

Mining Coal

Title: Mining Coal - Kentucky

Level: Primary - Intermediate (1 - 5)

Time: Varies according to which activity is used

KERA Goals: 1.2, 1.4, 2.6, 2.7, 2.8, and 6.1

Objective: Students will gain and demonstrate knowledge of the process used in mining coal

Background Information:

What is coal mining?

Mining is the process of getting the coal out of the ground.

How is coal mined?

Coal is mined by surface mining or underground mining.

What kind of mines are in Kentucky?

Kentucky has both surface and underground mines.

Surface mining is used when a coal seam is located close to the surface. Heavy equipment is used to clear the land of trees and shrubs. The topsoil is then removed and saved to be used later. Holes are drilled into the rock and explosives are placed in these holes. The explosion breaks up the dirt and rock called overburden. The overburden is then removed by giant earth-moving machines called draglines. When the coal is uncovered smaller shovels scoop up the coal and load it into trucks. Once the coal is mined the overburden and topsoil are replaced. Then the site is returned to the way it was before mining.

Underground mining is used when the coal lies in the deeper layers of the Earth. There are three types of underground mines: slope, drift, and shaft. When the coal seam is fairly close to the surface yet too deep to use surface mining, a slope mine can be built, with the mine entrance being a tunnel which slants down from the surface to the coal seam. A drift mine is a mine in which the entry is directly into a horizontal coal seam exposed at or near the surface. The most common type is the shaft mine. These mines may be 400 to 1,000 feet deep. Miners remove the coal by drilling a hole, or shaft, in the ground until they reach the layer of coal. Once they reach the coal, they dig tunnels in the coal seam. These tunnels are used for traveling throughout the mine, moving coal from place to place and allowing air to circulate within the mine.

What kind of underground mining is used in Kentucky?

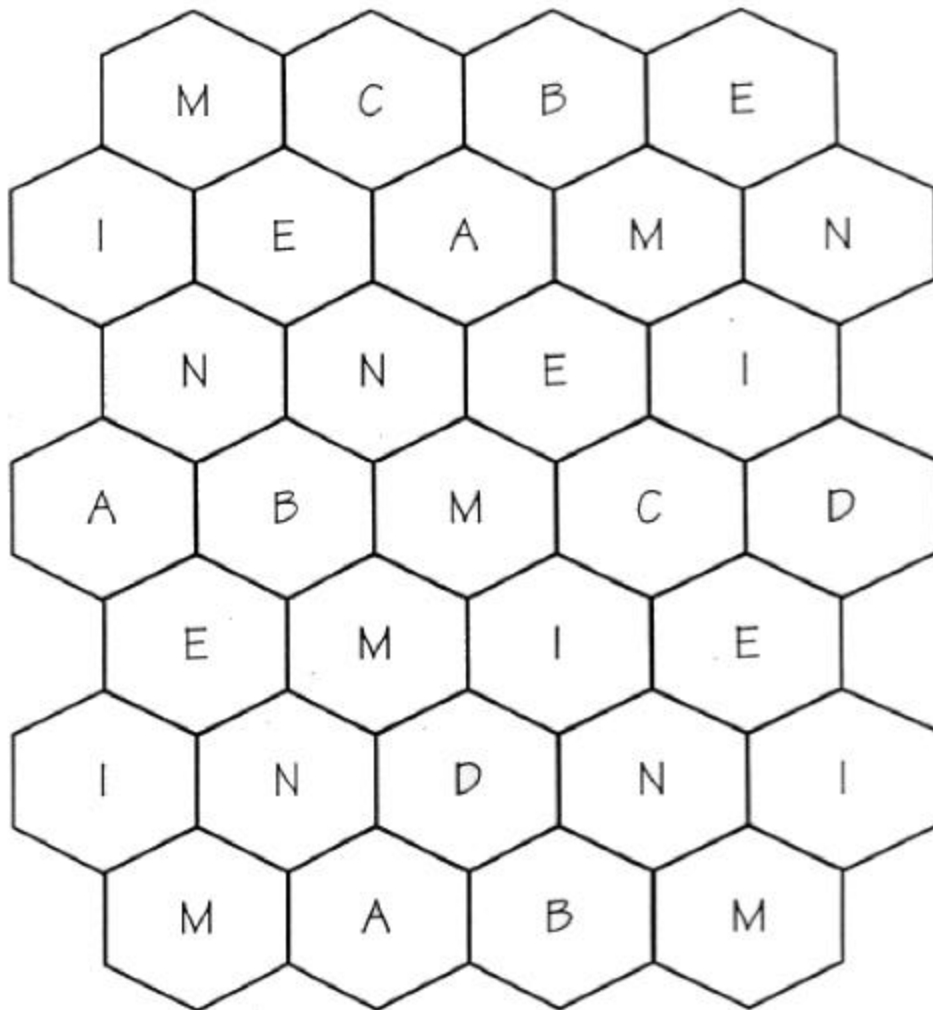
In Kentucky, two types of underground mining are primarily used: room and pillar mining and longwall mining.

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Room and pillar mining leaves pillars, or blocks, of coal behind. Continuous-mining machines are used to remove the coal. As the machine breaks the coal, large arms gather the coal on a conveyor belt. The conveyor belt then carries the coal away from the seam, and it is loaded into shuttle cars. The mining machine is then moved to the next area to be mined. This method of mining leaves almost half of the coal in the mine.

