Temperature Activity 1

Energetic Weather

How Temperature Affects Climate

Objectives and Standards
- To understand that temperature is a measure of energy, and to assess the role of temperature in the phase changes of water, which impacts climate.

NSTA Standards Addressed
Content Standards
A, B, C, D, F, G

4-H SET Abilities Addressed
Observe
Communicate
Organize
Summarize/Relate
Interpret/Analyze/Reason
Model/Graph/Use numbers

Supplies Needed

- pen and paper
- ruler
- bucket
-measuring cup

Background

Temperature plays a huge role in how our weather works. Using water, we learn about how temperature is really energy, and how energy transforms the water through the three phases of matter; solid, liquid, and gas. We also discuss the difference between linear relationships (like a 1:1 correlation) and stairstep, or threshold, relationships (like the phase changes of water). In this activity, after we learn how temperature is a measure of energy, we become a group of water molecules undergoing phase changes together.

CoCoRaHS Extension Ideas

Using the map of the United States provided by CoCoRaHS, have students locate regions on the map where water can be found in each phase; solid, liquid, and gas. Discuss with them the importance of the phase of water in the region (Colorado/Rocky Mountains have constant snowcover, good for tourism, provides meltwater for valley cities; Seattle, west coastline has lots of cloud cover because the Rocky Mountains create a rain shadow effect, provides lush forests and animal life, fertile soils for farming; Great Lakes region has lots of water for tourism, farming, shipping industry), and what would happen if the water resource wasn't there for each community

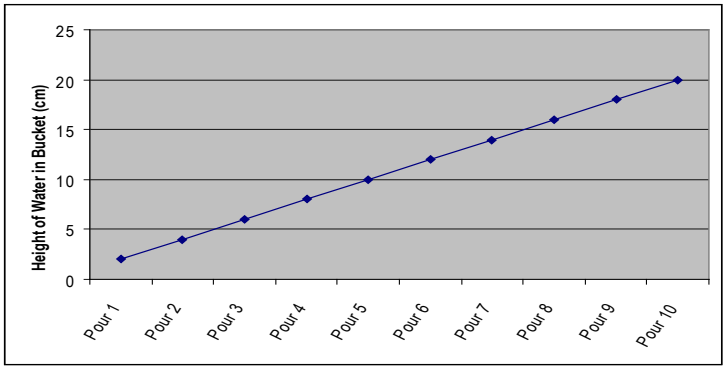
Activity

Part 1

1. Assign 1 person to be the official recorder and another to be the official measurer; give the rest of the youth cups filled with equal amounts of water.
2. One by one, have each youth pour their cup into the empty bucket. Between each pour, measure how high the water in the bucket is, and have that information recorded.

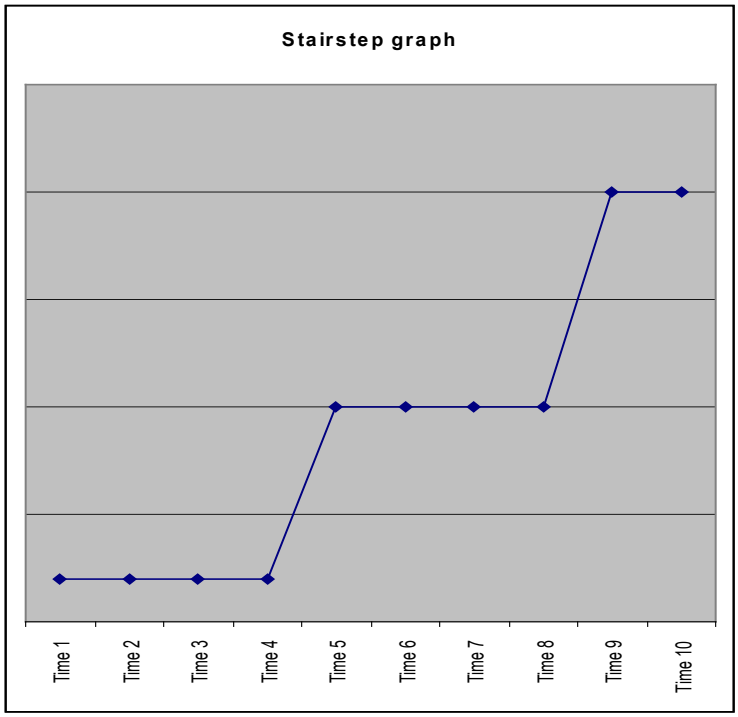
Pour 1 - 2 in
Pour 2 - 4 in
Pour 3 - 6 in

3. Work with youth to graph information on a large sheet of paper or chalkboard.



4. Explain that this is a linear relationship, that for each cup poured into the bucket, the height of water went up about the same abount, which is why the graph shows a nearly straight line.
5. Have students compare their graph with the stairstep graph below. Discuss what is similar (the both go up over time) and what is different (the 1st

graph shows a linear relationship and goes up an equal amount each time, but the stairstep graph is exactly the same for some amount of time and then dramatically rises).



6. Explain to students that the stairstep graph represents water as its temperature is changed. Ask what happens to water when it is really cold, below 32 degrees Fahrenheit (they respond that it is ice). Ask if it gets much colder, what happens to the ice (they respond that it stays in ice form).

7. Ask what happens when you boil water and it gets above 212 degrees Fahrenheit, the boiling point (they respond that it turns to steam or evaporates). Ask what happens to evaporated water when it gets even hotter (they respond that it stays evaporated, it doesn't do anything else).

