

Content Area Modified to Incorporate Communication Skills

NOTE: I am highlighting the portions of this document that specifically teach or reinforce communication skills in **bold red text**.

Course:

Earth Science (Middle School level)

Module:

Dating Rocks (Radiometric and Stratigraphic Dating)

Content Area:

How geological dating is performed. Limited for this module to two commonly-used and important methods, ignoring topics like varves, tree rings, and fluorine dating (although they would be available as enrichment subjects) and fossils (because fossils get their own unit).

Core Content Lesson:

Students will become familiar with two ways scientists determine the date of a rock's formation or modification This lesson will include the following topics:

- Radioactivity (very high level). This may be the first time the students have been exposed to the topic.
- Half-lives, again at a very high level. Most students at this level will at least know about the *Half-Life* games, which will provide a bit of familiarity.
- Stratigraphy, the recognition of geological layers and their use in dating.

Students will participate in various online activities (discussion, video-watching, reading, quiz-taking, etc.) using the school's LMS/LMCS. A help/homework assistance forum will be created, with older or more advanced students as first-line help and teachers available as backup.

The following tasks have been defined as the basis for learning:

- A reading assignment will be required as pre-work, via the LMS, e. g. <http://www.ck12.org/user%3Alewistonscience/book/Earth-and-Space-Science/section/12.2/>.
- Discussion of the assigned reading, in real time. This could be done in physical class or via a conferencing tool like Cisco WebEx or Google Hangout. For our purpose we will assume a classroom discussion. This will include a brief formative assessment using audience response systems (clickers). **This activity builds communication skills in free verbal interchange, especially if properly facilitated/formatively assessed by the teacher.**
- The teacher explains radioactivity, again live (since students are assumed to be in the classroom), using visual aids that may include physical models as well as smart whiteboard apps, video, etc. Clickers would be used again here.
- Video overview of radiometric dating (<https://www.youtube.com/watch?v=KWA5z59F8gA>) as a homework assignment for students to watch using their own phone/tablet/computer/smart TV.
- Exercises: students divide into small groups (3-4) and are given assignments to work through to do simple dating (relative dating with stratigraphy, mathematically transparent dating with radiometric systems), with very detailed instructions for the first problems and help from the teacher. Done the next day live in the classroom.
- Assessment/reinforcement: students divide into pairs (who weren't in their original group) to solve problems on their own. This could be either live or online depending on details of the course, the way the school schedules students, and geography.

Lesson Detail:

1. **Assessment/assessment Task:**

Live/virtual meetings, the quiz on stratigraphy, observation during the group exercises, and the results of the paired exercises, will constitute formative assessment, as well as being included in the rubric and thus having components of evaluation. Summative assessment/evaluation would take place for the overall topic of “Dating” which would include the “Fossils” unit as well.

2. **Learning Objectives**

- Students will demonstrate knowledge of the basis for stratigraphic dating:
 - a. Rocks are laid down in layers
 - b. The layers were laid down in large areas, in a specific order
 - c. Sometimes layers are bent, tilted, or even turned upside down
 - d. Geologists can figure out the original pattern by observing the rocks in many places
 - e. Using this knowledge, geologists can tell which rocks are older and which are younger

- Students will demonstrate knowledge of the basis of radiometric dating
 - a. Some atoms spontaneously change into other elements
 - b. The process can be predicted mathematically and involves half the atoms of a given element breaking down in a certain time period, the “half-life”
 - c. By counting atoms of the first element and of the element(s) it turns into in a specific rock, you can figure out how long it has been since the rock was formed

- The student will list two things that can make radiometric dating give the wrong or no answer:
 - a. The daughter element was already present in the rock
 - b. The parent or daughter element leached out of or otherwise escaped the rock
 - c. No useful radionuclides are present in the rock

- Students will use radiometric and stratigraphic principles, alone and in combination, to approximately date (hypothetical) rocks.

3. **Instructional Delivery**

- Students will be working with a Learning Management System, which will provide a structured course flow as well as an organized set of resources needed for this module.
- A separate forum for homework help will be provided.
- Students will watch an instructional video and will participate in live discussions and presentations using some required tool, e. g. Google Hangouts. Students must have a PC (preferred) or tablet capable of using all aspects of Google Apps and viewing YouTube videos. Microphone, speakers/headphones, and a webcam are also required.

