

## ALWAYS FROZEN!

### Overview:

Students research permafrost terms using UNITE US multimedia and the Internet to gain a foundation for future permafrost studies.

### Objectives:

The student will:

- complete an online scavenger hunt to gain knowledge of permafrost basics;
- research permafrost terms then teach peers what was learned; and
- film informational clips to be used in a final video about permafrost.

### Targeted Alaska Grade Level Expectations:

[9] SA1.1 The student demonstrates an understanding of the processes of science by asking questions, predicting, observing, describing, measuring, classifying, making generalizations, inferring, and communicating.

[10] SA1.1 The student demonstrates an understanding of the processes of science by asking questions, predicting, observing, describing, measuring, classifying, making generalizations, analyzing data, developing models, inferring, and communicating.

[9-10] SD2.1 The student demonstrates an understanding of the forces that shape Earth by recognizing the dynamic interaction of erosion and deposition including human causes.

### Vocabulary:

**active layer** – the layer of ground that is subject to annual thawing and freezing in areas underlain by permafrost

**beaded stream** – a stream characterized by narrow reaches linking pools or small lakes

**continuous permafrost** – geographic areas in which permafrost occurs everywhere beneath the exposed land surface; mean annual soil surface temperatures are typically below -5° Celsius

**debris flow** – a sudden and destructive variety of landslide in which loose material on a slope is mobilized by saturation and flows down a channel or canyon

**discontinuous permafrost** – permafrost occurring in some areas beneath the exposed land surface throughout a geographic region where other areas are free of permafrost

**drunken forest** – trees leaning in random directions caused by thawing permafrost

**dry permafrost** – permafrost containing neither free water nor ice

**frost action** – the process of alternate freezing and thawing of moisture in soil, rock and other material, and the resulting effects on materials and structures

**frost heave** – the upward or outward movement of the ground surface (or objects on or in the ground) caused by the formation of ice in the soil

**hummock** – a rounded knoll of ice rising above the general level of the land surface

**ice lens** – horizontal, lens-shaped body of ice under ground

**ice vein** – an ice-filled crack or fissure in the ground

**ice wedge** – narrow ice mass that is three to four meters wide at the ground surface and extends as much as 10 meters down formed when cold temperatures lead to cracks in the ground; during the spring these cracks fill with melt water and sediment then freeze

**ice-wedge polygon** – polygonal-shaped features often delineated with a furrow or crack; the result of ice wedges; vegetation is frequently concentrated in the furrow and helps emphasize the pattern

**massive ice** – large masses of ground ice, including wedges, pingo ice, buried ice and large ice lenses

**mire** – an area of wet, soggy, muddy ground that often features a layer of peat over permafrost

**needle ice** – thin, elongated ice crystals that form perpendicular to the ground surface

**palsa** – a peaty permafrost mound possessing a core of alternating layers of ice and peat or mineral soil material

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**peat** – a deposit consisting of decayed or partially decayed humified plant remains

**permafrost** – ground that remains at or below freezing for two or more consecutive years; ice is not always present (as in the case of bedrock)

**permafrost degradation** – a naturally or artificially caused decrease in the thickness and/or areal extent of permafrost

**pingo** – a perennial frost mound consisting of a core of massive ice with soil and vegetation cover

**talik** – a layer or body of unfrozen ground occurring in a permafrost area

**thaw slump** – a slope failure resulting from thawing of ice-rich permafrost

**thermokarst lake** – a lake occupying a closed depression formed by thawing of ice-rich permafrost or the melting of massive ice

### Whole Picture:

Permafrost is ground or any other substance that remains frozen for more than two years (enduring the heat of at least two summers). It forms the foundation of the Arctic, and in many instances, determines the landscape above. The Indigenous people of Alaska have traditionally viewed permafrost in a utilitarian way. Among other things, permafrost provided two important functions. It created cold storage to preserve food harvested in the warm, summer months and it made water more readily available by holding it close to the surface.

Permafrost is thousands of feet thick beneath Alaska's North Slope and decreases southward to become patchy in Fairbanks and almost nonexistent as far south as Anchorage.

