Video

AIR POLLUTION

Facilitator:

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Specific Learning Objectives

- At the end of session, the learner shall be able to:

➢ Describe the sources of air pollution.

➢ Enumerate the air pollutants.

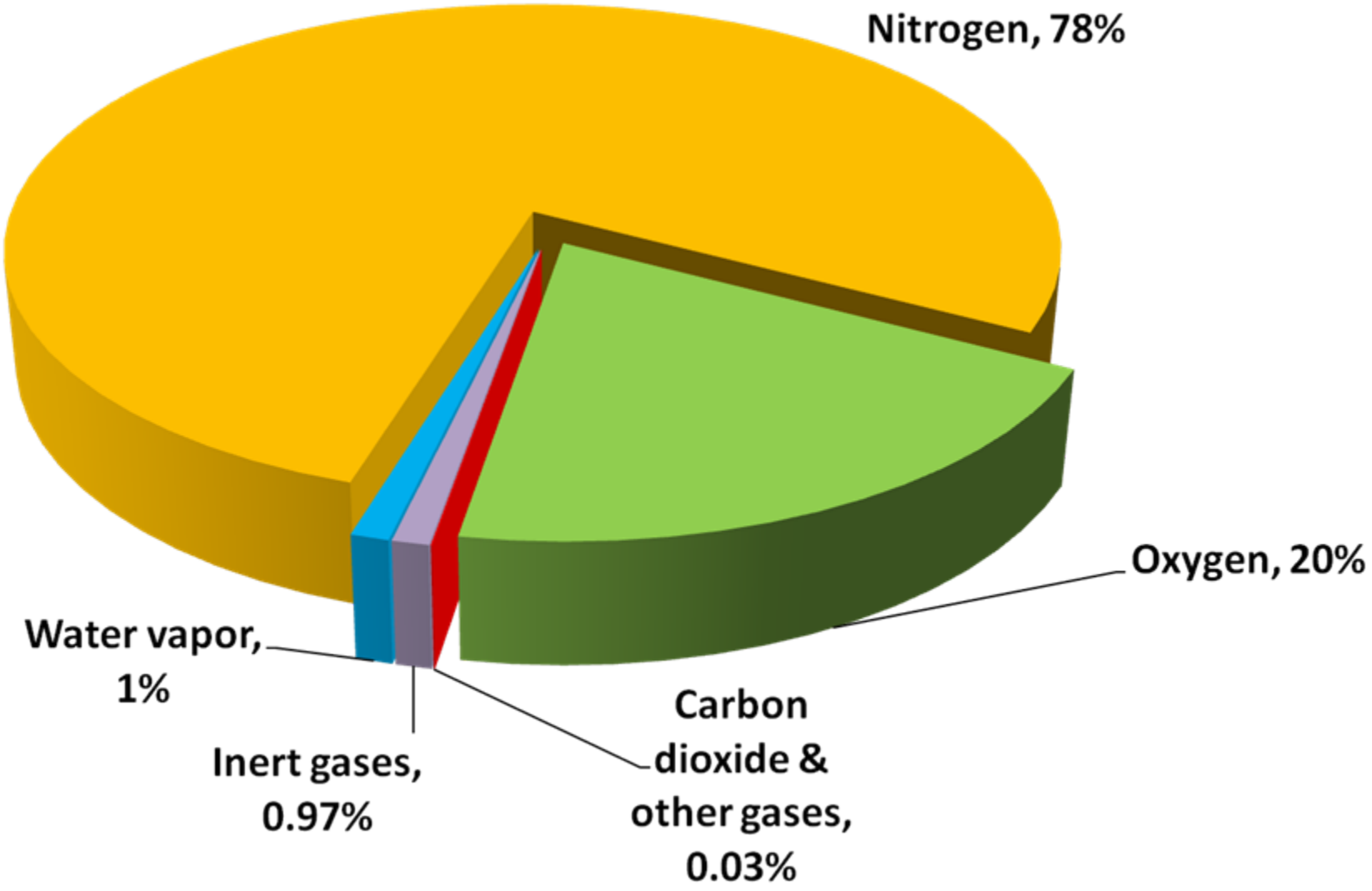
➢ Describe the effects of air pollution.

➢ Describe the prevention and control of air pollution.

Introduction

- Air is life!
- Air supplies us with oxygen.

Composition of Air



Air is rendered impure by

- Respiration of human beings and animals
- Combustion of coal, gas, oil etc.
- Decomposition of organic matter
- Trade, traffic and manufacturing processes.

Air pollution

- Air is considered to be polluted when:
  - it contains any extraneous constituent
  - in sufficient quantities
  - to adversely affect the environment or the health of people exposed to it.

