Why Is Something That's Happening Out in The Ocean Such a Danger to Us on the Land?

Time	Grade Level	Content Area (s)
60-90 minutes	Community Circle - All Ages	LS, ESS

Overview

Many of you have probably visited a body of water—the ocean, a lake, a pond or a river— but have you ever thought about how changes in those bodies of water could change things happening on land? In today's Community Circle—Why is something happening out in the ocean such a danger to us on the land?—we will figure out some things about the Gulf of Maine, the organisms living there, and how scientists are using information gathered there to better understand the changes occurring in our global climate.

Lesson-level Performance Expectation (Lesson Objective):

Read and use grade-appropriate texts and other media to ask questions and develop a model to figure out how **human activities that happen on land** can **affect the aquatic system** of the Gulf of Maine.

Lesson Summary

1. Participants watch the film *Our Beautiful Planet Sea Change*. Then they discuss their noticings and wonderings.
2. Participant groups also consider how rising ocean temperature is connected to any of the things they are including in their model to explain how rising sea level affects us on the land.
3. Participants reflect on the explanations shared and answer this question: *Why is something happening out in the ocean such a danger to us on the land?*
4. Participants find out what gases make up Earth's atmosphere and identify which of these gases are considered greenhouse gases.

Materials

Per student or pair of students

- Our Beautiful Planet Sea Change
- Chart paper or large whiteboard
- Markers

NSTA Collection of Resources for Today's Daily Do

NSTA has created a Why is something that's happening out in the ocean such a danger to us on the land? collection of resources to support teachers and families using this task. If you're an NSTA member, you can add this collection to your library.

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SCIENCE AND ENGINEERING PRACTICES	DISCIPLINARY CORE IDEAS	CROSSCUTTING CONCEPTS
Asking Questions and Defining Problems Ask questions that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information. **Developing and Using Models** Develop and/or use a model to predict and/or describe phenomena. **Obtaining, Evaluating, and Communicating Information** Read and comprehend grade appropriate complex texts and/or other reliable media to summarize and obtain scientific and technical ideas and describe how they are supported by evidence. (Grades 3-5)	**LS2: Ecosystems: Interactions, Energy, and Dynamics** **LS2.C: Ecosystems Dynamics, Functioning, and Resilience.** Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations. **ESS3: Earth and Human Activity** **ESS3.C: Human Impacts on Earth Systems.** Human activities have significantly altered the biosphere, sometimes damaging or destroying natural habitats and causing the extinction of other species. But changes to Earth's environments can have different impacts (negative and positive) for different living things. **ESS3.D: Global Climate Change.** Human activities, such as the release of greenhouse gases from burning fossil fuels, are major factors in the current rise in Earth's mean surface temperature (global warming). Reducing the level of climate change and reducing human vulnerability to whatever climate changes do occur depend on the understanding of climate science, engineering capabilities, and other kinds of knowledge, such as understanding of human behavior and on applying that knowledge wisely in decisions and activities.	**Cause and Effect** Relationships can be classified as causal or correlational, and correlation does not necessarily imply causation. **Stability and Change** Systems may interact with other systems; they may have sub-systems and be part of larger complex systems.

This lesson could be one in a series of lessons building toward:

MS-LS2-4. Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.

[Clarification Statement: Emphasis is on recognizing patterns in data and making warranted inferences about changes in populations, and on evaluating empirical evidence supporting arguments about changes to ecosystems.]

MS-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

[Clarification Statement: Examples of the design process include examining human environmental impacts, assessing the kinds of solutions that are feasible, and designing and evaluating solutions that could reduce that impact. Examples of human impacts can include water usage (such as the withdrawal of water from streams and aquifers or the construction of dams and levees), land usage (such as urban development, agriculture, or the removal of wetlands), and pollution (such as of the air, water, or land).]

MS-ESS3-5. Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century.

[Clarification Statement: Examples of factors include human activities (such as fossil fuel combustion, cement production, and agricultural activity) and natural processes (such as changes in incoming solar radiation or volcanic activity). Examples of evidence can include tables, graphs, and maps of global and regional temperatures; atmospheric levels of gases, such as carbon dioxide and methane; and the rates of human activities. Emphasis is on the major role that human activities play in causing the rise in global temperatures.]

Safety

NSTA encourages K–12 teachers and school leaders to promote and support the use of science activities in science instruction and work to avoid and reduce injury. Additionally, NSTA recommends teachers and school leaders visit the NSTA Safety Resource page for up-to-date information on safety issues and guidelines.

5. Participants share any new questions that arose while working in their small groups and/or whole-group discussion.
6. Participants shift their thinking from what is happening now to what will happen in the future and plan how they can work together to decrease humans' negative impact on the environment and slow climate change.

S = Students/Participants T = Teachers

Phenomenon

Changes in ocean water temperature affect ecosystems in the ocean and on land.

Experiencing the Phenomenon

Participants get direct experience with a phenomenon that is relevant to them. Participants generate question(s) that are used to drive the lesson.

1. **Tell participants to jot down any observations they find interesting, as well as any questions they have about the information provided in the film.**

   S Share what they notice in the film in small groups.

