

Open Access Historical Geology Lab Manual

Amy Weislogel, Department of Geology & Geography

2020 WVU Libraries-TLC OER Create Grant

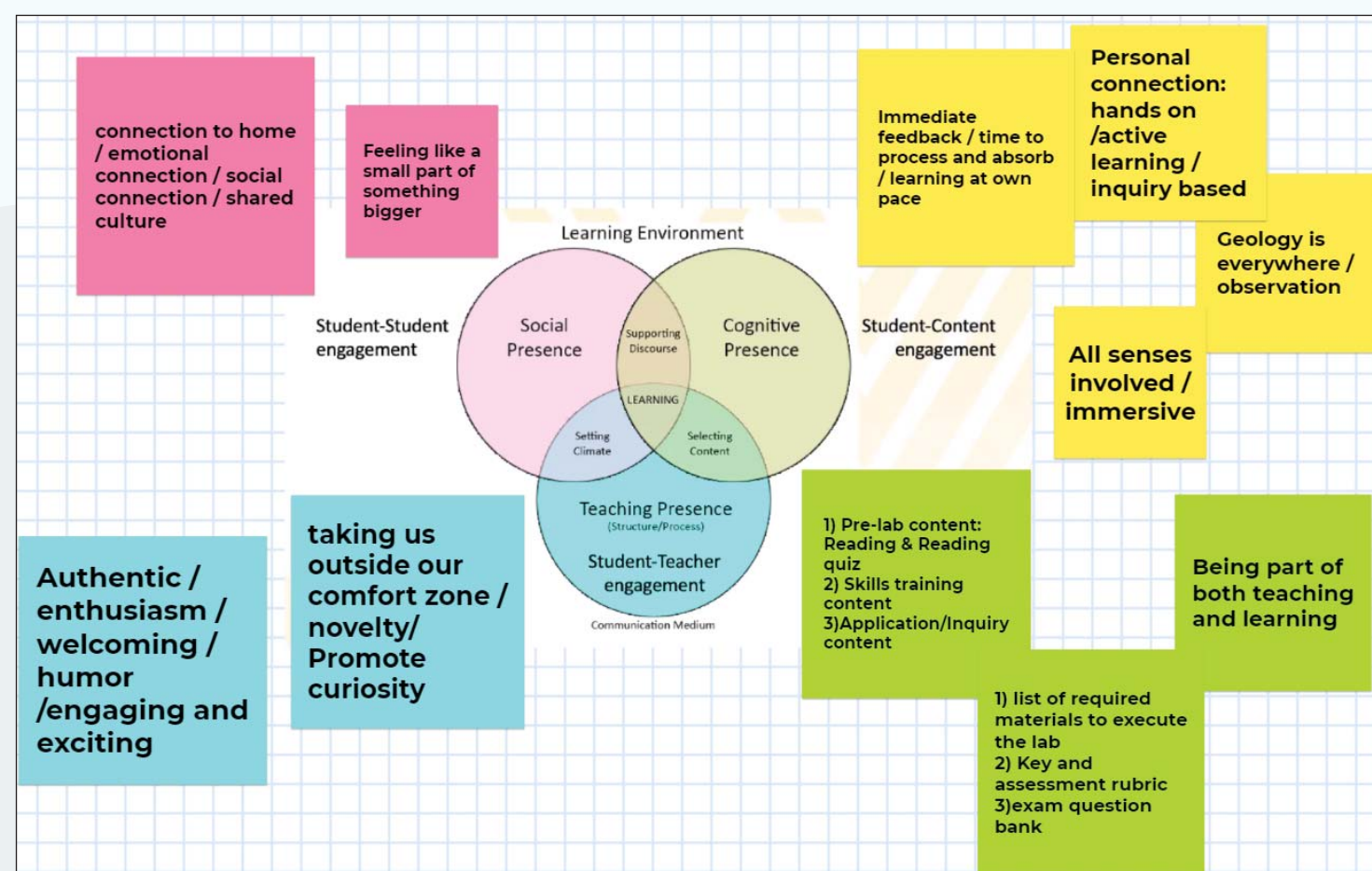
Rationale & Goals

I have drafted an open access Earth history laboratory manual that contains user-friendly exercises that emphasize geological thinking: observations at wide ranging temporal and spatial scales in geographic context and as part of an integrated earth system.

