

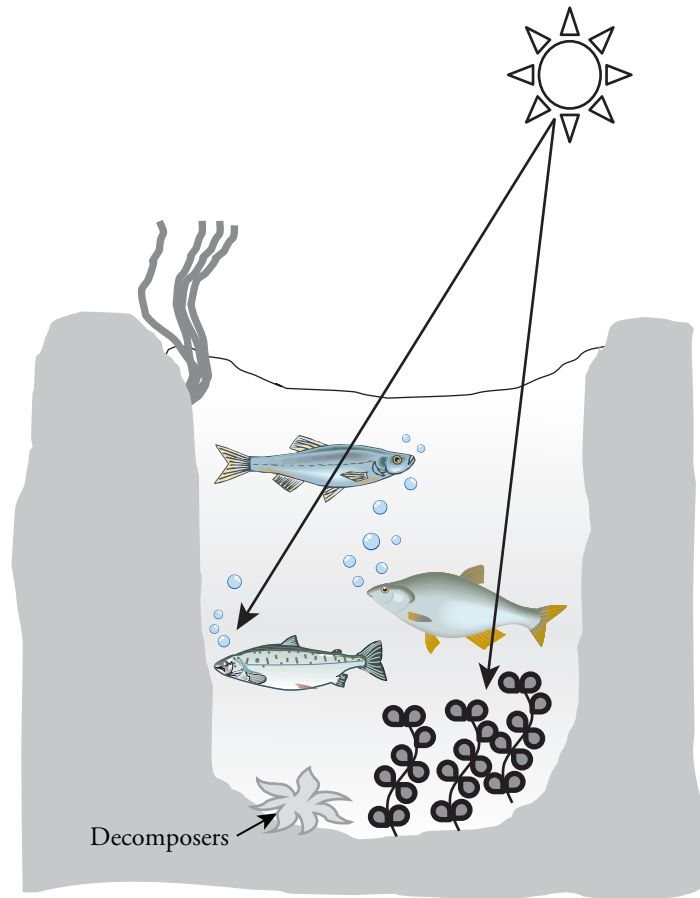
Eutrophication

How can aquatic ecosystems change over time?

Why?

If you could travel back in time millions of years, the land masses on Earth would not look like they do today. Huge areas were covered in swampy, marsh-like conditions. Today, many of those previously wet areas are now dry land. So what happened to change the land from wet to dry?

Model 1 – Biological Oxygen Demand



1. Consider the small lake in Model 1.
 - a. What organisms in the lake require oxygen to survive?
 - b. What organisms in the lake produce oxygen that dissolves in the water?
 - c. What characteristics of this lake make it “healthy”?

2. Indicate whether the following scenarios would increase, decrease or have no effect on the concentration of dissolved oxygen in the lake in Model 1. Justify your reasoning.
 - a. Ideal breeding conditions increase the population of fish in the lake.
 - b. Plant nutrients such as phosphates and nitrates are introduced into the lake.
 - c. Winter arrives and plants die off. Dead plant matter accumulates at the bottom of the lake.

Read This!

In healthy aquatic ecosystems there is a balance of two quantities—the concentration of **dissolved oxygen (D.O.)** and the **biological oxygen demand (B.O.D.)**. You might think that biological oxygen demand is the oxygen needed by the fish and other aquatic life in the lake, but it is actually the organisms you cannot see that are most important. Biological oxygen demand is the amount of oxygen needed by the decomposers in the ecosystem to break down the organic waste in the ecosystem.

3. Identify at least two sources of organic waste that are produced by aquatic ecosystems.

4. Indicate whether the following scenarios would increase, decrease or have no effect on the biological oxygen demand in the lake in Model 1. Justify your reasoning.
 - a. Ideal breeding conditions increase the population of fish in the lake.
 - b. Plant nutrients such as phosphates and nitrates are introduced into the lake.
 - c. Winter arrives and plants die off. Dead plant matter accumulates at the bottom of the lake.



Model 2 – Succession in Aquatic Ecosystems

Diagram 1

An oligotrophic lake with high D.O. and low B.O.D.

