



# ENVIRONMENTAL STUDIES & LIFE SCIENCES

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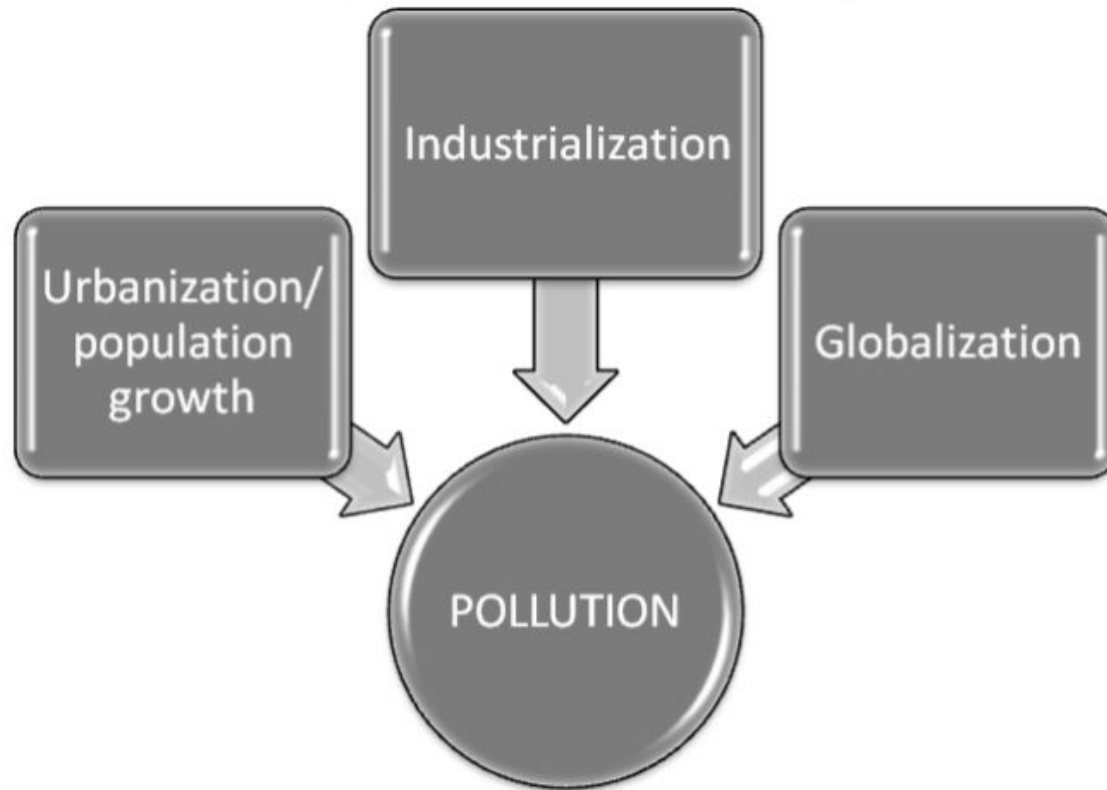
## Overview of pollution, Types of pollution

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- Pollution is the introduction of harmful materials into the environment.
- These harmful materials are called pollutants. Pollutants can be natural, such as volcanic ash.
- They can also be created by human activity, such as trash or runoff produced by factories.
- All living things—from one-celled microbes to blue whales—depend on Earth's supply of air and water. When these resources are polluted, all forms of life are threatened.

- Pollution is a global problem. Although urban areas are usually more polluted than the countryside, pollution can spread to remote places where no people live.
- For example, pesticides and other chemicals have been found in the Antarctic ice sheet. In the middle of the northern Pacific Ocean, a huge collection of microscopic plastic particles forms what is known as the Great Pacific Garbage Patch.



- The three major types of pollution are:
  - Air pollution
  - Water pollution
  - Land pollution
- However, thermal pollution, radioactive pollution and noise pollution are also of equal concern.

### 1. Air pollution

- Air pollution is the introduction of harmful chemicals into the atmosphere.
- The exhaust from vehicles for instance, is polluting the air with toxic chemicals such as carbon monoxide and formaldehyde. Carbon monoxide, sulfur dioxide and lead are typically released directly into the atmosphere from industrial activity and vehicles.

