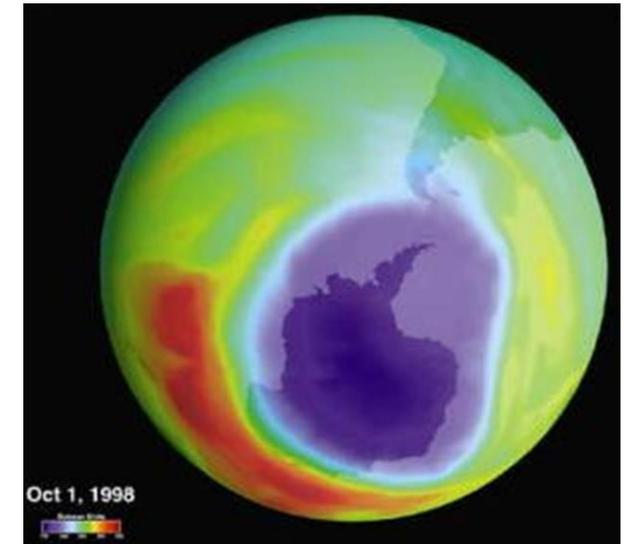
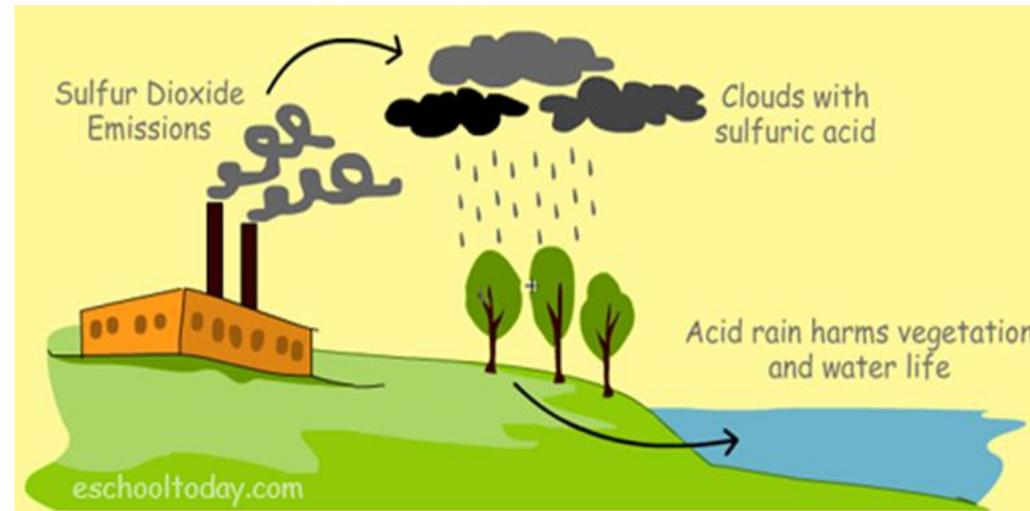
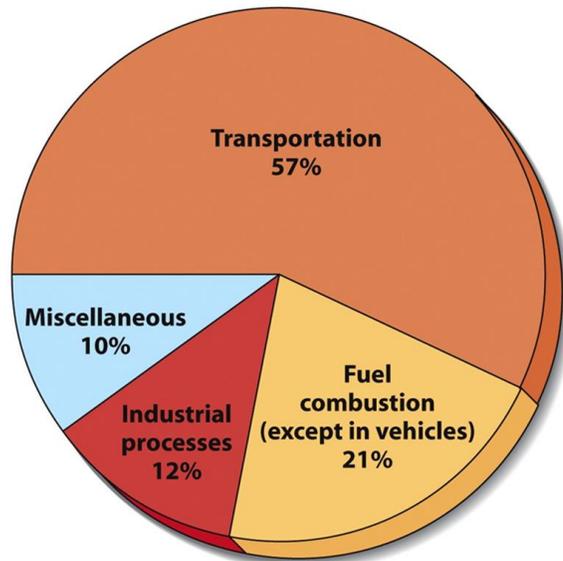


Air Pollution



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Community Medicine, First semester 2018/ 2019

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Learning Objectives

- 1. To understand the significance of air pollution.**
- 2. Identify the classes of air pollutants and their sources.**
- 3. Review the various effects of exposure to air pollutants.**
- 4. Evaluate different solutions to air quality control.**

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.

Significance of the Problem

- Although air pollution started with the beginning of the industrial revolution, we know that the burning of coal at a smaller scale (such as in households)—and the resultant pollution—began much earlier than this.

FIRST WHO GLOBAL CONFERENCE ON AIR POLLUTION AND HEALTH

IMPROVING AIR QUALITY, COMBATTING CLIMATE CHANGE – SAVING LIVES

30 October – 1 November 2018

WHO Headquarters, Geneva, Switzerland

save the date



World Health
Organization

LET'S ACT TOGETHER

BECAUSE THE COST IS FAR TOO HIGH

Air pollution claims 6.5 million lives a year

Air pollution is a major driver of the non-communicable disease epidemic

Air pollution accelerates climate change

AND WE HAVE SOLUTIONS

Affordable and clean urban, transport, waste & household energy strategies

Health, environment & development sectors can lead the way to change

Organized in collaboration with



Clean Air | Healthy Future | Healthy Climate

What is Air Pollution?

Air pollution occurs when gases, dust particles, fumes (or 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%.

☐ Ecosystem 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.

