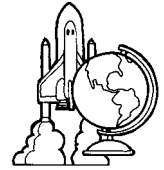


Earth's Journey Through Space



Topic: Speed of our planet

Objective: Students will manipulate models to demonstrate the Earth's motions as it travels through space.

Materials:

- **Optional:** *The Universe*, poster (available through National Geographic Society, Washington, DC; see Resources section)
- **Optional:** pictures of galaxies, including the Milky Way Galaxy (available through Astronomical Society of the Pacific; see Resources section)
- copy of Earth's Journey Cue Cards (page 14) for each student
- bright light source such as a 150 W light bulb in a clamp-on fixture
- globe with two small cardboard people attached
- copies of Earth's Journey Models (page 15)
- calculators for each student
- How Fast Are You Traveling? data sheet (page 16) for each student

Preparation:

- Enlarge pictures of Earth's Journey Models beginning with the solar system as the smallest and the universe as the largest.
- Copy Earth's Journey Cue Cards on card stock and cut them apart.
- Clear bulletin board space for the display of the Earth's Journey Models.
- Stick a small cardboard cutout of a person on the globe at your location and another at the equator on the other side of the Earth.
- Place the light in the center of the room and clear away as much furniture as possible to permit freedom of movement around the room.

Procedure:

- Select six students to assist in showing the Earth's journey through space. Distribute the Earth's Journey Cue Cards and corresponding props to the six students. Let them become familiar with their part in the demonstration and then assemble the class near the light to observe.
- Turn on the light (sun) and turn off the room lights. Have the first two students demonstrate steps 1 and 2.
- Turn the light on and have the remaining four students complete the demonstration, using the bulletin board to attach their props as explained on the cue cards.
- As each student finishes his/her explanation, mount his/her cue card on the appropriate place on the display and link each picture to the next with string to show the position of our solar system.
- Have students complete the data sheet How Fast Are You Traveling?

For Discussion:

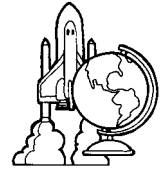
- Discuss the data sheet to check the Earth's speed calculations.
- Tell the students to "sit still" and then ask them why they can't really do this on Earth. Have them compare the Earth's motion with riding in a car or airplane. If they look out the windows, it appears as if the ground is moving. Explain that even though Earth is moving rapidly, it is so huge that we feel no motion. It appears that the sun and stars are moving, but actually this is caused by Earth's motion. Astronomers use powerful telescopes to discover the motions of galaxies.

Earth's Journey Through Space (cont.)



