

“Save Our Shells” - Bubbles Protocol

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Central Question:

How does carbon dioxide affect salt water?

Overview of experiment:

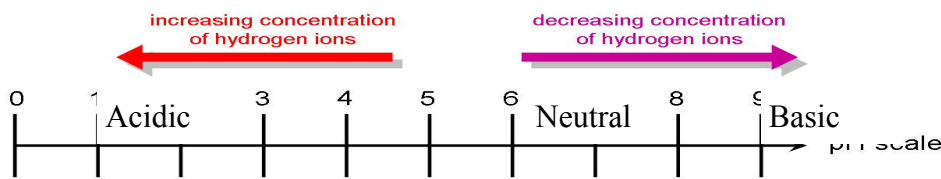
Exhaling carbon dioxide into a beaker of salt water mimics the gas exchange that occurs between Earth’s atmosphere and oceans. You will track the resulting changes in ocean chemistry by monitoring changes in pH as you exhale into the salt water.

Introduction:

Remember: C=carbon, H=hydrogen, O=oxygen

When CO₂ dissolves in seawater, the carbon and oxygen molecules bind together to form carbonic acid, which is shown in the following reaction: $CO_2 + H_2O \rightleftharpoons H_2CO_3$

This carbonic acid breaks apart in the water, **releasing hydrogen ions** and bicarbonate, shown here: $H_2CO_3 \rightleftharpoons H^+ + HCO_3^-$



Pre- lab questions:

1. What gas are you blowing into the water?
2. What happens to the gas when you blow it into the water?
3. How are you measuring change in the water during this lab?
4. What does measuring the pH of the water tell us?
5. After studying the reactions above, how do you think carbonic acid will affect the pH of salt water?

Hypothesis:

Role in Group	Student Name
Timer	
Recorder	
Breather	
Materials	

Material Checklist

Per Station:

- ___ 100 mL Saltwater
- ___ (2) 500 mL beakers
- ___ (2) straws
- ___ (1) timer
- ___ (1) disposable pipet solution
- ___ (1) 0.6mL tube with 0.2mL of universal indicator solution
- ___ Safety Goggles (1/student) and/or Parafilm

Shared Materials:

- ___ Thermometers
- ___ Hot Plate
- ___ Ice Bath
- ___ Tap water
- ___ 100mL Saltwater with indicator (to compare before/after)

Lab Procedure

Preparation

1. Assign a role to each group member
2. Familiarize yourself with the Universal Indicator Color Chart (p. 7).

Control Trial

1. **MATERIALS:** Add 100 mL saltwater to a 500 ml beaker.
2. **MATERIALS:** Using your transfer pipet, add 4 drops of universal indicator. (Save your pipet for your next experiment!)
3. **MATERIALS:** Place a white sheet of paper under the beaker and record the initial color using the table on the data sheet.
4. **MATERIALS:** Stretch the piece of parafilm or saran wrap to completely cover the top of the beaker – then insert the straw by poking a hole through the parafilm.
5. **RECORDER:** Get the data sheet and prepare to record the color of the solution every 30 seconds, using the colors listed on the Universal Indicator Color Chart.
6. **TIMER:** Get timer ready to record for TWO MINUTES - Begin timing AT THE SAME TIME as breather begins blowing.

BREATHER: Begin blowing through the straw into the water at exactly the same time as the timer begins timing. Breathe at a steady rate, **exhaling only** through straw. (Be careful to not inhale or suck on the straw!)

7. **TIMER:** Call out 30 second intervals.

RECORDER: As the timer calls out each 30 second interval, record the color at that time using the same color descriptions as the Universal Indicator Color Chart.

BREATHER: Exhale/blow at steady breathing rate for two full minutes.

8. **RECORDER:** Using the table on your data sheet and the Universal Indicator Color Chart, convert your color data to numbers, plot your data on the graph provided, and draw a line connecting the points to create a line graph.
9. **GROUP:** Decide on how you want to experiment by changing the variables. You will choose Protocol A, Protocol B, or Protocol C. Answer the following question to determine your experimental protocol:

What factors would affect the pH of water?

Hypothesis: _

Based on your hypothesis, which of the following experimental conditions will you test? Circle one and follow that protocol.

- A. Room temperature tap water
- B. Cold salt water
- C. Hot salt water

Protocol A:**Tap Water, Room Temperature**

1. MATERIALS: Add 100 mL tap water to a 500 ml beaker.
2. MATERIALS: Using your transfer pipet, add 4 drops of universal indicator. (Save your pipet for your next experiment!)
3. MATERIALS: Place a white sheet of paper under the beaker and record the initial color, using the table on the data sheet.
4. MATERIALS: Stretch the piece of parafilm to completely cover the top of the beaker – then insert the straw by poking a hole through the parafilm.
5. RECORDER: Get the data sheet and prepare to record the color of the solution every 30 seconds using the colors listed on the Universal Indicator Color Chart.
6. TIMER: Get timer ready to record for TWO MINUTES - Begin timing AT THE SAME TIME as breather begins blowing.

BREATHER: Begin blowing through the straw into the water at exactly the same time as the timer begins timing. Breathe at a steady rate, **exhaling only** through straw. (Be careful to not inhale or suck on the straw!)

7. TIMER: Call out 30 second intervals.

RECORDER: As the timer calls out each 30 second interval, record the color using the same color descriptions as the Universal Indicator Color Chart.

