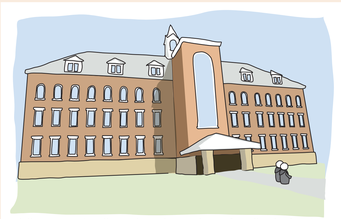
Clear As Fine-Grained Sediment Mixed With Water: A Discussion Forum

Karla M. Panchuk

St. Peter's College, Muenster, Saskatchewan, Canada



Idyllic St. Peter's College where the monks are friendly, the farming is organic, the parties are for poetry, and the classes are so small that you can't skip without it being noticed.

Once upon a time

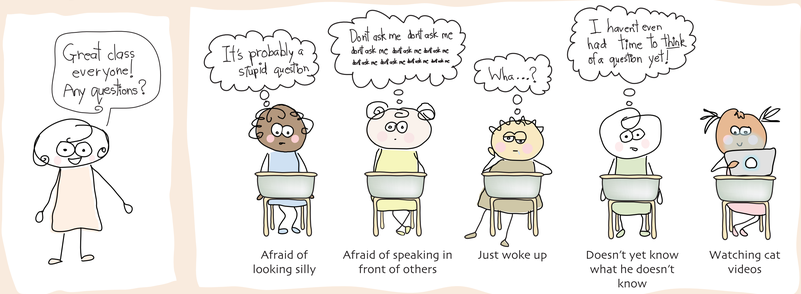
there was a tiny publicly-funded college nestled in the Canadian prairies. Each Monday students would gather for 3 hours to learn about physical geology. After class and throughout the week they thought about what confused them. They thought about what intrigued them. They went online to ask questions of their peers, and to receive help from them. They looked for ways to assist their peers, teaching and learning in the process. Some of their questions and answers were clever indeed! All were useful.

What is a discussion forum?

Similar to the comment section after an online news story, a discussion forum is an online space for students to have conversations with each other. A student starts a thread (an initial comment or question), and others reply.

A key advantage of a discussion forum is that when students prepare their comments in writing they have more time to be thoughtful, to do research, and to pay attention to how they are communicating.

Why does a discussion forum help when things are clear as mud?



There are many reasons why students don't ask questions in class. A perfect understanding of everything that was covered that day is rarely one of them.

A graded discussion-forum activity, where students are required to post a question, and respond to the questions of other students, can assist the students themselves, as well as providing insights to instructors.

Critical to making the discussion forum work is teaching students how to ask a good question, and what makes a good answer. These matter because asking good questions and offering good explanations require students to probe their knowledge and fill gaps they might find.

How does it work?[1]

1. Ask a question

(due 11:59 p.m. on Wednesdays)

Students describe the specific question or issue that gave them trouble, and comment on what might be causing the difficulty.

2. Reply to two questions

(due 11:59 p.m. on Fridays)

Students respond in one of the following ways:

- Answer the question.
- Clear up a misconception or error. (This may or may not include answering the question itself.)
- Pose a question that could help clarify why the student is having difficulty, and explain the rationale behind the question. E.g., "If you asked yourself question X, you could tell whether you were confused for reason Y or reason Z."

Students are given the rubrics below to guide their posts. The criteria do not require that posts be factually correct. If there are errors in the posts, or clarification is needed, this is discussed at the beginning of class the following Monday.

Rubric for Questions			
Poor (25%)	OK (50%)	Better (75%)	Best (100%)
How specific is your description of the problem? (2 points)			
Very vague, like the title of a chapter. E.g., "I don't get igneous rocks."	Slightly less vague, like the title of a main unit within a chapter. E.g., "I don't understand the minerals in igneous rocks."	More specific, like a subheading within a main unit. E.g., "I don't understand why igneous rocks have different minerals."	Very specific, like the topic of a paragraph. E.g., "I don't understand why an igneous rock can have olivine or quartz, but not both."
How specifically do you identify the source of your problem? (2 points)			
It is unclear what part of a very broad subject area is causing your problem. E.g., "I'm no good at chemistry."	Your issues could be constrained to part of a textbook. E.g., "I don't understand chemistry when it comes to rocks and minerals."	Your issues could be constrained to part of a chapter in a textbook. E.g., "I don't understand Bowen's Reaction Series."	Someone could answer your question without guessing at what you meant. E.g., "I don't understand why minerals form in the order described in Bowen's Reaction Series."
Was it posted by the deadline? (1 point)			

