

Global Warming: Sea Level Rise

Resident Scientist: Stacy Curry

Date:

Subject / grade level: Earth Science (Grade 9)

Materials:

- food storage boxes (approximately 6 inches square) per group
- modeling clay per group
- 1 ruler per group
- 1 tray of ice cubes per group
- 4-5 intensely colored ice cubes per group
- 1 1/2 liter of water per group
- Sea Level Rise Worksheets
- salt

NC SCOS Essential Standards and Clarifying Objectives

EEn.2.6 Analyze patterns of global climate change over time.

- EEn.2.6.3 Analyze the impacts that human activities have on global climate change (such as burning hydrocarbons, greenhouse effect, and deforestation).
- EEn.2.6.4 Attribute changes in Earth systems to global climate change (temperature change, changes in pH of ocean, sea level changes, etc.).

Lesson objective(s):

In this lesson, students will

1. Learn that ice formations locations dictate the amount of rise in sea level
2. learn that ice is less dense than water.
3. learn that ice displaces water equal to the mass of the ice.
4. practice some of the steps involved in a science investigation.

In this activity, students will learn which masses of ice pose the biggest threat for rising global sea level and why.

Differentiation strategies to meet diverse learner needs:

- Instead of writing out observations, some students do better by drawing their observations and then verbally communicating their results

ENGAGEMENT

- Describe how the teacher will capture students' interest.
 - Two sets of approaches:
 - Start by talking about polar bears? Where do they live? What do they eat? What would happen if their environment got warmer?
 - Is there something here?
- What kind of questions should the students ask themselves after the engagement?
 - Have a discussion about global climate change and its impact on sea level rise. Ask students where there is a lot of ice in the world. Is the ice on land or on water? Does it matter whether the ice is on land or water? Will one or both cause sea level to rise when they melt?

EXPLORATION

Global Warming: Sea Level Rise

- Describe what hands-on/minds-on activities students will be doing.
- This activity will take one class block approximately 1 hour (after settling in and bellwork)
 - Group 1
 1. Place half of the clay into one side of each box. Form the clay to represent land rising out of the ocean. In one box, form a level place at the highest part as shown below. Make rivers on the land if you like.
 2. Place as many ice cubes as possible on the level place formed with the clay in the first box.
 3. Place the same number of ice cubes next to the clay in the second box, so that they are resting on the bottom of the container.
 4. Pour water into the container where the ice is resting on the bottom until the ice floats. Be sure the ice is floating, not resting on the bottom. If this occurs, add more water.
 5. Pour water into the second container with the ice resting on the clay (be careful not to disturb the ice cubes) until the water levels in the two containers are approximately equal.
 6. On their Sea Level Rise Worksheets, have students record initial measurements of water height (in mm) using a ruler. For visual impression you may wish to draw a line in the clay where the water height begins for each container.
 7. Add "inhabitants to your land!!!
 8. Leave the setup. If possible, have students take measurements every hour and record the results on their worksheets. You can also leave the setup for several hours or overnight and just record the final measurement after the ice has melted.
 9. Have students measure new water heights and make observations about what occurred once the ice melted. Make sure students enter their measurements on their worksheets.
 10. Have students include the answers to the following questions in their conclusions on the worksheet.
 11. In which "situation" did the water level rise more?
 12. How do the results compare with your predictions?
 13. Why do you think this happened?
 - Group 2
 1. Place half of the clay into one side of each box. Form the clay to represent land rising out of the ocean. In one box, form a level place at the highest part as shown below. Make rivers on the land if you like.
 2. Place as many ice cubes as possible on the level place formed with the clay in the box.
 3. Pour water into the container with the ice resting on the clay (be careful not to disturb the ice cubes).
 4. On their Sea Level Rise Worksheets, record initial measurements of water height (in mm) using a ruler for your floating ice box. For visual impression you may wish to draw a line in the clay where the water height begins for each container.
 5. Add "inhabitants to your land!!!
 6. Leave the setup. Name your land something creative!
 7. In which "situation" did the water level rise more?
 8. How do the results compare with your predictions?
 9. Why do you think this happened?
 - Group 3
 1. Place half of the clay into one side of each box. Form the clay to represent land rising out of the ocean. In one box, form a level place at the highest part as shown below. Make rivers on the land if you like.
 2. Place the ice cubes next to the clay in the box, so that they are resting on the bottom of the container. Use the colored ice in place of regular ice, and build your "landlocked ice" box

