Module 2

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Air Pollution

Air Pollution

- **Air pollution** is the introduction of particulates, biological molecules, or other harmful materials into Earth's atmosphere, causing diseases, allergies, death to humans, damage to other living organisms such as animals and food crops, or the natural or built environment. Air pollution may come from anthropogenic or natural sources.

- According to the 2014 WHO report, air pollution in 2012 caused the deaths of around 7 million people worldwide.

Contd.

- It's the quantity (or concentration) of a chemical in the air that makes the difference between "harmless" and "pollution."

Pollutants

- Pollutants in the air can be grouped into
- Particulate air pollutants and
- Gaseous air pollutants

Particulate air pollutants

- Solid Particulate - Dust, smoke, fly ash, fumes, and natural particulates (pollen, viruses, bacteria etc.)
- Mist and Spray are the liquid particulates.

Sources of particulates

- Natural Sources: Volcanic eruptions, forest fires, wind, storm and pollens from flowers etc.
- Anthropogenic Sources – Thermal Power plants, industries, smelters, mining, agriculture, construction, deforestation, automobile exhaust etc.

Effects of particulate air pollutants

- Reduce visibility
- Corrosion, soiling the surface of buildings
- Reduces photosynthesis in plants
- Asthmatic attack
- Allergies etc.

Gaseous Air Pollutants

- Carbon Monoxide: poisonous gas
- It is produced by incomplete burning of carbon in fossil fuels
- Reaction between CO_2 and C containing materials at very high temps in industrial processes, such as in electrical and blast furnaces.
- By dissociation of CO_2 at higher temperatures.

Contd.

- Sources – Natural and anthropogenic sources
- Sink – Oxidation of CO to CO2 (Atmosphere)
- Some bacteria of forest soil are capable of removing this gas with high efficiency.
- Effect on living organisms – Hemoglobin has got high affinity towards CO.

Contd

- Carbon Dioxide – Level in the earth's atmosphere has increased from about 280 ppm in the pre-industrial times to the current level of 400 ppm.
- Increased rate of combustion and deforestation.

Contd.

- Hydrogen Sulphide
- Oxides of Sulphur
- Oxides of Nitrogen
- Hydrocarbons
- Methane
- Chlorofluorocarbons (CFCs)

Secondary Pollutants

- Fog – Particulate and gaseous pollutants at times of inversion, lower layers become heavier than upper layers and pollutants discharged tend to stay near the surface of earth.
- High concentration of pollutants near the lower layer.
- As temp drops water vapor condenses on the surface of fine particles and form tiny liquid droplets and this result in the formation of fog.
- Various gases adsorb onto the film.

Smog

- Formed of smoke and fog.

Effects of air pollution on human life

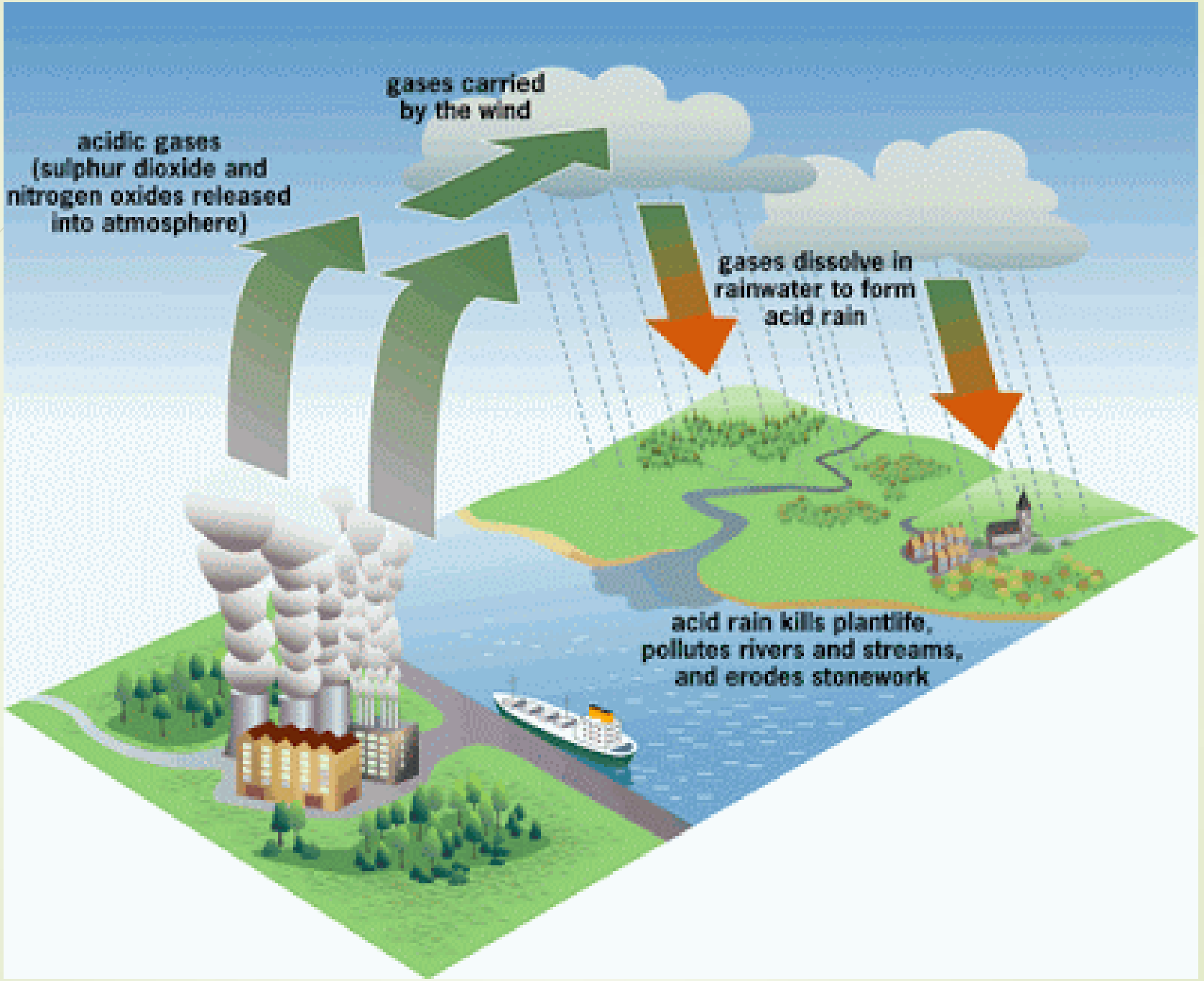
- It weakens the lungs to function well
- It causes irritation of eyes, nose, mouth and throat
- It brings on asthma attacks
- It causes respiratory symptoms such as coughing and wheezing
- It increases the chances of respiratory diseases such as bronchitis
- It reduces the energy levels
- It is the main reason of headaches and dizziness

Contd.

