Using Google Earth for Remote Teaching

GSA / NAGT
Digital Field Tools
Webinar Series

June 16, 2020
11:00 am MDT
1:00 pm EDT

Using Google Earth for Remote Teaching

Presenters:

Steve Whitmeyer *(James Madison University)*

Drew Laskowski *(Montana State University)*

Contributors:

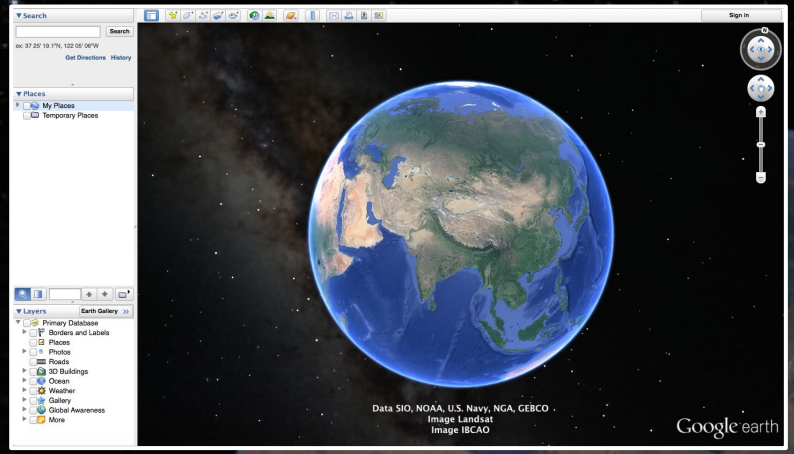
Barb Tewksbury *(Hamilton College)*

Tom Blenkinsop *(Cardiff University)*

Mladen Dordevic *(IRIS, Inc.)*

Devon Orme *(Montana State University)*

Desktop - *install on PC or Mac*



Web - *Chrome, Firefox, Edge, and Opera*

Mobile – *iOS and Android*

earth.google.com

Interactive 3D Model of the globe

Satellite and Aerial Data, 360˚ Imagery and DEM

Features

Allows manipulation of the model

e.g. Navigation, Measuring Tool

Content

Viewing, Creating, Importing and/or exporting of internal or third party information

e.g., Search, Data Layers, ***KML***

What is KML?

- KML = Keyhole Markup Language

- It is an eXtensible Markup Language (XML), Open Geospatial Consortium (OGC) standard used for managing 3D geospatial data

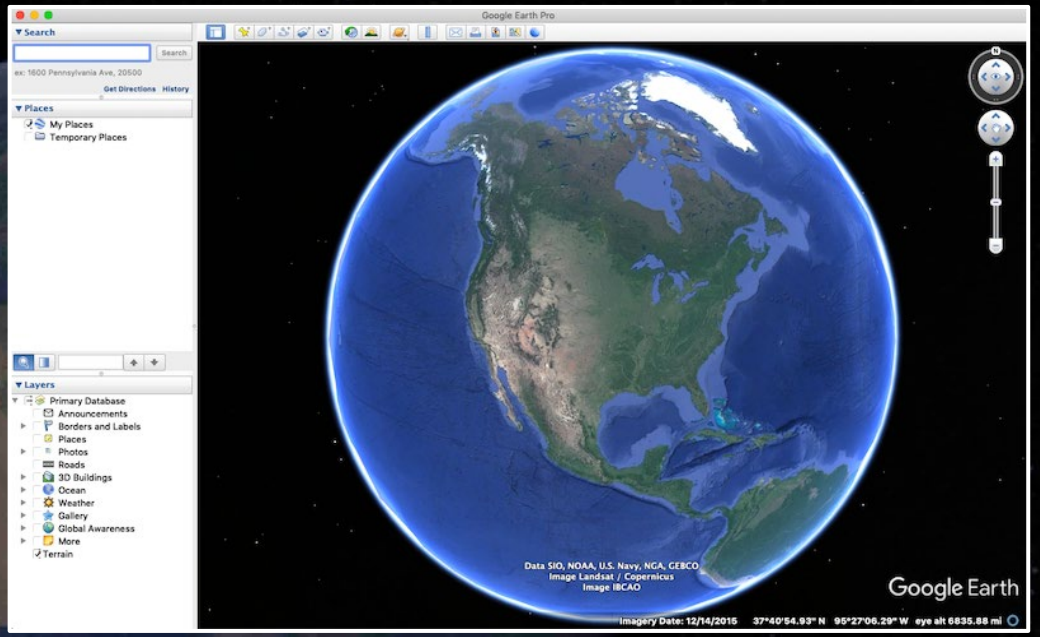
  https://developers.google.com/kml

- KMZ is a zipped version of KML

Desktop Google Earth

Features:

- Most familiar version of Google Earth
- Includes some KML features that aren't supported in Web Google Earth
- Desktop GE not supported in the future?



But there is good **Content** ...

Resources for teaching mapping using Google Earth

Using Google Earth for more effectively teaching undergraduate structural geology

