

Name _____ Date _____

A 3-D Model of the Earth and the Moon EXTRA CREDIT

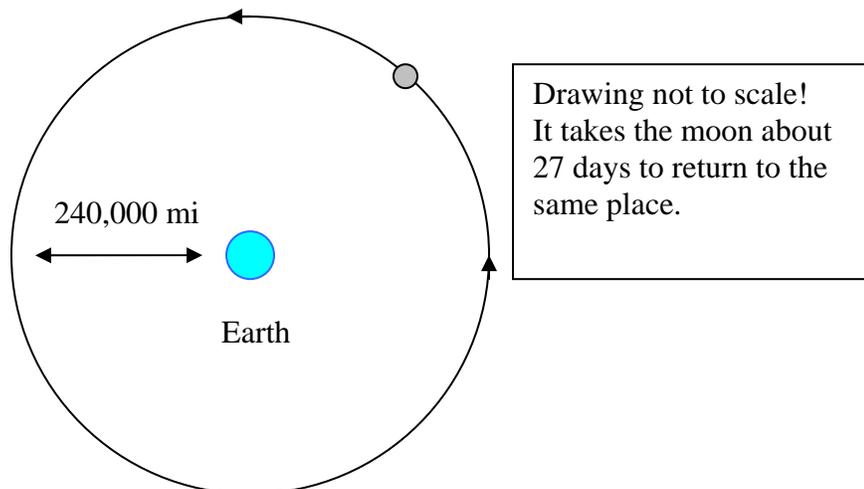
Background: In our models, if we wanted to make the Moon go around the Earth in the same time it takes in real life (the sidereal period is about 27 days, the synodic period is 29.5 days), we would have to walk pretty slow, just a few feet per day.

How fast does the Moon move in real life as it goes around the Earth?

Note we used some approximations so the answers, if you look them up, will be slightly different.

Activity 1 – MOON SPEED

1. From the in-class activity we learned that the Earth/Moon distance is about 240,000 miles. We'll use this number for the radius of the moon's orbit.
2. Every 27 days the moon returns to the same point in space relative to the Earth. In other words it travels along the circle shown below.



3. The circumference of a circle is equal to the radius multiplied by 2 multiplied by PI (use 3 for the value of PI). Therefore the circumference of a circle with a radius of 240,000 miles is _____ miles
4. It takes the moon 27 days to go that distance you calculated in #3. Let's convert that to miles per hour.
5. 27 days is _____ hours.
6. Now divide your answer from #3 by the answer in #5 to get the moon's speed around the Earth in miles per hour: _____

Activity 2 – EARTH SPEED

Now we can do the same steps to see how fast Earth goes around the Sun.

1. From the in-class activity we learned that the Earth/Sun distance is 93 million miles. How fast is the Earth moving around the sun?
2. The circumference of a circle with a 93,000,000 mile radius is _____ miles.
3. It takes Earth about 365 days to make one orbit around the sun. This is _____ hours.
4. Now divide your answer from #2 by the answer in #3 to get the Earth's speed around the sun in miles per hour: _____
5. If you did your math right the answer to #4 was a big number. Let's convert miles/hour to miles/second.
6. There are _____ seconds in an hour.
7. Divide the answer from #4 by the answer to #6: _____ miles per second is how fast the Earth goes around the Sun.

So right now, as you read this, your body is moving at (insert answer from #7) _____ miles in a second! How come you don't notice it?

Activity 3 – SOLAR SYSTEM SPEED

Only if you like big numbers! Please note that the exact numbers are not known, the values here are reasonable ones. Also, the actual orbit is not a simple circle, but again our *model* using a circle will be good enough.

Our entire solar system orbits the center of our galaxy about every 200 million years.

We orbit at a distance from the center of 25,000 light years (remember, a light year is a unit of distance).

A light year is about 6,000,000,000,000 (that's 6 trillion) miles.

If you want to figure it out on your own, cover up the rest of this page.

ANSWER:

The circumference of a 25,000 light year circle is about 150,000 light years.

So every year our solar system goes: $150,000 / 200,000,000 = .00075$ light years.

In miles that is $.00075 * 6 \text{ trillion} = .0045$ trillion miles, or written a little easier, 4.5 billion miles.

To put that in perspective, from Earth to Pluto is 3.6 billion miles, and our fastest space probe (New Horizons) is going to take 11 years to get there (arrives in 2015).

4.5 billion miles per year is the same as about 514,000 miles per hour, or 143 miles per second!

ANSWER KEY

Part 1: Moon speed

Circumference $240,000 * 2 * 3 = 1,440,000$ miles.

Speed = 2,222 miles/hour

Part 2: Earth speed

Circumference = $93M * 2 * 3 = 558$ million miles

365 days = 8760 hours

558 million miles/ 8760 hours = 63698 miles/hour = 17.7 miles/second (18.5 mi/sec is the actual average value).