

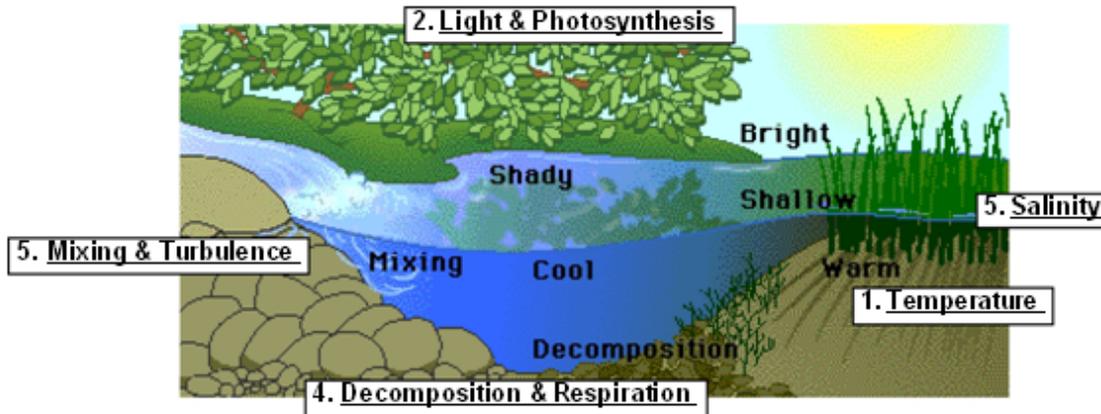
AP Lab 12--DISSOLVED OXYGEN & AQUATIC PRIMARY PRODUCTIVITY (LabBench)

Web address: http://www.phschool.com/science/biology_place/labbench

Click on Lab 12: Dissolved Oxygen & Aquatic Primary Productivity

A. KEY CONCEPTS:

1. **Dissolved Oxygen Availability** in ponds and lakes. Using the following diagram describe the effect that each of the factors has on availability of oxygen and explain why.



- a. Temperature: Water becomes warmer, its ability to hold oxygen decreases.
- b. Light & Photosynthesis: bright light, aquatic plants are able to produce more oxygen.
- c. Decomposition & Respiration: organic material decays, microbial processes consume
- d. Mixing & Turbulence Wave action, waterfalls, and rapids all aerate water and increase the oxygen concentration.
- e. Salinity water becomes more salty, its ability to hold oxygen decreases.

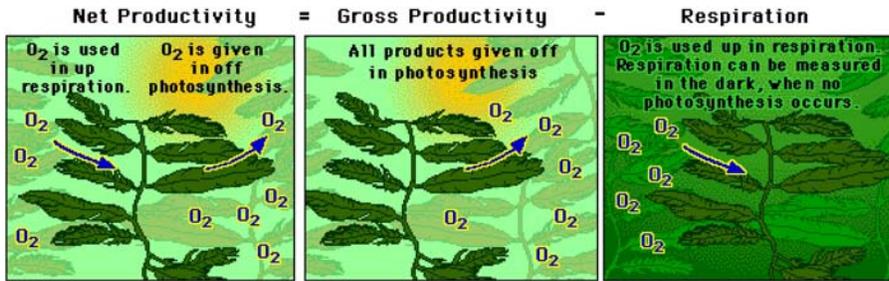
2. **Productivity:** Define each of these terms in your own words.

- a. Primary productivity: State in which plants and others photosynthetic produce organic compounds into the ecosystem.
- b. Gross productivity: the Photosynthetic production.
- c. Net productivity: amount of energy produce

3. Why do we use dissolved oxygen as a measure of productivity? Does productivity include more than oxygen?

Since it's one of the most easy measure of product, for both photosynthesis and respiration. Oxygen and organic compounds

4. Using the diagrams below explain:



- a. How does putting a sample of pond water and algae/freshwater plants in the light enable us to measure gross productivity? by measuring oxygen production in the light, when photosynthesis is occurring.
- b. How does putting a sample of pond water and algae/freshwater plants in the dark enable us to measure respiration? measuring O2 consumption, photosynthesis does not occur.
- c. How does subtracting the two enable us to indirectly measure net productivity? Subtracting both gives us net productive is the left of gross and respiration.

5. What are the three ways that primary productivity can be measured? Highlight the way will be used in this lab?.

- a. The amount of carbon dioxide used
- b. The rate of sugar formation
- c. The rate of oxygen production

B. LAB PART 1: EFFECT OF TEMPERATURE ON DISSOLVED OXYGEN

We actually did this part of the lab already. Remind yourself of our experiment, our procedures, and our conclusions. We were investigating the effect of the physical factor of temperature on the percent dissolved oxygen in a body of water.

