Lesson Three: Let's Dig it!

Grade Level: 5th Grade

Time: 60 minutes

Essential Question: How can we be stewards of Wyoming's mineral and energy resources to benefit current and future generations?

Objective: Students will learn the location of Wyoming's minerals and explore how each is mined.

Purpose: Students gather facts from various sources to understand where Wyoming's minerals are found and how they are mined.

Required Materials/Resources:

- Wyoming Mineral Map - http://uwmaps.wygisc.org/studentAtlas/index.html?page=1 (Coal is on page 40 and other minerals are on page 41. Pages are listed in the upper right-hand corner.) - (Source 7)
- Hand Organizer booklet (One per student. Each book should have 5 hand pages.)
- 5 electronic devices with internet access
- Links
    - Video: https://vimeo.com/120809644 *The Story of Bentonite (BPM)* (Source 1) *Video length: 4 minutes 46 seconds*

- Video: https://www.youtube.com/watch?v=ovtNHFFzG78 *Wyoming's Trona Resources – WY Cultural Geology* (Source 2) *Video length: 4 minutes 0 seconds*
- Video: https://www.youtube.com/watch?v=dg13rhh-qbg *Cat® EL3000 Shearer At Work in Wyoming Trona Mine* (Source 3) *Video length: 0 minutes 30 seconds*
- Video: https://www.youtube.com/watch?v=-m4kb9iWJX4 *China rare earth dispute strikes Wyoming* (Source 4) *Video length: 4 minutes 56 seconds*
- Videos: http://www.pbs.org/video/2225785189/ *America Revealed: Coal* (Source 5) *Video length: 6 minutes 46 seconds* ***OR*** https://www.youtube.com/watch?v=ecVnVH3mbPE *Arch Coal - Black Thunder Coal Mine* (Source 8) *Video length: 2 minutes 35 seconds*
- Video https://www.youtube.com/watch?v=258xiAv_8FQ *University of Wyoming Extension: Exploring the Nature of Wyoming: Uranium Mining … with Baking Soda?* (Source 6) *Video length: 1 minute 36 seconds*

- Green, yellow, pink, blue, and orange markers/colored pencils
- 5 Large pieces of paper with a Wyoming mineral written on each one (coal, bentonite, uranium, trona, and rare earth elements)

Suggested Teacher Preparation:

- Have Wyoming Mineral Map ready to display.
- Set-up electronic devices to show each mineral video, preview videos, and place appropriate colored markers with the matching video (see step 7). Choose coal video to

show.
- Place students into 5 groups.
- Prepare Hand Organizer booklets.
- Choose questions, and set-up corners for the Assessment activity.
    - 5 large pieces of paper with a Wyoming mineral written on each one (coal, bentonite, uranium, trona, and rare earth elements)

Standards:

Science: 5-PS1-3(DCI)- (Practiced/Encountered)

Social Studies: SS5.3.3 (Practiced/Encountered)

ELA: 5.SL.2 (Practiced/Encountered)

Vocabulary:

- **Extract** - remove or take out, especially by effort or force
- **Surface mining** - includes strip mining, open-pit mining, and mountaintop removal mining, where soil and rock overlying the mineral deposit (the overburden) are removed
- **Underground mining** - is a technique used to access ores and minerals in the ground by making tunnels

Instructional Procedure/Steps:

1. Say: **"In the previous lesson, you learned about the minerals that are found in Wyoming. Today, you are going to be learning about where they are found in Wyoming and how they are mined."**

2. Display the Wyoming Mineral Map on the Smart Board. As a group, discuss the map. Starting with coal, talk with students about where the active coal mines are found in the state. Ask:
    - **"What do you notice about the active mines and where they are located?"** *Students should*

notice that the active mines are mostly in a band in the northeast corner of the state - in between Douglas and the Montana line.

- **"Why do you think they are located where they are?"** *Students might notice that there is a coal seam that runs that length and that the mines are located in different parts of the seam.*

3. Next, discuss the trona mines in the state. Ask the same questions you asked for coal. *Students should notice that trona is found in a cluster in the southwest corner of the state only - Sweetwater County. Students should hypothesize why trona is located there but will learn in the video why the mines are located only there.*

4. Discuss the bentonite mines in the state. Ask the same questions as previously asked. *Students should notice that bentonite is found near mountain ranges such as the Big Horns and the Black Hills along with gypsum.*

.

