Finding Black Treasure:
the Formation and Exploration of Coal

I. INTRODUCTION

Three years ago, I participated in a coal unit with the three elementary teachers at my school. Having grown up and spending over half my life in Central Kentucky, I was amazed to learn so much about coal during the unit. Before, I had no idea how coal was formed. I didn't know how many people are involved in the coal industry, nor did I understand its importance to Eastern Kentucky, as well as the rest of the world. I only saw coal as a nuisance because of all the dust on the roads. Before we taught the unit, the teachers at my school had the opportunity to tour an underground mine. I went and was so amazed! Now, not only do I understand some of the forethought, planning, and safety involved in underground mining, but I also respect coal miners and the coal industry so much more.

While teaching Earth Science to my class, in the fall of 2006, the question of, "How do 'coal people' find coal?" came up in discussions with my students. Other questions that arose included "How far down is coal?", "Which is lower, coal or gas?", "Can you also find gas where coal is located?", and "Can coal be man-made?" Because of their interest in these topics, and because I knew resourceful people who could help me, I was sure this would be a great topic for my coal unit. Hence, the title and focus of my unit is "Finding Black Treasure: the Formation and Exploration of Coal".

II. ACTIVITIES AND GOALS

The educational objectives for the unit included:

- students make sense of the various things they observe
- students make sense of ideas and communicate with visual arts
- students will understand scientific ways of thinking and working; and use those methods to solve real-life problems
- students identify, analyze, and use patterns such as cycles and trends to understand past and present events and predict future events
- students identify and analyze systems and the ways their components work together or affect each other
- students use the concept of scale and scientific models to explain the organization and functioning of living and nonliving things and predict other characteristics that might be observed
- students understand how living and nonliving things change over time and the factors that influence the changes.

To kick off the unit, I had each student complete an individual K-W-L chart and include it in their coal journal. The next day they worked in small groups to compose a larger K-W-L chart (see picture #1). They listed what they already **K**new about coal and what they **W**ant to know about coal. While teaching the unit, I tried to cover all the "W" questions, not only covering the unit materials, but also answering any additional information they wanted to know about coal. At the end of the unit, the students went back and completed the what they **L**earned portion of the chart.

Grade appropriate lessons were taught on the following topics: the formation of coal, types of coal, where and how coal is found, types of mining, uses of coal, and reclamation. Crossword puzzles, maps, coal samples, and review sheets were used to reinforce learning.

After the lesson on how coal was formed, we made a coal swamp model. Students were able to simulate, observe, and explain the conditions under which coal is formed. Students enjoyed mixing the sand with water, collecting vegetation, and mixing dirt and water for the final layer. However, none of us enjoyed the smell (see picture # 2).

We also made a model of rock layers and a coal seam. The layers were made from three different colors of jello, bananas, crumbled graham crackers, and whipped topping. The jello represented rock layers of limestone and sandstone, the bananas were fossils, the graham crackers represented coal, and the whipped topping - siltstone. Once the formation had set we were able to look through the side of the glass dish and see a model of various strata. With a straw we simulated drilling a core sample. With a large square section of the model, we simulated uplifting, overthrust, and faulting. We ran water over the square section to demonstrate water erosion and used a hair dryer to show wind erosion. The students loved this experiment. They made the various layers of the model (see picture # 3), performed the simulations, and of course were able to eat the remaining gelatin layer cake. With this model, they were able to make observations similar to those geologists and paleontologists see when working in the field.

We made a model of settling rock, sand, and water, showing sedimentation (picture # 4).

Another was created to demonstrate how mountain ridges, like those in Eastern Kentucky, were formed after years of water runoff (see picture # 5).

A parent of one of the students made a model (see picture # 6). This model showed how subduction at convergent plate boundaries happens. He explained how geologists many be confused when looking for coal where subduction has occurred. The older strata are no longer under younger ones. In fact, half of the youngest stratum is on the very bottom. Students had many questions and were fascinated with the demonstration.

After studying the types of coal, coal samples were used to identify the types (picture # 7). Also, we watched the video "Coal: The Inside Story".

The next lesson included types of mining. Students drew examples of surface mining and three types of underground mining on construction paper (picture # 8).

Following the lesson on how coal is found, Mr. Rusty Justice brought in a core drill sample. (see picture # 9). He explained how coal companies use core samples to find coal. He also identified each rock layer; and explained how to use the core sample to determine how far down the coal seam was. The students were amazed with the core drill sample.

