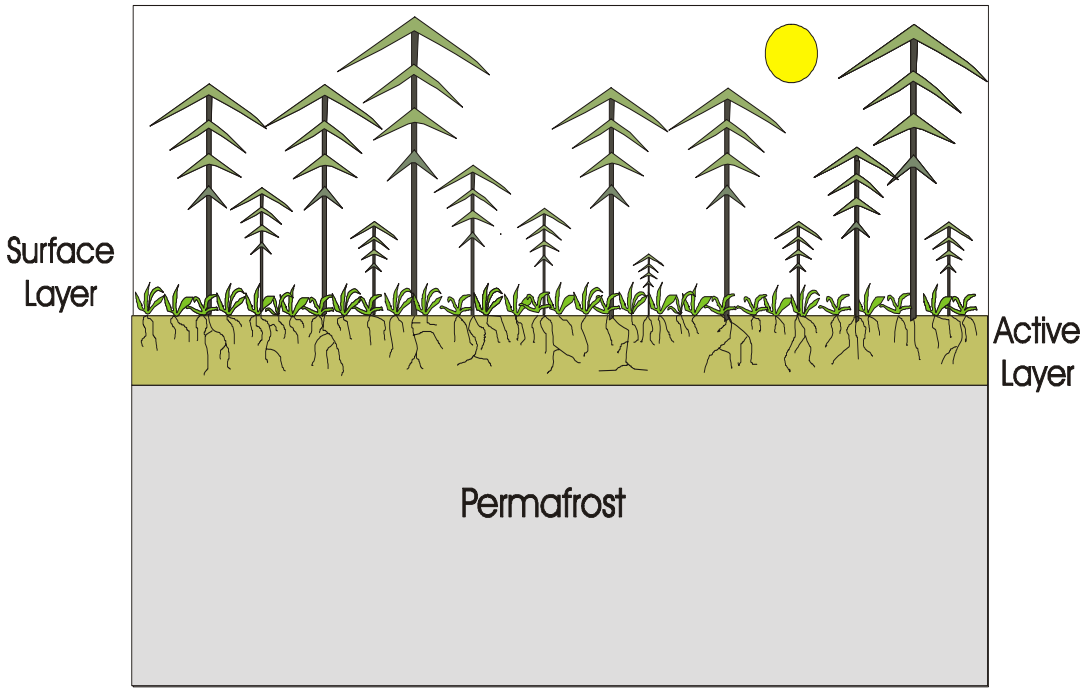
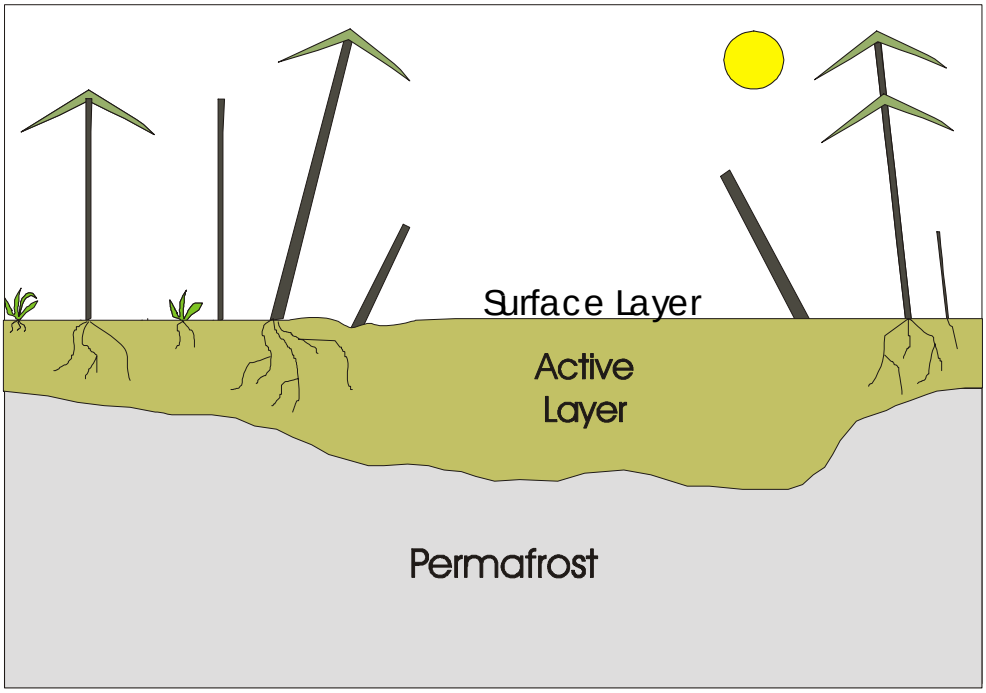
Permafrost