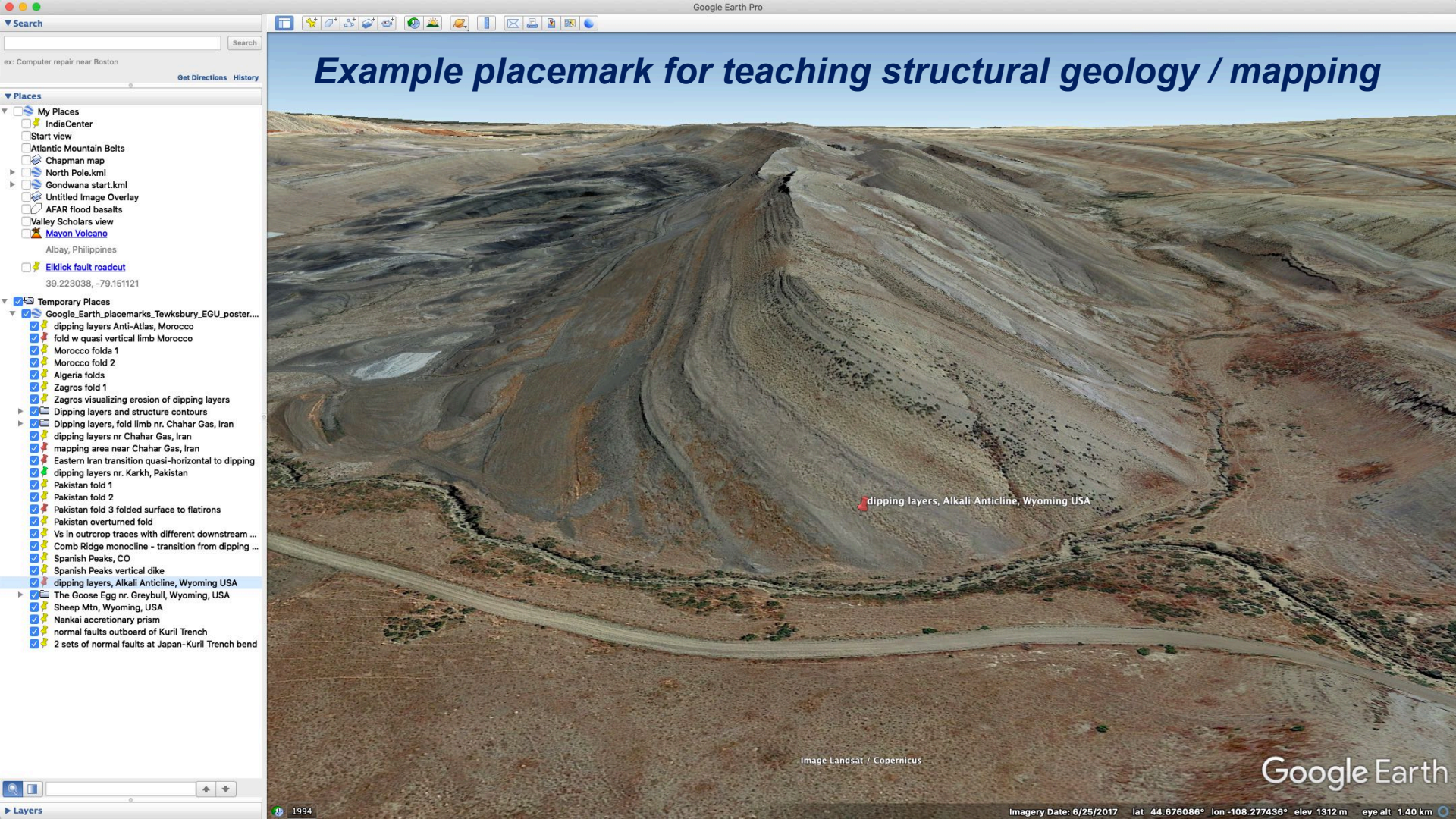
Barb Tewksbury, Hamilton College

Scroll down to *Public File* to download pdf of EGU 2019 poster

Click *Linked data* tab to download KMZ files with:

- Placemarks for locations shown on EGU poster
- An assortment of additional placemarks for teaching geologic mapping
- A set of placemarks used in the geology training for the 2017 NASA astronaut candidate class.

Note: many of these placemarks take advantage of historical imagery that is available only in Google Earth desktop


Google Earth Pro
Search
Search
ex: Computer repair near Boston
Get Directions
History
Places
My Places
IndiaCenter
Start view
Atlantic Mountain Belts
Chapman map
North Pole.kml
Gondwana start.kml
Untitled Image Overlay
AFAR flood basalts
Valley Scholars view
Mayon Volcano
Albay, Philippines
Elklick fault roadcut
39.223038, -79.151121
Temporary Places
Google_Earth_placemarks_Tewksbury_EGU_poster....
dipping layers Anti-Atlas, Morocco
fold w quasi vertical limb Morocco
Morocco folda 1
Morocco fold 2
Algeria folds
Zagros fold 1
Zagros visualizing erosion of dipping layers
Dipping layers and structure contours
Dipping layers, fold limb nr. Chahar Gas, Iran
dipping layers nr Chahar Gas, Iran
mapping area near Chahar Gas, Iran
Eastern Iran transition quasi-horizontal to dipping
dipping layers nr. Karkh, Pakistan
Pakistan fold 1
Pakistan fold 2
Pakistan fold 3 folded surface to flatirons
Pakistan overturned fold
Vs in outcrop traces with different downstream ...
Comb Ridge monocline - transition from dipping ...
Spanish Peaks, CO
Spanish Peaks vertical dike
dipping layers, Alkali Anticline, Wyoming USA
The Goose Egg nr. Greybull, Wyoming, USA
Sheep Mtn, Wyoming, USA
Nankai accretionary prism
normal faults outboard of Kuril Trench
2 sets of normal faults at Japan-Kuril Trench bend
Layers
Example placemark for teaching structural geology / mapping
dipping layers, Alkali Anticline, Wyoming USA
Image Landsat / Copernicus
Google Earth
1994
Imagery Date: 6/25/2017 lat 44.676086° lon -108.277436° elev 1312 m eye alt 1.40 km

S2K
(Structure 2 kml)

P2K
(Paleomagnetic data 2 kml)