1. A Pattern Play Word Puzzle

DESIGN - TWO - SHAPE



MINE

Directions: Color all the hexagons (six-sided shapes) that have the same letters as the

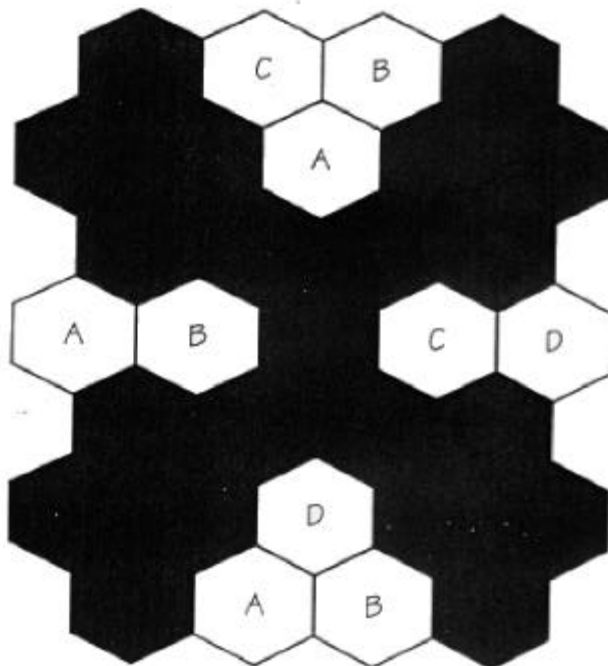
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word MINE. When you are finished, you will have a nice design.

Answer to Design - Two - Shape:

Instructions for Exercise: Students will color all of the hexagons that have letters which are in the word MINE. Then color, using a different color, all the shapes having letters not found in the word. The letters -M-I-N-E- do not have to be in order. When students are finished, there will be a pleasing two-color pattern design.

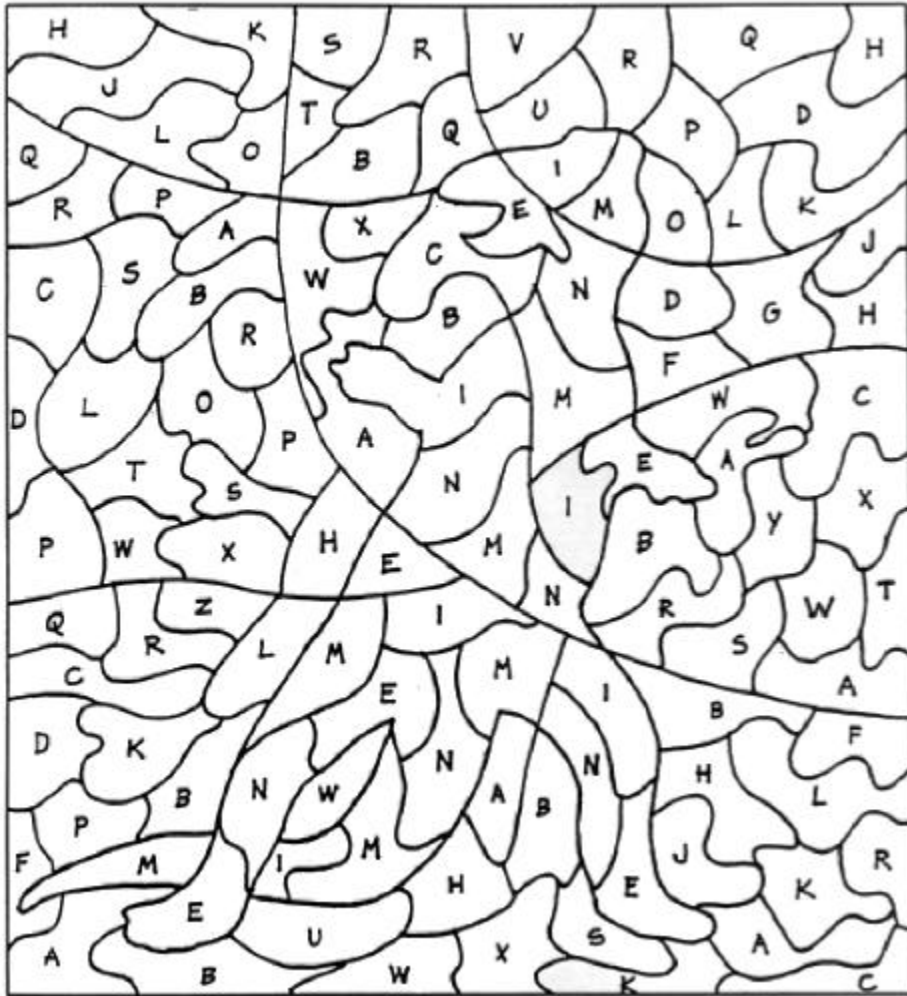
*Younger students may color the hexagons with the letters -M-I-N-E- and not color the other hexagons.



