Vital Ice STEM Kit Use Instructions

Note: This kit is intended for students 4th grade and higher in a supervised classroom setting. It is strongly recommended that instructors try the kit themselves before using it with students. This kit covers the scientific practices of Developing & Using Models; Analyzing & Interpreting Data; Using Mathematics & Computational Thinking; Constructing Explanations & Designing Solutions; and Engaging in Argument from Evidence.
(https://www.nap.edu/read/13165/chapter/7#50)

Unpacking Instructions

One classroom set of 15 kits is inside one large green case or two smaller yellow cases (in Alaska). Also included are containers of extra "soil" sand, mug warmers and a battery charger. There will be a teacher's kit (different color) with the ice core graph keys and other extra supplies in case they are needed.

Kit Contents

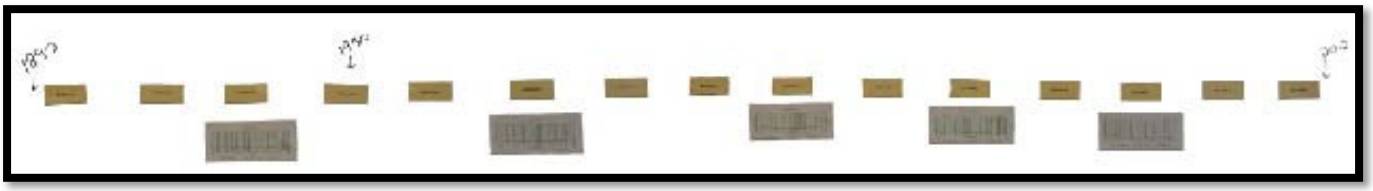
Each individual kit should contain:

- 30 mL of Black Sand (Road)
- 30 mL of Green Sand (Vegetation)
- 50 mL Beaker
- 60 mL of Brown Sand (Soil)
- Colored Pencils
- Ice Core
- Ice Core Scanner
- Ice Core Support
- LED Solitaire Maglite
- Magnifying Glass
- Map of Volcanic Eruptions
- Metal “Buildings” (2)
- Metal Spoon
- Metal Track
- Multimeter w/Cables
- Pipette
- Ruler
- Tin Pan
- Tweezers
- Blank Graph Templates (1 per student)
- Vital Ice Booklet

Room Setup

1. Arrange tables and chairs so students can work in pairs.

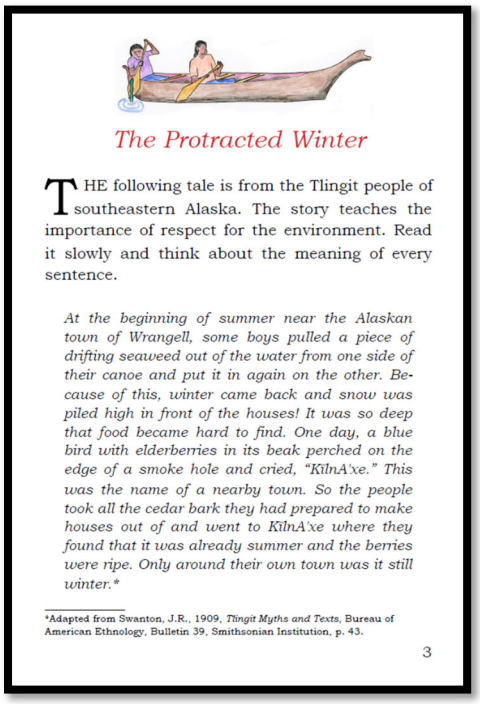
2. Post the laminated Ice Core Labels (#1 - #15) on the whiteboard or wall approximately 6" apart and going from right to left as shown below. Write 2012 above label #1. Write 1950 above label #12. Write 1890 above label #15.



3. For any unused kit, post the laminated answer key graph under the appropriate Ice Core Label. Your students will fill in the missing pieces. This way, when the students have finished their graphs, you will have all 15 on the board, even if you don't use all of the kits.
4. Make sure to have the following supplies on hand:
   - Water
   - Paper Towels
   - Extension Cords (if needed to plug in mug warmers)
   - Science Notebook
   - Tape (for taping graphs into Science Notebooks)
5. Have each pair of students obtain a kit (**hand out the kits in this order: 15; 2; 14; 11; 13; 1; 12; 8; 4; 9; 10; 6; 5; 3; 7**), a paper towel, a mug warmer and a beaker of water (roughly 25 mL).

