Place the Planets: An Astronomically Awesome Activity

Created by Dave Kirsh for Science Rendezvous at Ryerson University

Instructions:

Watch the provided video of the "Place the Planets" activity (maybe just watch the start – I will note when I am about to reveal the answers!).

Print out pages 3 and 4 of this document, in colour or in grayscale, and cut out the planets.

Lay out a strip of tape or string on the ground, that measures 152.4cm long (or so…), and label one end "the Sun". The other end will be the location of the outermost planet.

Place the planets along that string according to how you think the planets are spaced in our solar system (assuming that the Sun is at one end, and the last of the planets is at the other end). Do you know the correct order of the planets? Are they evenly spaced? Are some of them closer together than others? Are they mostly close to the Sun or far from it?

The planets should *actually* lie at the following distances (with zero being one end, the Sun):

Mercury	Venus	Earth	Mars	Jupiter	Saturn	Uranus	Neptune
2cm	3.7cm	5.1cm	7.6cm	26.4cm	48.3cm	96.5cm	152.4cm

Chart 1. Place the centres of the planets at these distances from the start of the tape/string.

How did you do?

Follow-up points:

The real-life planets are not actually placed in a line, they all do their own almost-circular orbits around the Sun, so their spacing will always be *much* more than what this line-up looks like. (See Page 2 for a way to turn this point into a follow-up Activity.)

Are the planets you've printed the right size compared to the "size of the solar system" given by the string? No! Not even close! They are *much much too big*. To make this scale model, I shrunk the planets by a factor of 850 million, but I shrunk the *distances* even more, by a factor of 3 *trillion!* **The cut-outs are 3.5 thousand times too big**. If you shrunk them by that amount, the Jupiter cut-out should be about the width of a human hair – good luck cutting that out and sticking it on your line! It is very hard to make a proper scale of the solar system where *distances* **and** *sizes* are at the same scale.

To make a properly-scaled solar system (distances and sizes at the same scale) you can take your existing planet pictures out to a park and lay them out this way:

- The Sun should be a *large* hula hoop with a diameter of 1.6m (ten of the Jupiter cut-outs wide)
- Your existing Mercury cut-out should be placed a whopping 70.5 metres from the Sun
- Quit now, because you're going to have to walk 5.3 *kilometres* to get to Neptune

There are some "solar system walks", including at the University of Toronto Scarborough, but they start with smaller sizes for the planets, and they are still fairly long walks.

The Solar System is *big* and *incredibly empty*, especially the outer Solar System where the planets are dramatically farther apart!

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Follow-up Activity: **Planets in Orbit**

One option if you'd like to continue with this activity is to cut out 8 strings, with lengths given by the numbers in Chart 1.

Attach one end of each string to a nail, pin, piece of tape, or otherwise stationary point. This central pivot point will represent the Sun.

Attach the free ends of each string to the appropriate planet.

Each planet is now free to orbit the Sun along its own path. Orbits are not truly circular, they are *ellipses*, but this will do for now! You have now made an entire model Solar System!

Note that the farther the planet is from the Sun, the slower it orbits. See Chart 4 below for a comparison of their *orbital periods*. If you were to orbit your little Earth cut-out around the Sun *once every second*, Neptune should only orbit around the Sun in 2.75 *minutes*. Slow!

Additional Information:

The average distance between the Earth and the Sun is 1 Astronomical Unit or 1 AU, which is almost 150 million kilometres. Light itself takes 8 minutes and 20 seconds to travel that distance (at the speed of light) – so we see the Sun as it *was* more than 8 minutes ago. The other planets, as you've now seen, are at very different **distances** from the Sun:

Mercury	Venus	Earth	Mars	Jupiter	Saturn	Uranus	Neptune
0.4 AU	0.72 AU	1 AU	1.5 AU	5.2 AU	9.5 AU	19 AU	30 AU

Chart 2. This chart gives the distance between the Sun and each planet, measured in Astronomical Units. In other words, Jupiter is 5.2 times farther from the Sun than Earth, Neptune is 30 times farther, etc.

The planets' **sizes** are often pictured inaccurately. The Great Red Spot on Jupiter, for example, is easily large enough to swallow the Earth. Below is a chart with the sizes of the planets as compared to Earth's diameter. The pictures you have printed should be fairly accurate, you can fit your Earth cut-out across the face of Jupiter 11 times, for example.

