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

Presented by:

John W. Johnston

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UNIVERSITY OF WATERLOO
FACULTY OF SCIENCE
Department of Earth and Environmental Sciences

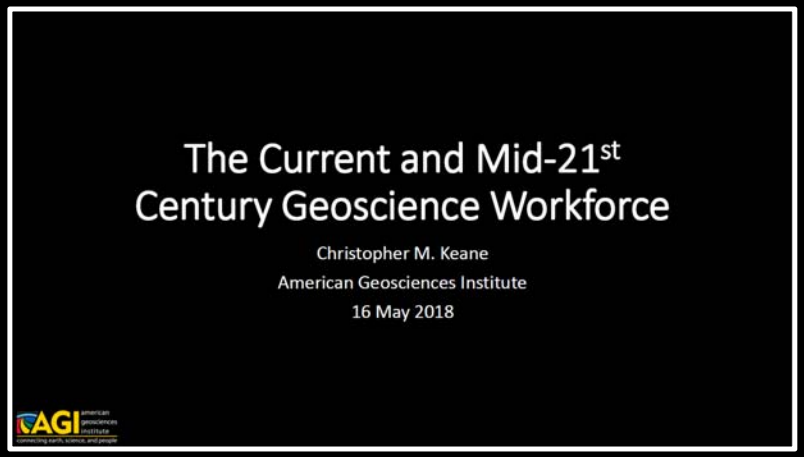
with contributions by:

Jen Parks[1], Keith Delaney[1],
Jason Thompson[2], and Max Salman[1]
[1]UW Earth and Environmental Science
[2]UW Centre for Teaching Excellence

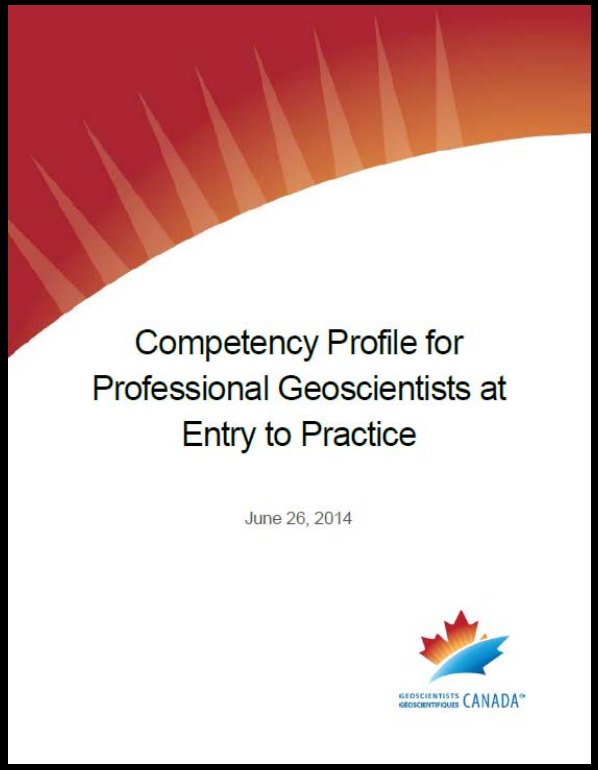
Photo by John Johnston

Geoscience

- Geoscience Thinking
- Technical Skills
- Field Experiences

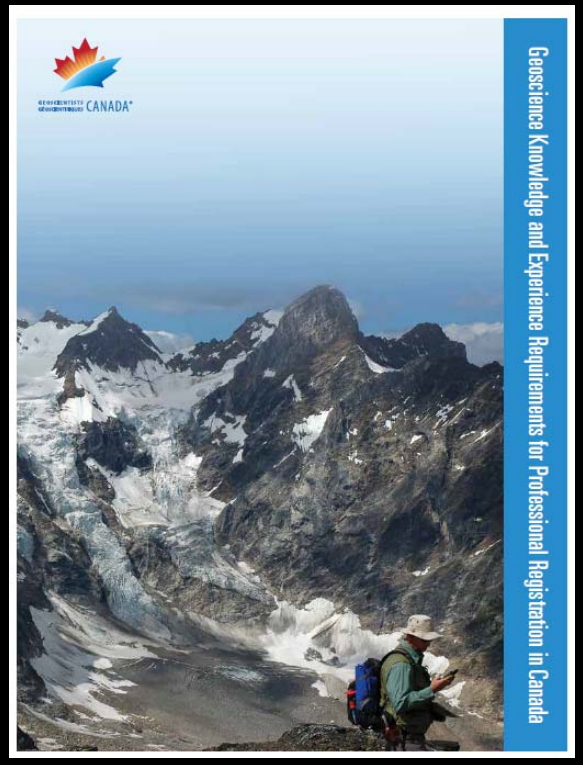


https://www.americangeosciences.org/webinars/current-and-mid-21st-century-geoscience-workforce



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-Requ.BKLT-.REV-.EN-.web-.final-.pdf

Gap: Classroom to Fieldwork


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

Better Prepare?

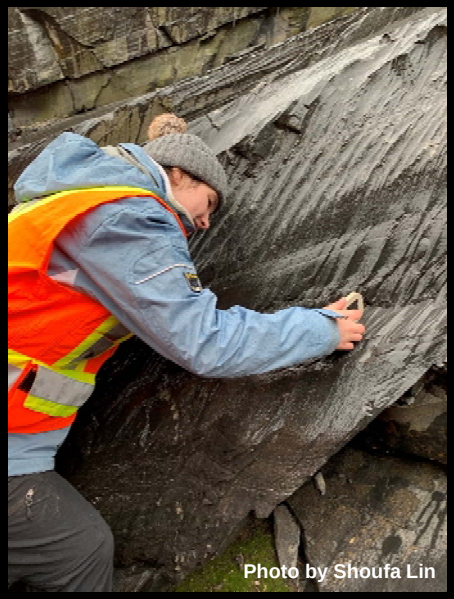
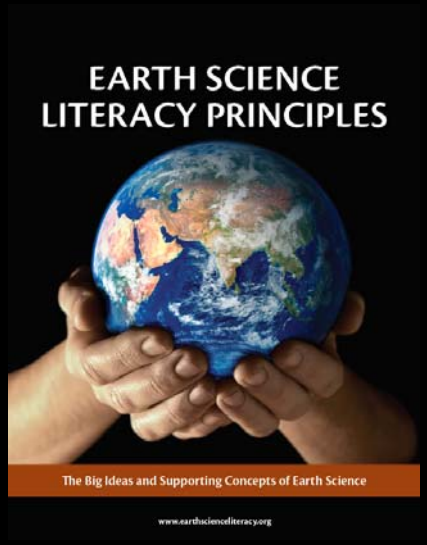


Photo by Shoufa Lin

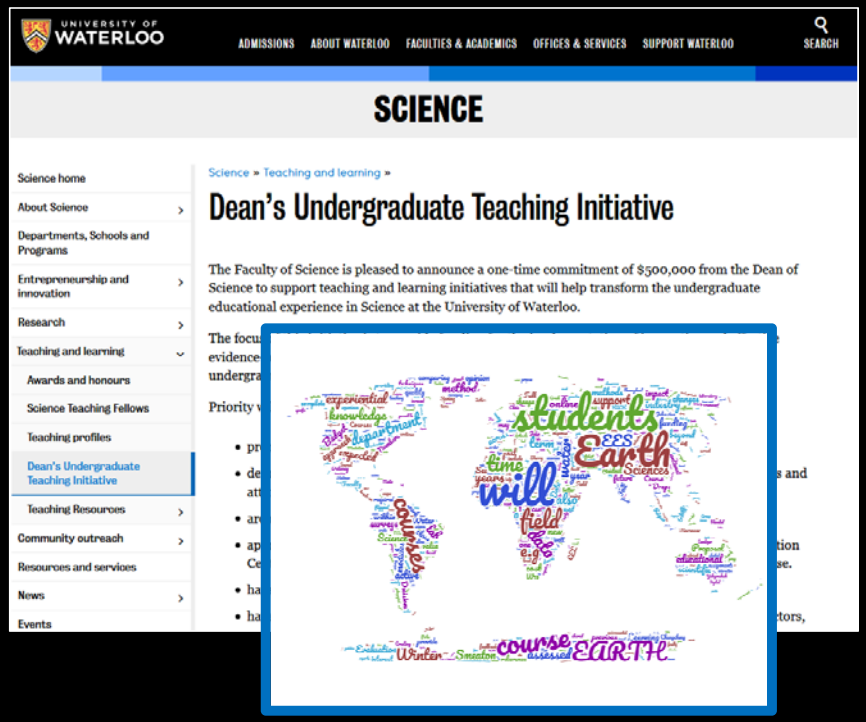


Adopting the mind of a geoscientist:

- 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**



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)

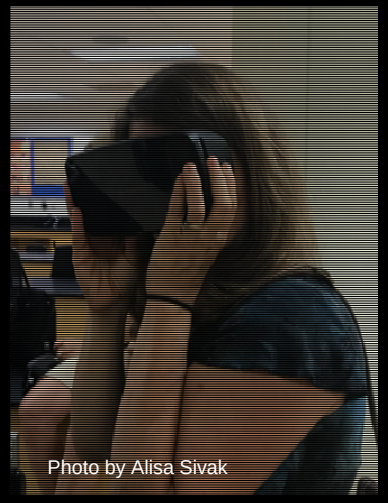
Headset
Phone

360° Image

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

Simulate
Physical
Presence

Imaginary
Environment



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

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

https://edu.google.com/intl/en_ca/products/vr-ar/?modal_active=none

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."

