

SIO15: Natural Disasters – Forces&Energy

<https://geowiki.ucsd.edu/sio15>



SIO15 (10/1/25): Topic 02: Forces and Energy – Part 2

Today's Lecture

sorry about the confusion today

... but this is a life & death situation



Chewbacca (Chewie)

<https://geowiki.ucsd.edu/sio15>

SIO15 (10/1/25): Topic 02: Forces and Energy – Part 2

Basic Types of Energy

short Videos on forces, energy (topic 2)

- potential (e.g. landslide, earthquakes, plate tectonics)
- kinetic (e.g. wind storms, landslides, volcanoes)
- rotational (e.g. Earth, Earth-Moon, tornadoes, landslides)
- heat (e.g. volcanoes, plate tectonics, severe weather)

internal heat

“primordial” +
radiogenic

fission

external heat

SUN



fusion

Earth's 4 External Sources of Heat

- Earth's surface receives 5300 times more heat from sun than from inside
- sun's energy produced by nuclear fusion

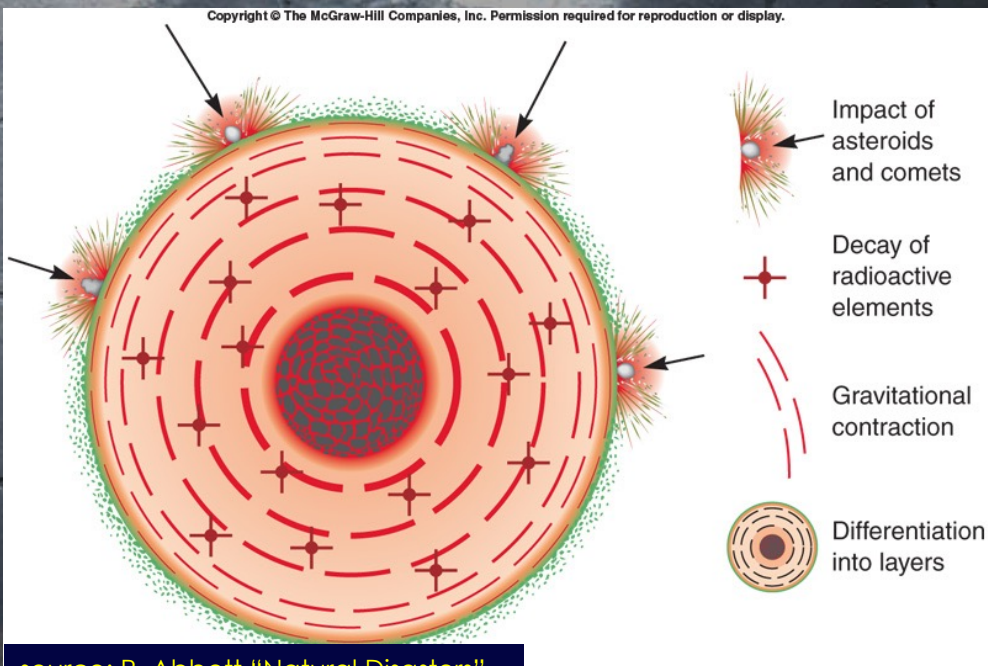


Sun provides huge amounts of energy to drive weather disasters

Earth's 4 Internal Sources of Heat

- numerous early impacts during formation
- early gravitational compression
- differentiation (sinking of heavier elements)
- decay of radioactive elements (fission)