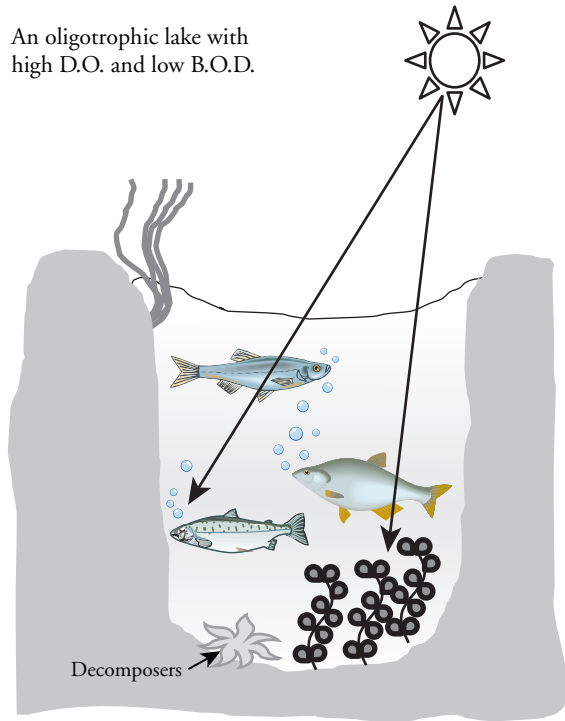


Diagram 2

Phosphates and nitrates are introduced into the lake from natural sources, farms, and industry. Algae and plant growth accelerate. High D.O. and low B.O.D.

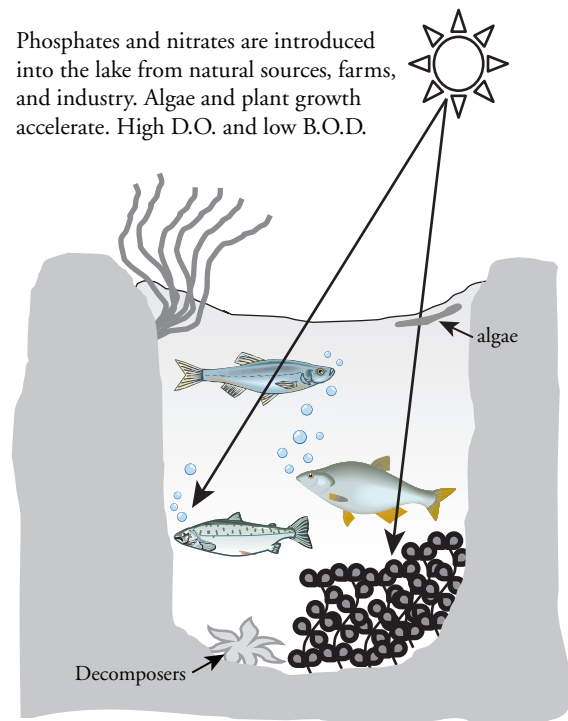


Diagram 3

Algae blocks light penetration. Plants die. _____ D.O. and _____ B.O.D.

