



## **Minor Challenge Set #3**

**STEM Field:** Mechanical Engineering

**Level:** Intermediate / Senior

**Challenge Name:** Build a Gear on TinkerCAD

**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:**

- The hands-on time for this challenge is about 1 hour, 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 gear.

## 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”.

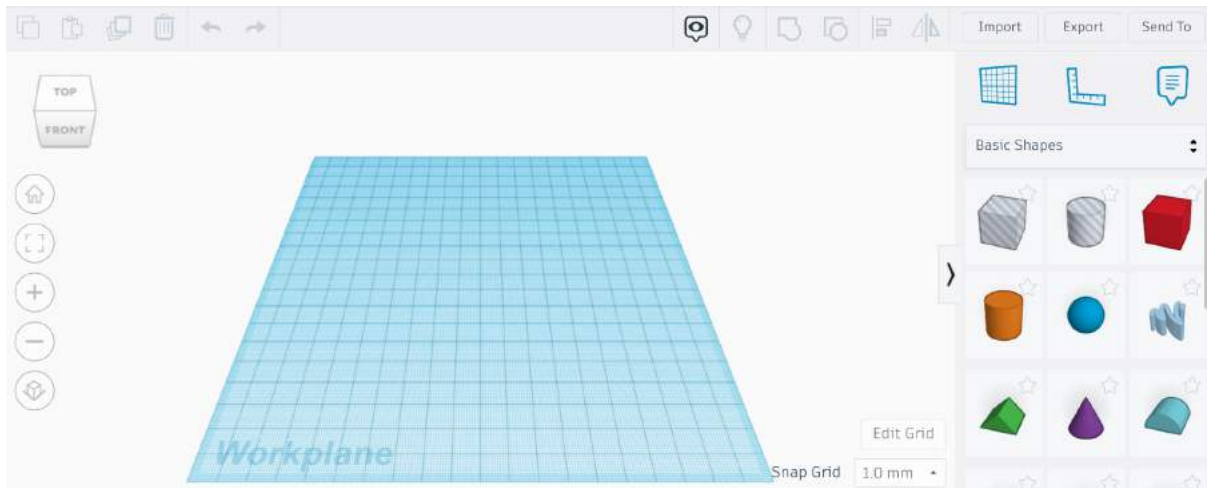
Alternatively, click “Sign In” to log into your TinkerCAD account.

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

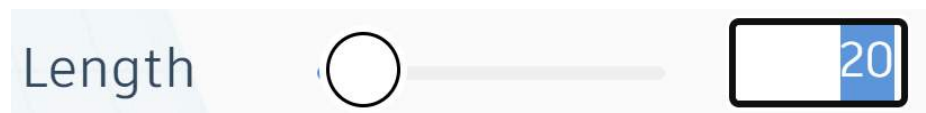
**Note:** If you have not designed a 3D model on TinkerCAD before, we recommend working through part A to learn more about TinkerCAD. Otherwise, you can skip to part B and design your gear model!

3. The blue space in the middle shows the workspace. 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).



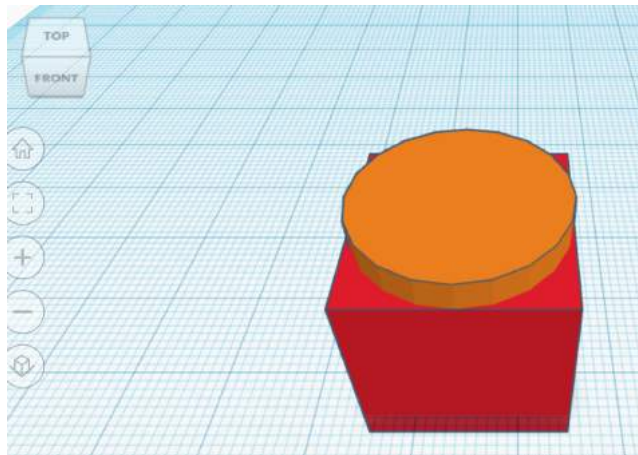
6. When creating designs, you may want to view your model from different sides.




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.



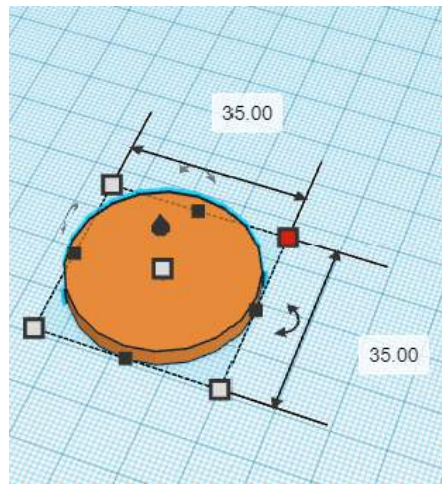
We want to group them together. Hold the Shift key while selecting the shapes you want to group together: the box, and the cylinder. Then click on the  button at the top to group them together. You will see that both shapes turn the same colour.