- **Primarily air pollutants** can be caused by primary sources or secondary sources. The pollutants that are a direct result of the process can be called Primary pollutants. Eg. sulfur-dioxide emitted from factories.
- **Secondary pollutants** are the ones that are caused by the intermingling and reactions of primary pollutants. Smog created by the interactions of several primary pollutants is known as a secondary pollutant.



- **Visible air pollution**, like smog over a city is an example of visible pollution. Smog makes breathing difficult, especially for children and older adults. Some cities that suffer from extreme smog issue air pollution warnings.
- **Invisible air pollutants** are less noticeable, but they can be more deadly. Good examples of invisible air pollutants are sulfur dioxide, carbon monoxide and nitrogen oxides.

- Natural disasters can also cause air pollution to increase quickly. When volcanoes erupt, they eject volcanic ash and gases into the atmosphere. Volcanic ash can discolor the sky for months.
- Most air pollution is not natural, however. It comes from burning fossil fuels—coal, oil, and natural gas. When gasoline is burned to power cars and trucks, it produces carbon monoxide, a colorless, odorless gas.



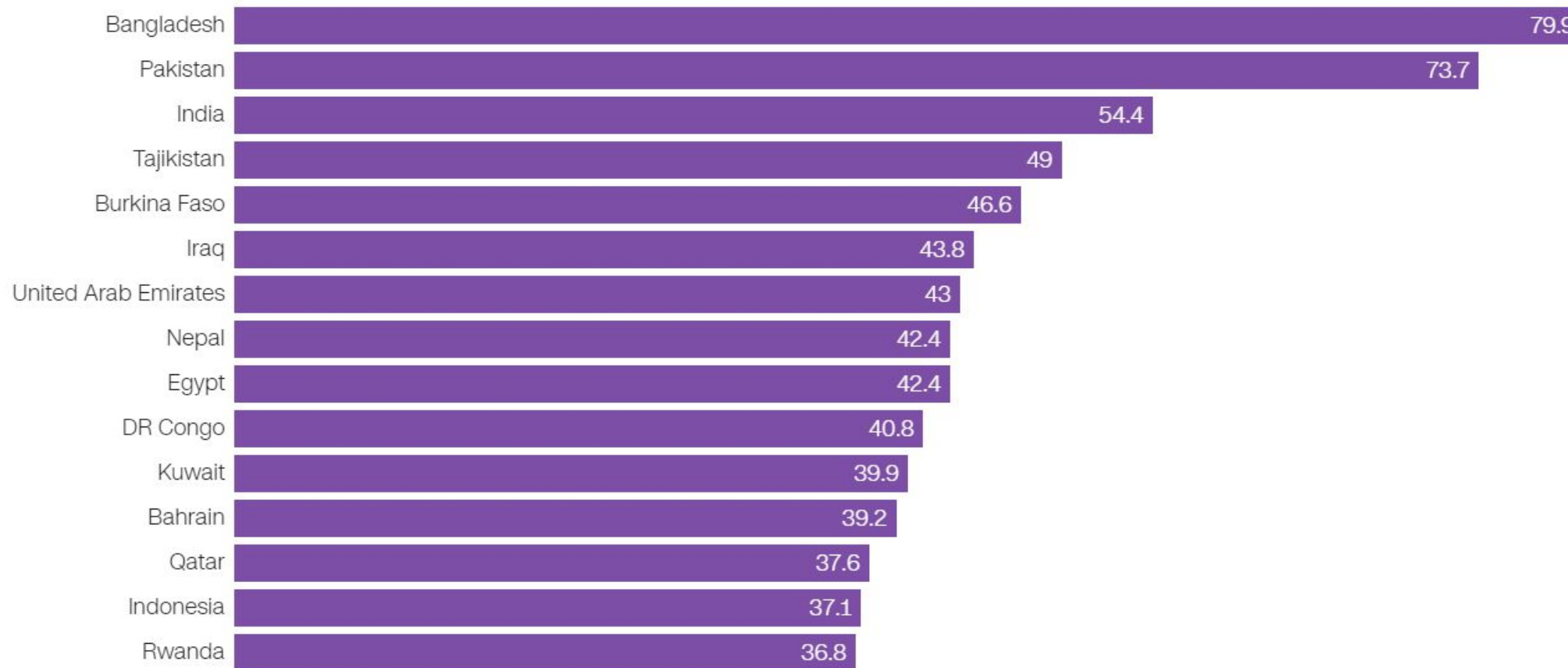
Manmade air pollution



Natural air pollution



Countries where avg. PM2.5 concentration (micrograms per cubic meter) exceeded WHO guideline seven to 10 times in 2023