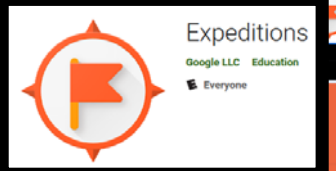
Advantages

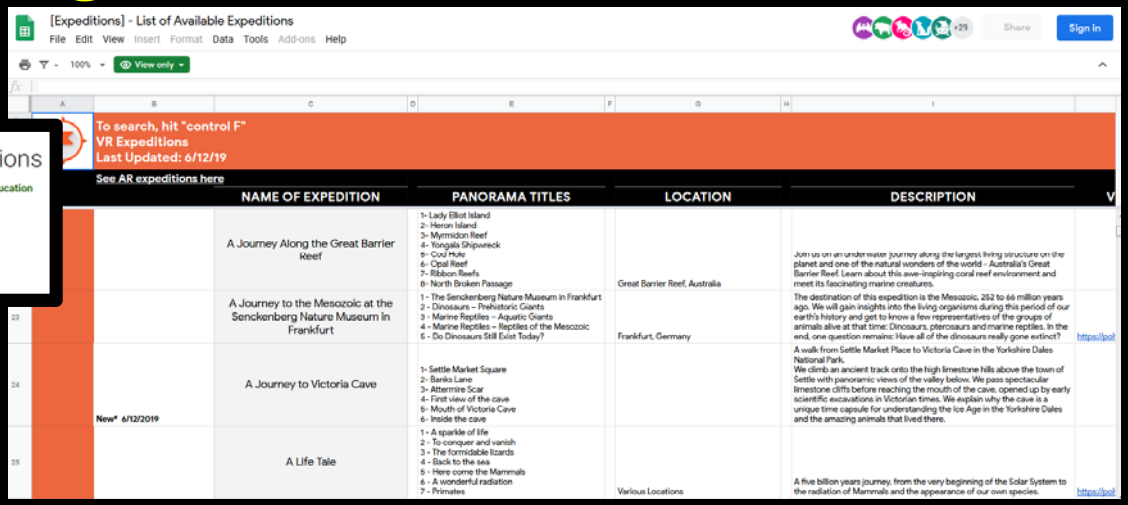
- Cost-effective (other VR/AR options or traveling expenses)
- Self-contained (phones, connected, communicate, battery power)
- Already tested classroom technology (K-12 Pioneer Program 2015)
- Versatile (start, pause, transition, pointer, draw, viewing location)

Perceived advantages and disadvantages of this system in geoscience education

Advantages

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





Google Street View

Library

Downloads My Tours

Search Downloads

DOWNLOADED TOURS

A Closer Look at Volcanoes
Vida Systems
AR

America's National Parks
Houghton Mifflin Harcourt
VR

Basic Landforms
Vida Systems
AR

Dinosaur Walk at Melbourne Museum
Melbourne Museum, Google Arts ...

Dinosaurs
Vida Systems
AR

Earth Geology
Vida Systems
AR

Earth Timeline
VidaSystems
VR

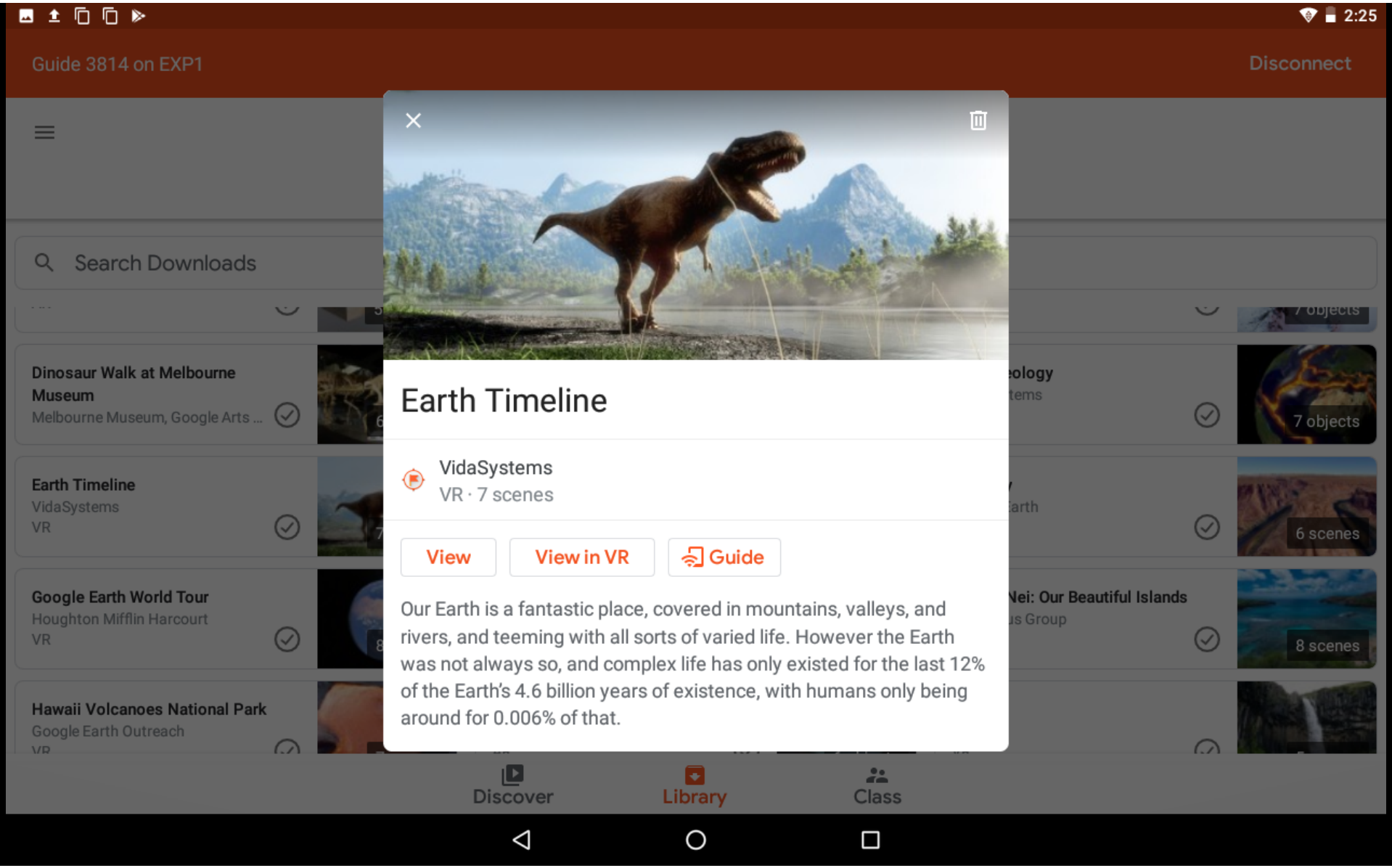
GeoTour: Discover Alberta's Landscapes
AGS Infosales

