Environmental Studies

(CE 155)

Power Point Presentations -April 2020

Prof. Mrs. Esi Awuah, Prof. Richard Buamah, Dr. Mrs. Helen Essandoh and Priscilla Addo

Learning Outcome

- **Students have a deep commitment to protect the environment for sustainable development.**
- **Student must understand**
- **The basic concepts of environment**
- **The laws of nature**
- Anthropogenic behaviours and impact on the environment
- Mitigative measures
- Have a desire to protect the environment for sustainability

UNITS

- The lectures have been divided into four units namely UNIT 1, 2, 3 and 4
- Each unit contains the the course content and there is assignment at the end for the student to work on
- Endeavour to do them since they give you the opportunity to assimilate and apply the course material to everyday life

Environmental Studies

- Also Looks at
  - Environmental problems
  - Solution to the environmental problem
  - Human impact on the environment
  - Effects of natural and unnatural processes
  - Interaction of the physical component of the planet on the environment

Environmental Studies

- An interdisciplinary field that includes both scientific and social aspects of human impact on the world.
- It involves an understanding of the scientific principles
- Their impacts
- Economic influences and political actions.

Course Outline

- Introduction to the environmental studies
- Structure of earth and the solar system
- Overview of Humans and nature

Components of the environment earth and the solar system

- Ethics and Sustainable development
- Environmental Resources
- Basic ecological concepts
- Matter and laws of energy
- Biogeochemical cycles
- Environmental crises
- Pollution and pollution control
- Contemporary environmental issues

UNIT 1 Overview of humans and nature

- Humans and Nature
- The Solar System
- The structure of the Sun
- The Electromagnetic spectrum
- Albedo and Emissivity
- Our Planet Earth
- Other planets
- Theory of Plate tectonics
- Earth’s Atmosphere
- Human societies and their impacts

HUMANS AND THE ENVIRONMENT

Humans and Nature an Overview

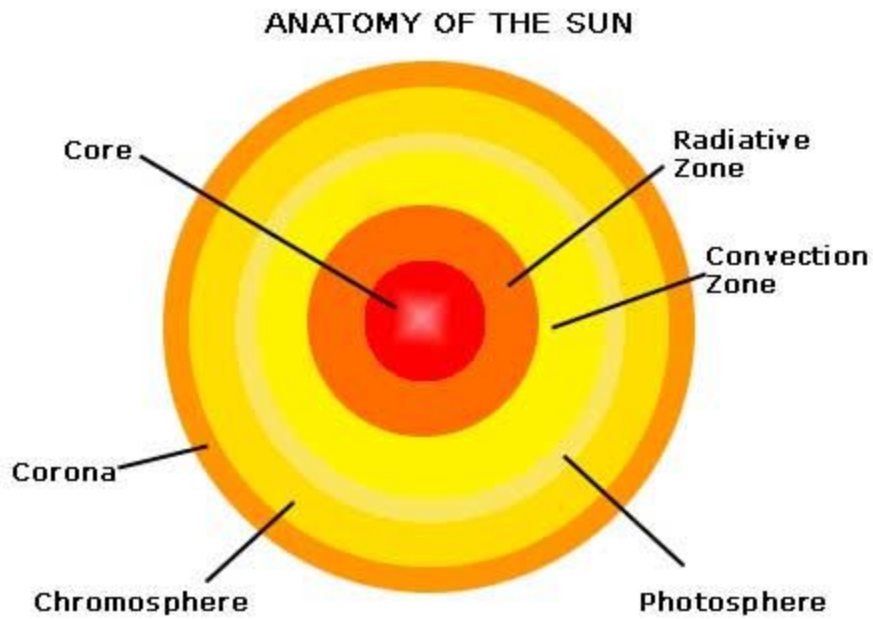
- Environmental Science is broadly the protection of the environment through the study of sciences including natural and social sciences.
- Management of the resources for sustainability is key component of this course.
- To study our immediate environment the Earth and its cosmic environment must be understood
- Earth revolves around the Sun and it is the only planet where life is found.
- Failure of man to fit into the delicate structure is what is causing the environmental problems

The Sun and Solar System

- Sun provides the earth with all the energy it needs
- Sun is one of the stars in the Milky Way Galaxy
- Hot gases make up the Sun; it is 1.35 million kilometres in diameter and 150 million kilometres from the Earth
- Observation and facts about the sun were studied through X-ray telescopes
- The Sun is a solar fusion reactor, which constantly converts Hydrogen atoms to produce Helium atoms
- The process involves a loss in mass, which is converted into energy in accordance with Einstein's law:

$\frac{1}{2}mc^2$= energy from the sun

Structure of the Sun



CORE

- Innermost part of the sun
- Temperature more than a 1,000,000 ˚C
- Cannot be seen

PHOTOSPHERE

- Is visible and it gives off light
- Average temperature is about 6,000 ˚C

CHROMOSPHERE

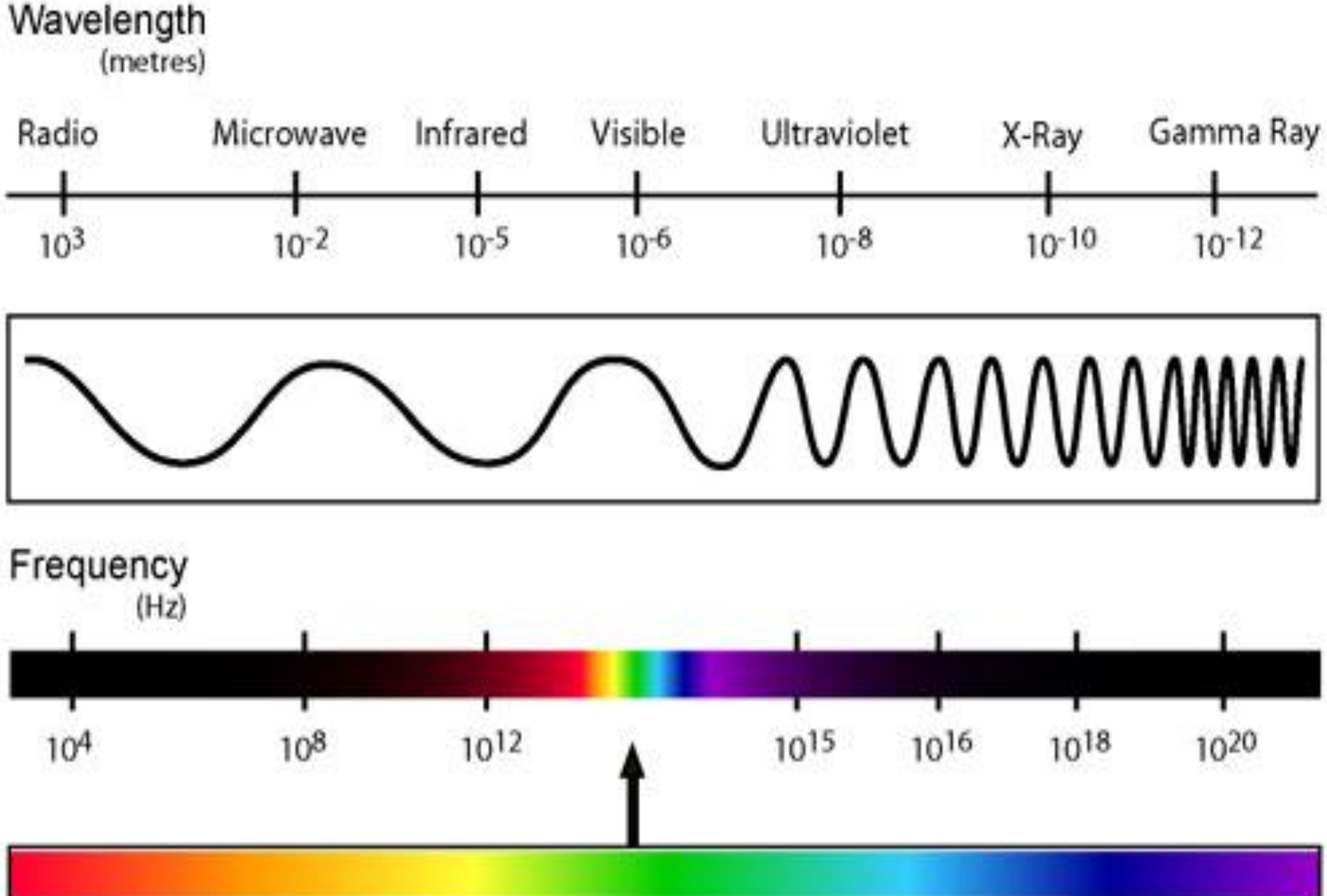
- Inner part of the sun’s atmosphere
- The red colour is caused by the glow of hydrogen
- The average temperature is 15,000 ˚C

- Chromosphere and Corona are visible only during a total solar eclipse
- The sun has cooler spots known as sun spots which appears dark
- The sun keeps the earth warm, gives it light and controls the weather
- It provides energy for photosynthesis, and provides vitamin D.
- Without the sun, the earth's atmospheric temperature would be about 38˚C less than what it is now

Solar Electromagnetic spectrum

- Gamma rays,
- x-ray, ultraviolet (UV rays)
- Visible Light rays
- Infrared
- Microwaves
- Radio waves

