Unit Plan: Iceberg of Antarctica

Grade/ Grade Band: 3-5	**Topic:** Glaciers, Climate Change, Antarctica, Sediment core, Communicating like a scientist	**D. Nihart and T. Haste**

Brief Lesson Description:

After exploring the various hands-on, art, kinesthetic activities, and electronic resources after reading the book: Iceberg of Antarctica by Marlo Garnsworthy, students will develop, create, and produce their own children's book and accompanying artwork to demonstrate their understanding of one of the topics covered in the book that they investigated.

2050 Framework:

Ground Truthing Future Climate Change: By collecting the robust data required for reconstructing global climate evolution over extended geologic time periods, scientific ocean drilling will provide information that is critical for improving climate model performance.

NGSS DCI:

3-ESS2-2 Obtain and combine information to describe climates in different regions of the world.

Science & Engineering Practices:	**Disciplinary Core Ideas:**	**Crosscutting Concepts:**
Obtaining, Evaluating, and Communicating Information: Obtaining, evaluating, and communicating information in 3–5 builds on K–2 experiences and progresses to evaluating the merit and accuracy of ideas and methods. • Obtain and combine information from books and other reliable media to explain phenomena.	**ESS2.D: Weather and Climate** • Climate describes a range of an area's typical weather conditions and the extent to which those conditions vary over years.	**Patterns** • Patterns of change can be used to make predictions. **Cause and Effect** • Cause and effect relationships are routinely identified.

Specific Learning Outcomes:

Students will develop, create, and produce their own children's book (or podcasts of them reading books/stories) reflecting their understanding of one of the topics investigated.

Overall Objectives (TSWABAT):

Describe the location of Iceberg Alley and the use of geologic information to describe climates.

Narrative / Background Information

Teacher Background:

- **Expedition Iceberg Alley** (Where is Iceberg Alley?) from IODP **Expedition 382: Iceberg Alley and Subantarctic Ice and Ocean Dynamics, and blog posts** from the expedition.
- Voyage to Iceberg Alley from Envirobites
- Ice, Snow, and Glaciers and the Water Cycle from USGS
- Arctic vs. Antarctic from PolarTREC
- Weather and Climate Lesson Plans from Smithsonian
- Weather and Climate from The UCAR Center for Science Education (UCAR SciEd)

Possible Preconceptions/Misconceptions:

Glacial icebergs are formed quickly, glacial icebergs are only made of water, sea ice and glacial icebergs are the same thing, timescale, animals associated with icebergs (polar bears, seals, penguins), where icebergs can be found, glacial icebergs are made of saltwater, Glaciers erode by pushing rocks. There is only one season in the Polar Regions. (Polar Regions are dark, frozen places year-round.): Temperatures are similar at both poles. Snow and ice make it cold. The Polar Regions are not important for global climate. This website has a formative assessment that are applicable to establish misconceptions about glaciers as well as other resources to assist in identifying student pre and misconceptions. Beyond Penguins and Polar Bears: Common Misconceptions about Icebergs and Glaciers.

Prior Student Knowledge:

Compare and contrast, different places on the earth experience different temperatures and season at different times, state of matter (solid), density and buoyancy (sink/float).

PLAN – 5-E Model

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

Investigate:

- Ask: What is an iceberg? Where might you find an iceberg? What animals do you associate with icebergs?
- Ask students to either or both draw pictures of icebergs, or find examples online. Discuss the commonalities of the images, sort images into categories, create a Venn Diagrams of similarities and differences.
- Using a globe, ask students where in the world they would expect to find icebergs.
- Ask: How are icebergs made?
- Read the book **Iceberg of Antarctica by Marlo Garnsworthy** out loud or use author's reading audio file from **IODP Expedition 382: Iceberg Alley and Subantarctic Ice and Ocean Dynamics. (See attached file.)**
- Using student responses to all the above, create a KWL chart for icebergs. If KWL chart is made with sticky notes, students can move terms to new locations after they have learned about the topics. If class is on-line, use Jamboard or similar is an alternative.