5. Discuss the uranium mines in the state. Ask the same questions as previously asked. *Students should notice that uranium is found in the center of the state, and the mines are fairly spread out.*

6. Finally, say: **"Did you notice that there are not any dots on the map for rare earth elements? That is because they are not actively mined yet. The mine is in the development process and, therefore, not active. If we were to put a dot on the map, it would be in northeast Wyoming."**

7. Either watch the videos as a whole group or divide students evenly into 5 groups. Either way, each student will complete his/her own Hand Organizer booklet. Students will travel to 5 video stations set up around the room (one for each mineral). Say: **"At each station, you will watch a video about how each mineral is mined.**

Each mineral will have an organizer to go with it on which to take notes. You will need to label your organizer with the name of the mineral: bentonite - green, trona - yellow, coal - pink, uranium - blue, and rare earth elements - orange." Have the above markers/colored pencils available at each specific station. Pass out the Hand Organizer booklets. Say: **"As you watch the videos, you are to fill out the Hand Organizer booklet with the following information in the fingers":**

- **"How is the mineral extracted from the ground?"** *Either surface or underground.*
- **"Where is the mineral found in Wyoming? If information in video isn't clear, use the maps and information from our previous discussion to answer this question."**
- **"What special equipment is needed to extract the mineral?"** *heavy equipment, tools, materials*
- **"What does the land look like before/during/after mining?"** *surface area will be disturbed by a surface mine; in an underground mine, the surface is minimally disturbed in comparison*
- **"What does the mineral look like before it is processed?"** *color, shape, etc.*

Say: **"In the palm of the hand, write a short summary about the video you watched."** Since videos vary in length, have groups with shorter videos discuss something new they learned, before rotating.

8. Once all videos have been watched, gather students back as a whole group. With an elbow partner, have students discuss the following:
    - **One big thing they learned…**
    - **One thing they wonder about…**
    - **One way mining impacts them…**

In this task, students will be engaged in the higher order thinking skill of evaluation by comparing ideas and by judging and defending the relationship of these minerals with Wyoming.

9. **Assessment:** The purpose of this formative assessment is not about making one perspective right but to help provide closure. The exercise gives participants a chance to truly engage about what they learned and start forming an opinion about the Wyoming minerals. Teacher should be listening for an understanding of the minerals and how they are mined. Complete at least two rounds of the activity. Say: **"Notice the names of Wyoming's minerals posted in five different locations around the room. In a moment, choose a mineral based on your answer to a question I ask. You will then move to that mineral and discuss/ defend your reason for choosing that mineral with your classmates who made the same choice."** *Answers will vary based on students' opinions but should be based on some knowledge learned in today's and previous lessons.* Teacher can choose representatives to share what was discussed. Suggested questions include:
    - **"What Wyoming mineral do you think is the most important? Explain why?"**
    - **"What Wyoming mineral do you think we could live without? Explain why?"**
    - **"What Wyoming mineral do you think is the most difficult to mine? Explain why?"**
    - **"What Wyoming mineral do you think you use the most? Explain why?"**
    - **"What Wyoming mineral do you think brings the most money to Wyoming? Explain why?"**
    - **"What Wyoming mineral do you think will be used the most in the future? Explain why?"**
    - **"What Wyoming mineral do you think travels the farthest to be used? Explain why?"**

Credits/Sources:

1. Brown, Kurt D. Halliburton.Vimeo Inc. (“two years ago”). *The Story of Bentonite (BPM)*. Retrieved July 31, 2017, from https://vimeo.com/120809644
2. Wyoming Geological Survey. (2015, August 6). *Wyoming’s Trona Resources – WY Cultural Geology* Retrieved July 31, 2017, from https://www.youtube.com/watch?v=ovtNHFFzG78
3. Caterpillar Global Mining. (2014, July 2). *Cat® EL3000 Shearer At Work in Wyoming Trona Mine*. Retrieved July 31, 2017, from https://www.youtube.com/watch?v=dg13rhh-qbg
4. CNN Money (CNN). (2012, September 19). *China rare earth dispute strikes Wyoming*. Retrieved August 23, 2017, from https://www.youtube.com/watch?v=-m4kb9iWJX4
5. Public Broadcasting Service (PBS). (2012, April 25). *America Revealed: Coal*. Retrieved July 31, 2017, from http://www.pbs.org/video/2225785189/
6. University of Wyoming. (2013, July 26). *University of Wyoming Extension: Exploring the Nature of Wyoming: Uranium Mining … with Baking Soda?* Retrieved July 31, 2017, from https://www.youtube.com/watch?v=258xiAv_8FQ
7. Hammerlinck, Jefferey D., Webster, Gerald R. University of Wyoming Department of Geology, Wyoming Geographic Information Science Center, Wyoming Geographic Alliance. (2014). *Coal Mining; Other Mining*. Retrieved July 31, 2017, from http://uwmaps.wygisc.org/studentAtlas/index.html?page=1
8. Wyoming Geological Survey. (2014, September 10). *Arch Coal - Black Thunder Coal Mine*. Retrieved July 18, 2108, from https://www.youtube.com/watch?v=ecVnVH3mbPE