Environmental Philosophies

a. Technocentric/ Anthropocentric (intervening or manipulative):
    a. Anthropocentric: people centered attitude changing
        i. People can manage environment in a sustainable manner
        ii. Regulation used to prevent environmental damage
        iii. Educational tools to promote sustainable behavior
        iv. Population control as important as use of resource control
        v. Community participation is important to ensure sustainability

Example of solutions:

- Agreement on use of natural resources
- Giving legal rights to people to raise awareness of environmental importance
- Strong regulations by government (Acid rain Program of USA/ carbon taxes)
- Offer compensation to those affected by pro-sustainability regulations

    b. Technocentrism: technology centered
        i. Trust science and technology to provide solutions to environmental problems
        ii. Seek for scientific understanding of issues rather than socio-economic or political point of view
        iii. Technological evaluations done by experts (doesn't need community participation)

Example of solutions:

- Technological solution to environmental degradation through substitution/non-polluting solutions
- Transnational corporations of sustainable development

b. human-centered – humans as dominant species and thus we can manage environment to suit our needs, nature is there to benefit humankind

- curnocopians:
    - o world resources benefit humanity
    - o through technology, solve environmental problem and continually improve living standards
    - o growth matters more (free market economy)
- Environmental managers: sees the earth as a garden, there are problems and we need governments to legislate to protect environment from overexploitation. **Look after earth, it looks after us**.

b. Ecocentric: earth-centred (**nurturing)**– respects the rights of nature and the dependence of humans on nature

- soft technologists: self-reliant – believe the importance of local actions to make a difference
- deep ecologists: more value on nature than humanity (existence of **biorights**, rights for all species and ecosystems)

c. Biocentric (life-centred): all life has inherent value, not always for humans

d. Anthropocentric: we consider environment importance but believes on the ability of our institutions to adapt to environmental demands and changes to reduce resources use

SYSTEM AND MODELS

system: an assemblage of parts and their relationship forming a functioning entirety or whole

open system: a system where matter and energy is exchanged with its surroundings (example: natural ecosystems)
closed system: a system where **energy is exchanged** but not matter with its surroundings (example: space (radiation from sun with longwave radiation from earth))
isolated system: a system that exchanges neither matter nor energy with its environment (example: nothing natural)

Law of thermodynamics:
first: energy is neither created nor destroyed, therefore in an isolated system such as this universe, the total energy is constant.
second: entropy (def: dispersal of energy) of an isolated system not in equilibrium will tend to increase over time.
what it means: energy conversions from one trophic level to another are never 100% efficient (existence of **waste heat**)
calculation: energy = work +heat (and other wasted energy)

equilibrium: tendency of the **system** to return to an original state following disturbance (inertia)
stable equilibrium: returns to the same equilibrium after disturbance
unstable equilibrium: the system returns to **a new equilibrium** after disturbance

feedback: feedback mechanisms either change a system to a new state or return it to its original state
positive feedback: feedback that **amplifies or increase change, increases/decreases output,** to a **new state of equilibrium.**
negative feedback: feedback that tends to damp down, **neutralize** or counteract any deviation from an equilibrium. results in **self-regulation** of a system. results in **vicious circle**.

Example of positive feedback: higher temperatures -> sea temperatures rise --> increased evaporation --> more water vapour --> wetter atmosphere --> more heat trapped in atmosphere --> higher temperatures

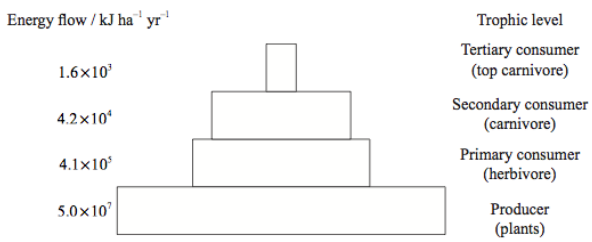
transfer and transformation
transfer: normally flow through a system does not involve a change of form or state
example: water moving from a river to the sea
involves:
a. movement of material through **living organisms**
b. movement of material in a **non-living process**
c. movement of **energy**
example of transfer process: erosion, irrigation, precipitation

Transformation: when a flow involves a change of form or state
involves:

a. matter to matter
energy to energy
matter to energy
energy to matter
examples of transformation process: evaporation, condensation, respiration

