Robogals
Science Challenge

Minor Challenge Set #4
STEM Field: Mechanical Engineering
Level: Intermediate / Senior
Challenge Name: Build a 3D Model of a Button
Project Cost: 0 USD
Materials Required:

- Laptop/ Computer with Internet access
- A mouse with scroll wheel (recommended)
- An account on TinkerCAD (a free software)
    - Registration for an account is necessary to save progress

Duration:

- This challenge will take approximately 1-2 hours to finish, however, the time guideline is an estimation only, and students and mentors can complete the tasks around their schedules

Introduction:

Mechanical engineers are involved throughout the product lifecycle, from design, develop product ideas and prototypes, to install, test and maintain the finished product. Mechanical engineers often use different computer technologies to create and analyse designs. One of the most important software programs they use is called Computer Aided Design (CAD) software. CAD is used to digitally create 2D drawings and 3D models of real-world products.

In this project, we will learn to use a simple CAD software to design a 3D model of a simple button for our clothes.

Instructions:

1. Navigate to the website: https://www.tinkercad.com. It is recommended that you open this website on a browser such as Chrome. This software is free-to-use, and creating an account is necessary to save the progress of your project.

   If you have not registered, click “JOIN NOW”, then select “Create a personal account”.

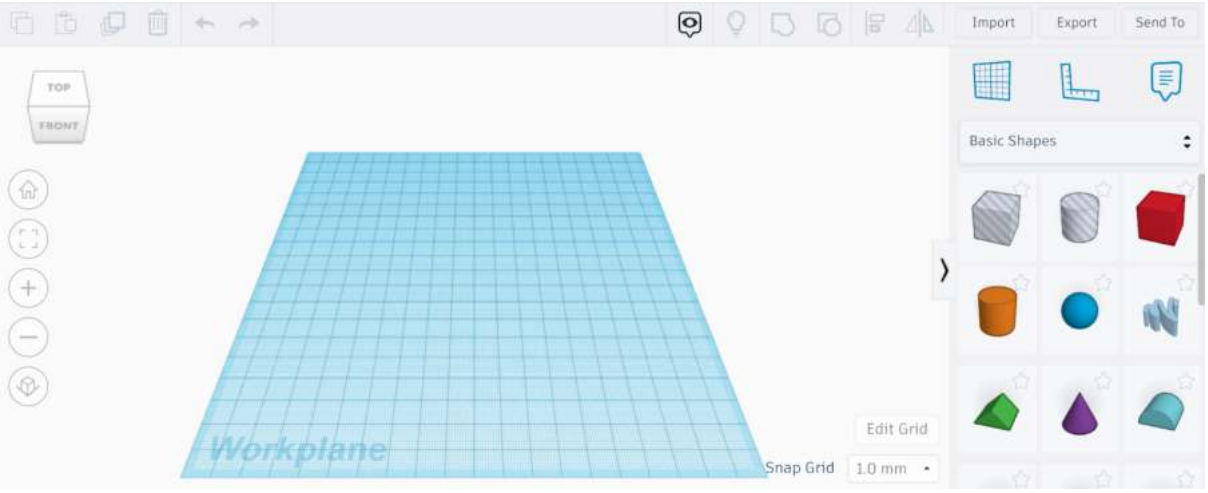
   Alternatively, click “Sign In” to log into your TinkerCAD account.

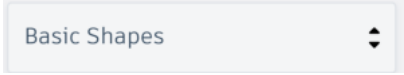
2. After you have logged in, you will see a dashboard with projects you are working on. TinkerCAD can be used to create 3D models or other software projects. In this activity, we will do 3D modelling, so select “3D Designs”, then “Create new design”.

Part A: Navigating TinkerCAD

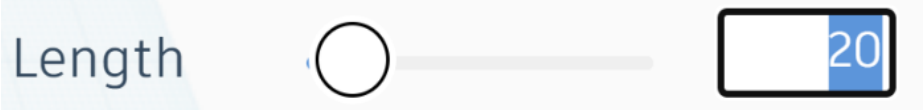
Note: If you have not designed a 3D model on TinkerCAD before, we recommend working through part A to learn more about TinkerCAD. Otherwise, you can skip to part B and design your clothes buttons!

3. The blue space in the middle shows the workplane. This is where you can build your 3D models. On the right hand side, you have a library of shapes to build your models with.



