Concentrating on Copper: An Exploration of Mineral Commodities

Phase IIa: Exploration of some of the major economic factors related to copper mining.

Some commodities (commodities = elements in this exercise) are more valuable than others. To be economical, ore deposits must contain sufficient amount of the commodity of interest to make mining profitable. "Mineable wt%," which geologists call **minable grade**, values are given in the table below. Use the data to calculate the *concentration factor* for each commodity. (*Concentration factor* is the amount it must be enriched over normal crustal abundance to be economically minable.)

		A	B	B/A
Ore Metal		**Crustal Wt %**	**Minable Ore Grade (wt %)**	**Concentration Factor (CF)**
Aluminum	Al	8.0	28.0	
Iron	Fe	5.8	40.0	
Copper	Cu	0.0058	0.52	
Nickel	Ni	0.0072	1.08	
Zinc	Zn	0.0082	2.46	
Uranium	U	0.00016	0.19	
Lead	Pb	0.00010	0.20	
Gold	Au	0.0000002	0.0008	
Mercury	Hg	0.000002	0.2	
Tin	Sn	0.0002	0.5	

1) To be considered a mineral commodity, an orebody has to reach an ore concentration of at least the concentration factor (CF). How does copper compare to other commonly mined mineral resources?

2) How does the concentration factor likely related to the costs of production of that ore? Think about the amount of wasted rock (gangue) versus ore in the early stages of production. How might the concentration factor affect the decision to mine underground (more expensive process) rather than on the surface (less expensive process)?

3) Why are some mineral commodities inherently more precious than others, even prior to any mining even beginning?

Phase IIb: Have students explore the concepts of "ore" and "gangue" using the following problem of building a home.

"Suppose that you are building a new house. It will take about 90 kg (198 pounds) of copper to do the electrical wiring. In order to get the copper in the first place, someone needs to mine solid rock that contains copper, extract the copper minerals, throw away the waste rock, and smelt the copper minerals to produce copper metal. Rocks mined for copper typically contain only very small percentages of copper—about 0.7% in the case of most of the big porphyry copper deposits of the world. How much rock would someone have to mine in order to extract enough copper to wire your new house?"

Show Your Work!

Question: Much of this "gangue" rock contains small amounts of other metals as well as elements that are environmentally dangerous, such as mercury. Why is it important that it is dumped or processed properly?

Phase IIc: Diagram your flowchart for the copper production supply chain below as you watch the video with the class.

Lists some things that you use daily that contain copper:

Question: As an end-user of copper in the modern world, what are some things for which you might have to learn to do without if copper reserves were to run out?

Phase IId: The price of copper changes due to changes in demand, supply, natural disasters, and many other factors. How have copper prices behaved historically and what is the future of copper globally?

List some possible explanations for the long-term fluctuations you see in the price of copper.

When did some of the key events occur and what happened to the price?

Analyze the data for the USGS Mineral Commodity Summaries for the years below and describe for each what was happening in the world to affect the prices during those years:

2004:

Cost to wire home in this year: $_____ (Part IIe, class discussion)

2007:

Cost to wire home in this year: $_____ (Part IIe, class discussion)

2014:

Cost to wire home in this year: $_____ (Part IIe, class discussion)

Phase III: Take notes in your notebook on what the teacher has to say regarding the following important terms.

1) Law of Diminishing Returns

2) Commodity

3) Demand Curve

4) Supply Curve

5) The Four Basic Laws of Supply and Demand:
    a)
    b)
    c)
    d)

6) Production

7) Supply Chain

8) Scale of Production

9) Economies of Scale

10) Average Crustal Ore Concentration

11) Mineable Concentration

12) Concentration Factor

13) Profit Margin

14) Environmental Reclamation

15) Gangue

16) Orebody

17) Ore

Phase IV: Calculate the profit possible in each mining scenario based upon current prices.

Ore	CF	Tons of Ore	Tons of Copper	Pounds of Copper	Value of Copper	Cost of Mining/Ton of Copper	Total Cost of Mining Ore	Env. Protection Costs	Profit
Orange		55,000				$30		$600,000	
Red		55,000				$20		$350,000	

Question: Is the concentration of an ore the only consideration when choosing whether to mine it or not?