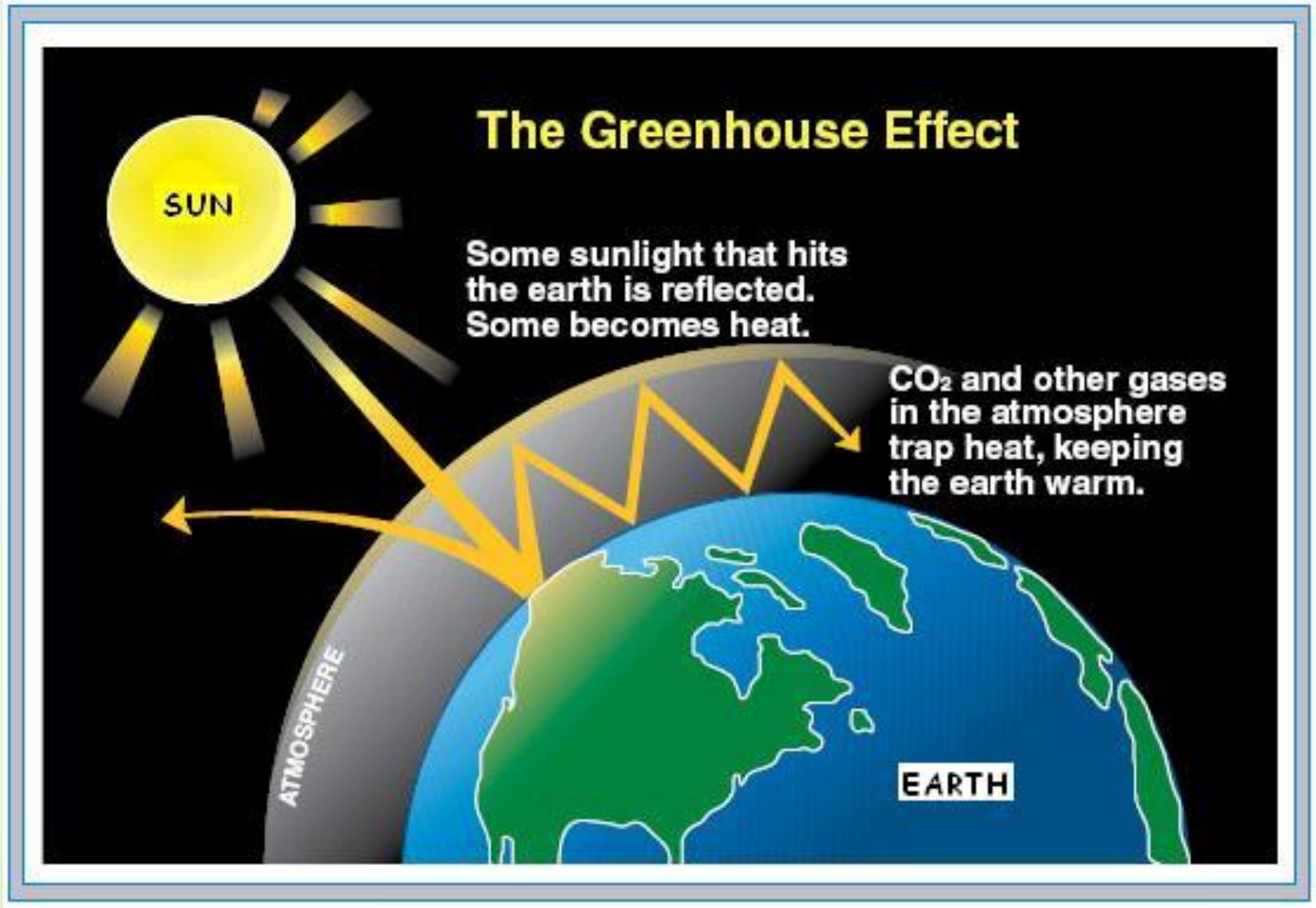
- It causes disruption of endocrine, reproductive and immune systems
- It is the cause of neuro behavioral disorders
- It creates cardiovascular problems
- It may cause cancer due to presence of carcinogenic contents in it
- It causes premature death


Enhancing Vitality - One Breath At A Time


VITALITY AIR


gases carried
by the wind
acidic gases
(sulphur dioxide and
nitrogen oxides released
into atmosphere)
gases dissolve in
rainwater to form
acid rain
acid rain kills plantlife,
pollutes rivers and streams,
and erodes stonework

Greenhouse Effect and Global Warming



Causes of Global Warming

- Carbon Dioxide – Concentration of CO2 is rising at a rate of about 0.5% per year.
- Methane – rising at the rate of 1% per year. About 18% of total warming has been attributed to this gas alone.
- Chlorofluorocarbon (CFCs) – Very stable compound, has got highest potential for global warming. Present in the atmosphere for a long time.
- Nitrous Oxide – Global warming potential is 170 to 290 times that of CO2. Long time in the atmosphere

Contd.

- Combustion – it causes nitrous oxide emission. Concentration of this gas increases about 0.3% per year.
- Water Vapor – Large quantity of water vapor present in the atmosphere contributes significantly to global warming.

Consequences of Global Warming

1. Increased global mean temperature (0.3 degree per decade)

This results

a. in melting of ice

- Melting of ice – melting of ice in the polar region results in flooding of coastal areas.
- Areas like Netherlands, Maldives, Lakshadweep islands, Andaman and Nicobar islands will get affected.
- Melting of glaciers and ice sheet over land and mountains will reduce the availability of fresh water in the long run.

Consequences

b. Increased mobility of air masses – frequent and severe storms.

c. Increased movement of water currents of oceans and seas – affects the climate of the region.

2. Releases methane from stable hydrates results in further increase in global warming.

3. Change in the existing precipitation patterns.

4. Habitat loss or alteration in ecosystems

Consequences

5. Insects and pests may increase.

6. Affects world food production

Impacts on India

- Sea level rise
- Beach erosion
- Water resource depletion as glaciers melt
- Affects south west monsoon
- Urbanization at an increased pace.
- Diseases and skin disorders
- Indian sub continent will become more cyclone prone as the sea water warms up.

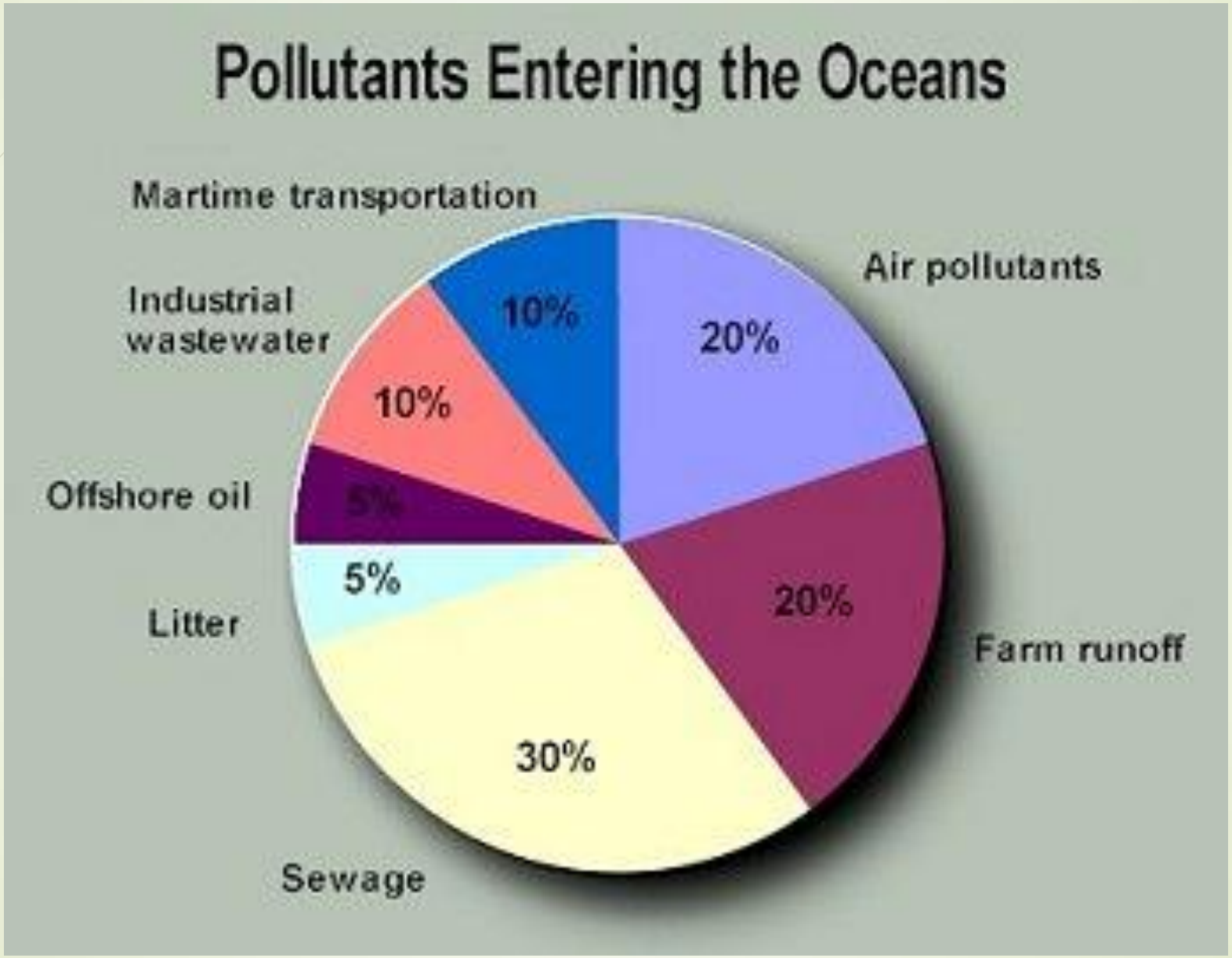
Main sources of water pollution in India

- The largest source of water pollution in India is **untreated sewage**. Other sources of pollution include **agricultural runoff** and unregulated small scale industry.

