Last Time:

• Why are mineral resources valuable?
• How is their value determined?
• How are mineral resources explored?

This Time:

• How are mineral resources extracted from the ground?
• What are the impacts from the extraction?

Mineral Extraction
Bingham Mine, Utah
1863
1915
1998
• The Bingham Mine is the largest man-made excavation on earth.
• 45.7 mega tons of ore were extracted in 2004.
• The pit will be exhausted in 2013.

Mineral Processing
Heap Leaching with Cyanide
App. 150 heap leaching operations in U.S.
Ore is pulvarized and spread in piles over clay or plastic liners. Piles are sprayed with dilute sodium cyanide to leach metals: gold/silver
Mineral Processing - Smelting

- Flash furnace
- Slag pour
- Converter furnace
- Anode furnace

Where is the nearest smelter?

Smelting - The Tacoma Smelter

- The Tacoma Smelter was in operation between 1890 and 1986.
- It operated first as a lead smelter, then copper and finally arsenic.
- At one point it was the only domestic arsenic supplier in the US.
- Arsenic production approached and at times exceeded 10,000 tons per year.
- Arsenic emissions averaged 1,000 tons per year, with a cumulative total of several tens of thousands of tons that was released into the air.
- This particulate air pollution resulted in arsenic soil contamination.
- The “plume” of soil contamination covers several hundred square miles in Vashon Island, Pierce and King Counties.
- Child-use facilities in the area of soil contamination are especially vulnerable and have been well investigated.

Tacoma Smelter Arsenic Plume

- Construction of roads/buildings
- Stripping of surface vegetation and soil
- Excavation of large pits, permanent changes in topography
- Storage of rock waste (tailings)

Impacts on Land

Waste rock piles from Bingham Mine, Utah
Impacts on Water

Acid Mine Drainage
- water percolates through waste rock rich in sulfides and produces sulfuric acid.
- acid water leaches and disperses Fe, Cu, Zn and other toxic metals to environment.
- Kills aquatic life
- Erodes concrete structures.

Impacts to the Air

Smelting and refining emit air pollutants:
- Particulate matter (smoke and small particles)
- Nitrous and sulfur oxides which produce acid rain
- Vaporized metals which get deposited in sediments and water downwind.

Conservation of Mineral Resources

- Overall need for resources is growing—This expansion must be curbed
- Some mineral resources maybe substituted by other, more abundant resources
  - Plastics replacing automobile parts
- Recycling—many metals are successfully recycled
  - More recycling is required
  - Not all commodities are easy to recycle
- Measures to reduce demand are key
Table 12.4

Gypsum Recycling

- A company in British Columbia has recycled 2 million tonnes of wallboard since 1985.
- New wallboard may be able to incorporate in excess of 25% recycled gypsum.