

# Earth and Environmental Sciences immersive learning experiences using a Google Expedition Kit

*Presented by:*

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**with contributions by:**

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# Geoscience

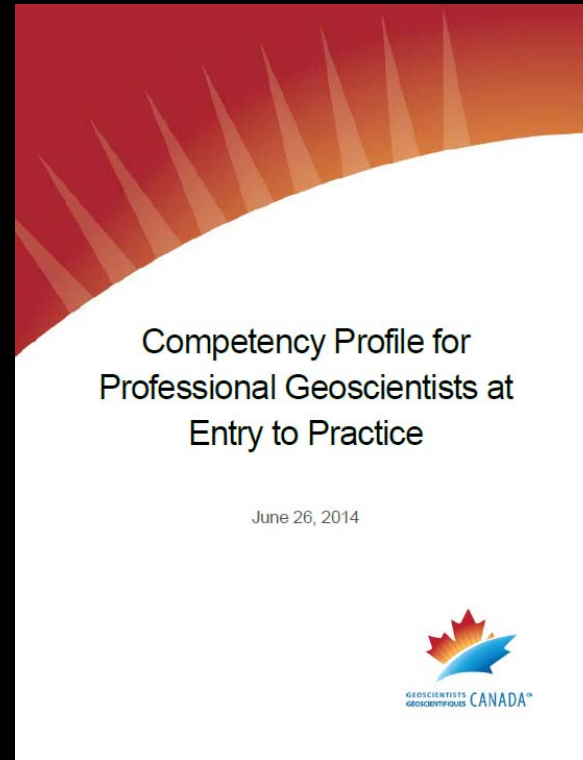
- Geoscience Thinking
- Technical Skills
- Field Experiences

## The Current and Mid-21<sup>st</sup> Century Geoscience Workforce

Christopher M. Keane  
American Geosciences Institute  
16 May 2018

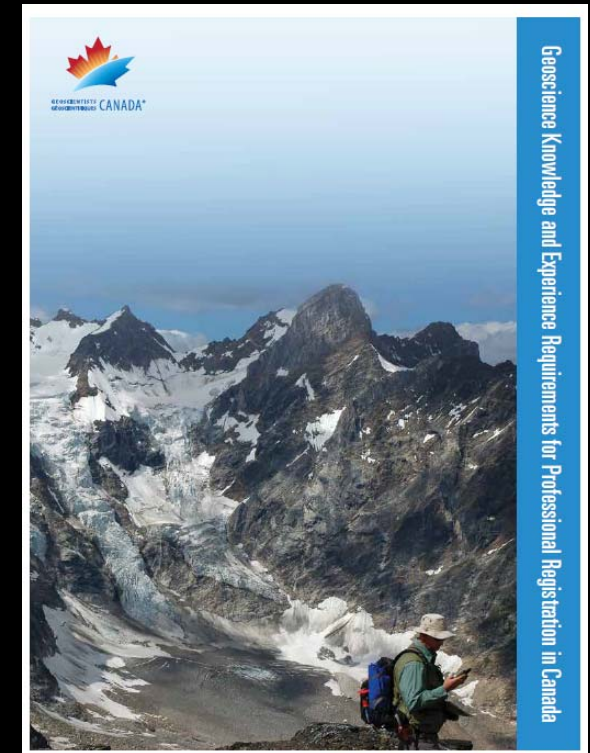


<https://www.americangeosciences.org/webinars/current-and-mid-21st-century-geoscience-workforce>



## Geoscience Canada - Competency Profile for Professional Geoscientists at Entry to Practice

<https://geoscientistscanada.ca/wp-content/uploads/2015/07/Competency-Profile-for-Professional-Geoscientistsat-Entry-to-Practice-Combined-Doc.pdf>



## Geoscience Knowledge and Experience Requirements for Professional Registration in Canada

<https://geoscientistscanada.ca/wp-content/uploads/2019/02/GC-Knowledge-Req.BKLT-REV-.EN-.web-.final-.pdf>

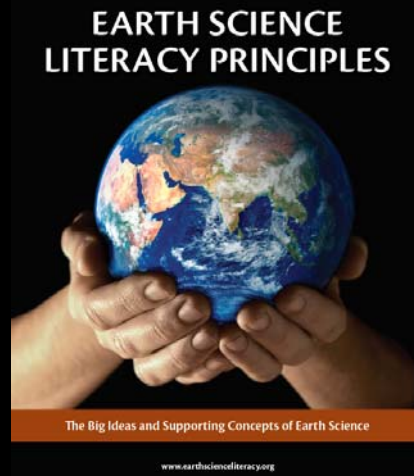
# Gap: Classroom to Fieldwork



<https://uwaterloo.ca/stories/chris-hadfield-delivers-first-lectures-waterloo-students>



