

Atmosphere, Light, Noise & Indoor Pollution

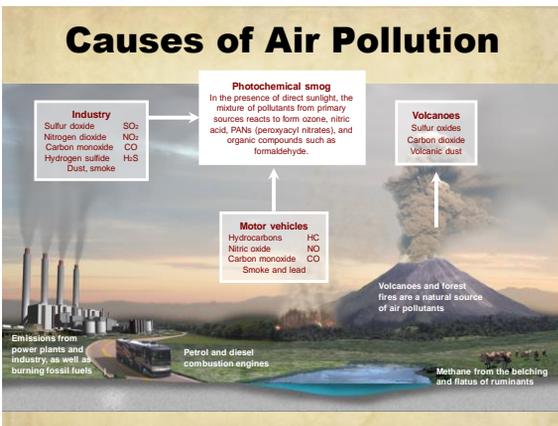
Atmospheric Pollution

▸ **Air pollution** comprises gases, liquids, or solids present in the atmosphere at concentrations high enough to harm living things or cause damage to materials.

- It does not only exist outdoors; the air enclosed in spaces such as cars and buildings may have higher levels of air pollutants than the outside air.
- **Sick Building Syndrome** occurs when air pollution inside a building causes a range of health ailments to the building's inhabitants.



Pollution over Mexico City Smoke from chimney stacks



Heat Islands

- ▶ Heat islands occur where a patch of rock or bare ground, surrounded by covered ground (e.g forest), heats up during the day to produce higher air temperatures than over the surrounding land.
- ▶ Cities contain a lot of concrete and asphalt that acts in the same way as bare rock.
 - Consequently the air above them heats up quickly during the day.
 - This can cause changes in local climate including higher temperatures and heavier rainfall than in surrounding areas.

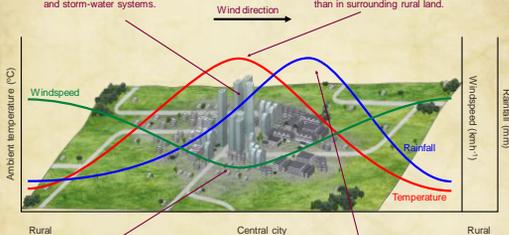
The heat island effect can be easily seen using satellites. The green areas are mostly vegetation.



Effect of Cities

Up to 70% of the rain that falls in a city is diverted into drains and storm-water systems.

Average temperatures in a city can be between 5-10°C higher than in surrounding rural land.

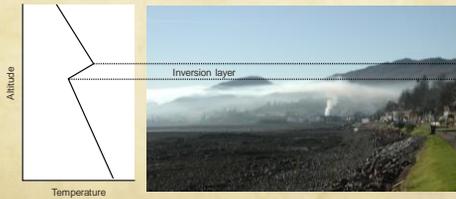


Windspeed is often lower in cities than in surrounding rural areas, although some streets may act to funnel wind at high speed. The direction is often not constant.

Rising hot air carries moisture with it. The air cools and the moisture falls as rain downwind of the city.

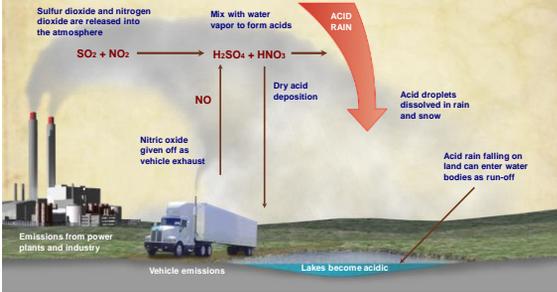
Temperature Inversion

- ▶ Temperature inversion occurs when a layer of warm air sits on top of a layer of cold air.
 - The cool dense air remains close to the ground and disrupts normal convection currents and diffusion, preventing pollutants such as smoke rising to higher altitudes.
 - When this happens in a city, pollutants from cars and factories can be concentrated near the surface, creating serious health issues.



Acid Rain

► **Acid rain** (or more correctly termed **acid deposition**) can fall to the Earth as rain, snow or sleet, as well as dry, sulfate-containing particles that settle out of the air. It is a world-wide problem.

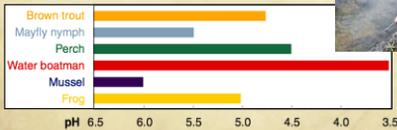


Acidity Tolerance

► **Acid rain** produces forests with sickly, stunted trees and lakes that are so acid that they cannot support fish. It also releases heavy metals (for example, cadmium and mercury) into the food chain.

► Changes in species composition of aquatic communities may be used as **biological indicators** measuring the severity of acid deposition.

● The graph shows the acidity tolerance of some common aquatic species.



Noise Pollution

► **Noise pollution** is becoming a greater problem as people begin to move into formally unpopulated areas.

► **Ship engines** and **sonar** fill the sea with noise that can travel hundreds of kilometres, affecting marine life.



