How Learners Learn, the Learning Cycle and Design

Foundational Ideas on Learning

1. Learning is ***an active process*** to construct understanding
2. Learning ***builds on prior knowledge***.
3. Learning should be ***authentic*** to the learner to build a deeper understanding
4. Learning occurs ***in a complex social environment*** and is a social activity
5. Learning is affected by ***motivation and engagement***

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Learning from Mistakes

- Tendency to only value correct answers neglects everything that can be learned from wrong answers
- Hindered by prior knowledge (misconceptions)
  - Learners use prior experience or knowledge to generate an explanation but don't pay attention to what the lab is really about or question is asking
- Lacking reasoning
  - Students use technical language, but do not provide reasoning to explain how those ideas are connected to the phenomenon
- Flawed understanding
  - Learners provide a concept, but the explanation reveals they may not really understand the concept.

The Regents of the University of California UC Berkley, 2018. Transforming STEM Teaching Faculty Learning Program. Five Foundations.

Inspiration for the OOI Lab Manual

Wouldn't it be great to have a lab manual of OOI data activities aligned to our oceanography classes?

Dr. Sid Mitra
(East Carolina U)

Data Lab Manual Team

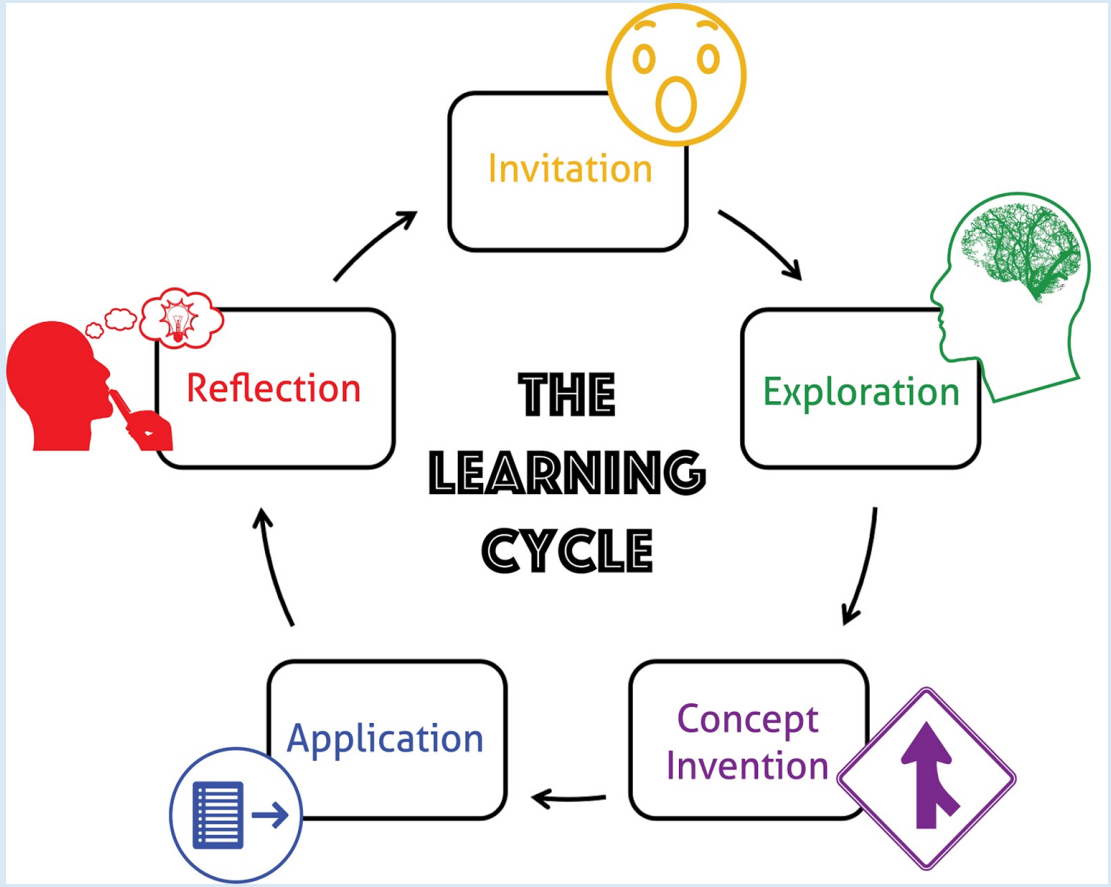
Translating OOI data into educational resources

Resource collection created by the community through curricular workshops, fellows, pilot testers and more…