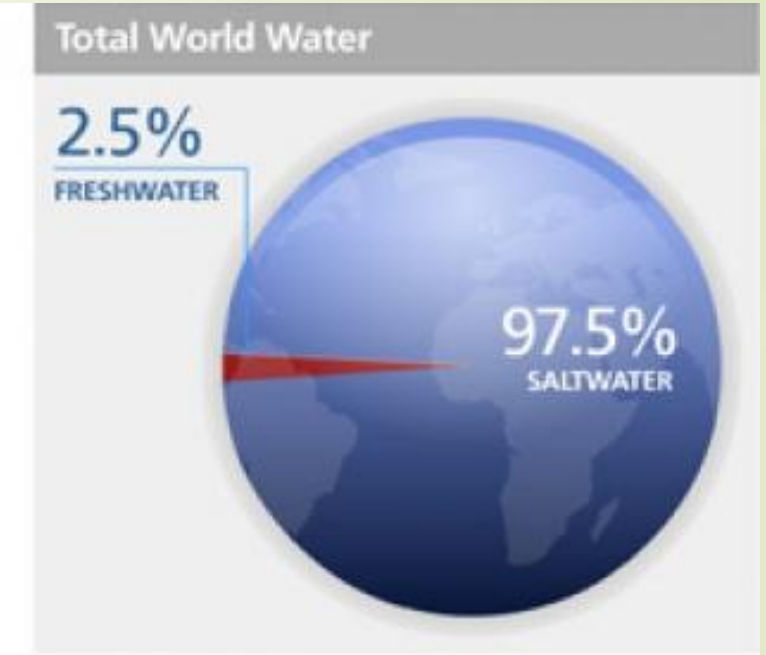
Water Pollution

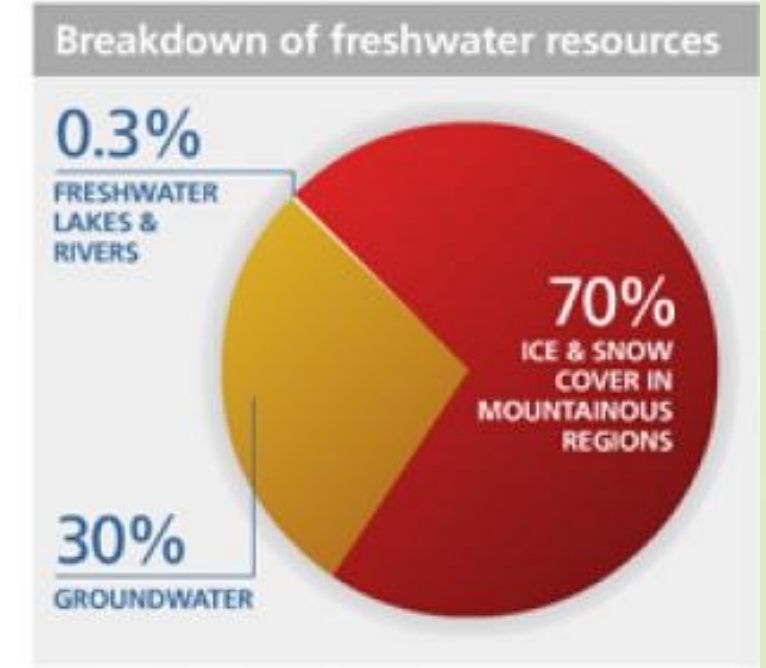
Water Pollution

- **Water pollution** is the **contamination** of **water** bodies (e.g. lakes, rivers, oceans, aquifers and groundwater). This form of environmental degradation occurs when **pollutants** are directly or indirectly discharged into **water** bodies without adequate treatment to remove harmful compounds.


Pollutants Entering the Oceans
Martime transportation
10%
Air pollutants
20%
Industrial wastewater
10%
Offshore oil
5%
Litter
5%
Farm runoff
20%
Sewage
30%

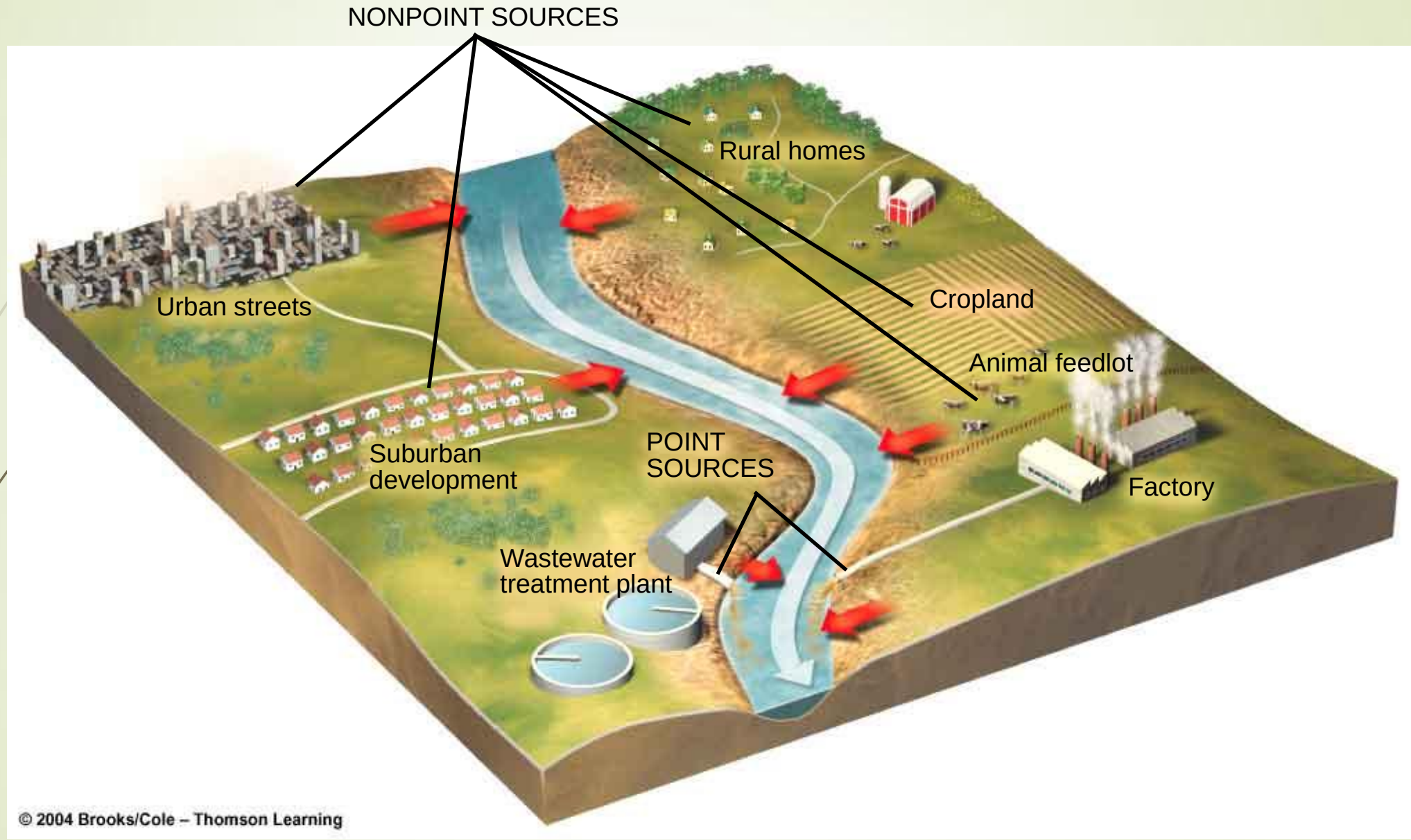
The total volume of water on Earth is about 1.4 billion km3. The volume of freshwater resources is around 35 million km3, or about 2.5 percent of the total volume. Of these freshwater resources, about 24 million km3 or 70 percent is in the form of ice and permanent snow cover in mountainous regions, the Antarctic and Arctic regions.





Types of water pollution

- If pollution comes from a single location, such as a discharge pipe attached to a factory, it is known as **point-source pollution**.
- water pollution happens not from one single source but from many different scattered sources. This is called **nonpoint-source pollution**.


