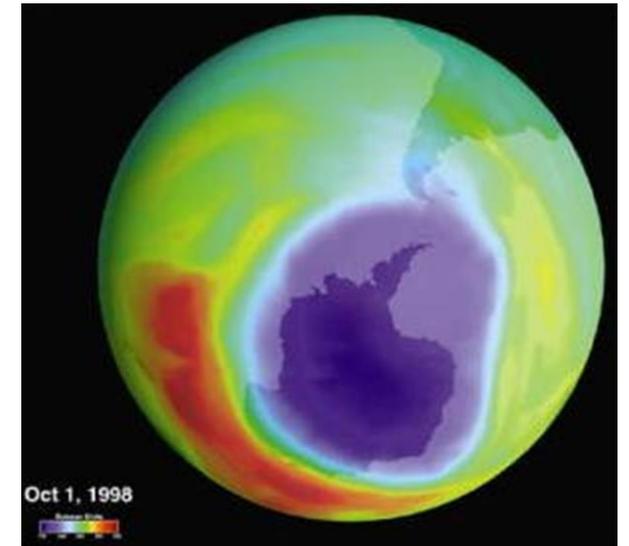
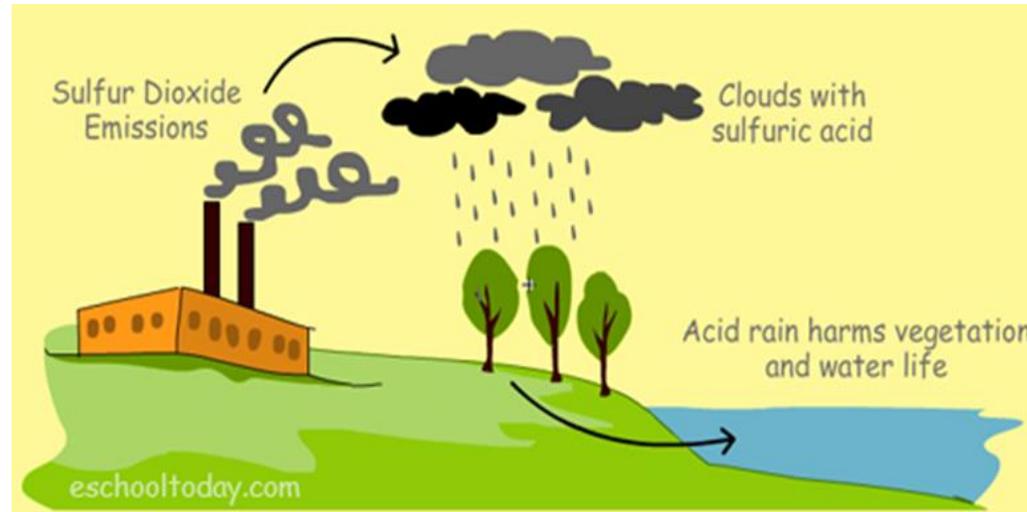
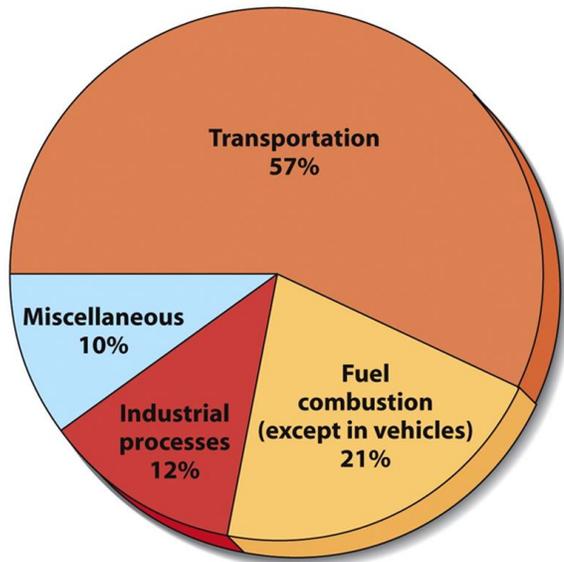


# Environmental Health

- **Air Pollution**
  - **Water Pollution**
  - **Food Pollution**
- 
- **Dr. Sireen Alkhalidi, DrPh**
  - **Community Medicine, First semester 2018/ 2019**
  - **Faculty of Medicine/ The University of Jordan**

# Air Pollution



Textbook: Frumken, H., Environmental Health (from global to local) 3<sup>rd</sup> edition (2016); Wiley, San Francisco, CA.

# 7 shocking facts about air pollution

- ❑ It is the deadliest form of pollution, killing millions of people each year.
- ❑ **The Cost of Air Pollution:** premature deaths linked to air pollution cost the global economy \$225 billions of dollars in 2016 in lost labor income.
- ❑ More than nine out of 10 of the world's population ( 92%) live in places where air pollution exceeds safe limits, according to research from the World Health Organization (WHO).

# 7 shocking facts about air pollution

- ❑ Air pollution is the fourth-largest threat to human health, after high blood pressure, dietary risks and smoking.
- ❑ 4.2 million deaths every year as a result of exposure to ambient (outdoor) air pollution
- ❑ 3.8 million deaths every year as a result of household exposure to smoke from dirty cookstoves and fuels (in 2012, WHO).
- ❑ That's 11.6% of all global deaths – more than the number of people killed by HIV/AIDS, tuberculosis and road injuries combined.

# Significance of the Problem

- Almost all deaths (94%) linked to air pollution occur in low- and middle-income countries, the WHO says.
- Around 3 billion people (more than 40% of the world's population) still do not have access to clean cooking fuels and technologies in their homes.
- Parts of Africa, Eastern Europe, India, China and the Middle East are the biggest regional danger spots.
- WHO estimates that some 80% of these deaths were due to ischemic heart disease and strokes, while 14% of deaths were due to chronic obstructive pulmonary disease or acute lower respiratory infections; and 6% of deaths were due to lung cancer.

# What is Air Pollution?

**Air pollution occurs when gases, dust particles, smoke, or odors are introduced into the atmosphere in a way that makes it harmful to humans, animals and plants.**

# What is the Atmosphere?

The Earth is surrounded by a blanket of air (made up of various gases) called the atmosphere.

The atmosphere helps protect the Earth and allow life to exist. Without it, we would be burned by the intense heat of the sun during the day or frozen by the very low temperatures at night.

# What is the Atmosphere?

## ☐ Atmospheric Composition:

Nitrogen 78.08%, Oxygen 20.95%, Argon 0.93%,  
Carbon dioxide 0.04%.

## ☐ Benefits:

- 1) Blocks UV radiation
- 2) Moderates the climate
- 3) Redistributes water in the hydrologic cycle

# Definitions

**Air pollutants** are airborne gases, particles, and aerosols that are added to the atmosphere by natural events or human activities in concentrations that threaten the well-being of organisms or disrupt the orderly functioning of the environment.

