



Maryland and Delaware Climate Change
Education Assessment and Research

Evidence for Climate Change: Demonstrating Cause and Effect (OSS 3.5 and 3.6)

University of Maryland
Learning Sciences Team

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July 16, 2014

Virden Center, Lewes Delaware

Guiding Questions:

- **What evidence shows that climate change is happening?**
- **What are some effects of climate change?**

Two Primary Causes of SLR

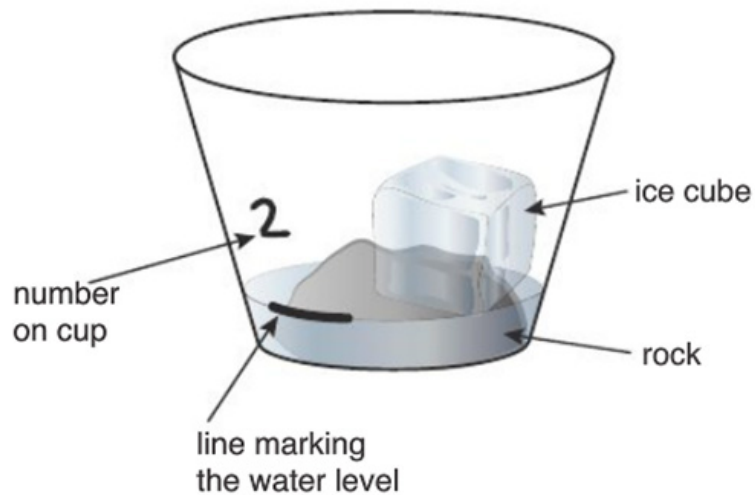


Figure 3-3. The Model Glacier.

