

Basic 3D Design

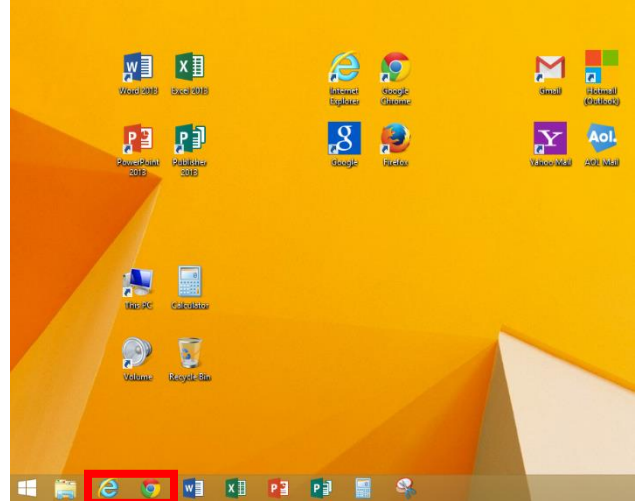


0. Create a Tinkercad account and create a new design

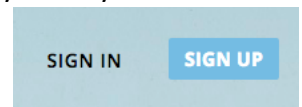
- On one of the library Macs, single left click one of the icons for **Safari**, **Chrome**, or **Firefox** web browsers in the bottom bar.



- On one of the library PCs, single left click one of the icons for **Internet Explorer** or **Google Chrome** in the bottom bar.



- All of the web browsers have a large bar across the top. It should say **www.eapl.org**. Type **Tinkercad.com** in that bar instead and then press the **Enter** key on your keyboard.



- Once it loads, click **Sign up** (or **Sign in** if you have an account) in the upper right corner.
- Fill out the information they ask for to create an account.

Country:

BirthDay:

Already a user? [Sign in](#)

[more providers](#)

Email:

Password:

By clicking on Create Account, you agree to the [Terms](#) and [Privacy Statement](#).

Username: _____ Password: _____

- On the page that loads, click the **multicolor Tinkercad logo** in the upper left corner.
- Click the **Create new design with Beta** button in the middle of the page.

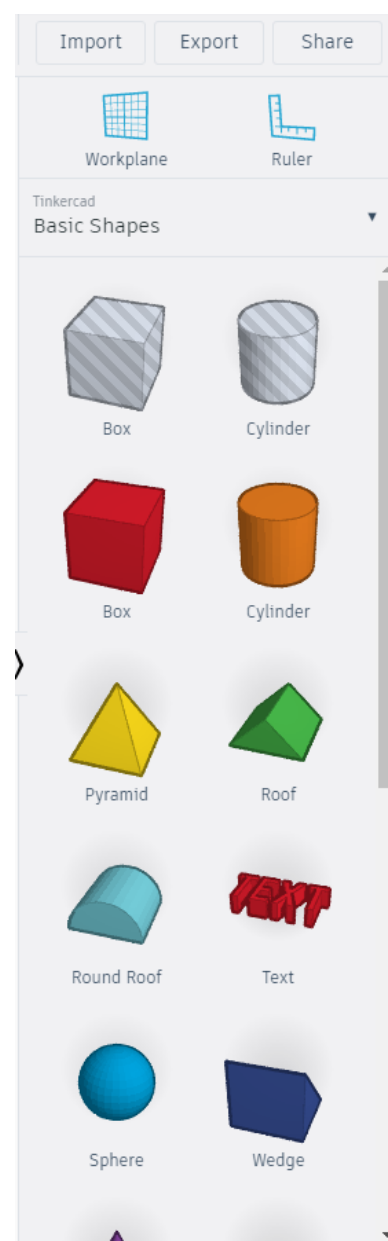
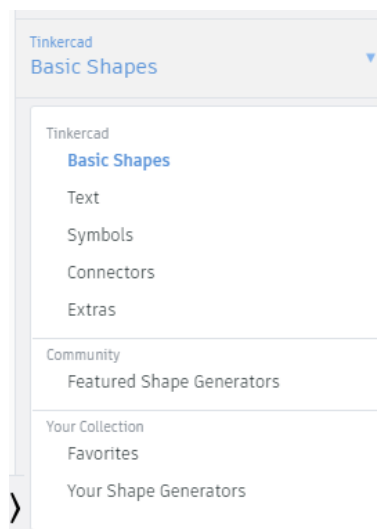
Basic 3D Design



