- The Moon’s surface is covered in craters. This indicates that the surface of the Moon:

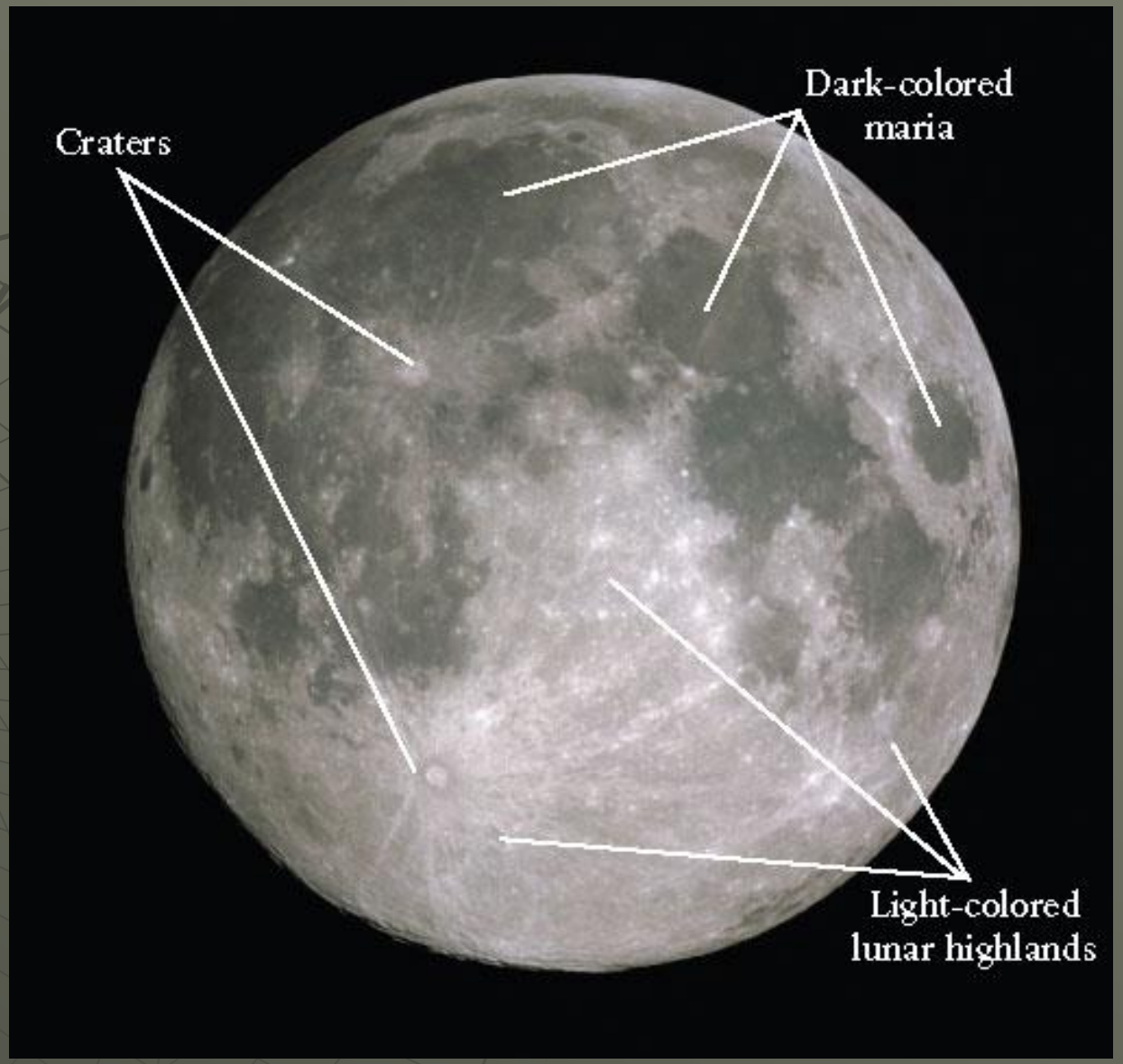
A. is very young
B. is very old
C. is the same age as the surface of Earth
D. was born yesterday