primordial heat

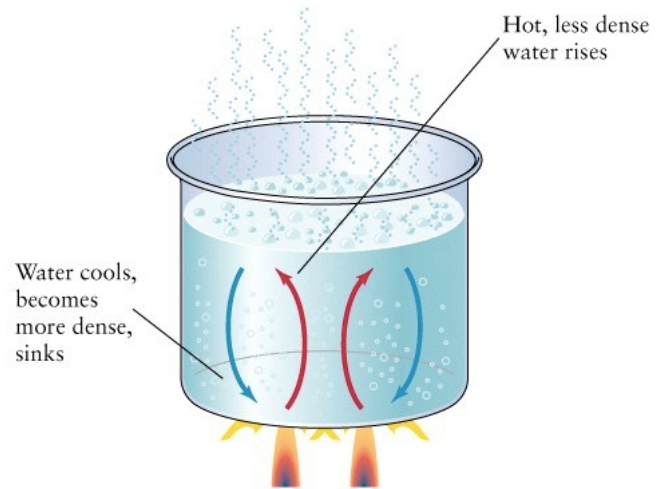
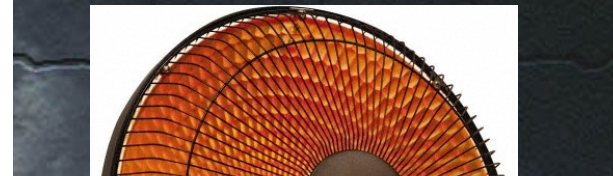
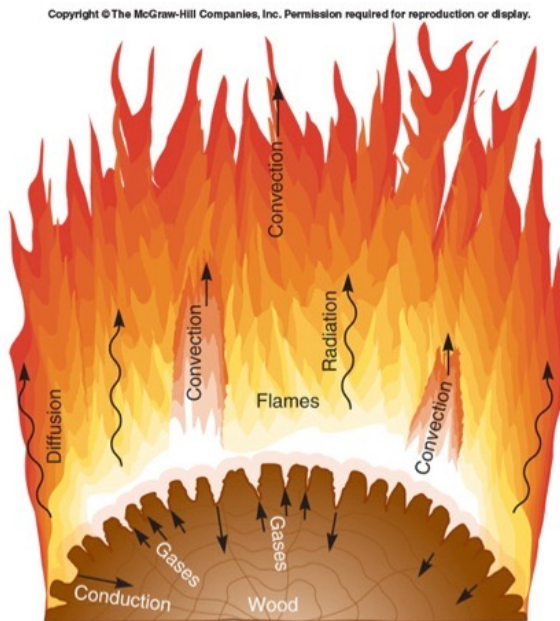


source: P. Abbott "Natural Disasters"

4 Ways to Transport Heat

- conduction (energy passed between vibrating atoms)
- radiation (EM waves, no particle movement)
- diffusion (migration of single particles)
- convection (mass transport; MOST EFFECTIVE)

Fig 2.11

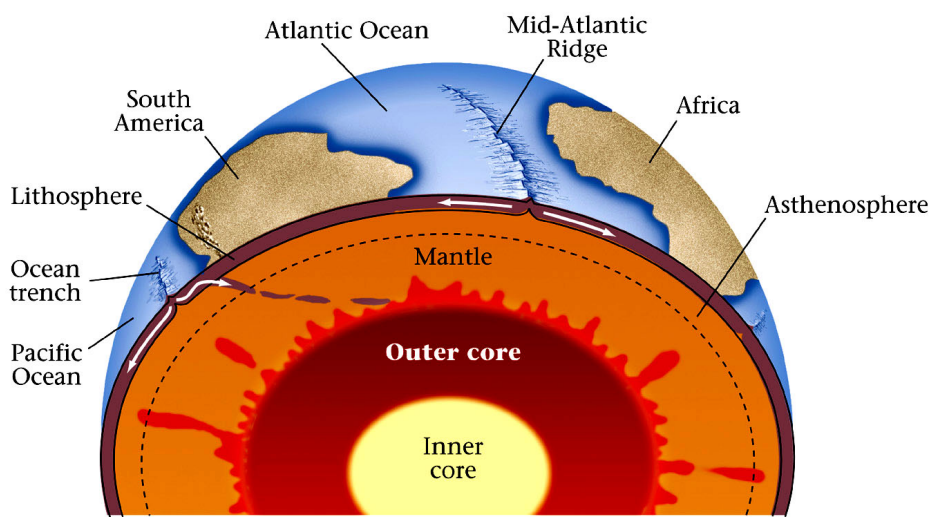


Source: P. Abbott "Natural Disasters"

Earth's Internal Heat and Mantle Convection

- mantle moves/convects over geologic times (a few cm/yr)
- -> plate tectonics on surface
- -> earthquakes, volcanoes, uplift and landslides

Fig 4.17



Source: S. Marshak "Earth, Portrait of a Planet"

of a Planet, 2nd Edition
W. Norton & Company



a little bit like this

Latent Heat

“hidden heat”

Heat Capacity: ability to absorb heat while temperature rises slowly

Air:	0.00031
cal/cm ³ /°C	
Quartz Sand:	0.31
Granite:	0.51
Water:	1.0
Aluminum:	0.215
Copper:	0.0924
Glass:	0.20
Human body:	0.83

