over the years, Alaskan elders from the northern part of Alaska have been recording their stories orally and passing them down from generation to generation. They have seen changes over the years that may or may not be connected to wildfires, precipitation changes, and increasing temperatures. Instruments have not always collected data in Alaska, but the elders' stories are an important historical record to help us understand what is normal and what is changing there. Because these communities rely on the environment for their way of life, their accounts of what is occurring are very much in tune with what is going on around them.*

Explain to students that we have an oral account of the changes that are occuring in the northern part of Alaska. Tell students that we will have a chance to hear an account of these changes from an Alaskan elder. Remind students that this is an oral account, and since this account is not written, we will need to record the claims as they are told to us.

**Create a Claims and Data We Might Need chart.** Project **slide L**. Direct students to create a Claims and Data We Might Need T-chart in their notebooks to record the claims they hear and any data they believe we would need to look at in order to figure out if these changes are related to the increase in temperatures and changing precipitation.

**Watch the Alaskan video.** Play the *Alaskan Elder Claims* video at www.teachersopensciedfieldtest.org/droughtsfloods or directly from the YouTube link, clip from 7:48-13:12. Remind students before pressing play to record their claims as the video is playing and think of any data we might need to figure out if that claim is related to increasing temperatures and precipitation changes. If needed, a transcript of this video for students is located in *Alaskan Elder Claims Transcript*.✱




At the conclusion of the video, give students 2 minutes to finish writing their ideas for data we might need. Allow students to share their ideas with a partner before going public. Students should share the following claims from the video:

- The amount of old, multi-year sea ice is decreasing.
- There is less sea ice than there was in the past.
- There is more water where the sea ice should be.
- Temperatures are increasing.

Write these on the class chart.

After identifying the claims made in the video, ask students what data might be needed to investigate these claims. Students should bring up the following data:

- Data for the age of sea ice over time.
- Data for the amount of sea ice over time.
- Data for temperature over time.

Add data to the class chart. If students do not identify precipitation and temperature data, ask them what they think might be causing these changes in sea ice, and what we would need to compare the sea ice data to.

Say, *Do we think these changes are also related to the claims made by our headline?* Allow students to respond. Accept all responses.

Project **slide M**. Have students turn and talk to a partner about the following questions:

- What were the claims from the headline that we can add to our chart?

### ✱ ATTENDING TO EQUITY

**Universal Design for Learning:** Some students may struggle with listening to the video and recording ideas in their notebooks at the same time. You can support *representation* and perception of the information by adjusting the timing of the video. Pause the video every minute or two and give students time to write. This will allow those students to fully listen while the video is playing and write while the video is paused. A transcript is provided as an alternative to the auditory information and can be located in *Alaskan Elder Claims Transcript*.

- What data would we need to look at to determine if these changes are also related to the headline?

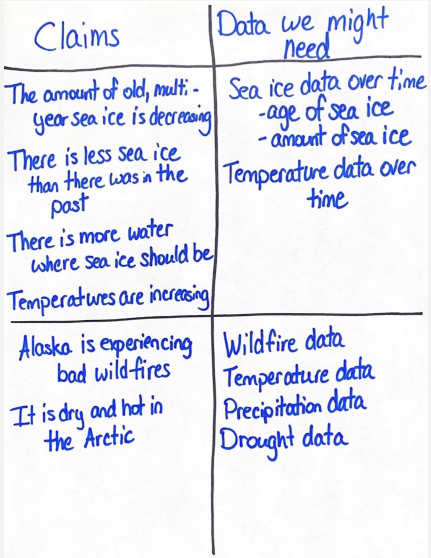
Draw a line under the claims and data from the video and then add the claims and data from the headline. Allow students to share their claims and data they might need with the class. Students should identify the following claims to add to the class chart:

- Alaska is experiencing bad wildfires.
- It is dry and hot in the arctic.

The following data we might need should be identified:

- Data over wildfires
- Temperature data
- Precipitation data
- Drought data

Say, *We have some great ideas for data we think could be helpful, and I think I have most of this data you want to look at. Let's spend some time looking at the data I have in groups and see what it can help us explain about the changes in Alaska.*




## 8 · INVESTIGATE NEW GRAPHS FROM ALASKA

16 min

MATERIALS: *Alaska Graph Notes*, *What Causes Wildfires?*, *Alaska Graphs*

**Go over Alaskan graphs and wildfire handout.** Project **slide N**. Point out the two different handout examples on **slide N**. Explain to students that they will get a chance to read about wildfires and look at the Alaskan graphs of data in groups. Tell students that each student will get a handout over wildfires, and each group will receive one set of graphs. Encourage students to mark up any of the graphs as needed. Explain that students will be given the Alaskan graphs after their group has finished going over the wildfire handout together.

