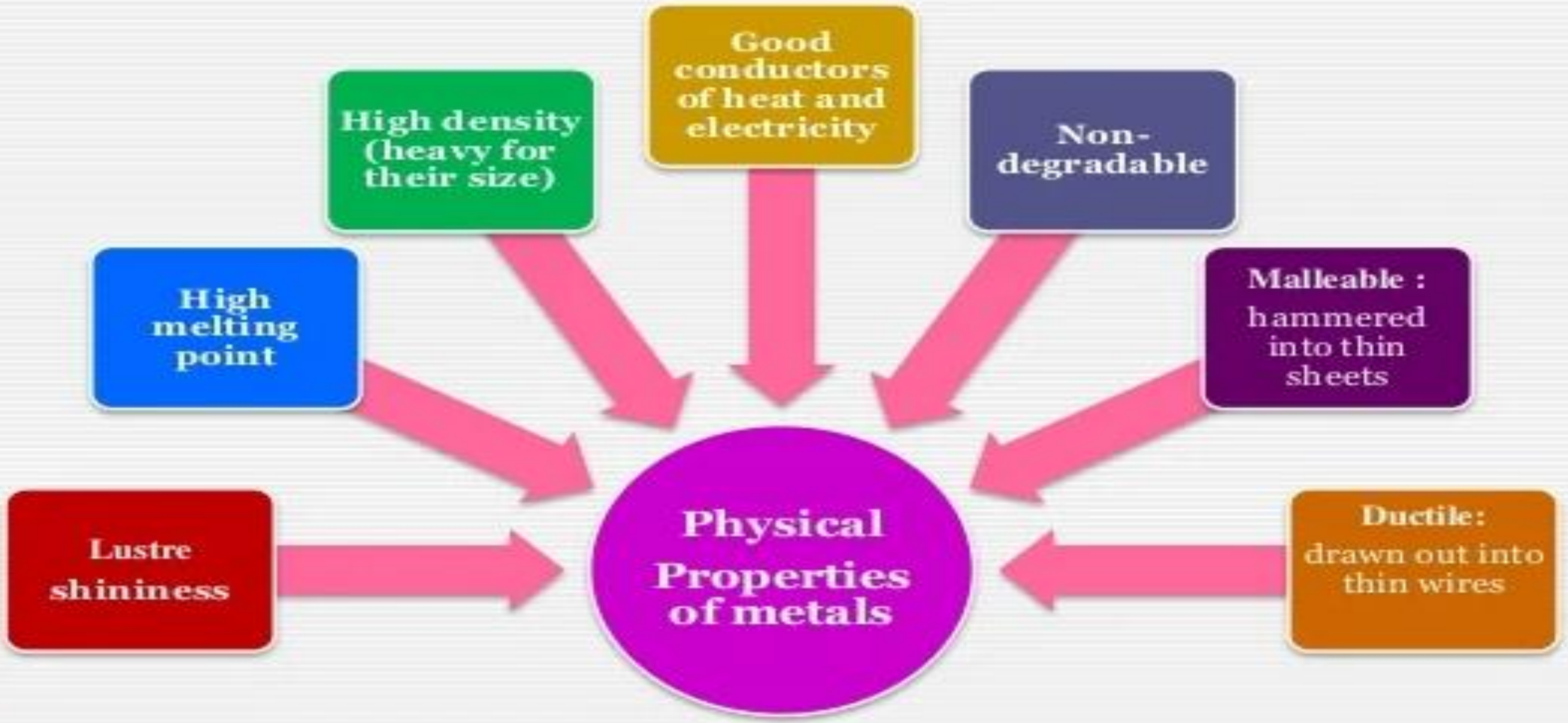
# Removal of Heavy metal from wastewater treatment