- Air pollution is much more than just smoke!

- Primary pollutant:
  - A chemical added directly to the atmosphere from natural or human activity.

- Secondary pollutant:
  - A chemical formed in the atmosphere when primary pollutants react with air, chemicals or sunlight.

Sources of Air pollution

- Automobiles
- Industries
- Domestic sources
- Tobacco smoke:
  - Passive smoking
  - Second hand smoke
  - Third hand smoke
- Miscellaneous

Air pollutants

- Particulate matter
- SOX
- NOX
- Ozone
- CO
- Others

Particulate Matter

- Affects more people than any other pollutant.
- Complex mixture of solid and liquid particles of organic and inorganic substances suspended in the air.
  - The major components are sulfate, nitrates, ammonia, sodium chloride, carbon, mineral dust and water.
- The particles are identified according to their aerodynamic diameter,
  - PM10 (particles with an aerodynamic diameter <10 μm) or
  - PM2.5 (aerodynamic diameter <2.5 μm).
    - PM2.5 are more dangerous since, when inhaled, they may reach the peripheral regions of the bronchioles, and interfere with gas exchange inside the lungs.

- These are emitted into the atmosphere through man-made (anthropogenic) and natural processes
  - combustion of fuels in vehicle engines or in households; industrial activities; erosion of road surfaces by road traffic and abrasion of brakes and tyres; and work in caves and mines.
- Also formed in the air, usually by chemical reactions between gaseous pollutants.
- Particles produced by outdoor sources (industry and traffic) penetrate easily into indoor spaces and add to the burden of PM emitted indoors.

- Chronic exposure to particles contributes to the risk of developing:
  - Cardiovascular diseases
  - Respiratory diseases,
  - Lung cancer.
- In developing countries, exposure to pollutants from indoor combustion of solid fuels on open fires or traditional stoves increases the risk of:

- Acute lower respiratory infections (LRTIs) and associated mortality among young children;
- Chronic obstructive pulmonary disease (COPD) and lung cancer among adults.

Sulphur dioxide (SO2)

- Sources:
  - Burning of fossil fuels (coal and oil) for domestic heating, power generation and motor vehicles, and
  - Smelting of sulphur containing mineral ores.

- When SO2 combines with water, it forms sulphuric acid; this is the main component of acid rain.

- Affect the respiratory system and the functions of the lungs
  - coughing, mucus secretion, aggravation of asthma and chronic bronchitis and makes more prone to respiratory tract infections.
- Causes irritation of the eyes.
- Hospital admissions for cardiac disease and mortality increase on days with higher SO2 levels.
- The upper limit of acceptable values are 20 µg/m3 (24-hour mean) and 500 µg/m3 (10-minute mean).

Nitrogen dioxide (NO2)

- The major sources of anthropogenic emissions of NO2 are combustion processes (heating, power generation, and engines in vehicles and ships).
- As an air pollutant, NO2 has several correlated activities: -
  - At short-term concentrations exceeding 200 µg/m3, it is a toxic gas which causes significant inflammation of the airways.
  - NO2 is the main source of nitrate aerosols, which form an important fraction of PM2.5 and, in the presence of ultraviolet light, of ozone.

- Epidemiological studies have shown that symptoms of bronchitis in asthmatic children increase in association with long-term exposure to NO_2.

- The upper limits of guideline values are:

➢ 40 µg/m3 (annual mean) and 200 µg/m3 (1-hour mean).

Ozone (O3)

- Ozone is one of the major constituents of photochemical smog.
- It is formed by the reaction with sunlight (photochemical reaction) of pollutants and industry emissions and volatile organic compounds emitted by vehicles, solvents and industry.

- NO_2 is the main precursor of ozone in a reaction catalysed by sunlight ($h\nu$) *and* volatile organic compounds:

  $NO_2 + h\nu \rightarrow NO + O^{*}\cdot$

  $O^{*} + O_2 \rightarrow O_3$ (where $O^{*}\cdot$ represents an exited state atom)
- High levels of nitrogen dioxide tend to be associated with low levels of ozone and vice versa.
- Ozone is typically highest in peri-urban and rural areas rather than in city centres, where the NO is thought to react with ozone-forming NO_2.

- The highest levels of ozone pollution occur during periods of sunny weather.
- Excessive ozone in the air can have a marked effect on human health.
  - It can cause breathing problems, trigger asthma, reduce lung function and cause lung diseases.