Geology
Google Earth
VR

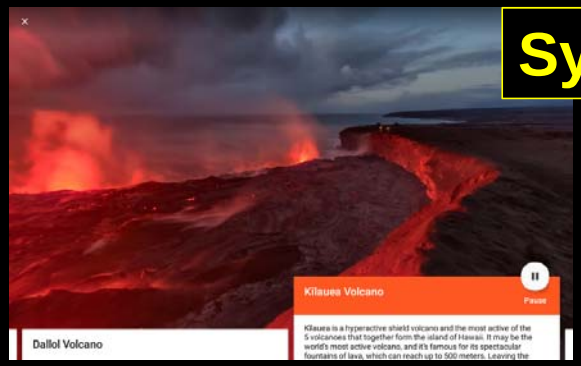
Google Earth World Tour
Houghton Mifflin Harcourt

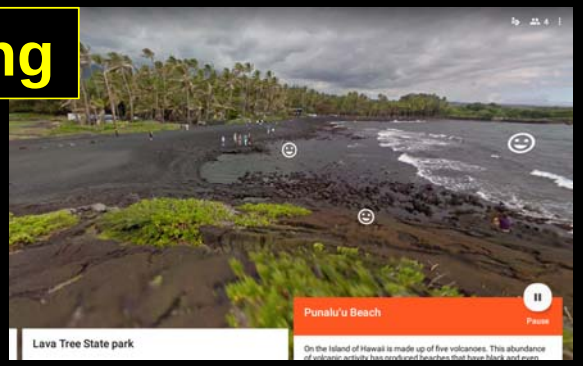
Grand Canyon
AirPano

Hawaii Nei: Our Beautiful Islands
The Janus Group

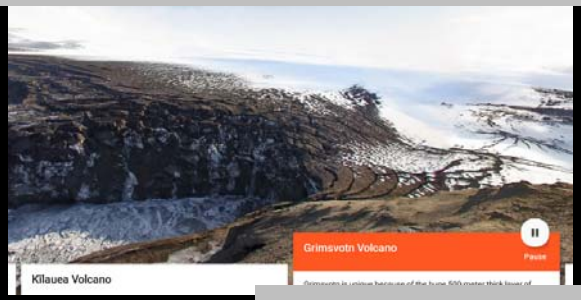

2:25
Guide 3814 on EXP1
Disconnect
Search Downloads
Dinosaur Walk at Melbourne Museum
Melbourne Museum, Google Arts ...
Earth Timeline
VidaSystems
VR
Google Earth World Tour
Houghton Mifflin Harcourt
VR
Hawaii Volcanoes National Park
Google Earth Outreach
7 objects
6 scenes
8 scenes
Earth Timeline
VidaSystems
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.
Discover
Library
Class

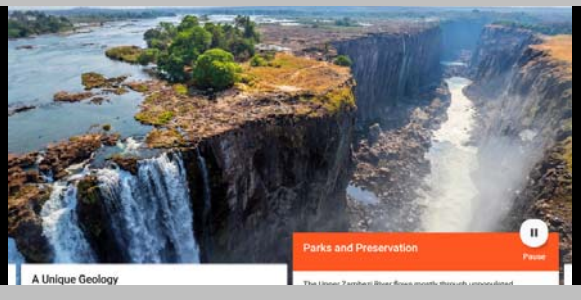
System and Field Thinking





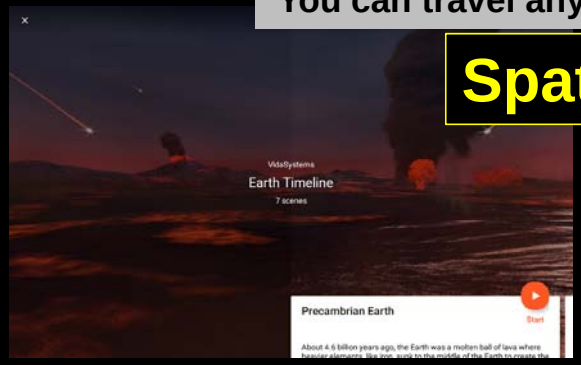
Do you see individual components that are organized and connected? Best geologists are those that have seen the most!

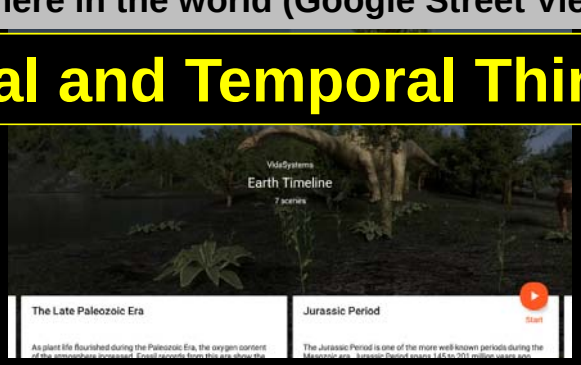


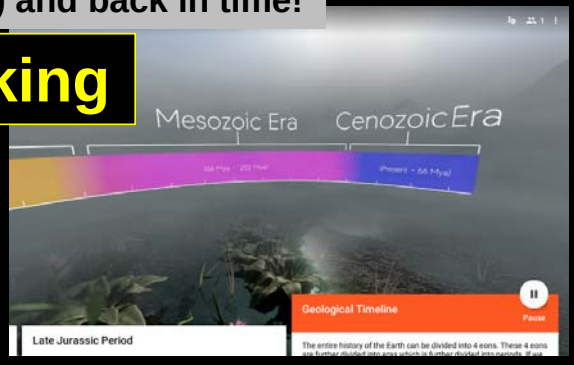


You can travel anywhere in the world (Google Street View) and back in time!

Spatial and Temporal Thinking







What does a Google Expedition look like?

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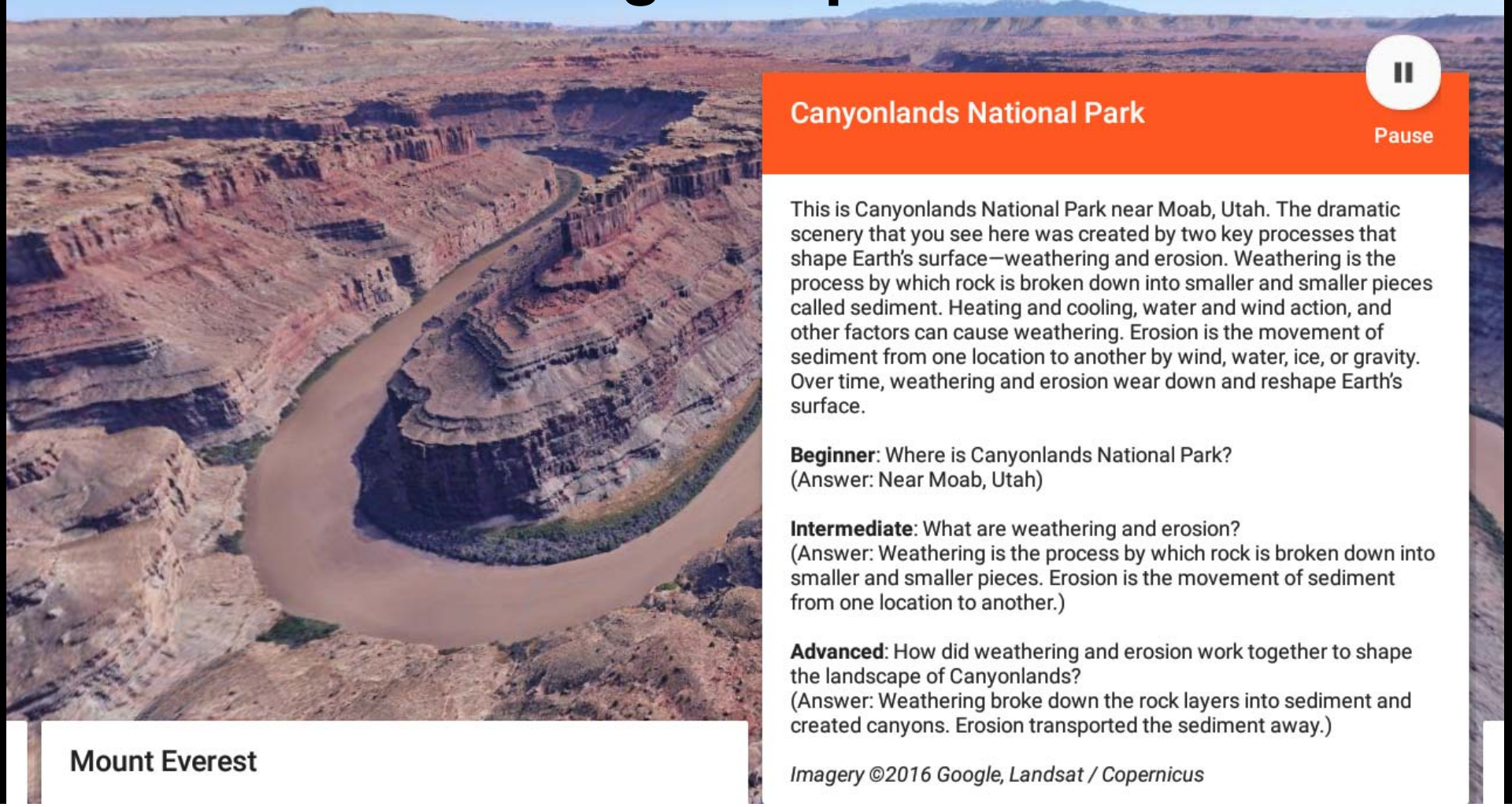


