

**Social Studies Coalition of Delaware
Grades 4-5 Geography Lesson
Standard 2 - Environment**

Lesson Title: Strip Mining a Chocolate Chip Cookie

Lesson Author: Mary Schoettinger, Caesar Rodney School District
(mary.schoettinger@cr.k12.de.us)

Lesson Description: This is a simulation of the effects of coal mining on the environment and landscape. Students will “mine” for chocolate chips from cookies using three different techniques. They will understand that land can lose value as a result of human impact, even though coal increases our ability to create power. Finally, students will create a choropleth map that shows the regions in the U.S. where coal mining most impacts the landscape.

Grade Level: 4-5

Geography Standard Two: Students will develop a knowledge of the ways humans modify and respond to the natural environment [ENVIRONMENT].

End of Cluster Expectations (Benchmarks): Students will apply a knowledge of topography, climate, soils, and vegetations of Delaware and the United States to understand how human society alters, and is affected by, the physical environment.

Link to Additional Standards: Geography Standard 1, Benchmark 4-5: Students will demonstrate development of mental maps of Delaware and of the United States which include the relative location and characteristics of major physical features, political divisions, and human settlements.

Assessments: (DSTP type) 1 constructed response and 2 multiple choice attached.

The constructed response assessment should give evidence of the student’s ability to explain the possible outcomes when human activity alters the physical environment by building a road over a mountain. (see page 7)

The multiple choice assessments give evidence of the student’s comprehension that alterations to the physical environment change the physical environment in ways that cannot be returned to the original state in the context of building a road over a mountain and damming a river. (see page 8)

Focus Question: How is the environment of the United States affected by the human activity of coal mining?

Objectives: Upon completion of this lesson students will be able to:

1. explain different ways society changes the landscape through mining
2. explain that an environment, once changed, cannot be totally reclaimed to its original state

- use a map to explain that the effects of coal mining are felt in many states

Prior Knowledge and Skills:

Students will need to understand what the terms *landscape* and *environment* mean as applied to a mountain.

Time to Complete: Approximately 2 class periods (35-45 minutes each)

Materials Needed:

- chocolate chip cookies (enough for 3 per student)
- paper towels for each student (at least 3 per student)
- toothpicks (2 per student)
- plastic spoons
- vocabulary cards
- white glue (one per group)
- Handouts # 1, # 2, # 3 (one of each per student) see Appendix
- Visuals #1 and #2 (may be printed on transparencies) see Appendix
- Assessment # 1 (constructed response and multiple choice)

Vocabulary:

- landscape
- environment
- mine shaft
- surface mining
- reclamation

Procedure: Day 1

(Before starting the lesson, have the students arrange their chairs so they can form a group of 3-4 later in the procedure.)

- Show the picture/transparency of an environment (Visual #1). Ask students what the landscape of the picture shows. Remind students that landscape is the shape and form of the land. (*Mountain range, tall peaks, forests, etc.*) Ask what the environment of the picture is. (*Answers might include cold weather, trees, animals, shrubs, etc.*)
- Ask the **Focus Question:** How is the environment of the United States affected by the human activity of coal mining? Have the students think about the positives and negatives of coal mining. Tell the students that they will participate in a coal mining simulation so they can experience the human impacts on the environment.
- List monetary amounts on the board from \$0.25 down to \$0.00.
- Hold up a chocolate chip cookie. Ask students, “How much would you pay to eat this cookie?” (*Student responses will vary.*)
- Record student responses on the board in tally form (you’ll do this several times as follows).

(See handout #1, questions 2, 4, 6, 8)

	\$0.25	\$0.20	\$0.15	\$0.10	\$0.05	\$0.00
# 2.						
# 4.						

6.
8.