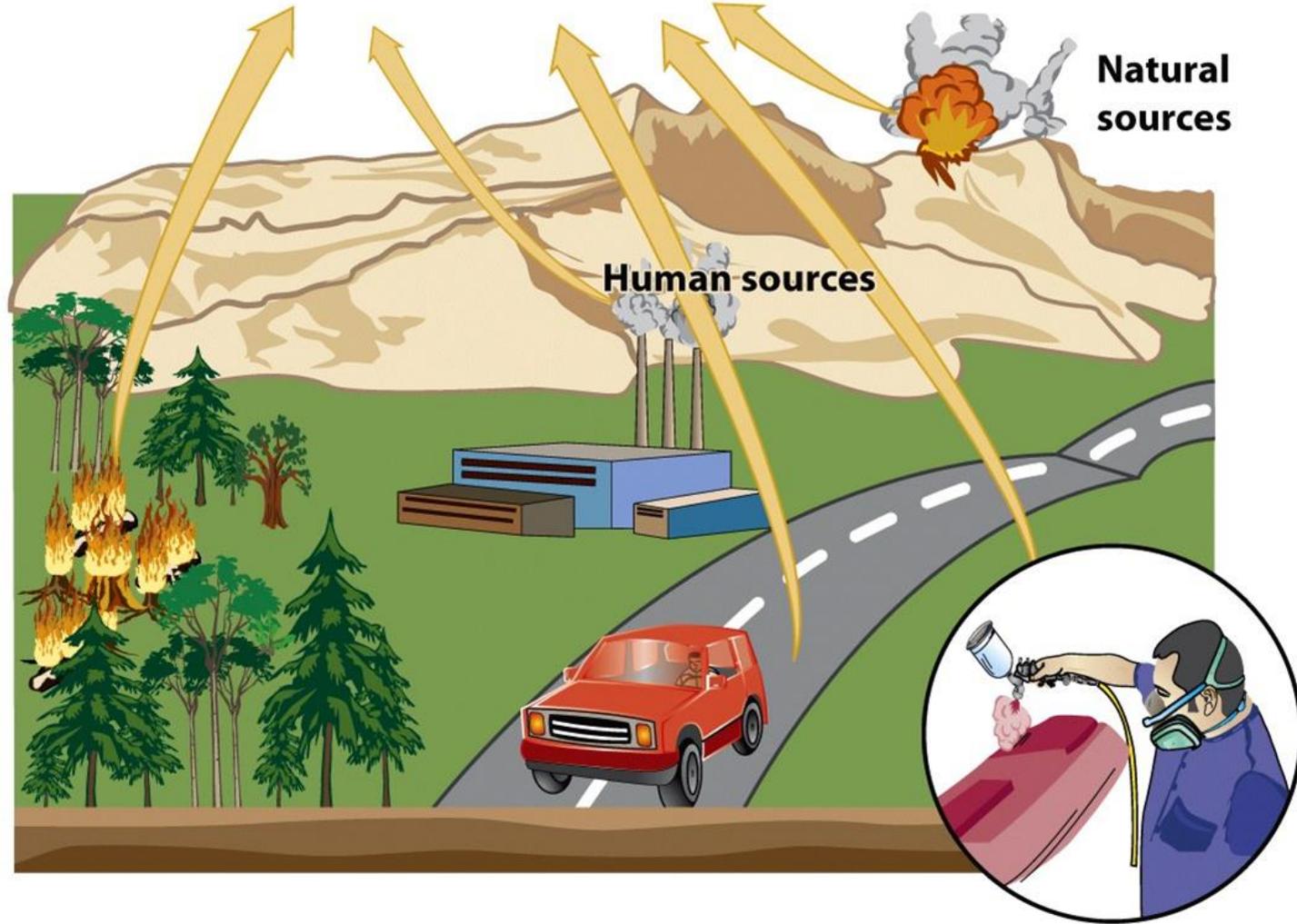
- **Primary air pollutants** pollute the air when emitted directly into the atmosphere.
- **Secondary air Pollutants** are created by chemical reactions between primary air pollutants in the atmosphere. May involve sunlight or a catalyst.

Primary air pollutants

CO
SO₂ NO NO₂
Most hydrocarbons
Most particulates

Secondary air pollutants

HNO₂ SO₃
HNO₃ H₂SO₄
H₂O₂ O₃ PANs
Most NO₃⁻ and SO₄²⁻
salts



The most common air pollutants

1. Oxides of Carbon
2. Volatile Hydrocarbons (VOC's)
3. Oxides of Nitrogen
4. Sulfur Compounds
5. Photochemical Smog
6. Suspended Particulates (aerosols)



1. Oxides of Carbon

Oxides of Carbon: odorless, colorless

1. Carbon dioxide (CO₂):

fourth most common atmospheric gas

produced from oxidation of hydrocarbons

asphyxiant

greenhouse gas

2. Carbon monoxide (CO):

toxic in low concentrations

produced by incomplete combustion of fossil fuels.

2. Volatile Hydrocarbons: (VOC's)

Volatile Hydrocarbons

1. Methane, terpenes: Mostly natural sources (marshes, ruminants, rice paddies, trees).
 2. Benzene, tetrachloroethylene, gasoline, formaldehyde, many others: products of chemical industry used as solvents, paints, cleaning agents.
- ✓ All may form secondary pollutants that irritate eyes and damage respiratory system (photochemical smog).

3. Oxides of Nitrogen

1. Nitric Oxide (NO)

Produced by soil microbes

Forms NO_2 in combination with oxygen in atmosphere

2. Nitrous Oxide (N_2O)

Natural and man made sources

Anesthetic

Greenhouse gas

3. Nitrogen Dioxide (NO_2)

Formed in auto engines and electrical generating plants.

Contributes to heart, lung, liver and kidney diseases at high concentration

Responsible for brownish haze (smog)

Forms nitric acid in rainwater

4. Compounds of Sulfur

Compounds of Sulfur:

1. Sulfur Oxides (SO_2 , SO_3 , SO_4):

volcanoes, sea spray, combustion of fossil fuels (coal)

irritate respiratory passages (SO_2)

form acidic aerosols, acid rain (SO_3 , SO_4)

damage lakes, forests, steel and masonry structures.

