



TEACHERS AND RESEARCHERS EXPLORING AND COLLABORATING

PolarTREC Lesson Resource

Investigating Permafrost Depth in the Arctic

Kate Steeper

Shrubs Snow and Nitrogen in the Arctic 2019

PolarTREC Expedition Page

<https://www.polartrec.com/expeditions/shrubs-snow-and-nitrogen-in-the-arctic-2019>



This program is supported by the National Science Foundation under award 1918637. Any opinions, findings, and conclusions or recommendations expressed by this program are those of the PIs and coordinating team and do not necessarily reflect the views of the National Science Foundation.

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Objectives

Students will be able to:

- Graph, analyze, and predict data
- Develop claim, evidence, and reasoning
- Explain how permafrost is made, current conditions, and its impacts on climate and humans

Preparation

- This lesson plan can be taught either in the classroom or virtually online. Instructions on how to teach both ways are given in the Procedure.
- Students should have a basic understanding of climate change including how greenhouse gasses impact climate.
- Have Warm-Up video (In Resources - Climate Change In Alaska: Coastline disappearing at a rate of 30 football fields per year) ready to go before students arrive. The teacher should make sure the video is expanded to take up the entire screen and will start immediately. The article below the video may give them clues.

In-class: Have student handouts ready.

- If using Part I In-Class Option B: print handouts for groups and cut up pieces of the reading prior to class. This option encourages active movement and group work.
- If using Part I In-Class Option C: have one of each reading for each student.
- For both in class and virtual setting: Use Presentation A to project to class to show experimental setup and data.
- Depending on the student skill level, the teacher may need to review the graphing of independent and dependent variables and line of best fit.

Procedure

Warm-Up

In Class

1. Start class by showing students video (<https://www.washingtonpost.com/video/national/climate-change-in-alaska-...>). Do not provide students with any explanation or additional information about the phenomenon. See Preparation for further details.
2. Elicit student ideas about phenomenon using think-pair-share or other methods for gathering student ideas. The teacher may start by asking about details for what they observed in the video such as “the weather changed from winter to summer” or “it looks like there was an ocean on the right side of the screen”. Ultimately the teacher is looking to connect the phenomenon of the loss of landmass to the loss of permafrost and climate change. Do not confirm students’ thoughts about the reason for the loss of land. The teacher will revisit this at the end of the lesson.

Virtual

Resource Details

Region

Arctic

Grade

Middle School and Up

Permission

Download and Share

Location

Toolik Field Station

Expeditions

Shrubs Snow and Nitrogen in the Arctic 2019

Related Members

Kate Steeper

Syndonia Bret-Harte

Materials

Handouts

Computer or tablet with internet access

- Using a platform such as Zoom or similar the teacher can begin class with the above video. For think-pair-share the teacher can put students in breakout rooms and have students return at the end of a predetermined set of time.

Part I - Background Reading

In Class

A. Handout A - Permafrost Reading (Downloaded from the Internet - See Resources)

- Lower grade levels or struggling readers: Climate Kids Permafrost Reading;
- Higher grade levels or more advanced readers: National Geographic Reading
- Individual reader option: The teacher can pass out Handout A to individual students and have students read passages independently or along with class by calling on readers.

B. Group reading option: The teacher may choose to print out one of Handout A per group (ideally 3-4 students per group) and cut predesignated passages in Handout. When students get together in groups, have each student grab a piece of the reading and then work with the others to determine what part of the reading they have. Then, have students read their passages silently and share back with their group when finished. Finally, bring students back for whole-class discussion. For struggling readers, it is helpful to have them identify or highlight keywords or phrases. The teacher can review these keywords with the group and add words to the word wall if present.