Canyonlands National Park

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)

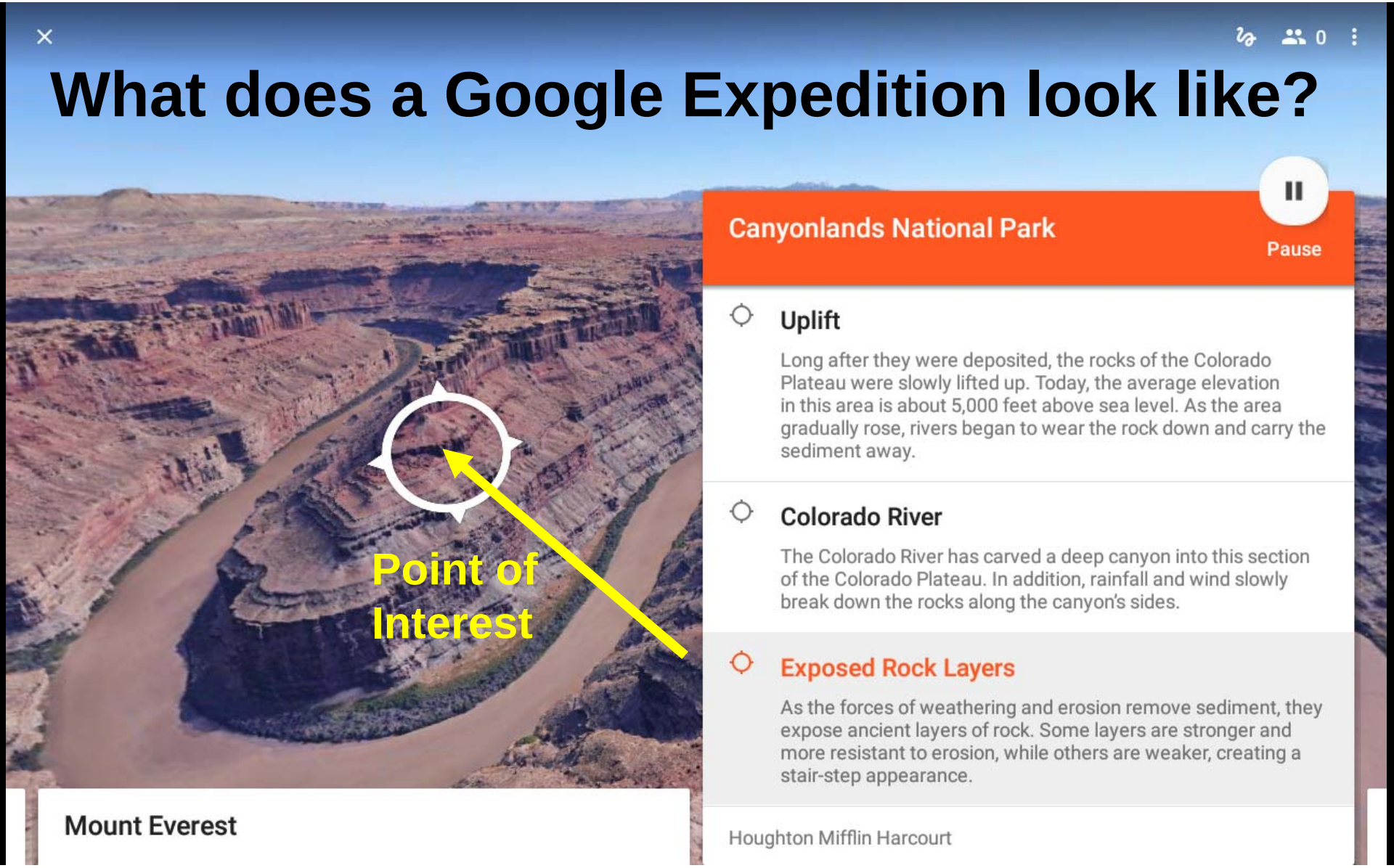
Intermediate: What are weathering and erosion?
(Answer: Weathering is the process by which rock is broken down into smaller and smaller pieces. Erosion is the movement of sediment from one location to another.)

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?



