Mary-Helen Armour, York University

From your experience, what practices make for excellent online Earth Science learning?

I think for online courses, I have to be aware of the circumstances that result in students taking courses online as opposed to normal classroom lectures. This requires a different approach to communication with the students. I try to structure the courses so that students are required to cover the material at a certain pace, and need to complete the material in an order that would reflect the order that a classroom might also follow. I try to present material in a variety of different formats (podcasts, online notes, etc.) to allow students to access material in a format that is most effective for them to learn from.
As the courses I teach are aimed at non-science majors taking their breadth requirement in science I try to have the access outside news and science sources like USGS and NOAA to allow them to learn where to find accurate science information even after they have left the course.

How do you utilize technological tools (Google Earth, topical databases, blogging, etc.) in your online courses?

I use our institutions LMS (MOODLE) along with lecture capture (Camtasia) to present material. I have also be using various textbooks resources (Smartworks 5 from Norton.) I have not yet used Google earth much, but I plan to incorporate more of that in the future.

How do you manage student engagement and assessment in your online courses?

I use MOODLE for this course, and all material flows through that. I have not had much success trying to encourage online discussion, though I use forums in MOODLE to answer questions from students. I use a variety of the assessment tools in the MOODLE as well as the smartworks 5 from Norton. I tend to have a certain percentage of the mark for small weekly assignments to encourage students to work at the material on a regular basis, and they need to complete these before they move on to the next material. I will have 2-4 longer assignments that are a mix of application of concepts and research and writing about topics that are relate course material to current events.

For reasons of academic honesty, our departments normal practice with all online courses is to have invigilated on campus midterms and/or final exams which constitute generally 50% of the grade. (students at out of town locations can arrange to write at a recognized invigilation center if they are more than 3 hours from the university).

Erica Barrow, Ivy Tech Community College-Central Indiana

From your experience, what practices make for excellent online Earth Science learning?

I developed, teach, and mentor adjuncts for a large state-wide community college introductory Earth Science online course. The students who take this class are generally non-science majors completing their science elective. Many of our students have the perception that online science is going to be "easier" than taking a science course face-to-face. This incorrect perception leads to a harsh reality check during the semester, where students are unprepared for the additional rigors and self-motivation needed to succeed in the online environment.
I have found that the best practices for online Earth Science success start with organized and purposeful course design that includes a variety of learning strategies and assessments aimed at achieving measurable course objectives. Timely feedback to students and opportunities for student personalization & creativity of assignments are also useful practices for success.

How do you utilize technological tools (Google Earth, topical databases, blogging, etc.) in your online courses?

For my online Earth Science course I do have students complete a Plate Tectonics activity that utilizes Google Earth. The overall success of this activity is either hit or miss. Most of the highly-engaged, technology-confident students like the use of Google Earth and enjoy the activity; while other less-confident students struggle with the basic use and interaction with Google Earth, ultimately failing or skipping this assignment. I've not found a great way to utilize Google Earth for ALL my students yet.

How do you manage student engagement and assessment in your online courses?

Student engagement is a constant struggle in my online Earth Science course. Much of the engagement is teacher-to-student focused, while student-to-student interaction (such as discussion boards) is simplistic or lacking high-level details.

Callan Bentley, Northern Virginia Community College

From your experience, what practices make for excellent online Earth Science learning?

Interactive, rich, user-driven exploration of real geoscience data. Students should get opportunities to get geoscience procedures demonstrated for them, then practice on their own at both basic (identification, labeling) and advanced (interpretation, synthesis) levels. The students benefit from prompt, detailed feedback. In my situation, the on-assignment annotation provided by Croco-doc helps this goal.

How do you utilize technological tools (Google Earth, topical databases, blogging, etc.) in your online courses?

In my online-only Physical Geology course, I have 'lab' experiences that utilize both Google Earth and virtual sample sets (mainly GigaPan format) but I'm also developing a suite of 3D models that users only need a web browser to access. I think the IRIS set of tools (earthquake browser, 3D models of hypocenters) is something I'd like to weave into the course.

How do you manage student engagement and assessment in your online courses?

The way my course is set up is not quite ideal. It is the result of a committee's work, and feels like it. There are some discussion-based activities, including one I like wherein students collaborate on the identification and interpretation of rock samples they have found, but we only have four "required" discussions through the semester, conscious of the fact that these "conversations" can be extraordinarily boring for high-achieving students if they are forced into a group with a disengaged or low-achieving student. Assessment: in terms of summative evaluations, we have weekly (unit) quizzes and then 4 tests throughout the 16-week-long semester.

Denise Bristol, Hillsborough Community College

From your experience, what practices make for excellent online Earth Science learning?

I have found that using a combination of short introductory video clips to demonstrate the concepts in combination with interactive data activities and virtual field trips that mimic FTF labs lead to excellent online learning because they help to develop critical thinking skills. I have found that 2YC students often need additional instructions and screen prints for navigation in the online setting. I also find that I have to provide additional instructions as to how to "describe" the data that they are reviewing, as the younger students are seeking to simply "google" an answer to the questions rather than completing the activity and thinking about what they are looking at in the data layers or graphs. Introductory activities are often needed prior to using some of the online activities developed by various groups, so I often slightly have to modify the activity for the level of student at the 2YC.

How do you utilize technological tools (Google Earth, topical databases, blogging, etc.) in your online courses?

Every year I incorporate more and more online data sets or activities into both my online and FTF courses. I use Google Earth to teach the lab component of my Oceanography Course. I incorporate activities and layers from "Google Earth for Onsite and Distance Education (GEODE)" [http://geode.net/] starting with Pangea Breakup and then Exploring Marine Sediments. I also incorporate data from the Ocean Observatories Initiative where I can link the Marine Sediments to Primary Productivity in the oceans and SST. In addition, there are various NOAA tide data that I have the students use within the course as well as introduction NOAA video clips/activities for oceanography [http://www.montereyinstitute.org/noaa/].

Other than online data activities, students discuss current oceanographic topics such as ocean acidification, sea level rise or other ocean issues, where they have to conduct a literature search and post to an academic discussion board within the LMS.

How do you manage student engagement and assessment in your online courses?

I'm still working on increasing student engagement as it tends to decrease during the semester in online classes.

