STEAM Subject: 3D printing
Lab: Racing Car Part 2

Grades: 3-6

Learning objective:
Students will be able to:
- o explore the real applications of 3D printing.
- o identify basic design-criteria about 3D design and 3D printing.
- o practice techniques and skills used in the field of rapid-prototyping.

ENGAGE:
Ask students the following questions:
- ● What did you learn in Part 1 of this lesson?
  - o Review a PDF of the lesson for Part 1 found here
  - o Watch the step-by-step video of Part 1: https://youtu.be/ghA6d-Z-EUQ
- ● What elements of your 3D design were the most difficult to complete? What elements were the easiest?

EXPLORE:

Science Question: Is it possible to make a simple prototype of a car?

Activity: Racing Car – Part 2
Students will create the second part of a car. Follow the steps below along with the video found here: https://youtu.be/9JPXIUpCro0

Materials needed per student**:**
- ● Desktop or laptop
- ● Internet access
- ● Tinkercad account (free)
- ● No prior experience with Tinkercad is requires for this activity
- ● Optional: Access to a 3D printer

Directions:

1. Turn on the computer and go to www.Tinkercad.com. Click on "Sign in" to access your account.
2. Click on the picture of the "Racing Car EIS" to open the previous workspace you were working on for Part 1.
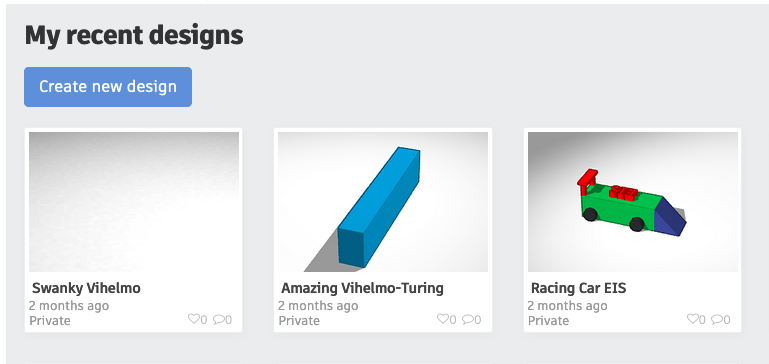
My recent designs

Create new design

Swanky Vihelmo	**Amazing Vihelmo-Turing**	**Racing Car EIS**
2 months ago	2 months ago	2 months ago
Private ♡0 ♡0	Private ♡0 ♡0	Private ♡0 ♡0

Figure 1: Racing Car EIS – Model

3. Zoom in and out of an object by using the scroller wheel in the middle of the mouse.
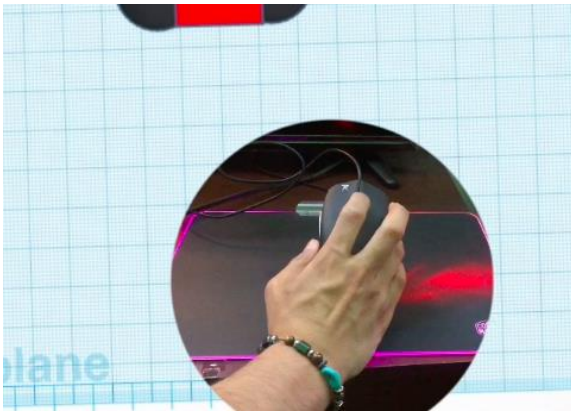
Figure 2: Zoom in and out

4. Click and hold the wheel/scroller in the middle of the mouse, then move the mouse in order to drag the whole workplane around. Find an angle/perspective that you like and leave it there for now.
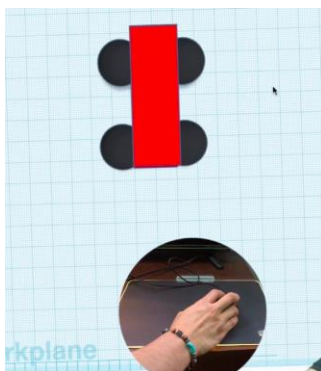
Figure 3: Drag the workplane

5. Delete all 4 of wheels/spheres on the car by clicking "delete" or "backspace" on your keyboard. You should have only the red block or car body there. Next, we will add the wheels using cylinders.

