2018

Peer Review of Teaching Benchmark Portfolio- GEOL 100: Introduction to Geology

Mindi Searls

University of Nebraska-Lincoln, msearls2@unl.edu

Peer Review of Teaching Benchmark Portfolio

Geol 100: Introduction to Geology

Spring 2018

Dr. Mindi Searls

Research Assistant Professor

Department of Earth and Atmospheric Sciences

Center for Science, Mathematics, and Computer Education

University of Nebraska-Lincoln

msearls2@unl.edu

Table of Contents

A. Introduction and Portfolio Objectives

For over 20 years the University of Nebraska, Lincoln has supported The Peer Review of Teaching program. This program is designed to provide faculty members with the support, environment, structure and time to thoughtfully reflect on their teaching and student learning in a particular course. At the end of the process the participants will make their teaching and learning visible through the creation of a benchmark portfolio.

This benchmark portfolio targets Geol 100: Introduction to Geology. Since I arrived at UNL in 2010, I have taught a section of Introduction to Geology or Physical Geology every semester. Although, I am constantly working to make improvements to the course, I feel that it is time for me to take a step back and look at the course as a whole. As the saying goes 'it's hard to see the forest for the trees'. I feel that this project will allow me to critically evaluate my course with fresh eyes to determine a path for the future.

The key goals that I wanted to accomplish through completing this teaching portfolio are to:

1. Document the instructional approach and student learning that occurs within the course.
2. Investigate the impact on learning of requiring the students to submit responses to weekly Review Questions.
3. Identify areas to improve and create future goals for teaching and learning in my course.

B. Description of the Course

Geol 100: Introduction to Geology is the study of physical processes that occur on our planet, that shape our planet's surface and that affect our everyday lives. Intro to Geology focuses on both *internal* Earth processes, such as those that cause earthquakes, volcanoes, mountains and the Earth's magnetism, and *surface* Earth processes, such as the action of water, the movement of rivers, the restless coastlines, shifting sands of the desert and stationary soil formation.

B.1. Course Goals

Upon completion of the course, the students will be able to **explain core geologic concepts**. They should have a clear understanding of the importance of understanding local geology and how that understanding will help them **make better choices as informed citizens**: both personal choices, such as where you will live and what sort of impact you will have on the environment, and public choices, such as what sort of energy policy would best serve our country and our planet. Additionally, the students will gain a better **appreciation of the nature of science**. What does this mean? In broad strokes, they will gain a better understanding of how scientific knowledge is obtained and how our knowledge and understanding of scientific ideas evolves over time.

For a complete copy of the Geol 100 syllabus, see Appendix 1: Syllabus.

B.2. Audience

Geology 100 is designed as a large introductory geology course for non-STEM majors seeking to satisfy their general ACE 4 requirement. In spring 2018, 78% of the students enrolled were non-STEM majors. There was a wide range of diverse majors in the course from PGA Golf Management, to Theatre, to Mechanical Engineering. Out of the 81 students enrolled, there were 39 majors represented. The most common majors were Business Administration and Fisheries and Wildlife with 8 students in each.

As this is an introductory course, it tends to bring in first and second year college students. In spring 2018, approximately half of the students (40) were freshman. There was an equal number of sophomores and juniors (19), one senior and 2 graduate students.

Although this course is not designed for geology majors, we do tend to recruit new geology majors through our introductory courses and this one is no exception. Although it is exciting to see students find their major, it does raise some interesting challenges when it comes to course design. All geology majors are required to enroll in Geol 101: Physical Geology which is a 4 credit hour course with a lab component. There is a great deal of overlap in content between Geol 100 and Geol 101 with the only major difference being the lab component. As such, it is common to allow geology majors who have completed Geology 100 to take the lab portion of Geology 101 as an independent study and waive the Geology 101 requirement. This link between the courses places constraints on the depth and breadth of topics that are covered in Geol 100 as it serves as a proxy for Geol 101 in some circumstances.

Over the course of my teaching career I have found that each class has its own personality. Some groups are boisterous and love to interact in small group activities. Other groups are more reserved. The spring 2018 class was an unusually quiet group. Even prior to the start of class, the amount of chatter was minimal (even for 8:30 in the morning). When provided with group work, many students would try to complete the work individually. When students do work in groups, the undergraduate learning assistants and I circulate the class to help facilitate the discussions. When students asked me questions, I would often turn around and redirect the question to another group member to help start the conversation. Initially the students were hesitant to contribute in full class discussions, but after many uncomfortable silences during the first week the students quickly figured out that participation was expected.

B.3. Classroom

Geology 100 in typically taught in Bessey 117 which is a large lecture hall with stadium seating. The layout of the room is ideal for the traditional lecture. Unfortunately, interactive in-class activities can be challenging due to this layout. In a full classroom setting it is difficult for both the students and the teacher to move around easily. It is almost impossible to speak one-on-one with students seated in the center of the room.

C. Instructional Practices

C.1. Teaching Methods and Rationale in the classroom

My teaching approach for this course can best be described as an interactive lecture. With the exception of a two day jigsaw activity on discovering plate boundaries (http://plateboundary.rice.edu/), my class consists of lecture with daily in-class activities.

To give you a good feel for what my teaching style is like, let me walk you through our first day of class. To follow along with the lecture slides and activities go to Appendix 2: Day One. After introductions and a brief discussion on course logistics, I presented the students with a slide that has what looks like 2 sets of animal tracks (see Figure 1). I gave them a minute to write down a minimum of five observations and then I had them share what they had written. Initially I called on individuals to share and after that I had them just shout out additional observations. The observations included

Figure 1: First slide of the Tricky Tracks activity

statements like "There is a big bird and a small bird" and "the big animal starts to run towards the small animal". I moved to the next slide which includes the first image to the left, but the tracks continue to the right to show a mess of intermixed tracks. I asked them to write their new observations and I repeated the process from step 1. The last image shows only one set of tracks leaving the page. This is typically accompanied by a few sad remarks with observations along the lines of "the big one ate the small one". A different take that I heard from one student is that the birds were dancing and the bigger one carried the smaller away. This activity is known as Tricky Tracks (http://media.rsc.org/Nature%20of%20science/NSci-Bbox1.pdf) and it is designed to highlight the nature of science which is one of the course learning goals. The students learn the difference between observations and inferences. All of the observations that I heard from the students were actually inferences. Observations would include statements like "there are black marks on a white background"; however, based on their prior experiences all of the students skipped to interpreting the observations that they saw. This leads into a great discussion of what scientists do. They make observations and try to piece together the story based on their current understanding of the world. This activity also highlights the idea that sometimes new ideas come along which do not fit the old ideas so our ideas need to evolve with new evidence. This is a good first day activity because it sets the interactive tone for the class in a low-stakes way. Everyone had a list of observations to pull from so I could easily call on students without putting them on the spot. It also puts the students in the role of the scientist and makes them think about the nature of the science. This is a theme that permeates many of the activities throughout the semester.

The Tricky Track activity was followed by a brief question-answer session on the differences between a hypothesis, theory and law. I then introduced them to a scientist named Alfred Wegener who was a German meteorologist from the early 1900's. Alfred looked at fossil distributions of several animals and plants and came up with a hypothesis that revolutionized the idea that the surface of the earth is never changing. I challenged the students to come up with a hypothesis to explain Alfred's observations. The observations that I provided are among those that that led Alfred to propose the revolutionary
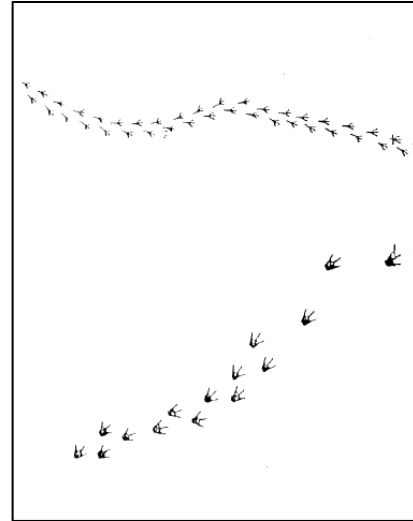
3

hypothesis that the continents move over time. This hypothesis is the precursor to the theory of Plate Tectonics which is used to explain most of the geologic activity and features seen on earth. This activity reinforces the concepts introduced in the Tricky Tracks that the state of scientific knowledge can change over time. The second to last slide of the day was their exit ticket from the class. The students were tasked with providing me a sketch of the interior layers of the earth. They handed me their diagrams on the way out. This was the topic that was discussed on day 2. The exit tickets were used as a formative assessment to let me know what depth of knowledge the students brought to class. This allowed me to tailor the next lesson to the students' level of understanding. The final slide of the day included review questions that addressed the key learning objectives for the day.

In general, I like to use a wide variety of teaching techniques to keep the students actively engaged in the learning process. Table 1 shows a list of some of the teaching strategies that I commonly employ in the classroom with a link to more information about each strategy. This list is not meant to be exhaustive, but to give you a sense of the types of strategies that I use on a day to day basis.

Table 1

Teaching Strategy	Link with more information
Exit Ticket	https://www.edutopia.org/practice/exit-tickets-checking-understanding
Just-in-Time Teaching	https://serc.carleton.edu/introgeo/justintime/index.html
Think-Pair-Share	https://serc.carleton.edu/introgeo/interactive/tpshare.html
Interactive Demonstrations	https://serc.carleton.edu/introgeo/demonstrations/index.html
Lecture Tutorials	https://serc.carleton.edu/NAGTWorkshops/teaching_methods/lecture_tutorials/what.html
Jigsaw Activity	https://en.wikipedia.org/wiki/Jigsaw_(teaching_technique)
Peer Instruction with Clickers	https://cft.vanderbilt.edu/guides-sub-pages/clickers/
Problem based worksheets	http://www.educationworld.com/a_curr/problem-based-learning-tips-ideas.shtml

The tool that I use most consistently is the clicker. The role of the student is to learn the material. That is difficult to do if they are in the class physically, but not mentally. Clickers provide a quick and effective way to keep the students engaged during lecture. Clickers are also invaluable as formative assessment tools. In a small class it is relatively easy to gauge how well the students are understanding the material through class discussion; however, that becomes more challenging as the class size increases. Based on student clicker responses, I can quickly gauge if the students have a solid grasp on the material or if more time needs to be devoted to a topic before moving on. This also provides valuable formative assessment for the students as it lets them know what topics they need to focus their studies on.