Earth's Journey Cue Cards

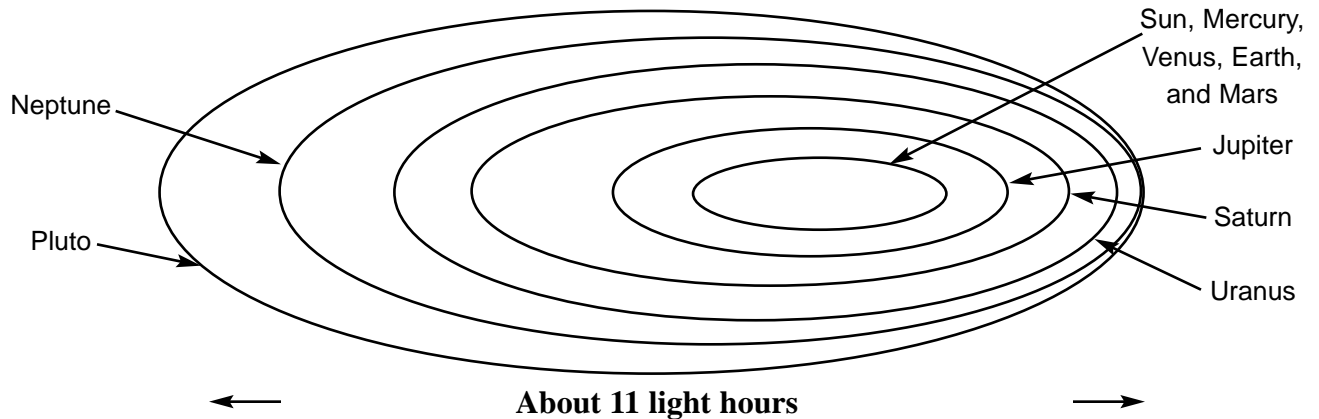
<p>1. Earth rotates on its axis.</p> <p>Demonstration: Hold the globe in the light and point out the location of the people fastened to the equator and location of your school. Slowly spin the globe west to east (counterclockwise), showing that when the people are in the light, it is day. When they move around to the dark side, it is night. Show that it is day on one side and night on the other.</p> <p>Explain that the person at the equator travels at 1,043 miles per hour (1,669 kph).</p> <p>Props: globe, light, two cardboard people</p>	<p>2. Earth orbits the sun at 66,600 mph.</p> <p>Demonstration: Hold the globe so the axis is always pointing in the same direction. Walk slowly around the light in a counterclockwise direction. Slowly spin the globe counterclockwise to show day and night.</p> <p>Explain that the Earth travels around the sun once a year at 66,600 mph (106,560 kph). This takes 365 1/4 days, which we call a year.</p> <p>Props: globe and light</p>
<p>3. The solar system is pulled toward Vega in the outer edge of the Milky Way Galaxy.</p> <p>Demonstration: Pin the Solar System to the bulletin board. Show where Earth is located. Pin the Milky Way Galaxy to the bulletin board beside the Solar System. Show the Sun is located near the outer edge of the Milky Way Galaxy. This is where our solar system is located as it is pulled toward the star Vega in this area.</p> <p>Explain that the speed of this motion toward Vega is 43,200 mph (69,120 kph).</p> <p>Props: Solar System and Milky Way Galaxy</p>	<p>4. The spiral shaped Milky Way Galaxy is rotating around a central cluster of stars.</p> <p>Demonstration: Spin the Milky Way Galaxy counterclockwise. Explain that the galaxy is spinning at 489,600 mph (783,360 kph). Our solar system moves with the spiral arms of the galaxy.</p> <p>Props: Milky Way Galaxy</p>
<p>5. The Milky Way Galaxy is pulled toward the Andromeda Galaxy in the Local Group.</p> <p>Demonstration: Pin the Local Group of Galaxies to the bulletin board and show the Andromeda Galaxy. Explain that the Milky Way Galaxy is being pulled at a speed of 180,000 mph (288,000 kph) toward the Andromeda Galaxy.</p> <p>Props: Milky Way Galaxy and Local Group</p>	<p>6. The Local Group is pulled toward the Virgo Cluster in the Local Supercluster.</p> <p>Demonstration: Pin up the Local Supercluster of Galaxies and show the location of the Local Group in it. Explain that the Local Group is being pulled at a speed of 540,000 mph (864,000 kph). Pin the Known Universe to the bulletin board and show the Local Supercluster. Everything in space is part of the Known Universe. Scientists are not sure if the Known Universe is in motion.</p> <p>Props: Local Supercluster and Known Universe</p>



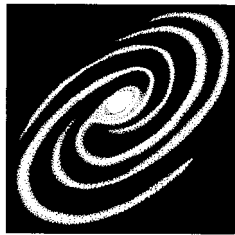
Earth's Journey Through Space (cont.)