The Moon

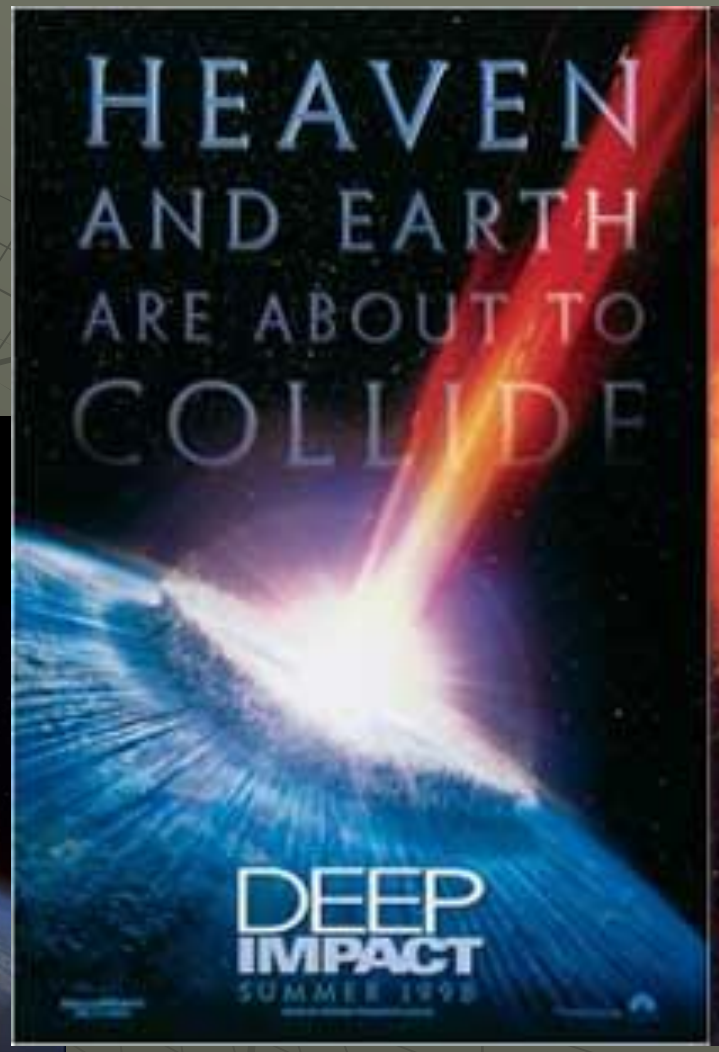
- Objectives
  - Surface of the Moon
  - Craters/Impacts
  - Moon Formation

Surface

- Maria: Dark, low lands
- Highlands: brighter, highlands
  - Several km above lowlands
- Craters!
  - Caused by asteroids, comets, other debris still flying around in the solar system.



Impact Movies!!!!



Who volunteers to stay behind and detonate the nuke!

Reality

- 1000's the size of rice /day
- 1 or 2 the size of a basketball/day
- 1 per week: car
- 1 per couple months: house
- All mostly breakup in the atmosphere

1 every 100's of Years

1908 over Siberia. ~100 m asteroid 10's of Megatons of TNT energy

Never hit the ground. It exploded just above!

Meteor Crater

- 1 mile diameter
- 500 ft deep

- Meteorite~50 m
- Struck the earth at 20 km/s!!!

Order of Millions of Years

Map showing asteroid impact in Gulf of Mexico

- Found shocked quartz and iridium in the layer of rock that corresponds to a mass extinction

- Estimates of the impact:
- 10 km meteorite
- 100 tera-tons of TNT explosion
- Possibly created the gulf of mexico???

Conservation of Energy

- **Conservation of energy:** energy cannot be destroyed or created.

- **Potential Energy (PE):** the energy of an object due to its position

$$PE = mgh$$

- **Kinetic Energy (KE):** energy of a moving object

$$KE = \frac{1}{2} mv^2$$

- Energy units: ergs ($g*cm^2/s^2$)

PE (ergs) = mgh

- If you make a crater in a tub of sand by dropping a ball of 200 g from a height of 100 cm, what was the potential energy of the ball right before you dropped it?

A. 20,000,000 ergs
B. 200,000 ergs
C. 20,000 ergs
D. 20 ergs

g=acceleration on the Earth's surface=980 cm/s^2
*you can round to 1000 cm/s^2

KE (ergs) = ½ mv^2

- If a ball of 200 g was dropped from a height of 100 cm and reached a velocity of 450 cm/s right before it hit the sand, what is it's kinetic energy right before it hit the sand?

