MAPPING OUT THE STARS

Subject: Math & Science

Grade Level: grades 3 and up
NGSS: General math modeling, using mathematics and computational thinking, analyzing and interpreting data.

Topics: Space Exploration, Space travel, Parallax

Concepts: Parallax and triangles

Knowledge and Skills Needed for the Project:

- How to use a protractor to measure the internal angles of a triangle's vertexes

Materials:

A space about the size of a common classroom (if at home, about the size of a living room), a pencil, blank paper, a ruler, and a protractor.

Lesson: This lesson can be done as a class, in groups or individually.

Procedure:

1. Watch the Futures Channel video "Aaron Yazzie" with the class.

2. Discuss with the class that curiosity about stars and planets has been a

worldwide endeavor for most cultures, including Mr. Yazzie's native tribe. Bringing up the point that there are quite literally billions of stars in the night sky. How would the students decide which ones to study and why?

3. Do the following lesson with the students.

MAPPING OUT THE STARS

On a clear night, we can look into the sky and see hundreds and hundreds of stars with just the naked eye. When scientists get their powerful telescopes involved, hundreds of stars become millions, and when the famous Hubble telescope is used, millions become billions!

A big part of learning about space and the stars has been mapping out where the stars are, this means making a huge 3D map in a computer, but how can scientists tell which stars are closer or farther away? When it comes to the stars, brighter doesn't always mean closer. Stars are built from a variety of gases, which make them burn at different temperatures, making them different colors and have different brightness levels. Not to mention the fact that some stars are much, much larger than others. So how do they do it?

PARALLAX!

Parallax is how an object seems to change position depending on how it is viewed. To understand this concept, let's do a demonstration.

Experiment 1:
Find an area where there is a wall or objects that are at least ten feet or more from you. Stand or sit facing it. Put your hand straight out in front of you with your thumb pointing up. Without moving your head or thumb, close one eye. (If you can't close one eye at a time, use your free hand to cover one eye.) Notice the location of your thumb in relation to the objects or wall you chose. Your thumb blocks some of your view. Now, without moving your head or thumb, open the first eye up, and close the other eye. (If you can't close one eye at a time, use your free hand to cover the other eye.) You will see that suddenly, without moving at all, your thumb changed position in relation to the objects that are further away. It now blocks other things that it was not in front of before. As you switch from eye to eye, you can almost see your thumb jumping back and forth - that's parallax!

Experiment 2:

Without moving your head, bring your thumb closer to your face, until it is about 6-8 inches from your eyes. Try the experiment again. You should notice that when your thumb is closer to your face, the “jumps” are bigger as you switch back and forth from eye to eye. THAT is the key to how scientists determine how close a star is to us. A star’s “jump” is called its **parallax angle.**

STUDENT HANDOUT

When scientists are trying to determine how close a star is to us, they use the earth's rotation around the sun to be the right and left eye, just as you did with your thumb in the earlier experiment. Earth orbits the sun at a relatively constant distance of approximately 93 million miles away from the sun. That means that at the beginning of the year (January) Earth will be 93 million miles from the sun, let's say on the right, but 6 months later (June) Earth will be halfway through its full orbit, so will be 93 million miles to the left of the sun. Scientists view a single star from the left and then from the right of the sun, just as you view your thumb from one eye and then the other. Stars with more "jump" are closer!

ACTIVITY

Using a ruler, draw a line down the center of a clean sheet of paper, longways, creating a right and left half. Draw a line perpendicular to your long line near the bottom of your paper, about 1 inch from the bottom.

Draw a small dot right where the two lines meet. This will be the sun. Draw a 2inch ring around the sun. (Small children may trace something circular, older children should use a compass.) Draw the earth on the ring, to the right and the left of the sun. Label one of them Earth in January, and the other Earth in June.

Far away, at the top of the page, draw some small stars near the top of your long line. Somewhere between the distant stars and the sun, draw one star right on the long line.

Using your ruler, create a triangle by drawing lines between the star that is on the long line and Earth in January and the Earth in February. Your lines should go from the closer star, to Earth (on the right), through the Sun and to Earth (on the left). All three should be connected as the vertexes of a triangle.

Using a protractor, measure each angle on the inside of the triangle. What is the angle of the star's vertex of the triangle?

Draw another star, this time put it closer to the sun than the one before but keep it on the long line. Draw lines again connecting this new star in a triangle with the

Earth in January and the Earth in June. Measure the angles again. What is the measure of the star's vertex in this new triangle?

Did the angle change? Why do you think it did? What does this have to do with Parallax? How does this knowledge help scientists determine a star's location?

ANSWER KEY

Students should have drawn something similar to this diagram.

The closer the star is to the sun, the larger the angle is going to be. When the angle is larger, it creates a larger "jump", telling scientists that the star is closer to us than the surrounding stars.