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3. Add salt to the water that will be poured into the boxes in a ratio of 3 tablespoons of salt to 1 liter of refrigerated water. This makes your water approximately the same salinity as the ocean.
 4. Pour water into the container where the ice is resting on the bottom until the ice floats. Be sure the ice is floating, not resting on the bottom. If this occurs, add more water.
 5. On their Sea Level Rise Worksheets, record initial measurements of water height (in mm) using a ruler for your floating ice box. For visual impression you may wish to draw a line in the clay where the water height begins for each container.
 6. Add "inhabitants to your land!!!
 7. Leave the setup. Name your land something creative!
 8. In which "situation" did the water level rise more?
 9. How do the results compare with your predictions?
 10. Why do you think this happened?
- List "big idea" conceptual questions the teacher will use to encourage and/or focus students' exploration
 - Guide students through the development of a question about the melting of ice and sea level rise. Which type of melting will cause a greater increase in sea level? How will each type of melting affect populations? How does the addition of the salt variable change the water density and how would that affect marine life?

EXPLANATION

- Student explanations should precede introduction of terms or explanations by the teacher. What questions or techniques will the teacher use to help students connect their exploration to the concept under examination?
 - Have a discussion about global climate change and its impact on sea level rise. Ask students where there is a lot of ice in the world. Is the ice on land or on water? Does it matter whether the ice is on land or water? Will one or both cause sea level to rise when they melt?
- List higher order thinking questions that teachers will use to solicit *student* explanations and help them to justify their explanations.
 - How will each type of melting affect populations? How does the addition of the salt variable change the water density and how would that affect marine life?

ELABORATION

- Describe how students will develop a more sophisticated understanding of the concept.
 - Have a discussion about global climate change and its impact on sea level rise. Ask students where there is a lot of ice in the world. Is the ice on land or on water? Does it matter whether the ice is on land or water? Will one or both cause sea level to rise when they melt?
 - How will each type of melting affect populations? How does the addition of the salt variable change the water density and how would that affect marine life?
- What vocabulary will be introduced and how will it connect to students' observations?
 - **global climate change**: the alteration of average global temperature, rainfall, and wind patterns as a result of increased atmospheric greenhouse gases
 - **greenhouse gases**: gases in Earth's atmosphere that absorb and reradiate heat near the surface of the planet
 - **density**: a measurement of compactness. For solids, this is usually measured as mass per unit volume. For substances dissolved in water, this is usually measured as parts per thousand or million.
 - **displacement**: the forced relocation of water due to a submerged or partially submerged object occupying fluid space
- How is this knowledge applied in our daily lives?

Global Warming: Sea Level Rise

Ice already in the oceans does not contribute to sea level rise, but ice covering land will contribute to sea level rise upon melting. Greenland, for example, is covered by vast quantities of continental ice. The melting of this ice will contribute to sea level rise. The sea ice in the area of the North Pole is floating in water and thus the melting of this ice will not contribute to sea level rise.