Sound Levels

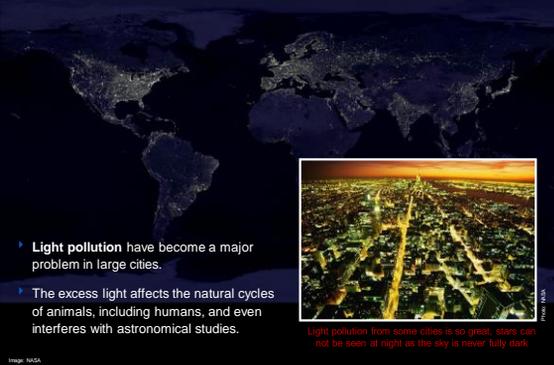
▶ Sound is measured in **decibels (dB)**.

- The scale is logarithmic. 30 dB has ten times more energy than 20 dB.
- Exposure to sound above 85 dB can cause permanent hearing loss, while pain is experienced above 120 dB



Light Pollution

Light from Earth's major cities as seen from space.



- ▶ **Light pollution** have become a major problem in large cities.
- ▶ The excess light affects the natural cycles of animals, including humans, and even interferes with astronomical studies.



Light pollution from some cities is so great, stars can not be seen at night as the sky is never fully dark.

Toxins in the Environment

▶ Certain substances in the environment are harmful when absorbed in high concentrations. These substances include:

- **Pesticides**
- Radioactive isotopes
- Heavy metals
- Industrial chemicals such as PCBs (polychlorinated biphenyls).

▶ They can be taken up by organisms via food or water or simply absorbed from the surroundings.



Toxicants in the Home

▶ Toxicants are man-made poisons such as artificial pesticides or solvents (as opposed to toxins which are poisons naturally made by an organism).

Commonly occurring toxicants include:

PBDEs

Polybrominated diphenyl ethers. Used as flame retardants in appliances and fabrics. They build up in tissues and cause problems with development.

Phthalates

Chemicals widespread in many products including cosmetics and vinyls. Implicated in problems with male sexual development.

Pesticides

A wide range of chemicals used to kill household pests. Many are linked to neurological, developmental, and immunological problems.

Metals

Some of the most common industrial poisons in the home. Include mercury, lead, and arsenic. Effects include nervous and mental disorders.

PFAs

Used in scratch and stain resistant coatings. Widespread in the environment, they take years to eliminate from the body. Implicated in cancers.

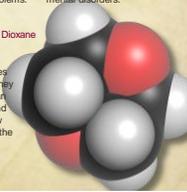
Bisphenols

Found in hard plastics and leak out as the plastic degrades. Estrogen mimics implicated in reproductive damage in males and females.

Dioxins and PCBs

Dioxins result from fires and heavy industry. They build up in fats and can cause birth defects and cancer. PCBs are now banned but persist in the environment.

1,4 Dioxane



Toxicants in the Home

Kitchen:

PBDEs: coffee maker, microwave, toaster
Phthalates: Plastic containers and bottles, some food wraps, vinyl flooring
Metals: contaminated fish
Dioxins and PCBs: fatty meat, dairy products, fish
Bisphenols: plastic containers, lining of food cans.

Bedroom/Bathroom:

PBDEs: foam mattresses and pillows, carpet, cushions, phone, hairdryer
Phthalates: shower curtain, nail polish, shampoo, perfume, lotions, hairspray, vinyl flooring, toothpaste
Pesticides: antimicrobial soaps
Metals: lead paint (in older homes)



Outside:

Phthalates: outdoor furniture, garden hose, roofing, PVC
Dioxins and PCB: fatty meat and fish
Pesticides: lawn, garden
Metals: treated wood, lead paint

Living room:

PBDEs: cushions, electronics, carpet
Phthalates: extension cords, vinyl wallpaper, blinds
PFAs: furniture fabric

Health Effects of Pollution

▶ The effects of pollution on health depends on the pollutant and its concentration.

- Some pollutants are difficult to avoid, such as carbon monoxide from traffic, while others, e.g. cigarette smoke, as much more easily avoided.



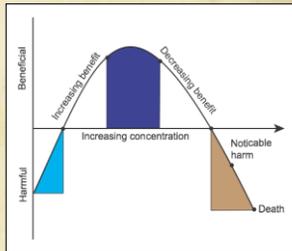
Air Pollution and Health

- Carbon monoxide reduces the blood's ability to carry oxygen and results in headaches, and impaired reflexes.
- SO₂, NO_x, and O₃ detrimentally affect respiratory function.
- Air pollution in the USA causes up to 200,000 deaths a year and costs \$150 million to treat.



Dose and Response

- "Everything is poisonous, yet nothing is poisonous"
Paracelsus ~1500 AD.
 - In essence this means that for all substances, it is the dose that matters when determining the toxicity.
- This can be shown as a dose and response curve.



Fluorine is a well known example of dose and response. Low levels of fluorine result in faster tooth decay and defective bone development. High levels of fluorine, however result in discoloration of the teeth and damage to the bones.

Economic Impacts

- Placing a monetary value on the cost of pollution is difficult but it can be divided into three areas:
 - direct costs (e.g. clean ups)
 - indirect costs (e.g. revenues losses)
 - repercussion costs (e.g. public opinion).
- These have to be weighed up against the cost of not polluting at all, which may mean the failure of some industries.
- Cost-benefit analysis is used to determine the short and long term costs of controlling pollution.