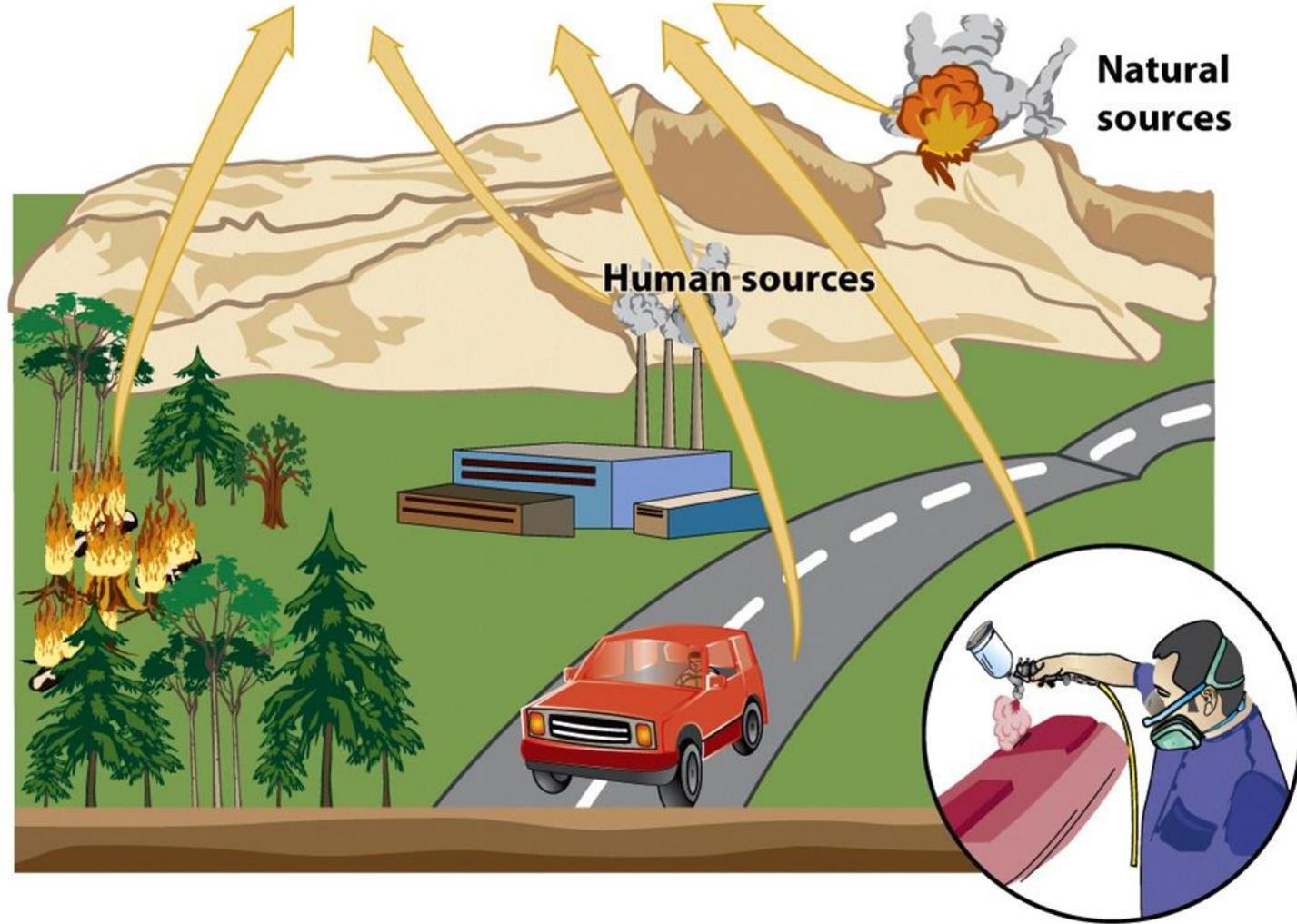
- **Primary air pollutants** pollute the air when emitted directly into the atmosphere.
- **Secondary air Pollutants** are created by chemical reactions between primary air pollutants in the atmosphere.

### Primary air pollutants

CO  
SO<sub>2</sub> NO NO<sub>2</sub>  
Most hydrocarbons  
Most particulates

### Secondary air pollutants

HNO<sub>2</sub> SO<sub>3</sub>  
HNO<sub>3</sub> H<sub>2</sub>SO<sub>4</sub>  
H<sub>2</sub>O<sub>2</sub> O<sub>3</sub> PANs  
Most NO<sub>3</sub><sup>-</sup> and SO<sub>4</sub><sup>2-</sup>  
salts



# The most common air pollutants

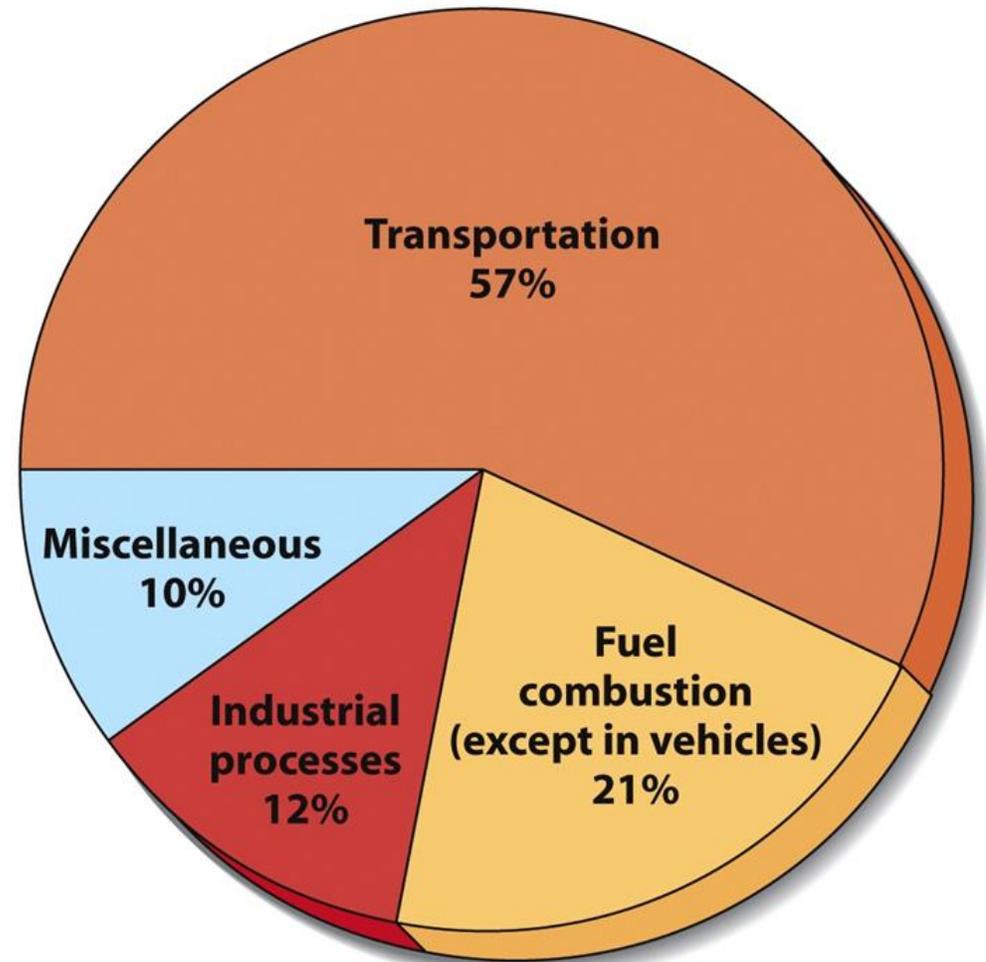
1. Oxides of Carbon (CO, CO<sub>2</sub>)
2. Volatile Hydrocarbons (VOC's)
3. Oxides of Nitrogen
4. Sulfur Compounds
5. Photochemical Smog
6. Suspended Particulates