Photo by Shoufa Lin

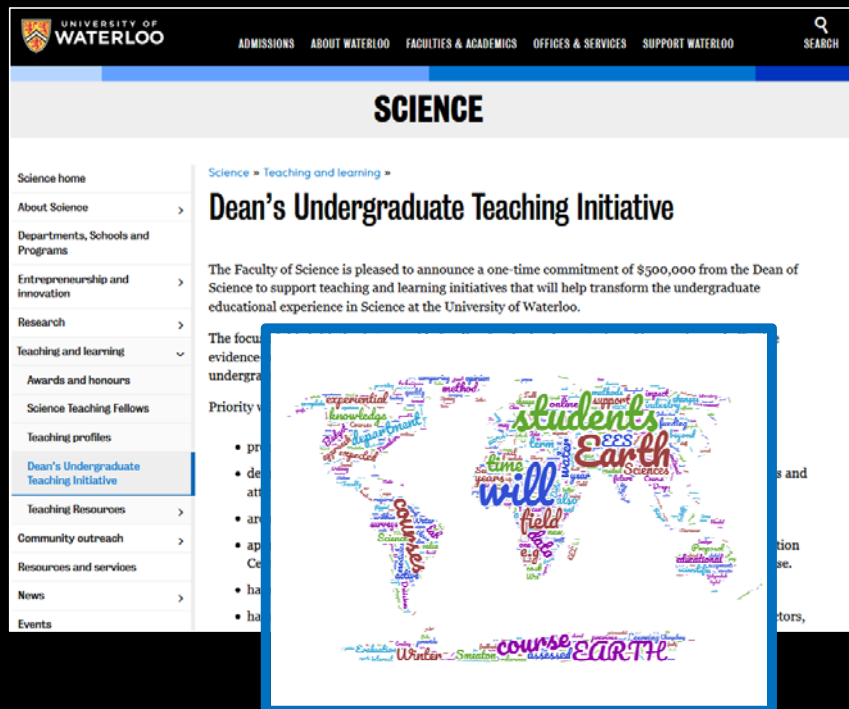


## Adopting the mind of a geoscientist:

- Systems Thinking
- Spatial Thinking
- Temporal Thinking
- Field Thinking

# Opportunity: UW Dean's UG Teaching Initiative

Proposal: Using Emerging Technologies to enhance field, experiential and active based learning in Earth and Environmental Sciences



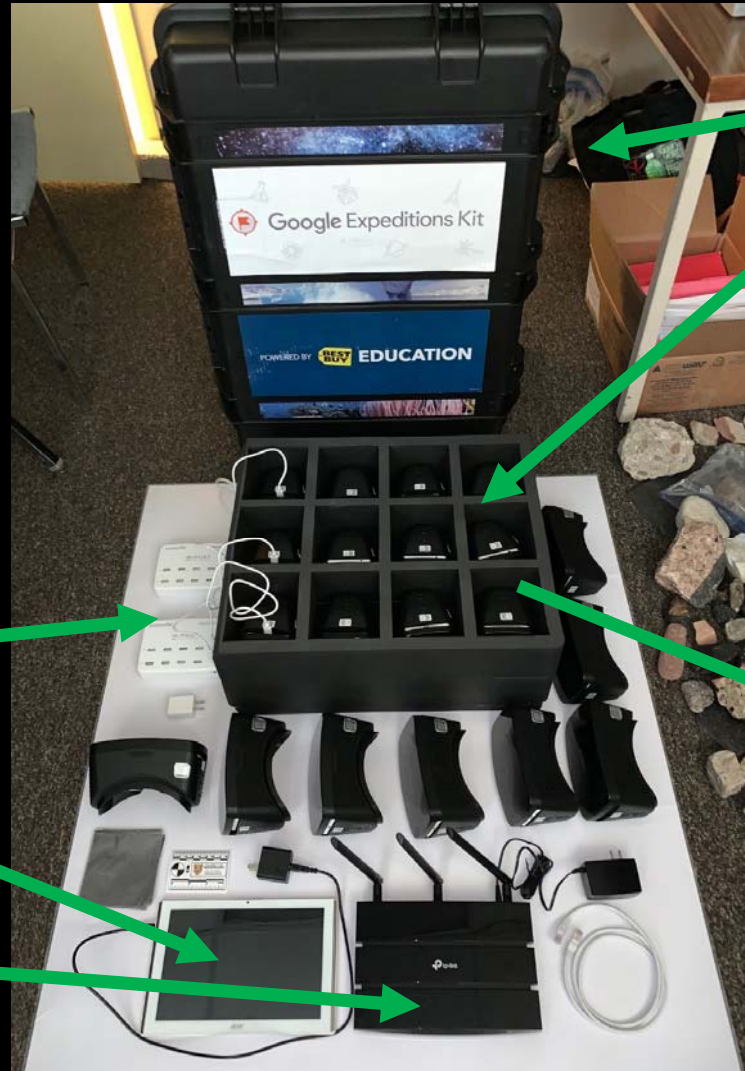
The screenshot shows the University of Waterloo website. The navigation bar includes 'UNIVERSITY OF WATERLOO', 'ADMISSIONS', 'ABOUT WATERLOO', 'FACULTIES & ACADEMICS', 'OFFICES & SERVICES', 'SUPPORT WATERLOO', and 'SEARCH'. The main content area is titled 'SCIENCE' and 'Dean's Undergraduate Teaching Initiative'. A sidebar on the left lists various categories like 'About Science', 'Departments, Schools and Programs', 'Entrepreneurship and Innovation', 'Research', 'Teaching and learning', 'Awards and honours', 'Science Teaching Fellows', 'Teaching profiles', 'Teaching Resources', 'Community outreach', 'Resources and services', 'News', and 'Events'. The main text on the page states: 'The Faculty of Science is pleased to announce a one-time commitment of \$500,000 from the Dean of Science to support teaching and learning initiatives that will help transform the undergraduate educational experience in Science at the University of Waterloo.' Below this text is a world map graphic filled with colorful words and phrases related to learning and science, including 'students', 'Earth', 'will', 'field', 'course', 'EARTH', 'experiential knowledge', 'support', 'time', 'will', 'field', 'course', 'EARTH', 'Winter', 'Summer', 'course', 'EARTH'.

Project 2 – Leveraging the use of a Google Expedition Kit to engage and motivate students in immersive learning experiences that are otherwise impossible (i.e. Geologic History of the Grand Canyon) or not feasible (i.e. 3D perspective of volcanoes) or invisible (i.e. Age dating rocks).