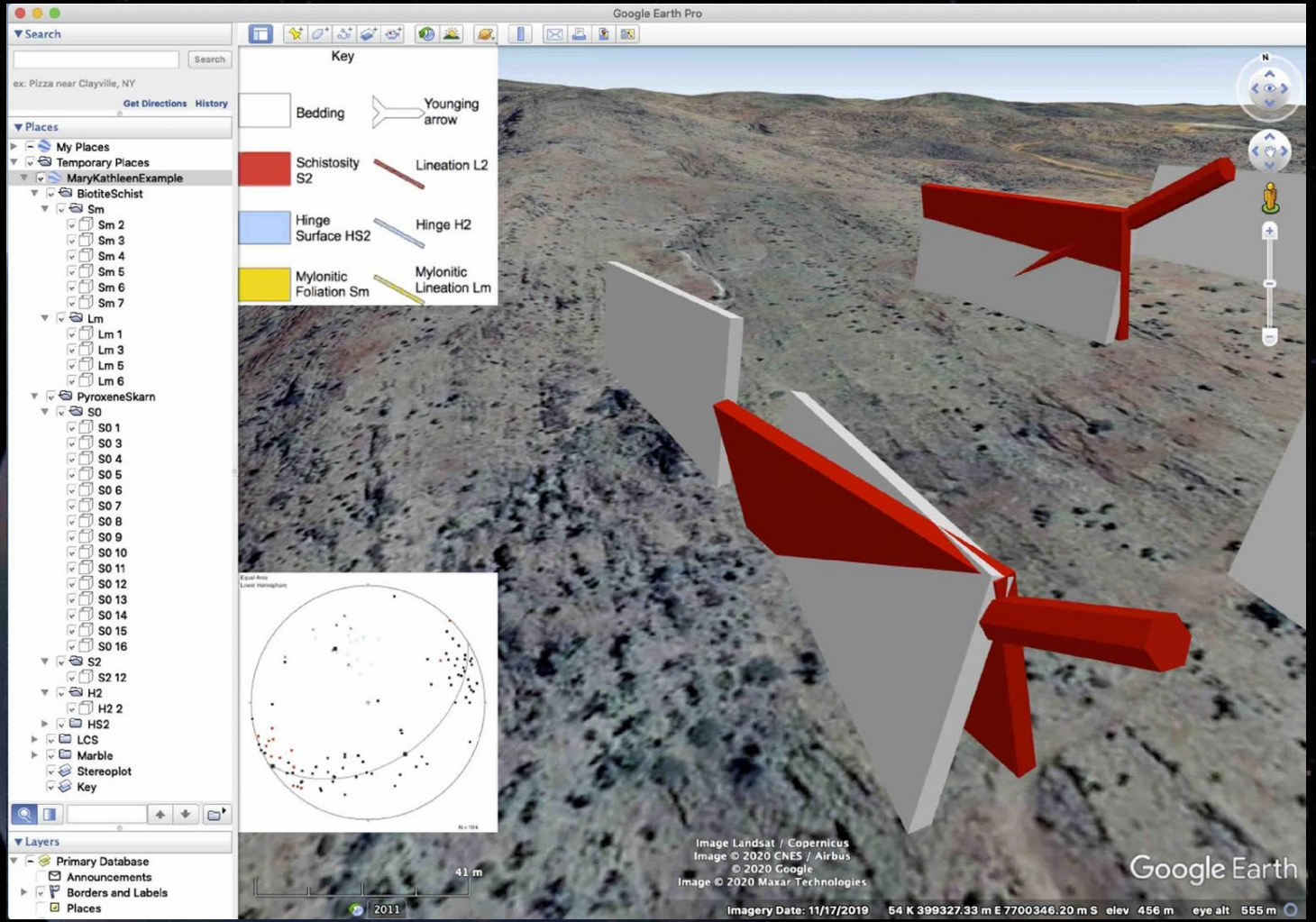
Tom Blenkinsop

School of Earth and Ocean Science

Cardiff University

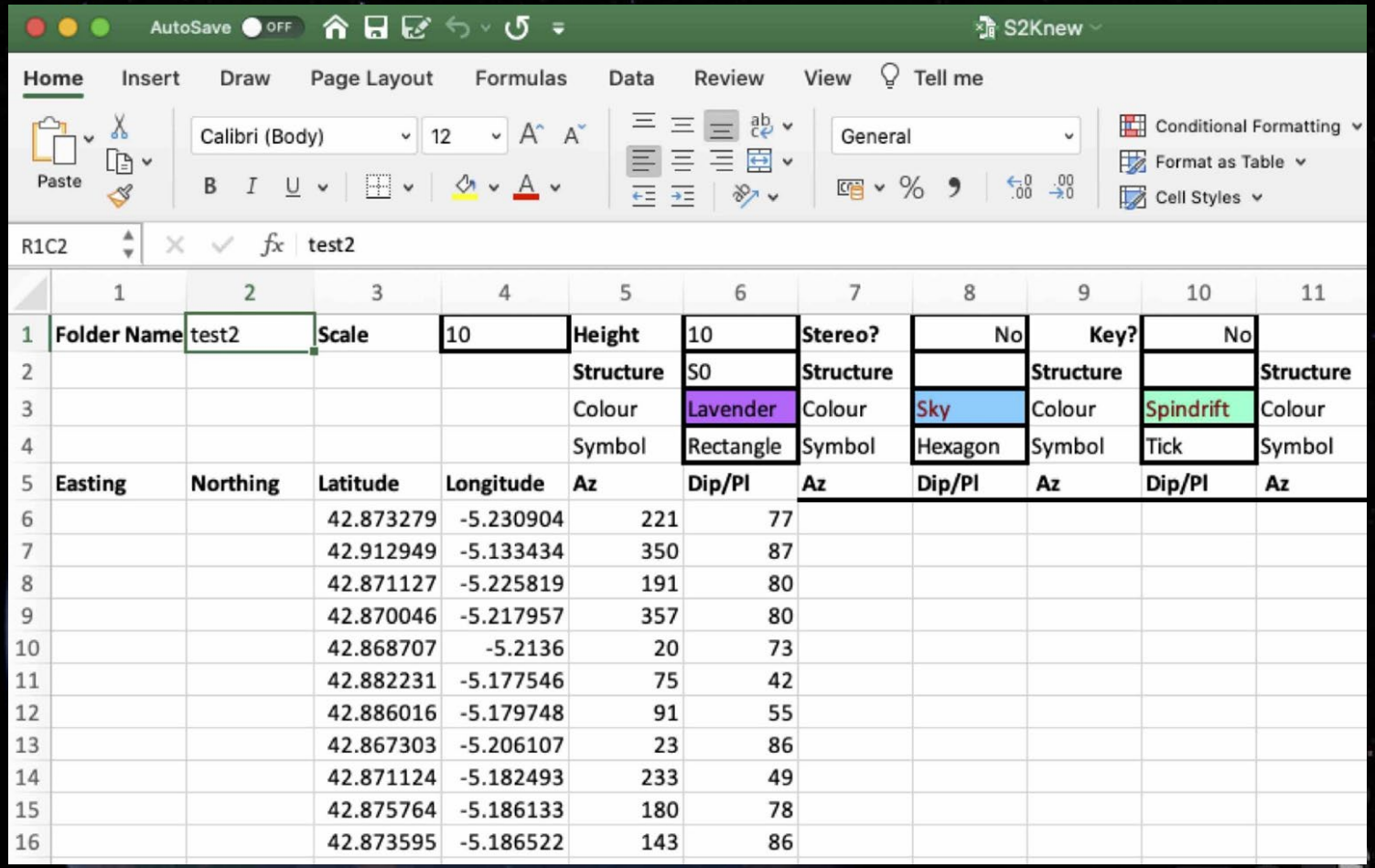
Tania Mochales

PLANAGEO - Spanish Geological Survey IGME



S2K and P2K are Excel workbooks that run modules to generate KML files.