C. Student choice option: The teacher may allow students to choose between the two readings provided above. It is suggested that

- (1) there are enough readers for each option to form a group to discuss reading,
- (2) students read their passage independently first and then gather in groups to review,
- (3) return to the whole class for discussion about readings and summarize findings OR have groups quickly present with class scribe recording on poster for class

Virtual

- * Provide links to readings to students.
- * Students can read articles independently following 1a OR students can read independently and summarize for class after breakout room discussion. Teachers can also choose to have groups make a small presentation about the reading in their breakout rooms and present it to the class.
- Option C is possible in a virtual setting but will require students to preview readings. The teacher can ask students to quickly preview readings during class and then the teacher can set up groups during the class OR the teacher can assign readings as homework (students still choose one of the readings to read) and leave classwork to group and class discussion. Student choice is more likely to result in student engagement, however, assigning homework may result in the opposite. Teachers should choose what they think will best fit their group of learners.

Part II - Graphing

In Class

- Present permafrost experimental set up to class using Presentation A. Permafrost data is found at end of the presentation which can be left on the screen for the class to use.
- Pass out graphing paper to each student.
- If students are familiar with graphing post data in front of the class and have each student graph individually or with a partner. As students work circulate to check for understanding and progress. Students should have graphs similar to those found in Handout B.

- If students are not as familiar with graphing group students in groups of 3-4, post data in front of the class, and using one whiteboard or poster paper have groups graph data. Review x and y-axis, independent and dependent variable, and line of best-fit graphs if needed.
- As students work, circulate to check for understanding and progress. Students should have graphs similar to those found in Handout B.
- You may have students present graphs to peers using gallery walk format to uncover misunderstandings and allow students to reconstruct graphs if time allows.
- Have students record the final graph on individual graphing paper and save for Part III.

Virtual

- Teachers and students can use *Desmos* or a similar online graphing tool to graph data.
- If desired, teachers can group students in breakout rooms to complete graphs.
- If time allows, teachers can have students present graphs to class to facilitate discussion of misconceptions. Be sure to make sure all students save their graphs for use in Part III.

Part III - Claim Evidence Reasoning (CER)

In Class

- Ask students to analyze graphs in groups to develop a claim and reasoning (evidence is their graph) based on background reading.
- Depending on time and familiarity with CER format teachers can use a gallery walk format with whiteboards or posters to ask groups to display their claims, evidence, and reasoning. If following gallery walk format, be sure to allow time for class discussion and revision of claims or reasoning as needed.
- After discussion students will write a CER paper and include their graph. The teacher can choose to have students write the paper in groups or individually.

Virtual

- Students can be placed in breakout rooms to develop their claim and reasoning based on the graph and background reading.
- Teachers can structure this time by asking students to create presentations of claim, evidence, and reasoning that will be shared with the class.

Part IV Closing (In-Class and Virtual)

- Return to the warm-up video and ask students to explain the phenomenon. This can be facilitated in a whole-class discussion or as an exit ticket.

Extension

n/a

Resources

Handout A

Choose One:

- Climate change in Alaska: Coastline disappearing at a rate of 30 football fields per year Video <https://www.washingtonpost.com/video/national/climate-change-in-alaska-...>

- Climate Kids Permafrost Reading:
<https://climatekids.nasa.gov/permafrost/#:~:text=and%20South%20Poles-,...>
- National Geographic Permafrost Reading:
<https://www.nationalgeographic.org/encyclopedia/permafrost/>

Assessment

Student CER paper

Author/Credits

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Investigating Permafrost Depth in the Arctic Experimental Set Up

[Shrubs, Snow, and Nitrogen in the Arctic 2019
PolarTREC Expedition](#)

Snowdrift Fence

Purpose: to collect snow on one side (orange arrow) so that there is a higher snowpack on one side of the fence during the winter months.



