Science Objectives

- Students will collect data for the cooling rates of water and isopropyl alcohol.
- Students will compare and contrast the cooling rate data, both graphically and numerically.
- Students will predict how human homeostasis would be different if we perspired a liquid other than water.
- Students will draw conclusions about the physical and chemical characteristics of water and how those characteristics impact organisms and the ability of the Earth to sustain life.

Math Objectives

- Students will generate linear regression models and compare rates of change from those models.

Materials Needed

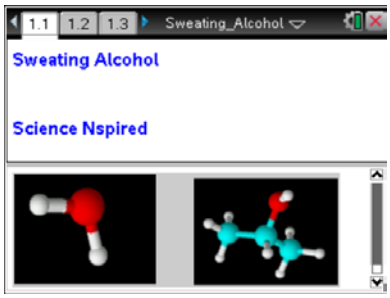
- TI-Nspire™ or TI-Nspire™ CX unit for each student
- Data collection cradle (optional)
- Vernier® EasyTemp™ probe or 2 stainless steel temperature probes
- Small plastic cups
- Bottle of rubbing (isopropyl) alcohol
- Room temperature water

Vocabulary

- polar
- nonpolar
- cohesion
- solvent
- solute
- solution
- homeostasis

About the Lesson

- This activity involves collecting data with a temperature probe as two different liquids cool via evaporation.
- As a result, students will:
  - Compare the two rates of cooling and predict the physiological and metabolic implications if we, as humans, perspired some liquid other than water.
  - Develop a deeper understanding of the properties of water and how those properties allow life to exist.



TI-Nspire™ Technology Skills:

- Download a TI-Nspire™ document
- Open a document
- Move between pages
- Entering and graphing data using multiple applications
- Tracing, interpolating, predicting

Tech Tips:

- Make sure the font size on your TI-Nspire handhelds is set to Medium.
- You can hide the function entry line by pressing ctrl G.

Lesson Materials:
Student Activity

- Sweating_Alcohol_Student.pdf
- Sweating_Alcohol_Student.doc

TI-Nspire document

- Sweating_Alcohol.tns

TI-Nspire™ Navigator™ System

- Screen Capture to monitor student progress.
- Live Presenter allows students to show their graphs to the class.

Discussion Points and Possible Answers

The goal of this activity is to help you begin to understand the "magic" of the water molecule. Without water and its incredibly unique characteristics, life as we know it would be impossible. Not only is water a really good solvent (a dissolver of things), it is a POLAR molecule, which means it is "charged" on either end; one end is positive and the other is negative. Thus, water molecules stick to each other.

This "cohesion" of water molecules makes it hard to heat it up and cool it down. This may sound bad, but it is REALLY good for us living things! Since most organisms are made mostly of water, they retain their heat really well. On a grander scale, since Earth is covered mostly with water, the overall global temperature remains pretty constant. Again, this helps make life possible here.

Move to pages 1.4 through 1.7.

Answer these questions on your handheld.

1. Because of its properties, most of the water on Earth is very warm. True or False.

   Answer: False.

2. In a solution of sugar-water, the sugar is called the ___, and the water is called the ___.

   Answer: B. solute; solvent

3. A water molecule is considered to be "polar" because it is negatively charged on both "ends" of the molecule.

   Answer: Wrong.

4. What do you predict is the approximate percentage of water inside human beings? Express your answer as a percentage (ex: 30%).

   Answer: 60-65%.

Move to page 2.1.

5. Pour a small quantity of alcohol into the plastic cup (an inch or so).
6. Plug in the temperature probe, and place it into the alcohol.
7. Set the TI-Nspire handheld to collect data every second for 30 seconds.
8. Click start to begin sampling, count to 2, THEN lift the probe straight out of the alcohol, keeping the tip pointed down, until the data collection is complete.
   - The data is graphed on Page 2.2.

Move to page 2.2.

9. To determine the rate of cooling, select **MENU > Analyze > Regression > Show Linear (mx+b)**.
10. Record the equation in the data table below.
11. Move back to the *DataQuest*™ page, and run a trial with water instead of alcohol.
12. Move back to the graph, and start sampling. Store the previous run by clicking on the "filing cabinet" icon.
13. Pour a little water into a clean cup, and repeat the procedure for water.
14. Analyze the data as before, and record it in the data table to the right.

Data Table

Equation for Alcohol:

Answer: Answers may vary

Equation for Water:

Answer: Answers may vary

Move to page 3.1.

Answer the following questions on your handheld or here on this worksheet.

15. Which liquid showed a greater decrease in temperature?

    Answer: Alcohol

16. Which liquid seemed to evaporate more slowly?

    Answer: Water

17. Which liquid "cooled" more quickly?

    Answer: Alcohol

18. In the equation that you generated for the regression line ($y=mx+b$), what is "b"?

    Answer: The "y-intercept", which is the temperature when the data collection started.

19. In the equation that you generated for the regression line ($y=mx+b$), what is "m"?

    Answer: The rate of change (slope) in temperature in degrees per second.

20. What is another name for "slope"?

    Answer: Rate of change.

21. In this activity, what data label should be included with the rate of change?

    Answer: Degrees/second.

22. If, rather than perspiring water, you perspired rubbing alcohol, would you cool off more slowly or more rapidly?

    Answer: More rapidly.

23. Consider the heat that is produced and then is taken "away" by your perspiration. What is the source of this heat in your body?

    Answer: Cell respiration.

24. So, if you perspired something like rubbing alcohol, rather than water, how would your lifestyle need to change?

    Answer: You'd need to eat more.

25. Is water a polar or a nonpolar molecule?

    Answer: Polar.

26. Predict whether alcohol is a polar or a nonpolar molecule.

Answer: Nonpolar.

TI-Nspire Navigator Opportunity: *Screen Capture*
See Note 1 at the end of this lesson.

Assessment

Formative assessment will consist of questions embedded in the TI-Nspire document. The questions will be graded when the document is retrieved. The Slide Show can be utilized to give students immediate feedback on their assessment.

TI-Nspire Navigator
Note 1 Screen Capture
Screen Capture can be used to monitor student progress.