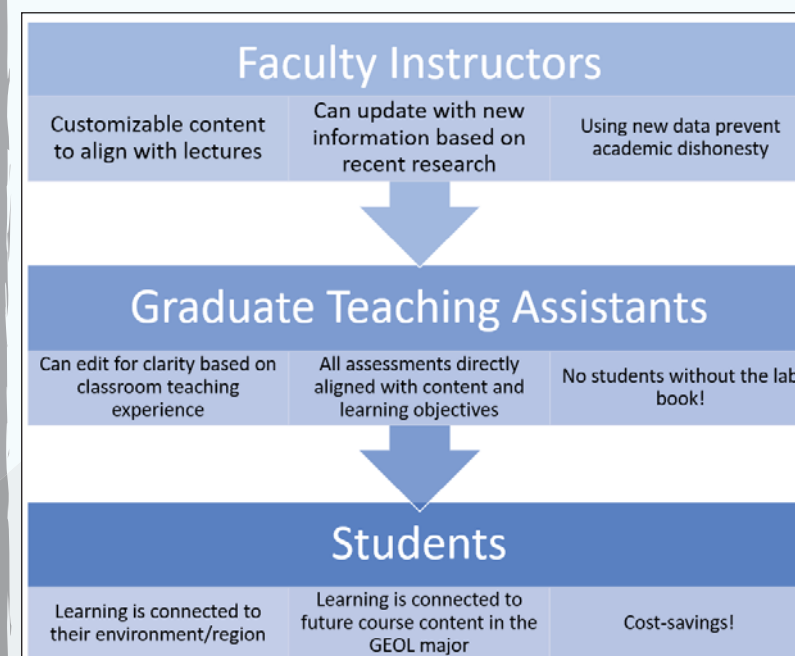
An overarching goal in designing the manual is to maximize accessibility of instruction. So far I have accomplished 2 primary goals:

- 1) blend of low-tech (done with paper and pencil) and digital format, including data acquisition from internet sources and analysis using basic tools to engage students in a variety of activities that develop diverse skills
- 2) incorporate content and issues of societal relevance to encourage students attraction to and connection with the geosciences

RIGHT: Meetings with the OER group inspired the development of this jamboard that guided development of the lab manual



Added Benefit to Instructors and Students:



- I will circulate the lab manual among my colleagues for input regarding content and emphasis and edit according to this feedback.
- Ultimately this will lead to greater cohesion between lab content and lecture/major content
- Graduate student feedback has and will continue to be used to improve lab investigations.
- Having control to edit/customize lab content will improve instruction and no students will be without the manual!
- Students will have a better experience engaging in content that is related to the location of WVU, that links to potential career paths and that is FREE!

- Formative Assessment: Investigations**
 - Each investigation is graded
- Summative Assessment: Exams**
 - Exam content aligned with concepts from each investigation
- Metacognitive Assessment: Pre & Post surveys**
 - Points are awarded for student participation in metacognitive assessments conducted at the beginning of the exam period and then after the exam is completed

- This lab manual will be aligned with several assessment mechanisms:
- The investigations themselves will be graded according to keys and rubrics that accompany the manual
- An exam bank will be compiled and aligned to each investigation
- Surveys regarding student attitudes and perceptions as well as reflection on their engagement with material will be developed for Pre- and Post-exam use.

Table of Contents

The lab manual is currently a Google Doc. It contains 13 laboratory exercises referred to as "investigations"; most investigations have multiple parts.

