

2/24- Climatology part 1

- Geology in the News: dating of remains in Oregon caves sheds new light on human migration into the Americas
- Climate Basics
 - o Why do we care?
 - It is a big part of what geologists study
 - Since earth is the only place we have to live, we have to deal with the weather and conditions we have, and it is in our best interest to understand them. We also need to know what's going to happen in advance (weather forecast) to be prepared
 - o **Climate**: average surface conditions on earth over long time scales (minimum 10 years of data)
 - o **Weather**: average surface conditions on earth over short time scales (days, weeks, months, seasons)
 - ex- weather today (snowy) is not Clemson's climate
 - o Why is climate so difficult?
 - has an understanding of many different fields
 - Many scientists from different areas must work together to accurately measure the climate
 - The entire world has many different climates going on at one time
 - We have to understand all of the locations because they all interact with each other in very complex ways
 - **Feedback**: when you change 1 variable, it triggers a series of changes that causes the variable to change again. ****BE SURE YOU CAN IDENTIFY****
 - **Positive feedback**: change in 2nd component loops back and enhances the change in 1st component.
 - o ...when A increases, B changes, causing A to increase again
 - ex- temp raises → ice melts → temp rises more
 - o A can also decrease every time the cycle goes around, too
 - ex- lower temp → more ice forms → temp drops again
 - o Hard to break out of , system keeps spiraling out of control until an outside force interrupts it.
 - **Negative Feedback**: change to the 2nd component offsets the initial change in the 1st component.
 - o 1- A increases, B decreases
 - o 2- B decreases, A decreases

- o 3- A decreases, B increases
- o 4- B increases, A increases (back to step 1)
- o ex- you do poorly on exam 1, so you start to study more. You do better on exam 2, so you start to slack off, and thus do poorly on exam 3.
 - Creates a stabilizing see-saw effect
- What Controls Climate?
 - o Temperature is a key variable
 - Earth gets most heat energy from the sun
 - **Insolation:** energy the earth receives from the sun (in=incoming, sol=solar, ation=radiation)
 - Several things affect how much insolation earth receives (but most have no impact on immediate times, they take thousands of years to take effect)
 - how far away the earth is from the sun (farther=less)
 - o Aphelion: 152 million km- earth is farthest from the sun
 - o Perihelion: 147 million km- earth is closest to the sun
 - o These occur because earth's orbit is elliptical
 - This is not the reason for summer! In the winter, we are actually in perihelion
 - **Milankovich cycles:** cycles to describe how the earth moves
 - o 1- **Eccentricity:** the shape of earth's orbit as it moves around the sun
 - shape changes over time
 - over periods of time, earth changes the orbit slightly
 - eccentricity maximum=very elliptical
 - eccentricity minimum=more circular
 - 50,000 years to get from max to min & vice versa (100,000 total)
 - ice ages are related to eccentricity
 - last ice age matches up with cycle!
 - o 2-**Obliquity (tilt):** describes how earth is tilted on its axis
 - over long time scales, this axis angle changes
 - earth=giant rocking chair
 - rock forward (22.5 deg)
 - rock backward (24.5 deg)
 - cycle takes 41,000 total (20,000 years forward)

- obliquity is why we have opposite seasons in the N/S hemispheres
 - **seasonal contrast:** how different are the summers and winters? (hot summer → freezing cold, or mild both ways)
 - o low obliquity angle = low seasonal contrast
 - o high obliquity angle = high seasonal contrast
 - o **3-Precession:** as earth is rotating on its axis, it has a slight wobble, like the top of a spinning top.
 - 1 full wobble takes about 22,000 years
 - affects what time of year we experience seasons
 - in 11,000 years, Feb will feel like summer in the N hemisphere (seasons will flip)
- o Atmospheric heat conditions
 - A lot of solar radiation (30%) never reaches earth/doesn't stay long enough to warm it up
 - **Albedo:** measure of reflectivity of different materials and different surfaces
 - 4% reflects off the ground
 - 6% bounces off of gases in atmosphere (never makes it to the ground)
 - 20% is reflected off clouds
 - Atmospheric gases: Nitrogen-78%, Oxygen-21%
 - **Greenhouse gases:** good at preventing insolation from bouncing off the surface of the earth (trap insolation and keep it closer to the earth)
 - o All together, GG make up less than 1% of the atmosphere
 - **Greenhouse effect:** sunlight provides heat energy, but gets held inside by the glass
 - Without greenhouse gases, earth's mean surface temperature would be 33 degrees C lower.
 - Insolation Changes with latitude
 - Why are the poles colder than the tropics?
 - o Light energy is concentrated on a small area when it reaches the equator
 - o Energy falls over a larger area closer to the north pole