4. You can click on the  button to view the full library of shapes.

5. Drag and drop a red box to the middle of the workspace. Play around with the length, width and height of the box. You can click on the number next to each dimension to edit the measurement (similar to figure below).



6. When creating designs, you may want to view your model from different sides.

   Click on the ViewCube  (at the top left) and drag anywhere to see how it changes the point of view. You can also click on different areas, for example, “Top”, “Front”, “Left”, “Right”, to view the design from different sides.

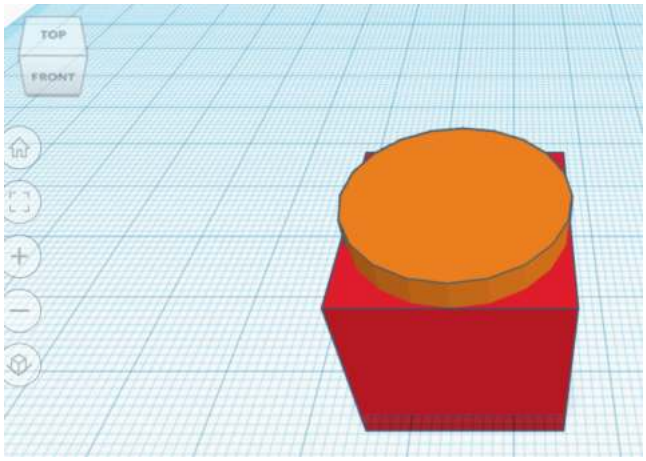
   Then click on the  symbol to return to the original view.

7. If you have a mouse with a scroll wheel, scroll the wheel to zoom in and out. Otherwise, you can use the touchpad, then zoom using the gesture you normally use to zoom in other apps.

8. Let's practice rotating the design faster! Hold the right mouse button while moving your mouse to rotate your view of the design. If you use the touchpad, depending on the setting on your computer, either press Ctrl and left click while you drag, or right click and drag.

9. Let's try to move the design around. Left click on the shape, and move the box around the workspace. If you accidentally change the dimensions of the box in the process, press Ctrl and Z to undo this.

10. We will now try to group shapes together. Drag and drop a cylinder onto the box. Note that we currently have two shapes of two different colours, similar to the figure below.



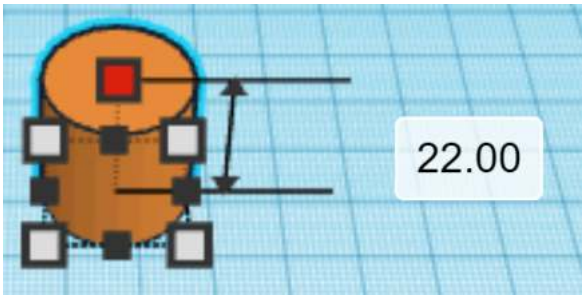
We want to group them together. Hold the Shift key while selecting the shapes you want to group together: the box, and the cylinder. Then click on the  button at the top to group them together. You will see that both shapes turn the same colour.

Rotate the design to see what this will look like from different sides!

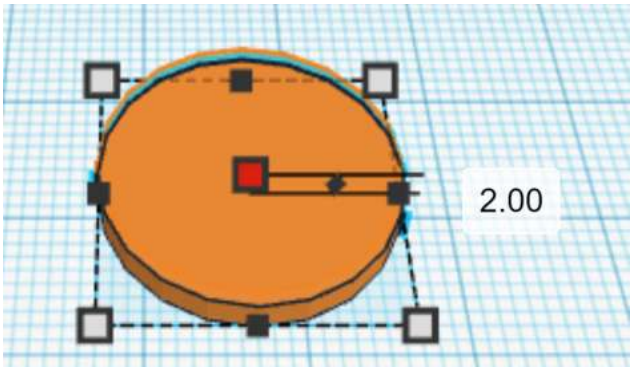
11. If we want to create a round hole inside the box, we can select the transparent cylinder, instead of the solid coloured one. Repeat step 10 for the box and a transparent cylinder.