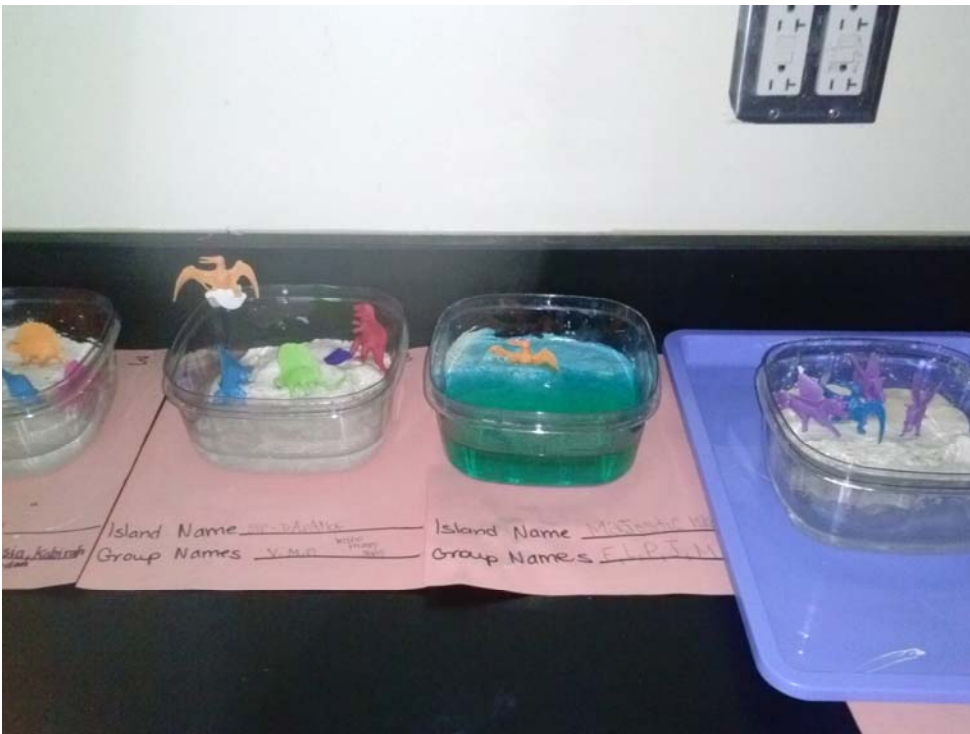
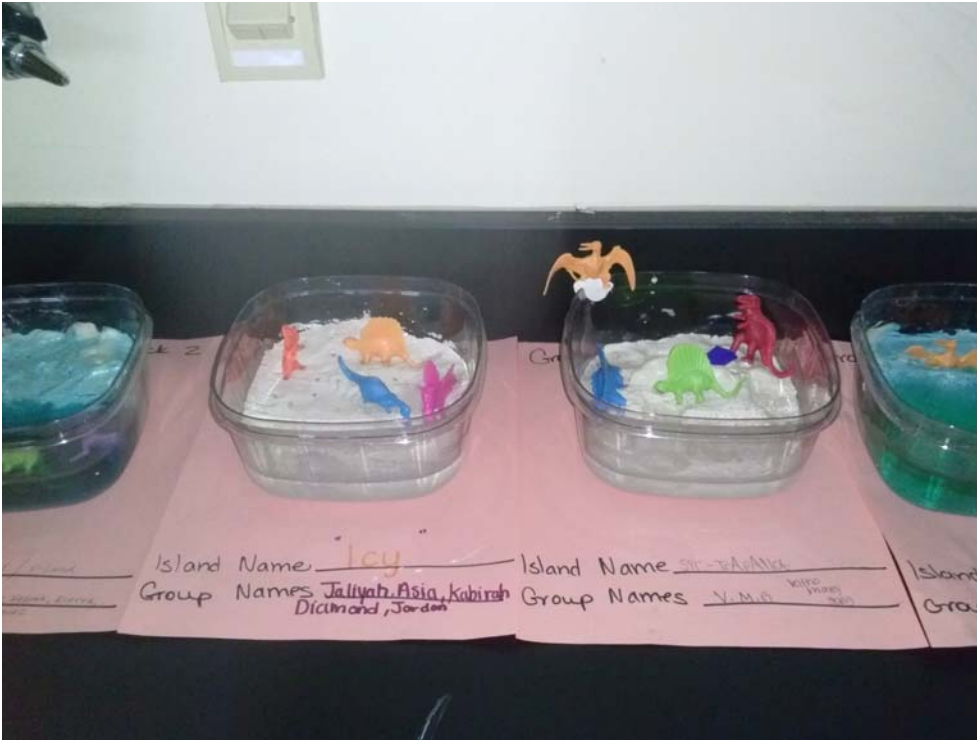
Although many of the icy areas that could melt with climate change are far away from the North Carolina Coast, this issue is extremely relevant locally due to the proximity of the coastline and implication resulting from sea level rising on our state.