EXPLORE:

Set up stations for students to explore various aspects of icebergs and Polar Regions:

- (Video) **5 Things You Didn't Know About Icebergs** (2:10 length) from **IODP Expedition 382: Iceberg Alley and Subantarctic Ice and Ocean Dynamics.**
- (Video/reading) **Expedition Iceberg Alley** (Where is Iceberg Alley?) from **IODP Expedition 382: Iceberg Alley and Subantarctic Ice and Ocean Dynamics.**
- (Activity) **"Where in the World?"** IODP/JOIDES Resolution. After learning the basics about latitude & longitude, students will plot locations on a map and answer questions about coordinates.
- (Compare/contrast) **Describing the Antarctic and what it is to be a Polar Region: "To the Ends of the Earth: Comparing the Arctic and Antarctic"** from Ice Drilling Program Education and Outreach. "Going to the "ends of the Earth" takes you to the Arctic and the Antarctic. This activity engages students in sorting picture cards comparing similarities and differences between the Polar Regions in a table-sized Venn Diagram."
- (Hands-on lab) **Great Ice Cube Race** from Kids Earth Science. "These science experiments test the rate different shapes of ice cubes melt. Each ice cube contains the same amount of water. In this experiment you will use ice cubes that have different shapes and see if the time it takes them to melt varies with the shape of the ice cube."
- (Art activity) **Why is Snow White?** from Mystery Science. "In this mini-lesson, students see how the shape of snowflakes causes them to look like the color of light that is shining on them. In the activity, Wax Paper Snowflake, students create a decorative snowflake and investigate how to make something transparent look white."
- (Hands-on lab) **Learning through Experimentation: Ice Cubes, Density, Currents,** (COSEE) adapted from Adapted from Lawrence Hall of Science GEMS "Ocean Currents: Marine Science Activities for Grades 5-8"Activity 5: Ice Cube Demonstration, p 85. In a jigsaw lab activity, students create and test marine currents of varying temperature with icebergs to examine melting and movement.

EXPLAIN:

Investigating floating and sinking (*buoyancy and density*):

- (Reading) **Flipping icebergs: Capsizing icebergs may release as much energy as a bomb** from *Science News for Students*. Terms are defined, register for free article-related educator resources.
- (Kinesthetic) Have students act out the following terms: *Drift, Wander, Dwindling*
- (Read) **Ice and the Density of Water** from ThoughtCo. Article discusses density as reason for floating and sinking of substance in water.
- (Art) To learn the different types of ice that are found in a glacier (*Granular Ice, Firn, Glacial Ice*) do the art activity **Flakes, Blobs, Bubbles: An Ice Core Art Project** from Polar Educators International and Fall 2012 International Polar Week. Students create paper glacial components to make a glacial mural. Activity is located here: http://icecoreart.weebly.com/activity-for-download.html This activity may assist students in creating snow for the paper glacier: (Technology – web app) **Grow Snow Crystals** from the Cooperative Institute for Meteorological Satellite Studies by Tom Wittaker and Steve Akerman, University of Wisconsin. Madison. Students can use web app to grow ice crystals in clouds and learn the various temperatures associated with formation. The variety of crystal shapes may assist students with creating snowflakes.