Clicker use can be incorporated into most of the teaching strategies listed in Table 1. I frequently use clickers in think-pair-share activities where you pose a problem or question to the student and have them think about it for a minute or two. They students then turn to their neighbor and discuss the problem and finally they can share with the group via clickers in junction with class discussion. Another strategy that I use with clickers is peer instruction. I pose a question to the students and they submit their answers via the clicker. If a significant number of students choose the incorrect answer, I have the

students discuss the question with their neighbor. After a few minutes of discussion, the students submit their answers again. Since this was a quiet classroom, I found that I had to provide guidance on how to structure their discussions with their peers. If the students submitted different answers they each had to explain to their partner why they selected the answer that they did. If they students submitted the same answer, I asked them to play devil's advocate and argue for the answer that they did not select. After this discussion the students submit their answers again. This technique often results in a shift towards the correct answer.

Clickers can also be used effectively with interactive demonstrations. For example, when talking about groundwater we introduced the concept of porosity which is essentially the percentage of total volume of open space of a sample/rock. In class I showed show them a container of marbles and challenged them to come up with a method to determine the porosity of container using only the tools on the table (measuring cups and water). I gave them several minutes to discuss the problem with their peers. This was followed up with a class discussion where we agreed on a procedure and used it to calculate the porosity of the container of marbles (porosity = 40%). I then followed it up with a clicker question:

Which has a greater porosity?

a. Well sorted sandstone
b. Poorly sorted sandstone

The clicker responses showed that 64% incorrectly predicted that poorly sorted sandstone would have a greater porosity. To test their prediction, I added BBs to the container of marbles to represent a poorly sorted sandstone and we calculated the new porosity (32%). A comparison to our previous calculation showed that the porosity of the poorly sorted sample was less porous than the well sorted sample (see Figure 2).
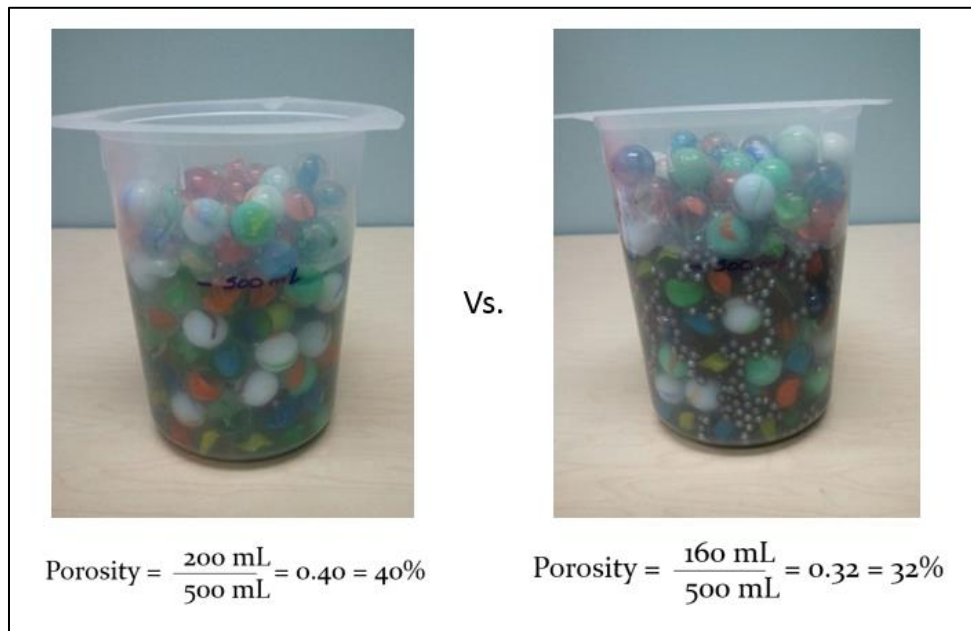

$$\text{Porosity} = \frac{200 \text{ mL}}{500 \text{ mL}} = 0.40 = 40\%$$

$$\text{Porosity} = \frac{160 \text{ mL}}{500 \text{ mL}} = 0.32 = 32\%$$

Figure 2: The well sorted sample is shown on the left with the poorly sorted sample shown on the right.

In general, I adhere to the constructivist view of how people learn. This theory says that students construct their own understanding and knowledge of the world through experiencing things and reflecting on those experiences. The rationale for using many of the teaching strategies is to allow the students to become invested in their learning in a constructivist way. New knowledge is built upon existing knowledge. Since not all students come into the classroom with the same experiences and knowledge, I need to provide opportunities for the students to reflect and actively incorporate new ideas into their existing knowledge framework. In many cases, this means that I need to challenge misconceptions to allow for the new ideas to be built on a stronger foundation. Many of the clicker questions and activities that I incorporate into my lectures are based upon the educational research on geoscience conceptions. The more awareness that I have as an instructor of the misconceptions that students hold, the easier it is to challenge these incorrect viewpoints. In the porosity demonstration, the majority of students demonstrated the misconception that the poorly sorted sample would have a greater porosity. When the demonstration contradicted the predictions it created cognitive dissonance which opened them up to learn the new concepts.

C.3. Course Activities Outside of Class

The grade breakdown in the course is shown in the chart below:

Type of Assessment	Percent Contribution Toward Course Grade
Exam 1	20%
Exam 2	20%
Exam 3	20%
Clickers	5%
Review Questions & Quizzes	20%
Exercises	15%
Total	**100%**

As with most instructors, I use a combination of formative and summative assessments. The formative assessments allow one to monitor student learning during the instructional process to provide feedback that will benefit both the instructor and the student. The formative assessments come in the form of our daily in-class worksheets and activities, clicker questions, and review questions. Summative assessment occur at the end of a unit to assess a student's mastery of a topic after instruction. Homework exercises and exams serve as summative assessments.

There are 3 exams which make up 60% of the overall course grade. There are 2 components to each exam. Part A is a multiple choice section that must be completed at the exam commons (http://its.unl.edu/dlc) and Part B of each exam is an applied section that is open book/open note. For example, for Exam 1 Part B the students were given a map and based on the surface features such as mountain ranges, coastlines, and submarine trenches, the students were asked to determine likely locations for plate boundaries. They also had to identify likely locations for volcanoes and earthquakes. For exam 2 they interpreted a geologic cross section (side view of a region showing the different rock layers at depth) to determine a geologic history for the region. On the last exam the students were given

3 seismic readings from seismometers at different locations in the Caribbean. They had to determine 1. Where the earthquake epicenter was, 2. Did the earthquake occur along a plate boundary? If so, what type of plate boundary was it? 3. Was the earthquake the result of compression or extension of the rocks? 4. What did the fault look like?.

The multiple choice exam questions covered a wide range of difficulty. There were questions asked at all levels of Bloom's taxonomy. It is human nature to make mistakes and (hopefully) learn from them. With this belief in mind, after exams 1 and 2 the students had the option of retaking Part A as a take home exam. If they opted to complete the retake their score for Part A of the exam would be an average of the original score and the retake score.

In spring 2016 I started incorporating daily review questions at the end of each class period. The questions would address the main learning objectives for each day. The number of questions would vary depending on the content from 3 to 7. For example, during the second week of class we completed a hands on activity where the students analyzed 4 maps: A topographic map, a map of volcanoes, a map of earthquake locations and depth, and a plate boundary map. In a jigsaw activity the students had to summarize their observations at different types of plate boundaries. After a class-wide discussion session on their observations the students were given the following review questions:

- What is a tectonic plate?
- Discuss the features and processes associated with ocean-ocean and ocean-continent convergent boundaries.
- Describe the earthquake pattern that is observed at ocean-ocean and ocean-continent convergent boundaries. Why do we observe this pattern?
- Discuss the features and processes associated with continent-continent collisions.
- Given a map of topographic features, be able to determine the most likely place for a convergent boundary (no written response required).
- Sketch and label a cross-section of what happens below the surface at the different types of convergent boundaries.

These review questions served as study guides for the exams. Each question on the exam can be directly linked to one of the review questions. The feedback from the students was positive, the students communicated to me that they liked seeing the review questions; however, there was no accountability for the students to complete the review questions prior to fall 2017. In fall 2017, I started collecting the review questions on a weekly basis. The purpose behind collecting the review questions was to encourage the students to study each week instead of cramming for each exam the night before. The review questions were worth 15% of their course grade and they were graded on completion. The impact of collecting the review questions is explored in section D.3. Review Question Analysis.

C.3. Course Materials

The required course materials included the Exploring Geology textbook by Reynolds et al and a clicker (or the clicker app). Although the current edition for the textbook is the fourth, I gave the students the option of buying either the second, third or fourth edition. The content did not change significantly from one version to the next and since this was a general education class for most students I didn't want them to have to spend large sums of money for a textbook. A used copy can be found online for around

$20. This geology book is unique in that the layout of the material is designed with the education research in mind. Instead of large paragraphs, most text is incorporated into the figure descriptions and annotations which makes the textbook easy to use as a quick reference.

D. Documenting and Analyzing Student Learning

D.1. Alignment of Course goals and assessment

In the course syllabus I included a paragraph that describes the course goals (see Appendix 1: Syllabus). These course goals can be summarized as follows:

1. The students should be able to explain core geologic concepts
2. The students will become informed citizens with regards to both personal choices such as where to live and the impact you will have on the environment and public choices such as helping to define policies
3. The students will gain an appreciation for the nature of science

The first course goal is the easiest to address. The review questions that were collected weekly contain a summary of the specific learning objectives for that week. Each of these learning objectives is geared towards explaining a core geologic concept. I can readily demonstrate that the first course goal was met through an analysis of the weekly review questions, homework exercises and exams.