Ice Melt



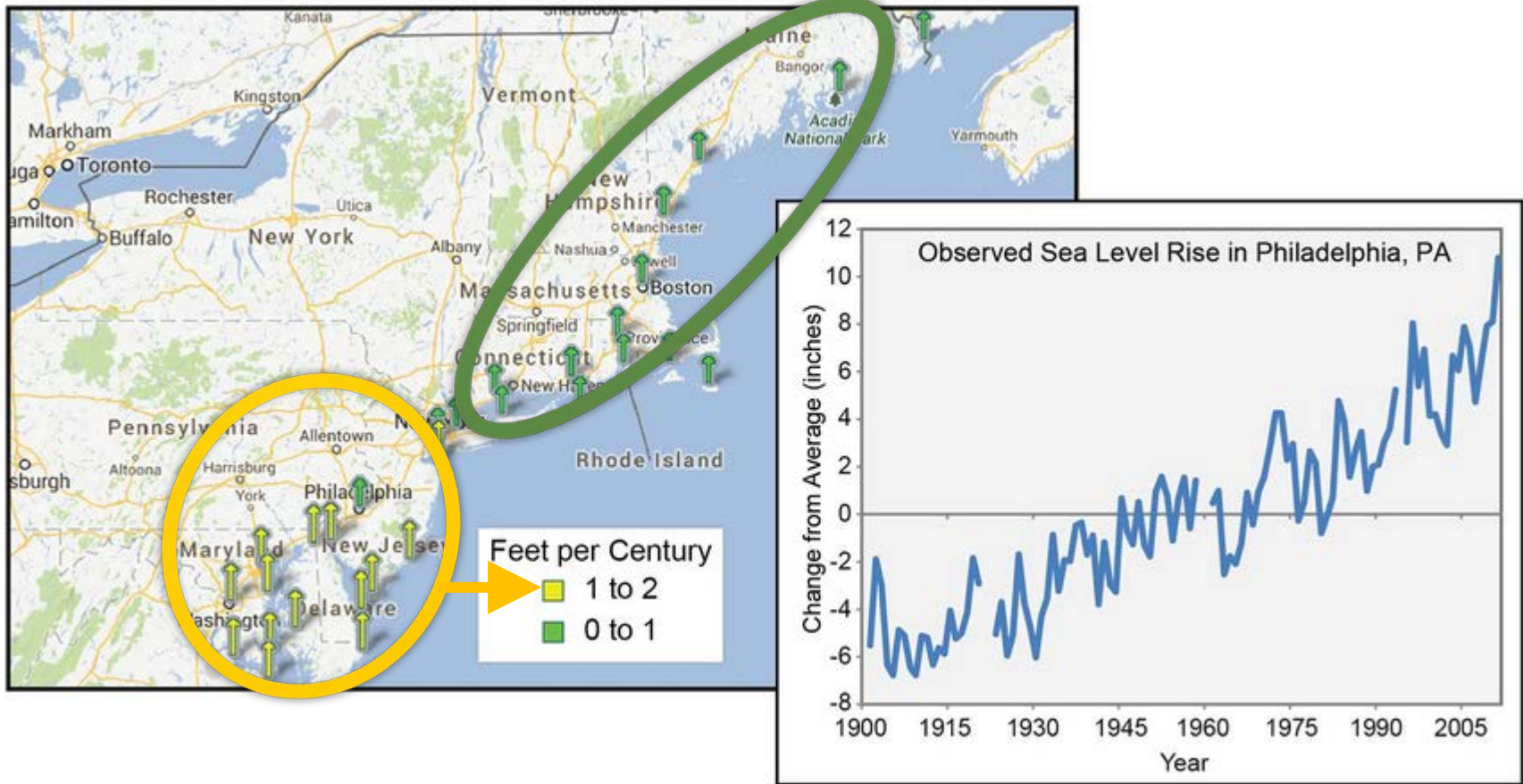
Thermal Expansion of Water

Discussion: Ice Melt and Thermal Expansion

For each model:

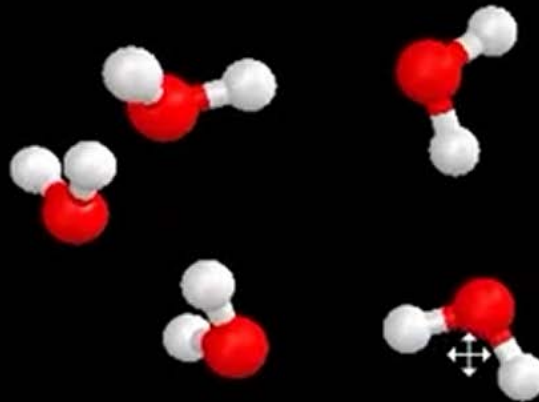
- What will students learn from the activity?
- How will you know what they learned?
(assessment)

Where is Sea Level Rising?



Sea Level Rise and Thermal Expansion

Thermal Expansion of Water



Video Link: [Local](#) [Internet](#)



Potential Assessment Item

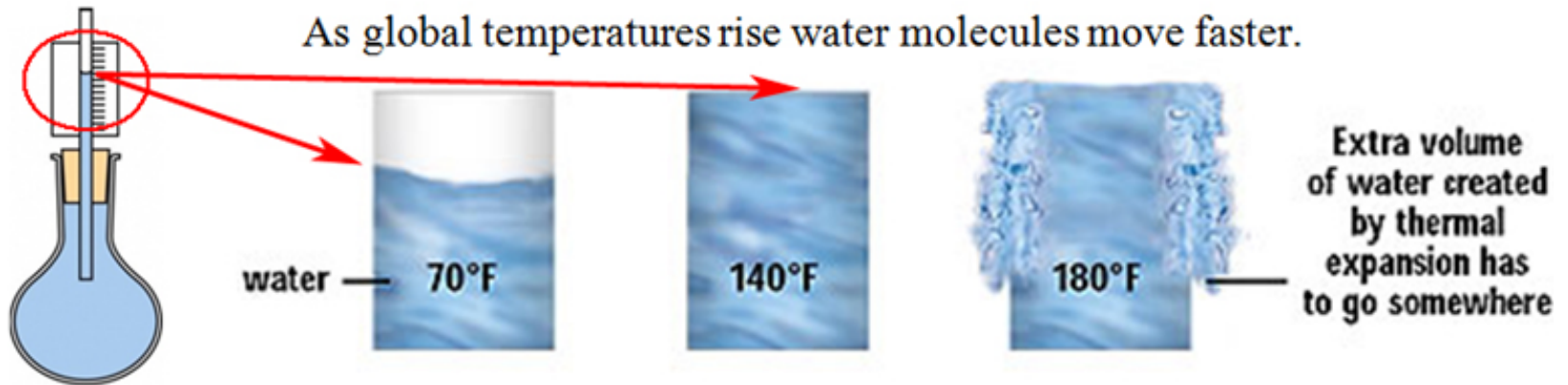
The overall, or average, global sea level is rising. However, sea level can rise different amounts in different geographic areas.