Permafrost is soil that is always frozen. Because the Arctic and sub-arctic are so cold and dark for much of the year, soil under the surface doesn't receive enough warmth through the sun to thaw. As a result, a portion of the ground is always frozen, even during the summer.

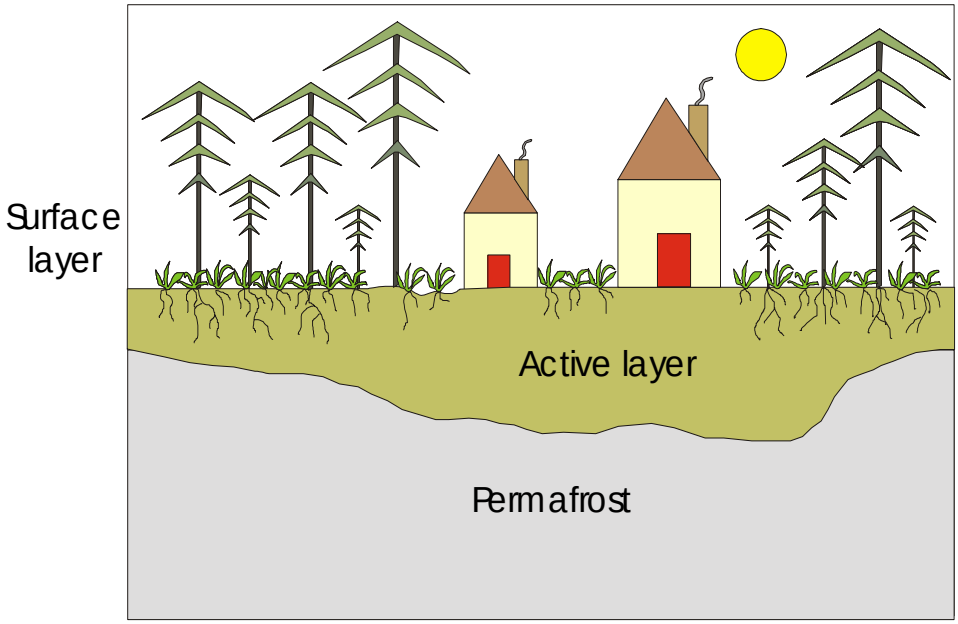


Vegetation on the surface layer serves as a protective, insulating layer for underlying permafrost. In warmer months, the sun's warmth melts through the active layer (the layer that thaws during the summer months), and releases nutrients stored in the previously frozen soil. Plants' roots are then able to permeate this softer layer and access those nutrients. As a result of the vegetation on the surface layer and the active layer, the sun's warmth does not reach the permafrost layer, leaving it frozen year-round.