Throughout the semester, the students had a few opportunities to show that they were becoming more informed citizens. For example, when we discussed flooding the students had to complete a Flood Frequency Lecture Tutorial (see Appendix 5: Flood Frequency Curve). This activity allowed the students to demonstrate an understanding of the risks of living in a flood plan. Although, this goal was incorporated into the curriculum, I feel that I can do a better job in this area. In hindsight there were several opportunities where I could have made more explicit connections between the science and the impacts on society. In addition, there is limited summative assessment that I can pull to show that the students are meeting this goal.

The final goal states that the students will gain an appreciation for the nature of science. This is a topic that permeated much of the curriculum in both overt and covert ways since day one of class where we completed the tricky track activity and explicitly discussed the nature of science (for a description of this activity go to C.1. Teaching Methods and Rationale in the classroom). In the geosciences there are many hot topics for some sectors of the general public such as evolution, age of the earth and climate change. When discussing these topics it is critical that the students have a solid understanding of the nature of science so they can approach these topics through the lens of scientist. Although the nature of science was a running thread throughout the semester, the summative assessment does not reflect this. For future iterations of this course, I need to incorporate the nature of science more explicitly in the formative assessments.

D.2. Mid-Semester Survey

After the second exam of the semester, I asked the students to complete an Exam 2 Reflection (Appendix 3: Exam 2 Reflection & Appendix 4: Exam 2 Reflection Student Responses). The purpose of this reflection was two-fold: first, I wanted the students to reflect on their study habits and think about ways to improve their exam performance and second, I wanted to gain some student insight on my teaching. Student responses on self-reflection portion of the survey (questions 1-4 and 6) provide great insight into the study habits of the students; however, as this was not one of the main goals of this

portfolio, I am not going to delve into that portion of the dataset. Instead, I will focus on the questions that provide insight into my teaching practices.

The last question on the survey asked: "What can the instructor do better to help you learn the material? What additional advice or comments would you like to leave for your instructor?". I coded the student responses for common threads. Out of this emerged four common themes:
1. The instructor is doing great / No changes need to be made   (24 responses)
2. The lecture slides need to include more information   (11 responses)
3. Include more practice quizzes and examples   (6 responses)
4. There is no time to take notes / The pace is too fast   (5 responses)

It was reassuring to see quite a bit of positive feedback and constructive feedback. The second most common theme revolved around the lecture slides. 11 out of the 71 respondents wanted more details included in the lecture slides which I provide to the students through canvas after each lecture. Here are two examples of the comments that were coded to this theme: 1. "put the answers to slide questions on the powerpoint when posting it; possibly put more information on the slides?" and 2. "I maybe like you should go slower and your powerpoints should not be just all pictures." The lack of extensive text on the lecture slides is by design. The slides are there to provide visual support to the discussion and they are not designed to convey all of the information discussed during class. Students are expected to take notes during class and the lecture slides can be used to supplement their class notes and not replace them. Unfortunately, it seems that the art of notetaking is not one that many of my students have had the opportunity to develop and many students do not take notes at all. I also do not want the lecture slides to serve as a replacement for going to class. Since this course is taught at 8:30 in the morning, attendance can be very low at times (see Figure 3). I worry that if I provided more details in the slides the students would be more likely to skip class thinking that they can simply read the lecture slides and learn the material.
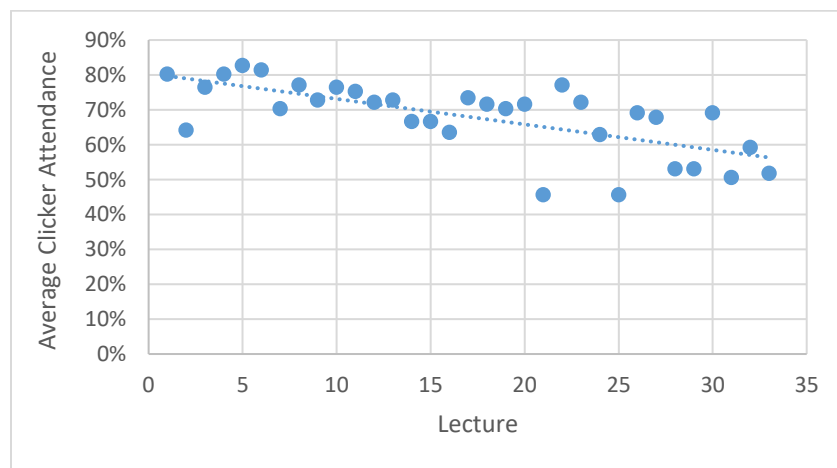
Figure 3: Average clicker attendance through time. Lecture 1 corresponds to the first lecture where clickers were used in the classroom and lecture 33 was the last. Clickers were not used during every class period. Also note that only 1 clicker question was asked on the each of the 2 lowest clicker attendance days.

Something that I struggle with in teaching an introductory course is the battle between depth vs. breadth. Since this is an introduction to geology, I feel that there are certain topics that must be covered. What would a geology course be without a discussion on volcanoes, earthquakes, climate change, floods, groundwater … etc.? In addition, as we do have some geology majors enrolled in this course, there is a base set of knowledge that the students must have to excel in the more advanced geology courses. I would like to cover topics in more depth, but I feel constrained by time. In past end-of-the-semester course evaluations I have had students comment that the pace of the course is too fast. Of course, in the same set of evaluations I saw comments that take the opposite view so it is difficult to gauge if pacing is a real issue. This is also a theme that ranked 4th on the coding of question 10 of the survey with 5 students commenting on the lack of time and the fast pace.

To gain a sense of what the overall student consensus was on this issue I asked the students to rate the pace of the class (see Table 2). I was happy to see that only one student out of the 73 respondents rated the pace as 'way too fast'Table 1. Although 60% of the students rated the pace as 'just right', another 30% rated it as 'slightly too fast'. I think that the next steps in the depth vs. breadth battle is to talk with the colleagues in my department who teach the upper level courses to get their take on what they expect the students to know going into their classes so that I can determine the best areas to pare down to allow for more depth in other areas.

Table 2: Student responses to the question 'How would you rate the pace of the course?'

Way too fast	1 respondents	1 %	
slightly too fast	22 respondents	30 %	
just right	44 respondents	60 %	
slightly too slow	5 respondents	7 %	
way too slow		0 %	
No Answer	1 respondents	1 %	

Another recurring theme in past end-of-the-semester course evaluations is the connection between material covered in the class and the exams. Some students have commented that the exam questions are unrelated to the material discussed in class; however, other students have left feedback that the review questions are a great study guide for the exams. To see if this was a commonly held view-point I asked if the 'problems on the exam fairly reflected the topics covered in class'. While 78% of the students responded with an affirmative, 22% of the students did not feel that the exam questions reflected the material discussed in class. It seems that some students have difficulty making the connections between the review questions which are pulled directly from lecture content and the multiple choice exam questions. Over the last year I have batted around the idea of adding weekly multiple choice canvas quizzes to accompany the weekly review questions. This would allow the students to more clearly see the connections between the lecture material and the exam questions. I envision that the students would be allowed multiple attempts to complete the quizzes so that this tool can be used for formative assessment to help the students identify gaps in their knowledge base. Since the addition of examples and practices quizzed ranked 3rd on the coding of the final question, I feel that this addition would be well received.

D.3. Review Question Analysis

In this section, I want to delve into the impact of incorporating daily review questions on student scores. The table below summarizes my approach to review questions over the last 3 years:

Treatment	Semester	Approach
1	Fall 2015	No daily review questions were provided
2	Spring 2016	Review questions were provided daily but not collected
	Spring 2017	Review questions were provided daily but not collected
3	Fall 2017	Review questions were provided daily and collected once a week (graded on completion)
	Spring 2018	Review questions were provided daily and collected once a week (graded on completion)

There are three treatment groups. In the first group no daily review questions were provided. For the second treatment group review questions were provided at the end of each day but they were not collected. For the last treatment group, review questions were provided daily and collected once a week. They were graded on completion and counted for 20% of the course grade.

For each of these treatment groups, I have collected the original exam scores (prior to any retakes) for both exams 1 and 2. Histograms and box and whisker plots of the scores for each treatment and exam are shown in**Error! Reference source not found.** Appendix 6: Stats. As we can see there is a significant jump in the average exam 1 score for treatment 3 in which the review questions were turned in.
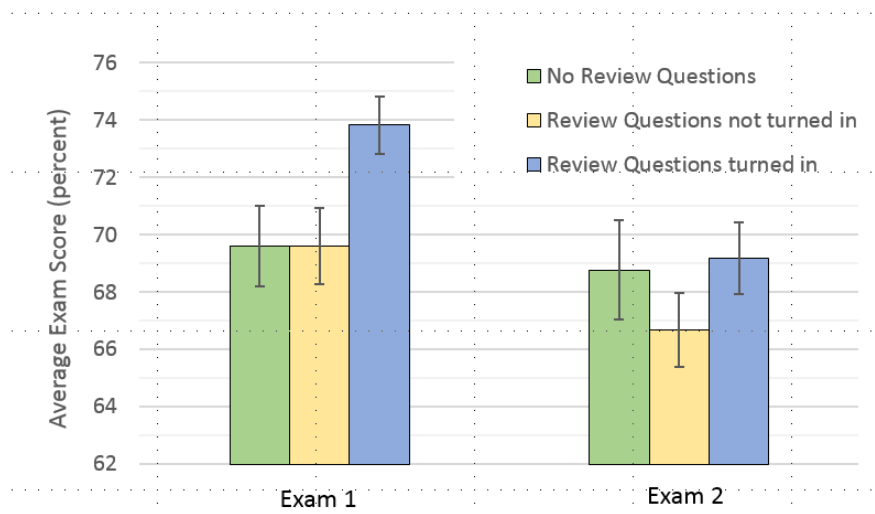
Figure 4: Average exam scores for each of the treatment groups.