EVALUATION

- How will students demonstrate that they have achieved the lesson objective?
 - They will be evaluated on the answers to the worksheet, participation in discussion, and follow-up quiz on Global Warming
- This should be embedded throughout the lesson as well as at the end of the lesson
 - Have another discussion about global climate change. Why might we be concerned about sea level rise? (Coastal areas will be flooded. People will lose their homes. Some fresh water resources will become too salty to use. Habitat loss will occur.) What can we do to help slow this process by using less fossil fuel? (Take public transit instead of driving, eat local foods, turn off lights and electrical equipment when not in use, plant a tree, reduce, reuse and recycle.)

Global Warming: Sea Level Rise

Lab Photos



Global Warming: Sea Level Rise



Climate Change: Sea Level Rise Lab Activity

Part 1

Group 1: Floating Ice (Sea Ice)

In this activity, students will learn which masses of ice pose the biggest threat for rising global sea level and why.

Materials:

- Clear food storage box
- Clay
- 1 ruler
- 1 tray of ice cubes
- 1 liter of water
- "inhabitants"
- Observation Worksheet (1 per student in the group)

Vocabulary

- global climate change: the alteration of average global temperature, rainfall, and wind patterns as a result of increased atmospheric greenhouse gases
- greenhouse gases: gases in Earth's atmosphere that absorb and reradiate heat near the surface of the planet
- Density: a measurement of compactness. For solids, this is usually measured as mass per unit volume. For substances dissolved in water, this is usually measured as parts per thousand or million.
- displacement: the forced relocation of water due to a submerged or partially submerged object occupying fluid space

Procedure

1. Place half of the clay into one side of each box. Form the clay to represent land rising out of the ocean. In one box, form a level place at the highest part as shown below. Make rivers on the land if you like.



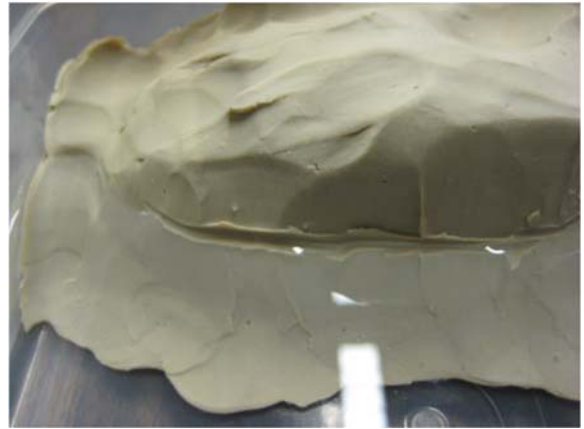
2. Place the ice cubes next to the clay in the box, so that they are resting on the bottom of the container.



3. Pour water into the container where the ice is resting on the bottom until the ice floats. Be sure the ice is floating, not resting on the bottom. If this occurs, add more water.

4. On their Sea Level Rise Worksheets, record initial measurements of water height (in mm) using a ruler for your floating ice box. For visual impression you may wish to draw a line in the clay where the water height begins for each container.

5. Add "inhabitants to your land!!!



6. Leave the setup. Name your land something creative! We will look at it on Monday and take more measurements.

Climate Change: Sea Level Rise Lab Activity

Part 1

Group 2: Landlocked Ice (Glaciers!)

In this activity, students will learn which masses of ice pose the biggest threat for rising global sea level and why.

Materials:

- Clear food storage box
- Clay
- 1 ruler
- 1 tray of ice cubes
- 1 liter of water
- "inhabitants"
- Observation Worksheet (1 per student in the group)

Vocabulary

- global climate change: the alteration of average global temperature, rainfall, and wind patterns as a result of increased atmospheric greenhouse gases
- greenhouse gases: gases in Earth's atmosphere that absorb and reradiate heat near the surface of the planet
- Density: a measurement of compactness. For solids, this is usually measured as mass per unit volume. For substances dissolved in water, this is usually measured as parts per thousand or million.
- displacement: the forced relocation of water due to a submerged or partially submerged object occupying fluid space

