Moving Ball Maze - Tinkercad Student Project

by JonathonT

In this assignment, students use Tinkercad to construct their own Ball Maze and 3D print it! The Ball Maze is an introductory Tinkercad project geared for elementary school-aged kids with very limited or basic knowledge of using Tinkercad. A template is provided with step-by-step instructions for designing, modeling, and completing the project. It is simple, but inspires creativity as each student comes up with their own design and paths for the maze. Maze size can be scaled larger depending on the grade, but currently is about 3" square (the same size as a sticky note). At this size, overall cost is minimal (less than $0.50 per print, and $0.08 per ball). At less than $0.60 per student, a classroom of 30 students can be printed and completed for less than $20! Individual designs can be worked on remotely, emailed to a teacher, and printed easily.

Follow the steps to get started!

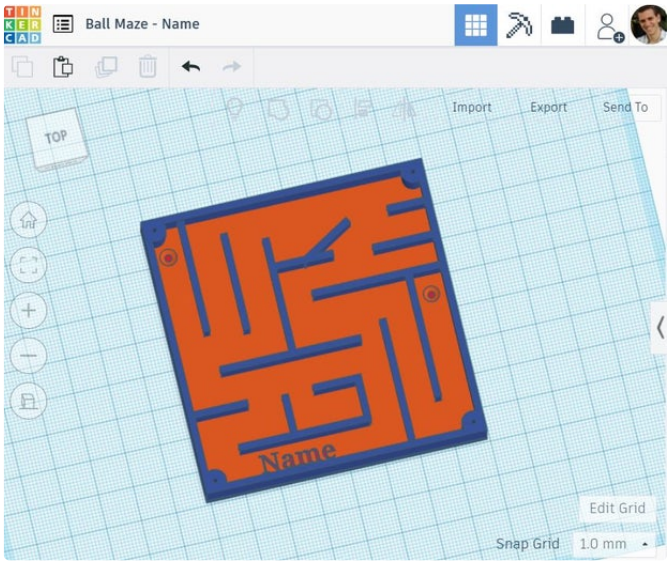
Supplies:

Basic Maze

- Sticky Notes or Paper
- 3D Printer and Filament
- 7mm Ball Bearings

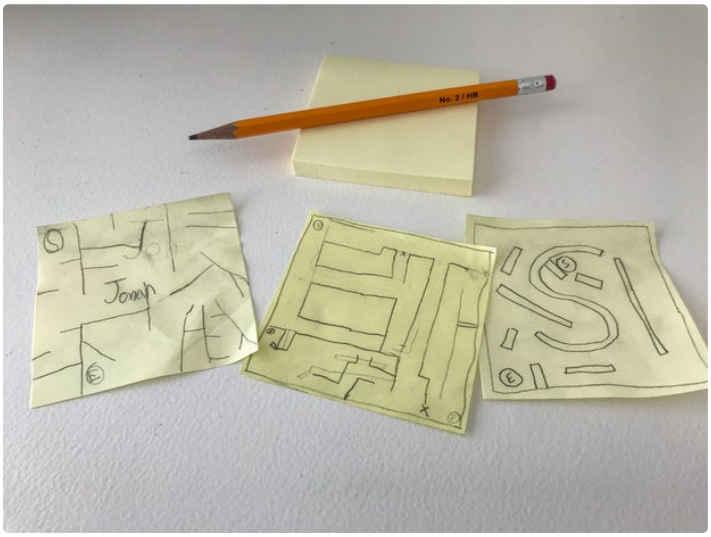
For Added Transparent Cover *(this keeps the ball in to not get lost)*

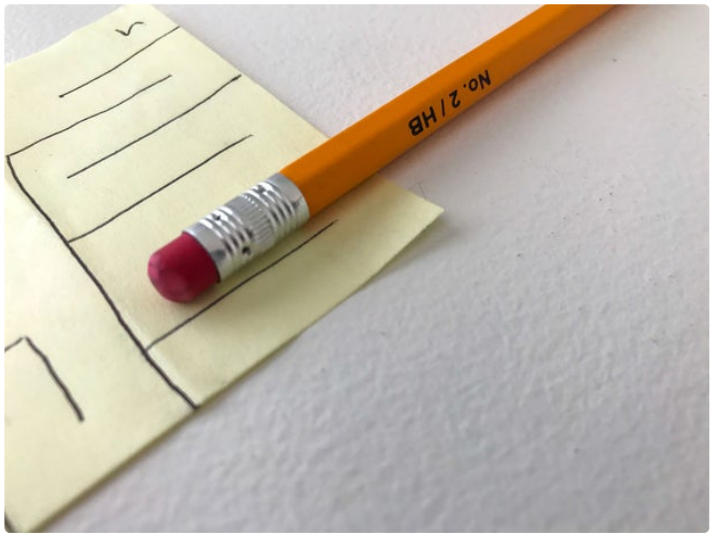
- Clear Plastic Sheets (or Plexiglass)
- Small Screws M2 x 4-6mm (AliExpress) (Amazon)
- Scissors
- Screwdriver



Step 1: Maze Design

To understand the size of the maze, start with a sticky note or by measuring a 3" square on paper. Sketch your design of the corridors of the maze. Mark a start and finish, pencil in lines for walls with a ruler or straight edge, and come up with a rough path that works from start to finish. Note that the walls of the path should be slightly wider than a standard #2 pencil to let the ball through.