I completed an Analysis of Variance (ANOVA) test between each of the treatments for each exam to determine if there was a statistical difference in the average scores between the groups. For Exam 1 there is a statistical improvement between treatments 1 and 3 ($F = 7.47$, F critical = 3.87, P value = 0.0066) and again there is a statistical difference between treatments 2 and 3 ($F = 6.35$, F critical = 3.87, P value = 0.0122).

It is encouraging to see the increase in exam scores for exam 1, but this begs the question: Can this increase be attributed to the collection of the review questions? There are several factors that could be influencing the statistical analysis. First, the exams were not completely identical. The exams were very similar and there were several test questions that carried over from one exam to the next, but they did not match exactly. If the exams were identical would we see the same results? With more time this is something that I have the capability to look into. Instead of comparing results of the entire exam, I could compare exam questions that are consistent from year to year.

I also have to consider the students within each treatment group. Since I did not have a pre-test, I cannot guarantee that the populations are comparable. I could just have a group this year that started out more knowledgeable in the material from exam 1. This is a factor that I have very little control over.

The time of day could also play into exam scores. I typically teach Geology 100 at 8:30 am; however, the time was moved to 1:30 pm in spring 2017. As attendance drops for early morning classes, one can assume that the grades for that semester will also differ. One way to test for this is to remove that class from the dataset and rerun the statistics. For exam 1 the results are intriguing, but more work will need to be done before I can conclusively say the collection of the review questions had a positive impact on exam scores, especially considering that we did not see a corresponding increase in the second exam.

D.4. Attendance and Grade

Since I teach class at 8:30 in the morning, attendance can lag at times as we saw from section D.2. and Figure 3. This prompted me to look into the possible connections between attendance and course grade. As we can see from Figure 5, there is a strong correlation between the two as expected. This is a chart that I plan to show future students on the first day of class to emphasize the importance of coming to class and participating in the activities.
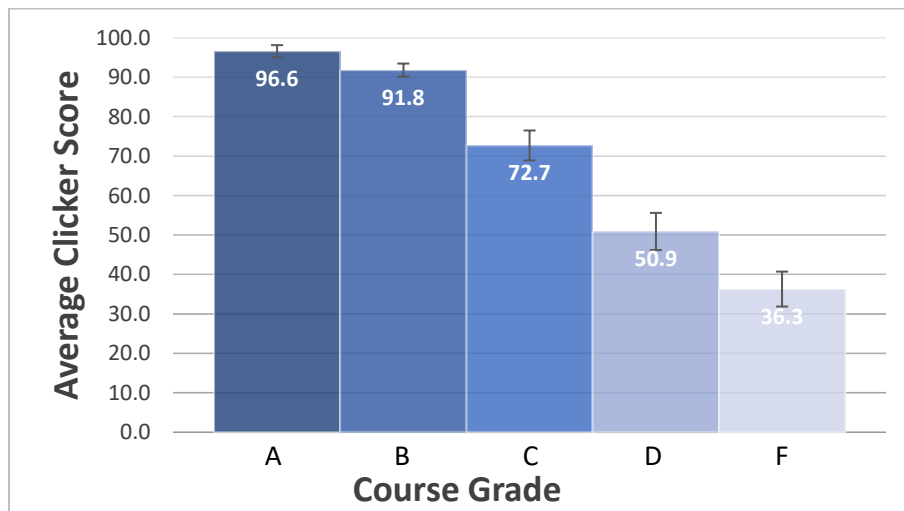
Figure 5: Average Clicker Score and Course Grade

E. Directions for the Future

Throughout the text of this portfolio I have discussed plans for future iterations of this course. This plans are summarized here:

1. Incorporate all of the course goals into the student assessment in a more explicit fashion.
2. Meet with the faculty who teach upper level geology courses to fine tune the depth and breadth of topics covered.
3. Develop a series of weekly review quizzes to complement the weekly review questions and analyze the impact on scores.

Geol 100: Intro to Geology
Spring 2018

Instructor: Dr. Mindi Searls
Office: 220 Bessey Hall
Office Hours: MWF 9:30-10:30
Email: Available through Canvas

Undergraduate Learning Assistants:
Megan Speich
Alicia Chan

Graduate Teaching Assistant: Mei Liu
Office: 131 Bessey Hall
Office Hours: Thurs 9:30-10:30

Required Textbooks and Equipment
- "Exploring Geology (2nd, 3nd or 4th Edition)" (Reynolds)
- I>clicker2. You must register and maintain your own transmitter. BRING TO EVERY CLASS.

Description:

Intro to Geology is the study of physical (and some chemical and some biological) processes that occur on your planet, that shape our planet's surface and that affect our everyday lives. Intro to Geology focuses on both *internal* Earth processes, such as those that cause earthquakes, volcanoes, mountains and the Earth's magnetism, and *surface* Earth processes, such as the action of water, the movement of rivers, the restless coastlines, shifting sands of the desert and stationary soil formation. This course is demanding, but not difficult. You must put some work into this class every day in order to do well in it. But you will be amply rewarded. The next time you visit a National Park or Monument you will see its history and know the place as you never did before!

Course Goals:

When you have completed this course, you will know a great deal more than you do now about how the Earth works. You should have a clear understanding of the importance of understanding local geology and how that understanding will help you make better choices as an informed citizen: both personal choices, such as where you will live and what sort of impact you will have on the environment, and public choices, such as what sort of energy policy would best serve our country and our planet. Additionally, you will gain a better appreciation of the nature of science. What does this mean? In broad strokes, you will gain a better understanding of how scientific knowledge is obtained and how our knowledge and understanding of scientific ideas evolves over time.

ACE Certification:

This course is certified as an Achievement-Centered Education (ACE) Course and meets Student Learning Outcome #4: *"Use scientific methods and knowledge of the natural and physical world to address problems through inquiry, interpretation, analysis, and the making of inferences from data, to determine whether conclusions or solutions are reasonable."*

Grade Breakdown:

Type of Assessment	Percent Contribution Toward Course Grade
Exam 1	20%
Exam 2	20%
Exam 3	20%
Clickers	5%
Review Questions & Quizzes	20%
Exercises	15%
Total	**100%**

Grades are determined as follows:

Letter Grade	Corresponding Percentage
A+	≥97.0%
A	93.0% ≤ and < 97.0%
A-	90.0% ≤ and < 93.0%
B+	87.0% ≤ and < 90.0%
B	83.0% ≤ and < 87.0%
B-	80.0% ≤ and < 83.0%
C+	77.0% ≤ and < 80.0%
C	73.0% ≤ and < 77.0%
C-	70.0% ≤ and < 73.0%
D+	67.0% ≤ and < 70.0%
D	63.0% ≤ and < 67.0%
D-	60.0% ≤ and < 63.0%
F	< 60.0%

Note: If you elect to take the course with the "Pass/No Pass Option", according to the Office of Registration and Records, a minimum grade of C is required for a Pass. A "C-" or less is an "N".

I am happy to fill out grade check forms; however, I will need advance notice if you would like me to fill one out for you. Please notify me least one class period before the grade check is due.

Late Work

Late homework will be accepted with a 10% per day late penalty. For example, if an assignment is due in class on a Monday, it will receive a 10% late penalty if it is turned in after class on Monday or Tuesday. It will receive a 20% late penalty if it is turned in on Wednesday (30% on Thursday… etc). No late assignments will be accepted after an answer key has been posted. If appropriate documentation can be provided for missing work, the late penalty will be waived. Examples of acceptable documentation:

- Medical excuses: The documentation must be signed by a physician on official paper, cover the period during which the course component was due, and indicate that the severity of the illness was sufficient to cause you to miss the course component

- Bereavement: Often an excuse such as "I had a death in the family" is given for an absence. If such is the case, then proof of death and proof of close family relation must be supplied in order for the work to be made up.
- Military Service: A copy of your official orders.
- University-sponsored activity: A signed letter from the department or advising faculty member.

Exams

The exams are designed to test your comprehension and knowledge of basic geologic concepts, theories, and processes. As such, you will be expected to apply the material that has been covered in lecture to solve problems (vs. just having to memorize facts). The first 2 exams will cover the portion of the course most recently presented. However, geology is a subject that builds upon concepts. Therefore, it is likely that each exam will contain some previously covered material. Exam 3 will focus mainly on the most recent material; however, it will also cover some material from the first 2 exams.

There will be 2 components to each exam: Part A will be a multiple choice exam and Part B will be a take home section where you will be asked to apply your knowledge in more depth. The multiple choice section of the exams will be taken at the Digital Learning Center Exam Commons (http://its.unl.edu/dlc). **You must register with the Exam Commons in the 2 weeks leading up to the exam for an exam time**. If you miss your scheduled exam time, you may not be allowed to sign up for a new time and you will get a zero for the exam. Please sign up PRIOR to the first available test day to ensure that you get a reservation to take the exam. You will have 3 days to complete the exams.

Clickers

Your role as a student is to LEARN the material. This is difficult to do if you are in the class physically but not mentally. Therefore, clicker responses WILL count as part of your course grade. You will earn points each class period for participating in clicker questions. You must answer 75% or more of the questions to get all of the points for that day. This means that if there are 3 or fewer questions, you must answer all of the questions for that day to get the points. It will not count against you if you get a question incorrect; however, I do expect honest participation. I do NOT count a response of 'E' when the answer choices are A, B, C or D as honest participation and this type of response will not get you any points.

There are ~35 classes where clickers will be used. You may miss up to 4 classes without penalty. These 'skip' days must be used for all documented and undocumented absences so plan accordingly. If you forgot your clicker or your clicker does not work, you will not get clicker points for that day (I will not accept pieces of paper).

Class attendance is important! Data from past semesters show a direct correlation between average clicker scores and course grades.

Review questions & quizzes

The last lecture slide for each day will include a small handful of Review Questions. These questions relate to the key concepts for each class period. After class on Friday, I'll create a canvas assignment with the review questions for the week and you will be able to upload all of the questions for that week as one file. The review questions will be due the following Monday at the end of the day (11:59pm). These review questions also serve as your study guide for each exam so it's in your best interest to put some time into this.