Permafrost may form any time the mean yearly temperature of an area lingers near or below the freezing mark for a few years, but much of it was established during a much colder time when the cold air of ice ages penetrated deeply into the ground thousands of years ago. That frozen ground, incredibly stable, has endured in cold climates because air temperatures haven't had enough punch to thaw it. Mats of spongy vegetation help to insulate permafrost from warming summer air temperatures.

The movement of people northward means more people are living and traveling over permafrost. This has resulted in the clearing of land above permafrost, the building of houses and roads in permafrost areas, and the subsequent thawing of some ice-rich permafrost and damage to structures above due to settling.

### Materials:

- Colored pencils
- VISUAL AID: "Illustrating Permafrost"
- VIDEO: "Introduction to Permafrost - Explore Permafrost"
- VIDEO: "How Ground Freezes"
- STUDENT WORKSHEET: "Permafrost Scavenger Hunt"
- STUDENT WORKSHEET: "Illustrating Permafrost"

### Activity Preparation:

1. Copy STUDENT WORKSHEET: "Illustrating Permafrost" then cut the sheets apart so there are enough cards for each student. (Nine copies will provide enough cards to cover the 25 vocabulary words.)
2. Bookmark the UNITE US multimedia and video playlists, available under the curricula description

### Activity Procedure:

1. Introduce topic with a movement activity. Write the word "permafrost" on the board. Hand the marker to a student and ask the student to write a word or short phrase on the board that tells something about permafrost. That student then hands the marker to another student, who writes a word or short phrase. Continue until everyone who would like to write something has a chance. If there is little information, continue to brainstorm, asking some leading questions such as:

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- a. How do you know if there is permafrost in an area?
  - b. Have you ever tried to dig into permafrost? What happens?
  - c. How long has permafrost been in Alaska?
  - d. Does permafrost affect the ecology (plants and animals) of an area? How?
- Leave the ideas on the board for a later activity.
2. Hand out STUDENT WORKSHEET: "Permafrost Scavenger Hunt." Ask students to access VIDEO: "Explore Permafrost." Students will explore the multimedia activity to complete questions one through 15 on the worksheet.
  3. Ask students to access VIDEO: "How Ground Freezes." Students will explore the multimedia activity to complete the remainder of the worksheet.
  4. Display VISUAL AID: "Illustrating Permafrost." Pass out the cards from STUDENT WORKSHEET: "Illustrating Permafrost." Students will choose one or more words (depending on class size) to define and illustrate. Use the visual aid to keep track of who is researching what word. Students should use classroom resources and the Internet to define the word and draw an accompanying illustration. Ask students to use their definition(s) and illustration(s) to give the class a mini-lesson, teaching about the terms that were researched.
  5. Collect and display the sheets in the classroom. If possible, make copies (three per page) so that each student has a set for future reference.
  6. Review the brainstorm words and phrases on the board. Ask students if they would like to change anything or add anything. Ask the following critical thinking questions:
    - a. A material must remain below what temperature all year to be considered permafrost?
    - b. Why do we say permafrost thaws, not melts?
    - c. Can material that does not contain any water or ice be considered permafrost?
    - d. What would happen to the Arctic landscape if the underlying permafrost were to thaw?
    - e. Would construction be simplified if permafrost were not a factor?
    - f. What is one thing you learned about permafrost that you did not know before?

### ***Ideas for Filming:***

NOTE: Students will create a short film about permafrost for the final project associated with this UNITE US unit. Each lesson leading to the final project contains ideas about what students might film as they compile clips. Students are not limited to the list and are encouraged to use their imagination and creativity when filming.



Students can film classmates as they teach each mini-lesson using illustrations completed in STUDENT WORKSHEET: "Illustrating Permafrost."



In VIDEO: "Explore Permafrost" in the "What is the Active Layer?" section (1:33-4:11) students will watch a slider bar to see the action of the active layer for one year. As the student watches the slider bar, he or she should explain what is happening to the active layer for the camera. If possible, students should find an area in their community where they can see the exposed active layer or simply film the surface vegetation, which grows in the active layer, and discuss its properties.



In VIDEO: "Explore Permafrost" in the "What Happens when Permafrost Thaws?" section (4:18-5:16) students will watch a series of pictures that show ways permafrost affects the ground above. As the student watches, he or she should narrate about what is on the screen while another student films. If possible, students should film a structure in their community that has been damaged due to permafrost thawing and/or create a public service announcement (PSA) on the dangers of building on thawing permafrost.



