Lesson Planning Tool for Climate Change

Title of Lesson: Thermal Expansion and Land Ice

Grade Level: 7-8
Subject: Physical and Earth Science

Source(s) of the lesson:
https://www3.epa.gov/climatechange/kids/documents/sea-level-rise.pdf- EPA: Sea level on the rise

Essential Question(s): Why are sea levels rising?

Massachusetts Curriculum Frameworks Science Standards:
7 ESS 3-2 Obtain and communicate information on how data from past geologic events are analyzed for patterns and used to forecast the location and likelihood of future catastrophic event---s.
8 PS 1-4 Develop a model that describes and predicts changes in particle motion, relative spatial arrangement, temperature, and state of a pure substance when thermal energy is added or removed.

Content Objectives	Practice Objectives	Language Objectives
Solid, liquid, or gas expands when thermal energy is added.	1. Ask questions	I can display my knowledge on why sea levels will rise using sentences.
Thermal expansion and continental glaciers are reasons for sea level rise.	2. Modeling	

Important Vocabulary:
Tier 1 matter, solid, liquid, gas **Tier 2** heat, temperature, thermal, energy, expansion **Tier 3** continental glacier, kinetic energy, molecule **Advanced** geosphere, hydrosphere, biosphere, cryosphere, eustatic and steric sea level rise

Materials Needed:
Thermal Expansion- Flask, hot plate, thermometer, china marker, ruler/measuring tape
Land Ice vs Sea Ice- Clay, ice, 2 clear plastic bins, ruler, china marker, ruler

Other Resources: (websites, videos, books, etc.)
Suggested HW Article- Newsela- *Submerged bricks in Florida give clue to rising sea levels, climate change* or Advanced- Warming Seas and Melting Ice Sheets- http://www.jpl.nasa.gov/news/news.php?feature=4699

Background Information for Teacher:
There are two major causes of sea level change- 1) eustatic change- increase in the number of molecules and 2) steric change- thermal expansion of water molecules. Oceans absorb heat

from the atmosphere with only a slight difference in temperature (ocean heat content). Patterns from other times in geologic history are used to predict the future.

Background Information the Student Needs to Access the Lesson:

The average global temperature is *rapidly* rising due to more greenhouse gases in the atmosphere because of humans. This rapid rise in the atmosphere will affect other aspects of the world- hydrosphere, geosphere, and cryosphere. Sea level rise is occurring due to thermal expansion as well as the melting of continental and alpine glaciers. Suggested to be done after Investigation 6 *Water in the Air* from the Foss *Weather and Water* unit.

Lesson Structure

Lesson Launch (Do Now)	**KWL** on essential question **Quiz to Quiz** on Vocabulary (https://www.engageny.org/sites/default/files/resource/attachments/appendix_protocols_and_resources.pdf) Image of Helheim Glacier Melt, Greenland **observations**- have images projected/ printed at group and ask students what they notice about the two pictures
Background Instruction (pre-activity)	**Fireproof balloon trick** (activator) http://www.stevespanglerscience.com/lab/experiments/fire-water-balloon/ This shows how water can absorb thermal energy. Probe students and ask why? What is happening in the water that it is able to absorb the energy? New England Aquarium Blue video- Thermal Expansion- Rising Oceans and student guide NASA Earth minute videos- Sea level rise and Greenland Ice
Activity	Read/Post in the classroom **Intro**- *For thousands of years, sea level has remained relatively stable and human communities have settled along the planet's coastlines. But now Earth's seas are rising. Globally, sea level has risen about eight inches (20 centimeters) since the beginning of the 20th century and more than two inches (5 centimeters) in the last 20 years alone.All signs suggest that this rise is accelerating.* (http://www.jpl.nasa.gov/news/news.php?feature=4699) 1) Thermal Expansion 2) Sea vs Land Ice (overnight) Students should copy organizer into notebook; Give copies for ELL/Special Ed students
Discussion/ Debrief	1) Interpretation of Data questions 2) Molecular motion of solid, liquid, gas; other real world examples of objects expanding/contracting when thermal energy added/removed (wood floors/doors, tires, railroad, jars, bridges, sidewalks etc) 3) Identify coastal cities that will be affected
Formative Assessment	1) **Give one, get one, move on** (https://www.engageny.org/sites/default/files/resource/attachments/appendix_protocols_and_resources.pdf) 2) **Written Conversation**- students write down what was learned and pass the note to a partner; partner then replies with a

	written response

Notes:

EXPEDITIONARY LEARNING

PROTOCOL

Quiz-Quiz-Trade

Purpose

Quiz-Quiz-Trade is a vocabulary reinforcement protocol that allows students to both review key vocabulary terms and definitions from their reading and get them moving and interacting with peers.