4. **Resources**

- Teacher and students to be provided access to the Learning Management System, Simple Machines Forum, and Google Apps by the learning institution.
- All participants must have Internet access, microphone and headphones/speakers, and a webcam.
- Lesson plan, scoring rubric, and activities to be created and posted as links, discussions or assignments in the LMS and on Google Apps.
- An extensive list of resources will be provided via the LMS to enable students to complete their assignments. Note that students finding additional material themselves will be a learning outcome for the entire course (and indeed, curriculum), although it is not specific to this module.

5. Assessment Plan

Formative Assessments:

- Reading Assignment

Students will participate in a realtime (synchronous) discussion after completing the reading. Clickers will be used for formative assessment/reinforcement as part of this discussion. **Clearly this teaches/reinforces reading skills.**

Students are required to participate in this solo/guided activity. This task will be 5 points of their grade and is based solely on completion/participation.

- Mini-Lecture on Radioactivity

Despite the word lecture, this portion of the instruction should be highly interactive and involve props, video clips, etc. Clickers can/should be used again and at least 1/3 of the class's time should be spent on questions and answers.

Students are required to participate in this realtime activity. The instructor will be able to gauge interest and understanding by each student's participation and feedback. This task will be 5 points of their grade.

- Video Overview of Radiometric Dating

Students will watch this video at their discretion, outside of scheduled class time. This can be at home, on the school bus, etc. (I am making the assumption here that the students and school have reasonably high-end 21st Century technology available.)

Students are required to view the video. This task will be worth 5 points of their grade and will be scored entirely on completion.

- Guided Group Practice: Dating Rocks

Students will be divided into groups of 3-4 and solve simple dating problems. The teacher will demonstrate all required techniques and the first problems will be very simple, building to moderate complexity. **Each group will be asked to explain how they solved one problem to the other groups, using a smart whiteboard. Students will be assessed both on the presentations and on the asking of insightful questions. Using Greenstein's inventory of communication activities (page 102), this will touch on MATH, SUMMARIZING, POST ME, and TEACH ANOTHER.**

All students are required to participate. This task will be worth 10 points of their grade and will be scored on completion and correctness (of principle—arithmetic errors will not be penalized at this point, for instance).

- Pairwork: Dating More Rocks

Students will be divided into pairs and solve moderately complex dating problems. This

work will be both reinforcement of the material learned in the previous lesson as well as reinforcement. The teacher will monitor the pairs and ensure that every student does some work.

All students are required to participate. This task will be worth 30 points of their grade and will be scored on completion and correctness (of principle as before).

Summative Assessments:

- Final Exam

This “traditional” type test will be used as the module's summative assessment.

A grading rubric will be defined to detail all the topics covered on the exam. Based on outcome, the instructor will be able to assess if learning was successful. This task will be 45 points of their grade.

General Rationale:

Given the assumption that this course would be taught in a blended environment, with both synchronous and asynchronous activities, and with an assumed high-tech school and tech-savvy teachers, as much as possible of the “imparting information” portion of the class is moved to asynchronous mode, so that teacher-interaction time is spent on the more challenging and more productive problem-solving portions. As that implies, this unit is highly problem-solving-oriented. This writer's attitude toward science and its teaching has always been that one should emphasize “Do” over “Know,” since at its core science is an active pursuit.

The emphasis on group/pair work is based on my (limited) experience in teaching middle school science. I found that students were much more comfortable asking each other for help, and that a fellow student could easily be the best encouragement. There are also the well-documented benefits of group activities in general, of course.

I continue to favor a traditional question-and-answer style exam for evaluation here, mostly because it fits this material well and this specific unit is not well-suited for experiments at the middle school level. (Imagine parents hearing their children were handed radioactive samples!)

Note that because of the lack of experimental opportunities here, I would mix this with another topic (divide each class period) that would have the students up and out of their

seats at least part of the day, doing something physical, e. g. splitting rocks and looking at the pieces under a dissecting scope to try to find and identify microfossils.