GLG 110 - CHAPTER 1 – Fundamental Concepts

- Overstripping of the resources of Easter Island by people during the ~1000 years they lived there led to a societal collapse that left the island uninhabitable due to lack of resources. This is a stark reminder of what could happen on a global scale if we don't learn to be better stewards of our environment

- ***Geology*** is the study of the materials (rocks, minerals), structures (mountains, valleys, continents), and processes (volcanism, earthquakes, erosion) that occur on and within the Earth, and of the history of Earth and its ***biosphere***

    - ***Biosphere*** – the sum total of all living organisms on Earth

- ***Environmental Geology*** **(EG)** is the use of geologic information to help us solve conflicts in land use, to minimize environmental degradation, and to maximize the beneficial results of using our natural and modified environments, including the study of:

    - Rocks, minerals and soils
    - Natural hazards such as floods, landslides, earthquakes and volcanic eruptions
    - Land-use planning
    - Groundwater and surface water processes and pollution
    - Mountain building, erosion and deposition (piling up of sediments) processes

- Some fundamental concepts relating to **EG** include:

    - Human population growth
    - Sustainability
    - Earth as a system
    - Hazardous Earth processes
    - Scientific knowledge and values

- ***Human population growth*** is the number one environmental problem, and has exploded in recent human history due to:

    - ***Agriculture***
    - ***Sanitation***
    - ***Modern medicine***
    - ***Energy resources*** that are relatively inexpensive and readily available

- Current "doubling time" for human population on Earth is down to about 50 years – check out this website (6.64 billion as of 8/21/06):

    http://www.ibiblio.org/lunarbin/worldpop

- We are probably nearing the ***carrying capacity*** (perhaps ~10-15 billion) – the maximum number of people the world can hold without causing environmental degradation that reduces the ability of the planet to support the population

- ***Sustainability*** involves using resources at a rate and in a manner that allows them to be replenished or replaced in ways that are **not harmful to the environment**, that **increase the quality of life**, and that are **economically viable**

- ***Deforestation***, ***strip mining***, and ***overdevelopment of water resources*** has led to environmental crises throughout the world

    - Major problem is not one of entirely "destroying the Earth", but rather of destroying the ***quality*** of Earth environment w.r.t. humans (and other large organisms)

- ***Earth as a system***

    - **Changes** in systems are critical
        - ♣ Input/Output analysis
        - ♣ Residence time: T=S/F

    - **Uniformitarianism** – the present is the key to the past (and future)
        - ♣ Processes operating today have occurred before, and will occur again
        - ♣ Human activities **can** have a significant effect, particularly with flooding and erosion

    - **Earth Systems Science**
        - ♣ Lithosphere, biosphere, hydrosphere, and atmosphere are linked, and changes in one system (whether natural or man-made) can lead to changes in one or more others, often in a domino-like fashion
        - ♣ Challenge is to predict how changes will occur that may be important to society, and how societal changes may feed back into these systems
            - Good urban planning will take such matters into account
            - Climate change, like **global warming**, is an example of this

- ***Hazardous Earth Processes***

    - **Volcanic eruptions, earthquakes, landslides, floods**
        - ♣ Such processes have occurred throughout Earth history, but increasing numbers and concentrations of people and structures have led to increasing loss of life and property in recent times
        - ♣ Hazard assessments done by Environmental Geologists and others can be valuable tools in future urban planning and in minimizing losses of life and property in the future

- ***Scientific Knowledge and Values***

  - **Scientific Method**
    - ♣ Question --> Observations --> Refine question --> Pose **hypothesis** --> Test hypothesis (in a lab or in "the field")--> Accept or reject hypothesis --> mooooooooore testing ----------> **theory**

  - Time-frames involved in geologic processes can be immense:
    - ♣ Mountain uplift – takes millions of years to build mountains several km high
    - ♣ Erosion of land – takes millions to hundreds of millions of years to wear away a mountain range
    - ♣ Creep of soil and rock downhill under pull of gravity - ~1000 years to move 1 m
    - ♣ Coastal erosion – as high as 1 m/year
    - ♣ Glacier flow – 1m/year – 1 m/day
    - ♣ Lava flow – m's/day to m's/second
    - ♣ River flow during flooding – m's/second
    - ♣ Debris avalanche – 100s of km/hour
    - ♣ Earthquake rupture; asteroid impact – 1 to 10s of km/second\

  - Humans have been around for about 0.04% (1-2 million years) of **Geologic Time** (~4.56 billion years)

  - Global warming has occurred **naturally** since the last ice age (ended about 10,700 years ago), but is likely to have increased due to **human activities** (e.g., burning of fossil fuels) in the last 200 years
    - ♣ Release of carbon dioxide and other **greenhouse gases** (methane, esp. increases from decaying vegetation, garbage, and massive numbers of domesticated cattle)

  - **Land ethic** – we are citizens and caretakers, not just conquerors, of the environment, and should work to preserve it
    - ♣ New idea – within past century or so
    - ♣ National parks, monuments, forests, and wilderness areas are examples

  - Solutions we choose to solve environmental problems depend on how we **value** people and the environment
    - ♣ Can be tricky, since our genetics are essentially identical to ice-age hunter/gatherers, and many of our core attitudes evolved then/there
    - ♣ Hard-box vs. "greenbelts" for floodplains
    - ♣ Seawalls vs. setbacks (dunes, marshes, wetlands) for low coastal areas