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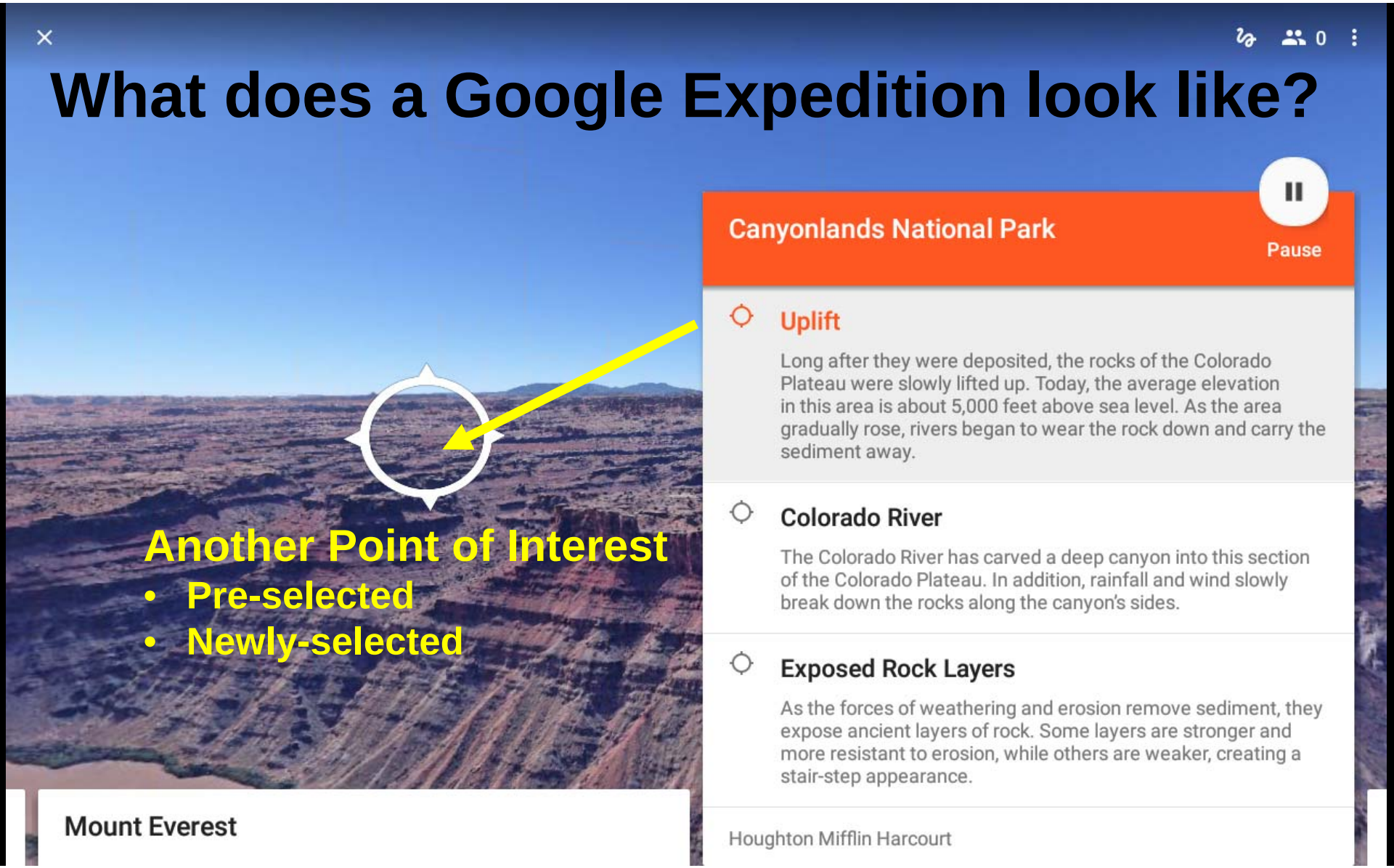
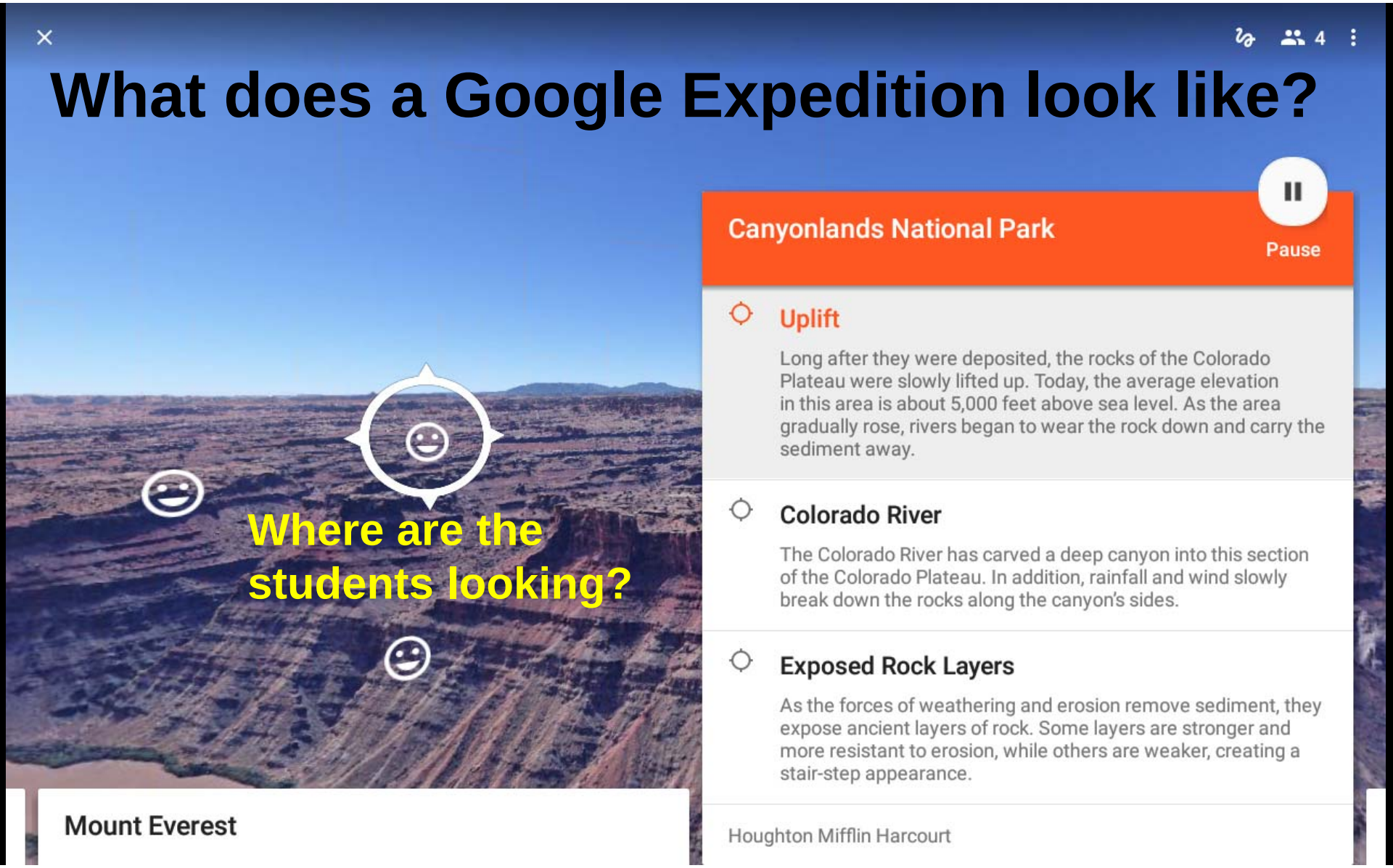