THE ELECTRO MAGNETIC SPECTRUM



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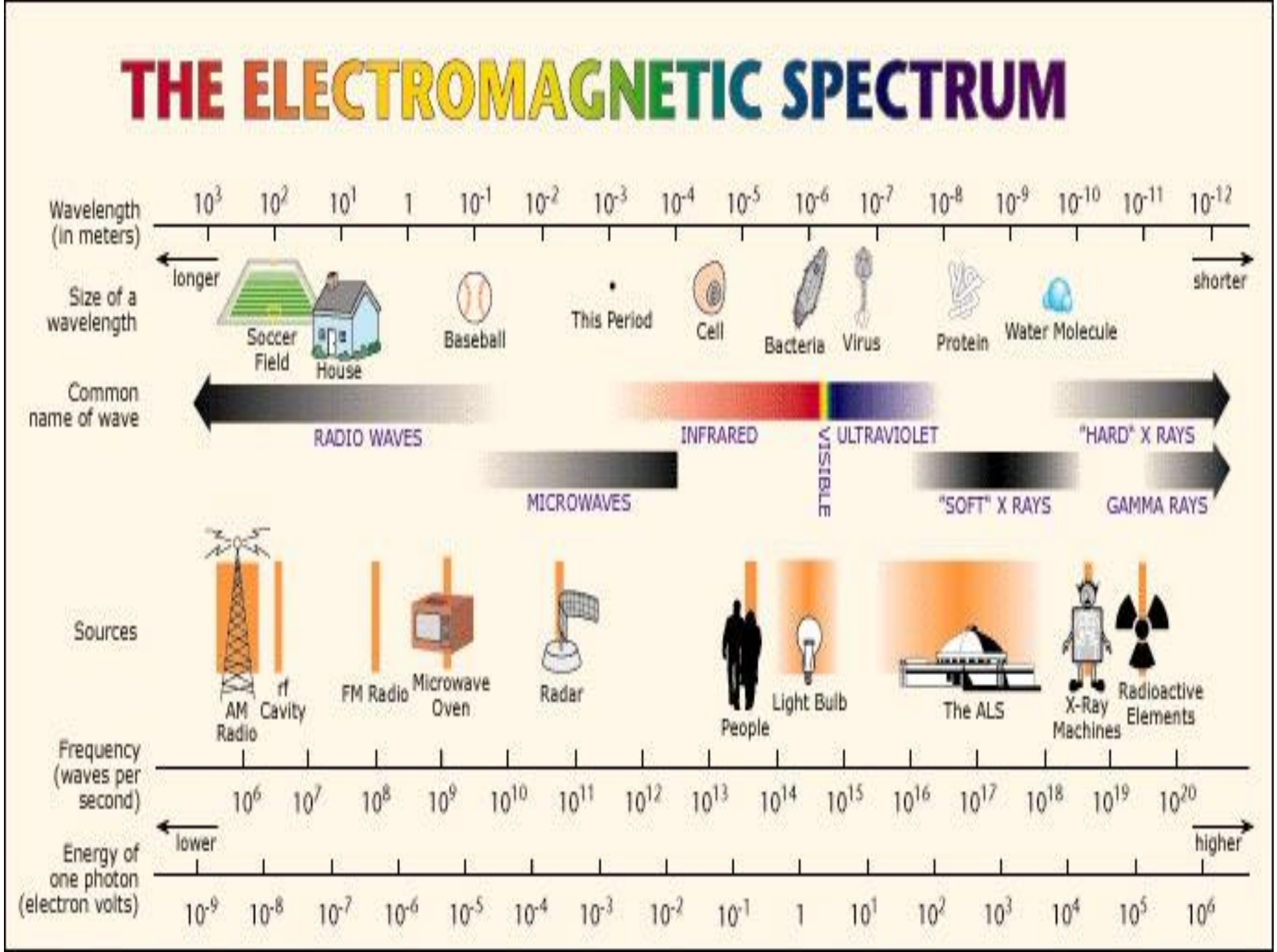

THE PLANETS

- A planet is a celestial body orbiting a star that is massive enough to be rounded by its own gravity, is not massive enough to cause thermonuclear fusion, and has cleared its neighbouring region of planetsimals (IAU, 2006)
- Become gravitationally dominant, and there are no other bodies of comparable size other than its own satellites or those otherwise under its gravitational influence
- There are 8 planets

Temperatures on other Planets and our Moon

Planet Mercury

- It is about 70m km from the sun and the nearest
- Has no atmosphere due to low gravity and high day time temperature
- Temperature during the day is 400^{o}C and at night

  -200^{o}C

Planet Venus

- It is 108 million km from the sun; has thin pale yellow clouds
- Atmosphere mainly $C0_2$ with 1 to 3% Nitrogen
- Has small amounts of helium, argon and water vapour and allows only 25% of the sun's rays to penetrate its surface and heat the rock.

Planet Mars

- About 249 million km from the sun
- Atmospheric daytime temperature ranges from 0^{o} to $27^{o}C$ because of its $C0_2$
- Night time temperature is about $-125^{o}C$ because of its thin atmosphere

Planet Jupiter

- More than 8 million km from the sun and has clouds
- Has hydrogen, helium and methane, water droplets and ammonia crystals in it's atmosphere; radiate more heat back into space than it get from the sun
- Cloud top temperature is about $-150^{o}C$.

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The Earth's Moon

- Has no atmosphere and therefore no weathering takes place
- No wind and erosion
- Temperature is 100^{o}C at daytime and -150^{o}C at night time

Our Planet Earth

- The planet earth is one of the 8 planets of the solar system; often called the living planet
- The earth is 12,800 km in diameter;
- Earth's atmosphere has large amounts of oxygen and water vapour; help to make life possible on earth
- Constantly revolves around the sun in an orbit once in 365 days in a year
- About 75% of the earth's surface is covered with water 97.1% of the water is Saline
- the remaining 2.9% are not available for use; tied in icecaps, glaciers and the atmosphere
- Only 0.32% of the world's water is available for use

Geologic Processes

Formerly the earth was thought of to be a stable unchanging mass but recent findings and research has shown that activities such as earthquakes, floods, tsunamis, volcanic eruptions and windstorms have been changing the surface of the places we live. Much of these activities cause large portions of the Earth surface (known as plates) to shift. The Earth comprise the crust, the mantle, inner and outer core. The crust is the outermost and superficial less dense but thin layer that covers a thick underlying layer called the mantle.

The mantle consist of an inner part and an outer portion that is adjacent to the crust. The crust together with the outer mantle is referred to as lithosphere. The inner mantle portion is a relatively thin layer known as asthenosphere. The asthenosphere is capable of plastic flow. Below the asthenosphere is a solid mass that forms the remaining part of the mantle. The central core consists primarily of iron and nickel and has a solid centre and liquid outer region.

The structure of the earth

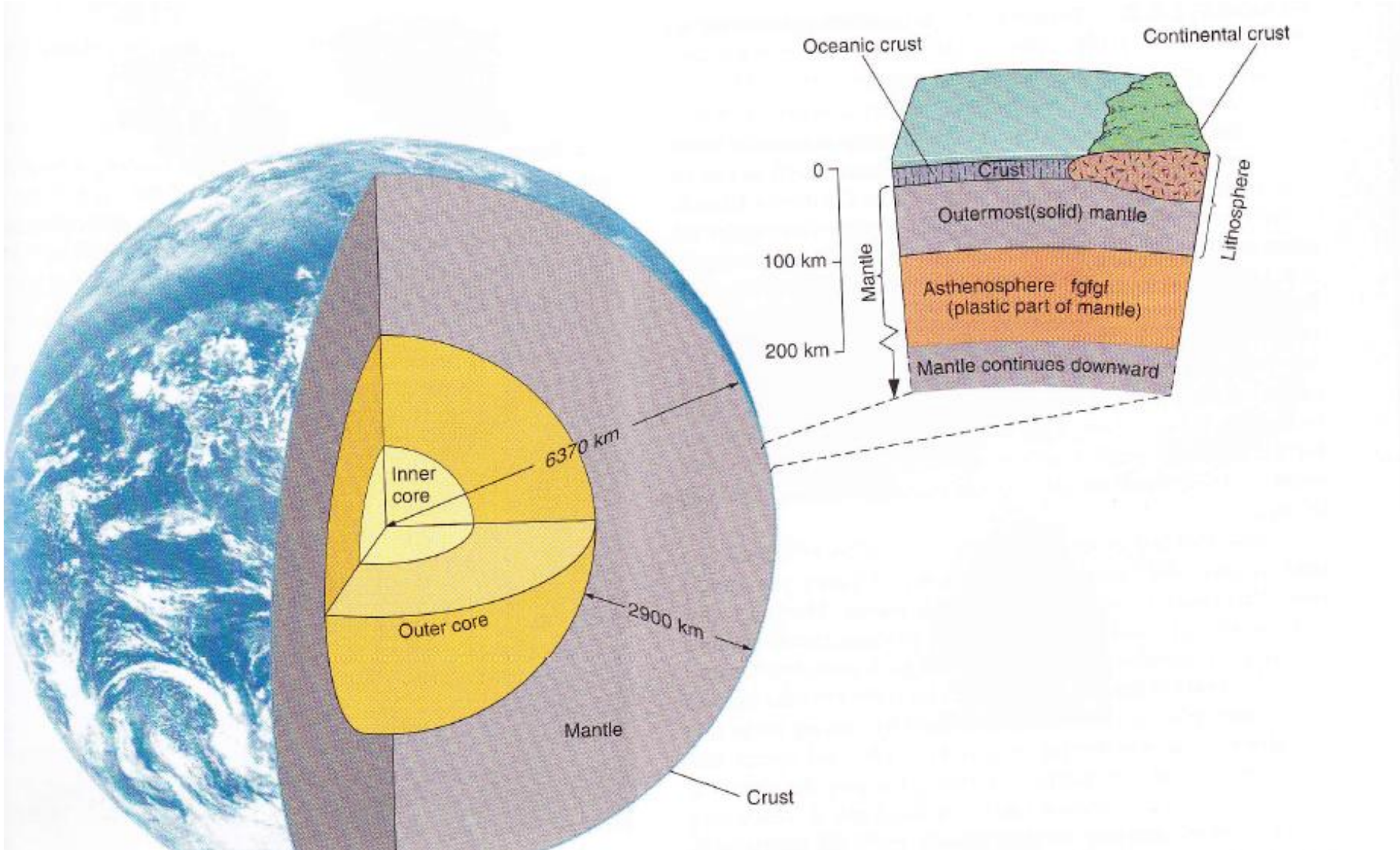


Plate Tectonics

The earth is made up of:

- Lithosphere (hard plate),
- Asthenosphere (hot gases and liquid)
- Innermost part (metal core)

❖Theory of Plate Tectonics begins with the idea that the crust (lithosphere) of the earth is made up of seven major plates and several smaller plates

- A scientific theory that describes the large scale motions of Earth's lithosphere

Plate Tectonics

The concept of plate tectonics indicates that the outer surface of the Earth consist of large plates composed of the crust the outer portion of the mantle and that these plates are slowly moving over the surface of the liquid outer mantle. The movements of the plates on the plastic outer layer of the mantle are independent of each other. Therefore, some of the plates are pulling apart from one another, while others are colliding. Where the plates are pulling apart from one another, the liquid mantle moves upward to fill the gap and solidifies. Thus new crust is formed from the liquid mantle. Approximately half of the Earth surface has been formed in this way in the past 200 million years. The bottom of the Atlantic and Pacific Oceans and Rift Valley and Red Sea of Africa are areas where this is occurring. Where

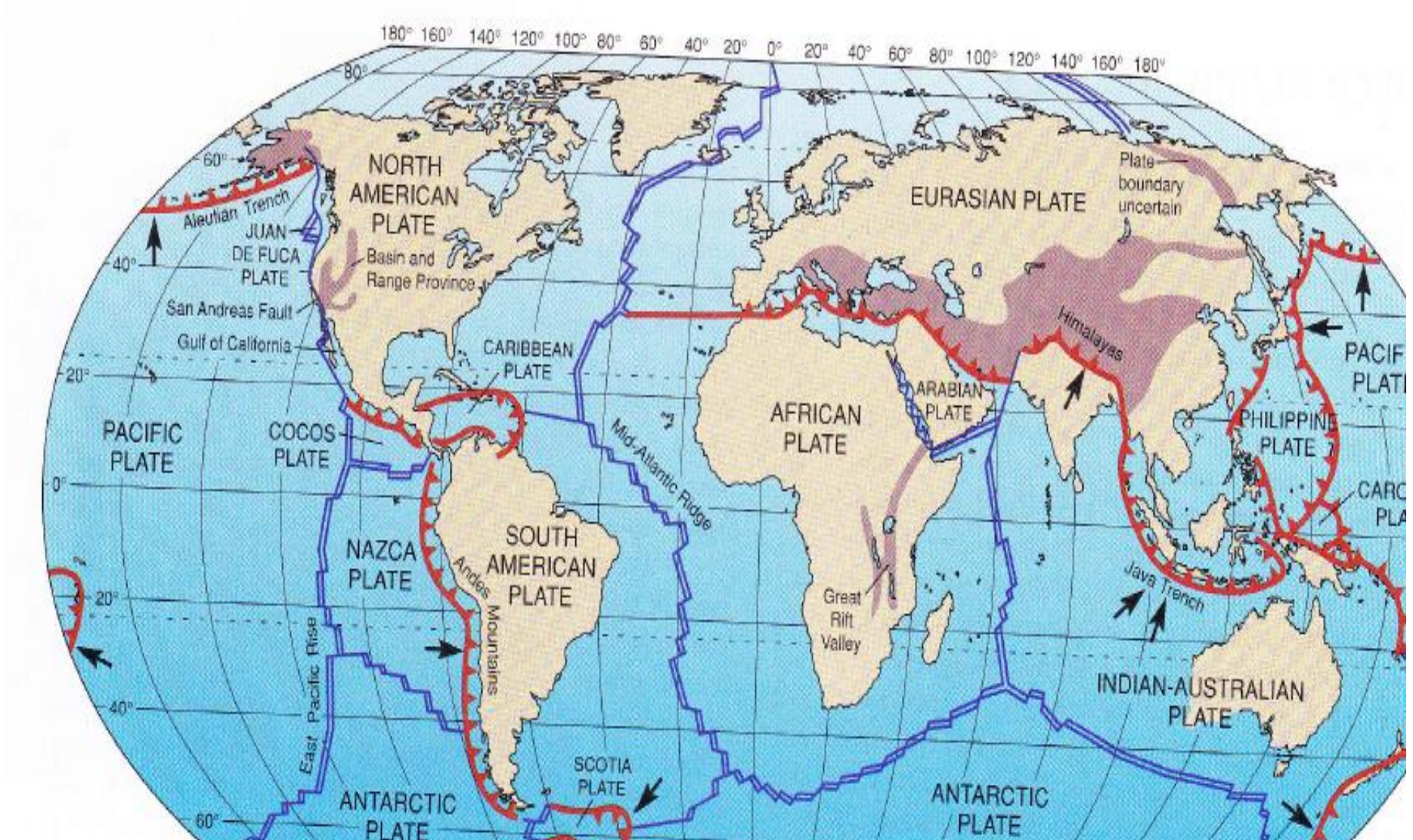
plates are pulling apart on one portion of the Earth, they must be colliding elsewhere. Where plates collide, several other things can happen. Often one of the plates slide under the other and is melted. Often when this occurs, some of the liquid mantle makes its way to the surface and volcanoes are formed that results in the formation of mountains. Volcanic activities add new material to the crust. When a collision occurs between two plates under the ocean, the volcanoes may eventually reach the surface and form a chain of volcanic islands, such as can be seen in the Caribbean Islands. Most of these movements are associated with earthquakes. The movements of the plates are slow and steady sliding movements but tend to occur in small jumps.

These building processes are counteracted by processes that tend to make the elevated surfaces lower. Gravity provides a force that tends to wear down the high places.

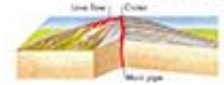
Seven major lithospheric plates:

- the Pacific,
- the North American,
- the South American,
- the Eurasian,
- the African,
- the Antarctic, and
- the Australian

Location of the Lithospheric plates

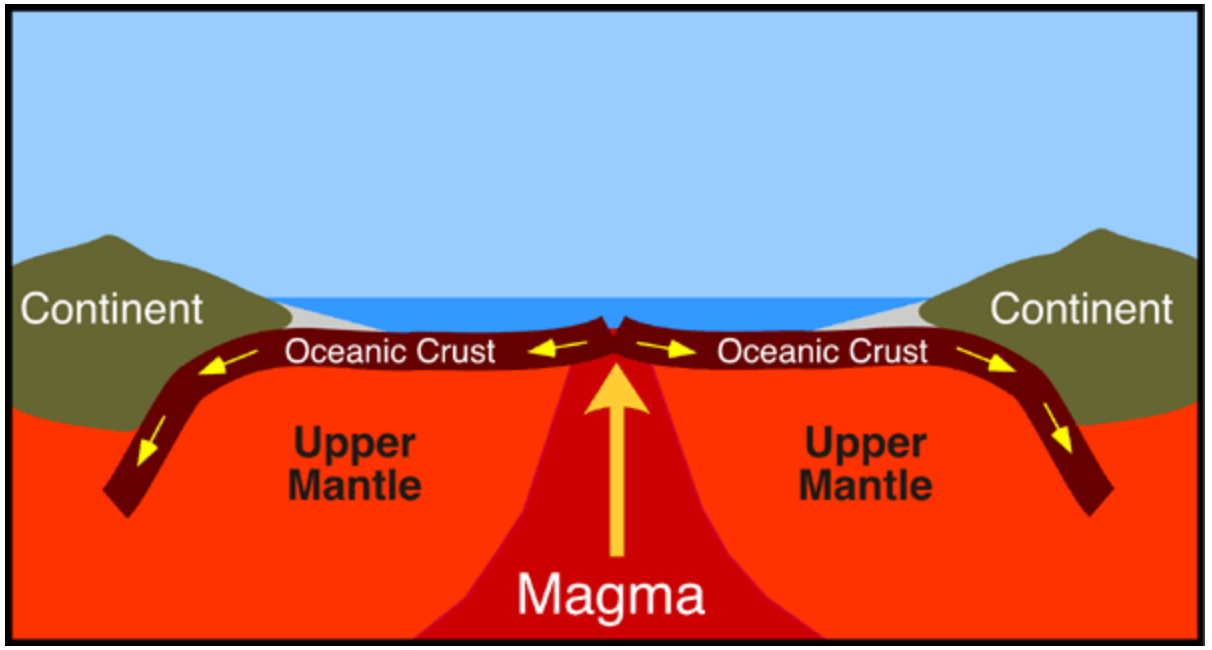


Natural Hazards 1 : Plate Tectonics



Ocean – Floor Spreading

Eruption of lava from between plates can cause:



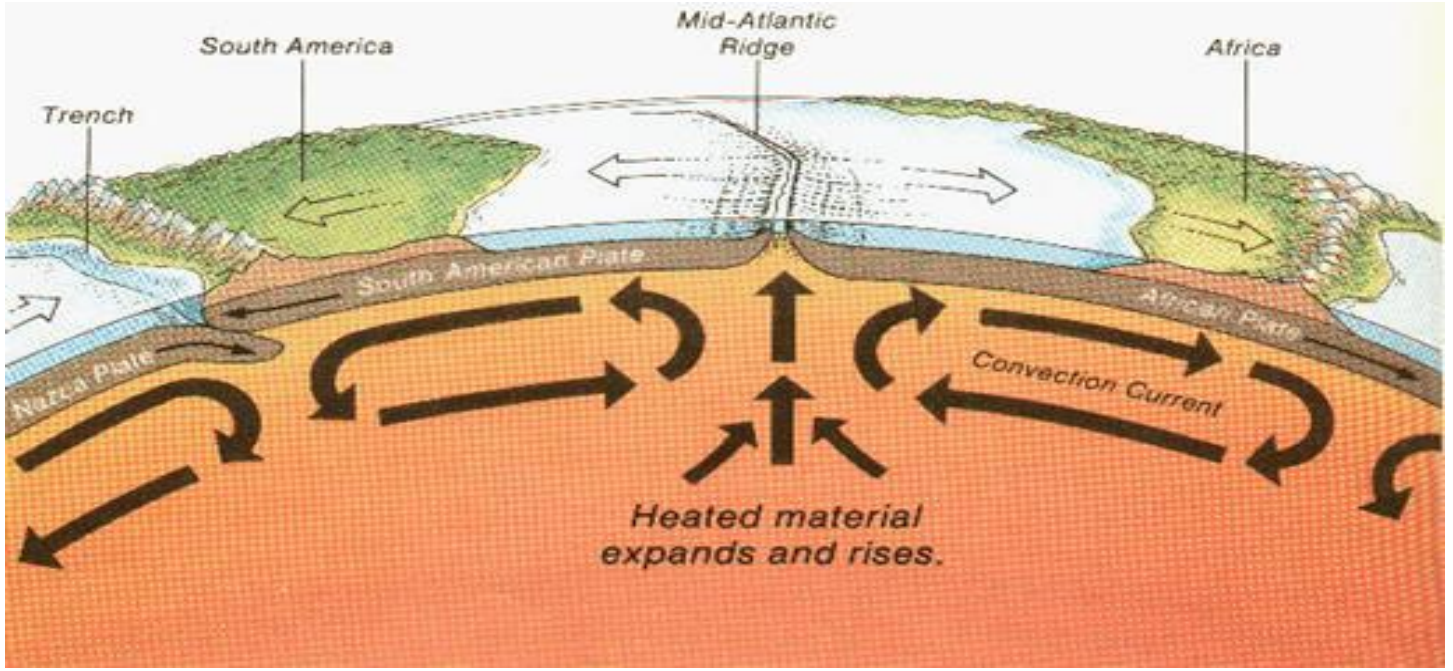
- the opposite edges of plates to be pushed down into the asthenosphere
- the process is called Ocean Floor Spreading

Continental Drift

Earlier theory by Wegener in 1900 postulated:

- that all the continents were once together and drifted apart

❖the theory of plate tectonics is key in the understanding of many natural occurrences like earthquakes in addition to ocean floor spreading and continental drift



Structure of Earth's atmosphere

The thin film of gas that surrounds the earth varies in structure as the distance increases outward from the surface. The earth's atmosphere is divided into regions based primarily on considerations of temperature as shown in the figure on the next slide. The temperature at the earth's surface varies from sub-zero °C (i.e. temperatures beneath zero; so it is a term normally used for negative number – temperature) in the polar regions and high mountains areas to highs of about 70°C in the arid desert regions.

The corresponding air temperatures close to the earth's surface (within a few metres) are lows of sub-zero and highs of about 50°C. In very warm areas, the air temperature is typically 10 to 20°C cooler than the hot surface temperatures. Typically, at mid latitudes the temperature falls with increasing altitude in the troposphere. This is known as positive lapse rate.

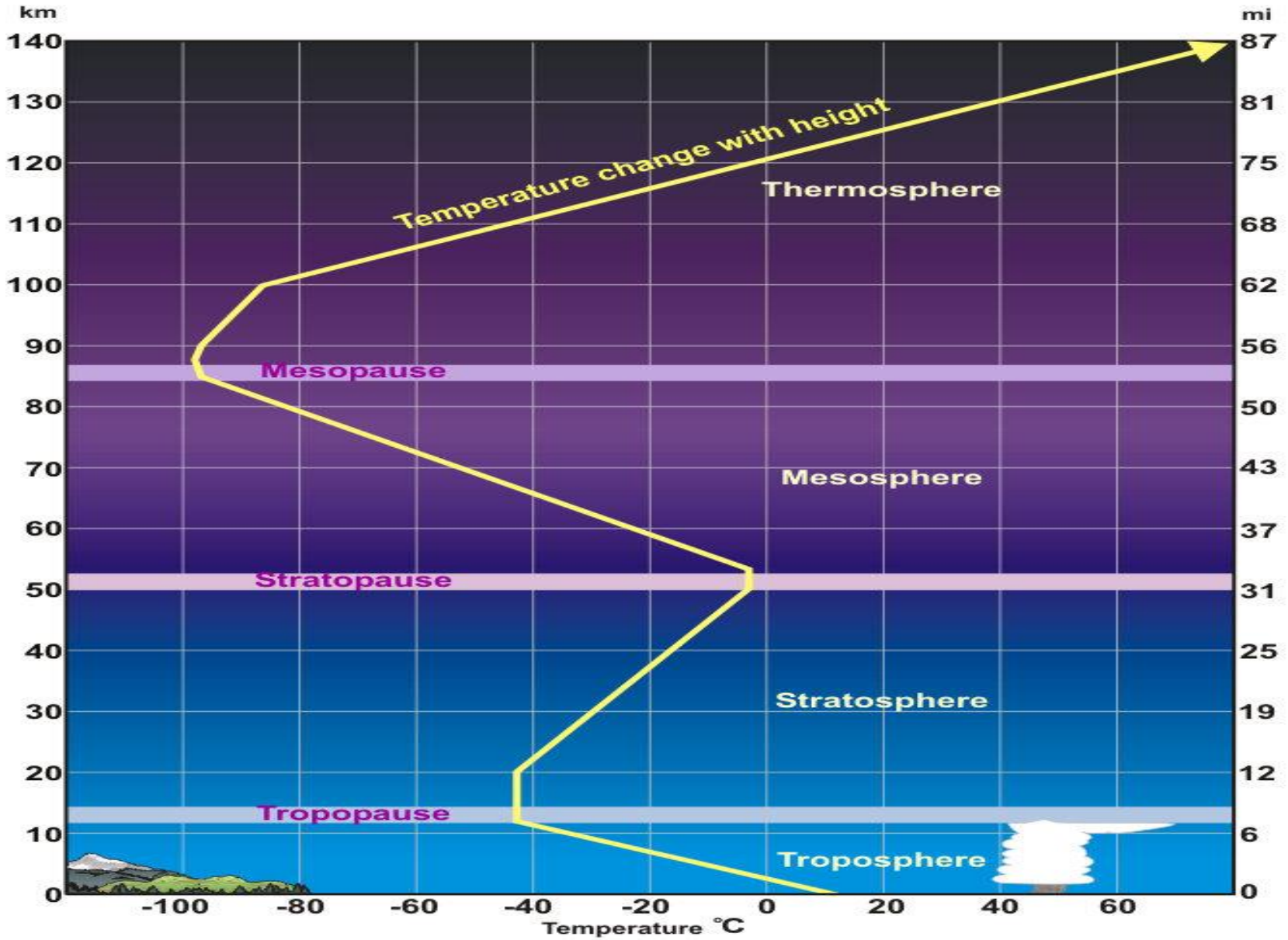
Composition and Structure of the Earth's Atmosphere

- Earth's atmosphere is divided into layers based on:

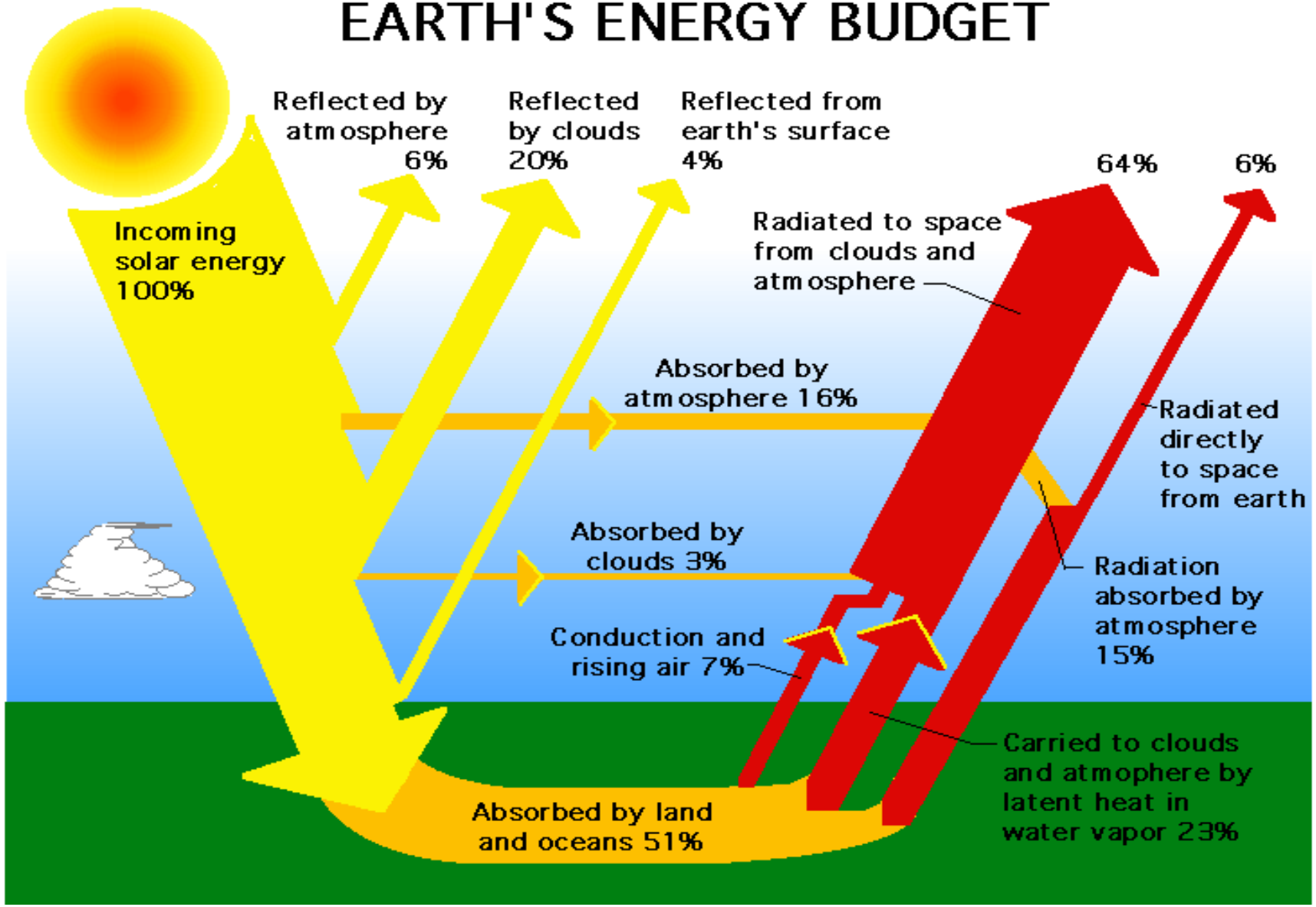
(A) Distance

- The Troposphere
- Stratosphere
- Mesosphere
- Thermosphere

The Temperature Profile of the Earth's Atmosphere



EARTH'S ENERGY BUDGET



Emissivity and Albedo

Albedo: Is the reflection of solar radiation back into the atmosphere

Emissivity: The total amount of heat flow into space

FACTORS AFFECTING EMISSIVITY

- H2O vapour [water vapour]
- CO [Carbon monoxide]
- CO2 [Carbon dioxide]
- CH4 [methane]

(B) Gaseous Composition

- Nitrogen 78.00%
- Oxygen 21.00%
- Argon 1.00%
- Carbon dioxide 0.03%

Within the ABL the average percentage chemical composition of the air is as follows:

		%
Nitrogen (N_2)		78
Oxygen (O_2)		21
Argon (Ar)		0.9
Carbon dioxide (CO_2)		0.03
Neon (Ne)		0.0018
Helium (He)		0.00052
CH_4		0.00022
Krypton (Kr)		0.0001
Di-nitrogen oxide (N_2O)	0.0001	
Hydrogen (H_2)	5.0×10^{-5}	
Xenon (Xe)		8.0×10^{-6}
Ozone (O_3)		2.0×10^{-6}
Ammonia (NH_3)	6.0×10^{-7}	
Nitrogen dioxide (NO_2)	1.0×10^{-7}	
Nitrous oxide (NO)		6.0×10^{-8}
Sulphur dioxide (SO_2)	2.0×10^{-8}	
Hydrogen sulphide (H_2S)	2.0×10^{-8}	

How has man survived on the planet for the last hundred thousand years

- Learning to co-operate with each other and the environment through effective social organization
- Using Language to increase the efficiency of co-operation and survival experiences
- Belief in A supreme Being to rely on in difficult and good times
- Learning to use tools and for hunting, food gathering and cooking and protective clothing

Human Societies and Their Impacts on the Environment

1. Early Hunter Gatherers :

- Nature controlled them
- Material possession was minimal
- Used crude tools
- Cooperation and sharing of resources
- Survival was based on ecological wisdom
- Effective social organization
- Belief in a supreme Being as the Creator

2. Advanced Hunter Gatherers :

- Had affluent life styles

- Fire for hunting and stone axes were made
- Fire destroyed their local environment
- Survival was also based on ecological wisdom
- Nature controlled this society as well

Agricultural Society :

- Learned to use fire to clear land and practiced monocropping
- They became shepherds of large flock
- Landscape was changed dramatically
- Plant and animal diseases (Pests)
- Communicable diseases in man
- Water pollution
- Fought for land and water

Industrial Society :

- Machines were made to manufacture goods and in agriculture
- Synthetic products to mimic natural things
- Water and Air pollution (acid rain)

Computer and Robotics Age :

- Fast transfer of information
- Rapid production, improvement and efficiency of delivery in the manufacturing industry
- Health problems which includes blood pressure, diabetes etc
- Increased organised crime

Industrial Society :

- Machines were made to manufacture goods and provide services in agriculture
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- Water and Air pollution (acid rain)

Computer and Robotics Age :

- Fast transfer of information
- Rapid production, improvement and efficiency of delivery in the manufacturing industry
- Health problems which includes blood pressure, diabetes etc
- Increased organised crime

Nano age

Medical breakthroughs , communication, other impacts not yet known

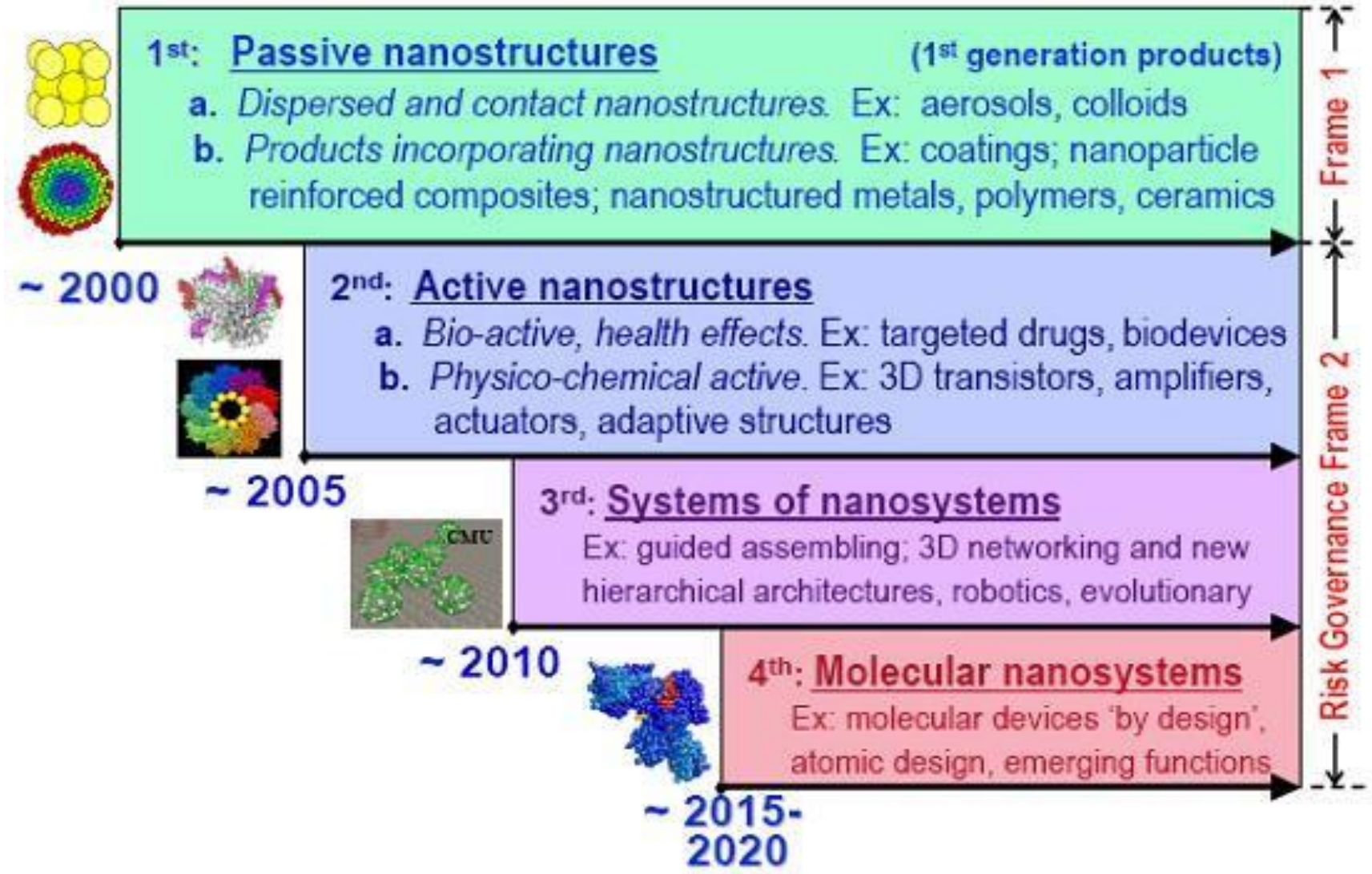
Nanotechnology

- This is the engineering of functional systems at the molecular and atomic level.
- It makes most products
  - lighter
  - stronger
  - cleaner
  - cheaper and less expensive.
  - Utilise less quantity of resources