2. An Outline to Find Word Puzzle

DINOSAUR LETTER SEARCH

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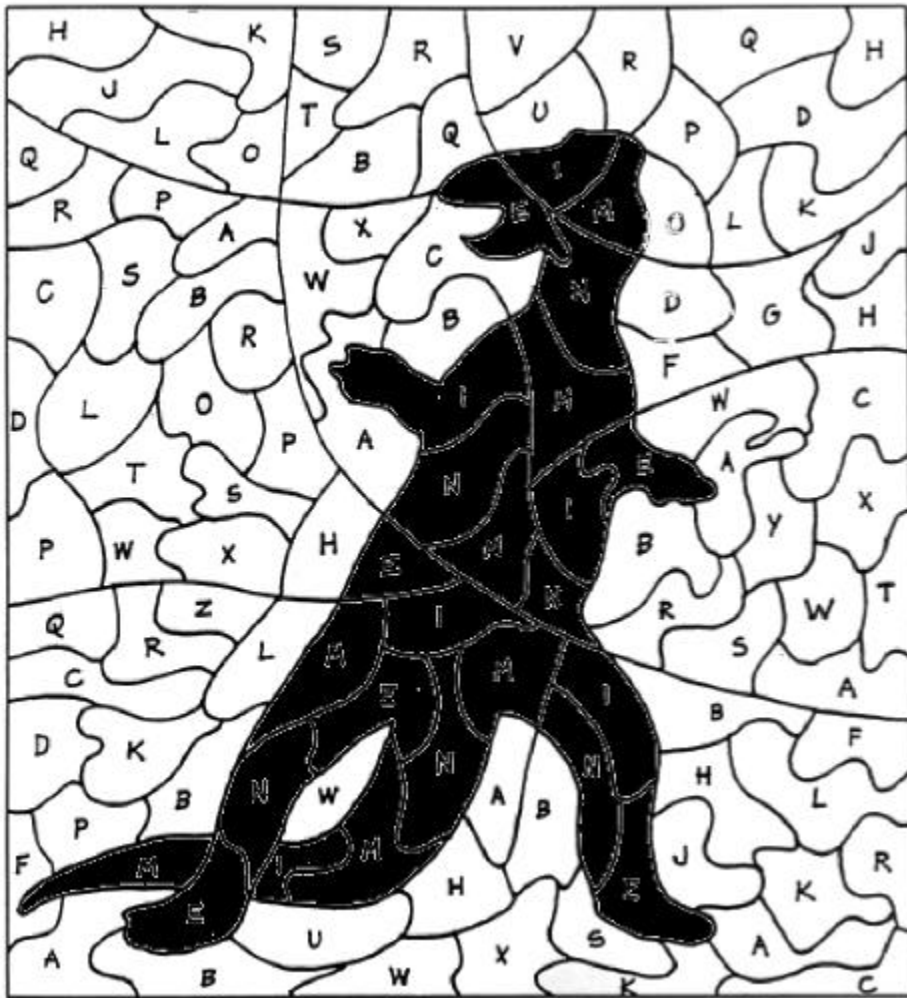
DIRECTIONS: Can you find the dinosaur? Color all the shapes in the puzzle which have the letters in the word MINE.

Answer to Dinosaur Letter Search:

Instructions for Exercise:

Students will color the shapes in the puzzle which have letters that are in the word MINE. After all the correct shapes have been colored a dinosaur will appear.

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3. A Spell - Well Word Puzzle

SPELLING DEMONS AND ENERGY

M WHOLE	U KNEW	U FRUM	C PASSED
N ANUTHER	H MAKING	C DEAR	D UNTILL
O WOMEN	A GRAMMER	E USEING	L HOUR
I HORSE	R ENUFF	S WRITING	G BECAUS
M READ	I WHETHER	N HOARSE	E USED
R	D	O	I

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WEER	THROUGH	ROAT	CLOTHES
U CAUT	N RECEIVE	K COUSIN	N FREND
E BUSINESS	N CHOSE	T BOUGHT	U RUNNING
C WITH	K MOTHER	D GETING	Y SEPARATE

M _ _ _ _ _ .

DIRECTIONS: Use the letters above the words with the correct spelling to fill in the blanks.

Answers to Spelling Demons and Energy:

Instructions for Exercise:

Students will decide which of the words are spelled correctly. Begin from the top space on the left and move across each of the word-letter boxes. Place the letters that are above the correct spelling words on the dotted lines. Skip the boxes that have spelling demons (misspelled words). When the exercise is completed, there will be a true energy statement, **MUCH COAL IS MINED IN KENTUCKY.**

Extension: The word, UNDERGROUND, can be spelled using the letters above the spelling demons.

4. A Math Code Word Puzzle

COAL = SUM DIFFERENCE

2 +9	4 -3	10 -5	1 +3	3 -1	2 +6	4 +6	5 -4
4 +5	5 +1	8 +4	5 -3	2 +4	5 -1	12 -7	5 -2
7 +7	2 +5	5 +3	6 +1	7 -2	5 +8	1 +7	

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LETTER CODE:

1	2	3	4	5	6	7	8	9	10	11	12	13	14
O	I	R	L	A	N	E	S	U	F	C	D	M	G

DIRECTIONS: Add or subtract the problems and then find the answers in the letter code. Put the letters on the dotted lines.

ANSWERS TO COAL=SUM DIFFERENCE:

Instructions for exercise:

Students will solve 23 addition and subtraction problems. Match the answers with the letter code. Transfer the letters below the answers to the dotted line. For example, an answer of 11 has the letter C in the letter code. COAL IS FOUND IN LARGE SEAMS.

2	4	10	1	3	2	4	5
+9	-3	-5	+3	-1	+6	+6	-4
11	1	5	4	2	8	10	1
4	5	8	5	2	5	12	5
+5	+1	+4	-3	+4	-1	-7	-2
9	6	12	2	6	4	5	3
7	2	5	6	7	5	1	
+7	+5	+3	+1	-2	+8	+7	
14	7	8	7	5	13	8	

COAL IS FOUND IN LARGE SEAMS.

