**Cosmic Distance Ladder Part I - Parallax**

**Student Worksheet**

**Student Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**i. Activity Guide**

1. Begin by measuring the distance between your planet and the Sun. Record this on the corresponding row of Table 1.
2. Now, take your astrolabe and hold it with the Front Mother facing towards you. Standing by your planet, carefully align the astrolabe so that the 0degree mark runs along the baseline. IMAGE
3. Point the Rule towards your star as precisely as possible. Read the angle from the inner ring on the astrolabe’s Mother Front. Record the angle on Table 1. This is the parallax angle, *p.*

Note: Be careful to read the angle correctly. Direct the sharp point of the Rule towards the star and read the angle along the long edge of the Rule.

1. Repeat this process and note down the parallax angle for all 5 stars.

**Table 1**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Planet** | **Distance from Sun (*Dp*)** | **Star A (*p*)** | **Star B (*p*)** | **Star C (*p*)** | **Star D (*p*)** |
| **Planet 1** |  |  |  |  |  |
| **Planet 2** |  |  |  |  |  |
| **Planet 3** |  |  |  |  |  |
| **Planet 4** |  |  |  |  |  |
| **Planet 5** |  |  |  |  |  |
|  **Planet 6** |  |  |  |  |  |

**ii. Activity Guide**

1. Using data provided by your classmates, fill in the parallax angle for stars A-D from each planet.
2. You will now calculate the distance to each star and fill in the Table 2.

**(Dp) tan *p* = *d***

Where *Dp* is the planet’s distance from the Sun (in metres), *p* is the parallax angle and d is distance to the star.

**Table 2**

|  |  |
| --- | --- |
|  | **Calculated distance to stars (*d*)** |
| **Star A** | **Star B** | **Star C** | **Star D** |
| **Planet 1** |  |  |  |  |
| **Planet 2** |  |  |  |  |
| **Planet 3** |  |  |  |  |
| **Planet 4** |  |  |  |  |
| **Planet 5** |  |  |  |  |
| **Planet 6** |  |  |  |  |
| **Planet 7** |  |  |  |  |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Average distance** |  |  |  |  |

1. Calculate the percentage error for each star and fill in Table 3 below.

 

To calculate the percentage error first find the different between the actual distance and average calculate distance. Divide this by the actual distance, and multiply your answer by 100 to convert it to a percentage.

**Table 3**

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Average Calculated Distance (*measured*)** | **Actual Distance (*actual*)** | **Percent Error** |
| **Star A** |  |  |  |
| **Star B** |  |  |  |
| **Star C** |  |  |  |
| **Star D** |  |  |  |

**iii. Questions**

1. Which planets yielded the most accurate results on average, those closer to the Sun or those farther away? Why do you think this was the case?
2. Which stars yield the most accurate results, those closer to us or those farther away? Why do you think this is the case?

In actuality, astronomers use the angle that the star appears to move compared to more distant background stars as Earth orbits the Sun. This is measured size months apart to get the greatest angle, then divided by two to get the parallax angle (*p)*. The formula they use to express the simple relationship between a star's distance and its parallax angle is:

***d* = 1/*p***

The distance *d* is measured in parallax seconds or parsecs, the parallax angle *p* is measured in arcseconds , there are 3600 arcseconds in 1 degree. The radius of Earth’s orbit is 1 AU (149, 598, 000 km).

1. Using the parallax angles provided below calculate the distance to each star in parsecs. Remember that astronomers often measure parallax in units called arcseconds. (Show your work.)
	1. Proxima Centauri has a parallax of 0.769
	2. Procyon has a parallax of 0.288 (3.472 pc)
	3. Beta Canis Minoris has a parallax of 0.019 (52.632 pc)
	4. Ross 128 has a parallax of 0.298 (3.35 pc)