

Station Card: Binary Orbits

Both bodies orbit the barycenter

Dr. Anna Rosen

Name: _____ Section: _____

Date: _____

Station: _____ Group members: _____

Goal: Use the demo to make a claim supported by (1) at least one number/readout and (2) at least one sanity check.

Demo: /demos/binary-orbits/

Controls: M_1 , M_2 , separation a , eccentricity e

Overlays: barycenter, velocity vectors

Your station artifact (fill in): 1) **Observation:** In the Sun + Jupiter system, which body's orbit is larger? By roughly what factor?

2) **Rule:** Write a relationship between orbit sizes and masses (in words or a ratio).

3) **Prediction:** If you doubled Jupiter's mass, what would happen to the Sun's wobble (bigger/smaller, and why)?

4) **Exoplanet connection:** How could an astronomer detect a Jupiter-sized planet using only the star's light?

5) **Connection sentence:** "This connects to another course idea because..."

💡 Word bank + sanity checks

Word bank: - **Barycenter:** the center of mass; both bodies orbit this point. - **Mass ratio:** if one mass is larger, the barycenter sits closer to that body. - **Orbit size about the barycenter:** the more massive body has the smaller orbit. - **Radial velocity method:** detect a planet by measuring the star's back-and-forth Doppler shift.

Key relationship (mass vs orbit size):

$$\frac{a_1}{a_2} = \frac{M_2}{M_1}$$

Sanity checks: - If $M_1 = M_2$, both orbits should be the same size (mirror symmetry). -

Making the planet more massive increases the star's wobble (harder pull \rightarrow larger response).
- The star's wobble is usually much smaller than the planet's orbit.