Rubric for Replies			
Poor (25%)	OK (50%)	Better (75%)	Best (100%)
How relevant are your comments and how well do you communicate them? (2 points)			
Comments do not address the topic and/or most people would not understand how what you are saying is related.	Comments are somewhat on topic and/or some people might understand how your comments apply.	Your comments are largely relevant and many people would understand how they apply.	Your comments are directly relevant and almost everyone would understand what you mean.
How much do *you* contribute to addressing the problem? (2 points)			
You echo other students' comments or the original post. E.g., "I agree with you that chemical bonds in minerals are confusing."	Your comments do not differ substantially from what other students have said.	You build on ideas that other students have raised, adding related insights or ideas.	You offer insight or ideas that do not appear in any of the previous replies.
Was it posted by the deadline? (1 point)			

1. This activity was inspired by Rich Cerkovnik's "concept conferences," where students posted to a discussion forum about concepts learned in a physical science class. Their options were to write about one of the following: a concept understood; a concept not understood; the relevance of the concept to their own lives; whether what they learned changed their thinking; provide a resource to help others learn about the concept. A description can be found in Ko, S. S., & Rossen, S. (2010). Teaching online: A practical guide. New York: Routledge.

Thoughtful questions, thoughtful answers

The threads below are from discussion forums for lectures on Earth's origin, and on plate tectonics. Threads were selected to demonstrate the utility of the discussion forum, but are representative of the engagement and quality of discourse in forums throughout the course. Conversations are reproduced verbatim, and avatars are randomly assigned.

Sue: Why is the Earth's core so hot? I mean, it's nearly the temperature of the Sun.

Thomas: I would say first of all, when the planet is being formed it has created a lot of energy and heat. Even though the Earth has been around for a long time, the heat is still being emitted and has not yet been lost.

Rodney: Adding on to what Thomas said, after research there are two more reasons why the earths core remains so hot. There is frictional heating, which is caused by the dense outer core sinking into the center of the planet. The second could be the heat that is emitted from radioactive decay.

Liza: Earth's core gets its heat from 3 main sources;
1. Heat from when the earth was formed and accreted, which has not yet been lost.
2. Frictional heating which is caused by denser core material sinking to the center of the planet and
3. Heat from the decay of radioactive materials.
It takes a very long time for heat to leave the earth and because of this, the earth's core stays hot. Hope I answered your question. If you are looking for a more thorough answer www.scientificamerican.com/article/why-is-the-earths-core-so/ is a great read.

Liza: How were tectonic plates originally formed? I'd like to relate this lecture to the previous one. While Earth was still being formed, it did not have liquid water until a later point, and was rather a ball of rock and magma (with other elements as well, of course). How did it progress from that state to the formation of tectonic plates and liquid water as we know it today?

Sue: According to this article, the plates started forming around 4 billion years ago. They were forming because the cooler parts of the Earth's crust were getting pulled towards the center of the Earth. This happened constantly until parts of the crust broke into different sized plates, thus forming what we know as Earth's tectonic plates.

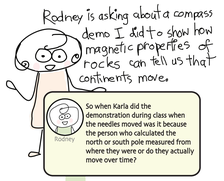
Sue: I forgot to include the link to the article! Here it is: http://www.huffingtonpost.com/2014/04/07/earth-tectonic-plates-new-model_n_5104087.html

Marci: It is believed that as the early Earth cooled, there developed subduction zones where cooler parts of the Earth's crust began to sink into the upper mantle. This phenomena created weak spots in the crust and would eventually lead to individual segments of crust known as tectonic plates. Similar conditions existed on Venus, however, that planet doesn't have any tectonic plates. This is because the surface temperature is much greater on Venus, and thus the crust is more malleable. http://www.nature.com/news/new-origin-seen-for-earth-s-tectonic-plates-14991
Water on the Earth is believed to have originated from comets and asteroids colliding into the planet over long periods of time. These bodies contain substantial amounts of water and could have easily amounted to the volume of water on the Earth today. http://www.smithsonianmag.com/science-nature/how-did-water-come-to-earth-73037248/

Marci: As we learned, plates that get pushed under another plate are illustrated as returning back into the earth. What actually happens to these plates as they are pushed down?

Liza: Well from what I've seen they seem to be melting due to the intensity of the heat combined with the assault of the pressure at the center of the earth.

Sue: As the plates are pushed under the Earths surface they melt and become softer. They stay solid until they are about 100km below the Earths surface.The high temperature and pressure cause the slabs to start to sweat out fluids. These fluids travel upward and form magma pockets. Mainly the plates just eventually melt and continue the cycle of plate formation. volcanoes.usgs.gov/about/edu/dynamicplanet/nutshell.php



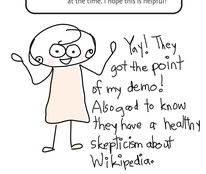
Rodney: So when Karla did the demonstration during class when the needles moved was it because the person who calculated the north or south pole measured from where they were or do they actually move over time?