  More organised crime, Genetically modified foods, more air pollution problems

  Holograms using light interference pattern to produce three dimensional images. This new technology is going to produce another society of its own

Nano structures



Human activities contribute heat to our environment

- Use of air condition in a house
- Use of washing machine
- Use of microwave oven
- Travels by any means using fossil fuel
- Cooking
- As more people live on earth they must be fed and clothed and all the activities to keep them alive produces heat which is increasing the temperature in the earth's atmosphere.
- Because with increase in population means increase in resource use and this is also becoming and issue to deal with
- Man has really had significant impact on the environment and he is having back lash

Natural resources in danger

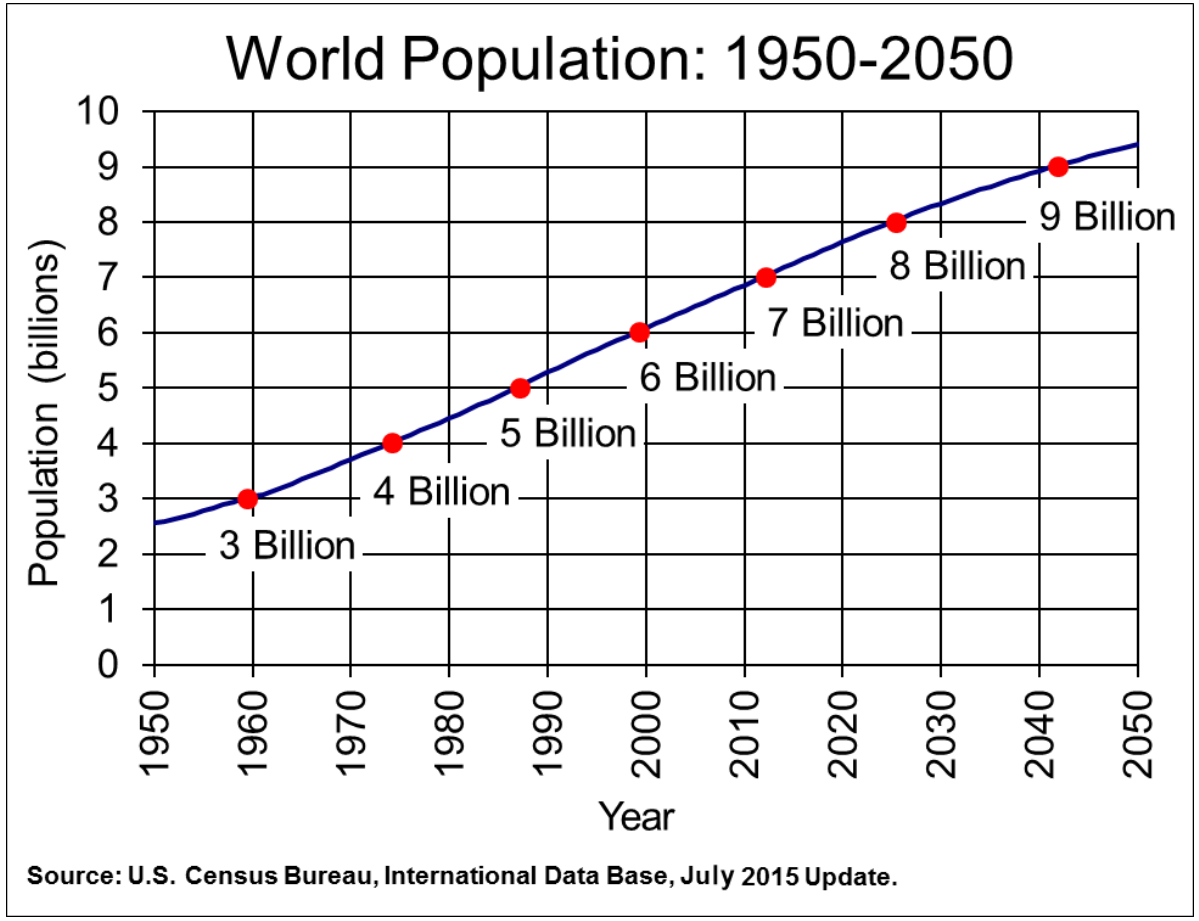
Resource: Anything needed by an organism or ecosystem

1. Renewable resources: Can theoretically last for ever
2. Non renewable resources : Can be depleted over a relatively short period of time, further recovery is impossible or expensive

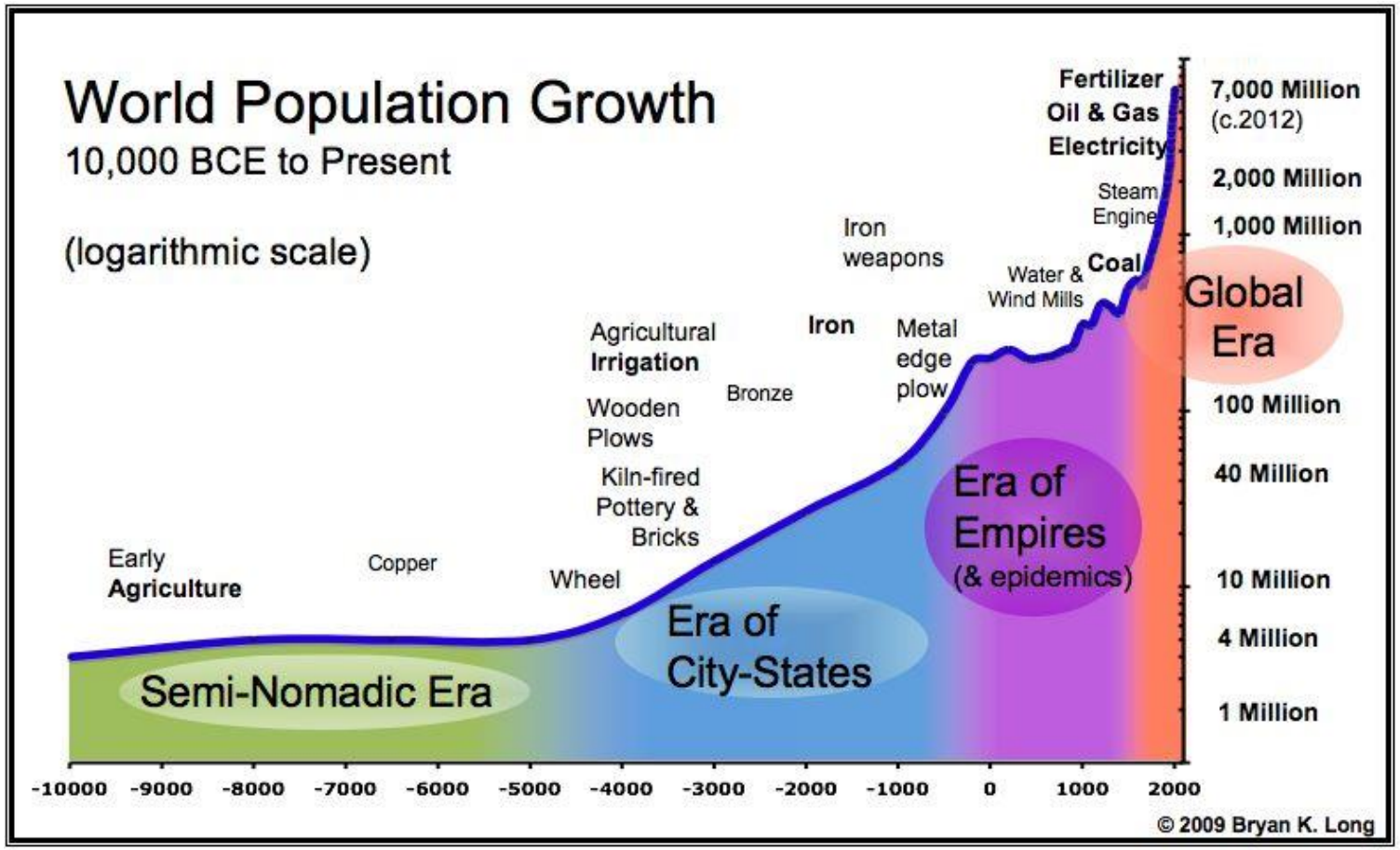
Population growth crises

- Population growth is the increase in the number of individuals in a population. Global human population growth amounts to around 83 million annually, or 1.1% per year. The global population has grown from 1 billion in 1800 to 7.774 billion in 2020. It is expected to keep growing, and estimates have put the total population at 8.6 billion by mid-2030, 9.8 billion by mid-2050 and 11.2 billion by 2100. Many nations with rapid population growth have low standards of living, whereas many nations with high standard of living as low population growth

