Lesson Objective:

1. Students will make a prediction of water the stream temperature will be based on surrounding habitat and land use.
2. Students will measure the temperature of a stream near the schoolyard and compare to their prediction.

Curriculum Standards:

- NGSS ESS3.C Human Impacts on Earths Systems
- MD E-Lit Standard 1 Topic A: Environmental Issue Investigation
    - Indicator 4: Design and conduct research

Materials Needed:

- Data Sheet, one provided or create your own.
- Manual thermometer, ideally one designed for rugged use (non-mercury, encased in hard plastic or other material to reduce the chance of breakage). Be sure to tie a string or cord around your thermometer so that you can hold on to it easily without losing it to the current.

AND/OR

- Temperature Logger, to observe fluctuations and averages over longer term

VISIT your local stream and observe its structure, stream habitat, and surround land use. Describe:

What type of land use is close to your stream? *Ex. Agricultural, industrial, urban, forest, wetland*	
Do you see any pipes dumping liquid into the stream, or an obvious area where runoff discharges from a pasture/surface?	
Look up. How much of your stream is shaded by tree canopy? *Ex. 0-100% shaded*	
Do you see exposed soil on the banks, erosion, or cloudy water?	
Do you see fish, insects or other animals in the water?	
Do you see more rocks/gravel or fine mud in the stream bottom?	

BEFORE you collect any temperatures and based on your observations, make a prediction of the stream temperature and enter into to box to the right ➔

AFTER you make your prediction, you are ready to perform the actual measurements.

Stream Temperature Prediction:

Collect temperatures of your local stream either by deploying a logger or take periodic measurements manually. Measure a reference stream as well for comparison.

Manual Stream Temperature Method

- Secure the string or cord around your wrist or a sturdy object on the bank, so that you do not lose your thermometer in the stream.
- First collect and record the air temperature before getting the thermometer wet.
- Place the thermometer in the water. You don't want to measure temperature right at the edge, or too deep in the middle.
- Allow the thermometer to adjust to the water temperature for a few minutes.
- Record your reading in your data sheet (example sheet at end of this lesson). Be sure to include the date and time of your measurement.

Hint: Scientist record temperatures in Centigrade
Be sure to record whether the reading is in Fahrenheit (F) or Celsius (C). If you need to convert from one unit to another, use the formulas below:

$°C = (°F - 32) \times 5/9$

$°F = (°C \times 9/5) + 32$

Measure Stream Temperature Over Time: Collect local stream temperatures, either manually or use a temperature logger. If recording manually, create a table for each date, air, and water measurement. Calculate the averages manually or use a spreadsheet program like Excel.

For loggers compatible with the Hood-CCWS Urban Heat Program visit http://www.ccwsscience.org to compare uploaded temperatures and determine averages.

>Complete the following table:

DATA SUMMARY Logger Deployment Dates:_____

Logger #:		**Temperature (°C)**
	• Highest Temperature recorded in your school stream:	
	• Average Temperature of your School Stream:	
	• Average Temperature of a stream that serves as your "reference":	
	Calculate the difference between the average school stream temp and the average reference stream temp	