Assessments include quizzes, exams, discussions and lab activities (data and/or virtual field trips).

Karen Rose Cercone, Indiana University of Pennsylvania-Main Campus

From your experience, what practices make for excellent online Earth Science learning?

Designing activities that start with students' natural curiosity about the environment around them and which then lead them to use critical thinking and apply what they've learning to situations that matter to them (IE, flood risks for a house they might buy) rather than simply 'googling for information' and regurgitating meaningless facts on their exams.

How do you utilize technological tools (Google Earth, topical databases, blogging, etc.) in your online courses?

I use Virtual Earthquake in almost every class I teach. I also have students in face-to-face classes using mineral identification apps on their phones or tablets, geologic map databases and flood risk identification sites. I would like to incorporate more of these tools into my online class.

How do you manage student engagement and assessment in your online courses?

Students are required to do daily open-note review quizzes to keep them from lapsing in class participation. They are also assessed with weekly open-book critical essay exams.

Ozeas Costa Jr, The Ohio State University

From your experience, what practices make for excellent online Earth Science learning?

Excellent online teaching (for all disciplines, not only Earth Sciences) is one that uses active learning as a centerpiece of the course. An online course that does not engage learners in their own learning is doomed to become just a chore.

A successful online course also need to establish (from the outset) clear rules of engagement (teacher-student and student-student) and offer structured opportunities for such interaction. "Interactivity is the heart and soul of effective asynchronous learning" (Bill Pelz).

For Earth Science courses, more specifically, the hands-on/experimental/lab component should also have a central role. Well-designed exercises should stimulate student's curiosity, and promote the use of the scientific method.

One last characteristic that (IMHO) makes for an excellent online Earth Science learning is its relevance/connection to the real world. Students will be more willing to engage in the course (and outside as well) if they can see the relevance of the content. Earth Science is rich on this type of content: what could be more relevant than energy, natural resources, natural hazards, global change?

How do you utilize technological tools (Google Earth, topical databases, blogging, etc.) in your online courses?

There are so many instructional technologies out there that I often find myself overwhelmed. Over the years, the most important lesson I've learned is to avoid making it about the "tool" but rather focus on the learning outcome. Also, trying to replace traditional tools just for the sake of using technology usually leads to frustration for both the teacher and the students.

Having said that, one still very helpful use of technology for me is the ability to collect information/insights about individual students and their learning outcomes. Data analytics (which is a basic tool on any LMS) can help identify struggling students early in the process, and bring them into the fold before it is too late.

In regards to tools that are specific to Earth Sciences, Google Earth is an indisputable favorite. I use it often to identify geologic structures, to explore tectonic features, to understand land use patterns around the globe, and to evaluate impacts and

vulnerabilities to natural hazards and climate change.

I am also a big fan of using real datasets in active learning and one of my favorite sources of geoscience data is ArcGIS Online. ESRI's GeoInquiries website provide a list of activities for elementary to high schools that can be modified and expanded for use with college students. NASA, USGS and USEPA also contain rich archives of long-term and spatially distributed datasets which can be used in inquiry-based activities that allow students to generate their own conclusions about critical issues of our time, from the use and availability of natural resources to the causes and consequences of climate change.

How do you manage student engagement and assessment in your online courses?

As I already mentioned above, two important ways for improving student engagement are (1) to establish clear rules of engagement from the outset and model these as a teacher; and (2) emphasize the relevance of the content, and the many connections between course topics and real-world issues.

Another way to foster a higher level of engagement (which I also mentioned previously) is to make yourself present and prevent students from falling through the cracks. Online learning has tools that allow a close monitoring of student performance and level of engagement with the course material, but it also permits the development of individualized responses to issues. In my experience, students usually respond well when the instructors show they care.

Another technique that has been proven successful for keeping students engaged and motivated is to break the content into smaller chunks. Students can further benefit if these chunks are logically connected (conceptually related) and follow a linear, intuitive progression.

As for assessment, it is important that: (1) assessments are aligned to learning outcomes (avoid measuring just the ability of students to absorb/memorize facts and figures) - for example, use assignments that measure higher thinking skills (Bloom's taxonomy), such as creating their own model of the solar system or producing their own KMZ files on Google Earth; (2) use a variety of assessments (formative and summative) and offer them frequently (once a week), including self-reflection opportunities and peer-review.

Brett Dooley, Patrick Henry Community College

How do you utilize technological tools (Google Earth, topical databases, blogging, etc.) in your online courses?

Google Earth and ArcGIS StoryMaps are great resources online students. I have used both to have students identify, for example, river features (e.g. meander, delta, alluvial fan, ...) as well as to describe the stages in a process (such as the development of an oxbow lake). I have used Gapminder as a tool to build slide shows, but I'd like to have students use the software to access the data for themselves. I am hoping to work this into the next iteration of the webquest on volcanoes and earthquakes.

Virtual field trips can also be used with online students. I coauthored and have used two iBook field trips with my historical geology classes. Now that I am teaching from a distance, and students no longer have access to the school's iPads, it has become more difficult.

I use software to maintain a website for my students. The website contains guided research projects and a couple of virtual field trips.

Although, in my classes the most commonly used technologies are those for communication. I create a class cell through the website Cel.ly and require all registered students to create a free account and to join the cell. Students receive a PDF with instructions to join through a web browser or phone app. Celly allows group and individual messaging. Thus, I can post to the entire class or to a single student. Similarly, students can ask a question of the entire class, to just me, or to their study group. I also use Google Hangouts both the video chat with students and for instant messaging.

How do you manage student engagement and assessment in your online courses?

An open and easily used form of communication is important for engaging students in any course, but especially online courses. I use tools within the Learning Management System, in my case Blackboard, such as discuss boards and group forums to engage students both with each other and with me. I also use social media to facilitate and expedite communication including Google Hangouts and Celly, which both allow chatting or instant messaging. This means, despite the 3000 miles separating us, I can generally respond to students almost immediately and no one needs to release personal information (like a phone number).

A personal connection is always beneficial, so during the first week of the online class I encourage all students to sign up on a calendar I provide to "meet" me through a Google Hangout video chat. The students can ask me questions about the class, about me, grading, whatever they want. Sometimes they sign up in pairs or triads, but at the very least we each can place a face with the names we see in emails and discussions.

