PEEBEDU

Ocean Acidification Simulator

Unit 8: Ecology

Name: ______________________ **Period:** ________ **Date:** ______________

Open **peebedu.com** and navigate to **Ocean Acidification Simulator**. Read the introduction popup, which describes the chemistry of ocean acidification and how corals build their skeletons. Select the **Today (2026)** scenario to begin.

Part 1 — Model Evaluation (MAPP Framework)

Scientific models are simplified representations of complex biological phenomena. Use the MAPP framework below to evaluate the Ocean Acidification Simulator as a scientific model.

M — Mode

What type of model is the Ocean Acidification Simulator? Describe how this computational simulation represents the relationship between atmospheric CO_2 and ocean chemistry. In your answer, identify at least three specific simulation elements and explain what each one is designed to show about ocean acidification.

A — Accuracy

(a) Identify two things this simulation represents **accurately** about ocean acidification. For each, name the specific simulation feature and explain what aspect of ocean chemistry or coral biology it demonstrates.

(b) Identify two things this simulation **oversimplifies or leaves out** about ocean acidification. Consider what you cannot observe in the simulation that would be important for a complete understanding of how rising CO&sub2; affects marine ecosystems.

P — Purpose

What is the learning goal of this simulation? Explain how the Ocean Acidification Simulator is designed to help you understand how human-driven increases in atmospheric CO_2 disrupt ocean chemistry and threaten marine organisms. In your answer, connect at least one specific simulation feature to a biological consequence for coral reef ecosystems.

P — Permanency

Could this model change with new scientific evidence? Describe one way that new discoveries might change or improve a simulation like the Ocean Acidification Simulator. Explain why scientific models, including computational simulations, are revised as new evidence becomes available.

Small-Group Discussion

With your group, discuss the following:

- What are the strengths of this simulation as a model for ocean acidification?
- What are its limitations?
- If you could add one feature to improve this simulation, what would it be and why?
- How does the simulation help you connect human activity at a global scale to molecular-level changes in ocean chemistry?

Part 2 — NGSS Questions

1.

> *Simulation Task: Set the CO_2 Concentration slider to 280 ppm (1850 Pre-Industrial) and click Start. Record the pH Level and Carbonate Conc. readouts. Then increase the slider to 425 ppm (Today 2026) and observe how the pH Level and H^+ Ions change.*

Describe how increasing atmospheric CO_2 from pre-industrial levels to today's levels changes ocean pH. Explain how CO_2 dissolving in seawater produces hydrogen ions that make the ocean more acidic, and why this shift in ocean chemistry is a direct result of human activities such as burning fossil fuels.

HS-LS2-7

2.

> *Simulation Task: Click Reset. Set the CO_2 slider to 425 ppm and click Start. Watch the Coral Height readout and the coral growth animation. Then increase CO_2 to 600 ppm (2100 Worst Case) and observe how Coral Health and Coral Height respond over time.*

Explain how reduced carbonate ion concentration in acidified oceans slows coral skeleton formation. Describe how the decline of coral reefs removes habitat for thousands of marine species and leads to a loss of biodiversity in ocean ecosystems.

HS-LS4-6

3.

> *Simulation Task: Click Reset. Set the CO_2 slider to 280 ppm and click Start. Observe the animated molecules in the water column and the color-coded legend. Then slowly increase the slider to 600 ppm and watch how the number and types of molecules change.*

Describe the pattern you observe in the types of molecules present as CO_2 increases. Explain how the ocean absorbs CO_2 from the atmosphere and how this absorption triggers chemical reactions that increase hydrogen ions and decrease carbonate ions in seawater.

HS-LS2-7

4.

> *Simulation Task: Click Reset. Set Initial Carbonate Ions to the maximum value and Initial Calcium Ions to the maximum value. Click Start at 280 ppm and let coral grow for at least 30 seconds. Then increase CO_2 to 600 ppm and observe how the Carbonate Conc. readout and Coral Health indicator change.*

Explain why corals need carbonate ions to build their calcium carbonate skeletons. Describe how ocean acidification reduces the supply of carbonate ions and predict what will happen to coral reef ecosystems if atmospheric CO_2 continues to rise.

HS-LS4-6

5.

> *Simulation Task: Run three separate trials by clicking Reset between each. Trial 1: Set CO_2 to 280 ppm and run for 30 seconds. Trial 2: Set CO_2 to 425 ppm and run for 30 seconds. Trial 3: Set CO_2 to 600 ppm and run for 30 seconds. Compare the Coral Height and pH Level readouts across all three trials.*

Using your observations from all three CO_2 levels, describe the relationship between atmospheric CO_2 concentration, ocean pH, and coral growth. Explain how human-produced CO_2 emissions are driving changes in ocean ecosystems that threaten marine biodiversity.

HS-LS2-7

6.

> *Simulation Task: Compare the simulation at 280 ppm and at 600 ppm. Pay attention to the molecule animations, the Coral Health indicator, and the Real-Time Tracking charts for pH and Carbonate Ion Concentration.*

In the box below, draw a diagram that shows how increasing CO_2 in the atmosphere leads to coral bleaching and biodiversity loss in the ocean. Include the following in your diagram: CO_2 entering the ocean, the increase in hydrogen ions, the decrease in carbonate ions, and the effect on coral health. Use arrows to show cause-and-effect relationships and label each step.

Draw your diagram here.

HS-LS4-6

7.

> *Simulation Task: Run the simulation at 600 ppm (2100 Worst Case) and observe the severe decline in Coral Health and Coral Height. Then reset and run at 280 ppm (1850 Pre-Industrial) to see healthy coral growth. Consider what changes in human behavior or technology could move future ocean conditions closer to the healthier scenario.*

Based on what you observed in the simulation, propose one technological solution or change in human activity that could reduce the rate of ocean acidification. Explain how your proposed solution would lower atmospheric CO_2 levels or protect marine ecosystems, and describe one challenge that would need to be overcome to implement it on a large scale.

HS-ESS3-4