GLG 101 – CHAPTER 21 - GLOBAL CLIMATE CHANGE

- ***Climate*** **–** characteristic atmospheric conditions (precipitation and temperature) over seasons, years, and decades

- ***Climate System*** – includes Atmosphere, Hydrosphere, Geosphere, Biosphere, and Cyrosphere (snow and ice)

- ***Climate Change Study***
  - Seeks to understand how our planet works, including the interactions of the atmosphere, hydrosphere, biosphere and solid earth
  - Multidisciplinary – chemistry, physics, meteorology, geology, biology
  - Ultimate goal is to be able to predict how changes in one part of the system do and will affect the others, and how climate is likely to change moving forward in time
  - Extremely challenging due to highly complex nature of atmospheric processes

- Climate change is important to society because it involves:
  - Changing weather patterns (intensity/frequency of storms, droughts, floods)
  - Changing sea level (coastal flooding in highly populated areas)
  - Changes in habitat for animals and plants (ecological/agricultural effects)
  - Potential changes in patterns of disease and famine

- Study methods (primarily review of climate data over time):
  - Written climate records
  - Tree rings
  - Ice cores
  - Lake sediments
  - Mathematical/computer models to predict future changes

- Human activity is contributing to climate change
  - Release of greenhouse gases, such as CO_2, methane, and *chlorofluorocarbons* (CFCs) traps heat near Earth's surface, increasing global temperatures
    - CFCs also have depleted ozone in Earth's upper atmosphere
  - ~1°C of global warming has occurred over the past two centuries
  - CO_2 levels have been rapidly increasing over this time-frame
  - Future human-induced climate change may accelerate due to the vastly increased CO_2 (about 35% more now than in 1800) in our atmosphere
  - CO_2 increase is due to massive burning of fossil fuels (coal, oil, natural gas) since the start of the "industrial revolution" in the early 1800s
  - Burning of fossil fuels continues to increase, with latest spike due largely to increased development of economies in Asia (India, China, S. Korea)
  - At the most basic level, *human population increase* (and the associated increase in energy needed to sustain society) is the primary cause
  - China and the U.S. are by far the two largest emitters of greenhouse gases
  - Even after greenhouse gas (e.g., CO_2) emissions max out and begin to

decrease, it will likely take centuries (or more) for global climatic and sea level conditions to stabilize

- Of all fossil fuels, burning of *coal* produces the most greenhouse gases per unit of energy, burning *oil* produces 23% less per unit energy, and burning of *natural gas* produces 28% less per unit of energy
    - However, burning of *any* carbon compound (including renewable biofuels like ethanol and biodiesel) produces CO_2/geenhouse gas!

- Use of corn or other food-staple based biofuels is more sustainable (renewable), but it can have widespread negative effects on global food availability and commodity prices that are immediately felt by the human population
    - Already food shortages, riots and economic hardship has been occurring in various places around the world

- Global warming produces sea level rise, as a result of melting of land-based polar ice caps (Greenland and Antarctica
    - Greenland ice sheet is melting at an increasing rate; Antarctic ice sheet seems to be stable or slightly increasing as of now
    - Seal level rise threatens low-elevation coastal cities (e.g., Miami, New York, New Orleans) with flooding and increased storm damage

- Natural contributors (i.e., non-human causes) include:
    - Orbital/Milankovitch cycles (ice ages vs. warm times)
    - Solar output
        - Currently on the rise – partly responsible for recent global warming
    - Volcanic activity
        - Rare, massive eruptions cause global cooling for months to years

- The sooner we adjust our activities to mitigate/reduce future negative effects from continued climate change/warming (sea level rise, flooding, drought, etc.), the easier it will be for us to possibly reduce or reverse the recent climate shift and reduce the negative effects on the human population

- Human response/adjustments can/should involve:
    - Reduction in use/burning of carbon-based fossil fuels
    - Sequestering carbon from atmosphere (e.g., “clean coal” technology)
    - Adapting to change
        - Coastal levees/barriers to flooding
        - Increasing efficiency of energy use
        - More renewable, non-greenhouse-gas-producing energy usage
        - Conservation and recycling
        - Changes in location and/or nature of croplands
        - Moving cities from endangered low coast areas(?)

- Because of dwindling fossil fuel supplies (we have several decades to a few

centuries of supply left), increasing sea level, increasing human population, increasing pollution and habitat destruction, and a lack of sufficient alternative energy source development at the present time, we are living in a highly *unsustainable* manner at the moment

- It is only through increased scientific understanding, public awareness, and societal attitude changes that we can hope to overcome the challenges of global climate change now and in the future

- Regardless of whether the current climate change is entirely, primarily, or secondarily due to human activities, it is still necessary to make significant changes in the way we produce and use energy and other resources, if we are to ensure the long term health of our planet's biosphere and the survival of humans as a species