There will also be periodic review quizzes. These will be multiple choice canvas quizzes (open book and open note) that directly relate to the review questions. You will be allowed multiple attempts at the quizzes.

Exercises

Throughout the semester there will 5-6 hand-on exercises for you to complete. For these exercises you will explore a topic in greater depth and apply the knowledge that you have gained. For example, our first exercise relates to

plate tectonics. You will be provided with a map of a region and you will be asked to interpret the map. Why do you see mountains or deep ocean trenches where you do? Where would you expect volcanoes or earthquakes to occur? What is happening below the surface of the earth? In the past we have looked at fictional maps such as Middle Earth from Lord of the Rings as well as paleomaps of what the earth liked millions of years ago.

Notetaking and Technology in the Classroom

It is highly recommended that you take notes during class. The lecture slides are posted after each class (except for review days); however, many of the lecture slides are heavy on images and do not include much text so it is important that you supplement these with your own notes. The exams focus heavily on material that is covered during lecture so good notes are important! Should you take notes by hand or on a laptop? Studies have shown that the degree of learning in the classroom increases if you take note by hand instead of a computer (visit this site for more information: http://www.npr.org/2016/04/17/474525392/attention-students-put-your-laptops-away?utm_campaign=storyshare&utm_source=facebook.com&utm_medium=social). You may use a laptop in the classroom if that is your preference; however, if the laptop is not being used for class related purposes, you will be asked to put it away.

Please refrain from using your cell phone for purposes that are not class related. If it is necessary that you answer your phone during class, be respectful of those around you and leave the classroom before answering.

Academic Honesty:
Academic Honesty is a requirement. You are *individually* responsible for any assignment and every exam. The Student Code of Conduct, printed in the Undergraduate Bulletin, sets forth the rules that govern student rights and responsibilities. Section 4.2 of this Code states: "The maintenance of academic honesty and integrity is a vital concern of the University community. Any student found guilty of academic dishonesty shall be subject to both academic and disciplinary sanctions."

According to the Code of Conduct, academic dishonesty includes, but is not limited to:
- Copying, or attempting to copy, from another student's test or assignment.
- Fabricating or falsifying any information used in academic work.
- Plagiarism, which is presenting someone else's work as your own.
- Using information from any source, including Internet sites, without proper citation.
- Misrepresenting or fabricating excuses for missed or late work.
- Helping another student to commit an act of academic dishonesty.
- Misrepresenting your clicker identity.

In this course, academic dishonesty will be punished by a zero on the assignment for a first offense. A second offense may earn an F in the course and will be reported in writing to the Office of Student Judicial Affairs.

Disabilities:
Students with disabilities are encouraged to contact the instructor for a confidential discussion of their individual needs for academic accommodation. UNL's policy is to provide flexible and individualized accommodation to students with documented disabilities that may affect their ability to participate fully in course activities or to meet course requirements. To receive accommodation services, students must be registered with the Services for Students with Disabilities (SSD) office, 132 Canfield Administration, 472-3787 voice or TTY.

Important Dates: The academic calendar can be found here: http://registrar.unl.edu/2017-2018

SCHEDULE (subject to change)

	Week of	Lecture Topic	Readings (from Exploring Geology 2nd edition)	Important Dates
1	Jan 8th	Nature of Science Drifting Continents Interior of the Earth	Ch 2.9 & Ch 10.1-10.4, 10.12 Chapter 1.3	
2	Jan 15th	Maps Plate Tectonics	Chapter 3 & Ch 10.1-10.6	Martin Luther King Jr. Day (no class on Monday)
3	Jan 22nd	Plate tectonics Hot Spots Minerals	Chapter 3 Chapter 10.5 Chapter 4	
4	Jan 29th	Rock Cycle Weathering Sedimentary Rocks	Chapter 4 Chapter 7	
5	Feb 5th	Sedimentary Rocks Streams	Chapter 7 Chapter 16	Exam 1: Feb 10-12 (Sat - Mon)
6	Feb 12th	Streams Groundwater	Chapter 16 Chapter 17	
7	Feb 19th	Contour Maps Coasts	 Chapter 14.1-14.9	
8	Feb 26th	Atmosphere & Deserts	Chapter 13.1-13.9	
9	Mar 5th	Geologic Time Igneous Rocks	Chapter 9 Chapter 5	
10	Mar 12th	Igneous Rocks Volcanoes	Chapter 5 Chapter 6	Exam 2: March 14-16 (Wed – Fri)
	Mar 19th	**Spring Break**		
11	Mar 26th	Earthquakes	Chapter 12	
12	Apr 2nd	Earth's Interior Structure	 Chapter 8	
13	Apr 9th	Metamorphism Mountain Building	Chapter 8 Chapter 11.2-11.6	
14	Apr 16th	Glaciers Climate Change	Chapter 14.10-14.19 Chapter 13.10	
15	Apr 23rd	Energy Resources		
		Finals Week		Exam 3: Apr 30 - May 2 (Mon-Wed)

Appendix 2: Day One
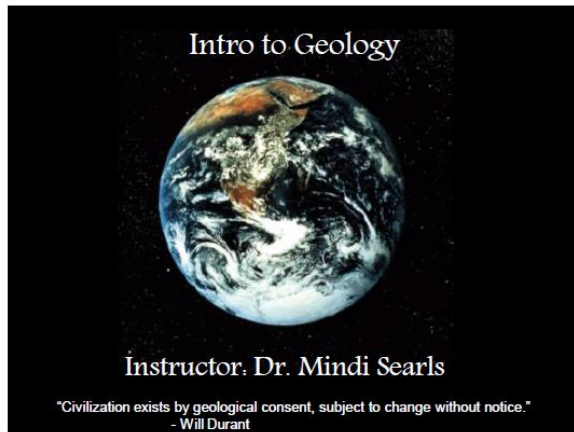
- Insert a few slides to introduce myself and the TA's
- Insert a couple of slides with course logistics & materials
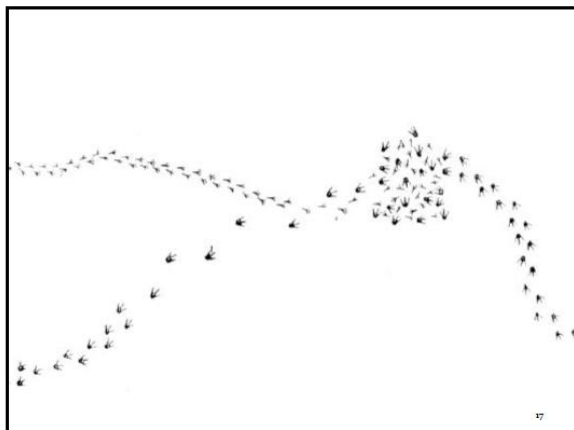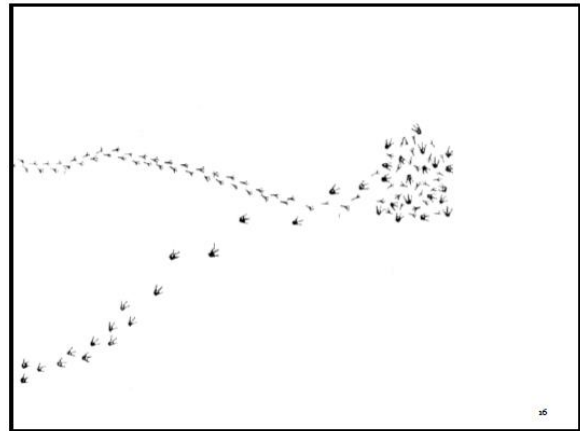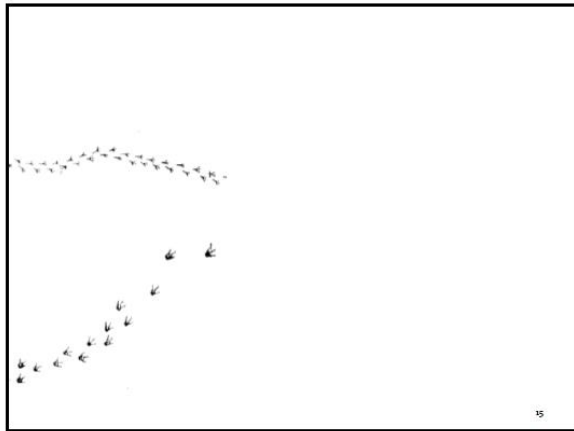
Nature of Science

- Observations
- Observations → Inference

"A possible, tentative, explanation for naturally occurring processes that can explain a set of observations of natural phenomena" describes a ...

a) Scientific theory
b) Scientific hypothesis
c) Scientific law

"A scientific idea that is supported by abundant evidence, and that has passed many test s and failed none"

a) Scientific theory
b) Scientific hypothesis
c) Scientific law

Can a scientific theory be disproven?

Example: Geocentric vs heliocentric theory

A scientific law is a description of an observed phenomenon

Theories do not become laws. They explain how or why laws work.

Scientific Law vs Theory Example 1

- Hubble's Law of Cosmic Expansion
  - Velocity = H$_o$ * Distance
    (H$_o$ = Hubble's Constant)
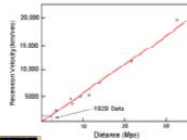
- Big Bang Theory

Scientific Law vs Theory Example 2

- Mendel's Laws of Heredity

- Darwin's Theory of Evolution
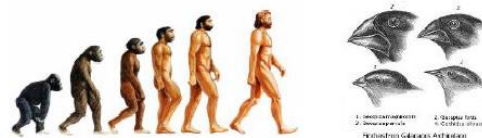
Scientific Law vs Theory Example 3

- Newton's Law of Gravity
  - $F = Gmm/r^2$

- String Theory
  - Predicts existence of Gravitons (quantum mechanical particles that carry gravitational force)
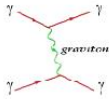
Alfred Wegener (Nov 1980 – Nov 1930)

Wegener (left) and Villumsen (right) in Greenland; November 1, 1930

Prior to the 1900's ...