Models: Gaia
Lovelock: earth is a planet-sized organism and the atmosphere is its organ

Pyramid of numbers:



adv:
simple method to give an overview
good to see the change of number of population

dis:
all organisms are included without regarding its size
numbers can be too great to be represented accurately

Human activity that causes a change in pyramid of numbers:
- deforestation: makes the producer smaller
- trophy hunting: decreases or removes the top carnivores

Pyramid of biomass:
similar but shows the energy stored by each level (J)
Note: in terrestrial ecosystem, energy should decrease as it goes up the trophic level, becomes a pyramid shaped

Ecosystem

terminology
species: a group of organisms that interbreed and produces fertile offsprings
population: a group of individuals of the same species
habitat: environment where a species normally lives
ecological niche: how an organism can be alive (relationships, where it lives, resources, respond to predators, availability of water and light)
community: a group of populations living and interacting with each other in a common habitat
ecosystem: a community of interdependent organisms and the physical environment which they inhabit

biome: collection of ecosystems sharing common climatic conditions
biosphere: part of the Earth inhabited by organisms

biomes
freshwater: swamps
marine: ocean
deserts: hot and cold
forests: tropical, temperate
grasslands: tropical or savannah and temperate
tundra: arctic and alpine

Net Primary Productivity (NPP): total gain in energy per unit area per unit time by green plants **after allowing for losses to respiration**

Gross Secondary Productivity (GSP): total gain in energy by consumers by absorption per unit per time minus fecal loss per unit per time

To calculate efficiency of conversion:
((GPP – R) / origin) x 100

why NPP of secondary consumers much smaller than primary:
loss to **respiration** by primary consumers = less energy for next trophic level
loss to **decomposition** by primary consumers = less energy for next trophic level

energy efficiency of terrestrial vs aquatic:
- aquatic is less productive, less energy efficiency
- less solar radiation reaches aquatic plants (less initial intake of solar energy)
- energy conversions along the food chain in aquatic more efficient

food chain: flow of energy from one organism to the next
trophic level: position of that organism or a group of organisms in a community in a food chain

trophic level
1 - producer: manufactures their own food from simple inorganic substances
2 - herbivore
3- carnivore:
4 - carnivore
consumers: feed on autotrophs to obtain energy

food webs: series of interlinking food chains (flow of energy from one organism to the next) in an ecosystem

biomagnification: chemical concentration is magnified from trophic level to trophic level, therefore it affects the top of the food chain the most
example: pesticide

bioaccumulation: the organism doesnt egest it accumulates in their bodies over tim**e**

Biodiversity

biodiversity: the amount of biological or living diversity per unit area. it includes the concepts of species diversity, habitat diversity, and genetic diversity

species diversity: number of **different** species within a given area or habitat. high species diversity: rainforests

genetic diversity: the range of genetic material present in a species or a population
note: domestication and plant breeding lead to a loss of genetic variety

habitat diversity: the number of different habitats per unit area that a particular ecosystem or biome contains, associated with the variety of niches that may be exploited by different species

Simpson's reciprocal index: N(N-1)/sum of n(n-1)

N: total number of organisms of all species
n: total number of organisms of a specific species

mass extinction
natural extinction: a species ceases to exist after the last individual in that species dies
reason:
a. human activities: transformation, **overexploitation**, pollution
b. rapid change of climate
c. natural disaster/change conditions

maintain biodiversity:
a. complexity of the ecosystem (more complex--> better)
b. stage of succession
c. limiting factors: abundance of abiotic factors
d. inertia: resist change when subjected to disruptive force

factors that lead to loss of biodiversity:
a. natural hazards
b. global catastrophe
c. habitat degradation: a large area is divided **up into patchwork or fragments**

d. introduction of non-native species
e. pollution
f. hunting, collecting, and harvesting (exploitation)

What makes a species prone to extinction:
a. small population: smaller genetic diversity (cannot adapt)
b. fragmentation
c. restricted food source
d. low reproductive potential
e. accumulation of toxins from pollution
f. hunted for food and sports
g. migrates long distances

