Ocean Acidification

Turning curiosity into scientific research

Grade Level: 9th – 12th

Lesson Summary:

Climate change has a multitude of effects, one being the acidification of our oceans. This lesson explains why oceans acidify as human release carbon dioxide into the atmosphere and describes the effects of mild pH change on the ocean's inhabitants. Students perform three tasks related to the topic through a "Tic Tac Toe Choice Board."

Standards:

SC.912.L.17.4 – Describe changes in ecosystems resulting from seasonal variations, climate change and succession.

SC.912.L.17.12 – Discuss the political, social, and environmental consequences of sustainable use of land.

SC.912.L.17.14 – Assess the need for adequate waste management strategies.

SC.912.L.17.16 – Discuss the large-scale environmental impacts resulting from human activity, including waste spills, runoff, greenhouse gases, ozone depletion, and surface and groundwater pollution.

LAFS.1112.WHST.3.8 – Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text.

LAFS.1112.WHST.3.9 – Draw evidence from informational texts to support analysis, reflection, and research.

Project Activity Assessment

Student choice is an excellent way to help your students dive deeper into complex issues such as ocean acidification. Giving students the ability to choose their learning path allows for greater buy-in on their part as well as improved final product quality. This Tic Tac Toe activity is developed in a way that learners of various types of abilities and interests have the opportunity to choose what activities they will complete. There are activities that require additional research, some require creative ability while others only require the student to use the information presented in a video or reading. Students drive their own, personal learning experience in learning menus. If done digitally, this format also allows for the creation of a Google folder on ocean acidification for a digital gallery walk of student work. This would allow students to see each other's responses and learning related to the topic.

Procedure:

- Students should read the "Ocean Acidification" document prior to class, taking notes and referring to the vocabulary listed at the bottom of the reading.
- Refer to the "Tic Tac Toe" choice board, and explain that each student must complete 2 boxes in addition to box 5. By all students participating in box 5, you have the ability to start here, come back together for a class discussion before moving on or coming together after assignment completion for the discussion.
- Below you will find a brief overview of each block, the purpose of the task as well as additional extension activities if you choose to add them.

Box	Purpose of the task	Extension activities
1 Watch https://youtu.be/qAkhuETYn5U After watching this YouTube video write a one paragraph summary of what ocean acidification means for the world's oceans. Do you believe that a drop of 30% in pH in the past 200 years is alarming? Why or why not? Give specific evidence as to why this drop in pH might be a real issue for species living in the oceans.	This is a fast (2 minutes) video with animation that gives a brief overview of the main points behind OA. This video is a wonderful choice for students who are on level or below level due to the short length and verbal and visual manner in its delivery. This video is a good "hook" for students.	You could group students together and ask them to do their own video on ocean acidification or another environmental concern that they have. The students could take it from storyboard to completion once they have presented their board to you.
2 Write A screenplay or conversation between three scientists who are studying ocean acidification. Be sure to include facts and information from online sources that you research. You may choose the setting and situation, but it must include is 3 scientists and details. Your screenplay or conversation should take at least 5 minutes to perform.	This activity is perfect for your more creative kids. It requires them to think of the dialogue between professional scientists while making them research facts and figures that they otherwise might not be interested in. This activity is geared to make a student who loves drama or creative writing take time to critically think about scientific facts that they might otherwise be less enthralled with.	Students could pick classmates to act out the or dialogue within the class. This would be an excellent way to showcase a student's work while also continuing the learning due to the need for the activity to have science-based data and facts in the script.
3 Create a model of a species that will be impacted by ocean acidification. This model can be 3D or 2D and should be in color. Some ideas for your model would be a fish species impacted, a coral species impacted or a representation of a taxa group that will be impacted by increased ocean acidification. Detail should be paid to make the model lifelike and realistic in whichever media you choose.	This activity is geared towards your more artistic kids. They will create a model of a species in the media of their choosing. Based on the supplies you have available the sky really is the limit on what could be created. It might be helpful to add on the requirement of labeling portions of the model so that it better resembles a scientific drawing, sketch or model in which key areas or pieces are labeled for added clarity.	If a student is computer savvy this model could be done digitally. If your school or classroom has access to 3D printing technology then the model could be uploaded to that and printed.
4 Watch https://www.youtube.com/watch?v=8m1X26Auw6Q and write 3 paragraphs about the video. In the video many scientific graphs are used. In your own words explain what at least one of the graphs is showing; what the X and Y axis points on the graph are; and how this information relates to evidence of ocean acidification. Your response should be in complete sentences and follow proper grammar rules.	This video is a 10 minute Ted Talk. This presenter has an accent so ELD students might find it difficult to follow the video. This video is very basic in its introduction of OA and covers main topics related to climate change and OA and would help make this topic understandable.	Students could research a specific aspect of OA such as animal impacts, carbon footprints, future outlooks or scientific reports related to current conditions with climate change. Students would then take this researched material and present it in their own personal Ted Talk which could easily be filmed with a laptop or smartphone.