Table 2.1

- water has high heat capacity!
- serves as **moderator**

The 3 Phases of H₂O

any substance

solid

liquid

gas

- ice
- water
- water vapor

any phase change costs or releases energy

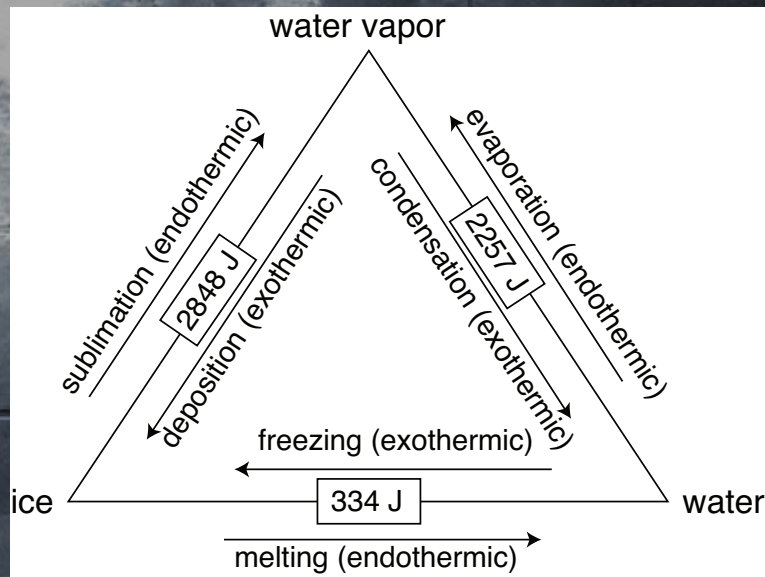
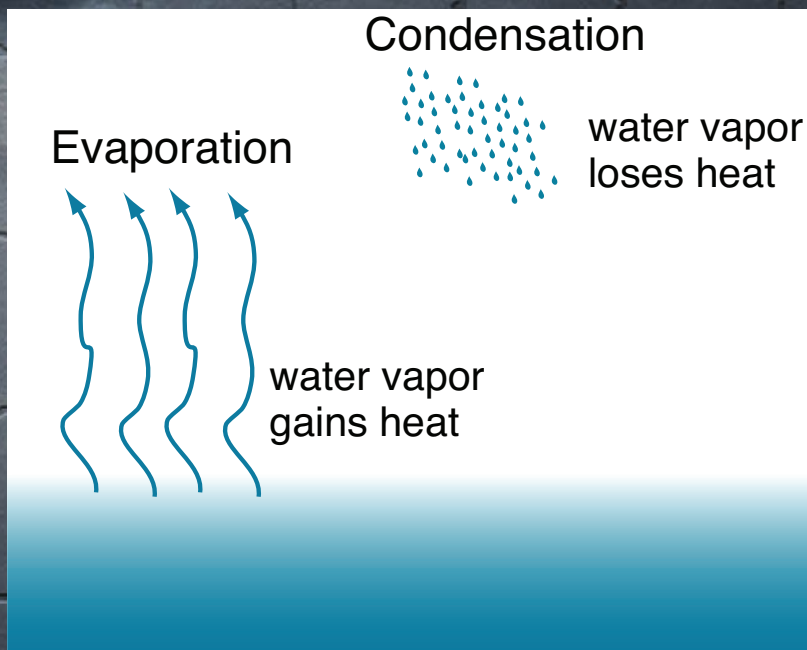


Fig. 2.12

Latent Heat, Evaporation and Condensation



evaporation:
water vapor absorbs heat

condensation:
water vapor releases heat

Fig. 2.13

*it takes 600 cal to
evaporate 1g water*

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Earth-Moon system: potential, kinetic, rotational

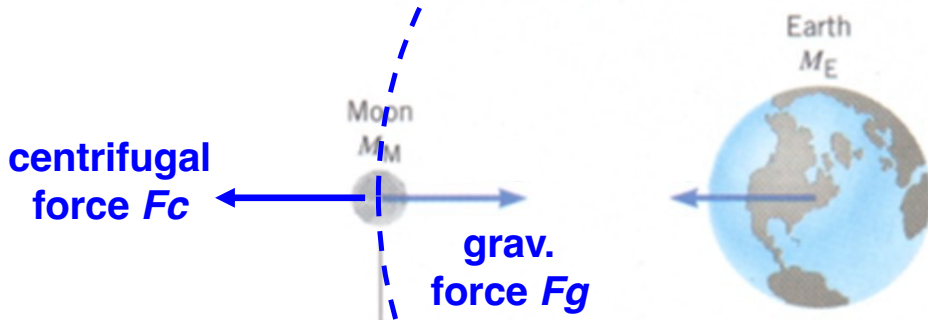
video 2b

Gravitation

video 2b

attraction of bodies due to their mass

attracting force:
gravitational force
 F_g



Q: If Earth pulls with force F_g on the Moon, why does the Moon not smash into Earth?

Energy in Earth-Moon system:
kinetic
rotational (Moon, Earth)
potential
The orbiting motion causes an acceleration and thereby a force (centrifugal force) that counteracts Earth's attraction.

The Moon and Earth: Different Types of Energy

Moon has potential energy because it is attracted by Earth

$$E_{pot} = M_M \times g \times h$$

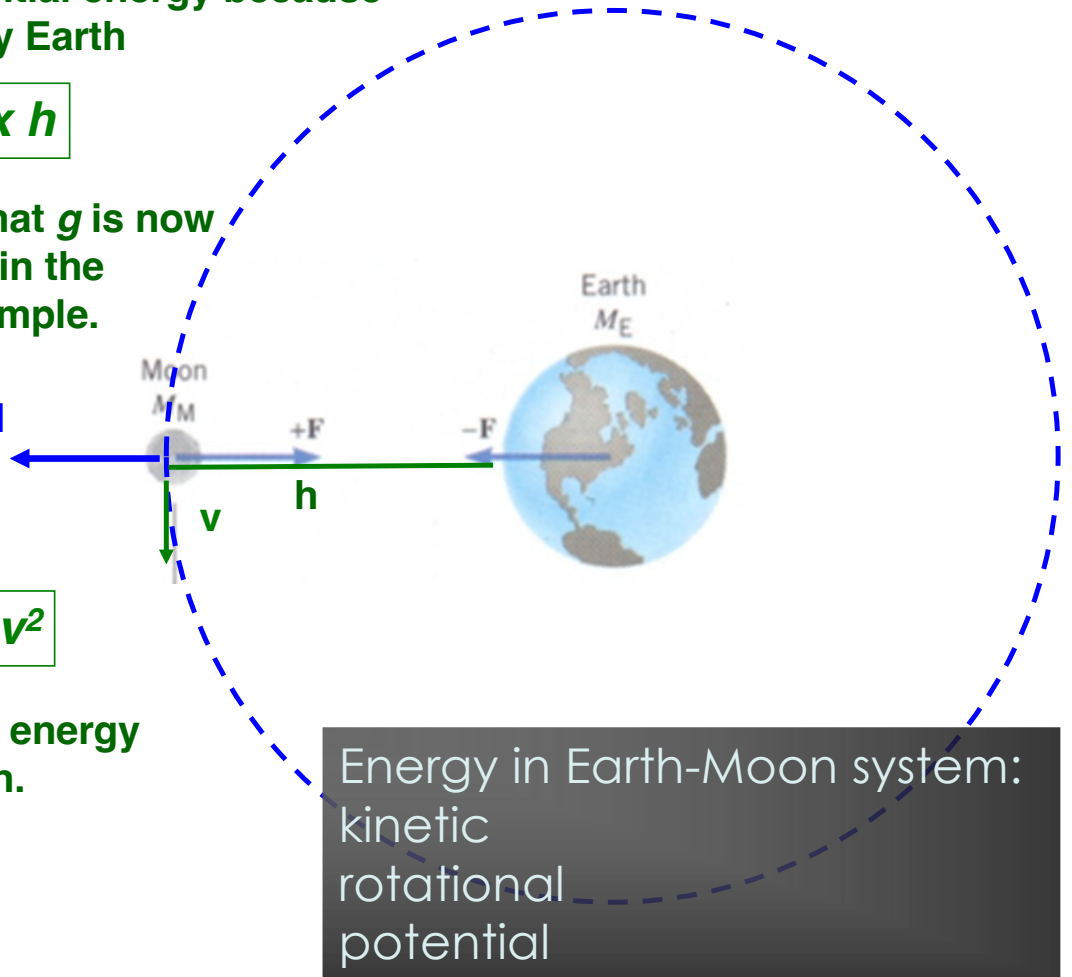
though remember that g is now different from the g in the Newton's Apple example.

centrifugal
force

$$E_{kin} = 1/2 m \times v^2$$

Moon also has kinetic energy because it orbits Earth.

Energy in Earth-Moon system:
kinetic
rotational
potential



The Moon and Earth: Different Types of Energy

$$E_{kin} = 1/2 m \times v^2$$