5. A Code Word Puzzle

COAL CODE DETECTION

CODE:

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
---	---	---	---	---	---	---	---	---	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----

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U M O A D L R B X F Q C I J T G V W K E N S P Z H Y

22 - 1 - 7 - 10 - 4 - 12 - 20 / 2 - 13 - 21 - 13 - 21 - 16 / 13 - 22 / 1 - 22 - 20 - 5 / 18 - 25 - 20 - 2 / 4 / 12 - 3 - 4 - 6 / 22 - 20 - 4 - 2 / 13 - 22 / 6 - 3 - 12 - 4 - 15 - 20 - 5 / 6 - 20 - 22 - 22 / 15 - 2 / 4 - 21 / 15 - 18 - 3 - 25 - 1 - 21 - 5 - 7 - 20 - 5 / 10 - 20 - 20 - 15 / 8 - 20 - 6 - 3 - 18 / 15 / 25 - 2 / 16 - 7 - 3 - 1 - 21 - 5 / 22 - 1 - 7 - 10 - 4 - 12 - 20.

WRITE THE FACT BELOW:

Directions: Be a code detective and search for the coal fact. Use the code and write the coal fact on the lines.

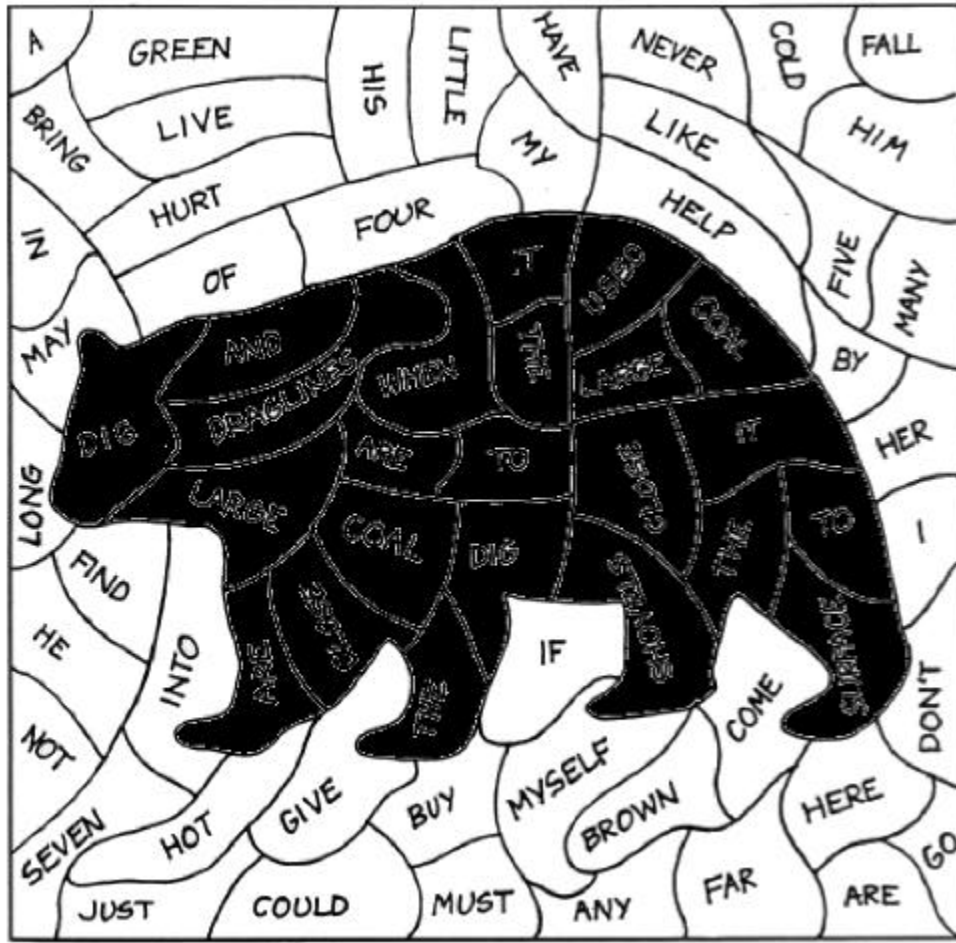
ANSWER to Coal Code Detection:

Instructions for Exercise:

Students will search for the coal fact. Each line has one or more words with a slant mark (/) placed at the end of each coded word, except for the last one which ends with a period. The numbers from 1 - 26 are arranged numerically with each letter of the alphabet matched with one of the numbers as the code. For example, the first number is 22 which is S, followed by 1 which is U. Continue with the remaining numbers until the hidden coal fact is found. SURFACE MINING IS USED WHEN A COAL SEAM IS LOCATED LESS THAN TWO HUNDRED FEET BELOW THE GROUND SURFACE.

6. An Outline to Find Word Puzzle

ANIMAL ENERGY PHRASE



7. A Phrase - Out Word Puzzle

COAL PHRASE - OUT

E	U	N	E	R	G	N	Y	E	N	I	N	E	R
N	S	L	O	P	E	E	N	S	E	T	L	O	R
E	E	Y	E	H	N	E	T	N	E	I	R	P	G
R	D	S	W	E	H	I	L	L	S	I	D	E	S
G	N	E	L	F	S	R	G	S	Y	E	E	N	N
A	E	R	G	O	Y	E	O	N	T	E	R	I	G
Y	E	N	P	U	P	F	E	C	T	H	E	N	R
A	R	E	G	N	Y	E	U	N	E	R	G	G	Y
E	D	N	R	D	R	R	D	M	G	Y	T	N	R
C	E	D	N	E	T	E	R	W	I	T	H	G	Y
O	N	E	N	S	E	A	E	R	G	N	E	S	E

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A	E	N	N	E	T	C	A	R	R	Y	I	T	Y
L	C	O	A	L	E	H	N	E	N	R	U	N	G
E	C	N	E	R	G	Y	E	N	T	O	E	R	G

SLOPE MINING IS USED **WHEN COAL** DEPOSITS ARE FOUND IN HILLSIDES, WITH A SLOPED OPENING **THEN** CONSTRUCTED TO REACH **THE** COAL AND CARRY IT OUT.