The KML files call up Sketchup structural symbols (COLLADA models)



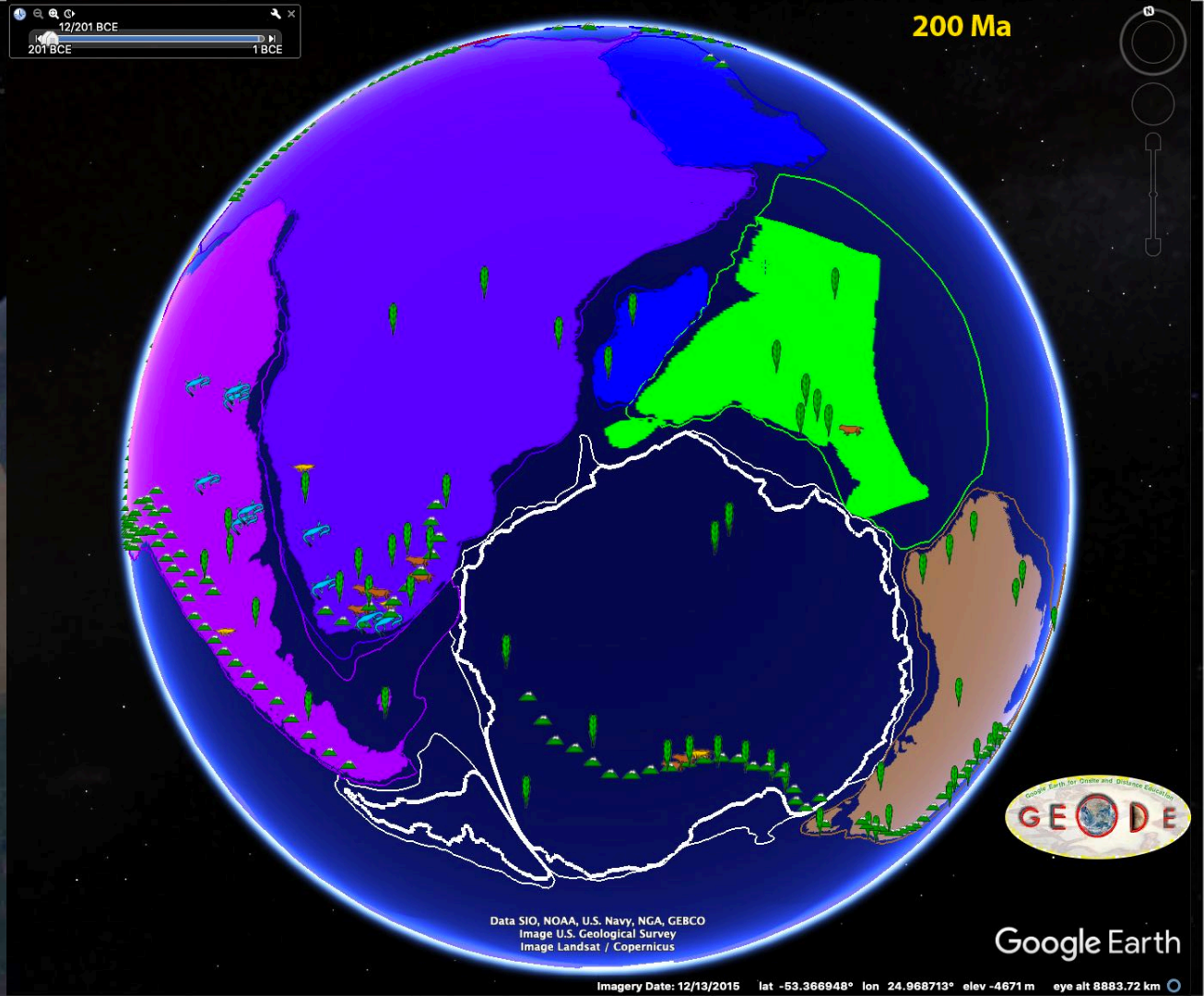
	1	2	3	4	5	6	7	8	9	10	11
1	Folder Name	test2	Scale	10	Height	10	Stereo?	No	Key?	No	
2					Structure	S0	Structure		Structure		Structure
3					Colour	Lavender	Colour	Sky	Colour	Spindrift	Colour
4					Symbol	Rectangle	Symbol	Hexagon	Symbol	Tick	Symbol
5	Easting	Northing	Latitude	Longitude	Az	Dip/Pl	Az	Dip/Pl	Az	Dip/Pl	Az
6			42.873279	-5.230904	221	77					
7			42.912949	-5.133434	350	87					
8			42.871127	-5.225819	191	80					
9			42.870046	-5.217957	357	80					
10			42.868707	-5.2136	20	73					
11			42.882231	-5.177546	75	42					
12			42.886016	-5.179748	91	55					
13			42.867303	-5.206107	23	86					
14			42.871124	-5.182493	233	49					
15			42.875764	-5.186133	180	78					
16			42.873595	-5.186522	143	86					

Pangaea Breakup Animation

Part of the GEODE collection

Has been used in Dave McConnell's GeoScience Videos YouTube collection

https://www.youtube.com/watch?v=ZCvkwG-W8pU



Resource Links: Desktop Google Earth

SERC Teach the Earth sites:
https://serc.carleton.edu/NAGTWorkshops/teaching_methods/google_earth
https://serc.carleton.edu/NAGTWorkshops/online_field/activities.html

GEODE:
https://serc.carleton.edu/geode/index.html
http://csmgeo.csm.jmu.edu/GeoLab/Whitmeyer/geode/pangaeaBreakup/

Tom Blenkinsop: https://github.com/tblenkinsop/S2K
https://github.com/tblenkinsop/P2K

Barb Tewksbury: Using GE for Teaching Structural Geology

Web Google Earth

Features

- Simpler menus

Content

- Map layers
- “Voyager”
- “Projects” (Google Drive or KML files)

