In this first project, the goal is to calculate the rotation curve of the milky way. Once we finish this project, we will notice that the rotation curves for the disk and halo components are different from what we expect from them. In this project, we also learned about many different pieces of code to calculate the rotation curve of the milky way. This includes defining formulas, overplotting data, using arrays for R, and solving for orbital velocity at multiple different R.

To calculate orbital velocity of the milky way, we had to split it up into three components: the bulge, disk, and halo. We used a similar method to find the r-orbital velocity of each part, though the disk and halo required a couple extra pieces of code to account for different masses at different radii. To start, we download four packages. They will give us the units, constants, graphs, and the math, which we will all use in our calculations. We then define our formula, which is$V = \sqrt{(G * M / R)}$, where V is orbital velocity, G is the constant 6.6743e-11 m3 / kg s2, M is the enclosed mass, and R is the radius. To find M, we look it up on Google and define M as this number. We then use an array of radii for R, which is from 1 to 30. Then, we use the formula to calculate the orbital velocity of each part of the rotation curve of the milky way. When we calculate the orbital velocity of the disk and halo, we also have to calculate their density to find an accurate enclosed mass at each R. We don't need to do this for the bulge because it is so small compared to the other two parts, so its mass doesn't change significantly when the R gets larger.

Finally, we graph our calculations by using one of the packages we had downloaded earlier. This package was given to us by GenAI when we asked the AI to help us plot our data. Once this was given, we adjusted the x and y components, named the axes, colored the lines, and labeled each of the four total lines. These four lines represent the rotation curve for the bulge, disk, halo, and the sum of all three, creating the rotation curve of the milky way. The central black hole is also considered a part of the milky way, but it barely creates a difference in the final rotation curve, so we don't include it in this calculation.

In our result, we notice that the velocity of the bulge component consistently lowers and levels out in the further radii. We expect this for the rotation curve of the milky way, but it actually levels out instead of consistently decreasing like the bulge component. This is because there is dark matter keeping it at such a high velocity.

In this project, we assume that the mass of the bulge given to us by Google is accurate. While calculating density for the disk, we assume that it is a perfect circle to use the area formula. We also assume that the halo is a perfect sphere to use the volume formula to find its density.

The members of this team are Ainsley, Maggie, and Lisa. We mostly did the coding on our own during class, but we did occasionally help each other when needed. When creating the presentation, we created a group chat and shared a Google Slideshow with each other to work on it. Ainsley worked on the halo component, Maggie worked on the disk component, and I worked on the bulge component. We also each worked on writing our own written report for this project.