Subject: Science, Social Studies

Grades: 8-12

Duration: 45-minute class period

River Water Quality

Lesson Overview

Students will learn about the importance of oxygen in rivers, as well as the concept of the "oxygen sag". They will then use a river quality simulator (the River DO Simulator) to learn about the parameters most important in determining the DO sag curve and water quality in general. They will change certain parameters in the simulator to see different effects on the curve and determine best management practices.

Objectives

By the end of the lesson, students should be able to:

- summarize/describe the oxygen sag curve
- use a simulator to model and change the curve
- define "best management practices"

Introduction

Begin the lesson by asking the students a question:

Where does oxygen come from? (the air, the atmosphere, etc.)

We get our oxygen from the air (which is made up of about 21% oxygen), and from oxygen producing plants like trees. So how do fish get their oxygen?

Fish get their oxygen from the same place; from the air, when it hits and mixes with the surface of the water, and from plants growing in the water. The plants perform photosynthesis, which releases oxygen either to the surface of the water if the plant is near the shore, or directly into the water if the plant is submerged. The difference here is that the oxygen must be incorporated into the water, so we call it dissolved oxygen, or DO. What do you think changes how much DO fish can get?

DO levels typically decrease as temperature increases. So, a fish in warmer water is likely to not have as much oxygen available as in colder waters. Also, the flowrate in rivers affects DO. Oxygen levels usually also decrease as the flowrate decreases. This is because there is less mixing going on when the water is moving more slowly, so the oxygen from the air doesn't mix as effectively.

At this point, pull up a graph of typical oxygen levels in a river over time and explain:

As time downstream increases, something strange happens to levels of oxygen in the river. The graph sags towards the start, which eventually returns to its initial state. Therefore we call this the "DO sag curve".

Let's say a fish needs 5 mg/L of dissolved oxygen to survive, and it swims downstream into the sag, which contains less than 5 mg/L of DO. What do you think will happen to the fish?

Luckily, there are some things we can do to prevent this from happening.

Have the students pull up the River DO Simulator on their computers and give a brief overview of how the program works and what each important parameter means.

Our goal today is to reduce the DO sag curve and move it up to the blue curve.

Allow about 10-15 minutes for everyone to do this. Once everyone is finished or close to finished, give the students an introduction to the concept of best management practices:

How do you think we, as engineers, can affect things like BOD removal or reaeration in a river?

BOD removal can be increased depending on the type of treatment done at treatment plants. Typically, this value does not go much higher than 80%, but it can. Reaeration can also be increased by aeration treatment in rivers. This puts more oxygen into the river, which decreases the effects of the sag curve. All of these improvements are also known as 'best management practices' or 'BMPs'. BMPs are the strategies environmental engineers use to solve or improve upon problems. All of you were environmental engineers today! We saw a problem and used BMPs to fix it. We'll be using more BMPs in the next water quality simulator when we look at lakes.