

# DATA *Nugget*

## Surviving the flood

### Respiration and productivity extension

Featured scientists: Andrew Blinn and Dave Costello from Kent State University

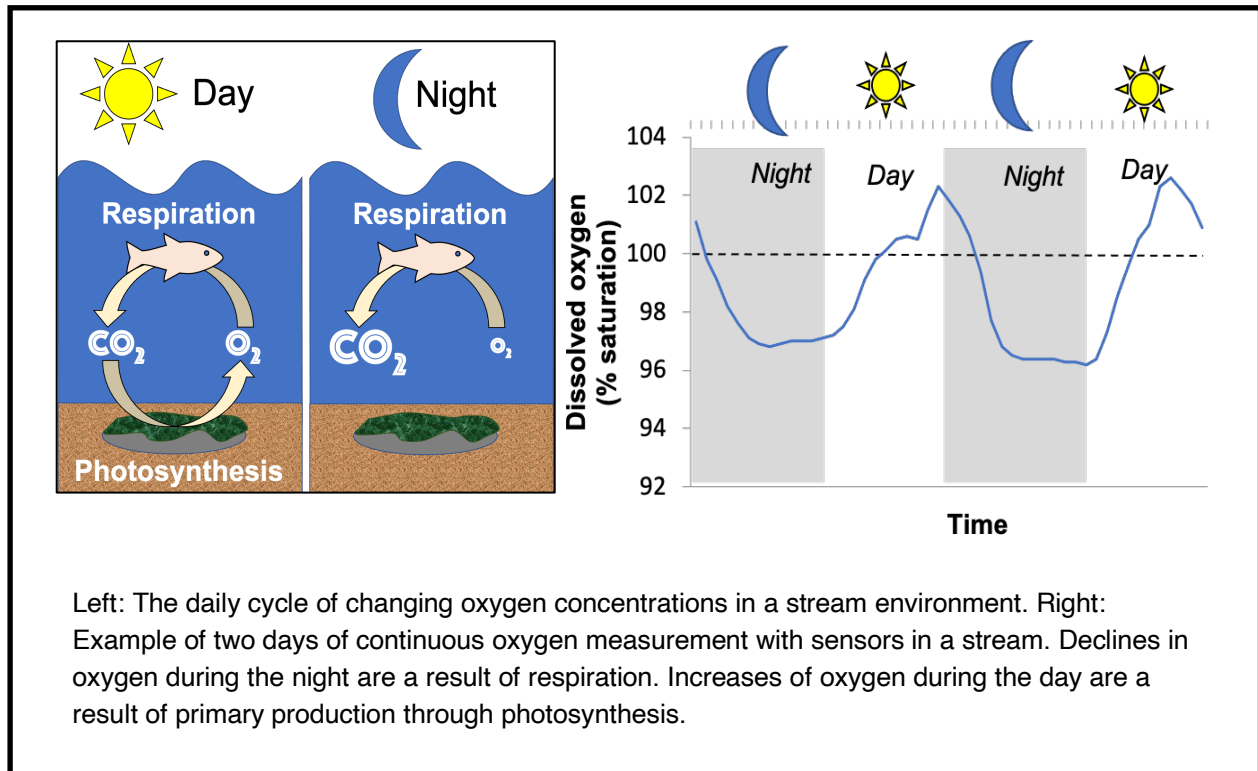
Andrew and Dave focused their research on algae because they are an important part of aquatic ecosystems. Algae use energy from sunlight and building blocks from carbon dioxide gas to create sugar and oxygen. This process is called **photosynthesis**. Just like trees and other plants, algae “breathe out” oxygen gas when they photosynthesize. The oxygen is then used by other organisms in the stream, like fish and insects, that breathe underwater. Like us, these organisms use **respiration** to use energy from the food they eat. Together, the photosynthesizing of algae and respiration of organisms causes the oxygen concentrations in stream water to be constantly changing.



Scientists use sensors to measure the daily “breaths” taken by a stream – during the day, algae photosynthesize and breath out oxygen. During the night, other species respire and take up

From dawn to dusk the sun is out. When sunlight is available algae photosynthesize by using energy from the sun to transform carbon dioxide into sugars, producing oxygen as a waste product. As algae photosynthesize, the amount of oxygen dissolved in stream water increases. Tracking the amount of oxygen that algae “exhale” during the day is an indicator of how much new algae has grown. Because the algae are making new biomass, ecologists call this process **production**.

At night, the sun is not out, so algae do not photosynthesize or release oxygen into the stream water. Fish, other animals, and bacteria are still respiring though – taking in oxygen and releasing carbon dioxide. You can see the changes in oxygen and carbon dioxide shift overnight. The oxygen is used, but algae are not adding more at night, decreasing the oxygen concentration until the sun comes up.



In a way, the whole stream ecosystem takes one big “breath” every day, with an exhale of oxygen during the day, and an inhale of oxygen at night. This cycle of increasing and decreasing oxygen concentrations in stream water can tell us how a stream works as an ecosystem and allows scientists to monitor the health of the stream.

Andrew and Dave are two scientists interested in stream health. They use sensors to monitor the daily “breathing” of urban streams to see how algae respond to storm events. Their sensors measure the oxygen concentration in the water every 10 minutes. Rising oxygen concentrations are caused by photosynthesis and falling oxygen concentrations are caused by respiration. By totaling these changes over an entire day, scientists can create graphs that show the daily “breaths” of a stream.

Technically, the scientists are measuring what ecologists refer to as **gross primary production**, which is the total amount of carbon dioxide that photosynthetic organisms like plants and algae (primary producers) “fix” into living biomass over a period of time. During this same period, primary producers use some of the sugars they made to grow and maintain their biological functions. They respire and some carbon dioxide is released back into the stream water. In an ecosystem, the amount of carbon dioxide fixed to sugars over a period of time minus the amount that is respired back to carbon dioxide is called **net primary production**.