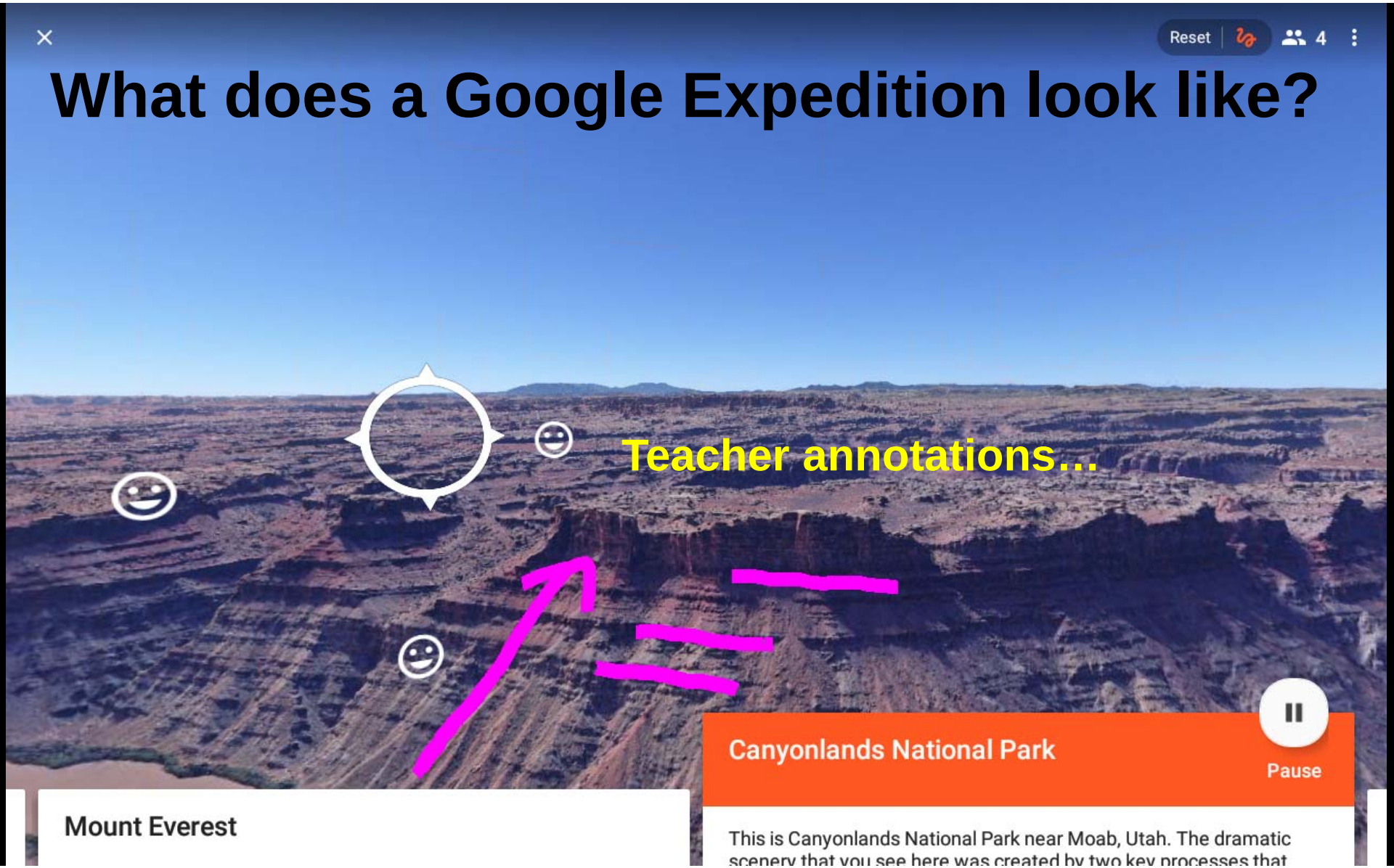
Another Point of Interest

- **Pre-selected**
- **Newly-selected**

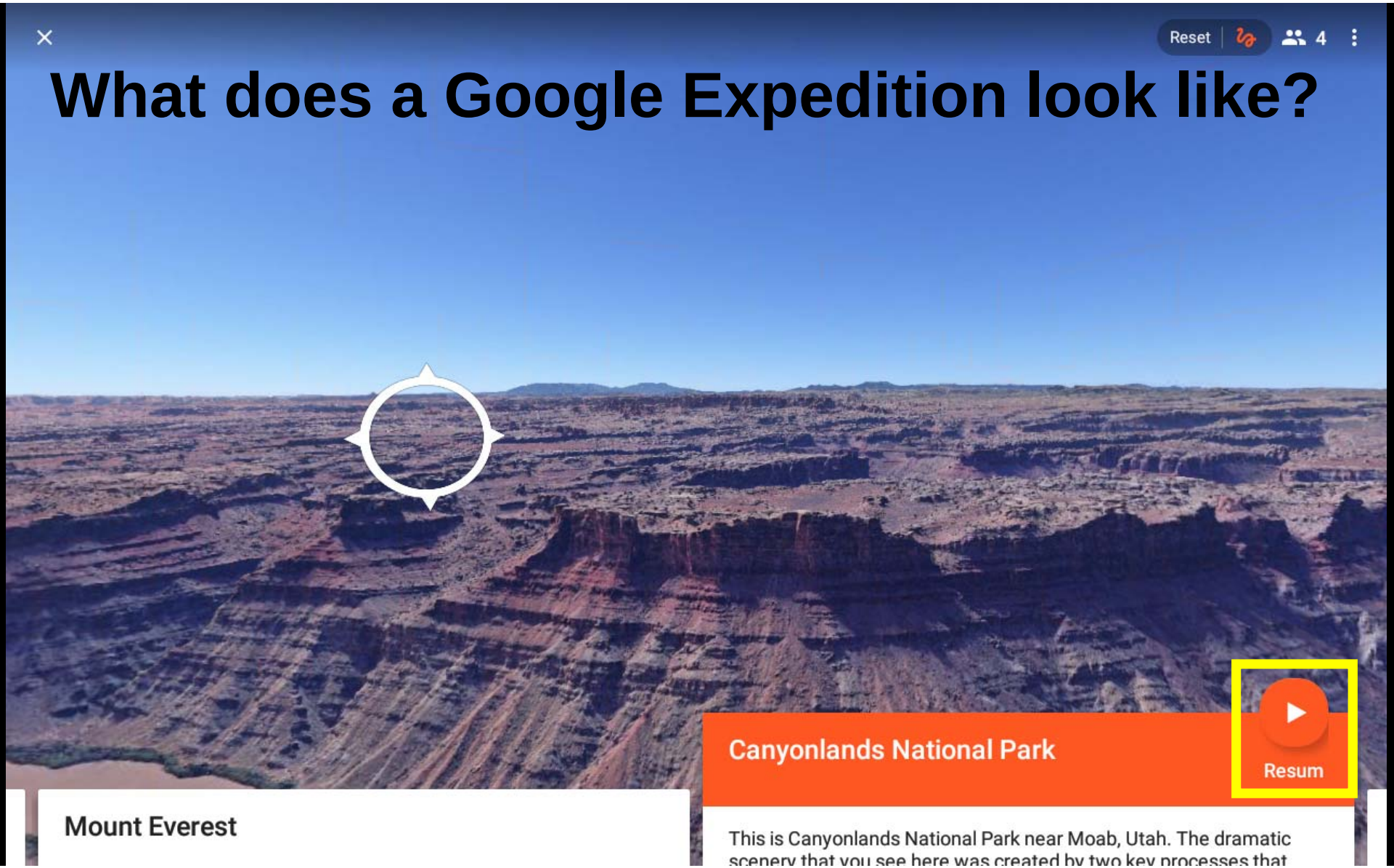
What does a Google Expedition look like?



Where are the students looking?


Reset
4
What does a Google Expedition look like?
Teacher annotations…
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


Reset
4
What does a Google Expedition look like?
What if a teacher wants the student's attention?
Pause
Canyonlands National Park
This is Canyonlands National Park near Moab, Utah. The dramatic
Mount Everest