5 Watch https://youtu.be/GL7qJYKzcsk and while watching this video be sure to take notes. After watching the video please create a quiz along with an answer key to your quiz on a separate sheet of paper. This might require you to watch the video twice or in smaller segments. Your quiz should have a combination of true/false, multiple choice and short answer questions. You will be having a classmate take your quiz (and you will take theirs) so do not make it "impossible" and also not too "easy."	This activity is a great one for visual learners since it is fast paced, attractive, modern and also very clear in it's messaging and visuals. Lower level students could be pushed towards this video and likely experience success with it. This video should be done prior to any other activities since it acts as a topic introduction.	A great extension for this video would be for visual arts capable students to complete an animation of their own. They could create their animation on diving deeper into a topic or portion of this video that they liked or even digitally animate their questions which they wrote on the actual assignment related to this choice item.
6 Research ocean acidification using the material found at https://ocean.si.edu/ocean-life/invertebrates/ocean-acidification Pick one section on this site to read. After reading the section write a two paragraph summary of the section. Be sure to include (a) what the section was about, (b) the issues or solutions regarding OA that were presented and (c) any other information that you feel is valuable.	This report is academically challenging but easily readable material. A student who is an avid reader would find this material to be quite understandable and also in depth.	The student could take the information researched in the reading and create a short news story, blog post or other written product which could be shared in a school newspaper, a class newsletter or similar outlet.
7 Develop a plan on how the general public could be made aware of ocean acidification and its impacts on the marine environment. In this plan, you should discuss the target audience, how you will craft your message, how you will distribute your message and some basic topics/facts that should be included in your message. You can combine this box with number 9 and create a product from this outreach campaign such as a t-shirt, website landing page, Facebook or Instagram post or other creative means that you can think of.	This item is geared towards a student with a focus in relationship building, public speaking or marketing. A creative student would be able to complete this choice item and likely enjoy the process.	This task is recommended to be done in conjunction with box 9. If this combination is done then the student will create an example of their outreach product.
8 Draw a diagram depicting ocean acidification using research from the Internet. Your diagram can be on impacts to species, the role of the ocean in carbon sequestering or the dramatic rise in CO_2 levels or drop in oceanic pH over a period of time.	An artistic student with either hand drawn art skills or whom is digitally capable would thoroughly enjoy this topic. This diagram could be as elaborate or simple as you feel they are capable of.	The student could create a class anchor chart or digital product that could be shared on a class website etc. This chart could be used throughout the lesson on OA and is an excellent way for visually talented students to display their abilities.
9 Choice: Create a lesson building activity of your own! The only requirements are that you clear the project with your teacher, the project must be directly tied to ocean acidification and this project should take 30-45 minutes to complete.	This topic allows for student creativity and free thought.	The extension possibilities to this choice are open to your imagination as an instructor.

Project Activity Rubric

AREA	1 Does Not Meet Expectations	2 Partially Meets Expectations	3 Meets Expectations	4 Exceeds Expectations
Science Content	NONE. Student does not exhibit or express the concepts of OA with clear and defined examples.	SOME. Student exhibits a basic understanding of OA but does not convey its problems.	MOST. Student grasps the concepts OA but lacks mastery of the subject.	ALL. Student grasps the principles of OA. Student can draw comparisons.
Use of Scientific Vocabulary	NONE. Student does not use any introduced concept or use scientific vocabulary to form thoughts and narrative.	SOME. Student attempts to use scientific jargon, but fails to use it properly or in context. Shows some mastery of science language, but fails to use effectively.	MOST. Student uses significant scientific jargon, but fails to identify all principles and concepts. Student exhibits some mastery of scientific concepts and vocabulary.	ALL. Student effectively communicates using scientific jargon and vocabulary to convey narrative. Student has achieved mastery of vocabulary and concepts.
Project completeness	Project was missing more than one major component OR prompts were not answered.	Project was missing one major component OR prompts were not fully answered.	Project contained all components but they were not as complete as they should have been, OR answers to prompts were missing a few key details.	Project or answer to prompt was fully completed, and all important information was present.
Conventions	Spelling, capitalization, and punctuation issues are significant and distract from clear communication and narrative.	Spelling, capitalization, and punctuation errors are present and distract from the story's narrative.	Few spelling, capitalization, and punctuation errors.	No spelling, capitalization, or punctuation errors.