A. 20,000,000 ergs
B. 200,000 ergs
C. 20,000 ergs
D. 20 ergs

Conservation of Energy
KE = PE
$\frac{1}{2} mv^2 = mgh$

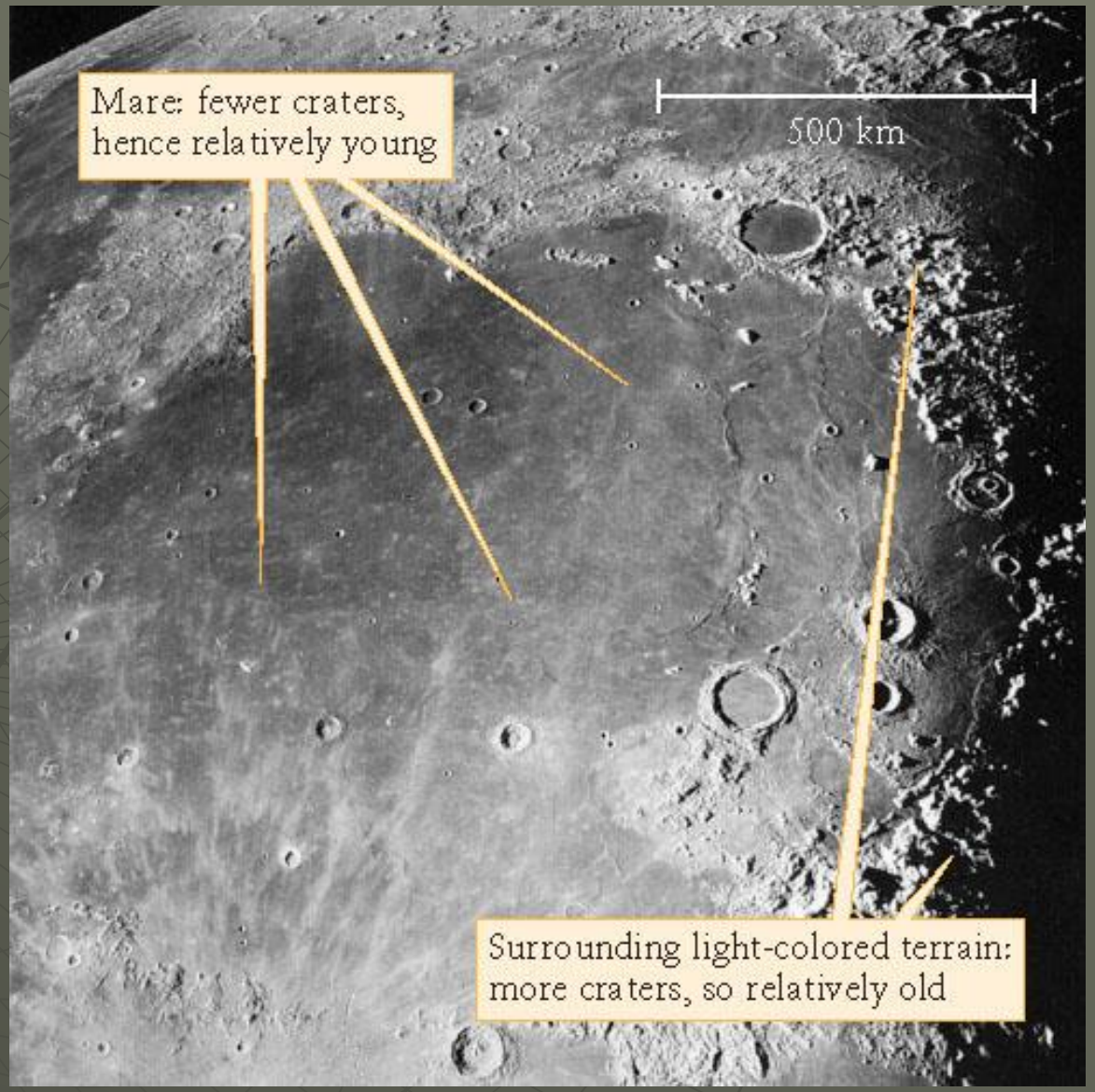
Why do we See lots of Craters on the Moon?

A: No Atmosphere & No Plate tectonics

Which parts of the Moon are older?