# Definition of Heavy Metals

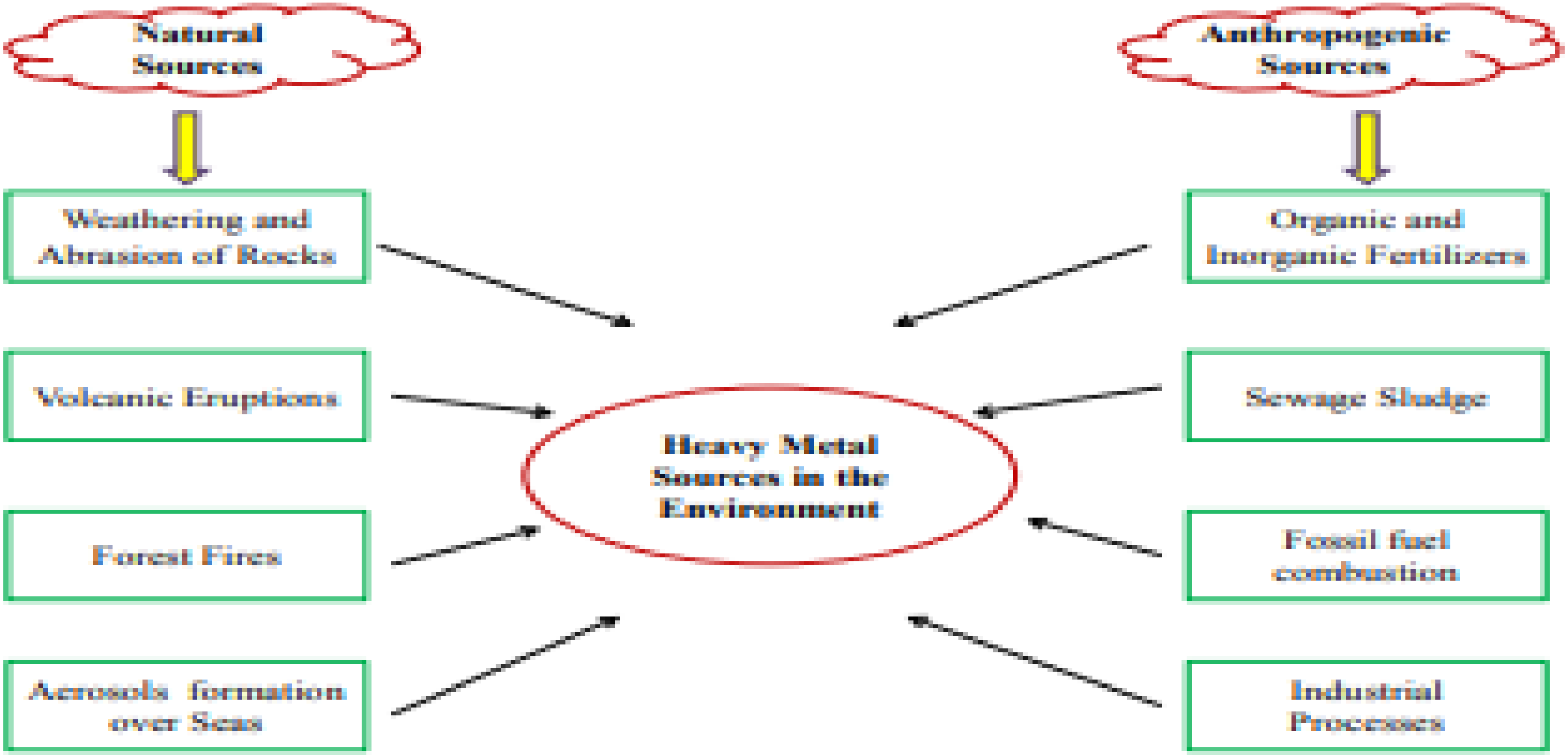
**Heavy metals are:**

- **Any metal and metalloid element with an atomic density ranging from 3.5 to7 g $cm^{-3}$**
- **one of the most persistent pollutants and non biodegradable in wastewater**
- **Includes mercury (Hg), cadmium (Cd), arsenic(As), chromium (Cr), thallium (Tl), zinc (Zn), nickel (Ni), copper (Cu) and lead (Pb).**
- **Some of them have an essential role in humans and animals metabolism in very trace amounts but their higher concentration may cause toxicity and health hazards.**
- **Their hazardous nature refer to their bio-accumulative nature in biotic systems.**