Courses: Earth 121L (F), Earth/Enve/Geoe/Cive 153 (W/S), and Earth 235 (F)

# Google Expedition Kit

- 2 Multi-Port USB Chargers
- 1 Android-Based Teacher Tablet
- 1 Router



- 1 Pelican Case
- 20 Virtual Reality Viewers and 20 Android-Based Student Phones



Charging 20 Phones Simultaneously

# Virtual Learning (VR)

Headset  
Phone

360° Image

3-DoF (static)  
6-DoF (move)

Simulate  
Physical  
Presence

Imaginary  
Environment



Photo by Alisa Sivak

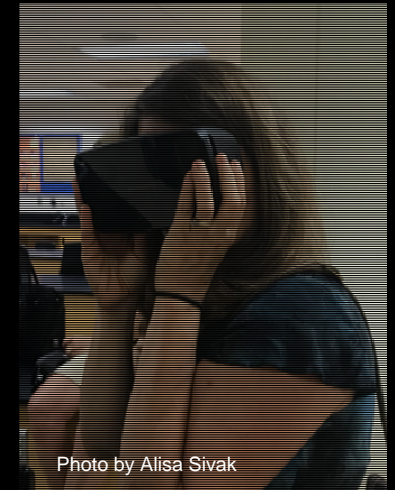


Photo by Alisa Sivak

UW VR/AR Community of Practice (CTE/CEL)

**What do you see? How does this make you feel?**



How would this differ if you were immersed?

# Perceived advantages and disadvantages of this system in geoscience education

“Best entry level system because it is cost-effective, self-contained, already tested and versatile for teachable moments.”

## Advantages

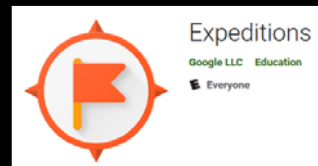
- Cost-effective (other VR/AR options or traveling expenses)
- Self-contained (phones, connected, communicate, battery power)
- Already tested classroom technology (K-12 Pioneer Program 2015)
- Versatile (start, pause, transition, pointer, draw, viewing location)



# Perceived advantages and disadvantages of this system in geoscience education

## Advantages

- Free App
- Existing Virtual Tours (>900 VR)
- Create own unique Virtual Tours



[Expeditions] - List of Available Expeditions

To search, hit "control F"  
VR Expeditions  
Last Updated: 6/12/19  
See AR expeditions here

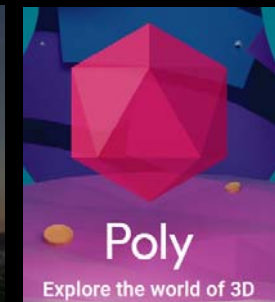
	NAME OF EXPEDITION	PANORAMA TITLES	LOCATION	DESCRIPTION
	A Journey Along the Great Barrier Reef	<ol style="list-style-type: none"> <li>1- Lady Elliot Island</li> <li>2- Heron Island</li> <li>3- Myrmidon Reef</li> <li>4- Tongala Shipwreck</li> <li>5- Cook Mule</li> <li>6- Coral Reef</li> <li>7- Ribbon Reefs</li> <li>8- North Broken Passage</li> </ol>	Great Barrier Reef, Australia	Join us on an underwater journey along the largest living structure on the planet and one of the natural wonders of the world - Australia's Great Barrier Reef. Learn about this awe-inspiring coral reef environment and meet its fascinating marine creatures.
	A Journey to the Mesozoic at the Senckenberg Nature Museum in Frankfurt	<ol style="list-style-type: none"> <li>1- The Senckenberg Nature Museum in Frankfurt</li> <li>2- Dinosaurs - Prehistoric Giants</li> <li>3- Marine Reptiles - Aquatic Giants</li> <li>4- Marine Reptiles - Reptiles of the Mesozoic</li> <li>5- Do Dinosaurs Still Exist Today?</li> </ol>	Frankfurt, Germany	The destruction of this expedition is the Mesozoic, 252 to 66 million years ago. We will gain insights into the living organisms during this period of our earth's history and get to know a few representatives of the groups of animals alive at that time: Dinosaurs, pterosaurs and marine reptiles. In the end, one question remains: Have all of the dinosaurs really gone extinct? <a href="https://bit.ly/2wz1v1d">https://bit.ly/2wz1v1d</a>
	A Journey to Victoria Cave	<ol style="list-style-type: none"> <li>1- Settle Market Square</li> <li>2- Banks Lane</li> <li>3- Antennae Scar</li> <li>4- First view of the cave</li> <li>5- Mouth of Victoria Cave</li> <li>6- Inside the cave</li> </ol>		A walk from Settle Market Place to Victoria Cave in the Yorkshire Dales National Park. We climb an ancient track onto the high limestone hills above the town of Settle with panoramic views of the valley below. We pass spectacular limestone cliffs before reaching the mouth of the cave, opened up by early scientific excavations in Victorian times. We explain why the cave is a unique time capsule for understanding the Ice Age in the Yorkshire Dales and the amazing animals that lived there.
	A Life Tale	<ol style="list-style-type: none"> <li>1- A spark of life</li> <li>2- To conquer and vanish</li> <li>3- The formidable lizards</li> <li>4- Back to the sea</li> <li>5- Here come the Mammals</li> <li>6- A wonderful radiation</li> <li>7- Primates</li> </ol>	Various Locations	A five billion years journey, from the very beginning of the Solar System to the radiation of Mammals and the appearance of our own species. <a href="https://bit.ly/2wz1v1d">https://bit.ly/2wz1v1d</a>

Tour Creator



Create a virtual tour

Tour Creator makes it easy to build immersive, 360° tours right from your computer









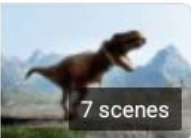
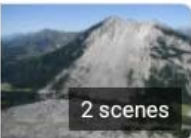