Reset
4
What does a Google Expedition look like?
Canyonlands National Park
Resum
Mount Everest
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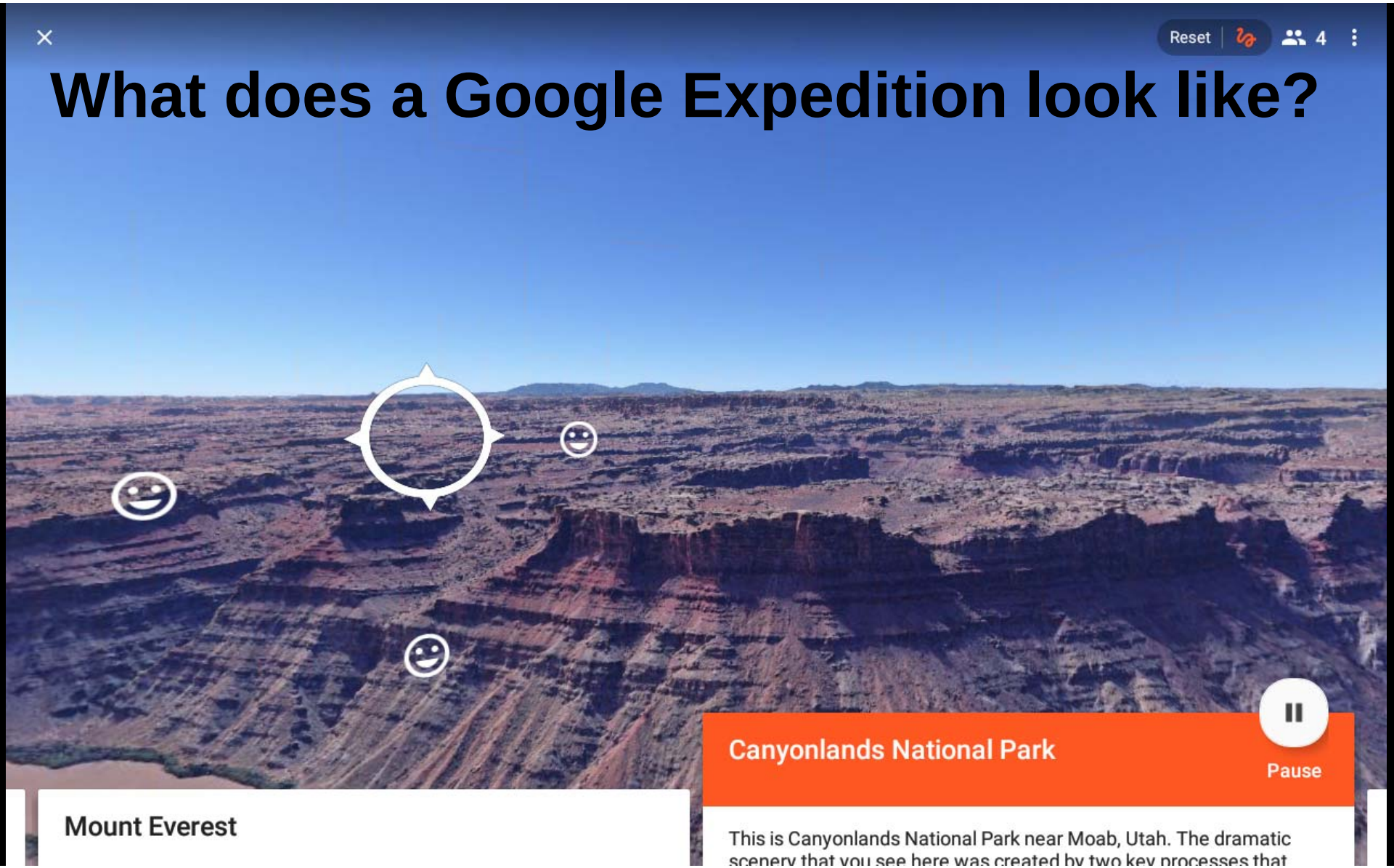
Reset
4
What does a Google Expedition look like?
Canyonlands National Park
Pause
Mount Everest
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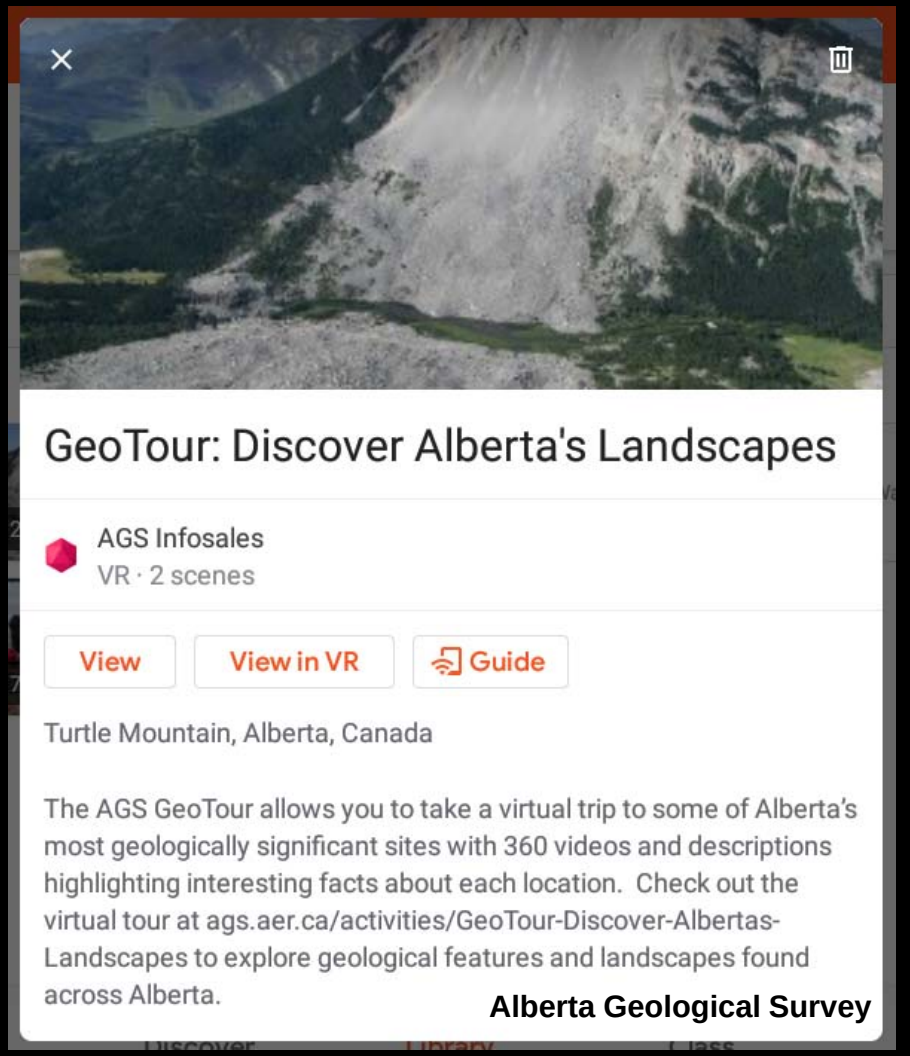
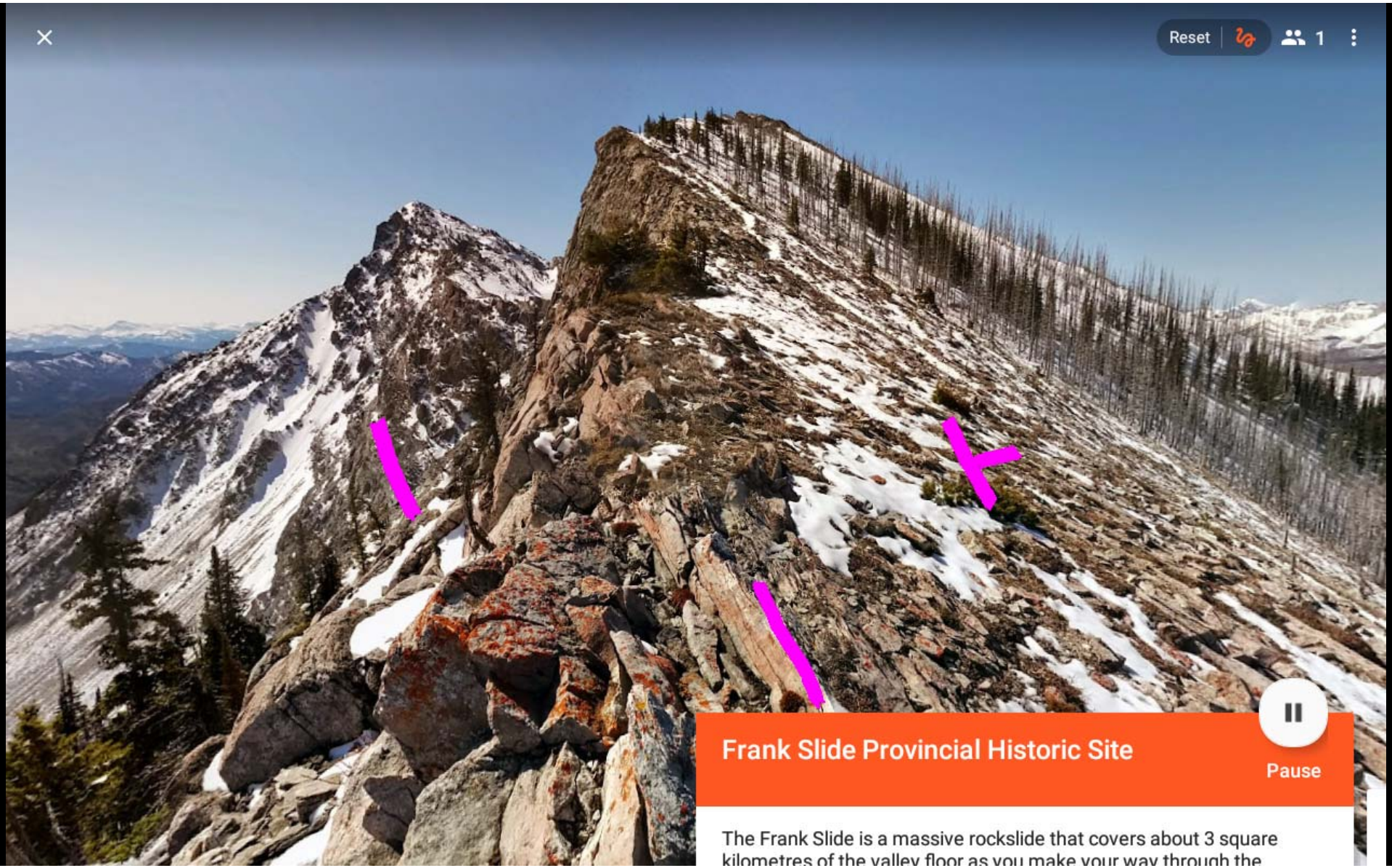
Contextualize rock in the U Waterloo Peter Russell Rock Garden