Present Day

One million years ago

One billion years ago

Mesosaurus
(299-280 Ma)

Fossil remains of *Mesosaurus* have been found in Africa and South America.

Cynognathus
(247-237 Ma)

Fossil remains of *Cynognathus* have been found in Africa and South America.

Lystrosaurus
(255-250 Ma)

Lystrosaurus fossils have been found in Africa, Antarctica, and India.

Glossopteris
(299- 252 Ma)

Glossopteris fossils have been found on all the southern continents.

Can you come up with a hypothesis to explain the observations seen in the last 4 slides?

Where is this supercontinent located?

Fossil remains of *Mesosaurus* have been found in Africa and South America.

Lystrosaurus fossils have been found in Africa, Antarctica, and India.

Fossil remains of *Cynognathus* have been found in Africa and South America.

Glossopteris fossils have been found on all the southern continents.
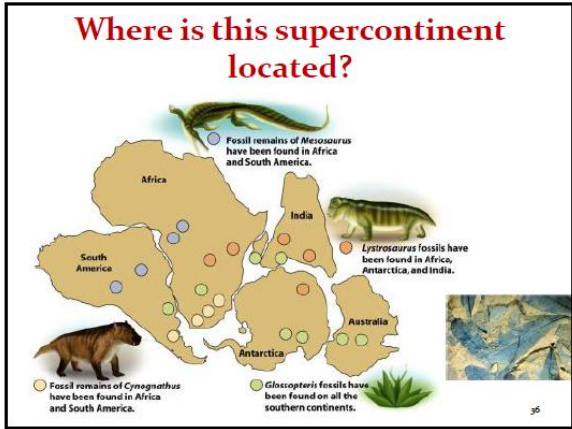
- Insert a couple of slides to give additional observations to support the hypothesis that the continents move over time.

Sketch and label a diagram of the interior layers of the Earth.

Image from Sept 1995 issue of "the science teacher"
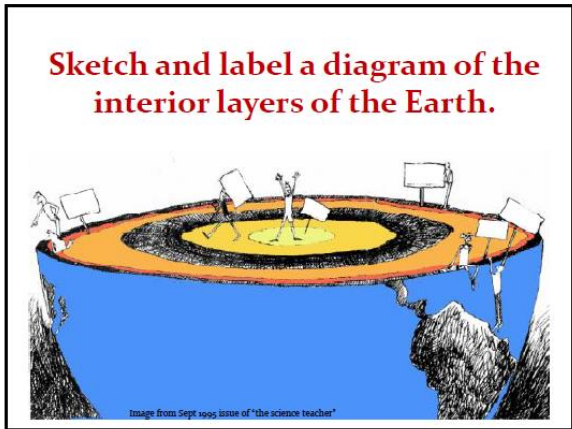
Review Questions

- Describe the differences between a scientific hypothesis, theory and law.
- Describe Wegener's theory of continental drift and the observations that supported his theory.

Appendix 3: Exam 2 Reflection

Exam 2 reflection

This is a reflection exercise designed to provide feedback to the instructor and to give you a chance to reflect on what activities you can do to improve in the course.

I have set this up as an anonymous graded survey. I will not know who submitted each survey so please be honest in your responses. It will be graded on completion and students will automatically receive full credit once the survey is completed.

1. What grade did you earn on Exam 2?

2. Approximately how much time did you spend preparing for exam 2?

3. How many days before exam 2 did you start preparing for the exam? Was this time adequate?

4. When you were studying for Exam 2, what percentage of your test-preparation time was spent on each of these activities?
    a. Reading textbook sections for the first time   _____
    b. Rereading textbook sections   _____
    c. Reviewing your own notes   _____
    d. Reviewing the weekly review questions   _____
    e. Review the lecture notes on Canvas   _____

5. Do you think that the problems on the exam fairly reflected the topics covered in class? Yes/No

6. Based on your responses to the questions above, what will you do differently in preparing for the next exam? For instance, will you change your study habits or try to sharpen particular skills? Please be specific.

7. Prior to each exam, the undergraduate learning assistants held an evening review session. Did you attend the review session? If so, how helpful was it? Select one of the following:
    a. I did not attend
    b. I attended and it was not very helpful
    c. I attended and it was helpful
    d. I attended and it was very helpful

8. How helpful are each of the following items in learning the course content? For each item enter a value from 1 to 4 based on the chart below:

Not Helpful	Slightly Helpful	Helpful	Very Helpful
1	2	3	4

    a. Class lectures   _____

    b. In-class clicker questions   _____

    c. Class handouts & activities   _____

    d. Lecture slides on Canvas   _____

    e. Weekly review questions   _____

    f. Homework assignments   _____

    g. Textbook   _____

9. How would you rate the pace of the course? Select one of the following:
   a. Way too fast
   b. Slightly too fast
   c. Just right
   d. Slightly too slow
   e. Way too slow

10. What can the instructor do better to help you learn the material? What additional advice or comments would you like to leave for your instructor?

Appendix 4: Exam 2 Reflection Student Responses

Student responses to questions 1-4 varied greatly and are not included in this portfolio

5. Do you think that the problems on the exam fairly reflected the topics covered in class? Yes/No

Yes	57 respondents	78 %
No	16 respondents	22 %

6. Based on your responses to the questions above, what will you do differently in preparing for the next exam? For instance, will you change your study habits or try to sharpen particular skills? Please be specific.

    The student responses to this question varied, but a repeating theme was time. In general students plan to dedicate more time to prepare for the next exam

7. Prior to each exam, the undergraduate learning assistants held an evening review session. Did you attend the review session? If so, how helpful was it? Select one of the following:
    a. I did not attend
    b. I attended and it was not very helpful
    c. I attended and it was helpful
    d. I attended and it was very helpful

I did not attend.	53 respondents	73 %
I attended and it was not very helpful.	3 respondents	4 %
I attended and it was helpful.	12 respondents	16 %
I attended and it was very helpful.	5 respondents	7 %

8. How helpful are each of the following items in learning the course content?

Class Lectures

1	Not Helpful		0 %
2	Slightly Helpful	6 respondents	8 %
3	Helpful	28 respondents	38 %
4	Very Helpful	38 respondents	52 %
No Answer		1 respondents	1 %

Weekly Review Questions

1	Not Helpful	1 respondents	1 %
2	Slightly Helpful	15 respondents	21 %
3	Helpful	24 respondents	33 %
4	Very Helpful	32 respondents	44 %
No Answer		1 respondents	1 %

In-class Clicker Questions

1	Not Helpful	1 respondents	1 %
2	Slightly Helpful	14 respondents	19 %
3	Helpful	25 respondents	34 %
4	Very Helpful	32 respondents	44 %
No Answer		1 respondents	1 %

Homework Assignments

1	Not Helpful	3 respondents	4 %
2	Slightly Helpful	32 respondents	44 %
3	Helpful	20 respondents	27 %
4	Very Helpful	17 respondents	23 %
No Answer		1 respondents	1 %

Class Handouts & Activities

1	Not Helpful	5 respondents	7 %
2	Slightly Helpful	21 respondents	29 %
3	Helpful	30 respondents	41 %
4	Very Helpful	16 respondents	22 %
No Answer		1 respondents	1 %

Textbook

1	Not Helpful	27 respondents	37 %
2	Slightly Helpful	20 respondents	27 %
3	Helpful	11 respondents	15 %
4	Very Helpful	10 respondents	14 %
No Answer		1 respondents	1 %
Something Else		4 respondents	5 %

Lecture Slides on Canvas

1	Not Helpful	4 respondents	5 %
2	Slightly Helpful	11 respondents	15 %
3	Helpful	22 respondents	30 %
4	Very Helpful	35 respondents	48 %
No Answer		1 respondents	1 %

9. How would you rate the pace of the course? Select one of the following:
   a. Way too fast
   b. Slightly too fast
   c. Just right
   d. Slightly too slow
   e. Way too slow

Way too fast	1 respondents	1 %	✓
slightly too fast	22 respondents	30 %	
just right	44 respondents	60 %	
slightly too slow	5 respondents	7 %	
way too slow		0 %	
No Answer	1 respondents	1 %	

10. What can the instructor do better to help you learn the material? What additional advice or comments would you like to leave for your instructor?

Student Responses to Question 10:

1	Add more explanation on power point notes
2	give more examples
3	She needs to slow down in class and make sure we know what to take notes on. This is because sometimes she changes the slide before I'm done writing it down, and she'll be explaining a graph that might have some information we need to know for the test, but we don't write it down because there's nothing to copy down.
4	Fun course and great Professor the only thing I would change is putting the answer to the clicker questions on canvas and making the slides with more information.
5	I believe the class is good and will continue to get better.
6	put the answers to slide questions on the powerpoint when posting it; possibly put more information on the slides?
7	I think giving more information on the slides, especially on topics that aren't covered on the slides specifically, and not going so fast through them so there's more of a chance to copy stuff down and ask more questions.
8	I would suggest more practice quizzes leading up to the exam, given example questions of what could be on the exam like the review questions but more of a quiz type scenario.
9	I didnt buy the textbook because money can be tight, the review questions, lecture, and powerpoints really allow me to pass this course with good grades.
10	More examples that are closer to the exam.

