

INTRO TO SCIENCE & EARTH'S FORMATION

I. WHAT IS SCIENCE?

- Science is a method of trying to understand what goes on around us
- It's not the only way of viewing the world (other ways include philosophy, religion, etc.)
- Science uses facts (something you can repeatedly prove is true) and principles (revolutionary idea that has been tested/proven so much that it is now fact; seem like common sense) to explain things
- Scientific Method
 - o Step 0: Observation
 - Ex: Dimetrodon has a spiny sail
 - o Step 1: Question
 - Ex: What was the sail for?
 - o Step 2: **Hypothesis** (an educated guess)
 - Use your Question and any background info you already know
 - Hypotheses must be testable & predictable
 - Can be about past/present/future events
 - Does it pass the "if-then test?"
 - Ex: If the sails were colorful, then they were a mating display
 - It does not matter how difficult or easy the hypothesis is to test, as long as "if-then" test is passed, it's a good hypothesis
 - o Step 3: Data
 - "classic" part of science- lab work & experiments
 - o Step 4: Evaluation
 - Do the data support the hypothesis or not?
 - In most cases, the hypothesis is wrong
 - Try it, get it wrong, try something else
 - Ex: Edison made ~200 failed lightbulbs before he got one to work; "it never bothered

me at all when something failed” because w/ each experiment he collected more data

- **Theory**- idea that has a lot of data supporting it; scientists see it as a compliment
- **Law**- so much data backing it up that it's almost irrefutable
- Theories and laws are tested and revised too
- One must have scientific data to challenge scientific ideas (use facts, not beliefs)

II. WHAT IS GEOLOGY?

- Greek- the study of the earth
- It's a newer science- goes back to 1800s
- Earlier approaches
 - o **Catastrophism**- everything on earth was formed from 6 giant catastrophes
- History
 - o James Hutton- studied natural world; published textbook Theory of the Earth; first ideas of geology
 - o **Principle of Uniformitarianism**- present processes are the same as past processes
 - Ex: every time it rained, small amounts of dirt would slide down a hill, that eventually would build up & the river would have to move around it
 - o Earth didn't change because of 6 big things but very many small things; do not compress Earth's history
 - o Actualism- uniformitarianism (rule) revised to include catastrophes (exception)
 - Ex: regular erosion & comet colliding with Earth
 - o Meteorites enter Earth's atmosphere at up to 40 km/s (90,000 mi/hr); when it hits it is going to lose a lot of energy
 - Ex: 30 m diameter meteorite at 15 km/s impacts the earth & releases energy equivalent to 4 million tons of TNT

III. HOW DID THE EARTH FORM?

- Before 6 bya (billion years ago), there was no solar system, just a nebula of hydrogen (H) atoms
- **Nebula**- large cloud of gas in space
- Forming the Solar System (**nebular hypothesis**):
 - o Step 1: Gravity
 - There is a gravitational presence between all objects
 - H atoms drawn together over time, temperature increases by millions of degrees
 - o Step 2: **Solar Disk Model**
 - Cloud is rotating & flattening
 - o Step 3: **Protostar**
 - Trying to become a star but not quite there
 - o Step 4: **Fusion**
 - Combining separate atoms ($H+H=He$)
 - Takes a lot of energy
 - Once fusion happens, Protostar becomes Star
 - This new star becomes our Sun
 - Surrounding disk begins to cool; particles can come together & begin to form planets
- Forming the Planets
 - o **Planetary accretion**- tiny particles move really fast so when they collide they combine (speck --> ball --> rock --> boulder --> asteroid --> planet)
 - o Uniformitarianism
 - o 4.5 bya Earth (& other planets) accreted most of what is here now
 - o Planetary accretion still happens today (it was responsible for the fireball over Russia)
 - o **Theia Impact**- planet that collided with Earth after it formed
 - Remnants of impact accreted & formed the moon
 - Higher density in the center; lower at the surface