Why might sea level rise be in different in different geographic locations?

- A. in some areas, such as polar regions, sea levels will be higher due to melting ice.
- B. humans are putting more waste water into the seas in some areas causing them to rise.
- C. varying amounts of rain and snowfall in different areas leads to different rises in sea level.
- D. the land in some areas is sinking while it is rising in other geographic areas.
- E. none of the responses are scientifically supported.

Why is this the best explanation?

Potential Assessment Item



How does the thermal expansion of water cause sea level to change?

The sea level will rise because an increased temperature will cause water molecules to:

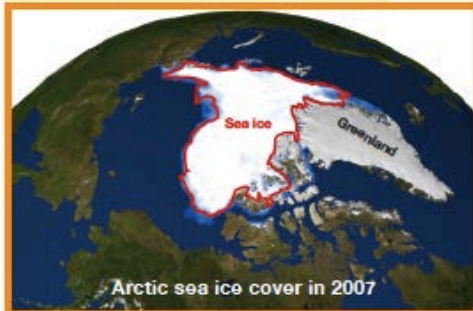
- A split apart and form additional water molecules.
- B. spread out, which causes them to occupy more space.
- C. become bigger, which causes them to occupy more space.
- D. break down and be released into the atmosphere as new chemicals.
- E. none of the responses are scientifically supported.

Why is this the best explanation?

Activity: Climate Change Evidence Stations

Arctic Sea Ice

SI-1



Color Sheet—Ocean Sciences Sequence 3.5

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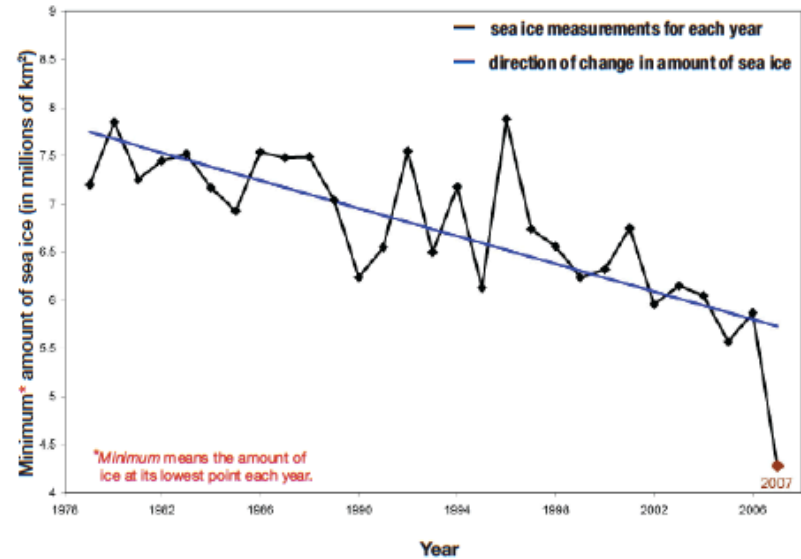
SI-2



Arctic Sea Ice Minimum* Measurements 1979–2007



Color Sheet—Ocean Sciences Sequence 3.5



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National Snow and Ice Data Center

Student Notebook pp. 20-21

Name _____ Date _____

Climate Change Evidence Stations

Changing Sea Ice sheets SI-1, SI-2, and SI-3

1. **Arctic Sea Ice.** Look at the images (SI-1) and look at the graph (SI-2) Discuss how sea ice in the Arctic has changed since 1979. Explain here using evidence.

2. **Sea Ice and the Sun.** Read the sheet (SI-3) and look carefully at the images. Find arrows showing sunlight being reflected and sunlight being absorbed. Discuss with your partner how the amount of sea ice affects temperatures on Earth. Explain your reasoning here.

Changing Glaciers sheets G-1, G-2, and G-3

Glacier Images. Look at the photographs of glaciers in different parts of the world (G-1, G-2, G-3). Discuss how these glaciers have changed over the years. Write your ideas here.