- Guidelines values for upper limits are:
  - 100 µg/m3 (8-hour mean)

Carbon monoxide (CO)

- Product of incomplete combustion of carbon containing materials such as in automobiles, industrial process, and incinerators.
- Concentrations in urban areas depend upon:
  - Traffic density : morning and evening rush hours
  - Density of petrol powered vehicles

Pollutant	**Source**	**Pathological effect**
Hydrogen sulphide	Refineries, chemical industries, bituminous fuels	Nausea, irritates eyes and throat
Hydrogen cyanide	Blast furnace, fumigation, chemical manufacturing, metal plating etc.	Interferes with nerve cells, dry throat, indistinct vision, headache etc.
Ammonia	Explosives, dye making, fertilizer plants	Inflames upper respiratory passage.
Lead	Motor vehicles	Toxic to nervous and blood forming system

Indoor air pollution

Pollutant	**Major indoor source**
Fine particles	Fuel/tobacco combustion, cleaning operations
Carbon monoxide	Fuel/tobacco combustion
Nitrogen oxides	Fuel combustion
Sulphur oxides	Fuel combustion
Pesticides	Consumer products, dust from outside
Lead	Remodeling/demolition of painted surfaces

Monitoring of air pollution

Measurements

- Sulfur dioxide
- Smoke or soiling index
- Grit and dust measurement
- Coefficient of haze (smoke shade)
- Air pollution index

Some Statistics

Effects of Air pollution

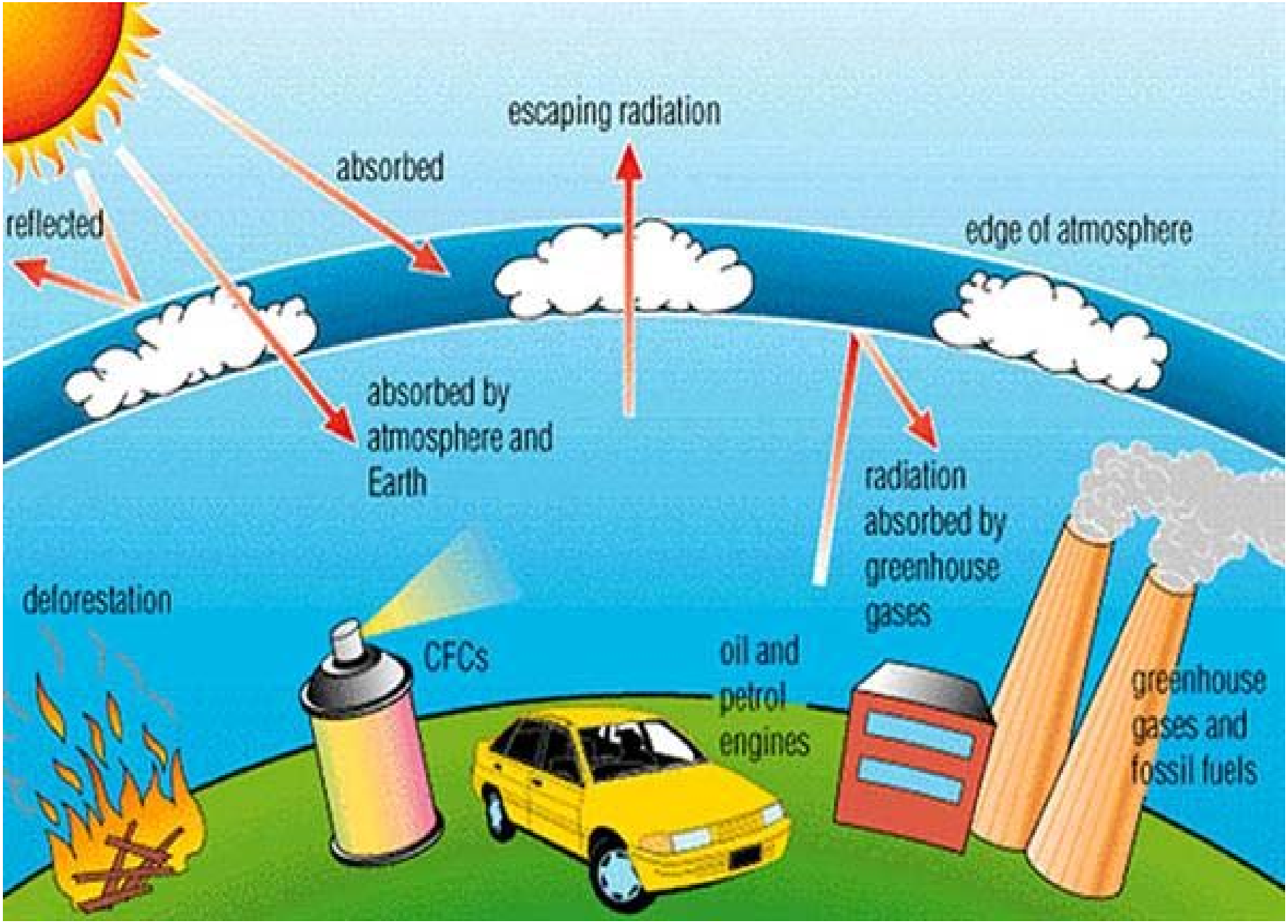
- **Smog**
  - It is caused by chemical reactions between pollutants derived from different sources, primarily automobile exhaust and industrial emissions.
  - Cities are often centers of these types of activities, and many suffer from the effects of smog, especially during the warm months of the year.