Mercury	Venus	Earth	Mars	Jupiter	Saturn	Uranus	Neptune
0.4	0.95	1	0.53	11	9.4	4	3.9

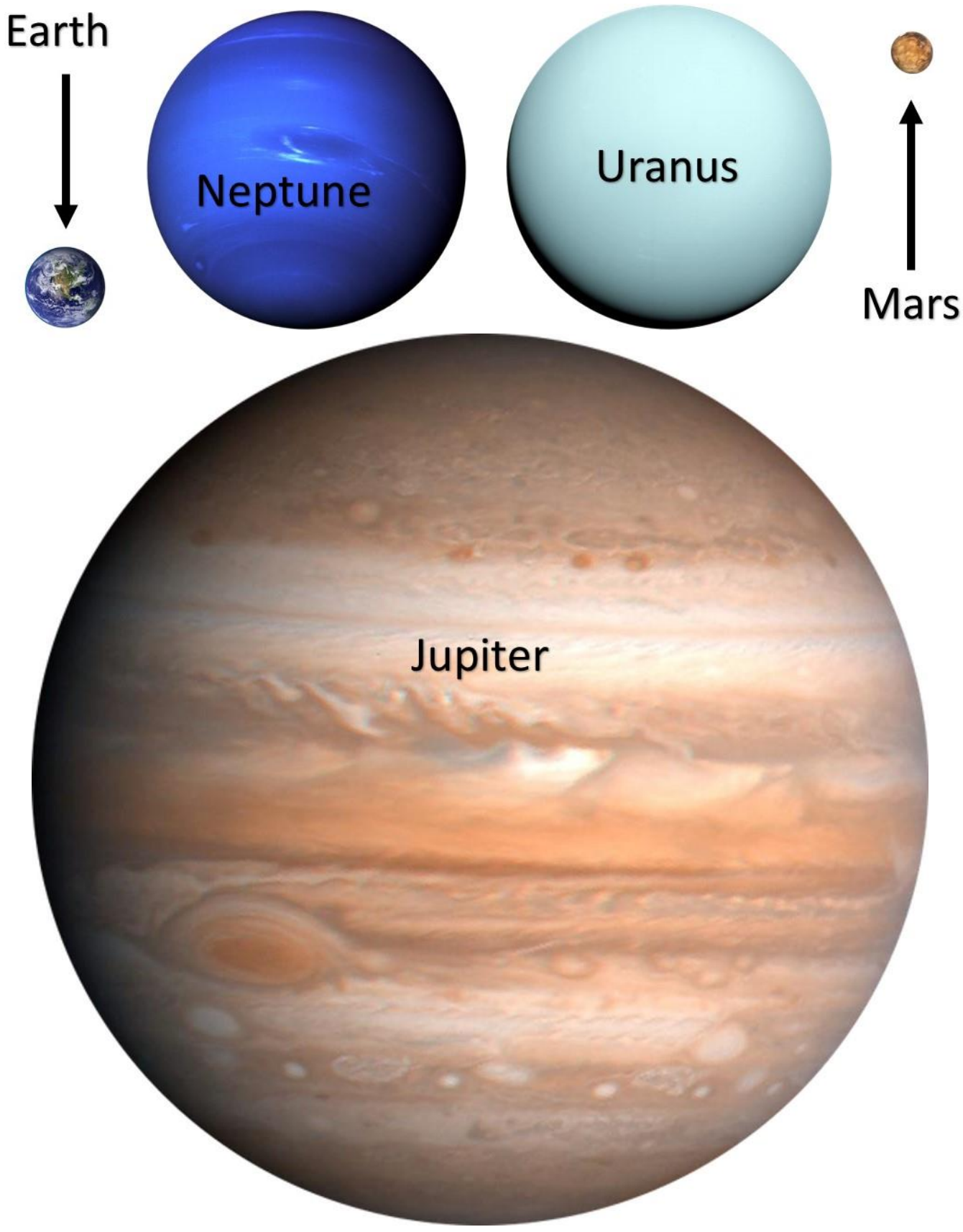
Chart 3. The sizes of each planet as measured in Earth Diameters. Earth is by definition 1 Earth diameter, Venus is 95% of Earth's diameter (just a bit smaller than Earth), while Uranus is 4 times Earth's diameter.