NONPOINT SOURCES
Rural homes
Urban streets
Cropland
Animal feedlot
Suburban development
POINT SOURCES
Factory
Wastewater treatment plant
© 2004 Brooks/Cole – Thomson Learning

Non point sources

- Garden fertilisers, chemicals and soil from gardens;
- lead, oil and tyre rubber from roads;
- bacteria and micro-organisms from animal droppings; and
- litter items such as plastic bags, drink containers, food wrappers and cigarette butts.

Causes of Water pollution

Sewage

- According to World Health Organization, some 780 million people (11 percent of the world's population) don't have access to safe drinking water, while 2.5 billion (40 percent of the world's population) don't have proper sanitation (hygienic toilet facilities)

Nutrients

- Sewages and chemical fertilizers lead to the deposition of chemicals like Nitrogen and Phosphorous in large quantities.
- This causes massive increase in the growth of algae or plankton that overwhelms huge areas of oceans, lakes, or rivers.
- This is known as a **harmful algal bloom** (also known as an HAB or red tide, because it can turn the water red). It is harmful because it removes oxygen from the water that kills other forms of life, leading to what is known as a **dead zone**.

Waste Water

- Around half of all ocean pollution is caused by sewage and waste water. Each year, the world generates perhaps 5–10 billion tons of industrial waste, much of which is pumped untreated into rivers, oceans, and other waterways.
- Factories are point sources of water pollution and humans are non point sources.
- Detergents used in washing machine and dishwashers
- Pesticides
- Highway run off

Chemical Waste

- Detergents
- Polychlorinated biphenyls (PCBs)
- Heavy metals, such as lead (petrol), cadmium, and mercury (battery).
- Tributyltin or TBT (paint)

Oil Pollution

- Tanker spills are not as significant as they might seem:
- Only 12 percent of the oil that enters the oceans comes from tanker accidents; over 70 percent of oil pollution at sea comes from routine shipping and from the oil people pour down drains on land.
- Suppresses Photosynthesis
- For biodegradation it consumes large amount of oxygen causing oxygen deficient condition.
- Kills fish and sea birds.

Plastics

- A plastic bottle can survive an estimated 450 years in the ocean and plastic fishing line can last up to 600 years.
- Ghost fishing

Control of Pollution

- Sewage treatment
- Industrial waste water treatment
- Agricultural waste water treatment
- Education
- Laws
- Economics

What can you do?

- Fertilize garden and yard plants with manure or compost instead of commercial inorganic fertilizer.
- Minimize your use of pesticides.
- Grow or buy organic foods.
- Do not drink bottled water unless tests show that your tap water is contaminated. Merely refill and reuse plastic bottles with tap water.

What can you do?

- Do not use water fresheners in toilets.
- Do not flush unwanted medicines down the toilet.
- Do not pour pesticides, paints, solvents, oil, antifreeze, or other products containing harmful chemicals down the drain or onto the ground.
- Compost your food wastes.

Do the God's Pollute??

- Scientists in Hyderabad discovered high levels of zinc, calcium and strontium in water samples from a lake containing hundreds of Ganesh and Durga statues.

Pollution : Ganga River

- Religious beliefs, cultural traditions, poverty, and a large population interact to cause severe pollution of the Ganges River in India.
  - Very little of the sewage is treated.
  - Hindu believe in cremating the dead to free the soul and throwing the ashes in the holy Ganges.
    - Some are too poor to afford the wood to fully cremate.
    - Decomposing bodies promote disease and depletes DO.

Solid Waste

- Any material that we discard, that is not liquid or gas, is solid waste
- Solid waste also includes garbage, rubbish, demolition products, sewage treatment residue, dead animals etc

Sources

- Municipal Wastes – Household activities, restaurants, markets etc.
- With rising urbanization and change in life style and food habits, the amount of municipal solid waste has been increasing rapidly and its composition is changing.

Industrial Waste

- Hazardous and could be highly toxic to humans, animals and plants.

Agricultural Waste

- Crop residues and animal wastes
- Around 2 kg per person per day
- It can be used for increasing the fertility of the soil rather than as a fuel.

Effects of solid waste

Health hazard :

- If it is not collected and allowed to accumulate this may lead to cholera, diarrhea, plague, jaundice etc.
- Health hazards for the workers

Environmental Impact

- If not treated properly decomposition and decay takes place.
- Organic solid waste during decomposition may generate intolerable odour.
- It may clog drains and results in water logging

Solid waste Management

Waste management is

- Storage
- Collection
- Transport and handling
- Recycling
- Disposal and monitoring of waste materials

Methods of disposal

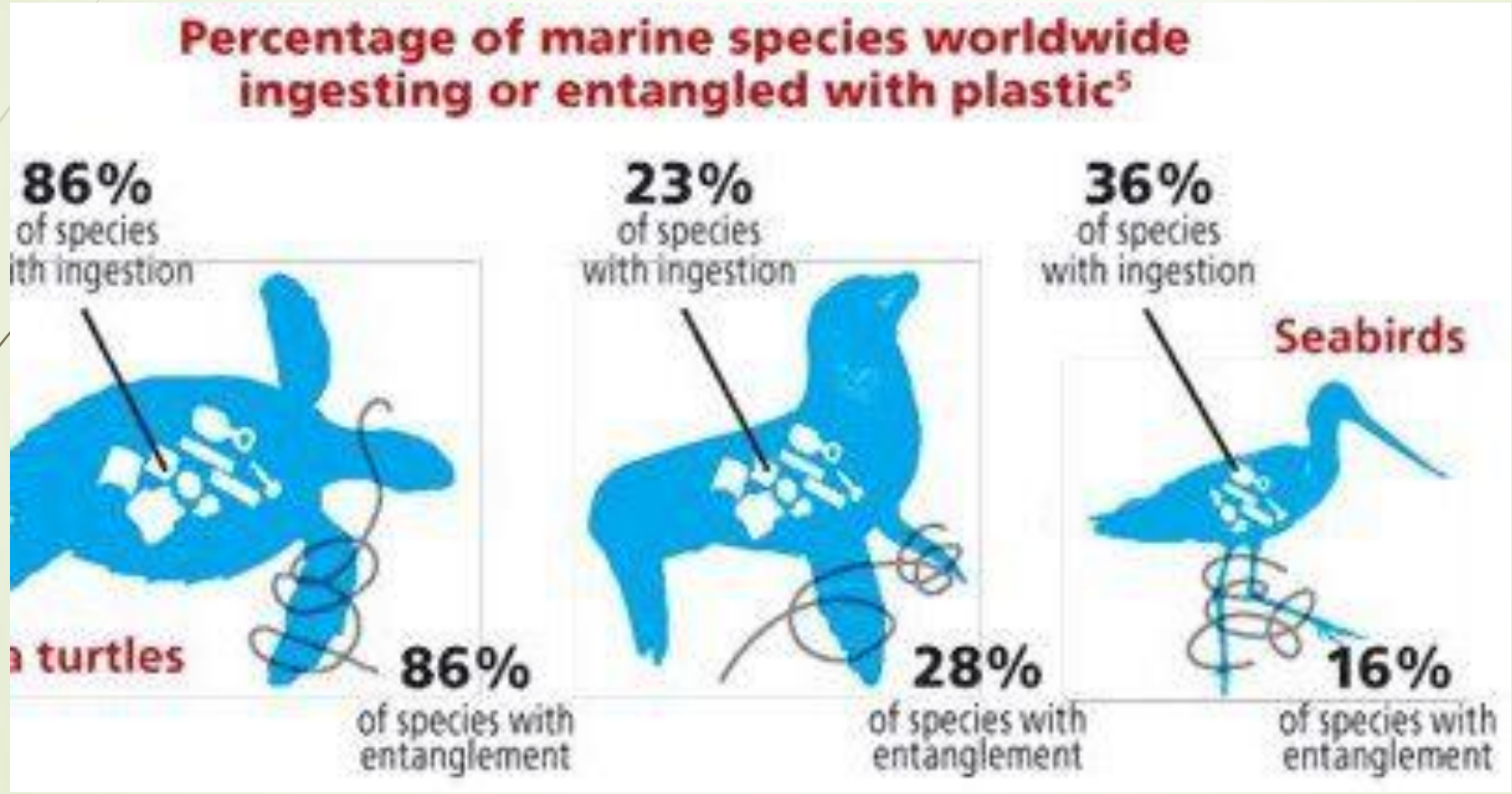
- Dumping
- Land filling
- Incineration
- Composting
- Manure Pits
- Burial

Recycling of Solid waste

- Utilization of hotel and hostel wastes
- Composting organic wastes to produce organic manure
- Use of waste paper
- Reuse of glass
- Metals can be recycled
- Plastics can be pyrolized to produce hard and soft waxes, greases, adhesives and tars

Plastic waste

Plastic waste



Management of Waste

Reduce and conserve materials

Refuse – Encourage producers to provide products or packaging that limit waste or emissions.