6. Then, explain to the students that the cookie represents the earth and the chocolate chips are valuable pieces of coal.
7. Ask students where coal might be found. (*Student responses may vary from underground to actual place names.*)
8. Ask students how coal is removed. (*Student responses may vary from digging it out to exploding it out.*)
9. Pass Handout #1 (questions), a paper towel, and a cookie to each student. Students should discuss and write out their responses to questions #1 and #2. Discuss student ideas. (*Cookie has chips that are inside, dark like coal, cookie is crusty, brown.*)
10. Pass out 2 toothpicks to each student. Explain that coal is often removed from the mine by chiseling out a deep **mine shaft** with manual labor. Have the students remove the chocolate chips from the cookie by chiseling them out with the toothpicks. Make sure that the chips are “clean,” with little or no cookie crumbs on them. NOTE: Remind students that the chips are more valuable when they are whole and clean and should not be touched with their hands because coal dust is unhealthy!
11. Ask students to answer Questions #3 and #4 on their handout sheet. Record their responses for question # 4 on the board.
12. Ask students what has happened to the environment of the cookie. (*There are big holes. Some cookies broke or cracked but it still looks like a cookie.*)
13. Ask if the cookie is still valuable. (*Students will likely respond yes but not nearly as valuable as when it had chips in it.*)
14. Distribute a second paper towel, another cookie, and a plastic spoon to each student. Explain that a second method of removing coal from the earth is to scrape the **surface** until a vein of coal is exposed. Tell students to remove as much coal as possible using only the spoon. (*Many cookies are likely to crack and crumble.*)
15. Ask students to answer questions # 5 and # 6 on their handout sheet. Record their responses for question # 6 on the board.
16. Ask students what has happened to the environment of the cookie. (*There are chunks of cookie left*). Ask if it was easier to get the chips using the spoon or toothpicks? (*Most students will likely respond it was easier with the spoon.*)
17. Distribute a third paper towel and another cookie. Have students wrap the cookie in the paper towel. Students should “pound” the cookie once or twice to represent dynamite explosives in a mine. Tell students to remove as much coal as possible now using their spoons and toothpicks.
18. Ask students to answer questions # 7 and # 8 on their handout sheet. Record their responses for question # 8 on the board.
19. Small group activity - Have the students read and discuss with their group members question # 9. Each student should record their answer to this question.
20. Now have the students analyze the tally record on the blackboard. Examine the pattern on the board by adding all of the tallies. The pattern should illustrate how each time the cookie was altered, the value of the cookie went down. Discuss this trend and explain how strip mining removes the important minerals from the ground and leaves a big mess, just like the cookie is a big mess without the valuable chips.

21. Ask why we allow mining companies to make a mess of coal-filled mountains. (*Coal is a valuable energy source and there are large reserves of it in the U.S.*)
22. Now explain that the government will step in to force the mine companies to clean up their mess. The coal company may also want to sell the land. Pass out bottles of glue and ask them to **reclaim** or to put the cookie back together so it looks like a new cookie. This final outcome is called **reclamation (reclaim)**.
23. Ask one last time, “How much would you now pay for the new cookie?” \$0.00. Why? *Students will probably respond that the cookie is ruined or not good for eating.*
24. Explain that when humans alter the earth it has an impact on the environment. What are those impacts: *Students may respond that trees are destroyed, habitats lost, and the landscape is changed (tall mountains may be shorter).*
25. Closure: Ask students to answer question #10 and share with their group. Discuss student responses. (*Both the cookie and the coal mine have something of value in them. When the valuable material is removed, what is left is different from what was originally present. Also, the cookie and coal mine environment can both be reclaimed but never to their original state.*)
26. Show students pictures of mined area before and after reclamation (Visual #2) and compare the changes noting the land does appear to be healing after reclamation but not to its original state. (pictures found at this site: http://66.113.26/mining/reclaim_5htm.)

Closure – How is the environment of the United States affected by the human activity of coal mining? Ask this question again. Also, ask the students if they think this lesson is a good activity to learn about how human activity affects the environment.