# What are the sources of air pollution?

## Three main sources:

- 1) **Transportation**
- 2) **Power plants**
- 3) **Industry**



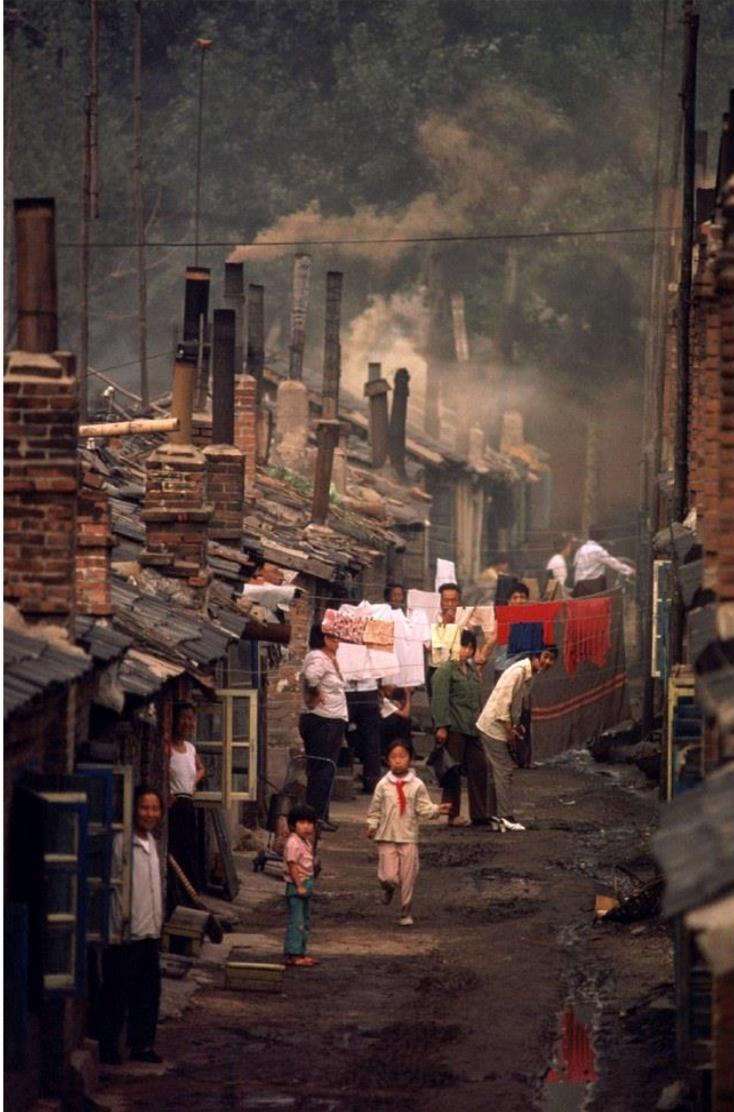
# Urban Outdoor Air Pollution

## Photochemical Smog (eg: Los Angeles)

- Brownish-orange haze formed by chemical reactions involving sunlight, nitrogen oxide, and hydrocarbons



# Air Pollution in Beijing and Mexico City



- Beijing (left)
- Mexico City (above)

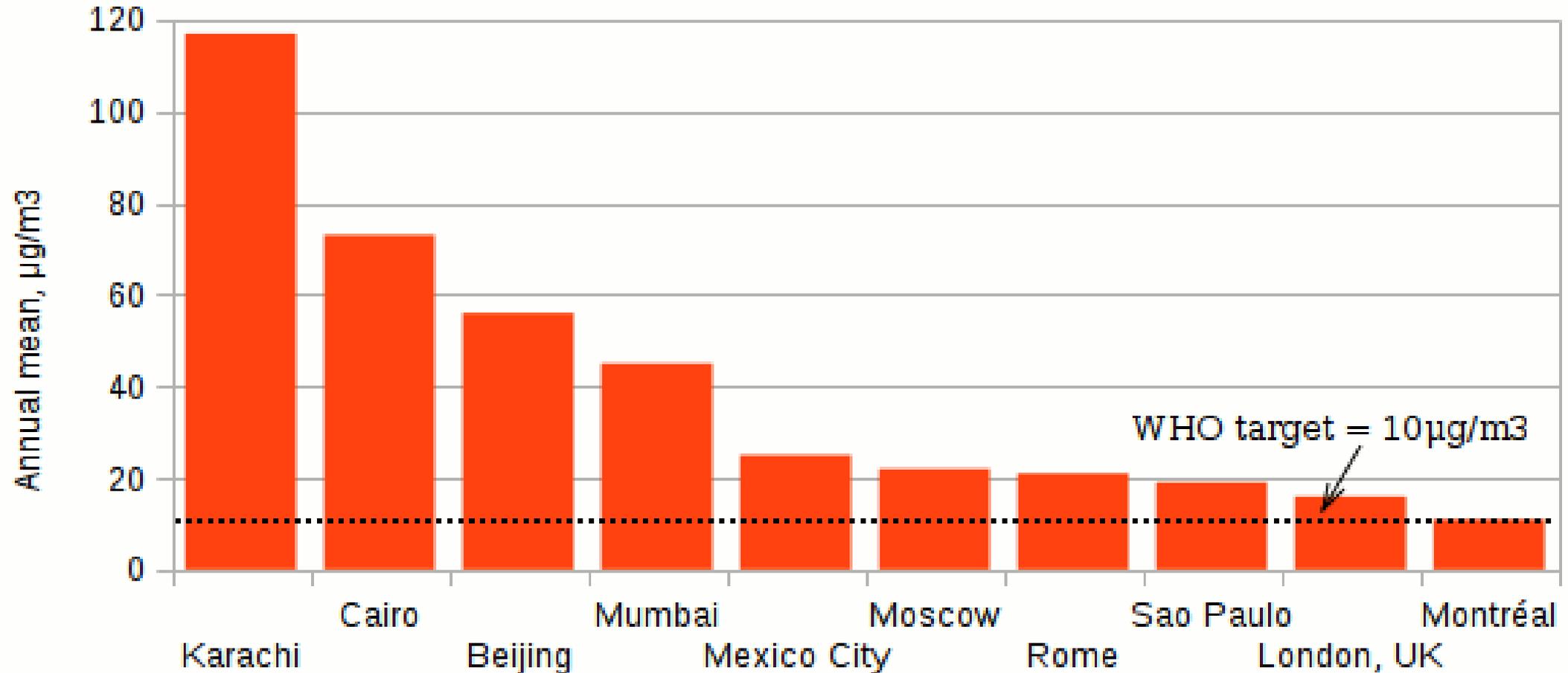
# Children and Air Pollution

- **Greater health threat to children than adults**
  - **Air pollution can restrict lung development**
  - **Children breath more often than adults**
- **Children who live in high ozone areas are more likely to develop asthma**

# Our polluted cities

www.explainthatstuff.com

Fine particulate concentration ( $PM_{2.5}$ )

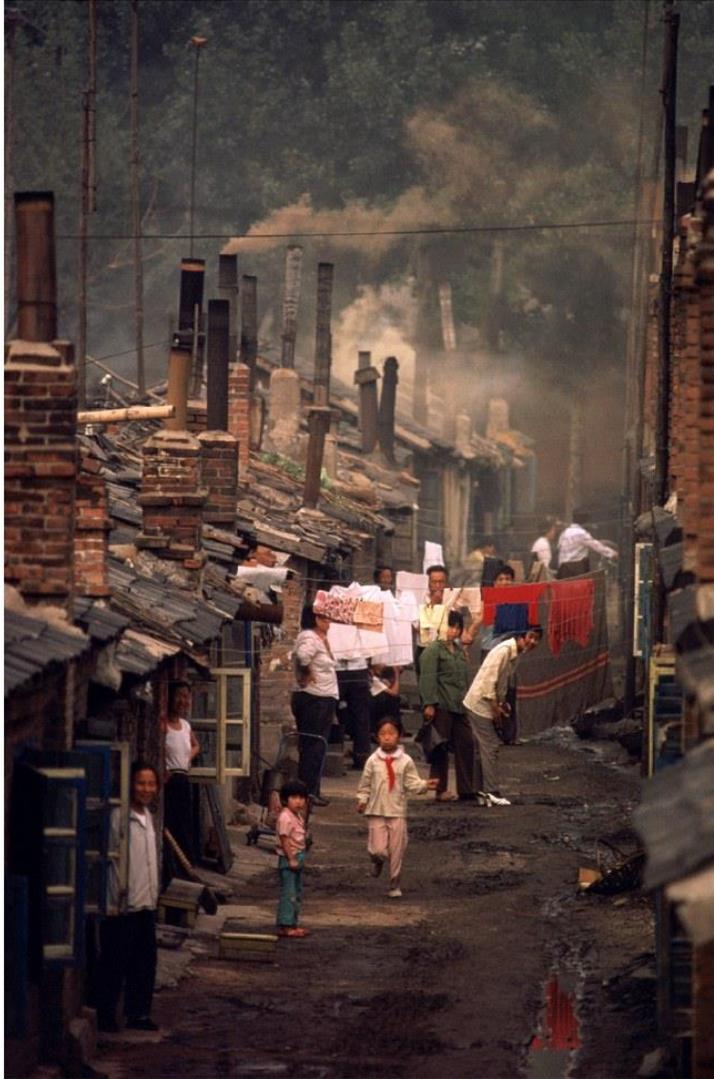


Source: World Health Organization (WHO) Ambient (outdoor) air pollution in cities database 2014