Again, while providing meaningful and timely feedback is always important, it feels more so for online classes. Students may already feel isolated, so getting feedback to them efficiently is important. While the syllabus states they should give me as long to grade an assignment as they had to work on it, I try to have no more than a 48-hour turn around for grades after submission. I always put comments on their submitted work using the LMS interface. Even if it is just, "keep up the good work," reminding students a real person is on the other side can be encouraging.

Aida Farough, Kansas State University

From your experience, what practices make for excellent online Earth Science learning?

I use many hands on activities that students submit along side the chapter assignments. In introductory classes I focus alot on how the scientific method is used in geosciences and I allow the students to learn geology based on their own experience. So the diversity of backgrounds always helps alot.
In the beginning of the semester I asked the students about how they think an online coruse is different froma face-to-face course and in the middle of the semester I do a voluntary course evaluation to get a sense of where there is a need for changes in the course structure. This helps tremendously in increasing motivation and getting them excited and engaged in the course.

How do you utilize technological tools (Google Earth, topical databases, blogging, etc.) in your online courses?

I use digital poster softwares (such as piktochart and etc.)and microsoft word and excel. I also use NOAA dataset on CO2 concentrations and USGS real time earthquake monitoring website. I have not used google Earth mainly because I think it might be too complicated for some students, but I would love to learn how others use it in introductory courses.

How do you manage student engagement and assessment in your online courses?

I engage students with multiple hands on activities (At least one activity per chapter) apart from the readings, assignments and exams. These activities provide some extra information and better understanding on some important topics of each chapter.
I regularly send emails to remind them of important deadlines and hints to some questions to keep them engaged.

Cynthia Hall, College of Charleston

From your experience, what practices make for excellent online Earth Science learning?

I have only taught hybrid classes thus far; Fall will be my first time strictly online. In a hybrid course, the students get to know each other the first face-to-face session. To me this is one of the biggest challenges for fully online courses. As such, developing strategies that help students build relationships and trust with each other and with the faculty are key for making an excellent course. These might be utilizing the discussion space, utilizing technology that allows for hangouts, collaborative work, blogging, etc.

How do you utilize technological tools (Google Earth, topical databases, blogging, etc.) in your online courses?

There are so many amazing data collections online from NOAA, NASA, USGS, etc. that allow for and promote data analysis and interpretation, where students can begin to "feel" like a scientist and experience the work of a scientist. Technological tools now allow for students to work collaboratively online, through hangouts and the like. Google resources, such as scholar, allows students to access peer-reviewed research, and Google Earth allows students a broad, as well as detailed view of places to visit virtually. In addition, Google Earth has layered information on many geologic content areas, such as plate tectonics, watersheds, etc. I intend to use these and more in my course.

How do you manage student engagement and assessment in your online courses?

This to me is one of the trickiest. I am planning to have students creatively introduce themselves to the online class. By doing so, each student will gain some background about the other online students. I also intend to heavily use the discussion spaces, hangouts, etc. to have students working together. I will use engaging resources and problem-based/real-world activities to keep students engaged. Assessment will be done through creative projects, as well as online quizzing tools and discussion.

Beth Hallauer, Sinclair Community College

From your experience, what practices make for excellent online Earth Science learning?

Many students in entry level geology have no concept of how geology and earth science apply to their everyday life in any way. You ask them the first day of class - "What do you think you're going to learn about in this class?" The typical answer is "rocks". Geology/Earth Science is SO much more than that. The information and activities that serve to help them to learn how geology applies to their lives in a practical and meaningful way while imparting basic Earth Science concepts and terminology are most effective. Also important are activities that utilize real online resources and data - to make students aware of the information available to them and to give them practice in determining what is valid and useful and what is not.

How do you utilize technological tools (Google Earth, topical databases, blogging, etc.) in your online courses?

Several activities that I utilize in both my Face-to-Face class and my online class make use of online resources provided by various government and private entities - specifically map resources for hazard evaluations. Sometimes preparation of the bulk of the assignment involves writing specific step-by-step instructions for the use of the online tools(and I have discovered that following step-by-step, written instruction is more challenging for some students than you might guess), but the use of those online resources and the resulting depth of understanding is incredibly effective and valuable in their learning process.

How do you manage student engagement and assessment in your online courses?

Announcements of what to expect at the beginning of each week for the entire class, e-mails - both to the class (when something needs to be addressed with the entire group) and in exchanges with individuals, Detailed feedback on assignments and discussion assessments primary methods of student engagement. Grading of class activities, with the exception of 4 online quizzes is done individually and is fairly time consuming, particularly, the discussion assessments. We currently do not use any "Mastering..." assessments as I have seen in some other academic disciplines and don't foresee that we will use them any time in the near future.

William Hansen, Worcester State University

From your experience, what practices make for excellent online Earth Science learning?

Timely responses to student questions are vital. Using materials at a variety of complexity levels, especially the use of well written "popular" science non-fiction. This material is approachable for students with diverse backgrounds.

How do you utilize technological tools (Google Earth, topical databases, blogging, etc.) in your online courses?

I Google earth to locate features which students interpret. I use downloadable mapping software which allows some analysis such as selecting features and summarizing.
I use some online climate data sites for students to download and analyze in Excel.

How do you manage student engagement and assessment in your online courses?

I use writing assignments, computational exercises and online timed exams. I send timed emails and releases of exercises and weekly emails. For students not completing materials in a timely manner I send weekly reminders.

Kathleen Harper, University of Montana-Missoula, The

How do you utilize technological tools (Google Earth, topical databases, blogging, etc.) in your online courses?

I have students do both online quiz type homework and topical Google Earth exercises during the course. I also have them do some exploration about active geoscience topics – like recent volcanic eruptions and earthquakes.

How do you manage student engagement and assessment in your online courses?