Begin Lesson

1. Students should start by opening their science notebooks to a new page. Notebook should be labeled "Vital Ice" with the date and the name of their lab partner.
2. They should then open the kit and take out the Vital Ice Booklet and begin reading on page 3.



The Protracted Winter

THE following tale is from the Tlingit people of southeastern Alaska. The story teaches the importance of respect for the environment. Read it slowly and think about the meaning of every sentence.

*At the beginning of summer near the Alaskan town of Wrangell, some boys pulled a piece of drifting seaweed out of the water from one side of their canoe and put it in again on the other. Because of this, winter came back and snow was piled high in front of the houses! It was so deep that food became hard to find. One day, a blue bird with elderberries in its beak perched on the edge of a smoke hole and cried, "KílnA'xe." This was the name of a nearby town. So the people took all the cedar bark they had prepared to make houses out of and went to KílnA'xe where they found that it was already summer and the berries were ripe. Only around their own town was it still winter.**

*Adapted from Swanton, J.R., 1909, *Tlingit Myths and Texts*, Bureau of American Ethnology, Bulletin 39, Smithsonian Institution, p. 43.

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3. The words 'Science Notebook', accompanied by a pencil icon, are located throughout the booklet, which indicates that the students should **stop and respond** to the prompt in their notebooks.
4. Blank graph templates that are supplied in the kit can be used by the students and taped into their science notebooks in the appropriate place. Extra copies of the graph templates can be downloaded from the EOC website at: https://www.cns-eoc.colostate.edu/national-park-service-partnership/vital-ice-stem-kit/.
5. Pairs of students should be allowed to proceed at their own pace. Make sure to encourage students to read the text rather than just looking at the pictures.
6. Walk around the classroom and check on students, especially if they are younger. Clarify any questions that the students do not understand. Make sure that they are setting up the ice core scanner correctly.

Part 1: The Protracted Winter

1. Students should read the entire story and be able to link it to deeper critical thinking.

Part 2: Permafrost

1. Make sure that students are only adding half a spoon full of the "ice" to their tin pan. Due to the fact that it grows with the addition of water, it has the potential to overflow and create a large mess. *Note: It may be beneficial to put a paper towel under the tin pan prior to adding the ice and water.*

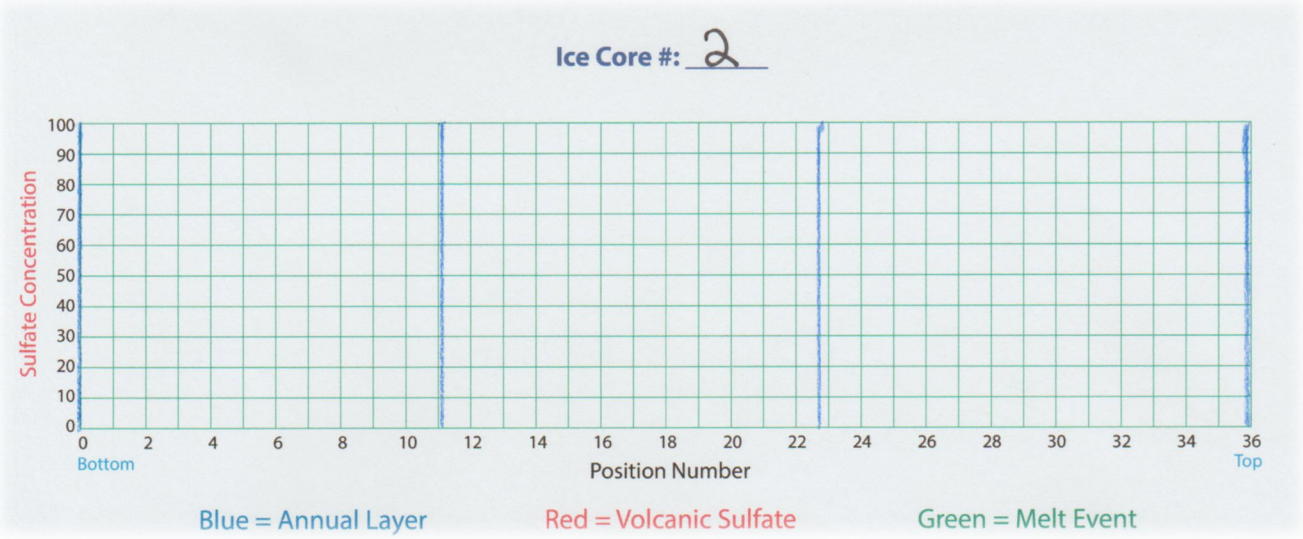
2. When students are adding water, they should only add one drop at a time in order to avoid an excessive amount of ice.
3. Students should have a ratio of 1:1 of the ice to soil for step 6 (page 7). The ice and soil should be thoroughly mixed before moving on to the next step. Make sure that the entire tin is not full, as they will be adding more items.
4. When pushing the sand/ice mixture (step 6) to one side of the tin, make sure there is a definitive line down the middle prior to adding in the plain soil. The soil and ice/soil mixture should both be packed down and the surface should be flat. This will help when the metal buildings are added to the model.