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Climate Change Evidence Stations (continued)

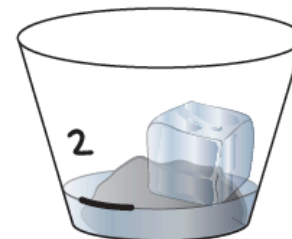
Changing Sea Level sheets L-1, L-2, and L-3

1. **Sea Level Graph and Map.** Look carefully at the graph (L-1) and the sea level map (L-2). Discuss any statements you can make about sea level changes, and record your ideas here.

2. **Some Places Vulnerable to Sea Level Change.** Based on the map on sheet L-3, discuss with your partner what areas of the world might be most affected by sea level changes. Use evidence to explain your answer here.

Model Glacier

Add dashed lines to show where “sea level” is located now that your “glacier” has melted.



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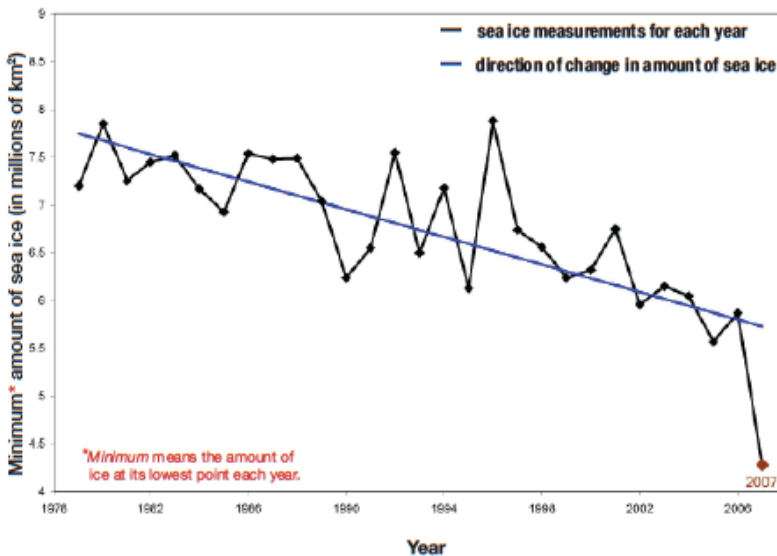
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Changing Sea Ice Station

1. Arctic Sea Ice

SI-2

Arctic Sea Ice Minimum* Measurements 1979–2007

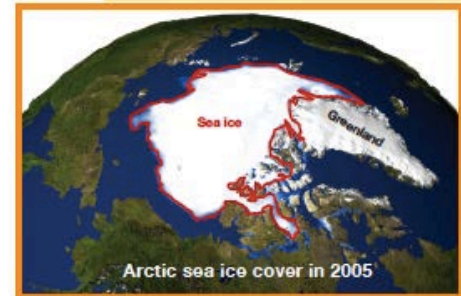


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Arctic Sea Ice

SI-1

Color Sheet—Ocean Sciences Sequence 3.5

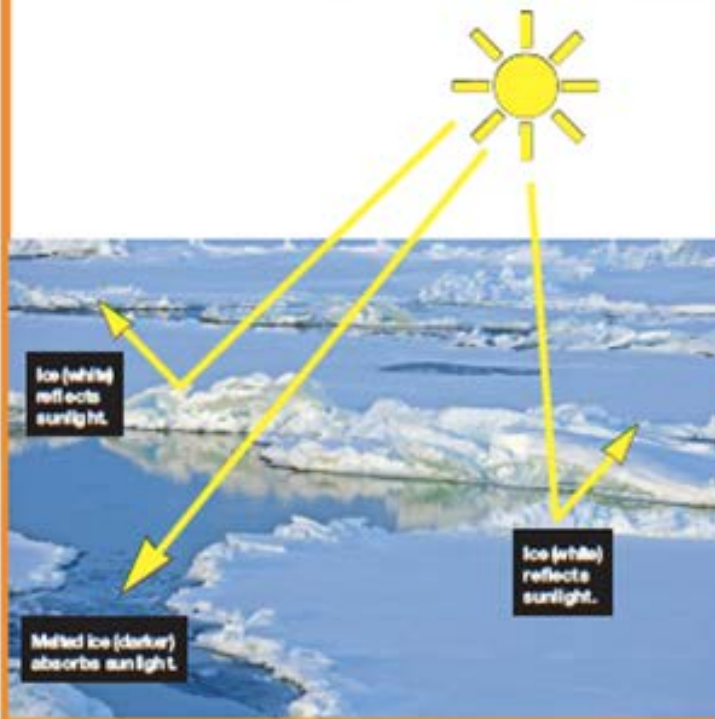
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Changing Sea Ice Station

2. Sea Ice and the Sun

Darker things absorb sunlight and heat up. White things reflect sunlight back toward space and do not heat up. These images show how polar ice reflects light from the Sun. Sunlight that is not reflected by sea ice is absorbed by the ocean and the land.