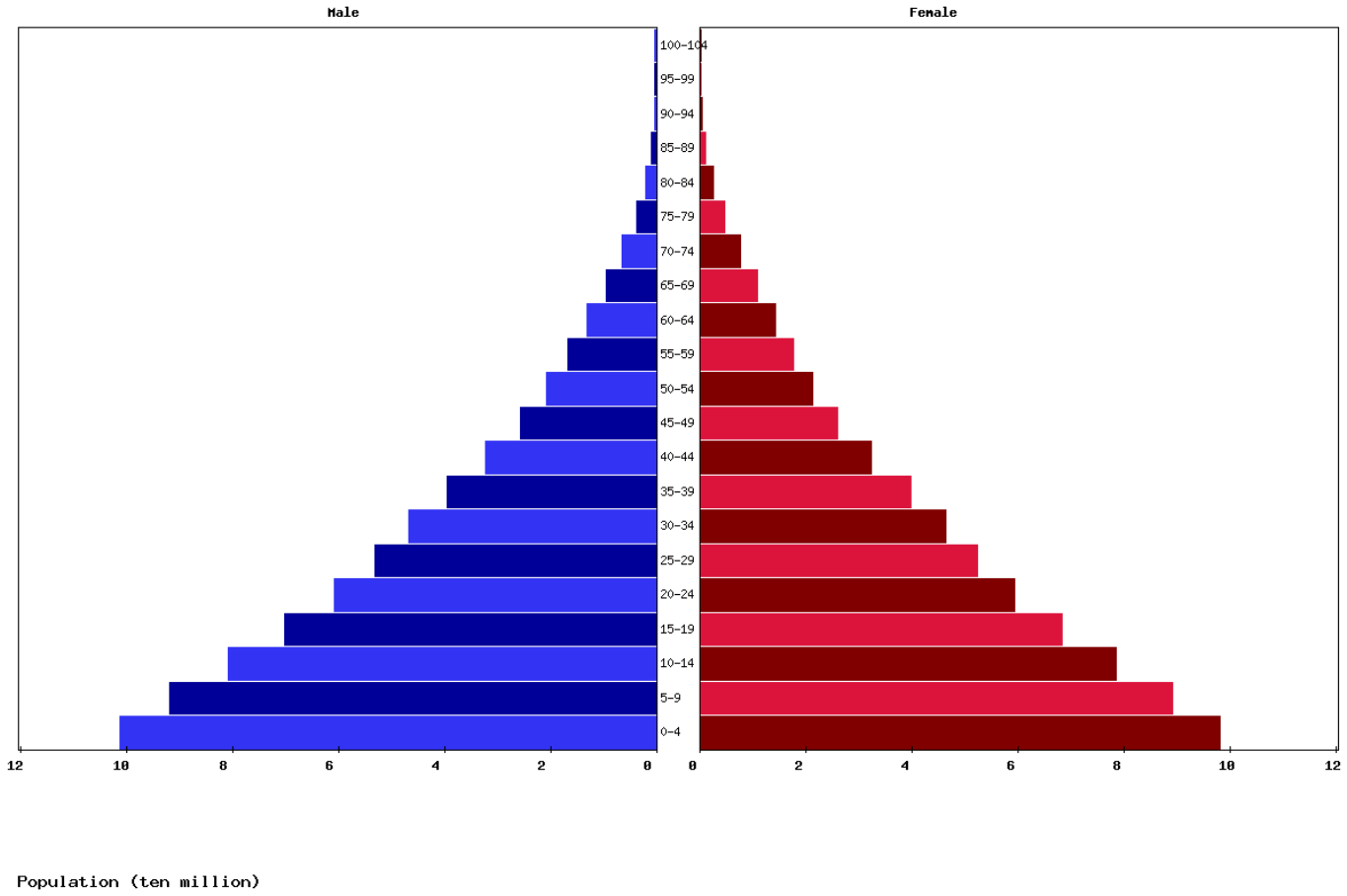
World population predictions



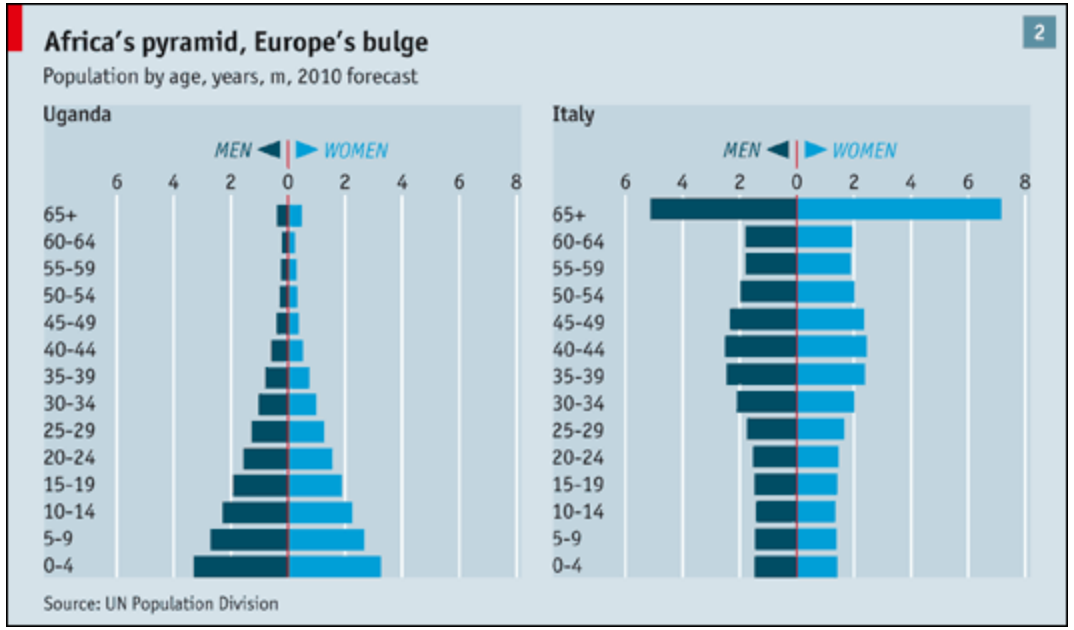
World population growth to present



Africa population pyramid



Comparison of population pyramids



Definitions in population studies

- Growth rate -No of population increase within a year and is measured as no of birth minus the number of death.
- Crude birth rate –child births per 1000 population in a year
- Crude death rate- No of death per 1000 people in a year
- Fecundity – No of offsprings one female can have under ideal conditions or as it exists in a particular community
- Real population growth rate takes care of immigration and migration within the year also into consideration

Population versus resources

1. FACTORS INFLUENCING POPULATION GROWTH:

- Birth
- Immigration
- Food availabilty

2. FACTORS LIMITING POPULATION GROWTH

- Emigration
- Education
- Diseases

❖ If resources that support a population are depleted, this population could become extinct.

Calculations for population growth

Population Growth Math

- Change in population = Births – Deaths
- Per capita birth rate = b
- Per capita death rate = d
- # of individuals = N
- Rate of population growth (r) = b – d
- Survivorship = % surviving

Ex: If there are 50 deer in a population, 13 die and 27 are born the next month. What is the population size the following month?