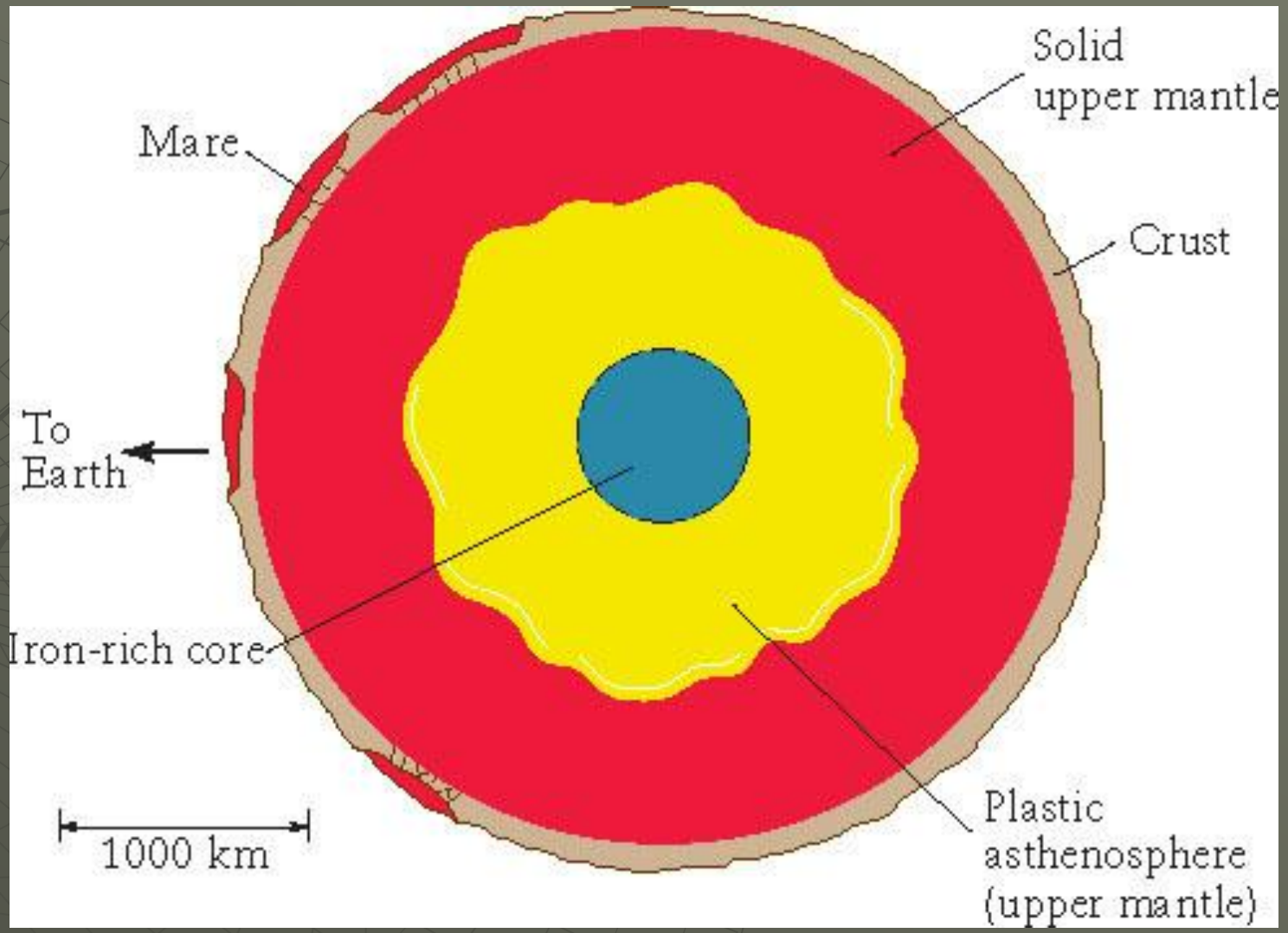
Less craters = younger

More craters = older



Moon Quakes

- Seismographs placed on the Moon
- No Plate Tectonics
- No magnetic field
- Earth' tidal forces



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TPS

- Why don’t we see MAJOR impact craters all over the Earth’s surface?

A. The Earth’s atmosphere protects us from impacts
B. The Earth is geologically active, and its surface is constantly being eroded
C. The Earth’s magnetic field diverts asteroids and comets away from the surface
D. Asteroids/comets hardly ever strike land
E. Chuck Norris roundhouse kicks all potential impacting bodies back to space

Moon Rocks

- Moon rocks are made of the same minerals found on Earth
  - Maybe The Moon formed of the same material???

- All are igneous (volcanic) rocks- no sedimentary or metamorphic. This suggests that the whole lunar surface was once molten

Formation of the Moon

Three possibilities were originally proposed for the formation of the Moon:

1. Fission theory- the Moon broke off of the Earth back when it was spinning faster
2. Capture theory- the Moon formed somewhere else and was captured by the Earth
3. Co-Creation theory- the Moon and Earth formed at the same time via the collisions of planetesimals