Changing Glaciers Station

G-1 Qori Kalis Glacier, Peru



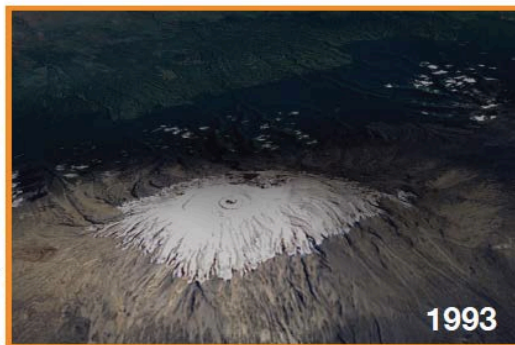
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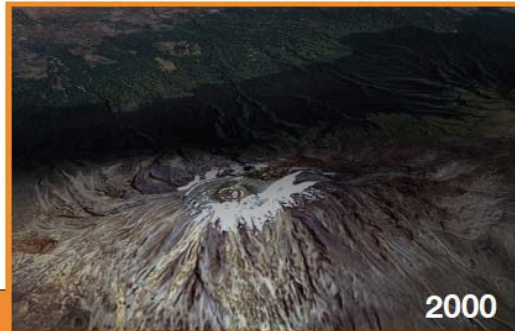
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Color Sheet—Ocean Sciences Sequence 3.5

G-2 Mount Kilimanjaro, Tanzania



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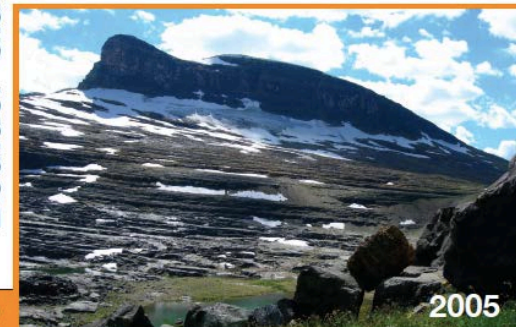
Ocean Sciences Sequence © 2014 The Regents of the University of California

Color Sheet—Ocean Sciences Sequence 3.5

G-3 Boulder Glacier, Montana



T.J. Hileman photo, courtesy of GNP archives



Grag Pederson photo, USGS

Color Sheet—Ocean Sciences Sequence 3.5

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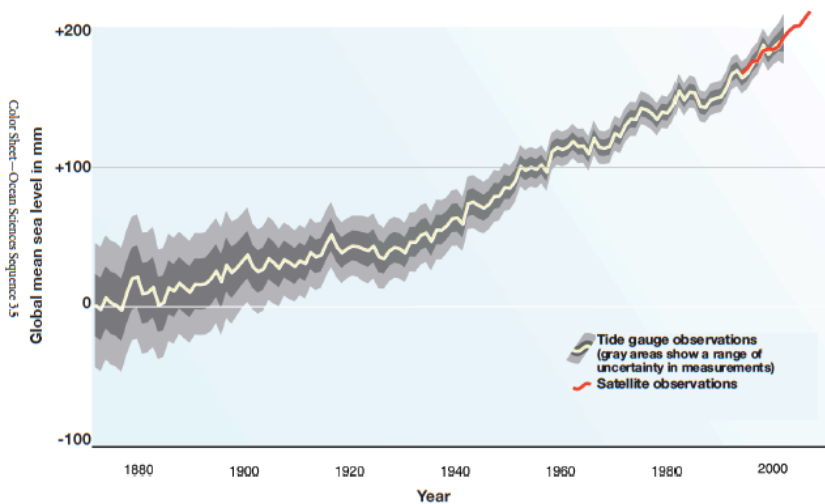
Changing Sea Level Station

