Remember…

You are allowed to bring one standard sized sheet of paper (8 ½ x 11), covered on ONE side, with anything you like written on it! Calculators are allowed during the exam but USE OF CELL PHONES DURING EXAMS IS NOT ALLOWED.

Exam is Thursday, May 21st

INTRODUCTION

Earth Systems Science
Geography
The Spatial Science
- **Spatially (*changes in location)***
- **Temporally *(changes over time)***

Physical Geography
Meteorology
Weather
Climate
5 Themes of Geography
- **Location**
- **Region**
- **Human-Earth Relationships**
- **Movement**
- **Place**

Maps
Cartography
- **reference maps** and **thematic maps**.

Map Projections
Map Scale

$$\text{MAP SCALE} = \frac{\text{MAP DISTANCE}}{\text{EARTH DISTANCE}}$$

CHAPTER 1

Hazards from the Atmosphere:

Severe Weather

4 Spheres of the Earth

- **Lithosphere (Geosphere)**
  - **Igneous**
  - **Sedimentary**
  - **Metamorphic**
- **Hydrosphere**
  - **Stores**
- **Atmosphere**
- **Biosphere**
  - **Biotic**
  - **Abiotic**

Interconnections: **None of the spheres exist in exclusion.**
The atmosphere has changed substantially at least 4 different times on Earth.

Air: *What is it?*
Air is a combination of mostly 3 gasses

Air Composition

3 main: **Nitrogen, Oxygen and Argon** Know %'s

Also:

CO2
H20
Aerosols
Ozone

Air Pressure

highest at the surface and it gets
lower as we move up (away from the surface).
begins at the surface of the Earth and extend out to ~300 miles (480km).
At high altitudes, the amount of air molecules is much less than at the surface.

- **Stratospheric Ozone: Ozone hole and CFC's ← understand this!**

Atmospheric Profiles

Temperature: (4 different divisions)

"Sphere"	*Location*	*Effect*
Thermosphere	50 - 90 miles	Heated by incoming shortwave radiation, but kinetic energy
Mesosphere	30 – 50 Miles	Similar to troposphere, Normal Lapse Rate
Stratosphere	7.5 – 30 Miles	Heating by Ozone absorbing UV radiation
Troposphere	Surface – 7.5 Miles	Air cools as it rises due to pressure changes: the Normal Lapse Rate

Composition: (2 different divisions)

"Sphere"	*Location*	*Effect*
Heterosphere	50 miles - Space	Layered by atomic weight
Homosphere	Surface – 50 Miles	Mixed into a single "air" in the lower atmosphere by weather

Ozonosphere – where ozone is absorbing UV rays in the stratosphere
Ionosphere –electrically charged layer of the atmosphere

- **Aurora Borealis (northern lights) → NORTH**
- **Aurora Australis (southern lights) → SOUTH**

CHAPTER 2

Earth's Motions
Rotation vs. Revolution
Perihelion vs. Aphelion
Yearly Changes:

- **Seasons: *Why they occur?***
  - **Winter and Summer Solstice**
  - **Spring and Fall Equinox**
  - **January and July Earth Temperature Patterns**
- **Tilt of the Earth**
  - **23.5°**
  - **Always points in the same direction in space**
- **Sun Angle Changes**
  - **Longest and Shortest Day (Northern Hemisphere)**
  - **12 Hours of Day/Night everywhere on Earth**
- **Know the lines of the Earth**
  (Prime Meridian, International Date Line, Equator,
  Tropic of Cancer & Capricorn, Arctic & Antarctic Circle)

Forms of Energy
Energy: The capacity to do work
Kinetic Energy: Energy due to motion
Potential Energy: Energy that **CAN BE** put into motion
Temperature
Temperature: A quantity the describes how warm or cold an object is with respect to the standard scale US = **Fahrenheit** World (Science) = **Celsius** and **Kelvin**
Heat: The transfer of energy into or out of an object because of temperature differences between it and another medium
Temperature **ALWAYS** flows **DOWNHILL.**

The flow of heat energy can occur in three ways:
• Conduction
• Convection
• Radiation
All three can operate simultaneously
Convective Circulation: This is where material heated in lower areas, expands and rises, only to cool off and eventually condense and fall.

