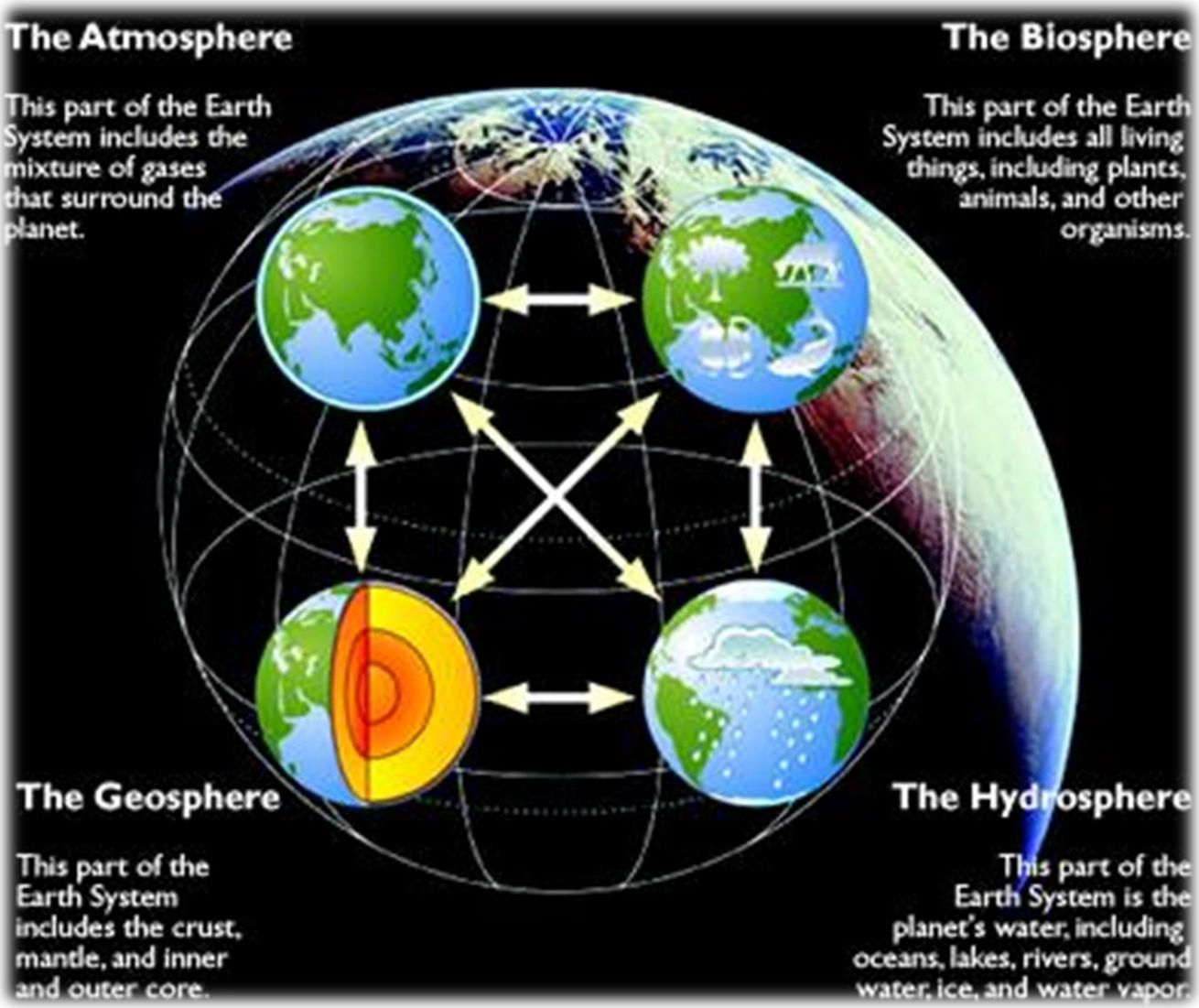


TOPIC NOTES FOR EASC1101: EARTH & ENVIRONMENTAL SCIENCE

Completed in 2016 with Distinction

Contents

WK1: Cosmology & the Birth of Earth - (Dr. Gaziela Miot da Silva)

Science: the systematic analysis of natural phenomenon

Throughout the past the concept of the universe has changed greatly, to begin with there was a geocentric model of the universe whereby Earth served as the centre and the celestial bodies revolved around it. However, this idea was disproven during the Renaissance by a variety of observations including:

- Copernicus: published evidence of heliocentricity
- Kepler: came up with elliptical planetary orbits
- Galileo: observed moons orbiting Jupiter (therefore not everything revolved around Earth)

Come the Enlightenment, geocentricity was firmly disproved through the work of Isaac Newton allowing for the heliocentric model to become the established model, which surmounted that the sun is at the centre of the solar system.

Hubble developed the Expanding Universe Theory (which is analogous to expanding bread) this in turn supported the idea of the Big Bang.