5. Students can have the autonomy to place the vegetation and road wherever they please in the tin. *Note: This can get very messy, so make sure students place a paper towel under the tin. After using the vegetation and road, make sure lids are completely closed before moving on.*
6. While students are using the hotplate, they should be supervised, as to ensure no one gets burned or hurt. All personal items should be moved away from the hot plate and the cord to the hot plate should be somewhere where no one can trip over it.
7. Students should periodically check on their tin pan and record observations in their science notebook.

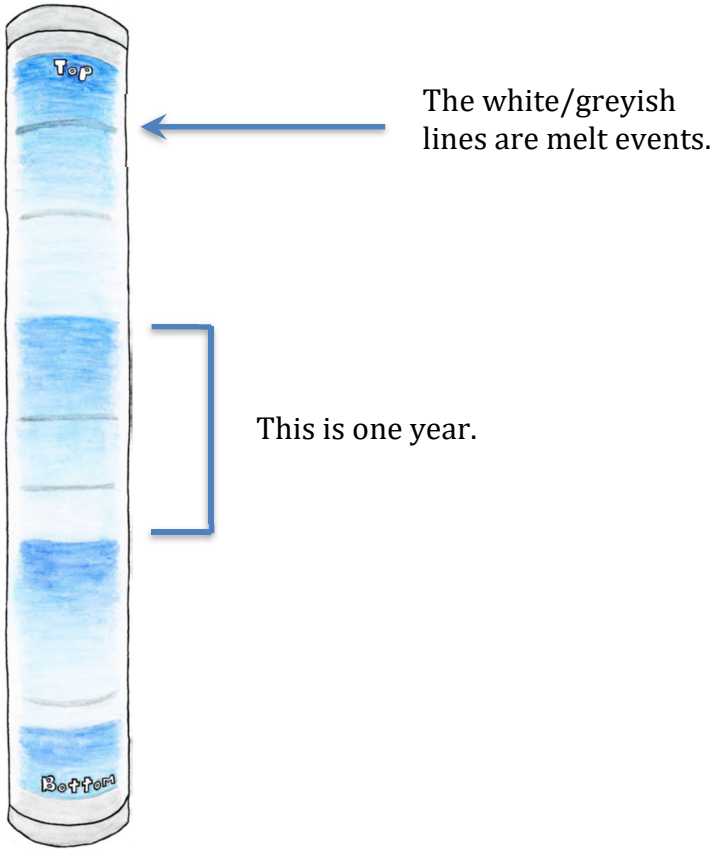
CAUTION: ***Students should NOT touch the hot plate, pan, or metal buildings, as they will be hot! Tweezers have been provided to move the pan if needed.***

Part 3: Glacial Ice

1. Students should identify the top and bottom of the ice core. The words can be faint, but are located near the end caps.
2. Students should be able to identify the number of years on the ice core. If they are unable to, help guide them.
3. When using the graph paper, make sure that the ice core is horizontal, with the bottom to the left and the top to the right. The ice core should be placed between 0 and 36 on the x-axis.