Sue: They are actually moving over time. It is very cool! According to wikipedia (I know it sounds sketchy) reversals happen on an average of every 450 000 years. It takes around 1 to 10 thousands years to reverse once it starts. The last one happened to be 780 000 years ago so may be in for one soon!

Thomas: I assume you're referring to the continents when you say "they actually move over time". Yes, it appears they do. This is because rock samples with magnetite are examined and the deeper layers in the sample are typically the oldest. These layers were portrayed by the compasses in class. When these layers formed, the magnetite aligned itself with the poles. The same process occurred to new layers on top of the preexisting ones. Theoretically, if the continents didn't move, then those magnetite particles within the layers should all align in roughly the same direction. This was not the case, for they actually aligned in different directions. Some critics believed that this was simply due to the movement of the poles, but were proven wrong when samples from around the world disagreed on the position of the poles if they were to be the cause of the non uniformity within the rock samples.

"I just realized I completely misunderstood your question, but don't feel like erasing the paragraph I wrote above. When Karla did the compass needle demonstration, she was actually talking about proving continental drift."

Liza: I assume you're talking about "polar wandering"? When the needles all pointed in different directions, all facing "north", people believed that the poles themselves were wandering. But they tried to track this in different places on earth, discovering that their findings didn't match up. Polar wandering became a piece of evidence in favor of the Continental Drift Theory. While the poles do seem to shift, they don't shift anywhere near as randomly or drastically as they were recorded to. The depth of rock was more showing where north was depending on where the plate was at the time. I hope this is helpful!!



Thomas: What does the continental drift theory state? We know from class that a German geologist/meteorologist named Alfred Wegener was one of the first people to propose a theory, but what exactly does it state and why is the continental drifts so important to know about?

Marci: The continental drift theory states that divisions of the earth's crust move/moved. Originally Alfred Wegener believed that all the continents were connected and that over time they began the move apart from each other. This is supported through the findings of plants and fossils not believed to be indigenous to certain locations.

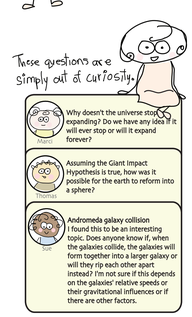
Rodney: The continental drift theory is so important to know about because it is always happening. The continents move at the pace our fingernails grow. We are able to predict what our earth will look like in millions of years. The drifting of the continents also affects us because it changes climate, and it explains the cause of volcanoes, earthquakes, oceanic trenches and the formation of mountain ranges.

Marci: Plates in Motion – Push and Pull Could someone explain to me the "10% ridge push, 90% slab pull", and how those factors cause the plates of the earth to move? I'd also like a little more info on "convection", I'm having a little trouble understanding why the plates move.

Rodney: For the 90% Slab Pull, One plate will be more dense and heavier than the other at the subduction zone. As you would think, the heavier and more dense plate will want to sink underneath the lighter and less dense plate. Since the heavier tectonic plate wants to sink into the mantle as the plates converge, it will continue to sink thus pulling the rest of the plate down along with it. Now, there is also a force that is being exerted by the sinking edge of the heavier tectonic plate that will want to pull the rest of the plate down along with it and that is why it is called the Slab Pull. I hope that helped with part of your question.

Sue: For 10% ridge push, since mid-ocean ridges are at a higher elevation's then the rest of the ocean floor, gravity pushes the ridge on to the lithosphere that lies farther from the ridge.

Thomas: Our planet's plates are helped moved by it's intense heat in it's core that cause molten rock in the mantle layer to move. It moves in a pattern called a convection cell that forms when hot material rises, cools, and then sink down. As the material sinks down towards earth's core it heats up again and rises.



Liza: I understand what each of the 3 types of boundaries are; Convergent, Divergent, and Transform, however during lecture, I did find it hard to grasp about where they are, the effects that they have on the earth, and how we can figure out which one is which.

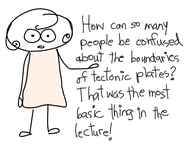
Rodney: What is a continental rift zone? I understand that it is created when continental plates split on the continental crust. But I do not understand the significance of the rift zone or what they may lead to.

Sue: Where are plate boundaries located and how do we know that? How do they form and disappear? Also how are magnetic strips formed on the ocean floor?

