

PROJECT REPORT

Northern Wyoming Community College District / National Science Foundation
Summer Energy Education Program 2011

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TITLE

Colorado Cross Section Cupcake Geology

SUMMARY

Our planet's thin outer layer, the crust is made up of many layers of rock that have been forming for over 4 billion years. Sedimentary rock layers can form as sediments which are deposited by wind and water. Dead organisms may also be deposited within the sediments forming fossils. The beginnings and endings of geologic time spans can be determined by dating the remains of these fossils and developing a stratigraphic unit diagram. Depending upon the porosity and permeability of some sedimentary rocks, petroleum reservoirs may be found within them.

Knowledge of the earth's structure such as knowing where to mine for gold or drill for oil helps humans locate and extract resources. Natural resources come from a variety of locations and have to be mined or harvested depending upon the type. Weld County, Colorado (where Erie Middle School is located), contains 37% of the state's active oil wells. Most of these wells are located in the DJ (Denver Julesburg) Basin comprised of Cretaceous sandstones. These include the Hygiene and Terry Sandstone Members, Coddell Sandstone, and the Muddy "J" Sandstone. Oil is also found in the Lyons Sandstone which is Permian in age. Resources in Colorado directly affect the state's economy by providing employment and sources of revenues.

ENERGY CONTEXT

This lesson focuses on the oil within the state of Colorado using a stratigraphic model for the front range, targeting Weld County.

ANTICIPATED TIME REQUIRED

1. Making and baking cupcakes – depends upon how many students are being taught
2. Set up Activity – 10 minutes
3. Conduct Activity – 30 + minutes
4. Analysis Questions – 15 + minute
5. Class Discussion/Analysis of Results – 30 + minutes
6. Tic-Tac-Toe Presentations – 10 minutes per student

INTENDED STUDENT LEVEL

Colorado State Standards

6th Grade

Standard: Earth Systems Science (3)

Describe how humans are dependent on the diversity of resources provided by earth and sun.

Concepts and Skills students' master: Earth's natural resources provide the foundation for human society's physical needs.

7th Grade

Standard: Earth Systems Science (2)

Describe and interpret how earth's geologic history and place in space are relevant to our understanding of the processes that have shaped our planet.

Concepts and Skills students' master: Geologic time, history, and changing life forms are indicated by fossils and successive sedimentation, folding, faulting, and uplifting of layers or sedimentary rock.

7th Grade

Standard: Life Science (5)

Explain how biological evolution accounts for the unity and diversity of living organisms.

ASSUMED PRIOR KNOWLEDGE

This lesson assumes prior knowledge of:

1. Geologic Time Sequencing
2. Stratigraphic Column Models
3. Fossil Formation
4. Colorado Rock Identification
5. Petroleum Formation
6. Weld County Oil Reservoirs
7. Geologic History of the Front Range in Colorado
8. Lab Safety Procedures
9. Science Notebook Protocol
10. Core Sampling Techniques
11. Sedimentation and Sedimentary Rock Formation

LEARNING OBJECTIVES

Lesson Objectives for the Unit

Students will be able to:

1. Use direct and indirect evidence to determine the sequence of events in geologic time.
2. Interpret and analyze data from the fossil record to support a claim that organisms and environments have evolved over time.
3. Understand what type of resources are found and used in our community.
4. Develop and communicate a scientific explanation addressing a question of local relevance about resources generated by the earth.
5. Use information and communication technology tools to gather information from credible sources, analyze findings, and draw conclusions to create and justify an evidence-based scientific explanation.

Cupcake Cross Section Lab Objectives:

Students will be able to:

1. Draw, label, and name their rock layers correctly.
2. Identify what rock layer the fossils occur in.
3. Describe, using core sample evidence, their interpretation of the cupcake cross section.
4. Identify the rock layer/layers where Weld and Boulder County oil is located.
5. Measure and record the width in mm of the colored rock layers in their core samples.

MATERIALS

Materials:

White cake mix plus the required ingredients to make the cake. Supply one cupcake per student.

Foil cupcake baking cups

Food Coloring – at least 5 different colors

Poppy Seeds

Assorted “mini” candies – these need to be small enough to fit into a regular size straw. Use at least 3 different types. Do not use cake decorating sprinkles as they melt.

Plastic Straws – not the bendable type, cut into 3 or 4 inch pieces depending upon the height of the cupcakes. One straw piece per student.

Knife – used for cutting the cupcakes

Paper Towels – one per student

Toothpicks - flat type. One per student.

