Sphere Lesson #2 plan- Eyes on Earth Course

Lesson: Polar Bears- Species on Thin Ice

Teacher: Emily McAfee

Grade-band: High School Biology- 10th grade

Length of Lesson: 2 full blocks (Blocks schedule- 1 block total (1 hour and 45 min))

Topics: Hydrosphere, Biosphere, Biodiversity, Human Impact

Materials Needed: Projector, Large white graphing paper, tape, rulers, sharpies

Cross-cutting Subjects: Math, Graphing, Conservation, Climate Change, Literacy

Standards:
HS-LS2-2. Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales. [Clarification Statement: Examples of mathematical representations include finding the average, determining trends, and using graphical comparisons of multiple sets of data.] [Assessment Boundary: Assessment is limited to provided data.]

Cross-Cutting Standards
CCSS.MATH.PRACTICE.MP2 Reason abstractly and quantitatively.
CCSS.MATH.PRACTICE.MP4 Model with mathematics.
CCSS.MATH.CONTENT.HSS.IC.B.6 Evaluate reports based on data.

This lesson uses a variety of math standards in that it requires students to both use mathematical skills such as graphing and interpreting these graphs by reasoning abstractly and quantitatively. When the students put all of the graphs together to place the full 41 years of data students can see the full 40 year change shown in sea ice minimum changes. In this situation students are modeling a physical phenomenon that has biological implications with mathematics. Students sharpen both their math skills and their critical thinking skills in this lesson.

Measurable Student Learning Objectives:

- Students will be able to identify sea ice as a variable that affects biodiversity.
- Students will be able to determine trends in a graph and compare to a second data set to make inferences from the data.
- Students will be able to provide evidence of sea ice minimum being a factor that affects biodiversity and support their claim/evidence with scientific reasoning.
- Students will be able to describe specific examples of how shrinking sea ice minimums affect a particular species population.

Lesson Plan: Use Google Slide provided as a reference for how the class will move along, including all links and visuals. All handouts are linked within the lesson description and on the right column.

5E Model	Student Experience	Resources/ links
Engage *Approx. 15 minutes*	Students will complete a see, think, wonder while looking at 3 photos of polar bears. Students will write down at least three observations of the photographs, write two inferences they make and write down what these photographs make them curious about. 1. Teacher will start the class by showing photos of starving polar bears on factors affecting biodiversity slides. Students will be asked to complete a "see, think, wonder" to help them get started on the topic and get them engaged. Most students will be really concerned when they see these images. Using their Species on Thin Ice Worksheet they will write their answers in the appropriate box. 2. Once students have been given an appropriate amount of wait time, the teacher should mediate a discussion among students. Students should share with their elbow partner (or otherwise assigned partner) first what they wrote in the first box. Pause and allow each group to share out an observation they made. 3. Next the students should think, pair and share with their elbow partner what they think about the photos.	https://climate.nasa.gov/vital-signs/arctic-sea-ice/ Factors affecting Biodiversity Slides Species on Thin Ice Worksheet

	This is where students are allowed to make inferences and pull in background knowledge. Again, once discussion time is given the whole class should share out their ideas. 4. Lastly, students will repeat the same process as in step # 2 and 3 for discussion then share out what it is these photographs make them curious about. 5. Students will be given the definition of biodiversity and will be asked to brainstorm ideas of things that might impact biodiversity? 6. Stemming from the discussion about what students "wonder" about it is likely students will be curious about whether there is actually less ice or if that is just what these photos present. The exploration stage will be introduced here as a way to answer the question students are curious about. The factor students will be studying about in the next section is sea ice loss.	
Citations:	Arctic Sea Ice Minimum. (2020, October 06). Retrieved November 11, 2020, from https://climate.nasa.gov/vital-signs/arctic-sea-ice/	
Explore *Approx. 45 minutes*	Students will graph the average sea minimum extent data from NASA to determine whether this is a significant factor that might affect the biodiversity of the ecosystem. Instead of just having students graph all 41 years of sea ice minimums, students will split the data into groups and assign it to groups of 3 students. This way, students will get practice graphing but will spend the majority of the activity doing what is most important- analyzing the graph for trends. Using large graphing paper I will split up each group to graph a different set of data points and then we will connect the graphs to see the overall trend. This will encourage discussion how graphs and photos can be used by others to be misleading. Now that students have analyzed the data to determine the trend for themselves students will then make predictions about what this loss of arctic sea ice will affect. Discussion should be aimed towards biodiversity 1. Students will be split into 6 groups, making groups of three if you have a class size of about 20. This will give each group 6 data points to graph. These groups should be modified according to your class depending on if you have a	https://climate.nasa.gov/vital-signs/arctic-sea-ice/

	smaller/larger group. Each group should be graphing at least 5 data points and there should be a minimum of two to a group. 2. Using the NASA Sea Ice Data worksheet students will graph their section of the graph as a group. The questions on the paper can be discussed as a group must be their own individual work. 3. Before students start, have students answer questions #1-4, so each student puts the independent and the dependent variable in the correct location. It is also important to set a basis for what the scale is for each group so the graph is as accurate as possible. I would suggest, have students use a ruler to measure one inch for each line they create on their graph to be sure the lines have a consistent distance between. Otherwise the trends seen on the graph will be unreliable. 4. To graph their data students should take turns each graphing a point then rotating the grapher. Once each group has graphed their subset of data, have each group answer questions #5-8 as a group. 5. On a large wall, tape each graph together to the wall to see the overall trend of the 41 year data. Discuss as a class question #9 for each group. The teacher should lead the group to see that this data can be easily misconstrued if we only choose to look at parts or even if we were to change the scale. 6. Discuss the downward trend that shows a decrease in the September sea Ice minimum. 7. Teacher should then show the time-lapse from NASA's satellite images to give students a visual and help them see just how significant the sea ice loss really is. 8. Now that students can see that there is a significant loss in arctic sea ice over the past 41 years. Have them brainstorm the impacts this would have on the ecosystems there including: species, abiotic factors, predator/prey relationships and biodiversity. 9. Students will complete	
Citations:	Arctic Sea Ice Minimum. (2020, October 06). Retrieved November 11, 2020, from	