Investigating Glaciers and Ice Sheets –

- (Technology) **Iceberger** inspired by @GlacialMeg. Draw an iceberg and see how it will float. "In reality, an iceberg wouldn't float *exactly* like this. Its three-dimensional distribution of mass and its relative density compared to the water are both significant factors that are only approximated here."
- (Kinesthetic) ***Ice Flow Direction #18-*** enactment of glacial movement using students and classroom furniture. From: **Rock Paper Glacier!** An appreciation of glacial landscapes. Glacier analogies and activities.
- (Read/write) **Ice Sheets are Like Pancakes** from University of Maine Earth and Climate Sciences. Describing the movement of glaciers through analogy.
- (Technology – web app) **Grow Snow Crystals** from the Cooperative Institute for Meteorological Satellite Studies by Tom Wittaker and Steve Akerman, University of Wisconsin. Madison. Students can use web app to grow ice crystals in clouds and learn the various temperatures associated with formation. This activity ties in with **Flakes, Blobs, Bubbles: An Ice Core Art Project** from "Floating and Sinking".
- (Hands-on lab) **Modeling Glacier Dynamics with Flubber** from the National Association of Geoscience Teachers. "A hands-on activity for middle and high school students (easily adapted to grade levels) that describes glacier mass balance in a changing climate. The students make a glacier using glue, water and detergent ("flubber") and construct a glacier valley using plastic sheeting. They are encouraged to run several tests with different values for valley slope, "flubber" temperature, and basal conditions. The students then calculate the "flubber" velocity for each scenario. We compare our glacier models to the dynamics of real glaciers and discuss how and why they might be changing over time."
- (Hands-on lab) **How to Melt a Glacier** from PolarTREC. "This lesson will provide students with an opportunity to design and carry out an experiment that mimics the conditions causing accelerated ice melt along the face of the Thwaites Glacier off the southwest coast of Antarctica."
- (Technology) Scientists use hydrophones to listen to the sounds icebergs make underwater. **The Sounds of Icebergs - NOAA Hydrophone Recordings. "**In this video provided to KLCC by NOAA, the various noises and resonant activity produced by icebergs are captured. Bob Dziak of NOAA's Ocean Acoustics Program in Newport, Oregon says these are of "mega iceberg"...masses of ice 50 to 60 miles long." NOAA's PMEL Acoustics Program **Cryogenic (Ice)** has several wave files and spectrograms of different ice sounds.
- (Technology) Iceberg calving video: **Large Iceberg Breaking near Ilulissat, Greenland** by M. Walls. After students watch and listen, ask viewing students to hypothesize why the videographer changes location during the video.
- *Extension* – (Read) **Ice on the move** from *Science News for Students*. For more advanced students, terms are defined, register for free article-related educator resources.
- *Extension* - (Technology) **Measuring Ice Like NASA Does** from PolarTREC. "One of the most important indicators of our warming climate is the extent and thickness of polar sea ice. Currently satellites measure the extent of polar sea ice but it takes more sophisticated equipment aboard a low-flying plane to actually measure the thickness of sea ice. This lesson will show students how this is done."
- *Extension* - (Hands-on lab) **Simulating Sea Level Rise** from Sea Earth Atmosphere, Hawaii Sea Grant College Program. This activity builds on the topic of glacier and sea level to help students understand how the atmosphere interacts with the hydrosphere.

- *Extension –* (Video and simulation) California Academy of Sciences **Heating H2O: The Chemistry of Sea Level Rise**. "Rising sea levels are about more than just melting ice. Understanding the behavior of water at the molecular scale can help us better prepare for changes on a global scale."

Investigating Sediment Cores-

- (Compare/contrast) *Sediment Core and Microfossils:* use the collage of images located at the start of the blog entry **"Not Just a Pebble in Mud",** from **Expedition 382: Iceberg Alley and Subantarctic Ice and Ocean Dynamics blog post April 21, 2019** to have students describe what they think scientists may be looking for. Print images individually on cardstock and make cards or use image files electronically.
- (Video) **"Drilling for DNA"** from **Expedition 382: Iceberg Alley and Subantarctic Ice and Ocean Dynamics.** "Diatom paleontologist Dr. Linda Armbrecht wants to use the past to understand how modern climate change might affect marine life. But the microfossils she looks at every day through the microscope are only one piece of the puzzle. To answer questions about how ocean ecosystems have changed over the last 12,000 years and beyond, she's looking for something else in the mud: ancient DNA."
- (Compare/contrast) After reading **Expedition 382: Iceberg Alley and Subantarctic Ice and Ocean Dynamics March 31, 2019 blog post "Core on Deck!", blog post April 3, 2019 Remarkable Shades of Grey,** and watching the video **Rock Visualization on the JOIDES Resolution;** students mimic the process by identifying what they think scientists might be studying in the images of cores from the **IODP poster The "Hole" Story about Ocean Cores.** Use the side with core images to provide a mock core to work from.
- (Hands-on lab) **Coring Is Not Boring!** From the EarthLabs project. "Students build a model sediment core drill and use it to take core samples from layers of PlayDoh."
- (Hands-on lab) Mock cores and forams: use stacks of petri dishes (at least 8 per stack) that have been sprinkled with Skittles. Skittles represent forams. Be sure to select one or two colors as "index fossils" and place accordingly in the layers of dishes. Using images from **IODP Microfossils: The Ocean's Storytellers Poster to create a key for the foram fossils**
- *Extension*- **Inquiry into Sediment Cores** from **IDOP School of Rock**. "This activity serves as an inquiry-based introduction to description of sediment cores and to primary types of marine sediments, their distribution on the sea floor, and the controls that determine their distribution." *This activity will need to be modified for use with younger students.*

