Dissolved Oxygen

Narrator: Just as we need oxygen to live, so do all aquatic organisms. While we get the oxygen we need from the air we breathe, many aquatic organisms rely solely on the water for their oxygen needs. What affects the level of oxygen in the water and how do we measure it? Here's Kristopher Wright, aquatic biologist from the University of Wisconsin-Platteville and Kris Stepenuck, volunteer stream monitoring coordinator, to answer those questions.

Kristopher Wright: Because all stream organisms require oxygen, measuring dissolved oxygen is one of the most important variables. The amount of oxygen within a stream is a consequence of the amount of oxygen within the stream and the amount of oxygen being consumed within the stream. Oxygen gets into the water by two different methods. First, the amount of exchange that happens between the water and the air itself; therefore, in riffles where the surface is very rough we get a lot of exchange with oxygen. In a pool where there isn't that turbulence, we may not get as much exchange. The other important way to get oxygen into a system is through the activity of algae and plants that are able to do photosynthesis; therefore, creating oxygen using sunlight.

Oxygen is removed from the stream by all organisms. All organisms including algae and our plants respire which means that they use oxygen to convert sugar for the rest of their daily activities. A very important part of sampling dissolved oxygen is making sure that you sample consistently, both in terms of location and time of day. Oxygen will fluctuate in terms of the location that you sample. As we mentioned earlier, the pools and the riffles allow for different exchange of oxygen with the water surface; therefore, we always want to make sure that we monitor at the same location.

In terms of the time, oxygen can fluctuate from day to night because of the activity of the organisms in terms of photosynthesis and respiration. At night, respiration is being done by all organisms and therefore the levels of oxygen tend to decrease. During the day, the algae and plants are able to photosynthesize, allowing oxygen levels to increase during the day.

The minimal levels in a 24 hour period generally occur just before dawn. Sampling twice during a 24 hour period will give you an idea of the daily fluctuations.

Because you're going to be using temperature later on to calculate percent saturation of your dissolved oxygen, you might want to measure temperature and dissolved oxygen at the same time.

The equipment you'll need to sample dissolved oxygen are: hip boots, a Hach kit, safety goggles, your data sheet, and a pencil.

I'm going to show you three different techniques to take your sample for dissolved oxygen. The first of which is based on your sample bottle from your Hach kit. As always, enter your study site from downstream and find your consistent sampling location. Then, turn downstream and completely submerge your sample bottle under water. You want to avoid getting bubbles in your bottle. So allow water to flow into the bottle for a while and invert your bottle a couple of times. Then, you can put the stopper into the bottle under water and lift the bottle out vertically. You're going to have a little water

around the rim next to the stopper. That's okay. It will be helpful later when we're processing the sample.

The second technique is using a modified jar or peanut butter jar that you may get from your monitoring coordinator. To use the sample jarring method, take your Hach kit bottle and stick it inside and remove the stopper. Insert the rubber stopper with the two tubes into the jar and put it on tightly. Again, turn downstream and completely submerge the entire unit under water. What will happen is that water will enter one of the tubes while bubbles are released from the other filling the Hach kit bottle from the bottom up. Bubbles will be coming out of the top tube and when they stop coming out, that means your jar is full and you can remove the unit. Then, remove the rubber stopper. Put your Hach kit sample bottle stopper into the glass bottle and remove the bottle vertically with the lip of water around it just like we mentioned before.

The third and final method is something we might use in case water conditions are too high or we can't have easy access to our sample site. To do that, we might want to use just a simple stick or PVC pipe in which we rubber band or tie our sample jar to the stick. Then, collect the sample just as before.

Now that we have our sample, we're going to go up on shore and finish processing our dissolved oxygen.

Kris Stepenuck: Now that Kristopher has collected the sample, I'm gonna show you how to process it. It's important to do this as soon as possible after you've collected the sample, because chemical processes are still happening which can affect your sample results. After you put your goggles on, pick up dissolved oxygen reagents 1 and 2 from your Hach kit. Then, use either the scissors or the toe nail clippers provided with your kit to open the packets. Pinch them open. Remove your stopper by twisting. Then, pour them in. If you get any chemical on the neck of the bottle, use your stopper to push it in.

It's important in this step that you don't get any bubbles in your sample. If you do, you need to go back. Collect a new sample and start again. If you don't get any bubbles, go ahead and shake it up. You should get what looks like an underwater snow storm or flocculant in the sample. You want to let this settle about half way down. This will take a few minutes. Longer if the water is cold. Once the flocculant has settled, you want to shake it a second time. This makes sure the chemical reaction is completed. Like before, let that flocculant settle about half way down.

Once you've let that settle a second time, you'll take dissolved oxygen reagent 3 which is the plastic powder pillow. Open that and add it to your sample. Pinch it open like you did with the other two packets. This time, it doesn't matter if you get a bubble in your sample. Like before, you can push the chemicals that may have collected on the neck of the bottle into the sample. And again, you want to pick it up and shake it.

At this point, your sample is fixed which means that you can put this in your Hach kit. Shut it. Take it home and process it the rest of the way in an hour or two. What we'll do now though is finish that in the field.

You're gonna use your measuring tube and your mixing vial and fill this measuring tube twice with your prepared sample. Your next step will be to use the chemical sodium thiosulfate to add to your prepared sample. It comes with an eyedropper. The important part for this step is to make sure you hold the eyedropper vertically and you make full drops as you add it into the sample. You want to count the number of sodium thiosulfate drops you add into your sample. Mix the sample each time you add a drop. You're trying to get your sample to change from yellow to clear. It will get lighter with each drop of sodium thiosulfate.

What we'll do is add a few drops of starch to the sample which is gonna turn the sample blue, because it's easier to see a color change from blue to clear than it is to see a change from yellow to clear. You're going to continue to add sodium thiosulfate drops adding onto your previous count and mixing after each drop.

If you aren't sure if you've gotten your sample to be clear yet, it sometimes helps to hold a white paper behind the sample. In this case, we're going to add one more drop. You can see now that it's clear. This means that you're done processing the sample.

At this point, what you wanna do is record on your data sheet the number of mixing tubes that you used. We used two unlike the Hach directions which tell you to use just one because that means that we can find our dissolved oxygen to that nearest half a milligram per liter instead of whole milligrams per liter. You also want to write down the number of sodium thiosulfate drops that you used. Then, to determine your number of milligrams per liter, divide the number of drops (in our case, 20 by 2) by the number of mixing vials to get your answer in milligrams per liter. For us, it's 10.

The last step is to determine the percent saturation of dissolved oxygen. To do this, turn your data sheet over. You'll find a chart on the back that has a place to find the dissolved oxygen in mg/L and temperature in degrees Celsius. Then, you'll use a straight edge to determine the percent saturation on the chart. Record that on your data sheet.

To dispose of your sample, if you've done it in the field, you can just pour your sample on the ground in some vegetation away from the stream. If you've taken it home, it's okay to dispose of it down the drain.

To summarize, to monitor dissolved oxygen, you want to:
-mark your site
-collect your sample
-process your sample
-record your results

Narrator: Although at first, measuring dissolved oxygen may seem a bit complicated. You'll find that after you've done it a few times, you'll feel comfortable with the procedure. One thing to remember is that dissolved oxygen levels fluctuate throughout the day. So, it's best to measure dissolved oxygen at about the same time of day each time you monitor.

If you would like to know more about dissolved oxygen, view the stream ecology section of this DVD series.