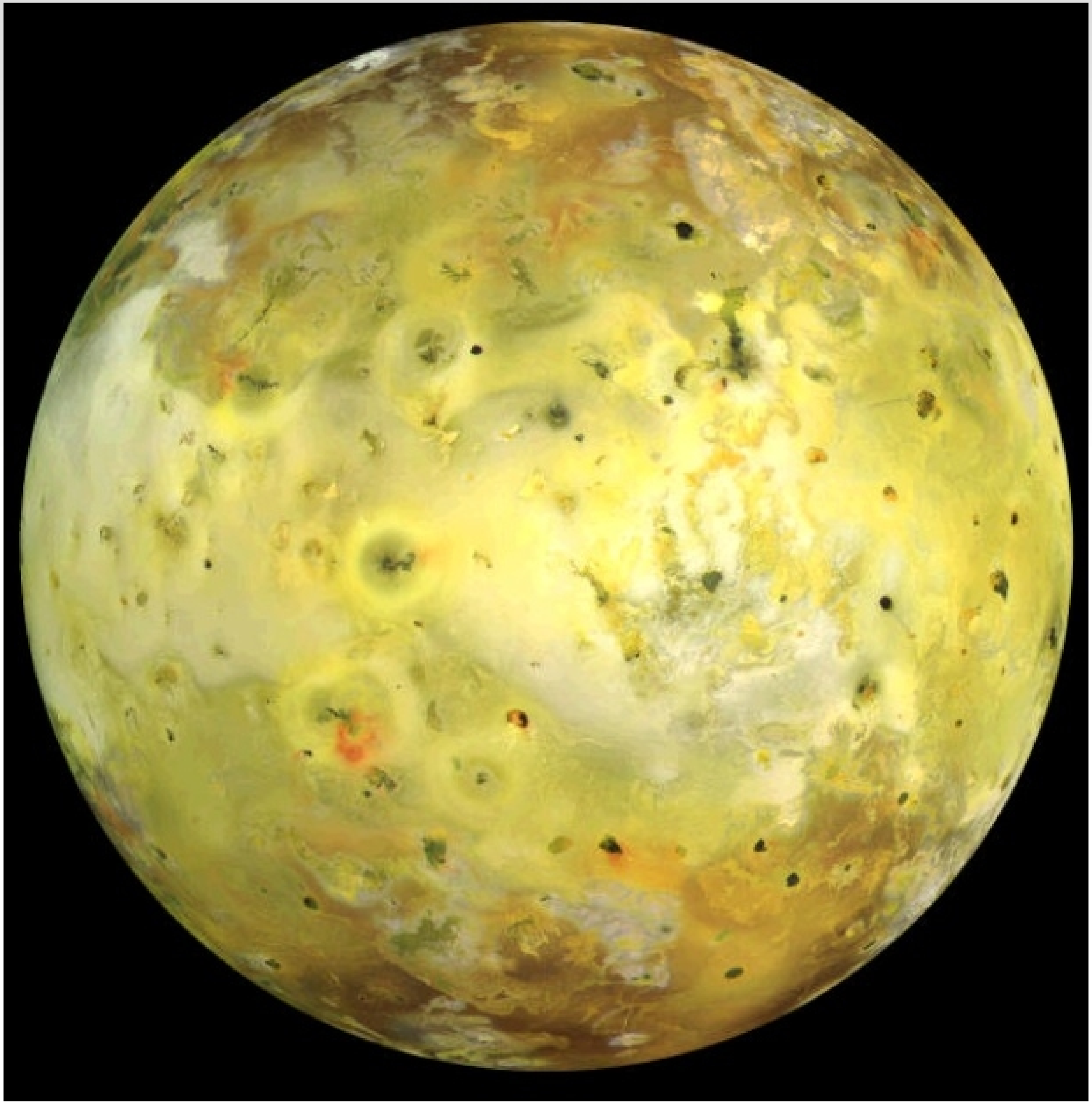
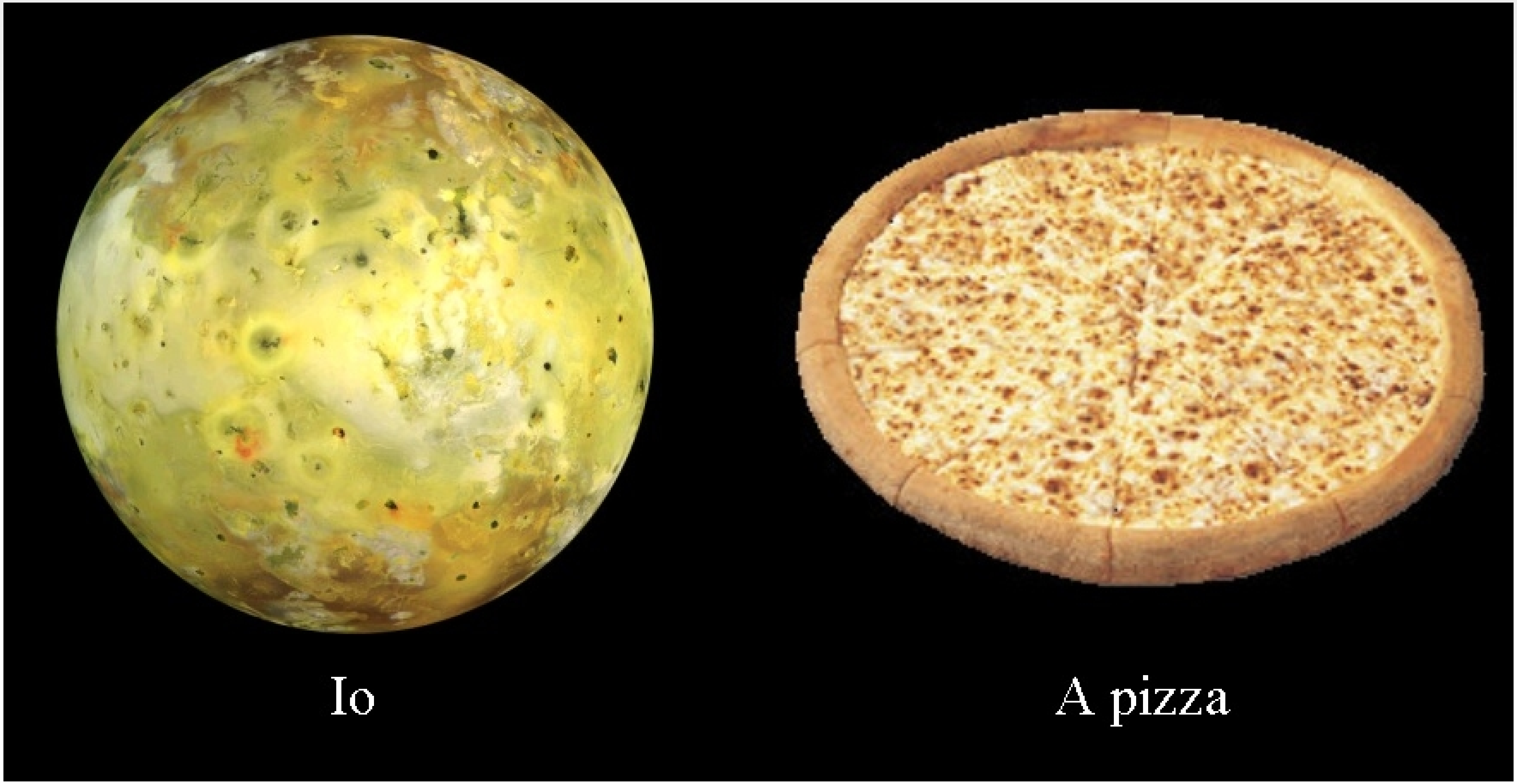
Tidal Heating of Io

