

Astro 305
HW#5
Partial Solution Set

1) Why is geology important when studying life in the universe?

Book Answer (i.e.: what you should know on the test)

- a) Volcanism: Volcanism created most of the Earth's atmosphere through out-gassing. This is important for finding *life as we know it*.
- b) Magnetic Field: The magnetic field is due to interactions in the Earth's core, and it protects the atmosphere from being stripped by the solar wind.
- c) Plate tectonics: The carbon cycle is important for *life as we know it* and plate tectonics make the carbon cycle possible.

Other possible answer (for most points)

As human history covers only the barest fraction of the Earth's age, the study of geology allows for the study of unrecorded history. Using geology to learn when and possibly how life first got started on Earth, as well as under what conditions, allows us to better search for life elsewhere.

4) Greenhouse Effect

The Sun's light is strongest in the visible part of the spectrum (which is probably why our eyes developed to see in this region). Visible light passes through the Earth's atmosphere fairly easily. Due to the clouds, oceans, snow and other reflective material however, about 30% of the light is reflected back into space. The remaining 70% is then absorbed by the Earth, and that energy heats the surface. The heat is emitted back into space in the form of infrared radiation (what we feel as heat). Unlike visible light, infrared light cannot pass easily through the atmosphere. Greenhouse gases such as carbon dioxide, methane and water absorb the infrared photons. However they cannot hold onto them forever, so they reemit them. But rather than always sending them in the direction of space, they emit randomly in any direction, thus slowing the photons' escape. After the photon has interacted with some random number of greenhouse gas molecules, it will finally escape the Earth's atmosphere. This slowdown of the infrared light is what allows the atmosphere to remain at a much higher temperature (by about 30 degrees C) than it would otherwise be capable of.

TA's note:

Also note that the Greenhouse Effect is GOOD. Without the Greenhouse Effect the Earth's average temperature would be below the freezing temperature of water. This would have made the survival of life much more difficult. Global warming on the other hand is BAD. Global warming is the *increase* of the Greenhouse Effect due to adding more Greenhouse gases into the atmosphere. Besides causing issues with the Earth's climate, this is bad because it may someday lead to a Runaway Greenhouse Effect. A Runaway Greenhouse Effect would turn the nice blue and green Earth into another

Venus, killed everything except perhaps the hardiest of extremophiles. The problem is that we do not know how much we can increase the Greenhouse Effect before it turns into a Runaway Greenhouse Effect.