Name: **Date:** **Section:**

Ocean Acidification Simulator Activity: pH Effects on Marine Life

Ocean Acidification: The Other CO_2 Problem

Phase 1: ENGAGE (8 minutes)

Getting Started:

Open peebedu.com and navigate to Ocean Acidification Simulator

Introduction Exploration:

1. Click "Introduction" to learn about ocean acidification
2. Study the chemical equations shown
3. Review the molecule guide

Initial Questions:

1. What happens when CO_2 dissolves in seawater? _____

1. Current atmospheric CO_2: _____ ppm (2026)

Increase: _____ ppm

1. Predict: How will more CO_2 affect:

- Marine life: _____

Key Concept: The ocean absorbs ~30% of human CO_2 emissions!

Phase 2: EXPLORE (20 minutes)

Investigation Setup:

You'll test three time periods to see how CO_2 affects ocean chemistry.

Scenario 1: Pre-Industrial (1850)

1. Select "1850 Pre-Industrial" scenario
2. Observe molecules and coral growth for 90 seconds
3. Observe changes over time

Data Table 1: 1850 Conditions

Observations:

- Coral growth rate: _____
- System stability: _____

Scenario 2: Present Day (2026)

1. Reset and select "Today (2026)" scenario
2. Repeat observations for 90 seconds

Data Table 2: Current Conditions

Comparison to 1850:

- pH change: _____

- Limiting factor: _____

Scenario 3: Future Projection (2100)

1. Reset and select "2100 Worst Case" scenario
2. Repeat observations

Data Table 3: Future Conditions

Critical Analysis:

- Can corals grow? _____

- Ecosystem impact: _____

Phase 3: EXPLAIN (15 minutes)

Understanding the Chemistry

1. **The Chain Reaction:**

Complete the sequence: _____

$CO_2 + H_2O \rightarrow H_2CO_3$ (carbonic acid)

$H_2CO_3 \rightarrow H^+ + HCO_3^-$ (bicarbonate)

$H^+ + CO_3^{2-} \rightarrow$ _____

Result: More H^+ = Lower pH = More acidic!

1. **pH Scale Review:**

- pH 8.2 = Pre-industrial ocean

- pH 8.1 = Current ocean
- pH 7.9 = Projected 2100

Small change, big impact! pH is logarithmic: _____

1. 1 pH drop = _____% increase in acidity

1. **Coral Chemistry:**

Corals need: $Ca^{2+} + CO_3^{2-} \rightarrow CaCO_3$ (skeleton)

Problem: More H^+ ions "steal" carbonate ions!

Less CO_3^{2-} = _____

1. **Real-World Connection:**

Besides corals, who else needs carbonate? _____

- Oysters: _____
- Sea urchins: _____

Pattern Summary:

As CO_2 increases → pH _____ → CO_3^{2-} _____ → Shell/skeleton formation _____

Phase 4: ELABORATE (10 minutes)

Deeper Investigations

1. **Your Custom Experiment:**

Question: At what CO_2 level do corals stop growing? _____

Design:

- Test CO_2 levels: 350, 400, 450, 500, 550 ppm

- Measure: Final coral height after 10 years

1. **Quick Test Results:**

- ---------- Yes/No

550	Yes/No

Critical threshold: _____ ppm

1. **Ecosystem Impacts:**

Draw a simple food web showing impacts: _____

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Phytoplankton → Zooplankton → Small fish → Large fish

↓ ↓

$CO_3^{2-}$ ions Shell formation

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If zooplankton can't form shells: _____

1. **Human Connections:**

Link these to ocean acidification:

- Fossil fuel use: _____

- Your daily activities: _____

Phase 5: EVALUATE (7 minutes)

Assessment Questions

1. **Concept Check:** (Circle the correct answer)

Ocean acidification is caused by: _____

a) Acid rain falling on oceans

b) CO_2 dissolving in seawater

c) Pollution from ships

d) Rising temperatures

1. **Data Analysis:**

From your data, calculate:

- pH drop from 1850 to 2026: _____ units

- Which period shows faster change? _____

1. **Prediction:**

If CO_2 emissions stopped today, would ocean pH: _____

a) Immediately return to normal

b) Continue dropping for years

c) Slowly recover over decades

Explain: _____

1. **Problem Solving:**

A coral reef has pH = 8.05. Corals need pH > 8.0 to survive.

pH drops 0.02 units per decade.

When will corals be threatened? Show work:

1. **Critical Thinking:**

List two ways to help reduce ocean acidification:

Global scale:

1. _____

Personal scale:

1. _____

Model Evaluation:

What does this simulation show well? _____

- _____

What's missing from the model? _____

- _____

Exit Question:

In one sentence, explain why ocean acidification is called "the other CO_2 problem":

- --

Take-Home Challenge:

Calculate your carbon footprint using an online calculator. How many kg of CO_2 do you produce yearly? If the ocean absorbs 30%, how much is that? _____

Your CO_2: _____ kg/year

Ocean absorption: _____ kg/year

1. Research local ocean pH monitoring
2. Interview a marine biologist
3. Design a CO_2 reduction plan for your school
4. Create an ocean acidification awareness poster