

## Tucker the Number Turtle's Story

For this project, we decided to make a shape board-like toy. When designing the toy, we wanted to make something that kids would relate to rather than one big box with holes, so we ultimately determined to make a turtle-themed shape board. The turtle has a large base and a removable shell large enough to store the smaller turtles with the shapes on them.

During the design process, the smoothest aspects were the initial design of the turtle shape. The turtle design is the same for all of the small pegs and the base of the large turtle. The large shell is designed to be taller to fit the peg turtles inside. The different peg turtles are labeled on the top with a number printed in white to stand out, and a number extruded from the base to act as the peg. The shell has number shaped holes cut into it in order to fit the pegs and act as a teaching toy for the pre-k kids.

During the design process, the most difficult aspect was making the cutouts on the shell and ensuring that the plugs slide in smoothly. To make sure this was accomplished correctly, a smaller, scaled-down version of the toy was printed to test the fit of the plugs. The initial prototype plugs did not fit well in the shell, so the number thickness was adjusted to better fit the cutouts, and the second prototype was successful, warranting the creation of the finished product.

During this project, our group learned to consider the design requirements and benefits of designing for both children and additive manufacturing. To design in a way that was safe for children's play, all pieces had to be larger than  $1\frac{1}{4}$  inches (3 centimeters) in diameter and  $2\frac{1}{4}$  inches (6 centimeters) in length to prevent choking. The parts also had to be strong enough to withstand any drop tests or damage from the children. We also had to learn and consider the 3D printer's capabilities and its tolerancing. This required careful designing to ensure the shell would fit in the turtle's body.

The actual print time was slightly longer than the predicted slicer time. This was due to the extra time used to switch materials when switching colors, printing the smaller turtles. The model is not perfectly represented in the print because the STL file uses triangular meshes to represent the curvature, which is not perfect. The curvature is also affected by the slicer and the printed layer heights. The curvature of the print could be improved with a smaller layer height; however the print time would drastically increase.