

WIRELESS DATA COLLECTION

Driving Question

How can data collection be incorporated into Science and Engineering Practices across Disciplinary Core Ideas?

Materials and Equipment

Part 1

- Data collection system
- Wireless Temperature Sensor
- Wireless pH Sensor
- Dynamics Track
- End Stop
- Cup
- water
- Straw
- Alka Seltzer
- Juice

Question

How does sweating help regulate body temperature?

Procedure - Sweat

1. Open SPARKvue software on your computing device.
2. Connect the Wireless Temperature sensor via Bluetooth.
3. Create a graph of temperature vs time.
4. Put the temperature sensor into a cup of room temperature water.
5. Start data collection.
6. Remove the temperature sensor and rest it on the rim of the cup.
7. Autoscale the graph to better see the changes in the data.
8. Stop data collection after ~3-4 minutes.

Analysis – Sweat

- 9. How does the final temperature of the probe compare to the room temperature?
- 10. How does the final temperature of the probe compare to the initial temperature of the water?

Table 1: Sweat

Maximum Temperature (°C)	
Maximum Temperature (°C)	
Temperature change in the first 15 seconds (°C)	
Temperature change in the last 15 seconds (°C)	

- 11. What were the maximum and minimum temperatures?
- 12. What was the change in temperature during the first 15 seconds (after the probe was pulled out of the water)?
- 13. What was the change in temperature during the last 15 seconds of data collection?
- 14. Was the *rate* of change consistent during the entire experiment?

Understanding - Sweat

Why do you sweat? Nervous system indicates that your body temperature is too high, stimulating sweat glands causing perspiration.

How does this cool your body? Water molecules absorb energy from your body as they evaporate. This cools your body, just like the temperature probe was cooled during the experiment.

Question

How does dissolved carbon dioxide affect ocean water?

Procedure – Carbon Dioxide

1. Connect the Wireless pH Sensor via Bluetooth.
2. Create a graph of pH vs time.
3. Put the pH sensor into a cup of room temperature water.
4. Start data collection and observe the initial pH.
5. Use the straw to blow carbon dioxide into the water.
6. Stop data collection after you have a noticeable change in pH.

Analysis – Carbon Dioxide

- 7. What evidence is there that the exhaled breath DID NOT dissolve into the water?
- 8. What evidence is there that the exhaled breath DID dissolve in the water?
- 9. Did a reaction occur? If so, what kind of substance was formed? How do you know?

Understanding – Carbon Dioxide

Most of the CO₂ does not dissolve in, or react with the water. A fraction of the CO₂ does react to form carbonic acid.



This can reduce the pH and impact the availability of calcium carbonate minerals that are needed for shellfish and corals.

Experimental observation is that the pH of the top layer of the ocean has decreased by 0.1 unit, from 8.2 to 8.1 during the past century.

Question

How can you tell if a physical or chemical change is occurring?

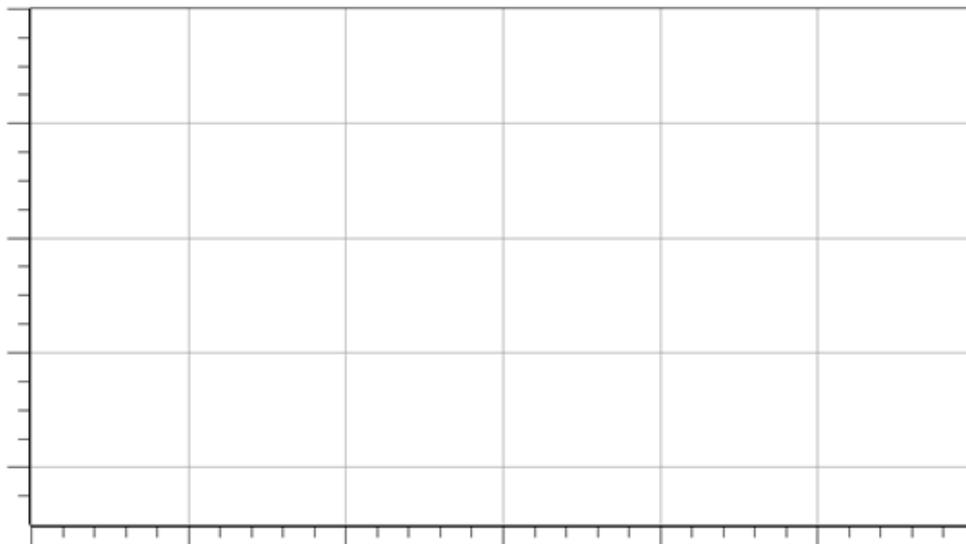
Procedure – Physical or Chemical

1. Connect the Wireless pH Sensor and Wireless Temperature Sensor via Bluetooth.
2. Build a page with a graph display of pH vs time, and a digits display of temperature.
3. Half fill a cup with juice and put the pH sensor and the temperature sensor into the cup.
4. Predict what will happen to the pH and the temperature when the Alka seltzer is added to the juice.

Table 2: Physical or Chemical predictions

I predict the temperature will ...	
I predict the pH will ...	

5. Draw your predicted changes in the pH.



6. Start data collection and observe the initial pH and temperature.
7. Add an Alka seltzer tablet.
8. Auto-scale the graph to better see the changes in the data.
9. Add the other Alka seltzer tablet.
10. Stop data collection after ~3-4 minutes.
11. Build a new display with temperature and pH on the y-axes.

Analysis

- 12. Did the experiment match your predictions?

- 13. Was this a physical or chemical change? List all the evidence that support your answer.

- 14. Was the juice acidic or basic? Provide evidence of your answer.

- 15. What were the minimum and maximum pH values during the experiment?

- 16. Did the mixture become more or less acidic?

- 17. Would the process be considered exo- or endothermic?

Understanding – Physical of Chemical

Physical changes are typically changes in size, shape, or state or matter, while chemical changes result in a new substance being formed. Evidence of a chemical change includes change in color, gas formation, solid formation, change in energy.

Change in the value of a measurement is also good indicator of change.

Question

How can you impact be minimized in a collision?

Procedure – Physical or Chemical

1. Connect the Smart Cart via Bluetooth.
2. Place a dynamics track with end stop on the table. Use a book to elevate the end of the track without the book.
3. Attach a magnetic bumper to the Smart Cart and Place the Smart Cart on the elevated end of the track.
4. Open *Better Bumper* SPARKlab and go to page 5.
5. Start data collection and release the Smart Cart.
6. Data collection will stop after 10 seconds.
7. Place a “student designed crash barrier” on the end of the track with the end stop.
8. Place the Smart Cart on the elevated end.
9. Go to page 6 of the *Better Bumper* SPARKlab
10. Start data collection and release the Smart Cart.
11. Data collection will stop after 10 seconds.

Analysis

- 12. What was the maximum impact force for Run 1 (no crash barrier)?
- 13. What was the maximum impact force for Run 2 (with crash barrier)?
- 14. How could you build a better bumper to minimize impact force?

Understanding

Impact forces, which can be high, cause an abrupt change in velocity. The impact force can be minimized by spreading the collision out over a longer period of time.

Car Bumpers, crumple zones and crash barriers minimize impact forces.