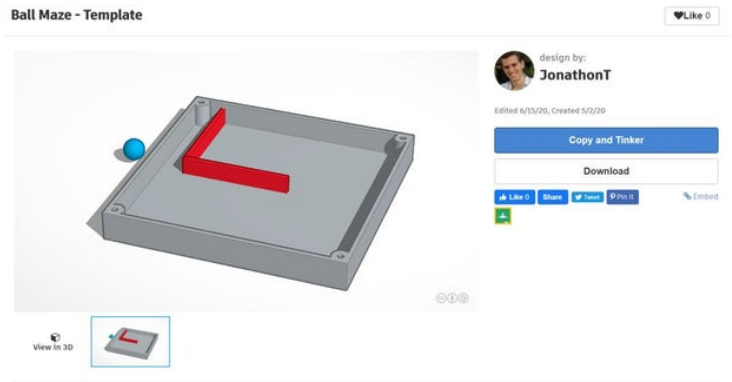




Step 2: Tinkercad: Copy the Template

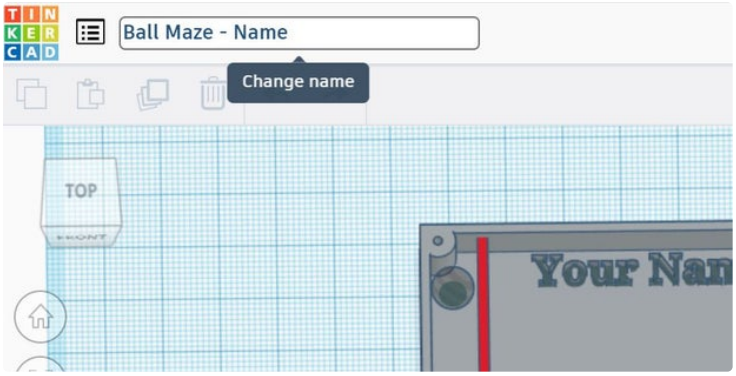
Login to Tinkercad and open the Ball Maze Template, then copy it for yourself by clicking the "Copy and Tinker" button. Templates provided here are with and without the screw guides in the corner for adding a transparent cover:

- Ball Maze - Template (With Cover)
- Ball Maze - Template (No Cover)



Step 3: Tinkercad: Rename Your Tinkercad Design

At the top left, rename your maze "Ball Maze - [Your Name]."

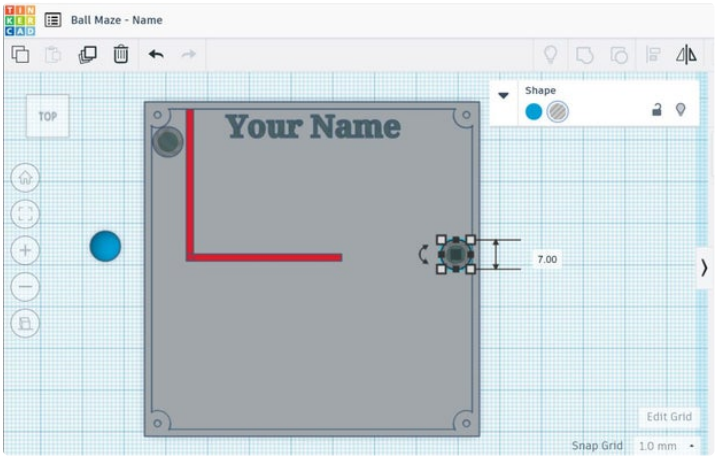


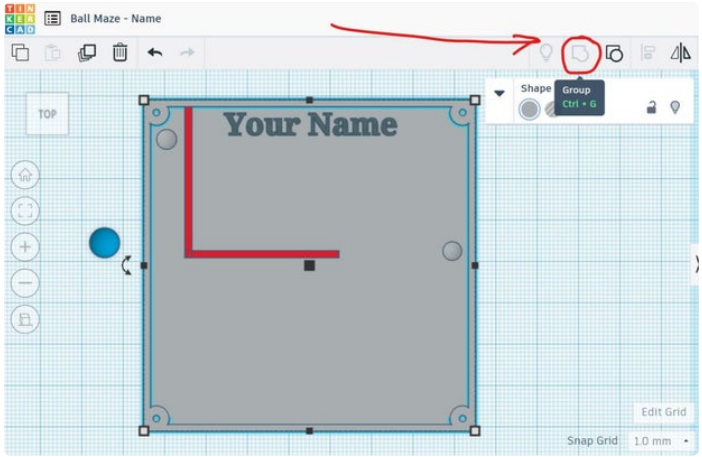
Step 4: Tinkercad: Add a Start and Finish Cutout

