How to Achieve Accurate Aquarium Temperature Control

One of the goals of teaching kids science is to give them a sense of why it's important to make careful observations. Trout in the Classroom gives them a great chance to practice observing and recording their observations and learning how fish develop from eggs and what variables control the process.

Temperature regulates all chemical processes, including the growth of all life forms. What your students are about to experience, apart from the obvious biological changes, is how the development of Rainbow Trout - from eggs to fish - is affected by the temperature of their environment. Many scientists have studied this in detail and there is much literature that quantifies the effect of temperature on the development of eggs to Alevins and from Alevins to Fry.

People who study this use a unit of temperature measurement over a period of time called the TU or thermal unit. It is defined as the number of degrees of temperature above the freezing point of water for a time period of 24 hours. If something is kept at a temperature of 55° F for one day, the number of thermal units it experiences is 55-32=23 TU. The total number of TUs that are required for eggs to hatch into Alevins has been studied for a range of temperatures from 33°F to 60°F and from Alevins to fry from 40°F to 60°F. Temperature is the basic variable that determines the development.

So how are we going to teach our students to measure the temperature? We give them aquariums with appropriate gravel beds; show them how to go about assembling, cleaning and sterilizing them and how to control the water temperature. However, the device that measures the temperature, a digital thermometer, must be able to make accurate temperature measurements. The out-of-the-box supplied device is an inexpensive one made for fish aquariums and is not always capable of precise measurement. So as a first experiment, even

before assembling your aquariums, I would suggest that your class do a simple experiment to "calibrate" your Digital Thermometer.

Ice, water, and water vapor (solid, liquid and gas) exist together at an unique well-known temperature (and pressure) called the "triple point" or "freezing point" which is 32°F. Incidentally, water also has another unique point where only liquid and water vapor exist and this called the boiling point (212°F) and we would normally take a straight-line correction between these two points to calibrate the thermometer. However, unless you plan to cook your eggs we will assume a constant correction for all our low temperature measurements.

For the class experiment, take a plastic insulated coffee mug, fill it near the top with crushed ice and add room temperature water to the point where the ice is covered. Break it up to form an ice/water slurry. Fashion a plug of Styrofoam (~1/2 inch thick) that fits snugly into the top of the mug. Insert the probe of the thermometer into the ice slurry and plug the Styrofoam into the top of the cup over the ice slurry.

After 10 minutes or so, or when the temperature stops changing, record the temperature. Ask your students to read what the temperature shows. Then tell them that It should read exactly 32.0° F. If it doesn't, they must apply the difference to all future readings of the temperature with their digital thermometer. This process is called "calibration". Because of manufacturing differences, some of these devices can be off by as much as 2°F. Over a 10 to 20 day interval this error could amount to 20 to 40TUs and this could make your projected hatch or swim-up dates off by as much as one or more days. The moral of this experiment, loosely speaking, is to always check the accuracy of your measurement tool.

Jim Scherer
Cell: 510-418-1776
11/12/2012