earth.google.com/web

Mobile Google Earth

Features

- (Mostly) same as web GE

Content

- Projects can only be viewed, not created

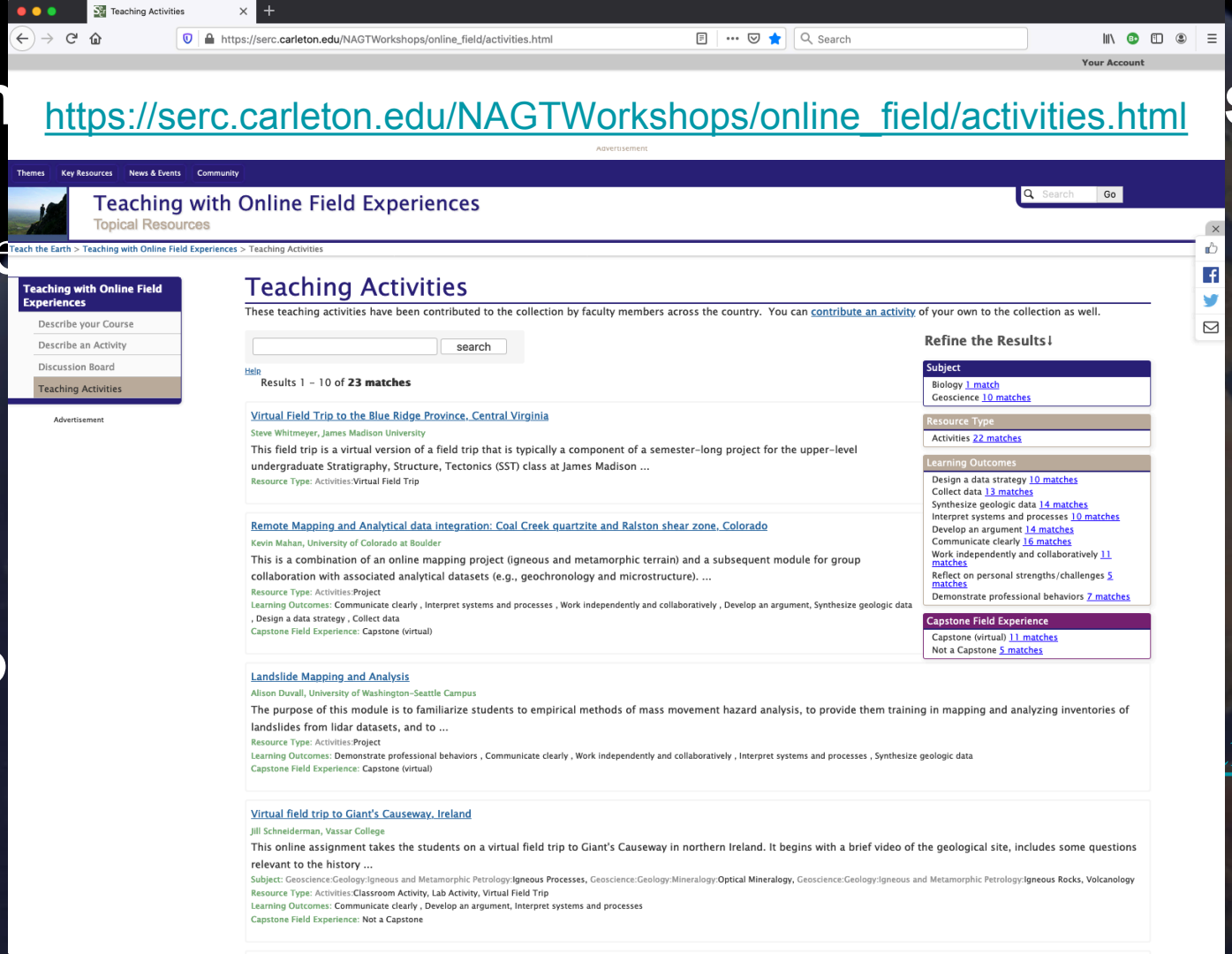
Resource Links: Google Earth on Web

- Google Earth EDU
  - https://www.google.com/earth/education
  - Help page: https://support.google.com/earth
- Symbols tool (for generating strike & dip symbols):
  - https:// csmgeo.csm.jmu.edu/Geollab/Whitmeyer/geode/symbols/
- Custom KML code examples:
  - https://vdpluijm.blogspot.com/ (Ben van der Pluijm)
  - https://geteach.com/blog/ (Josh Williams)

Exam ses

- We
- Go nd

https://serc.carleton.edu/NAGTWorkshops/online_field/activities.html



Example Exercise: Sandy Hollow Virtual Field Geolo

- Classic field locality in the Block Mountain region of southwest Montana visited by numerous field camps
  - Upper Paleozoic and Mesozoic strata
  - Classic “thin-skinned” fold-thrust structure in a well-exposed area on public land (BLM)

Traditional Field Geology at Sandy Hollow

- Measure a stratigraphic section
  - Understand how depositional environment changed in response to tectonics
- Conduct geologic mapping and structural analysis
  - Fold analysis
  - Identification of faults
  - Is cleavage axial planar?
- Construct geologic history from observations

Google Earth Adaptation

Part 1: Stratigraphy

- Students construct a representative graphic log/stratigraphic section based on provided outcrop investigations (YouTube), high-res outcrop photos (GigaPan), and locations (GE placemarks)

Part 2: Mapping

- Students map the geology using provided bedding measurements and unit ID's (GE placemarks) and GE imagery.

Part 3: Structural Analysis

- Students test the hypothesis that cleavage is axial planar by plotting provided data on stereonets