- **Acid rain**

  - When a pollutant, such as sulfuric acid combines with droplets of water in the air, the water (or snow) can become *acidified*
  - The effects of acid rain on the environment can be very serious.
  - It damages plants by destroying their leaves, it poisons the soil, and it changes the chemistry of lakes and streams and kills trees and harms animals, fish, and other wildlife.

Greenhouse Effect

- Referred to as global warming, is generally believed to come from the build up of carbon dioxide gas in the atmosphere.
- The amount of carbon dioxide in the air is continuing to increase.
- This buildup acts like a blanket and *traps heat* close to the surface of our earth.


escaping radiation
absorbed
reflected
edge of atmosphere
absorbed by atmosphere and Earth
radiation absorbed by greenhouse gases
deforestation
CFCs
oil and petrol engines
greenhouse gases and fossil fuels

Ozone depletion

- Chemicals released by our activities affect the *stratosphere.*
- The ozone layer in the stratosphere protects the earth from harmful *ultraviolet radiation* from the sun.
- Release of *chlorofluorocarbons* (CFC's) from aerosol cans, cooling systems and refrigerator equipment removes some of the ozone, causing "holes"; to open up in this layer and allowing the radiation to reach the earth.
- Ultraviolet radiation is known to cause skin cancer and has damaging effects on plants and wildlife.

Effects on Health

- Air pollution can affect our health in the form of:
  - Short-term (acute) effects and
  - Long-term (long) effects

Short-term effects

- Irritation to the eyes, nose and throat.
- Upper respiratory infections such as bronchitis and pneumonia.
- Other symptoms can include headaches, nausea, and allergic reactions.
- Short-term air pollution can aggravate the medical conditions of individuals with asthma and emphysema.

Long-term health effects

- Chronic respiratory disease, lung cancer, heart disease, and even damage to the brain, nerves, liver, or kidneys.
- Continual exposure to air pollution affects the lungs of growing children and may aggravate or complicate medical conditions in the elderly.

Social & Economic Aspects

- Destruction of plant and animal life.
- Corrosion of metals.
- Damage to buildings.
- Cost of cleaning, maintenance & repair.
- Soiling and damage to clothing.

Acid Rain: Taj Mahal

The Taj Mahal "The Crown of Palaces"is a white marble mausoleum located in Agra, India. It was built by Mughal emperor Shah Jahan in memory of his third wife, Mumtaz Mahal. The Taj Mahal is widely recognized as "the jewel of Muslim art in India and one of the universally admired masterpieces of the world's heritage."

Acid rain is damaging India's famed Taj Mahal but is becoming less of a threat to Europe's cultural monuments, scientists reported on Thursday at an international conference in Prague.

"The milky white marble of the Taj Mahal is turning pale," said SK Sharma of India's Geological Research Institute at the International Conference on Acid Deposition.

"This one-time marvel is now being subjected to all types of industrial and garbage pollution," he said.

ABOUT THE TAJ MAHAL

Location	Agra, India
Coordinates	27.174799°N 78.042111°E
Elevation	171 m (561 ft)
Built	1632–1653
Architect	Ustad Ahmad Lahauri
Architectural style	Mughal
Visitation	approx 3 million

WORLD HERIATAGE SITE

Type	Cultural
Criteria	i
Designated	1983 (7th session)
Reference #	252
State Party	India
Region	Asia-Pacific

Prevention

To help control the pollution, the Indian government has set up the Taj Trapezium Zone, a 10,400-square-kilometre area around the monument where strict emissions standards are in place. Polluting traffic is not allowed near the complex and tourists must either walk from parking lots or catch an electric bus.

Only corrective measures to make the nearby environment eco-friendly and shifting hazardous industries away can help in restoring the lost glory of the Taj Mahal.

Prevention & Control of Air Pollution

- Containment
- Replacement or modernization of equipment
- Zoning
- Regulatory measures
- Dilution
- International action

Take Home Message

THANKS….