Goals of the manual

- Build data literacy and critical thinking skills in undergraduate students using authentic (“messy”) scientific data
- Engage students with data activities that reinforce student confidence in scientific questioning, data analysis, and synthesis
- Provide a real-world context for key concepts in oceanography

Design of data activities - Based in learning science:



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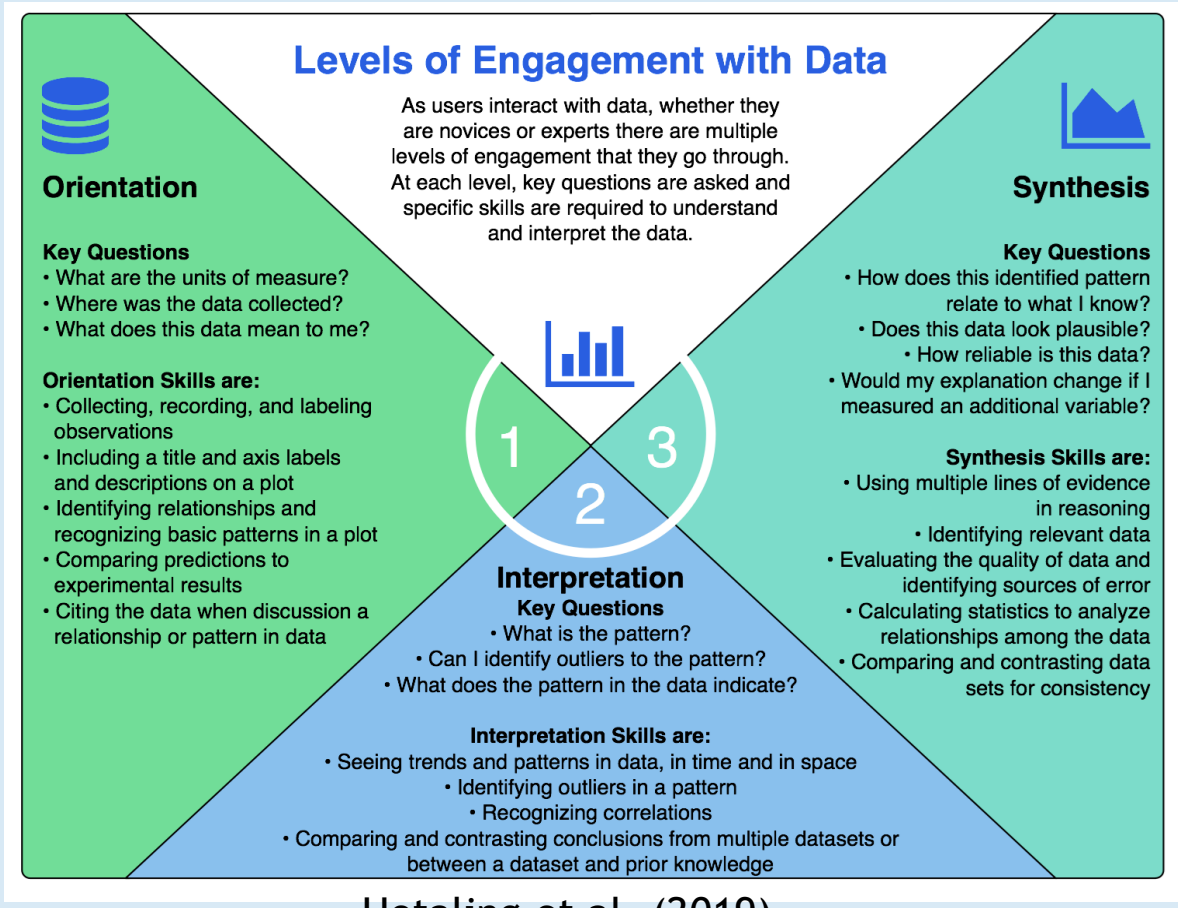
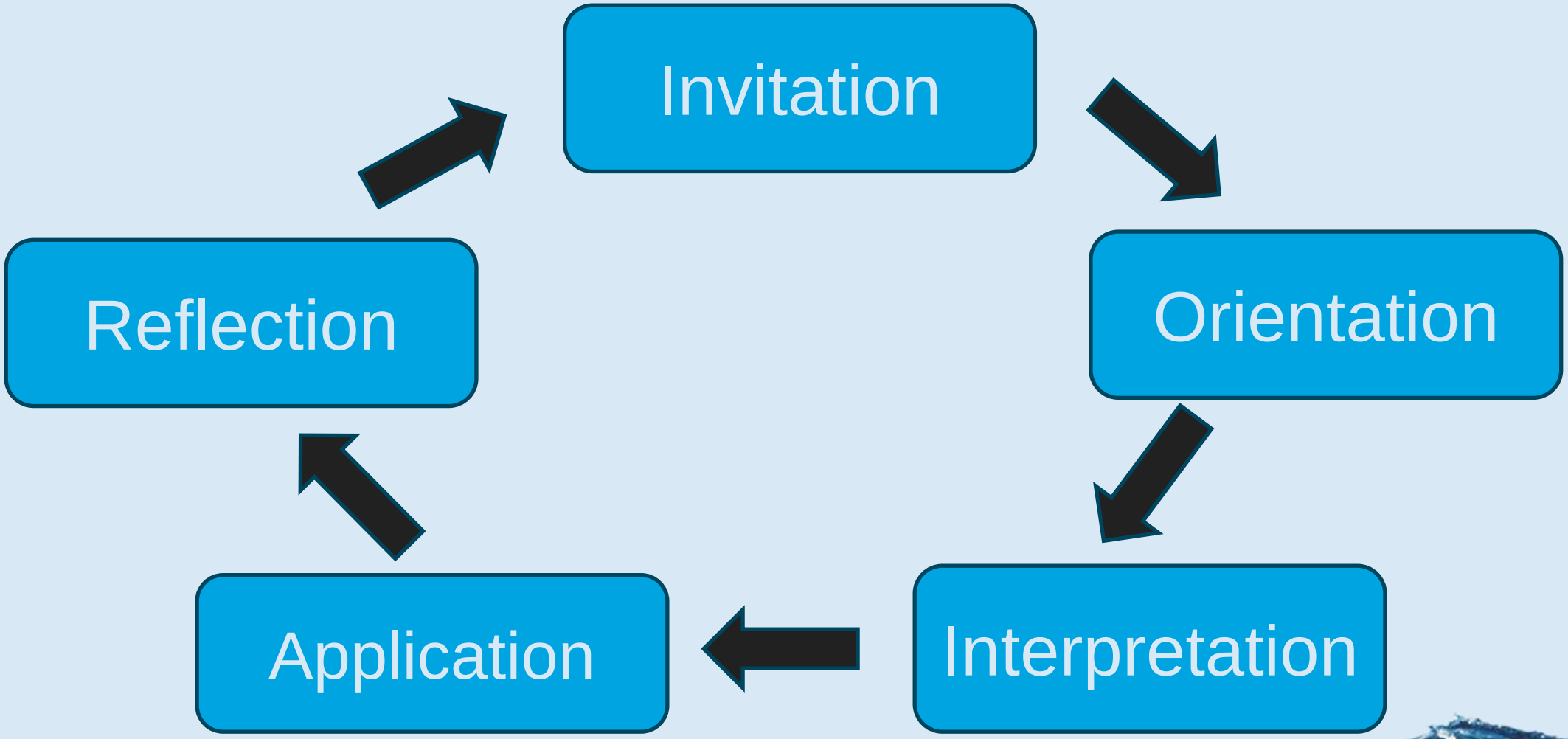