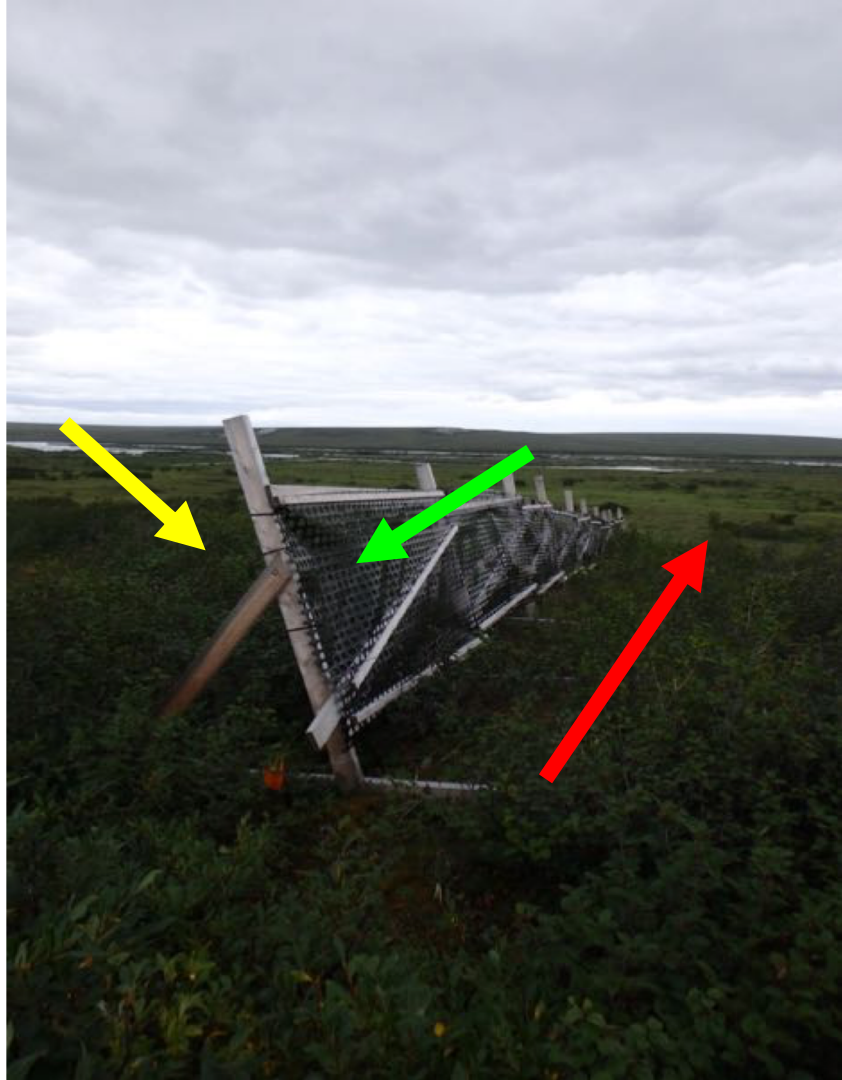
How do scientists measure the permafrost layer?

- Scientists can push a metal probe into the ground. When they reach ice the probe stops. This allows them to measure the depth of the permafrost and see how close it is to the surface.
- Photo credit: <https://www.polartrec.com/expeditions/shrubs-snow-and-nitrogen-in-the-arctic-2019>



