

C6.1.9 Biological metal extraction

Previous knowledge:

C6.1.6

An ore is a rock or mineral that contains enough metal to be economically worth extracting

Learning Objectives

- Recall why new methods of metal extraction are needed
- Describe the processes of bioleaching and phytomining
- Evaluate the advantages of biological methods of extracting metals

Fuse school video

- <https://www.youtube.com/watch?v=XF399zN36LE>

Alternative Metal Extraction Methods

- An ore is a rock containing enough metal that it is worth the cost of extracting it
- But the Earth's resources of metal ores are finite and limited.



Mine

- High grade ore = rock that contains a high % of metal
- Low grade ore = rock that contains a low % of metal
- A lot of the high grade ore has already been extracted
- Traditional mining methods are too expensive with low grade ores



- The two methods are:
 - phytomining
 - bioleaching

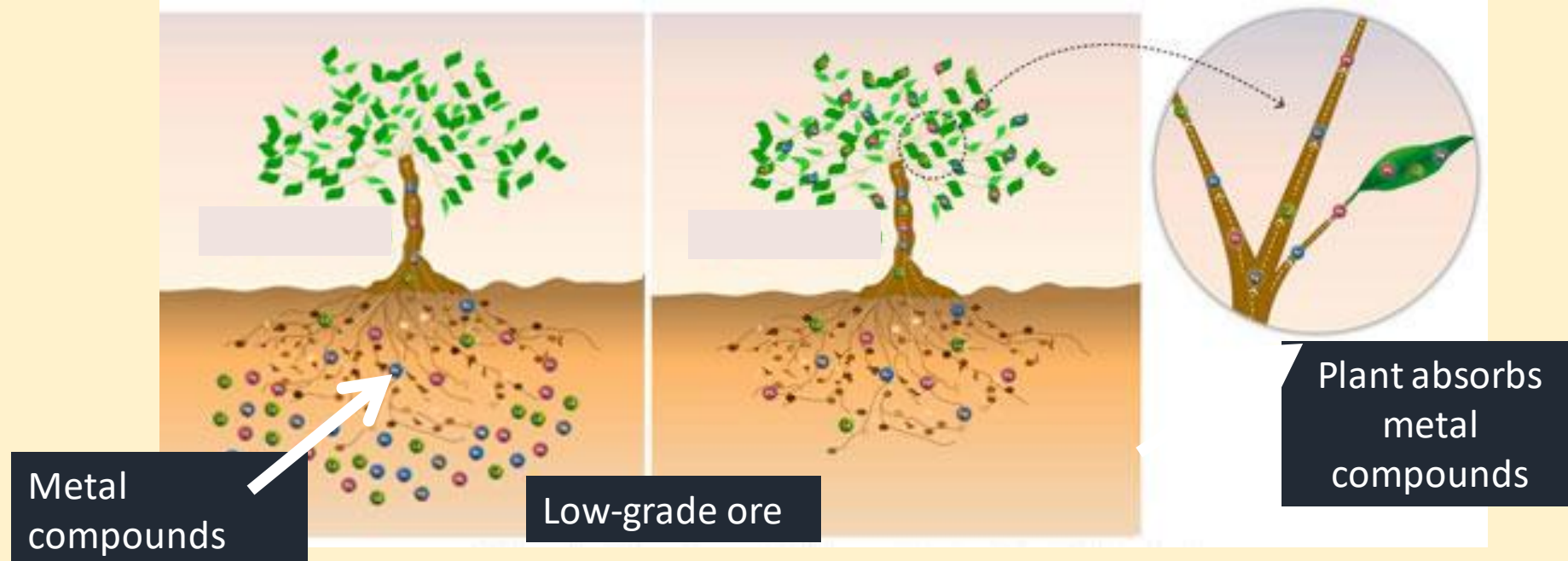
Both these methods avoid traditional mining methods of digging, moving and disposing of large amounts of rock



Traditional mining blights the landscape.