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

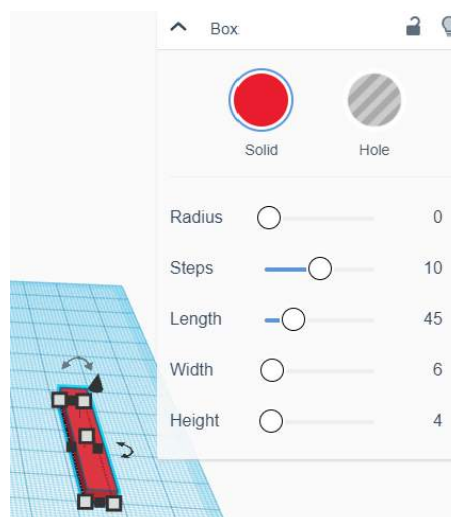
11. If we want to create a round hole inside the box, we can select the transparent cylinder, instead of the solid coloured one. Repeat step 10 for the box and a transparent cylinder.

## Part B: Make the Gear

12. Drag and drop a cylinder shape to the workspace. Change the cylinder dimensions to 35mm (length) x 35mm (width) x 4mm (height).




13. Drag and drop a box shape to the workspace. Change the box dimensions to 45mm (length) x 6mm (width) x 4mm (height).

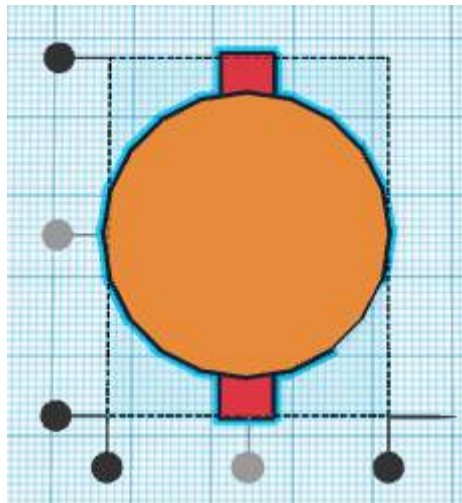



14. Use CTRL+C and CTRL+V or copy and paste to duplicate the box shape. We will need a total of 4 box shapes.

15. Hold left click and drag to select both the cylinder and the box.

Then select the Align button  at the top, and click the middle dot. We want to align the box to the middle of the cylinder. Finally,

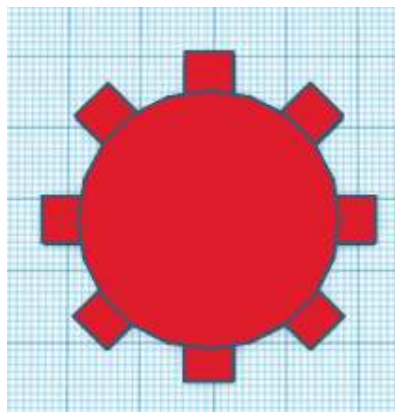
select the Group button  to group the shapes together.




16. Left click and drag to select the cylinder and another box. Use the curve arrow  to rotate the box -45 degrees. Use the align tool to centre the new box and group them together.

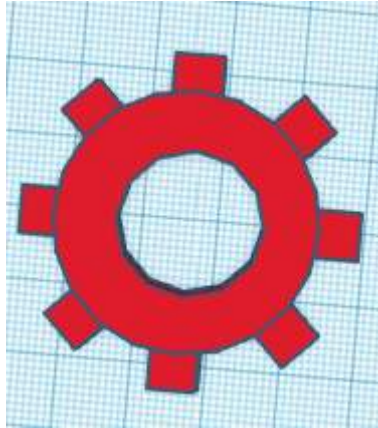
17. Repeat step 16 and rotate the next box -90 degrees.

18. Repeat step 16 and rotate the final box -135 degrees. Your product should look similar to the figure below.



19. Drag and drop another cylinder, select the Hole button  .  
Use the align tool to centre the hole. Ensure the hole cylinder is in the cut through the shape. Finally, group all the shapes together.

20. You've got the 3D model of the gear!



### **Extension:**

We can use TinkerCAD to make many more things. 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 design. 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 mentor 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>