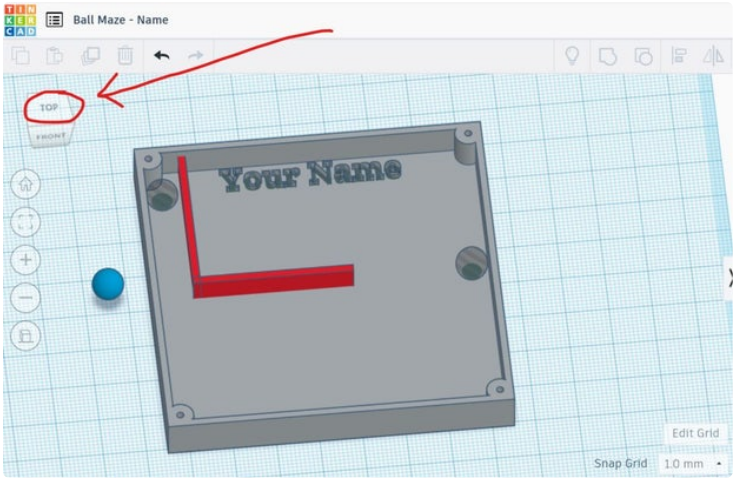
The 2 hollow balls already in the maze are to use as cutouts for a start and finish of your maze. These areas will allow the ball to sit in the cutout and stop rolling.

- Use the arrow keys or mouse to position the 2 balls where you want the start and finish of the maze. *(Make sure not to overlap with the walls!)*
- Hold the "Shift" key on the keyboard and select the gray base of the maze, and the 2 hollow balls to select all three objects.
- Use the "Group" button on the top right menu to cut the start and finish holes out.

Note: If at any time while working on the screen you have moved the view angle of the workspace, you can view again from the top by clicking the "Top" face of the cube on the top left.



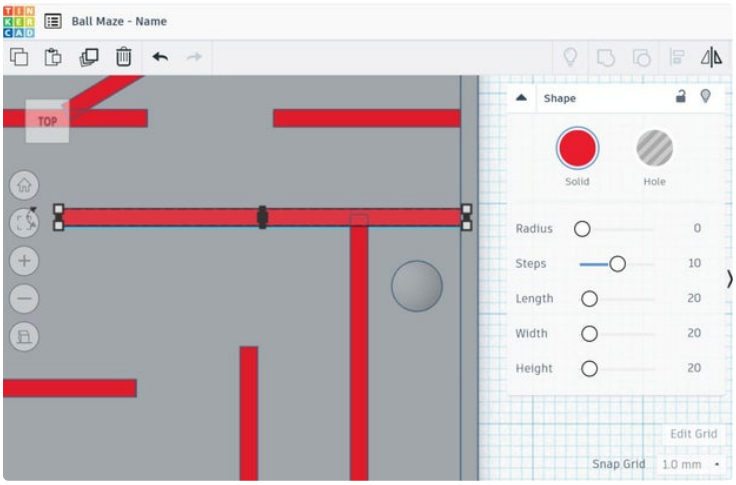




Step 5: Tinkercad: Add Walls and Shapes to Create a Path

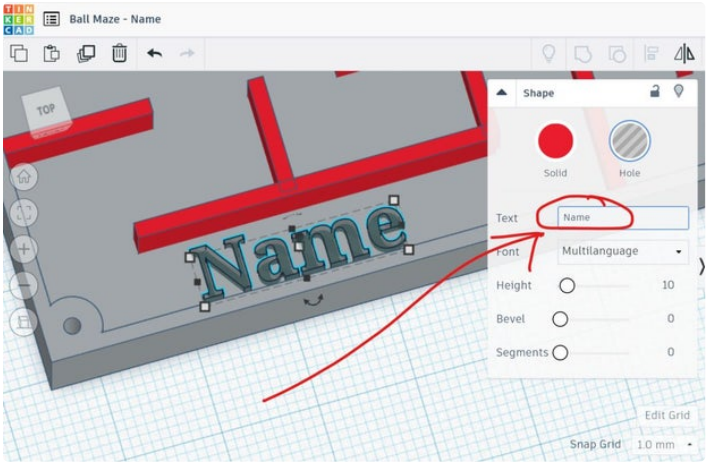
Two walls have been provided for you in red as part of the template. You are on your own to create any challenge you want. Some general thoughts to help you:

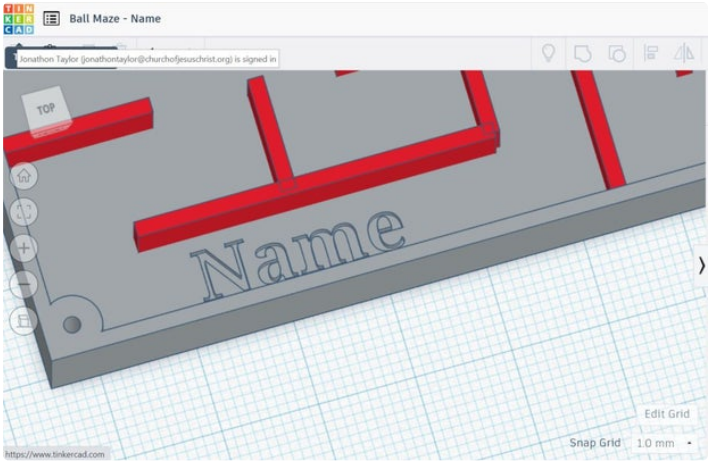
- You can duplicate the provided walls to quickly add standard walls to your maze.
- Expanding and shrinking the length of the walls allows you to make smaller or larger walls as needed.
- Making the walls much thinner than 1.5mm risks having them too thin and breaking after printing.
- Feel free to add other shapes from the right object pane.
- The height of anything added should be between 8 and 10 mm high to make sure the ball can't go over the object and so it doesn't come out the top of the box.
- Keep all objects within the maze box template.
- It is ok to leave some smaller spaces open where it looks like the ball can go through to make it trickier for those trying to do the maze. The ball is 7mm, so anything less than that typically won't fit through!
- Try a fun design, letter, or shapes to make it your own!



Step 6: Tinkercad: Add Your Name

As part of the template, a cutout text has been provided that you can add your name. Click on the "Your Name" and change the text field. Position somewhere in your maze. Select both the name and the gray base of the maze and group together to cut out the imprint of the name.



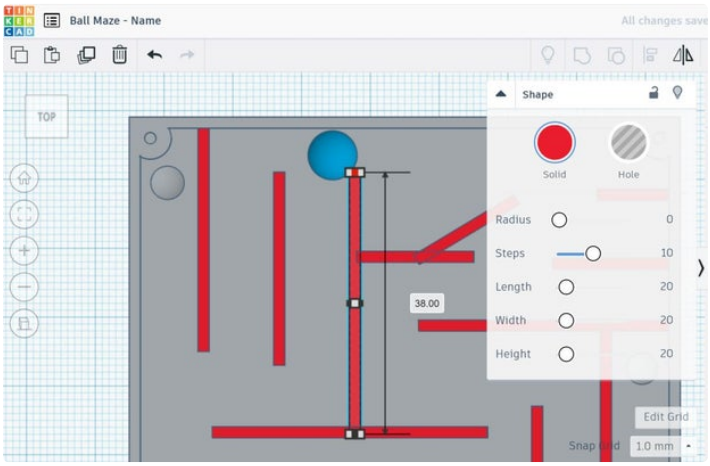


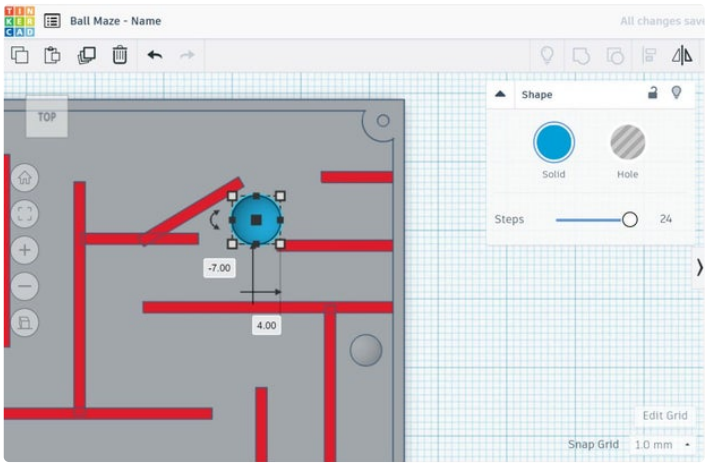
Step 7: Tinkercad: Test Moving the Ball Through the Maze

Before merging the inside walls together with the gray base of the maze, first test moving the provided ball through the maze from start to finish. You need to make sure the ball can fit through openings you want and doesn't fit where you don't want.

- The ball is a 7mm sphere. It is 2mm above the workspace because the gray base of the maze is 2mm tall.
- Take the ball and move it to the starting cutout.
- Use the arrow keys or mouse to move the ball through the maze corridors from start to finish.
- If any path is too narrow, appropriately resize objects to let the ball get through.
- If you make many corrections, retest afterwards again to make sure moving one wall in one location doesn't make another path too narrow.

Note: After testing is finished, delete the test ball!