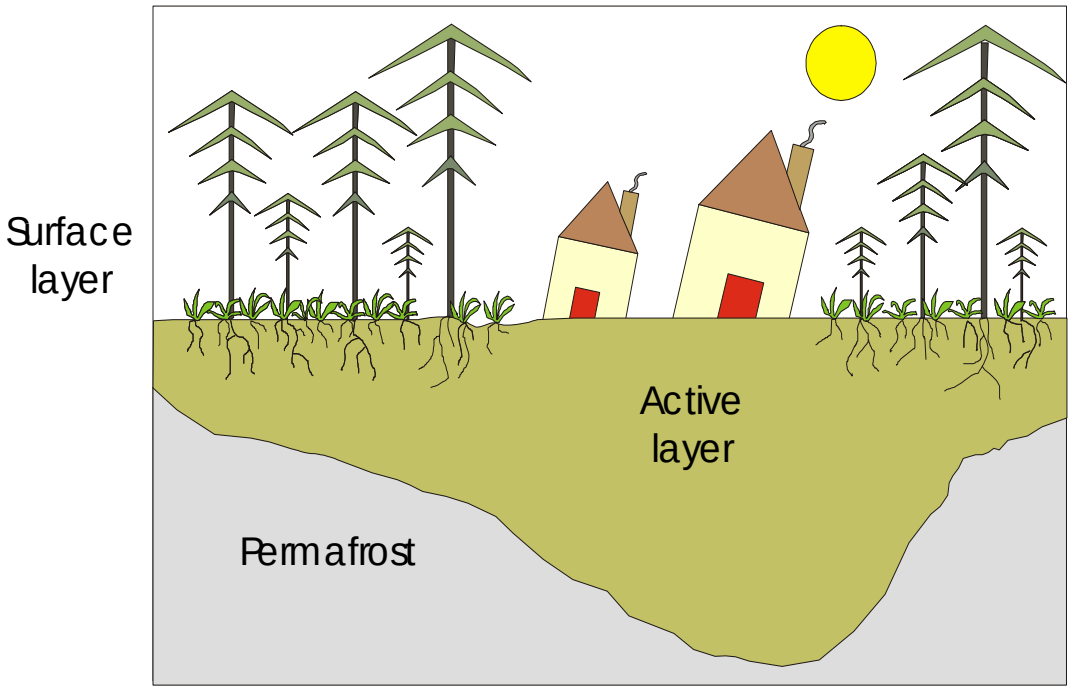


When a wildland fire comes through an area, the protective vegetation layer is burned away. The soil becomes black and absorbs more heat from the sun. As the heat increases on the surface and active layers, the permafrost layer begins to melt. In areas where wildland fires are frequent, permafrost is probably far below the surface.

Building on Permafrost:



Building homes and roads on permafrost creates a variety of hazards of its own. Removing the insulative vegetative layer above the permafrost permits the sun's warmth to penetrate deeper into the soil and allows the permafrost to thaw at a rapid pace. When roadways or buildings are built on top of this situation, they tilt at unsafe angles and become unsafe to drive or live on. Even the heat generated within houses is enough to cause the frozen soil to melt, allowing the foundations to sink and eventually crack.