**Explain *Alaska Graph Notes***Project **slide O**. Direct students to look at the individual recording page example on the slide. Explain to students that they will each get a sheet to record any connections between the graphs and the claims to see if we can understand why the changes are happening and if the headline claims and elder claims are related. Go over each column and explain what should go in each space.

**Encourage collaboration on the explanation of claims.** Tell students that today is a good opportunity to discuss their ideas with their partners about what they think is occurring in Alaska and if these changes are related to each other and related to changes in temperatures and precipitation. Let students know that tomorrow they will be given an assessment where they have to explain these changes and relate them to their case site.

**Begin group task.** Distribute a copy of *Alaska Graph Notes* and *What Causes Wildfires?* to each student. After students have completed the row on wildfires, distribute *Alaska Graphs* to each group. Give students until the end of the class period to investigate the graphs.

As students work on their graph analysis, make sure to circulate to each group. Encourage students to work together to record their ideas on their charts. Remind them that their notes on the charts that they make today can be used as a tool on their assessment next class period to help determine if these claims are related and if these claims are also related to their individual case site from day 1.

## 9 · COLLECT THE ALASKA GRAPH NOTES HANDOUT

3 min

MATERIALS: *Alaska Graph Notes*, *What Causes Wildfires?*, *Alaska Graphs*

**Collect handouts.** As the class period is ending, collect *Alaska Graph Notes*, *What Causes Wildfires?*, and *Alaska Graphs* from students. Review *Alaska Graph Notes* before the next class period to check student understanding before the individual assessment and to provide individualized feedback to students.

**ASSESSMENT OPPORTUNITY**

**Building towards:** 5.B Compare graphs and charts depicting a changing climate in Alaska looking for similarities and differences to determine that trend lines and patterns across Alaskan claims are caused by increasing temperatures.

**What to look for/listen for:**

- Increasing wildfires can be partially attributed to the decrease in precipitation.
- The increase in temperatures contributes to the increase in wildfires, changes in precipitation, and decreases in sea ice age and amount.
- The drier than normal conditions in Alaska contribute to wildfires increasing and can be explained by decreasing precipitation.
- The two sets of claims are related. The changes seen in the environment are all caused by increasing temperatures.

**What to do:**

- This handout is meant as a formative assessment before *Alaska Wildfires and Sea Ice*.
- If students are not making the connections above, touch base with the student(s) at the beginning of the next class period. Ask students if any of the graphs are related and then how those graphs would also be related to any of the data from the other claims.
- Focus on the temperature graph as a causal mechanism, and ask students if the increase in temperatures would contribute to any of the other changing graphs and how the increase in temperatures would cause those changes to occur.
- Alternatively, another strategy would be to cut out each graph and lay them next to each other in a partnering fashion. Ask students if the graphs are similar or share a trend line or relationship. This can help students see patterns of change across multiple graphs.

**ALTERNATE ACTIVITY**

Graphs can be posted in an online format for students to access and review between class sessions, or copies can be given to students who want to look at the data more before their assessment on day 3.

If students would like more time to complete *Alaska Graph Notes*, students can take *Alaska Graph Notes* home to work on the data analysis. If students have taken *Alaska Graph Notes* home and there isn't time to do a full formative check and provide teacher feedback on the work they completed at home, ask students to place *Alaska Graph Notes* on their desks as they enter class, and as *Alaska Wildfires and Sea Ice* is distributed. Conduct a quick check of ideas by looking at the student responses on the last question. If students still identify that the claims are all connected, there is likely a connection made between graphs on the first section of *Alaska Graph Notes*. After students begin to read and complete *Alaska Wildfires and Sea Ice*, a more thorough check can be done by going from student to student to look at *Alaska Graph Notes*.

Alternatively, additional time could be given on day 3 for students to work together in groups to finish the graph analysis if needed before they begin the assessment. A quick check-in with each group to note what is documented on their charts and listening to student ideas can give a good glimpse into student ideas before the assessment begins.

## End of day 2

## 10 · BEGIN ASSESSMENT

25 min

MATERIALS: *Explaining Water Stories*, *Alaska Graph Notes*, *Alaska Wildfires and Sea Ice*, *What Causes Wildfires?*, *Alaska Graphs*

As students return to class, pass back *Explaining Water Stories* and *Alaska Graph Notes* to students with your feedback. After all students have the materials, pass out *Alaska Wildfires and Sea Ice*. Explain to students that we will work for half of a class period to complete this assessment.

**Go over part 1 of the assessment.** Project **slide P**. Walk through the assessment with students. Point out that part 1 of the assessment is asking students to explain any potential connections between the data and claims from our last class period. Direct students to use their notes from *Alaska Graph Notes* to help, and let them know that there are class copies of *What Causes Wildfires?* and *Alaska Graphs* available if they would like to re-analyze any of the graphs and information.