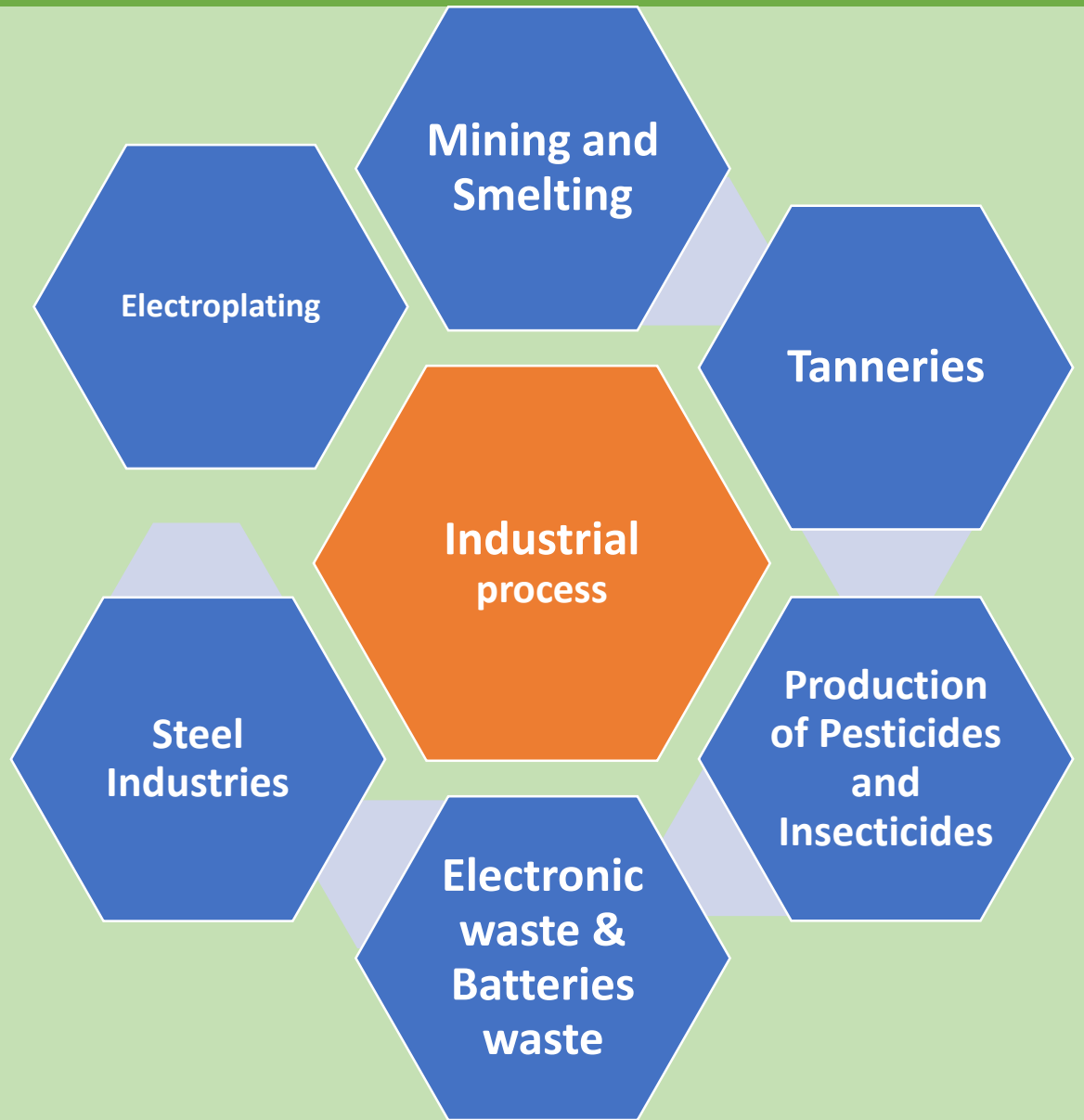
# Physical properties of metals



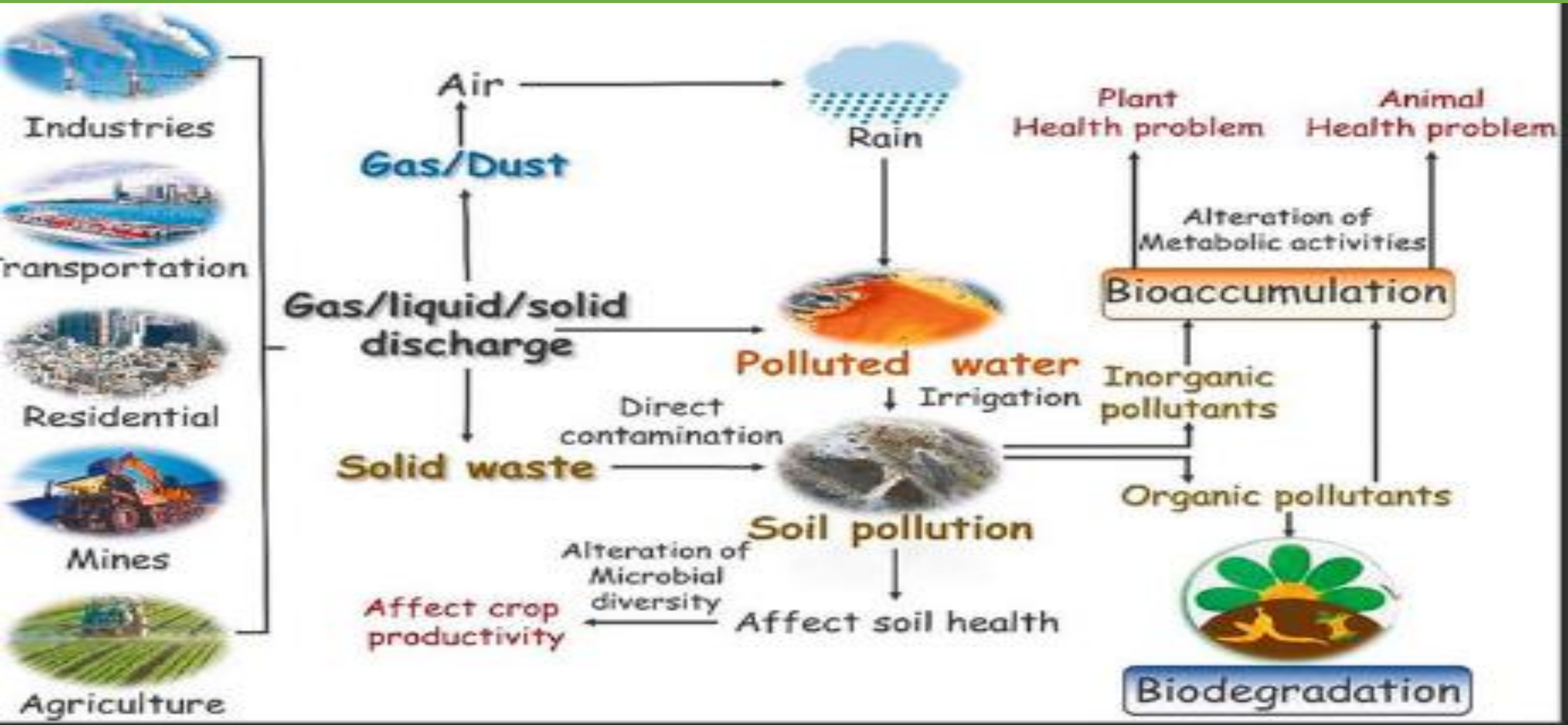
# Sources of metals in Environments

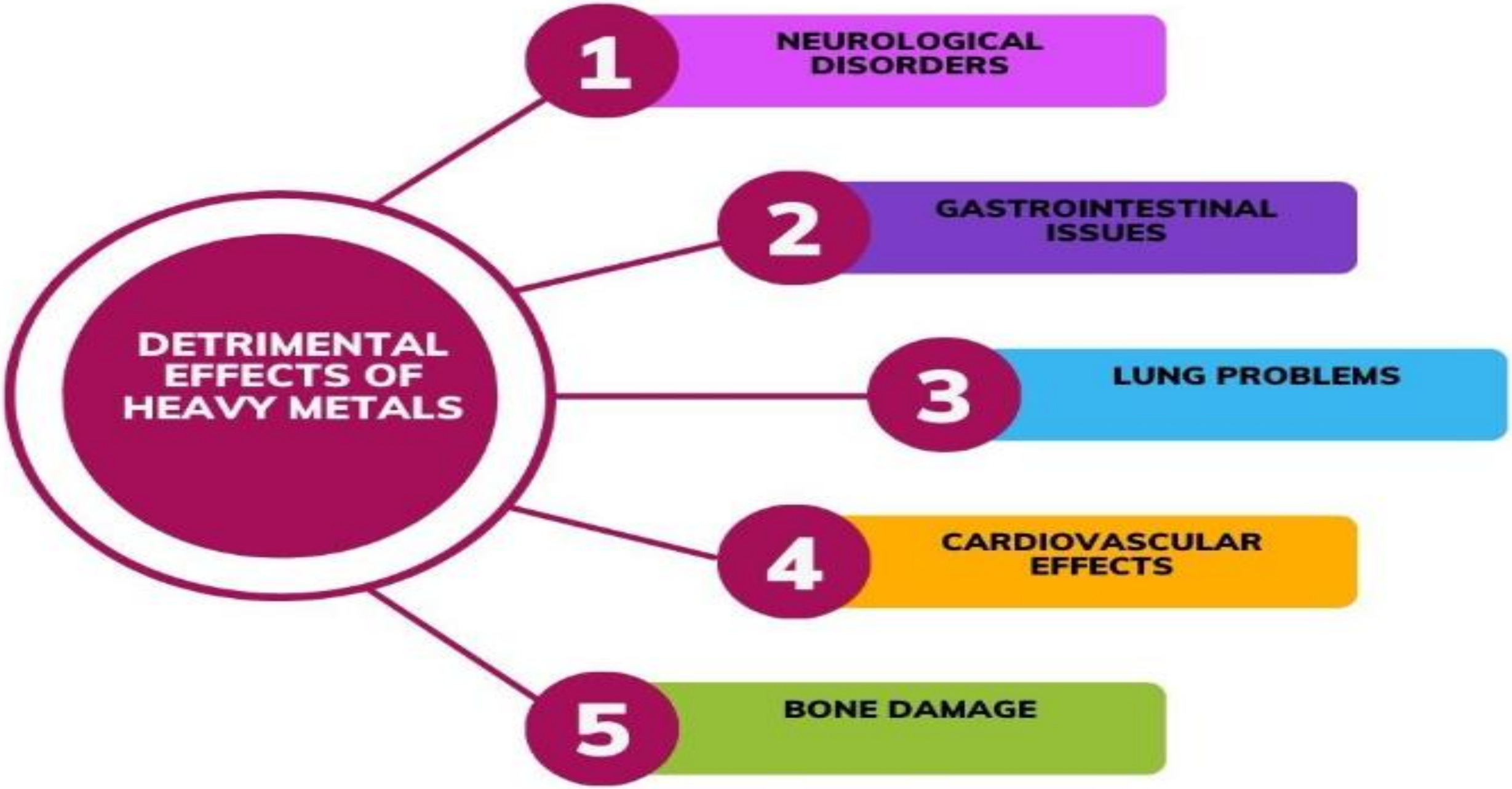


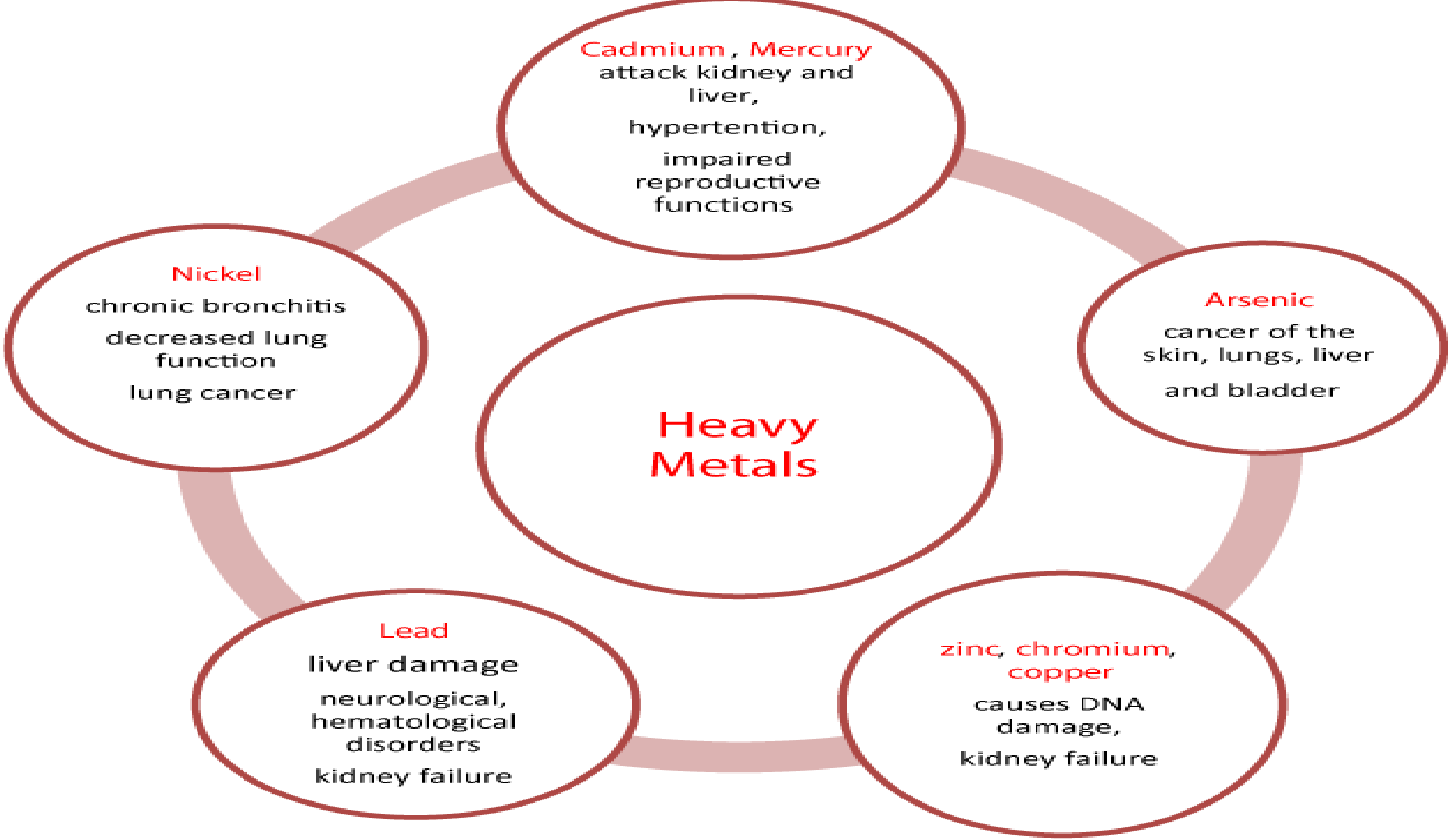
# Sources of heavy metals from some Industrial process



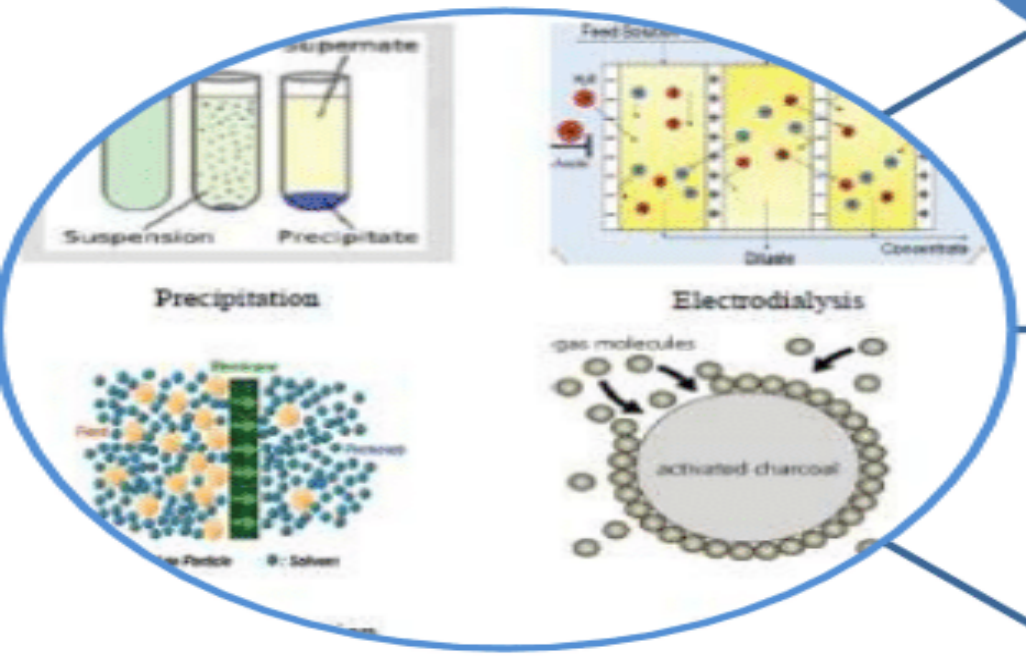
# Effect of heavy metal in Environment




DETRIMENTAL EFFECTS OF HEAVY METALS
1
NEUROLOGICAL DISORDERS
2
GASTROINTESTINAL ISSUES
3
LUNG PROBLEMS
4
CARDIOVASCULAR EFFECTS
5
BONE DAMAGE


Cadmium , Mercury
attack kidney and liver,
hypertention,
impaired reproductive functions
Arsenic
cancer of the skin, lungs, liver
and bladder
zinc, chromium, copper
causes DNA damage,
kidney failure
Lead
liver damage
neurological, hematological disorders
kidney failure
Nickel
chronic bronchitis
decreased lung function
lung cancer
Heavy Metals