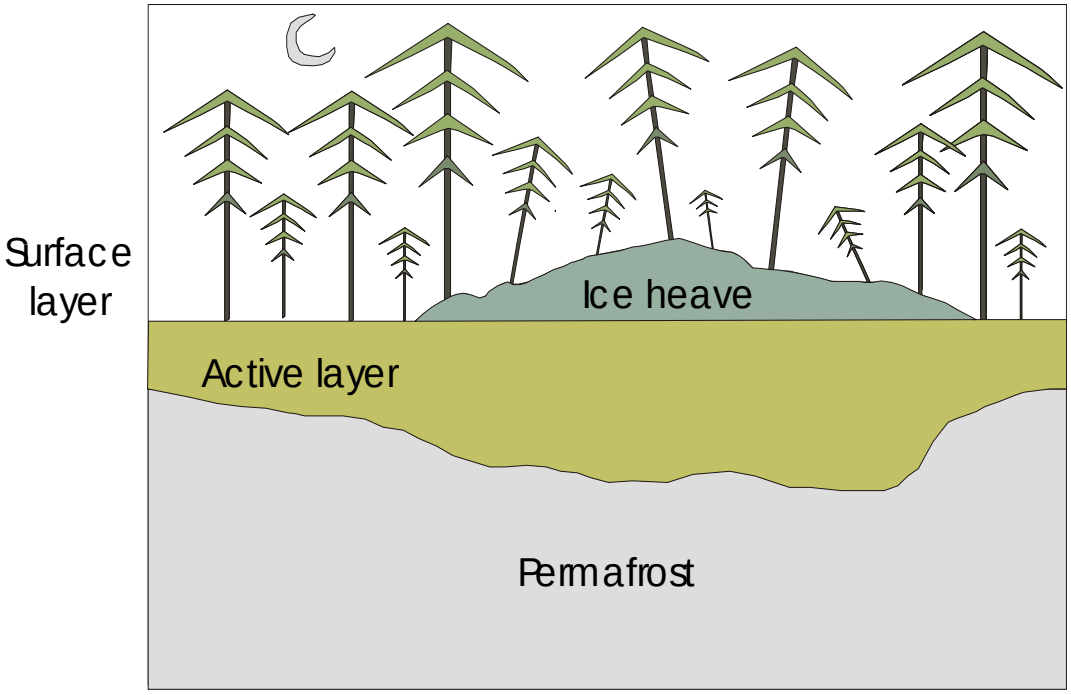


After some time of sitting on top of melting permafrost, houses begin to tilt and sink. The same process happens to roads built on permafrost. Without precautionary measures, houses become unsafe to live in and roads become unsafe to drive on. Most houses on permafrost begin to tilt in the direction of their stove or furnace. Most of the heat from the house comes through these two locations and contributes to the majority of the heat escape.

To combat this problem, roadways are insulated with a thick layer of gravel. By insulating the roadbed, highway workers ensure the permafrost under the highway will remain frozen year-round. Houses can have a thick layer of gravel under them or may be built on pilings. Pilings allow the heat from the house to escape without melting the underlying permafrost.

The Alaska Pipeline, eight miles to the east of Kanuti National Wildlife Refuge, is an example of the specialized engineering and construction needed to ensure structural integrity in permafrost areas. A road was constructed to allow equipment to access the pipeline. Boards of polystyrene insulation were put down under the gravel bed to reduce the amount of gravel needed while still providing the desired insulative effect. The pipeline was buried for the majority of its 800-mile length. When buried, the pipeline had

to be covered with a variety of insulating wrappings to protect the soil from the heat of the oil flowing thorough the pipe. When the pipeline went over areas with permafrost near the surface, it went above ground on a specialized support system. Heat pipes containing a refrigerant were put into these vertical supports to reduce the soil temperatures underground. The refrigerant is pumped below ground and helps removes heat from the ground. When the refrigerant warms it becomes a gas and begins to flow to the top of the supports. As it rises in these supports, it begins to cool and turn back into its liquid form. The heat then escapes through the fins on top of the supports, while the refrigerant drops back to the bottom of the supports to pick up more heat.



When the soil above permafrost and snow melt thaws during the warmer months it has nowhere to go, hence the arctic is so wet during the summer months. The underlying permafrost inhibits the water from seeping into the ground. When the weather gets cold again, the trapped water freezes, causing it to heave at times. When buildings and roads are on top of the heave they are moved with the ground.

Clues to Existence of Permafrost:
Vegetation and topography of the Arctic and sub-arctic can provide an idea of where permafrost is located without having to look underground. North-facing slopes feel little of the sun's warmth. They tend to be cooler than south facing slopes and have more permafrost. South-facing slopes receive more warmth from the sun's rays, so have little, if any, permafrost. Low-lying areas typically have permafrost near the surface, especially if stunted black spruce are found. Running water keeps permafrost from forming, so rivers and streams are typically not associated with permafrost.

Fires also can prevent permafrost from forming. A severe fire will burn off the vegetative layer that protects and insulates the underlying permafrost. Vegetation in a severely burned area will take a much longer time to return to an area compared to a low intensity burn. The soil temperature will rise, thus increasing the active layer, until that protective vegetative layer is returned. An area that is frequently burned probably will not have permafrost near the surface. These tend to be the drier, well-drained, upland sites. These sites are normally windswept and have a greater chance of getting struck by lighting, thereby starting a wildland fire.

Benefits of Permafrost:

Despite all the problems associated with building on permafrost, permafrost is important to arctic life. Precipitation is minimal in the Arctic. What little there is accumulates on the soil surface because it cannot penetrate into the soil. This causes large portions of the arctic landscape to be waterlogged throughout the summer months. Plants, animals, and insects rely on this abundant water source.