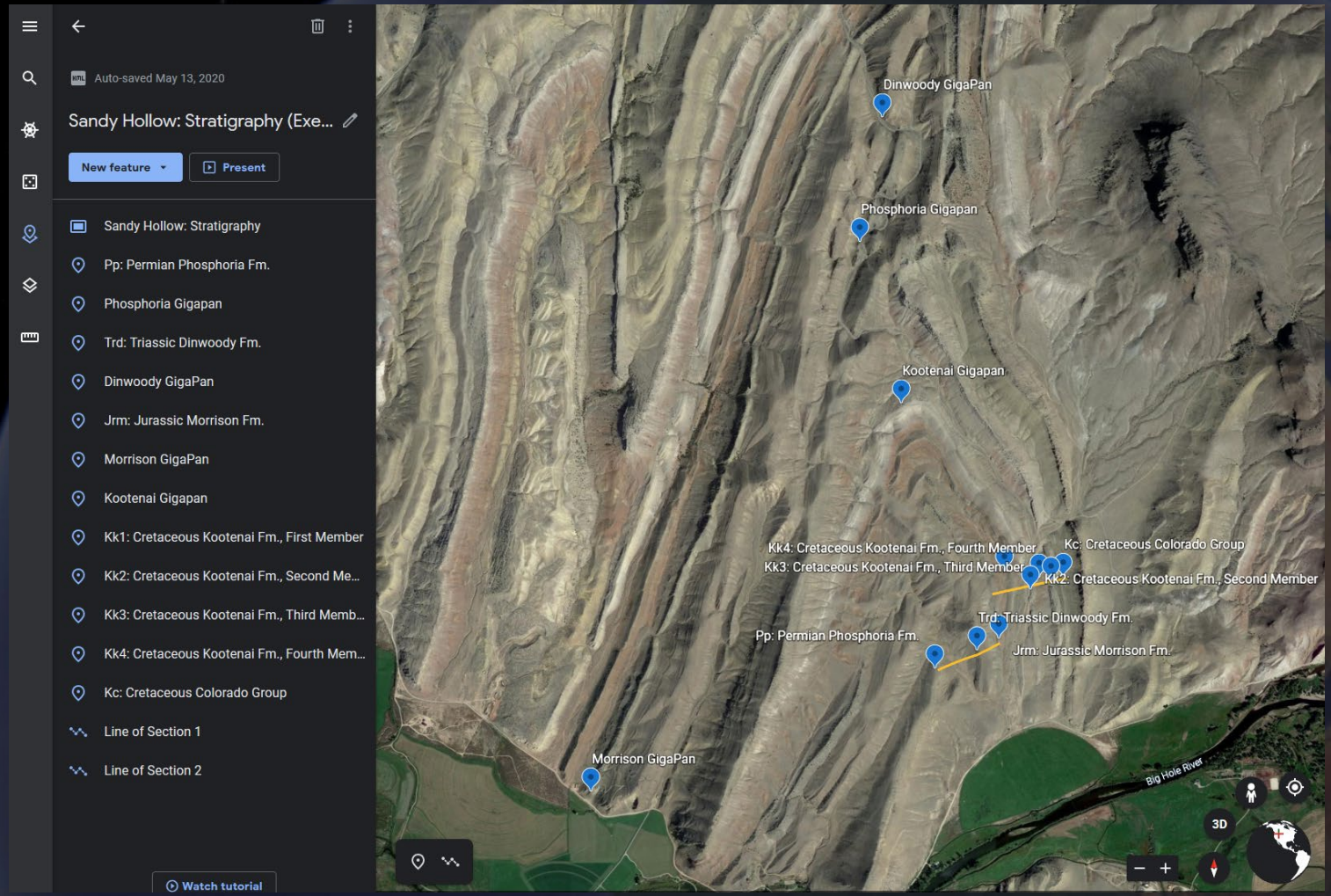
Learning Objectives Satisfied

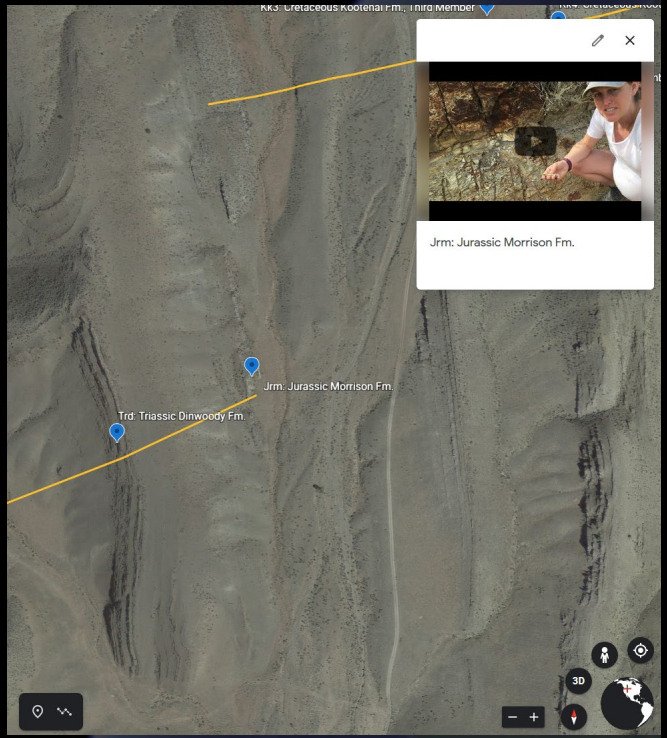
Synthesize geologic data and integrate with core concepts and skills into a cohesive spatial and temporal scientific interpretation.

Interpret earth systems and past/current/future processes using multiple lines of spatially distributed evidence.

Develop an argument that is consistent with available evidence and uncertainty.

Communicate clearly using written, verbal, and/or visual media (e.g., maps, cross-sections, reports).


Auto-saved May 13, 2020
Sandy Hollow: Stratigraphy (Exe...
New feature
Present
Sandy Hollow: Stratigraphy
Pp: Permian Phosphoria Fm.
Phosphoria Gigapan
Trd: Triassic Dinwoody Fm.
Dinwoody GigaPan
Jrm: Jurassic Morrison Fm.
Morrison GigaPan
Kootenai Gigapan
Kk1: Cretaceous Kootenai Fm., First Member
Kk2: Cretaceous Kootenai Fm., Second Me...
Kk3: Cretaceous Kootenai Fm., Third Memb...
Kk4: Cretaceous Kootenai Fm., Fourth Mem...
Kc: Cretaceous Colorado Group
Line of Section 1
Line of Section 2
Watch tutorial
Dinwoody GigaPan
Phosphoria Gigapan
Kootenai Gigapan
Kk4: Cretaceous Kootenai Fm., Fourth Member
Kk3: Cretaceous Kootenai Fm., Third Member
Kc: Cretaceous Colorado Group
Kk2: Cretaceous Kootenai Fm., Second Member
Trd: Triassic Dinwoody Fm.
Pp: Permian Phosphoria Fm.
Jrm: Jurassic Morrison Fm.
Morrison GigaPan
Big Hole River
3D


Jrm: Jurassic Morrison Fm.
Trd: Triassic Dinwoody Fm.
Jrm: Jurassic Morrison Fm.
3D


Jurassic Morrison Formation at Sandy Hollow
Copy link
MORE VIDEOS
3:09 / 4:09
YouTube

Auto-saved May 13, 2020

Sandy Hollow: Stratigraphy (Exe...

New feature | Present

- Sandy Hollow: Stratigraphy
- Pp: Permian Phosphoria Fm.
- Phosphoria Gigapan
- Trd: Triassic Dinwoody Fm.
- Dinwoody GigaPan
- Jrm: Jurassic Morrison Fm.
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- Kk4: Cretaceous Kootenai Fm., Fourth Mem...
- Kc: Cretaceous Colorado Group
- Line of Section 1
- Line of Section 2

Watch tutorial

Ziegler Gul

Morrison GigaPan

2D

Google 100%

Camera: 1,565 m 45°26'25"N 112°35'13"W 1,502 m

Auto-saved seconds ago

Sandy Hollow: Mapping (Exerci...