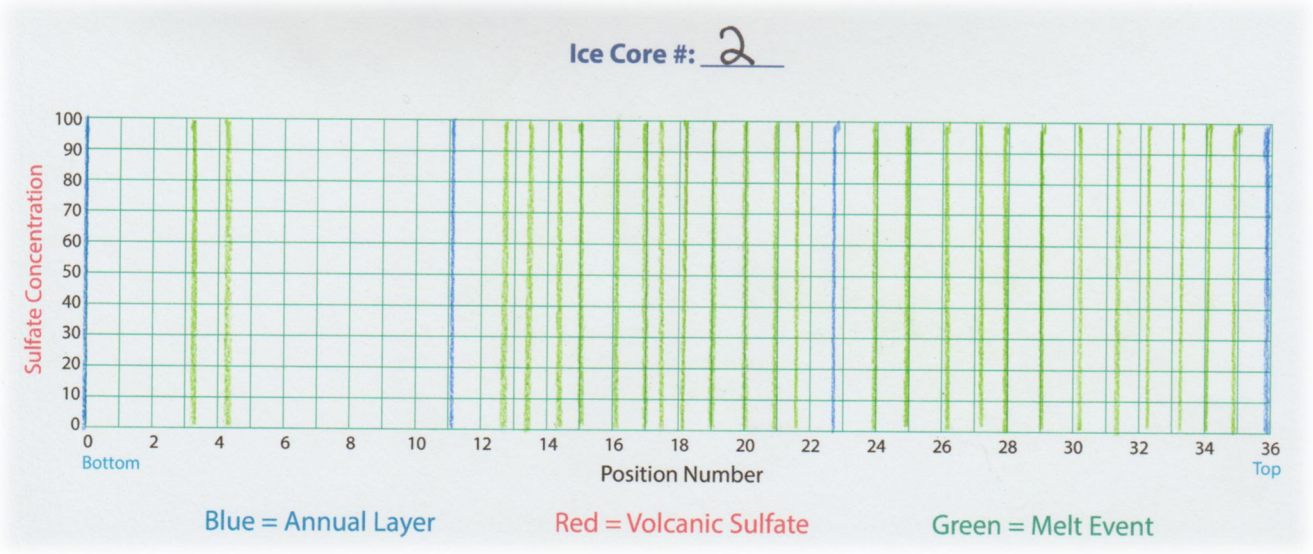


This is an example of what the graph should look like after Part 3.



Part 4: Melt Layers

1. When students are graphing the melt events, make sure they are using the correct colored pencil on their graph. Failing to do so could lead to confusion.

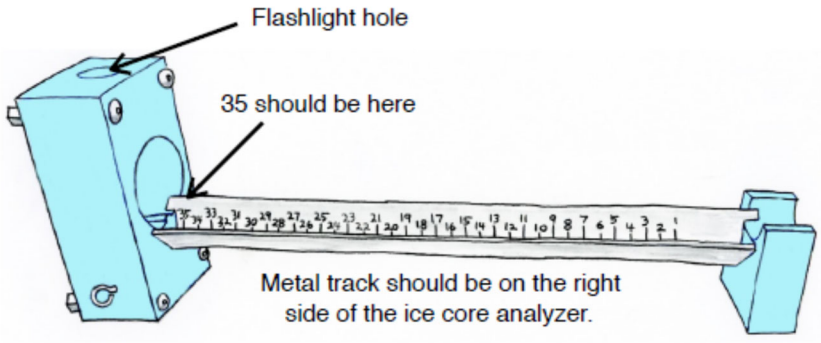


This is an example of what the graph should look like after Part 4.

