Human Orrery http://blackboard.miracosta.edu

scale: 1 AU = 1 meter (1/150 billionth scale)

Have one partner stand on an Earth marker while the other partner stands on the nearest Mars marker. The moment when Earth and Mars are lined up on the same side of the Sun is called “opposition” (because seen from Earth, the Sun and Mars are on opposite sides of the sky). Recall the average distance between Earth and the Sun is 1 AU. It takes light approximately 8.3 minutes to travel this far.

(a) About how far apart (in AUs) are Earth and Mars when they are at opposition?

(b) At opposition, about how long does it take to send a radio signal to one of the spacecraft on Mars?

Move to Earth and Mars markers that are on opposite sides of the sun. This moment is called “conjunction” because seen from Earth, the Sun and Mars are together (“conjoined”) in the sky.

(c) About how far apart (in AUs) are Earth and Mars when they are at conjunction?

(d) How many times farther from Earth is Mars when the two planets are at conjunction, compared to when they are at opposition?

(e) At conjunction, about how long does it take to send a radio signal to Mars?

Have one partner stand on an Earth marker while the other stands on the nearest Saturn marker. Saturn is approximately 10 times farther from the Sun than Earth. (Does it look it?)

(a) Compared to Earth, about how many times farther must Saturn travel to orbit the Sun? ($C = \pi d$)

(b) About how many centimeters apart are the Earth markers?

(c) About how many centimeters apart are the Saturn markers?

The Saturn (and Jupiter) markers show its location every 160 days while the markers for the inner solar system show the planets’ locations every 16 days.

(d) If we also used 16-day markers for Saturn, about how many centimeters apart would they be?

(e) Which planet is traveling faster: Earth or Saturn?

(f) Approximately how many times faster?

At about 10 times farther from the Sun than Earth, Saturn takes a little more than 30 times longer to complete an orbit.

(g) Use Kepler’s third law to show this is true.

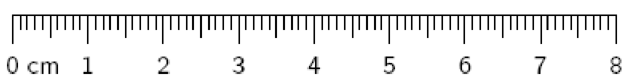
This should now make sense: Saturn travels about 3 times slower but it has about 10 times farther to go...so it takes about 30 times longer.

scale: 1 AU = 1 meter (1/150 billionth scale)

The diameter of Earth is approximately 12,700 kilometers. In our scaled model, about how big would it be? (Recall 1 AU = 1.5×10^8 km) You do not need a calculator if you use scientific notation and estimate.

Using the information in the table, draw a **scale** model of Jupiter and its Galilean moons.

	Actual		Scaled
	(km)	(AU)	(mm)
Jupiter's **diameter**	143,000	0.001	1
Orbital radius of:			
Io	422,000	0.003	3
Europa	671,000	0.005	5
Gaynmede	1,070,000	0.007	7
Callisto	1,880,000	0.013	13



Have one partner stand on a Jupiter marker and hold up the drawing while the other partner views it from Earth (maybe pick the closest Earth marker).

(a) Can you see the dot of Jupiter or the orbits of its Galilean moons?

(b) If they're so small, how can you see Jupiter with your naked eye at night (when it's up)?

(c) And how could Galileo – using a very weak telescope – see the moons?

The International Year of Astronomy [2009] celebrated the 400th anniversary of the first use of a telescope to look at the sky in 1609 – by Galileo!

The nearest star to our solar system is Proxima Centauri at about 267,800 AU. If we want to include it in our scaled model, where must we put it? (1 mi = 1.6 km) You do not need a calculator if you use scientific notation, round, and estimate.

over at the beach (~5 mi) San Diego (~35 mi) Santa Barbara (~160 mi)