# Library

Downloads My Tours

🔍 Search Downloads

## DOWNLOADED TOURS

- |   |   |  |
|---|---|--|
| <p><b>A Closer Look at Volcanoes</b><br/>Vida Systems<br/>AR</p>  <p>5 objects</p>                     | <p><b>America's National Parks</b><br/>Houghton Mifflin Harcourt<br/>VR</p>  <p>8 scenes</p> | <p><b>Basic Landforms</b><br/>Vida Systems<br/>AR</p>  <p>7 objects</p>       |
| <p><b>Dinosaur Walk at Melbourne Museum</b><br/>Melbourne Museum, Google Arts ...</p>  <p>6 scenes</p> | <p><b>Dinosaurs</b><br/>Vida Systems<br/>AR</p>  <p>6 objects</p>                            | <p><b>Earth Geology</b><br/>Vida Systems<br/>AR</p>  <p>7 objects</p>         |
| <p><b>Earth Timeline</b><br/>VidaSystems<br/>VR</p>  <p>7 scenes</p>                                  | <p><b>GeoTour: Discover Alberta's Landscapes</b><br/>AGS Infosales</p>  <p>2 scenes</p>     | <p><b>Geology</b><br/>Google Earth<br/>VR</p>  <p>6 scenes</p>               |
| <p><b>Google Earth World Tour</b><br/>Houghton Mifflin Harcourt<br/>VR</p>                           | <p><b>Grand Canyon</b><br/>AirPano<br/>VR</p>    | <p><b>Hawaii Nei: Our Beautiful Islands</b><br/>The Janus Group<br/>VR</p>  |

Discover

Library

Class



## Earth Timeline



VidaSystems  
VR · 7 scenes

[View](#)

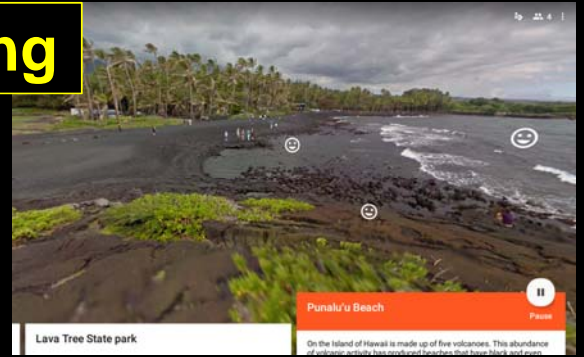
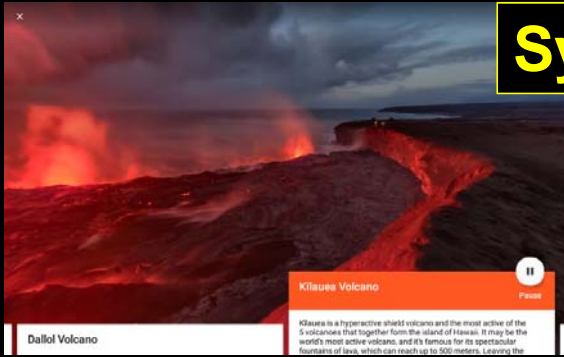
[View in VR](#)

[Guide](#)

Our Earth is a fantastic place, covered in mountains, valleys, and rivers, and teeming with all sorts of varied life. However the Earth was not always so, and complex life has only existed for the last 12% of the Earth's 4.6 billion years of existence, with humans only being around for 0.006% of that.



# System and Field Thinking

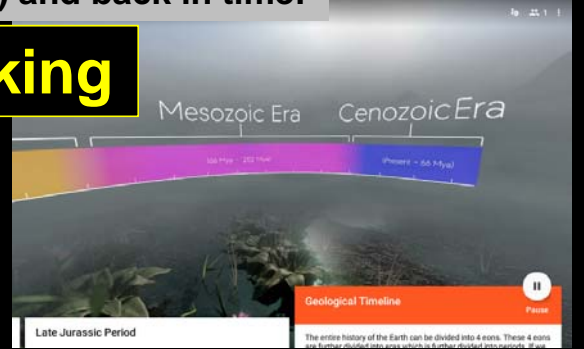
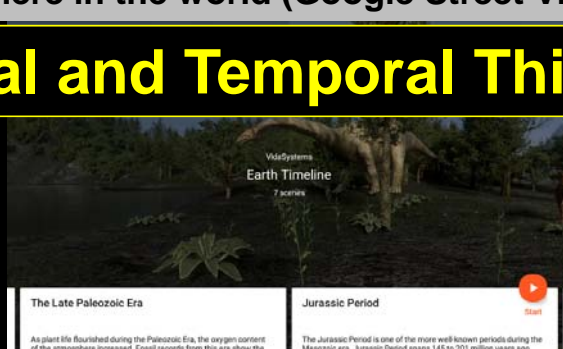
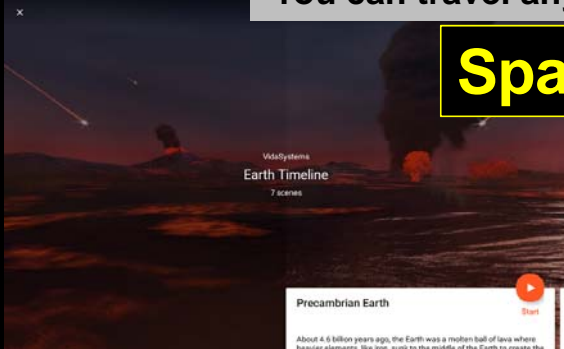


Do you see individual components that are organized and connected? Best geologists are those that have seen the most!



You can travel anywhere in the world (Google Street View) and back in time!

# Spatial and Temporal Thinking





# What does a Google Expedition look like?



Scenes (6 in this "Geology" Expedition)



Canyonlands National Park

Pause

Mount Everest

This is Canyonlands National Park near Moab, Utah. The dramatic scenery that you see here was created by two key processes that



# What does a Google Expedition look like?



## Canyonlands National Park

Pause

This is Canyonlands National Park near Moab, Utah. The dramatic scenery that you see here was created by two key processes that shape Earth's surface—weathering and erosion. Weathering is the process by which rock is broken down into smaller and smaller pieces called sediment. Heating and cooling, water and wind action, and other factors can cause weathering. Erosion is the movement of sediment from one location to another by wind, water, ice, or gravity. Over time, weathering and erosion wear down and reshape Earth's surface.