In the classroom students participated in a simulation called The Geologists' Dilemma. In this simulation students explain the relationship between supply and demand of various energy resources. Five different colors of beads are used to represent energy resources, with the black beads being coal and having more "coal" beads than any other. The students were divided into teams or coal companies of about three students. The beads were then thrown all over the classroom. Students had about one minute to find as many beads as possible. After collecting for the minute, they stopped, counted their beads (see picture # 10) and completed a trial sheet. This was done three times. Then students answered and discussed questions related to supply and demand. (See attachment # 1.)

The class also took part in "Exploration Activities". The objective for this activity was to understand the stages in finding coal resources. Students created maps of the school yard. (See

attachment # 2.) One evening I buried black rocks on the school yard at various locations. The next day, students were given a shovel and a copy of the school yard map with the location of the rocks marked with an "X". They used the maps to locate the rocks (see picture # 11).

As part of our review, we made coal BINGO cards. For the clues, definitions were given and students had to match the definition to the key term used on the BINGO card (attachment # 3). Students also created word find puzzles using key terms (picture # 12 and attachment # 4). Students also completed a final test on the coal topics discussed in class (attachment # 5).

Our culminating activity was a field trip on which they were able to see a mountain that had been cut through in order to build a road. Students were able to view at least three coal seams, as well as other rock layers. They gathered rock and coal samples (picture # 13) and used the Mohs scale of hardness to determine what their rock samples were.

Each student at our school participated in a school-wide coal fair. Projects were brought to school and one evening we invited school families to come and view the projects (picture # 14). Each child was presented with a certificate of participation (attachment # 6) and projects were chosen to be entered into the C.E.D.A.R. Fair.

III. SUMMARY

I feel this unit was a complete success based on the work, discussions, and involvement from each of my students. Each of the educational goals were met and learning took place which was evidenced in students' work samples and class discussions. My students always beg for more hands-on activities and coal units provide ample opportunities for such activities.

Based on their responses, the students' favorite activities were the making of rock layers and coal seam from jello and graham crackers. Middle school students love to eat! They also loved having to find their coal samples based on information provided on a map. It became a big race, even though I reminded them not to run. Middle schoolers are also competitive. The sample of a core drill was also

very "neat". Their interest was obvious from the thoughtful questions that were raised.

Many of the multiple intelligences were integrated into this unit. The verbal/linguistic, logical, visual, kinesthetic, intrapersonal and interpersonal intelligences were all incorporated into the unit. If I teach this unit again, I will plan to include more activities related to the musical intelligence.

Many of the parents told me they were amazed at how much their child had learned about coal. There were numerous positive comments the night of the coal fair. At our school, we do not teach the coal unit every year, but many parents seem to think we need to teach it each year. A fellow teacher who teaches special classes at our school sat in on one of my lessons. She later told me, "I am so amazed at how much those kids know, especially about coal!"