Figure 4: Delete the wheels/spheres

6. Go to Basic Shapes, locate a "Cylinder," which is orange, and left click on the shape. Once you click on it, put it on the right side of the "car" in the workplane.
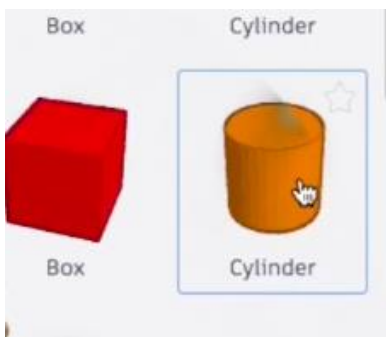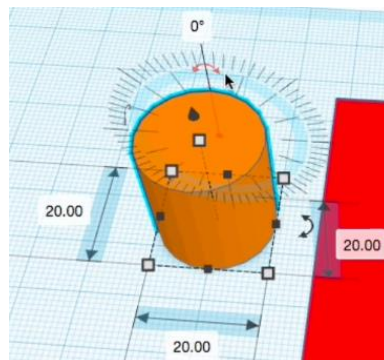

Figure 5: Object labeled "Cylinder"

Figure 6: Cylinder placed on the right side of the car

7. Left click on the arrow on top. You will see it turns red when you hover the mouse over the arrow. Type "90.00" to rotate cylinder 90 degrees on its side.
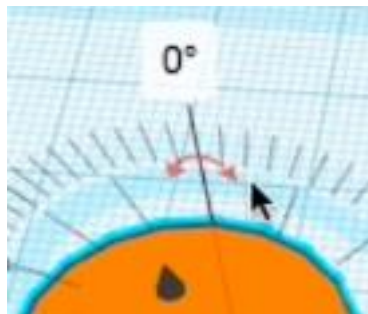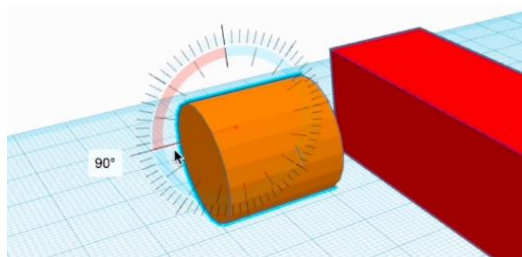

Figure 7: Measurements on the object

Figure 8: Object with positional angle changed to 90 degrees

8. Right click on any empty space in the workplace, hold the right-click and move the mouse to see different angles/views of the object.
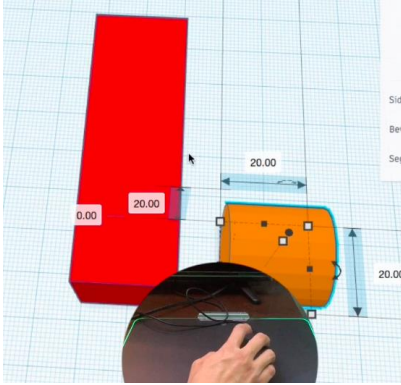

Figure 9: Different view of the object

9. Click on the "20" on top of the cylinder and change it to "30." Then place the cylinder at the center of one end of the red block. Then change the "20" on the left of the cylinder and the "20" on the right of the cylinder to "10" (see Figure 12).
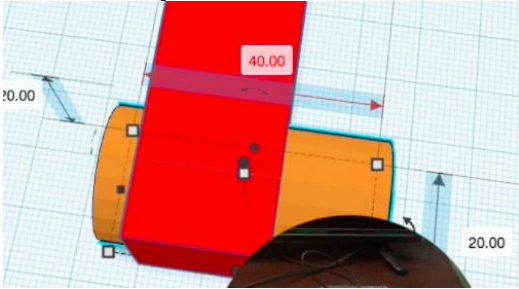

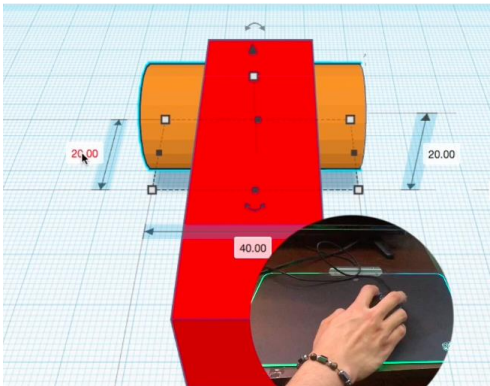Figure 10: Longer cylinder (note that the 40 should be 30)

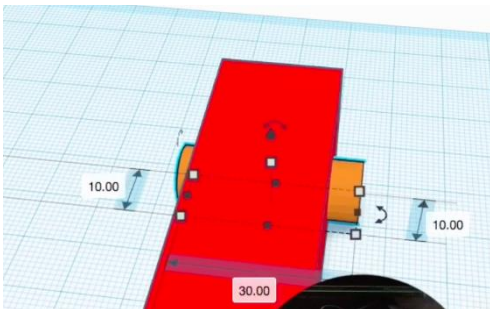Figure 11: Cylinder centered in one end of red block

Figure 12: Cylinder with sides changed to "10"