**Beginner:** Where is Canyonlands National Park?  
(Answer: Near Moab, Utah)

**Intermediate:** What are weathering and erosion?  
(Answer: Weathering is the process by which rock is broken down into smaller and smaller pieces. Erosion is the movement of sediment from one location to another.)

**Advanced:** How did weathering and erosion work together to shape the landscape of Canyonlands?  
(Answer: Weathering broke down the rock layers into sediment and created canyons. Erosion transported the sediment away.)

*Imagery ©2016 Google, Landsat / Copernicus*

Mount Everest



# What does a Google Expedition look like?



Point of Interest

## Canyonlands National Park



Pause



### Uplift

Long after they were deposited, the rocks of the Colorado Plateau were slowly lifted up. Today, the average elevation in this area is about 5,000 feet above sea level. As the area gradually rose, rivers began to wear the rock down and carry the sediment away.



### Colorado River

The Colorado River has carved a deep canyon into this section of the Colorado Plateau. In addition, rainfall and wind slowly break down the rocks along the canyon's sides.



### Exposed Rock Layers

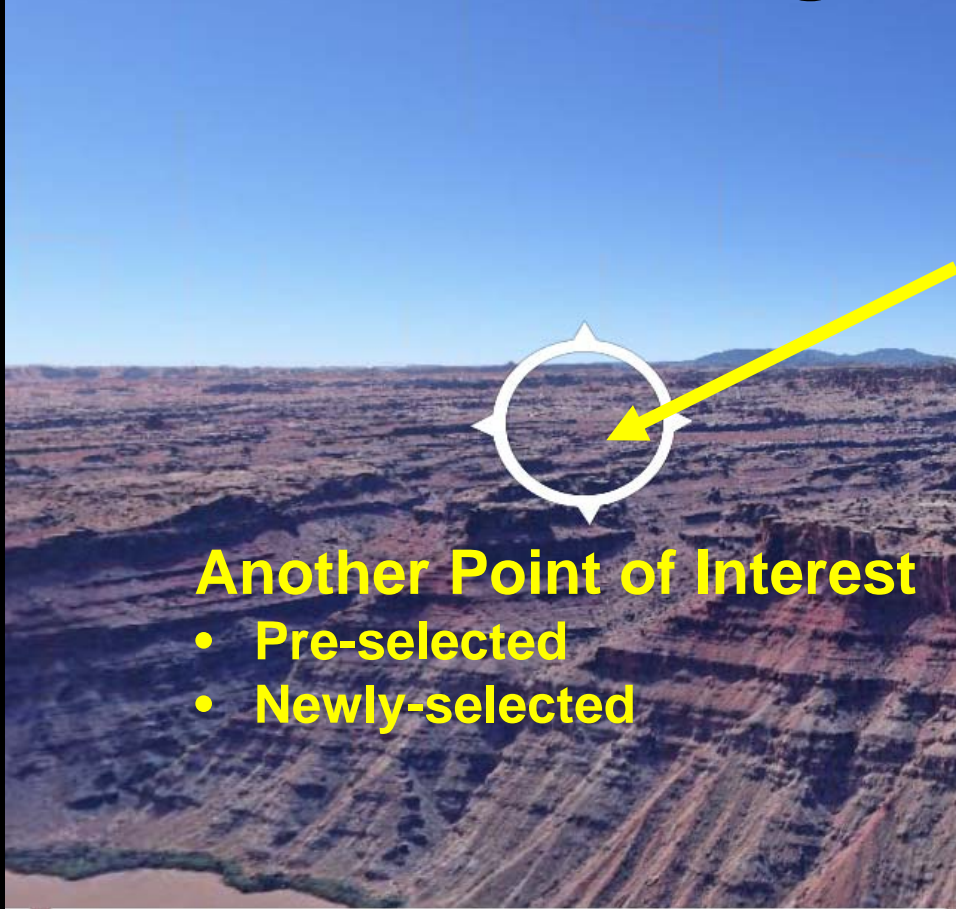
As the forces of weathering and erosion remove sediment, they expose ancient layers of rock. Some layers are stronger and more resistant to erosion, while others are weaker, creating a stair-step appearance.

Mount Everest

Houghton Mifflin Harcourt



# What does a Google Expedition look like?



## Another Point of Interest

- Pre-selected
- Newly-selected

### Canyonlands National Park



Pause

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Mount Everest

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# What does a Google Expedition look like?



Where are the students looking?

Mount Everest

## Canyonlands National Park



Pause



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Houghton Mifflin Harcourt





Reset



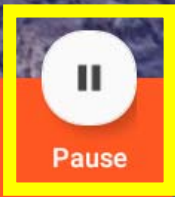
4



# What does a Google Expedition look like?



What if a teacher wants the student's attention?