# Removal of Heavy metal from wastewater




**Physical Methods**

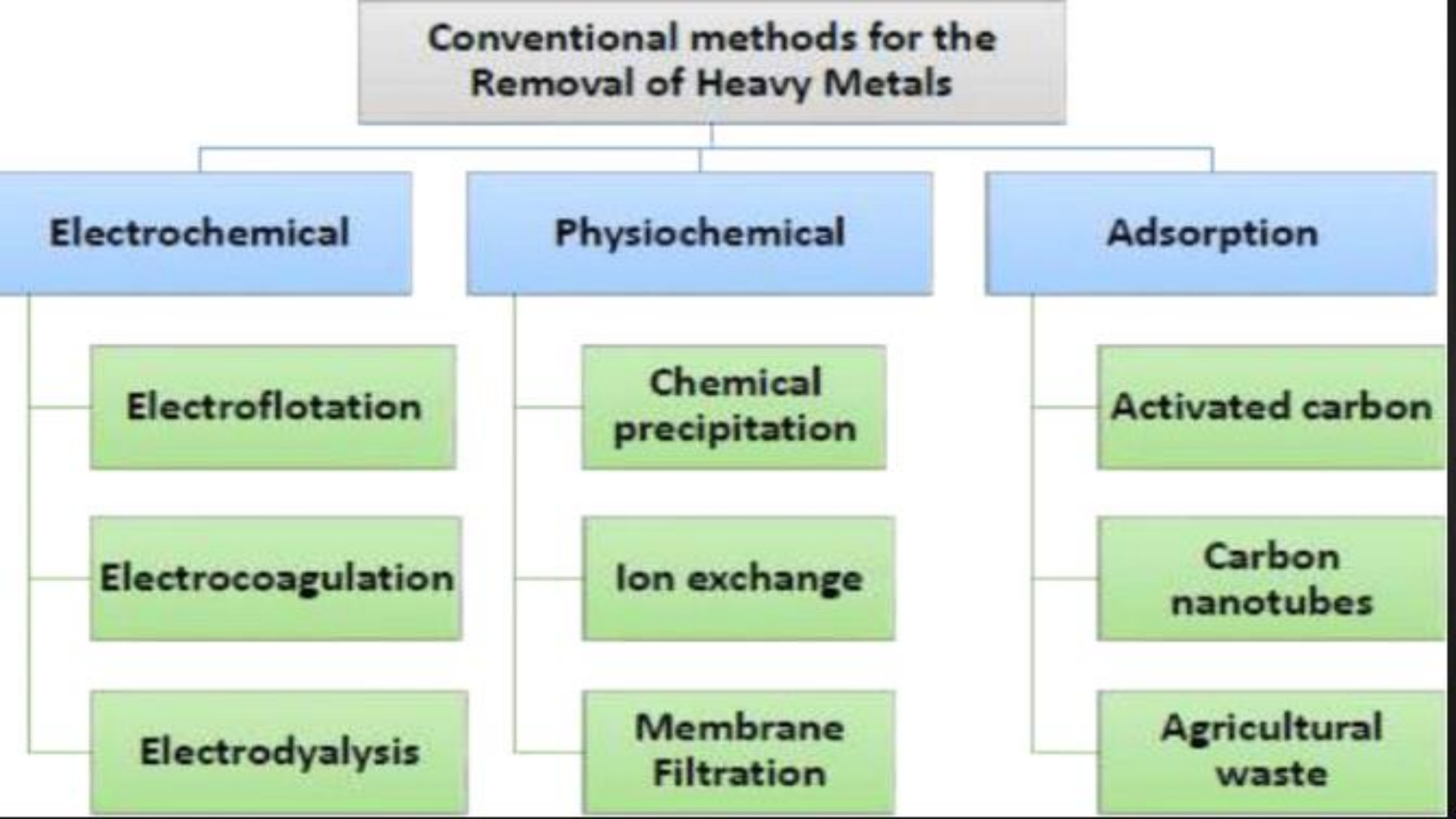
- Sedimentation
- Screening
- Filteration
- Membrane separation

**Chemical Methods**

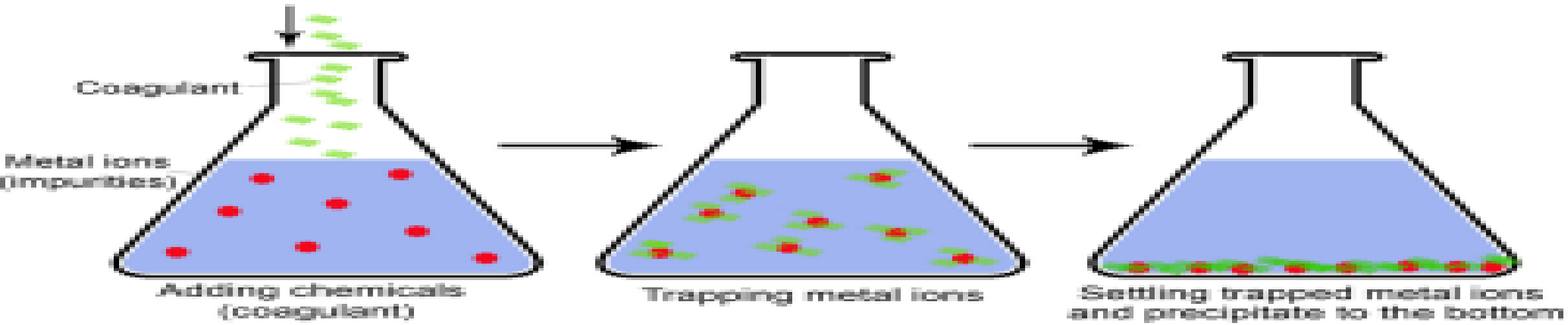
- Chemical precipitation
- Coagulation
- Ion exchange
- Adsorption
- Neutralization
- Solvent extraction

**Biological Methods**

- Aerobic
- Anaerobic

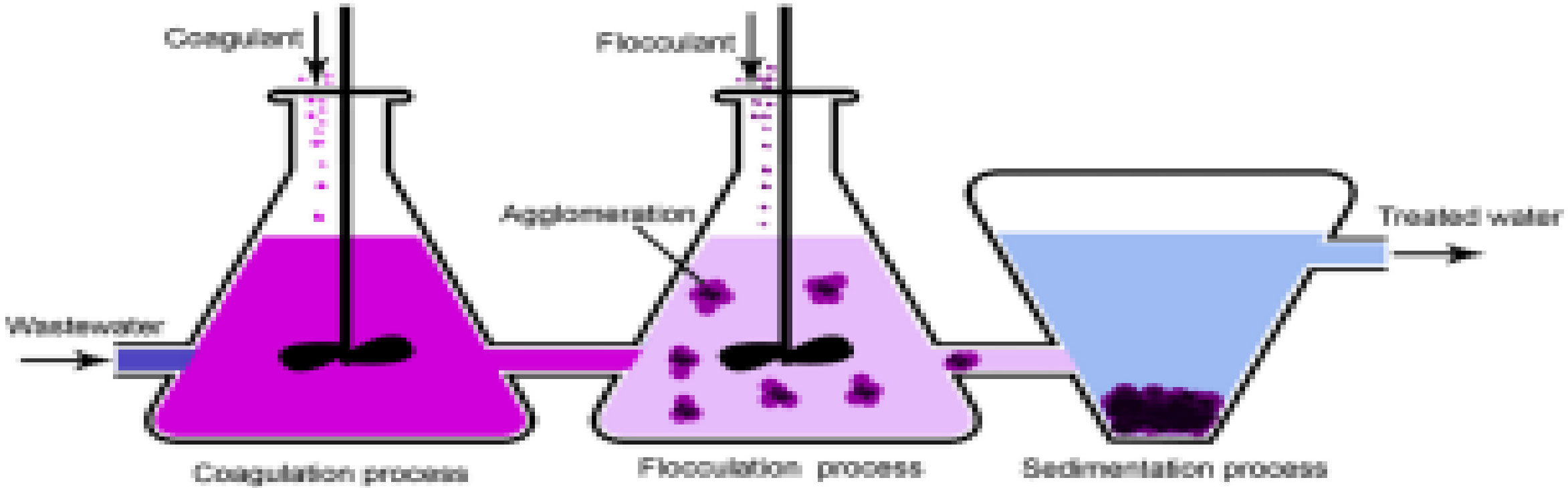

Conventional methods for the Removal of Heavy Metals
Electrochemical
Physiochemical
Adsorption
Electroflotation
Electrocoagulation
Electrodyalysis
Chemical precipitation
Ion exchange
Membrane Filtration
Activated carbon
Carbon nanotubes
Agricultural waste