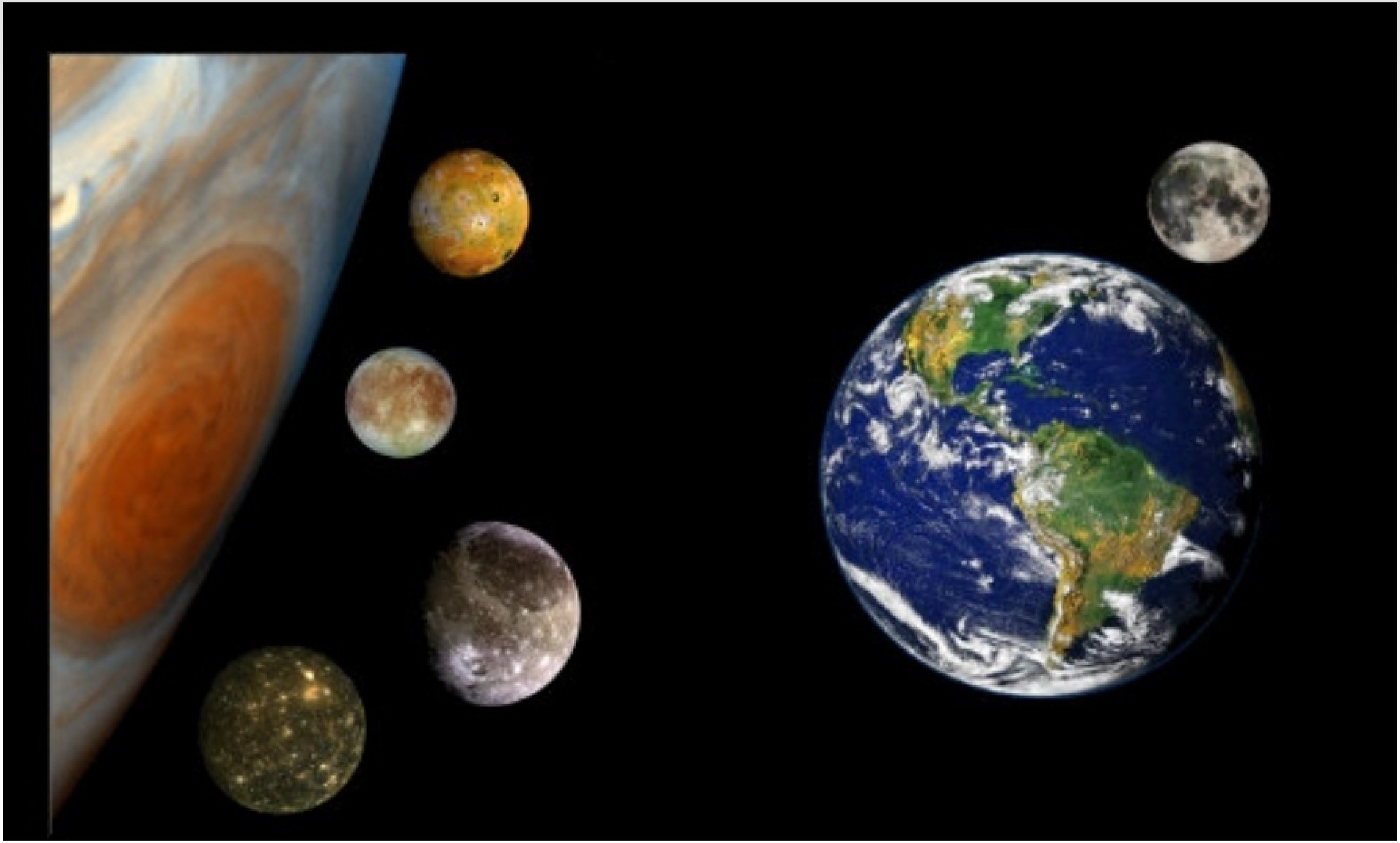
Io

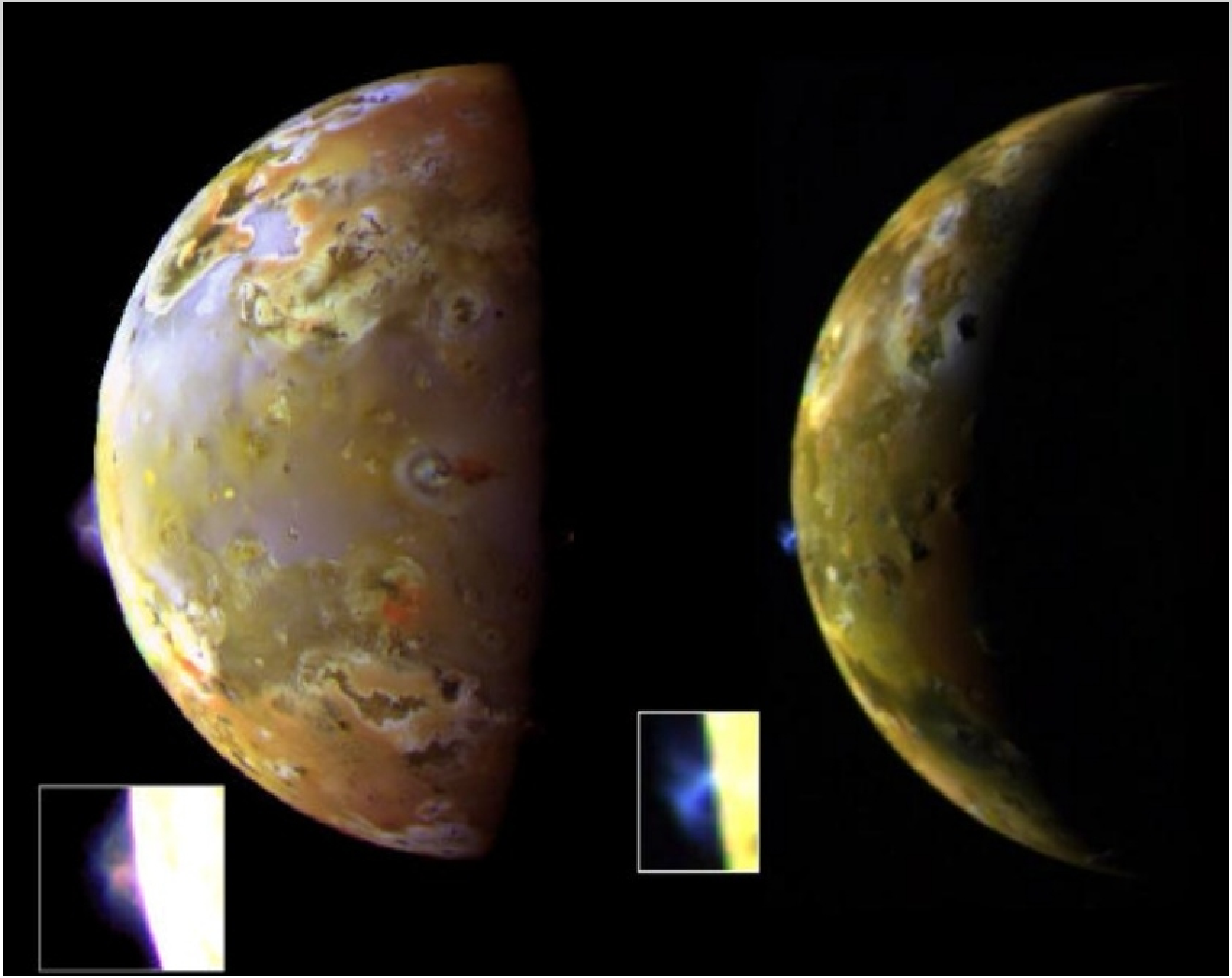


The moon that looks like a pizza

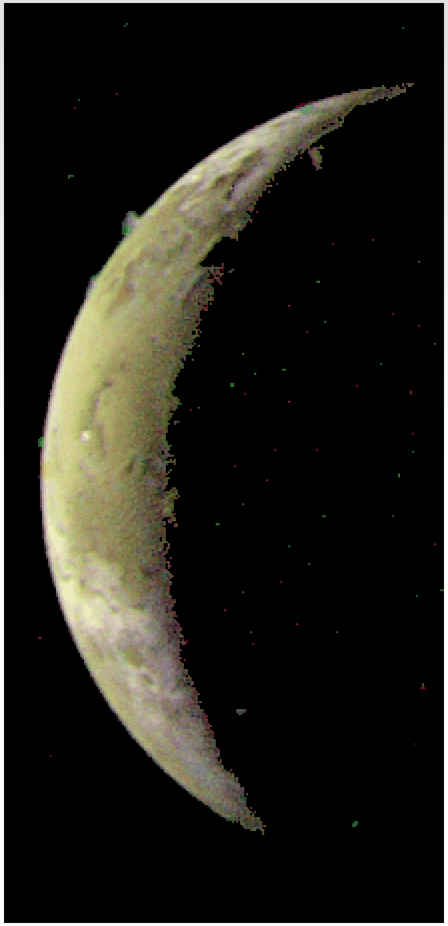


Relative Sizes

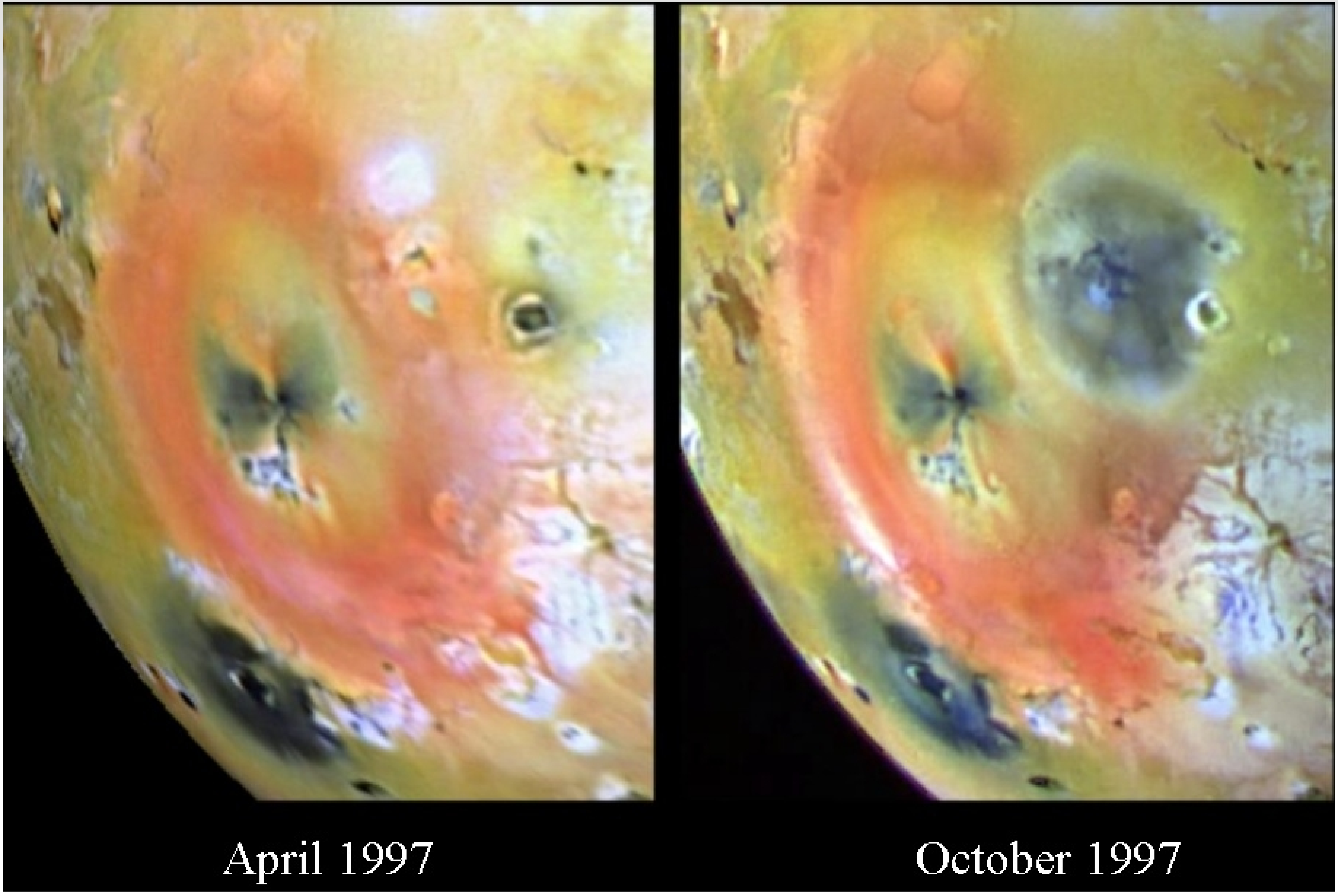




Io Movie



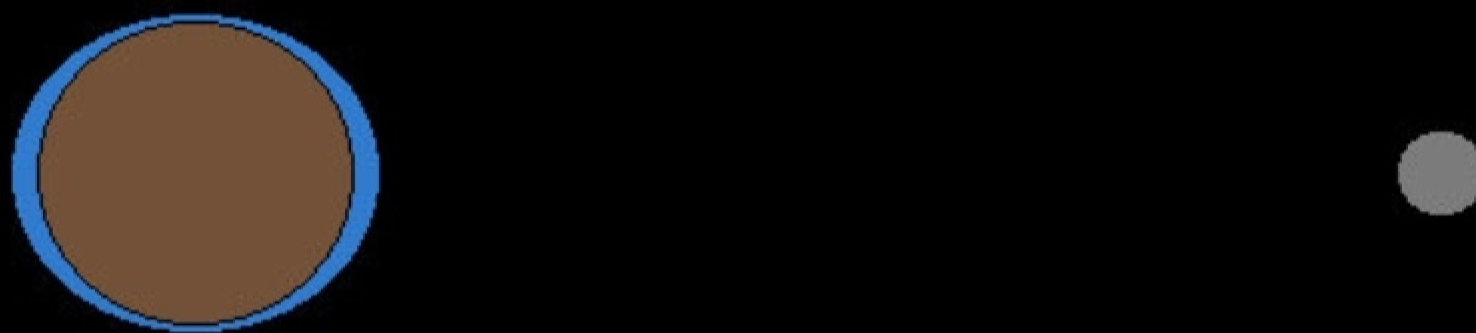
Io's Changing Surface



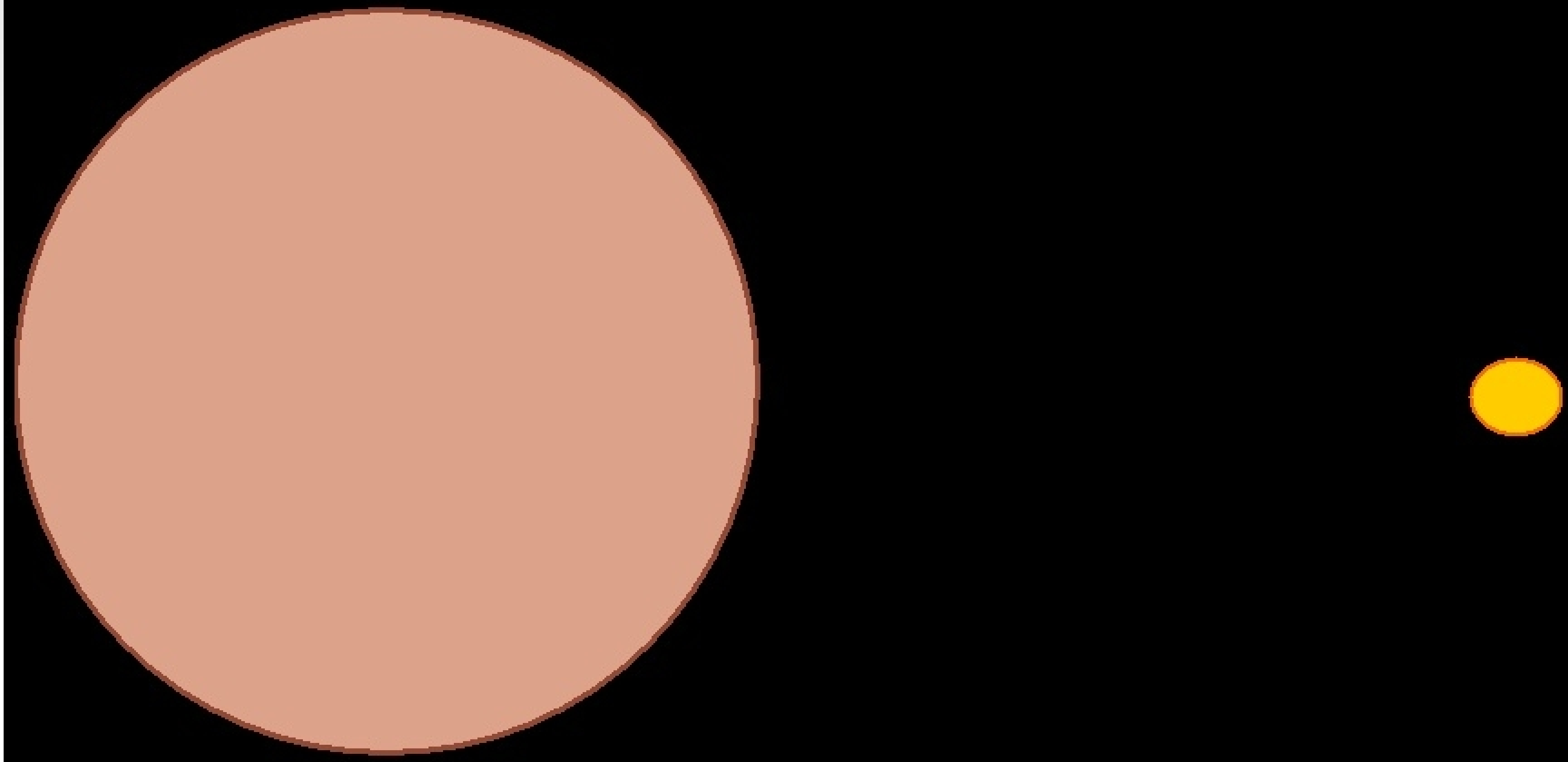
Questions

- Why does Io have volcanoes?
- Why don't other moons have volcanoes?
  - TIDES!!!!

Earth-Moon Tides

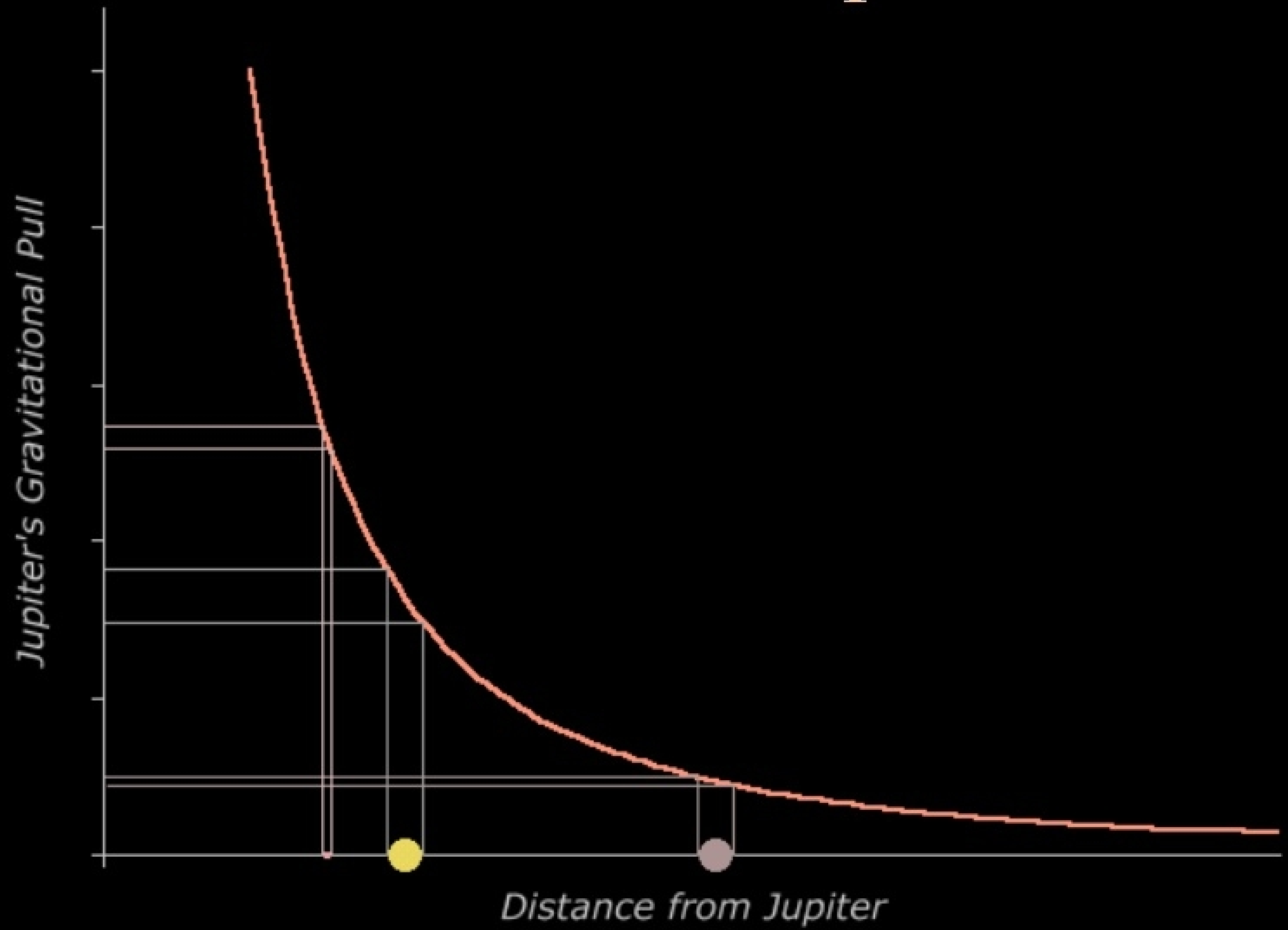


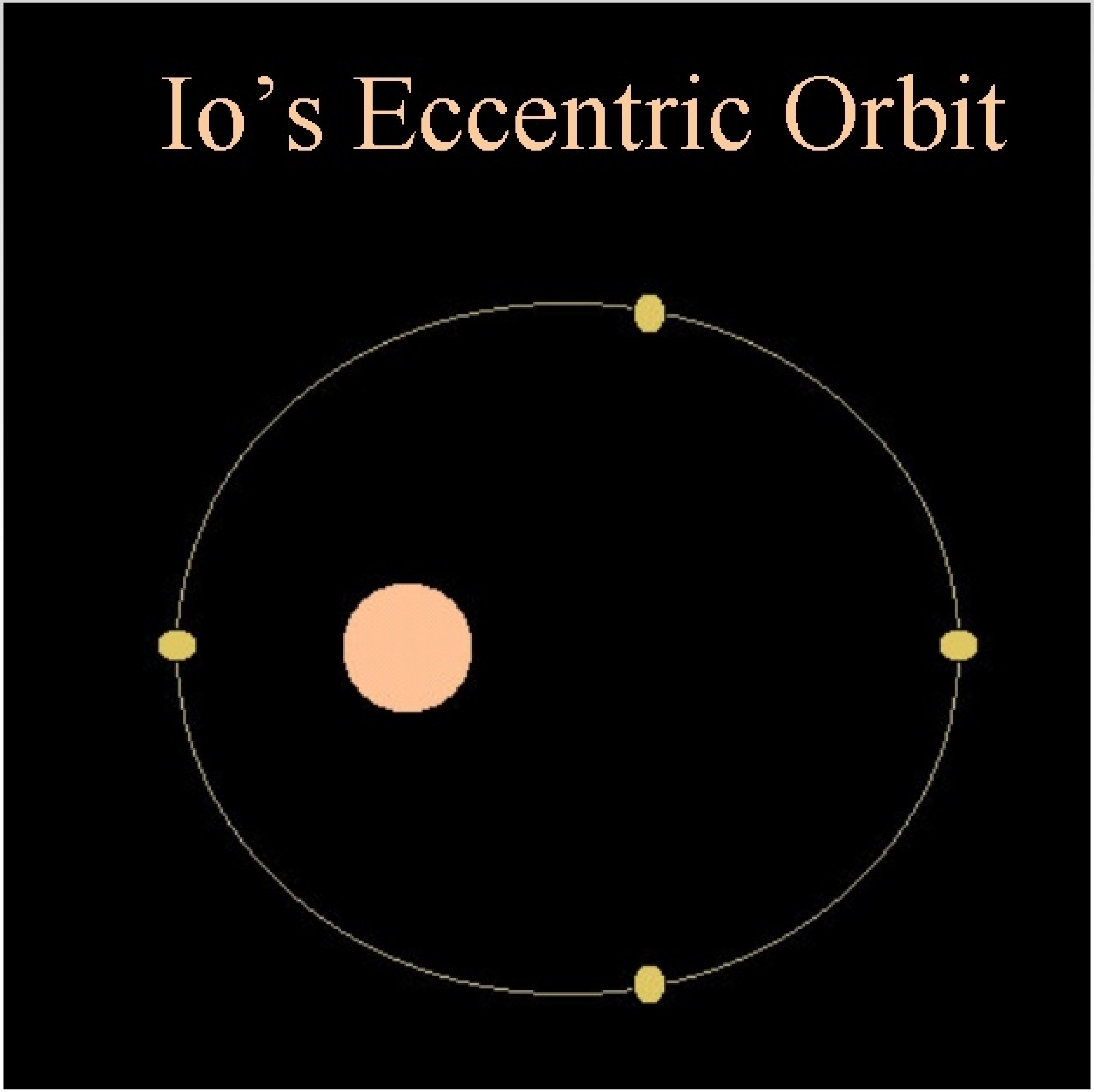
Jupiter-Io Tides



Tides from Jupiter

Tides from Jupiter




Io’s Eccentric Orbit

- 1) So, why does Io even have volcanoes?
- * Close to a massive object.
- * Large moon, so it feels a big difference in gravity between near side and far side.
- * Wants to get into circular orbit, but resonant moons keep pulling it into an eccentric one.
- * Plus, other moons produce tides, too.

- Why don't other moons in the Solar System have volcanoes?
- * Other moons aren't close enough (e.g. Europa)...
- * ...or they're not orbiting a huge planet (e.g. Earth's Moon)...
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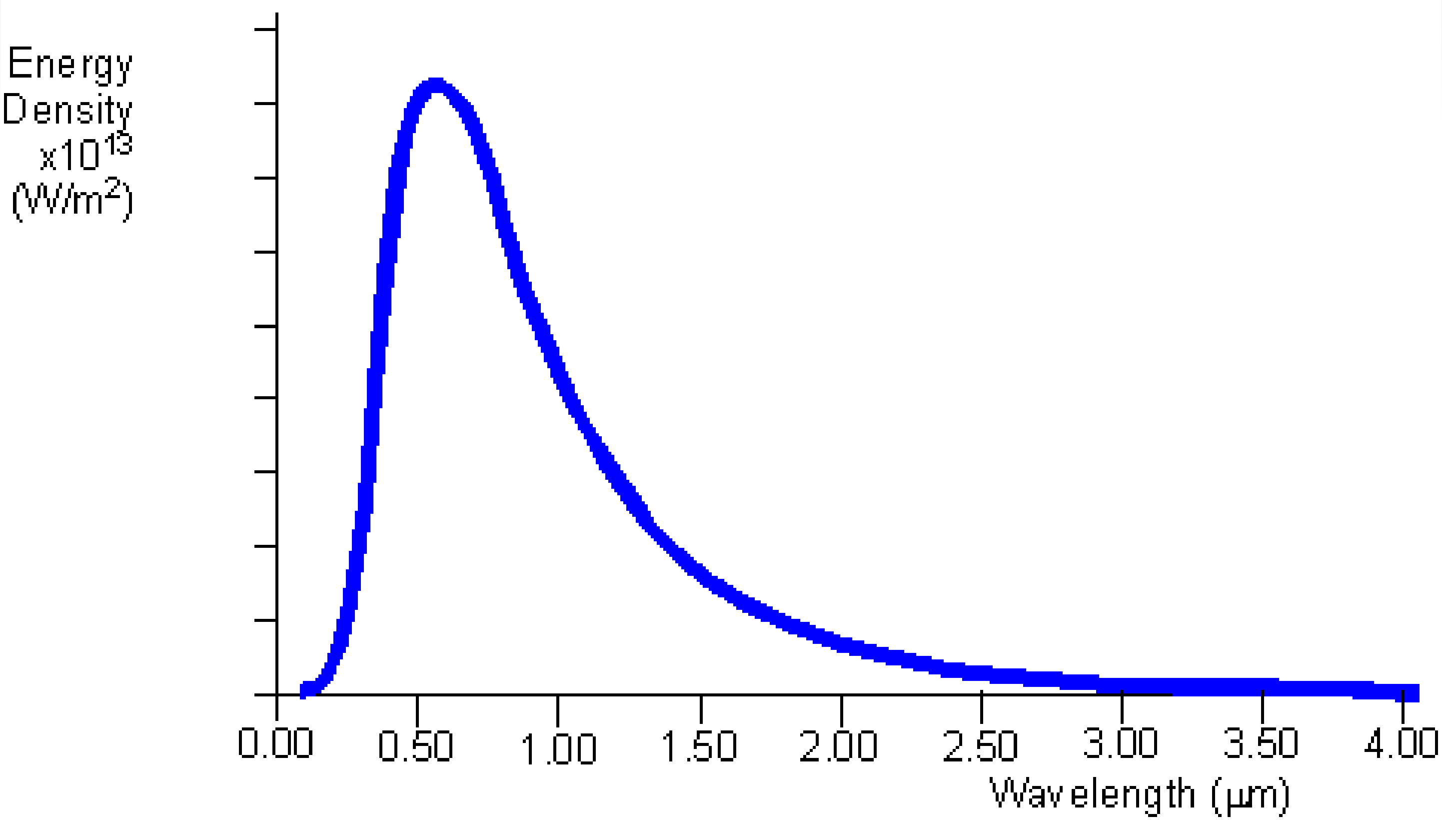
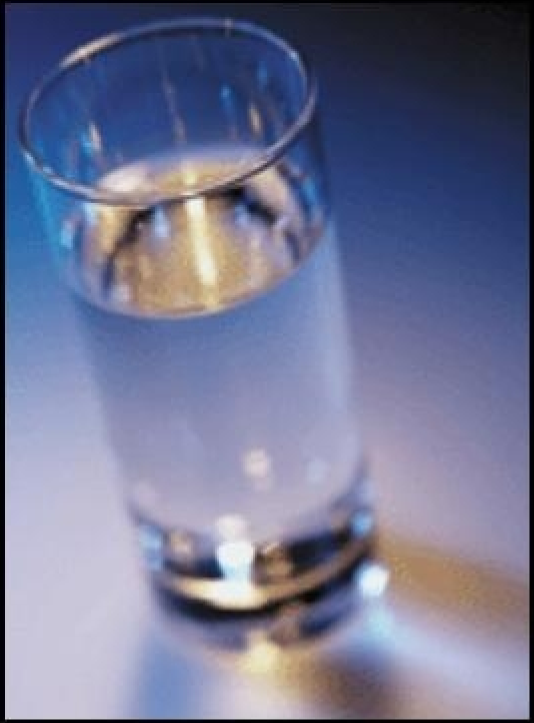
Blackbody Radiation

- radiation emitted by a body which perfectly absorbs at every wavelength



Part 2: Energy to Temperature conversions.

Which emits more energy:



A glass of water at 44°F...

...or a glass of water at 80°F?

Amount of energy emitted per unit area per unit time $= \sigma T^4$

44º F = 280 K   Energy output = (some number) x 280^4

80º F = 300 K   Energy output = (same number) x 300^4

Account for Surface Area

Now which emits more energy:

A glass of water at 80°F...

...or two glasses of water at 44°F?

We can also work backwards!

$$\text{Flux} = \sigma T^4$$

$$T = \left(\frac{1}{\sigma} \times F\right)^{1/4}$$

$$T = \left(\frac{1}{\sigma} \times \frac{\text{Energy Output}}{\text{Area}}\right)^{1/4}$$

Temperature Conversion Chart

50 K	-370° F	250 K	-10° F
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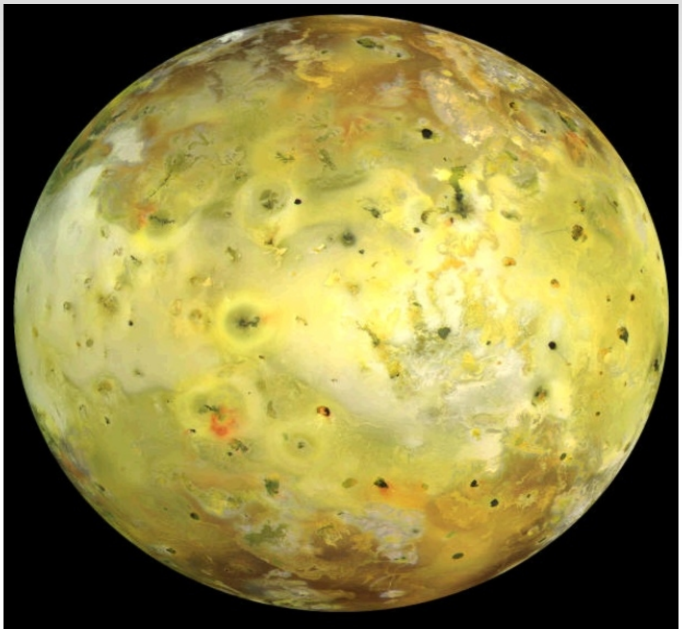
Tidal Heating of Io

Io



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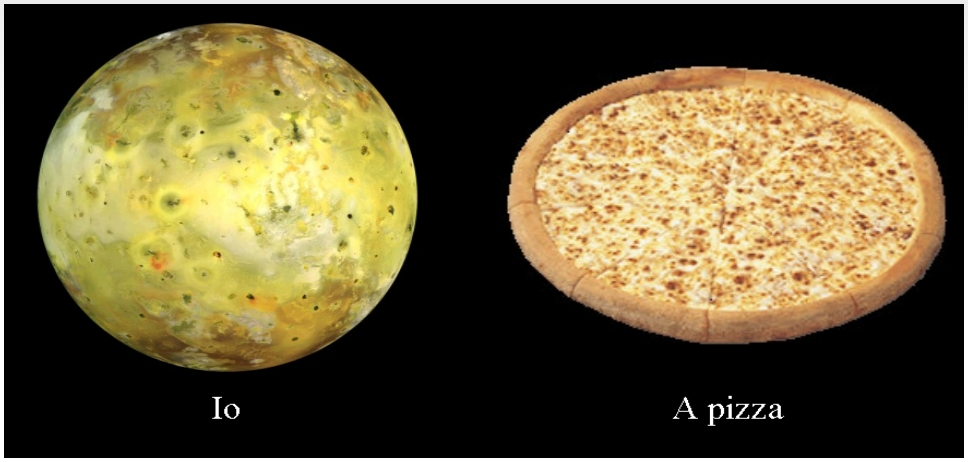

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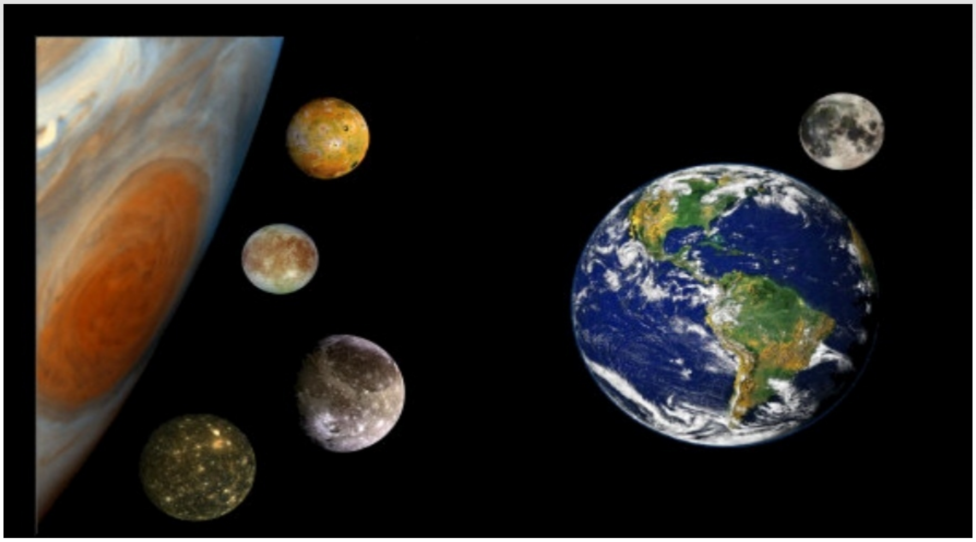

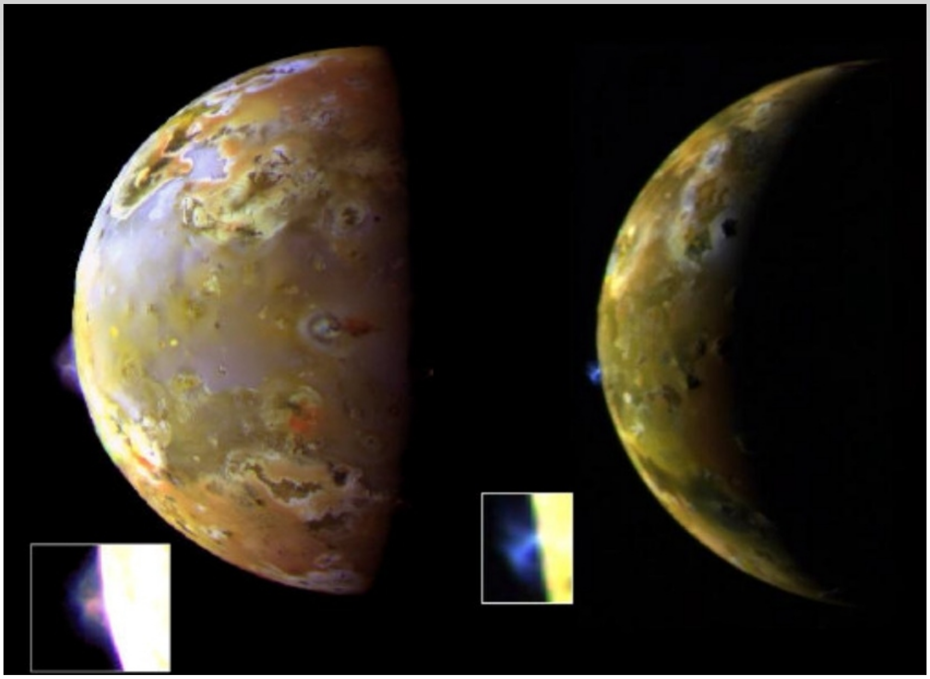

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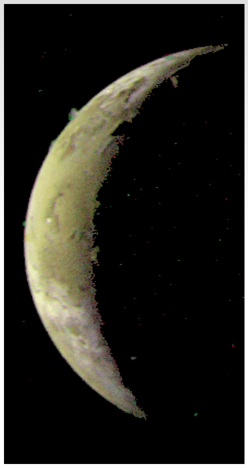

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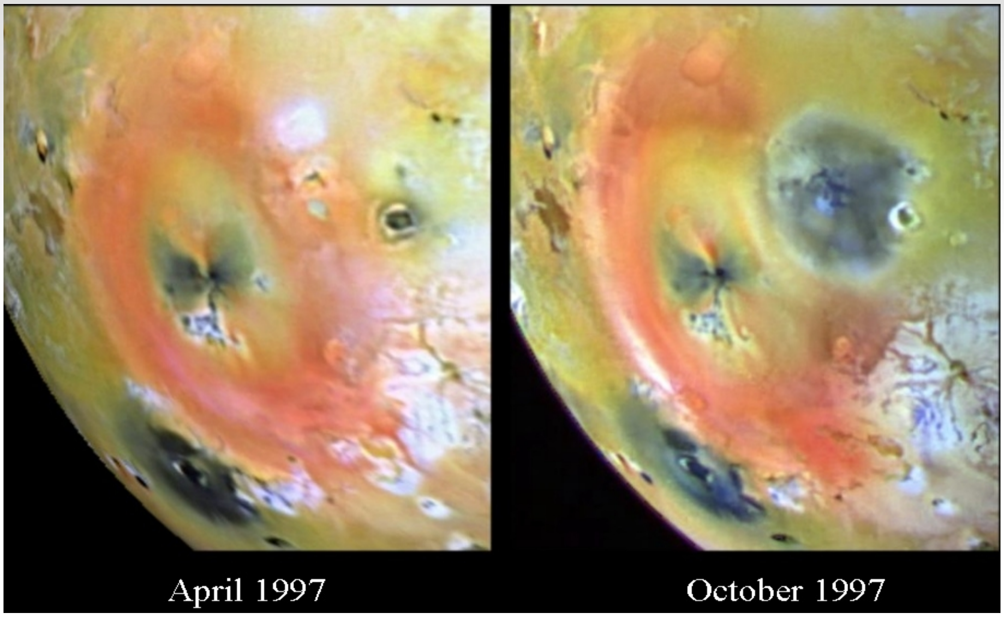

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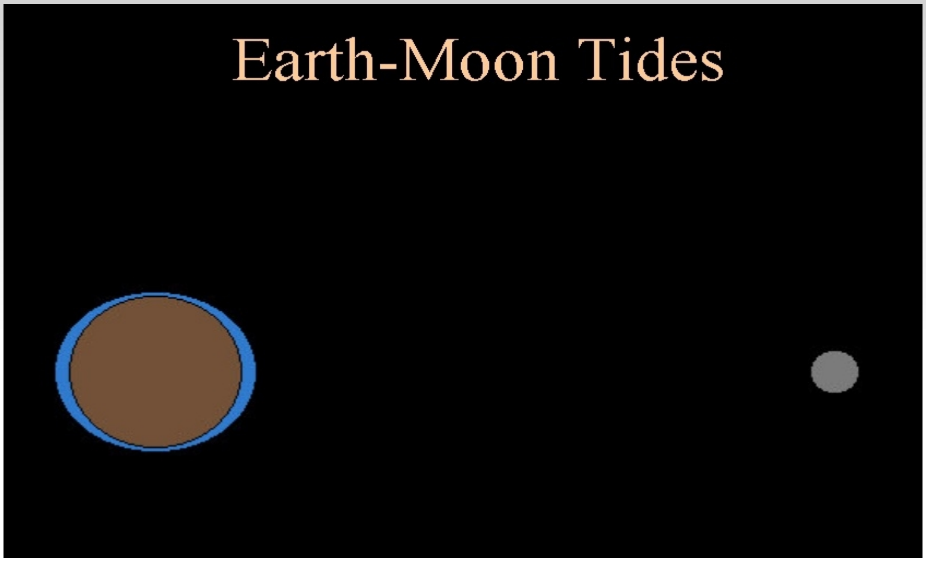
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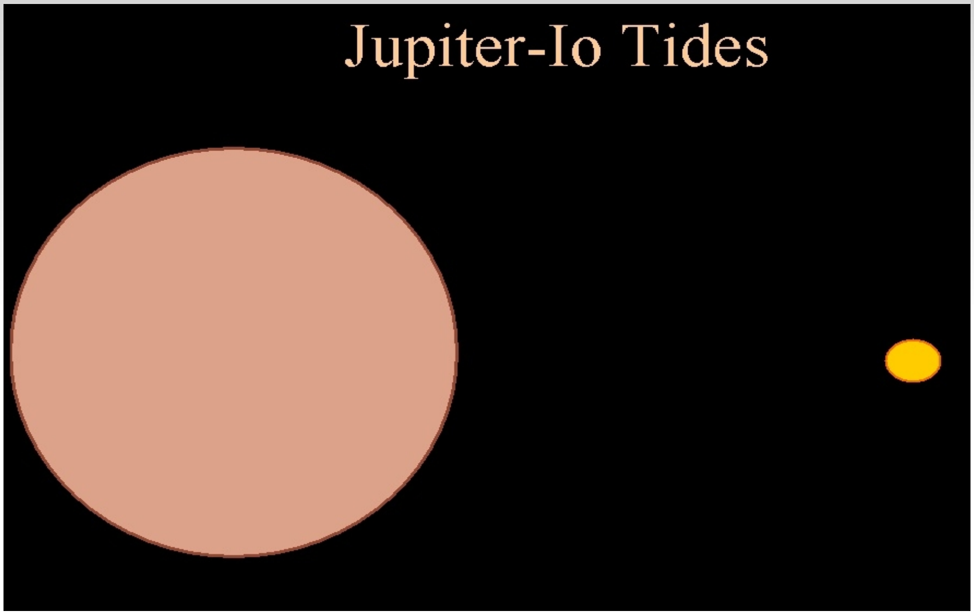
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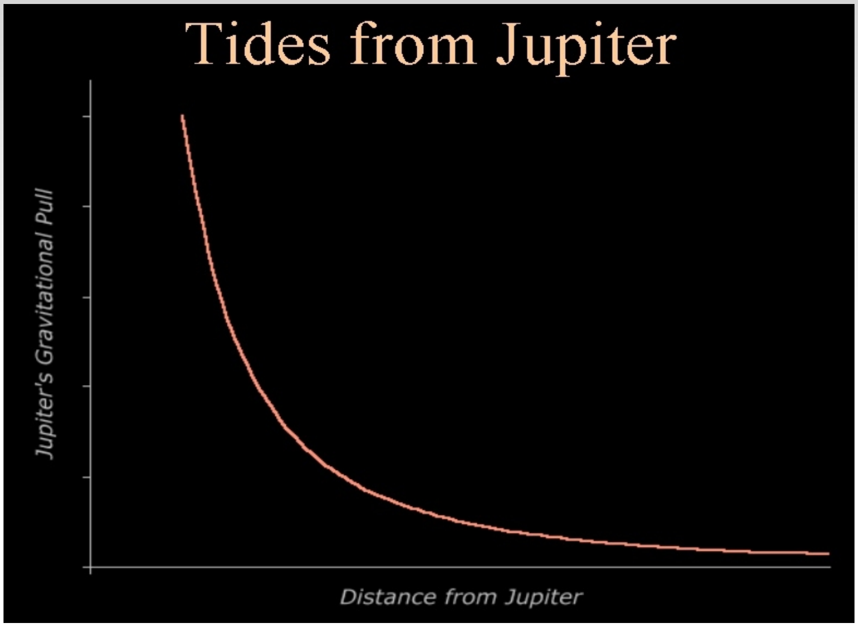
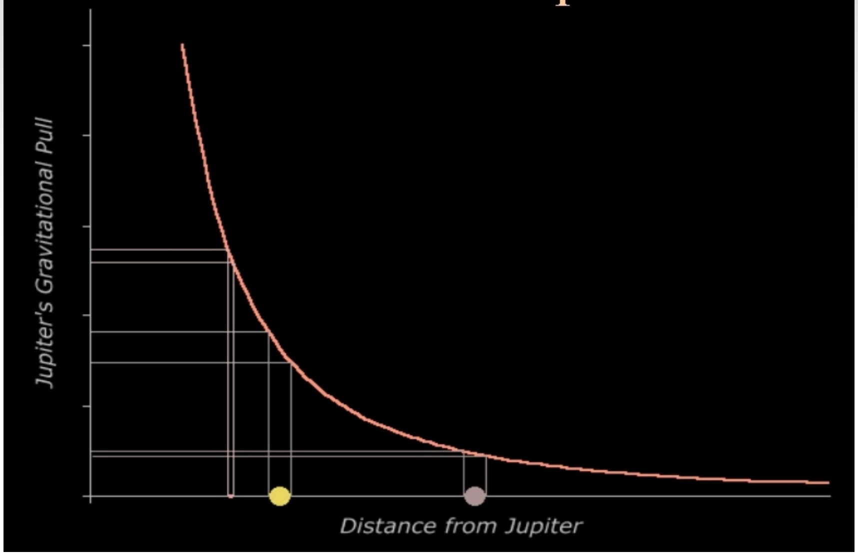

Tides from Jupiter
Jupiter's Gravitational Pull
Distance from Jupiter

Tides from Jupiter



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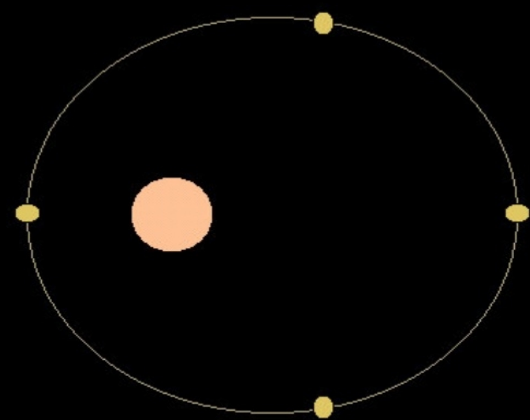

Click to add title

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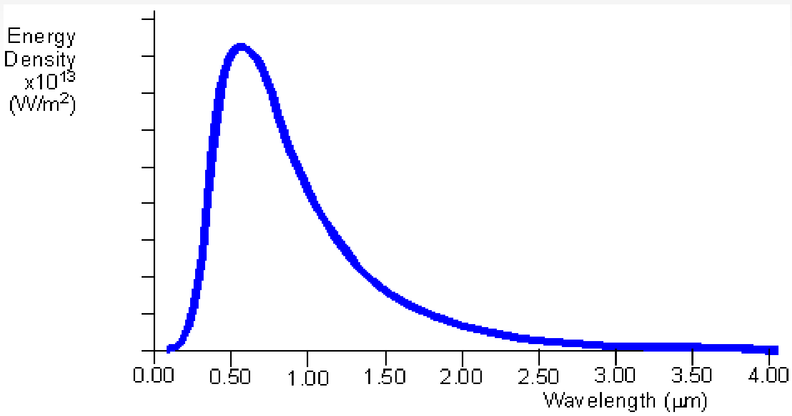

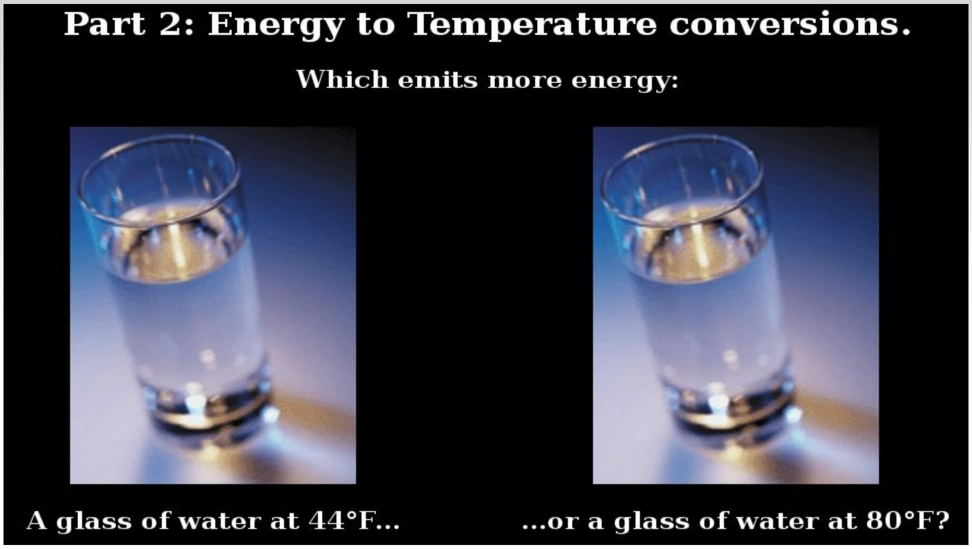
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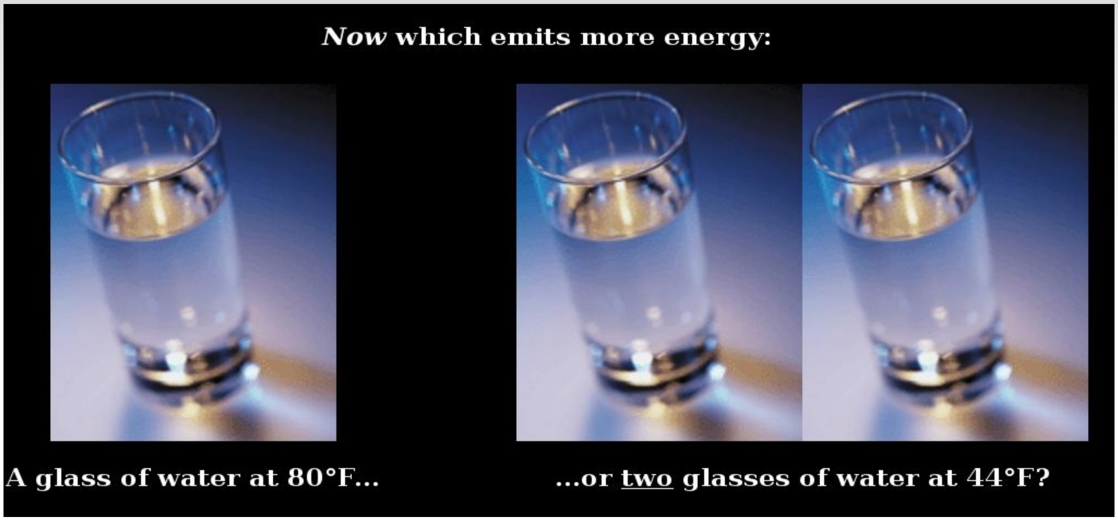

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