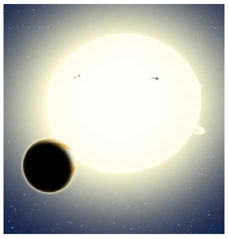
Activity: Wobbling Stars and Planets



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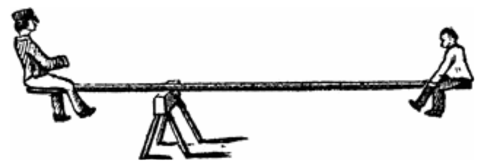
In this activity, you will investigate the effect of the relative masses and distances of objects that are in orbit around a star or planet. The most common understanding of how the planets orbit around the Sun is that the Sun is stationary while the planets revolve around the Sun. That is not quite true and is a little more complicated.

An important parameter when considering orbits is the *center of mass*. The concept of the *center of mass* is that of an average of the masses factored by their distances from one another. This is also commonly referred to as the *center of gravity*. For example, the balancing of a seesaw about a pivot point demonstrates the center of mass of two objects of different masses.



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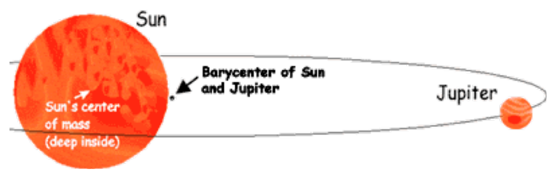
Another important parameter to consider is the *barycenter.* The *barycenter* is the center of mass of two or more bodies that are orbiting each other, and is the point around which both of them orbit. When the two bodies have similar masses, the barycenter may be located between the two bodies (outside of either of bodies) and both objects will follow an orbit around the center of mass. This is the case for a system such as the Sun and Jupiter. In the case where the two objects have very different masses, the center of mass and barycenter may be located within the more massive body. This is the case for the Earth-Moon system.



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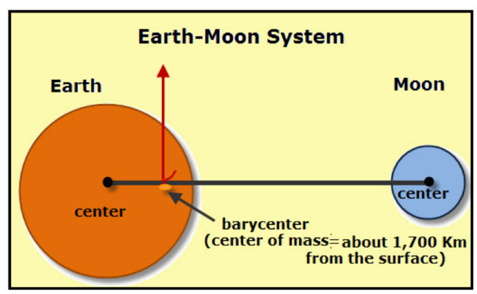

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Classroom Activity

Materials
- Wooden skewers
- Modeling clay
- String
- Scissors

Part 1

1. On the end of the wooden skewer, place a small ball of clay (~1.5 inches in diameter).

2. Tie the string near the middle of the skewer.

3. Place a slightly larger ball of clay at the other end of the skewer.

4. Move the string along the skewer until the system balances (the skewer is horizontal when the system is suspend on the string).

5. Once the system is balanced on the string, push one end so that it spins around the string and observe how the objects move when they orbit.

Part 2

1. On the end of the wooden skewer, place a small ball of clay.

2. Tie the string near the end of the skewer opposite the small clay ball.

3. Mold a larger ball of clay at the other end of the skewer so that the string is located within the larger ball.

4. Add more clay (or remove clay) from the balls until the system is in balance (the skewer is horizontal when the system is suspend on the string).

5. Once the system is balanced on the string, push one end so that it spins around the string and observe how the objects move when the small object orbits the larger object.

Questions

When the two objects have about the same mass (such as a small star and a very large planet in Part 1), what is the effect of the orbit of the planet on the position of the star?

When the two objects have different masses (such as a large star and a small planet in Part 2), what is the effect of the orbit of the planet on the position of the star?

Explain why a star with a relatively large planet may "wobble" more than a star with only a small planet.

How would the wobble of a star be affected in a system containing more than one planet?

Would it be easier to detect/infer the presence of a large or small planet orbiting a star? Why?