Mary Driskell
Eyes on Earth
Sphere Lesson #1
M. Holzer, PhD

Grade Level 7-12	Glacial Retreat	Lesson Length- 3-4 - 90 Minutes classes

Lesson Objects and Standards
Students will:

- Analyze changes in glacier coverage over time using satellite images.
- View global climate models to predict future climate changes.
- Interpret and summarize quantitative data,
- Receive real experience with the topic.
- Make observations, record results, and make connections.

NGSS: **Science Standards:**

- HS-ESS2-2. Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems
- HS-ESS2-4. Use a model to describe how variations in the flow of energy into and out of Earth's systems result in changes in climate.
- HS-ESS2-7. Construct an argument based on evidence about the simultaneous coevolution of Earth's systems and life on Earth.
- HS-ESS3-5: Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth's systems.
- HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.

ELA Standards:

- CCSS.ELA-LITERACY.SL.11-12.1-Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 11-12 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.
- CCSS.ELA-LITERACY.SL.11-12.5
- Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.

Math Standards:

- NM-ALG.9-12.3 Use Mathematical Models to Represent and Understand Quantitative Relationships

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Lesson Summary:
Students will be viewing satellite images from the NASA Landsat team. In addition, they will be investigating the change in the size of the Bear Glacier in Kenai Fjords Nation Park located in the southeastern part of Alaska's Kenai Peninsula from 1986 to 2018.
Students will investigate how glacial retreating and coverage have changed over time. They will use technology from space-based observations to calculate glacier retreating over 32 years.
Students will also read from other sources about climate change, melting glaciers, and their effect on animal life. At the end of the unit, the student will develop a plan to help save the plants and animals that live in the areas where glacial are retreating and sea ice is thinning.

Materials:

- 1 internet-connected device per group
- NASA Landsat Images of Bear Glacier during 1986, 2002, and 2018, printed in color for each group
- Complete Glacial Retreat packet from NASA - Microsoft Word - Glacial Retreat_Intro (nasa.gov)
- Copy of student handouts from the Glacial Retreat lesson: Glacial Retreat: Quantifying Changes in Glacier Cover Over Time | MyNASAData
  - Glacier retreat worksheet for each student
  - Cover Change Grid for each pair of students
- Fine point erasable marker
- Transparencies for each group

Engagement Phase:	**Duration: 10-15 minutes**
Start with asking the students **What is the Cryosphere?** Then, have the students submit their answers into a word cloud type document projected onto an interactive board if available. Alternative activities: discuss the question as a class or have the students write their answers on a post-it note, placing them on a large sheet of paper o review at the end of the lesson. Finally, you can post the question again and compare how the student's answers have changed—this is a quick formative assessment to gauge students' understanding. **Video:** *Watch NASA Explorers: Cryosphere- The Big Thaw*	Teacher Role- • Facilitate learning and guide student understanding **Goals** • Connect student's experiences • Create interest • Ask questions

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• During the video students can take notes over facts they learn about the Cryosphere to have for later class discussion. • After watching the video, have a class discussion about what the students learn about the Cryosphere and compare their new answer to their previous ones. • Read the Glacial Retreat information sheet aloud as a class. Discuss with the students any questions or misconception they might have about glacier. The Glacier Retreat articles is located on page 5 of the following document. -Microsoft Word - Glacial Retreat_Intro (nasa.gov) Teacher Notes: • The video is 4:35 minutes long. • Word Cloud sites- mentimeter.com, wordcloud.com. polleverwhere.com • If using Google Classroom, prepare a google document for the students to complete their work in. Source: (10) NASA Explorers: Cryosphere - The Big Thaw - YouTube Microsoft Word - Glacial Retreat_Intro (nasa.gov) Glacial Retreat: Quantifying Changes in Glacier Cover Over Time | MyNASAData	• Understand the objectives of the lesson
Exploration Phase • Have the students work in pairs or small groups (depending on class size) to study the three images of Bear Glacier. Have the students discuss and share what they notice about each photograph. While the students are in their groups walk around listening to their discussions checking for their understanding and answering questions. • Project the images onto a smartboard (if available) and discuss with the students the different features that they see to make sure they are identifying them correctly. • Next follow the Procedures from Day 7 of the Glacial retreat lesson. The students will only need the 1986 and 2002 images of Bear Glacier. They will continue working in the same	**Duration: 30-40 minutes** Teacher Role- • Correct students' misconception about glaciers. • Facilitate learning and guide student understanding. • Explain how to calculate percent of