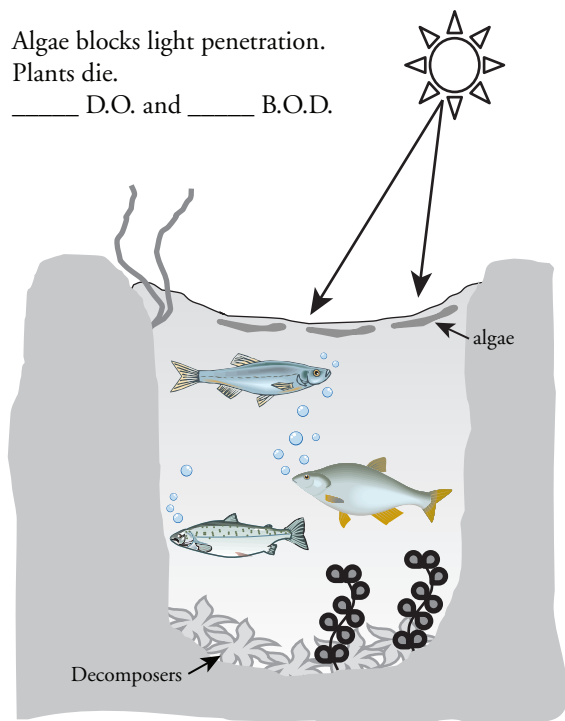
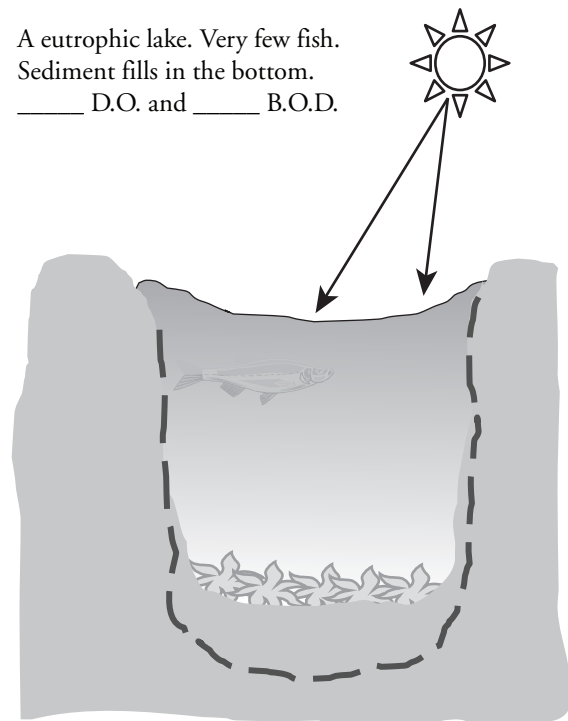


Diagram 4

A eutrophic lake. Very few fish. Sediment fills in the bottom. _____ D.O. and _____ B.O.D.



5. Consider the lake diagrams in Model 2.
 - a. Which diagram shows the healthiest lake? Justify your reasoning.

 - b. What term is used to describe the healthiest lake?

6. Describe the biological oxygen demand and dissolved oxygen measurements in the healthy lake in Model 2.

7. Explain how the introduction of nutrients such as nitrates and phosphates affect the penetration of light through the water.

8. What effect does the change in light penetration have on the plants that grow deeper in the water? Justify your answer.

9. Considering what you learned in Model 1, fill in the B.O.D and D.O. measurements in diagrams 3 and 4 of Model 2.
10. What has happened to the biological oxygen demand of the lake over the course of time?

11. What has happened to the dissolved oxygen concentration of the lake over the course of time?

12. Propose an explanation for why the population of fish is reduced in diagram 4 of Model 2.



13. With your group write a short statement that describes the connection between nutrient levels, dissolved oxygen, biological oxygen demand, plants, fish, and decomposers.

14. What are some of the physical and chemical characteristics of a eutrophic lake?

15. Compare the biodiversity in an oligotrophic lake with a eutrophic lake.



16. Using information from all the previous questions, summarize the characteristics of each type of lake in the table below.

Characteristic	Oligotrophic Lake	Eutrophic Lake
Light penetration		
Biodiversity of animals		
Biodiversity of plants		
Dissolved Oxygen		
Biological Oxygen Demand		
Water clarity		
Presence of algae/algal blooms		
Number of aerobic decomposers		
Amount of organic sediments on the bottom		



17. Considering what you know about succession in terrestrial ecosystems, if eutrophication continues, what will eventually happen to the lake and the surrounding area? Justify your answer using complete sentences.

Extension Questions

18. Healthy ecosystems cycle matter.

a. Draw a diagram to illustrate or describe in words the cycle(s) of matter within the healthy lake in Model 1.

b. How did the influx of nutrients in the lake disrupt the cycle of matter in the lake and cause eutrophication?

19. Healthy ecosystems have a continuous flow of energy.

a. Draw a diagram to illustrate or describe in words the flow of energy through the healthy lake in Model 1.

b. How did the influx of nutrients in the lake disrupt the flow of energy in the lake and cause eutrophication?

20. Following recent agricultural expansion in the surrounding area you have observed that in a nearby stretch of river the population of river water-crowfoot has been replaced by fennel-leaved pondweed. Using the data table below, explain how this could have happened and what the connection is to the agricultural expansion.

Phosphorous Level (mg/L)	Plant species present
<0.1	River water-crowfoot
0.1-0.4	Fennel-leaved pondweed
0.4 -1.0	Yellow water-lily
>1.0	Spiked water-milfoil