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In VIDEO: “Explore Permafrost” in the “How does Permafrost Shape Earth’s Surface” section (5:24-11:46) students will drag a slider bar to watch how permafrost action creates landforms visible from the surface. Ask students to drag the slider bar slowly as a partner films. As the student drags the slider bar, he or she should explain what is happening to create surface landforms. If possible, students should film landforms in their community that are a result of permafrost action.

### Answers:

#### STUDENT WORKSHEET: Permafrost Scavenger Hunt

1. Arctic
2. Discontinuous
3. False
4. False
5. Late autumn/fall
6. Heat
7. The thawing of permafrost
8. Winter cold
9. Wedges of ice in the soil
10. Ice wedge polygons
11. True
12. False
13. Soil that contains water
14. Yes
15. Dry gravel

#### STUDENT WORKSHEET: Illustrating Permafrost

See Vocabulary Section for definition . Use teacher discretion for illustrations.

# ILLUSTRATING PERMAFROST

Word	Assigned to
• active layer	_____
• beaded stream	_____
• continuous permafrost	_____
• debris fl w	_____
• discontinuous permafrost	_____
• drunken forest	_____
• dry permafrost	_____
• frost action	_____
• frost heave	_____
• hummock	_____
• ice lens	_____
• ice vein	_____
• ice wedge	_____
• ice-wedge polygon	_____
• massive ice	_____
• mire	_____
• needle ice	_____
• palsa	_____
• peat	_____
• permafrost	_____
• permafrost degradation	_____
• pingo	_____
• talik	_____
• thaw slump	_____
• thermokarst lake	_____

**word:**  
alass

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**definition**

A large depression of the ground surface produced by thawing of a large area of permafrost that has a lot of thick ice.

**illustration:**

**NAME:** \_\_\_\_\_  
**PERMAFROST SCAVENGER HUNT**

**Information:**

You will be exploring a multimedia activity that provides an introduction to permafrost. Permafrost is permanently frozen ground – ground that has remained below freezing for two or more consecutive years. It occupies nearly a quarter of the exposed land surface in the Northern Hemisphere. Changes in permafrost have a strong impact on Earth’s air, land, water and life.

Watch “Explore Permafrost,” then answer the following questions:

1. Permafrost is found mostly in the \_\_\_\_\_.
2. *Circle one.* Interior Alaska has mostly this type of permafrost:
  - A. Continuous
  - B. Discontinuous
  - C. Sporadic
  - D. Isolated
3. *True or False.* The active layer is the layer of soil above permafrost that never freezes.
4. *True or False.* The active layer is always about 1 meter deep.
5. At what time of year does the active layer thaw to its maximum depth? \_\_\_\_\_
6. A home built on land underlain with permafrost it at risk of transferring \_\_\_\_\_ directly into the ground.
7. What can cause a forest to begin to lean and topple over? \_\_\_\_\_  
 \_\_\_\_\_
8. What causes soil to shrink and crack? \_\_\_\_\_  
 \_\_\_\_\_
9. During warm spring days, water seeps into the cracks and freezes. This forms \_\_\_\_\_.
10. What surface land feature emerges from the continual growth of ice wedges? \_\_\_\_\_
11. *True or False.* Lakes, ponds, knolls, and ridges can be formed when permafrost thaws.
12. *True or False.* A pingo will never melt.

Watch “How Ground Freezes,” then answer the following questions:

13. Which takes longer to freeze – soil that contains water or soil with no water? \_\_\_\_\_
14. Is the answer you provided in question 13 true for most types of soil? \_\_\_\_\_
15. Compare the types of soil, wet versus dry. Which freezes the quickest? \_\_\_\_\_

NAME: \_\_\_\_\_

### ILLUSTRATING PERMAFROST

<p><b>word:</b></p> <hr/> <p><b>definition</b></p> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/>	<p><b>illustration:</b></p>
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<p><b>word:</b></p> <hr/> <p><b>definition</b></p> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/>	<p><b>illustration:</b></p>
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<p><b>word:</b></p> <hr/> <p><b>definition</b></p> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/> <hr/>	<p><b>illustration:</b></p>
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