Hotaling et al. (2019)

Ocean Data Lab Manual Learning Cycle



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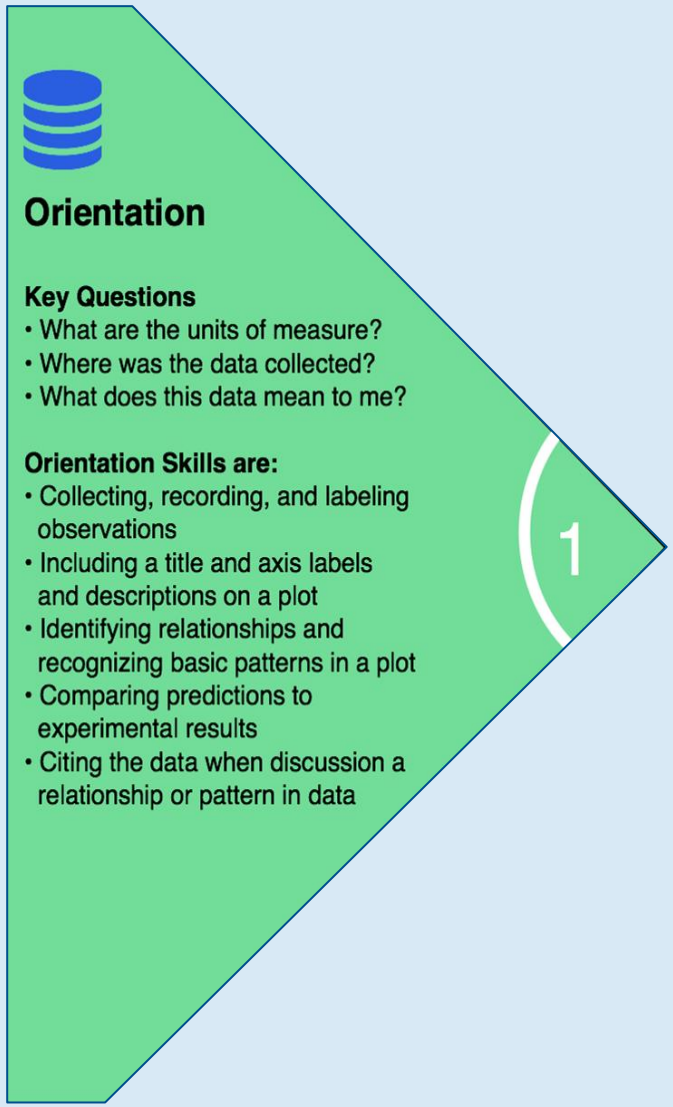
Invitation

- Sets the context of the activity
- Overarching ***authentic*** scientific ‘hook’ or concept story to catch students attention and peak interest
- Helps to incorporate ***prior knowledge***
- ***Motivation*** for students – anticipation and attention for activity



Orientation

Guiding the novice data user by questions that mimic how experts view the data

Introduce data visualizations with review of data skills:

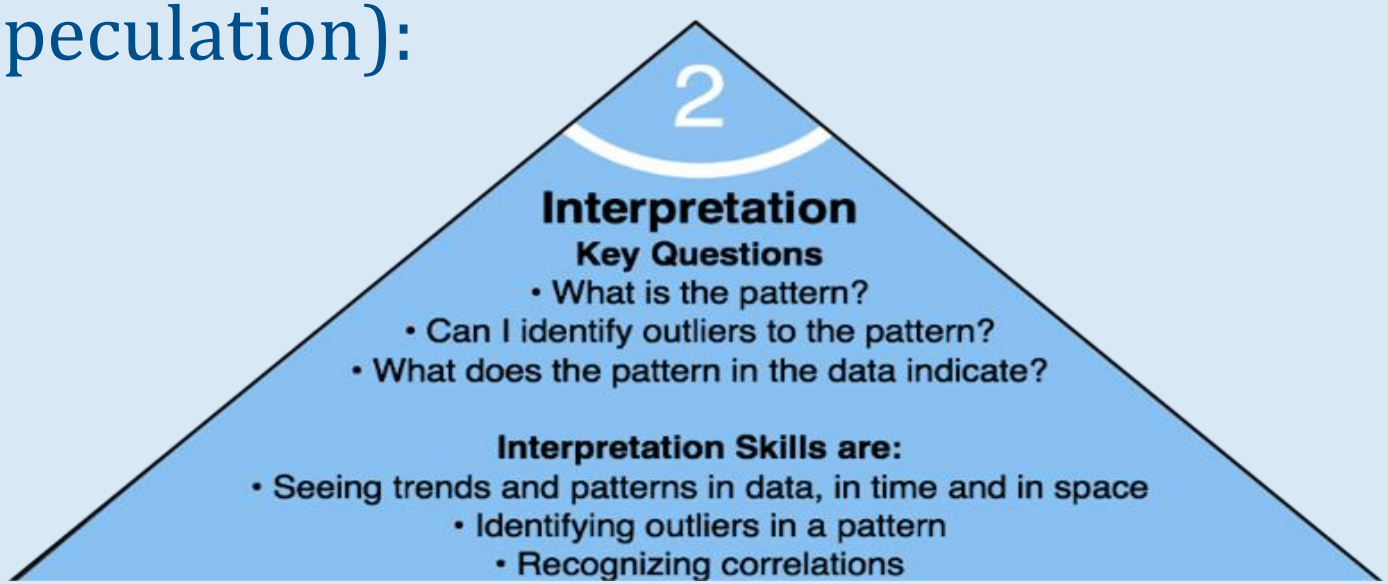
- data source
- variables and units
- graph axes (including scales)
- maxima and minima
- gaps and outliers

