The Solar System

As an example of star system design, here is a summary of the major objects in our own solar system as they are described by the world-building rules in this book.

Primary Star (Sol): Spectral type G2 V, mass 1.0 solar masses, age 4.7 billion years, effective temperature 5,800 kelvins, luminosity 1.0 solar luminosities, radius 0.0046 AU.

Orbit 1 (Mercury): Orbital radius 0.39 AU, diameter 3,900 miles, density 0.98, mass 0.055, blackbody temperature 445 kelvins, world type Tiny (Rock). No major moons.

Orbit 2 (Venus): Orbital radius 0.72 AU, diameter 7,500 miles, density 0.95, mass 0.82, blackbody temperature 328 kelvins, world type Standard (Greenhouse). No major moons.

Orbit 3 (Earth): Orbital radius 1.0 AU, diameter 7,900 miles, density 1.00, mass 1.00, blackbody temperature 278 kelvins, world type Standard (Garden). One major moon: Luna – Tiny (Rock).

Orbit 4 (Mars): Orbital radius 1.5 AU, diameter 4,200 miles, density 0.71, mass 0.11, blackbody temperature 225 kelvins, world type Small (Rock). No major moons (but two moonlets).

Orbit 5 (Asteroid Belt): Orbital radius 2.7 AU, world type Asteroid Belt.

Orbit 6 (Jupiter): Orbital radius 5.2 AU, diameter 89,000 miles, density 0.24, mass 320, blackbody temperature 122 kelvins, world type Medium Gas Giant. Four major moons: Io – Tiny (Sulfur), Europa – Tiny (Ice), Ganymede – Tiny (Ice), and Callisto – Tiny (Ice).

Orbit 7 (Saturn): Orbital radius 9.5 AU, diameter 75,000 miles, density 0.13, mass 95, blackbody temperature 90 kelvins, world type Small Gas Giant. One major moon: Titan – Small (Ice).

Orbit 8 (Uranus): Orbital radius 19 AU, diameter 32,000 miles, density 0.24, mass 14, blackbody temperature 64 kelvins, world type Small Gas Giant. No major moons.

Orbit 9 (Neptune): Orbital radius 30 AU, diameter 31,000 miles, density 0.32, mass 17, blackbody temperature 51 kelvins, world type Small Gas Giant. One major moon: Triton – Tiny (Ice).

Notice that Pluto isn't listed as a *planet* here. Indeed, present-day scientists aren't in agreement on whether Pluto has any claim (other than tradition) to planetary status. Instead, it can be considered an unusually large, but otherwise typical, object of Sol's *Kuiper Belt* (p. 131).

Special Cases

Several special cases can arise during world design. These require special treatment – but they can also provide interesting local situations for play.

Gas Giant Moons

A gas giant's major moons are likely to be interesting worlds in their own right, but they are subject to forces that most worlds are not.

Radiation

A gas giant will normally have a very powerful magnetic field, which tends to collect charged particles given off by the primary star. A gas giant's major moons will often be placed so that they orbit in this charged-particle zone, subjecting their surfaces to intense radiation. For example, the surfaces of Jupiter's large Galilean satellites are among the most radiation-hostile places in our solar system.

If a gas giant's moon has a significant atmosphere, this will help protect visitors from the radiation belts. Even a moon with a substantial atmosphere will still have significant background radiation on the surface, but the blanket of air may make the difference between "inhospitable" and "instantly fatal!"

Tidal Effects

A gas giant's major moons will be subject to powerful tidal forces from the gas giant itself. If there are multiple major moons, they will also exert tidal forces on each other, and those forces will actually change in direction and strength as the moons orbit their parent planet. All of these forces will tend to flex and strain the body of each moon, heating them internally and encouraging volcanic activity.

In the case of icy moons of the Tiny (Ice) or Tiny (Sulfur) types, this tidal flexing has a profound effect on the moon's surface composition. A Tiny (Ice) moon that suffers a great deal of tidal flexing will actually lose most of its light volatiles through volcanism, leaving sulfur and sulfur compounds behind on the surface. The result is a Tiny (Sulfur) world, like Jupiter's moon Io.

A lesser degree of tidal flexing causes *differentiation* of the moon's materials, causing stony and metallic material to sink toward the center while ices rise to the surface. Greater differentiation leads to subsurface oceans, as water ice gathers close to the surface and melts due to tidal heating. Differentiation also means that the surface is "cleaner," more likely to be composed of fresh ice without a dusting of stony material (this will lower the absorption factor used in computing world surface temperatures).

When designing a gas giant's system of moons, assign each Tiny (Ice) moon its own degree of differentiation. In general, the innermost moon