1. Sea Level Graph and Map (L-1, L-2)

L-1

Sea Level Change

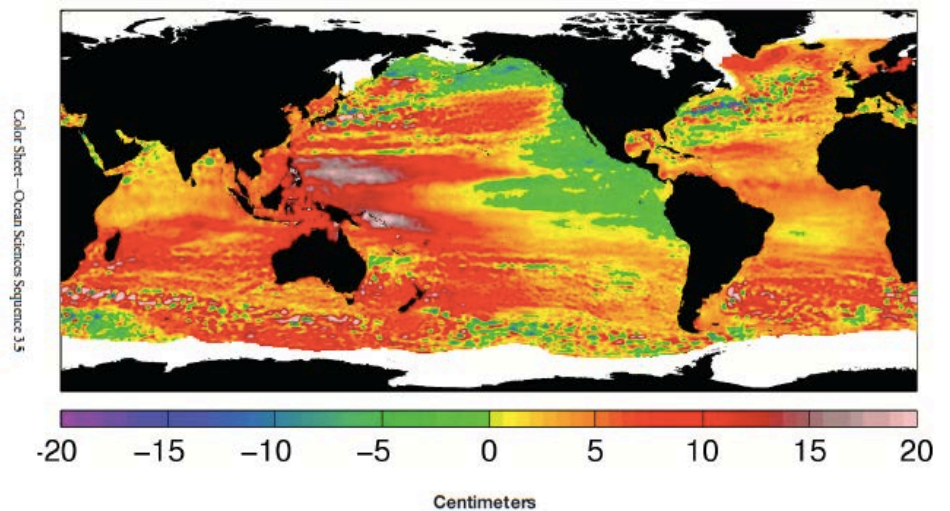
1870–2006



L-2

Sea Level Change

1993–2008





Related Video

Extension option from OSS curriculum:

<http://www.pbslearningmedia.org/resource/ess05.sci.ess.watcyc.sealevel/antarctic-ice-sea-level-change/>

Possible Assessment Item



Local officials in the town of Lewes, DE are working with scientists to develop methods to protect against flooding from severe weather and rising sea levels due to climate change.

Which method below do you think would be the best strategy to lessen future damage from climate change to the town of Lewes?

- No idea will work because climate change is outside of our control.
- Create new apartment buildings along the shoreline in Lewes.
- Relocate major shipping ports from Lewes to Atlantic City.
- Create seawalls to act as a buffer against floodwaters in Lewes.



Possible Assessment Item

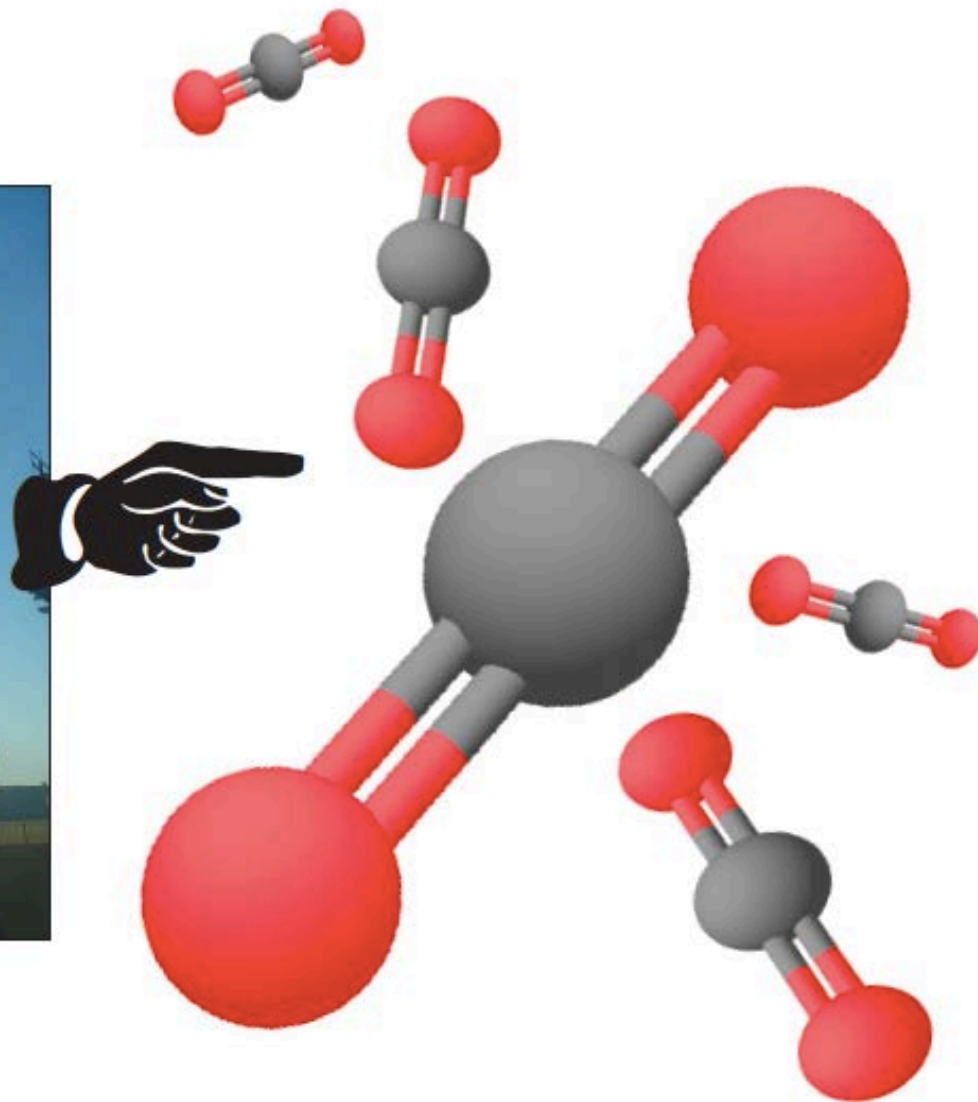
Human activities and technologies are being developed to slow the increasing rate of global climate change.

