*Astronomy Activity*

# *Modeling the Earth's Motion around the Sun*

## Introduction

We recently looked at "How Fast Are We Moving" and determined that the **Earth is orbiting the Sun at about 30 km/s** (= 2πAU /yr) That's fast! At that speed, you could cross the United States in 2.5 minutes.

**Is this something we could actually measure?**

Well, if we could look at a fixed object while we move in a circular path, then maybe… Imagine a child going around a merry-go-round at a constant speed. The mother is standing outside watching her child go around. The child, looking for his mother, would see her getting closer, then he would pass her, then he would move away...This is the nature of circular motion. In the analogy, the center of the merry-go-round is the Sun, the child is the Earth, and the Mother is the Center of the Galaxy. If the child had a Doppler radar gun, then he would be able to measure the rate at which he is getting closer, or further away from, his mom. This is what we can do with the Radio Horn Telescope!

**Let's Start with some MODELING!**

Modeling is a big part of the scientific method. Copernicus created a model of the Solar System, based on circles, with the Sun at the center. Though it was good, observations testing the model were off a little. This eventually led Kepler to create a model with ellipses instead of circles. More observations showed this to be a much better explanation of the Solar System…We will be starting with a simple model of the Earth around the Sun to help us discover what observations to expect.

You are going to use the "Earth around the Sun" diagram to figure out what part of the speed of the Earth is moving "towards" or "away" from the center of the Galaxy. There is one construction of the velocity arrow on the circle already. You will use that as an example on what you need to do for the other 6 given positions of the Earth around the Sun in the diagram. (Use the example on the sheet to help guide you.)

1) Look at the **Model Chart** (next page) and note the angles for the **6 different positions** of the Earth.

2) **Get a Circle Protractor** and line it up on the chart with 0, 90, 180, 270. This might be the toughest part. *(You can cut out the provided on a separate sheet.)*

3) **Mark the 6 positions from the chart** as best you can. Yes, it is a strange collection of values, but just go with it. *(The reason for the specific angles listed will reveal itself in a future assignment)*

4) At each dot, **draw an arrow that is TANGENT to the circle** (ask if you must) in a counter clockwise direction that is **6.0 cm long**. You may wish to use different colors. **Why 6.0 cm?** You are drawing the Earth's velocity vector and each **1.0 cm = 5 km/s**, so, 6.0 cm = 30 km/s.

5) **Draw a RIGHT TRIANGLE** for each 6.0 cm line (as shown in the example) The lines you draw (the 2 sides of the right triangle) should **ONLY BE DRAWN HORIZONTAL and VERTICAL**.

6) **Measure the Length of the JUST the Up/Down portion** of the triangle. Record in the Chart. This is the amount of the velocity **TOWARD (+) or AWAY FROM (-)** the center of the Galaxy.

**The MODEL CIRCLE SHEET Data Chart**

*(This is the MODEL CHART referenced in final conclusion activity coming up in near future)*

| Position of Earth on Circle (°) | Length of Up/Down Portion of Triangle Use (-) for Away From and (+) for Towards Center of the Galaxy (cm) (0.1 precision) | Speed of Earth towards/away from the Center (5 x column 2) (km/s) |
|---|---|---|
| 294 | *(From Example on diagram)* - 5.5 cm | -27.5 km/s |
| 10 | | |
| 74 | | |
| 132 | | |
| 180 | | |
| 217 | | |
| 251 | | |

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**Questions**

1) What is the scale for the velocity vector arrows drawn on the diagram? 1cm = _____

2) Why are each vector arrows drawn to 6.0 cm long? _____

   _____

3) What direction, on the diagram sheet, in the center of the Galaxy? _____

4) Look at the chart. What angle position would the Earth need to at in order for the Sun and Galactic Center to appear along the same line? _____°
   *(That means line the ruler straight up and going from Earth, through the Sun, to top of page)*

This Chart will be the **MODEL CHART** that will be referenced in the future activities, Final Comparisons. Keep it handy.

This is a printable full circle, counterclockwise, protractor that could be cut out and should fit nicely inside the circle from the Model diagram for marking the points on the orbit asked for in the activity.