Conservation
conservation: the act of preservation, protection, or restoration of natural resources or wildlife and humans are a part of the picture and their needs are also taken into consideration
preservation: excludes humans and human needs
Role of the governmental and NGO
GO:
Write policies to prevent illegal hunting
Establish conservation for habitat of endangered species
increase prosecution for illegal hunting and any action that destroys biodiversity
Create sustainable development strategies
International agreements for laws that leads to prosecution

Example: **UNEP**
Actively involved in negotiations such as the **biodiversity conventions**

NGO:
Increase **awareness** of endangered species and their threats
Give fast **responds** to information of illegal actions that destroys biodiversity
Be the **third party** that is unaffected by political constraints
Help the GO to create conservation for habitat of endangered species

WWF: animals
GREENPEACE: campaigns

IUCN: International Union for Conservation of Nature
- Mission: influence, encourage, assist societies to conserve diversity and integrity of nature, ensure sustainable use of natural resources
- Wold Conservation Strategy (WCS):
    - maintain essential ecological processes and life support systems, preserve genetic diversity
    - balance development with conservation of the world’s living resources
- Red List of Threatened Species: collection of objective lists of species under varying level of threat

- global scale
- regularly updated and inform government policies on trade

strength and weaknesses species based conservation
CITES: governments set up to work together in preventing trading of specific species.

strength:
- the policies made by the governments will be good and effective as illegal hunters will be prosecuted

weaknesses:
- Will need cooperation between governments (will need a long time to set up)

Captive breeding and zoos: keep captive and breed species that are endangered in zoos

strength:
- could potentially increase the population by a large number
- Often brings positive side to the social community (education and employment)

weaknesses:
- Animals may be used to having humans helping them
- Expensive
- Some zoos are known for their bad press and the animals kept are in confinement.

species based conservation:
designing protected areas
- How **large** to protect? Specific species that need protection in large reserves? better large
- How **many individuals** of the species needs to be protected?
- Is it better to have **one large or many smaller** reserves? one large, no dispersal problem
- Best **shape**? round, reduces the edge effect
- How **close (deket)** should reserves be? Should they be separated? should be close, as it is easier to disperse among patches, allows easier recolonization

- Ecotones: when two habitats meet and there is a change near the boundary --> increase in predation and competition

population dynamics
The reason why the population can increase or decrease

increase:
- Population will increase as long as there's **constant supply of resources** populations grow
- Exponential Growth: enough food, water, and space

decrease:
- limiting factors:

density-dependent (internal factors biotic: act within species and limited availability of territories &

external factors disease)

density-independent (abiotic): weather, climate, earthquakes

Population dynamics
Growth pattern S-Curves: exponential growth, growth rate slows down (constant) and number stabilize at carrying capacity (K)
stationary phase: population growth reaches maximum population

growth pattern J-curves: exponentially at first and then collapses due to over capacity

K and R-selected species:

K: fewer, large offspring, late reproductive age, adaptable to stable climate, **lower population growth rate**, population size **stable** close to **K (**carrying capacity)

R: many small offspring, early reproductive age, adaptable to unstable climate, **high r**, population fluctuates wildly above and below carrying capacity (K)

Differences of pyramids in developing and developed country
Age/sex pyramid: diagram that shows the proportion of population of each sexes at each age level (0-14, 15-44, 45<)

rapid growth: 0-20 rapid, slowly decreases
slow growth: constant change from age level
stable: less change except to the post-reproductive age
Decreasing: less pre-reproductive age to post-reproductive

DEVELOPING COUNTRIES: Rapid growth (high birth, high death)
DEVELOPING COUNTRIES: Slow Growth (High birth, medium death rate)
DEVELOPED COUNTRIES: Zero growth (low to medium birth, low death)
DEVELOPED COUNTRIES: negative growth (low birth rates, low death rates)

terminology in population dynamics chapter
Birth rates: infant mortality rates, status of women, available birth control, cultural traditions
death rates: Food, healthcare
population: number of individuals of a species in a defined place and time

Calculation (maybe) bring calculator
CBR: b/p x 1000
CDR: d/p x 1000
Natural Increase Rate (RNI): CBR- CDR / 10

