Station Card: Kepler's Laws

Orbits: shape, speed, and period

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/keplers-laws/`

Controls: a, e (and in Newton mode: M)
Overlays: foci, apsides, equal areas, vectors

Your station artifact (fill in): 1) **Observation:** where is the planet fastest (perihelion or aphelion)?
2) **Kepler law:** explain using "equal areas in equal times."
3) **Geometry:** identify perihelion and aphelion in the orbit.
4) **Scaling:** if a doubles (same M), what happens to P (longer/shorter, and why)?
5) **Connection sentence:** "This connects to another course idea because…"

> 💡 Word bank + sanity checks
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> **Word bank:** - **Semi-major axis a (AU):** the orbit's size scale. - **Eccentricity e (unitless):** orbit shape (0 = circle; larger = more stretched). - **Perihelion / aphelion:** closest / farthest point from the star. - **Kepler 2:** equal areas in equal times (a timing law $\rightarrow$ speed changes). - **Kepler 3:** bigger orbits have longer periods (for the same central mass).
> **Key relationship (period scaling):**
>
> $$P \propto a^{3/2}$$
>
> **Sanity checks:** - If $e = 0$, speed should be constant around the orbit. - For an ellipse, the planet should move fastest at perihelion. - Increasing a should increase the period P.