Where is Wyoming's Coal?

By Greg Schliske
Wyoming Geographic Alliance

Overview: The idea of this lesson is to have students participate in small group and whole group activities which center on Wyoming coal mining. Locations of coal mines will be identified, as well as how coal is transported out of the state. The new 12' by 12' map will be used to identify rail locations and mines. The use of map legends, symbols, and scale of distance will be an important part of this lesson.

Grade Level: 4th grade

Materials required: Twenty 3 x 5 cards; 12' by 12' Wyoming map; chart paper, computer with projector or smart board;

Learning Objectives:

- Students will understand which areas of Wyoming contain coal deposits/mines
- Students will understand that most coal is transported out of Wyoming by rail to power plants in the Midwest and Texas
- Students will use map scale to determine distances between coal mines in the state
- Students will use the map legend to determine what different symbols and objects stand for
- Students will demonstrate understanding of relationships of one map location to another using cardinal and intermediate directions

National Geography Standards
The World in Spatial Terms
Standard 1 - How to use maps and other geographic representations tools and technologies to require, process, and report information from a spatial perspective
Places and Regions
Standard 4 - The physical and human characteristics of places
Standard 5 - How culture and experience influence people's perceptions of places and regions
Human Systems
Standard 11 – The patterns and networks of human interdependence on Earth's surface

State Standards:
SS 4.3.1 Students describe the importance of major resources, industries, and economic development of the local community and Wyoming.
SS 4.3.2 Students describe different ways that people earn a living in Wyoming.
SS 4.5.1 Students use physical maps, political maps, and globes to identify locations using scale, cardinal and intermediate directions, legends, keys, and symbols

Geographic Themes: Places and Regions; Environment and Society; Human Systems

Opening:
Shut off the lights in the classroom.
Pose the following question to the class: "How do we receive the power to run our lights, computers, and all other electrical devices in our homes and at school?" If a student doesn't provide the answer of "electricity" the teacher leads the class in the direction of this answer. Turn the classroom lights back on. Have students discuss other items in their homes which need to have electricity to work. Then have the students think about how electricity is generated. Ask, "How do we obtain the electricity we use for our electrical devices?" (for teacher: The learning will focus on energy generated by coal.) Depending on the discussion which takes place, the teacher will direct the discussion toward coal. The teacher may say, "Wyoming has many sources of energy, but we will be discussing coal in today's lesson".

Procedure:
1. Have the students get into groups of two or three and write down as many locations of coal mines in Wyoming as they can think of. (Student responses may vary based on how much knowledge they bring into the classroom on the subject, and how much class discussion has taken place).

2. Have groups contribute to a whole-class discussion using a K-W-L chart to answer the question: "Where does coal mining occur in Wyoming?" After the "knowledge" column has been completed, have the students then complete the column of "what they want to know". (Where are coal mines in Wyoming? Are they all in one location. How is the coal transported once mined?)

(The "what we learned" column will be completed at lesson's end).

3. Explain to students Wyoming is a wealth of energy sources. It is rich in deposits of the fossil fuels coal, oil, and natural gas. Fossil fuels come from the remains of plants and animals from long ago. Our state used to look much different than it does today. Here's an animation of how coal was formed in prehistoric times.
http://www.hk-phy.org/energy/power/source_phy/flash/formation_e.html

Wyoming contains much of the nation's coal. (show pdf of U.S. coal production)
http://www.nma.org/pdf/c_production_state_rank.pdf

4. Once Wyoming's coal is mined what happens to it? It is sent from Wyoming's mines to power plants. Most of them are out of state.
These power plants generate electricity. Here is how it is done.
Go to the following site and project it on the smart board or big screen.
http://www.darvill.clara.net/altenerg/fossil.htm#how
Click on the link "fossil fuel power station – how it works"

Have a brief discussion of what the students noticed in the video. Focus the questions on how the coal is delivered to the coal fired electricity plants. (rail)

5. Next, take the class to the Wyoming map. Have them stand next to their KWL activity partner in a semi-circle near the bottom of the map so they can see the map and the legend. Direct the students' attention to the legend, noting what each symbol stands for. Tell the students, "I am going to stand on a river in Carbon County." Walk to Carbon County and stand on the blue line representing the North Platte River. Explain that you knew to stand on the blue line because that is the symbol for a river in the map key. Ask a student who volunteers to stand on a roadway on the map and tell what type of roadway it is. They tell what type of roadway it is and its specific name. (example: Interstate 80) Have them explain how they know what type of roadway it is. (the symbol in the key)
Other suggestions: stand on a county seat noting the green star symbol
Have a student walk to a fort. They should explain the symbol in the legend is how they found a fort. (They are also labeled on the map).

Ask students if they see a symbol for coal. They will notice there isn't one.

Tell students they are going to next discover where the coal mines are located in the state. Tell students the cards will help us locate the mines. Beside the legend place 18 3 x 5 index cards face down. The cards should be labeled with county names as follows: make sure they are shuffled and in no particular order. A sketch of a lump of coal could be on the unlabeled side of each card.