Return – Set up systems that require producers to take back products and packaging that create wastes or emissions.

Reduce toxics use – Eliminate toxic chemicals use; replace them with less toxic or non-toxic alternatives.

Reduce consumption and packaging – Use less; buy less and with less packaging; avoid disposables; bring your own.

- Small percentage of waste cannot be usefully recycled or composted is handled by modifying the production process thereby attaining Zero waste.

- **Encourage cyclical use of resources and shift incentives to stop wasting**

  Shift government funds or financial incentives (at any and all levels) from supporting harvesting and use of virgin natural resources to support the circular economy.

  Government and businesses should implement sustainable purchasing that support social and environmental objectives.

  Ensure incentives are in place for cyclical use of materials and disincentives in place for wasting (policies, research funds, regulations, etc)

  Set up systems to encourage local economies.(for example. use of proximity principle, marketing support, policies, incentives, social and environmental purchasing practices, information exchanges, etc.)

Manufacturers design products for sustainability and takeback

- Design to be durable, to be repairable, to be reusable, to be disassembled, to be fully recyclable, from reused, recycled or sustainably-harvested
  renewable materials designed for easy disassembly.
  Label products to identify who has made it and what it is made of
  Minimize volume and toxicity of materials used in production.
  Lease services and products rather than just sell products to customers.
  Take products and packaging back after they are used, and reuse, or recycle them back into the economy or nature.

Reuse (retain value and function)

- Reuse products.
  Repurpose products for alternative uses (e.g. old doors made into walls; old photos and scrap metal into art).
  Repair to retain value and usefulness.
  Refurbish.
  Remanufacture with disassembled parts.
  Dismantle to obtain parts for repairing and maintaining products still in use.
  Encourage thrift stores, used building materials store, garage sales, flea markets, and charity collections.
  Encourage or allow licensed recovery of reusable goods from tipping areas of discards collection and processing facilities.
  Provide incentives to takeout customers to bring their own containers, coffee cups and bags.
  Organize household hazardous waste swap meets.

- **<u>Regulate disposal, dispersal, or destruction of resources</u>**
  Ban materials or products that are toxic or that cannot be safely reused, recycled or composted.
- **Recover Energy/Bio-fuels** only using systems that operate at biological temperature and pressure, such as sustainable biodiesel from used vegetable oils or biologically or chemically producing ethanol from urban wood, biosolids, manures or food scraps.
  Landfilling is the last step.
  Materials sorting for recyclables and research for design purposes.
  Biological stabilization before burial
  Require insurance to cover post-post-closure repairs.
  Plan systems to be flexible to be adjusted towards Zero Waste with changes in waste stream as waste is reduced.


MASS
EXTINCTION
BUSH
FIRES
SEVERE
DROUGHT
NEXT 100 YEARS

Climate Change

- It is a pattern of change occurring in the environment affecting global or regional climate.
- Change in average temp., rainfall, change in frequency of occurrence of extreme weather conditions.
- Deforestation, fossil fuel use, population growth, industries of various types are the main causes.
- Indian Network on Climate Change Assessment (INCCA)

Climate change impacts for India

Expected climate change impacts for India


Changes in weather patterns


Cyclonic disturbances


Sea-level rise


Changes in agriculture yields

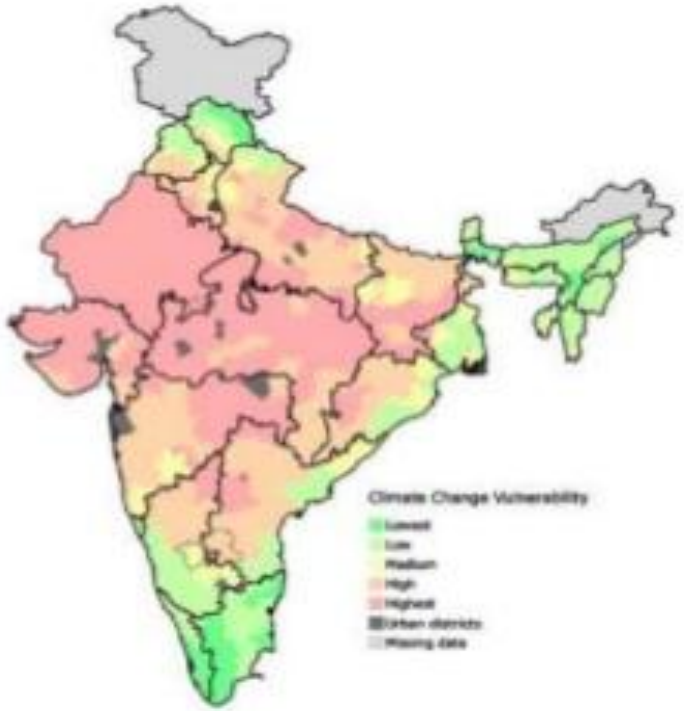

Changes in fresh water supply


Impacts on forests and natural ecosystems


Impacts on human health

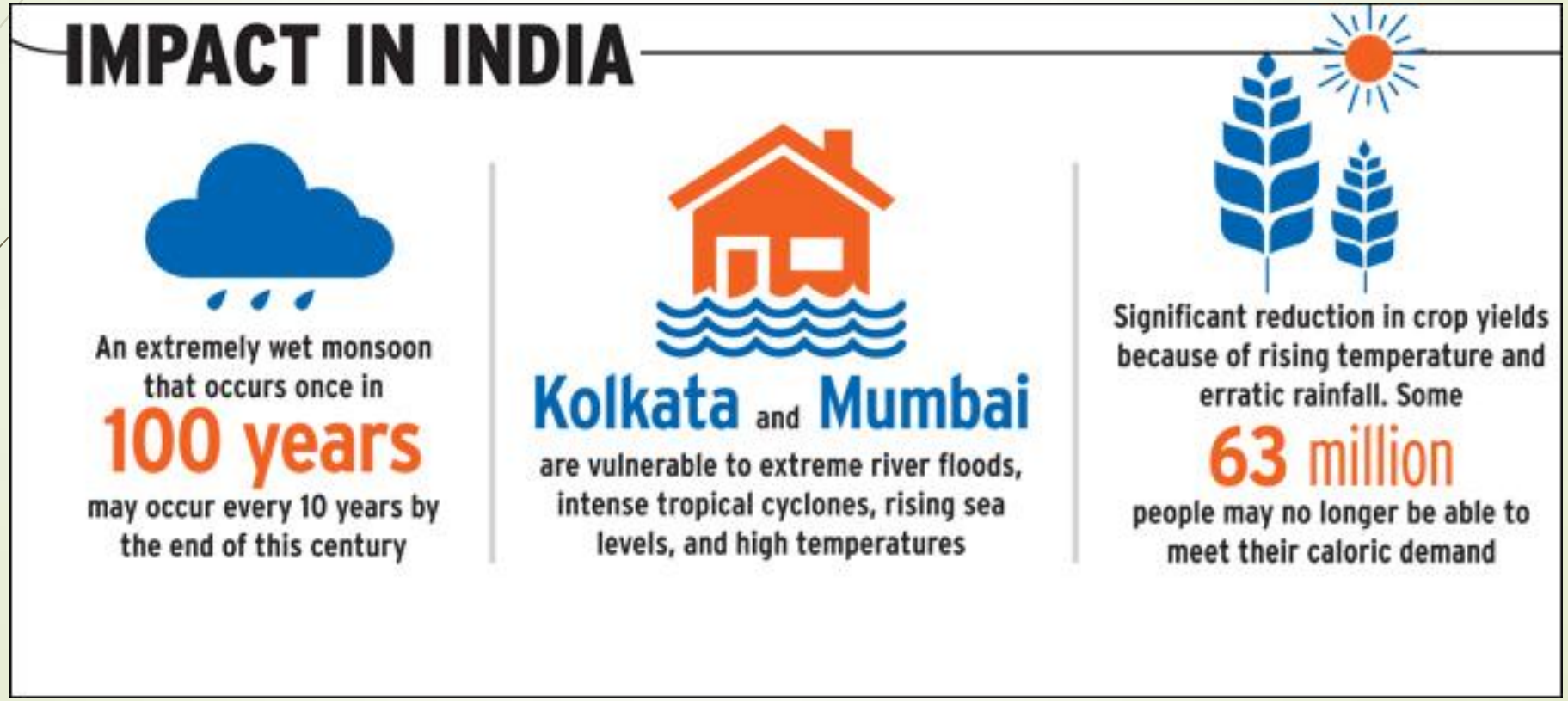
Source :Expected effects (of expected climate change) for India: examples (INCCA 2010)

Mapping vulnerability : climate change in India



Source: Mapping vulnerability to multiple stressors: climate change and globalization in India

Impact in India



National Action Plan on Climate Change (NAPCC) - 2008

- 1. National Solar Mission – promote the development and use of solar energy for power generation and other uses.
- Its goals are: encourage the public to increase the use of solar thermal energy in urban areas, industry and commercial establishments
- Establishment of solar research center, strengthening of domestic manufacturing capacity and increased government funding.

