



## How do fish survive in icy waters?

In cold winter months, lakes and rivers freeze over forming ice. How do aquatic animals survive in frozen lakes and ponds?

All liquids have a boiling point and a freezing point. Water boils at 100 degree Celsius (100 °C) and freezes at 0 °C. When the outside temperature falls below the freezing point of water, lakes and rivers freeze over.

Only the top layer of a lake or river freezes, underneath the frozen upper layer the water remains in its liquid form and does not freeze. Also, oxygen is trapped beneath the layer of ice. As a result, fish and other aquatic animals find it possible to live comfortably in the frozen lakes and ponds.

But why doesn't the entire body of water freeze, like a giant, lake-sized ice-cube? Generally, all liquids expand on heating, but water is an exception to this rule. If water is heated, its volume gradually decreases. At temperatures over 4 °C water starts expanding. At 4 °C, water has the least volume and maximum density. This anomalous expansion plays an important role by only freezing the upper layer in lakes and rivers.

During winter months in colder countries the outside or atmospheric temperature is very low, it drops to below freezing, and the upper layers of water in the lakes and ponds start cooling. When the temperature of the surface layers falls to 4 °C, the water body acquires maximum density and sinks down. The water that sinks down displaces water below, and the lower layers of water simultaneously rise up. This also gets cooled to 4 °C and again sinks down. When the temperature of the water body finally goes below 4 °C, the density or heaviness of water decreases and as a result water does not sink down. The surface water finally freezes at 0 °C while the lower part still remains at 4 °C. The light frozen layer of ice floats on top.

Ice does not allow heat to pass through it easily, so the freezing of the waters below is a very slow process. At depths below 30 metres, temperatures are cold and stable, but food is scarce. As a result animals have adapted to this situation by growing more slowly.

(Taken from <http://www.pitara.com/discover/5wh/online.asp?story=25>)

## EXERCISES

### 1 True or false?

- a. All liquids have the same boiling point.  T  F
- b. There is no oxygen under an iced lake.  T  F
- c. At 4°C water has its maximum volume.  T  F
- d. At depths below 30 metres, temperatures are cold and stable.  T  F

### 2 Complete.

Lakes do not freeze ..... but only their ..... layers, because water starts ..... at temperatures below 4°C. This ..... expansion makes life ..... even under a ..... lake. When the upper ..... of water start freezing, ..... 4°C, the body of water acquires ..... density and ..... down, this causes a ..... of the water below, so that the lower layers of water ..... up. This process continues ..... the upper layers are ..... frozen. At that moment the ..... and heaviness of water ....., and water no longer ..... down. Thus the ..... layer is at 0°C whilst the lower part ..... at 4°C.

*under • anomalous • sinks • displacement •*

*possible • surface • remains • maximum • layers • density • frozen • completely • until • decreases • sinks • expanding • rise • completely • top*

### 3 Match questions and answers.

QUESTIONS		ANSWERS	
A	What happens to the water in lakes when the temperature of the surface layers falls to 4°C?	1	The body of water acquires its maximum density and sinks down.
B	What are the conditions for life like under a frozen surface of water?	2	When the outside temperature falls below the freezing point of water.
C	When do lakes and rivers freeze?	3	The water under a frozen surface of water does not freeze, but food is scarce, for this reason animals have adapted by growing more slowly.
A .....		B .....	
		C .....	