Doubling Time: 70/RNI
Total feritlity rate: birhts/1000 women

Natural Capital

definition: resources or goods and services that are not manufactured but is valuable to humans
Natural income: form of wealth that comes from renewable and replenishable resource properly managed

renewable resources: living resources that can replace or restock themselves (self-producing and self-maintaining)

non-renewable resources: exist in a finite amount on earth and are not renewed or replaced after used or depleted (only after a long time scale is renewed) e.g. fossil fuels and minerals

replenishable resources: replaceable over a time period e.g. groundwater

sustainable development: development that fulfills current generation's need without compromising future generation's needs
sustainability: **use of global resources at a rate that allows natural regeneration and minimizes damaged to the environment**
sustainable yield: rate of increase in **natural capital** which can be exploited without depleting original stock or its potential to be replenished

SY= total biomass at time t+1 - total biomass at time t

Dynamic nature of a resource:
can be valued in different ways:
economic: marketable g/s
technological: useful for application (genetic, medicinal)
ecological: providing life support services (water storage)
intrinsic: having cultural, esthetic, spiritual or philosophical value

note: ecological goods do not have financial value therefore they are under-valued and often taken for granted

carrying capacity: the maximum number of individuals that an environment can sustainably carry or support

problems of carrying capacity:
humans usually use a much greater **range of resources**
resource requirements vary according to **lifestyles, culture, and economic situation**
technological developments
import resources --> letting humans grow beyond their boundaries set by their local resources and

increases their carrying capacity

thus, **human carrying capacity: maximum load (rate of resource harvesting and waste generation) that can be sustained indefinitely without reducing productivity and functioning of ecosystems**

why population and carrying capacity may not match:
- carrying capacity accounts the number of resources available as well
- the country's situation, low water resources, weather, etc.

Ecological Footprints: area of land and water that would be required to sustainably provide all of a particular population's resources and standard of living and assimilate all its wastes.

Causes of difference in ecological footprints:
- dietary differences (lower EF would be vegetarians, higher EF would be meat eaters)
- energy use (^population = ^ energy use = ^ EF)
- greater level of industrialization
- greater level of pollutants (transportation ^ if population ^)

Ecological footprints as a measure of resource use:
Advantage:
- Shows a general look at a population's sustained lifestyle
- Iconic symbols to raise awareness of environmental issues
- Helpful for government to what lifestyle should be changed

Disadvantage:
- Does not include all impacts of human activities to the environment
- Only a model, simplified and not precise
- Could be demotivating

Energy Resources
Evaluation of energy resources:
coal (fossil fuel):
adv: plenty, easy to transport (solid), no need for processing, cheap to mine, up to 250 years left
dis: non-renewable energy sources, burning releases carbon dioxide+sulfur dioxide, leave degraded land and pollution, less energy released per unit mass
biogas: adv: cheap and readily available energy source, long term and sustainable
dis: replacing food crops on a finite crop land and lead to starvation, when burnt still gives off atmospheric pollutants, if crops are not replanted then it is a non-renewable resource
wind: clean energy, little maintenance
OIL:

Soil Resources
soil: a part of lithosphere where life processes and soil-forming processes both take place
use: plants + animals for humans, habitat, holding water and mineral nutrients, water filter, store and transfer heat

made from: mineral: particles from underlying rock, organic matter: dead plants and animals, water: pore spaces between soil particles, air: pore spaces between soil particles

fraction:
rock particles: insoluble, gravel sand silt clay chalk + soluble, mineral salts nitrogen phosphorus.. = provide skeleton of soil
humus: plant and animal matter in the process of decomposition = returns mineral nutrients back tot he soil, absorbs water
water: water seeping down from precipitation = leaching of minerals, dissolved mineral salts move through soil
air: O_2 and N_2 = oxygen for respiration of soil organisms and plant roots
soil organisms: soil invertebrates, microorganisms and large animals: break down dead organic matter, mix and aerate the soil

soil profile: a vertical cross section from earth's surface down through the soil layers into the underlaying base rock
humus layer: incomplete decomposition
soil: caused by translocation (water movement)
salinization: increase evaporation water&mineral uptake
leaching: water dissolves mineral and trasnports them downwards
podsolization: nutrient-poor and bleached
gleying: soil is waterlogged

soil formation:
weathering processes: inorganic component of the soil
introduction of living organisms: mixing and opening up the soil
decomposition and formation of organic component

Soil erosion: natural vegetation covers a soil, processes that could damage the soil structure are largely eliminated. however, agriculture removes this vegetation and makes soil prone to erosion.
major processes:
- sheet wash: large areas of soil washed away during storms
gullying: channels develop following rainfall
wind erosion: drier soils high winds remove surface layer

