

# Student Experience LESSON: STaRRS Temperature Tools

## When

Prior to the expedition

## Disciplines

All sciences

## Description

Students get a chance to use various temperature tools to explore the Celsius temperature scale. They also will explore the differences in the temperature tools and determine and share with the whole group which tools are appropriate for measuring temperature in different situations.

## Learner outcomes

The student will:

- Learn to use three different kinds of thermometers
- Learn to use the Celsius temperature scale
- Make and explain their choices for using a particular thermometer to do a measuring task.

## Materials

- One or more Kestrel® pocket weather meters
- One or more probe-type thermometers
- One or more IR surface temperature thermometers
- Several standard room thermometers
- it is best if they only measure in Celsius
- Data collecting sheets (one per team)

## Background

Students learn to use a Kestrel pocket weather meter, a probe thermometer and an IR (infrared surface temperature thermometer) to measure temperature using a Celsius scale. As teams they choose five different sites where they measure the temperature using all three thermometers. They record their findings and consider which tool measures most accurately what they intended to measure. Teams present and discuss their findings with the class.



[http://www.bluewaterperformancegear.com/assets/images/kestrel®3000pocketwindmeter.jpg](http://www.bluewaterperformancegear.com/assets/images/kestrel%3000pocketwindmeter.jpg)



<http://www.uvlamp.com/product.asp?code=TEMPNONC+D>



<http://www.rapidonline.com/catalogueimages/module/M118138P01WL.jpg>

**Suggested procedure**

In preparation for this lesson be certain you have read the instructions that come along with these instruments. It is especially important to remember is that the laser feature should never be aimed at any animal (including humans) since it can cause eye damage that will not be immediately noticed, but manifest over time. Do not let the laser beam reflect into eyes when measuring a reflective surface. If you feel you cannot trust the students with this instrument, you may show it to them, but limit its use to teacher.

- 1.** Tell the students that we will be measuring temperature in Celsius because this the international scale used (metric). The USA is the only developed country that uses the English Standard scale known as Fahrenheit. Conversion is not usually appropriate as – the best way to become comfortable with Celsius is to use it. Teach student some standard benchmarks: 100° Celsius = water boils, 0° C = water freezes, 37° C = human body temperature, 20-21° C = standard room temperature (68-70° F)
- 2.** Show students a classic alcohol (red or green) room thermometer. What do F and C stand for? What do we measure with this type of thermometer? (air temperature) Explain that mercury thermometers contain a silver substance that is poisonous. If this type of thermometer is broken it needs to be disposed of in special ways. (They are no longer allowed in schools because they are dangerous, but students may have seen them at home.) Remind students that playing with mercury or tossing it in the garbage can be dangerous – it can harm them and the environment.
- 3.** Demonstrate the probe thermometer. C/F switch, max/min switch, H/T switch. Where might you use this thermometer? What do you think could be measured with this type of thermometer? (internal temperature – students may have seen something like this at home – a meat thermometer)
- 4.** Demonstrate Kestrel®(You can use the Kestrel® User Sheet in this curriculum for yourself and/or print it out for student use, [found at the end of this document](#)). The middle button turns it on. Push again to get the back-light. Hold down this same button to turn it off. The side buttons move icons. We will learn about the thermometer and wind speed icons today. What do you think we could measure with the Kestrel? (air temperature, wind speed) Think about what the double icon wind/thermometer might measure. (wind chill).
- 5.** Demonstrate IR thermometer. (It would be a good idea to read the background about IR thermometers found at the beginning of the Asking Answerable Questions Using IR Thermometers Lesson. There is a section that talks specifically about how these tools work and limitations to their accuracy.) Point at an object - pull and hold trigger for scan, release trigger for a constant reading/hold. The red button on the type of IR thermometer used for STaRRS activates the laser feature. This may be different if you are using a different brand. Make sure you know how it works before you demonstrate it. Explain safety concerns associated with the laser pointer. Explain that the further away from an object we are the less accurate reading is. At about 2 meters, the area being read becomes too large for accuracy. What are we measuring with the IR thermometer? (surface temperature) Explain that IR thermometers may not accurately measure glass and highly reflective objects.
- 6.** Prior to going to the field site: Show students the data sheet and lead a discussion as to why we take 3 readings per tool (called triplicate) at each site. You want them to realize that using 3 readings and averaging them will help to eliminate differences that may occur while taking readings. If there are a limited amount of tools, explain how they will be shared for this activity. Divide students into teams.

