Evidence #1: Earth's average density is higher than the Moon's.

Earth has three main layers: the crust, the mantle, and the core. The core has two parts: the outer core and the inner core (Figure 1).

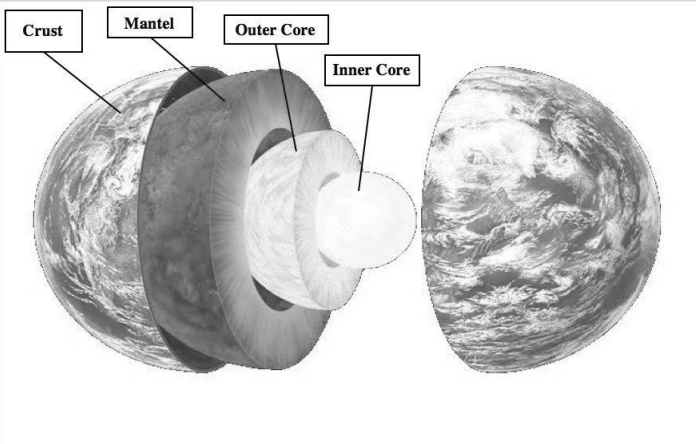

Figure 1: Artist's depiction of Earth's structure. Credit: Victoria Museum

Because each layer has a different composition, they also each have a different density. The average density of each layer is given in Table 1. The density is smaller than this average at the top of each layer and larger at the bottom.

Table 1. Density of Earth's layers.

Layer	Density
Crust	2.7 g/cm^3
Mantle	4.5 g/cm^3
Outer Core	11.1 g/cm^3
Inner Core	13.0 g/cm^3

Seismometers left on the Moon by Apollo astronauts suggest that the Moon also has three main layers: the crust, the mantle, and the core. We don't know the density of each of these layers, but the average density of the Moon is 3.3 g/cm^3. The average density of the Moon is close to the average density of Earth's crust and upper mantle, but much less than Earth's overall average density of 5.5 g/cm^3.

Evidence #2: Simulations of other star systems show that planets form when smaller objects collide.

Astronomers use computer simulations to determine how star systems (and our Solar System) formed. They then compare the simulations with observations of real objects to see how well they match.

Stars—and the planets around them—form out of giant clouds of gas and dust. Gravitational forces cause much of the gas to be pulled inward. At the center of the cloud this gas thickens and forms a star. Figure 1 shows how a forming system might appear.

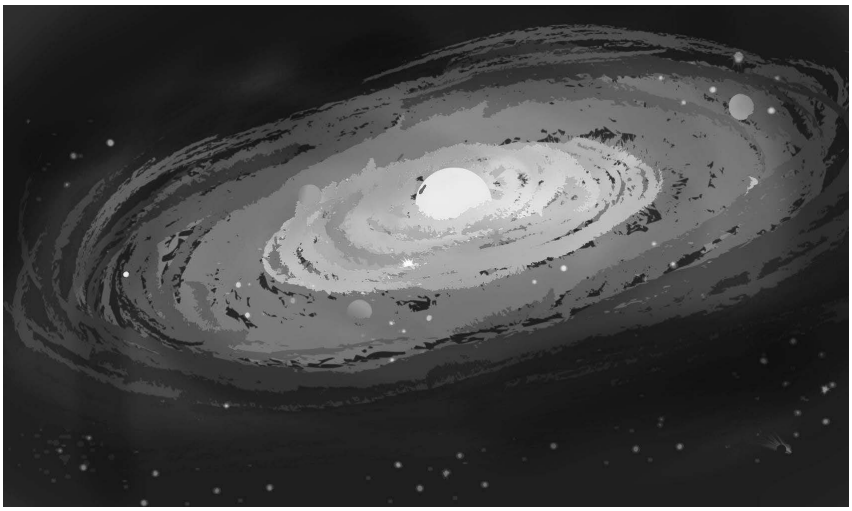

Figure 1: An artist's image of a star system during formation. Credit: Wright Seneres

Dust and other materials begin to collide as they orbit around the center of the cloud. Figure 2 shows these collisions over time. When they collide, these pieces fuse together because of the heat of the crash, forming larger chunks. This a little like how individual snowflakes can come together to make a snowball. As the chunks get bigger, they have even more collisions. The smaller pieces collide with and stick to larger chunks. These chunks of material will continue to combine and form even bigger objects. After many collisions (too many to count!), a planet and other bodies will have formed.