Interpretation

Guided questions to describe the data and identify trends and relationships

Interpret data (without speculation):

- identify patterns
- trends
- correlation



Application

Apply knowledge of key concepts to the data, make conclusions and explanations

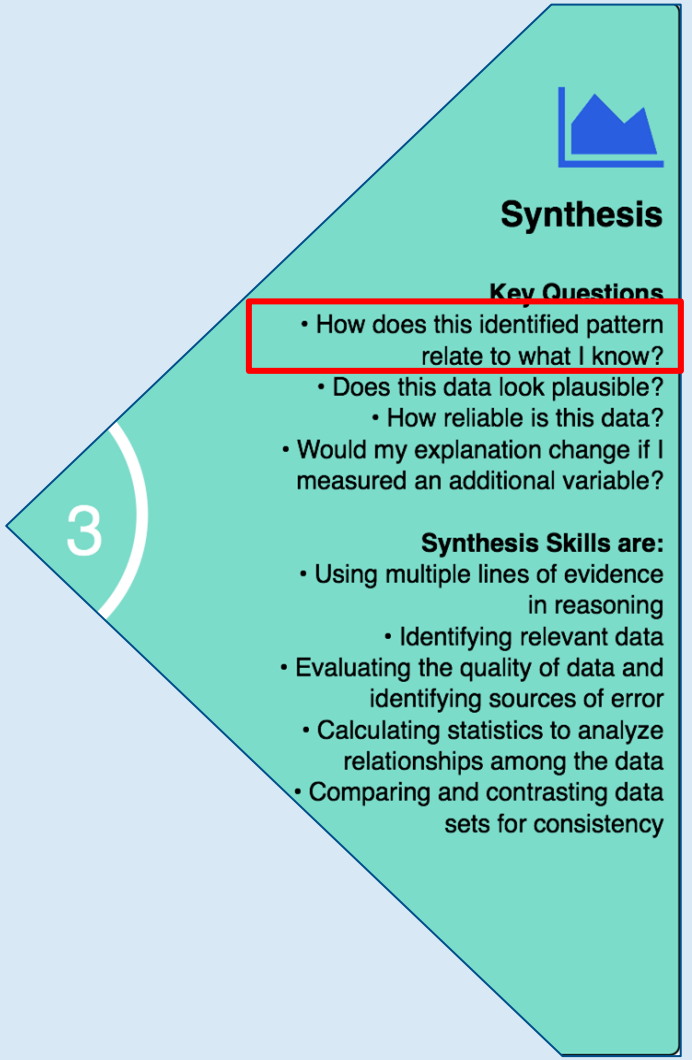
- Apply ***concept knowledge*** from textbook
- recognize correlation vs. causation
- compare to known pattern
- develop hypothesis or conclusion, supported by evidence from the data

• Comparing and contrasting conclusions from multiple datasets or between a dataset and prior knowledge

Reflection

Elaborate the greater implications of the data to other scientific phenomenon or real-world scenarios

- Analyze data limitations
- Relate to ***known phenomenon***
- Evaluate implications of trends or patterns
- Connect to practical applications
- Relate to other scenarios



Alignment to Intro Oceanography curriculum

OOI science themes and data availability

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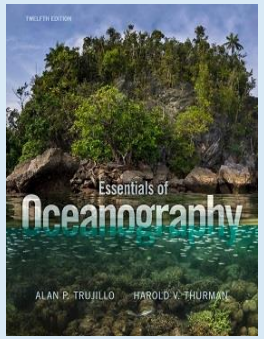
common Oceanography textbooks



Topic	Chapter
Ocean geography Ocean technology	**Lab 1**: Introduction to the OOI, the collection of oceanographic data
Data skills for oceanography	**Lab 2**: Building data skills
Marine Geology	**Lab 3**: Plate tectonics and the seafloor **Lab 4**: Seafloor changes in a volcanically active setting
Ocean Chemistry	**Lab 5**: Investigating density stratification
Physical Oceanography	**Lab 6**: Waves generated by large storms
Biological Oceanography	**Lab 7**: Primary production **Lab 8**: Anoxic events

Lab Manual chapters

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Lab 2 Live Overview

What Students Think after Lab 2!

"Just the large amount of different graphs and having in-depth questions about them really helped me to get the hang of how to interpret them better."

"For me, the guiding questions honestly allowed me to get better primarily because they allowed me to know where to look for what in the graphs, and gave me a better understanding of them."