These activities are currently able to be completed remotely, but plan to adapt the manual for in-person use in Spring 2022

TABLE OF CONTENTS	
Investigation 1: Evolution of Earth Materials In The Rock Cycle	1
PART 1: Identify Common Minerals	5
PART 2: Identify Common Igneous Rock Types	7
PART 3: Identify Common Metamorphic Rock Types	9
Investigation 2: Absolute and Relative Ages of Earth's Geological Events	12
PART 1: Absolute Dating	12
PART 2: Relative Ages	13
PART 3: Ages of Rocks Exposed in the Grand Canyon	15
Investigation 3: Geologic record of mountain building events	16
PART 1: Accretion Orogeny of the eastern U.S.	16
PART 2: Allegheny orogenic structures of the eastern US	17
PART 3: Laramide orogeny of the western US	19
Investigation 4: Interpreting sea-level change from sedimentary strata	23
PART 1: Sedimentary Structure Examples	27
PART 2: Environment of Deposition & Sedimentary Structures	32
Investigation 5: Paleogeographic Reconstruction	33
PART 1: Study of coastal sedimentary deposits	33
PART 2: Paleoenvironment Reconstruction	33
Investigation 6: Patterns of Biological Evolution	40
PART 1: Phylogeny of major animal phyla	40
PART 2: NOVA Evolution Lab	46
Investigation 7: Evidence for Evolution	50
PART 1: Fossils Rooting the Earth	50
PART 2: Tetrapods are fit for walking	51
PART 3: Tetrapods Relatives	55
Investigation 8: Stratigraphic and Biostratigraphic Correlation	57
PART 1: Interpreting delta evolution from stratigraphic correlation	57
PART 2: Biostratigraphic correlation exercise	57
Investigation 9: Geologic Map Construction & Analysis	58
PART 1: Introduction to Google Earth tools and functions	60
PART 2: Reading a geologic map overlay	61
PART 3: Lava flow mapping	63
Investigation 10: Earth History Reconstruction from Geologic Map Data	65
PART 1: Interpreting geological evolution from topographic patterns	65
Investigation 11: Geologic Records of Icehouse Paleoclimates	69
Investigation 12: Analyzing Geologic Records of Greenhouse Paleoclimates	70
Investigation 13: Anthropocene Climate Change	71

Example of Linked Investigations

PART 1: Sedimentary Structure Examples

Instructions:

- Identify and sketch each sedimentary structure in the box on the left-hand column. Then answer the question/ follow the directions in the right-hand column. You can complete your sketches on a separate piece of paper so you do not have to print out the lab as long as you adequately label your drawings. It may also be helpful to download a gif viewer to view the samples; [here's one option](#). Remember: **draw the sedimentary structure, not just the rock.**

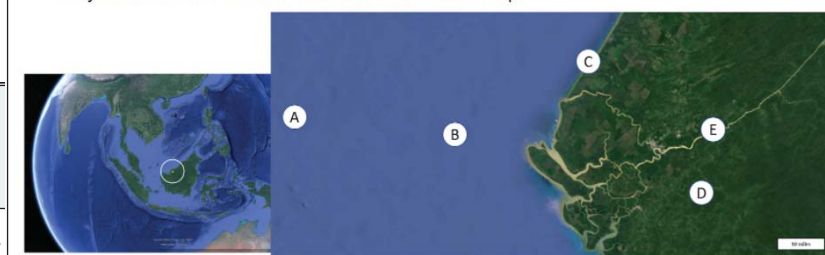
- 1) **Horizontal stratification**
(Sample scale: ~6 in./30 cm)

What environmental conditions produced this horizontal stratification?

LEFT: Part 1 of Investigation 4 guides students in identification and interpretation of sedimentary structures using digital rock modes in lieu of physical samples