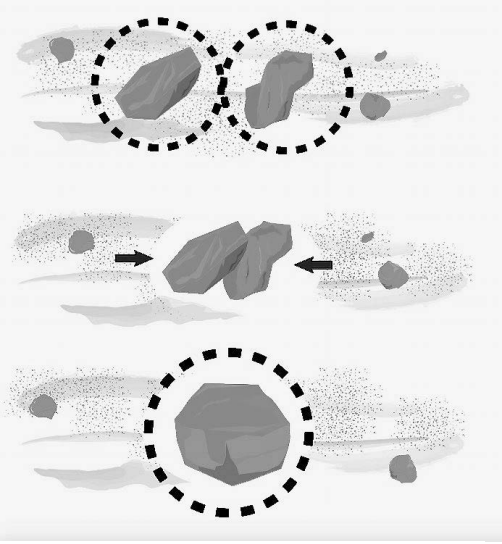

Figure 2: Clumps of rock join together during planet formation. Credit: Wright Seneres

Evidence #3: The Moon's orbit around Earth is tilted compared to Earth's orbit around the Sun.

The path of an object in the Solar System as it orbits the Sun makes a plane. For Earth's orbit, this is called the ecliptic.

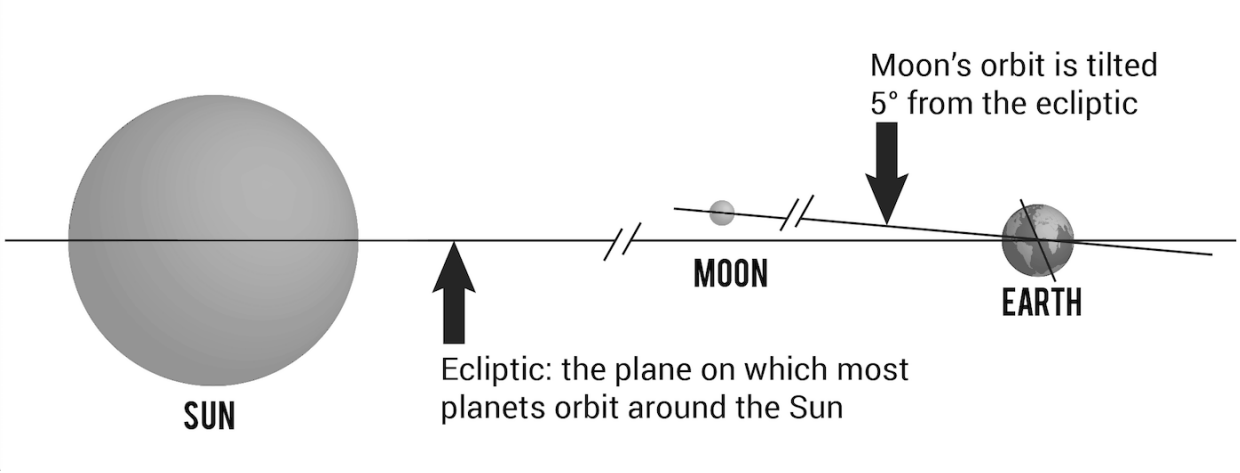

Figure 1: The Moon's orbital plane compared to Earth's orbital plane as viewed from the side. The figure is not to scale; parallel lines on the orbits (//) indicate breaks in the distance. The line through Earth indicates its rotational axis. Credit: Wright Seneres

The Moon's orbit around Earth also makes a plane. But, this plane is tilted about 5° from the ecliptic. This means that sometimes the Moon is a little above the ecliptic and other times it is a little below the ecliptic. Figure 1 shows the ecliptic and the tilt of the Moon's orbital plane.

If the Moon formed at the same time as Earth, it probably would have an orbit that is closer to the ecliptic. Its tilt may be related to a collision.

Evidence #4: The composition of Earth and the Moon is similar near their surfaces. Their cores are different.

Geologists study the composition of Earth and the Moon. By studying rock samples and seismology, they can estimate the percentage of different elements present. There are many of the same types of elements present on both Earth and the Moon, but in different amounts depending on where you look. Table 1 lists the percentage by mass of four major elements near the surface of each body (crust and upper mantle).

Table 1. Composition (percentage by mass) of Earth and the Moon near their surfaces (crust and upper mantle).

Element	Earth	Moon
Oxygen	44.4%	43.6%
Magnesium	23.0%	19.5%
Silicon	21.3%	21.7%
Iron	6.4%	9.3%

Earth's inner core contains mostly solid iron. The outer core is mostly liquid iron and about 10% other elements like magnesium and sulfur. This means that overall, Earth is about 35% iron. Geologists dono't know as much about the Moon's interior composition. They think it is about 1-2% iron in the core.