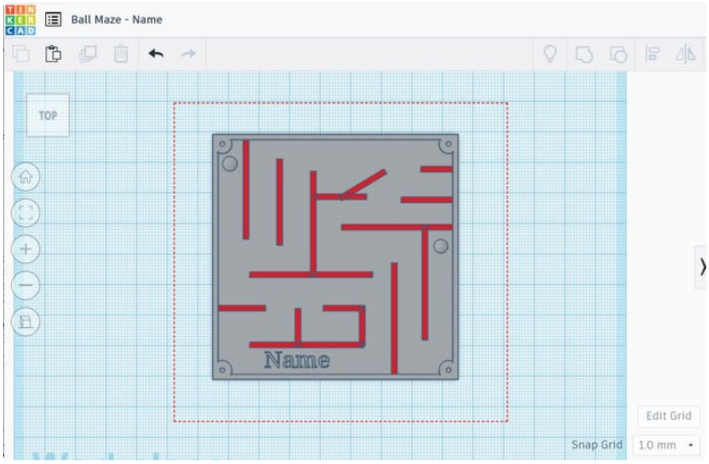


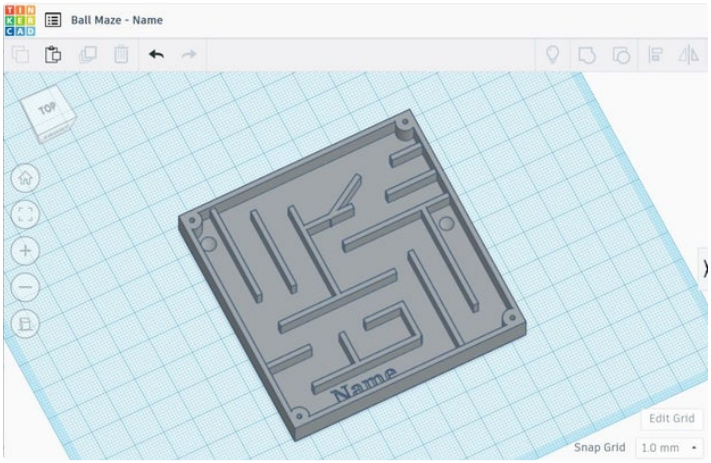
Step 8: Tinkercad: Merge the Walls

Next, merge all the walls to maze base following the below steps.

- First do a check to see if all walls and objects are inside the maze.
    - Switch to the front view in the cube on the top left of the screen
    - Make sure there is nothing below the plane or above the maze or to the sides.
    - Then switch to a side view and check again.

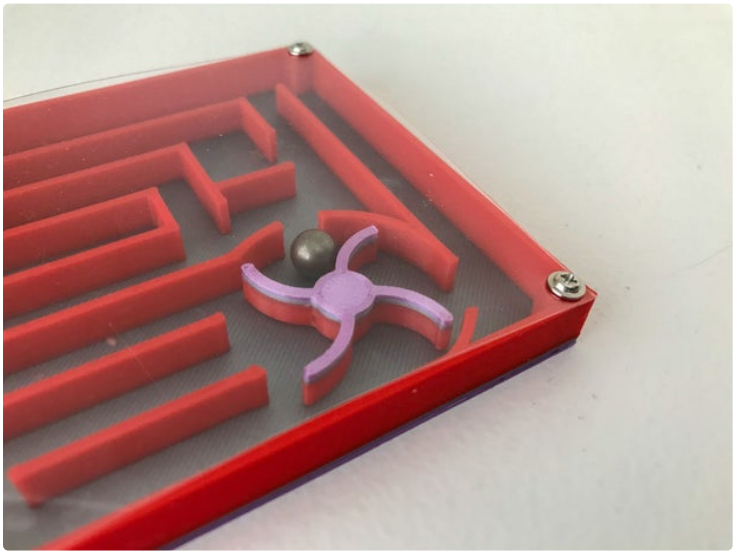
- Next, zoom out to see the entire maze from the top.
- Click and drag from the top left to the bottom right to select all the walls and the base of the maze.
- With all objects selected, use the group button to group all the objects together.





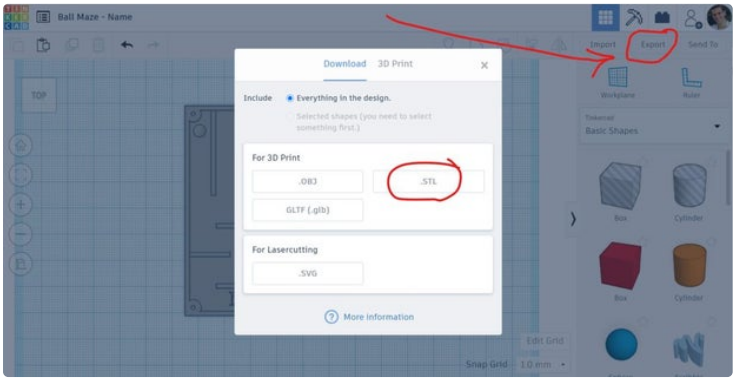
Step 9: Bonus Points: Add a Custom Movable Part!

For upper grades, consider adding a movable part to the maze design. Some ideas are a spin-wheel, a hinged wall section, a gear, or simply a block that moves around and obstructs the way! Any separate pieces can be printed to the side of maze base, just make sure to group everything together before exporting.



