

Climate Models to Study Sea Level Rise

Companion Lesson to X-STEM All Access Episode “[Do the Climate Rock](#)”

Grade/ Grade Band: High School	Topic: Climate Models for Ice and Sea Level Change	
Brief Lesson Description: Students will develop an understanding of Climate Models by analyzing data on sea ice melting to determine the extent and impact of ice sheet melt and sea level rise using a variety of NASA Resources.		
Performance Expectation(s): NGSS HS-ESS3-5: Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems.		
Specific Learning Outcomes: Students will analyze data to determine the extent and impact of ice sheet melt and sea level rise.		
Narrative / Background Information		
Prior Student Knowledge: <ul style="list-style-type: none"> • Students should be familiar with the water cycle and how changes in one component directly impact other components. • Students should be familiar with the concept of Climate Change and increasing temperatures in our atmosphere. • Students should be familiar with analyzing both image and numeric data. 		
Science & Engineering Practices: <u>Analyzing and Interpreting Data</u> Analyzing data in 9-12 builds on K-8 experiences and progresses to introducing more detailed statistical analysis, the comparison of data sets for consistency, and the use of models to generate and analyze data <ul style="list-style-type: none"> • Analyze data using computational models in order to make valid and reliable scientific claims.(HS-ESS3-5) Connections to Nature of Science <u>Science Knowledge is Based on Empirical Evidence</u> <ul style="list-style-type: none"> • Science arguments are strengthened by multiple lines of evidence supporting a single explanation (HS-ESS3-5) <u>Scientific Investigations Use a Variety of Methods</u> <ul style="list-style-type: none"> • Science investigations use diverse methods and do not always use the same set of procedures to obtain data. (HS-ESS3-5) • New technologies advance scientific knowledge.(HS-ESS3-5) 	Disciplinary Core Ideas: <u>ESS3.D: Global Climate Change</u> <ul style="list-style-type: none"> • Though the magnitudes of human impact are greater than they have ever been, so too are human abilities to model, predict and manage current and future impacts. (HS-ESS3-5) 	Crosscutting Concepts: <u>Stability and Change</u> <ul style="list-style-type: none"> • Change and rates of change can be quantified and modeled over very short or very long periods of time. Some system changes are irreversible. (HS-ESS3-5)

Possible Preconceptions/Misconceptions:

1. Sea level change is caused by melting icebergs. ([Explanation](#))
2. There is no scientific consensus about climate change and the expected acceleration of sea level rise. ([Explanation](#))
3. Evidence must be numeric to be valid.
4. Newer evidence must be “best”.

LESSON PLAN – 5-E Model

ENGAGE: Opening Activity – Access Prior Learning / Stimulate Interest / Generate Questions:

Introduce today’s lesson by explaining that, “Sea Level rising is a topic that has caught the attention of both scientists and the public as the world considers the impacts of climate change. But how does the status of Ice on our planet impact sea levels around the globe? Today we will answer that question using the research that NASA is conducting on this topic.”

Explain to students that we will start our thinking about this topic by watching the timelapse of a glacier over one year in Greenland. As you show <https://climate.nasa.gov/interactives/global-ice-viewer/#/2/21>, have students record their notices and wonderings. (Teacher Tip—have students create a T-chart to record their notices and wonderings in. Have the students watch the timelapse twice—once without recording anything and a second time recording their thinking).

After watching the time lapse, have students share their notices/wonderings with another student. Have them pick which 1-2 they want to share as a full class. As a class, create a list of notices and wonderings based on the timelapse. If students have the same observations, put a check mark next to them on the list to show that many students have the same ideas.

Today we are going to explore how melting ice in glaciers and ice sheets is impacting sea level rise. NASA scientist Josh Willis will share his research with us to help us understand this system.

[Show X-STEM Video: Josh Willis](#)

As students watch the video, have them add more notices/wonderings to their chart. Discuss them using a similar process as before.

EXPLORE: Lesson Description – Materials Needed / Probing or Clarifying Questions:

Set the purpose of the next portion of the lesson for students:

“Today you will become an expert on one type of ice on our planet and how it has changed over the past several decades. We will have four different groups studying the following topics:

[Glaciers](#)

[Greenland/Iceland Ice Sheets](#)

[Arctic Sea Ice](#)

[Antarctic Ice Shelves](#)

Split students into four groups and provide each group the appropriate assignment.

Preview the task with students:

“You will start by using NASA resources to learn about your specific type of ice on Earth. You will first learn how this type of ice is related to climate change and the missions NASA has used to gather data. Next you will collect evidence on how this type of ice has changed. Finally, you will write a scientific argument about how the type has changed and support using evidence from your investigation.”

*Note: If your students are new to scientific investigations, you may want to consider using the [Scientific Explanation tool](#) from the AMNH.

After students have completed their own analysis, you will regroup them into mixed groups that have one member from each of the four different forms of ice. They will share their explanation with the group. Then, as a group, they should create a collaborative explanation to answer the question “How is ice changing on earth?” to share with the class. (Teacher tip: Students can create their group explanation on poster paper/large whiteboards so that it is easy for other students to read/access).

Have students do a [gallery walk](#) to observe other groups' arguments. At each argument, students should use post it notes to provide feedback. They can leave a positive (One thing you did well was...), areas of growth (Next time you could consider...) or clarifying questions (Can you explain....).

