High Energy Groove
How Hot is One Million Degrees Kelvin?

Level: Grades 7-9

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National Science Standards:
Physical Science: Transfer of Energy
-The sun is a major source of energy for changes on the earth's surface. The sun loses energy by emitting light. A tiny fraction of that light reaches the earth, transferring energy from the sun to the earth. The sun's energy arrives as light with a range of wavelengths, consisting of visible light, infrared, and ultraviolet radiation. (Grades 5-8)
-In most chemical and nuclear reactions, energy is transferred into or out of a system. Heat, light, mechanical motion, or electricity might all be involved in such transfers. (Grades 5-8)
Science and Technology: Understandings about Science and Technology
-Scientists in different disciplines ask different questions, use different methods of investigation, and accept different types of evidence to support their explanations. Many scientific investigations require the contributions of individuals from different disciplines, including engineering. New disciplines of science, such as geophysics and biochemistry often emerge at the interface of two older disciplines. (Grades 9-12)

Enduring Understanding:
In order for the sun to emit x-rays the temperature must rise to one million degrees Kelvin.

Essential Question:
How hot is one million degrees Kelvin converted into Fahrenheit and Celsius?

Objective:
The students will covert various temperatures between the Fahrenheit, Celsius, and Kelvin scales.

Background:
http://imagine.gsfc.nasa.gov/docs/science/know_l1/xray_sun.html
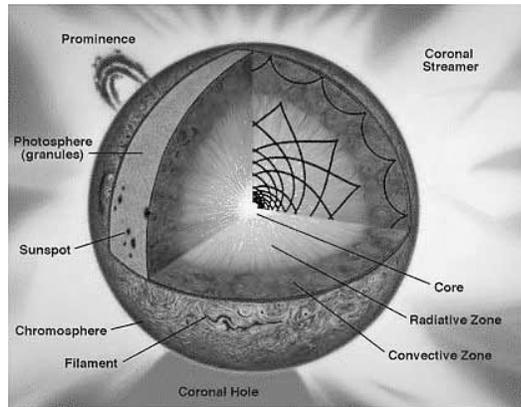
Materials:
Thermometer (lab)
Thermometer (oral)
Ice water
Ground soil (outside)
Access to indoor and outside temperature

Warm up:
Draw and label the structure of the sun.

Prominence
Coronal Streamer
Photosphere (granules)
Sunspot
Core
Radiative Zone
Chromosphere
Convective Zone
Filament
Coronal Hole

Procedure:
1. Review and discuss "The Coronal Heating Problem."
   (http://imagine.gsfc.nasa.gov/docs/science/know_l1/xray_sun.html)
2. Reinforce the information that we do know: We know that the sun emits x-rays. We know that temperatures must rise to one million degrees Kelvin in order to emit x-rays. We know that the surface temperature of the sun is only 6000° Kelvin and that the temperature of the corona is over 1,000,000° Kelvin.
3. Therefore, the question of the day is, how hot is 1,000,000° Kelvin?
4. In order to complete the activity sheet, students will need to complete mathematical conversions. Therefore, depending on the level of students, a quick math review may be in order.
5. Students will complete the first eight conversions to practice on their own.
6. The last five conversions will require students to actually take the temperature of various objects around the school.

Assessment:
Check and review the activity sheet as a class.

Name _____ **Date** _____

How Hot Is One Million Degrees Kelvin?
Activity Sheet

Directions: Use the formulas to complete the table.
Fahrenheit (Tf)   **Celsius (Tc)**   **Kelvin (Tk)**

$Tf = [(9/5) \times Tc] + 32$ $Tc = (5/9) \times (Tf - 32)$

$Tc = Tk - 273$ $Tk = Tc + 273$

Object	Fahrenheit	Celsius	Kelvin
1. Absolute zero			0°
2. Freezing point	32°		
3. Room temperature		21°	
4. Boiling point	212°		
5. The Solar Corona			1,000,000°
6. Universe at Big Bang			3°
7. Surface Temperature of Sun		5727°	
8. Temperature required for H fusion	15,000,000°		
9. Ice water			
10. Classroom temperature			
11. School yard (soil)			
12. Current outdoors temperature			
13. Student temperature (one student)			