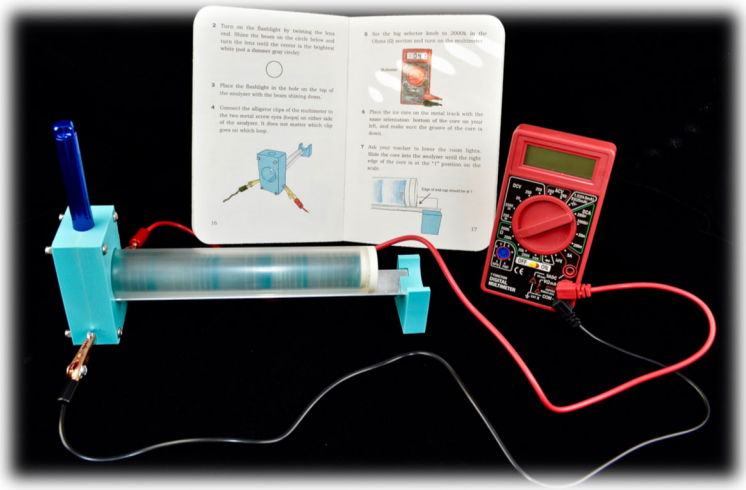
2. ***If you have a 50-minute class, skip to page 20 in the booklet (Piecing it Together).***

Part 5: Chemical Record

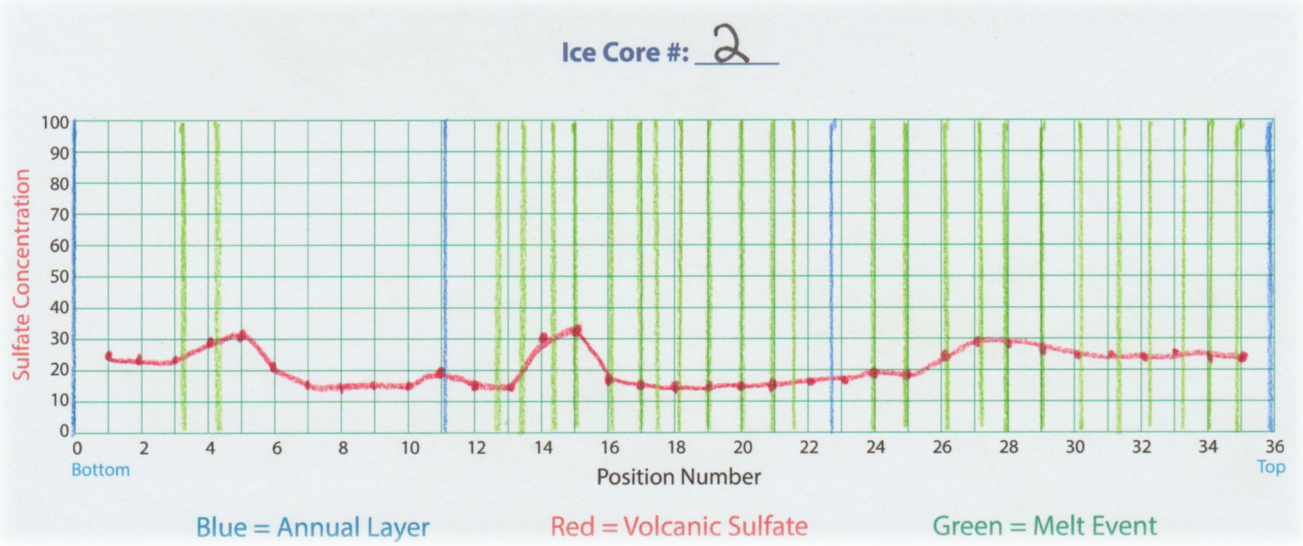
1. Students should be cautious when assembling the ice core analyzer. Nothing should be forced, as it could harm the items.
2. To assemble the scanning device, start with the ice core scanner (larger blue piece with the eye hooks). Slide the metal track into the groove – the #35 should be closest to this end. Then slide the ice core stand (smaller blue piece) onto the other end of the metal track – the #1 should be closest to this end.



3. The cables for the multimeter should be plugged in correctly – there are 3 plugs available. The red cable should be plugged into the middle hole and black cable should be plugged into the bottom hole. The setting on the multimeter should be at 2000k in the Ohms section.