NOISE POLLUTION

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Noise

- Derived from the Latin term nausea.
- Defined as unwanted sound.
- Noise can be taken as a group of loud, non harmonious sounds or vibrations that are unpleasant and irritating to ear.
- Recognized stress factor

- Section 2 (a) of the Air (Prevention and Control of Pollution) Act, 1981 includes noise in the definition of ‘air pollutant’.
  - Air pollution means any solid, liquid or gaseous substance including noise present in the atmosphere in such concentration as may be injurious to human beings or other living creatures or plants or property or environment.

Properties of noise

1. Loudness: depends on the amplitude of the vibrations
    - Measured in decibels
    - “Reference” sound and relationship with decibels
    - Limit of tolerance ‘85 dB’

2. Frequency: denoted as Hertz (Hz)
    - Human ear can listen from 20 to 20,000 Hz
    - Higher frequencies may be lost in certain jobs

Sources of Noise Pollution

- By-product of **I. C. U.**

  Industrialization

  Modern **C**ivilization

  Urbanization.

- Roads traffic (pressure horn), aircraft, rail.
- Construction, noise in buildings (as furniture and plumbing), industries,
- Consumer products (as household commodities as mixer grinder, vacuum cleaners, etc.)
- Recreational (as loud music, discos, religious and social festivals, etc.).

Effects of noise exposure

- 2 types:

1. **Auditory effects**
2. **Non-auditory effects**

1. Auditory effects

a) **Acoustic trauma :**
   - Sudden hearing damage caused by short burst of extremely loud noise such as a gun shot or blasts.

b) **Tinnitus :**
   - Ringing or buzzing in the ear.

c) **Temporary hearing loss :**
   - Occurs immediately after exposure to a high level of noise. There is gradual recovery when the affected person spends time in a quiet place.

d) Permanent hearing loss :

- Progresses constantly as noise exposure continues month after month and year after year.
- Noticeable only when it is substantial enough to interfere with routine activities.
- When noise exposure stops, the person does not regain the lost hearing sensitivity.

Noise-induced hearing loss is a cumulative process, both level of noise and exposure time over a worker's work history are important factors.

2. Non auditory effects

a) **Interference with speech:**
   - 300 – 500 Hz causes maximal difficulties

b) **Annoyance:**
   - primarily a psychological response

c) **Efficiency:**
   - where mental concentration is to be undertaken, a low level of noise is always desired

d) **Physiological changes:**
   - temporary changes like rise in BP, heart rate and sweating

Control of noise

1. Careful city planning
2. Control of vehicles
3. Acoustic insulation of buildings
4. Industries and railways
5. Protection of exposed persons
6. Legislation
7. Health Education