Investigating microfossils -

- (Video) **Lab Profile: Micropaleontology** (3:31 length) "The micropaleontology team on **IODP Expedition 374: Ross Sea West Antarctic Ice Sheet History** look at the microfossils in the sediment cores that come on deck. The team looks at diatoms, dinoflagellates, foraminifera, and radiolarians under their microscopes to help estimate the ages of the sediment. Learn more about each team member's work."
- (Compare/contrast) **IODP Microfossils: The Ocean's Storytellers Poster** and from **Expedition 382: Iceberg Alley and Subantarctic Ice and Ocean Dynamics May 30, 2019 Exquisite Worlds** and use *Samples 1 -4* (just the samples, not the instructions) from **IODP Finding Fossils: A Biostratigraphy Activity** Print out fossil images onto cards, students look for similarities and differences in organisms to identify various microfossils.
- (Video) **The Tiniest Fossils - Shelf Life #6** (6 min length), American Museum of Natural History. You could easily mistake foraminifera fossils for flecks of dust, but these tiny specimens hold big insights about Earth's climate. Scientific Assistant Bushra Hussaini, researcher Ellen Thomas, Curator Neil Landman, and intern Shaun Mahmood are preserving this invaluable collection.

- *Extension*- (Compare/contrast/discuss) for more advanced students include the discussion on Micropaleontology from **Expedition 382: Iceberg Alley and Subantarctic Ice and Ocean Dynamics May 5, 2019: An Experienced Voice** to investigate the history of microfossils through storytelling.

Investigating dropstone -

- (Hands-on lab) Freeze pebbles from outside onto the bottom of a small to medium disposable cup to create "icebergs". Once frozen, place in large aquarium or tank with water and blow a fan to move the icebergs. Where do the pebbles end up? Ask students to create a top-down map of the path of their iceberg and mark where the pebbles fall out. Discuss and compare maps.

Investigating being a science communicator –

- Interview with Author and Illustrator of **Iceberg of Antarctica,** Marlo Garnsworthy. **(See attached audio file.)**

ELABORATE: Applications and Extensions:

Art from sediment cores and rock slices-

- (Art) Using the elements of art — shape, line, color, texture, value — students make sense of images of foraminifera, thin slices, and sediment core images as they hone observation skills and think of inspiring questions. Learners create a beautiful piece of art while learning to recognize geologic and related features from close ups of sediment cores. This activity is taken from NASA's Art and the Cosmic Connection, a two-part interdisciplinary program developed by artists and educators Monica and Tyler Aiello.

  After reading the accompanying text from the blog, project the images from **Expedition 382: Iceberg Alley and Subantarctic Ice and Ocean Dynamics May 14, 2019 blog post Rock Through the Looking Glass and Expedition 382: Iceberg Alley and Subantarctic Ice and Ocean Dynamics April 19, 2019 blog post What Can We Learn From a Smear Slide?. (**There are also thin section images on the lesson plan side of the **IODP poster The "Hole" Story about Ocean Cores.)** Have students create art images that reflect their impressions of these images.

  Use **"Starry"** from **Expedition 382: Iceberg Alley and Subantarctic Ice and Ocean Dynamics May 24, 2019 blog post** as an example.

EVALUATE:

Formative Monitoring (Questioning / Discussion):

Changes in position of terms on KWL chart for icebergs. If chart is made with sticky notes, students can move terms to new locations after they have learned about the topics. Art products from art activities, accurate kinesthetic enactment and analogy use, products from hands-on lab activities.

Summative Assessment (Quiz / Project / Report):

Students develop, create, and produce their own children's book (podcasts of them reading books/stories) reflecting their understanding of one of the topics investigated. Use a rubric to evaluate student products based on specific student/class objectives and ability.

Examples for students-

- **Expedition 382: Iceberg Alley and Subantarctic Ice and Ocean Dynamics May 5, 2019: An Experienced Voice** to investigate the history of microfossils through storytelling.
- Use **"Starry"** from **Expedition 382: Iceberg Alley and Subantarctic Ice and Ocean Dynamics May 24, 2019 blog post.** This blog post can be used a model to discuss with students how to present the information as an example of a final project.
- Reading of **Iceberg of Antarctica** by Author and Illustrator Marlo Garnsworthy from **IODP Expedition 382: Iceberg Alley and Subantarctic Ice and Ocean Dynamics. (See attached audio file.)**

Elaborate Further / Enrichment:

- Create a museum and invite community members to visit. Have students select their favorite activities from the unit and become docents for visitors who stop to visit the activity during the event.
- Other extension opportunities are placed within related content and activities.