Human activities leading to soil degradation:
- overgrazing: too many animals graze at the same area.
- overcropping: depletion of soil nutrients --> reduces soil fertility as no nutrients are being returned to the soil
- deforestation: removal of forest --> soil prone to erosion
- unsustainable agriculture: monoculture, removal of crops after harvest without replanting, growing crops in rows, excessive use of pesticide (toxification),

soil conservation:
soil conditioners to increase pH and improve texture

wind reduction: planting trees, alternating low&high crops, building fences
cultivation technique: terracing, ploughing, contour farming
improve irrigation technique: cover irrigation
crop rotation: leaving ground fallow, growing several crops in a year

soil:
particle size: clay < silt < sand

Earth Plates

Platetonics: the movement of plates in the earth's lithosphere (rocks)
When plates move:
- Slide: past each other
- Diverge: moving slowly pass
- converge: collide and form a mountain range, or heavier plate may fall under the lighter plate and make an ocean ranch

impact on habitat and species diversity:
- volcanic activity new islands
- mountain greater habitats due to range of altitudes
- plate activities unique ecosystems ocean trenches
- habitat diversity increases niches increase species diversity
- mixing gene pools from different regions new species
- bridging isolated populations new species
-

Nitrogen Cycle
N_2 in air fixation by lightning, bacteria becomes nitrogen in plant proteins and ammonium ions and **nitrates** in soil absorption by plant roots and ingested by animals (proteins) egestion/excretion/death goes back to soil conversion of nitrates to nitrogen by denitrifying bacteria

Human intervention take animals away (extract nitrogen from the cycle) human sewage lost at sea/ + nitrogen by adding artificial fertilizers made in the **haber process (planting leguminous crops with root nodules containing nitrogen-fixing bacteria)**

IMPACT ON NITROGEN CYCLE AND ECOSYSTEM

Production of nitrogen fertilizers converted large amounts of N_2 to NO
Agriculture burning -- NO to the ecosystem
Fossil fuel large amount of NO_x
Over-harvesting reduce mineral N in soils

More NO_x acid rain sensitive species, reduce nutrients in soil in forests and damages trees (weakening tree growth), leaching of nutrients
NO_x greenhouse gas global warming
More N in soil leaching eutrophication

Water Resources
3% of water on earth is fresh
water problems: drought + salinization + soil erosion = people must import because not enough water to use for domestic use and agriculture

Food Resources

Undernourishment: do not get enough energy from their food
malnourishment: lack of essential nutrients
MEDC: cost of staple relatively cheap, purchases based on preference, globalization makes products always available
LEDC: Price fluctuation of staple food, purchases based on nutritional needs and affordability, political and economic agenda may affect food production

traditional extensive rice production: low input of energy and chemical. high labour, low productive, low output, but big energy efficiency

intensive rice production: high inputs of energy and chemicals, low labor, high productivity --> high output + extra outputs (pollution excess fertilizer) but low energy efficiency

Terrestrial vs Aquatic

Terrestrial: harvested at first or second trophic level --> efficient use of solar energy, however energy transfer between trophic levels not as efficient
Aquatic: harvested at higher trophic levels: energy losses of trophic levels and so energy efficiency lower than terrestrial, however energy transfer between trophic levels more efficient

Farming: types:
subsistence: family or local community, mixed crops, low chemicals and technology, low productivity high energy efficiency
commercial: profit making, high chemical and technology, low labor, high productive, low energy efficiency, high energy input
extensive: using more land with lower density of stocking or planting, lower inputs and outputs, limited selective breeding, no genetically engineered organism, polyculture
intensive: using land intensively, high level of input and output, selective breeding, genetically engineered organism, monoculture

Pollution management:

Pollution: addition to the biosphere of a substance by human activity at a rate greater than that at which it can be rendered harmless by the environment, and which has an appreciable effect on the health of organisms within it.