Participation in weekly asynchronous discussions is a really important element to keep students engaged, both with the instructor and with each other. For me as in instructor, the online discussions have given me great insight into the students' learning process. I teach the same course in the classroom and online, and while some students do speak up in the classroom to comment, respond to questions, and ask their own questions, many will never say anything. This is in contrast to the online class, wherein participation in discussion is a requirement, which allows me to hear from everyone, even those who would be lacking in confidence to speak up in the classroom. I have had a couple of students express resistance to the idea of posting to the discussion, because of their fear of receiving negative feedback from other students. These students have, in my experience, warmed up to the idea after making a few posts, and realize that their classmates might respond to their posts, but are almost always supportive or at least diplomatic in posting an opposing viewpoint or perhaps responding to a misconception (although the second is most often done by me).
Discussions also provide opportunities for students to share aspects of their past knowledge, experience of the world, or independent web research with me as well as with their classmates. This adds an element of richness to the online course that doesn't always emerge in the classroom.
In my course, the total assessment consists of both online activities, such as online homework on each chapter topic and some google earth activities, required participation in online discussions, and quizzes on assigned videos and web explorations. In addition to these activities, there are two essay-format midterms, and a final exam over the whole course which is multiple-choice format. Discussion participation involves making two posts – one initial post halfway through the week, and a second post (which could be a response to someone else) by the end of the week. Posts are also evaluated based on a rubric that includes criteria such as contribution to the overall discussion and the knowledge and understanding expressed by the post.

Michael Hernandez, Weber State University

From your experience, what practices make for excellent online Earth Science learning?

I focus on two areas to assist student learning. First, I bring in current geologic events making the news during the semester to emphasize the "reality" of Earth Science across the globe. The goal is for students to connect the course topics with the dynamic real-world processes and how those processes impact society. I provide web links to mainstream news articles, videos, official government releases, and geologic hazards centers that contain interesting data/information about relevant geologic events.

Second, I have students accomplish interactive assignments that present Earth Science concepts using multiple methods of delivery, such as video, animation, simple calculations, online data collection and analysis, and readings. For example, on one assignment, I have students use Google Earth and the U.S. Geological Survey Earthquake Hazards Program website to determine the number and location of Magnitude 5.0 or larger earthquakes that occur over a 4-day window. Students examine the data and discuss the relationship between the distributions of the earthquakes as it relates to Plate Tectonics.

How do you utilize technological tools (Google Earth, topical databases, blogging, etc.) in your online courses?

Technological tools are used moderately in my online introductory Earth Science course. I use Google Earth when I want to focus on the geographic distribution of some geologic process (e.g., major plate boundaries, earthquakes, major faults, active volcanoes, etc.). This platform allows me to easily display many geologic features available through the application as well as upload additional geospatial features created in other applications such as a GIS.

I also extensively use the text publisher's online learning tools (e.g., videos, animations, interactive assignments) in concert with public-domain online data tools from the U.S. Geological Survey hazard programs to augment text chapter topics. However, I make an effort not to rely on technology alone as some students are intimidated when trying to utilize the applications and become frustrated which diminishes their learning experience.

How do you manage student engagement and assessment in your online courses?

Student engagement is managed through use of an online discussion board. Assessment is performed through examination of exam answers associated with specific learning outcomes. Both managing student engagement and performing accurate assessment of student learning outcomes in an online course are areas I would like to improve upon.

Amy Hochberg, Utah State University

From your experience, what practices make for excellent online Earth Science learning?

I teach several introductory geology courses to non-major students. Since many of my students have very little scientific background, I make use of as many forms of media and learning tools as possible, such as scientific articles, photos, podcasts, videos, and animations. I even incorporate assignments that involve drawing and sketching because some students may excel in art rather than writing. With a variety of learning methods, students stay engaged and science does not become boring.

I have recently incorporated a Discussion panel where students are required to ask or answer two questions during the semester on anything related to the material learned in class. The result has been even better than expected. Students are asking very thoughtful questions and attempting to answer them as best as they can, which they typically have to do by conducting some independent research. When needed, I step in and expand on the answers. Since asking a question is required this format is beneficial because many students are typically afraid to ask for fear that they may be the only one that doesn't "get it". It is also making me realize where there are common misconceptions.

To make for an excellent online Earth Science learning experience, I also try to make topics relevant to the daily lives of the students. I use local examples when possible to make students understand and appreciate the world around them. The hope is that this will make them value natural resources and in turn become better stewards of the Earth.

Mustapha Kane, Florida Gateway College

From your experience, what practices make for excellent online Earth Science learning?

By Introducing the at-your-own-pace online format, and no weekly deadline assignments; by using interactive technological tools that reduce the student dependency on the instructor and put the student on the driver's seat.

How do you utilize technological tools (Google Earth, topical databases, blogging, etc.) in your online courses?

In an interactive way by using Geods, Smart Figures, Give-It-some-thoughts, Video Field Trips, Video Tutor, Plug and Chug, Google Earth, etc... and many other interactive practice items that help the student study interactively and at his/her own pace without much teacher's intervention, only when needed.

How do you manage student engagement and assessment in your online courses?

Regular feedbacks e-mails to students; by posting topic for discussion on the discussion board to prevent procrastination.

Blair Larsen, Utah State University

From your experience, what practices make for excellent online Earth Science learning?

In my experience, I've found two main components to an effective online learning course, and I'm delighted to share these small pieces of wisdom with the group.
One of the key components is faculty communication. Students respond to frequent, personal, and helpful communication from the instructor. This practice helps the students feel connected to the instructor, and they feel the class if more personal. This feedback can come from assignments and/or grading, and it can come from announcements and discussion.
The second key component is student engagement. This factor is also key in a face-to-face class, so it makes sense that it is important in an online course. Students respond to being involved in the class, and by extension, involved in assignments and assessments. In my online class, students engage with the course by utilizing problem-based learning, peer interaction, and faculty interaction. This class also requires students to apply what they have learned, and to reflect on their learning - both of which keep students engaged in the course.

How do you utilize technological tools (Google Earth, topical databases, blogging, etc.) in your online courses?

While I would like to utilize more technology tools, currently my course is designed to allow students to do research and learning on their own. To aid them in their learning progress, I provide links to informative and pertinent web sites, videos, interviews and podcasts. My course does not have a textbook, but I provide resources for the students.

How do you manage student engagement and assessment in your online courses?

