SCIENCE NORTH SCIENCE NORD
SUDBURY, ONTARIO, CANADA

Absolute Dating and Isotopic Age Determination **Grade 12 – Recording Earth's Geological History**

Lesson Plan

Assessment	AFL, Assignment Questions
Cross-curricular	Physics & Technology

Big Ideas

- Earth is very old, and its atmosphere, hydrosphere, and lithosphere have undergone many changes over time.

Learning Goals

- I know the terms *isotope*, *radioactive decay, half-life, parent, and daughter.*
- I know that objects can be dated using different radioisotopes and their products.
- I know that objects that radiocarbon dating can be used to date objects that have been alive.
- I can build a model and determine the half-life of a decaying material.
- I can solve radiometric problems involving half-life and proportion.

Specific Expectations:

D2. investigate geological evidence of major changes that have occurred during Earth's history, and of the various processes that have contributed to these changes

D2.6 design and build a model to represent radioactive decay and the concept of half-life determination

D3. demonstrate an understanding of how changes to Earth's surface have been recorded and preserved throughout geological time and how they contribute to our knowledge of Earth's history

D3.4 compare and contrast relative and absolute dating principles and techniques as they apply to natural systems (e.g., the law of superposition; the law of cross-cutting relationships; varve counts; carbon-14 or uranium-lead dating)

D3.5 identify and describe the various methods of isotopic age determination, giving for each the name of the isotope, its half-life, its effective dating range, and some of the materials that it can be used to date (e.g., uranium-lead dating of rocks; carbon dating of organic materials)

Description:

In this lesson students will learn that scientists, archaeologists, and geologists use radiometric dating to measure the physical properties of rocks and objects and determine their chronological age. This lesson should follow the lesson on Relative Dating. **This lesson is intended for the university level.**

Materials

Radiometric Dating Visuals
Graphic Organizer (Student)
Graphic Organizer (Teacher)
The Half Life of a Diet Cola Foam Activity
Group Materials: A graduated cylinder, stopwatch, 2 L of Diet Coke and Masking tape
Radiometric Dating Assignment (Student)
Radiometric Dating Assignment (Teacher)
Additional Resources

Safety Notes

Students are not to drink the Diet Coke during the Half Life of a Diet Cola Foam Activity.

Introduction

Scientists, archaeologists, and geologists use various ***absolute dating*** techniques to measure the physical properties of rocks and objects and determine their chronological age.
Students will now learn about one such technique called ***radiometric dating***. This method was developed in response to a long-held question: How old is the earth?

Students watch this presentation to learn more about radiometric dating: Radiometric Dating Visuals (See Link).

With a partner, students complete the Graphic Organizer (See Link). Students may use their notes, look online, or use a textbook to complete the table.

Action

Students will calculate the half-life of Diet Cola foam activity.

The Half-Life of Diet Cola Foam Activity (See Link)

The measurement of the half-life of a radioactive isotope allows scientists, archaeologists, and geologists to determine what isotope is in a sample. They may then determine what proportion of the radioisotope has decayed and use this proportion to determine how old the sample is.
In the following activity, your group of three will calculate the half-life of Diet Coke foam to see how this physical characteristic may be measured.

Group Materials:
- A graduated cylinder
- A stopwatch
- 2 L of Diet Coke
- Masking tape
- Pen or marker

Instructions

1. Place a strip of masking tape along the vertical scale of the graduated cylinder.
2. Shake up a little bit, and then pour Diet Coke into the cylinder. Allow the foam to settle a little bit.
3. Mark the height of the liquid level.
4. Continue to mark the liquid level at 5-second intervals until as much foam turns into liquid as possible and then continue waiting for another two minutes to mark the final liquid height. This final height will be $H_{(max)}$.
5. Remove the tape from the cylinder. Measure from the end point ($H_{(max)}$) to the measured levels (i.e. Height of Foam = $H_{(max)} - H_{(t)}$) and record in an appropriate table.
6. Repeat the experiment a second time and graph Foam Height versus Time.

Discussion

1. What is the half-life of Diet Coke foam? How do you know?
2. How long would it take for less than 1% of the foam to remain? How long, in seconds, is this?
3. What represents the parent atoms in this activity? What represents the daughter atoms?

Consolidation/Extension

Complete the Radiometric Dating Assignment (See Link).