**Go over part 2 of the assessment.** Explain that part 2 of the assessment is focused on explaining how the increasing wildfires and the decreasing sea ice might be related. Tell students that *Explaining Water Stories* was returned to them so that their explanations are available for their use during this assessment, as well as any feedback you were able to provide on their explanations. Remind students that on part 2 they can use the class's Model Idea list, Earth's Water System Model, and any of their notes from their Progress Tracker.

**Conduct assessment.** Allow students 25 minutes to finish the assessment.

**ADDITIONAL GUIDANCE**

*Alaska Wildfires and Sea Ice* was written to occur on a separate day from the completion of *Alaska Graph Notes* for formative assessment purposes. If the *Alaska Wildfires and Sea Ice* is conducted on the same day as *Alaska Graph Notes*, the language referencing "last class period" on *Alaska Wildfires and Sea Ice* would need to be changed to "earlier in the class period," and so forth.

**ALTERNATE ACTIVITY**

**Universal Design for Learning:** During *Alaska Wildfires and Sea Ice*, some students may benefit from having graphs from the Alaskan claims to help write their explanations. For some students, providing a visual *representation* of the data from the Alaskan claims can be helpful for students to comprehend the similarities and differences in the graphs. To do this, distribute copies of *What Causes Wildfires?* to students as they complete part 2 of *Alaska Wildfires and Sea Ice*.

**ASSESSMENT OPPORTUNITY**

**Building towards:** 5.C Compare graphs and charts from multiple claims to identify patterns in the similarities and differences to determine that changes in the environments are caused by increasing temperatures.

**What to look/listen for:** See *Alaska Wildfires and Sea Ice Key* for information regarding assessment guidance.

**What to do:**
To revisit part 1:

- Review the claims and graphs from *Alaska Graph Notes*, *What Causes Wildfires?*, and *Alaska Graphs*. Ask students what connections might be seen among the graphs and wildfire information.
- Focus on the temperature graph that shows an increase in temperature. Compare graphs from both the headline claims and the elder claims to the temperature graphs for any similarities or patterns that may be present.
- Ask students if these patterns are present across all graphs, or if all the claims might have a similar cause.

To revisit part 2:

- Direct students to the graphs. Ask if any of the graphs have anything in common, and how they are different.
- Cut out the graphs and place different graphs next to each other. Ask students if one graph is related to another graph, and how they may be related.
- Help students compare the temperature and precipitation data for the case site and Alaska, and then look for similar graphs that might share the same trend lines.
- Look at the graphs that have opposite trend line directions from the temperature graphs and determine if there is a connection between increasing temperatures and the trend lines on other graphs.
- Ask students if one of the graphs could cause a change in another graph.

## 11 · COLLECT ASSESSMENT AND DISCUSS FUTURE PROJECTIONS

5 min

MATERIALS: *Alaska Wildfires and Sea Ice*

**Collect assessment.** Project **slide Q**. Collect *Alaska Wildfires and Sea Ice* and all other materials from students. As the papers are being collected, ask students to turn and talk about the questions on the slide that correspond with the last question on the assessment:

- What trends did we notice on our graphs?
- Do you think this trend in data will continue to head in the same direction in the future?

After a couple of minutes of sharing with partners, bring the class back together. Discuss the questions and trends as a class, and speculate as to what might be causing these trends.

| Suggested prompts | Sample student responses |
|---|---|
| *We looked at a lot of different graphs from Alaska and from our individual case sites. What trends did we notice on our graphs?* | • *Some graphs showed increasing or decreasing precipitation.*<br>• *There were also graphs from some sites that showed an increase in flooding, where other sites had an increase in drought.*<br>• *One graph showed an increase in wildfires in Alaska. One graph showed a decrease in Alaskan sea ice amount and another in sea ice age.*<br>• *All of the graphs showed an increase in temperatures.*<br>• *Accept all other relevant responses.* |
| *So, you're saying that the graphs showed an increase in temperatures across all case sites?* | *Yes.* |
| *Why do you think this increase in temperatures is happening?* | • *We saw some things like climate change in our headlines.*<br>• *I think it's because we are polluting.*<br>• *Maybe it's because of fossil fuels.*<br>• *Accept all other relevant responses.* |
| *Interesting. Do you think this trend will continue to happen in the future?* | • *Maybe. It seems to be going in one direction, but maybe at some point, it has to turn back down.*<br>• *If it's because of fossil fuels and pollution, it may depend on what we do with fossil fuels and pollution.* |
| *Does that also mean that the trends in precipitation data may also continue to change?* | • *It may continue to change if the temperature keeps changing.* |

**Add "climate change" to the Word Wall.** Say, *It sounds like we may expect this trend for warmer temperatures to continue in the future, and the precipitation trends may also continue. When we see long-term precipitation and temperature trends changing for a place, we have a name for this trend. It's called* climate change. Remind students that climate is the long-term weather patterns for a place, often measured by temperature and precipitation (from Lesson 2), so climate change is similar to a change in those long-term patterns. Add "climate change" to the Word Wall (example definition: a change in the average conditions—such as temperature and precipitation—in a place over a long period of time).