As noted above, I strongly support faculty feedback to online students, and that aids student engagement. In addition to that, though, I developed my course to encourage peer engagement (student-student). I achieve this by requiring a discussion post (based on a detailed discussion prompt) on each module in the course, and requiring each student to respond to at least 3 other student's discussion posts.
In addition, I am an advocate for grading rubrics, and I heavily utilize these in my course. I have grading rubrics for discussion posts, written assignments and a reflection assignment. Rubrics allow students to see what level of work the instructor expects, and to determine what they need to do in order to achieve the grade they want. Rubrics also provide immediate feedback to the student, and greatly speed up the grading process.

Between requiring peer interaction and the use of grading rubrics, I find that my students are actively engaged (and invested) in my course.

Mary Leech, San Francisco State University

From your experience, what practices make for excellent online Earth Science learning?

I think it's important to provide a clear connection between the online and in-person parts of the class. Classes are used for lab sessions (rocks, minerals, petrographic microscopes), small group work, etc. Short, focused lecture videos with questions/quizzes that will encourage active participation in the online lectures too.

How do you utilize technological tools (Google Earth, topical databases, blogging, etc.) in your online courses?

I have used tools like Google Earth and GeoMapApp to explore different tectonic settings in both qualitative and quantitative ways. I have included petrologic data (whole-rock and trace element chemistries mostly) in the GEOROC database to understand petrologic differences between different tectonic environments.

How do you manage student engagement and assessment in your online courses?

I use in-class quizzes about online material (pop quizzes sometimes if students are not keeping up with the online lecture material); online quizzes; short, written assignments (short answer questions, definitions); and practical exams on lab material.

Tamara Misner, Edinboro University of Pennsylvania

How do you utilize technological tools (Google Earth, topical databases, blogging, etc.) in your online courses?

I actively incorporate technology in my teaching. I regularly utilize digital media (i.e. satellite imagery, LIDAR data, etc.) and Google Earth in my classes in order to give students the opportunity to experience and visualize concepts discussed in lecture. As an example, Google Earth is used in order to take students on virtual fieldtrips around the world, which allows them to see examples of geologic landscapes and landforms that they would otherwise not be able to experience. This technique increases student excitement and interest in the topics discussed. Furthermore, it encourages them to investigate areas of personal interest (student ownership) and gives them an opportunity to make their learning more personal, which makes it easier for them to internalize topics discussed in class.

Daren Nelson, University of North Carolina at Pembroke

From your experience, what practices make for excellent online Earth Science learning?

An excellent online experience requires the professor and the students to work together in a variety of formats and media. The students need to be more active in their learning environment instead of doing more passive experiences such as watching boring webcasts or reading a text and doing online quizzes/exams. The experience will need to merge audio/video, written, peer discussion, and interactive materials so that the students will learn through their preferred individual mode of learning and to engage with the materials/content.

How do you utilize technological tools (Google Earth, topical databases, blogging, etc.) in your online courses?

I am currently developing virtual field trips of local geological regions in North Carolina (via google earth, gigapans, and video) to try to help students spatially interact with geological data and to connect the students to their local environments. We are also developing the virtual field trips to be used in face-to-face courses and in a hybrid version of the course; however, in these versions of the course, the activities will be coupled with hand samples collected at the site. These virtual field trips are not complete yet and will be implemented into the classroom in the Fall of 2017. However, I also I use online quizzes and homework produced through the publisher of our textbook to help students understand may of the conceptual ideas. Some of the publisher materials have similar virtual field trips and my students have enjoyed them thus far.

In addition, I create webcasts of lectures by using a screencast program, try to do a weekly virtual meeting (via AdobeConnect or WedEx), and have tried to engage the students in discussion boards.

How do you manage student engagement and assessment in your online courses?

The two main ways that I use to assess my students in the course is by having them do online quizzes/homework and ask them to participate in discussion boards. Most of my material that I currently use is from the publisher of our textbook. I use these assignments in my hybrid, face-to-face, and online courses. I have felt that the material does help the students learn the material and engage the student in active learning; however, I feel that the students also need engagement with their peers and so will ask

them to take part in discussion boards. Usually, a student is asked to read an article on a current event/hot topic (i.e. Hydraulic Fracturing, a natural disaster such as Hurricane Matthew...) or do a small activity that can engage the student in the practical application of a topic (i.e. trash, power, or water use assessment). After the student reads or does the small assignment they are asked to write a small post regarding the material and then engage with the other students by commenting on their peer's posts. Their discussion board activity is graded by a rubric that assesses their engagement and quality of their posts.

Jennifer Nelson, Indiana University-Purdue University-Indianapolis

From your experience, what practices make for excellent online Earth Science learning?

Excellent online Earth Science teaching integrates real-world applications and opportunities for students to apply their knowledge. Because the Earth Sciences are intrinsically a hands-on science, online teaching must integrate opportunities for students to make observations and inferences about the Earth. Further, online teaching should integrate the same pedagogy we use in the classroom – collaborative learning, critical thinking, problem solving, and meaningful assessment are all components of a quality online course.

How do you utilize technological tools (Google Earth, topical databases, blogging, etc.) in your online courses?

For most topics, we use online resources to explore maps, data, graphics, or articles about the concepts (for example, NOAA Coral Reef Watch, MarineBio, Earth, and NOAA Buoy Data). My students practice finding quality information online by searching scientific websites and journals for information on concepts. I would like to explore strategies for integrating more technology tools in the online classroom – I am concerned about my student's ability to learn to use complicated online tools and databases and lose the educational impact of the tool. I have also integrated virtual field trips where students explore the oceanography and geology of a specific place and write an essay that pulls together their exploration and observations.

How do you manage student engagement and assessment in your online courses?

I use discussion forums to encourage student-to-student interaction, and the feedback tools of our LMS to provide encouragement and help to my students. I know I could do more with engagement, perhaps by integrating weekly video (synchronous or asynchronous) updates, and I hope to explore these during this workshop. Assessment of student work in my classes includes automatically graded quizzes, essay responses, written work, and exercises that explore data, maps, and other online sources.

Megan Pickard, Brigham Young University-Idaho

From your experience, what practices make for excellent online Earth Science learning?

In general I find that online courses work best when students have regular interaction with the instructor and other students, materials that are easy to access digitally, and rubrics are provided that clearly define outcomes and expectations. It is also important to provide early and frequent feedback opportunities both to and from the students to help maintain a connection with students. In addition, an online course that includes assignments and activities that are a mix of individual and synchronous and asynchronous group work help keep students engaged, while allowing them to teach one another and improve content understanding and retention. For our Earth science online course specifically, we found that activities that use real data when possible help students make real-world connections to the material they are learning.