Directions: Search for all the words in the energy sentence. You will find them across, down or slantwise. Four of the words have already been found. As you find each word in the puzzle, cross it out in the sentence. There is also a hidden word not in the sentence. Can you find it?

Answers to Coal Phrase Out:

Instructions for Exercise:

Students will find all the words in the puzzle that are in the sentence, SLOPE MINING IS USED WHEN COAL DEPOSITS ARE FOUND IN HILLSIDES, WITH A SLOPED OPENING THEN CONSTRUCTED TO REACH THE COAL AND CARRY IT OUT. These words can be found across, down or slantwise. There are four words already marked. As each word is found, cross it out in the sentence. All of the spaces not used for needed words are filled with the letters in the word ENERGY. There is also an additional energy word in the puzzle that is not in the sentence. Ask students to find the word FOSSIL.

E	U	N	E	R	G	N	Y	E	N	I	N	E	R
N	S	L	O	P	E	E	N	S	E	T	L	O	R
E	E	Y	E	H	N	E	T	N	E	I	R	P	G
R	D	S	W	E	H	I	L	L	S	I	D	E	S
G	N	E	L	F	S	R	G	S	Y	E	E	N	N
A	E	R	G	O	Y	E	O	N	T	E	R	I	G
Y	E	N	P	U	P	F	E	C	T	H	E	N	R
A	R	E	G	N	Y	E	U	N	E	R	G	G	Y
E	D	N	R	D	R	R	D	M	G	Y	T	N	R
C	E	D	N	E	T	E	R	W	I	T	H	G	Y
O	N	E	N	S	E	A	E	R	G	N	E	S	E
A	E	N	N	E	T	C	A	R	R	Y	I	T	Y
L	C	O	A	L	E	H	N	E	N	R	U	N	G
E	C	N	E	R	G	Y	E	N	T	O	E	R	G

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SLOPE MINING IS USED WHEN COAL DEPOSITS ARE FOUND IN HILLSIDES, WITH A SLOPED OPENING THEN CONSTRUCTED TO REACH THE COAL AND CARRY IT OUT.

8. A Word Seek Word Puzzle

FIVE - WAY ENERGY WORD SEARCH

Instructions for Exercise:

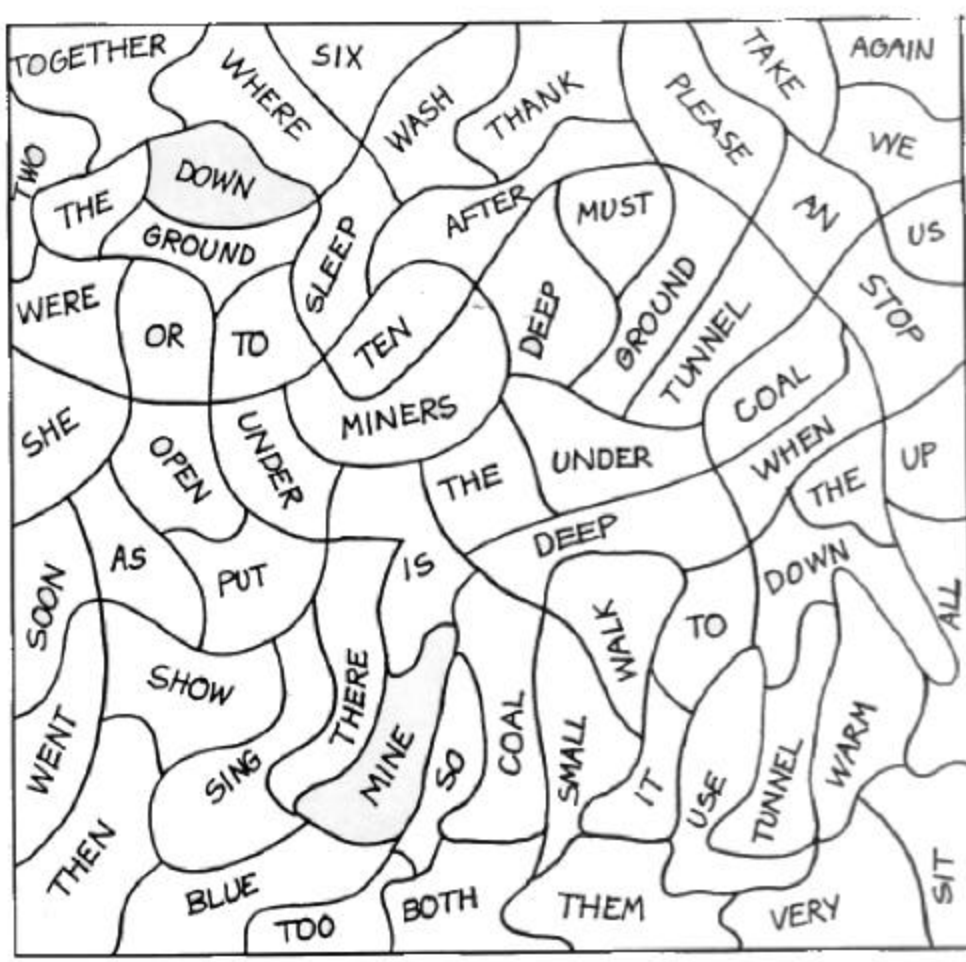
Students will find the word UNDERGROUND across or down. Some of the letters in the squares can be used to spell the word UNDERGROUND while others will not allow the word to be spelled. There are five UNDERGROUND words and one has already been found.