Loose Leaf Paper – for recording data and observations

Science Notebook – students have their own

“Sedimentary Rocks of the Boulder Valley Stratigraphic” Poster

Colorado Geologic Highway Map

INTRODUCTION / MOTIVATION FOR STUDENTS

When geologists want to know more about earth formations, they try to figure out what is beneath the surface. Rather than excavating large tracts of land to expose oil fields or coal bearing strata, core samples can be taken and analyzed. Once analyzed, a cross section of the rock layers can be developed. Core sampling can also unearth fossil remains. You will be the geologist trying to “see” what the inside of your cupcake looks like in a cross section.

PROCEDURE

Procedure

Activity Preparation - Cupcakes

1. Make cupcakes with at least 4 layers of colored batter. Coordinate the colors to match the colors of the stratigraphic layers you wish to represent from the poster.
2. Put the poppy seeds in your oil layer. Choose from the layers listed in the Summary Section.

3. Put the “mini” candies, which represent different types of fossils, in the correct colored layers. Use different types of candies for the different fossils.
4. Supply one cupcake per student.

Activity Procedure

1. Read the above Activity Introduction together as a class.
2. Inspect your cupcake.
3. DO NOT PEEL OR EAT IT!
4. In your Science Notebook predict what you think a cross section of your cupcake will look like. Do this by using a drawing that includes ALL of the following: labeled rock layers, color, labeled fossils and oil deposits. Include a written description as well. Also include a bird’s eye view drawing that is labeled.
5. Hypothesize about what is inside your cupcake. State your hypothesis in your Science Notebook.
6. Sample the cupcake below the surface by making a minimum of 7 core samples. You may use a turning motion with the straw for removal. To remove the sample from the straw, gently blow it out. A toothpick may be necessary to get some of the samples out of the straw.
7. For each core sample: Place it on the paper towel, draw it, number it, describe the location of the sample, the direction of the sample (was it taken vertically or diagonally), layer colors, and any other information you wish to record. Measure using mm the width of each colored layer and record. Is oil present? Fossils? You may want to draw a bird’s eye view to designate core sample locations. Record the information on the loose leaf paper and then transfer it into your Science Notebook.
8. Observe your core samples. Make comparisons and look for patterns within your cupcake. Record your findings in your Science Notebook.
9. Revise your original hypothesis and make a final detailed drawing for your cupcake cross section.
10. With your instructor present, cut your cupcake in half and compare your cross section with the actual cupcake cross section. Were there any surprises? Explain in your Science Notebook.

Analysis Questions – Answer using complete sentences in your Science Notebook.

1. Describe the process of sedimentation.
2. In what rock layers of the Front Range are oil deposits found?
3. Why are oil reservoirs found in these particular rock layers?
4. List 3 facts about the oil deposits in Weld County.
5. Compare and contrast the width of your core sample layers to the width of the layers on the stratigraphic poster.

SAFETY ISSUES

1. Check for food allergies among the students, especially peanuts.
2. Instructor cuts the cupcake.
3. Students only use their own materials. No sharing.

TROUBLESHOOTING TIPS

1. Remind the students about cupcake orientation during core sampling.
2. Remind the students that the core samples will be upside down when they come out of the straw.
3. Remind students to blow gently to remove the core samples from the straws.
4. Students may want to draw a bird's eye view to represent core sample locations and numbers.
5. Before the instructor cuts the cupcake, students must have their core samples, cross section drawing with labels, and final hypothesis completed.

ASSESSMENT

Activity Assessment

1. Completion of all the following: prediction, initial drawing, initial hypothesis, core samples with labeling, revised hypothesis, revised cross section, analysis questions.
2. Tic-Tac-Toe Menu

Choose activities in a tic-tac-toe design. Fill in the Tic-Tac-Toe Menu Sheet and have the instructor OK your choices. When you have completed the activities in a row (horizontally, vertically, or diagonally) you are finished. See attached sheets.

SUGGESTED EXTENSIONS

Biological Sciences Initiative at CU Boulder has an outreach program called the Science Squad. Instructors and graduate students visit classrooms and have great presentations. I have booked a presentation by Erin Leckey who is a paleontologist and ecologist doing research at the University. Her presentation is called: Exploring Colorado's Cretaceous Seaway with Fossils and Sediments.

There are many geologic features which can be explored, demonstrated, and discovered with the cupcakes.

Colorado has many different types of mining and resources to expand upon.