2. Hydrogen Sulfide

produced in anaerobic environment

bad odor, toxic asphyxiant, explosive

5. Photochemical Smog

- ✓ **Forms in bright sunlight from:**
 - nitrogen oxides**
 - Hydrocarbons (VOCs)**
 - oxygen**
- ✓ **Interact chemically to produce powerful oxidants like ozone (O₃) and peroxyacetyl nitrate (PAN).**
- ✓ **These secondary pollutants are damaging to plant life and lead to the formation of photochemical smog.**
- ✓ **PAN and ozone are primarily responsible for the eye irritation so characteristic of this type of smog.**

Ozone

- ✓ **Tropospheric Ozone**

 - Man- made pollutant in the lower atmosphere**

 - Secondary air pollutant**

 - Component of photochemical smog**

- ✓ **Stratospheric Ozone**

 - Essential component that screens out UV radiation in the upper atmosphere**

 - Man- made pollutants (ex: CFCs*) can destroy it.**

 - *CFC's are gases used in refrigeration and in pressured spray cans.**

6. Suspended Particles

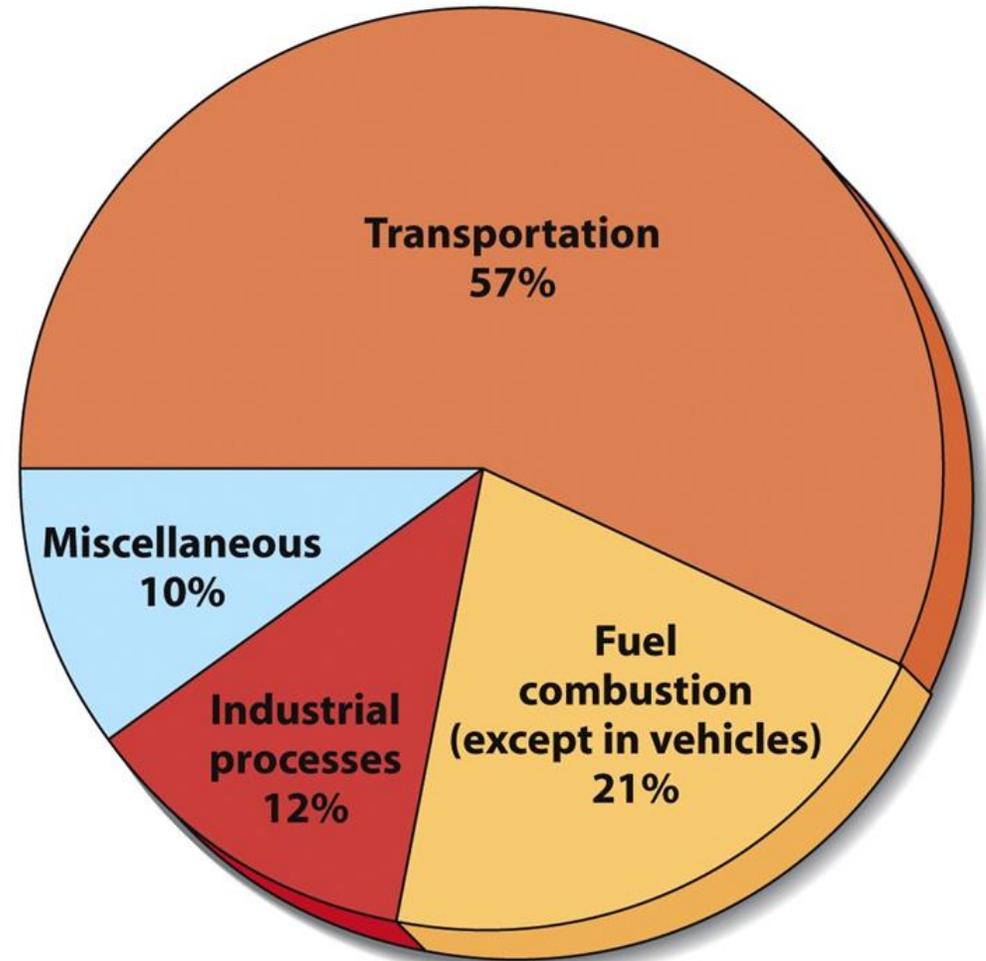
Particulate matter (PM): Thousands of different solid or liquid particles suspended in air. It includes dust, fungal spores, ammonia, sodium chloride, lead, asbestos, black carbon (soot), soil particles, and sulfuric acid droplets.

- ✓ PM affects more people than any other pollutant.
- ✓ The most health-damaging particles are those with a diameter of 10 microns or less, ($\leq \text{PM}_{10}$), which can penetrate and lodge deep inside the lungs.
- ✓ Greatest threat to health among air pollutants.
- ✓ Chronic exposure to particles contributes to the risk of developing cardiovascular and respiratory diseases, as well as of lung cancer.

What are the sources of air pollution?

Three main sources:

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



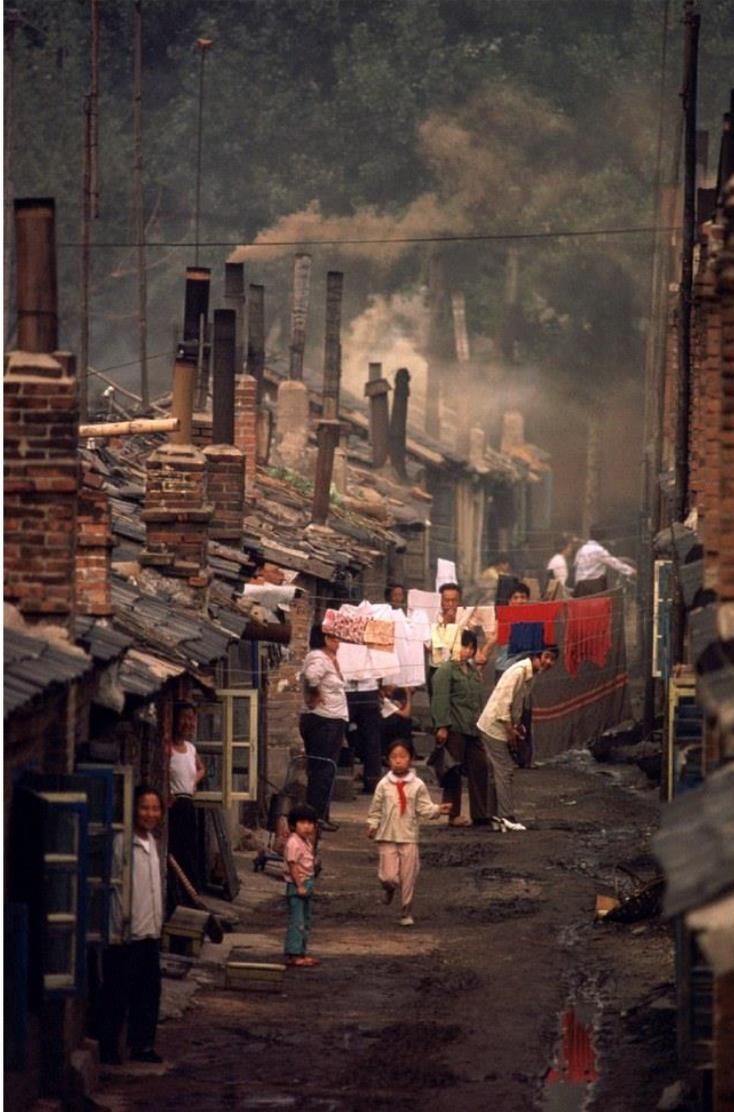
Urban Outdoor Air Pollution

Photochemical Smog (ex: Los Angeles below)

- 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)

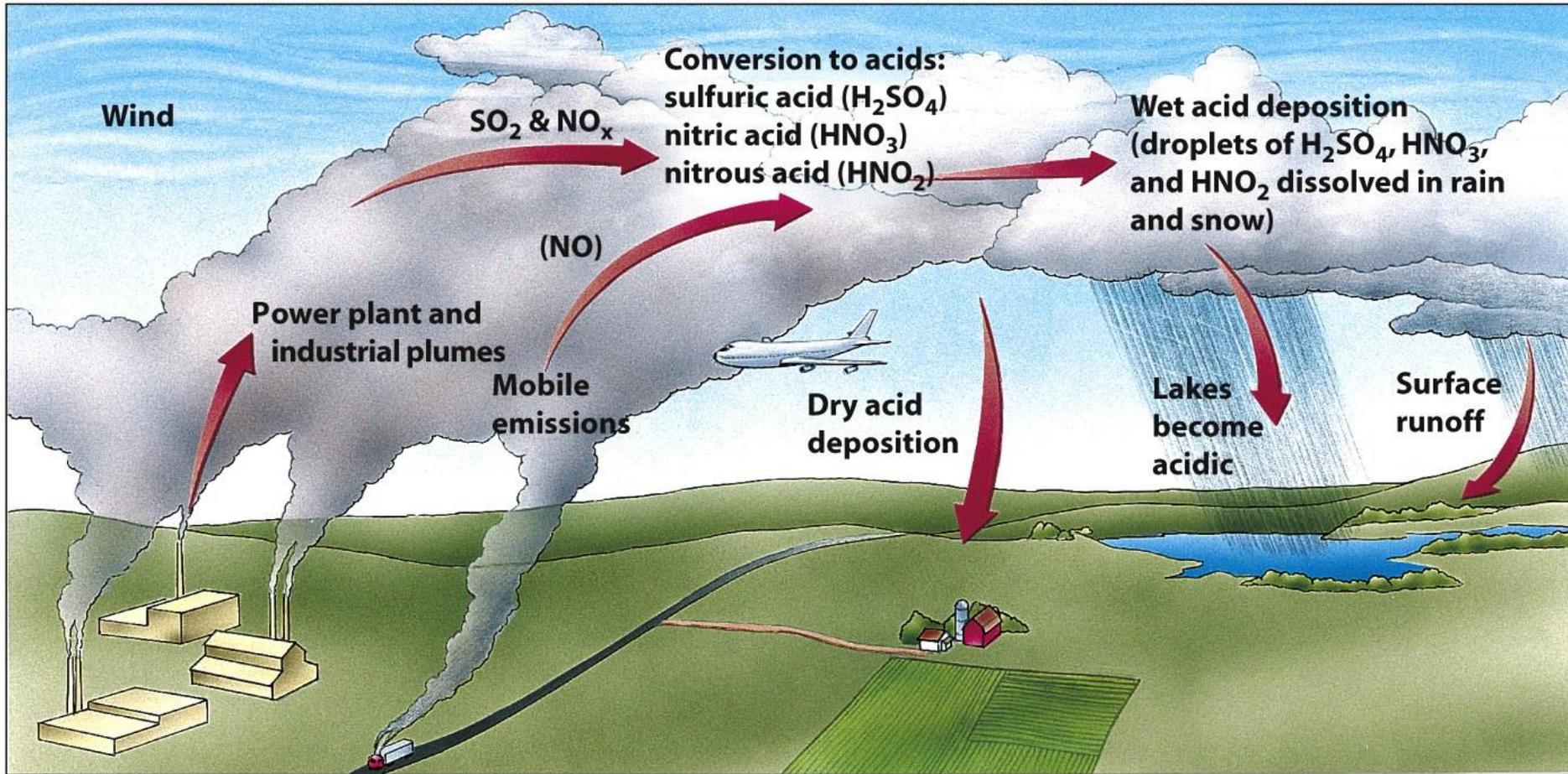
Children and Air Pollution

- **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**

Acid Deposition

Sulfur dioxide and nitrogen dioxide emissions react with water vapor in the atmosphere and form acids that return to the surface as either dry or wet deposition.