	U		N				G				D	
	N					G		U				
U	D							N			D	
	E	U						D	R			
	R						D	E		O		
	G	U	N	D	E	R	G	R	O	U	N	D
	R			D				G		N		
	O	E						R				
	U							O		U		
	U	N	D	E	R	G	R	O	U	N	D	
	D		D			R		N	N			
		U		D				D			D	
	U	N	D	E	R	G	R	O	U	N	D	

9. An Outline to Find Word Puzzle

ANIMAL ENERGY PHRASE

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WHEN THE COAL IS DEEP UNDER THE GROUND, MINERS MUST TUNNEL DOWN TO THE COAL TO MINE IT.

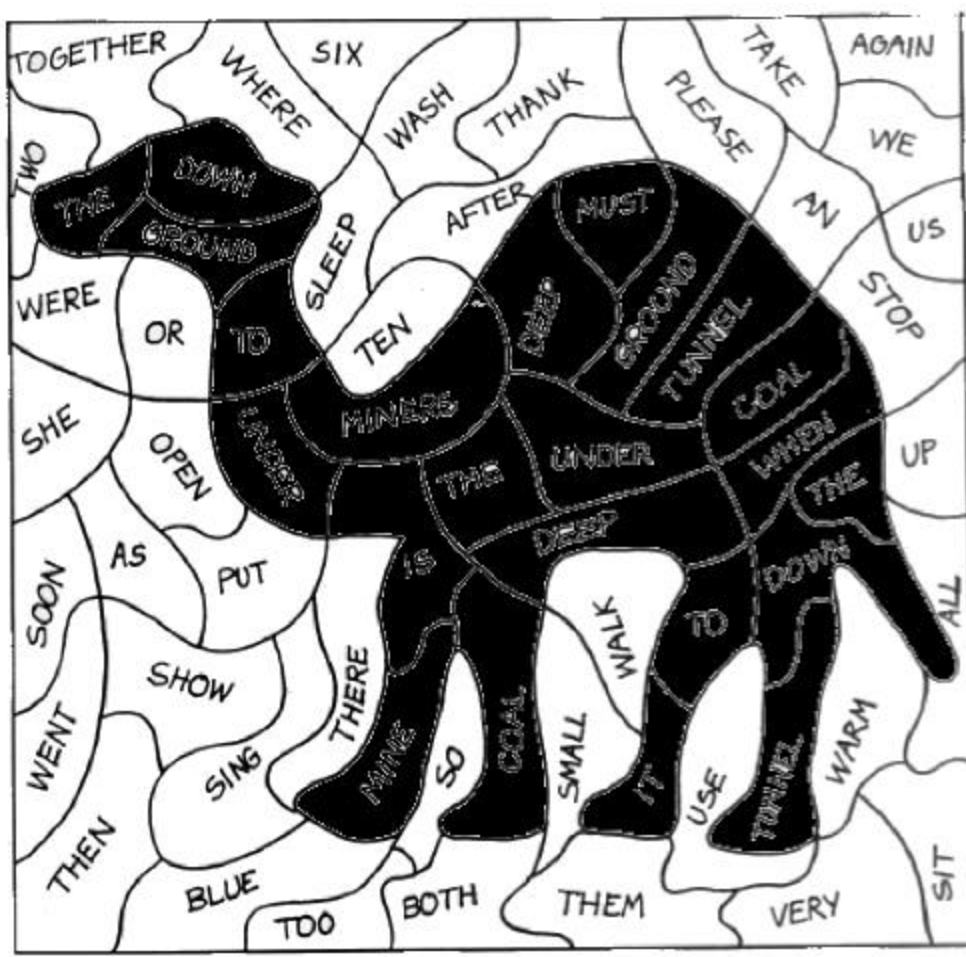
Directions: Color all the shapes in the puzzle which have words that are in the sentence and discover what animal is in the puzzle.

Answer to Animal Energy Phrase:

Instructions for Exercise:

Students will color each shape in the puzzle which has a word that is in the sentence, WHEN THE COAL IS DEEP UNDER THE GROUND, MINERS MUST TUNNEL DOWN TO THE COAL TO MINE IT. When students are finished the shape of an animal will appear.

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10. An A-Maze-In Pattern Word Puzzle

COAL PATTERN PHRASE

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LARGE CONTINUOUS-MINING MACHINES ARE USED TO REMOVE COAL FROM UNDERGROUND MINES.

Directions: Start with the dot and connect all the hexagons (six-sided figures) that spell the energy sentence. Then color the route.

Answers to Coal Pattern Phrase:

Instructions for Exercise:

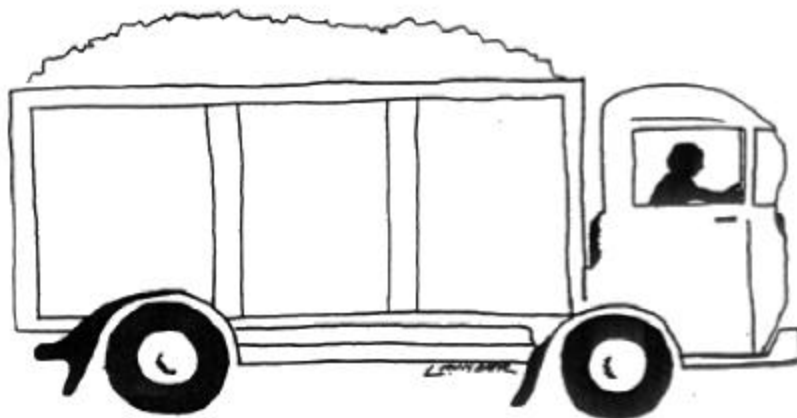
Students will spell all of the words in the sentence, LARGE CONTINUOUS-MINING MACHINES ARE USED TO REMOVE COAL FROM UNDERGROUND MINES. Begin at the dot in the middle of the puzzle. Move in any direction to spell the sentence. This is a maze, so a wrong letter route may be followed. If this happens retrace the route and continue with the remaining words in the sentence. There is only one correct route. When the route has been marked, color all the hexagons that are on that route.

