

Why do rivers take longer to freeze than lakes? (January 2011)



Solid ice may form along the river banks since the water moves slower along the river's edge and it cools more quickly than the water in the deeper, faster flowing center of the river. Photo source: www.crrel.usace.army.mil/ierd/ice_guide/iceguide.htm

Most of New Hampshire's approximately 1,000 lakes and ponds are frozen now—sealed off from the rest of the world, thanks to what appears to be one continuous sheet of ice. In many places the ice is thick enough to stand on it, and in some places, even drive on it. **Have you noticed, though, that many rivers aren't "frozen over" or may appear completely frozen one day but running like a torrent the next?**

The formation of river ice is a complex process that depends on many factors. Of course, as with lakes, the most important factor is that the air temperature is at least cool enough (32 degrees Fahrenheit) for the water to freeze in the first place. Factors that include how cold it gets and how quickly this happens, how deep and wide the river is and how fast it flows, and if a mid-winter thaw or rainstorm occurs, will determine when and how the river freezes, thaws, re-freezes, and thaws for the last time in the spring.

Here's a simplified explanation of how a river freezes...

Frazil Ice: River ice formation begins when ice crystals (referred to as "frazil") start to form and grow. However, since the water in the river continues to move, the crystals aren't able to join together to form a continuous sheet like they do at the top of a lake. Instead, the ice crystals mix with the river water, resulting in what looks like a slushie drink and typically referred to by scientists as "frazil slush."

Pancake Ice: As the air temperature continues to cool as the winter progresses, the river water continues to cool as well. Eventually, the frazil ice clusters freeze together and form plates of ice called "pancake ice." These circular formations typically have raised edges caused by



Pancake ice. Photo source: www.denniskalma.com/ice.html

repeated collisions with other pancakes.

Border Ice: Solid ice may form along the river banks since the water moves more slowly along the river's edge and it cools more quickly than the water in the deeper, faster flowing center of the river. Over time, if the air temperature continues to cool gradually, this "border ice" may grow toward the middle of the river until it "freezes over."

Freezeup Ice: If the temperature drops rapidly over a short period (such as an overnight), the frazil slush and pancake ice may freeze together and cover the center of the river all at once. This "freezeup" mass of ice may slow the flow of water in the river, causing an ice jam and resulting in flooding which could seriously damage bridges and nearby buildings and roads.

Sheet Ice: If the cold weather persists, some of New Hampshire's smaller rivers may become completely covered with a solid-looking layer of ice, referred to as "sheet ice." However, unlike most lakes, the ice cover on a river is not a uniform thickness. Under the sheet ice the river continues to flow, and, often where the flow is turbulent, slightly warmer water is upwelled from the river bottom which melts away at the underside of the ice. As a result, the ice will be unpredictably thin in places, making walking on the river extremely dangerous.

Candle Ice: As the winter comes to an end, and the air temperature climbs above the freezing point during the day but still drops below the freezing point during the evening, the river will repeatedly thaw and refreeze—creating what looks like a honeycomb of water containing thin, long crystals resembling candles. While this "candle ice" may be many inches thick, it is not solid and breaks apart very easily—and certainly would not support very much weight.

Breakup Ice: As spring arrives, and warmer air temperatures persist through the night, the candle ice sheet breaks up into chunks and floats downriver as "breakup ice." If the river narrows, such as where a bridge abutment juts out into the water, the ice may jam the river and cause flooding.



Candle Ice.

Because the thickness of the ice on a river can vary greatly from day to day and from location to location, NH LAKES recommends that you choose not to venture out onto any of New Hampshire's rivers that appear to be frozen. In addition, when recreating on a frozen lake, we recommend that you follow basic ice-safety guidelines which can be downloaded from the New Hampshire Fish and Game Department's website at www.wildlife.state.nh.us/Fishing/Fishing_PDFs/Ice_Safety_Brochure.pdf. We also recommend that anyone who plans to go out onto a frozen lake watch the Discovery Channel's video about how to survive falling through the ice which can be downloaded at dsc.discovery.com/videos/how-to-survive-falling-through-ice.html.