Modeling Other Solar Systems

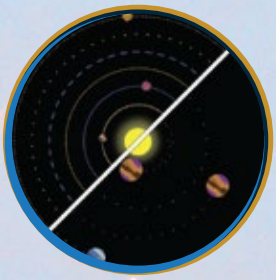
We've found thousands of solar systems, but we need models to help us understand them.

Thanks to NASA missions like Kepler and TESS, we now know of thousands of exoplanets, and they help us improve our understanding of how solar systems form. Some have multiple stars, some have Earth-like worlds, some have giant worlds. But the basic rules are always the same: the combined gravity of the stars and planets has to allow them to form stable orbits if they're going to last.

This is an artist's conception of 51 Pegasi b. It's a gas giant like Jupiter, but it's so close to its star its "year" is only 4 days long!

Make some solar systems and test your predictions

The Planet Families computer table uses a simple model to let you explore what kinds of solar systems might be stable. Here are a few things to try.

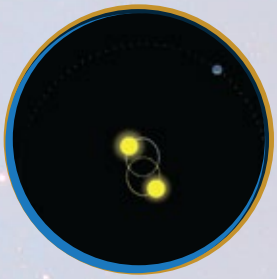


Big and Small

Is it easier to have stable systems with big planets, or small ones? Does the distance between the planets matter?

Binaries

We now know that most stars have one or more companion stars. (The North Star is actually a triple star system!) Can you make a binary system that includes a planet? How can you make a planet's orbit stable?

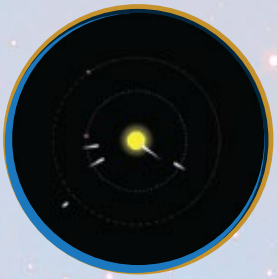


Asteroids

Solar systems form from a lot of gas and rocky debris, but there's not much left in our Solar System today. Where do you think it went? Throw in a few asteroid belts and see.

Comets

You can launch comets by dragging your finger across the screen. Comets tend to be on highly elliptical (non-circular) orbits that reach to the outer solar system. Do you think they can last long with those kinds of orbits? Scientists think that our Solar System has many comets orbiting far beyond Pluto.



Every model has its limits

The best scientific models of 30 years ago predicted that gas giants like Jupiter and Saturn would orbit far from their stars, because they had to form in the cold outer Solar System. But the first exoplanet we discovered was a gas giant with an orbit much smaller than Mercury's! Something was missing from the models: it may be that planets can move into new orbits after being formed. It's a good example of how the universe keeps surprising us.

The key to this model is taking very small steps

Gravity is universal. It isn't just the star that pulls on its planets: the planets pull on each other, and pull back on their star. This simulation models a solar system by adding up all of the pulling for a single moment in time. It then calculates the pull on each object, moves each one a tiny step forward in time, and repeats. By doing that many times a second you can see how your solar system evolves. It's a very simple model compared to what scientists use, but it can still help answer important questions.

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