Step 10: Tinkercad: Export STL File

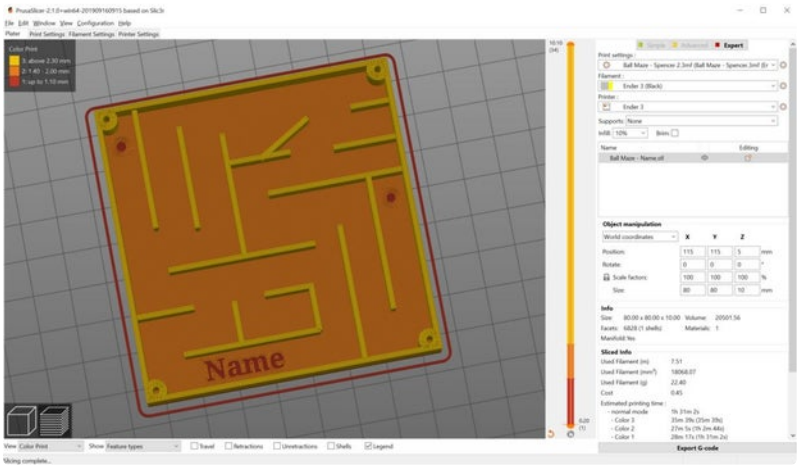
With everything finished, click the "Export" button at the top right of the screen. Then click on ".STL". This creates the file that will be used to prepare the maze for 3D printing.

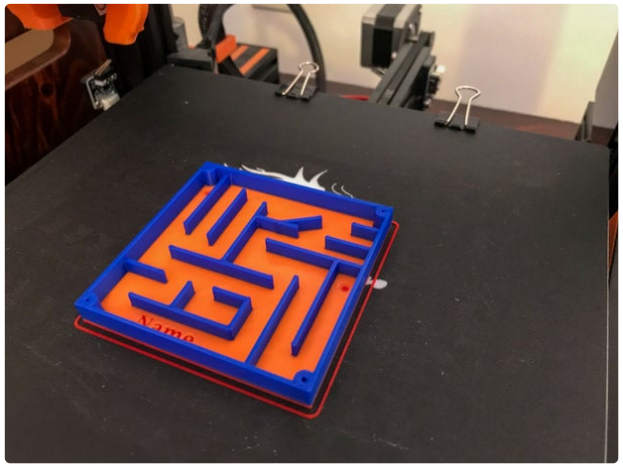


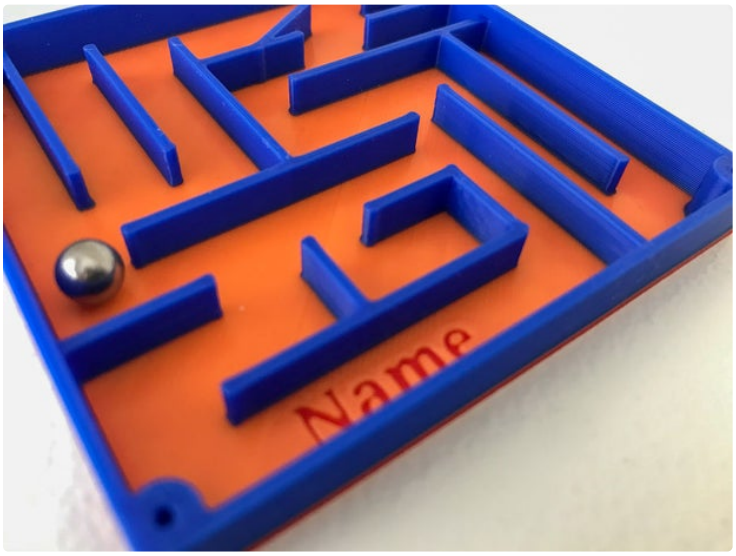
Step 11: Slicing and 3D Printing the Mazes

For the instructor or parent, using slicer software, prepare the .STL file for printing. Optionally add a color break between the base and the walls to more easily see the walls and navigate the maze. Also, adding a color break for the start and finish cutouts and the name allow them to be more visible. In my case I added color breaks at the 5th layer and 8th layer. Here were our print settings:

- Infill - 10%
- Layer Height - 0.3mm
- First Layer Height - 0.2mm
- Perimeters - 2
- Color break at layer 5 and 8
- Estimated printing time - 90 min