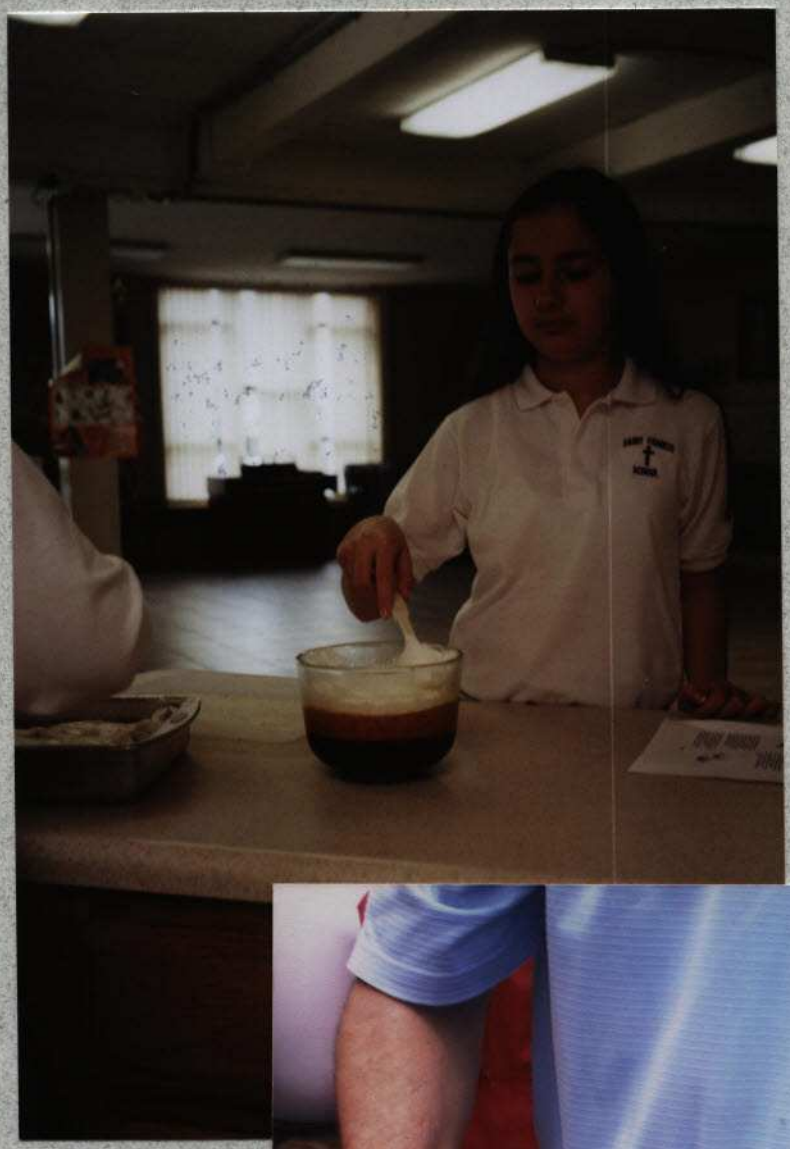
From the students' comments on the evaluation, (attachment # 7), they loved all the hands-on activities and the field trip. New things they learned included how to find out how far down the coal seam is, that there could be several coal seams at one location, what room and pillar mining is, that not all the states in the U.S. have coal reserves, and all the different types of reclamation projects available. Some things to be changed included: some students wanted more taught about how coal is changed into electricity, some wanted more coal to be hidden on the coal dig activity, and some said they would not change a thing.

I had planned for this unit to be completed in two weeks. Actually, it took three weeks and I certainly could have used a fourth week. Because of testing, bad weather, and other interruptions, I was not able to complete a couple of the activities planned. However, other activities were able to be substituted.

When I teach this unit again, I plan to utilize more parent involvement. I would be nice if they shopped for all the items needed. I would also make more time to include the energy and electricity aspect of coal.

