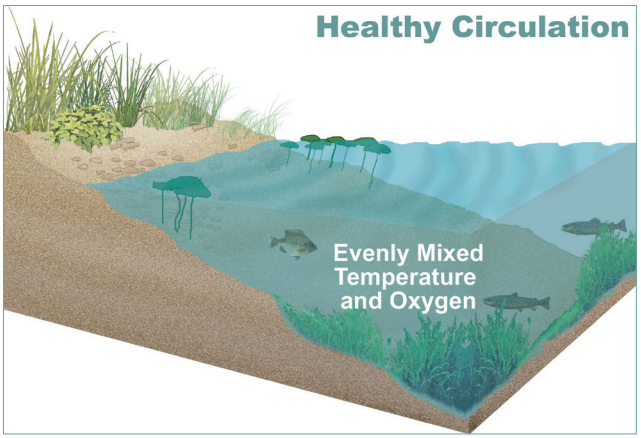
A Few Things to Know About...

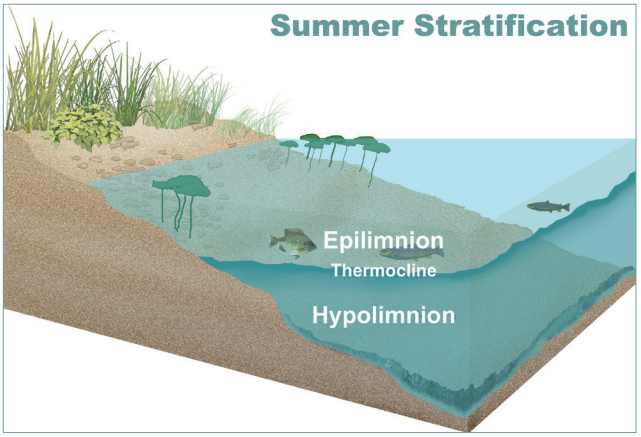
Seasonal Changes in Ponds and Lakes

Seasons are generally defined by precipitation and temperature patterns expected during different times of the year. The way we experience seasons varies greatly depending on our geographic location, however lakes and ponds commonly respond in similar ways to the same ecological inputs. While this article focuses primarily on temperate lakes, tropical and subtropical lakes also undergo seasonal changes, even in areas where temperatures do not fluctuate substantially throughout the year. Tropical areas experience seasonal patterns of rainfall that impact lakes in ways similar to the forces that take place further north.



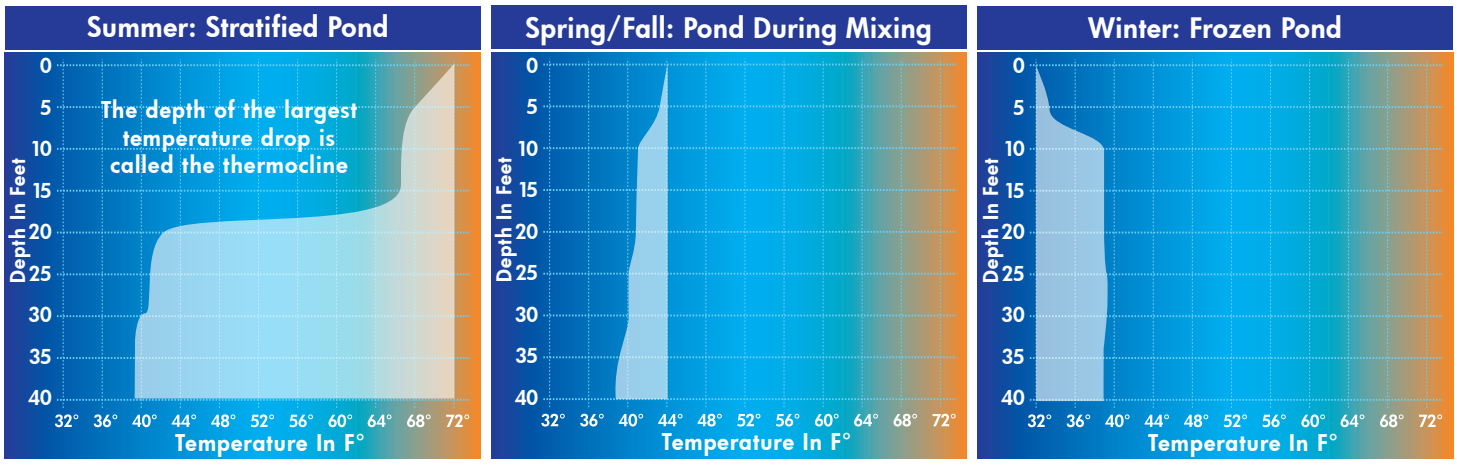
Summer

As the weather gets hotter, the density difference between warm surface waters (the epilimnion) and cold bottom waters (the hypolimnion) increases to a point where the two layers do not mix. This phenomenon, called summer stratification, prevents whole lake mixing, and nutrients from the lake sediments are no longer available to surface organisms. Bacteria consume nutrients and dead organisms that fall through the water column, using up oxygen in the hypolimnion. Since this oxygen cannot be replaced by photosynthesis (too dark) or diffusion with the atmosphere, the hypolimnion loses all oxygen and becomes anoxic. Some bacteria (anaerobic) can still slowly digest organic material, resulting in the formation of hydrogen sulfide gas, which has a 'rotten egg' smell. This gas generally stays in the hypolimnion until autumn cooling allows the lake to mix again.