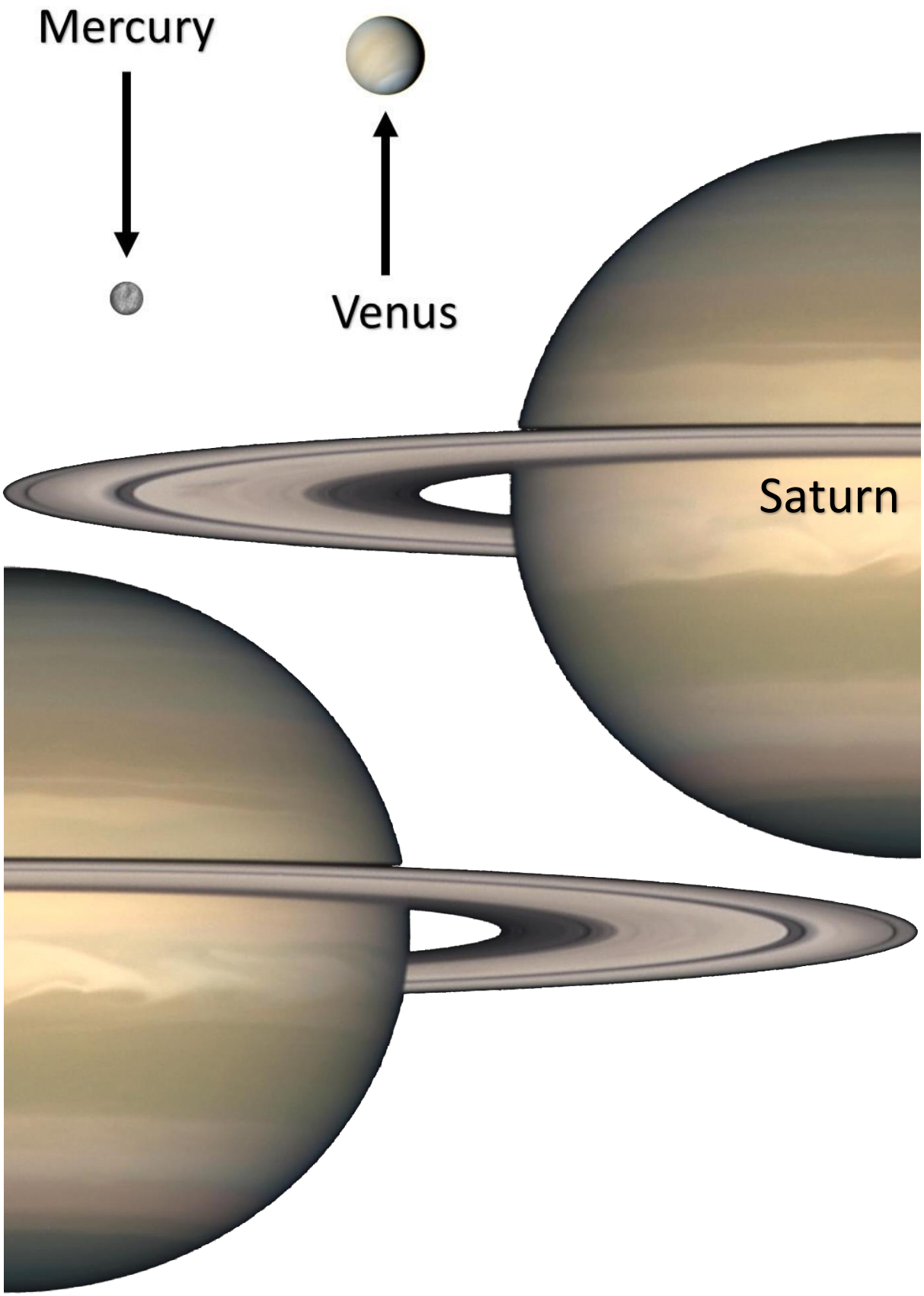
The planets take very different **times** to go around the Sun, called their *orbital period.* Neptune, discovered in September 1846, only *finally* completed a full trip around from that point (a "Neptune year") in July 2011!

Mercury	Venus	Earth	Mars	Jupiter	Saturn	Uranus	Neptune
88 days	225 days	1 year	1.9 years	11.9 years	29.5 years	84 years	165 years

Chart 4. Orbital periods for the planets of our Solar System. A year on Mars is almost two Earth years.

Our Solar System is a fascinating place, and this is just a little bit of detail on the scale of it all. There's a lot to discover out there, and I hope this activity propels you to research more for yourself!


Earth
Neptune
Uranus
Mars
Jupiter


Mercury
Venus
Saturn