10. Change the color of the cylinder to black. Left click on the cylinder, click on "solid," then choose the color black.
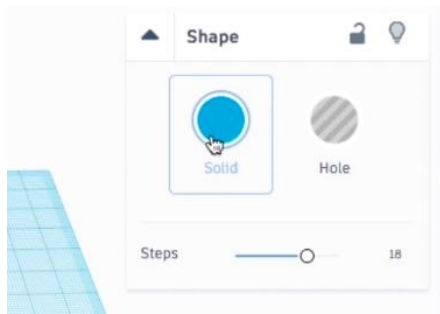

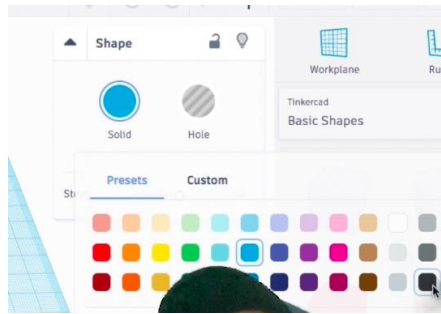Figure 13: Click on solid to change color

Figure 14: Choose the color black

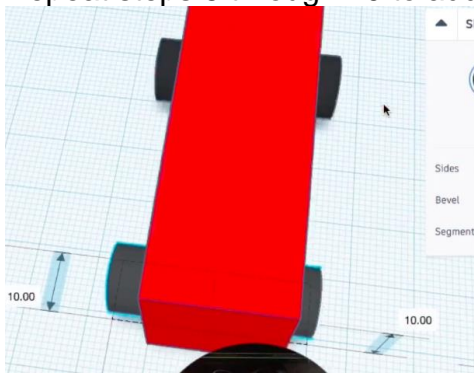11. Repeat steps 6 through 10 to add the rest of the tires.

Figure 15: Frame of car with 4 wheels

12. Go to Basic Shapes, scroll down and look for "wedge." Select it and put in front of the box. This will act as the hood of the car.
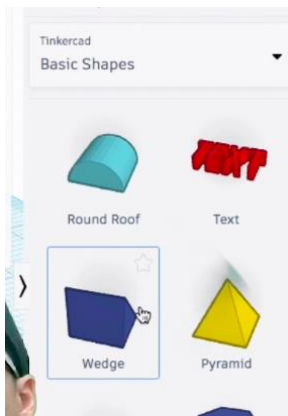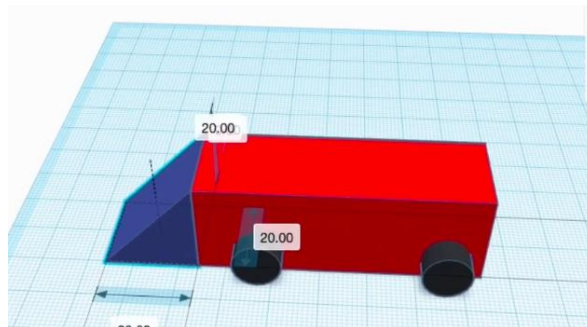

Figure 16: Select object labeled "Wedge"

Figure 17: Wedge placed in front of the box

13. Click on the workplane option on the right side of the screen and place the workplane on the top of the car. Now change the color of the car to green.
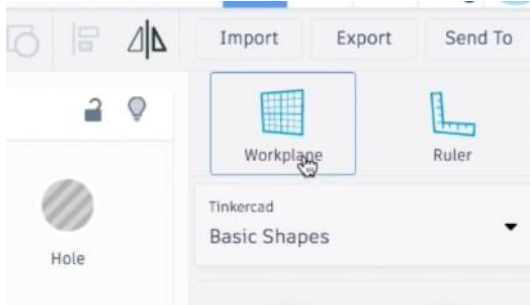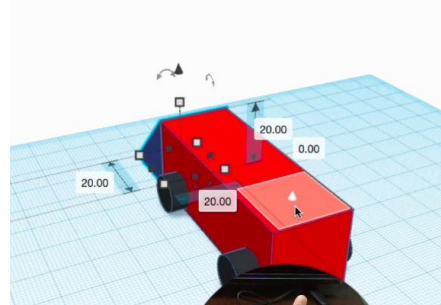

Figure 18: Select Workplane

Figure 19: Place workplane on top of the car

14. To make the spoiler, grab a red box from Basic Shapes and add it to the top of the car. Then change the measurements in the box to "3" on the left, "3" on the bottom, and "10" on the right.
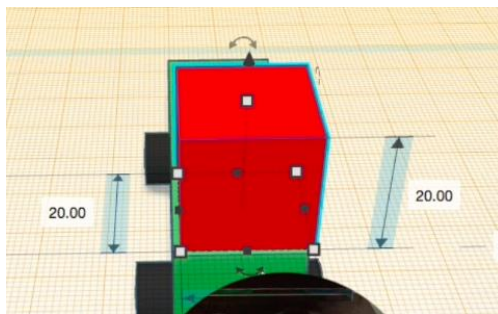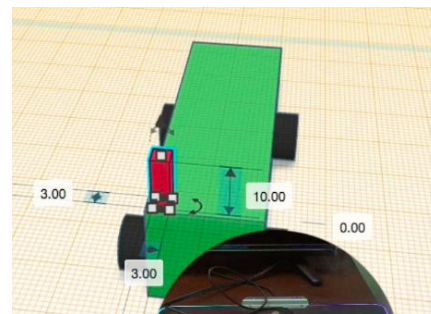