14. Imagine you are asked to describe how hot 1,000,000° is to a friend. Write a dialogue of your discussion.
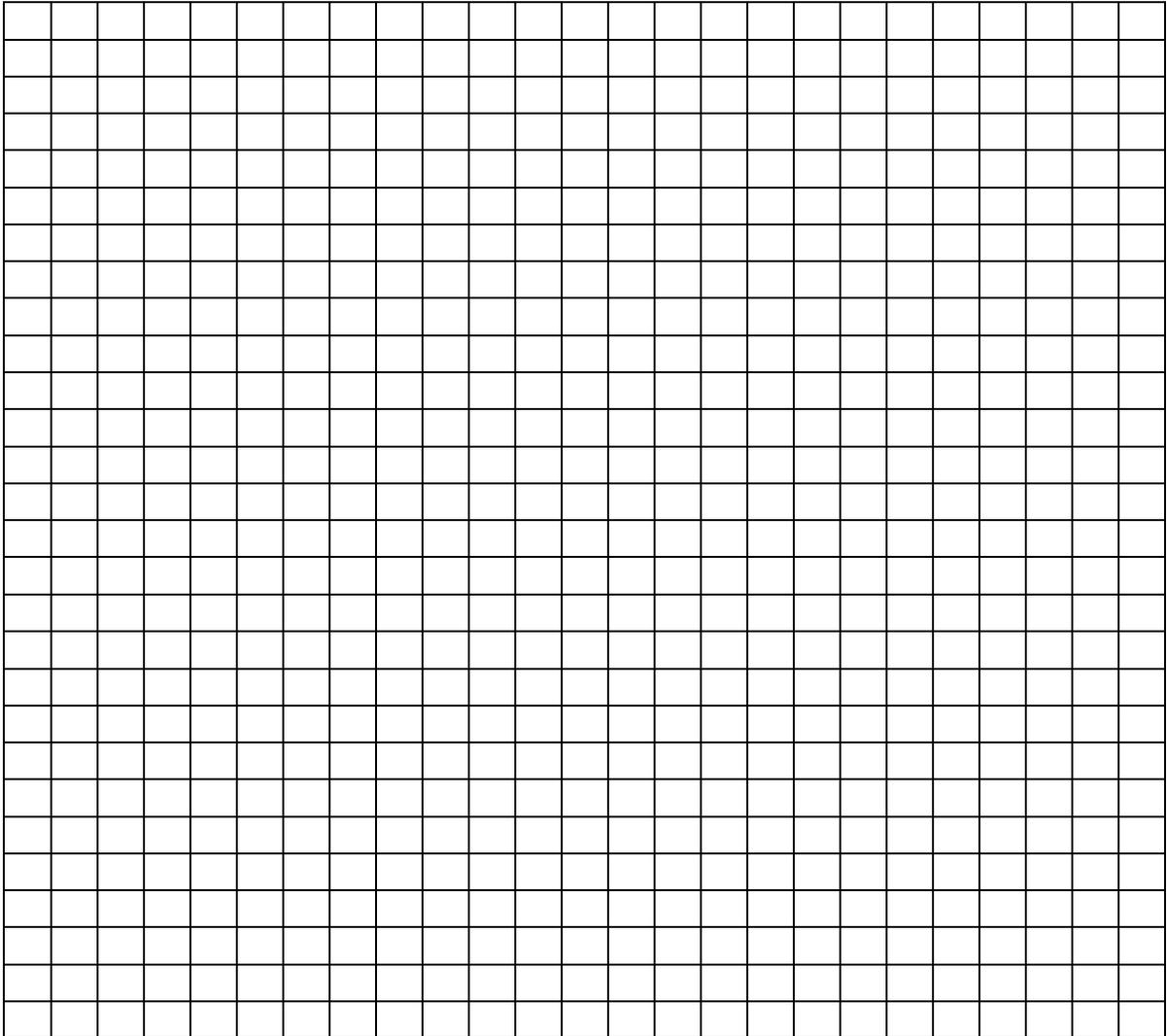

15. Depending on the task, scientists may prefer one temperature scale to another. Pretend you are a x-ray astronomer studying the x-rays emitted by stars. Which temperature scale would be most beneficial to your research? Why?

Name _____ **Date** _____

How Hot Is One Million Degrees Kelvin?
Activity Sheet

Directions: Create a line graph to display your results. Use a different color for each temperature scale.

Temperature

Object