Major source:
- combustion of fossil fuels = + CO_2 (greenhouse gas), SO_2 (acid rain), Nitrogen Oxides, Carbon Monoxide
- domestic waste: organic waste (eutrophication) + waste paper glass tins (fills landfills)
- industrial waste (heavy metals, leads, acids)
- agricultural waste = nitrates (eutrophication) + pesticides

Atmospheric pollutants: example: CO_2, NO_x, organic compounds
. Method: filter-collected

1. use a monitor/probe;
2. select correct material (filter paper / rain gauge water);
3. **weighing** filter before and after collection;
4. **extraction** of material filtered / chemical analysis;
5. select location and time for sampling / take measurements at different locations/regular intervals;

Biological Oxygen Demand: a measure of the amount of dissolved oxygen required to break down the organic material in a given volume of water through aerobic biological activity

Detection:

Indicator species: plants and animals that show something about the environment by their presence, absence, abundance or scarcity

Three-level model of pollution management:

Replace (with alternatives)

Regulate (the release)

Restore (the environment)

Process of pollution: human activity producing pollutant (should be educated and have penalty to adopt alternative lifestyles) ▯ release of pollutant into environment (regulating pollutant at the point of emission) ▯ long-term impact of pollutant on ecosystem (cleaning up pollutant and restoring ecosystem)

Waste Management

Waste: material which has no value to its producer

Strategies to minimize waste: reduce, reuse, recycle

Recycling: collecting and separating waste materials and processing them for reuse.

Economics of recycling: depending the market cost of raw materials and cost of recycling

Landfills: burial of waste. (+): cheap, may be used to generate electricity, no need of time/labor . (-): not many location can be used increase vermin and greenhouse gas (methane)

Example: Japan ? has isolated (for hazardous waste), leachate controlled or non-leachate controlled (stable waste).

Recycling: creates job and reduces amount of material in landfill sites, but requires energy and transport of heavy goods

Incineration: cheap way of producing energy from waste, but release of pollutants

Eutrophication: a process where water bodies receive **excess nutrients** that stimulate **excessive** plant growth.

- Point Source pollution: release of pollutants from a single, clearly identifiable site, eg. A factory chimney
- Non-point source pollution: release of pollutants from numerous, widely disperse origins, eg. Gases from the exhaust systems of vehicles

Eutrophication Management Strategies:

- replace: altering human activity producing pollution (ban detergents containing phosphate, plant buffer zones to absorb excess nutrients, stop leaching of animal waste from their sources
- regulating reducing the pollutants at point of emission: pump air through the lakes, divert sewage waste, minimize fertilizer dosage
- clean up: dredge sediments with high nutrient levels from river, remove excess weeds physically

Impact of eutrophication:

- oxygen-deficient water
- loss of biodiversity (shortened food chain)
- death of higher plants
- increase turbidity of water

Ozone:

Found in troposphere (bad), stratosphere (good)

Ozone:

- reactive gas of which the majority is found in the so-called ozone layer in the lower stratosphere.
- Made and form oxygen (dynamic equilibrium) □ absorbs UV radiation □ crucial for life on land

Exposure to uv radiation: mutation on health, damage to photosynthetic organisms

Ozone hole: air pollution (CFCs) □ reduced thickness of ozone layer

CFC, HCFC □ release chlorine atoms

Nitrogen oxides (NOx) from intensive farming + supersonic aircraft □ react with ozone creating **tropospheric ozone (O3)**

O3:

- **causes damages to crops and forests, irritates eyes, etc.**
- **photochemical smog:** ozone, nitrogen oxides and gaseous hydrocarbons from vehicle exhausts interact with strong sunlight. □ increase concentration of pollutants on ground level, damage to plants chlorophyll + reduce lung function
- **damage to plants** □ degrades chlorophyll for photosynthesis
- **damage to humans** □ irritation

Strategy for reducing pollution of CFC:

Replace: gas blown plastics, CFC with carbon dioxide, aerosol propellants

Regulating: recover and recycle CFCs from refrigerators and AC, legislate to have fridges returned to manufacturers, clean up by add ozone to or remove chlorine from stratosphere

Montreal Protocol □ UN Environment Program, agreement on reduction of emission of ozone-depleting substances

Effective? Yes. However the long life of CFCs in the atmosphere would not return to normal levels till 2050. LEDCs are still allowed to use CFC

Acidity: chemicals that donate hydrogen ion to other chemicals

Normal unpolluted rain is slightly acidic □ presence of CO2

Acid rain □ under 5.6 pH

Acid deposition: general term for acid coming down to earth's surface from air (rain □ wet deposition, dry particles □ dry deposition)