# Agricultural Effects of Air pollution

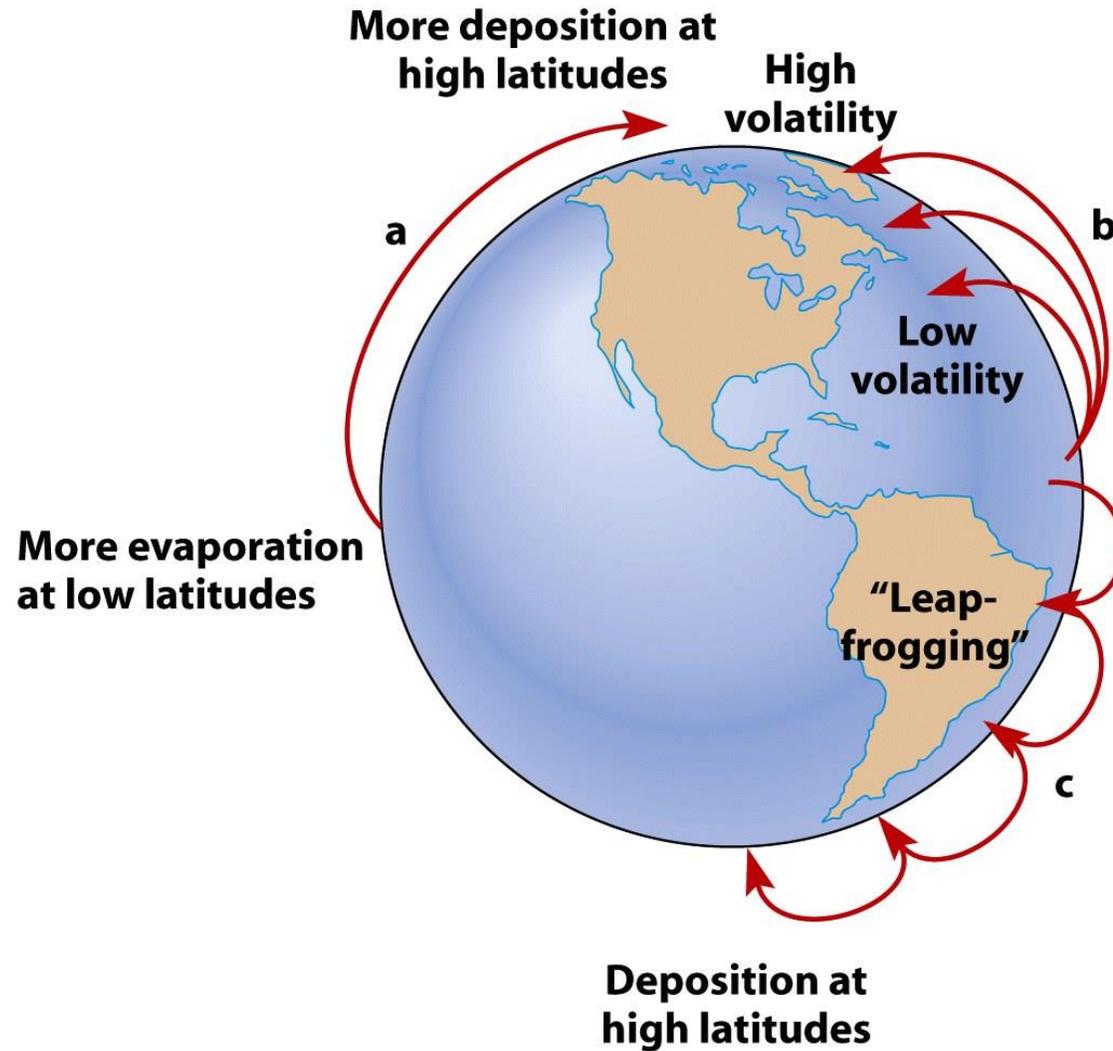
- ❑ Air pollution can seriously affect the growth of plants.
- ❑ It is easy to find chemical residues in plants that grow alongside highways.
- ❑ Also, the huge increase in atmospheric carbon dioxide now causing **global warming**, and climate change is expected to have a major impact on the world's agriculture (reducing crop yields in some places but potentially increasing yields elsewhere).

# Air Pollution Around the World

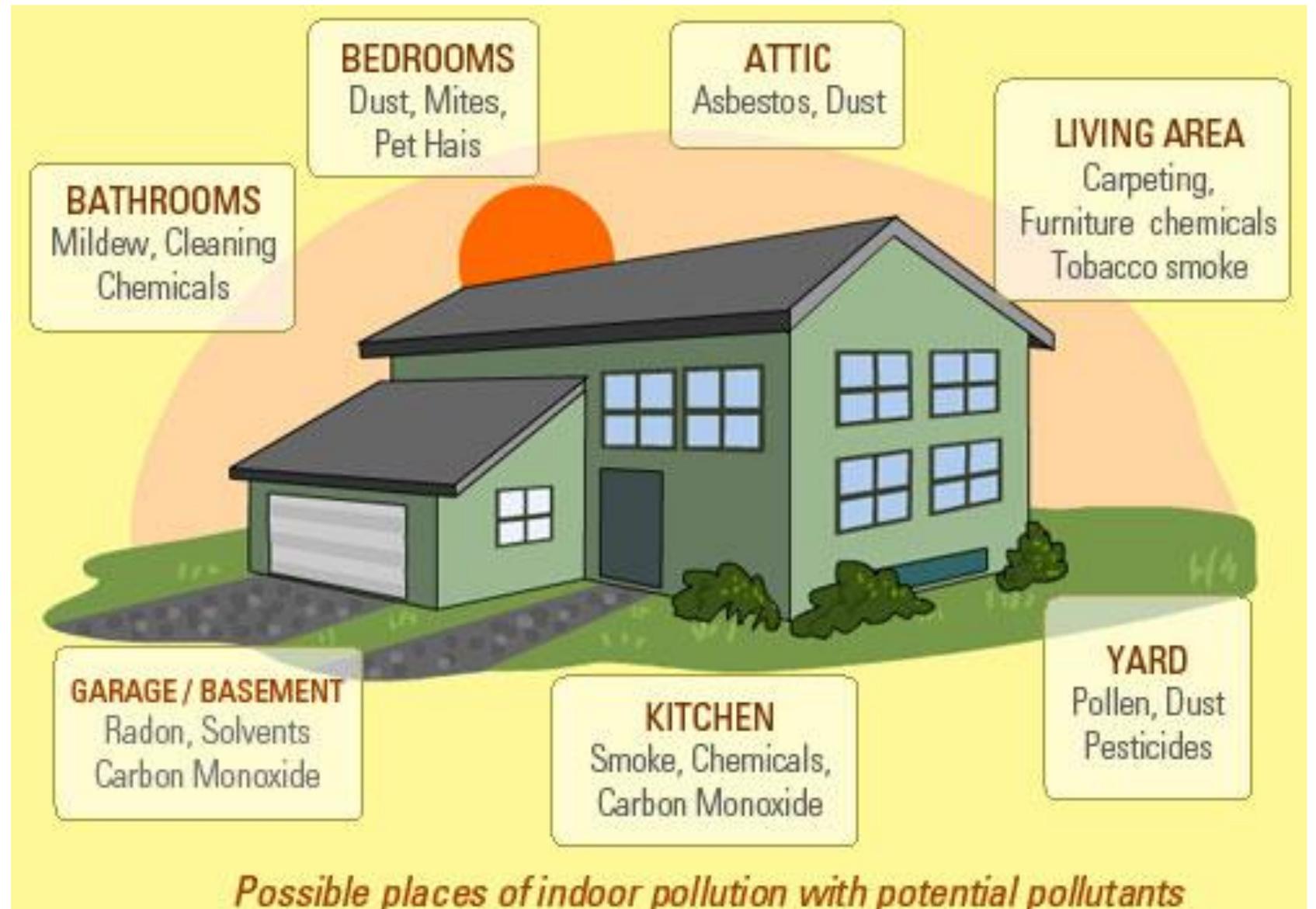


- Air quality is deteriorating rapidly in **developing countries**
- **Shenyang, China**
  - Residents only see sunlight a few weeks each year
- **Developing countries have older cars**
- **Still use leaded gasoline**

# Long Distance Transport of Air Pollutants



# Indoor Air Pollution



# Indoor Air Pollution

- Around 3 billion people cook and heat their homes using open fires and leaky stoves, and burning biomass (wood, animal dung and crop waste) and coal.
- Nearly 3.5 million people die prematurely from illness attributable to indoor air pollution from household solid fuel use (e.g. chronic obstructive respiratory disease).
- Nearly 50% of pneumonia deaths among children under five are due to particulate matter inhaled from indoor air pollution.
- Both women and men exposed to heavy indoor smoke are 2-3 times more likely to develop COPD