Procedure

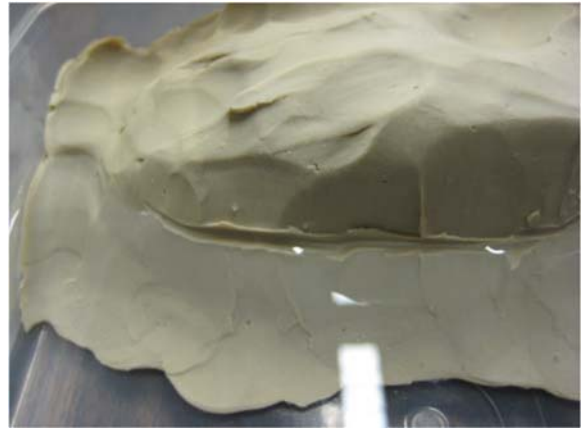
1. Place half of the clay into one side of each box. Form the clay to represent land rising out of the ocean. In one box, form a level place at the highest part as shown below. Make rivers on the land if you like.



2. Place as many ice cubes as possible on the level place formed with the clay in the box.



3. Pour water into the container with the ice resting on the clay (be careful not to disturb the ice cubes).
4. On their Sea Level Rise Worksheets, record initial measurements of water height (in mm) using a ruler for your floating ice box. For visual impression you may wish to draw a line in the clay where the water height begins for each container.
5. Add "inhabitants to your land!!!



6. Leave the setup. Name your land something creative! We will look at it on Monday and take more measurements.

Climate Change: Sea Level Rise Lab Activity

Part 1

Group 3: Salt water vs. Freshwater

In this exercise, students will be able to visualize differences in water density and relate this to potential consequences of increased glacial melting.

Materials:

- one clear food storage box (approximately 6 in square)
- clay
- blue food coloring
- ice cube trays
- 4-5 intensely colored ice cubes per group
- salt
- 1/2 liter of refrigerated water per group
- "inhabitants"

Vocabulary

- global climate change: the alteration of average global temperature, rainfall, and wind patterns as a result of increased atmospheric greenhouse gases
- greenhouse gases: gases in Earth's atmosphere that absorb and reradiate heat near the surface of the planet
- Density: a measurement of compactness. For solids, this is usually measured as mass per unit volume. For substances dissolved in water, this is usually measured as parts per thousand or million.
- displacement: the forced relocation of water due to a submerged or partially submerged object occupying fluid space

Procedure

1. Place half of the clay into one side of each box. Form the clay to represent land rising out of the ocean. In one box, form a level place at the highest part as shown below. Make rivers on the land if you like.



2. Place the ice cubes next to the clay in the box, so that they are resting on the bottom of the container. Use the colored ice in place of regular ice, and build your "landlocked ice" box

3. Add salt to the water that will be poured into the boxes in a ratio of 3 tablespoons of salt to 1 liter of refrigerated water*. This makes your water approximately the same salinity as the ocean.

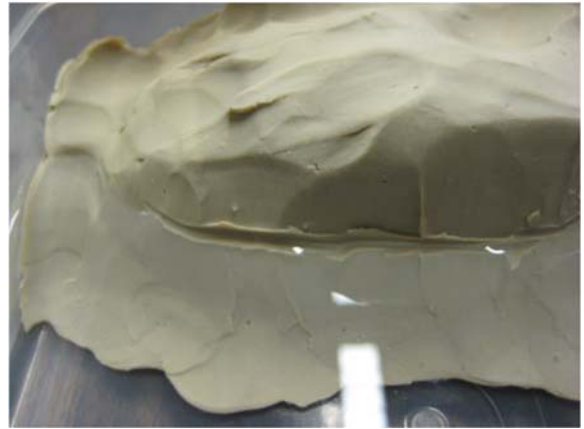
4. Pour water into the container where the ice is resting on the bottom until the ice floats. Be sure the ice is floating, not resting on the bottom. If this occurs, add more water.

GROUP 3



5. On their Sea Level Rise Worksheets, record initial measurements of water height (in mm) using a ruler for your floating ice box. For visual impression you may wish to draw a line in the clay where the water height begins for each container.

6. Add "inhabitants to your land!!!



6. Leave the setup. Name your land something creative! We will look at it on Monday and take more measurements.