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11. Color -N- Learn

COLOR - N - LEARN



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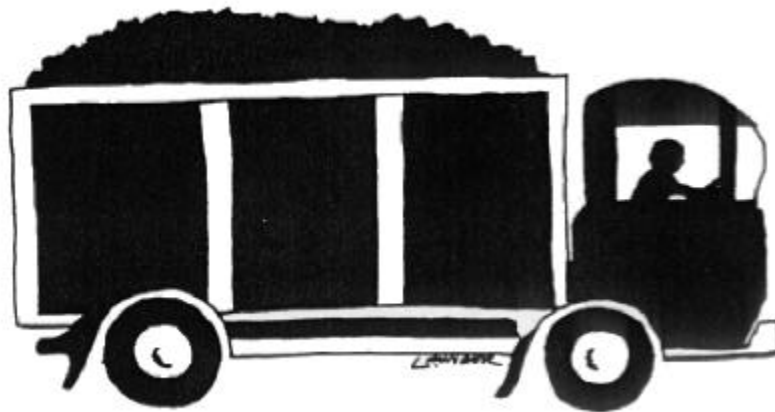
BIG TRUCKS ARE USED TO MOVE COAL.

Directions: Color the picture.

Answer to Color -n- Learn

Instructions for Exercise:

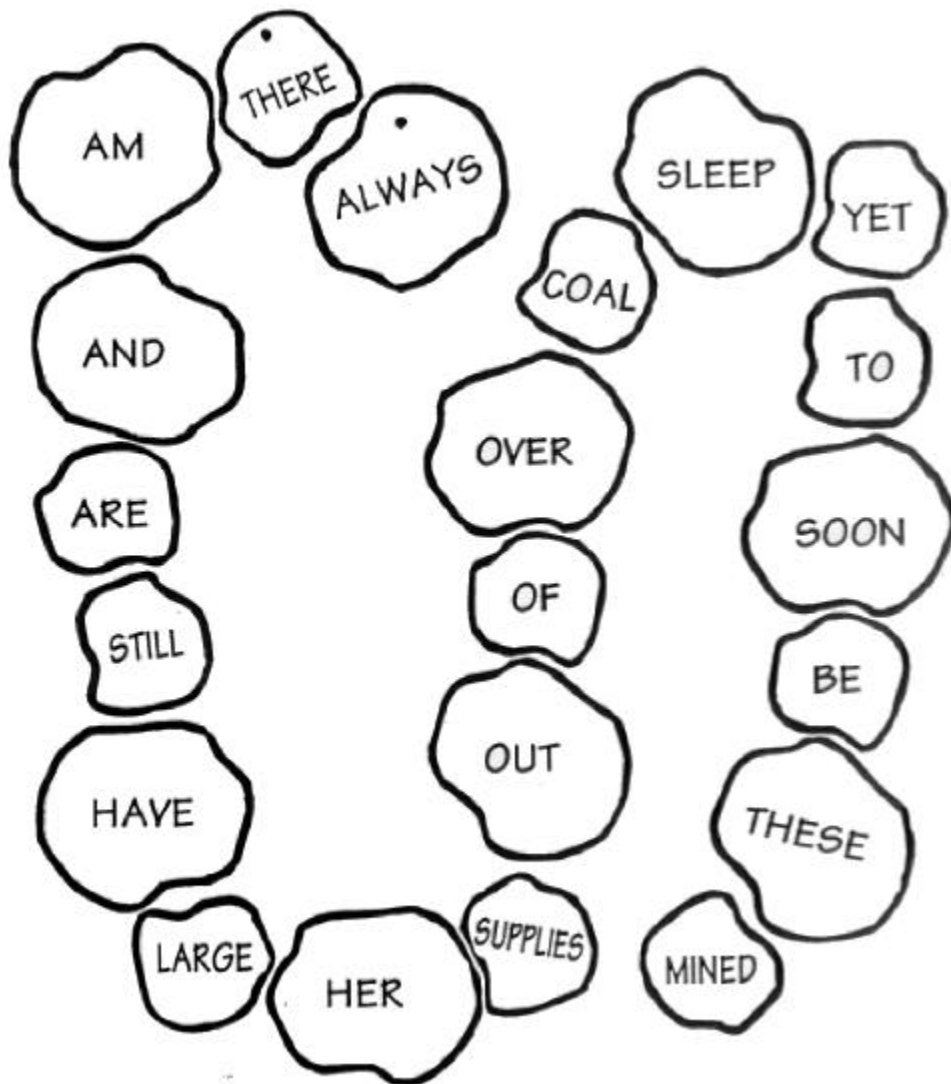
Discussion: Ask students to describe the various ways that coal can be transported from the mines to the power plants. To complete this exercise, students will color the truck.



12. A Coal - Cabulary Word Puzz

BIG LUMP / LITTLE LUMP ENERGY TRAIL

Directions: Choose the word, ALWAYS or THERE, to begin a sentence. Follow the trail using the same size of lumps. Will you use the big lumps of coal or the little lumps of coal?



