



Earth & Moon Interactions

- **tides**: Moon pulls *gravitationally* on *both sides* of Earth, but *most strongly* on *closest side* - *Why?*
- *Sun* also pulls on Earth & *causes tides*
- *solar tides* are $\sim 1/2$ as strong as *lunar tides*

- *far side* of Earth gets *pulled on least*

ocean Earth Moon

- *wrt* the **center** of the *Earth*, you get:

- *at any time* on Earth there are *two high tides* & *two low tides*

Earth, Moon, Oceans

Mont Saint-Michel, France



- **Spring Tides** occur during *New & Full Moon*

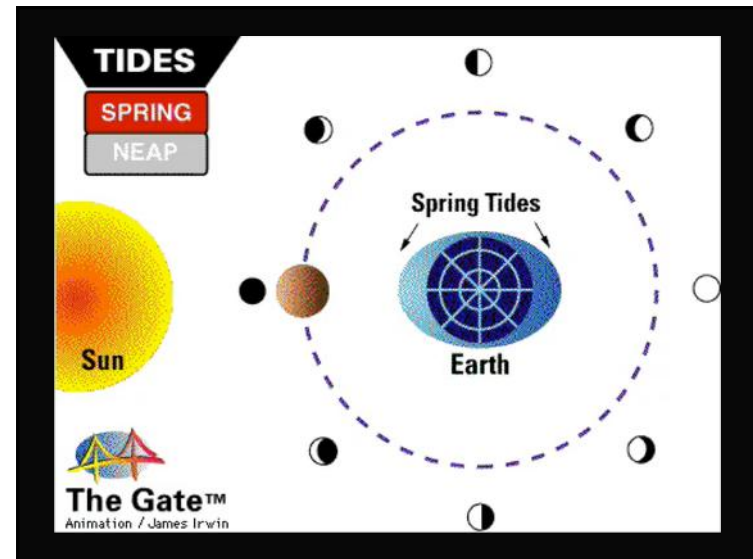
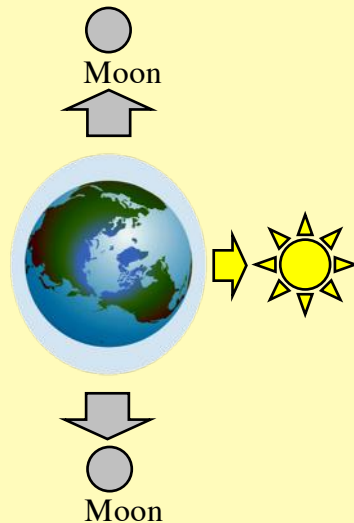


- Sun & Moon create *tides* in *same* direction
- *largest high tides*
- *smallest low tides*

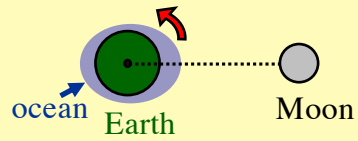
- **Neap Tides** occur during *1st & 3rd Quarter Moon*

- solar & lunar *tides* are *perpendicular* (at 90°)
- *lowest* high tides
- *highest* low tides

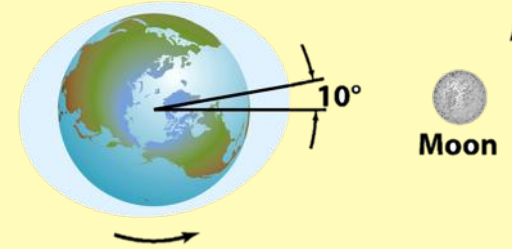
Q: Why are high tides below Moon, not Sun?



- if Earth did *not rotate*:



- Earth's *rotation* moves *tidal bulge* ahead of Moon
- Moon “pulls” *tidal bulge* back towards itself
- *friction* between Earth & ocean keeps *tidal bulge* from moving *all* the way back beneath Moon
- *result*: *tidal bulge* “leads” Moon



- Moon pulls on tidal bulge *against Earth's rotation*
- Earth's *rotation slows*
- may have been as fast as *6 hours* in the past
- Earth's tidal bulge *pulls on Moon, speeding it up*
- Moon's *orbit* moves away from Earth *~4 cm/year*
- may have been *10 times closer* in past



CLICKER: The *lowest* high tides occur during a...

- (a) *Full Moon*
- (b) *New Moon*
- (c) *1st Quarter Moon*
- (d) *Waning Gibbous Moon*

Synchronous Rotation

- Moon *rotates* once every *27.3 days* on its axis
- Moon *revolves* once every *27.3 days*... called?

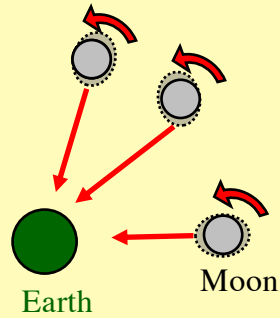
Q: *Result?*

- *always* see *same side of Moon* from *Earth!*



Q: Why is the Moon in synchronous rotation?

- early Moon was still *partially molten*
- Earth *pulled on Moon*, causing "*lunar bulge*"
- *like tides on Earth*, grav pull on lunar bulge affected *Moon's rotation period*



- *nearside*: side of Moon *facing* Earth
- *farside*: side of Moon *facing away from* Earth
- *darkside*: *unlit* side of Moon

*CLICKER (T/F): The **farside** is **always** dark.*