Earth's Journey Models

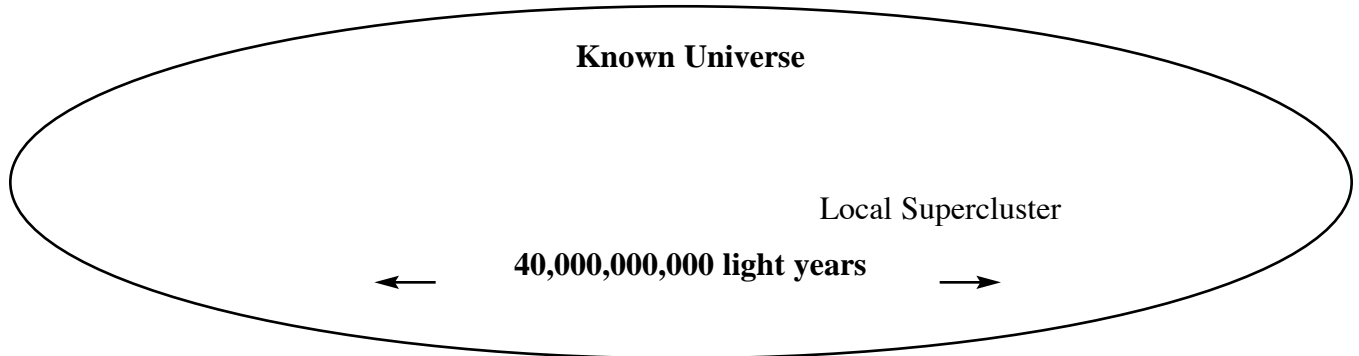
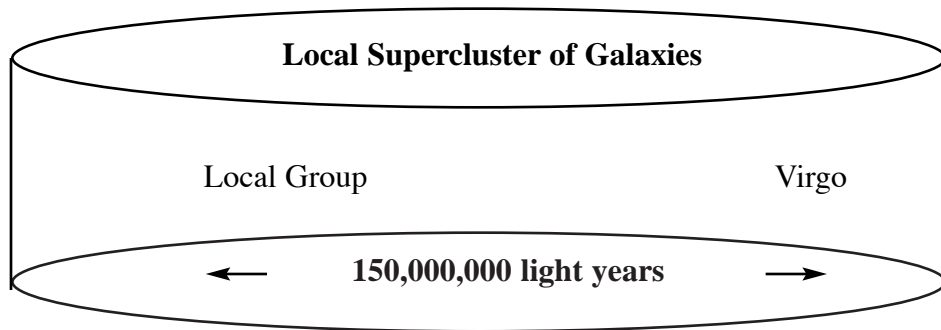
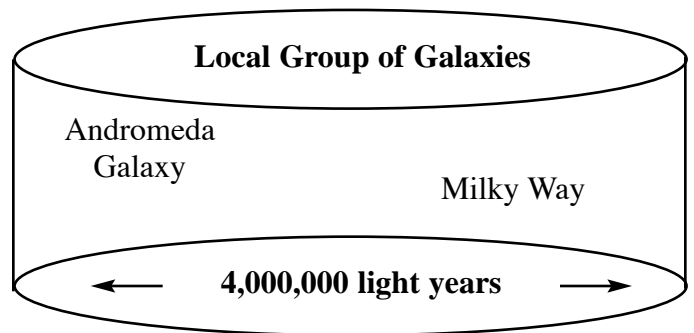
Solar System (showing Sun and orbits of outer planets only)



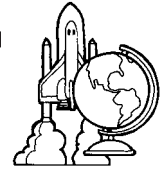
Milky Way Galaxy



← 100,000 light years →



Earth's Journey Through Space (cont.)



How Fast Are You Traveling?

As we sit on this third rock from the Sun, which we call Earth, we feel no motion. For that reason, long ago when people watched the Sun, moon, and stars move in the sky, it looked like they were all traveling east to west around the Earth. Today, we know that only the moon travels around the Earth; the daily motion of the Sun and stars is caused by Earth's rotation around its axis once every 24 hours. The gradual change of the sun's position, as well as that of the constellations, is due to Earth's 365-day trip around the Sun.

Review the data used in the bulletin board display of Earth's Journey Through Space to find the total speed of our planet as it makes this journey.