4. When attaching the clips to the ice core stand loops, it does not matter which side you place the clips.
5. To use the flashlight, twist the lens end and shine the beam into the hole located at the top of the ice core stand. The light beam should be bright white. *Note: After use, turn off flashlight to conserve the battery.*
6. Most readings from the ice cores should be between 10 and 20. Peaks should be between 30 and 50. **NOTE:** If your students are getting reading much higher than this, check the brightness of the flashlight and perhaps put in fresh batteries.
7. When generating the table, students should have a total of 35 data points at the end of the exercise. These points should then be plotted on the graph paper in red.



This is an example of what the graph should look like after Part 5.

Part 6: Piecing it Together

1. Students should post the graph of their section of the ice core under the correct ice core number on the white board. When all graphs are up, they can start counting backwards from 2012 (the top of ice core #1) to figure out the range of years for their individual ice core. These years should be written on across the top of their graph paper in line with the corresponding section of the ice core (see the example below).

2. Students should check their permafrost experiment and journal about it while waiting for all students to post their graphs to the white board.

Part 7: Thawing Effects

1. Students should be using their observation skills when observing their permafrost experiment. There is a magnifying hand lens available for them to look for the slightest changes and use these observations to compare the two sides of the tin.

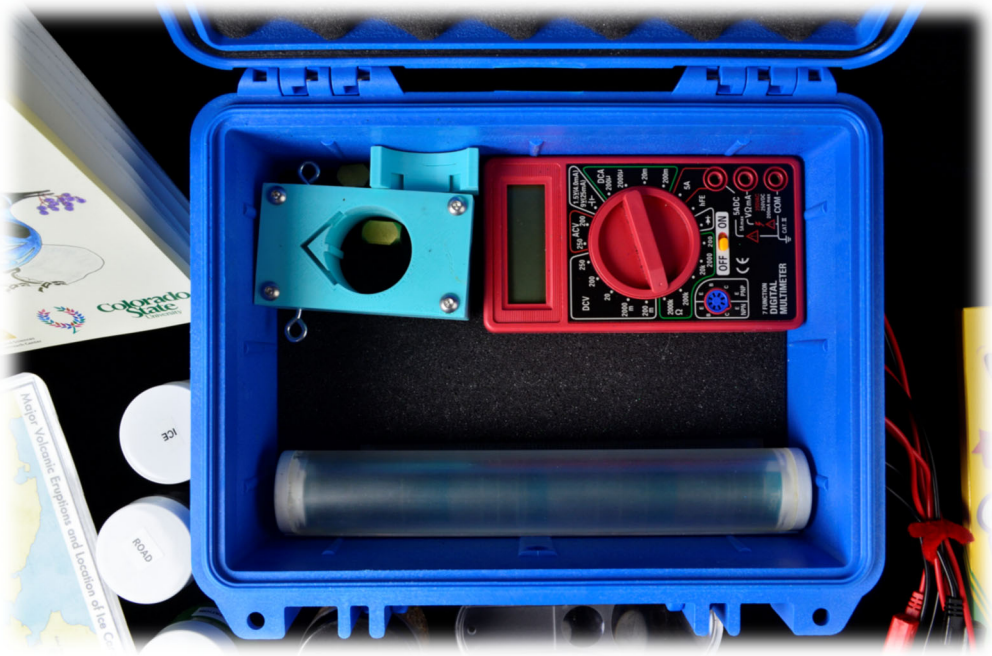
CAUTION: ***The tin and metal buildings may still be hot, so be careful!!***

Clean Up

1. Turn off the mug warmer and let the model cool before cleaning up as the pan and buildings will be **HOT!**
2. Dispose of the ice and soil tin pan contents in the trash and thoroughly rinse out the pan with soap and water. ***Make sure the tin pan is completely dry!***
3. The multimeter needs to be turned off and the alligator clip cables should be unplugged and neatly coiled.
4. Make sure the flashlight is turned off.
5. **GENTLY** disassemble the ice core stand, scanner, and metal track.
6. Rinse off and ***dry*** the spoon, pipette and metal buildings.
7. Wipe off work area with damp paper towel and dry.
8. ***Make sure everything is completely dry before putting away in the kit.***

Packing Instructions

Step 1: Place the multimeter in the upper right corner of the case. Place the ice core under the metal track at the very bottom of the case. Next, place the ice core scanner and support directly to the left of the multimeter and place the metal buildings inside the ice core scanner.