Canyonlands National Park

Mount Everest

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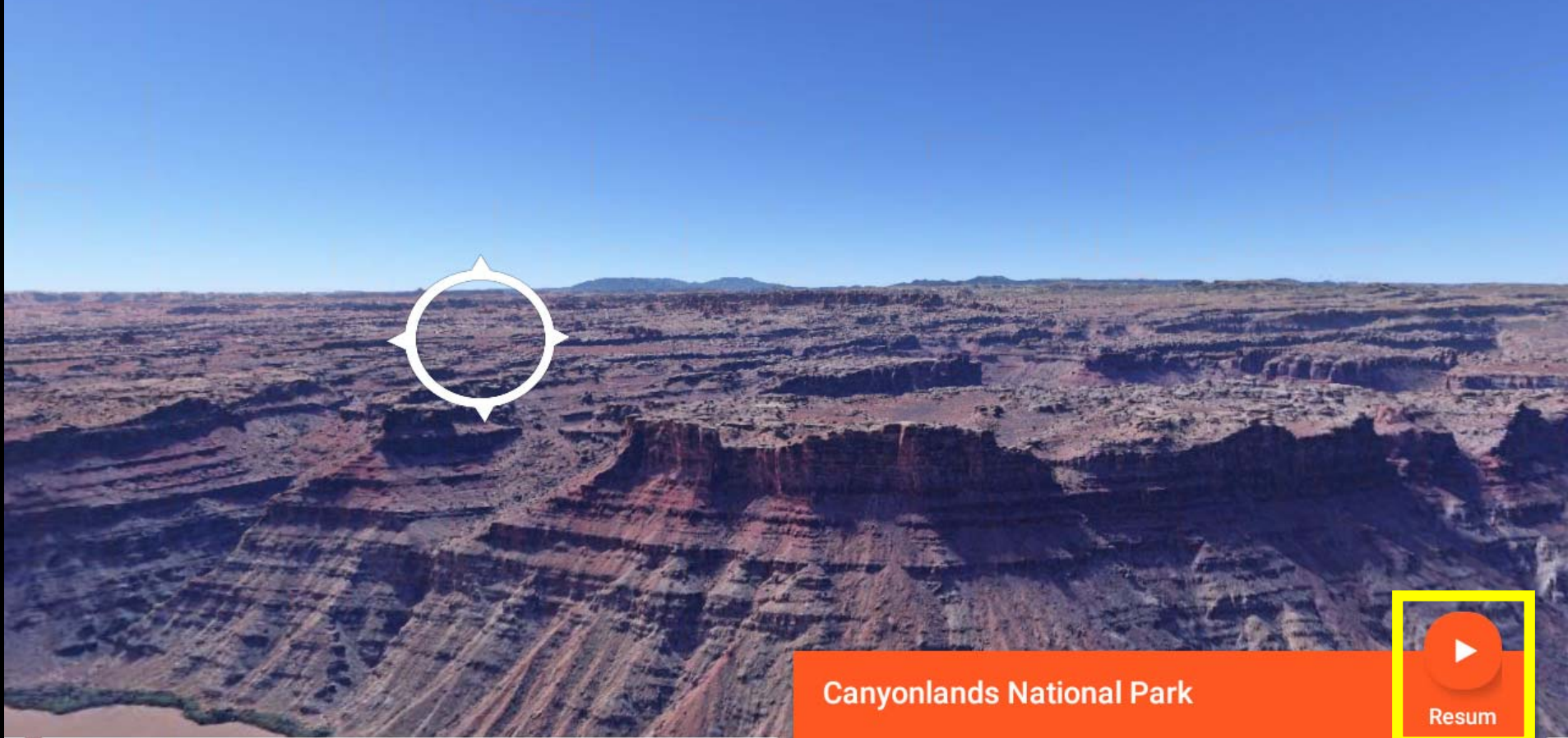
Reset



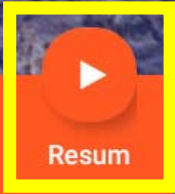
4



# What does a Google Expedition look like?



Canyonlands National Park



Mount Everest

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Reset



4



# What does a Google Expedition look like?



Canyonlands National Park

Pause

Mount Everest

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# Contextualize rock in the U Waterloo Peter Russell Rock Garden

Canada's Deadliest Rockslide  
"Frank Slide" - 4:10 am on April 29, 1903



GeoTour: Discover Alberta's Landscapes

AGS Infosales  
VR · 2 scenes

[View](#) [View in VR](#) [Guide](#)

Turtle Mountain, Alberta, Canada

The AGS GeoTour allows you to take a virtual trip to some of Alberta's most geologically significant sites with 360 videos and descriptions highlighting interesting facts about each location. Check out the virtual tour at [ags.aer.ca/activities/GeoTour-Discover-Albertas-Landscapes](https://ags.aer.ca/activities/GeoTour-Discover-Albertas-Landscapes) to explore geological features and landscapes found across Alberta.