# Chemical Precipitation Process




**A simple schematic of the chemical precipitation process.**

# Coagulation and flocculation process




. 5 An illustrative schematic of the coagulation-flocculation

# Ion Exchange Process

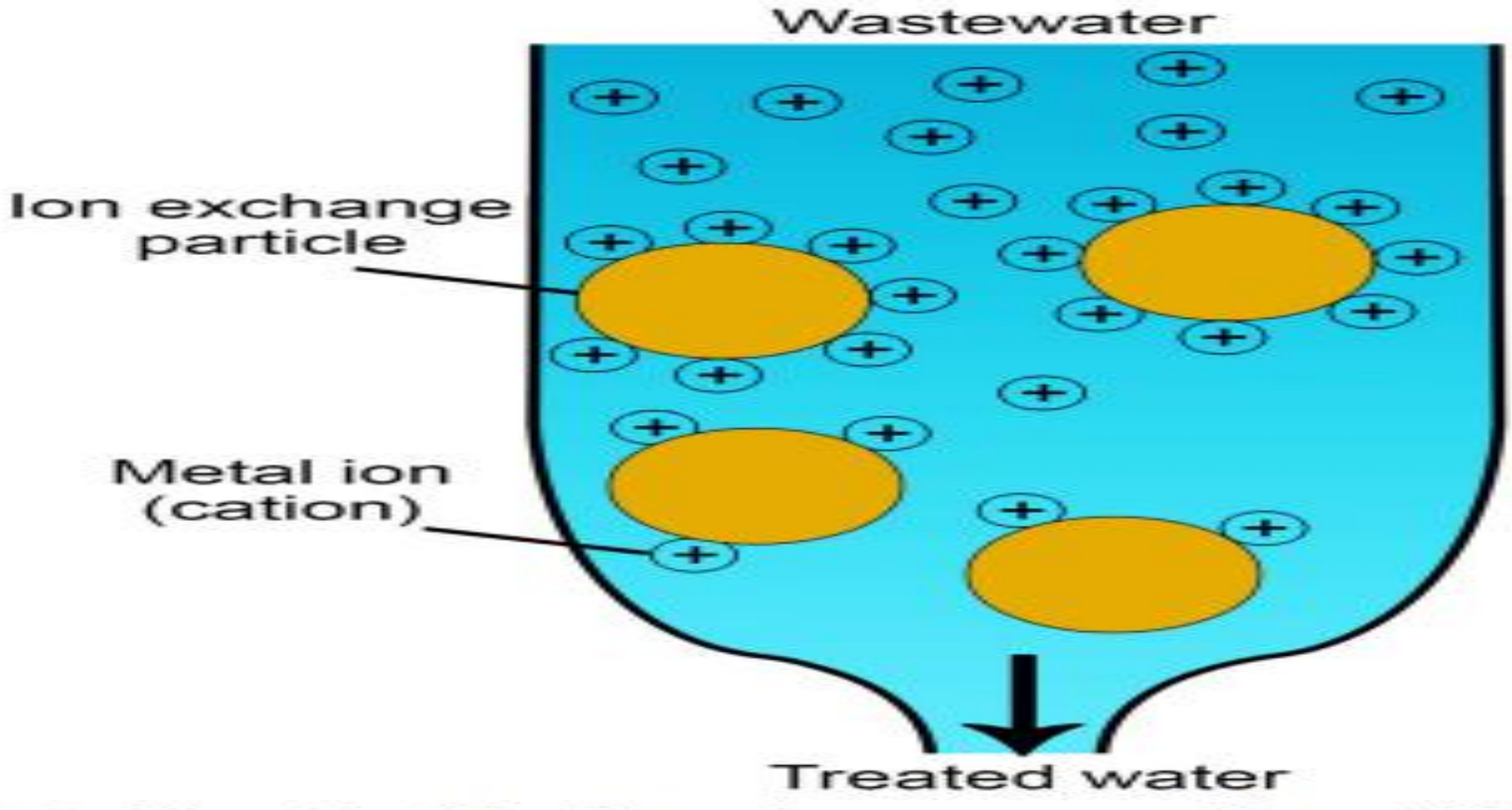
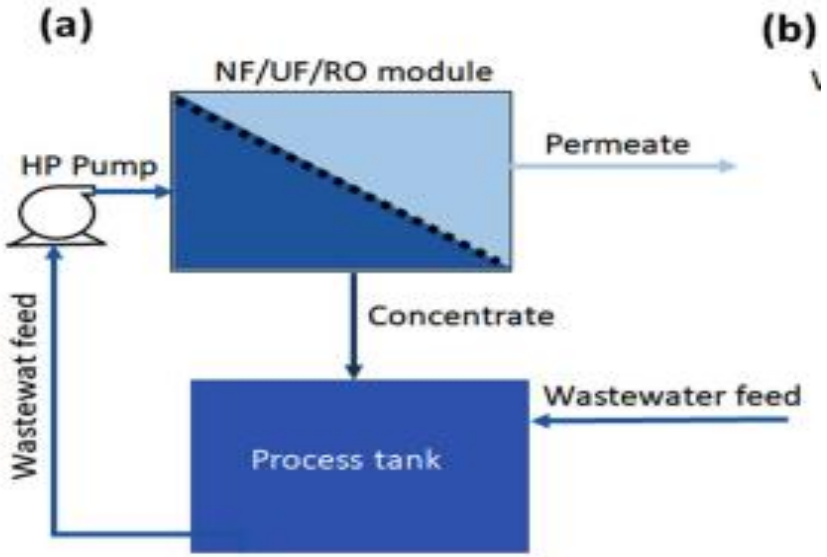