### AQI



### 10 INDIAN CITIES IN TOP 15 MOST POLLUTED PLACES

GLOBAL RANK	COUNTRY	STATE	CITY	AVG. PM 2.5*
1	India	Rajasthan	Bhiwadi	106.2
2	India	Uttar Pradesh	Ghaziabad	102
3	China	Xinjiang	Hotan	101.5
4	India	Delhi	Delhi	96.4
5	India	Uttar Pradesh	Jaunpur	95.3
6	Pakistan	Punjab	Faisalabad	94.2
7	India	Uttar Pradesh	Noida	91.4
8	Pakistan	Punjab	Bahawalpur	91.0
9	Pakistan	Khyber Pakhtunkhwa	Peshawar	89.6
10	India	Uttar Pradesh	Bagpat	89.1
11	India	Haryana	Hisar	89.0
12	India	Haryana	Faridabad	88.9
13	India	Uttar Pradesh	Greater Noida	87.5
14	India	Haryana	Rohtak	86.9
15	Pakistan	Punjab	Lahore	86.5
WHO's AIR QUALITY GUIDELINE				5.0

Source: IQAir's World Air Quality Report, 2021 | \* (microgrms/cubic meter)

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- Major pollutants of air
  - ozone
  - particulate matter
  - carbon monoxide
  - nitrogen dioxide and sulphur dioxide
  - lead
  - volatile organic compounds (VOCs)
  - chlorofluorocarbons (CFCs)
  - mercury (Hg)
  - peroxyacyl nitrates (PANs)

- **Smog**
- Smog is air pollution that reduces visibility. The term "smog" was first used in the early 1900s to describe a mix of smoke and fog.
- Today, most of the smog we see is photochemical smog. Photochemical smog is produced when sunlight reacts with nitrogen oxides and at least one volatile organic compound (VOC) in the atmosphere.

- **The Great Smog of 1952.** A fog so thick and polluted it left thousands dead wreaked havoc on London in 1952. The smoke-like pollution was so toxic it was even reported to have choked cows to death in the fields. It was so thick it brought road, air and rail transport to a virtual standstill.
- During November 1-7, 2016, Delhi residents were caught in a case of what has been termed as a severe air pollution episode (SAPE) or the '**Great Delhi Smog**'. The AQI exceeded 500. It encapsulated the entire Indo-Gangetic Plain.





- Effects of air pollution
- Respiratory and Heart Problems- Asthma, chronic bronchitis, emphysema, heart attacks and strokes
- Child Health Problems- Exposure to high air pollution levels during pregnancy causes miscarriages as well as premature birth, autism, asthma and spectrum disorder in young children.

- Global Warming - With increased temperatures worldwide, an increase in sea levels and melting of ice from colder regions and icebergs, displacement, and loss of habitat have already signalled an impending disaster if actions for preservation and normalization aren't undertaken soon.
- Depletion of the Ozone Layer- Ozone exists in the Earth's stratosphere and is responsible for protecting humans from harmful ultraviolet (UV) rays. Earth's ozone layer is depleting due to the presence of chlorofluorocarbons, hydrochlorofluorocarbons in the atmosphere.

- Acid Rain- Harmful gases like nitrogen oxides and sulfur oxides are released into the atmosphere during the burning of fossil fuels. When it rains, the water droplets combine with these air pollutants, becomes acidic and then falls on the ground in the form of acid rain. Acid rain can cause great damage to humans, animals, and crops.