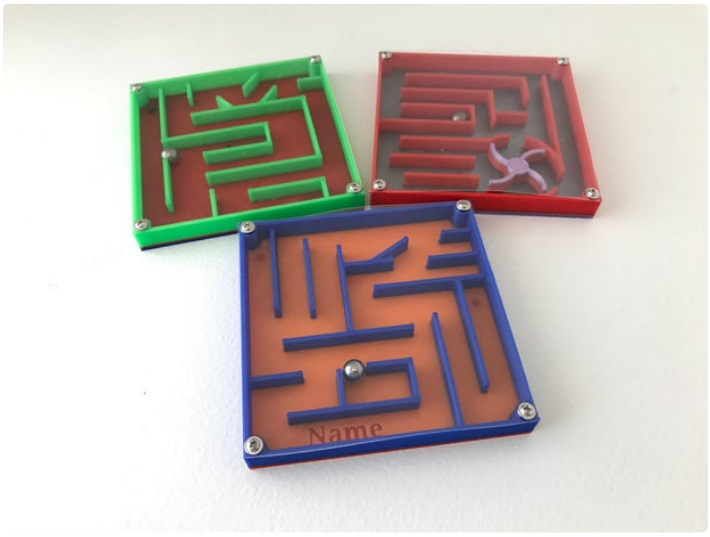


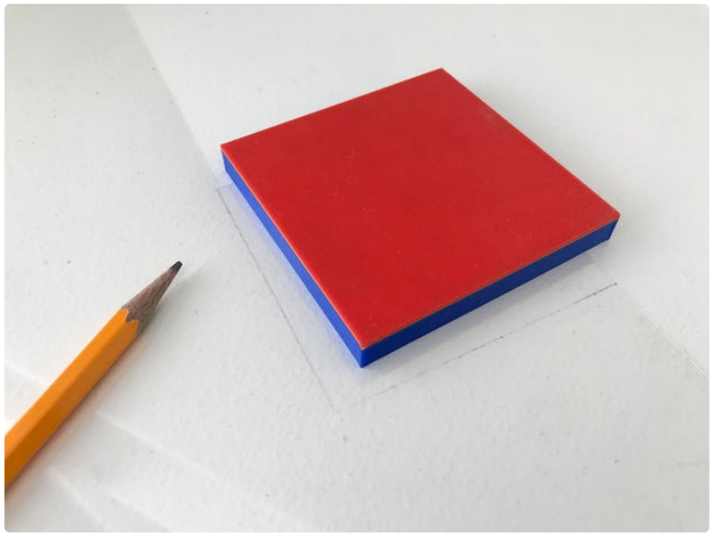


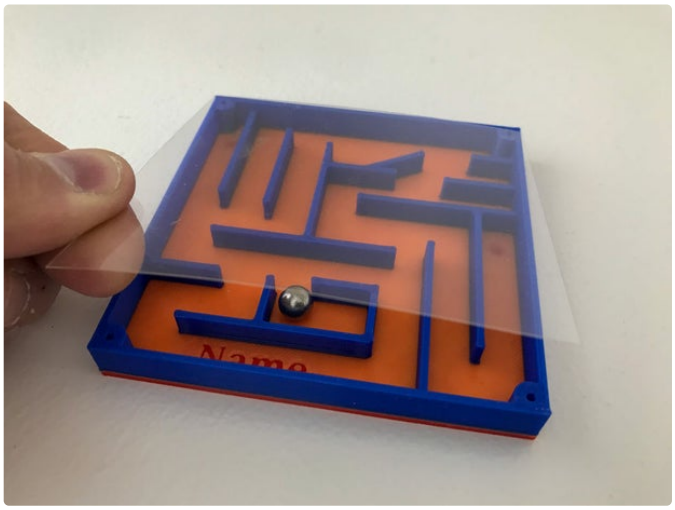
Step 12: Adding the Transparent Cover

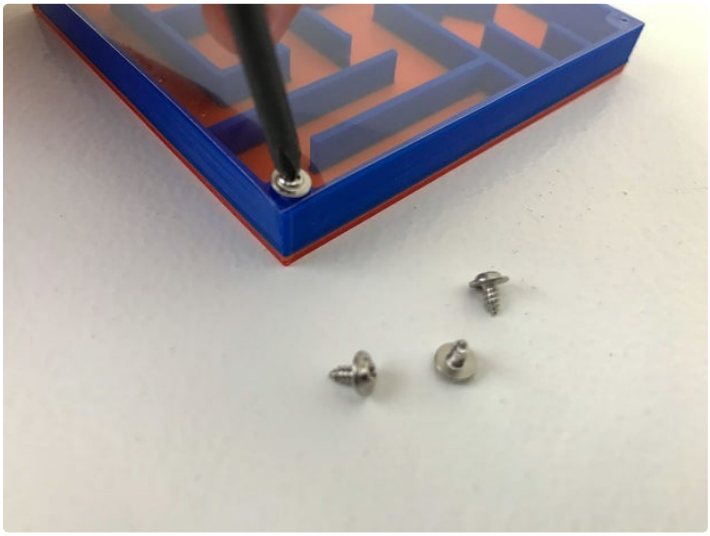
In order to keep the 7mm ball inside the maze, you can use plexiglass or a clear plastic sheet and screws to cover the top of the maze. Plexiglass is much more rigid and longer-lasting, but the clear plastic sheet does the same job at a fraction of the cost and is simple to cut and install. This will prevent the ball from being lost, or kids from putting them in their mouths.

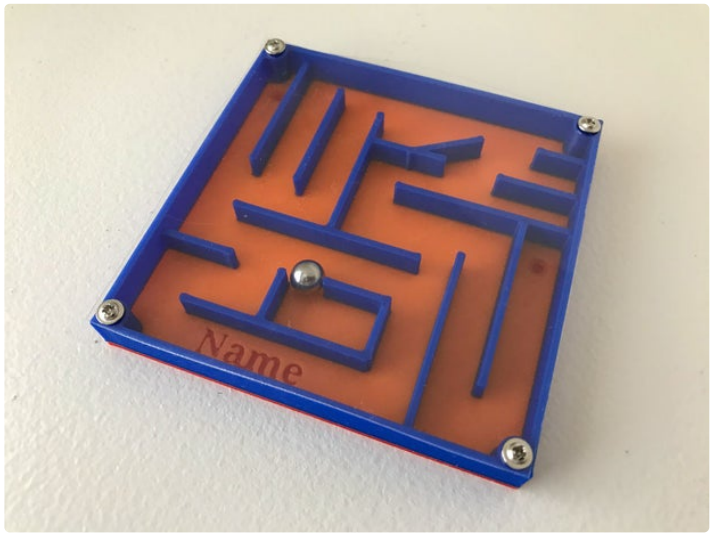
- Take the completed ball maze and trace the outline on the clear plastic sheet
- Cut along the outline with scissors
- Place the sheet over the top of the ball maze and either use the end of the scissors to poke a hole in each corner where the screw holes are, or use a small drill bit
- Place the ball inside the maze
- Use 4 screws to secure the sheet to the maze