PART 2: Environment of Deposition & Sedimentary Structures

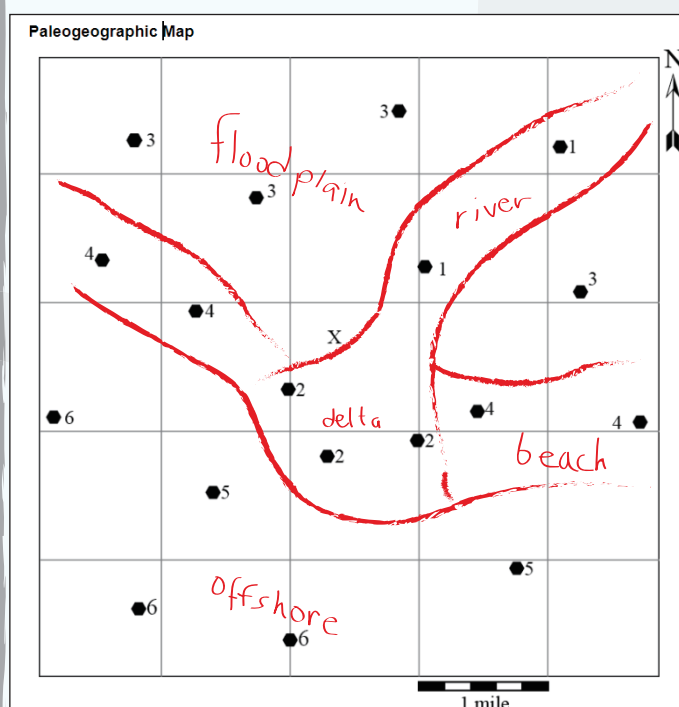
- Below is a Google Earth satellite image of the Rajang River delta located in Malaysia. You have likely never visited this region, but you can discern what types of sedimentary structures are likely to form in the various locations of this delta shown below labeled A-E.
- Examine the map provided and predict which of the sedimentary structures listed would be most likely to be found at the locations indicated on the map.



Location	Environment	Depositional Conditions	Which sedimentary structure would you find there?
A	Offshore	Deep water normally characterized by quiet water conditions at the seafloor; sedimentation mainly occurs during strong storms	

ABOVE: Part 2 of Investigation 4 asks students to consider an unfamiliar area and infer the sedimentary structures that would form based on what they have learned from Part 1

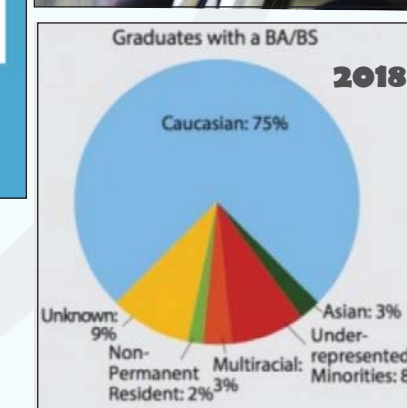
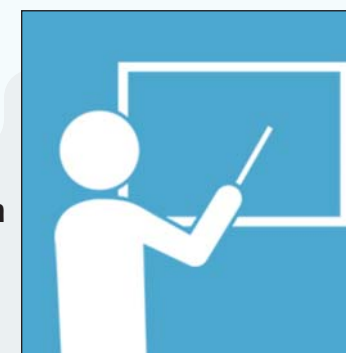
LEFT: In Investigation 5, students are given "unknown" rock samples keyed to locations on the map. They must describe and identify the sedimentary structures in these samples then use that information in spatial context to recreate an ancient delta environment from this synthetic rock record.



Planned Additions:

Planned implementation is for Spring 2022; several efforts will be completed before initial use of the lab manual:

- 1) Finalize investigations and compile aligned instructional materials: powerpoint presentations, instructional guide, answer keys and grading rubrics
 - these materials exist in various forms, but need to be developed as a single resource to standardize GTA instruction across lab sections
- 2) Compile exam questions aligned to each investigation
 - will created test bank from current exam questions so they are tied to each investigation
- 3) Develop surveys for students and instructors to assess metacognition
- 4) Incorporate information about career pathways that includes diverse representations of geoscientists to aid development of "science identity" and foster sense of belonging among diverse student groups
 - hope to get more ideas from a workshop I will help facilitate this summer!



Developing Strategies for Inclusive Teaching Practices

Monday, Tuesday, Wednesday | 8-11am PT / 9am-12pm MT / 10am-1pm CT / 11am-2pm ET | Online

Conveners

- Blair Schneider, University of Kansas Main Campus
- Angel Garcia, James Madison University
- Amy Weislogel, West Virginia University
- Yadira Ibarra, San Francisco State University

During this 3-day workshop, participants will learn to solicit diverse viewpoints and amplify voices of all students, to decolonize instruction and identify the influence of race and perspective, and work collaboratively to diversify course syllabi and classroom instruction.

Acknowledgement: Thanks to the WVU Libraries personnel, in particular Martha Vancey and Ian Harmon for their support! And thanks to the other OER grant recipients for sharing their thoughts and experiences along the way!