Picture #1 Making a K-W-L chart

Picture #2 Our coal swamp



Picture #3

Jello rock layers

Picture #4

Sedimentation

Picture #5 Model simulating mountain ridges

Picture #6 Subduction

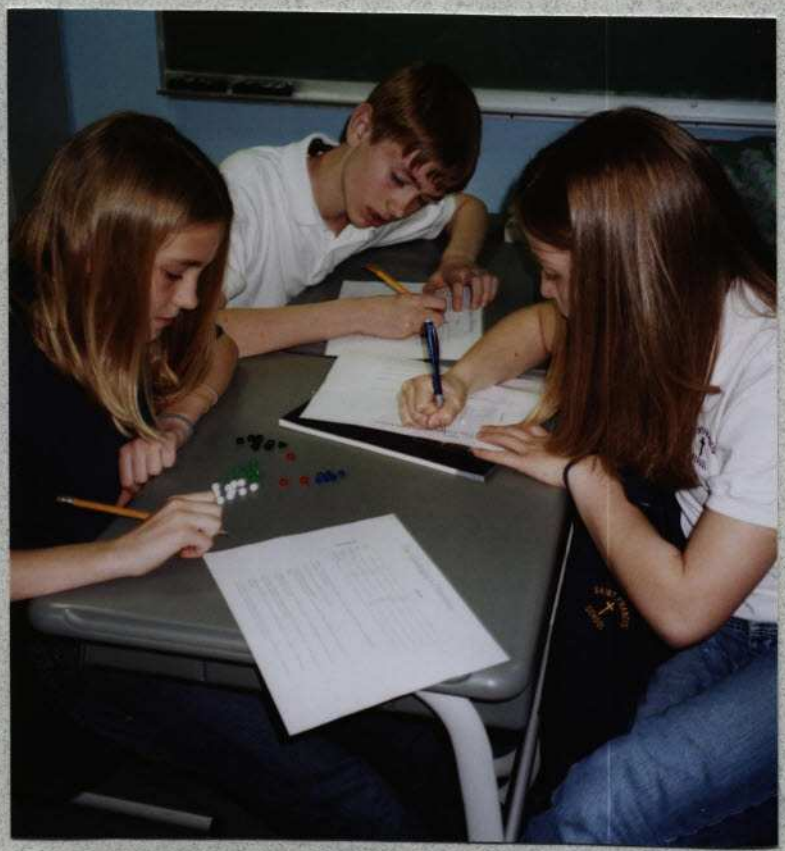
Picture # 7 Looking at coal samples

Picture # 8

Posters with types of mining

Picture #9

Core drill sample



Picture #10

Counting energy resources

Picture #11 Hunting for coal

Picture #12 Word-finds with coal related words

Picture # 13 Rock samples from our field trip.

Picture #14 Schoolwide coal fair

The Geologist's Dilemma

SOURCE	TRIAL 1	TRIAL 2	TRIAL 3
Coal			
Oil			
Natural Gas			
Nuclear			
Solar/Other			

3. Start a second search for one minute. Each company must search for resources still missing. Record totals.

4. Do the same for a third one-minute round.

5. Discuss the following questions:
   a. Which energy sources were easier to collect? Why? Which were the most difficult? Why?

   b. What makes them easy or difficult to find? Is it the availability of the beads or is it the skill of the searchers?

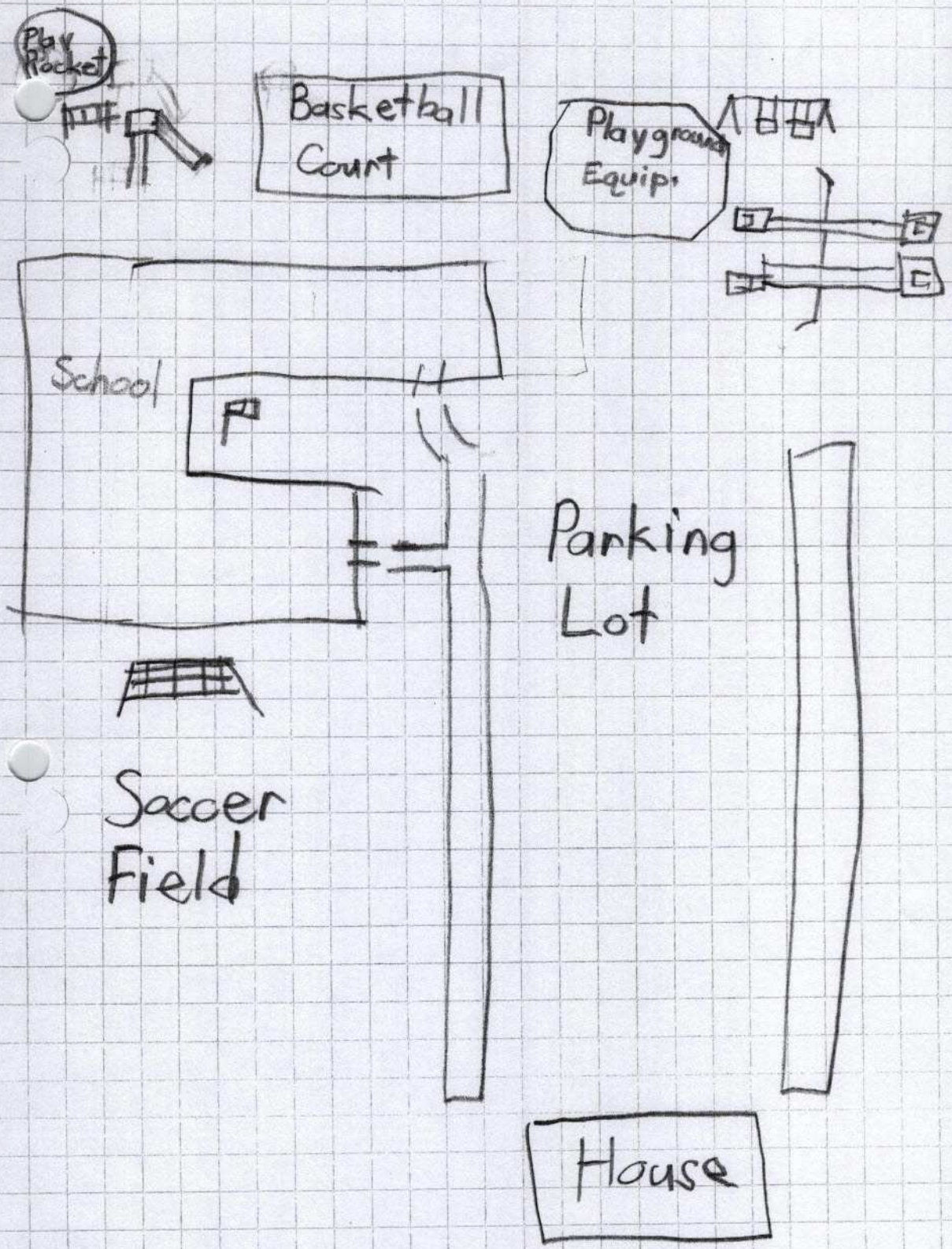
   c. Looking at the piles of energy from each of the different rounds, which is greater? Why? Which round is the smallest? Why?