11	I appreciate it a lot when we go through homework in class and you individually approach people and pick their brain to find the answers with knowledge already acquired. Obviously, it's tough to do very often with such a large class size, so talking about homework assignments in class is a helpful way for interactive learning. I appreciate your enthusiasm and pleasantness in the morning even though it's very early. I would encourage you to use clicker questions more often as leverage to make sure you can keep people engaged. Your lectures are informative, but as would be the case with any other 8:30 class, it takes a significant amount of discipline to stay engaged- especially for us early morning folks.
12	More homework assignments.
13	more practice with labeling and having the powerpoints be a bit more clearer as well as having two study sessions before the exams
14	I think she can have more review handouts and assignments, other than that I enjoy the class!
15	I think it is set up well. I find the assignments especially helpful.
16	Provide slides with answers to the clicker questions which don't already have the answer highlighted in the canvas slides so we can go back and review those. Other than that I think the instructor is doing an excellent job and there is only so much she can do to help us learn the material. I think a lot of the grade rides on the students being attentive and involved in class and using the resources the professor has provided. Maybe one thing I would add is that the instructor could provide more links to videos on canvas related to the specific course material.
17	The instructor is great. She offers a wide variety of study materials that are helpful in learning.
18	Honestly, by just doing the work the class stays very manageable. Despite it adding a significant amount of time, reading the textbook makes the course that much more comfortable. With this, in deciding not to read and take notes on the book, the material presented in class provides all of the necessary information to so well on the exams. I don't see there being anything that needs to be changed, and this is coming from someone who is taking your class to fulfill a General requirement; the course is interesting.
19	i just feel that thee part B of the test is made to difficult and the people who do well on it work together with others on it hurting those of us who do not.
20	I think she is doing a mighty fine job as is.
21	I love this class. The material is interesting and Professor Searls is very down to earth.
22	I think the instructor has a great way teaching her class.
23	I would really appreciate a study guide with a compilation of the important terms and concepts to get the ball rolling while studying because its a little hard to know what is going to be on the exams.
24	Cover the topic more in depth not for 2 minutes, The book is way to confusing to follow
25	I think I would have understood the information more if there was a consistency within the lecture slides. Within class there would be times I was taking notes and I'd miss some information or couldn't write fast enough. So, then after class I would look at the lecture slides to find that piece of information (like a definition) and sometimes a word would have that definition and other times there wouldn't be one. However, I did appreciate the reviews being due every Monday. It was a good way to retain some stuff before I began to actually study for the test.
26	Nothing. I need to put more time into it myself. Keep doing you.
27	Practice more exam like questions
28	I believe that if she went deeper into the clicker questions that I would better understand them.
29	Mindi does a great job
30	Materials being taught is very informative and instructor is at a good pace when presenting the materials.
31	I really enjoy this class and how many opportunities we have at grades. The tests are challenging, but that being said I feel as though I am really learning! Something I wish we got more of is picture/diagram examples. I know this last test contained a lot of cross-sections and we used them a lot so I was comfortable with them.. but sometimes that is not the case.
32	Don't try to hard to make the class fun. We college students do not want to stand up and move around. Find different ways to make the class interesting.

33	I think the only think that could be done better is to go over homework handout more because I have felt unprepared for part b on this last test.
34	Actually teach the class the material that will be on the exam. The assignments, reviews, and exercises do not help much with the exam questions. The only thing helpful is the lecture slides that I have to teach myself. The course is an intro level one science class that I am taking for an ace requirement and it is not fair to my gpa with how difficult it is. Make the exams the same difficulty as you make the reviews and exercises. Especially since this class is mostly being taken to fill ace requirements.
35	I think the instructor is doing a great job teaching the material and I have yet to approach a topic that I don't understand because she explains it very well and gives many examples and practice questions.
36	I think that the instructor does a good job of covering the material and that the exams reflect what we do in class, I just struggle to grasp some of the concepts but not because of a lack of instruction.
37	Explain more about certain subjects and update the answers on the worksheet online, to have answers.
38	The instructor can do better on explaining more what is going on in the lectures. I feel confident that the instructor is doing a good job of helping the students learn and contribute to the class whenever possible.
39	I think the instructor is doing a good job at teaching the material. I don't think the pace is fast, especially since the previous lecture day is often reviewed at the beginning of class. I enjoy this class and I feel the material is clearly explained and there are plenty of in class activities (for example, the grouping activity to explain coarse vs fine grains in igneous rocks) that help the concepts be cemented.
40	Nothing, I think that you go through the material at a good pace and explain things very well. Using lots of examples!
41	study guide handouts would be very helpful to make sure my work is on the right track for being able to ace a test.
42	I can't think of anything you could possibly do better. I genuinely enjoy your class, dispite the early hour.
43	I wish that we had weekly review sessions and questions on what to expect for the exam.
44	stay on slides a little longer and maybe go in depth more on each key term
45	Go over some of the topics more thoroughly
46	They could explain what the review questions are asking for, so that it is clear and the students know exactly what you are asking for.
47	none
48	more clicker questions. It was hard to grasp the whole layering section we covered
49	The instructor is doing a great job helping me to learn the material. It is on me to get better on learning the material.
50	I have nothing to say but the teacher does an excellent job. I would like her to allow students to ask questions during class though.
51	give us practice tests to work through. other than that i think you are doing a great job
52	I think it would be helpful to have a sort of test outline or study guide even with just the main points that will be covered in the test. We have the review questions each week, but sometimes there seems to be so many and they might not cover quite everything that is on the test, or some things that aren't even on the test. I think it would help to prepare if we had a better idea on what exactly to study for.
53	I think the instructor is doing a great job, and it's personal problems like my lack of studying that lead to bad scores
54	Keep all the answers to the review questions and homework assignments in the lecture slides.
55	It looks like Dr. Searls is doing the best she can to help us learn the material. I just need to take the time to make sure I need to take the time understand the material more adequately, which means instead of simply copying down answers from the book (for the review questions), I should make sure I understand the concept fully.
56	I think the test dates should be longer than just three days. It should be for a week so the students can pick a day in that week instead of the three days.

57	Sometimes i don't get everything from the slide and then also miss out on whats being talked about not on the actual slide so when i go back to canvas to fill in the notes i can't. This sometimes affects me being able to study.
58	Instructor is doing well. Maybe offer 2 review sessions if it fits into her agenda. I have had to miss each review session due to work.
59	better lecture slides
60	Some times the test questions are confusing. It seems like some of them are worded to trick the student. I felt like I was very well prepared for the last test and felt confident answering the questions through out the test, and still I didn't perform as well as I would have liked to.
61	Sometimes I feel like the material we need to know before the test is too broad and often a lot of them are not presented on the actual test if there was a way to be more accurate on what exactly will be on the test then will be helpful.
62	I think Prof. Searls is great and she is doing an excellent job. The only reason why I did so poorly was because I did not give myself enough time to study.
63	Everything is working.
64	I like our instructor. I think she maintains the class well.
65	Thank you!
66	nothing
67	She can focus more on what will actually be on the test. Sometimes things on the test I did not feel like were covered very well, and other things that you went into depth on was not on the test very much.
68	I just have a difficult time understanding anything and I go home and study the book and still come confused. I take the worksheets to my tutor and leave more confused than I came. I maybe like you should go slower and your powerpoints should not be just all pictures.
69	Having more interactive activities in class would be helpful as it forces involvment and really helps me grasp the concept.
70	One thing I really like that we do in class is clicker questions. I think those are very helpful to look over and review when studying and keeps us engaged in class. Something I believe could be changed is the weight of our homework assignments (15%) in our overall grade. I believe that we're still trying to comprehend the material when the homework assignments are given and therefore shouldn't be worth almost as much as an exam is (20%).

Appendix 5: Flood Frequency Curve

Part 1: Constructing a Curve

A flood-frequency curve plots the discharge of a particular stream against how often that discharge occurs. In the graph below, the levels of floods of a stream in the United States were recorded each year between 1950 and 1999.

Year	Flood * discharge	Year	Flood * discharge	Year	Flood * discharge	Year	Flood * discharge	Year	Flood * discharge
1950	18	1960		1970	33, 18	1980		1990	50
1951	50	1961	18	1971		1981	18	1991	18
1952		1962	18, 33, 18	1972	33	1982		1992	
1953	18	1963		1973	50	1983	18	1993	
1954	33	1964	50, 18	1974	18	1984	33	1994	33, 18, 33
1955	18, 33	1965	33, 50	1975	18, 50	1985	18	1995	
1956		1966	18	1976	100	1986		1996	18
1957	18	1967		1977		1987	18, 18	1997	18
1958	33	1968	18	1978	33	1988		1998	
1959	18	1969		1979	18	1989	33	1999	18, 33

* in thousands of cubic feet per second (1000 ft^3 / sec); some years have more than one flood

1) According to this table, which size flood happens more often?

        large   small

The table below summarizes the number of times each flood happens in 50 years (data are from the previous table). The recurrence interval indicates how often a flood of that size occurs.

Recurrence interval = 50 years ÷ the number of times that flood occurs in 50 years

2) Determine the recurrence interval (average number of years between floods) for the largest and smallest flood heights. The other recurrence intervals have been calculated for you.

Flood discharge	# of times in 50 Years	Recurrence interval (1 flood every ____ years)
100,000 ft^3/sec	1	
50,000 ft^3/sec	6	8.3
33,000 ft^3/sec	13	3.8
18,000 ft^3/sec	25	

3) Does a flood with a large recurrence interval occur more or less often?   more   less

        LECTURE TUTORIALS FOR INTRODUCTORY GEOSCIENCE

Flood Frequency Curve

Below is the flood-frequency curve for this stream. The recurrence interval is plotted compared to the discharge (size of the flood).

Recurrence interval (years)
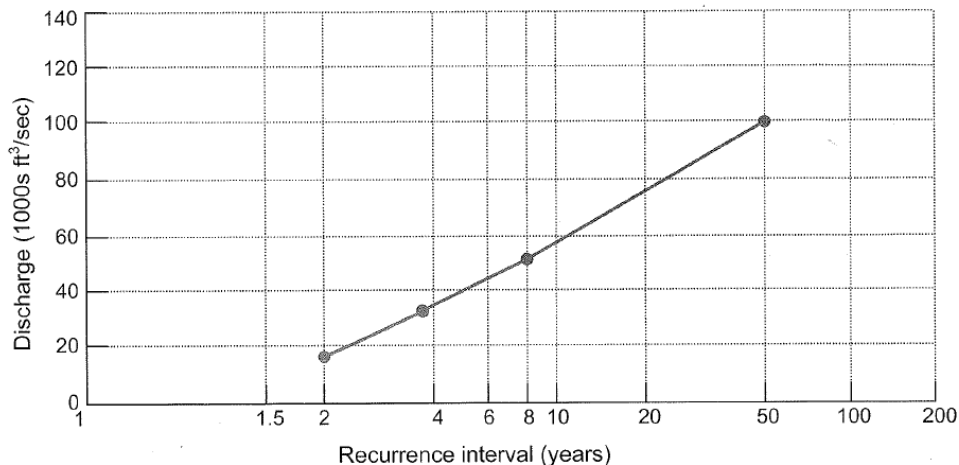
4) Large floods that are 75,000 ft³/sec occur on average once every _____ years.