   T Additional teacher guidance...

   - Younger participants may want to create a notice-and-wonder chart on a sheet of paper to help them organize what they observe in the film and any questions they have.
   - For groups of mixed ages, consider having the younger participants share their ideas first, and make sure to include their ideas when the small groups are invited to share with the whole group.

   Common noticings will likely include these:

   - Sea level is rising.
   - Ocean temperatures are rising.
   - Some aquatic life (like lobsters) is moving to find colder water.
   - Some people depend on aquatic life to make a living.
   - Pollution (carbon dioxide) from factories can cause the ocean temperature to rise.
   - Some (atmospheric) gases have a warming effect on the Earth.
   - The ocean holds heat (thermal energy).
   - The climate in Maine could change.
   - We cannot stop climate change, but we may be able to manage it.

Using Artifacts and/or Discussions to Formatively Assess Student Learning

Many opportunities exist within the lesson to formatively assess student learning. One example is described below.

Artifact/Discussion: Models

Initial Model Look and Listen Fors:

- represents natural and human-produced sources of carbon dioxide in Earth's atmosphere
- human activities which produce carbon dioxide identified
- cause and effect relationships represented [model shows relationship between increased amounts of carbon dioxide and changes to Earth systems].

Revised Model Look and Listen Fors:

- represents relative amounts of natural and human produced sources of carbon dioxide in Earth's atmosphere
- correctly identifies human activities which produce carbon dioxide
- Additions to and/or revised cause and effect relationships represented [model shows relationship between increased amounts of carbon dioxide and changes to Earth systems].

Participants as Scientists

Participants engage in science and engineering practices to develop and/or use science ideas needed to explain how or why the phenomenon occurs.

2. Now that participants have shared their noticings from the film, have them share their questions in small groups.

3. Ask each small group to share two to three questions with the whole group.

   S Share two to three questions with the whole group.

   T Common questions might include these:

   - Can water really affect what is happening on the land?
   - How can gases in the air make the ocean change (get warmer, make the sea level higher)?
   - Does this (increased carbon dioxide and methane in the air) only affect oceans?
   - We don't live by an ocean, so we're okay, right?
   - Does the temperature of the water really matter that much?
   - Why do Maine lobsters have problems with warm water?
   - How could water temperature affect hurricanes?
   - The oceans are really big, so how can one spot be used to help understand what's happening all over the world?

   Additional Guidance

   - Be sure to allow younger participants to share their questions first.
   - As the number of small groups will vary, the number of questions shared is left to the facilitator's discretion.
   - Once all of the questions have been shared, arrange similar questions together and ask the participants' help with labeling the categories of questions that emerge.
   - Assign each group of participants a category of questions to discuss.

4. Provide each group of participants with a piece of chart paper or a large whiteboard and markers.

5. Have groups record ideas and create models to explain or predict the answers to the questions in their category.

6. Ask the groups to consider how rising ocean temperature is connected to any of the things they are including in their model.

7. Encourage participants to also capture new questions that arise.

   S Participants will...

   - Record ideas and create models to explain or predict the answers to the questions in their category.
   - The example below is a model created by a young participant trying to explain how smoke (carbon dioxide) from factories causes lobsters to move north.

   T Additional teacher guidance...

Participant model

   - These models need not be very detailed or offer complete explanations, but do encourage participants to build on the science ideas shared in their group.
   - The overarching goal here is for everyone to notice that living and nonliving things interact with one another in a variety of ways.
   - Participants should also notice that when something changes, it can directly or indirectly affect other living and nonliving things.
   - Point out instances when things that seem unrelated affect one another.
   - In the model above, a young participant uses the word *trapped*.
   - This term is commonly used by people to explain

the phenomenon of climate change: for example, "Greenhouse gases get trapped in the atmosphere, which causes the temperature to increase."

- Using models is a way to evaluate participants' thinking to determine what they know and areas in which they might have incomplete understanding or misconceptions.
- For example, you might also ask participants what they mean by "air gets hot and heats up the water."

8. **Suggest that participants find out what gases make up Earth's atmosphere.**

9. **Ask them, "Which of these gases are considered greenhouse gases?"**

   T When you hear or see participants state that "greenhouse gases get trapped in the atmosphere, which causes the temperature to increase," ask participants, "What do you mean by 'gases get trapped'?"

10. **Tell participants, "According to the film, greenhouse gases (carbon dioxide and methane) have been in Earth's atmosphere for thousands of years."**

11. **Ask, "Why are they a problem now?" (What's changed?)**

    T Additional teacher guidance...

    - If participants can't answer the question, consider showing the film from 2:48 to 3:54, then posing the question again.
    - Listen for participants to share that more greenhouses gases are in the atmosphere today than in the past.

12. **Follow up by asking participants, "Why are increased amounts of greenhouse gases a problem?"**

    T Additional teacher guidance...

    - They will likely respond, "Greenhouse gases trap heat." (thermal energy)
    - Point out the difference between the ideas that greenhouse gases are trapped (inaccurate) and that greenhouse gases trap heat (accurate).
    - Note that heat is used in everyday language to mean thermal energy.
    - Using models is a way to evaluate participants' thinking to determine what they know and areas in which they might have incomplete understanding or misconceptions.
    - For example, you might also ask participants what they mean by "air gets hot and heats up the water."