   d. Did anyone collect more than one energy resource? Is it realistic to collect more than one?

   e. As energy resources become more scarce and demand continues to increase, what should happen to the price or cost of energy resources?

Attachment # 1

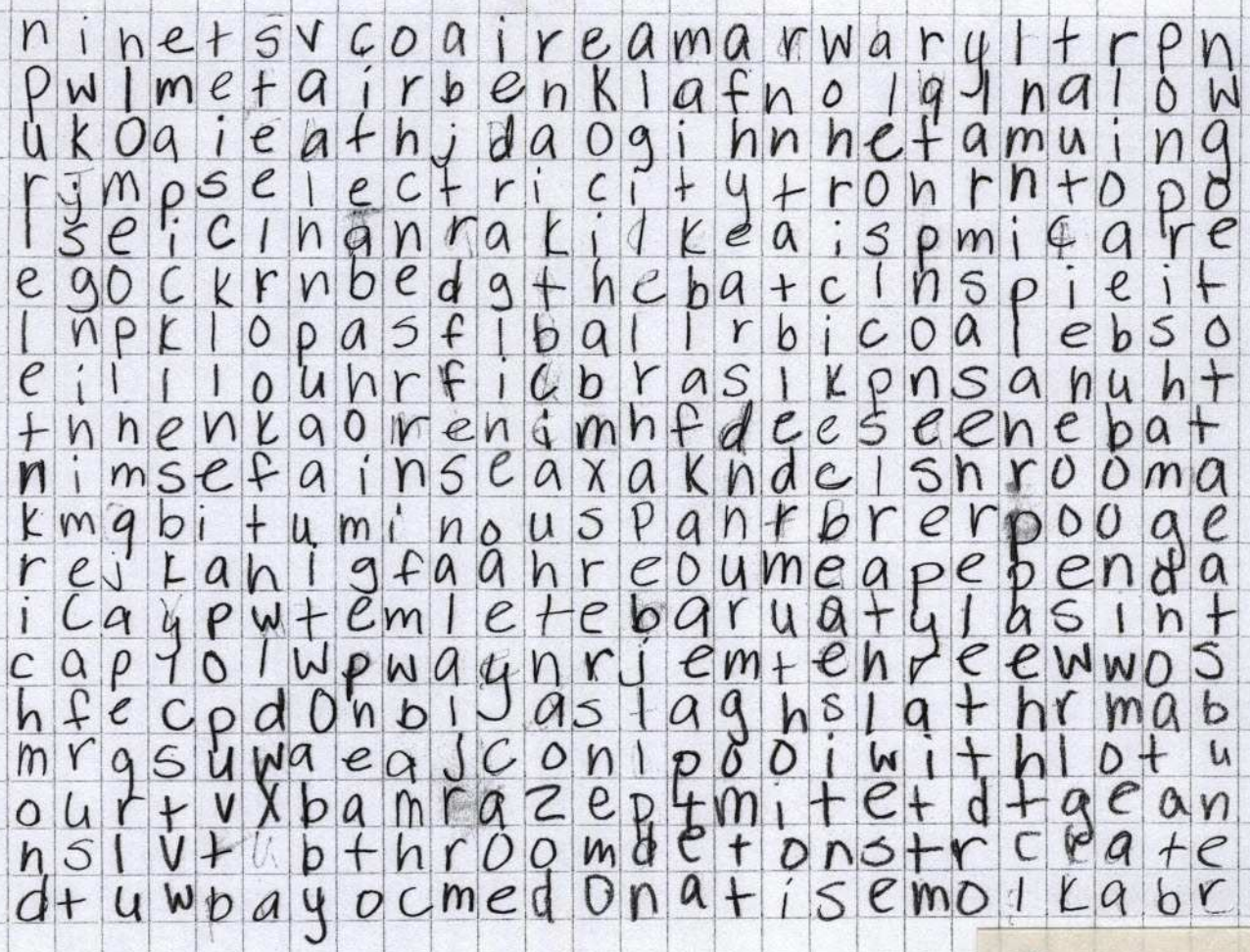
Attachment #2



B I N G O

dragline	peat	exports	trains	trucks
shuttle	barge	steel	shaft	miner
lignite	drift	Free	coke	over burden
surface mining	seam	carbon	slope	electricity
deposition	anthracite	bituminous	longwall miner	continuous miner

Attachment #3



Attachment #4

Seam
steel
exports
electricity
carbon
miner
coke
dragline

bituminous
deposition
surface mining
Shaft

Attachment #5

SCIENCE - COAL TEST Name _____

1. What are the two basic methods to mine coal? Surface mining and underground mining

2. Match the types of coal to their definitions:

bituminous C

sub-bituminous b

lignite a

anthracite d

a. the softest coal, it is brownish-black and crumbles easily

b. medium-soft coal, it is used mostly to produce steam for electricity generation.

c. medium-hard coal, it has high heat value and is widely used to make coke used in the steel industry.

d. the hardest coal, has a very high heat value, it burns slowly and makes a good home heating fuel.

3. List five examples of reclamation projects:

a. campground

b. airport

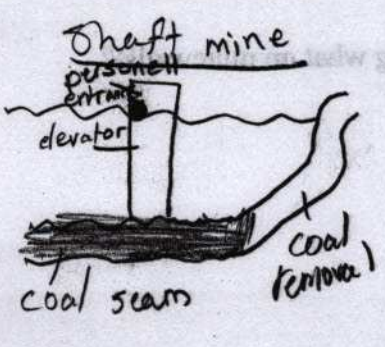
c. wildlife reserve

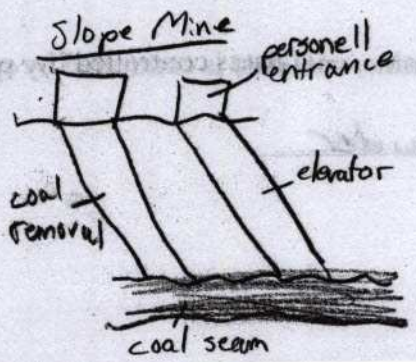
d. golf course

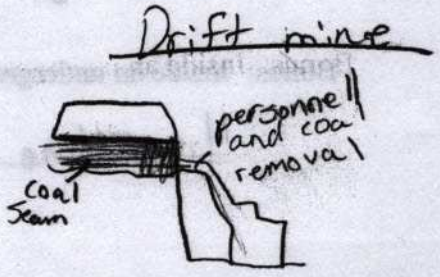
e. school