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<td>pairs/groups to calculate the change in the size of the glacier over time. -Microsoft Word - Glacial Retreat_Intro (nasa.gov)
• Depending on the age and math abilities of the students the teacher may need to review how to calculate the percent of cover change. There is also a reference sheet with example problems to share with the students if needed.
• After each group has finished their calculations, they will share them as a class. The teacher will write them on the board to determine the class average for the percent of change in the glacier size.
• Last have the students complete the Evaluation questions on their own to gauge their understanding of the lesson.
• Have the students share their answers to question number three on the handout. “If the glacial retreat captured in the satellite images of Bear Glacier is typical of most glaciers, what do you think will happen to the glaciers worldwide in the next 50 years” This can be completed in many ways, I like to use a word cloud document or as an exit ticket.
• This will lead to the discussion for the Explanation Phase of the lesson.

Teacher Notes:
• While the students are working in their groups circulate around the room making sure they are understanding the activity and answer any questions.

Source:
Bear Glacier Images_0.pdf (nasa.gov)
Microsoft Word - Glacial Retreat_Intro (nasa.gov)</td>
<td>cover change.

<u>Goals</u>
• Students will analyze changes in glacier cover over time using satellite images</td>
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<td><u>Explanation Phase</u>

• Start with watching Glacial Pace, which describes the studies about glaciers and ice sheets melting, which is leading to a dramatic rise in sea level. - NASA Explorers: Glacial Pace - YouTube
• Next watch Flying Alaskan Glaciers: the video spotlights the significant changes in ice thickness from data collect from 1994 to2013. -NASA Explorers: Flying Alaskan Glaciers - YouTube

• Have the students discuss in their groups what they found interesting and or concerning about the two videos and share with the class.</td>
<td>Duration: 15-20 minutes

Teacher Role-
• Encourages students to explain concepts in their own words
• Asks for clarification from students
• Builds on student explanations
• Provides time for students to compare their ideas with others and revise</td>
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<td>Teachers Notes:

• Depending on the class, you could assign one article to each group to read and then share with the rest of the class.
• A Decade of Exploring Alaska's Mountain Glaciers | NASA- is the article that is tied to the video Flying Alaskan Glaciers, if needed for extra information.

Sources:

NASA Explorers: Glacial Pace - YouTube

NASA Explorers: Flying Alaskan Glaciers - YouTube

Optional - A Decade of Exploring Alaska's Mountain Glaciers | NASA</td>
<td>their ideas

<u>Goals</u>
• Students will learn about the changes in glaciers and the thickness of the ice sheets.</td>
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<td><u>Elaborate Phase –</u>

• In groups the students will read the three articles included in the Glacier Retreat packet: Climate Change in National Parks, Global Climate Change and Melting Glaciers and Climate Change and Biotic Patterns. Microsoft Word - Glacial Retreat_Intro (nasa.gov)

• After reading the articles have the students complete a Claim, Evidence and Reasoning paper answering the following question- What is likely to happen to the plants and animals that live in the Artic area where the glaciers are retreating, and the sea ice is thinning?

 
CER Glacier.docx

Teacher Notes:

• I normal assign the CER's as an assignment and post it on Google classroom, so I can check students understanding over the topic of study. This can be used as formative assessments to gage students understand of the topic.</td>
<td>Duration: 30-40 minutes

Teacher Role-
• Provide explanation, and information through text.
• Builds on student understand about the consequences of climate change.

<u>Goal</u>
.
• Students make claims and reinforce them with evidence and reasoning from the articles they read.
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Source: Microsoft Word - Glacial Retreat_Intro (nasa.gov)	
Evaluate Phase • The student will develop a plan to help save the plants and animals that live in the areas where glacial are retreating and sea ice is thinning. • They may make a digital presentation of their choice or create a model to represent their plan. • The presentations/plans will be presented in class. • Presentation/ plan need to include sources of information. Teacher Notes: • Provide a list of sources for the students to use if needed. • Review with students the correct format for citing their sources. • Scoring guides that I like to use. Microsoft Word - Creative Project Rubric.doc (spps.org) Microsoft Word - Science Presentation Rubric.doc (spps.org)	**Duration: 90-180 minutes** Teacher Role- • Asks open-ended questions • Provides opportunities for students to assess their progress **Goal** • Students will develop and present a plan in class.

Work Cited

Between Langley Research Center and - nasa.gov. (n.d.). Retrieved October 13, 2021, from https://www.nasa.gov/saa/domestic/33359__33359_SAA1-28174_Annex2_.pdf.

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