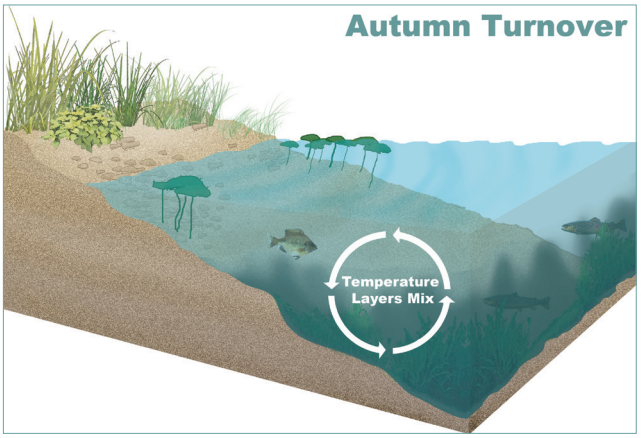


Warm water actually holds less oxygen than cold water, and when coupled with increased respiration rates, summer lakes can be depleted of much of their oxygen. This can lead to summer fish kills. This is especially common after large algae blooms that overcome the oxygen supply when decomposing after dying off. Aerating lakes combats summer problems by preventing stratification and increasing the overall oxygen supply in the lake.

Seasonal Temperature Profiles



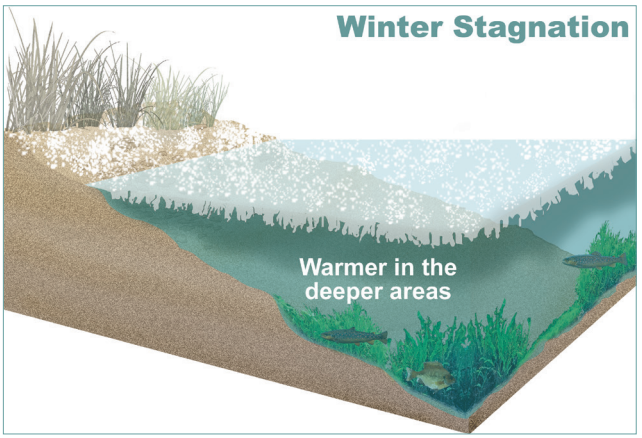
Autumn



Cooler autumn temperatures reduce the energy required to mix lakes, allowing complete lake turnover to occur. This mixes nutrients and gasses (like smelly hydrogen sulfide) from the summer hypolimnion throughout the water column. Mixing of the lake increases oxygen by exposing a greater volume of water to the atmosphere, but if a substantial portion of the lake volume lost oxygen in the summer, a rapid fall turnover can cause fish kills in autumn by diluting the oxygen that was available in the surface layer before mixing. Aerating during the summer can prevent this type of fish kill.

As autumn temperatures continue to drop, ice formation at the surface gradually reduces mixing as the lake is cut off from the atmosphere.

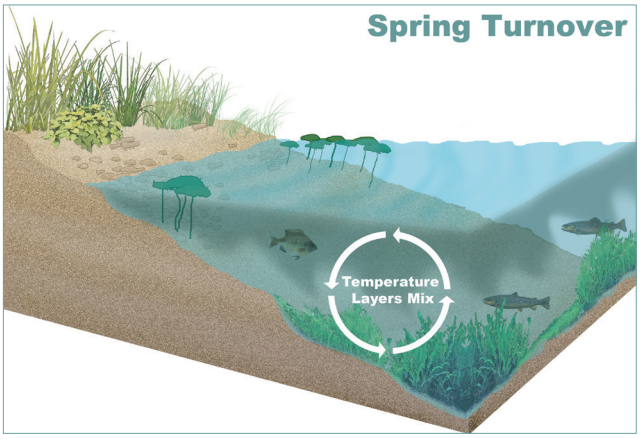
Winter



As cold temperatures slow the metabolisms of all living creatures, winter lakes and ponds exhibit reduced rates of photosynthesis and respiration. In temperate lakes covered by ice, water temperatures are about 4˚C (39˚F) top to bottom except at the very top where ice forms between 0˚C (32˚F) and 4˚C. The unique properties of water molecules make ice less dense than water, so it floats on the top of the lake, allowing fish and other life to remain alive below.

Ice can become so thick that little light penetrates to the water below. Photosynthesis, already slowed by the cold temperatures, ceases to take place altogether in the dark. The ice also separates the lake water from the atmosphere so that no direct diffusion of oxygen can occur. Although fish and other organisms need very little oxygen when water temperatures are so cold, oxygen may entirely deplete, resulting in a winter fish kill. These fish kills can be prevented by keeping a hole open in the ice, which is easily accomplished by moving the water with a small aeration system. Aeration systems may also be used to prevent ice around docks and other structures in winter.

Spring



As temperatures increase and melt winter ice, lakes in spring experience warming at the surface that leads to stratification, or temperature layering. Whole lake mixing usually occurs in spring just after ice melts, but the difference in temperature between the surface and the bottom soon prevents mixing of the two layers, especially in lakes deeper than 5 or 6 feet.

Frequent spring storms bring not only water to the lake, but an influx of nutrients from the landscape. This often leads to a series of spring algae and zooplankton blooms that allow nutrients in the lake to be cycled up through the food chain.

For more information on ways to prevent stratification visit:
www.vertexwaterfeatures.com/aeration/pond-aeration-and-lake-restoration-case-studies

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