

A Geometer's Sketchpad Solar System



Why is a "year" on Saturn longer than a "year" on earth?

Because it's farther from the sun than earth is?

Build your own solar system with GSP and find out if this is the right answer.

Skills you'll need to review before starting this:

- How to make circles with the compass tool
- How to make a ray
- How to hide objects

Making circles:

- Click the compass tool
- Move your mouse onto the screen: click and drag
- Notice that **the point where you started becomes the center**, and the point where you finish dragging the arrow becomes a point on the circumference (edge) of the circle
- Move your mouse over the center of the first circle (you will see a blue halo when you're at the right place) and drag to make a second circle

Making a ray from a point:

- Click the point from which you want the ray to start
- Click a second point
- In the menu bar, click **Construct > Ray**

Hiding Objects:

- Click all of the objects you want to hide
- In the menu bar, click **Display > Hide Objects**

First,

- Make a set of concentric circles
- The orbits do not have to be evenly spaced, but should all be visible on the screen.

TIP: As you make the circles, drag the mouse downward so the point that is made on the circumference is in the lower part of each circle. This will help make steps 2 and 3 easier.

Second,

- Hide all of the points these circles have except the center one

Third,

- Click all of the circles
- In the menu bar, click **Construct > Points on Circles** (these will be your planets)
- Each circle will get a point that is highlighted in pink
- Drag each of these points to the top (12 o'clock) of its orbit
- **Do not de-select** these new points - go to step 4!

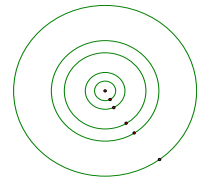
What are concentric circles?

Take the word apart:

Co-, or **Con-** is a prefix meaning "**together**"

Centric is a root word meaning "**center**"

Thus, "concentric" means, literally, "centers together"; in other words, like a "bullseye", with all circles made using the same point as their centers.



I know my astronomy!

Planet orbits are ellipses, not circles!

*You are absolutely right. We are making a **simplified model** with circles, which are much easier to make than ellipses.*

Our results with circles won't be different than if we had made ellipses.

Fourth:

- With the new points still selected, go to the menu bar and click **Edit > Action Buttons > Animation**
- You will get a window with a list of animation commands - for now, accept the defaults and click "OK"
- A grey "Animation" button will appear on the screen
- De-select this button (so the pink outline disappears)
- Click the button to animate your planets



Check: The orbits should not move: just the planets should go moving around their orbits. If the orbits start to wiggle around as well, you probably had them selected as well as the planets. To repair this, UNDO (CTRL+Z) until the animation button disappears, then de-select everything. Now select just the planets (nothing else), and re-do the animation steps following the list above.

Fifth - Customize Your Solar System:

For starters, let's name the planets:

- (a) Select (highlight) one planet
- (b) Go to the menu bar and click **Display > Label Point...**
- (c) You will get a dialog box that gives a "default name" that is a single letter (bo-ring!)
- (d) Change this single letter to an interesting name by typing in your planet name instead of the single letter
- (e) Click "OK" when finished
- (f) Repeat these steps for each of the other planets

Now, let's color the planets:

- (a) Select (highlight) a planet
- (b) Go to the menu bar and click **Display > Color >** [choose a color from the palette]
- (c) The point will change color (unfortunately, you can't change the size of a point).

Sixth - Let's Get Ready to Answer the Question:

- Select the planet in the orbit farthest from the center
- Drag it around its orbit until it is at the 12 o'clock position
- Click the center (the planet and the center should be the only things highlighted)
- Construct a ray with these two points, then de-select everything
- Select the ray, then click **Display > Line Width > Dashed**
- You should have a dashed ray pointing from the center to the 12 o'clock point of your screen

And now, let's answer...

- (a) First, drag each planet to the point in its orbit where the dashed-line ray crosses the orbit. This will be the "start line".
- (b) When you are ready, **animate** your solar system.
- (c) Watch how the planets move around their orbits. Look for such things as:
 - Which planets stay lined up as they orbit the center?
 - How many orbits does the innermost planet make in the time it takes another planet to make just one complete orbit?
 - What can these answers tell us about **WHY** Saturn's "year" is longer than earth's "year" ?

Remember this:

In astronomy, a "year" is defined as the period it takes a planet to travel once around the sun. In our solar system, "years" are usually expressed in earth terms, e.g. Mercury takes a little less than 1/4 of an earth year to complete its "year", but Saturn takes almost 29 1/2 earth-years to complete its "year".