Answer to Big Lump / Little Lump Energy Trail

Instructions for Exercise:

Students will decide which of the words, ALWAYS or THERE, begin a sentence about coal. Notice the size of the lump of coal that contains that word. Then use that size of coal to follow the trail. Color the lumps that are NOT the correct size. All of the words remaining will complete the sentence, THERE ARE STILL LARGE SUPPLIES OF COAL YET TO BE MINED.

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13. A Math Magic Word Puzzle

MULTI-MATH COAL FACTS

16	21	27	36	45	51	58	61	66	71	74
O	P	O	P	O	L	P	S	B	Y	T
81	9	18	28	54	63	72	76	52	43	34
E	D	T	E	W	E	R	T	N	U	R
72	63	56	51	46	40	81	9	18	24	28
V	O	T	N	A	L	P	L	A	C	T
68	54	45	38	31	24	16	21	27	36	43
E	M	S	M	L	A	L	I	N	T	Y
72	63	36	27	18	9	52	63	54	45	34

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T	A	I	L	A	O	I	Y	B	S	B
81	54	45	36	27	C	81	72	66	58	51
E	W	N	O	S		R	T	R	I	N
9	21	28	34	18	18	9	21	28	34	40
R	A	T	E	E	C	U	C	K	A	S
36	45	54	63	9	27	34	40	48	52	58
D	B	Y	B	G	K	A	R	T	R	O
27	34	43	72	81	36	45	54	63	71	78
N	A	R	A	R	S	A	N	D	N	S
18	74	63	54	45	36	43	56	72	66	58
A	R	L	N	O	S	O	N	T	I	N
9	81	72	34	31	27	18	9	81	76	68
D	N	A	N	D	N	I	A	R	A	I

C _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _
 _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _
 _ _ _ _ _ _ _ _ _ _ _ _

Directions: Search for the coal fact. Begin with the letter C in the middle of the puzzle and fill in the first blank. Multiply the 9's, beginning with 9X1 and find the box with the number 9. The letter O will be used to fill in the next blank. Continue to multiply the 9's using the products to find the letters needed to fill in the blanks.

Answers to Multi-Math Coal Facts:

Instructions for Exercise:
 Students will spell a coal statement, COAL IS MOVED TO POWER PLANTS BY TRUCKS AND TRAINS ON LAND AND BY BARGES ON WATER. Start with the letter C in the middle of the puzzle. Then move one box at a time, in any direction but slantwise, using the products of the 9's. (Multiply the multiplication facts 9X1, find the answer 9 in a box and write the letter O on the dotted lines. Continue multiplying the facts and placing the letters on the dotted letters. After reaching 9X9=81, start over with 9X1=9 and continue until all the spaces are filled.

16	21	27	36	45	51	58	61	66	71	74
O	P	O	P	O	L	P	S	B	Y	T
81	9	18	28	54	63	72	76	52	43	34
E	D	T	E	W	E	R	T	N	U	R

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72 V	63 O	56 T	51 N	46 A	40 L	81 P	9 L	18 A	24 C	28 T
68 E	54 M	45 S	38 M	31 L	24 A	16 L	21 I	27 N	36 T	43 Y
72 T	63 A	36 I	27 L	18 A	9 O	52 I	63 Y	54 B	45 S	34 B
81 E	54 W	45 N	36 O	27 S	C	81 R	72 T	66 R	58 I	51 N
9 R	21 A	28 T	34 E	18 E	18 C	9 U	21 C	28 K	34 A	40 S
36 D	45 B	54 Y	63 B	9 G	27 K	34 A	40 R	48 T	52 R	58 O
27 N	34 A	43 R	72 A	81 R	36 S	45 A	54 N	63 D	71 N	78 S
18 A	74 R	63 L	54 N	45 O	36 S	43 O	56 N	72 T	66 I	58 N
9 D	81 N	72 A	34 N	31 D	27 N	18 I	9 A	81 R	76 A	68 I

COAL IS MOVED TO POWER PLANTS BY TRUCKS AND TRAINS ON LAND AND BY BARGES ON WATER.

14. An A-Maze-In Phrase Word Puzzle

FIND-AN-ENERGY-PHRASE

ARE	THERE	ARE	TO
LARGE	SUPPLIES	MINED	BE
SUPPLIES	LARGE	OF	SUPPLIES
OF	YET	COAL	LARGE
COAL	OF	SUPPLIES	ARE
THERE	ARE	LARGE	THERE
TO	MINED	BE	ARE
BE	SUPPLIES	TO	YET
MINED	COAL	BE	COAL
SUPPLIES	OF	SUPPLIES	OF
LARGE	COAL	LARGE	COAL
ARE	THERE	ARE	YET

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THERE ARE LARGE SUPPLIES OF COAL YET TO BE MINED.

Directions: Draw a line to connect the words in the sentence.

Answers to Find-An-Energy-Phrase

Instructions for Exercise:

Students will draw a continuous line connecting the ten words in the sentence, THERE ARE LARGE SUPPLIES OF COAL YET TO BE MINED. Begin from one of the four THERE words on the outer edges and move forward, either right or left, but never slantwise. There is only one correct route.

ARE	THERE	ARE	TO
LARGE	SUPPLIES	MINED	BE
SUPPLIES	LARGE	OF	SUPPLIES
OF	YET	COAL	LARGE
COAL	OF	SUPPLIES	ARE
THERE	ARE	LARGE	THERE
TO	MINED	BE	ARE
BE	SUPPLIES	TO	YET
MINED	COAL	BE	COAL
SUPPLIES	OF	SUPPLIES	OF
LARGE	COAL	LARGE	COAL
ARE	THERE	ARE	YET

Acknowledgment: Adapted from materials developed by the Illinois Department of Commerce & Community Affairs and Office of Coal Development & Marketing