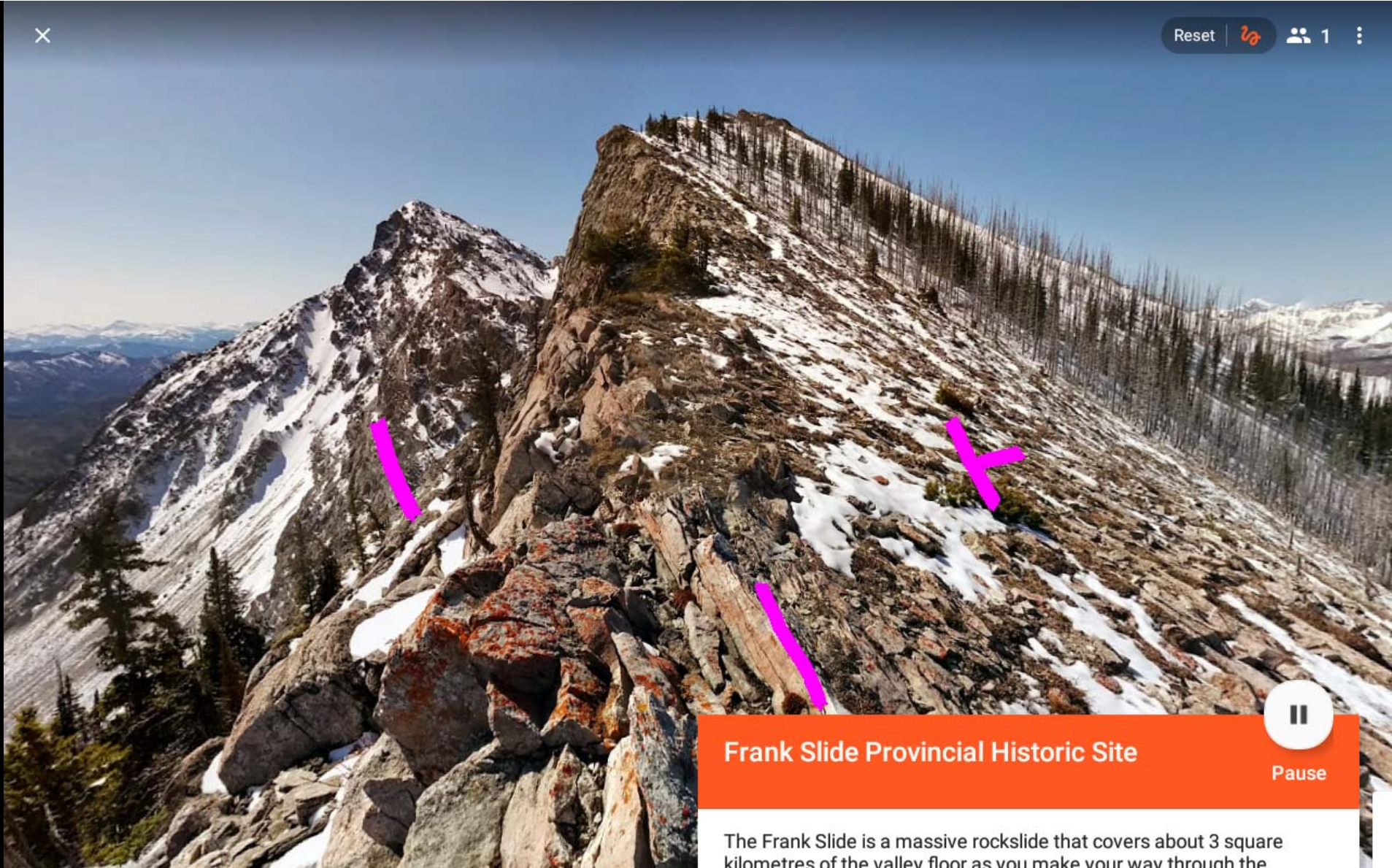
**Alberta Geological Survey**



Reset



1

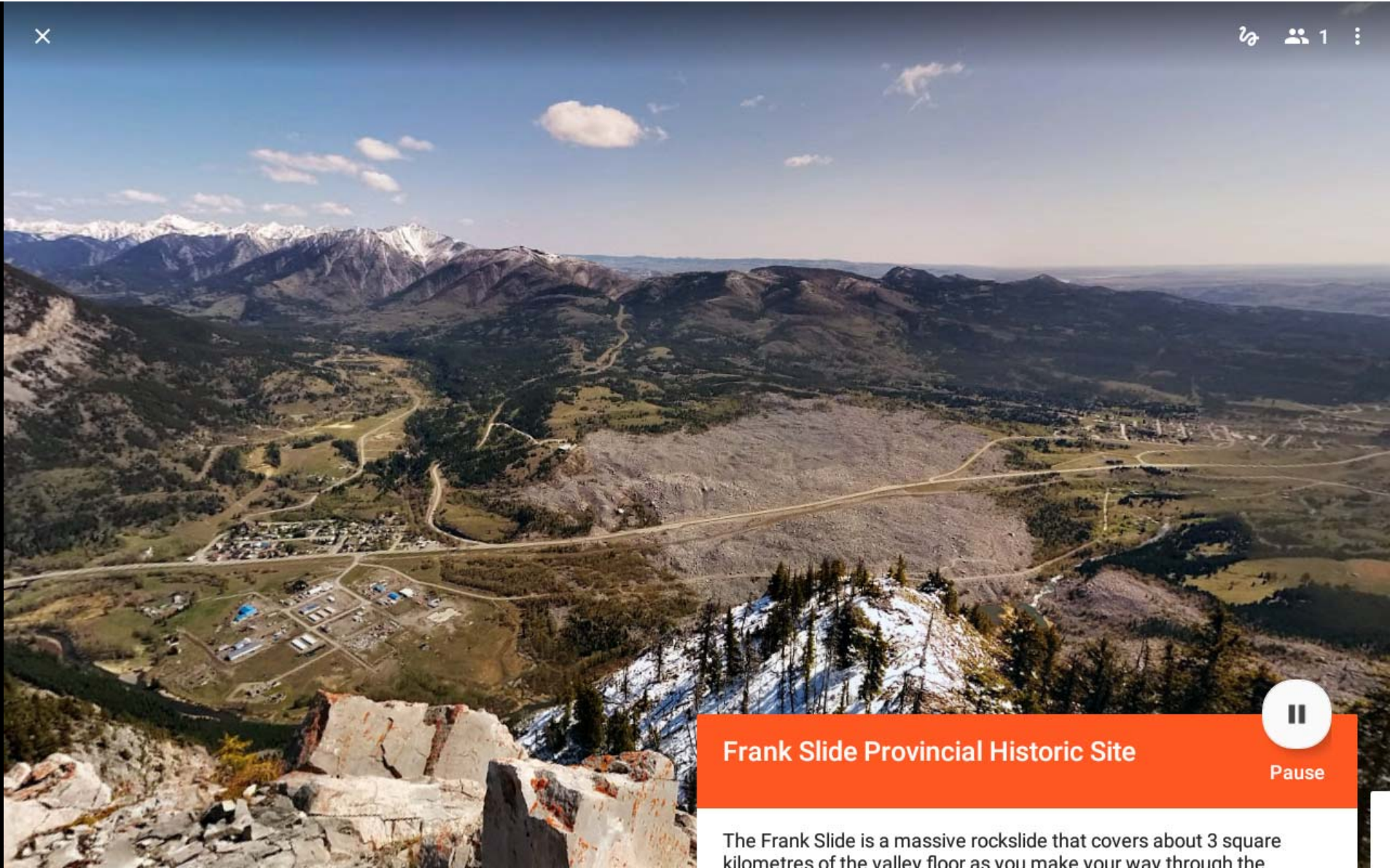


## Frank Slide Provincial Historic Site



Pause

The Frank Slide is a massive rockslide that covers about 3 square kilometres of the valley floor as you make your way through the