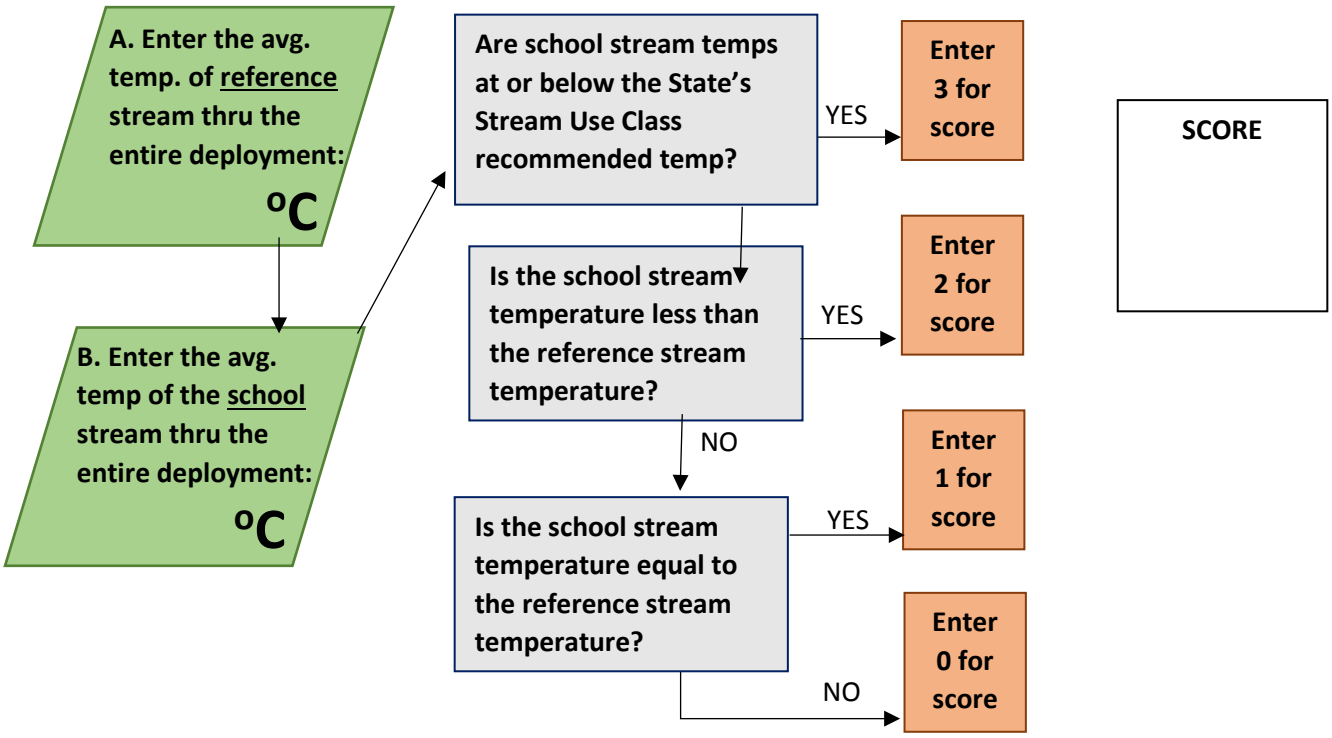
DISCUSSION

- How does your prediction compare to the actual temperature measurement?

- Recall from Lesson 2, the state of Maryland designates each stream a "Use Class" with a maximum stream temperature. Does your stream temperature measurements exceed the Maryland Standards for your stream's Use Class at any time? If so, when?

#4 Schoolyard Stream Temperature versus Reference Stream Temperature

Score your schoolyard stream below:



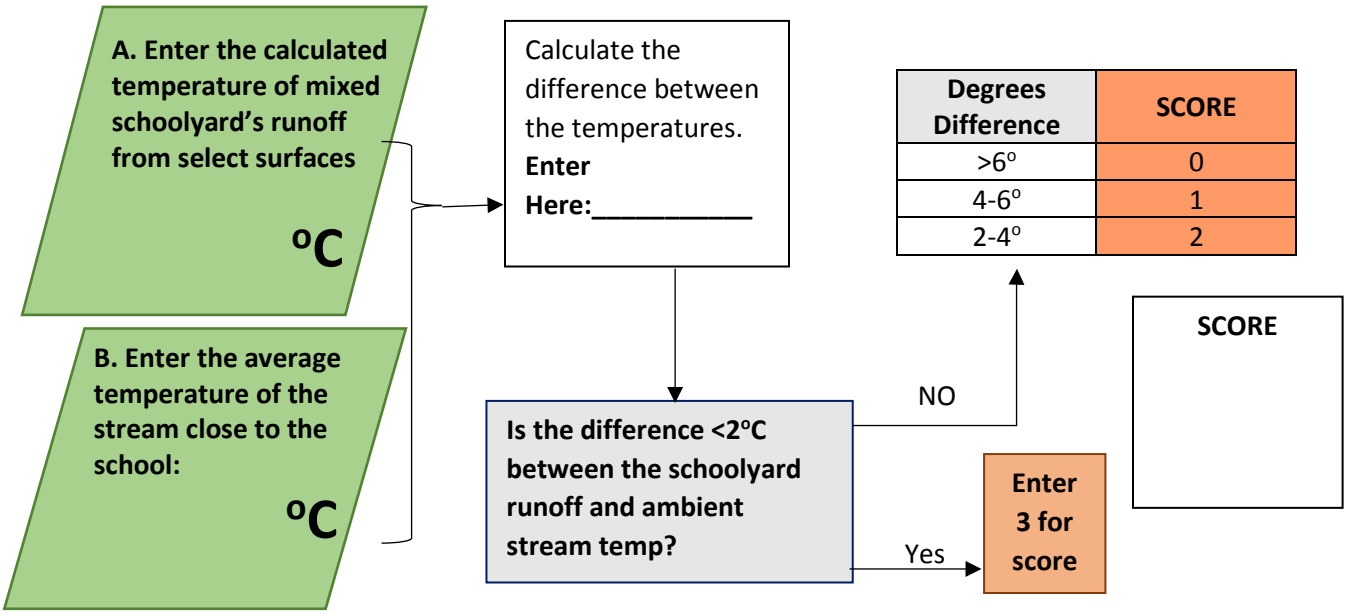
Synthesize the information:

What are some root causes of elevated stream temperatures	What are the environmental effects from this problem?	Who has the ability to influence change on this problem?
Ex: policies, practices, phenomena		

#5 Schoolyard Select Surfaces Runoff Temperatures versus Local Stream Temperature

Score your school's runoff impact below:

Use data from Mixing Model (Water Lesson 3)



Synthesize the information:

What are some root causes of elevated stormwater runoff temperatures	What are the environmental effects from this problem?	Who has the ability to influence change on this problem?
Ex: policies, practices, phenomena		