2. National mission for Enhanced Energy Efficiency

- This mission expects energy savings to about 1000 MW.
- Mandatory reduction of specific energy consumption in large energy consuming industries.
- Energy trading
- Energy incentives

3. National Mission on Sustainable Development

- Strong rules on conserving the energy.
- Proper urban waste management and recycling, including power production from waste.
- Making automobiles more fuel efficient.

4. National Water Mission

- Measures to adapt to water scarcity.
- Save water.
- Sustain Himalayan ecosystems

5. National Mission for Green India

- Afforestation

- 6. National Mission for sustainable agriculture
- 7. National Mission on Strategic Knowledge for climate change

Good life at the beach threatened?

Mr. OZONE: Will I be able to continue enjoying this life without problems?

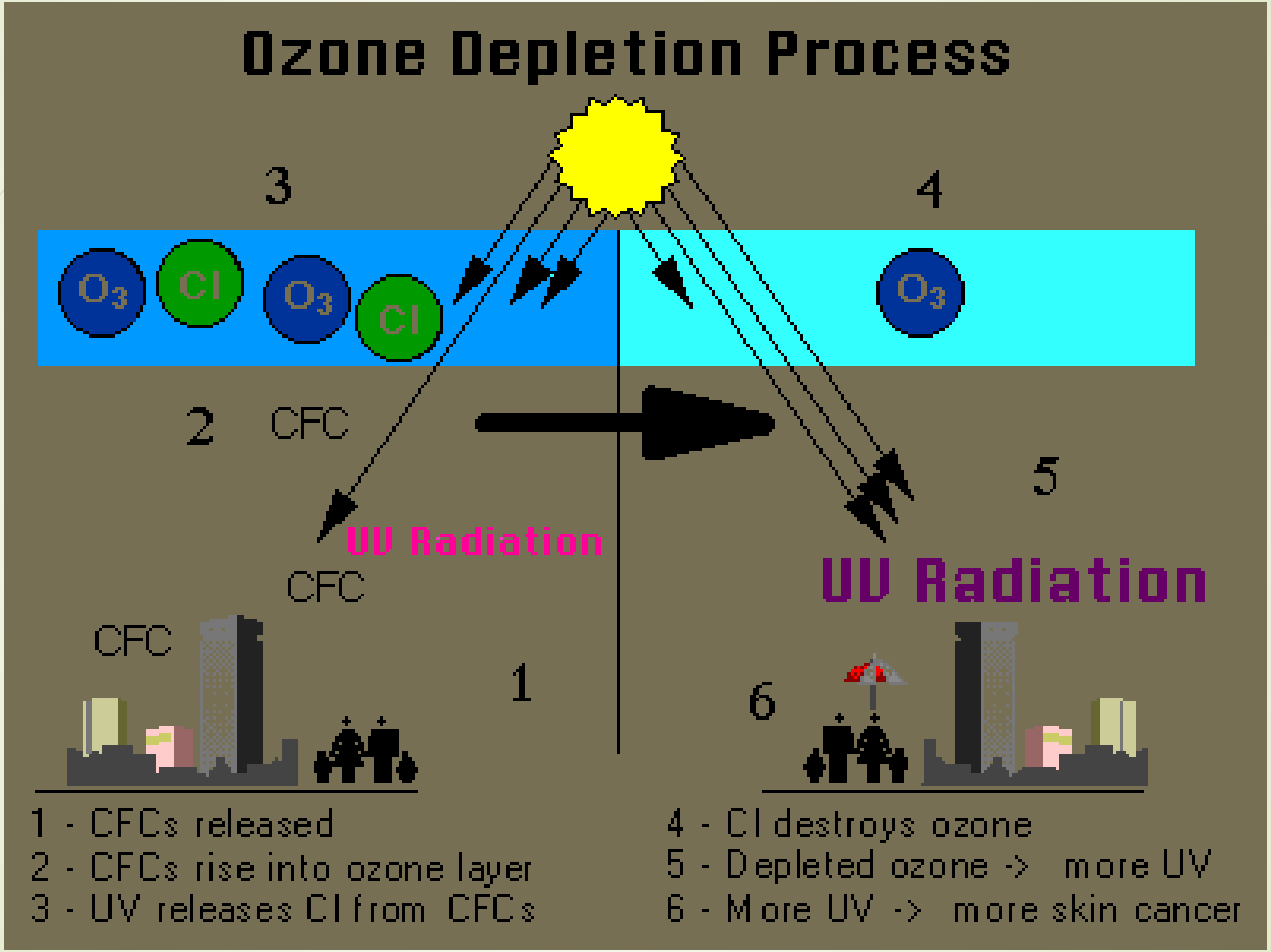
Ozone Layer Depletion

- O_3
- a gas composed of three atoms of oxygen
- bluish gas that is harmful to breathe
- Nearly 90% of the Earth's ozone is in the stratosphere and is referred to as the ozone layer
- Ozone absorbs a band of ultraviolet radiation called UVB

Ozone layer depletion

- In the stratosphere only Ozone strongly absorbs the short wave regions of electromagnetic spectrum. (UV B radiation)
- Wavelengths shorted than this also is harmful to living organisms. But they are absorbed by other gases like oxygen, nitrogen etc.


30 miles
PROTECTIVE OZONE LAYER
STRATOSPHERE
TROPOSPHERE
10 miles
SMOG
EARTH


Ozone Depletion Process
3
4
O3
Cl
O3
Cl
O3
2
CFC
5
UV Radiation
CFC
UV Radiation
CFC
1
6
1 - CFCs released
2 - CFCs rise into ozone layer
3 - UV releases Cl from CFCs
4 - Cl destroys ozone
5 - Depleted ozone -> more UV
6 - More UV -> more skin cancer

Ozone Depleting Substances (ODS)

- CFCs,
- HCFCs,
- halons,
- methyl bromide,
- carbon tetrachloride, and
- methyl chloroform.

Substances that influence ozone layer

- Presence of Oxides of Nitrogen
- Presence of halogens like Cl, Br

Sources of Ozone depleting substances

- Natural Sources – Volcanic eruptions
- Human activities – Combustion of fossil fuels and organic matter, Excessive use of nitrogenous fertilizers, Excessive use of CFC's, Supersonic transport rockets and space shuttles, Nuclear tests.

The Antarctic Ozone hole

- The ozone hole is defined as the area having less than 220 dobson units (DU) of ozone in the overhead column (i.e., between the ground and space).