    S Participants will..

    - Take a gallery walk around the room to observe the models created by other groups.
    - Look for similarities and differences between their models and other groups' models.

13. **Ask them to look for similarities and differences between their models and other groups' models.**

14. **Next, facilitate a whole-group discussion about what they noticed.**

    T These discussions will vary greatly depending on the age and background knowledge of your participants.

    Key takeaways from the discussion should include the following:

    - Changes in ecosystems can happen for many reasons, including rising temperatures. Changes to one aspect of an ecosystem can affect other parts of the ecosystem and even change that ecosystem entirely.
    - People and other organisms depend on one another for many reasons (food, shelter, jobs); if something changes in an ecosystem, it could affect resources people depend on.
        - Rising ocean temperatures cause lobsters to move, affecting both a food source and jobs.
    - Even if we don't live by the Gulf of Maine or any other coastline, what happens there could eventually affect us.
    - Greenhouse gases can also affect other large bodies of water like the Great Lakes, which also provide resources to the people and other organisms living in and around them.

15. **Ask participants if they can now answer the overarching question from the *Sea Change* film: "Why is something happening out in the ocean such a danger to us on the land?"**

    S Support their answers (claims) with evidence provided in the film, the group models, and their experiences with related phenomena.

T Claims

- If rising temperatures cause the sea level to rise, then the people living on the coast would need to find somewhere else to live. Even though I don't live by the ocean, it could affect me because lots of people might move to my town.
- Oceans cover a lot of the Earth, and they are all connected. If all the oceans are rising, then they are going to cover up a lot more land and cause huge floods all over the Earth.
- The film says the Gulf of Maine could be 7 degrees F warmer in 2100 than it is today. That can change the climate on land, which means the seasons could all be different.

Reflecting on the Phenomena

What have we figured out? What new questions do we have? Where do we go next?

16. **Revisit the questions participants asked after watching the Sea Change film and ask them to identify the questions they can now answer.**

17. **Next, ask participants to share any new questions that arose while working together in their small groups and/or during the whole-group discussion.**

S Share any new questions that arose while working together in their small groups and/or during the whole-group discussion.

New questions may include these:

- How can we keep ocean temperature from rising more?
- Can we do something to make the ocean temperature decrease?
- Why can't lobsters live in warm water?
- Can we stop the gases (carbon dioxide and methane) from getting in the air?
- Don't cows make methane? If we got rid of cows, could that help keep ocean temperature from rising?

T Questions will vary depending on the age and background knowledge of the participants, but school-aged participants will likely have many additional questions about how rising sea level could directly affect them and how they can keep this from happening.

18. **Remind participants that Earth's climate has changed a lot over time.**

19. **Ask participants, "What are some things we can do to slow climate change?"**

S Share ideas for things we can do to slow climate change.

T Additional teacher guidance...

- While we can't control some things that contribute to climate change (volcanic eruptions, Earth's orbital changes, solar variations), we can do some things to decrease the effects.
- Allow the younger participants to share their ideas first.
- You may also consider working together to develop an action plan.

Below are some resources that share ideas for changes you can make to help mitigate the effect of climate change.

- How You Can Stop Global Warming
- How Can Kids Help Prevent Global Warming?
- NASA: Climate Kids—What Can We Do to Help?
- The Nature Conservancy—What Is a Carbon Footprint?

About the *Our Beautiful Planet* Film Series

This lesson is based on information provided in *Our Beautiful Planet Sea Change*. *Our Beautiful Planet* is a fascinating new series highlighting the work that climate scientists around the country are doing to solve some of the world's most pressing issues. These dedicated scientists are seeking to better understand and plan for the realities of our changing climate. Using cutting edge technology and innovative problem solving, their answers are sometimes found in rather surprising and unexpected places. Our series brings the viewer along for the ride to some of the most important field work being done today, taking the science out of the classroom and into the world. These compelling stories will not only teach our viewers crucial scientific principles, but will also inspire them to use science to examine the issues their own communities face in this changing world and climate. Through these films, we hope scientists and citizens alike can come together to safeguard our environment and to protect our beautiful planet. Productions by Kikim Media. Support provided by Kennebunkport Climate Initiative.

KIKIM MEDIA

KENNEBUNKPORT
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Meet the Scientist from *Our Beautiful Planet*

Charles Tilburg

Charles Tilburg is the director of the School of Marine and Environmental Programs, director of the Arthur P. Girard Marine Science Center, and a professor of marine sciences at the University of New England. He received a bachelor of science degree in aerospace engineering and a master of science in environmental engineering from the University of Texas and a PhD in oceanography from Florida State University. He has 20 years of research and teaching experience in physical oceanography, numerical modeling, and biophysical coupling of marine systems. He has authored more than 40 peer-reviewed publications and received more than $3 million in research funding. Tilburg taught in the marine science departments of the University of Georgia and the University of New England before becoming director of the School of Marine Programs.

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