Earth's Energy Budget

INSOLATION:
IN = Incoming
SOL = Solar
ATION = Radiation

Albedo
High Reflectivity = High Albedo
Low Reflectivity = Low Albedo
KNOW SOME Common Surface Albedos
Energy Pathways:

- **Reflected**
- **Refracted**
- **Transmitted**
- **Absorbed**
- **Scattered**

Radiation
• Electromagnetic Radiation
– Wavelengths
• Short / Long
• Ultraviolet, Visible / Infrared
• Laws of Radiation
– All Objects Emit
• Hotter - More Radiation
• Hotter - Shorter Waves
• Absorb Well - Emit Well
Heating the Atmosphere
• Heating from the sun - top-down (shortwave)
•Heating from the bottom-up (long-wave)

The Greenhouse Effect
• Sun = Energy In (Shortwave)
• Shortwave passes through Greenhouse gasses in the Atmosphere
• Energy heats Earth's Surface
• Earth reradiates heat as Long Wave radiation
• Long Wave radiation is absorbed by Greenhouse gasses in the atmosphere
• This energy is then reradiated:
– Some is sent out to space
– Some is sent back to the Earth
– The Earth therefore is warmer than it normally would be
❖ **One way to remember this is that it is like a credit card with a cashback bonus!**

The Role of Clouds in Heating Earth
Heat Budget
Latitudinal Heat Transfer

CHAPTER 3 - Temperature

Temperature Data
- Daily Mean Temperature
- Daily Temperature Range
- Monthly Mean Temperature
- Annual Mean Temperature
- Annual Temperature Range

What do these terms mean?
- Mean = Average (total / number)
- Range = "Spread" of values (high – low)

Daily Mean Temperature	Total 24 Hourly Readings / 24 or Daily Max + Daily Min / 2
Daily Temperature Range	Daily Max – Daily Min
Monthly Mean Temperature	Total Daily Means / # Days
Annual Mean Temperature	Total Monthly Means / 12
Annual Temperature Range	Max Monthly Mean – Min MM

Mapping Temperature
- Isotherm: Lines of equal temperature
  - Iso = Equal
  - Therm = Temperature

Standard "look" of a weather map showing temperatures
- Temperature Gradient: Temperature change per unit of distance
  - Closely spaced lines equal rapid rate of change
  - Widely spaced = slow temp change

Controls of Temperature
1) Earth/Sun Relationship
   a) Sun Angle
   b) Length of Day
2) Differential Heating of Land and Water
   a) Specific Heat
   b) Amount Heated
   c) Conduction vs. Convection
   d) Evaporation
3) Ocean Currents
   a) Transfer of Heat
   b) Warm and Cold Currents
4) Altitude

a) Environmental Lapse Rate OR Normal Lapse Rate
b) Formulae
c) 3.5° f / 1000 ft
d) 6.5° c / 1000 m

5) Cloud Cover
   a) Day / Night

6) Albedo
   a) Reflection
7) Geographic Position
   a) Combination of influences

Know these ocean currents: C = COLD W=WARM

- Alaska Current (W)
- Alaska Current (C)
- North Pacific Current - W
- California Current - C
- North Equatorial Current - W
- South Equatorial Current - W
- Labrador Current - C
- East Greenland Current - C
- Gulf Stream - W
- North Atlantic Current - W
- Canary Current - C

World Temperatures

- Seasonal Difference
- Annual Temperature Range
- Northern vs. Southern Hemispheres

World Temperature Range:
Max Monthly Mean – Min Monthly Mean

Cycles of Air Temperature

- Daily March of Temperature
- Annual March of Temperature
- Lag of the MAXIMUM
  - Surplus continues to exceed deficit after MAX Input
  - Max daily temperature → 2:00-3:00 pm
  - Max annual temperature → late July - early August

Applications of Temperature

1. Temperature and Comfort
   Our bodies are susceptible to factors (besides actual temperature) that effect how it "feels" outside
   - Relative humidity
   - Wind
   - Solar Radiation

a) Heat Stress
    1. High humidity → less evaporation from skin
    2. Hot & Humid (muggy) “feels” warmer
b) Wind Chill
    1. Wind penetrates clothing → less insulation
    2. Higher winds “feels” colder