Figure 20: Box on top of car

Figure 21: Box with new measurements

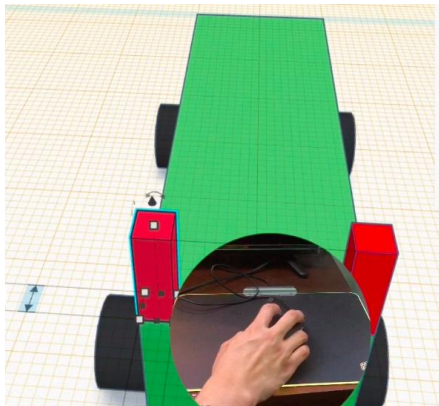15. Repeat step 14 to add one more column on the right side.

Figure 22: Two columns for the car's spoiler

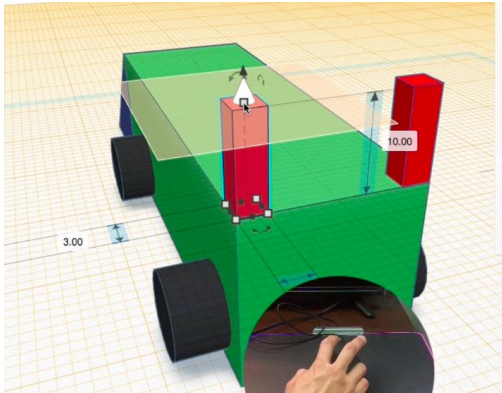16. Add a new workplane to the top of the left column.

Figure 23: New workplane on top of columns

17. Grab another red "box" from Basic Shapes and add it to the top of the left column in the spoiler.
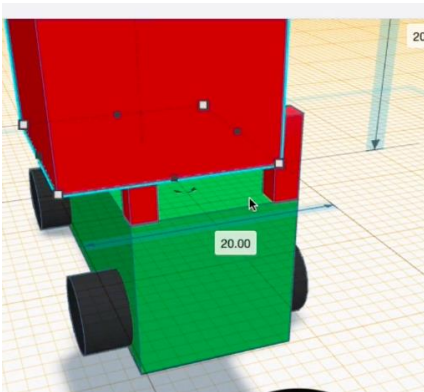

Figure 24: Red box on top of spoiler

18. Change the measurements of the box you just added to the following:
   a. Change the "20" on the right to "2"
      Change the "20" at the bottom to "22"
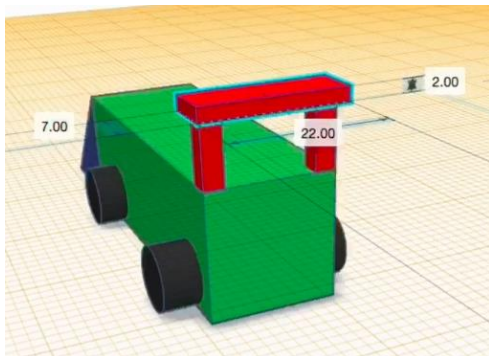   Change the "20" on the left to "7"

Figure 25: Final look of the spoiler

This concludes Part 2 of the lesson. In Part 3, we will learn how to add the missing parts and prepare the model for 3D printing.

EXPLAIN:
Have students add different objects at the end of the lesson to modify and personalize the car. The students can also start a new project and design their own car from scratch using the techniques they learned in this lesson.

Review STEAM Vocabulary:
- **CAD:** Computer-Aided-Design. A design or object made using a computer.
- **Tinkercad:** Software web-based used to design 3D objects online.
- **Workplane:** The area in which objects are added to Tinkercad.
- **3D Design:** In 3D design, a designer uses all three axes (x, y and z) to interpret and develop a realistic figure of the desired object
- **3D Printing:** 3D printing refers to using a 3D printer to make an object previously designed in a computer.

Extension/Elaborate
Questions:
- What are the benefits of 3D design?
  - https://www.flatworldsolutions.com/engineering/articles/3d-cad-modeling-benefits.php

EVALUATE:
Ask students to:
- Explain the difference between 3D design and 3D printing
- Mention a simple object they could make using a 3D printer
- Suggest how can they improve the car we made today