V-Noise

ANIDIOTSAR

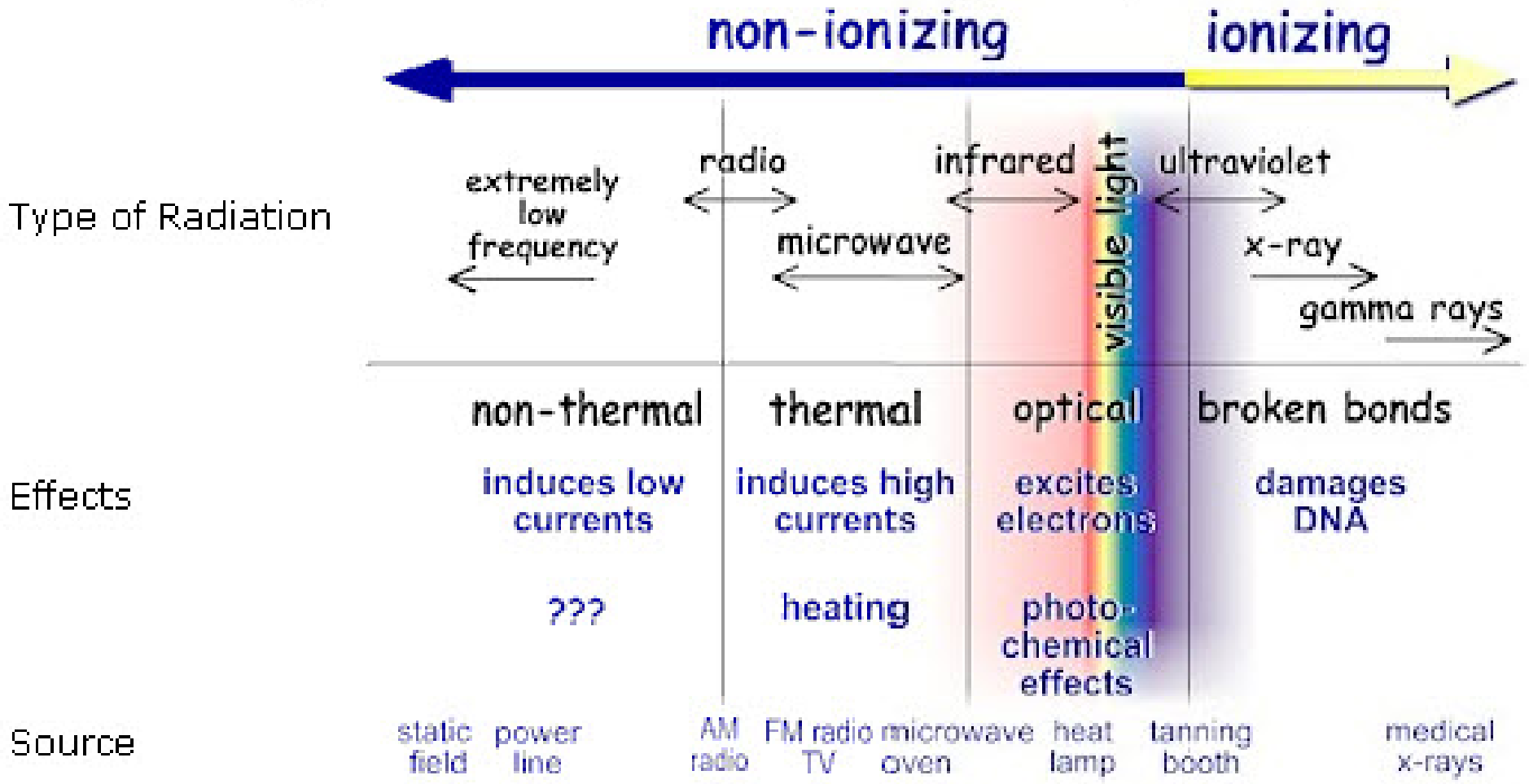
it’s

RADIATIONS

Radiation

- Natural part of environment
- Radon is the chief source of naturally occurring pollutant
- There is a high risk perception for radiation hazards
- Increased risk with the advent of nuclear medicine and investigative techniques

Types of Radiation in the Electromagnetic Spectrum



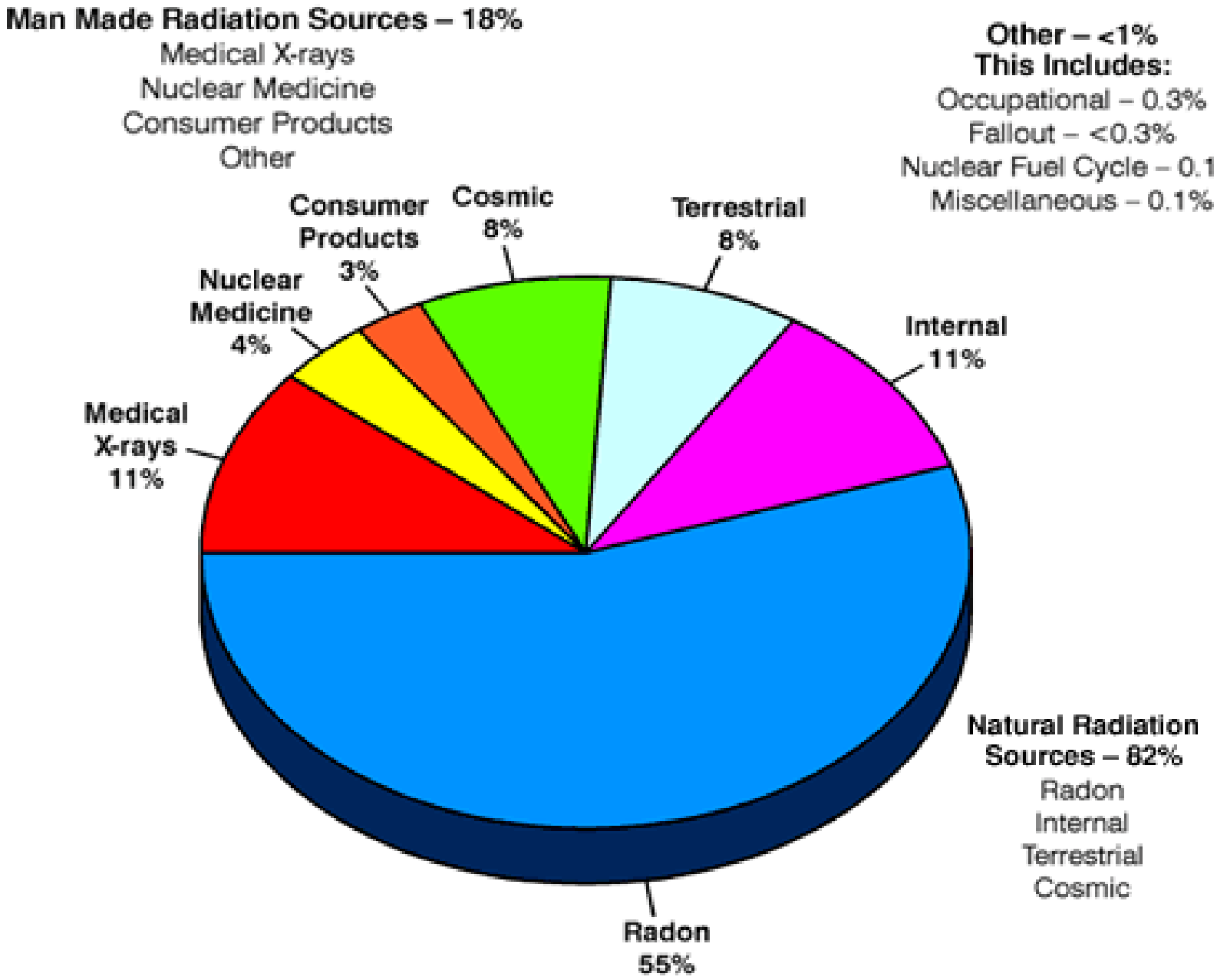
Classification
(International Agency for Research on Cancer)