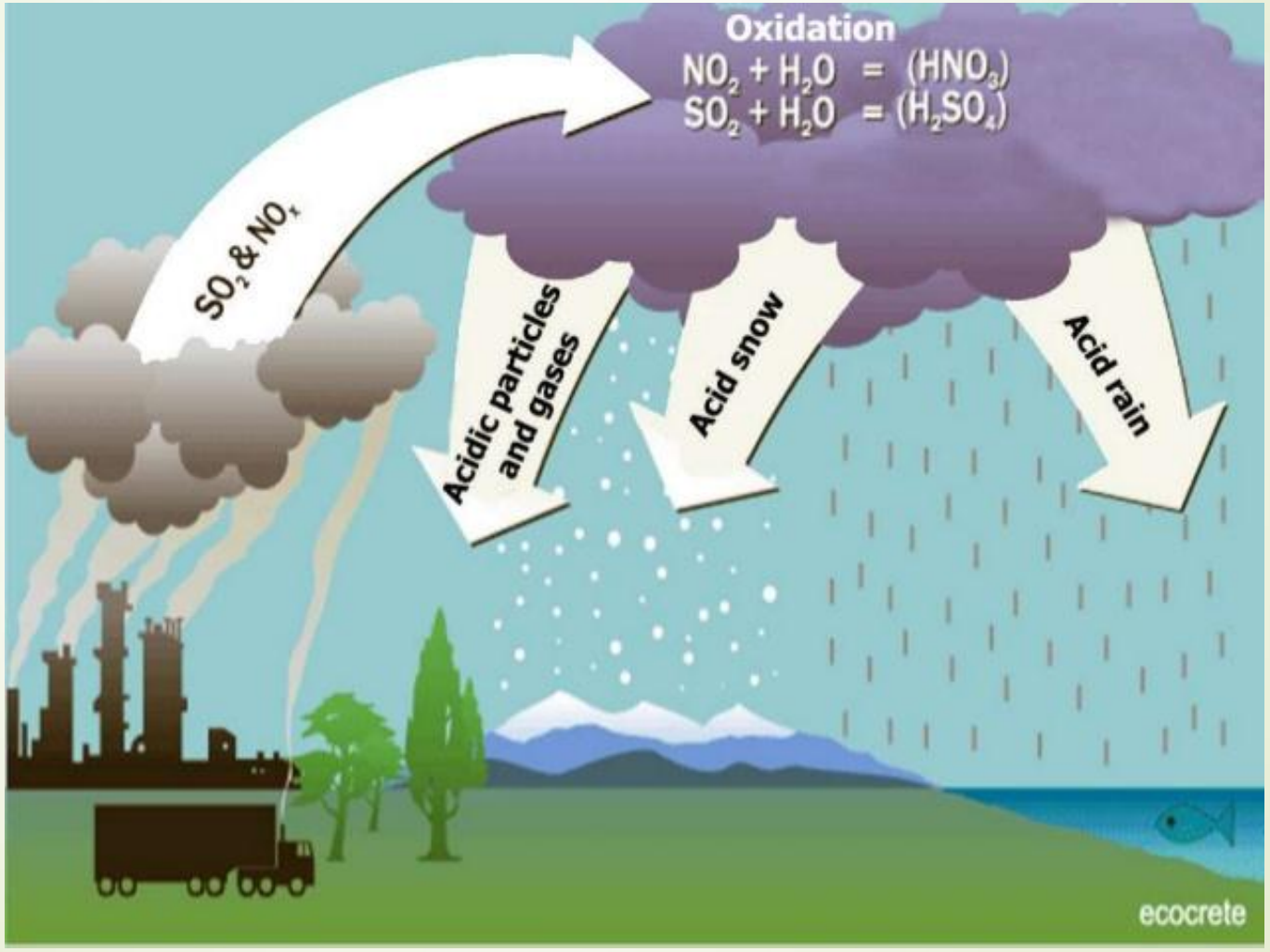
Acid Rain

- Acid rain, or acid deposition, is a broad term that includes any form of precipitation with acidic components, such as sulfuric or nitric acid that fall to the ground from the atmosphere in wet or dry forms. This can include rain, snow, fog, hail or even dust that is acidic.
- Acid rain results when sulfur dioxide (SO_2) and nitrogen oxides (NO_X) are emitted into the atmosphere and transported by wind and air currents. The SO_2 and NO_X react with water, oxygen and other chemicals to form sulfuric and nitric acids. These then mix with water and other materials before falling to the ground.

Sources

- a small portion of the SO_2 and NO_X that cause acid rain is from natural sources such as volcanoes, most of it comes from the burning of fossil fuels. The major sources of SO_2 and NO_X in the atmosphere are:
- Burning of fossil fuels to generate electricity. Two thirds of SO_2 and one fourth of NO_X in the atmosphere come from electric power generators.
- Vehicles and heavy equipment.
- Manufacturing, oil refineries and other industries.

Acid rain


Oxidation
$NO_2 + H_2O = (HNO_3)$
$SO_2 + H_2O = (H_2SO_4)$
SO_2 & NO_x
Acidic particles and gases
Acid snow
Acid rain
ecocrete

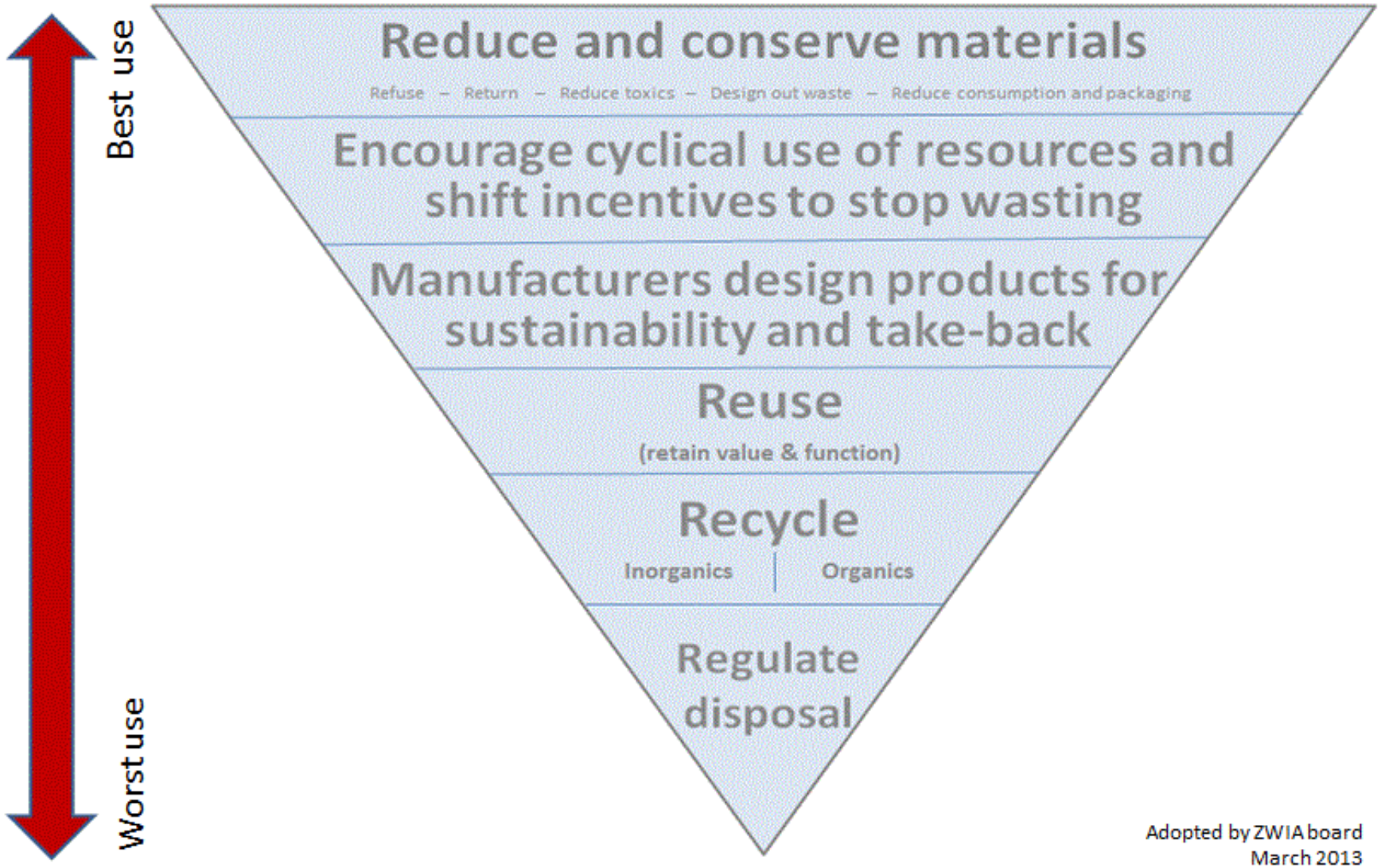
Effects of acid rain

- Acid rain makes waters acidic and causes them to absorb the aluminum that makes its way from soil into lakes and streams. This combination makes waters toxic to crayfish, clams, fish, and other aquatic animals.
- Acid rain also damages forests, especially those at higher elevations. It robs the soil of essential nutrients and releases aluminum in the soil, which makes it hard for trees to take up water.
- The pollutants may also inhibit trees' ability to reproduce.