Data of Earth's Speed

1. Earth rotates once around its axis every 24 hours. The Earth's circumference at the equator is 25,035 miles (40,056 k). If we divide that distance by 24 hours, we discover that a person standing at the equator would be traveling at about 1,043 miles per hour (1,669 kph).
2. As the Earth is spinning, it also moves around the Sun. This trip takes about 365 days, moving at a speed of 66,660 mph (106,560 kph).
3. Our solar system consists of the Earth and eight other planets in orbit around the sun. The solar system is traveling toward the star Vega at 43,200 mph (69,120 kph).
4. The solar system and Vega are located in the spiral Milky Way Galaxy near the outer edge. This galaxy looks like a pinwheel rotating at 489,600 mph (783,360 kph).
5. It was discovered in the 1920s that our Milky Way Galaxy was not the only one in the universe. The Milky Way Galaxy is falling toward the great Andromeda Galaxy at 180,000 mph (288,000 kph). The oval shaped Andromeda Galaxy is part of the Local Group of galaxies.
6. The Local Group of galaxies is being pulled toward the constellation Virgo. Virgo is located in the Local Supercluster of galaxies. The Local Group is moving at a rate of 540,000 mph (864,000 kph).

Calculating Earth's Speed

- | | |
|---|-----------|
| 1. Earth rotates around its axis at | 1,043 mph |
| 2. Earth revolves around the sun at | _____ |
| 3. Our Solar System travels toward Vega at | _____ |
| 4. The Solar System moves around the Milky Way Galaxy at | _____ |
| 5. The Milky Way Galaxy falls toward Andromeda at | _____ |
| 6. The Local Group is pulled toward the Local Supercluster at | _____ |
| Earth is traveling at | _____ |

Finally, the Universe is made up the Local Group, as well as other galaxies and quasars. Scientists are not sure if the Universe is rotating. If it is there would be more speed added. So, as you sit there, as still as possible, are you really motionless?

Answer Key



Travel Time to the Planets (page 9)

Planetary Travel Time Averages								
Planets	Satellite Visits							Average
	1	2	3	4	5	6	7	
Venus	4 months	4 months	3 months	4 months	6.5 months			4.3 months
Mercury	5 months							5 months
Mars	7.5 months	5 months	4 months	5.75 months	10.25 months	11 months	7 months	7.2 months
Jupiter	21 months	20 months	18 months	22.75 months				20.4 months
Saturn	6 years	3 years	4 years					4 years
Uranus	8 years							8 years
Neptune	12 years							12 years

Rotation Speeds of the Planets (Answers for Vacation Package Outline page 10)

	Mercury	Venus	Earth	Mars	Jupiter	Saturn	Uranus	Neptune	Pluto
Diameter in Miles: (km)	3,050 (4,880)	7,563 (12,100)	7,973 (12,756)	4,246 (6,794)	89,365 (142,984)	75,335 (120,536)	31,938 (51,100)	30,938 (49,500)	1,438 (2,300)
Circumference Miles: (km)	9,577 (15,323)	23,748 (37,994)	25,035 (40,056)	13,332 (21,333)	280,606 (448,970)	236,552 (378,483)	100,285 (160,454)	97,145 (155,430)	4,515 (7,222)
Length of Day in Hours	1,416	5,832	24	25	10	11	17	16	153
Rotation Speed mph (kph)	7 (11)	4 (7)	1,043 (1,669)	542 (867)	28,061 (44,897)	22,108 (35,372)	5,797 (9,438)	6,072 (9,275)	29 (47)

Calculating Earth's Speed (page 16)

	mph	kph
1. Earth rotates around its axis at:	1,043	1,669
2. Earth revolves around the sun at:	66,660	106,560
3. Our solar system travels toward Vega at:	43,200	69,120
4. The solar system moves around the Milky Way Galaxy at:	489,600	783,360
5. The Milky Way Galaxy falls toward Andromeda at:	180,000	288,000
6. The Local Group is pulled toward the Local Supercluster at:	<u>540,000</u>	<u>864,000</u>
Earth is traveling at:	1,320,503	2,112,709