8. Ask them to guess where on the stairstep graph might be the freezing point, and where the boiling point might be (time 4 and time 9, respectively)? Discuss with them what is happening at each time before the water melts (Time 1 could be 29 degrees, Time 2, 30 degrees, Time 3, 31 degrees, and Time 4 ,32 degrees). Time 5 is unique because the temperature must go above 32 degrees, a threshold point that causes a phase change from solid to liquid. Similarly, at the boiling point (time 9) the temperature must go above 212 degrees, another threshold point that causes a phase change from liquid to gas.

Discussion

After a few entries, discuss observations with the group. Is there a correlation between the type of snow crystals observed and the weight of the snow? In how well the snow packs? Discuss the relationship between snow weight and density with your group, relating it to the above questions. Encourage weather observation journals to continue, recording temperature and precipitation into the other seasons. Ask them to come up with what important measurements should be taken during different times of the year.

Part 2.

1. Explain that temperature is energy, and that higher temperatures have more energy than lower temperatures, and threshold points in water happen when water molecules can no longer handle the amount of energy in their current form and change phases. Then tell youth that they will simulate water molecules that are being affected by temperature.

2. Ask youth to form a human ice cube, reminding them that ice is cold and has a low energy level. Tell them the temperature is really cold, around 20 degrees (F). Encourage them to shiver, displaying the energy in their water molecule. Help them create a shape that is organized, with youth close together in a square shape. They should look something like the diagram below.

O O O O O
O O O O O
O O O O O

3. Remind them that they are water molecules in the form of ice, and even though there isn't a lot of energy present, there is some. Encourage shivering, wiggling, and other slight mvement to simulate the energy in the water molecules.
4. Tell them temperature is now 25 degrees (F). What would happen to their wate rmolecules and ice cube? (It should stay the same shape, without youth moving their feet, but movement in the ice cube should increase)
5. Tell them temperature is now 30 degrees. What would happen to their molecules and ice cube now? (The shape remains, the movement increases again) Remind students that water molecules can gently tap one another as they move.
6. Tell youth that temperature is now 33 degrees. Before they begin to move, ask what their ice cube is turning into (water). Ask them about the properties of water (that it flows around but doesn't fill up the entire space it is given). As they become liquid water molecules, remind them that they should always be able to touch a neighboring water molecule because water cannot expand too far. Also, the temperature is cold, so they don't have too much energy to move around. This means that they can flow freely in any direction as long as they stay within arm's length of other water molecules.
7. Tell youth that temperature has increased to 75 degrees. Youth can move faster, but still need to be able to touch one another at all times.
8. Tell youth that temperature has increased to 200 degrees. Movement should increase, but youth still need to be able to touch one another. There shouldn't be any running, jogging, or speed walking. Encourage youth to move in other ways.
9. Tell youth that temperature has increased to 212 degrees (boiling point). Before they move, ask what happens as liquid water boils (it turns to gas). Ask about properties of gas (still able to flow, fills up all available space it's given), and ask them to mimic those properties. Youth no longer have to be within reach of one another. If space allows, speedwalking, jogging, and running can happen. Youth may continue to gently bump into one another if space allows.
10. You may wish to reverse the process for the students, returning them to a liquid and a solid before bringing them together for discussion.

Discussion

Ask youth what they learned from being a water molecule. How did the temperature affect them? From what they learned, how can temperature affect weather? What kinds of weather can be associated with different temperatures? How does evaporation work when it isn't boiling outside? (the Sun heats up individual molecules so temperature doesn't have to be boiling outside for water to evaporate)

Discuss how different regions of the world have different climates, citing rainforests, temperate zones, the Polar regions, and deserts. What is the daily temperature range in eachzone? Do you think that temperature affects the climates of the different regions? Do you think that small changes in temperature can have large impacts on climates?

Please send us your feedback!

As a 4-H Educator, you know what has worked well, what has not, and how we can improve the *Tracking Climate in Your Backyard* curriculum. Please share your feedback about the curriculum. We'd love to receive copies of any reports or newspaper coverage about completed *Tracking Climate in Your Backyard* projects.

Fax or mail your completed feedback to Trisha Smrecak, Museum of the Earth, 1259 Trumansburg Rd., Ithaca, NY, 14850 or fax to: 607-273-6620.

Check the activity completed	Suggestions for improving the activity
Rainfall Activities ☐ Make It Rain ☐ Where Does the Rain Come From? ☐ Stormy Weather	
Snowfall Activities ☐ Confetti Snow Maps ☐ How Much Water? ☐ Edible Education ☐ The Snowflake Game ☐ Snow Journaling	
Temperature Activities ☐ Energetic Weather ☐ Shade of the Old Oak Tree ☐ Temperature Through Time	
Wind Activities ☐ Why Does the Wind Blow? ☐ Make Your Own Wind Dial	
Hydrologic Cycle Activities ☐ The Incredible Journey ☐ Understanding Evapotranspiration ☐ Pinecones: Mother Nature's Weather Forecasters ☐ What is a Watershed?	
Climate Activities ☐ Where is My Backyard? ☐ Soak up the CO_2 ☐ Buckets O' CO_2 : How Your Backyard Can Change the Ocean ☐ Raise the Waters	
CoCoRaHS Participation ☐ Precipitation measurements and other activities	

Please share your suggestions for improving the Tracking Climate in Your Backyard curriculum.

How have you used Tracking Climate in Your Backyard in your community?

Thank you for completing the Tracking Climate in Your Backyard curriculum feedback. We appreciate learning about how you are using the curriculum and receiving your suggestions for improving it.

Organization _____ **Contact Person** _____

Email _____ **Date** _____