Part B: Make a Simple Button

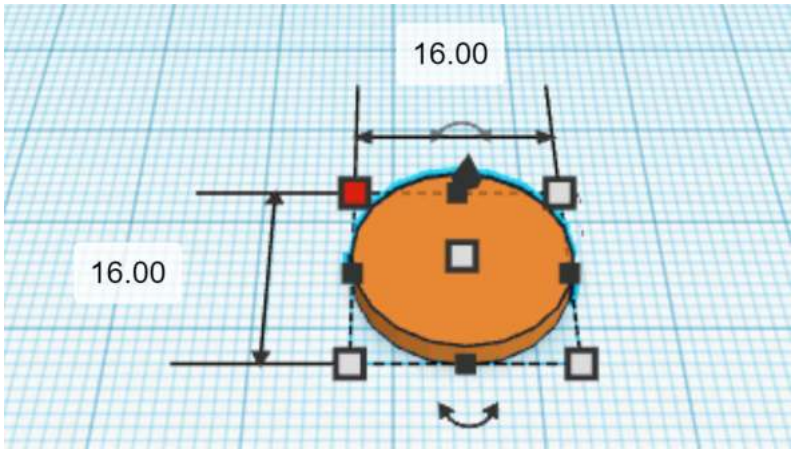
1. Drag a solid coloured cylinder to the workplane.
2. Scale the cylinder down to a height of 2 mm. You can do this by clicking on the white dot at the top of the cylinder.



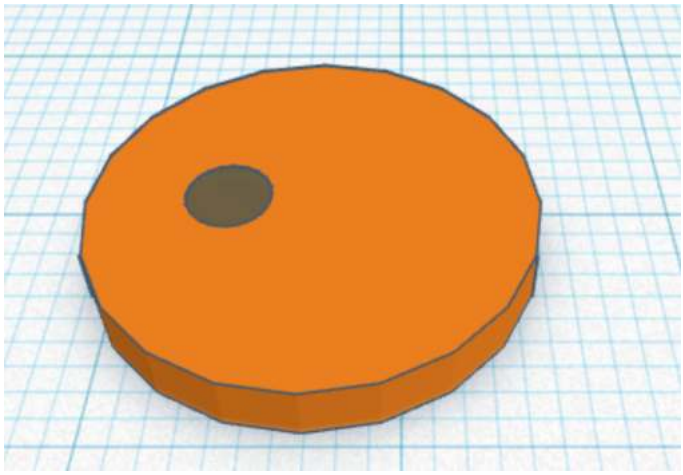
Once the white box turns red, drag the cylinder down until you get a height of 2 mm, similar to the figure below.



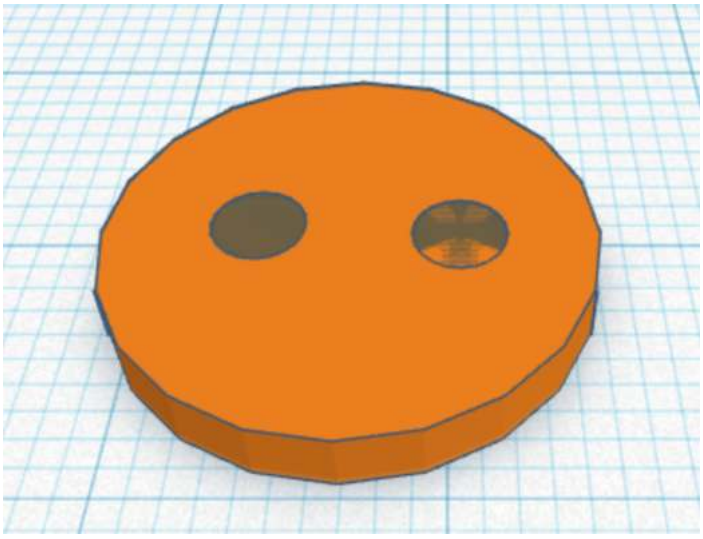
3. Scale it to a diameter of 16mm. You can do this by clicking on any of the four white dots outside the cylinder, then click on the numbers and change to 16 mm. This will be the main shape of the button.