As a class, come to a consensus answer to the question. Discuss what evidence used in student explanations was most effective and why.

EXPLAIN: Concepts Explained and Vocabulary Defined:

Set the purpose of the next portion of the lesson for students. “Now that we understand how ice is melting across the globe, our next questions become “How is melting ice related to sea level change?” and “How will rising sea levels from ice melt affect humans?”

To answer this question, students will read the article “[Sea Level Rise Facts and Information](#) from National Geographic.” (Note: Students can access for free with an email).

As students read this article, they should answer the three questions in the [Sea Level Rise Fact and Information Reading Guide](#).

Question 1: How is ice melting tied to the phenomena of sea level rising?”

Question 2: How much has the sea level already risen? What are predictions about how sea levels will rise in the future?

Question 3: How will humans be impacted as sea levels continue to rise?

After reading, students should discuss their answers as a class.

Key points are as follows:

Question 1: How is ice melting tied to the phenomena of sea level rising?”

- As glacier melt increases, the balance between runoff and ocean evaporation is thrown out of balance. This results in higher sea levels.
- As ice sheet melt increases, the same imbalance is seen as above. Seeping meltwater from the glaciers also increases rate as it brings warmer water from below the surface up to the surface. (See animation from X-STEM video [here](#) to reinforce this idea.

Question 2: How much has the sea level already risen? What are predictions about how sea levels will rise in the future?

- Oceans have risen 8 inches since 1880. 3 of those inches have risen in the last 25 years.
- It is projected that the ocean will rise an additional foot by the year 2050. By 2100, estimates suggest there can be up to 30 inches of sea level rise.
- This projection means that we will see more of a rise in the next 30 years than we have in the past century!

Question 3: How will humans be impacted as sea levels continue to rise?

- Many impacts are addressed including:
 - Flooding
 - Habitat destruction
 - Migration
 - Infrastructure damage/destruction

ELABORATE: Applications and Extensions:

Students will now put their practice into action and develop an additional scientific explanation based on data to answer the question “How will sea level rise affect Earth’s Coasts?”

Students should independently complete the activity “[How will Sea Level Rise Impact Coasts?](#)” They will receive initial data from the [NASA Climate Time Machine](#) but then also be asked to research an area.

Differentiation Tip:

For students needing more support with research, here are articles to support students with the independent research on this activity:

[Southeast United States](#)

[Northern Europe](#)

[Amazon Delta](#)

[Southeast Asia](#)

EVALUATE:**Formative Monitoring (Questioning / Discussion):**

Class discussions in the Engage, Explore, and Explain portions of this lesson will allow teachers to determine student understanding of both the content and scientific practice of scientific explanations based on data.

Summative Assessment (Quiz / Project / Report):

The final student argument in the Elaborate portion of this lesson can be used as a summative assessment. If a local student explanation rubric is unavailable, use the [Explanation Rubric from the AMNH Found here](#).

Elaborate Further / Reflect: Enrichment:**Go Deeper with the Data**

Have students compare their arguments and data sets for melting ice on Earth with those found at the [Exploratorium Climate Change](#)

Explorer. Have them compare and contrast what is similar in their own work with that of experts at the exploratorium. Students could then use the data sets provided to improve their own explanations.

Reflect on Personal Connections

Have students complete a journal activity to reflect on how changes in the ice/rising seas might impact their lives in the next 30 years. What opportunities might they lose/gain from this phenomena occurring? How might it affect the lives/economics of their own local area?

SOCIAL EMOTIONAL LEARNING ACTIVITY

CASEL Competency: Self Awareness

In the video, Josh Willis talked about failing at Physics in graduate school set him on his current career path. Today's SEL activity will give students an opportunity to consider how failures in their own lives have helped them to move to where they are today.

1. Ask students to take out a piece of notebook paper.
2. On the paper, have students create a list of mistakes they have made. Tell them these mistakes can be big or small. Give them 2-3 minutes to make the list.
3. Next, have students journal for 2-3 minutes about how these mistakes made them feel at the time they made them.
4. As a class, discuss some of the feelings that they came up with. Common responses might include failure, shame, frustration, anger, etc.
5. Now, ask students to go back to their list of mistakes and write down what they learned from each of them. Again, remind them that the lessons can be big or small. Provide 2-3 minutes for students to jot down their learnings.
6. Now, ask students to crumple up the paper. Ask them what would happen if they threw out all of these items that they had learned. Would they be the same person today? Why or why not?
7. Finally, show the video [Fear of Failure](#) to the class to help them learn how mistakes help their brain grow.
8. After the video, generate a list of how your class can use mistakes to learn. Post and help students refer to these strategies when mistakes occur.

INTERDISCIPLINARY CONNECTIONS/IDEAS

Math: Have students complete a [Data Nugget Lesson on Sea Level Rising](#). Search the site to find one that matches students interests or math topics being covered.

English Language Arts: Communicating about Climate Change is often challenging in a charged political climate. Have students investigate how to talk to people with other opinions using this [lesson from Yale Program on Climate Change Communication](#).

Materials Required for This Lesson/Activity	
Quantity	Description
3	Post It Note Pads
1	Easel Poster Paper



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