Step 2: Place the "ice" container inside the 50mL beaker and place to the very right of the case on its side. Then, place the road, vegetation, and soil container to the left of the 50 mL beaker.

Step 3: The tin pan should be flipped upside down and placed on top of the soil container. Neatly bundle the alligator cables together and place them along with the pipette, magnifying glass, spoon, and flashlight, on top of the ice core scanner and multimeter.

Step 4: Lastly, place the map of volcanic eruptions, colored pencils and the Vital Ice booklet on top and carefully close the lid without pinching any of the items. **CAUTION:** ***Do not force the case shut – it should close with ease!***

Class Discussion Questions

Note: The questions provided below are guide questions that students can discuss as a class in order to determine what they learned/took away from the kit.

Part 1: The Protracted Winter

1. What do you think the story represents?
   The story shows what the Tlingit people think about the environment. The Tlingit people gather observations and experiences that helped shape their beliefs and perception of the environment. They think that even the slightest action on their part had a big influence on the environment.
2. How do you think this relates to this kit and how we view the world today?
   The accumulation of observations and experiences helps generate hypothesis, questions, and sometimes answers. Due to the Tlingit people living in an extreme environment, this brings to light the idea of small actions presenting big consequences, which is what this kit focuses on.
3. Name some examples of small things that you do every day that may cause bigger problems later on.
   Littering, driving car, leaving lights on, using plastic, etc.

Part 2: Permafrost

1. In what way does the polymer ice behave like real ice?
   The polymer ice expands when it gets wet and shrinks when it dries out on the hot plate. Real water expands when it freezes and shrinks when it melts.
2. What was observed when adding water to the polymer ice?
   The polymer ice absorbed the water and grew in size.
3. Compare the permafrost side of the tin to the soil side of the tin as time goes on. What differences were observed? Any similarities?
   Answers will vary according to actual observations.

Part 3: Glacial Ice

1. How many years of ice were represented in your ice core? Why did some only have a few years and others had many years?
   The weight of the ice compresses the years towards the bottom of the core.
2. How can glaciers and ice cores be used to tack past climatic events?
   Ice cores are used to reconstruct temperature, atmospheric circulation strength, precipitation, ocean volume, atmospheric dust, volcanic eruptions, solar variability, marine biological productivity, sea ice and desert extent, and forest fires.

Part 4: Melt Layers

1. How many melt events were there between 1880 and 1950? How many between 1950 and 2012? What does it mean if there is a significant number of melt events on the ice core?
   ~23 and ~125; Melt layers are related to summer atmospheric temperatures. If the surface of the ice warms enough at 13,000 feet to melt a small layer of the snow, when the temps drop again, the water refreezes, creating thin layers of ice within the annual layer of snow (different crystal structures).

Part 5: Chemical Record

1. What is the point of a spectrometer?
   A spectrometer is used to analyze ice cores.
2. What does the concentration of sulfate in glaciers signify?
   The concentration of sulfate is a major component of volcanic eruptions.
3. How did the volcanic sulfate get into the middle of the ice core?
   It fell from the ash cloud in the sky onto the surface of the ice in the year of the eruption. Subsequent years of snow covered the ash and buried it over time.
4. Why do ice scientists record sulfate concentration?
   Scientists use known volcanic eruptions and their sulfate peaks to help confirm they counted the annual ice layers accurately.

Part 6: Piecing it Together

1. When comparing your results to the graph, what similarities and differences were observed? What does this mean?
   Answers will vary according to actual observations.

Part 7: Thawing Effects

1. What did you observe happened to your permafrost model over time as it heated up?
   The side containing the permafrost heated up and 'melted' the ice. This caused the road and building to sink.
2. What happened as you added water to the edge of the black road on the permafrost side? Why did this happen?
   The addition of water to the permafrost side caused the ice to increase in size and therefore expand the road

Teacher Feedback Survey:

http://dat.cns-eoc.colostate.edu/STEMkits/stem_kit_survey.php

Thank You!