Phytomining

1. Use plants to absorb metal compounds from low-grade ore (soil) as they grow
2. Plants are harvested then burned. The metal compounds are extracted from the ash.

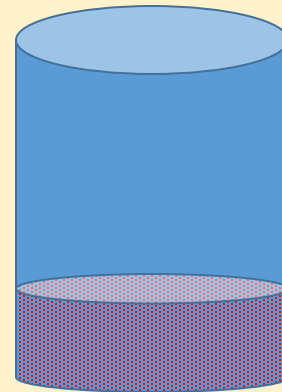


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Metal compounds extracted from ash and put in solution

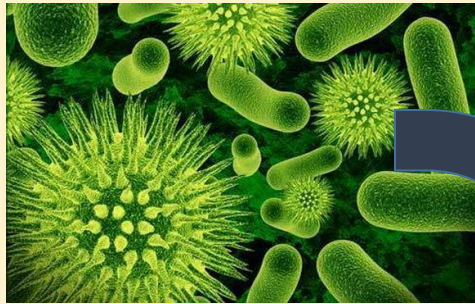


Metal compounds concentrated in solution



Bioleaching

- Bacteria feed on low-grade metal ores to produce a solution of copper ions – leachate



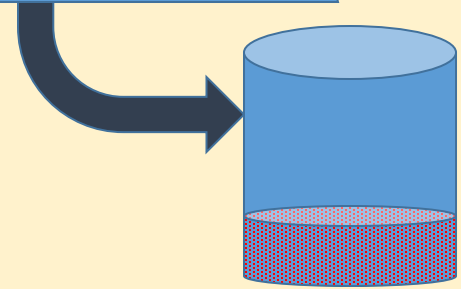
bacteria

Bacteria oxidise Fe^{2+} and S^{2-} ions
This produces sulfuric acid
The acid reacts with the metal ores (e.g. copper sulfide)
to give a leachate solution containing metal ions



Low grade ore

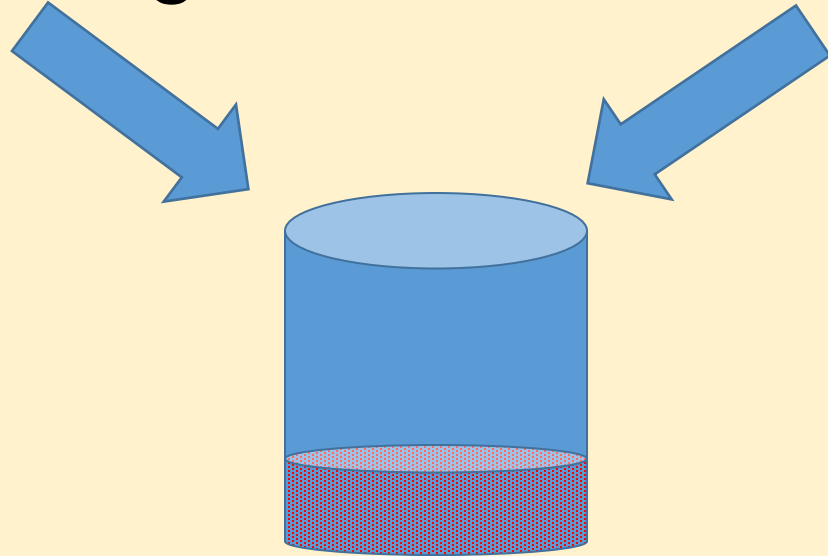
Metal compounds – spread out in low grade ore



Metal compounds concentrated in leachate solution

Phytomining

Bioleaching



Both methods produce a solution of metal compounds – more concentrated than they were in the low-grade ore

The metal compounds can be processed to obtain the metal

Biological metal extraction

Process	Environmental consequences	Economic consequences
Bioleaching	Does not release SO_2 But toxic substances can be produced.	Can use low grade ores. But is a slow process.
Phytoextraction	Produces less waste than traditional methods. Close to being carbon neutral.	Cheaper than traditional mining and extraction. But is a slow process.