Primary Pollutants: those emitted directly (leaving the chimney of a factory)

Secondary Pollutants: pollutants made by reaction with other substances in the atmosphere

Sulfur dioxide (SO_2), Nitrogen oxide (NO_x) □ acid deposition (Sulfurous acid (H_2SO_3) sulfuric acid (H_2SO_4), nitric acid (HNO_3))

Effect:

- direct □ weakening tree growth (Germany's black forest □ leaves show yellowing)
- toxic effect □ aluminium ions on soil fertility (nutrient removal), on fish (fish's ability to regulate salt and water in its body is affected by aluminium ions)
- nutrient effects □ leaching of nutrients
- regional nature

Pollution Management of acid deposition:

Replace: fossil fuel, private transport (reduce carbon dioxide emissions)

Regulating: clean-up technologies at point of emission (but expensive)

Clean up: liming acidified lakes and forestry plantations, international agreements

UN Convention on Long Range Transboundary Air Pollutants □ average of 50% reduction in Europe, but LEDC is still rapidly industrializing

Environmental Impact Assessments (EIA): measures the impact of a development to the environment

- legal requirement
- involves **baseline study** and subsequent **monitoring** of environmental aspects

Succession

Succession: natural increase in the complexity of the structure and species composition of a community over time.

gradual colonization of a lifeless abiotic substrate. Succession passes through several stages called **seral stages.** A sere is a set of communities that succeed one another over the course of succession at a particular location.

Primary succession: colonization of newly created land by organisms, eg. River deltas, volvanic la s fields

Seral stages:

-organic surface
-colonization
-establishment
-competition

-stabilization
-seral climax

Primary sucession starting on dry land: xerosere, water: hydrosere

Secondary sucession: occurs on soils that are already developed and ready to accept seeds carried by wind.

-shorter seral stages

Changes during sucession:

- size of organisms increases

- energy flows become more complex

- soil depth, humus, water-holding capacity, mineral content and cycling increase

- biodiversity increases because there are more niches, falls as the climax community is reached.

- NPP and GPP rise then fall

Species diversity in successions:

Disturbance: disturbs the climax community to self-perpetuate

Succession and zonation:

Zonation: how an ecosystem is changing along an environmental gradient like water content in the soil, altitude or salt percentage

Arrested and deflected successions: a sere may be arrested during a seral stage due to an abiotic factor, eg. Waterlogging. --> subclimax community which will only continue its development if **the limiting factor is removed.**

Natural events or human activity--> deflected or **plagioclimax** community such as pasture

Distinguish succession and zonation.
Succession is the natural increase of the complexity of the structure and the species composition in a community over **time,** caused by changing conditions through biotic factors or seral communities' influences. Example would be succession on sand dunes, where vegetation colonizes a once bare surface of sand.
Zonation is change or difference in an ecosystem over **distance,** caused by environmental gradient such as abiotic factors. Example would be zonation caused by altitude in mountains.

With reference to a **named** ecosystem, explain why climax community is more diverse and therefore stable, than a community, which has been interrupted by human activity.

Answer:

Named example: sand dunes in southern England
Climax community: creates **many niches** and so an increase in biodiversity. In the sand dunes, pines and oak and ash woodland has grown. Climax community would also have **better abiotic factors**, such as in the sand dunes, the vegetation cover, soil depth, humus content, soil acidity increases, making the diverse community have balanced **relationships and feedbacks** mechanisms, and so becomes a **stable state**.

As for community that has been interrupted by human activity, they would experience a decrease in productivity **as primary producers are removed**, threatening niches and species that could cause a **deterioration of abiotic factors** that would further decrease the species diversity as some species may not be able to **live in the deteriorated conditi**on. This would lead to a **reduction of complexity of food webs**, that would generate **rapid change** that would **not allow a balanced relationship and feedbacks mechanism**, and so a **more unstable state**.

Explain why an understanding of how ecosystems work can help people to manage resources effectively.
Ecosystems is a community of interdependent organisms and the habitat they live in.