How do you utilize technological tools (Google Earth, topical databases, blogging, etc.) in your online courses?

In our physical geology online course we use GigaPan images and Google Earth as virtual field trips that incorporate typical 'field' skills such as observation, interpretation, measurements, sketches, and group discussion. Some Google Earth assignments incorporate instructor provided files of data (e.g. USGS earthquake feed file, overlays, etc.). Group work is done synchronously using Google Hangouts and asynchronously using discussion boards or blogs that group members have access to. Several assignments utilize YouTube videos, either by having students view specific instructor provided videos or by asking students to find and analyze a video that applies to a particular concept they are learning.

How do you manage student engagement and assessment in your online courses?

We work to maintain student engagement by incorporating activities that help connect course content with the student's world outside of the online course. For example one activity asks students to go outside and find evidence of sediment transportation, photograph it and post the photograph with a description. For discussion boards, we find that instructor involvement is critical to the effectiveness and engagement of students. When instructors participate by prompting and guiding student discussions to be meaningful, student engagement increased. Student understanding is assessed through assignments and tests throughout the course as well as a pre and post assignment and content survey.

Eliza Richardson, Pennsylvania State University-Main Campus

From your experience, what practices make for excellent online Earth Science learning?

The one single practice that makes for excellent online Earth Science learning is essentially the same one which makes for excellent learning in any environment: knowing the instructor cares about you and your journey through material. In an online environment, the way an instructor cares for the students may be delivered differently or with asynchronous timing but it is absolutely essential that it be delivered. Three important and interlinked ways an instructor can demonstrate how much he cares for the student experience in his online class are: 1. Planning ahead, 2. Expectation management, 3. Clear explanations.

Planning ahead means that when you create a new lesson or new activity, you must step through it yourself first to make sure it works the way you predicted it would. In a face to face laboratory course, we can often get away with teaching a new lesson on the fly and troubleshooting problems in real time as they come up, but when teaching online, you won't look creative by doing this, you'll look sloppy and unprepared. Students will realize you didn't care enough about them to make sure your exercise would work. In practice this means checking that links to databases and reading assignments are working, and that students have enough time between the assignment and the due date to get help if a wrong first step ruins the exercise.

Expectation management means that you are clear in communicating with your students how often you will check in with them, how soon they can expect a reply when they have a question, and how long it will take for you to grade their assignments. It is crucial that feedback on the first few assignments be detailed and prompt so students know what level of thinking you expect from them for the rest of the course.

Clear explanations go a long way when you ask students to work with large databases, electronic plotting programs, or engage in group activities. If your directions are too long and cumbersome, nobody reads them which is the same as not having written them at all. If they are too short or vague students will give up in frustration. You don't want the cognitive load of trying to navigate poor instructions to be so high that students don't have any brainpower to spare for thinking about the interesting science that was the whole point in the first place! Use both screencasts and written explanations. It takes time and practice to produce the right set of directions but it is always worth doing. When you clarify directions or explain scientific content for students, always keep the questions and your responses to save time next time you teach the class when the same question crops up.

Anthony Santorelli, Anne Arundel Community College

From your experience, what practices make for excellent online Earth Science learning?

- A high level of engagement among students as well as between students and the instructor
- A constant presence by the instructor through coursework and providing feedback/grades/announcements on a regular basis
- Clear, frequent, prompt communication between the instructor and students that is established as formal from the first day of class
- Clear learning objectives for each topic as well as general competencies for the course
- A variety of teaching methods and forms of assessment to optimize student learning and keep students engaged
- A clear set-up of the course with regular deadlines all established before a course for students' convenience
- Ease of access to course materials for all types of learners and needed accommodations, including modular learning and clear instructions for how students can get acquainted with both the course, and, for first-time online learners, the learning management systems being used
- Connections with other campus resources remotely (i.e. Virtual Writing Center, distance librarian)
- Clear set of expectations given through the course syllabus

How do you manage student engagement and assessment in your online courses?

In terms of student engagement for our online General Oceanography lecture course, we have weekly discussions pertaining to specific topics. We have a list of questions to be addressed initially by the students, and then we require students to respond to each other's post by supplementing or correcting information using credible websites, videos and figures. We also facilitate the discussion by providing follow-up questions that allow students to have a deeper understanding of the material. There is also a discussion at the beginning of the semester in which students introduce themselves to our embedded librarian. This allows the students and the librarian to establish a relationship in which the librarian can help students with library resources, research and citation, especially with writing assignments. In addition, we also have a dynamic front page of our course website that we update every week based upon the topic being covered. We include relevant photos, figures, links and videos to capture the students' interest. We also have important announcements about course deadlines, grades and so on.

The discussion element is the same for our online Fundamentals of Weather course, but we do not use the online resources provided by our textbook. We do have additional discussions that allow students to ask each other questions about the course as well as to ask our embedded online librarian questions. We have a set of laboratory exercises that we use that align with the topics covered each week in class; this involves use of real-time weather data from AMS DataStreme as well as other resources. It is critical for students to have experience with surface analyses, meteograms, radar/satellite images and upper-level diagrams (Stuve) to tie real-time conditions to concepts that are being learned. Our course front-page is set with updated announcements, but it consists of real-time maps and images embedded into the page. This includes a surface analysis, radar and satellite images and upper level maps. This year, we have experimented with how to use this page to have our students participate in a weather discussion of the current state of the atmosphere in our local vicinity via discussion board along with some simple forecasting of the next day's weather. We may have more to report on this once the semester ends!
In terms of student assessment, we have a variety of methods. We use the discussions that I mentioned above as low-stakes formative assessment. We give a small amount of points based upon participation and effort along with proper content and citation in APA format. More substantial homework is given in the form of multiple choice and short answer questions in Mastering Oceanography for that course. The additional HW in the Weather course is from the lab exercises. In both Oceanography and the Weather courses, we have several writing assignments that are graded on content as well as proper writing and citation of sources. Exams in the Oceanography course are given through Mastering Oceanography with format similar to that of the homework (multiple-choice and short answers), while, for the Weather Course, it is mainly essay-style questions with some data and image interpretation. We also provide some extra credit opportunities, including reflection papers on videos, online resources and optional field trips.

