**Child's Stacking Toy Project**                    Team Members' Names: _____
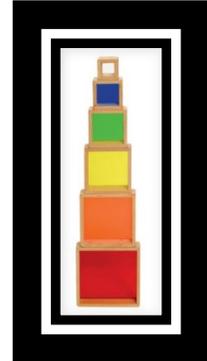
_____

_____

**Overview:** Recently you have learned about how 3D printing works and some of the things that can be made with a 3D printer. Now it is your turn to use the 3D printer to make an item of your very own. Your mission is to work with a team to design a child's stacking toy using Computer-Aided Design (CAD) software (we will be using a program called Tinkercad).

The files containing the best designs will be transferred over to a program called Cura, and then we will save the files (in both .stl format and .gcode format) and print the designs on the 3D printer. The printed designs will then be given to a child to enjoy.

**Here is how your project will be scored:**

| Scoring Criteria | Points Earned | Points Possible |
|---|---|---|
| **SCIENCE GRADE** | | |
| Stacking toy meets each of the following specifications (number, shape, etc.): <br> • Three stacking pieces <br> • Each piece is no smaller than 3 cm or larger than 10 cm in any dimension <br> • Uses only rectangular prisms, cubes, or cylinders <br> • Each piece has the same height but different dimensions, unless it is a cube (use metric measurements- i.e., centimeters and millimeters) <br> • Pieces are decorated with a "theme"- i.e., colors, pictures, etc. | | 20 |
| Teamwork: All team members are on-task throughout the project and contribute sufficiently to the final products. <br> • Completed Project Design/Permission to Construct Worksheet <br> • Completed 3+ journal entries detailing team's work structure and progress <br> • Teacher observation notes | | 10 |
| **MATH GRADE** | | |
| Project Board: <br> • Includes all relevant parts (rationale, math calculations, colored rendering) <br> • Is neat and organized | | 20 |
| Student completed individual calculations worksheet | | 10 |
| **TOTAL SCORE** | | 60 |

|  |  |  |
|---|---|---|

### What to do when you have successfully created your stacking toy on Tinkercad

1. Be sure you have saved each of your three files on Tinkercad.
2. Open one of your files in Tinkercad. In the upper-right corner of the screen, click on "Export" and then on "Download for 3D Printing."
3. Click on the boxes that say "Everything in the design" and ".STL."
4. Since you designed your stacking toy to have three separate pieces, you will need to create a separate file for each piece of your toy. Therefore, you would have three files, each with the same team members' names (but possibly different colors). Click "save as" and then save each separate file. Change the file names to the following format before saving: 1_Last Name_Last Name_Last Name_ Color. For example, if my last name is Miller and my partners' last names are Jones and Smith, and we would like a blue stacking toy for our first piece, our file name would be "1_Jones_Smith_Miller_Blue." And our second piece, for example, would be "2_Jones_Smith_Miller_Pink."

**Now we need to convert the file to a format that our 3D printer can read.**

5. Open the Cura program on your desktop.
6. Click "File" and then "Load File Model."
7. When prompted, select one of your team's files.
8. Your stacking toy should appear on the screen. If, by chance, a robot also appears on the screen (this is Ultimaker's mascot), be sure to delete it.
9. Next we want to make sure each piece of the stacking toy is between 3 cm and 10 cm (or 30 mm and 100 mm) in all dimensions. Click on the piece of your stacking toy, then click on the scale icon (it is the middle of the three icons found in the bottom left-hand corner of the screen). Make sure the length, width, and height (X, Y, and Z axes) are somewhere between 30 mm and 100 mm each.
10. Next, click on the box next to where it says "Print Support Structure." Otherwise, the design on the pieces of your stacking toy won't print properly because they won't have appropriate support beneath them. Also, click on the box on the left that says "Fast Print."
11. Finally, save your file by clicking the "Save Toolpath" icon (it is the middle of the three icons found in the upper left-hand corner of the screen). Be sure to save your file in the following format: Piece Number_Last Name_Last Name_ Last Name_Color (like you did the first time).
12. Repeat steps 6-12 for all three pieces of your stacking toy.
13. Check to see that your files are on the SD card (if you saved it correctly, the file name should end with "gcode"). Return the SD card to your teacher for printing.

**Final Checklist for Each Stacking Piece:**
- ✓ Box on Cura that says "Print Support Structure" is checked.
- ✓ Box on Cura that says "Fast Print" is checked.
- ✓ One stacking piece (and no Ultimaker robot) is shown on the screen.
- ✓ The dimensions of each stacking piece are between 30 mm and 100 mm.
- ✓ File is saved on all team members' U Drive folders and on SD card (both in Tinkercad's STL format and Cura's G-Code format).

**Please check your work carefully. No reprints will be made.**

Your toy should have 3 levels. In each box below designate the type of 3-D figure used for that level, the dimensions of the figure, its volume and surface area.

| Level & Type of Figure | Dimensions | Volume Show ALL calculations | Surface Area Show ALL calculations |
|---|---|---|---|
| | L: <br><br> W or Radius: <br><br> H: | | |
| | L: <br><br> W: <br><br> H: | | |
| | L: <br><br> W: <br><br> H: | | |

# Project Design
*one per team*
Brainstorm some theme ideas

| | | |
|---|---|---|
| | | |

What theme are you going to choose for your toy and what colors/pictures will you choose to show your theme? (Color choices for printing- Pink, blue, green, red, white and silver)

What type of 3-D figures are you going to use? Remember you need 3 levels and can use rectangular prisms and cylinders.

Decide on preliminary dimensions of each figure.
(Remember no smaller than 3cm and no larger than 12 cm)

| | | |
|---|---|---|
| | | |

**Permission to Construct**
**\*One per team\***

Team Members:   _____

                           _____

                           _____

Toy Name:_____

Describe your toy:




Provide the type and dimensions of each piece:

| Piece 1: | Piece 2: | Piece 3: |
|---|---|---|
|  |  |  |

| | | |
|---|---|---|
| | | |

Supervisor Signature_____          Date   _____

**Team Member Journal**                    **Team Member's Name: _____**

Rate your team on your progress during today's session. Describe what each person worked on or was able to complete. Analyze your team's next steps.

How productive was your work today?   1      2     3     4     5
**1 is not very productive and 5 is very productive**

| Date: |
|---|
| |

Supervisor Notes:

_____
_____
_____

How productive was your work today?   1      2     3     4     5
**1 is not very productive and 5 is very productive**

| Date: |
|---|
| |

Supervisor Notes:

_____
_____
_____

# Project Board Requirements

Each team member should contribute at least one part of the project board.

_____    Name of Toy and Group Members

_____  Rationale of choice of theme and toy
   -Paragraph explaining why your toy would be the best toy for a young child to play with. Why is your toy better than another type of stacking toy?
   Completed by: _____

_____   Mock- up drawing (in color) of your figure
   Completed by: _____

_____    A net (labeled with dimensions), volume calculations, and surface area calculations for each piece of your toy.
   Completed by: _____

Use the space below to plan out your board.