**Fig. 8 Schematic of the ion exchange process.** The metal ions

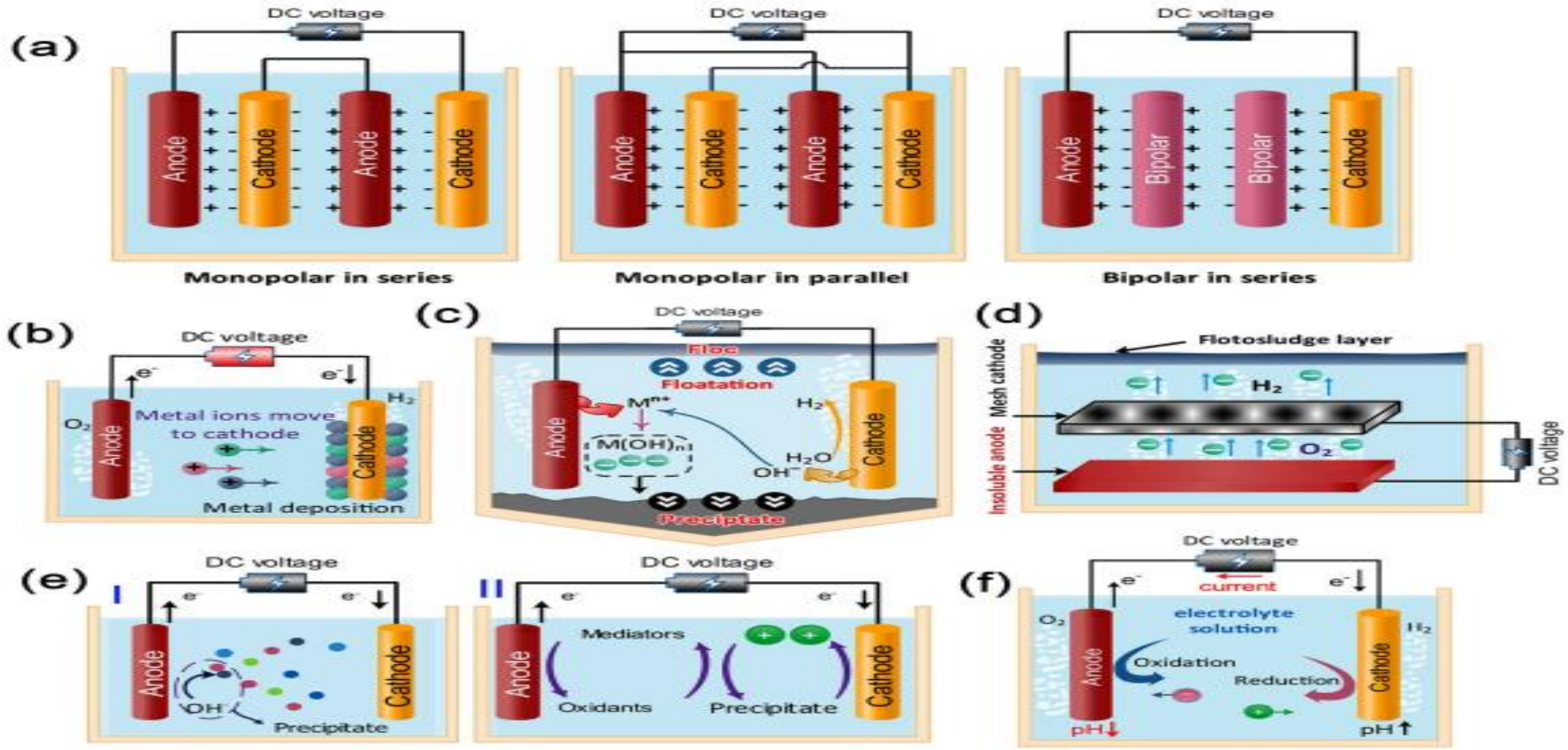
# Membrane-based Treatments




nanofiltration, ultrafiltration, or reverse osmosis method

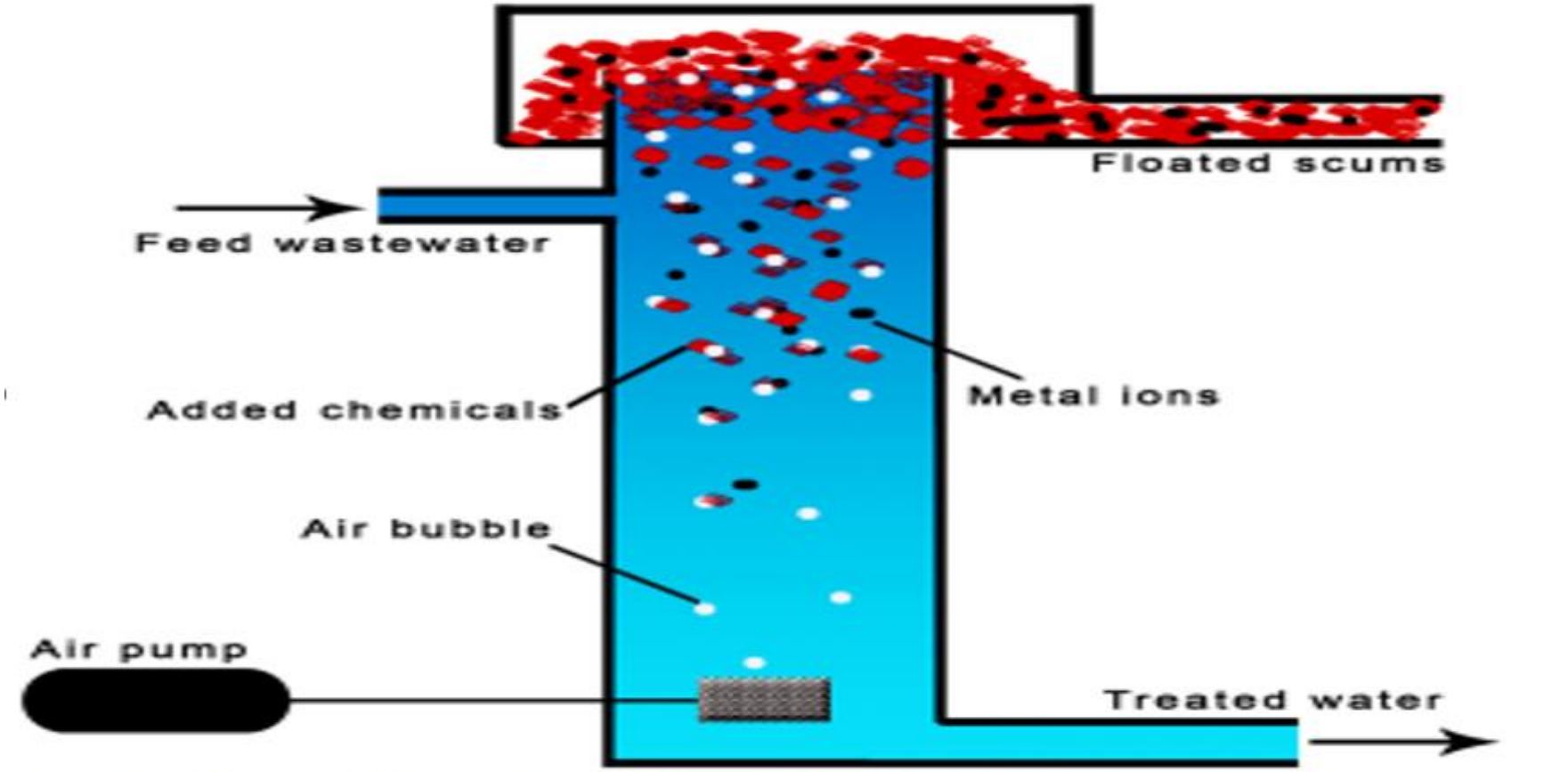
The separation capabilities of different membranes against different pollutants.