In ecosystems, all species/component would have their role and the wellbeing of that species would **affect other species' wellbeing,** as species and component in an ecosystem are **interconnected** and **interdependent.** This is shown from **a food web**, where a disappearance of one species or a decrease in one species would affect the source of food of another species greatly, except in ecosystem with high biodiversity and so a species may have many source of food. This shows that all components in an ecosystem **contribute in making a stable system**. With this knowledge, people may manage resources in a way that would not **cause disturbance to the stability** of the system, **ensuring long-term wellbeing and thus availability of the resources that are components of the system**.

As explained, as the interdependence of components in a system is shown in the food web**, biodiversity** is another aspect that needs to be understood to ensure effectiveness of resource management. There are **many human activities that could endanger biodiversity**, such as **domestication and plant breeding that** decreases genetic diversity. Knowing about factors that affect diversity would help in determining what human activity should be done so that it would not endanger diversity. People may opt to **polyculture,** that would sustain the **diversity of the community better than monoculture.**

1. Sustainability is the **use of global resources at a rate that allows natural regeneration and minimizes the negative externality to the environment**. Examples of this is harvesting or farming of fishes without exploiting the resources and allow **natural rate of regeneration**. Whereas sustainable development is **development that meets the current society needs without compromising the need of future**

generations. Sustainability focuses **on the rate of use of the resources,** while development would not and has **a broader concept about progress of development**. Development looks at **making improvements and changes in the world to become better**, while **sustainability look for having a balanced system**.

2. GPP is the **total gain of energy per unit per time by primary producers**, while NPP is the total gain of energy per unit per time by primary producers **deducted by respiration**. We may contrast the biomes of Tropical rainforest and Tundra. Tropical rainforest such as the Borneo rainforest would have a **high biodiversity**, climate with **sunlight and rain at its optimum,** that allows **high efficiency in transfer of energy**, and so a **high GPP and NPP**. While Tundra biomes such as in the arctic would **have limited water, frozen grounds, and significantly lower temperature**. This would create **low respiration, photosynthesis and decomposition**, creating **low production of nutrients**. This shows that they would have lower GPP and NPP than tropical rainforest. NPP is also v**ery low because decomposition is very slow in a Tundra biome**. This shows how tropical rainforest would have a higher productivity than Tundra.

3. There are several criterias that should be used to judge the success of a conservation area, those are the **design** of the conservation area, **involvement or cooperation with local community**, and **sustainability**. The design of the conservation area, that **is considering the shape and size of the reserve, how close reserves are between each other**, would affect the e**ffectiveness of the conservation effort as it would affect the wellbeing of the species living in the reserve**, thus determining if the **species would survive in the reserve**. Involvement with local community is important because if the conservation effort is supported by the local community, there may be **little conflict between the establishment of the reserve with the local community**, and they **may give effort in preserving the species and habitat of the reserve**. Sustainability is important because conservation areas have **long-term objectives** and should be able to be **sustained for a long time** in order to be successful.

One conservation area that we may inspect is the **Kruger National Park in South Africa**. As the **largest wildlife reserve in the world**, it fulfills the first criteria of **good design of the conservation area**. It has a large size, and so the edge effect is not felt by the species inside it. However the large size makes the **observation of the animals hard**, and human maintenance is more to security than direct maintenance and provision to the species. The local community has been involved in the establishment of the national park, as they have benefitted from the increase in tourists who come to the park. The local community may also be benefitted as they then **have access to information and better education of the species in the park.** Lastly, the cooperation **between countries in the establishment of this large reserve** has ensured its sustainability for the long run.

Effect of global warming

To sea levels, they increase the sea levels and had made water expand and cover many what was once land. Also, as oceans absorbs carbon dioxide, the increase of CO_2 in the air would then cause more acidic ocean water that may affect marine organisms especially corals.

To glaciers, the effect is that there is higher melting of the glaciers that would then allow more water to be supplied and exploited in many different cities around the world, including the cities around Ganges river that has increase in flow from the Himalayan glacier.

To climate, they would cause a change in the pattern of climate due to higher temperature or lower temperature in many places that may cause drought and storms. This could cause more soil erosion and disturbs irrigation and may consequently cause salinization.

To food production, warmer temperatures may have positive and negative impacts. The positive is for northern countries such as Siberia where there will be longer growing season. This would mean the once unfertilized or unsuited soil in Siberia may be used for more agricultural production. Also, the higher temperature may kill several planktons in the sea that is food for fishes and marine organisms, that may then cause decrease in food supply from marine animals.