Source: WHO: <http://www.who.int/mediacentre/factsheets/fs292/en/>



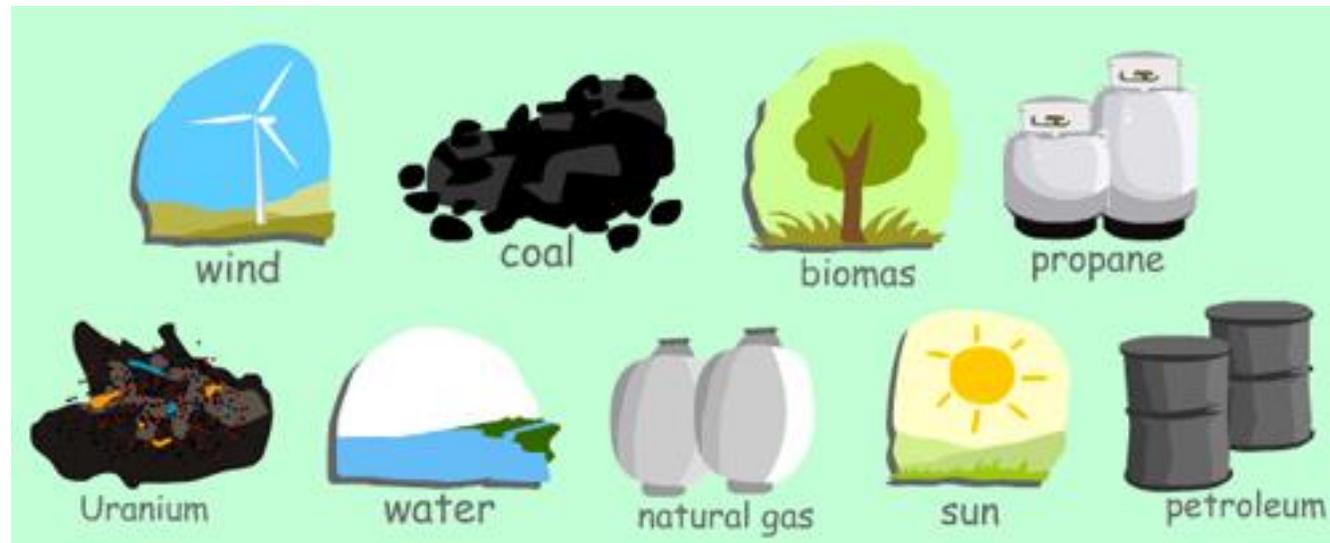
# Indoor Air Pollution

## Common indoor air pollutants include:

- **Tobacco smoke:** This is smoke burning cigarettes or exhaled smoke by people smoking.
- **Biological Pollutants:** These include allergens such as pollen from plants, hair from pets, fungi and some bacteria.
- **Radon:** This is a gas that is naturally emitted from the ground. Radon can be trapped in basements of building and homes. The gas is known to cause cancer after exposure over a period.
- **Carbon Monoxide:** This is a poisonous gas with no color or smell. Carbon monoxide is produced when fuels such as gas, oil, coal or wood do not burn fully

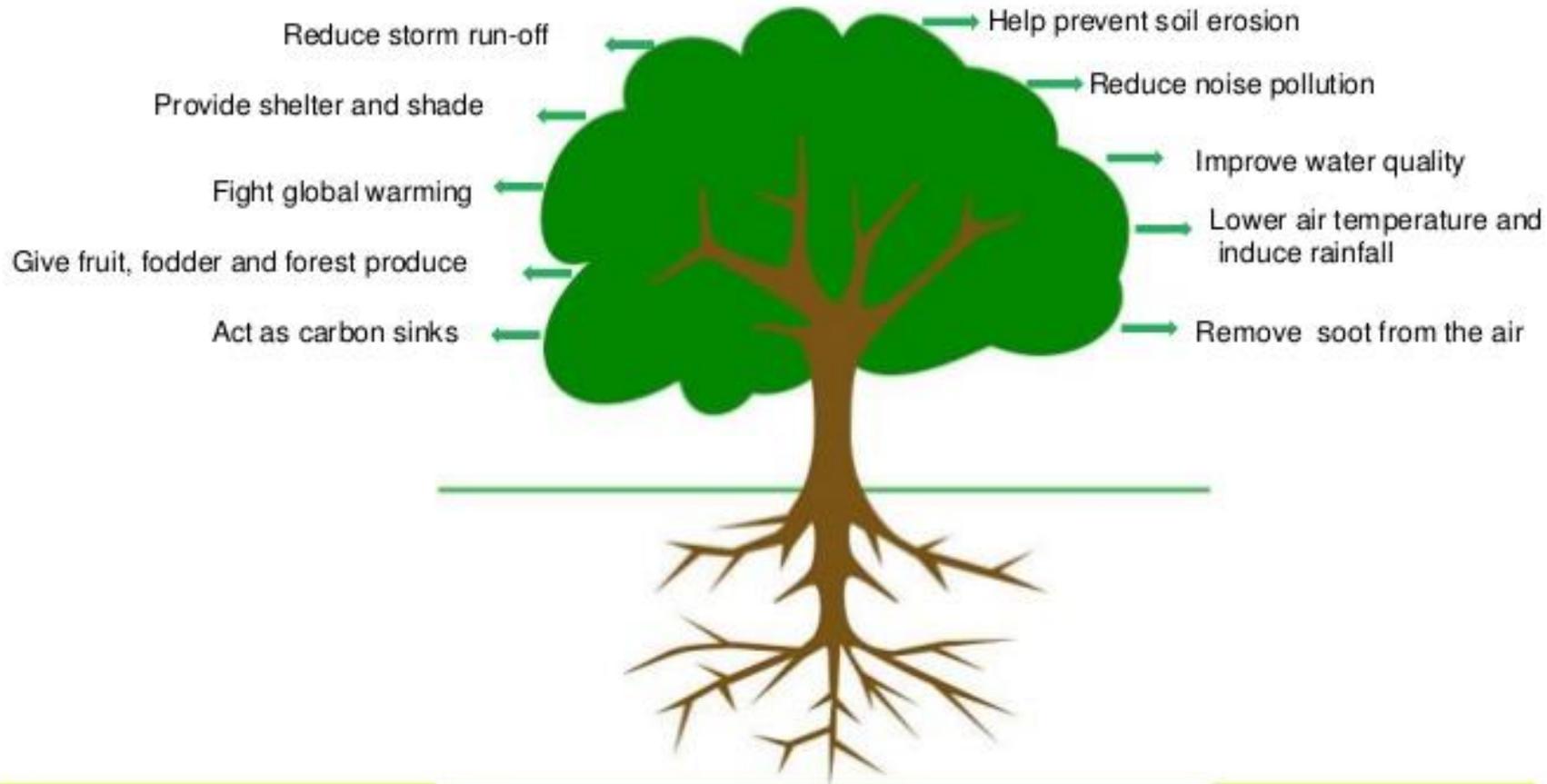
# How can we solve the problem of air pollution?