BREATHER: Exhale/blow at steady breathing rate for two full minutes.

8. RECORDER: Using the table on your data sheet and the Universal Indicator Color Chart, convert your color data to numbers, plot your data on the graph provided, and draw a line connecting the points to create a line graph.

Protocol B: **Salt Water, Cold**

1. MATERIALS: Add 100 mL saltwater to a 500 ml beaker.
2. MATERIALS: Place beaker on ice for about 3 minutes.
3. MATERIALS: Using your transfer pipet, add 4 drops of universal indicator. (Save your pipet for your next experiment!)
4. MATERIALS: Place a white sheet of paper under the beaker and record the initial color, using the table on the data sheet.
5. MATERIALS: Stretch the piece of parafilm to completely cover the top of the beaker – then insert the straw by poking a hole through the parafilm.
6. RECORDER: Get the data sheet and prepare to record the color of the solution every 30 seconds using the colors listed on the Universal Indicator Color Chart.
7. TIMER: Get timer ready to record for TWO MINUTES - Begin timing AT THE SAME TIME as breather begins blowing.

BREATHER: Begin blowing through the straw into the water at exactly the same time as the timer begins timing. Breathe at a steady rate, **exhaling only** through straw. (Be careful to not inhale or suck on the straw!)

8. TIMER: Call out 30 second intervals.

RECORDER: As the timer calls out each 30 second interval, record the color using the same color descriptions as the Universal Indicator Color Chart.

BREATHER: Exhale/blow at steady breathing rate for two full minutes.

9. RECORDER: Using the table on your data sheet and the Universal Indicator Color Chart, convert your color data to numbers, plot your data on the graph provided, and draw a line connecting the points to create a line graph.

Protocol C: **Salt Water, Hot**

1. MATERIALS: Add 100 mL salt water to a 500 ml beaker.
2. MATERIALS: Place beaker on the hot plate for about 3 minutes.
3. MATERIALS: Using your transfer pipet, add 4 drops of universal indicator. (Save your pipet for your next experiment!)
4. MATERIALS: Place a white sheet of paper under the beaker and record the initial color, using the table on the data sheet.
5. MATERIALS: Stretch the piece of parafilm to completely cover the top of the beaker – then insert the straw by poking a hole through the parafilm.
6. RECORDER: Get the data sheet and prepare to record the color of the solution every 30 seconds using the colors listed on the Universal Indicator Color Chart.
7. TIMER: Get timer ready to record for TWO MINUTES - Begin timing AT THE SAME TIME as breather begins blowing.

BREATHER: Begin blowing through the straw into the water at exactly the same time as the timer begins timing. Breathe at a steady rate, **exhaling only** through straw. (Be careful to not inhale or suck on the straw!)

8. TIMER: Call out 30 second intervals.

RECORDER: As the timer calls out each 30 second interval, record the color using the same color descriptions as the Universal Indicator Color Chart.

BREATHER: Exhale/blow at steady breathing rate for two full minutes.

9. RECORDER: Using the table on your data sheet and the Universal Indicator Color Chart, convert your color data to numbers, plot your data on the graph provided, and draw a line connecting the points to create a line graph.

Data/ Results

Known pH measurements:
~7.0

Seawater = pH ~8.0

Tapwater = pH

Universal Indicator

Orangish Red	pH 2
Reddish Orange	pH 3
Orange	pH 4
Orangish Yellow	pH 5
Yellow	pH 6
Greenish Yellow	pH 7
Yellowish Green	pH 8
Green	pH 9
Bluish Green	pH 10

Conversion Chart

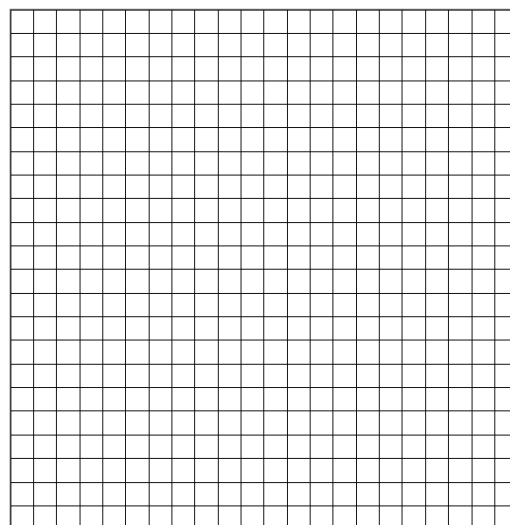
Data Table:

Control	0 seconds	30 seconds	1 min (60 sec)	1 min 30 sec (90 sec)	2 min (120 sec)
pH					
color					
Experimental A,B or C	0 seconds	30 seconds	1 min (60 sec)	1 min 30 sec (90 sec)	2 min (120 sec)
pH					
color					

Label the graph, experiments (in connect the points

plot your pH data from both different colors), and to create a line graph.

pH



Time - Seconds

Analysis and Discussion of data:

1. As you blew through the straw, what were you adding to the water and how did that change the pH?
2. What did the universal indicator tell us about the water?
3. What does this tell us about the effects of carbonic acid in ocean water?
4. Based on the results of your experimental protocol, which factor affects the pH of the water most, temperature or salt?

Conclusion/Summary (Revisit your hypothesis.)