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|---|---|
| **ADDITIONAL GUIDANCE** | Definitions for climate change often include human activities as the cause. For now, do not include human activities on the definition as students will explore this concept more in the next lesson set. |

## 12 · REVISIT DRIVING QUESTION BOARD

15 min

MATERIALS: *DQB Check-in*, initial consensus model (Lesson 1), Earth's Water System Model, DQB, Ideas for Investigation chart

Say, *Before we dive into figuring out what might be causing these long-term changes in climate, let's look back and see if we have answered any of our questions!*

**Complete a DQB check-in.** Distribute a copy of the *DQB Check-in* to students with student questions added. Instruct students to work with a partner to determine which questions they have fully answered, partially answered, and not answered yet by placing a checkmark in the appropriate column. Give students roughly 8 minutes to complete this activity.

**Discuss answered questions with students.** Bring students back together focusing on the Driving Question Board. Ask students to share what questions they believe we have made progress on or have answered. As students share, confirm that the rest of the class agrees that progress has been made. If the class agrees, add a small checkmark to the bottom corner of the sticky note or move the sticky note to an area of the board that can be designated for "answered questions."

After students have had a chance to share what questions we have made progress on, shift the focus of the classroom to the initial consensus model from Lesson 1 and the Earth's Water System Model.

Say, *We have figured out a lot about one part of our initial model—we can now explain how rising temperatures relate to droughts and floods using our Earth's Water System Model. But it seems that we still have questions about what is causing the temperatures to increase. I remember you all had some really good ideas for what was causing it at the beginning of our unit, and we even recorded a couple of the ideas. Let's review what we added in the beginning that we thought was causing this increase in temperatures.*

**Revisit the consensus model for temperature increase ideas.** Point out this area on the class's initial consensus model and the Earth's Water System Model. Ask students to state what we have already added to the initial consensus model that might be causing these temperatures to go up and if they would like to add anything else. Add any additional ideas students may have.

Say, *We seem to want to dive into what is causing these temperature changes. Do we have any new questions about this area of our model?*

**Add any new questions to the DQB.** Give students a moment to consider any new questions that they have. Give the student a sticky note and allow them to add those questions to our DQB. After new questions have been added to the DQB, ask students, *Do we have any ideas for investigation or data sources that might help us figure out what is causing these temperatures to rise?*

**Add any new ideas for investigations or data we might need** to the Ideas for Investigation chart.

Say, *OK. It seems like we can all agree that the temperatures are causing the changing climate, and we think that the temperature may increase in the future. We are also very curious about why the temperatures are increasing. Let's see if we can dig more into explaining what is causing temperatures to rise using some of the data we think we need to look at next class period."*

| | |
|---|---|
| **ALTERNATE ACTIVITY** | Alternate start to Lesson 6: In pilot studies of the anchor phenomenon and initial models to explain them, most students identified "pollution", "carbon dioxide", and "greenhouse gases" as the cause of temperature change. However, it is possible that students may believe that the Sun is getting warmer or closer to Earth or that the ozone hole is related to warming temperature. If your students identified these as possible warming mechanisms, explore them more using the Extension Opportunity located in *Exploring Possible Causes of Warming*. |

# Additional Lesson 5 Teacher Guidance

## SUPPORTING STUDENTS IN MAKING CONNECTIONS IN ELA

**CCSS.ELA-LITERACY.W.7.1: Write arguments to support claims with clear reasons and relevant evidence.**

- **CCSS.ELA-LITERACY.W.7.1.A: Introduce claim(s), acknowledge alternate or opposing claims, and organize the reasons and evidence logically.**
- **CCSS.ELA-LITERACY.W.7.1.B: Support claim(s) with logical reasoning and relevant evidence, using accurate, credible sources and demonstrating an understanding of the topic or text.**
- **CCSS.ELA-LITERACY.W.7.1.C: Use words, phrases, and clauses to create cohesion and clarify the relationships among claim(s), reasons, and evidence.**

**CCSS.ELA-LITERACY.W.7.2.B: Develop the topic with relevant facts, definitions, concrete details, quotations, or other information and examples.**

When students are recording their first draft and revised explanations, they are writing an explanation, conveying their understanding of key science ideas, and drawing on evidence from investigations. While we are not calling it a "claim," students are developing a how or why account for the phenomenon and backing up that explanation using evidence and reasoning from class investigations.