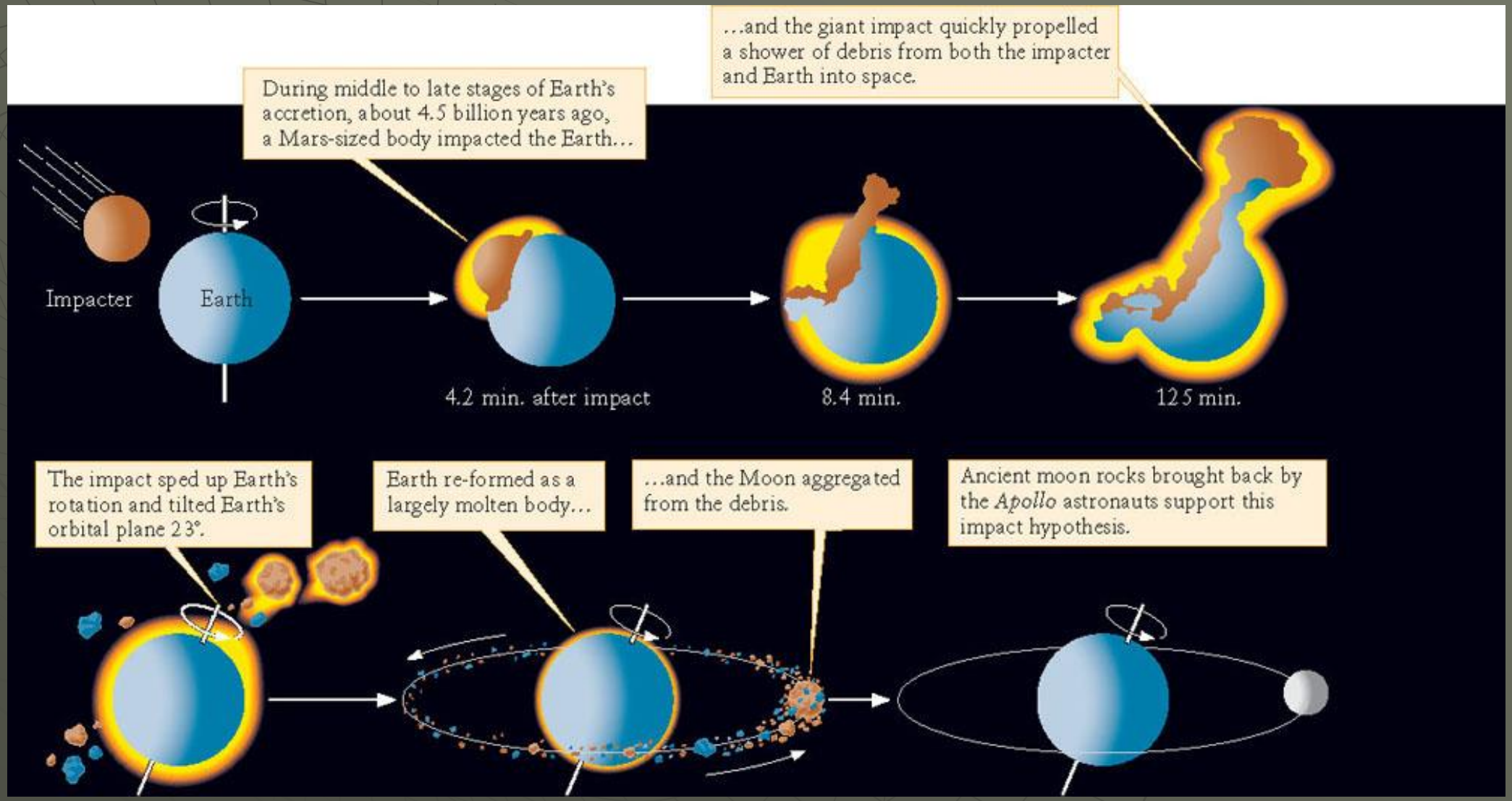
Formation of the Moon

- *Collisional ejection theory*- a Mars-sized object hit the Earth off-center and ejected what formed the Moon.

- The absence of volatile elements & water suggest the Moon rocks were once extremely hot (big impact)

- Moon has less iron. Fe had already sunk to the core of Earth and wasn't ejected in the impact. And it explains Earth's tilted axis!

Moon Formation



- The fact that fewer craters are found in the maria regions of the Moon than surrounding regions suggests that the maria are

A. younger surfaces
B. composed of less dense material
C. lower in elevation and harder to hit
D. thicker layers of crust that are more resistant to impacts.

Scientific Notation

- $20 = 2 \times 10^1$ (twenty)
- $2000 = 2 \times 10^3$ (2 thousand)
- $2{,}000{,}000 = 2 \times 10^6$ (2 million)
- Multiplication:
- $2 \times 10^6 * 2 \times 10^3$
- $= 2*2 \chi 10^{(6+3)} = 4 \times 10^9$
- Division:
- $2 \times 10^6 / 2 \times 10^3$
- $= 2/2 \chi 10^{(6-3)} = 1 \times 10^3$