What is one direct benefit of changing human behavior and using technologies to reduce climate change?

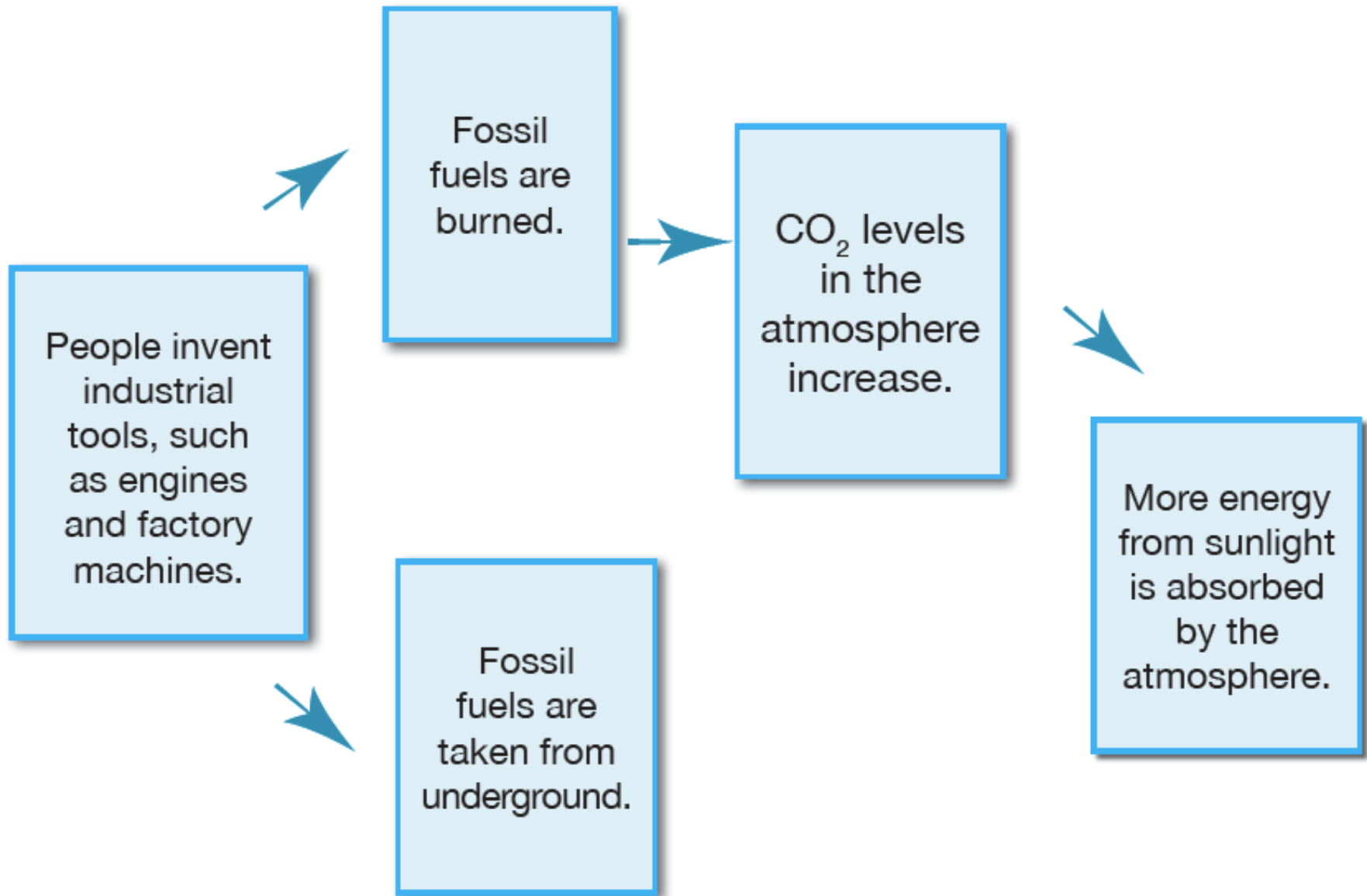
- a. Coastal areas would be less likely to flood.
- b. Humans will become more dependent on fossil fuels.
- c. Endangered species will be better protected by laws.
- d. There would be less cases of skin cancer in humans.

