Rocks, Minerals, & Mining …

(I ain’t sayin’ she a golddigga)
The Rock Cycle!

- Rocks are made up of multiple minerals. Minerals are made up of multiple elements.

- Rocks and minerals “recycle” or change due to chemical and physical processes.

- The rock cycle explains the forms that rocks come in and how they change.
• Based on the Rock Cycle diagram, define how these are formed:
  – Igneous Rock
  – Sedimentary Rock
  – Metamorphic Rock
• Define Weathering
The Rock Cycle!

- **Igneous Rock** -- Rocks that originate from cooled magma.
- **Sedimentary Rock** -- Rocks that form when sediments or small rock flakes compact together.
- **Metamorphic Rock** -- Rocks that form when other rock types are put under heat or pressure and chemically change.
- **Weathering** -- the break down of rock.
The Rock Cycle!

Diagram showing the process of rock transformation through weathering, uplift, transportation, crystallization, melting, radioactive processes within the Earth's core, deep burial, heating, squashing, and sediments.
1) **Mine**
   - Remove upper layer of non-mineral filled rock called the overburden
   - Extract mineral ore from lower layers

2) **Ore Processing**
   - Ore is a mix of the desired mineral & gangue (waste rock)
   - High-grade ore has high levels of mineral compared to gangue. Low-grade ore has more gangue in it
   - Ore is processed to removed mineral from gangue rock

3) **Smelting**
   - Final processing of ore to get pure metal from ore.
   - Smelting usually requires the use of heat and chemicals to get the final metal or desired outcome.
Surface Mining Techniques

- **Strip Mining**
  - The overburden is removed and set aside
  - Minerals are removed and trenches are filled in with overburden
  - New strips are dug out after old one is filled in
  - Vegetation may struggle to grow back on mined land
  - Highly susceptible to erosion, since piles of mine material are left behind
Surface Mining Techniques

- Open-pit Mining -- pit is dug & minerals extracted
  - Groundwater pollution potential since water in the pit can pick up toxic mine elements.
  - Has high erosion potential

- Mountaintop Removal – removing the top of a mountain to expose minerals
  - Safer than subsurface mining
  - Lots of erosion potential
  - Mountain tops are lost and surrounding valleys filled with gangue and other mine wastes
Subsurface Mining

• The digging of mineshafts below ground to get to the ore
  – Less surface land destruction is involved
  – Most dangerous form of mining, due to mineshaft collapse, possible mineshaft fires, and poor air ventilation
  – Subsurface is expensive!
    – Need more workers
    – Need to pay workers more due to higher risks
    – Need more safety measures
    – Have more health care costs due to more insurance
The Benefits of Mining

• Mining provides the means for minerals, which are essential in countless numbers of products.

• Mining provides natural resources that fuels economic trade and growth

• Mining provides high-paying jobs

• Mining provides economic boosts for many poor or rural communities
Problems Surrounding Mining

- Major Alterations to the Land
  - Creates habitat loss with destruction of vegetation & soil
  - Mined surfaces are likely to have more soil erosion.
  - Mined lands require reclamation -- the process of trying to return disturbed lands to an improved state.
  - Reclamation will require:
    - Recontouring land to original topography
    - Replacing topsoil to improve soil structure
    - Planting of vegetation to revitalize the area
Problems Surrounding Mining

- Mining Wastes
  - Mining produces 75% of all US solid waste.
  - Mining waste can be toxic – it often had traces of heavy metals in it.
  - Wastes from ore processing are called tailings - a mixture of small rock waste with water and chemicals
  - Tailings are usually stored on site at a mine in a holding pond or held back by a dam.
  - Tailings can contaminate waters if it gets into local streams (pond leakage or dam collapse)
Problems Surrounding Mining

• Acid Mine Drainage
  – Water flows through mine/mine shafts. Water and exposed minerals interact to form iron compounds and sulfuric acid.
  – Acid will drop the pH of the water.
  – Lower pH water causes release of heavy metals from surrounding rock into water sources
  – Acid mine runoff is usually a red-orange, orange-yellow color with sediments
  – Some waterways are so acidic that they become unlivable for organisms
  – Acids can also corrode human structures (like bridges)
Problems Surrounding Mining

• Health Problems In Miners
  – Black Lung disease in coal miners
  – Subsurface miners exposed to more air pollutants due to less ventilation in mines
  – Potential death in subsurface mineshaft collapses
  – Deadly gases can suffocate miners in mineshafts

• Land Subsidence (sinkholes)
  – Land has potential to collapse if subsurface mining is not properly monitored.
Problems Surrounding Mining

• Smelting
  – Requires use of toxic chemicals. This creates toxic waste which requires proper disposal
  – Smelters create lots of air pollution

• Mineral Supplies
  – Supplies are lowering worldwide, as most high-grade ore is extracted.
  – We extract faster than new minerals are made in the lithosphere
  – Minerals will likely never run out, but hit a point where remaining supply becomes too costly to mine. This is known as economic depletion.
    • Economists mark the depletion time of a mineral when 80% of the supply is gone. The other 20% is generally considered too hard to extract.