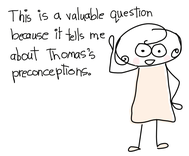
Marci: I believe that there are these cameras from satellite that allow for them to take pictures of things through the water, so if you see past the water the physical boundaries should be easy to see. I also know that they dissapear sometimes because they are pushed down below the crust and get swallowed up by the mantle.

Thomas: I couldn't find much information on the subject of how plate boundaries are located and mapped. However, another possible way is through using seismographs; mapping the epicenters of earthquakes could provide a good outline of each tectonic plate since earthquakes occur where plates interact with each other. Whether or not there is a better way of locating boundaries (such as visual observation), I do not know for sure.

Liza: Addressing your third question, magnetic strips are present on the ocean floor due to the periodic flipping/switching of the Earth's magnetic poles. Magnetite in the ocean floor aligns itself with the poles when new crust is created along MORs. When the poles are switched, the magnetite's orientation is also switched. Magnetite is magnetic, so you essentially have expanses of magnetic rock on the ocean floor that every so often switch polarity.



Thomas: Why are there deep earthquakes? Before entering this class, I was taught that earth quakes occur when two tectonic plates slide past each other abruptly. How can this happen when only one plate is deep within the Earth?



Liza: Hot Spots
I understand that hot spots are places where a mantle plume burns through a tectonic plate, but what exactly is a mantle plume? What causes them?

Rodney: Mantle plumes are thought to be a cooling function of the core, by transmitting excess heat from the core to the crust. They can be hundreds of miles in diameter and stay near the crust for thousands, if not a million years at a time. An example of the work done by a mantle plume are the Hawaiian Islands. They were formed by a plume which was not moving in relation to the mantle, but released volcanic material through the crust as the tectonic plates drifted above it. This is why the islands bear their curved shape.

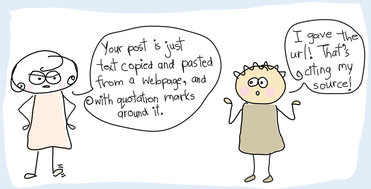
Strategies for success

1. Explain how a forum works

Students who have not used a discussion forum before may need assistance to get started. This can be accomplished by going through the steps in class, by writing directions, or by providing links to online tutorials.

2. Communicate expectations

Rubrics tell students what is required in the content and style of their messages. This is where to tell students that they should write complete sentences, and how they should cite their sources.



Netiquette guidelines for appropriate behavior in online settings are also recommended.

3. Observe

Some discussion-forum activities require on-going moderation by an instructor or TA. As tempting as it might be to help out with a hint or two, the value of this activity comes from students examining their knowledge on their own.

In this case the students were told that the instructor would be observing their conversations, and would comment on them in class, but would not be participating online.

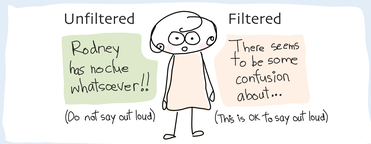
4. Debrief

Take time in the next class to talk about the following:

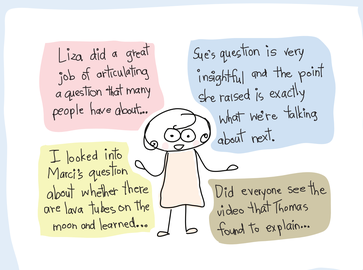
- Common questions
- Misconceptions and misunderstandings
- Particularly interesting or unusual questions
- Questions that can be used to illustrate or review interconnected concepts or processes

5. Encourage

Admitting that one doesn't know something can be intimidating. Make it safe for students to get things wrong.



Reward students for their courage, celebrate their successes, and model a positive attitude toward inquiry.



Summary

1. Blank stares but not blank minds

Blank stares in response to "any questions?" are misleading as a guide to how thoughtful students can be, how interested they are, and what they've understood (or not understood) in class. A discussion forum gives them an opportunity to collect and express their thoughts.

2. Diagnostic (formative) assessment

Students learn by examining their own knowledge and attempting to help their peers. Candid expression within a discussion forum is a unique opportunity to gain insight into students' thought processes and preconceptions. As with any study of wildlife behavior in its natural habitat, more insight can be gained when the observer is not directing the behavior of the subjects.

3. Discuss the discussion

Explain to students what is expected of them. Use class time to address issues that arise from the discussion forum. This might mean correcting misconceptions, or revisiting details from the previous lecture. It might mean going on a bit of a tangent to talk about things that normally wouldn't make it into the class, but which are of interest to students.