How Acid Deposition Develops



Effects of Acid Deposition

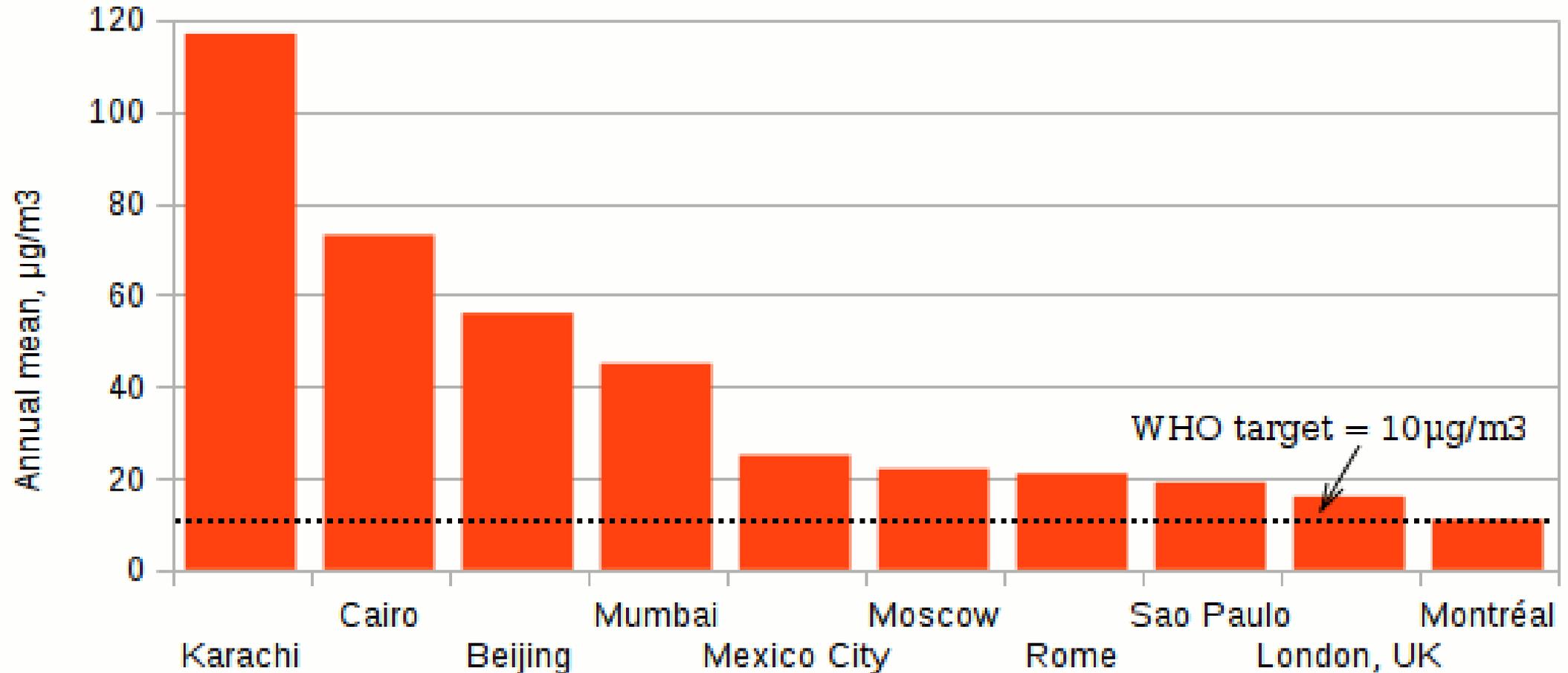
- Declining Aquatic Animal Populations
- Thin-shelled eggs prevent bird reproduction
- Forest decline
 - Ex: Black forest in Germany (50% is destroyed)



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

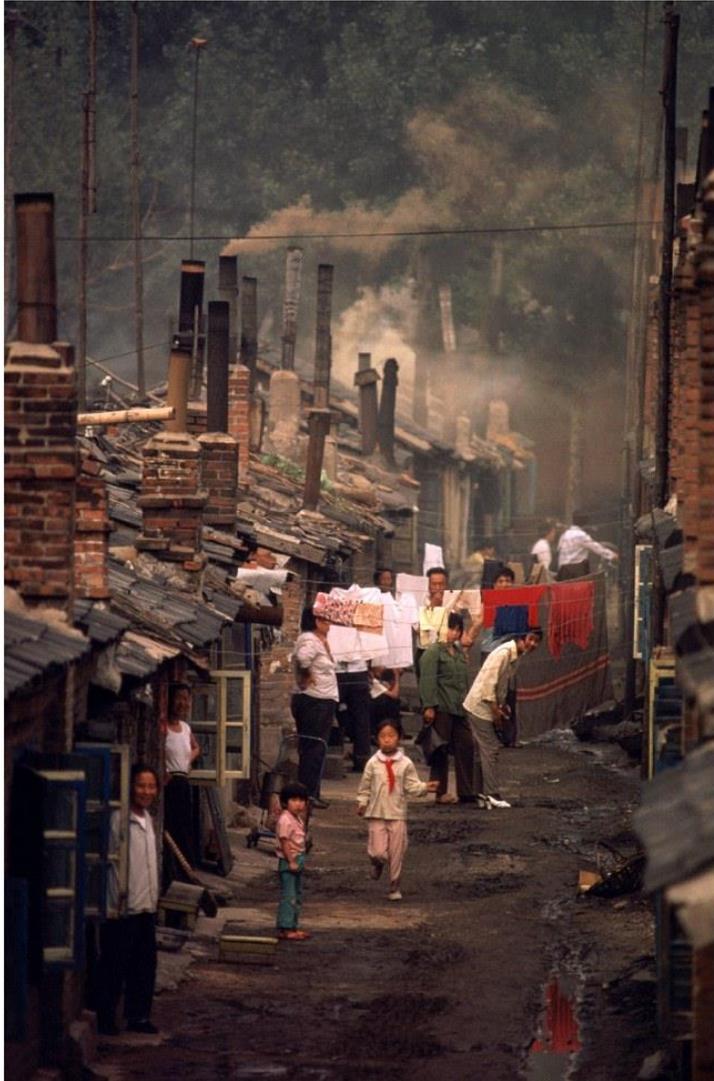
- ❑ Air pollution can seriously affect the growth of plants.
- ❑ It is easy to find chemical residues in plants that grow alongside highways.
- ❑ Also, the huge increase in atmospheric carbon dioxide now causing **global warming**, and climate change is expected to have a major impact on the world's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

