

Virtual Dating: Isochron & Radiocarbon Dating

Lesson source: Geology Labs On-Line at
<http://nemo.sciencecourseware.org/VirtualDating/>

Focus on Inquiry

The student will observe and interpret radioactive decay graphs and tables to explain relative and absolute dating methods.

Lesson Overview

This lesson contains two activities, “Virtual Dating Isochron” and “Virtual Dating: Radiocarbon”. Both activities are independent of each other, so students can complete one or both activities. In “Virtual Dating: Isochron” students learn about absolute and relative dating of rocks. They experiment with the half-life of radioactive elements. They use the Rb-Sr method to calculate dates. In “Virtual Dating: Radiocarbon”, students use half-life of carbon-14 to place an absolute date on once living matter. During both activities, students are required to correctly answer questions before being allowed to move on to the next part of the activity. Students are given a certificate of completion at the end of each activity.

Duration 3 class periods	Setting Classroom or computer lab	Grouping Individual, pairs, or small groups	PTI Inquiry Subskills 3.1, 3.3, 3.5, 3.7, 3.8, 4.2, 4.3, 4.4, 5.2, 5.3, 7.2, 7.3
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Lesson Components	Estimated Time	Inquiry Subskills Used	Technology Used	Level of Student Engagement	Brief Description
Engage	5 min.	4.2	Internet & Projector (optional)	2	Observe geologic timeline answer various questions about events in earth’s history.
Explore	100 min.	3.1, 3.3, 3.5, 3.7, 3.8, 4.2, 4.4	Computer with Internet: Simulation	3	Complete Virtual Dating Isochron and Virtual Dating Radiocarbon activities from Virtual Dating website.
Explain	Part of explore	3.1, 3.3, 3.7, 3.8, 4.2, 4.3, 4.4, 5.2, 5.3,	Computer with Internet: Simulation	3	Students collect data, create graphs, and analyze information during the activities on the Virtual Dating website.
Expand	50 min.	3.1, 3.7, 5.2, 7.2, 7.3	Computer with Internet: research, Interactive Video with Online Quiz	3	Students research radiation humans are exposed to in their daily lives and prepare a presentation explaining the effects of radiation on human life. Optional: Students can view BrainPop videos and take the quizzes provided with each video.
Evaluate	varies	7.2, 7.3	Computer with Internet: Online quiz	3	Students will receive a certificate upon successfully completing the activities on the Virtual Dating website. Their presentations of radiation and its effect on human life can be used as assessment. Optional: The BrainPop quizzes can be used as formal or informal assessment.

Level of Student Engagement

1	Low	Listen to lecture, observe the teacher, individual reading, teacher demonstration, teacher-centered instruction
2	Moderate	Raise questions, lecture with discussion, record data, make predictions, technology interaction with assistance
3	High	Hands-on activity or inquiry; critique others, draw conclusions, make connections, problem-solve, student-centered

National Science Education Standards – Inquiry



Design and conduct a scientific investigation.
 Use appropriate tools and techniques to gather, analyze, and interpret data.
 Develop descriptions, explanations, predictions, and models using evidence.
 Think critically and logically to make the relationships between evidence and explanations.
 Use mathematics in all aspects of scientific inquiry.

National Science Education Standards – Earth Science

The earth processes we see today, including erosion, movement of lithospheric plates, and changes in atmospheric composition, are similar to those that occurred in the past. Earth history is also influenced by occasional catastrophes, such as the impact of an asteroid or comet.
 Fossils provide important evidence of how life and environmental conditions have changed.

Louisiana Grade Level Expectations – Inquiry



Gr. 8, Inquiry GLE#6 – Select and use appropriate equipment, technology, tools, and metric system units of measurement to make observations (SI-M-A3)
 Gr. 8, Inquiry GLE#7 – Record observations using methods that complement investigations (e.g., journals, tables, charts) (SI-M-A3)
 Gr. 8, Inquiry GLE#8 – Use consistency and precision in data collection, analysis, and reporting (SI-M-A3)
 Gr. 8, Inquiry GLE#9 – Use computers and/or calculators to analyze and interpret quantitative data (SI-M-A3)
 Gr. 8, Inquiry GLE#11 – Construct, use, and interpret appropriate graphical representations to collect, record, and report data (e.g., tables, charts, circle graphs, bar and line graphs, diagrams, scatter plots, symbols) (SI-M-A4)
 Gr. 8, Inquiry GLE#12 – Use data and information gathered to develop an explanation of experimental results (SI-M-A4)
 Gr. 8, Inquiry GLE#13 – Identify patterns in data to explain natural events (SI-M-A4)
 Gr. 8, Inquiry GLE#16 – Use evidence to make inferences and predict trends (SI-M-A5)
 Gr. 8, Inquiry GLE#19 – Communicate ideas in a variety of ways (e.g., symbols, illustrations, graphs, charts, spreadsheets, concept maps, oral and written reports, equations) (SI-M-A7)
 Gr. 8, Inquiry GLE#22 – Use evidence and observations to explain and communicate the results of investigations (SI-M-A7)

