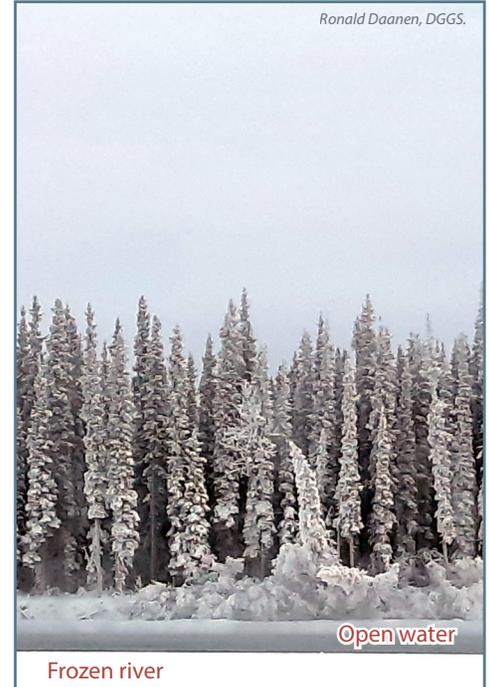


Why is there a hole in the ice?

It may be surprising to come across open water in the middle of an otherwise frozen lake or river. During winter, surface water is typically cooler than the water below and freezes over. **However, when deeper, warmer water moves toward the surface it can prevent freezing, creating areas of open water.**

- **Turbulent currents** in a river or stream can push warm water toward the surface, preventing freezing.
- **Methane bubbles** from decomposing organic materials and thawing permafrost at the lake bottom drive warm water to the surface.
- **Warm groundwater from a deeper aquifer** warms the water as it enters a surface water body.
- In rare cases holes in the ice are caused by **hot springs**, where warm or hot water is carried from much deeper, warmer depths in the earth's crust. Typically these systems prevent ice formation on a much larger scale and even affect the local vegetation.

There are several reasons why the water surface may remain ice free, but all have one thing in common: **More heat is transported to the water surface from below than the cold air can remove from above.**



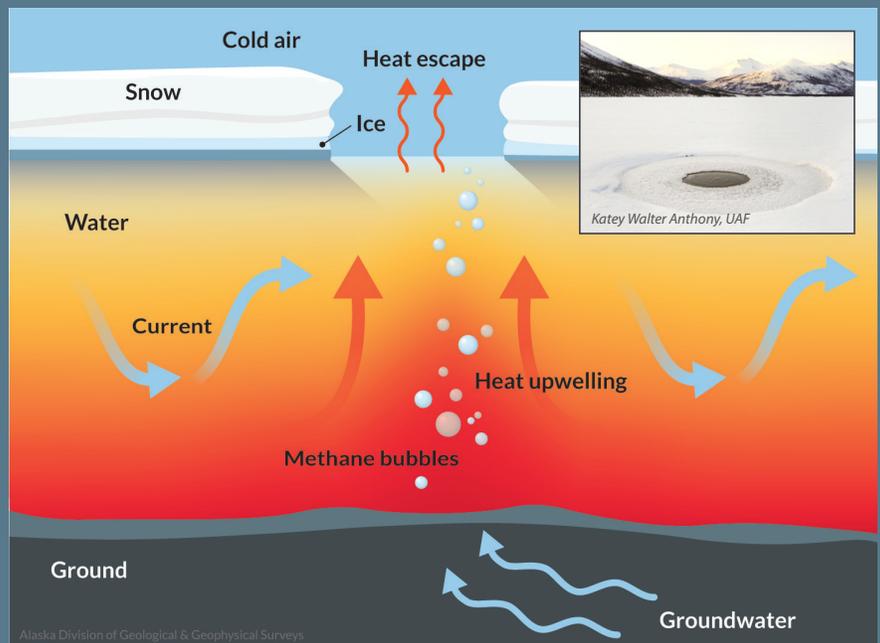
River leads, elongated open areas in rivers, are caused by turbulent water motion that prevents freezing.

The science of ice and water

Convection (or transfer of heat by movement of a heated fluid such as air or water) is the most common form of heat movement in water. Natural convection results from the tendency of most fluids to expand when heated (become less dense) and rise due to increased buoyancy.

Did you know?

Ice floats because it is less dense than water. Also, in winter the coldest layer of water is at the top of the water column, with warmer (32°F–40°F) water at the bottom.



Can you always see holes in the ice?

No! In the fall, cold air temperatures can create an ice layer above mixing waters, but as snow falls and provides a layer of insulation, the ice can become thinner, posing a hazard to travelers. **The more snow there is on the ice above areas where warm water is forced to the surface, the thinner the ice.**

Always use caution while traveling on ice, especially if you see any open water.

If you see a hole, it could mean you are already on thin ice!



Ronald Daanen, DGGs.

Springs that transport groundwater to the surface can be identified by rust-colored deposits.



lakeice.squarespace.com/warm-water-holes/

The water transported toward the surface from deeper aquifers is barely above freezing.

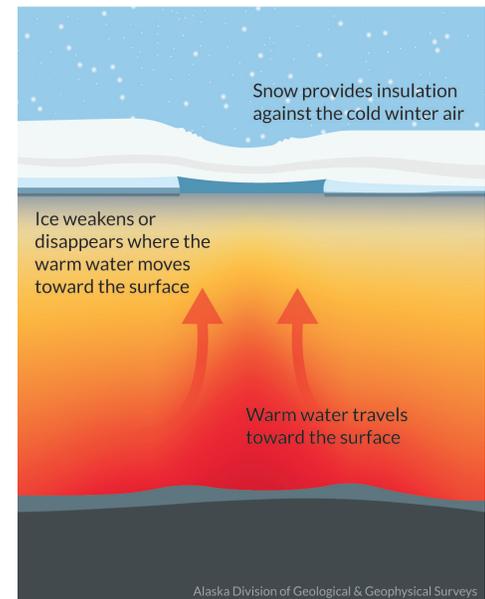
How much heat does it take to make a hole in the ice?

The amount of heat associated with holes in the ice depends on weather conditions, size of the holes, and snow depth. Springs that transport groundwater from aquifers to the water surface can carry a significant amount of energy, but the water temperature is barely above freezing. This is especially true in areas with permafrost where the groundwater is constantly cooled by ground ice. These springs can be identified by rust-colored deposits at the bottom of the water bodies, created by iron deposits transported with the groundwater.

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Snow provides insulation over thin layers of ice formed in the fall. As warm water is pushed toward the surface the ice—insulated from the cold air by the snow—weakens or may melt entirely. Obscured by snow, these holes in the ice pose unseen hazards for those traveling on the ice.

Resources

The following websites provide further information about ice travel in Alaska and elsewhere.

jukebox.uaf.edu/site7/sites/default/files/documents/Dangerous%20Ice%20web%202013-08-07-A-1.pdf

www.weather.gov/aprfc/IceThickness

www.adfg.alaska.gov/static-sf/Region2/pdfpubs/icefish.pdf

m.wikihow.com/Know-When-Ice-is-Safe

dnr.wi.gov/topic/outdoorrecreation/activities/icesafety.html

ak-wx.blogspot.com/2014/02/chena-river-ice-thickness.html