Other Effects of Air Pollution

The buildings look dirty and **stained** in black. Exhaust fumes from traffic are generally to blame.

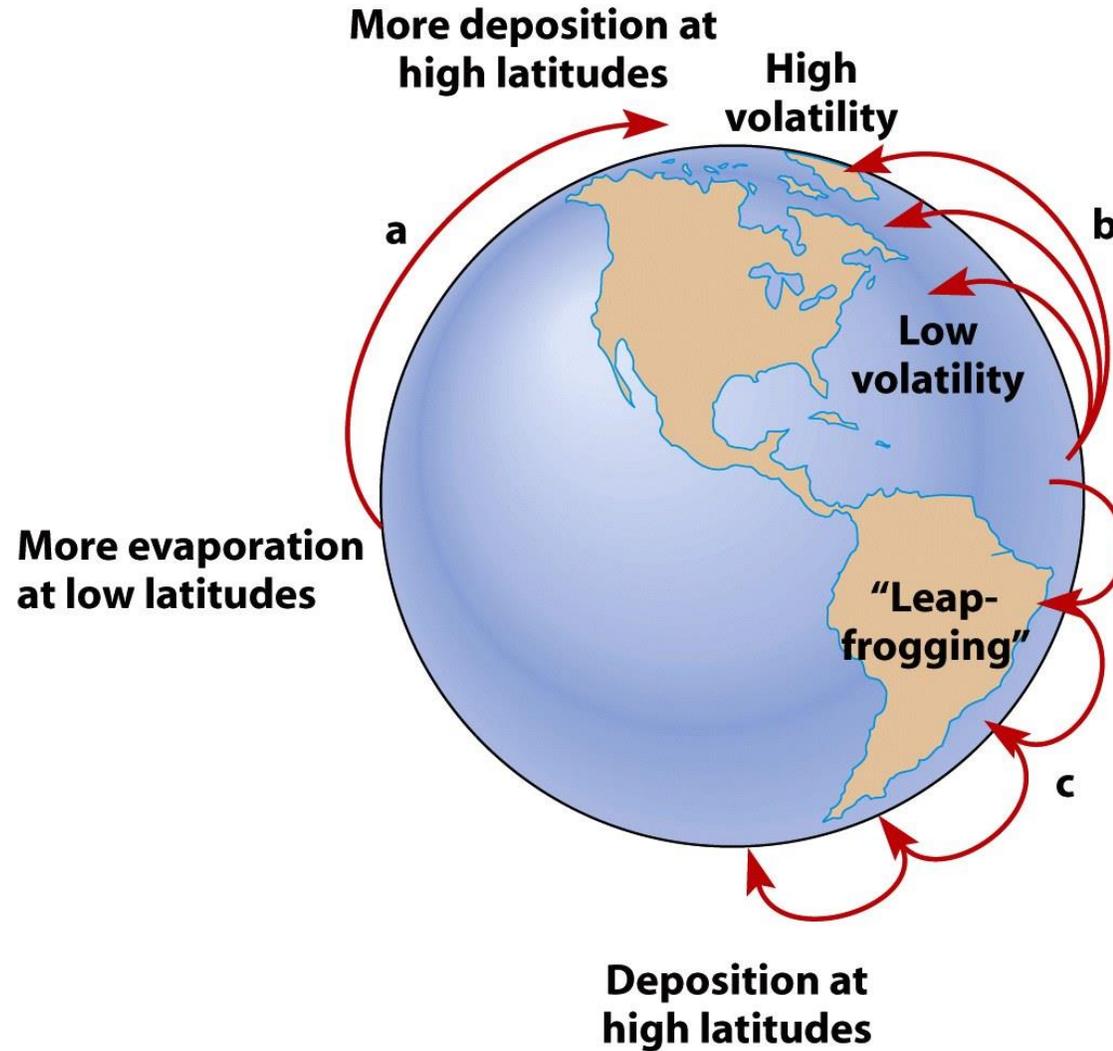
Apart from blackening buildings with soot, they also contribute to acid rain (see below) that can **wear away stonework** in a matter of years or decades.