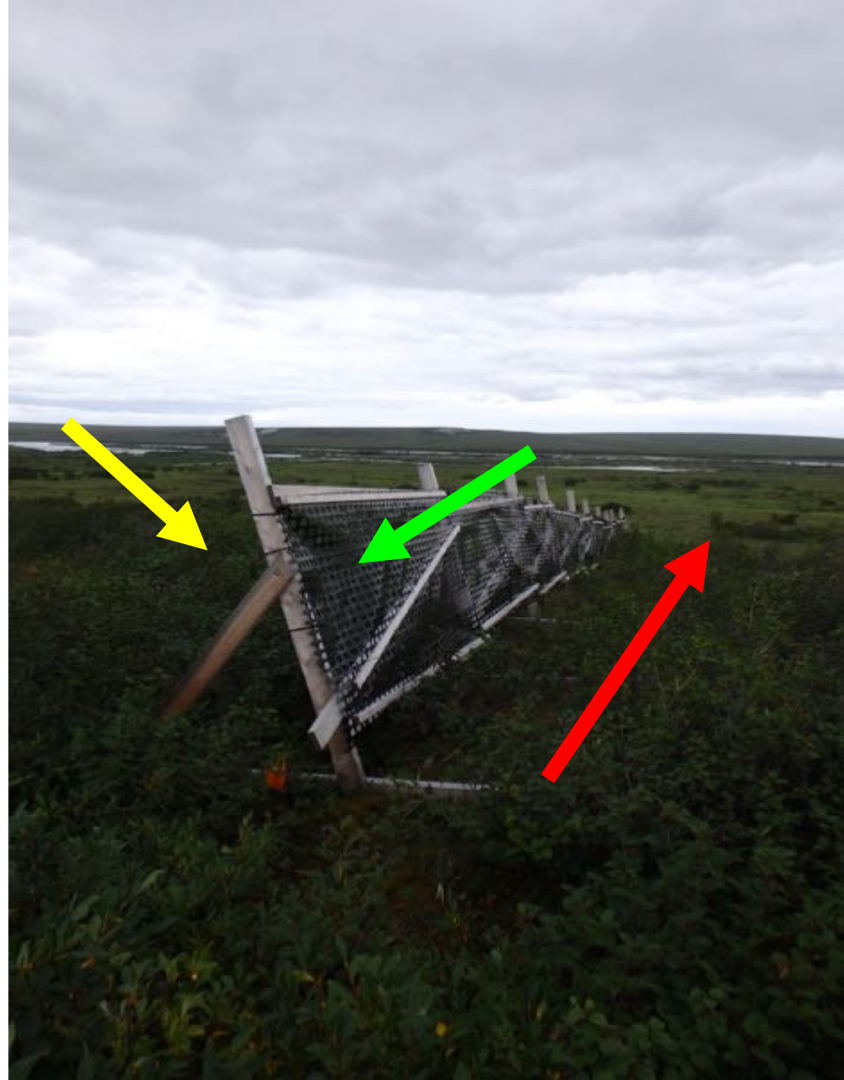
Snowdrift Fence

- Red arrow: direction of measurements. Arrow tail = 0 m
- Green arrow: snowdrift side
- Yellow arrow: control side