4. How was coal formed? Millions of years ago huge plants deteriorated to peat which was compressed into coal under the crust.

5. What are the three types of underground mining? Name and describe them (or draw pictures and label them.)







6. What are four of the major uses of coal in the United States?

a. For electric power

b. For industry

c. For making steel

d. For export

7. How is electricity generated from coal?

Coal is burned to heat water, producing steam. The steam turns a turbine. Turbine spins magnets inside wire. That is Electricity!

8. Name five different types of safety equipment that underground miners use:

a. hard hats

b. light

c. air filter masks

d. boots

e. goggles

9. What are four of the major challenges (consequences) of using coal?

a. air pollution

b. " the greenhouse effect"

c. methane is released when mining coal

d. falling rocks underground endanger miners

Bonus: Inside an underground mine, coal dust is controlled by spraying what on mine walls?

limestone powder

ST. FRANCIS SCHOOL 2007 COAL FAIR

This certifies that

_____

Participated in the

ST. FRANCIS SCHOOL 2007 COAL FAIR

We appreciate your participation!

SPECIAL COAL FAIR AWARD

Sister Kathleen Morrissey, B.V.M.

Sister Kathleen Morrissey — Principal

Mrs. Traci Bishop

Mrs. Traci Bishop — Teacher

STUDENT EVALUATION OF THE COAL UNIT

Attachment #7

1. What did you like best about the coal unit?

2. What were some things you learned about coal that were new to you?

3. What changes could be made to improve the coal unit?

4. What did you learn from completing your coal fair project?