Air Pollution Around the World

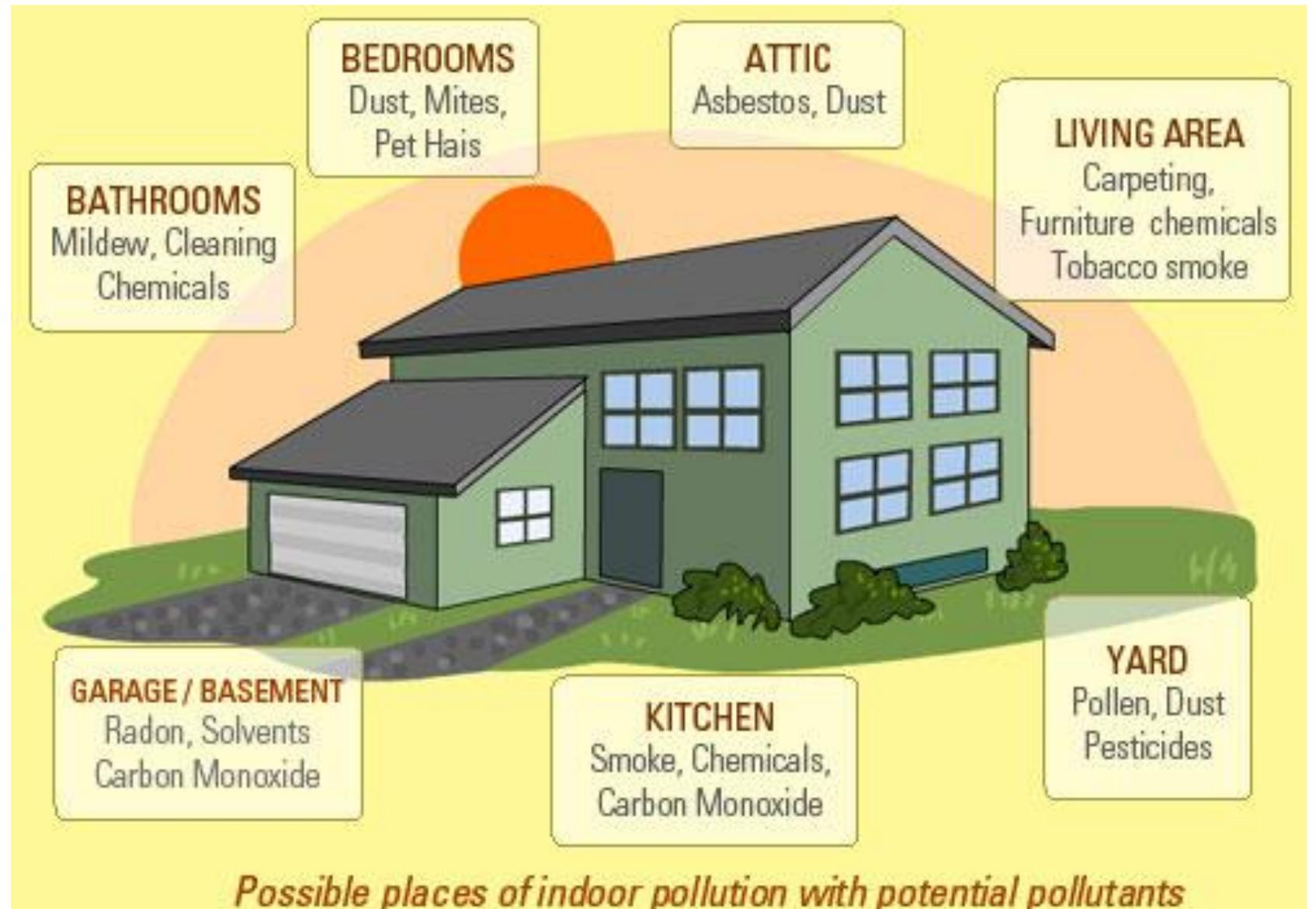


- Air quality is deteriorating rapidly in **developing countries**
- **Shenyang, China**
 - Residents only see sunlight a few weeks each year
- **Developing countries have older cars**
- **Still use leaded gasoline**

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/>

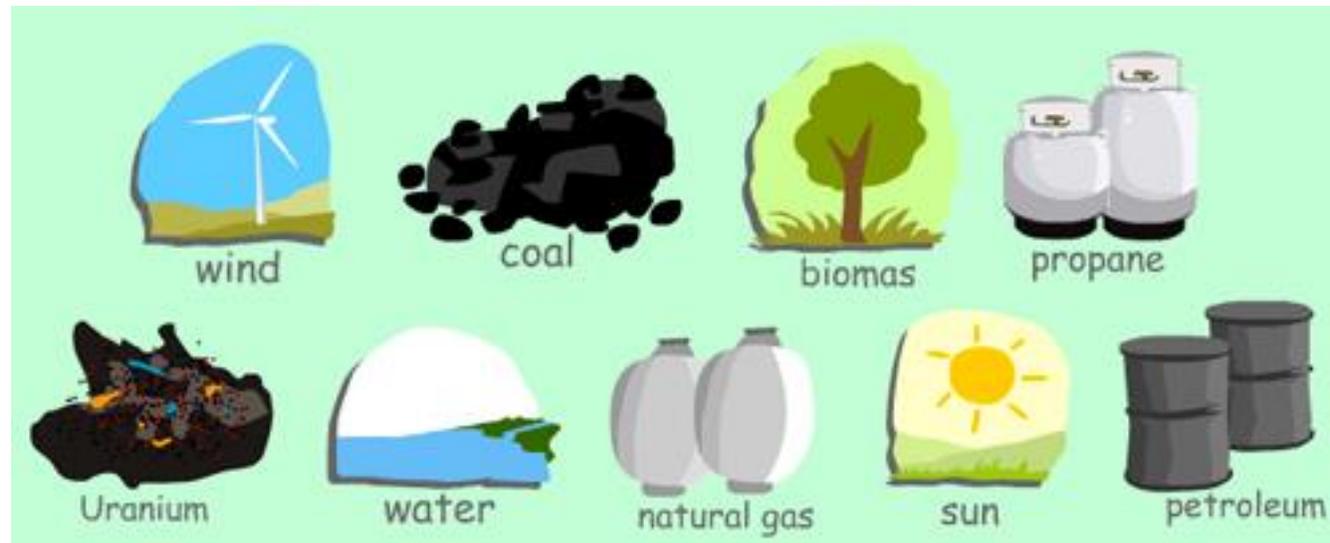
Indoor Air Pollution

Common indoor air pollutants include:

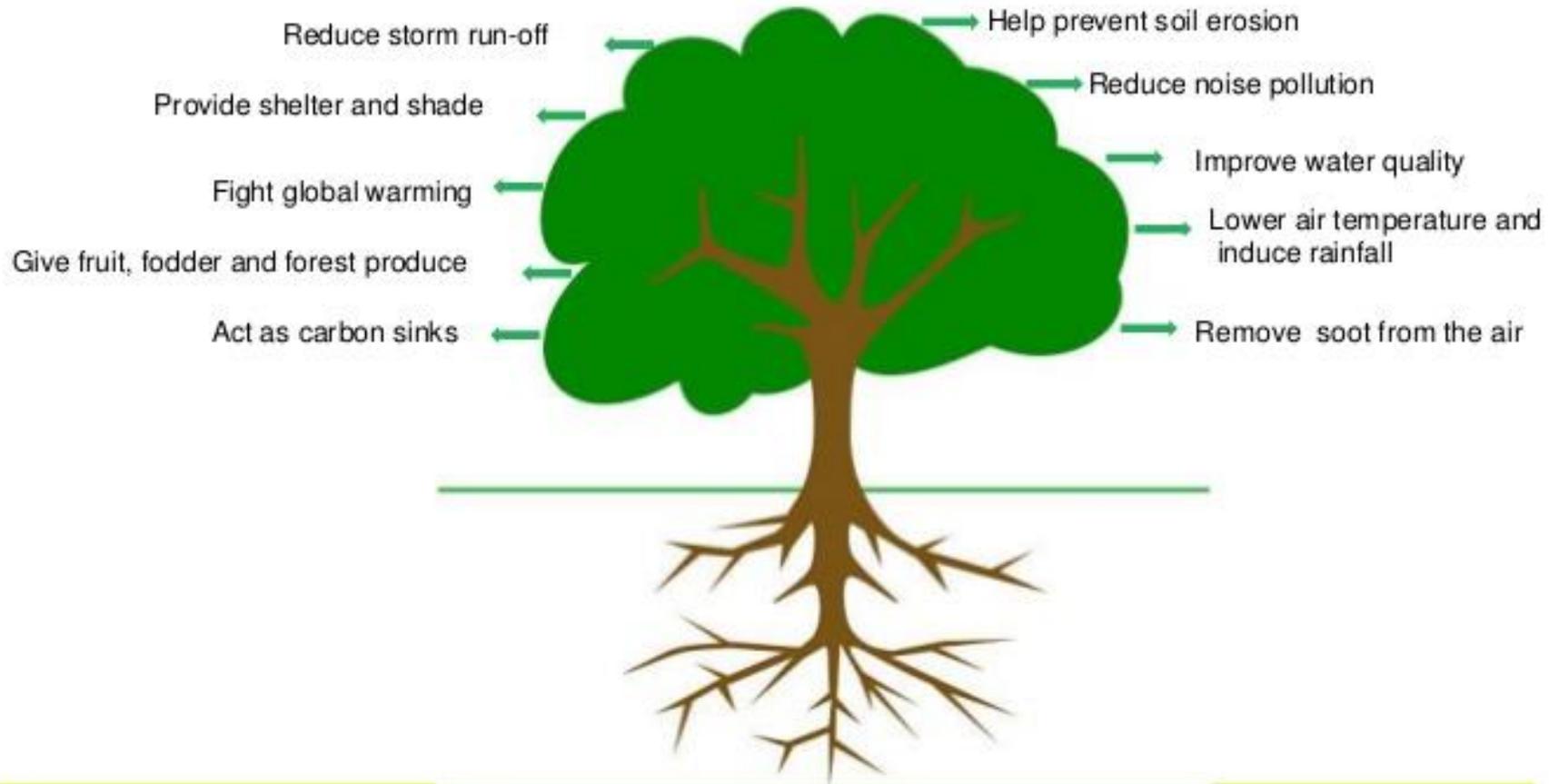
- **Tobacco smoke:** This is smoke burning cigarettes or exhaled smoke by people smoking.
- **Biological Pollutants:** These include allergens such as pollen from plants, hair from pets, fungi and some bacteria.
- **Radon:** This is a gas that is naturally emitted from the ground. Radon can be trapped 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?





**5 Paper Tips:
Think Before You Print**

1. Use both sides of the paper
2. Go digital – read, send and store digital documents
3. Be selective about what you print
4. Reach for the right paper
5. Recycle

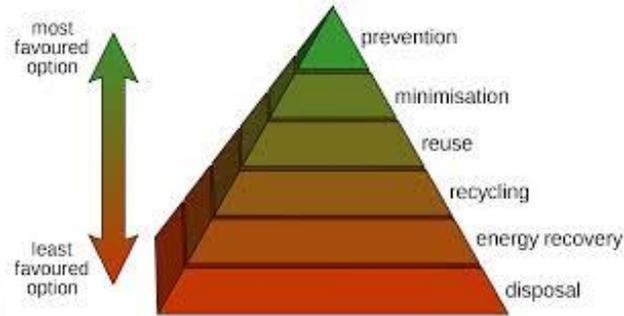
Source: Xerox Corporation



- Use a mug instead of a paper cup
- Reuse paper cups

**Be Environmentally
Friendly**

Adam Rawashdeh



Paper is made from cutting trees

Trees are the lung of earth

Stop Global Warming, Save Trees..



Reduce the amount of paper used

Reuse paper repeatedly

Recycle paper to make new paper

- Buy recycled paper
- Go paperless if you can
- Print on both sides of a paper
- Use paper made from sustainable wood forests

Adam Rawashdeh

Reduce. Reuse. Recycle.



Every
3000 sheets
of paper costs
us a **TREE**

**So, Consider
the impact of
using paper on
the Environment.**

Save Planet Earth

**LET'S GO
GREEN....
SAVE THE
ENVIRONMENT**

Prepared by:
Adam Rawashdeh