Zero Waste Concept

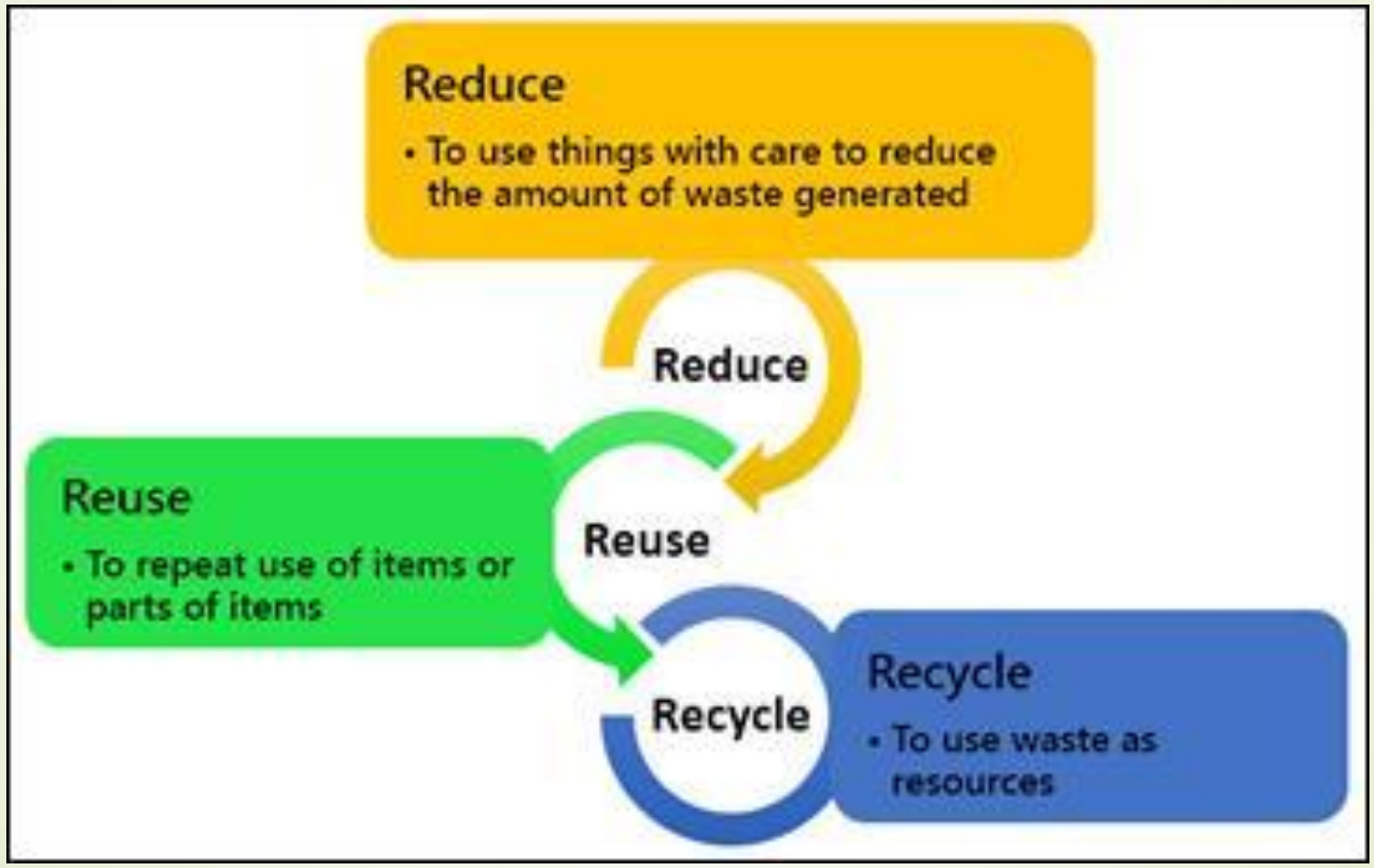
- Zero Waste is a philosophy that encourages the redesign of resource life cycles so that all products are reused. No trash is sent to landfills or incinerators.
- Implementing Zero Waste will eliminate all discharges to land, water or air that are a threat to planetary, human, animal or plant health

Zero Waste Hierarchy

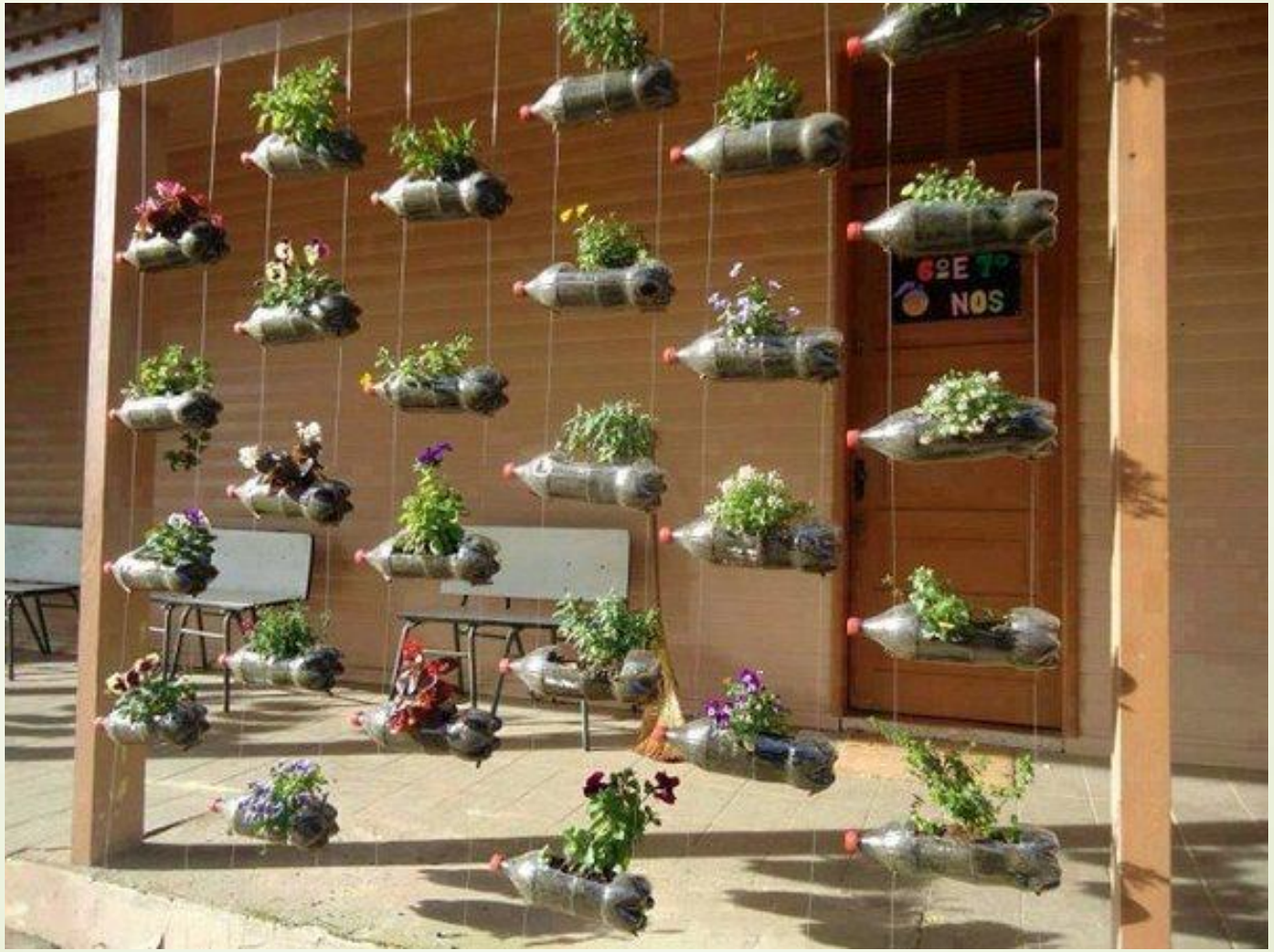


Adopted by ZWIA board
March 2013

3 R Concept


Reduce
• To use things with care to reduce the amount of waste generated
Reduce
Reuse
• To repeat use of items or parts of items
Reuse
Recycle
Recycle
• To use waste as resources

- Reduce – reduce creating waste, use long lasting goods
- Reuse – reuse goods by repairing
- Recycle – turn things that would otherwise become waste to valuables.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