6. What is the relationship between water temperature and dissolved oxygen?
It's that the temperature increases, and the ability of the water to hold oxygen decreases.

7. Explain why this relationship exists.
Because as temperature increases the more oxygen it's need it for the cellular respiration

8. So, now explain why the fish in the aquarium (on the LabBench Web site) above the radiator died?
It died, because the heat from the radiator decreased the oxygen level in the water, suffocating the fish.

C. A MODEL OF PRODUCTIVITY AS A FUNCTION OF DEPTH IN A LAKE

Now we are going to look at the biological factors that affect dissolved oxygen in a body of water. Look at the experimental design on the LabBench Web site (http://www.phschool.com/science/biology_place/labbench/lab12/model.html). We are taking a sample of pond water (with algae) and then modeling different depths in the pond by using screening to block out successive amounts of light. One hundred percent light for shallow depth, all the way to 0% light for deep ponds.

9. Why do we take an initial reading of dissolved oxygen? What purpose does this serve in the experiment?

So we can get a baseline measure. The purpose, so we can measure the difference.

10. Click on the “closer look” magnifying glass on the “initial bottle”. Why does the animation show oxygen being diffusing out of the freshwater plants? What does this signify?

It shows diffusion, oxygen it's being released by the plant. signify cell respiration, and photosynthesis.

11. Click on the “closer look” magnifying glass on the foil- covered bottle. Why does the animation show oxygen diffusing into the freshwater plants? What does this signify?

It shows diffusing, because molecules are being taken in. It signify cell respiration only because the bottle light its dark.

12. Click on the “closer look” magnifying glass on the 100% bottle under the light. Why does the animation show oxygen diffusing both into and out of the freshwater plants? What does this signify?

Oxygen being taking cellular respiration and released by photosynthesis, by the plant. Signify and stable, balance environment.

D. ANALYSIS OF RESULTS

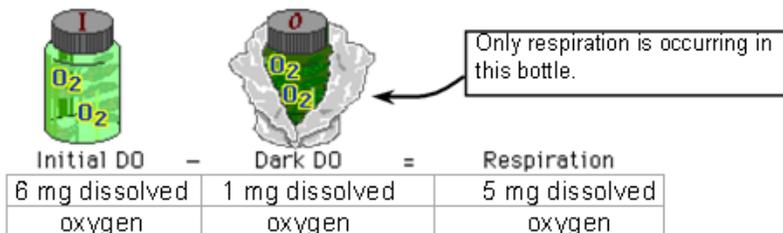
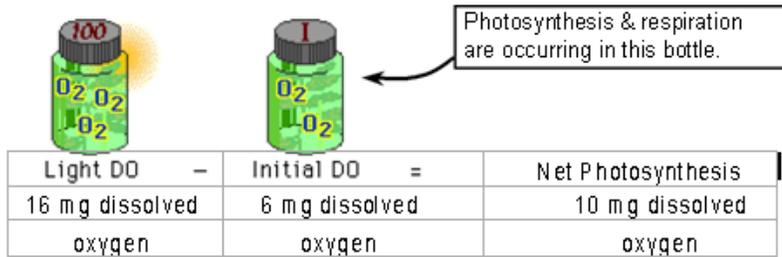
Let's look at the results that will allow you to calculate the different types of productivity.

13. **Measuring Respiration:** Remember that plants (producers) perform both photosynthesis and respiration. To measure the amount of respiration that is happening in the bottle, we measure the amount of dissolved oxygen in the initial sample and then the amount of oxygen in the bottle kept in the dark. As shown in the illustration below, you then subtract the amount of dissolved oxygen in the “dark bottle” from the amount of dissolved oxygen in the “initial bottle” to calculate the amount of oxygen consumed in respiration. I have added some possible measurements to help. Explain why this calculation works.



Since there's not light, photosynthesis is not happening, but respiration is. Due to this there's less dissolved oxygen.

14. **Measuring Gross Productivity:** Remember gross productivity is the total amount of sugars and oxygen produced by the plants in an ecosystem. I don't like how this Web site shows you how to calculate gross productivity. The equation is correct, but it is a short cut, so it makes it more difficult to understand. So follow me with the illustrations and the possible measurements below.