Susan Schwartz, University of California-Santa Cruz

From your experience, what practices make for excellent online Earth Science learning?

Providing high quality engaging, but relatively short (<15 minutes each) video lectures allows students to view them multiple times and at their own pace. Reminding students to take notes while watching the video lectures, as they would do for an in class lecture is important. Frequent short multiple choice quizzes with very low stakes that students can take unlimited times helps them to assess their learning. Supplemental and tutorial material available online, in the same format as the class delivery, makes it much easier and therefor more likely that students will view them. Finally, activities designed to support the lecture material that work well in an online setting are crucial. I think Google Earth is a wonderful platform to design such exercises.

How do you utilize technological tools (Google Earth, topical databases, blogging, etc.) in your online courses?

My class consists of textbook readings, online lecture videos, supplemental and tutorial videos, homework activities, quizzes and tests an online discussion forum and office hours and help sessions. Many of the homework exercises use Google Earth to help students understand the geomorphology and geology of the National Parks. Specifically, students interact with virtual field trips created in Google Earth to learn and practice the following concepts and skills: reading and interpreting topographic and geologic maps including elevation profiles and slopes, processes creating and recognizing particular geologic features including alluvial fans, cirques, exfoliation domes, joints, moraines, fault offset drainage channels, sag ponds, tarns, U shaped valleys, etc. Students use Google Earth to determine rates of geologic processes such as plate velocities from tracking hot spot chains, fault slip rates and rates of glacial retreat at Grinnel Glacier. Many of the exercises require the use of image editors to annotate maps and figures and to construct concept sketches. I include tutorial videos that teach students how to use image editors, Google Earth, how to construct a concept sketch and other required skills.

I make extensive use of the discussion forum tool, Piazza. Piazza allows students to pose questions anytime and have them answered by fellow students (validated by instructor and/or TA) and/or the instructor or TAs very quickly. Students use this discussion forum to form study groups and produce joint answer keys to practice tests and quizzes.

Jennifer Sliko, Pennsylvania State University-Penn St. Harrisburg

How do you manage student engagement and assessment in your online courses?

Keeping students engaged with the instructor, each other, and the course materials can be a challenging aspect of teaching an online course, but that engagement is a critical component to creating a meaningful learning space for students. Creating short videos that include an image of the instructor is a meaningful way for the students to connect with the instructor in an asynchronous course. These videos can be created as part of the learning materials for the class and only need to be updated periodically. Additionally, weekly communication (typically through email) can include a brief comment about any current events relevant to the learning material in addition to tips about upcoming lessons. Prompt responses to individual student emails are crucial in any online class. Finally, a series of mandatory individual student-instructor meetings (at the start of the semester and mid-way through the semester) is a valuable tool in not only keeping the students engaged with the class but as mid-year student progress report and a chance for self-reflection on how the student is performing in the class. Keeping the students engaged with each other in an online class can be extremely challenging, especially in undergraduate level courses. Group discussions, while sometimes beneficial, can be problematic if not all group members participate in the activity. Another method that keeps students engaged with each other is a "drop-in chat room" experience. The chat rooms event typically starts with an instructor-organized event (office hours, exam review, homework help, etc.). However, if the chat room is left open after the instructor leaves, the students have the opportunity to working together. Student assessment is a means to keep students engaged with the course materials in an online course. Similar to responding to student emails, prompt and detailed feedback is important in online assessment. Numerous, low-stakes assessments (such as weekly activities, blogs, or quizzes) are beneficial in keeping students motivated to stay engaged with the course materials throughout the semesters. These assessments can utilize the features of most course management systems (such as automatic grading of multiple choice or numerical questions) to assist with student feedback. Likewise, many course management systems include features to minimize the possibility of cheating in an online class. Keeping students engaged, through instructor interactions, online synchronous events, and formative assessments, is a fundamental component of student success in an online class.

Katherine Ocker Stone, Walters State Community College

From your experience, what practices make for excellent online Earth Science learning?

The best practice I have utilized is when the students become even more curious and search for further information than the topic at hand. The use of Discussions on a subject often increases the awareness of geology in the student's daily lives and the world around them.

How do you utilize technological tools (Google Earth, topical databases, blogging, etc.) in your online courses?

Google Earth has been a vital asset for the introduction of many geological features. Having stumbled upon a few assignments that others have posted on the internet that utilized Google Earth, I was inspired to utilize the software. When Google Earth Pro became free to use, I have expanded, modified or created new assignments using this technological tool. The tool is easy to use and the students have fun exploring the world via the satellite and ground base images. These images help expose the students to actual geological features.

Sara Stone, Harvard University

From your experience, what practices make for excellent online Earth Science learning?

In my experience, online Earth Science learning can be enhanced through three primary methods. Firstly, sharing the established learning objectives with students ensures that the goals that they are working towards are known and tangible; the students can then continuously compare themselves against that which they are working to achieve, helping them better gauge their self-progress. Secondly, including links to additional, multimodal resources helps to build out the background content and understanding for the student. For example, if you are teaching about biogeochemical cycles, include links to YouTube explanations, news articles to provide case examples, or blog posts to showcase colloquial understanding. Or, if you provide a potentially complex peer-reviewed article, also provide related blog posts or podcasts to ensure solid topical understanding through utilizing easily digestible content. And thirdly, cultivate student engagement through providing creative assignments that have very explicit real world application, like asking a class to draft a policy brief for the haze episodes in South East Asia. This real-world application provides a clarity to why you are asking your students to learn a particular topic. Together, these three methods serve to complement one and other and improve the quality of online learning. In addition, a fourth, and possibly more difficult option to improve online Earth Science learning is to, whenever possible, connect all students taking a course at the same time so that near-peer learning may occur and any questions they may have can be 'crowdsourced' for a response. This also allows for much greater potential for interactive assignments and group work to engage the students, which can provide the dual benefit of cross-cultural competency building in an online classroom. The challenges that exist for teaching Earth sciences online, are matched by the incredible opportunities for engaging a broader audience across geographic boundaries and increasing the interdisciplinary nature of the work.

