Sphere Lesson #1 plan- Eyes on Earth Course

Lesson: The Breathing Ocean

Teacher: Emily McAfee

Grade-band: High School Biology- 10th grade

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

Topics: Photosynthesis, Carbon Cycle, Ocean Acidification

Materials Needed: Electronic device, data analysis worksheet, CER worksheet, no manipulatives needed

Cross-cutting Subjects: Literacy (pulling evidence from text)

Standards:
HS-LS2-5. Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere. [Clarification Statement: Examples of models could include simulations and mathematical models.] [Assessment Boundary: Assessment does not include the specific chemical steps of photosynthesis and respiration.]
CCSS.ELA-LITERACY.RL.9-10.1
Cite strong and thorough textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text.

Measurable Student Learning Objectives:

- Students will be able to explain how phytoplankton play into the earth's carbon cycle and identify the causes of productivity from looking at the data.

NASA Mission Focus/Real-Life Connection: Using the Terra Satellite scientists are able to study patterns on our earth on a global scale.

Background knowledge: As background to this lesson students will need to have experience with identifying the inputs and outputs of photosynthesis and cellular respiration. Students should be able to identify how the two processes are in a cyclical relationship with each other. Students will also

have basic understanding of the vocabulary carbon sinks and carbon sources and how these terms fit into the carbon cycle.

Data Integration:

Students will be interpreting a topographic time-lapsed map showing chlorophyll levels and sea-surface temperatures on the globe. From this data they will interpret the phenomenon and make a claim stating why the observed phenomena happened.

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. 10 minutes*	Overview: Students will gain background knowledge of what phytoplankton are and the role they play in the carbon system. In general, most students are unaware of the role that these microscopic ocean-dwelling organisms play in our earth's constant flux of carbon. 1. Class is going to start with a poll using google slides asking, "Which environment do you think contributes the most to the oxygen production of our planet?". The slides will use Pear Deck to allow for questioning and answers within Google Slides. 2. I will reveal the correct answer to the question. I will then ask students to show what they know about oceanic photosynthetic life. Using the Pear Deck question tool the entire class will get to see the thoughts of each student in the class. Next, I will give students a definition for plankton as microscopic marine algae as well as some visuals. Discussion will follow about the diversity and microscopic nature of such an important organism! 3. Using Pear Deck, students will analyze a diagram forming 3 questions they have about the diagram. The purpose of this diagram is to have students visualize what is happening to the carbon as it moves through various processes in the ocean. I will draw their attention to the arrow at the center of the screen at the surface water level. Students should observe that the arrow is larger going into the water showing that more CO2 is going into the ocean than what is coming out. Point out to students that while this is a positive thing and a natural part of the balance of systems, we continue to add more CO2 into our atmosphere. This can lead to too much dissolved CO2 in the ocean leading to ocean acidification.	Google Slides Phytoplankton NASA Global Phytoplankton Distribution Story Map https://earthobservatory.nasa.gov/features/Phytoplankton https://ocean-climate.org/?page_id=3896
Citations:	Lindsey, R., & Simmon, R. (2010). What are Phytoplankton? Retrieved October 14, 2020, from https://earthobservatory.nasa.gov/features/Phytoplankton The Ocean, a carbon sink. (2020, January 30). Retrieved October 14, 2020, from	

	https://ocean-climate.org/?page_id=3896 N. (n.d.). Story Map Series. Retrieved October 14, 2020, from https://nasa.maps.arcgis.com/apps/MapSeries/index.html?appid=426fc4ec6f8b456d847c5729a683753d	
Explore *Approx. 30 minutes*	Students will then be asked the question "If phytoplankton is microscopic how can we possibly study them in the vast ocean that covers 70% of our planet?". This will prompt students to explore a topographic map showing the chlorophyll levels 1. Students will follow the pear deck link to the NASA website showing the time lapse for chlorophyll levels in the oceans. 2. Students will then complete the observation portion of the Data Collection Worksheet with a SEE, THINK, WONDER. This will allow students to start by sharing their observations, learning from others and sharing in their curiosity. 3. Students will use *the data cubes as prompts to interpret and ask questions about the map. The student will roll the cube, if they roll a one they will go to section one and choose a question to answer from that section. Students will roll again and repeat until they answer each question. If they roll a repeat question they may roll again. Student responses to each prompt will be recorded on the Map Cube question prompts. 4. Students should find that chlorophyll levels are at the highest in a few general locations such as near the equator, the arctic, and along coastlines. Students should also notice the huge bloom of phytoplankton in the arctic in the summer months. Students asked to answer directly on the sheet choosing only one question for each section to answer. 5. In the next section students will have these phenomena explained. ***The data cubes were adapted from NASA Data Literacy Cubes for maps. I adapted these cubes by taking the general idea of student choice while still adding in structures questions to help them interpret the data. The questions on the Map cube question sheet	https://modis.gsfc.nasa.gov/about/ https://earthobservatory.nasa.gov/global-maps/MY1DMM_CHLORA Data Collection Worksheet Data Cube

