

Lesson Routine

Questions

Phenomena / Problems

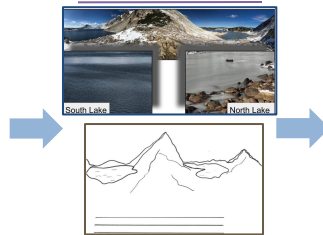
What We Figured Out

L1

Anchoring Phenomenon:
Freezing Lakes



How are these neighboring lakes so different in their ice cover on the same day?



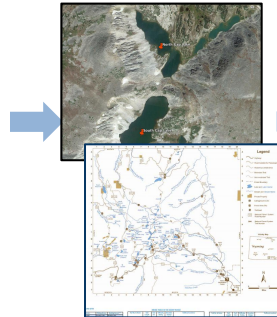
Hikers came across two large lakes only separated by a small ridge, one completely frozen and one with no ice at all. We have lots of questions we'd like to investigate to understand what caused this difference.

Learners document ideas and questions on initial models.

L2

Investigation:
Exploring Area Maps & Data

What are the physical similarities & differences between the lakes?



Forest Service lake data demonstrated that South and North Lakes have similar maximum depths, but South Lake has a larger surface area. They are at similar elevations. This makes us wonder about the role surface area and volume might play in freezing, as well as other abiotic influences.

L3

Investigation:
Water Freezing Investigation 1

Could the different amounts of water make a difference in the lakes' freezing?



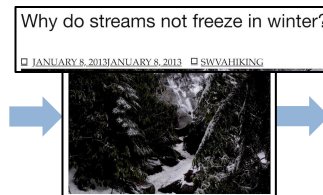
Smaller volumes of water froze more quickly, which might help explain why North Lake (less water) was frozen. We still wonder if volume or surface area makes a bigger difference, and need to gather more data to figure this out.

Learners synthesize learning in context of phenomenon, adding to summary chart

L4

Investigation:
Reading about and Observing Moving vs. Stagnant Water

But is the North Lake frozen solid, or is it just frozen on the surface? Could wind have caused the surface to freeze?

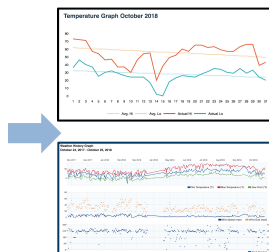


Reading an article, "Why do streams freeze in winter?" and observing a local stream, we learned water is less likely to freeze when it moves because it's being "replaced" by warmer water. We think wind could move the surface water, but wonder about the wind near the lake.

L5

Investigation:
Analyzing & Interpreting Prevailing Wind Data

Are winds near the lakes sufficient to prevent surface freezing? Do winds impact the South Lake more?



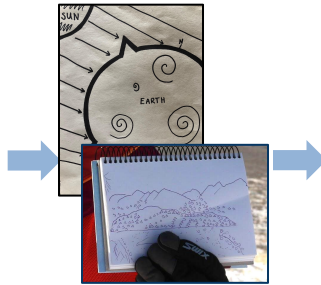
Wind data from a nearby town show that prevailing winds are WSW, which means that the South Lake could be more affected by the wind (causing water to move and not freeze). This might help explain why the South Lake lacks ice cover. This leaves us to wonder about the sun's role.

Learners synthesize learning in context of phenomenon, adding to summary chart

L6

Investigation:
Aspect on Earth
& in Place

Could sunlight affect
the two lakes
differently?



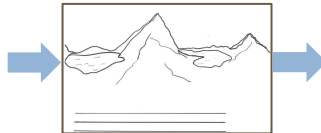
Because we are in the northern hemisphere, the North Lake should receive less direct sun (insolation) than its southern counterpart in the wintertime. We saw the impacts of this on the vegetative patterns in our place. Maybe the ridge blocks sun on the North lake, increasing the likelihood of freezing..

Learners synthesize learning in context of phenomenon, adding to summary chart

L7

Putting Pieces
Together

But what really matters? Did insolation, wind, or surface area/volume result in ice on North but not South Lake?



Based on our evidence, we think volume affects freezing the most, though insolation and wind likely had influence, too. We still wonder if rocks absorb heat, vegetation impacts freezing, and how topography along the bottoms of the lakes affects freezing.

Learners revise their initial models, including explanations and further questions.