The Big Bang was an event that occurred about 14 billion years ago (13.7 Ga) which saw the explosion of all mass and energy creating the universe. This initially created the basis of atoms (protons, neutrons & electrons) which in turn formed hydrogen atoms (the simplest atoms). More complex atoms formed via nucleosynthesis whereby atoms fused to produce heavier elements.

Nucleosynthesis type	Elements formed
Big Bang	Light Elements (1-5)
Stellar	Heavier Elements (6-26)
Supernova	All elements after 26

With the cooling and expansion of the universe, atoms were able to begin bonding, beginning with H_2 (the fuel of stars). Gaseous nebulae (large diffuse clouds of dust and gas in space) formed from the aggregating of these early atoms and molecules. Gravity would result in the collapse of the nebulae resulting in an increase in temperature, density and the rate of rotation of the matter. These would form flattened accretion discs where nuclear fusion took place, consuming the H_2 and producing heavy metals. Once the H_2 is all consumed these stars collapse and go supernova allowing for the formation of even heavier elements.

Planet: a large solid and almost spherical body that orbits a star, which has cleared its neighbourhood of other objects. There are two types of planet that occur in the solar system. Terrestrial (Earth-like) are small, dense, rocky planets. Jovian (Jupiter-like) are large, low-density gas-giant planets.

Moon: a solid body locked in orbit around a planet

The solar system also includes asteroids, which are rocky or metallic fragments, and comets, which are orbiting fragments of ice.

The solar system is believed to have developed from a 3^{rd} – n^{th} generation nebula that condensed around 4.56 billion years ago.

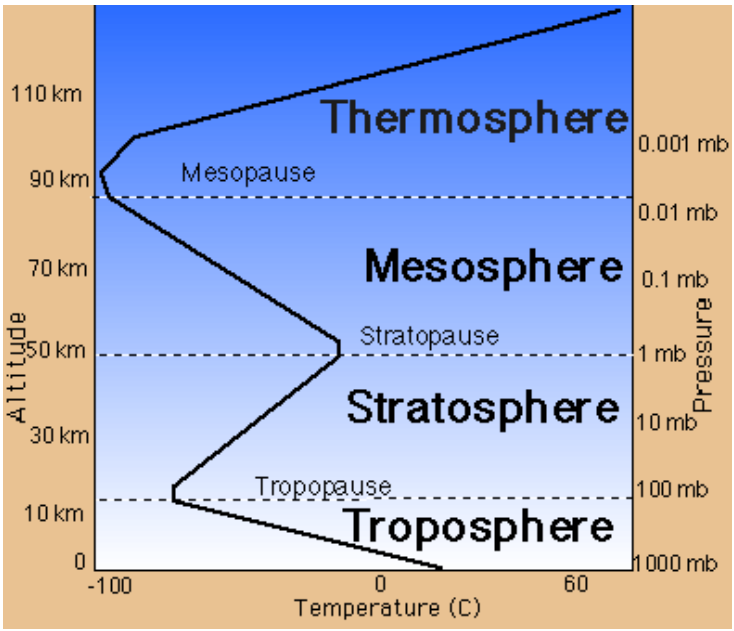
WK1: Atmosphere & Atmospheric circulation (Dr. Gaziela Miot da Silva)

The atmosphere is responsible for the upkeep of long-term climate, short-term weather patterns as well as relatively consistent temperature conditions on Earth. This however is affected by several factors including:

- The solar radiation emitted by the sun
- The Earths movement relative to the sun
- The matter that the atmosphere is comprised of
- Components of the Earth's surface

The atmosphere is divided into a series of section based on temperature fluctuations.

Layer	facts
Troposphere 0-12 km ↑ sea level	Lowest layer, the temperature and air pressure decreases with altitude (warmest closest to earth surface where energy is being reflected from), most weather also occurs in this layer.
Stratosphere 12-50 km ↑ sea level	Temperature increases with altitude due to presence of O_3. (ozone layer found here)
Mesosphere 50 – 90 km ↑ sea level	Temperature decreases with altitude as there are less particles to absorb energy and maintain high temperatures.
Thermosphere >90 km ↑ sea level	Extends into space, there is a slight temperature increase due to direct interaction with solar radiation.



http://teachertech.rice.edu/Participants/louviere/struct.html, accessed 4 March 2016

The air around us is primarily comprised of gas, mainly nitrogen (N_2), oxygen (O_2) and a variety of trace gases (Ar, CO_2, Ne, He, etc.). There also exists suspended microscopic particles, water droplets and water vapour.

Atmospheric pressure: weight of the overlying column of air (the particles in it).

The density of air is heaviest at the coolest temperature, and therefore lightest in warm air, (hence why warm air rises).