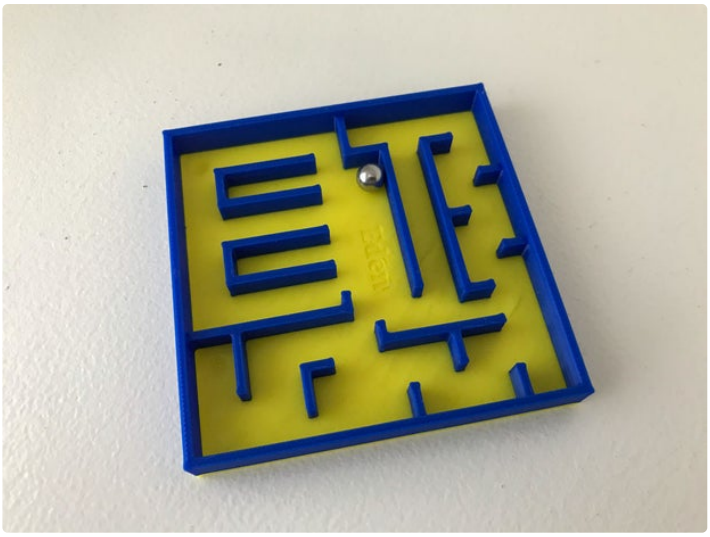
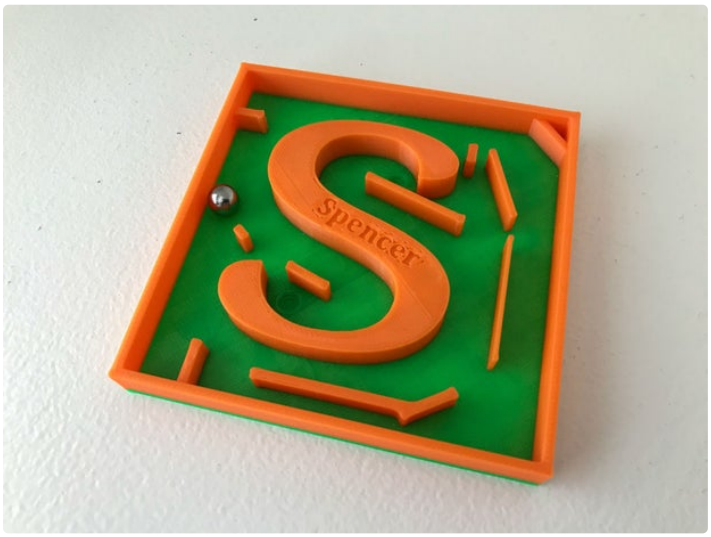


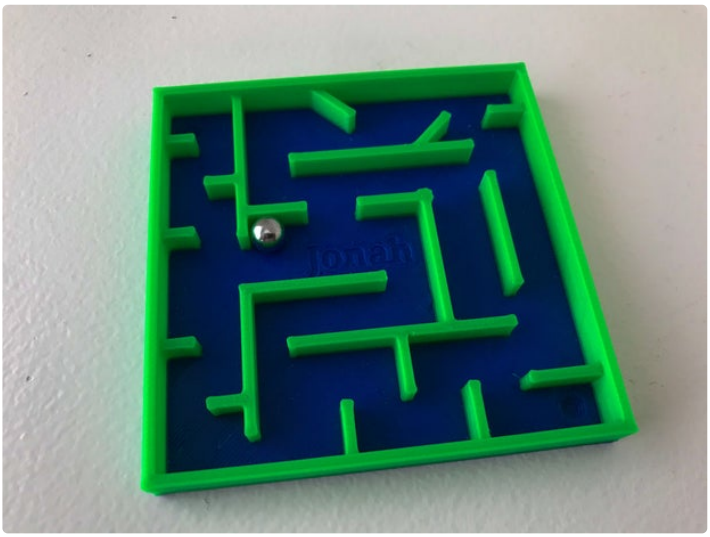


Step 13: Example Results

Here are few kid-designed maze submissions. (From experience, Kindergarten - 2nd grade will need some hands-on help. Around 2nd - 3rd grade they can complete this on their own. Around 4th grade they start getting more creative and challenging!)

For reference, here is the completed example that was walked through in the instructions: Ball Maze - Name




This is such a fun activity!


Thanks! It is really fun to see the pride and accomplishment from kids in making something simple like this. :)