Procedure

1. Choose 15-20 high frequency academic and/or domain specific words from class reading(s) (Note: you may want to list a word more than once or twice if it is essential to students' understanding of text and/or used more frequently than other words in common texts).
2. Create vocabulary 'strips' with these words, that can be folded vertically so one side of the slip shows the word, and the other side of the slip has the definition.
3. Give each student one vocabulary strip.
4. Each student finds a partner.
5. Partner A shows the side of the paper with the word on it to his/her partner.
6. Partner B says the definition (if he/she knows it), or finds the word in the text and tries to determine the definition, using context clues.
7. Partner A then reads the definition aloud to confirm or correct the definition that Partner B gave.
8. Partners switch roles and repeat the steps above.
9. Partners then trade vocabulary slips and find a new partner.
10. Students should meet with at least 2 or more partners during this activity (5-10 minutes)
11. After completing the steps above, gather students as a whole group. Make sure to review and emphasize vocabulary that you want students to know and understand, since individual students will not have the opportunity to see and define every key term during this activity.

EXPEDITIONARY LEARNING

PROTOCOL

Give One, Get One, Move On (GoGoMo)

Purpose

This is a protocol that can follow any workshop, exploration, research, or experience. Use it to spread good ideas and to see what "stuck" with participants. You can structure it with movement, or make it a silent, written experience.

Procedure

1. Ask participants to write down 3-5 key learnings or important ideas about the topic of study. You may choose to have people write each idea on a different index card or sticky-note to give away to his or her partners.
2. Invite the group to get up and mingle with their peers or colleagues.
3. After about 30 seconds, call out "GIVE ONE to a partner."
4. Participants form pairs and each "gives" one of his or her key learnings or important ideas about the topic to the other, so each person "gives one" and "gets one." Time may range from 1-3 minutes.
5. Call out "MOVE ON" and participants mingle again.
6. Repeat the sharing for as many ideas as people have to share.

Give One, Get One, Move On (GoGoMo) – Written Version

Directions: Think of an important idea you have learned about this topic or one that has recently been reinforced. Write it down in Box 1. Pass the sheet to another participant who will silently read what was written in the first box. That person will add an idea in Box 2. Do not repeat ideas that are already listed. Continue passing on the paper and adding ideas until all the boxes are filled with ideas. Return the sheet to the original owner.

1	**2**	**3**
4	**5**	**6**
7	**8**	**9**

Thermal Expansion

Question: _____

Materials (list what you will use after reading through procedure)

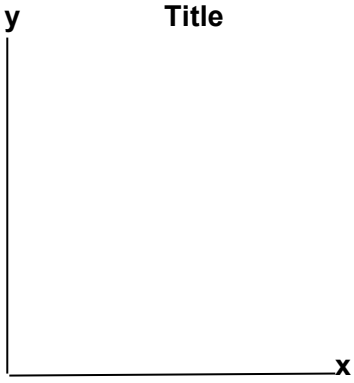
Procedure

1. Fill flask with 100 ml of water
2. Using china marker, mark water level on flask
3. Take temperature of water, note down in data table
4. Place flask on hot plate with medium temperature and plug with stopper
5. Record water level increase every 2 minutes from initial marking for 20 minutes
6. Analyze data by graphing time and water level increase measurement
7. Interpret the data by answering the questions

Data- Copy into notebook

Thermal Expansion	
Minute (x)	**Water Level Increase (y)**
0	

Analyze Data- Graph points on data table



Interpret Data

What happened to the water level in the flask as the temperature increased?

Explain why the water level in the flask changed over time. What caused this?

Draw a diagram that shows what happens to the volume and molecules of water when energy is added to it.

Sea vs Land Ice
Question: _____

Materials (list what you will use after reading through procedure)

Procedure
1. Label one bin land ice and other bin sea ice
2. Mold equal amounts of a clay mountain in each bin (be sure that both are exactly the same)
3. Pour 1000ml of water into each bin
4. Place 5 cubes of ice in the water in the sea ice bin
5. Place 5 cubes of ice on clay mountain in the land ice bin
6. Mark the initial water levels on each bin using the china marker and measure with a ruler to the nearest cm
7. Allow ice to melt overnight
8. Mark final water levels on each bin using the china marker and measure with a ruler to the nearest ml
9. Record final water height in data table
10. Interpret data by answering questions

Collect Data

Sea vs Land Ice		
	Initial Water Level Height (cm)	**Final Water Level Height (cm)**
Sea Ice		
Land Ice		

Interpret Data
What does the land ice represent? Sea ice?

Why is it important to ensure everything is the same except for the placement of the ice?

In which bin did water level rise more?

Why do you think this happened?