- *(Answer: 27-13 = 14, so new population is 64)*

Ex: What is the birth rate for the deer? #Births/N = b

- *Answer: 27/50 = .54*
- *Death rate (d) = 13/50 = .26*

Ex: What is the rate of growth for the deer? r = .54 -.26 = .28

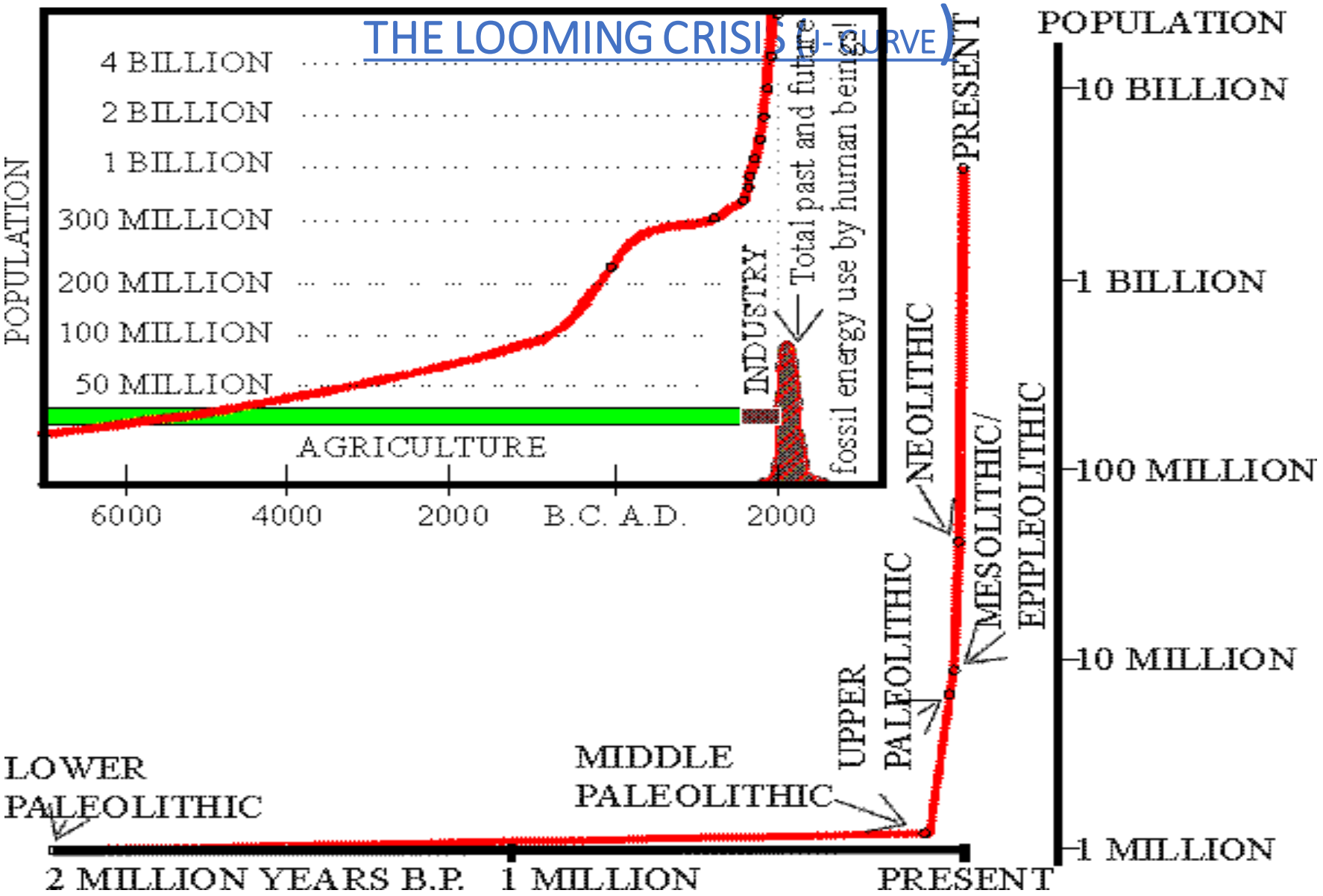
The Earth’s carrying capacity

- Carrying capacity is the maximum number of a species an environment can support indefinitely. Every species has a carrying capacity, even humans. However, it is very difficult for ecologists to calculate human carrying capacity. Humans are a complex species.
- Hunter gatherers' life style could support only 100 million
- Some experts are saying it is 40-50billion
- What will happened when we reach the earth’s carrying capacity?
  - Increase in crime
  - Hunger
  - Pandemics
  - Wars
  - Natural disasters

Assignment 1

- Using the population growth pyramids of Italy and Uganda, explain why the death toll of ITALY was very high if the disease affect the aged in the community?
- What is the most important thing to prepare for as population increases?
- Has KNUST reached its carrying capacity?
- Suggest ideas and plans to avert the situation?
- What are major impacts the agricultural society had on the environment?

THE LOOMING CRISIS (J-CURVE)



Resource use and distribution has major impacts on the environments

- Understanding resources within our environment
- How human activities affect the quality, composition, constitution of these resources.
- What is a resource?

Resource

- Any physical or virtual entity of limited availability or anything used to help one earn a living.
- Anything needed by an organism or living things, a population or the ecosystem

Two divisions

■Natural Resources

■Human Resources

Natural Resources

- These are basically derived from the natural environment.

Natural Resources

Natural resources may be classified based upon

- **Origin**
- **Stage of development**
- **Renewability**

Origin

Biotic and Abiotic

Biotic – living things and materials derived from them e.g. Forest, animals, birds and their products

Abiotic – Non living resources e.g. land, water, air, minerals etc.

Stage of development

Potential resources

Actual resources

Potential resources are;

- Those that exist in a particular region
- Their quantity are not known
- May be exploited and may be used in the future
- Eg. minerals may exist but if it has not be drilled and put to use, it remains potential
- High speed winds(some 200yrs ago)

Actual resources

- Resources that have been surveyed.
- Their quantity and quality have been determined
- They being put to use in the present times
- Eg. Water, coal, petroleum

Renewability

Renewable and the non-renewable resources

Renewable

They can be used repeatedly

Replaced naturally.

e.g.. the sun, plants and animals, fresh air, fertile soil, fresh water, energy from the sun and wind tides.

Non renewable sources

- Can be depleted after a period of time of exploitation.
- Recovery may be expensive and may be impossible e.g..
- **metallic** minerals e.g. gold, iron, copper, tin etc.
- **Non-metallic e.g. fossil fuel, clay, sand, salt phosphates etc.**

Renewable and Non-renewable

- Renewable resources can become non -

renewable resources.

- if they are used at a faster rate than they can be replenished.
- Some animal and plant spp. have become extinct because the rate at which they are being utilised is faster than being replaced naturally

The world is running out of resources e.g..

Fossil fuels - 50 yrs

Pb, Sn, Cu, Ag, Hg – 2000 – 2040. etc

Mitigation Measures for resource use control

The 4Rs

Recovery

Recycle

Reuse

Reduction in consumption

- More devised technologies to recover more

minerals from used ores;

- Alternative method or alternative materials for same purpose that a mineral or a particular resource is used.

THE ENVIRONMENT

1. The totality of influences acting upon an organism from without
2. The sum total of external conditions and influences affecting the development and life of an organism.
3. It is the aggregate of all natural and operational or other conditions that affects operation of equipment or components
4. Sum total of all external influence acting on the organism or on part of the organism
5. Is the aggregation of all conditions and the influence that determines the behave of a physical system

The Environment

- Physicochemical
- Factors are physical and chemical conditions
- Abiotic factors that affect the **environment**
- Examples of **physicochemical** factors are: Temperature, relative humidity, light intensity etc

The Environment

- Cultural: history (beliefs), attitudes and practices
- Socio-economic: population, economy, infrastructure

Environmental Ethics

- The Ethics is a branch of philosophy that seeks to define

what is right and what is wrong.

- The laws of any nation should match the ethical commitment of those living there.
- Not every action that is ethically right can have a law supporting it.
- E.g. 1) Not urinating/defecating in unauthorised place
- 2) Throwing rubbish in drains
- 3) Littering the street

Goal of environmental ethics

- The goal of environmental ethics is not just
- To convince people to be concerned about the environment but;
- To focus on the moral foundation of environmental responsibility.
- How far this responsibility extends

Environmental Ethics Theories

- Three primary theories on moral responsibilities in relation to the environment.
- They include:

1) Anthropocentrism or human centred ethics
2) Biocentrism or life centred environmental ethics
3) Ecocentrism

Anthropocentrism

Anthropocentrism has the view that all environmental responsibility is derived from human interest alone.

It assumes that only humans are morally significant and have direct moral standing.

- In this view the adage is ‘protect when it benefits humans’. This view is flawed in the sense that ;
- The Earth remains environmentally hospitable for supporting human life
- It remains a pleasant place for humans to live now and for the future.

Environmental Ethics

- In this view the adage is ‘protect when it benefits humans’. This view is flawed in the sense that ;
- The Earth remains environmentally hospitable for supporting human life
- It remains a pleasant place for humans to live now and for the future.

Biocentrism

- Biocentrism or life centred environmental ethics
- According to this theory all forms of life

Humans

animals

Plants

microorganisms etc.

- Have an inherent right to life.

Ecocentrism

- This approach / theory maintains that the entire environment deserves direct moral consideration.
- Not consideration that is derived merely from human or animal interests.
- In this regard everything existing on the Earth should have the same right to life as any other.

Environmental Ethics and Sustainable Development

Generally our attitudes or approaches to the environment must evolve round

- Development
- Preservation or
- Conservation.

For this to occur; our development should be sustainable.

Sustainable development (SD)

- SD is often defined as ‘meeting the needs of current

generations without compromising the ability of future

generations to meet theirs’.

- SD focuses on the promotion of appropriate development to reduce poverty while still preserving the ecological health of the landscape.

Environmental Ethics and Sustainable Development

- SD hinges on three pillars namely: Economic development,
  Social development and
  Environmental protection.

❖At times consideration is given to cultural development as well.

Environmental Engineering

Basically the application of theories of science and material forces to confront ecological and socio-economic problems so as to reduce pollution, contamination and deterioration of the surroundings in which humans live.

Environmental Engineering involves control of water, soil and atmospheric pollution and the social and environmental impact of planned projects.

Environmental Engineering ensures the following:

- Provision of safe water
- The proper disposal or recycling of urban rural waste
- The control of water, soil and atmospheric pollution
- The elimination of industrial and health hazards
- Provision of adequate sanitation in urban, rural and recreational areas

THE ENVIRONMENT

What Environment Is

- The sum total of external influences acting on an organism or on part of an organism

Some Terminologies Relating To Environment Studies

- Environmental Control Systems (Engineering)

the system provides the occupants with a suitably controlled atmosphere to permit them to live and work in the area.

- Environmental Engineering
- EIA etc

What Environmental Engineering Is

- The provision of solution of problems of environmental sanitation,
- including water and wastewater treatment to maintain good quality water,
- Clean contaminated Soils,
- Reduce Atmospheric pollution, and assess the
- Social and environmental impact of these solutions and developmental projects such as bridges, road construction, provision of electricity for communities

Engineering Ethics And The Environment

❖**Environmental ethics deals with:**

- the attitude of people towards other living things and towards the natural environment and engineers must have positive attitude toward the protection of the environment in their designs and operation of their systems

Assignment 2

- We are running out of resources. What practical ways would you recommend for packaging of milk and other canned foods?
- What are Four Rs?
- What are pillars of sustainable development?
- Name the three theories of environmental ethics?
- Calculate the population of Kumasi for 2021 if the growth rate is 3% per annum and death rate is 1%. The impact of the opening of the borders to other Ecowas countries brings in 4% of immigrants from neighbouring countries. Residents leaving the Kumasi for greener pastures is also 0.05%
- What do environmental engineers do? (slides of this have been highlighted with more than two slides take note)