

### Lesson 3-1: Engagement Question

Time	Engaging the Student (entry Task)	Developing the Ideas--Lesson			Checking for Understanding (exit ticket)
		Student Handout	Teacher/Lecture Notes	Materials	
~45 minutes	<p>1. Break students into teams of 3 or 4. We recommend that you decide between random or assigned teams. You may want to put students into teams that balance their skills, interests, and abilities to work together, therefore encouraging positive team dynamics.</p> <p>2. Pose to teams the Engagement question: "Will the oyster farmers still be in business in 5 years?" Allow students to discuss in teams and then report their team consensus back to the entire class. An effective engagement question is an open-ended either/or</p>	<p><a href="#">Effects and solutions worksheet</a></p>	<p>Discuss and write their evidence to the engagement question on the board.</p> <ul style="list-style-type: none"> <li>Have the students categorize the evidence listed on the board. Guide them to the categories of causes, effects and solutions of the issues in the oyster farmer video.</li> </ul> <p>Point out that these categories can be applied to ocean acidification at large.</p> <p>To make sure that everyone understands the process and chemistry of ocean acidification, you will want to either give a lecture outlining the information, or show an explanatory video and then answer questions. Explain the process of <math>CO_2</math> dissolving into the ocean 3 reactions take place during this process</p> <ul style="list-style-type: none"> <li>Reaction 1: <math>CO_2 + H_2O \rightarrow H_2CO_3</math></li> </ul>	<p>Students' journals</p> <p><a href="#">Explanation of the process of ocean acidification</a></p> <p><a href="#">Video explaining the process</a></p>	<p>Start list of causes, effects and solutions of Ocean Acidification</p> <p><i>Journal check-in</i> Spend a few minutes answering reflection questions in journals. "What did you learn today? Who does ocean acidification impact? What questions do you still have about the process of ocean acidification?"</p> <p>Have them complete the effects and solutions worksheet for homework</p>

question that stimulates further discussion and questions about the topic.

- Reaction 2:  
 $H_2CO_3 \rightarrow HCO_3^- + H^+$ 
  - Reactions 1 and 2 are directly related to  $CO_2$  dissolving into the ocean. Reaction 1 explains how  $CO_2$  reacts with water to form carbonic acid, and reaction 2 shows that carbonic acid quickly dissociates into bicarbonate and a  $H^+$  ion.
- Reaction 3:  
 $CO_3^{2-} + H^+ \rightarrow HCO_3^-$ 
  - Reaction 3 describes how carbonate ions in the ocean attempt to reverse this process. Carbonate ions that already exist in the ocean react with the  $H^+$  ions to form bicarbonate. However, this means that there are fewer carbonate ions for shells and coral to use to make

their calcium carbonate structures.

- Net reaction:  
 $CO_2 + H_2O + CO_3^{2-} \rightarrow 2HCO_3^-$
- These reactions cause ocean acidification because reactions 1 and 2 happen at a much faster rate than reaction 3, so there are still  $H^+$  ions being added to the ocean

*For homework:* research 10 bullets on the effects of ocean acidification and possible solutions

- This would be a good time to have a discussion about sources. (This is a time to gauge whether your class has enough experience to judge the reliability of sources.)
  - What makes a good source?
  - Was the author biased? If so how could you confirm the information given by that source?

## Effects and Solutions Worksheet

Name:

Directions: Research ten pieces of evidence on the effects and/or solutions of ocean acidification. Cite your sources for each piece of information you find. Make sure to use **reputable** sources.

Example: Oysters cannot form their shells as easily in more acidic water because the carbonate ions that they need for their calcium carbonate shells are reacting with the  $H^+$  ions instead of with calcium.

Source: <http://www.pmel.noaa.gov/co2/story/Ocean+Acidification>

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