

Frost Tube Protocol at Air Temperatures Warmer than -20°C

Field Guide

Task

Observe and record the depth of freezing in the ground (where there is no permafrost) when air temperatures are warmer than -20°C (determined by a GLOBE Atmosphere site nearby or from another reliable source).

or

Observe and record the depth of freezing in the ground's active layer (where there is permafrost) when air temperatures are warmer than -20°C (determined by a GLOBE Atmosphere site nearby or from another reliable source).

What You Need

- A properly installed Frost Tube
- Pen or pencil
- [Frost Tube Data Sheet](#)
- Meter stick

Students will measure the depth of freezing weekly, starting when air temperatures reach 0°C or colder.

- Depth of Freezing = distance in the inner tube of the Frost Tube from the soil surface to the boundary between the ice layer and unfrozen water. This represents the depth of freezing between the soil surface and the underlying unfrozen soil.

In the Field

First time only/getting started

1. Complete the upper portion of your data sheet.

Every visit

1. Record the date on the [Frost Tube Data Sheet](#).
2. If you have a GLOBE Atmosphere site nearby, record the current air temperature on the [Frost Tube Data Sheet](#). Otherwise, consult a reliable source (e.g., local Weather Service station) for this information. If the air temperature is colder than -20°C then use the [Frost Tube Protocol for Temperatures Colder than \$-20^{\circ}\text{C}\$ Field Guide](#). If the air temperature is warmer than -20°C then continue with the following procedure.
3. Walk to the Frost Tube site using the same path to reduce impact on the snow conditions.
4. Working quickly to reduce impact on the Frost Tube reading, remove the PVC cap and pull the inner tube (containing the colored water) out just far enough to note the depth of freezing or thawing. Be sure to hold the outer PVC pipe (outer tube) to prevent it from lifting out of the hole as well.

5. Determine the depth of freezing:

- Locate the soil surface mark (0 cm) on the water-filled inner tubing. Hold the meter stick by the inner tube.
- Find the boundary between the ice at the top of the clear tubing and the water below it. The ice appears relatively clear while the water is colored. (*Note: Sometimes the ice will be mottled with some color still left in it from the food coloring.* This happens when freezing occurs so quickly that some of the dye crystals are trapped in the ice.) There should still be a distinct boundary evident between such partially colored ice and the unfrozen water, which will have a homogeneous color.
- Read off the depth of this boundary to the nearest centimeter (by holding meter stick by the inner tube).

6. Quickly return the clear tube to the structure and replace the PVC cap.

7. Record the depth of freezing on the *Frost Tube Data Sheet* and the observer names.

8. Repeat the measurements **once each week at the same time**, ideally within one hour of solar noon.

9. If possible, for each time the Frost Tube is read, note the current air temperature and depth of snowpack (if present) in three representative locations at the Frost Tube site where there is minimal disturbance.