## 2. Water pollution

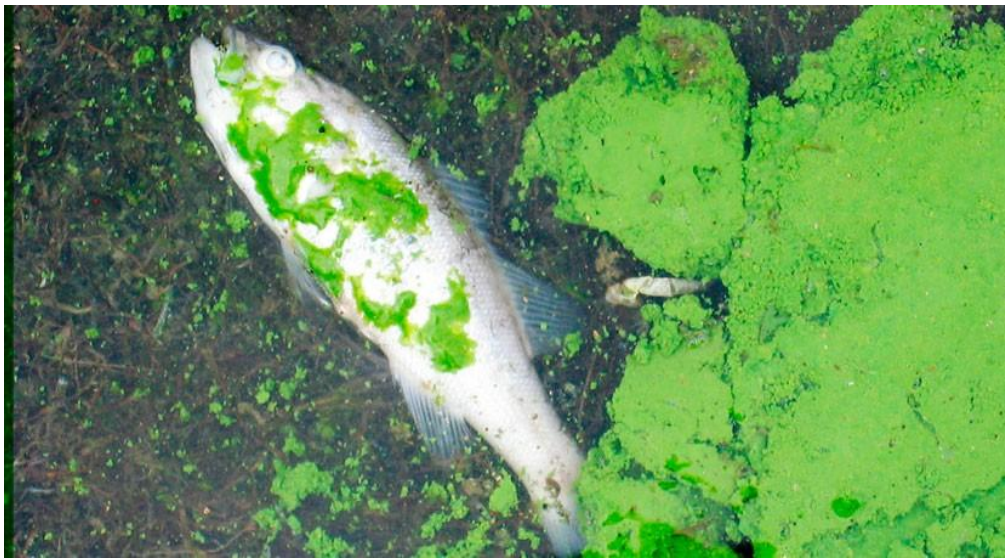
- The release of substances into subsurface groundwater or into lakes, streams, rivers, estuaries, and oceans to the point that the substances interfere with beneficial use of the water or with the natural functioning of ecosystems.
- In addition to the release of substances, such as chemicals, trash, or microorganisms, water pollution may include the release of energy, in the form of radioactivity or heat, into bodies of water.

- Water pollutants come from either point sources or dispersed sources.
- A point source is a pipe or channel, such as those used for discharge from an industrial facility or a city sewerage system. A dispersed (or nonpoint) source is a very broad unconfined area from which a variety of pollutants enter the water body, such as the runoff from an agricultural area.
- Point sources of water pollution are easier to control and treat than dispersed sources.

- **Industrial Runoff**- Stormwater and industrial runoff is a leading cause for water pollution. Industrial runoff typically contains high concentrations of pollutants such as heavy metals and petroleum hydrocarbons.
- **Domestic sewage** is the primary source of pathogens (disease-causing microorganisms) and putrescible organic substances. Because pathogens are excreted in feces, all sewage from cities and towns is likely to contain pathogens of some type, potentially presenting a direct threat to public health.



- Runoff from agricultural fields, industrial sites, or urban areas. Agricultural runoff typically includes fertilizer or toxic chemicals. Fertilizer can cause algal blooms.





- Oil Spill
- An oil spill refers to any uncontrolled release of crude oil, gasoline, fuels, or other oil by-products into the environment.
- The [Deepwater Horizon oil spill](#) was an industrial disaster that began on April 20, 2010, in the Gulf of Mexico on the BP-operated Macondo Prospect, considered to be the largest marine oil spill in the history of the petroleum industry

## *Deepwater Horizon oil spill*



- Effects of water pollution
- Groundwater—water contained in underground geologic formations called aquifers—is a source of drinking water for many people.
- Diarrhoea, skin diseases and other infections.
- Bioaccumulation occurs as heavy metals like mercury move up through the food chain contaminate shellfish and fish like mackerel, tuna and sharks, exposing consumers to these toxic chemicals.

- Mercury poses higher health risks to children under 6 and to child-bearing women because it interferes with brain development of the newborn.
- Oil floats on water, cutting off oxygen for plankton. Oil causes tissue damage in coral and coral larvae, causes heart defects in bluefin tuna larvae and other fish and even small amounts of oil impairs the ability of seabirds to fly, swim and dive for food.

### 3. Land pollution

- The deposition of solid or liquid waste materials on land or underground in a manner that can contaminate the soil and groundwater, threaten public health, and cause unsightly conditions and nuisances.
- The waste materials that cause land pollution are broadly classified as municipal solid waste (MSW, also called municipal refuse), construction and demolition (C&D) waste or debris, and hazardous waste.

