

Task 1a - Working alone, review the lesson plan below and assign a LOAFS phase to each line.

Lesson Plan for Teaching Practices Analysis: Buffers, Buffer Action, and Ocean Acidificationⁱ

Time	Phase	What the teacher does	What the students do
1 min		You've certainly seen headlines about the massive coral bleaching or dying and how this is the result of climate change. How is something as small as coral affected by atmospheric [CO ₂]?	
2 mins		The tools in this lesson plan will enable you to: <ul style="list-style-type: none"> • define buffers and describe buffer action • describe the terms buffer capacity and buffer range • explain the buffering action of seawater • explain ocean acidification and discuss possible impact on biosphere (ie coral) 	MINUTE PAPER Looking at the objectives, rate your own relevant background knowledge as LOW/MID/HIGH. Make a little note to yourself for later.
10 min		Use How Does A Buffer Maintain pH? ⁱⁱ to explain buffer action and the maintenance of pH in a buffer solution. Explain the terms: buffer capacity, buffer range, and the pH equation of a given buffer. Use examples 1+2 from the text to calculate changes in the pH values when a weak acid or base is added to a buffer solution. Discuss other examples of buffers in daily life, e.g., the buffering action of blood.	
10 min		Give instructions step-by-step + remind time left at half point: <ol style="list-style-type: none"> 1. 2 min 2. 3 min 3. 5 min 	THINK PAIR SHARE 1. Alone: Write a 1-2 sentence definition of a buffer. 2. Pair: Together, ensure you have a definition that explains HOW a buffer acts to maintain a stable pH. 3. Share: Ask for 3-4 volunteers to read their definitions
8 min		Surface Ocean pH Levels ⁱⁱⁱ <ul style="list-style-type: none"> • Run simulation to show global pH value (pH indicator strip) of oceans for given atmospheric [CO₂]. Vary the [CO₂] using slider at bottom. • Use "Options" tab to show different emission scenarios (Special Report on Emission Scenarios) and visualize the predicted ocean pH. 	
7 min		Show video micro-lecture Ocean Buffer Chemistry ^{iv} to describe buffering in the ocean.	

		<ul style="list-style-type: none"> - oceans as carbon sinks (absorb atmospheric CO₂) but stable pH due to the buffering capacity of seawater (carbonate) - buffering range of oceans and the chemical implications of a higher dissolved [CO₂] (from increased levels of atmospheric CO₂) -> excess [H⁺] -> acidification - Le Chatelier's Principle—increased [CO₂] concentration in seawater sequesters more carbonate (CO₃²⁻) ions to keep the system in equilibrium. - ocean biota may be affected in the absence of freely available carbonate (CO₃²⁻) ions. 	
15 min		<ol style="list-style-type: none"> 1. Create groups with 3-4 near neighbours. Divide room into 3 = groups a, b + c. "Together, answer your assigned question. You have 5 minutes" 2. At 3 min, say time half gone AND choose spokesperson to share their response. 3. For each topic, ask 2 groups to share their answer 	BUZZ GROUPS <ol style="list-style-type: none"> a. Describe carbonate buffering in the ocean. b. What is ocean acidification? c. How would higher levels of atmospheric CO₂ affect ocean pH?
4 min		<ol style="list-style-type: none"> 2. (After minute paper): Summarise the implications of the predicted pH value of oceans for different emission scenarios and the possible impacts on the Earth's biosphere 	<ol style="list-style-type: none"> 1. MINUTE PAPER <ol style="list-style-type: none"> a. What are the 3-4 key ideas you are taking away from class today? Write them down. b. Rate your own level of engagement in class today (LOW/MID/HIGH) and to what degree you are personally able to meet the objectives (LOW/MID/HIGH)
3 min		<ol style="list-style-type: none"> 3. Show my 3 key ideas and get students to compare to their own lists. 	<ol style="list-style-type: none"> 4. REFLECTION <ol style="list-style-type: none"> a. Compare your background knowledge and in-class engagement to your success in identifying the key ideas and meeting the objectives. b. How satisfied as you with what you learned today?
60	<i>Total time</i>		

ⁱ Lesson plan based on the ideas of Dr. Pragma Gahlot, Sri Venkateswara College (University of Delhi), India.

ⁱⁱ Reading, "How Does A Buffer Maintain pH?" by [LibreTexts™](https://chem.libretexts.org/Bookshelves/Physical_and_Theoretical_Chemistry_Textbook_Maps/Supplemental_Modules_(Physical_and_Theoretical_Chemistry)/Acids_and_Bases/Buffers/How_Does_A_Buffer_Maintain_Ph%3F) introduces the topic of buffers and explains the chemistry of buffer action in solution through examples. [https://chem.libretexts.org/Bookshelves/Physical and Theoretical Chemistry Textbook Maps/Supplemental Modules \(Physical and Theoretical Chemistry\)/Acids and Bases/Buffers/How Does A Buffer Maintain Ph%3F](https://chem.libretexts.org/Bookshelves/Physical_and_Theoretical_Chemistry_Textbook_Maps/Supplemental_Modules_(Physical_and_Theoretical_Chemistry)/Acids_and_Bases/Buffers/How_Does_A_Buffer_Maintain_Ph%3F)

ⁱⁱⁱ Simulation, "Surface Ocean pH Levels" uses visualization to explore changes in ocean pH levels for different atmospheric [CO₂] corresponding to various emission scenarios (as published by the Intergovernmental Panel on Climate Change). Developed by [The King's Centre for Visualization in Science \(KCVS\)](https://applets.kcvs.ca/OceanAcidification/oceanAcid.html) <https://applets.kcvs.ca/OceanAcidification/oceanAcid.html>

^{iv} Video lecture, "Ocean Buffer Chemistry" explains carbonate buffering in the ocean and the resulting effect on ocean biota. [Prof. David Archer](http://www.kaltura.com/index.php/extwidget/preview/partner_id/1090132/uiconf_id/20652192/entry_id/1_16ghjcjg/embed/auto), University of Chicago http://www.kaltura.com/index.php/extwidget/preview/partner_id/1090132/uiconf_id/20652192/entry_id/1_16ghjcjg/embed/auto