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**EXPEDITION: YELLOWSTONE! STaRRS**

- 7.** At the field site: Ask each team to find 5 sites (3 for 2-3 grades) to explore. When a team has decided on their sites, give them a data sheet and give them a set amount of time to collect data.
- 8.** At the end of the data collection time, gather the students again. Give them time (and instruction, if needed) to average their data and think about the questions they will discuss as a whole group (see below). Spend at least 15 minutes having teams briefly report to the whole group what the teams discovered. You can use the following questions to help guide the discussions.
  - A.** Summarize your group's findings – what did you learn about your sites using the thermometers?
    - i.** Which tools worked best at which sites? Why?
    - ii.** What were the characteristics about the site and the tools that made them a good/bad match?
  - B.** What questions do you have now about the tools?
  - C.** If you were going to conduct another investigation about these same sites, what might you want to investigate? Can you do it with the current tools or do you need others?
- 9.** Wrap up by summarizing the groups' findings as the best tools for the job – this could be done as a t-chart, or an oral discussion. You will most likely refer back to this exercise as you prepare to and gather STaRRS data.

**Extensions:**

- Follow up lesson – use these and other tools to help students develop and answer their own questions. See also answerable questions lessons.
- Compare air temperature and surface temperature at one location in or near your classroom throughout the year. (Have students investigate other variables that might affect their data collection, e.g. time of day, shade vs. direct sunlight, etc.)
- Consider air and surface temperature differences sun/shade; near body of water/far from body of water or on different surfaces such as cement, grass, blacktop, soil.



**Temperature Studies (Grades 3-6)**

Group Members: \_\_\_\_\_

Find 5 sites and measure the temperature in triplicate. Record the middle or mean reading.

Thermometer/ Site name →		Site #1	Site #2	Site #3	Site #4	Site #5
<b>IR</b>	Trail 1					
	Trail 2					
	Trail 3					
	Average/mean reading					
<b>Probe</b>	Trail 1					
	Trail 2					
	Trail 3					
	Average/mean reading					
<b>Kestrel</b>	Trail 1					
	Trail 2					
	Trail 3					
	Average/mean reading					

Now, look at your data.

Think about your 5 sites and decide which thermometer worked best to measure the temperature of each site. Explain why?

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# Kestrel® 3000 User Sheet

1. Slide off cover.
2. To turn on, hold down middle button.
3. Select operating mode;  
(Press right arrow to scroll through, instantaneous measurements will be displayed)
  - Current Wind speed
  - Max Wind speed since turning on
  - Average W. ind speed since turning on
  - Temperature
  - Wind Chill (combination of wind speed and temp)
  - Relative Humidity
  - Heat Stress (effect of temperature on animals at high temperatures due to humidity)
  - Dew point (moisture content in air) If temp=dew point, dew is produced.



4. Selecting units of measurement;  
Press right arrow while holding middle button to scroll through units. The available units will be different for each type of measurement

For example, wind speed can be recorded in...

- M/s meters per second
  - Ft/m feet per meter
  - Km/h kilometers per hour
  - Mph miles per hour
  - Kt knots
  - B Beaufort force
5. Hold mode  
Press left arrow while holding middle button to hold the measured value on the display. HOLD will flash.  
This is useful for taking measurements when you are unable to view display.
  6. To turn off: hold middle button for 2 seconds.