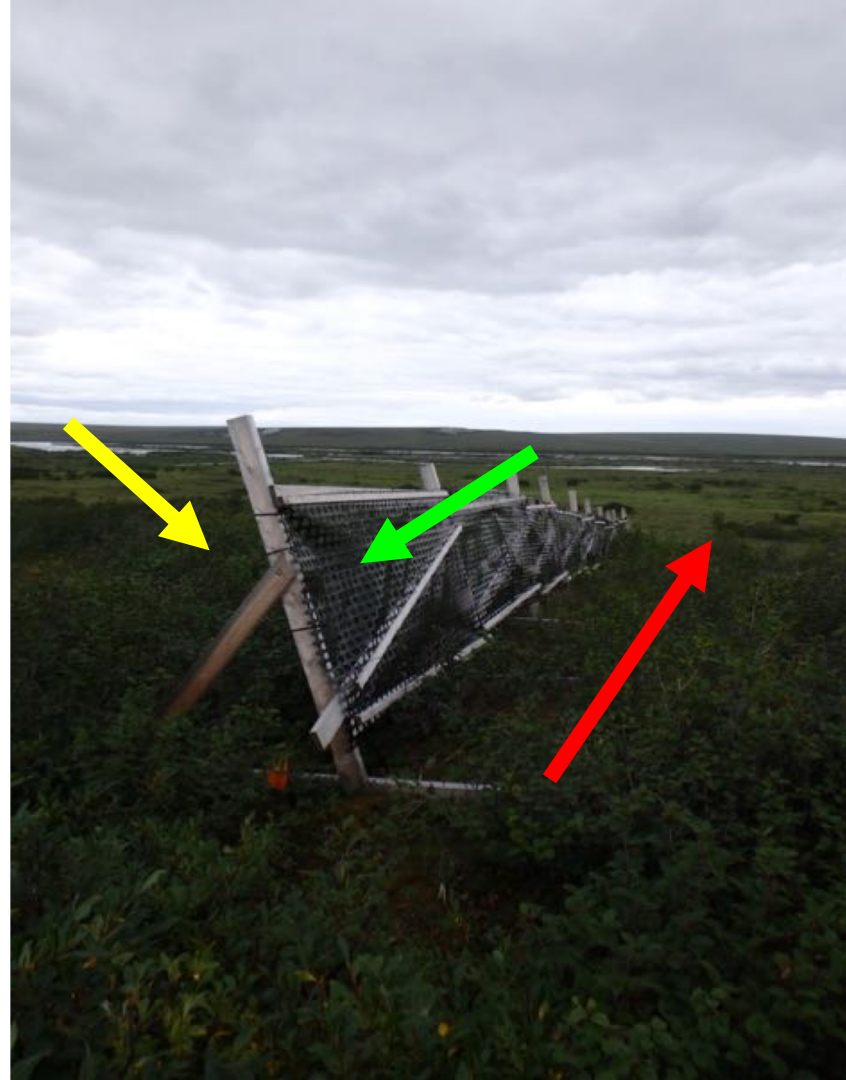


Snowdrift Side

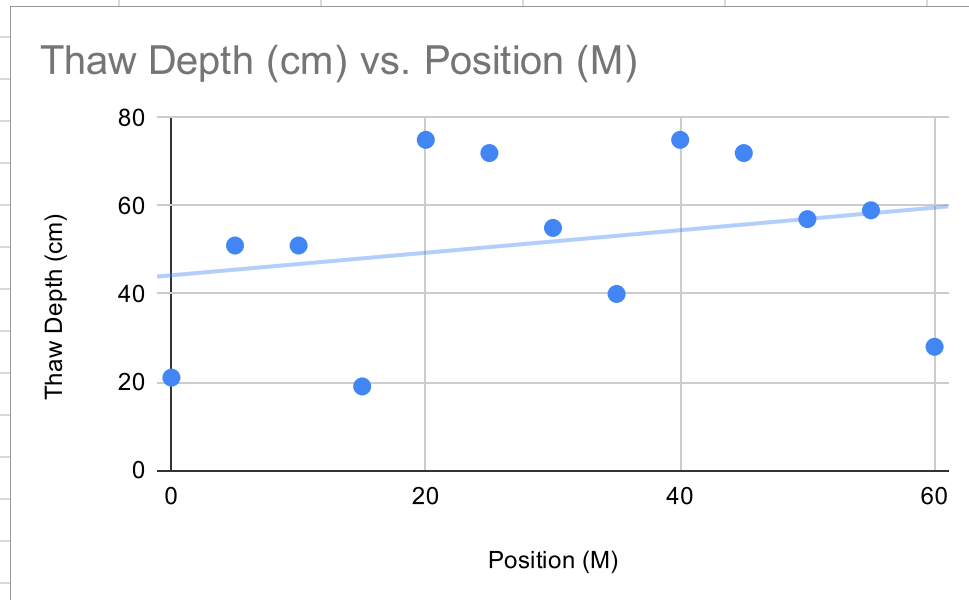
Position (M)	Thaw Depth (cm)
0	21
5	51
10	51
15	19
20	75
25	72
30	55
35	40
40	75
45	72
50	57
55	59
60	28



Control Side	
Position (M)	Thaw Depth (cm)
0	46
5	55
10	55
15	45
20	40
25	60
30	36
35	57
40	49
45	50
50	32
55	47
60	38



Position (M)	Thaw Depth (cm)	Tussok Drift
0	21	
5	51	
10	51	
15	19	
20	75	
25	72	
30	55	
35	40	
40	75	
45	72	
50	57	
55	59	
60	28	



Position (M)	Thaw Depth (cm)	Tussok Control
0	46	
5	55	
10	55	
15	45	
20	40	
25	60	
30	36	
35	57	
40	49	
45	50	
50	32	
55	47	
60	38	