Louisiana Grade Level Expectations – Earth Science

Grade 8 GLE#30 – Interpret a geologic timeline (ESS-M-B1)
 Grade 8 GLE#31 – Compare fossils from different geologic eras & areas of Earth to show that life changes over time (ESS-M-B1)
 Grade 8 GLE#33 – Use historical data to draw conclusions about the age of Earth (e.g., half-life, rock strata) (ESS-M-B2)
 Grade 8 GLE#34 – Apply geological principles to determine the relative ages of rock layers (e.g., original horizontality, superposition, cross-cutting relationships) (ESS-M-B3)
 Grade 8 GLE#35 – Describe how processes seen today are similar to those in the past (e.g., weathering, erosion, lithospheric plate movement) (ESS-M-B3)

Materials List (per group)

- Computer with Internet access
- Optional: projector for whole class viewing of websites
- Optional: calculator (The website does have an electronic calculator on some screens, but a calculator may help on other screens that do not offer this.)

Advance Preparation

1. Review the technical considerations and system requirements for running the activities on the Virtual Dating website (<http://nemo.sciencecourseware.org/tester/index.php?app=vd>). Install any hardware or software necessary.
2. Review the demonstration version of both activities on the Virtual Dating website.
3. Determine whether students will work individually or in small groups to complete the website activities.
4. It may be helpful to go through the activities first to review and record the correct answers. Students will not be able to advance without entering correct answers, so you can have the correct answers available to help them if the need arises.
5. Obtain a copy of a geologic timeline for students to observe and answer questions. A copy can be found at <http://cache.eb.com/eb/image?id=398&rendTypeld=4>. Teacher can print a copy for each student or project the timeline from the website if she has the necessary equipment.
6. Optional: Sign up for a membership to BrainPop at <http://brainpop.com>. This is **NOT** FREE, but you may sign up for a 30 day free trial. Review the videos, *Radioactivity* and *Carbon Dating*. Each video has a ten question student quiz. The quizzes can be taken as a review online or a printed copy can be handed out to students and used for assessment.

Other Information

Learning Objectives

1. Compare relative and absolute dating of rocks and minerals.
2. Explain half-life of radioactive elements.
3. Explain radiocarbon dating and its use.

Prior Knowledge Needed by the Students

Students need to understand how to create and analyze graphs and slopes of lines.

Procedure

Engage

1. Show students a geologic timeline. A copy can be obtained from <http://cache.eb.com/eb/image?id=398&rendTypeld=4>. Ask them to identify the dates of various major events that occurred before humans first appeared. Then ask them to identify when humans appeared. Discuss how we know of the events that were recorded by humans throughout earth's history. Then ask, "How do we know the actual dates of the events that occurred prior to human existence?" Accept all answers then tell students that they will engage in an online interactive web activity to help them understand how we know about earth's past.

Explore

1. Students complete "Virtual Dating Isochron" activity on the Virtual Dating website (<http://nemo.sciencecourseware.org/VirtualDating/>). This activity begins with an overview of absolute and relative ages of rocks. Students then simulate the passing of time in a mineral through the use of an interactive graph. They observe the decay of a radioactive parent isotope into a daughter isotope and analyze the parent element's half-life. They then use the graph of parent decay and daughter growth curves to determine the half-lives of various radioactive elements. In the final part of the activity, students prepare and use an isochron diagram to determine the age of rock using the Rb-Sr method.
2. Students complete "Virtual Dating Radiocarbon" activity on Virtual Dating website. This activity begins with an overview and history of the radiocarbon dating method. A diagram explaining radioactive carbon-14 is provided for students to analyze and answer questions. Students then use an interactive illustration of carbon-14 decaying over time and answer questions about its half-life. They then plot real data on a graph and compare the data with the theoretical carbon-14 decay curve.

Explain

1. Students are required to collect data, create graphs, and answer questions throughout both activities. They are not allowed to move on to the next part of the activity unless all of their information is correct.

Expand

1. Show students the BrainPop video, *Radioactivity*. (<http://www.brainpop.com/science/energy/radioactivity/preview.weml>)
Then have students take one of the quizzes provided with the video.
2. Show students the BrainPop video, *Carbon Dating*. (<http://www.brainpop.com/science/earthsystem/carbondating/preview.weml>)
Then have students take one of the quizzes provided with the video.
3. Optional: Students can research radiation that humans are exposed to on a daily basis and then prepare a presentation explaining to the class the effects of radiation on human life.

Evaluate

1. Students can print out a certificate of completion as proof of successfully completing the activity.
2. The BrainPop quizzes can be used as informal or formal assessment. There are three quiz options: (1) a graded quiz which gives a score, (2) a review quiz which gives hints and will not advance until correct answer is given, and (3) a printed quiz that you print and give to students on paper.



3. Teacher can use student presentations of radiation in our daily lives as a form of assessment.

Blackline Master

None

Supplementary Resources

U.S.NRC: United States Nuclear Regulatory Commission

<http://www.nrc.gov/about-nrc/radiation/around-us/doses-daily-lives.html>

This website contains information about radiation sources, uses, and doses in our daily lives. It also contains information about nuclear reactors, nuclear materials, radioactive waste, nuclear security, and public involvement.