1. Technological Solutions: cars and factories with less pollution, and using renewable energy.
2. Laws and Regulations
3. Raising awareness and changing behavior



# Why Trees?

---



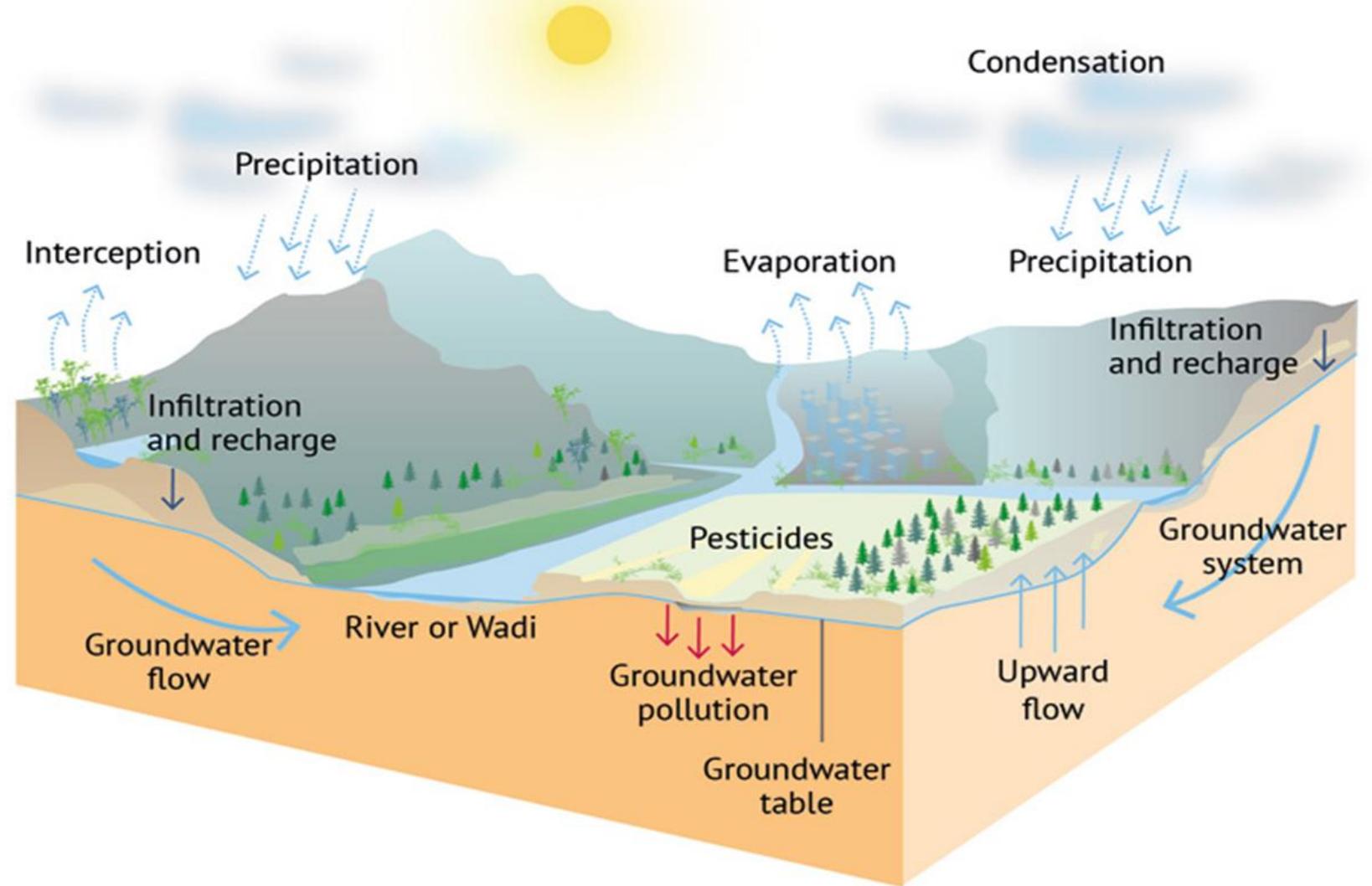
# Water Pollution



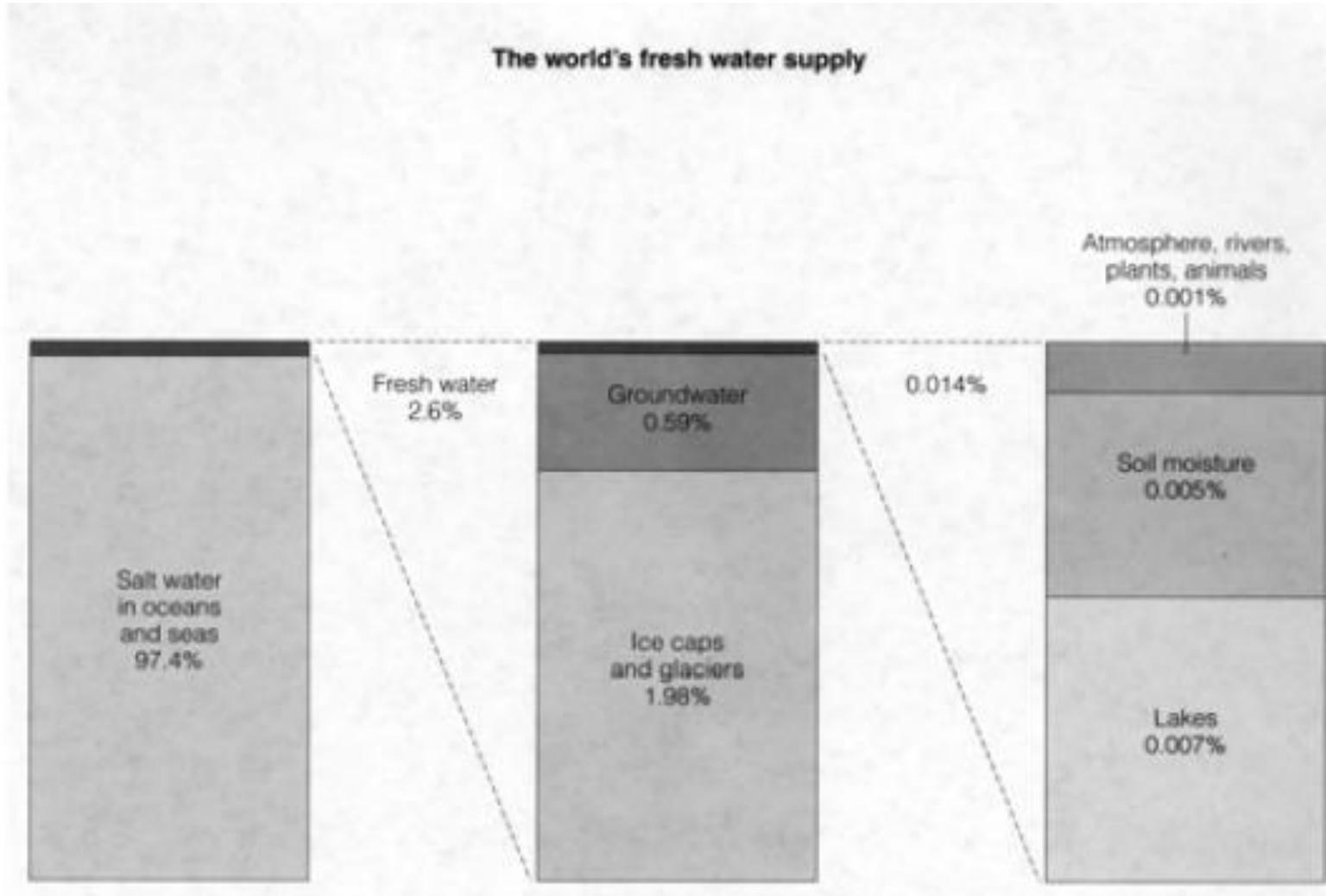
# Water Situation

- \* **85% of the world population lives in the driest half of the planet (United Nations, 2013)**
- \* **1 billion people do not have access to clean water and almost 2.5 billion do not have access to adequate sanitation.**
- \* **2 million people die each year due to unsafe water, sanitation and hygiene (WHO, 2015).**

# The Hydrologic cycle (the water cycle)



# World Freshwater Supply



# Water Pollution

According to WHO, water pollution occurs when:

“foreign materials either from natural or other sources are contaminated with water supplies and may be harmful to life, because of their toxicity, reduction of normal oxygen level of water, aesthetically unsuitable effects and spread of epidemic diseases”.

# Main Sources of Water Pollution

Examples of major water pollutants that affect the health of humans are:

- **Infectious agents:** (bacteria, viruses, and parasites) that contaminate the water through sewage, human waste, and animal excreta
- **Radioactive waste:** contains highly toxic materials such as uranium, thorium, and radon (mining activities, power plants or natural sources)
- **Chemical substances:** that contaminate the water (**organic:** pesticides, plastic, oil, detergents, etc. - coming from domestic, industrial or agricultural waste, or **inorganic:** acids, metals, salts - domestic and industrial effluents).