Campbell County – 13 cards
Converse County – 1 card
Hot Springs County – 1 card
Lincoln County – 1 card
Sweetwater County – 2 cards

Select one pair of students at a time. One of the students selected picks a card. This student and his/her partner walk on the map to the correct county. The student places the card on the correct county. Their partner announces the name of the county to the class. Then they return to their spot off of the map. Select another pair of students and have them do the same thing. This continues until all of the cards are on the map. Several pairs of students will have to go to the map twice. When every pair has gone to the map once, you may have them start over in the same order, or select pairs to continue to take cards to the map until all of them have been placed. When finished have students make observations regarding where the majority of coal mining takes place in the state. (Campbell County) There are 13 mines in this county.
Ask students how the mined coal is transported out of the state. (railroad) They should know since they have completed the first two columns in the KWL chart.
(Though there is no reference in the legend, each black dot on the end of a branch of the rail line is a coal mine.)
Share with students that most power plants in the country are located in Indiana, Illinois, and Texas. These plants are located east and south of Wyoming. Some Wyoming coal is used at coal fired plants in Wyoming. http://www.sourcewatch.org/index.php?title=Existing_U.S._Coal_Plants (this website shows coal fired power plants by state) This can be done later on the Smartboard or projector from the computer.

Students will next answer map questions which meet the lesson objectives regarding using scale of distance. Students can walk on the map as they

answer questions. Distance from heel to toe can be compared to map scale and used to find distance.
Any questions which get students to use scale and map symbols would reinforce map skills. Here are some sample questions:

1. Which county is directly south of Campbell County? (Converse)
2. Which Wyoming towns which are also county seats would coal trains pass through before entering South Dakota and Nebraska? (Lusk, Newcastle, Torrington)
3. On which side of Highway 59 are Campbell County's coal mines located? (east)
4. Using the scale of distance, about how far is the northernmost Campbell County mine from the southernmost mine (approx. 70 miles)
5. What is the county seat of Hot Springs County? (Thermopolis)

6. Follow a highway route from Gillette to Rock Springs. About how far is it? (about 350 mi.)
7. Follow a highway route from Kemmerer to Rock Springs. About how far is it? (About 60 mi.)
8. Follow the highway 59 route from the Campbell County seat to the Converse County seat. About how far is it? (120 miles)

Closing: Have students sit around the floor map. Fill in the final column of the KWL chart as the students volunteer answers regarding coal mine locations in Wyoming. The chart should continue to be used beyond this lesson as students discover other facts about energy resources in the state.

Assessing: Observing students during discussion in small group and in the large group map activity will be done by taking anecdotal notes. A formal assessment is located at the end of the lesson.

Extending:
1. One way to extend the lesson would be for students to make a drawing or painting of what it once looked like in Wyoming in prehistoric days. The drawings would include plants, trees, and animals from the time.
The class could place the drawings on the floor map where the ancient lakes and forests were located (The Powder River and Green River Basins would be two likely areas). You could also have toy dinosaurs available to place on the map.

2. Invite a representative from the mining and/or railroad industry visit your classroom. A field trip to a mine would also be a good way for students to get a first hand look at what happens in day to day operations. (There are over 6,000 coal mine employees in Campbell County.)
3. Go to the Wyoming Mining Association site which shows the coal mines in the state and provides production and employment information at each mine. Google – Wyoming Mining Association; click on Wyoming Coal; Create line graphs displaying the information provided at the Wyoming Mining Association site on production or employment numbers from one year to the next at a mine the teacher or students choose. (Click on a mine to get these numbers.)

Formal Assessment of student knowledge (using the floor map) Students will walk on the map to determine distance.

1. Which are farther north, Converse County mines or Sweetwater County mines?

2. What is the county seat of Hot Springs county?

3. Which general direction is a loaded coal train traveling as it heads to Newcastle from Gillette?

4. Use the scale of distance to determine how far it is in a straight line from the Campbell County seat to the Sweetwater County seat.

5. Following the rail lines, about how far is it from Lusk to the mines in Converse County?

Assessment answer key

1. Converse County mines
2. Thermopolis
3. east or southeast
4. between 300 and 350 miles (accept any answer in this range)
5. about 100 miles (accept an error of 10 miles above or below this number

Resources: Wyoming 12' by 12' map, computer with projector or Smart Board,
4th grade text, Wyoming Crossroads of a Continent Chapters 1 and 10, coal formation diagram (at bottom of page)

Web sites:
http://www.hk-phy.org/energy/power/source_phy/flash/formation_e.html
http://www.nma.org/pdf/c_production_state_rank.pdf
http://www.darvill.clara.net/altenerg/fossil.htm#how
http://www.sourcewatch.org/index.php?title=Existing_U.S._Coal_Plants
http://wsgs.uwyo.edu/coalweb
http://nationalatlas.gov/articles/transportation/a_freightrr.htm#two
http://www.wsgs.uwyo.edu/AboutWSGS/coal.aspx
http://www.cartracks.com/Powder-River-Basin.htm
http://www.dot.state.wy.us/webdav/site/wydot/shared/Planning/Wyoming%20State%20Rail%20Plan.pdf
exhibit 2-1 has a railroad map of WY in addition UP and BNSF USA rail lines