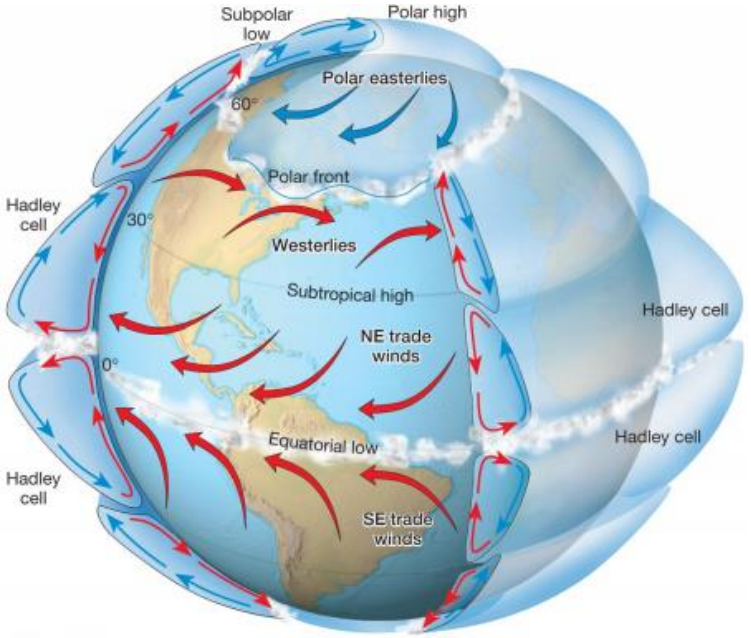
The atmosphere is warmed by the solar radiation produced by the sun (short length radiation) much of this energy is reflected back into space (the amount reflected is referred as the albedo). It is reflected as long wave radiation which can become trapped in the troposphere by clouds and greenhouse gases (driving factor behind global warming).

However, the concentration of this energy hitting the earth differs depending on the curvature of the planet. At the equator the light is hitting perpendicular and therefore has the highest concentration of energy for surface area. Nearer the poles and the earth's surface begins to flatten causing the concentration of energy hitting the area to lessen as it is distributed over a wider area.

Due to differences in density it is observed that hot air will rise while cold air falls, this consequently is responsible for a variety of weather formations and phenomenon's.

As hot air rises, it decreases in temperature which results in rain precipitation. Consequently, as it falls, once cooled, this cold air tends to have no rain.

- Hence, areas where cold air falls tend to form deserts (areas with less than 25 ml/year rain). This corresponds with the 30° latitudes and the Polar Regions that receive little rain.
- Adversely areas of hot air tend to receive lots of rain, particularly along the equator.

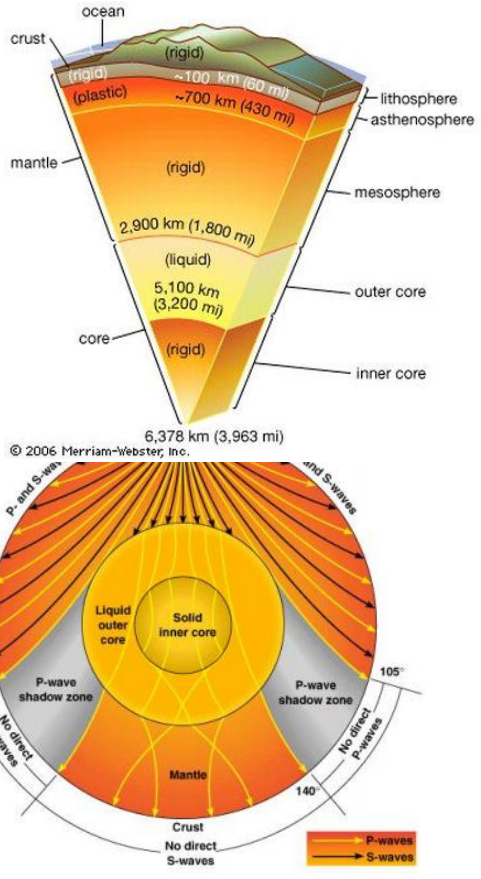


(Dr. Gaziela Miot da Silva, lecture notes, 4 March 2016)

High Pressure regions	Descending air, divergent winds and dry conditions
Low pressure regions	Rising air, converging winds, ample precipitation

WK2: Journey to the Centre of the Earth & Tectonic Plates- (Mrs Samantha DeRitter)

The earth is comprised of a variety of layers, made distinct due their composition and temperature. The distinctive layers are formed due to densities of their constituents (denser material sinks towards the planet's centre). The major layers include the upper mantle, lower mantle, outer core and inner core.



Seismic eruptions and the impact of bombs release energy in the form of waves which move around and through the earth, including both p-waves and s-waves.

P-waves (primary): these are fast moving longitudinal waves which move in the same direction as the direction of travel. This is seen as compression and expansion and these waves are capable of penetrating both solids and liquids.

S-waves (secondary or shear): are slower and are a transverse wave which means that the vibrations are at a right angle to the direction of travel (appears like a wave/ripple effect). These however cannot penetrate liquids which means that they cannot get past the liquid outer core.

Crust: The Earth's outer most surface, it is thickest under mountains and thinnest under ocean ridges.

The layer underneath is called the mantle with the plastic fluid part of the mantle is called the asthenosphere. Where the mantle meets, the crust is called the Moho. Finally, the crust and the upper rigid part of the mantle are collectively called the lithosphere.