Example of results for 3 trials to establish the control: students should let the pH stabilize before starting data collection. The 2 low pH lines are probably due to starting the collection before the probes were down in the solution.

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| ***Control: pH of Ocean Water*** |
| **Time (S)** | **trial 1** |  **trial 2**  |  **trial 3** |
| **0** | 6.72 | 8.15 | 4.86 |
| **10** | 7.21 |  8.2 | 5.48 |
| **20** | 7.52 |  8.2 | 6.14 |
| **30** | 7.79 | 8.15 | 6.71 |
| **40** | 7.92 | 8.15 | 7.13 |
| **50** | 7.98 | 8.23 | 7.45 |
| **60** | 8.04 | 8.23 | 7.68 |
| **70** | 8.09 | 8.24 | 7.93 |
| **80** | 8.11 | 8.19 | 7.93 |
| **90** | 8.14 | 8.19 | 7.99 |
| **ΔpH** | 1.42 | 0.04 | 3.13 |
| **Δ ⁰C** | 0.9 | 1.2 | 0.5 |

 

 Trial 2 was the most consistent and so should be used for the graph comparison ( see student directions – Analysis).

Students collected data (6 trials) while exhaling through a straw. They were concerned about controlling the temperature of the sample (warming due to their breath) but the data is usable even with a 5ºC increase (R trial 1). See data on the next page.



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| ***Effects of Breath on pH of Ocean Water*** |
| **Time (Seconds)** | **D Breath 1 (pH)** | **D Breath 2 (pH)** | **R Breath 1 (pH)**  | **R Breath 2 (pH)** | **M Breath 1 (pH)** | **M Breath 2 (pH) w/ice** |
| **0** | 5.74 | 6.67 | 7.88 | 4.41 | 7.67 | 8.11 |
| **10** | 7.52 | 8.02 | 7.89 | 8.09 | 7.92 | 8.10 |
| **20** | 7.73 | 7.93 | 7.75 | 7.98 | 8.08 | 8.09 |
| **30** | 7.78 | 7.97 | 7.36 | 7.96 | 8.09 | 7.95 |
| **40** | 7.72 | 7.88 | 6.61 | 7.81 | 8.08 | 7.73 |
| **50** | 7.51 | 7.52 | 6.23 | 7.69 | 8.03 | 7.37 |
| **60** | 7.36 | 6.67 | 6.13 | 7.37 | 7.91 | 6.47 |
| **70** | 6.53 | 5.93 | 6.04 | 6.57 | 7.73 | 6.02 |
| **80** | 6.17 | 5.89 | 5.99 | 6.17 | 7.42 | 5.89 |
| **90** | 5.94 | 5.97 | 5.98 | 6.04 | 6.81 | 5.82 |
| **ΔpH** | 0.2 | -0.9 | -1.9 | 1.63 | -0.86 | -2.29 |
|  **Δ⁰C** | 0.9 | 2.5 | 5.1 | 1.6 | 2.2 | 0.1 |

Students collected data (3 trials) using dry ice to generate CO2 gas. They used pieces close to the same size (1-2g) hoping that they could control the temperature of the sample. Of course, dry ice is very cold so they saw a temperature swing. Collecting CO2 in a balloon and then attaching a straw to introduce the gas into the sample could control the temperature further. This data was taken using 4.4% salinity which is high. The solution was made following the directions on the box of Instant Ocean®.

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| ***Effects of Dry Ice on pH of Ocean Water*** |
| **Time (S)** |  **pH 1** |  **pH 2** |  **pH 3** |
| **0** | 8.43 | 8.4 | 7.95 |
| **10** | 8.18 | 8.36 | 7.36 |
| **20** | 7.79 | 8.3 | 6.89 |
| **30** | 5.78 | 8.35 | 7.23 |
| **40** | 5.83 | 7.96 | 6.22 |
| **50** | 5.82 | 6.91 | 5.9 |
| **60** | 5.61 | 6.29 | 5.89 |
| **70** | 6.58 | 6.25 | 6.03 |
| **80** | 5.55 | 6.1 | 6.03 |
| **90** | 5.59 | 6.03 | 6.07 |
| **Δ pH** | -2.84 | -2.37 | -1.88 |
| **Δ (⁰C)** | -2.9 | -3.1 | -1.5 |



Students made 3 solutions and collected data (7 trials) while exhaling through a straw. They tried to keep the sample at 8⁰C.

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| **Effects of Salinity on pH of Ocean Water (with CO2)** |
| **Time (Seconds)** | **3.32% sal 1 (pH)** | **3.32% sal 2 (pH)** | **3.98% sal 1 (pH)** | **3.98% sal 2 (pH)** | **6.33% sal 1 (pH)** | **6.33% sal 2 (pH)** | **6.33% sal 3 (pH)** |
| **0** | 4.74 | 8.25 | 8.31 | 8.14 | 8.25 | 8.15 | 8.17 |
| **10** | 6.66 | 8.22 | 8.34 | 8.32 | 8.25 | 8.1 | 8.18 |
| **20** | 8.14 | 8.29 | 8.32 | 8.28 | 8.25 | 8.15 | 8.17 |
| **30** | 8.22 | 8.26 | 8.26 | 8.21 | 8.22 | 8.14 | 8.13 |
| **40** | 8.22 | 8.2 | 8.19 | 8.09 | 8.17 | 8.13 | 8.1 |
| **50** | 8.14 | 8.08 | 8.08 | 7.94 | 8.11 | 8.12 | 8.08 |
| **60** | 8.07 | 7.94 | 7.94 | 7.74 | 8.04 | 8.1 | 8.05 |
| **70** | 7.98 | 7.75 | 7.73 | 7.29 | 7.98 | 8.1 | 8 |
| **80** | 7.85 | 7.37 | 7.33 | 6.61 | 7.88 | 8.08 | 7.95 |
| **90** | 7.63 | 6.87 | 6.72 | 6.44 | 7.79 | 8.08 | 7.91 |
| **ΔpH** | 3.16 | -1.38 | -1.59 | -1.38 | -0.46 | -0.07 | -0.26 |
| **Δ ⁰C** | 0.5 | 0.4 | -1.4 | 0.4 | -2.2 | 1.1 | 1.1 |