# Electrochemical methods and arrangements used for heavy metals removal



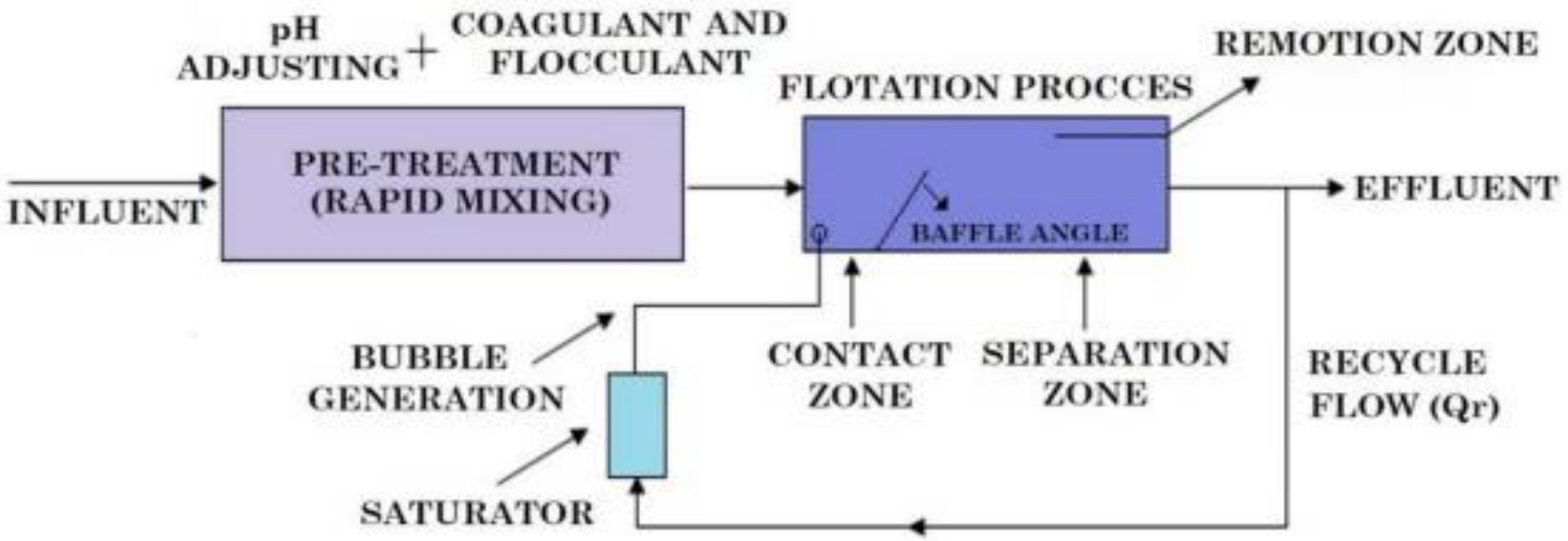

a Different arrangements of electrodes in electrolysis cell (i.e., **monopolar electrodes in series** (MP-S), monopolar electrodes in parallel (MP-P), and **bipolar electrodes in series** (BP-S)), b **mechanism of the electrochemical reduction** method in which positive metal ions are deposited over the cathode, c **electrocoagulation process** showing the flotation and precipitation of metal ions, d **basic electroflotation methods**—anions are released from anode to combine with cations (metal ions) and then floating over the water, e **electrochemical oxidation** (EO) process ((I) direct EO in which the ions react with OH and precipitate or (II) indirect EO in which mediators are used to forming oxidants that interact with the ions to be removed), **and d electro-Fenton process** in which OH− is released at anode and reacts with metal ions, and hence wastewater is purified due to precipitation

# Flotation Treatment Process




An illustrative schematic of the flotation treatment process.

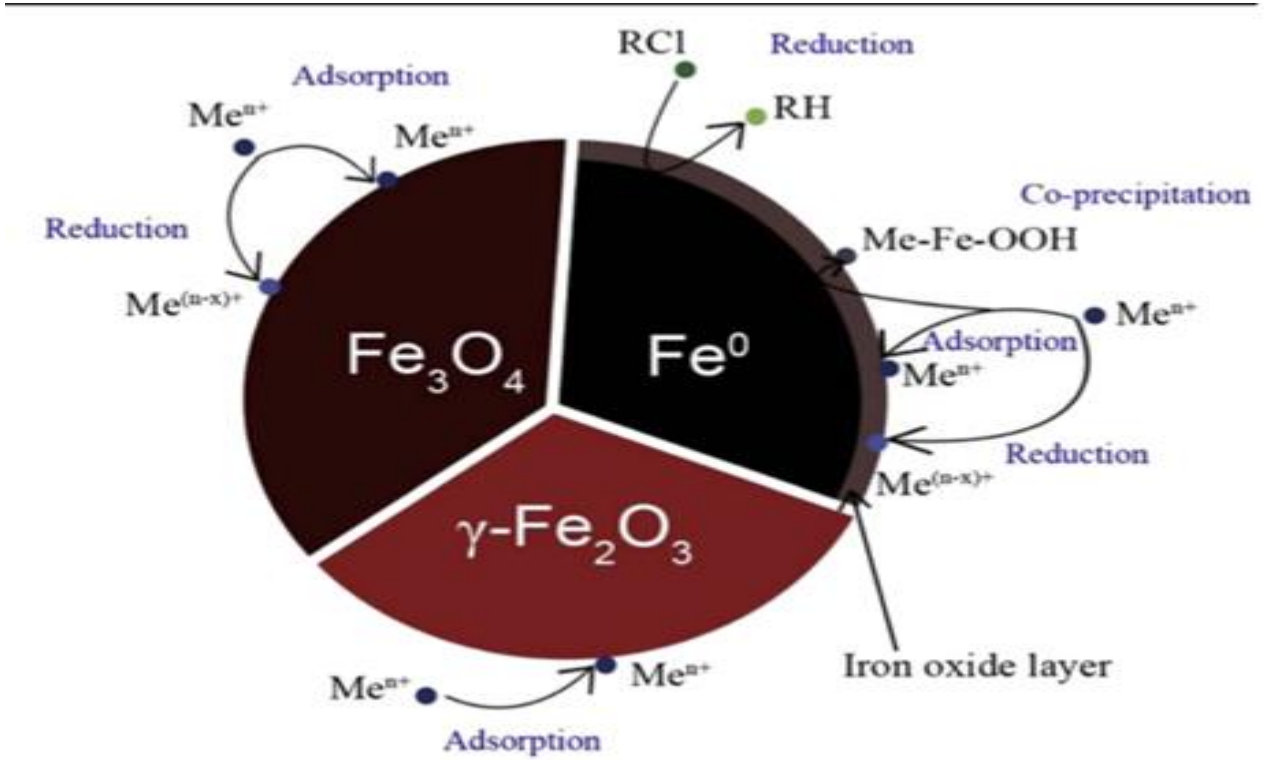
# Dissolved Air Flotation




**Process diagram of conventional DAF.**
**Source**

# Removal of metals by Metal Oxide Nanoparticle

Iron oxides(IO),oxy-hydroxides including amorphous hydrous ferric oxide (FeOOH), maghemite($\gamma Fe_2O_3$),and magnetite($Fe_3O_4$).
Having higher adsorption affinity, adsorption capacity, and faster adsorption rate in comparison to many other adsorbents
RCl=chlorinated compounds




Schematic representation of the removal mechanisms of pollutants by iron-based nanoparticles

# Conclusion

Methods of Heavy metal depends on Kind of Industry, Type of pollutant and the metal used and its the cost of Removal method

Thank you