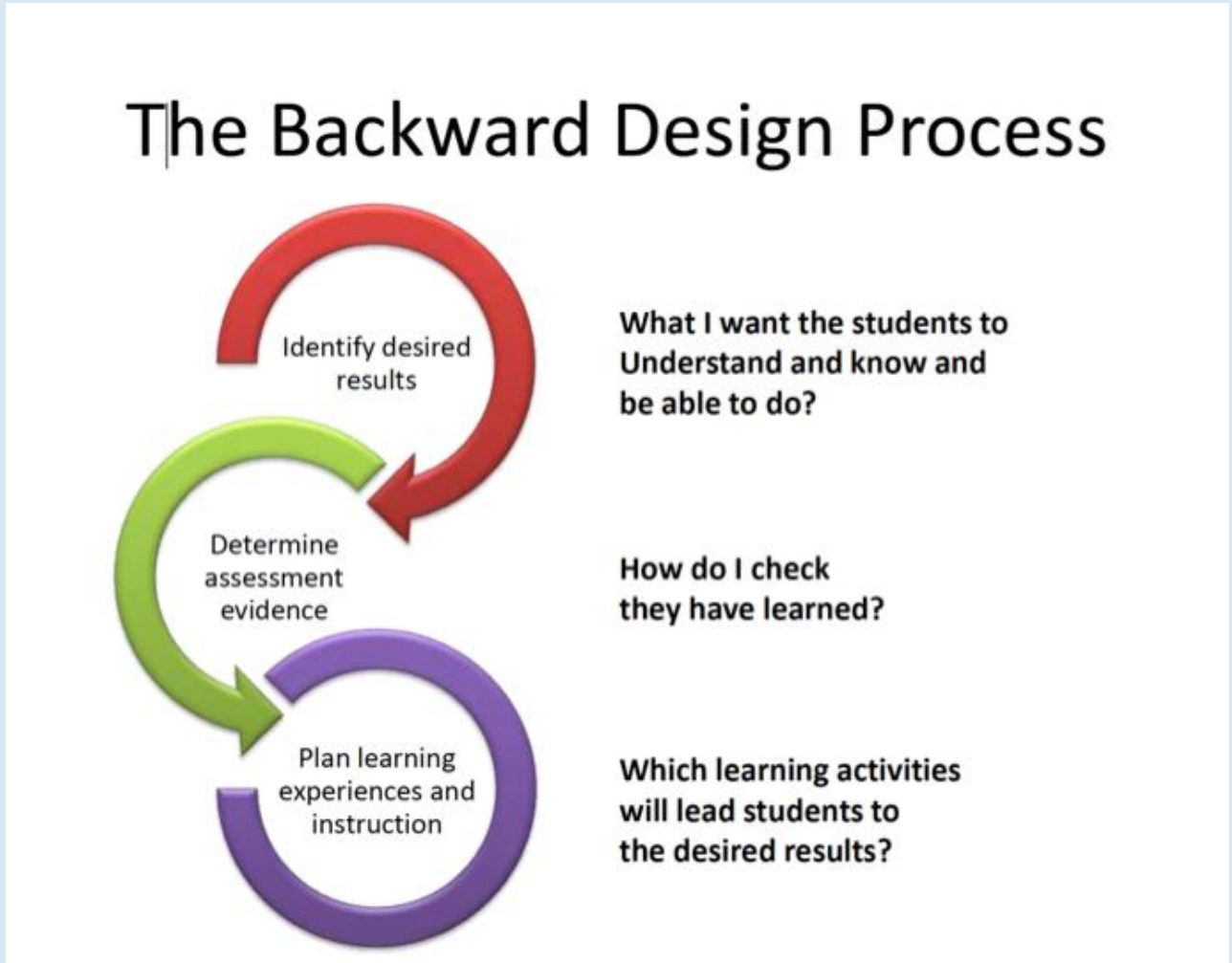
"Vertical line graphs and understanding topography graphs were completely new to me, but the information and learning activities helped me learn about them quickly and I feel much more confident about reading these kinds of graphs in the future."

End-of-semester student comment

"The most important skill I learned from this class was reading and analyzing graphs. In every class, homework, and test, [professor] included graphs and taught us how to analyze them. I notice in my other science classes that it is so much easier for me to analyze graphs, and I can do it lightning quick too."

Lightning talks

Planning Implementation



Identify Desired Outcomes

1. Identify your student audience
2. Finding the Big Idea(s) and identify what is worth knowing
3. Identify gaps in your course that you can fill in with OOI data
4. Write student learning objectives or outcomes