Canada's Deadliest Rockslide

"Frank Slide" - 4:10 am on April 29, 1903



Alberta Geological Survey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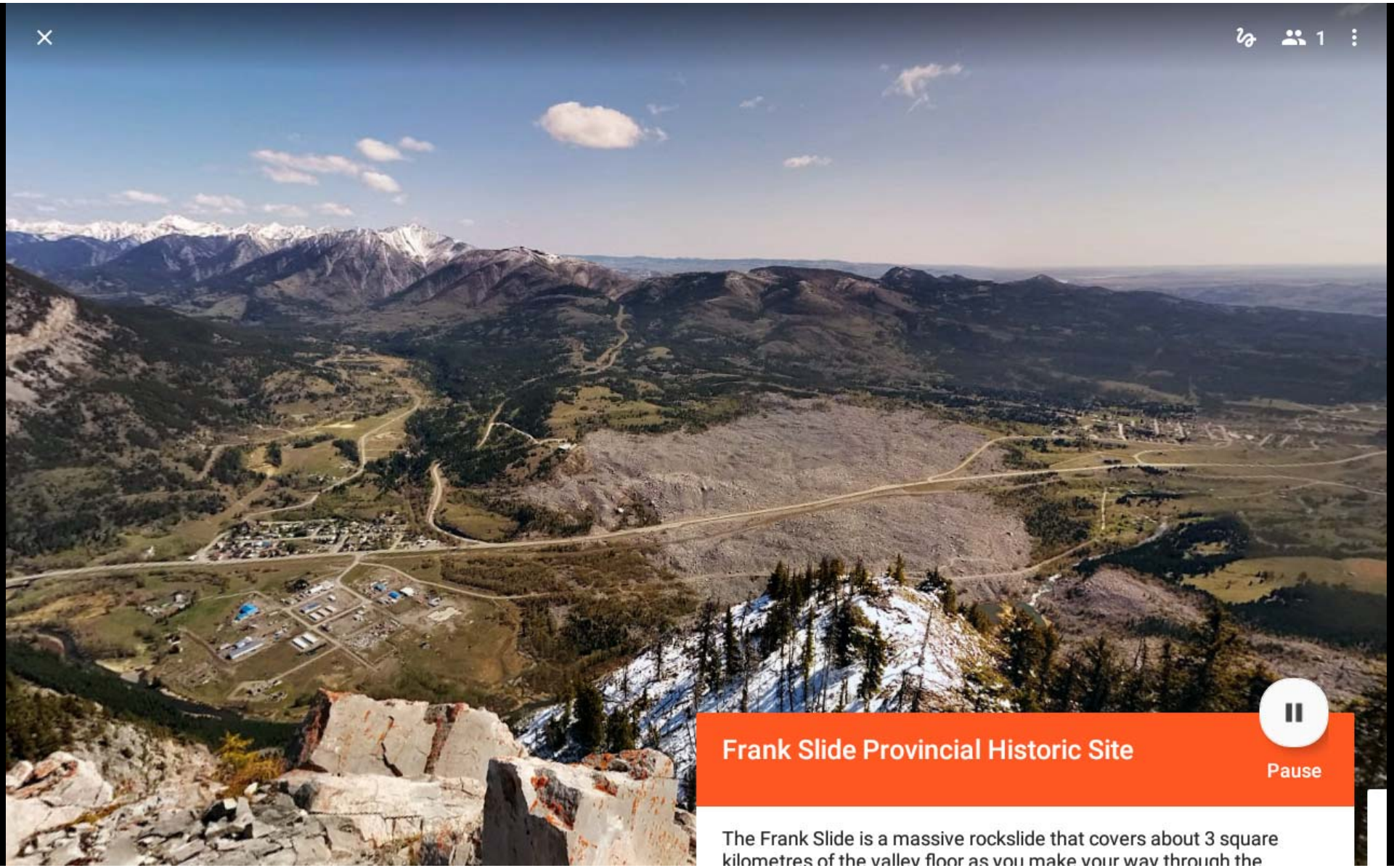
1
Frank Slide Provincial Historic Site
Pause
The Frank Slide is a massive rockslide that covers about 3 square
kilometres of the valley floor as you make your way through the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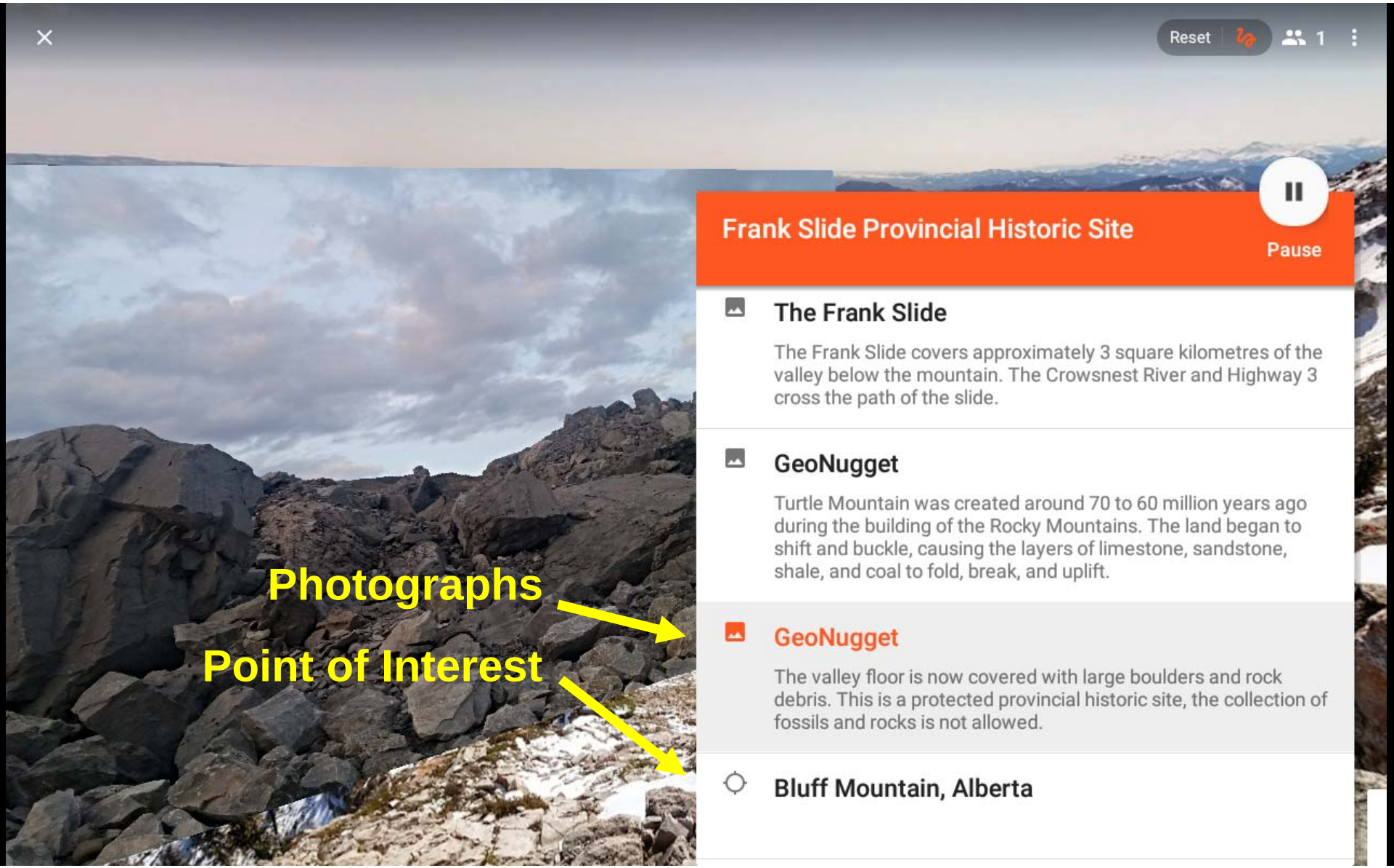
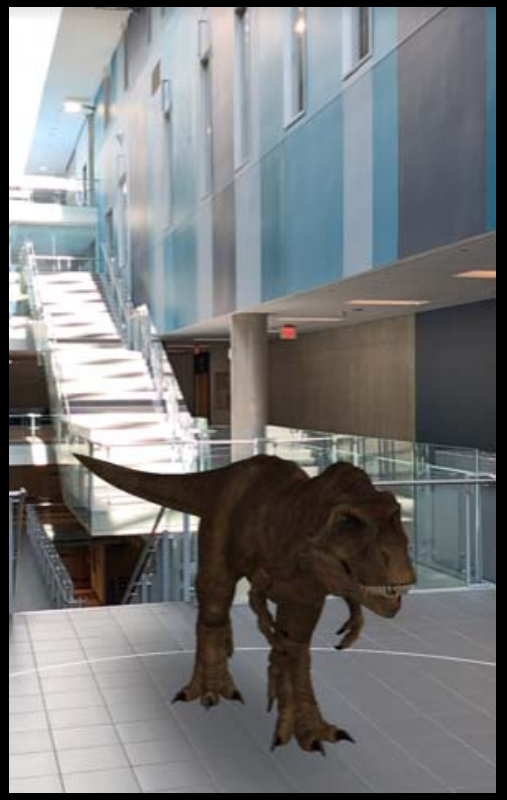

Reset
1
Frank Slide Provincial Historic Site
Pause
The Frank Slide
The Frank Slide covers approximately 3 square kilometres of the valley below the mountain. The Crowsnest River and Highway 3 cross the path of the slide.
GeoNugget
Turtle Mountain was created around 70 to 60 million years ago during the 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

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."

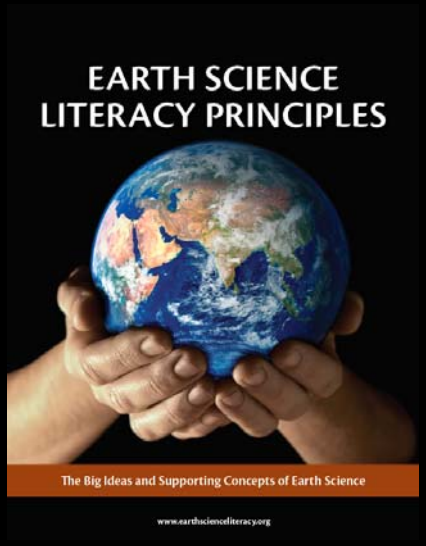


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Photo by John Johnston