# How Does Water Pollution Affect Us?

- **Drinking** polluted water
- **Bathing or showering** in polluted water
- **Swimming** in polluted water
- **Breathing the vapors** of a polluted water while sitting next to a polluted water source
- **Consuming polluted food** from animals fed with polluted water or food affected by polluted water OR vegetables irrigated with polluted water or grown in an area with polluted groundwater

# Two Types of Sources of Water Pollution

Although water pollution occurs from a variety of sources, there are two terms used to describe how the water becomes polluted:

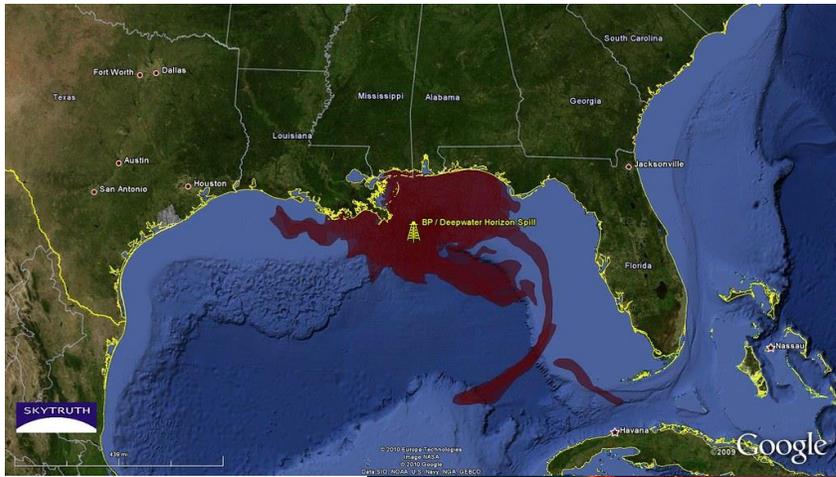
1. Point sources
2. Non-point sources



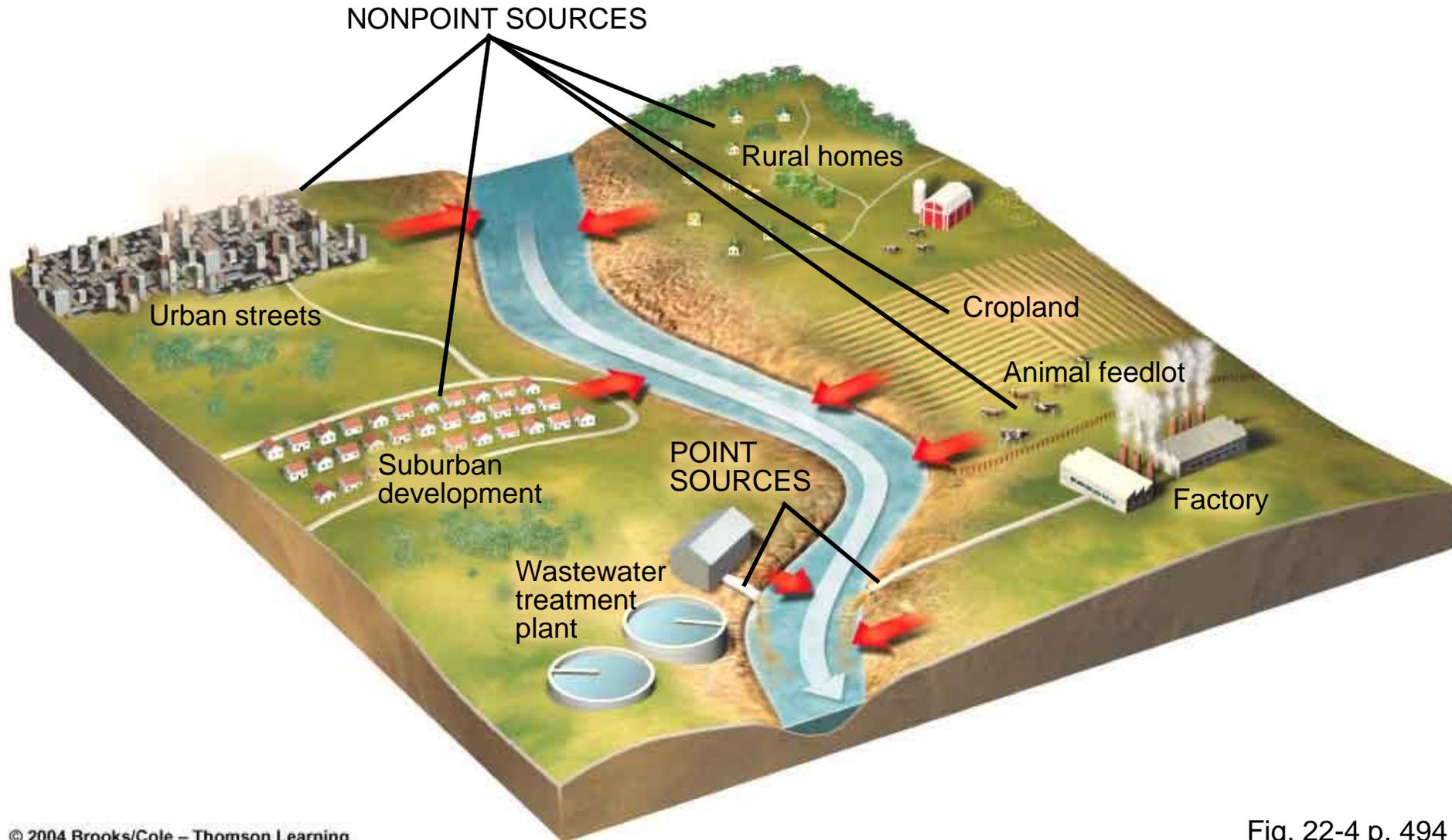
# Point Source Pollution

- 1. comes from a specific source, like a pipe. Pollution will be located at a specific place.**
- 2. Sources are: factories, industry, municipal treatment plants.**
- 3. Easy to identify, monitor and regulate.**

**The BP oil spill in 2010 is an example of point source pollution, because the massive amount of oil leaked from a single point of origin.**



# Point and Nonpoint Sources



# What is non-point source pollution?

- ✓ **Nonpoint Source (NPS) Pollution is pollution associated with storm water or runoff.**
- ✓ **Difficult to identify and control**
- ✓ **Broad and Diffuse area is affected**
- ✓ **Expensive to clean up.**

**For example, one water body (river or sea) may be contaminated by multiple sources like agricultural runoff, city street runoff, construction sites and residential lawns (e.g. The Mississippi River).**

# Non-point Sources

- **Agriculture activities: a leading cause of water pollution:**
  - Fertilizers and pesticides
  - Bacteria from livestock and food processing wastes
- **Industrial facilities**
- **Medical facilities**
- **Mining**
- **Transportation, roads and parking lots**
- **Human-made materials (E.g., plastics)**

# Point Source of Polluted Water in



# Nonpoint Sediment from Unprotected Farmland Flows into Streams



# Linking Land Use to Water Quality



**More Imperviousness = More Polluted Water**

# Highly Polluted River in China



# Trash Truck Disposing of Garbage into a River in Peru



# Controlling Water Pollution:

There should be vigorous efforts to control water pollution with the involvement of individuals, communities, governments and social activist groups.

- ✓ Mass social awareness should be inculcated regarding the nature and effects of water pollution, and remedial measures.
- ✓ Strict laws should be enforced, and persons violating the provision of pollution control should be penalized.

# Food Contamination

# Food Contamination

- ✓ A toddler is hospitalized as a result of drinking contaminated apple juice.
  - ✓ A preschooler dies because he eats a hamburger that is not thoroughly cooked.
  - ✓ A cruise ship comes back to port early because many passengers have become ill with the same symptoms.
  - ✓ A school cafeteria is unable to operate because half the staff is out with symptoms of vomiting, diarrhea, and fever.
- 
- **In each case, the illness or death was traced to something in the food supply.....this implies food contamination**

# What is Contamination?

- ***Contamination*** is the ***state of being impure or unfit for use due to the introduction of unwholesome or undesirable elements.***



# Contamination of food

- People's lives depend on a reliable and safe food supply that is free from harmful substances.
- ❑ Contamination occurs when something not normally found in the food is added.
- ❑ Contamination implies the addition is not intended or planned. The substance added may or may not cause health problems.