New feature | Present

- Sandy Hollow: Mapping (Exercise 2)
- Video Introduction
- Structural_Data
  - 0
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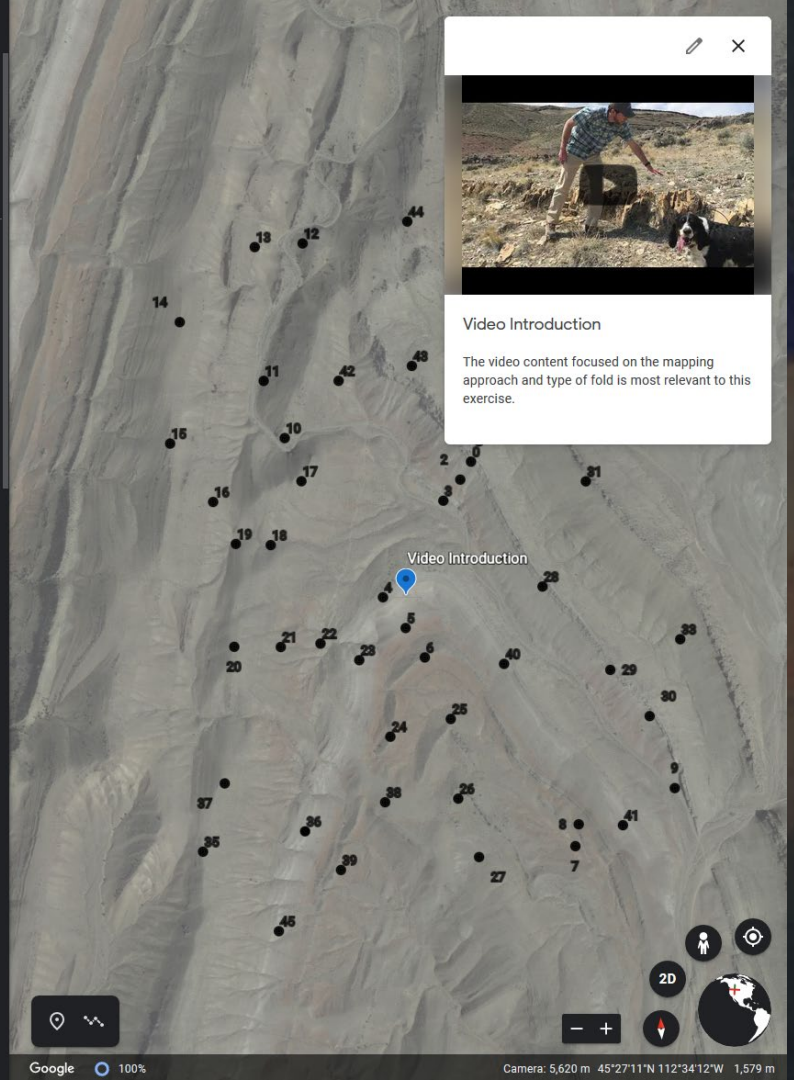
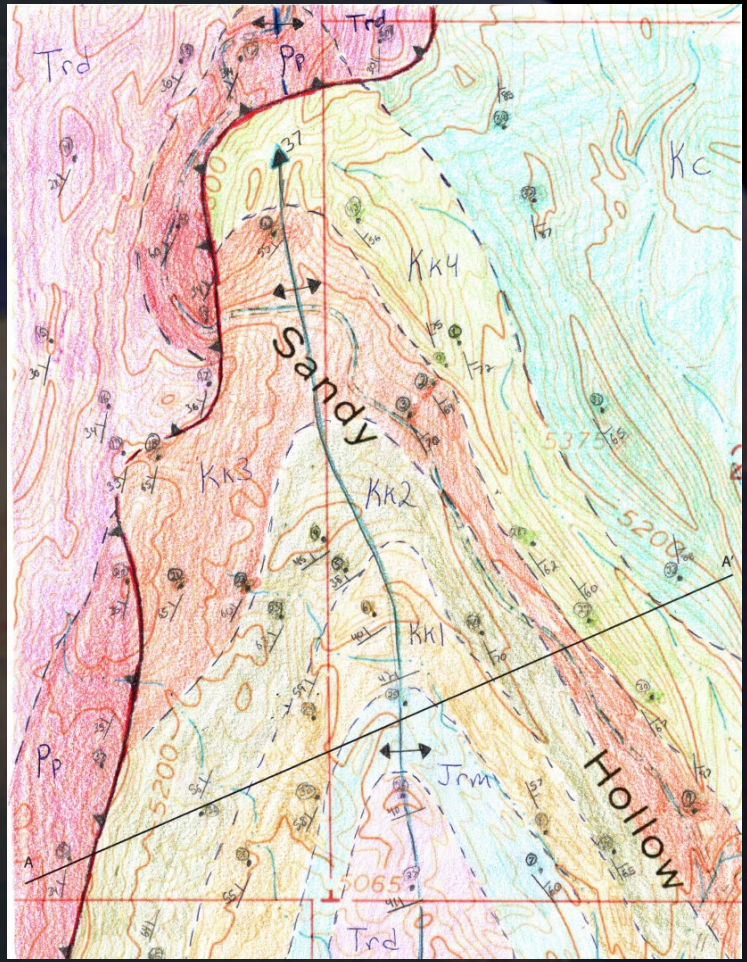
  - 15



Video Introduction

The video content focused on the mapping approach and type of fold is most relevant to this exercise.