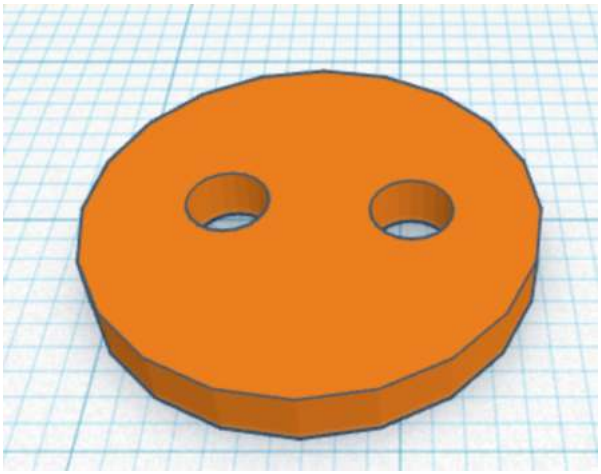
4. We will now create holes that will allow the button to be seun to a shirt. Drag a transparent cylinder shape to the workplane.
5. Scale the new cylinder to a diameter of 3 mm, and height of 2 mm.
6. Move the new cylinder onto the left side of the original shape of the button, similar to the figure below.



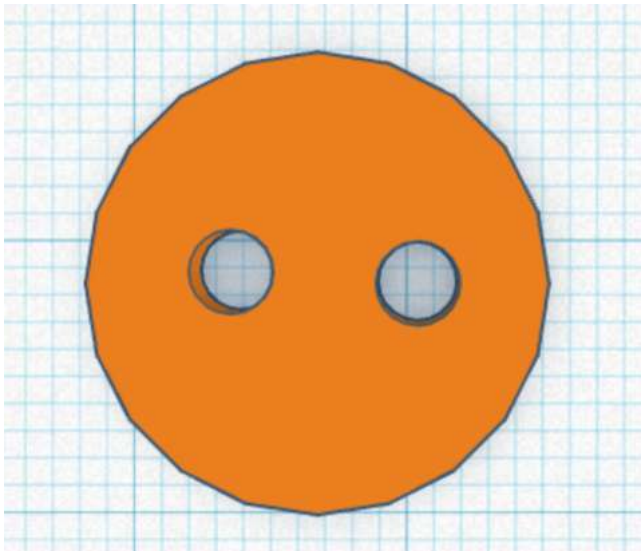
7. Create another transparent cylinder of diameter 3 mm and height 2 mm. Move the cylinder to the right side of the original shape of the button, similar to the figure below.



8. Select all the shapes and group them into a single object. More grouping instructions can be found in step 10 of part A.
9. And our basic button is done! You will have a shape that looks like the figure below.



From the top point of view, your button looks like this:



10. Click on the button to change the colour, or add in more holes for the button to be sewn to clothes.
11. You can also modify the shapes of the holes to any shape you want. How about adding a star, or a heart shape, modify the dimensions of the new shapes, then group them and the basic button shape together? Remember to make any shapes of the holes a transparent one!
12. You can also try adding some text onto your button. Select the TEXT shape and modify it to fit on top of your button.

Extension
We can use TinkerCAD to make many more things than a basic button. Here are some suggested guided lessons you can follow to make other shapes on TinkerCAD.

TinkerCAD - Make a flower shaped button using cylinder shapes

TinkerCAD - Make a teddy bear shaped button with simple shapes

TinkerCAD - Make a bat shaped button with simple geometric shapes

Reflection Questions:

- Are there any improvements you would make to this challenge?

- Can you describe real life applications of CAD software? Why do mechanical engineers need CAD in their work? What are some examples of CAD software that they use?
- Can you describe 2-3 advantages and disadvantages of using CAD in engineering?
- Once you have finished designing the 3D model, you can export it for 3D printing. From your own research and previous experience, can you describe (in 2-3 sentences) what 3D printing is, and how it works?

Submission Guidelines:

- Submit a photo of your button design. If you attempt other extension activities, also include photos of your button designs. Include a short summary that addresses the reflection questions.

Note: Remember, if you want to upload pictures of your Minor Challenge that also include you, please check if it is OK with

your parent or guardian first.

- The submission form is on the Minor Challenges page: https://sciencechallenge.org.au/index.php/minor-challenges/ Fill out the details and make sure you upload your submission.

Learn More! Resources:

- If you want to see other projects you can work on using TinkerCAD, here is a projects list: https://www.tinkercad.com/learn/project-gallery;collectionId=OY5L5E8IRXTI47Z
- If you enjoyed this challenge, you may like to read more on what mechanical engineers work on: https://careerdiscovery.sciencebuddies.org/science-engineering-careers/engineering/mechanical-engineer

Bibliography: