# Developing OER: Best Practices

## Threshold concepts and the Internal Processes of the Earth (GEOL 201) Lab Manual Project


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**10 March 2023, OER Publishing Program Workshop (via Zoom)**

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# Overview of today's talk:

- Two topics:
  - Threshold concepts: why are they and why should we care?
  - Our OER project: about our GEOL 201 Lab manual project, best practices we have learned with this project, and where we have run into threshold concept roadblocks we are working to address

# What is a threshold concept?

*'A threshold concept can be considered as akin to a portal, opening up a new and previously inaccessible way of thinking about something. It represents a transformed way of understanding, or interpreting, or viewing something without which the learner cannot progress.'*

Jan Meyer & Ray Land, Overcoming Barriers to Student Understanding Threshold Concepts and Troublesome Knowledge. 2006, p. 1.

*A threshold concept can be described as transformative (a significant shift in understanding), probably irreversible (difficult to unlearn), integrative (reveals the association between various topics), sometimes bounded (specific to a particular discipline), and potentially troublesome (difficult to grasp, counter-intuitive) (Flanagan, 2017; Meyer & Land, 2003).*

Olaniyi, Research and Practice in Technology Enhanced Learning (2020) 15: article 2

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# Examples of threshold concepts in Earth Science

- Principles of deep time and uniformitarianism
- 3-D visualization
- The rock and mineral ID process – integrating visual information, physical testing results, process related concepts

- Other examples that are more ubiquitous in science: concepts of weight, mass, gravity

# Why identify threshold concepts for our OER teaching projects?

- They can be **difficult for instructors to recognize** – because we personally overcame the threshold, often years ago. Once seen, a threshold concept cannot be unseen, and we often forget the threshold existed – may not even realize we need to highlight it for our students!
- They can be **difficult for students to overcome** – and the process can be uncomfortable and frustrating
- It's **critical to identify threshold concepts** so we can do a better job at helping students progress and get over the thresholds

# Group exercise/discussion:

- What are the topics you find most frustrating to teach to students, that they struggle with despite the topic being "easy"?
- What approaches have you happened upon that are effective for teaching these topics?
- Struggling to find answers to these questions? Other ways to approach threshold concept identification:
  - What "easy" questions do your classes bomb on their exams?
  - Ask your students for feedback on these questions, why did you answer what you answered?
  - Informal feedback, what was the hardest question on the exam?

# Our OER GEOL 201 Lab manual project

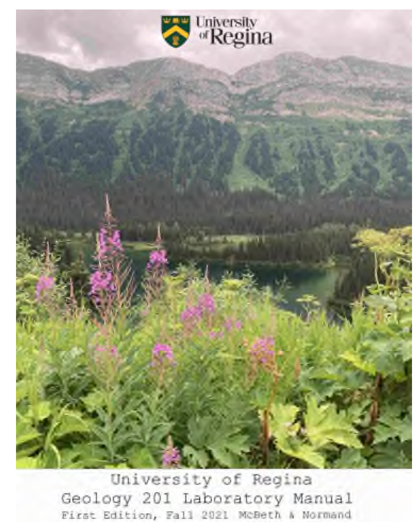
- **Motivation for our project:** preserving resources for our students and easing the load for our lab instructors and TAs, contributing to the larger pool of collaborative lab resources for Earth Science teaching globally
- **Project history:** integrating USask adaptation of U of W. Georgia manual and URegina existing resources, began in Jan 2021
- Details:
    - **Team structure**
    - **Best practice recommendations** and examples
    - Where we have run into **threshold concept roadblocks** and how we are addressing them

# Team approach

- Leadership
  - lab instructor (Normand), lecture instructor (McBeth)
- Teaching assistant – Crawford
- Undergraduate student assistants:
  - Senior undergraduates - did the bulk of the editing, alignment with pressbooks/word docs for printing
  - “consultants” - second year undergraduates, have taken the course and used the lab manual, applied their eyes to the documents to consider issues such as accessibility, EAL considerations, clarity, recommendations for additional content that would help their learning
- Communication: discord forum, google docs, weekly/biweekly meetings during the summers we worked on this more intensely

# Best practice lessons from the USask and URegina lab manual projects

- **Institutional support is transformative** for moving these projects forward, allowed us to pay students (USask and URegina) and sessional (USask) for their labour, and establishes a timeline.
- Key to **pick a good source starting point for adaptation**, tracking down images that are not original and poorly referenced is time consuming
- Developing the resource during the semester for **immediate application approach is efficient for first draft**, integrates deadlines into the process to keep the team on track
- It helps to have both **lab and course instructors involved** in the project.
- **Incorporate flexibility into student worker plan**, will likely have turnover so need to be prepared for that possibility. Pay hourly.
- **Establish plan for computer applications and formats you will use** (e.g., for image generation) at the start, ideally free open source products such as Inkscape. Format is the key part here, e.g., svg files, to ensure can edit later.
- **Regularly back up work files** from students. Have a backup plan from the start to ensure resources they have worked on are not lost.
- **Diverse communication system** that does not solely rely on email: discord forum, google docs, zoom meetings, etc.
- Ask the students! **Obtain constructive feedback from the students** who are using the resource and **iterate to improve the resource**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# Recommended open source/free tools for student workers to use

- **Inkscape:** scalar vector graphics program, comparable product to Adobe Illustrator or CorelDraw. Save in SVG format (compatible with illustrator). https://inkscape.org/
- **Google docs, Openoffice, Libreoffice**: MS office equivalents for word processing and spreadsheets. Can save to word or excel doc format. Bonus with google docs is it is located in the cloud so harder to lose the files (can make backup copies easily).
- If they are not using these program, ensure they can save to the preferred file type in whatever program they are using – if not, put your foot down!



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# Threshold concepts in the GEOL 201 project

- Rock and mineral ID
- Final project integration

# Rock and mineral ID labs:

- Students practice their hands-on rock and mineral identification in 4 labs in the course
- begin basic mineral and rock ID
- build up confidence to identify more challenging sets of rocks that closely resemble one another
- There is a logical process the students are trained to follow
- They also build their intuitive skills at rock and mineral ID (threshold concept!)
- Critical foundational skills that are used at every level in our program and in their practice as professional geoscientists after graduation



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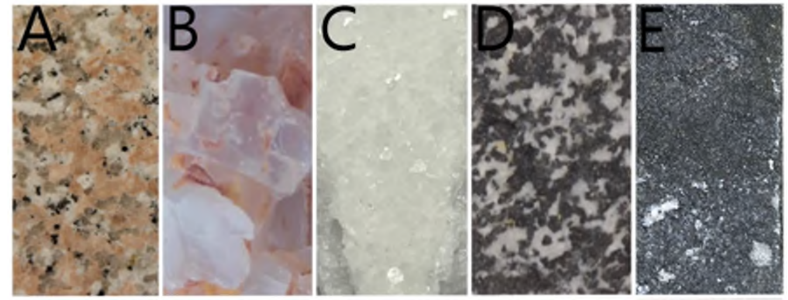
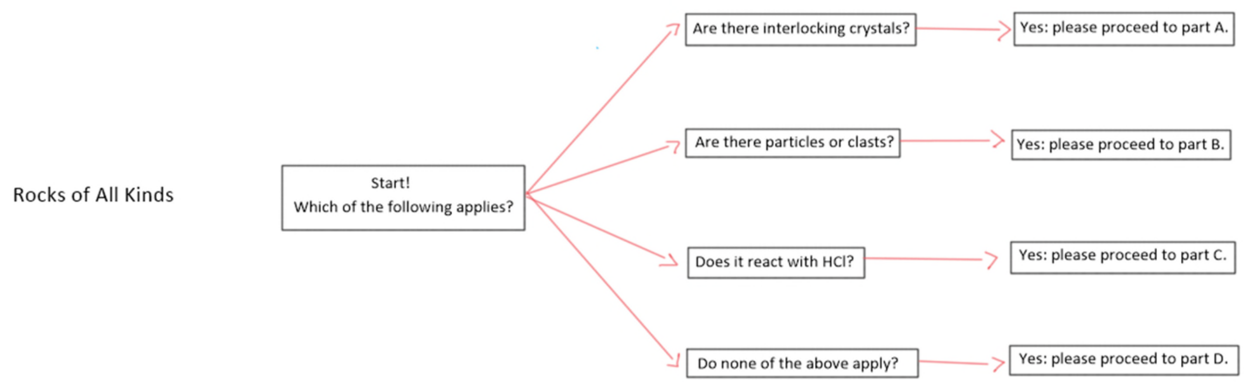
# Resources for learning:

- Samples and kits for ID
- Images and diagrams in the lab manual
- TA and lab instructor hands-on support
- Group work – helping one another



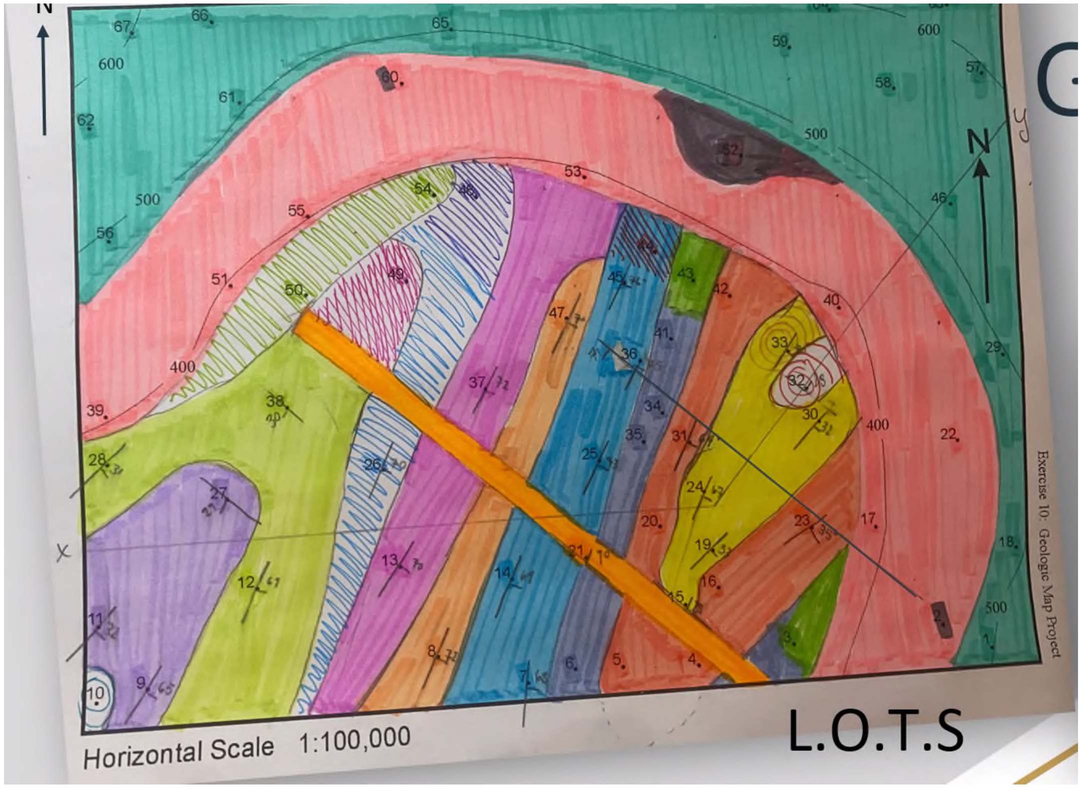
# Challenges:

- Integrating the logical process of ID and the intuitive process of ID – takes practice!
- Tools we developed: series of flow charts to help simulate the intuitive process experienced geologists use when they ID rocks
- Issues:
  - the process is not linear! Gaps or spots where one would circle back in the flow chart can introduce confusion and frustration
  - Students can become overly dependent on the flow charts, thrwart our goal of having them integrate the intuitive ID process too
  - Limits of samples in our collection (more samples, more practice)

# Rock and mineral ID threshold concept challenge: plan moving forward

- Revisions to flow charts to address gaps
- Developing games to encourage students to practice their skills and make it fun
- Prepare an exercise where they develop their own flow charts

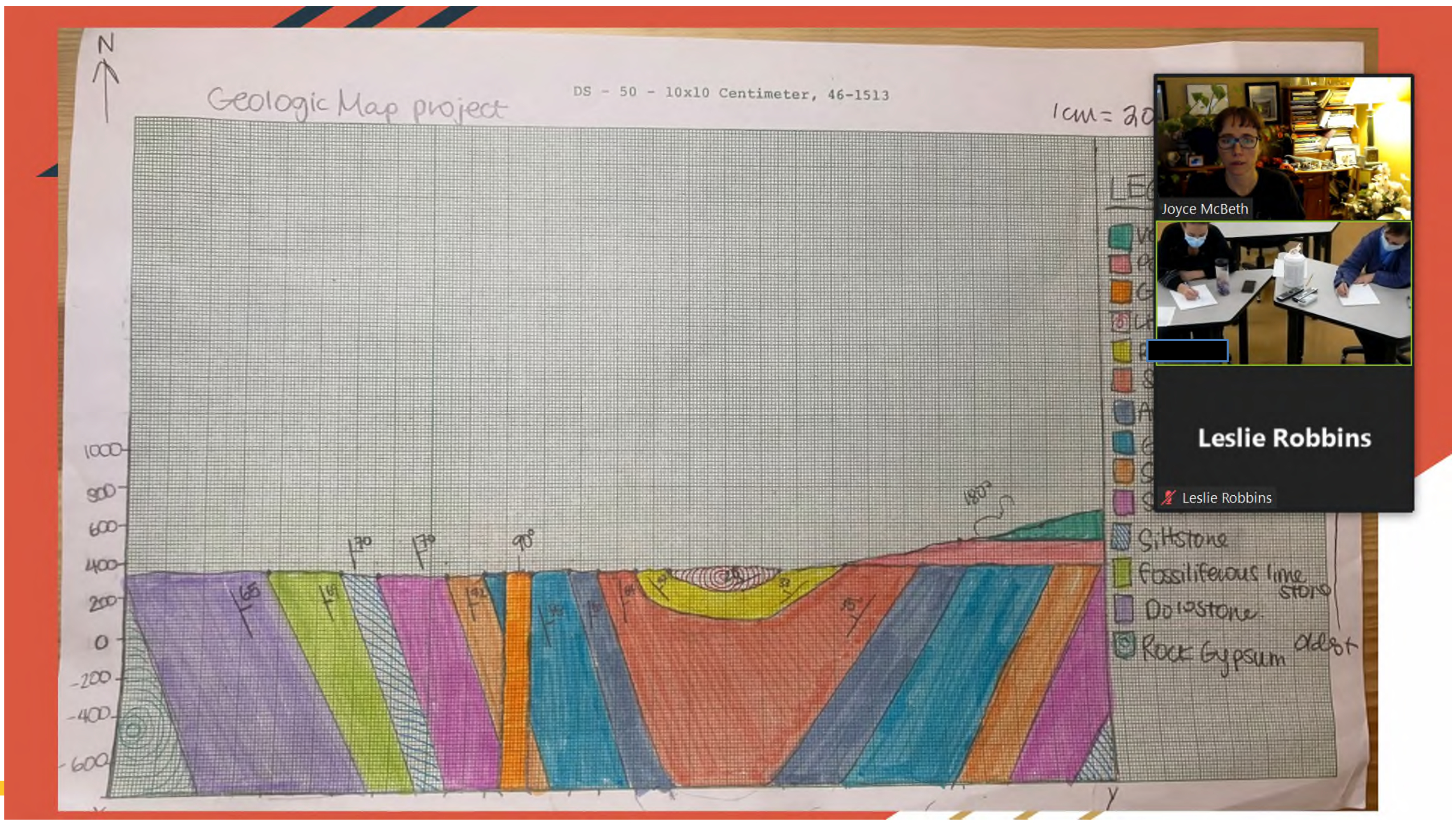
# Final project:




- Integrating the rock and mineral ID, structural geology, and mapping concepts they have learned
- Simulates an industry work experience preparing a geological map from field data and a geological history of their “study area”
- They present their data to the instructors and receive feedback, opportunities for reflection, integrate this into their final write up for the project

# Resources for learning:

- Samples and kits for ID
- Earlier labs in the course they can refer back to
- TA and lab instructor hands-on support
- Group work – helping one another

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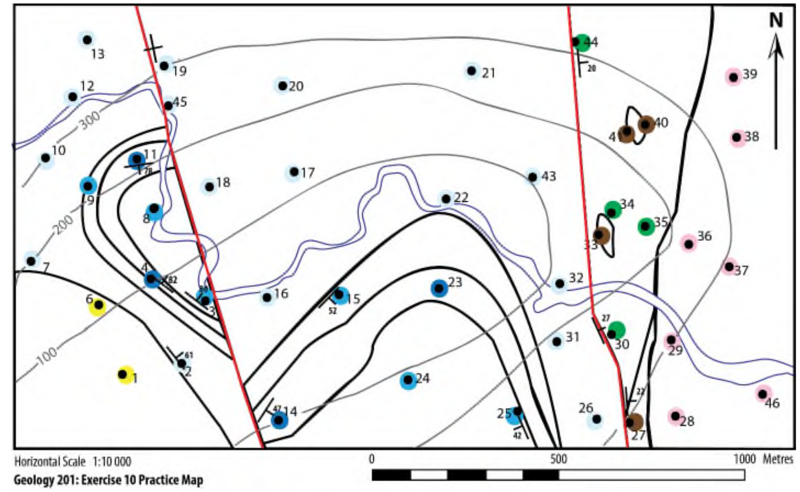
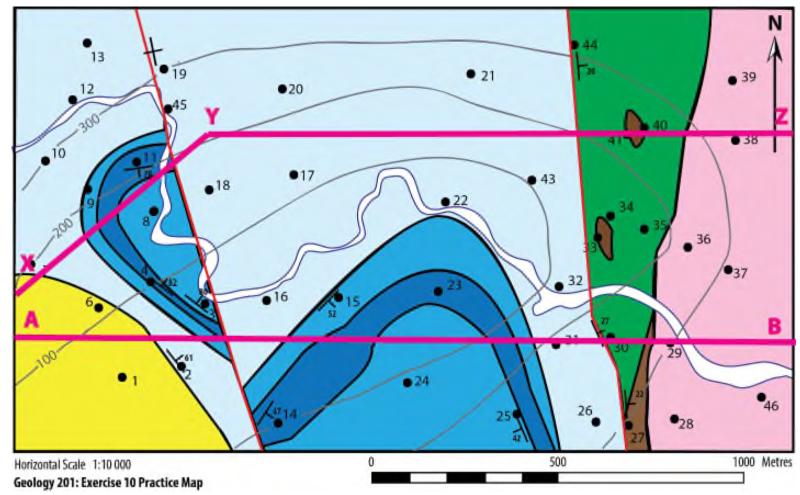
# Challenges:

- Students often struggle with where to start even with the lab preamble instruction which we thought was pretty clear 🚩!
- They requested an exemplar to work from




- Resource we developed: exemplar project
  - Example of the map generation process at each step
  - Example cross section
  - Written explanation of the process at each step
- Results – not what we expected, they still struggled 🚩 !

# Final project threshold concept challenge: plan moving forward

- Revisions to our exemplar
- Written explanation of the process at each step
- Potentially some interactive exercises with the exemplar to guide them
- Checking in with our students for informal feedback to help us to identify where the learning gaps are here and strategize about addressing them – still something we are working on.

# Summary

- Best practices in OER projects – consider both the materials you are working with and practical aspects of the project (organization, backups, funding)
- Threshold concepts – key to identify these to enhance the efficacy of your project overall – it's an iterative process!

# Thank you!

- AVP Academic and Uregina OER Publishing program, especially Isaac Mulolani for all his support!
- Karla Panchuk (UBC-O, USask), Michael Cuggy (USask)
- Heather Ross, Gwenna Moss Centre for Teaching and Learning OER grant program
- Department of Geology, URegina
- Department of Geological Sciences, USask
- You for your time and attention!

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