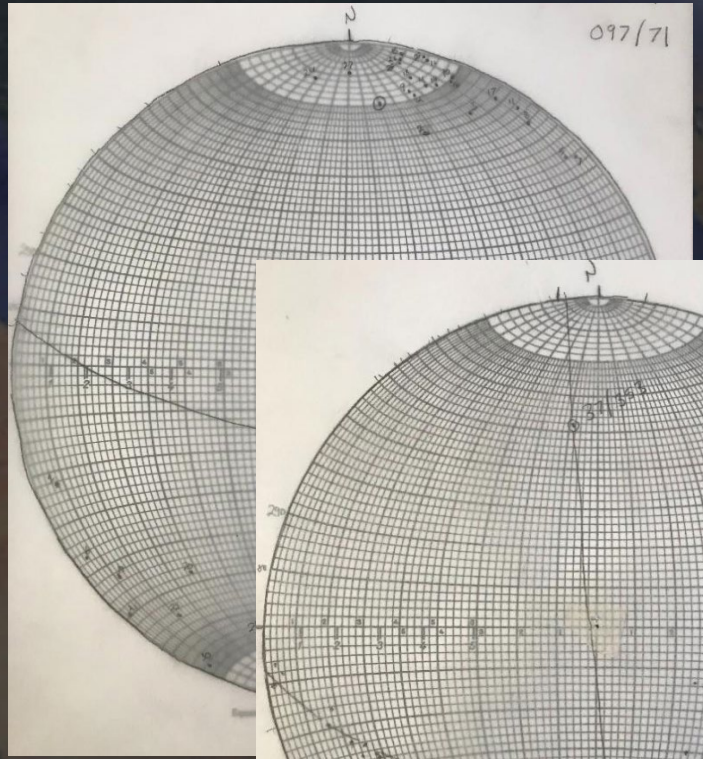
Cleavage measurements

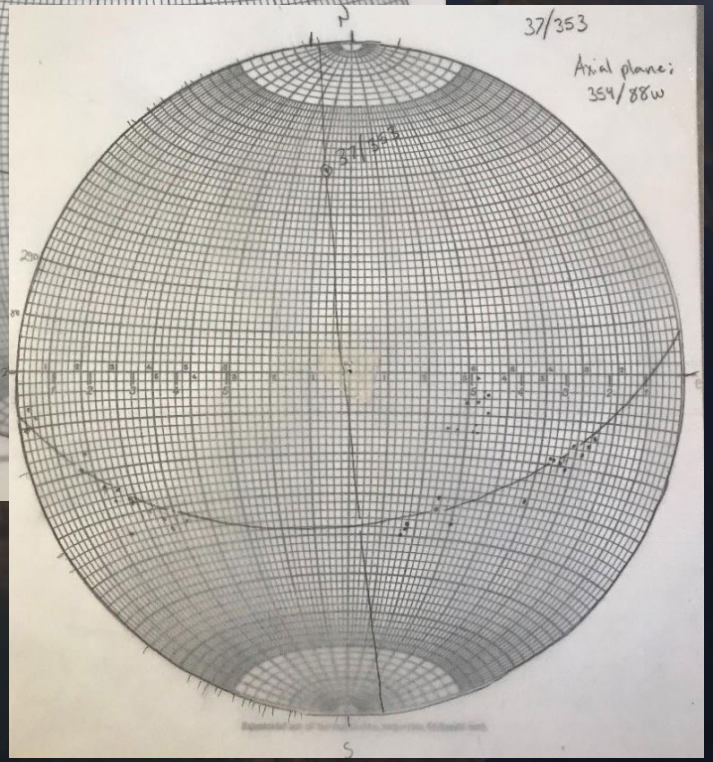
Video Introduction

Cleavage measurements

No.	Structure	Strike	Dip
1	Cleavage	337	83
2	Cleavage	108	66
3	Cleavage	115	77
4	Cleavage	105	80
5	Cleavage	135	84
6	Cleavage	322	86
7	Cleavage	136	86
8	Cleavage	126	82
9	Cleavage	102	77
10	Cleavage	109	85
11	Cleavage	122	86
12	Cleavage	103	78
13	Cleavage	102	81
14	Cleavage	107	81
15	Cleavage	99	88
16	Cleavage	104	88
17	Cleavage	118	85
18	Cleavage	109	84
19	Cleavage	316	82
20	Cleavage	306	68
21	Cleavage	310	88
22	Cleavage	103	88
23	Cleavage	303	79
24	Cleavage	84	79
25	Cleavage	99	85
26	Cleavage	99	86
27	Cleavage	90	80
28	Cleavage	285	73
29	Cleavage	276	83
30	Cleavage	293	88

Note: these data can be copied and pasted into Microsoft Excel





Teaching with Online Field Experiences

- Describe your Course
- Describe an Activity
- Discussion Board
- Teaching Activities

TeachTheEarth

Online Teaching resources from across Teach the Earth »

Teaching in the Field resources from across Teach the Earth »

Sandy Hollow Virtual Field Geology Exercise

Andrew K. Laskowski, Montana State University-Bozeman

Devon A. Orme, Montana State University-Bozeman

Author Profile

Summary

This is a Google Earth based virtual field exercise focused on Sandy Hollow, near Block Mountain and McCartney Mountain in southwest Montana. This is a classic field locality in the Montana portion of the Sevier fold-thrust belt. For more information on the area, the reader is referred to Chapter 6: Geology of Southwest Montana in Guidebook to the Geology of Central and Southern Idaho by Paul K. Link and William R. Hackett, available as a PDF from the Idaho Geological Survey.

Exercise 1 "Sandy Hollow: Stratigraphy" is a guided exploration of the Permian—Cretaceous stratigraphy at Sandy Hollow, including the Permian Phosphoria Formation, the Triassic Dinwoody Formation, the Cretaceous Kootenai Formation (members 1-4), and the Cretaceous Colorado Group (Blackleaf Formation). Students are tasked with construction of a representative graphic log of these units based on geo-referenced YouTube videos and GigaPan images embedded in Google Earth.

Exercise 2 "Sandy Hollow: Mapping" is a map project that tasks students with creating a hand-drawn geologic map of Sandy Hollow based on provided geo-located bedding measurements and rock unit identifications. Contact locations are informed by color changes that are clearly visible in Google Earth imagery. An embedded YouTube video introduction filmed on location is provided.

Exercise 3 "Sandy Hollow: Structural Analysis" is a stereonet-based project that asks students to compare the orientation of cleavage with the orientation of the axial plane of a major fold in Sandy Hollow. Students create two stereonets, one showing cleavage orientations as poles and another showing bedding orientations, the fold axis, and the orientation of the axial plane (π-diagram). This process requires synthesis of provided structural measurements and the geologic map (specifically, the axial trace) generated by the students in Exercise 2. Exercise 3 was informed by a MS thesis by Elizabeth A. Helmke at Montana State University.

Limitations

- Students do not get to collect their own data
- Students do not get practice locating themselves on topographic maps, planning traverses, or developing field safety plans.

Advantages

- Accessible
- Can be used as preparation for field work – it snows a lot in Montana!
- Useful in a pandemic.
- Teaches digital literacy and spatial thinking
- Can be adapted to suit specific needs and possibly improved (i.e. with high-resolution drone imagery)

Useful/Promising Tools

- GigaPan photos
- VR / spherical panoramas
- Drone/UAS data
- The possibilities are