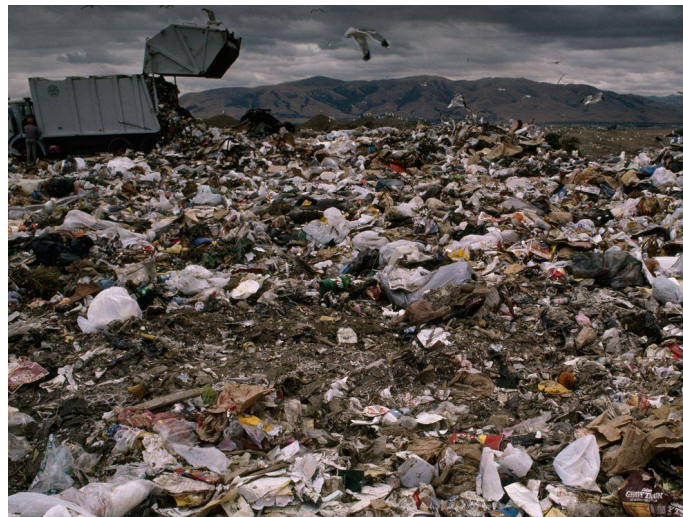
- Land degradation is caused by presence of Xenobiotics (human-made) chemicals or other alteration in the natural soil environment. It is typically caused by industrial activity, agricultural chemicals or improper disposal of waste.
- **Xenobiotics** are defined as chemicals to which an organism is exposed that are extrinsic to the normal metabolism of that organism. Examples- poly aromatic hydrocarbons (PAHs), persistent organic pollutants (POPs).

- **Recalcitrants** are pollutants that persist in the environment, they are capable of long range transportation, bioaccumulation, in human and animals, and biomagnifications in food chain.
- Landfills were originally designed as waste disposal areas. They went on to become well-engineered facilities designed to receive specific kinds of waste, including municipal solid waste, construction and demolition debris and hazardous waste.

- However, landfills by themselves have become a cause for major concern.
- Landfills have the potential to cause a number of issues.
- When precipitation falls on open landfills, water percolates through the garbage and becomes contaminated with suspended and dissolved material, forming leachate. If this is not contained it can contaminate groundwater.



- Rotting food and other decaying organic waste create decomposition gases, especially  $\text{CO}_2$  and  $\text{CH}_4$  from aerobic and anaerobic decomposition, respectively.
- Landfill gases can seep out of the landfill and into the surrounding air and soil.



### 4. Noise pollution

- Noise pollution is generally defined as regular exposure to elevated sound levels that may lead to adverse effects in humans or other living organisms.
- Noise pollution is commonly generated inside many industrial facilities and some other workplaces, but it also comes from highway, railway, and airplane traffic and from outdoor construction activities.



- Effects of Noise pollution
- Noise pollution is an invisible danger.
- It causes is Noise Induced Hearing Loss (NIHL).
- Exposure to loud noise can also cause high blood pressure, heart disease, sleep disturbances, and stress.
- These health problems can affect all age groups, especially children.
- According to the World Health Organization, sound levels less than 70 dB are not damaging to living organisms, regardless of how long or consistent the exposure is.

### 5. Thermal pollution

- Thermal pollution is a rapid change in temperature in a natural body of water.
- This pollution is most often caused by heated discharge from an industrial facility or another human activity.
- Thermal pollution can result in disruptions in natural systems and stress, disease, or even death for affected organisms.

- Causes of Thermal Pollution
- Natural phenomena such as wildfires, volcanoes, and underwater thermal vents can cause thermal pollution. However, it is more often the result of an industrial process or facility using large amounts of water from a natural source and releasing heated wastewater.



- Effects of thermal pollution
- It decrease the amount of dissolved oxygen in the water
- Aquatic life like fishes, their larvae and eggs gets damaged
- Kills some species of fish and macro-invertebrates that have a limited tolerance for temperature change, and migration of living entities
- Contributes to global warming



- Water-scarce countries, particularly in the Middle East, have turned to desalination as a means of bolstering water security in the face of drought and climate change. A 2020 study of desalination plants in Ashkelon and Hadera along Israel's Mediterranean coast found that the mixing of cooling water to dilute briny wastewater created a heated plume 25% warmer than the natural seawater temperature, placing stress on local benthic organisms near the seafloor.