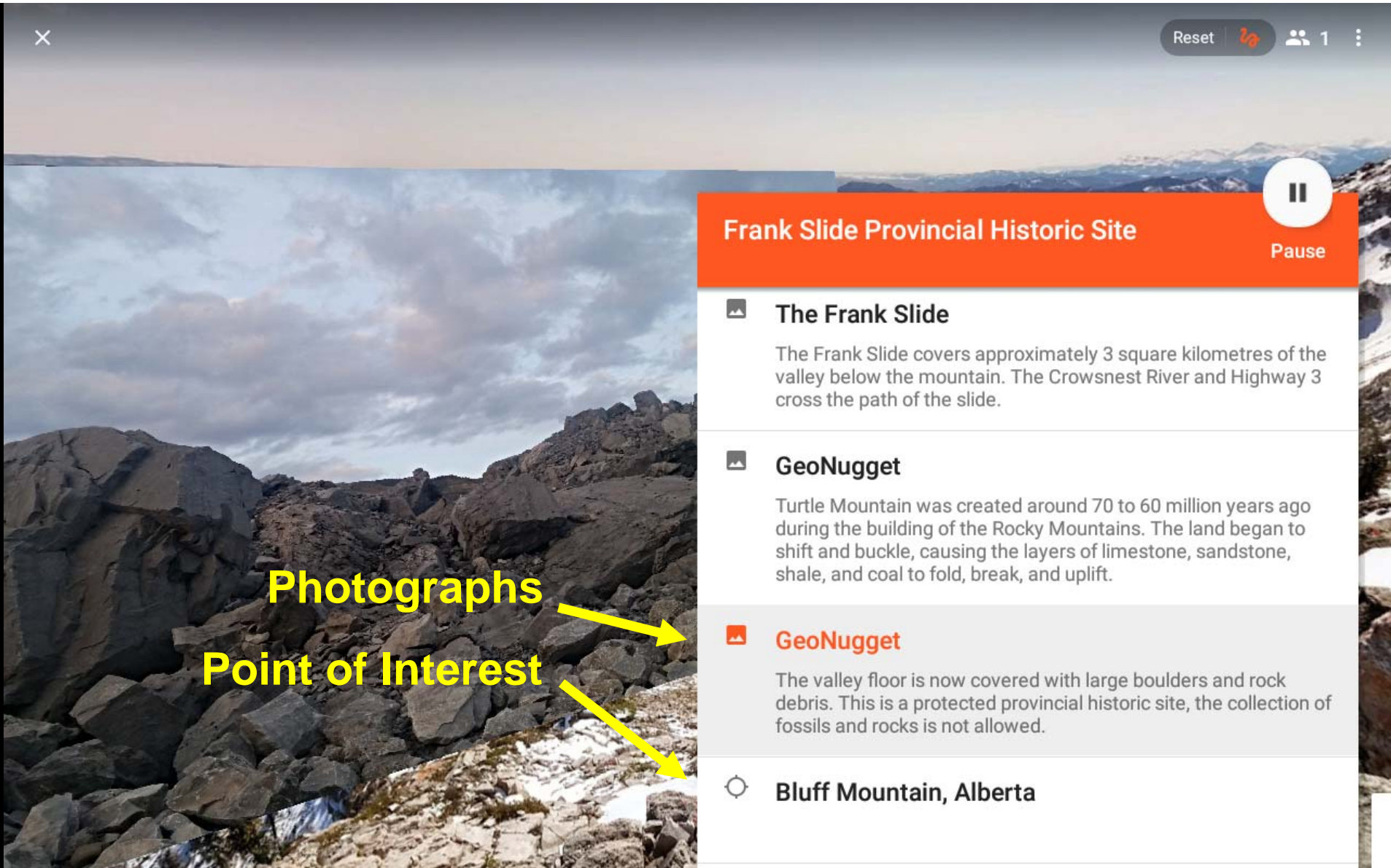
### Frank Slide Provincial Historic Site



Pause

The Frank Slide is a massive rockslide that covers about 3 square kilometres of the valley floor as you make your way through the





Reset



1



Pause

### Frank Slide Provincial Historic Site

#### The Frank Slide

The Frank Slide covers approximately 3 square kilometres of the valley below the mountain. The Crowsnest River and Highway 3 cross the path of the slide.

#### GeoNugget

Turtle Mountain was created around 70 to 60 million years ago during the building of the Rocky Mountains. The land began to shift and buckle, causing the layers of limestone, sandstone, shale, and coal to fold, break, and uplift.

#### GeoNugget

The valley floor is now covered with large boulders and rock debris. This is a protected provincial historic site, the collection of fossils and rocks is not allowed.

#### Bluff Mountain, Alberta

Photographs  
Point of Interest



# Did anybody see the dinosaur roaming across campus?



# Augmented Reality (AR)



In the Classroom

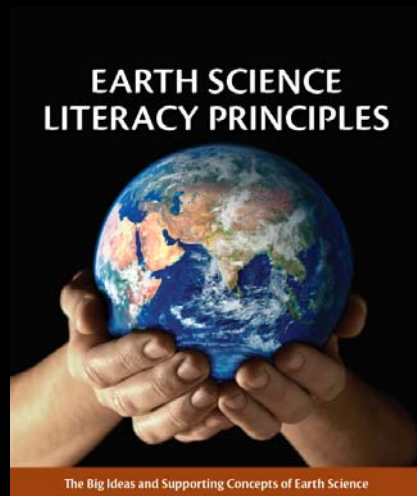


In the UW Earth Science Museum



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