End of Bend 1 (Year 1) /
Start of Bend 2 (Year 2)

L8

Anchoring
Phenomenon:
Re-introducing
the Freezing
Lakes (VIRTUAL)

To new learners: How are these neighboring lakes so different in their ice cover on the same day?



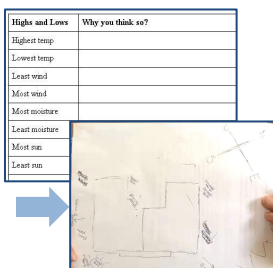
Hikers came across two large lakes only separated by a small ridge, one completely frozen and one with no ice at all. Many of the questions we'd like to investigate to understand what caused this difference are in line with what learners in Year 1 wondered about, too! We can use some of their findings and recommendations to guide our investigations in our own places.

Learners document ideas and questions on initial models.

L9

Investigation:
Wind and Sun
Patterns in Our
Places (VIRTUAL)

2018 learners recommended we explore nuances of how wind and insolation/aspect would impact the lakes (i.e., microclimates). What can our places tell us about wind and sun's role at this more specific scale?



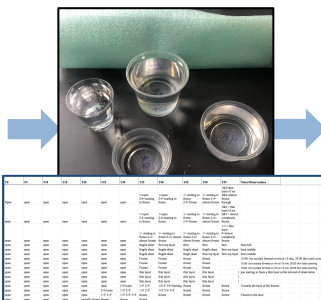
We observed and made generalizations across our places related to sun and wind:

- Even very small differences in what's near a spot make big differences in warmth, windiness, and moisture. Similar patterns near the lakes could make a big difference in the amount of warmth and wind protection.
- We noticed a pattern: different colors and substances hold heat more/less with the same amount of sun/wind exposure. We wonder how materials near the lake hold heat, which could affect freezing.

L10

Investigation:
Freezing
Experiment
(VIRTUAL)

2018 learners recommended we repeat freezing experiments with more standardization and replicates. What freezing differences will we find in varying volumes, depths, and surface areas?



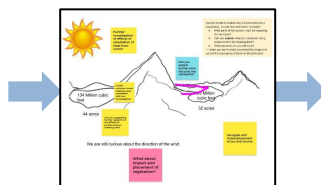
There were clear patterns: freezing on the surface was faster when the volume was smaller, though a smaller surface area or shallower depth alone did not seem to make a difference. This suggests to us that a larger lake volume is more likely to result in an unfrozen lake.

Learners revise their initial models, including explanations and further questions.

L11

Putting Pieces
Together
(VIRTUAL)

So, with investigations and evidence from both years, what really matters? Did sun, wind, or surface area/volume cause the ice to cover North Lake but not South?



We need to visit the lakes to definitively answer this question. However, by learning about the patterns we see in our places, we gathered sufficient evidence to suggest lake volume likely plays a larger role in the freezing difference than sun and wind. This helps us to confirm and extend findings from Year 1's learners.

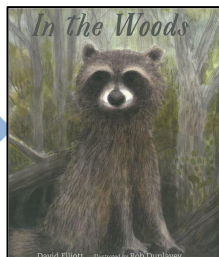
End of Bend 2 (Year 2) /
Start of Bend 3 (Year 2)

L12

Problematising:
*Identifying
Abiotic/Biotic
Interactions
Using Stories
and Personal
Experiences
(VIRTUAL)*



While we were investigating, you repeatedly thought about how no lake exists in isolation - there are lots of plants and animals that interact with the lakes. Let's dive into this: What impacts could the frozen and unfrozen lakes have on the biotic components of the system?



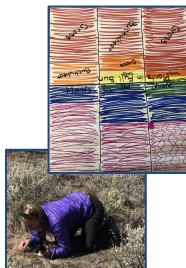
We made connections to our experiences, our previous storyline investigations, and phenology interactions in *In the Woods* (a picture book by David Elliott & Rob Dunlavey) to brainstorm possible impacts the frozen/unfrozen water could be having on the biotic components of the system. These ideas led us to generate a list of questions we could investigate.

L13

Investigation:
*Observing in
the Field*



What questions about abiotic/biotic interactions can I observe outside our classroom? How can I collect evidence of the interaction?



We planned and conducted our own investigations. We found two compelling abiotic/biotic interactions that we think translate to the lakes system (shrubs seem to support plants underneath them, and the edges of snow patches seem to contain lots of diversity in seeds/insects). This generated questions about the ways the biotic might impact the biotic in the lake system.

Learners reflect on methods for building understanding of lake system phenology