Day 2 (choropleth map)

1. Ask students where they think coal is mined in the United States. Do they think any coal is mined in their state? Why or why not? Tell them that today’s lesson will help them to see which states have coal mines.
2. Pass out the Table of Coal Production (Handout # 2) to each student. First have them look for their state. Is it listed? (No, no coal mines in Delaware!) Ask the students if they get a sense of “whereness” from this table? (The information is in alphabetical order.) Ask if they can think how the information could be arranged so that they would get a better sense of whereness? (Map it.)
3. Inform the students that create a special kind of map – choropleth map.
4. The information needs to be divided into categories. On the right side of the Coal Production Table have the students write the following categories and list the states under the appropriate category.
5. Students will list the states under the following categories:

1-15,000 (short-tons)	15,001-30,000	30,001-45,000	45,001+
AK, AZ, AR, CO, KS, LA, MD, MS, MO, OK, TN, WA	AL, NM, OH, UT, VA,	IL, IN, MT, ND	KY, PA, TX WV, WY

6. Students will color the boxes in the legend:

0-15,000	yellow
15,001-30,000	orange

30,001-45,000 red
45,001+ purple

NOTE: On a choropleth map the highest value should be the darkest color.
(choro = place, pleth = value)

7. Students should suggest and add appropriate map elements: title, date, legend, and author to their maps. Explain that these elements help others understand the map.
8. Ask the students why some states (including Delaware) are not colored in. (*States not colored produce no coal.*)
9. Lead a discussion with questions such as: What do all of the coal-producing states have in common? (*Students may recognize they all have higher areas of elevations.*) Why don't all states have coal mines? (*Coal is a fossil fuel that was created millions of years ago when swampy areas become compressed by layers and layers of decaying plants and animals. Over time, the land folded and the layers of coal were buried deep in the ground.*)
10. Tell the students that areas on a map that have something in common are called *regions*. The colored states form the coal regions in the United States.

Application:

1. Ask students to record in journal form or with a partner:
“What are some activities humans have practiced that have changed the environment (landscape, vegetation, or soils)?” (*Students might suggest mining, damming rivers, building beach jetties, building roads, cutting forests, etc.*) “What are some examples in Delaware?” (*Examples might include building roads, creating wetlands, draining wetlands, jetties, canals, dams, etc.*)
2. Ask how these activities have affected the physical environment. (*Answers may include loss of forests, habitat, changes in landscape, etc.*)
3. Students complete the assessments *pages 7& 8*.

Extensions or Reinforcement Ideas:

1. Students might create a choropleth map of the number of mines in each state and compare the two maps.
2. Students might research what the mining industry is like today (see Educational Links page).
3. Students might research other mineral mining practices (copper, magnesium) and compare to coal.
4. Students might research the life of an early 20th century mining family and write the story of a child living then.
5. Students might research the effects of surface mining on their surrounding environments and learn what types of regulations have limited mining today.
6. Refer the students to the library book, “In Country” by Cynthia Rylant.

Citations for Graphics, Information, Adapted Lesson, etc.

Lesson has been adapted from one presented by Michael Kijowski, CRS D

<http://www.wonderfulwv.com/gallery.cfm?menu=aug3> (picture at beginning of lesson)

<http://www.eia.doe.gov/cneaf/coal/cia/t1p01.txt> (coal production table)

<http://members.tripod.com/~cyberbros/Hobet.jpg> (land after reclamation)

http://66.113.204.26/mining/reclaim_5.htm (pictures of mining and reclamation)

<http://nationalgeographic.com/xpeditions> (U.S. Map)

Educational Links on coal mining

<http://www.eia.doe.gov/kids/non-renewable/coal.html>

<http://www.udu.edu/KGS/coal/webcoal/pages/coal3.htm>

<http://www.eia.doe.gov/kids/non-renewable/coalvisit.html>

<http://www.osmre.gov/mapinfo.htm>

<http://www.osmre.gov/learn.htm>

Tips for implementing this lesson:

1. Chocolate chip cookies can often be found at discount and dollar stores.
2. Students will eat the cookies no matter what you tell them. Try to have them wait until the end of the each mining activity. Some will relish the idea of putting the cookie back together with glue; others may not want to “spoil the cookie.” I have collected the chocolate chips (simulating the sale of the coal).
3. Soft cookies are easier to dig.

Name _____ Date _____

Constructed Response

Prompt:

How might the environment of a steep mountain chain be affected by the decision to build a super highway from one side of the mountain to the other? Explain your answer.

Multiple Choice: Select the best choice for each statement.

