ISP 205
Review Questions,Week 5

This is not required homework. It will not be graded. Answers will be supplied next week.

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1. Where is most of the solar system's mass located? What is the general shape of the remaining material? Within the solar system, what is the overall pattern of motions of the Sun and planets? *99.8% of the Solar System's mass is contained in the Sun. Somewhat over half of the remaining material is concentrated in a thin disk with all of the material orbiting in the same direction, which is also the direction in which the Sun spins on its axis (i.e. rotates). The sense of rotation of most of the planets is also in this same direction. This all reflects the direction of the slight spin on its axis of the gas cloud that collapsed down to form the solar system.*

2. Describe the two different types of planets. *The terrestrial planets (Mercury, Venus, Earth, Mars) are found in the inner part of the solar system, are small, and are made mostly of rock. "Rock" means different chemical combinations of the elements heavier than hydrogen and helium. The Jovian (or "Giant") planets (Jupiter, Saturn, Uranus, Neptune) are found in the outer solar system, are much larger, and are made mostly of H and He gas, but probably with rock+ice cores. Here "ice" means combinations of the heavier chemical elements in molecules that include hydrogen.*

3. What is the reason that these two different types exist? *In the inner part of the primordial solar system, it was too hot for ice to condense from the gas, so the only solids that were available to form planets had to be built from the heavier chemical elements. However, those elements are quite scarce, so the total amount of solids available to form into planets was small --- resulting in small planets.*

   In the outer part of the primitive solar system, ices could also condense. This meant that hydrogen, by far the most abundant chemical element, could also be incorporated into the supply of solid particles. The result --- more material to build planets → large planetary cores, which then had sufficient gravity to attract and hold on to a massive overlying layer of hydrogen and helium gas. This produced the giant (or Jovian) planets.

4. What is the interior structure of the Earth? How do we know that? *Lower-density mantle material over an inner core largely made of iron. The outer part of the iron core is liquid. We know this from studying seismic waves, plus the fact that currents of charged particles circulating through a liquid must be present to produce the Earth's magnetic field.*

5. How was the Earth's current nitrogen+oxygen atmosphere formed? *The free oxygen is a by-product of life. The original atmosphere was mostly CO_2 (carbon dioxide), but plant life in the sea converted some of this to C (forming the structure of the plants) + O_2 (originally absorbed into rocks, etc, on the ocean floor, but with some eventually leaking into the atmosphere). The nitrogen was in the atmosphere all along. The rest of the story… described in a later class when I lectured about Venus, is that the vast majority of the initial atmospheric CO_2 was removed from the atmosphere by being dissolved by rainwater, and then combining with rocks on the seafloor to form carbonates. So the fact that the Earth's atmosphere is cool enough to have water liquefy and form oceans is the key to it not being mostly CO_2 any more, while the presence of life is the key to having a substantial amount of O_2.*

6. How does the “greenhouse effect” retain heat on the Earth’s surface? *The Earth’s surface temperature is set by a balance between absorbing energy from sunlight at visible wavelengths, and emitting thermal radiation at infrared wavelengths that transports energy back out into space.* CO_2 *and other greenhouse gasses absorb some of the infrared radiation, preventing it from escaping out into space.*

7. How do we know the ages of the rocks that have been brought back from the Earth’s Moon? *We use radioactive age dating. Some types of minerals are formed with chemical elements that are radioactive. Then the radioactivity gradually converts those elements into a different “daughter” chemical element that could NOT initially have been incorporated into the rock. At any given time, the ratio of the amount of the daughter element to the remaining amount of the parent element shows how long the radioactive decay process has been going on since the rock was formed. The “half life” is the important concept for working out the actual amount of time involved (Hint: know what half-life means and how to use it to find an age).*

8. What is our current model for how the Moon was formed? *Through a “Giant impact” between the proto-Earth and something about half that size (i.e. about the size of present-day Mars). The material that forms the Moon is predominantly mantle material knocked loose from the two objects during the collision. The remaining material, including that from the iron cores of the two objects, wound up inside the Earth.*