# Contamination of food

The three main ways in which food can be contaminated are:

- 1) Microbial contamination (includes bacteria, moulds and viruses)
- 2) Physical contamination
- 3) Chemical contamination

# Microbial contamination:

**Mold** often occurs if food is stored at the wrong temperature, at high humidity or beyond its recommended shelf-life.

**Viruses** may be brought into food on raw foods such as shellfish which have been bought from an unapproved source.

**Bacterial** contamination is the most significant in terms of microbial food poisoning and foodborne illnesses.

# Bacterial Contamination of food

**Bacterial cross-contamination** may be defined as: “the transfer of harmful / pathogenic bacteria from one item / food / surface / person to food.”

**Direct cross-contamination:** occurs in food when there is direct contact between the source of the bacteria and food.

**Examples include:**

- Raw meat stored above or in contact with cooked meat
- Raw chicken stored above or in contact with coleslaw
- Food handler sneezing/coughing onto food

# Bacterial Contamination of food

**Indirect cross-contamination:** This occurs when harmful bacteria are transferred from the source to the food via a vehicle.

**Examples include:**

- Using the same knife/chopping board to slice raw meat and then cooked meat without washing it and disinfecting it between tasks
- Using the same cloth to wash down the raw food preparation area and then the cooked food preparation area
- Touching food after blowing your nose, without first washing your hands

# foodborne Infections (invasive Infections)

- Microbes release digestive enzymes that begin to damage body tissue and cause illness. This type of foodborne illness is called ***foodborne infection***.
- ❑ This infection cannot occur if the microbes are killed.
- ❑ Foodborne infections may be caused by bacteria and viruses. A large number of living organisms is usually required to cause illness.
- ❑ Symptoms caused by damage when organisms feed on their host (Fever, diarrhea, vomiting, abdominal pain).

# Invasive Infection Bacteria:

- ✓ SALMONELLA
- ✓ AEROMONAS
- ✓ CAMPYLOBACTER
- ✓ SHIGELLA
- ✓ VIBRIO PARAHAEMOLYTICUS
- ✓ YERSINIA
- ✓ ENTERIC-TYPE ESCHERICHIA COLI (e-coli)

# Viral Food Infections:

Three main types of viruses have been found to cause foodborne illness. These include:

- **Rotavirus**
- **Norwalk virus**
- **Hepatitis A virus.**
- **Infections have been traced to infected food handlers.**

# Chemical Contamination of Food

Undesirable chemicals can enter foodstuffs during:

- **Growth – e.g. veterinary drugs (antibiotics and hormones), fertilizers, pesticides and environmental contaminants e.g. lead**
- **Processing – e.g. oils and lubricants from machines, cleaning chemicals**
- **Transport – e.g. as a result of spillage or leaks**
- **Sale – e.g. cleaning chemicals**

# Chemical Hazards

## ACUTE

SMALLER MORE ISOLATED OUTBREAKS

USUALLY ACCIDENTAL/MIS-USE

## CHRONIC/LONG TERM

MAJORITY

EXCEPT TOXINS (USUALLY ACUTE)

LONG TERM EXPOSURE

CARCINOGENS/OTHER TOXIC EFFECTS

## RISK ASSESSMENT

LESS STRAIGHT FORWARD (compared to biological hazards)

# Classes of Chemical Residues

1. Food Additives (E.G. Vitamins, Colors, Flavors)
2. Pesticide Residues
3. Veterinary Medicines (E.G. Hormones And Antibiotics)
4. Environmental Residues (Lead: Leaded Gasoline, Solder For Tin Canned Food)
5. Cleaning Agents
6. Allergens

# Physical Contamination

- ❑ Food can be contaminated physically by foreign objects.
- ❑ Foreign objects can be brought into the premises with raw materials or introduced during storage, preparation, service or display.
- ❑ Foreign objects which are commonly associated with food complaints include:
  - Nuts, bolts, wire, metal
  - Cardboard, plastic, string
  - Rodent droppings, hairs
  - Cigarette butts, glass, flaking paint
  - Earrings, fingernails

# Global Environmental Problems



# Global Environmental Problems

- Environmental health issues are major risk factors in the global burden of disease.
- The WHO has estimated that between 25 and 33 percent of the global burden of disease can be attributed to environmental risk factors.
- The burden of preventable environmental diseases are disproportionately felt by residents of poor developing countries.
- The reasons for this disproportionate effect in poor countries include: **lack of modern technology, weak protective environmental laws and regulations, a lack of awareness, and poverty.**

# Global Warming:

- ✓ Climate changes like global warming is the result of human practices like emission of Greenhouse gases.
- ✓ Global warming leads to rising temperatures of the oceans and the earth' surface causing:
  1. melting of polar ice caps
  2. rise in sea levels and also
  3. unnatural patterns of rain such as flash floods, excessive snow or desertification in other areas.



## Global Warming:

- ✓ These gases possess heat trapping capacity that are needed to create greenhouse effect so that this planet remains warm for people to survive.
- ✓ During past several decades, the accumulation of greenhouse gases have grown rapidly, which means more heat gets trapped in the atmosphere and few of these gases escapes back into the space.
- ✓ These gases heat up the earth's surface and this results in global warming. According to Environmental Protection Agency (EPA) reports, the earth's temperature has increased by 0.8 degrees Celsius over the past century.

# Overpopulation:

- The population of the planet is reaching unsustainable levels as it faces shortage of resources like water, fuel and food.
- Population explosion in less developed and developing countries is straining the already scarce resources.
- Intensive agriculture practiced to produce food damages the environment through use of chemical fertilizer, pesticides and insecticides.

# Natural Resource Depletion:

- ✓ Fossil fuel over-consumption results in emission of Greenhouse gases, which is responsible for global warming and climate change.
- ✓ Globally, people are taking efforts to shift to renewable sources of energy like solar, wind, biogas and geothermal energy.
- ✓ The cost of installing the infrastructure and maintaining these sources has decreased in recent years.

# Waste Disposal:

- ✓ The over consumption of resources and creation of plastics are creating a global crisis of waste disposal.
- ✓ Developed countries are notorious for producing an excessive amount of waste or garbage and dumping their waste in the oceans and in less developed countries.
- ✓ Nuclear waste disposal has tremendous health hazards associated with it. Plastics, fast food packaging, and cheap electronic wastes threaten the well being of humans.

# Climate Change: Climate Change:

It occurs due to rise in global warming which occurs due to increase in temperature of the atmosphere by burning of fossil fuels and release of harmful gases by industries.

- Climate change has various harmful effects but not limited to:
  - ✓ melting of polar ice
  - ✓ change in seasons
  - ✓ occurrence of new diseases
  - ✓ frequent occurrence of floods and
  - ✓ change in overall weather scenario.

# Loss of Biodiversity:

Human activity is leading to the extinction of species and habitats and loss of bio-diversity.

- Eco systems, which took millions of years to perfect, are in danger when any species population is being destroyed.
- Balance of natural processes like pollination is crucial to the survival of the eco-system and human activity threatens this balance.
- An example is the destruction of coral reefs in the various oceans, which support the rich marine life.

## Deforestation:

Forests are natural sinks of carbon dioxide and produce fresh oxygen as well as helps in regulating temperature and rainfall.

- At present forests cover 30% of the land but every year tree cover is lost amounting to the country of Panama due to growing population demand for more food, shelter and cloth.
- Deforestation simply means clearing of green cover and make that land available for residential, industrial or commercial purpose.

# Ozone Layer Depletion:

The ozone layer is an invisible layer of protection around the planet that protects us from the sun's harmful UV rays.

- Depletion of the crucial Ozone layer of the atmosphere is attributed to pollution caused by Chloro-fluoro carbons (CFC's).
- Once these toxic gases reach the upper atmosphere, they cause a hole in the ozone layer, the biggest of which is above the Antarctic (the south pole).
- The CFC's are banned in many industries and consumer products.

# Urban Sprawl:

Urban sprawl refers to migration of population from high density urban areas to low density rural areas which results in spreading of city over more and more rural land.

- Urban sprawl results in land degradation, increased traffic, environmental issues and health issues.
- The ever growing demand of land displaces natural environment consisting of flora and fauna (plants and animals) instead of being replaced.



**Save the planet!**  
**For our future generations**