	were my own and tailored to my specific chlorophyll map. The only section of questions I kept from NASA's questions was the "Ask a question" because these were such general but important questions and would apply to any map.	
Citations:	Aqua Satellite, N. (n.d.). Chlorophyll. Retrieved October 14, 2020, from https://earthobservatory.nasa.gov/global-maps/MY1DMM_CHLORA Chlorophyll. (n.d.). Retrieved October 14, 2020, from https://earthobservatory.nasa.gov/global-maps/MY1DMM_CHLORA Lindsey, R., & Simmon, R. (2010). What are Phytoplankton? Retrieved October 14, 2020, from https://earthobservatory.nasa.gov/features/Phytoplankton Maccheron, B. (n.d.). MODIS Web. Retrieved October 14, 2020, from https://modis.gsfc.nasa.gov/about/ *My NASA Data. (n.d.). Retrieved October 14, 2020, from https://mynasadata.larc.nasa.gov/data-literacy-cubes-graphs-maps-and-data-tables N. (n.d.). Story Map Series. Retrieved October 14, 2020, from https://nasa.maps.arcgis.com/apps/MapSeries/index.html?appid=426fc4ec6f8b456d847c5729a683753d	
Explain *Approx. 20 minutes*	Students will read the data explanation provided under the chlorophyll map provided by NASA to help interpret the phenomenon they see in the data. 1. Students will read the scientific phenomena explanation by NASA. Students will answer these questions to show mastery: - What three factors are phytoplankton dependent on for survival? (Same as all plants) - What is ocean mixing? - Why do cold waters tend to have more nutrients than warm waters? - Why is there greater phytoplankton production in arctic waters? - What time of year do you see the huge blooms of phytoplankton in the arctic and why?	https://earthobservatory.nasa.gov/global-maps/MY1DMM_CHLORA/MYD28M Data Collection Worksheet

	2. Teacher-led discussion should follow students answering each of these questions.	
Citations:	Chlorophyll. (n.d.). Retrieved October 14, 2020, from https://earthobservatory.nasa.gov/global-maps/MY1DMM_CHLORA N. (n.d.). Story Map Series. Retrieved October 14, 2020, from https://nasa.maps.arcgis.com/apps/MapSeries/index.html?appid=426fc4ec6f8b456d847c5729a683753d	
Elaborate *Approx. 20 minutes*	Compare chlorophyll time lapsed map with the sea surface temperature map to look for further correlations and potential causes for the phytoplankton blooms. 1. As a class, the students will watch the time lapse of both chlorophyll levels and sea surface temperatures side by side. This will allow students to draw correlations between the two variables since they can see how they change over time and in comparison to one another. Students will complete a think pair share on each individual question. Class discussion should stem from each question the class goes over. The questions are, "Do there seem to be any patterns between the two maps at any same given moment in time?" and "As the temperature increases in the arctic regions, what happens to chlorophyll levels?". They already gathered this information from the explanation but looking into comparing this data allows them to see the correlation for themselves. 2. After discussion on the time lapse is complete the discussion will shift towards climate change and what the implications there are for phytoplankton with a warming planet. Students should connect that a warming planet would cause less productive phytoplankton and thus create a ripple effect that touches the entire planet.	https://phys.org/news/2019-04-view-ocean-impact-climate.html
Citations:	Chlorophyll & Sea Surface Temperature (n.d.). Retrieved October 14, 2020, from https://earthobservatory.nasa.gov/global-maps/MY1DMM_CHLORA/MYD28M Valich, L. (2019, April 25). New view of how ocean 'pumps' impact climate change. Retrieved October 14, 2020, from	

	https://phys.org/news/2019-04-view-ocean-impact-climate.html	
Evaluate *Approx. 20 minutes*	Students will create a CER to answer the question *"What causes phytoplankton blooms?". Students will use their knowledge from interpreting the data to support their claim and explain their reasoning of how the NASA data findings support the claim that they make*. 1. Students will use the CER Evaluation sheet to provide their claim to the question, "*What causes phytoplankton blooms?"*. 2. Students will use the NASA data on Chlorophyll levels to support their claim. At least one piece of evidence should be a screenshot with a description of what the observer is looking at on the map. Another piece of evidence should ideally be identifying sea surface temperature and seasons as a leading factor causing these blooms. 3. Students will then be asked in the "reasoning" portion of the CER to explain using scientific reasoning and principles to explain how the data supports their claim to the question. This section will be how we can evaluate what students learned in the explain section and even more whether they can actually use the data to explain the phenomenon that is occurring by staking a claim.	CER Rubric (Department Rubric for all CER's at BCHS) CER Evaluation Sheet
Citations:	Chlorophyll. (n.d.). Retrieved October 14, 2020, from https://earthobservatory.nasa.gov/global-maps/MY1DMM_CHLORA Chlorophyll & Sea Surface Temperature (n.d.).Retrieved October 14, 2020, from https://earthobservatory.nasa.gov/global-maps/MY1DMM_CHLORA/MYD28M	