Session 3.6

Demonstrating Cause and Effect



Flow Chart Example



*Key
Concept*



Increased CO₂ in the atmosphere, a result of human activity is the main cause of changing sea ice, rising sea level, and melting glaciers.

NGSS Connection: MS-ESS-3-5

MS-ESS3-5 Earth and Human Activity

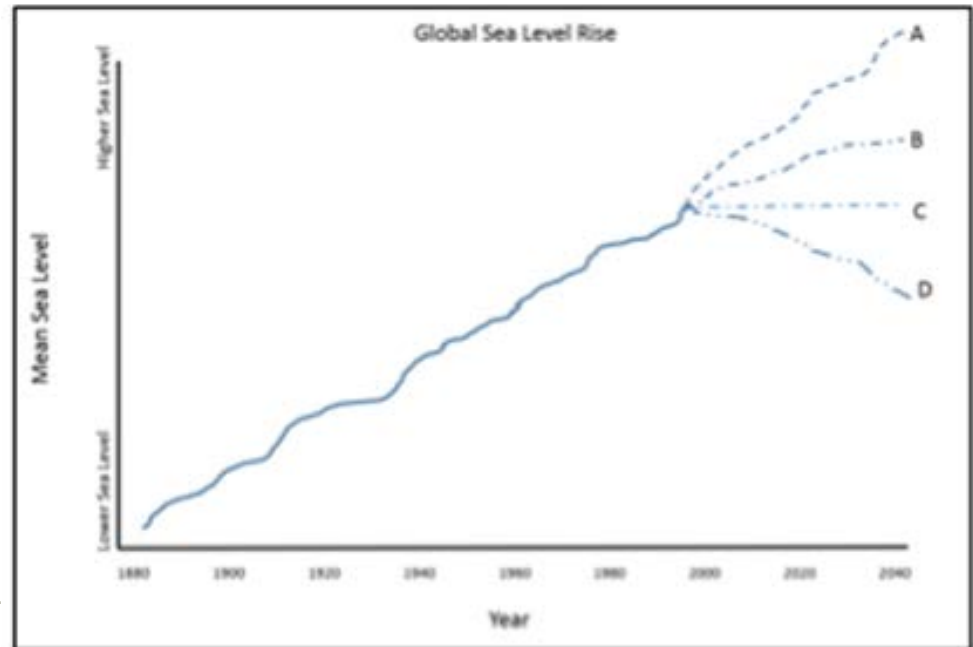
Students who demonstrate understanding can:

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.]

Possible Assessment Item

If everyone stopped burning fossil fuels today, how would this impact global sea level? Choose the best line that shows what the graph would look like in the year 2040.

- a. Line A – Extreme increase in global sea level
- b. Line B – Continued increase in global sea level
- c. Line C – Same level in global sea level as today
- d. Line D – Decrease in global sea level



Thank you.





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