

Element E: Application of STEM principles and practices

The solution to our problem will address many STEM (science, technology, engineering and mathematic) concepts.

The Engineering concept of product / project management was utilized at the start of this project. Using the free software download at ganttproject.biz, we created a project schedule that enabled us to track our progress so we will complete this project on time. Our Gantt chart can be viewed at: **[Gantt Chart PDF.pdf](#)**

Center of gravity is an important concept of our design. Our Crutch Beverage Holder relies on balance and precision. Therefore, understanding how the center of gravity works is important. Our cup holder, not including the frame, is a symmetrical object. The center of gravity or centroid is in the center of the inside of the cup holder, and closer to the top. Because of this, we made the pivot pins above the center of gravity. This allows the cup holder to stay upright with the bottom of the cup holder maintaining its position. When we fill a cup full of liquid and place it in the cup holder, the centroid moves closer to the top. In order to prevent our cup holder from tipping, we must add a weight to the bottom. This will offset the weight of the liquid and move the center of gravity. The lower the centroid in our cup holder, the more likely it will maintain its balance.

Reducing the weight of our product was a necessity. We decided to make the cup holder as thin as possible in order to reduce the weight and material needed. This in turn would reduce the cost and time it would take to manufacture our product. We also chose plastic as our material. This would affect the density which would also affect the weight. The mass of our product will be equal to the density multiplied by volume. The volume of our prototype would remain constant, but our density would be determined by the material. We also wanted to change the weight of the product because consumers had told us when there was a 2-3 pound difference between one crutch and another, it would cause an unbalance. They would have a harder time moving from one point to another.

We also used Autodesk Inventor, in which we applied many math and geometry concepts in our design. We used engineering notebooks on a daily basis and recorded the entire design process. There were also many safety requirements we had to follow while using the rapid prototype machine and the hand tools we used to create our prototype.

