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Lesson Plan: Steelworks

Grades: K – 5

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Steelworks Museum of Industry & Culture
Bessemer Historical Society, Pueblo, Colorado

(Lesson edited and formatted
by Real Curriculum, Inc.)

Summary	Students use the ProScope to examine coal and rocks and, through guided exploration, learn how steel is made.
Topic(s)	• Technology: Steel manufacture • Geology: Rocks and minerals • Chemistry: Burning, chemical combination
Concepts	• Properties (explicit) • Magnetism (explicit) • Elements (implicit) • Oxidation (implicit) • Compound (implicit) Note: "Explicit" refers to concepts which are named and discussed in the course of the lesson; "implicit" refers to concepts which students experience in the course of the lesson but which are not named and discussed.
Knowledge and Skills	• Coal is formed when dead plants are crushed and compressed for a very long time. • Coal contains carbon. • Carbon combines with oxygen when it burns. • Rocks contain many minerals, sometimes including iron. • Iron and steel are magnetic. • Steel is made by combining iron and carbon, and is stronger than iron alone.
Equipment and Materials	• Some pieces of coal • Some pieces of coke • Hand lenses (one per student) • ProScope M2, ProScope HR (recommended) or Scope on a Rope™ • Computer display or digital projector (for ProScope) or TV screen (for Scope on a Rope) • A tray of various rocks and minerals, including rocks containing iron and iron pyrite. • Magnets (one per student)

	• Shallow container of sand with iron filings mixed in • A nail

Discussion

The Bessemer Historical Society has recently opened the Steelworks Museum of Industry & Culture in Pueblo, Colorado. As the Science consultant for the museum, I heard a presentation at the Colorado State Science Convention in November 2006 about ProScope and saw its possibilities for the school groups that would be coming through for history and science activities. At first we were just going to try out the ProScope through School TR's borrowing program, but our enthusiasm for the possibilities of its use led our Executive Director to buy one. As we begin to use it on a regular basis, more and more ideas come to mind of where it can be useful. The children's responses (grades K-5) to the ProScope have exceeded our expectations. Here is a how we use the ProScope to show how the state standards in science (inquiry, technology and earth science) are met by visiting the new museum.

Procedure

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Part I

1. First we ask the inquiry question - is coal a rock? Many students will say "yes", even though they have seen a short introductory video explaining otherwise.

2. The facilitator stands up waving a bunch of fake ferns over her head (aren't teachers in any setting part-actresses?). She says, "Remember the video said it takes 8 feet of old dead plants to compress into 1 foot of coal."

3. We discuss whether the old dead plants that made coal came before the dinosaurs lived, whether men were alive when those plants and dinosaurs lived, (they will often say cave men were there!) and how cartoons can trick us when it comes to learning science.

4. Then students are given chunks of coal to handle and observe with their eyes. They note the color, shine and the residue on their hands. These are identified as "properties" of the coal.

5. We talk about technology – what is it, why are there improvements and how it helps us learn. Students are given hand-lenses to observe more closely. Now students begin to notice the cracks in the coal.

6. We talk about how humans keep trying to improve technology and the advent of microscopes and computers and how now we combine the two.

7. We use the ProScope to show the student several of their samples of coal on the computer monitor so they can see the cracks in the coal more clearly as a group.

8. Next they are given a sample of coke to touch and observe. (and of course, we make the distinction that this is not “coke” as in coca cola to drink). So what is this coke? Children might remember that it is coal that was blasted with hot air if they saw during video in the museum tour.

9. Question: Why is coke important for the steel industry? Usually there is little response.

10. Once again, we use the ProScope to look closely at the coke and see all the tiny holes and crevices.

11. A dialog ensues:

- Why is this important?
- Older students say that more air can get in there.
- What will that do?
- Help it burn hotter.
- Does it need everything in the air to burn?
- No, only the oxygen

12. Now the facilitator helps the students sum up ideas - so the more holes in the coke (pointing to the computer screen), the more places for oxygen to bond on to carbon in the coke and the hotter it will burn. So are coal and coke rocks? Usually, “no”. If “yes”, the facilitator waves the plants over her head and they remember, “no!”

Part II

1. Students then look at samples of rocks and facilitator initiates the following kind of inquiry dialog:

- What else do we need to make steel?
- "Rocks," they say as we look at a tray filled with rocks and minerals from Colorado.
- Just any old rock?
- No some with special properties.
- Such as?
- Color, crystal, shine (luster)
- What else? Eventually they will think about magnetism.
- What kinds of things are magnetic?
- Iron.

2. Which of these rocks are magnetic?

The students use the hand magnets to sample all the rocks and eventually find two rocks that are magnetic (an iron ore and a pyrite with iron).

3. Using the ProScope we see the minerals that make up the rocks on the screen.

4. Now we talk about why someone needed to take their sample of gold-looking rock to an assayer (a term most students know from social studies, especially in Colorado where gold mining was important). Students answer, "to make sure it was gold." But what happened when it was heated? Phew, the smell of sulfur made you know that you were a fool to think it was gold. i.e. Pyrite=fool's gold.

5. So if the miner was not interested in pyrite who might be? People who wanted iron ore to make steel.

6. But is it easy to get iron out of these rocks?

7. The facilitator now shows the students a sample plastic box of sand with iron filings and gives the students a chance to enjoy seeing the iron being easily drawn out of the sands. Then we show the iron filing with the ProScope. We ask them if they have ever been to the Sand Dunes National Park in Colorado and many have. Next time bring a magnet and try this for yourself. But the question is how long would it take you to get enough iron out of the sands to make steel. No kid wants to work that hard or wait that long!

8. So we look at the other rock with iron ore with the ProScope and ask so how do we get the iron out.

9. Students talk about crushing, melting etc.

10. So now if we use the coke which burns hot and the melted iron what can we make?

11. Steel. So the students are shown a steel nail.

13. Using the POE method – predict, observe and explain? Do you think this nail will still be magnetic. Usually there is disagreement and the facilitator asks- what do scientists do when they are not sure. They try it out.

14. So once again the magnets are used to find out that steel still has magnetic properties.

15. Finally the nail is shown on the ProScope while the ideas are reviewed including the idea that pure iron is not very strong (think of wrought iron fences) so the carbon from the coke helps harden and strengthen the steel

PS: When there is extra time, we talk about CSI and use the ProScope to look at shirt fibers and fingerprints - they love it.