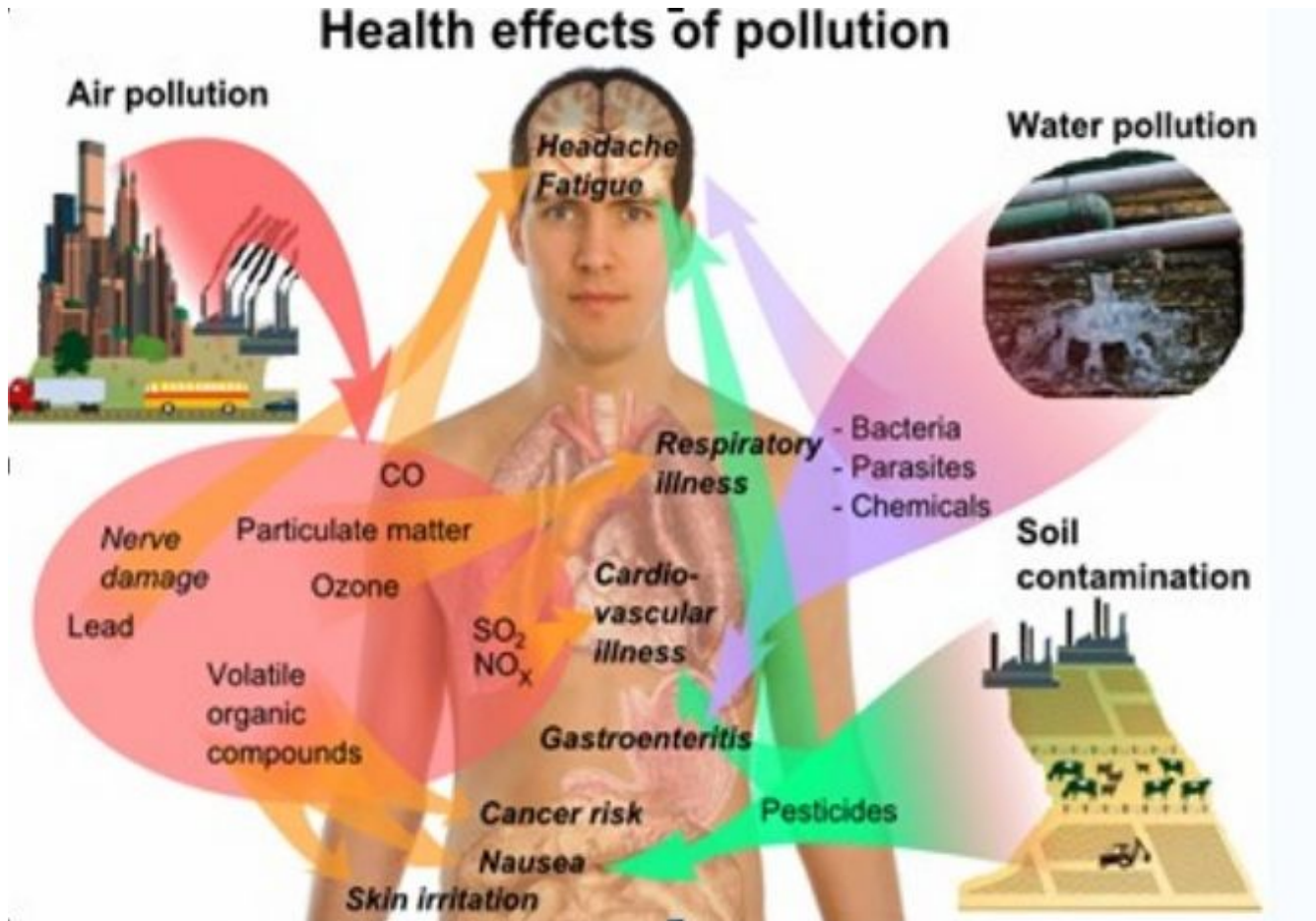


### 6. Radioactive pollution

- Radioactive contamination is defined as the deposition or introduction of radioactive substances into the environment, where their presence is unintended, or the levels of radioactivity are undesirable.
- It can be due to release of radioactive substances into the environment during nuclear explosions and testing of nuclear weapons, nuclear weapon production and decommissioning, mining of radioactive ores.



- Effects of Radiation:
- Exposure to very high levels of radiation, such as being close to an atomic blast, can cause acute health effects such as
- Skin burns
- Acute radiation syndrome ("radiation sickness")
- Skin cancer
- Cardiovascular disease.
- Chronic respiratory disease,
- Lung cancer





# THANK YOU

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