Al Trujillo, Palomar College

From your experience, what practices make for excellent online Earth Science learning?

Education studies show that one of the key practices that makes for excellent online learning is to build a sense of community. There are many different ways to do this, some small and some big. For example, I use a first week of class discussion board that allows students to interact and introduce themselves to the class. An extra credit assignment follows, where students are quizzed on some of the ocean-related characteristics of their classmates (ex: The name of the student who says they are afraid of the ocean but posted a picture of themselves riding a surfboard in Hawaii is _____). Another example is for other discussion board assignments, students must reply to 2 other students' posts and use the name of the other student in their reply (ex: "John, your post made me think differently about this subject because…").

The feedback I get from students confirm these strategies, such as a student who told me, "I know more people in this online class than I do in any of my other face-to-face classes!"

I also think a host of other good teaching practices translate well into online courses.

How do you utilize technological tools (Google Earth, topical databases, blogging, etc.) in your online courses?

Based on our teaching experience, we know where our students get stuck with our subject matter. I would encourage online teachers to produce short video clips about difficult topics to help their online students. I have produced several that are on YouTube, and they seem to help not only my students, but other students who are taking similar classes.

In addition, I am a big believer in increasing students' skill in analyzing real-world oceanographic datasets and have been involved in several recent projects to develop appropriate college-level curriculum to accomplish that: Ocean Tracks and Ocean Observing Initiative (OOI) Teaching With Data. I'd be happy to share these free, online curriculum projects with other participants.

How do you manage student engagement and assessment in your online courses?

Student Engagement: Make the subject matter interesting and incorporate active learning techniques into your online course, just like in a face-to-face course!

Student Assessment: Frequent quizzes and assignments.

Kelli Wakefield, Mesa Community College

How do you utilize technological tools (Google Earth, topical databases, blogging, etc.) in your online courses?

Since I teach a lab online, I use Google Earth for many of the lab assignments. I specifically chose this tool because it is free for me and the students, the robustness of the tools within the program, the availability of maps and files online, and for the historical imagery. Since students within the course are almost exclusively non-majors, I feel that part of my job is to give the access to tools that can be used in their "normal" life after the course is over.

I think having a single platform for students is important for consistency between weeks and assignments. So they are able to to assignments that range from different types of maps to locations and depths of earthquakes and from urban spread into geologically hazardous locations over time to before-and-after views of the Japanese tsunami, all using the same program and tools. This way they are better able to focus on the content rather than learning different technology.

Rachel Walters, University of Florida

From your experience, what practices make for excellent online Earth Science learning?

One of the biggest challenges associated with online Earth Science education is creating a laboratory experience where students can develop the practical skills they need to become a competent geologist. A major problem associated with this task is the absence of a teaching assistant or instructor to physically show a student what features of a mineral, rock or thin section they are supposed to be observing and how to interpret them. Several practices have helped in the quest overcome this challenge.

1. Informal "How-to" Videos
We have created "How-to" practical instructional videos covering different aspects of mineral identification. Each video covers a different type of observation: color, luster, cleavage, fracture, hardness, streak, and so on. Additionally we have one video that exhibits extremely good type-examples of the key Bowen's Reaction Series minerals and one video addresses some of the nuances of the more challenging samples in their kit. We have found this is much more useful for getting students started with mineral identification than reading a book or watching standard theory lecture videos. The "How-to" videos also provide practical tips and rules of thumb that may not be included in a more formal text or lecture format.

2. Low-stakes Practice Examples and Immediate Multi-stage Feedback
In the absence of in-person corrective instruction from a teaching assistant or instructor the importance of examples and intermediate stages of feedback grows significantly. We incorporated the UK Virtual Microscope to provide a more realistic experience of a microscope and excellent examples at the start of each optical microscopy lab.
We designed low-stakes interactive practice multiple-choice examples. Each question provides extensive individualized feedback for each answer choice that either explains what the correct answer is and why or attempts to highlight potential misconceptions that may have led to an incorrect answer. In the absence of in-person feedback, this has helped students correct their observations and identification skills before they embark on high-stakes practical skill assignments. Many of the high-stakes practical assignments are also structured in stages and set up as multiple-choice with extensive feedback so that students can learn from their mistakes while completing a singe lab. Immediate feedback decreases the overall frustration felt by students and significantly enhances the value of the learning experience of practical skills labs.

3. Peer-to-Peer Feedback Discussions
For each practical lab we set up peer group discussions monitored daily by the instructor. Each discussion is a forum for sharing challenges in the development of

practical skills and their solutions. This context provides three useful extensions beyond the how-to videos. Firstly, students who have just learned how to make a certain observation or interpret a certain feature can provide useful feedback to other students. Their advantage over the instructor is that they likely just solved, or overcame, the challenge that others are sill struggling with. Secondly, the instructor can track common issues that are being raised, share tips between different groups, and guide students toward answers to questions that are not being resolved (or are being resolved inaccurately) by other members of their group. Thirdly, and possibly most importantly, students often find their groups member's experiences very validating when they discover that they are not alone in the challenges they are facing.

Tim White, Pennsylvania State University-Main Campus

From your experience, what practices make for excellent online Earth Science learning?

First and most importantly is to have a well-designed and considered curriculum - evolved as you teach. In other words, work out the kinks and iterate each time you teach, just as if you were in a classroom. Second, be organized. Out of sight out of mind makes it easy to forget about your online students. So develop a routine for communicating with them and be very clear to them that regular communication will be important - it goes both ways. Finally, be available for phone calls. A lot can be accomplished through email, chatrooms, discussion groups, etc., but a timely scheduled phone call can make a big difference in a student's performance and life.

How do you utilize technological tools (Google Earth, topical databases, blogging, etc.) in your online courses?

I avail of two of the tools listed above: Google Earth and topical databases. Google Earth is used along with other remotely sensed imagery to look at, consider, describe and finally identify landforms from different regions of North America. I use a variety off federal data bases available online to help the students develop site specific environmental characterizations.

How do you manage student engagement and assessment in your online courses?

In an organized and regular fashion. I don't let it pile up and end up having to evaluate a series of student products all at once. This way I can see who is doing well and who is not and be able to intervene early (and often if needed) for those who need a little more guidance or motivation.