5) Small floods that are 20,000 ft³/sec occur on average once every _____ years.

6) Predict the recurrence interval of an extremely large flood with a discharge of 140,000 ft³/sec.

Part 2: Predicting Floods

7) The chart makes it look like floods of discharge 50,000 ft³/s occur <u>exactly</u> once every eight years. Look at the first table. Are floods of certain sizes regularly spaced?

8) If there is a flood with a discharge of 50,000 ft³/s, will that flood happen again in exactly eight years? Explain your answer.

9) A flood has a recurrence interval of four years. This flood occurs in 2006. What is the chance the flood will happen in 2007?

10) Two students are thinking about this question.

Student 1: *I think that it will not happen in 2007. It is just like an earthquake. If an earthquake just happened, then it will take many years for the stress to build up again for another earthquake. Since the flood just happened in 2006, it is not likely to happen the next year.*

Student 2: *But weather this year doesn't care what happened last year. The flood has a 25% (1-in-4) chance of happening each year, so it would have a 25% chance of happening in 2007. Floods are not evenly spaced over the years.*

Student 1: *I still think it will happen in 2010, exactly four years later. The flood frequency is one flood every four years.*
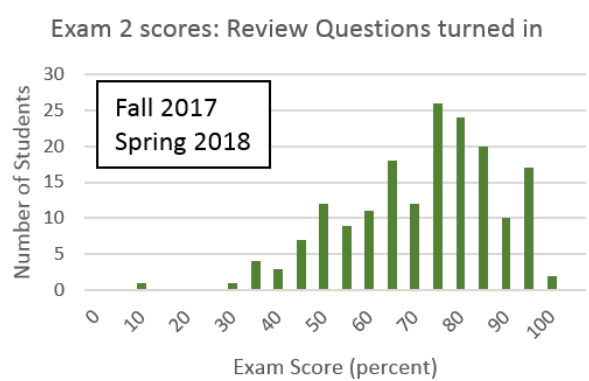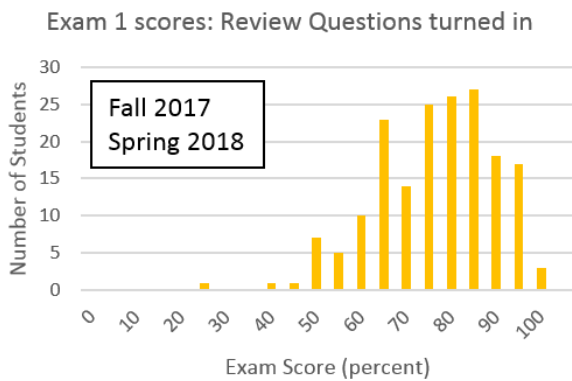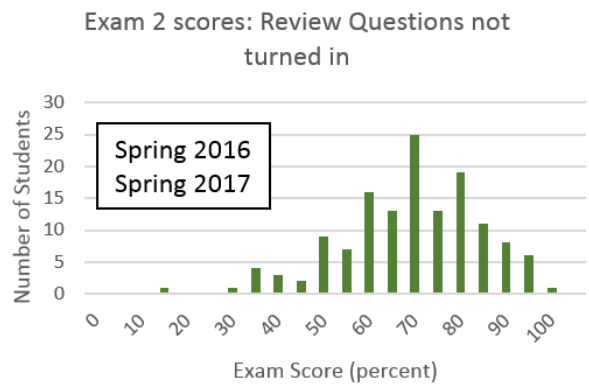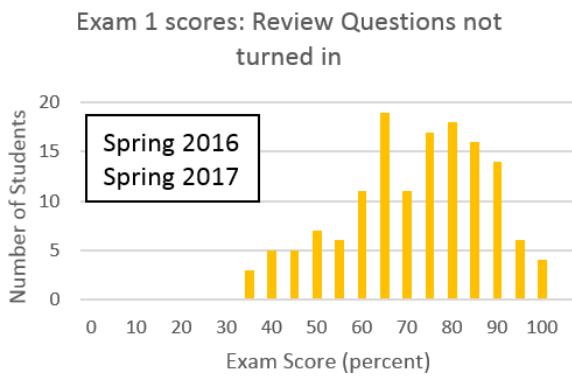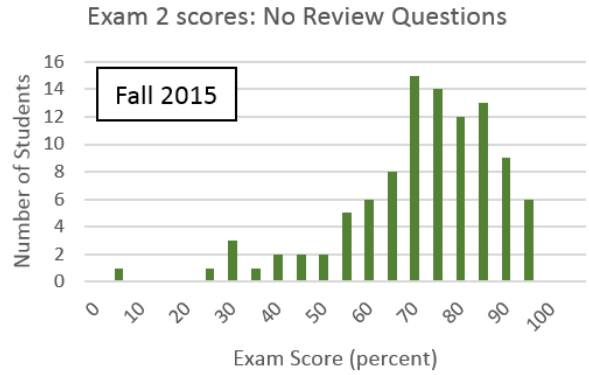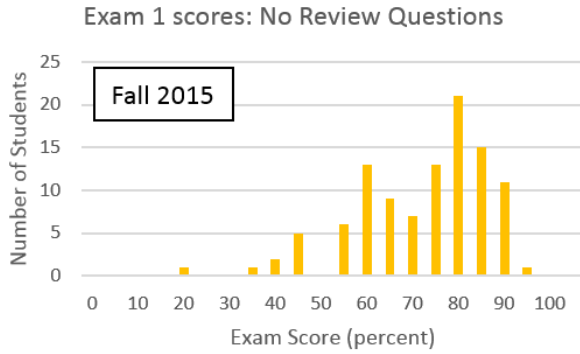
With which student do you agree? Why?

11) Find an example in the chart on the first page that shows that a large flood can happen two years in a row. Write the years you chose below.

12) A very large flood occurs in a small town. The local tourist board posts the message: "Come visit our city! We'll be safe from floods for another 100 years!" Do you agree with this message? What is the likelihood that the same flood will happen again next year?
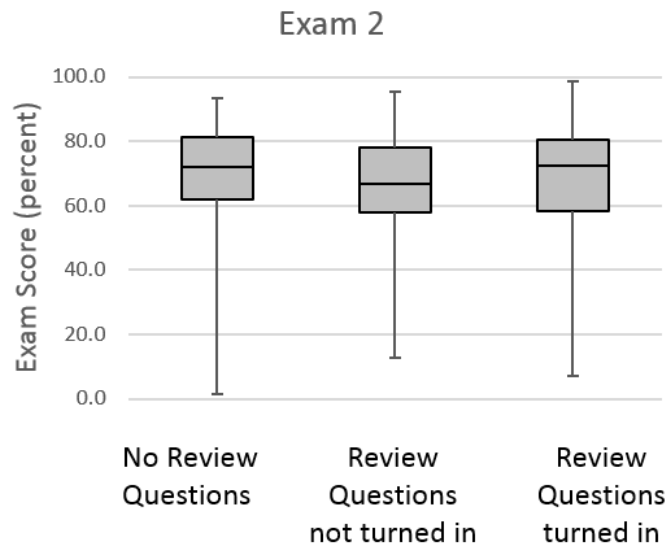
LECTURE TUTORIALS FOR INTRODUCTORY GEOSCIENCE

61

Appendix 6: Exam Stats

Histograms for Exam 1 and Exam 2 for the three different treatment groups.

Exam 1 scores: No Review Questions

Fall 2015

Exam 2 scores: No Review Questions

Fall 2015

Exam 1 scores: Review Questions not turned in

Spring 2016
Spring 2017

Exam 2 scores: Review Questions not turned in

Spring 2016
Spring 2017

Exam 1 scores: Review Questions turned in

Fall 2017
Spring 2018

Exam 2 scores: Review Questions turned in

Fall 2017
Spring 2018

Exam 1	Count	Average	St. Dev.	Min.	Max.
No Review Questions	105	69.6	14.4	18.1	93.8
Review Questions Not Turned In	142	69.4	15.8	31.3	98.7
Review Questions Turned In	178	73.8	13.2	24.0	96.8
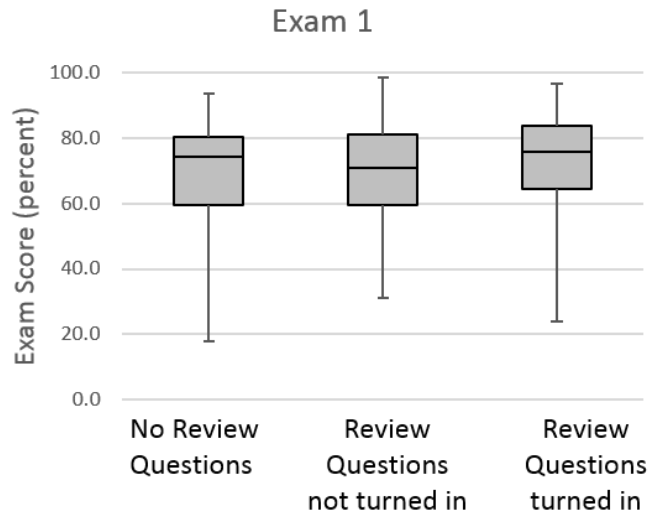
Exam 2	Count	Average	St. Dev.	Min.	Max.
No Review Questions	100	68.8	17.3	1.3	93.3
Review Questions Not Turned In	139	66.7	15.3	12.9	95.5
Review Questions Turned In	177	69.2	16.7	6.9	98.6

Appendix 7: Attendance and Grades

Course Grades as a function of Clicker Scores

- Spring 2017 (Geol 100)
- Fall 2017 (Geol 100)
- Spring 2018 (Geol 100)