Natural Environments Notes

Week 1 Lecture 1 Notes:

- In the tropics 10g of carbon is produced per metre squared per day

GLOSSARY:
- **Anthropocentrism-** a human-centric view
- **A catchment-** the area from which rainfall flows into a river, lake or reservoir

Week 1 Lecture 2 Notes:

- There are differing levels of definitions of sustainability
  - e.g. only using the amount of water that is caught by a catchment in a given year VS considering that the water is part of an ecosystem and may/will be needed by future generations.
  - Continuing practices without environmental degradation, going into the future without compromising future needs
- There are many ways to measure resilience in agriculture
- Agro-ecosystem resilience is important because-
  - Connection between the natural world and future prosperity is abstract and distant from everyday life (Wentworth group)
  - Food production is globally interconnected
  - Food production will be affected by climate change
- Important concepts:
  - Sustainability
  - Resilience
  - Systems
  - Scale

        - Time scale
        - Spatial scale, global and micro
    - Community
    - Science
- Themes of a natural environment:
    - Proximity to human settlement and the degree altered by humans
    - An environment that has functioning ecology
    - Beauty and/or grandeur
    - Often a natural environment is a landscape
- Natural Environments are conceptualised by considering the earth's different systems e.g. atmosphere, oceans and rivers (Hydrosphere), organic component (Biosphere) and the lithosphere.
- Natural environments can be closed or open
- Closed systems (cycles) only exchange energy (as heat) with no inputs or outputs of matter e.g. the hydrological cycle using the atmosphere, lithosphere and hydrosphere
- Open systems exchange energy and matter e.g. water flowing past a bridge is moving energy and matter
- Humanity has the ability to make development sustainable – to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs (Bruntland)

GLOSSARY:

- **Resilience**
    - Amount of change a system can undergo while still maintaining the same controls on structure and function
    - The system's ability to self-organize
    - the ability to build and increase capacity for learning and adaptation or 'the ability of the system to maintain its identity in the face of internal change and external shocks and disturbances' Cumming et al 2005

Week 2 Lecture 3 Notes:

- 2nd law of thermodynamics, Systems move to reduce their energy and increase their entropy. Systems reach equilibrium but at a slow rate e.g. soil
- Generally, the larger the scale of change the longer it takes
    - At the lower end things like atmospheric turbulence and convection take seconds/minutes to happen but also only happen over smaller areas of 1km or less
    - At the higher end plate tectonics is 10s of thousands od kilometres in scale and takes billions of years
    - Some large-scale things like global weather systems, carbon dioxide and atmospheric composition are on a global scale and take days, years/centuries and tens of thousands of years respectively
    - Some smaller scale things such as mountains, extinction events or soil erosion can happen over billions of years, millions of years and thousands/century respectively

- Attributes of a landscape
    - Climate
    - Soil
    - Water (on site, through the landscape and off site, off the landscape)
    - Vegetation
    - Macro and micro fauna
    - Community-how the community interacts with these attributes
    - Infrastructure-social
- Earth's crust is made up of thicker continental areas and thinner oceanic areas

- Compositional layers of the earth

    - Crust, 35km, light silicate rocks
    - Mantle 2900km dense silicate rocks, solid but weak, moves slowly via convection
    - Outer core, 5100km, molten Fe metal
    - Inner core, 6370km, solid Fe metal
- Mechanical layers of the earth
    - Lithosphere, 100km is divided into plates, rigid, brittle, where convection occurs new lithosphere is created at plate boundaries
    - Asthenosphere, 300km, partly molten and weak
    - Mesosphere, 2900km
- Theory of plate tectonics
    - The lithosphere is divided into a number of rigid segments called plates
    - The plates are constantly moving relative to each other
    - Major structural features of the earth are formed from processes occurring at plate boundaries
- Major structural features of the earth
    - Continents
    - Mountain chains
    - Ocean floor
    - Island art complexes e.g. Indonesia
    - Oceanic ridge system
    - Continental margins

- Seven major lithospheric plates
    - Pacific
    - Eurasian
    - Australian-Indian
    - North American
    - South American
    - African
    - Antarctic
- Plate Motions
    - Plates move 1-20cm per year. The average is 5cm/year
    - Plate movements are driven by gravity, linked to convection in the mantle
    - Continents are carried along passively by the plates
    - Plates can be made up of both oceanic and continental crust
- Plate boundaries and Interiors
    - Major geological processes occur mostly at plate boundaries
    - There are different types of plate boundaries
    - Plate interiors are geologically relatively quiet
- There are three different types of plate boundaries
- Divergent plate boundaries, moving away from each other, new crust generated e.g. oceanic ridges
- Convergent plate boundaries, moving towards each other, there are three types
    - Island arcs
    - Continental arcs
    - Continental collision zones
    - Subduction zones mark where old oceanic lithosphere dives back into the mantle
        - Marked by paired oceanic trenches and volcanic arcs
        - Gradually become regions of mountain building
        - Sites of intense earthquake activity, volcanoes, sedimentation, deformation and metamorphism
        - May lead to great mountain belts
- Transform plate boundaries, two plate moving past each other
    - Also called conservative plate boundaries

- Lithosphere is neither consumed nor generated
- Very earthquake prone

GLOSSARY

- **Entropy-**a quantity representing the unavailability of a system's thermal energy for conversion into mechanical work. The degree of disorder or randomness in the system.
- **Convection-** the movement caused within a fluid by the tendency of hotter and therefore less dense material to rise, and colder, denser material to sink under the influence of gravity, which consequently results in the transfer of heat.
- **Negative feedback mechanism**
- **Positive feedback mechanism**
- **Subduction-**the sideways and downward movement of the edge if a plate of the earth's crust into the mantle beneath another plate
- **Orogenesis-**

Week 2 Lecture 4 Notes:

- 75% of the earth's crust is oxygen and silica
- Minerals are naturally occurring inorganic chemical compounds having a specific internal structure and regular chemical composition
- Rocks are natural mixtures or aggregates of minerals e.g. Granit is made up of Feldspar, Quartz and Mica
- Minerals:
  - are the major solid constituents of the Earth and are mostly crystalline
  - have specific physical properties which reflect their composition and atomic structure and affect weathering
  - Silicates are the most common minerals making up 95% of the earth's crust, combining Si, O and other elements
    - Silicates are made up of one SI^{4+} plus four O^{2-} arranged in a tetrahedron $(SiO_4)^{4-}$, they can form rings, chains, sheets or frameworks
- The three main classes of rocks and their characteristics
  - Igneous rocks
    - Can be Extrusive (Volcanic) rocks
      - Cool rapidly at surface
      - Fine crystal grain size, or glassy
    - Can be intrusive (plutonic, below the ground) rocks, magma cools under the surface
      - Crystallise deep below the surface and cool very slowly
      - Coarse crystal grain size
      - Intrusive igneous rocks form carious structures when they solidify under the surface
        - Batholiths, largest igneous intrusion
        - Dykes, vertical structure where magma has solidified in fractures
        - Sill, horizontal sheets of solidified magma
        - Volcanic neck, feeders for surface volcanoes, very resilient to breakdown
        - Lava flows occur where magma breaks through to the surface
    - Mostly made up of silicate minerals
      - Can be felsic minerals, light in colour, low density e.g. Feldspars and Quartz
      - Can be Mafic minerals (dark in colour, higher density) e.g. Mica
    - Origin of Magmas
      - Most igneous rock activity is related to processes operating at active plate boundaries
      - Most magmas originate at 50-200km depth
      - Basalt magma is generated from partial melting of ultramafic rocks in the Asthenosphere