	https://climate.nasa.gov/vital-signs/arctic-sea-ice/	
Explain *Approx. 30 minutes*	Students will view a map of tagged polar bear movement in the 1990's and compare it to movement in the same region in the 2000's. Students will make inferences from the maps of the effects of this sea ice loss on the hunting grounds of these polar bears. The map shows where a tagged polar bear has traveled to in the region off the west coast of Greenland. After students have made their predictions students will read the article attached to the maps explaining some of the various effects on the polar bears using a prediction strategy. 1. Before reading the article students will just examine the map showing the movements of tagged polar bears in the movements of the 1990's compared to the 2000's. Students will use the questions on the NASA Sea Ice Data worksheet to help analyze the map. 2. Students will be using a strategy called Prediction Relay to work with a partner to predict and summarize the main points of a reading. First step, group students into heterogeneous groups with a higher level student paired with a lower level student. 3. Students will take turns being the designated coach and player. The player will predict what their section will say by scanning for vocabulary and main phrases. When it is the player's turn they will read the first 4 paragraphs of the article then the player is asked to summarize those four paragraphs. Some good questions to ask are: - the who or what of the paragraph; - the most significant thing discussed - the main idea If the player answers the questions incorrectly or is missing some details the coach will step to help correct the player- a constant coaching situation. This process will be repeated until the article is complete. 4. The last portion of this step of the model is to have students summarize the article by answering the question "how does the loss of arctic sea ice affect the polar bear population?"	https://earthobservatory.nasa.gov/images/146023/polar-bears-struggle-as-sea-ice-declines http://www.adlit.org/strategies/23276/ NASA Sea Ice Data worksheet

	** Prediction Relay is a reading instructional strategy adapted from adlit.org. This strategy was slightly modified for the amount of reading present and for the scientific questions being asked.	
Citations:	All About Adolescent Literacy. (n.d.). Retrieved November 11, 2020, from http://www.adlit.org/strategies/23276/ Polar Bears Struggle as Sea Ice Declines. (n.d.). Retrieved November 11, 2020, from https://earthobservatory.nasa.gov/images/146023/polar-bears-struggle-as-sea-ice-declines	
Elaborate *Approx. 1 hour and 20 minutes*	Like the polar bear populations students will choose an endangered species from the arctic region that will be affected by the receding sea ice. Students will complete a research on this species and will be using it to create a compelling video or poster to help be an agent of change for this species. This goal of this project is to help urge politicians and people to help protect the species and change our current trend of loss of sea ice. This means the student must also research the causes of climate change to be an effective influencer. The student must include their graph of sea ice as part of their case for the need for a call to action. . 1. Students will complete the research sheet to gather information about a species in the arctic that is being affected by the gradual loss of arctic sea ice. Students will need access to a device with the internet and an adequate amount of time to research the new species. 2. Once the students finish the research planning sheet, the teacher should go through the 3 point rubric with the students discussing what it should look like if the project exceeded expectations and what it might look like if it needs improvement. **This is a 3 point rubric: meaning I give the students the basic criteria then I walk through the rubric with my class and discuss what it would look like to exceed expectations or to need improvement. Students will begin research after we will read through the rubric together and they have a deeper	https://docs.google.com/document/d/1VdxgX57C3_RSghs4ss3c3Tz9MYsoq9ChV9ctCBznuhc/edit

	understanding of what is expected of them. 3. Students will create their project using the research gathered in the planning stage. The students' work will be evaluated and scored based on the rubric provided.	
Citations:	n/a	
Evaluate *Approx. 20 minutes*	Lastly, students will create a CER (claim, evidence, and reasoning) to demonstrate their understanding of how a factor (sea ice loss) can affect the biodiversity of an ecosystem. Students will create a claim stating that shrinking sea ice is a factor that affects biodiversity. Students will then pull evidence from the graph they made regarding sea ice, the tracking maps of tagged polar bears and also the research completed on their second species. All of this was research that supports the claims that biodiversity of the arctic region is affected by an abiotic factor such as sea ice. 1. Students will complete a CER by using the CER worksheet to help guide their evidence and reasoning. Claim- The students claim should be their answer to the question being asked. The claim should be supported by the research previously done in class. Evidence- Students will use the previous graphs, maps and research used earlier in the lesson to support their claim about whether sea ice is a factor that affects biodiversity. Reasoning- The reasoning apportion of the CER should tie directly into the correlating piece of evidence. For example, if a map is used as evidence for the shrinking of the sea ice minimum the reasoning should explain how that particular piece of evidence supports the claim. The reasoning should be present for each individual piece of evidence used. 2. The student will be evaluated on their CER according to the CER department rubric.	https://docs.google.com/document/d/1d-jRMiA7paqJ8eZ8TO9uuBwYgYrUQ4i9bAQjYdK8w9Y/edit#
Citations:	n/a	