'Known human carcinogen' or Group 1	Ionizing radiations
'Probable human carcinogen' or Group 2A	Ultraviolet radiations
'Possible human carcinogen' or Group 2B	Extremely low frequency magnetic fields
Not classifiable as to carcinogenicity to humans or Group 3	Static fields Extremely low frequency electric fields
Not evaluated for carcinogen potential	Intermediate frequencies Radio frequency fields Infra red radiations

Ionizing Radiation

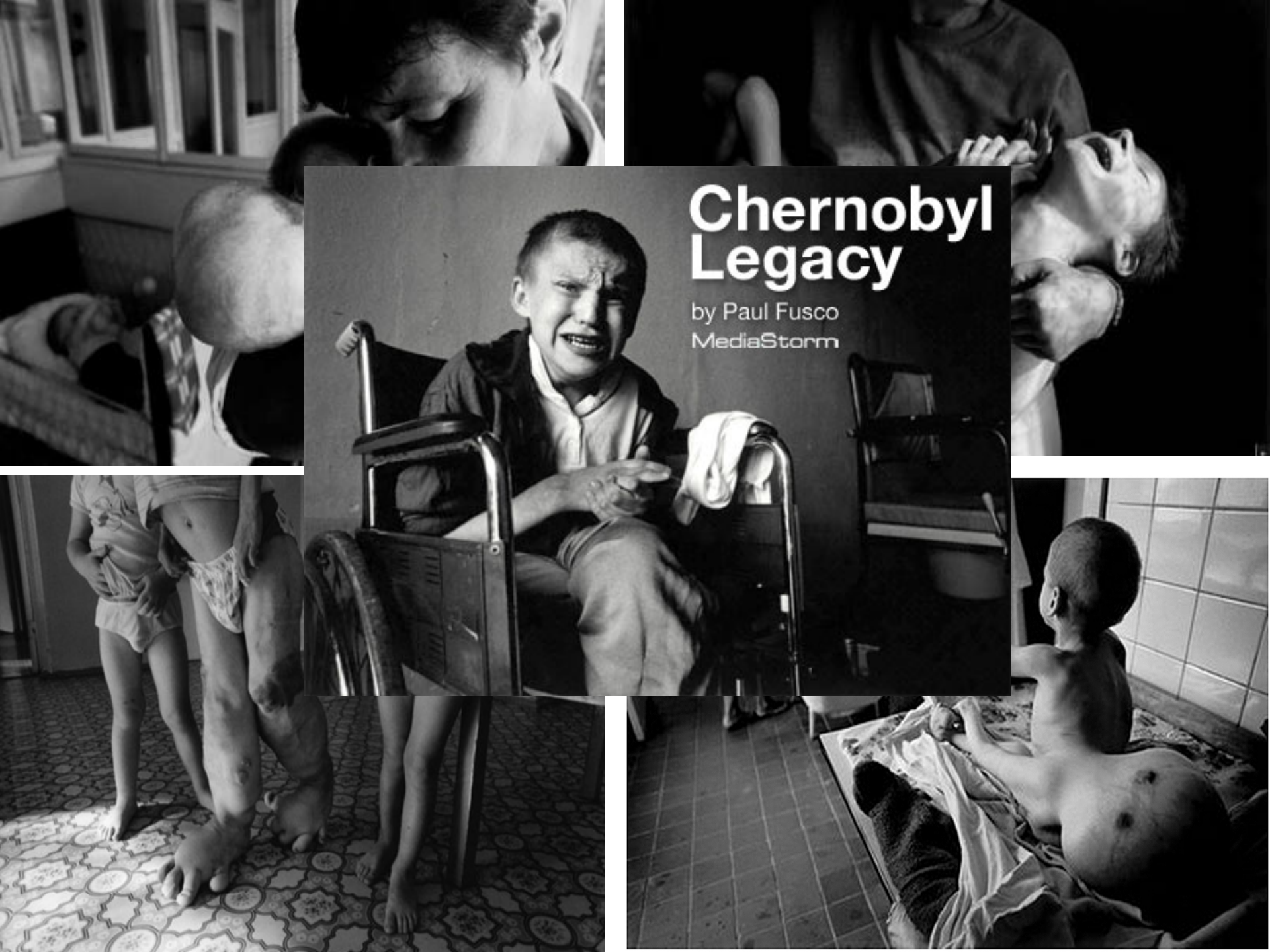
- Consists of electromagnetic radiation
  - e.g. X-ray, gamma ray
- Ionizing radiation exposure is measured as quantity of absorbed dose
- International System Unit: Gray (Gy)