Prompt: The United States decides to build a super highway from one side of a mountain to the other. How might this decision affect the environment of the mountain?

- a. The mountain may be unchanged.
- b. The mountain may have more rainfall.
- c. The mountain may stop being polluted.
- d. The mountain may lose some of its trees.

Prompt:

Central City decides to build a dam across the Brown River to create more electrical power. How might this decision affect the environment of the Brown River?

- a. The flooding may make the Brown River increase car traffic.
- b. The flooding may make the Brown River flow faster below the dam.
- c. The flooding may make the Brown River lose some surrounding trees.
- d. The flooding may make the Brown River turn red from being held back.

Multiple Choice

Benchmark Statement: Students will apply a knowledge of topography, climate, soils, and vegetations of Delaware and the United States to understand how human society alters, and is affected by, the physical environment.

This assessment should give evidence of the student’s ability to apply a knowledge of topography, soils, and vegetation of the United States to understand how human society alters, and is affected by the physical environment.

Prompt One:

The United States decides to build a super highway from one side of a mountain to the other. How might this decision affect the environment of the mountain?

- a. The mountain may be unchanged.
- b. The mountain may have more rainfall.
- c. The mountain may stop being polluted.
- d. The mountain may lose some of its trees.

Prompt Two:

Central City decides to build a dam across the Brown River to create more electrical power. How might this decision affect the environment of the Brown River?

- a. The flooding may make the Brown River increase car traffic.
- b. The flooding may make the Brown River flow faster below the dam.
- c. The flooding may make the Brown River lose some surrounding trees.
- d. The flooding may make the Brown River turn red from being held back.

Correct Response for Prompt One: d
Correct Response for Prompt Two: c

Picture of an undisturbed environment (make into transparency or make copies for groups)

<http://www.wonderfulwv.com/gallery/cfm?menu=aug3>



Active mine and its reclaimed result

http://66.113.204.26/mining/reclaim_5.htm



A Photo of a surface coal mine operation after mining was stopped, but before any reclamation had started.



The finished, reclaimed mine, with the land fully restored to a very useful state by the mining company.

Name _____ Date _____

The Mining of a Chocolate Chip Cookie

1. How is the chocolate chip cookie like a coal mine? _____

2. How much would you pay to eat this cookie? \$.05 \$.10 \$.15 \$.20 \$.25

4. How much coal were you able to “dig” from the mine without disturbing the rest of the surrounding area?

4. How much would you pay to eat this cookie? \$.05 \$.10 \$.15 \$.20 \$.25

5. How much coal were you able to “scrape” from the mine? _____

6. How much would you pay to eat this cookie? \$.05 \$.10 \$.15 \$.20 \$.25

7. How much coal were you able to “blast” from the mine? _____

8. How much would you pay to eat this cookie? \$.05 \$.10 \$.15 \$.20 \$.25

9. What happened to the value of your cookie with each type of mining? _____

10. How is mining the cookie like mining coal? _____

2003 U.S. Coal Production Table

Coal-Producing State	Number of Mines	Production (Short-tons)
Alabama	43	20,118
Alaska	1	1,081
Arizona	2	12,059
Arkansas	2	8
Colorado	12	35,831
Illinois	22	31,640
Indiana	31	35,335
Kansas	1	154
Kentucky	399	112,680
Louisiana	2	4,028
Maryland	16	5,056
Mississippi	1	3,695
Missouri	2	533
Montana	7	36,994
New Mexico	5	26,389
North Dakota	4	30,795
Ohio	54	22,009
Oklahoma	7	1,565
*Pennsylvania	242	63,725
Tennessee	23	2,564
Texas	12	47,517
Utah	13	23,069
Virginia	123	31,596
Washington	1	6,232
West Virginia	249	139,711
Wyoming	18	376,270

Information from Energy Information Administration

*Pennsylvania is the only state that produces the hard coal, anthracite

Anthracite	64 mines	1,260 short-tons
Bituminous	178 mines	62,465 short-tons

1 – 15,000 (short tons)	15,001 – 30,000	30,001 – 45,000	45,001 +
-------------------------	-----------------	-----------------	----------

Name _____

Date _____

(title)



Legend:



