1. Mark your confusion.
2. Show evidence of a close reading.
3. Write a 1+ page reflection

Note: this week's AoW is comprised of two articles—one about Earth and one about Saturn

How Earth Got its Tectonic Plates

Source: Monte Morin, *Los Angeles Times*, April 6, 2014

If you've ever felt the earth shudder beneath your feet during an earthquake, you're no stranger to the effects of Earth's ever-roaming tectonic plates. While scientists have linked the movements of these rigid, puzzle-piece slabs to our planet's most violent events -- quakes, tsunamis, volcanic eruptions -- they have struggled to explain exactly how they came to exist in the first place.

Now, in the journal Nature, two geophysicists have proposed that Earth's outermost layer, or lithosphere, was microscopically weakened and brittled by movement in viscous layers below it billions of years ago. Study authors David Bercovici of Yale University and Yanick Ricard of the University of Lyon note that Earth is the only planet in the solar system that appears to have tectonic plates that move freely on its surface, propelled by the motion of layers below.

"The emergence of plate tectonics is arguably Earth's defining moment," they write. "How our planet, alone amongst known terrestrial bodies, evolved the unique plate-tectonic form of mantle convection remains enigmatic."

The authors have created a mathematical model for the breaking of the lithosphere into pieces, and it involves the lava-lamp-like convection of Earth's molten mantle. The authors argue that when cooling sections of mantle moved downward, they stretched the rocks in the overlying lithosphere and this deformation caused microscopic changes in their the crystalline structure. From there, a "self-weakening feedback" occurred that made these deformed areas into weakened zones. These weakened areas became enlarged as the downwelling movement of the mantle shifted to other areas, they argue.

"Although this case is highly idealized, it shows that a fully developed plate can evolve from a downwelling only," they wrote.

The process likely began about 4 billion years ago, and caused complete fractures 3 billion years ago, the authors write.

The authors also offer an explanation as to why at least one other planet, Venus, lacks similar plates. Due to far hotter temperatures, any damage caused to the surface would become healed over time, according to their model.

"Only very faint weak zones accumulate because damage itself is weaker while healing is stronger," the authors wrote.

On Saturn's Moon Titan, Scientists Catch Waves in Methane Lakes

Source: Amina Kahn, *Los Angeles Times*, April 3, 2014

Saturn's icy moon Enceladus has earned a certain amount of attention for its waterworks show — it was caught squirting plumes of mineral-rich water out of "tiger stripe" cracks near its south pole in 2005. Scientists thought that could be a sign of a liquid ocean beneath its frozen shell, but couldn't be sure. Now, using data from NASA's Cassini spacecraft, they have found gravitational evidence that a vast sea the size of Lake Superior could extend out from around the southern pole.

The discovery, described in the journal *Science*, lends support to the idea that this tiny world is one of the few places in our own solar system that could be potentially friendly to life.

At just 313 miles across, Enceladus is a frozen dirtball that's too small to stay warm, so how could it have liquid water beneath the surface? The answer lies in its strange gravitational love triangle with ringed gas giant Saturn and Dione, another moon. Dione also tugs on Enceladus's orbit, stretching its path around Saturn from a circle to an ellipse. The gravitational pull from these two bodies also squeezes and stretches the moon itself, and all that kneading from this tidal distortion heats Enceladus, melting some of the water ice under the surface.

Anyway, that's the theory. The search for this subsurface ocean warmed up after scientists discovered plumes of mineral-rich water vapor squirting out of cracks near the south pole. But they couldn't be sure it was coming from liquid water below, rather than from the ice at the surface.

Scientists can't see beneath the thick ice shell of Enceladus, but they can get a sort of window into what lies beneath by measuring its gravity in different spots. A stronger gravitational tug means that something very dense is beneath the surface; a weaker tug indicates something lighter and less dense.

During a series of passes over Enceladus' frigid terrain, Cassini measured the moon's gravity using the Doppler method: The scientists could see how much the signal coming from the spacecraft was squeezed and stretched as the spacecraft wobbled in response to the moon's varying gravitational tug.

As Cassini passed over the south pole, they noticed that the tug from the moon was stronger than it should be. After all, there was a big dent in the bottom of the moon, which meant there should be less mass and thus the gravity should be weaker. Not so, which meant there was something dense beneath the surface. It had to be water, which is indeed denser than ice — that's why ice cubes float in your glass of water.

"There's no other reasonable candidate," said Caltech planetary scientist David Stevenson, a coauthor of the study. "There is rock down there, but it gives the wrong signal."

The scientists think there's a sea about 6 miles deep, covered by a shell of ice that's maybe 25 miles thick. This underground watery reservoir could be as large as Lake Superior, and though it's based around the south pole, could reach up toward the north. It's possible that it is a global ocean, but it's definitely at least a regional sea, based on the gravity data, the authors said.

Enceladus has been shown to have sodium and potassium salts as well as ammonia and methane in the plume of water vapor being spit out of its south pole. If it has organic molecules in its layer of liquid water, it's a candidate for habitable environments in our own solar system, scientists say.

But Bill McKinnon, a planetary scientist at Washington University in St. Louis, Mo., who was not involved in the study, pointed out that ultimately, Jupiter's moon Europa would be a more likely place for potential life to take hold: It's more massive and probably had some volcanic activity in the past. It, too, has been caught squirting water from its south pole.

Possible Response Questions:

- Which article interests you more? Explain.
- Do you buy the two theories? Why? Why not? Explain?
- Select any passage and respond to it.