Ionizing Radiation Exposure to the Public



Radiation effects

- Deterministic effects
  - Probability of causing harm is a function of the dose
- Stochastic effects
  - No threshold, and all or none rather than incremental
- Hereditary: When the damage occur to cell whose function is to transfer genetic information to later generations.


Chernobyl
Legacy
by Paul Fusco
MediaStorm

GLOBAL NUCLEAR INCIDENTS SINCE 1956

Source: International Atomic Energy Agency

- Risk vs. Benefits of the use of ionizing radiation in medicine

- Public concern about terrorist events
  - ‘Dirty bomb’ (technically known as Radiological Dispersion Bombs)

Ultraviolet Radiations

- Non-ionizing radiations
- UVA, UVB, UVC
- **Sources:**

➢ Direct exposure from sun

  ➢ Indirect exposure from reflection off any surface tends to have increased intensity

➢ Man-made sources:

  ➢ Occupational exposure to mercury vapour lamps, arc-welding, printing from finishing inks.;

  ➢ Cosmeticians use sunlamps and sun beds;

  ➢ Medical use in Phototherapy for Psoriasis.

Health effects

- Skin cancer (Melanoma)
  - 'Intermittent cancer hypothesis'
- Photokeratitis
- Conjunctivitis

- **Beneficial effects:**

➢ Enhances Vitamin D synthesis

➢ Immunosuppressive effect
  - Protection from Multiple sclerosis, Type 1 Diabetes, Rheumatoid arthritis

Radiofrequency Radiations

- Rapid advance in EMF technologies and communications.
- **Sources:** TV, radio, mobile phone base stations, mobile phones, Wi-Fi.
- Health effects ???

Radiation protection

- IAEA (International Atomic Energy Agency) and WHO
- Lead aprons 0.5 mm lead is a must
- Adequate control and surveillance of X ray installations
- Protection of workers
- Improvement in techniques and improvements leading to dose reduction

Thanks…

Light

- Good lighting is essential for effective vision
- Visual strain is a consequence of poor lighting
- The following factors are essential for efficient vision:
    - Sufficiency – illumination of 15 to 20 foot candles is necessary
    - Distribution – minimal contrast difference

- Absence of glare – glare causes annoyance and visual fatigue

- Absence of sharp shadows – shadows cause confusion and double vision

- Steadiness – there must be no flicker

- Light colour – must be as close to normal light colour

Light measurement units

Description	Units of measurement
Brightness	Candela
Flow of light	Lumen
Amount of light reaching surface	Lux
Amount of light remitted by surface	Lambert

Natural lighting

- Two sources
  - Visible sky
  - Reflection from objects

- Natural lighting depends upon the time of the day, season, weather pattern and atmospheric pollution

Improving day light illumination

- Following general principles are followed:
  - Orientation: better oriented towards north south
  - Removal of obstructions: most single effective intervention
  - Windows: window area is according to the use of the room. 10% criterion is outdated
  - Interiors of the room: ceiling must be white and the walls appropriately colored for adequate reflection of the light

Recommended illumination

- Casual reading 100 lux
- General office work 400 lux
- Fine assembly 900 lux
- Watch making 2000 lux

Biologic effects of light

- Body temperature
- Physical activity
- Activation of precursors of vit. D
- Adreno cortical secretion
- Food consumption
- In vitro degradation of bilirubin