



Coal Distribution in Utah

Grade/Subject: 8th Science

Strand/Standard 8.4.1 Construct a scientific explanation based on evidence that shows that the uneven distribution of Earth's mineral, energy, and groundwater resources is caused by geological processes. Examples of uneven distribution of resources could include Utah's unique geologic history that led to the formation and irregular distribution of natural resources like copper, gold, natural gas, oil shale, silver, and uranium. (ESS3.A)

Lesson Performance Expectations: Students will compare geological maps of Utah to coal maps of Utah to determine why coal is unevenly distributed across the state.

Materials:

Per student:

- Student Sheet
- Access to [Geological and Resource Map](#) this could be accessed digitally or printed for each student.

Material for Layering Model: This model can be done as a demonstration or in small groups.

- 1 bag of dark sand
- 1 bag of light sand
- 1 bag of soil
- 1 bag of small gravel
- Green leaves
- Spray bottle(s) with water (one per class or each small group)
- Shallow aluminum pan to put it in. The bottom needs to be flexible to enable uplifting.
- Spoon(s)
- Ruler(s)

Time: 1 period, 60 minutes

Teacher Background Information:

Coal was formed from the dead remains of trees, ferns, and other plants that lived millions of years ago in swampy areas. Geological processes such as uplift have unevenly distributed coal even further.

Student Background Knowledge:

- Students will understand what a fossil fuel is and that coal is a type of fossil fuel.
- Students will understand uplift.
- Students will understand that geological forces have shaped Utah's landscape.

Teacher Step by Step: A 3-d lesson should insist students do the thinking. Provide time and space for the students to experience phenomenon and ask questions. The student sheet provided below provides guidance but is only an example of how students might respond.

1. **Introduce *Phenomenon*:**

- a. Show students the following image and have students imagine they were hiking one day and saw this scene. Have them make a list of questions based on what they see in the picture.



- b. Students record their questions on their student sheet.
- c. Lead a discussion to focus students on the guiding question for the lesson: Where are earth's energy and mineral resources and what caused the uneven distribution of these resources?

2. Obtain Information

- a. Lead a discussion to review fossil fuels.

3. Optional - Develop a Model - This can be done as a demonstration or in small groups.

Develop a model of the layering of materials to form fossil fuels.

- a. Place a 1 inch (adjust thickness if necessary so it can be seen by students) layer of one of the earth materials in the container with the spoon. Mist with the spray bottle of water until damp, but not soaking.
- b. Place another earth material 1 inch deep on top of the first layer. Moisten this layer with the spray bottle (water) until damp.
- c. Continue alternating layers of earth materials and water, explaining how the weight of the top layers pressed the bottom layers together. If needed you can smash the layers to simulate pressure over time.
- d. Students will draw their models on the Student Sheet.

4. Obtain Information Show students the following videos about how coal is formed:

- a. <https://www.youtube.com/watch?v=OazrTT0I91c> (show through minute 2.55)
- b. https://www.youtube.com/watch?v=BQ_Ethb6_Wk (length 1:10)

5. Analyze Data/Asking Questions

- a. Lead with this question: Why is there not coal in an even layer across the entire earth?
 - i. Based on the model we would expect coal to be in an even layer across the earth, but it is not.
- b. Show the Simplified Geological Map and The Simplified Coal Map found at the following link (These can be printed in color and laminated for student use): <https://geology.utah.gov/map-pub/survey-notes/glad-you-asked/natural-resources-found/>

6. If you built the sand model - Use a model

- a. Discuss the geological process of uplift.
- b. Students will press up on the bottom of a section of their model to simulate uplift. Erosion can be shown by scraping some of the sand off and rivers can be simulated by dragging your finger through the sand layers.
- c. Students will observe what happens to the layers of the buried earth material when pressure is applied.
- d. Students will draw a second draft of their model representing uplift.

7. Engage in Argument

- a. Using the maps and coal formation information, students should develop an explanation about the

location of coal and the correlation with the geological features. Discuss the following questions with students.

- i. What is the cause of the uneven distribution of the coal? (geological processes, uplift, mountain building, erosion)
 - ii. Where is coal located in Utah? (identify on the map - Colorado Plateau)
 - iii. How was the Colorado Plateau formed? (Uplift)
- b. Students should realize that coal is located in the Colorado Plateau which is mostly sedimentary rock. The rocks were deposited in floodplains, tidal flats and seas. The Colorado Plateau has been uplifted a mile or more over the past 20 million years. This has exposed the coal that formed there millions of years ago.
- c. Students will construct an explanation that shows that the uneven distribution of coal in Utah is caused by geological processes.

Assessment of Student Learning.

Construct an explanation that shows that the uneven distribution of coal in Utah is caused by geological processes.

Student Sample Explanation:

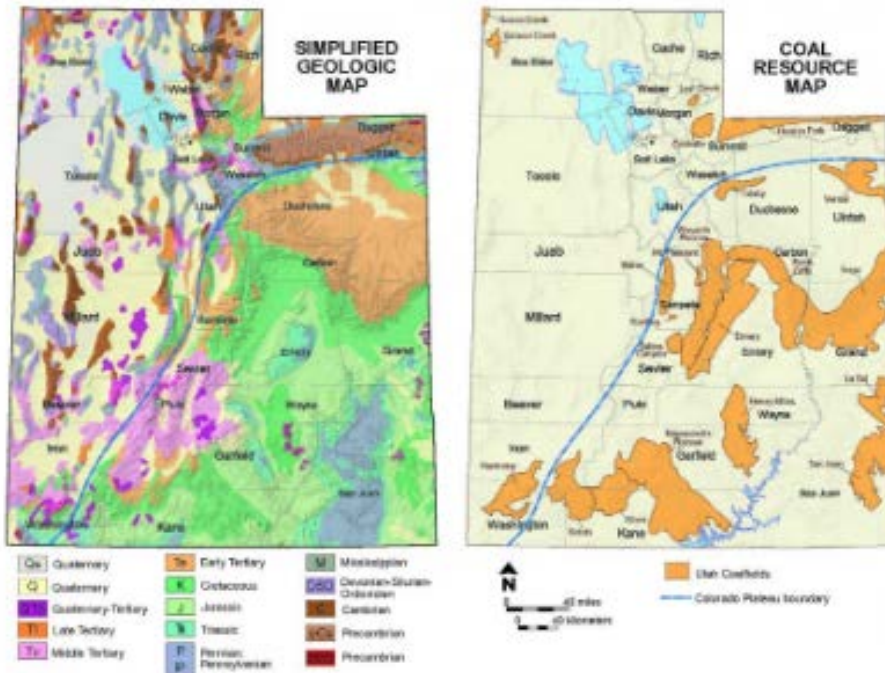
When I compare a coal resource map to a geologic map of Utah, I find that coal deposits are mostly found in the Colorado Plateau. I hypothesize that the Colorado Plateau area must have once had the right climate and conditions to host swamps containing lots of plants and organic material that converted to coal. I also expect to find layers of sandstone and mudstone.

The Colorado Plateau is made of many layers of sandstone, mudstone, limestone, and other sedimentary rocks. The rocks in the Colorado Plateau are 65 to 300 million years old and were deposited in deserts, floodplains, tidal flats, and seas. Over the past 20 million years or so, the Colorado Plateau has been uplifted a mile or more, causing rivers to cut deep canyons in the plateau, exposing the layers of various sedimentary rocks, including coal. This process has allowed coal to form in various places all over Utah and become unevenly distributed.

Standardized Test Preparation:

Coal Distribution in Utah

The key to the geologic map begins with Quaternary (youngest) and moves back in time to the Precambrian (oldest) rock.



- What age of rock layers is Utah coal most likely to be associated with?
 - Quaternary
 - Early Tertiary
 - Cretaceous
 - Cambrian
- Why is coal associated with a certain age of sedimentary rock formation?
 - The coal formed from volcanic lava flows.
 - The coal formed during times when oceans covered Utah.
 - The coal formed when mountains were formed and uplifted.
 - The coal formed during the time period from ancient swamps.*
- How does uplift under Earth's surface alter the location of coal beds? Choose all that apply.
 - The coal beds are disturbed and broken in segments.*
 - The coal beds melt and flow outward from the uplift.
 - The coal beds may be lifted closer to Earth's surface.*
 - The coal beds thicken and shorten into smaller areas.
- How is coal different from the materials it formed from?
 - It can burn and release energy.
 - It is a solid and not a liquid or gas.
 - It is darker, denser and more compact.*
 - It is composed of different atoms and molecules.

Extension of lesson and Career Connections:

- Have students research Utah Geological Survey (UGS). How do they gather their data? What kind of jobs are available at UGS?
- Students can research another mineral, energy, or groundwater resources and compare its distribution to geological processes. Students will present their to the class.

Coal Distribution in Utah

Name: _____

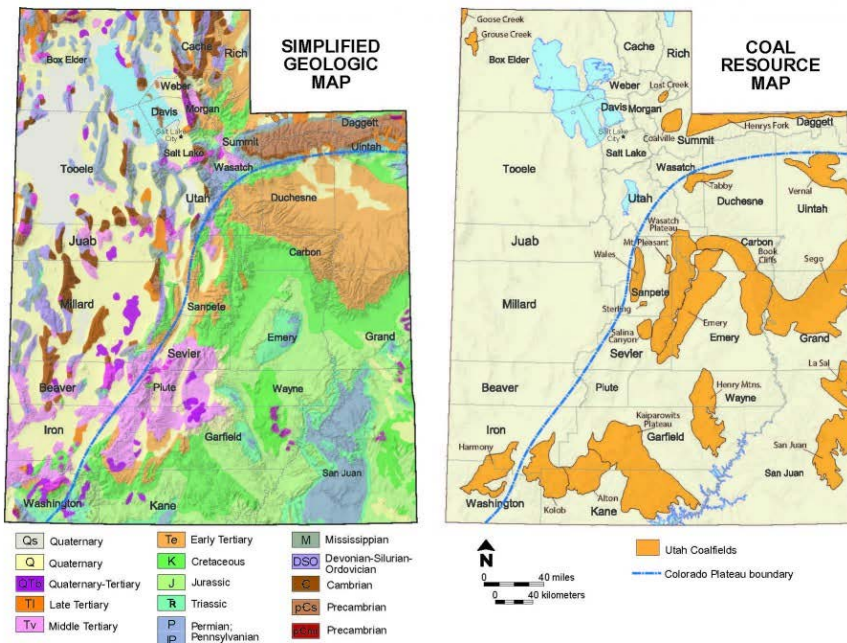
Phenomenon: Make a list of questions based on what you see in the picture.

- 1.
- 2.
- 3.

Question: After watching the videos, describe how coal is formed.

Why is there not an even layer of coal across the entire earth?

Analyze these two maps. The key to the geologic map begins with Quaternary (youngest) and moves back in time to the Precambrian (oldest) rock.



What are some reasons for the uneven distribution of the coal?

Construct an explanation that shows that the uneven distribution of coal in Utah is caused by geological processes. Include evidence and reasoning from your model and study of the maps in your explanation.

Claim _____

Evidence _____

Reasoning _____