So the illustration shows us there was 10mg increase in dissolved oxygen in the jar as a result of photosynthesis in the last 24 hours and there was 5mg decrease in dissolved oxygen in the jar as a result of respiration in the last 24 hours. So the gross productivity (the full photosynthetic production in this ecosystem) of the algae in the bottle is the 5mg dissolved oxygen lost to respiration added back to the 10 mg dissolved oxygen accumulated in the bottle kept in the light. So what the algae really produced in the bottle was a total of 15mg dissolved oxygen, it just lost 5mg to respiration. And remember, the oxygen is an indirect measurement of the sugars produced in photosynthesis and lost in respiration.

10 mg oxygen gained from photosynthesis	+	5 mg oxygen lost to respiration	=	15 mg oxygen as gross productivity
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Now, in your own words, explain why this calculation works.

Because Net equal gross - respiration. And NET = gross. It's a equivalent equation.

15. **Measuring Net Productivity:** Remember net productivity is the amount of sugars and dissolved oxygen produced by the plants in an ecosystem once you subtract out what the producers have consumed in respiration. So we actually already calculated that in the last example; I just called it "net photosynthesis." Explain why this calculation works.



Because it shows the initial amount of light DO and Initial DO, before being subtracted.

- 16. Print out the completed calculation table from Sample Problem page of the LabBench Web site, fill in your predictions on the graph as well, and attach it to this lab to show me that you have completed it.
- 17. Print out the Lab Quiz and attach it to this lab to show me that you completed it.

SUMMARY QUESTIONS

- 18. Would you expect the dissolved oxygen levels in water sampled from a stream entering a lake to be higher or lower than the dissolved oxygen levels in water sampled from the lake itself? Explain.

I would expected to be higher, because there's more turbulence in the stream then int he lake.

- 19. Would you expect the dissolved oxygen levels in water sampled from a lake at 7AM to be higher or lower than the dissolved oxygen levels in water sampled at 5PM? Explain.

I would expected to be lower, because photosynthesis doesn't happens at night. This cause cells respiration to drop.

- 20. One of the major sources of water pollution is the runoff from fertilizer used in agriculture and on suburban lawns as well as golf courses. In particular, the nitrogen and phosphorus nutrients in the fertilizer creates problems in the streams and ponds it flows into. They cause **algal blooms** and **eutrophication** in lakes.

- a. Why do nitrogen and phosphorus promote a lot of plant/algal growth?

Because both are main composer found the fertilizer. Nitrogen it's needed it to create proteins, that can be found on DNA and RNA. Phosphorous is a part of the "energy currency" of every cell, this two elements make the plant/alga growth.

- b. What is meant by algal bloom? (Look it up!)

Rapid growth in the amount of algal, in the ocean.

- c. What problems do algal blooms cause in ponds & lakes? Why isn't a lot more producers a good thing? (Look it up!)

Algal can take the nutrient needed for other plants, as well as much oxygen that decrease the amount of oxygen need it for then, and they died.

- d. What is meant by eutrophication? (Look it up!)

Excessive richness of nutrients in a lake or other body of water

- 21. At what depth—shallow or deep—will there be more primary productivity in a pond or a lake? Explain.

It would be in between, this way they get the same about of sunlight, and nutrients need it.

- 22. In an experiment, why do we use the mean of class data to make conclusions rather than individual student group data?

Because in a group everyone has the same date, there's not difference. And an individual it's always gonna have something different.

23. AP exam FRQ (2008). Consumers in aquatic ecosystems depend on producers for nutrition.

a. Explain the difference between gross and net primary productivity.

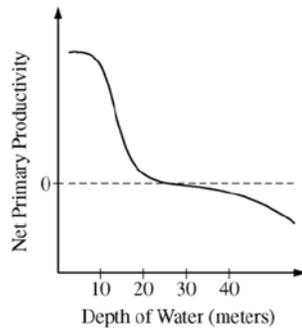
Gross, is all about photosynthesis how plants get and make their food. Net it's about the energy need it.

b. Describe a method to determine net and gross primary productivity in a freshwater pond over a 24-hour period.

The amount, rate of oxygen or energy/photosynthesis in the system.

c. In an experiment, net primary productivity was measured, in the early spring, for water samples taken from different depths of a freshwater pond in a temperate deciduous forest.

NET PRIMARY PRODUCTIVITY IN A FRESHWATER POND ECOSYSTEM DURING SPRING



Explain the data presented by the graph, including a description of the relative rates of metabolic processes occurring at different depths of the pond.

The graph shows that more depth decrease the about of production.

d. Describe how the relationship between net primary productivity and depth would be expected to differ if new data were collected in mid-summer from the same pond. Explain your prediction.

In the mid-summer the water temperature changes, this mean that the water get warmer. There would be more productivity, because it would increase the amount of plants in the water..