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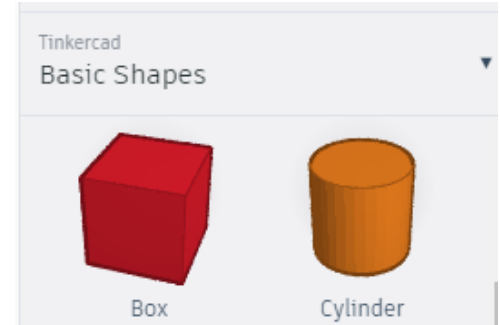
1. Right side menu

- The Tinkercad **right side menu** has lots of the buttons you need for designing objects.
- **Import** lets you to bring in pre-made 3D files to add/modify your design.
- **Export** lets you create a 3D printable file of your design such as .STL.
- **Share** allows you to create a link to send your design to others.
- **Workplane** lets you change the surface where objects are initially placed.
- **Ruler** tool helps do advanced measurement and placement of pieces.
- Below those is a drop down menu that allows us to select from sections of shapes that either Tinkercad employees or other **Community** members created. These include geometric **Basic Shapes**, **Text** letters and numbers, **@&!?** and other **Symbols**, **Connectors** for designing objects like robots, and a few **Extras**. Click the drop down arrow an extra time to hide the menu.
- **Basic Shapes** includes many simple shapes, and two premade holes (a box and a cylinder), although any shape can be turned into a hole in Tinkercad (more on this later).



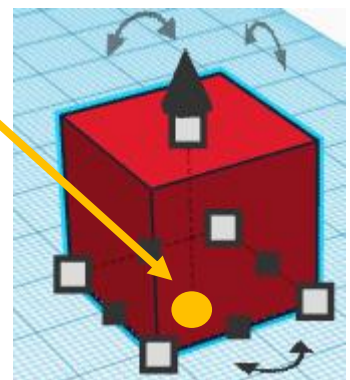
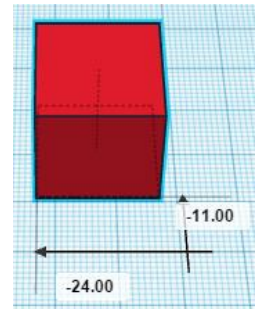
2. Inserting shapes

- We're going to design a basic house as an example today.
- Open the **Basic Shapes** section of the **right side menu**.
- First, let's insert a box shape to be the main portion of our house. Single left click the **red box**. Then, move your mouse above the light blue and white grid and click anywhere to set your box down.

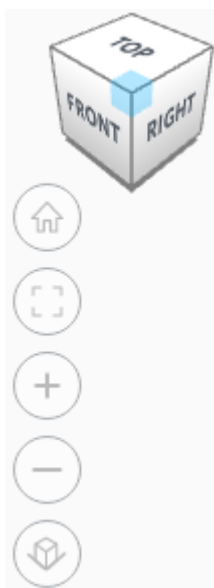


3. Moving shapes

- It's easiest to design an object with parts in the middle of the screen.
- Click and hold and drag the red box into the middle of the grid so it will be easier to see for later. *Make sure NOT to click and hold any of the square or arrow handles before dragging.* Use a **location like this one** in the middle of a face of the object.
- Labels on the screen will let you know how far left/right and forward/backward you've moved the shape. These labels briefly stay there after you've moved a shape, allowing you to type in custom amounts to move shapes, which you apply by hitting **Enter**.

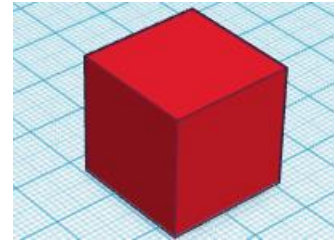


4. Changing the view



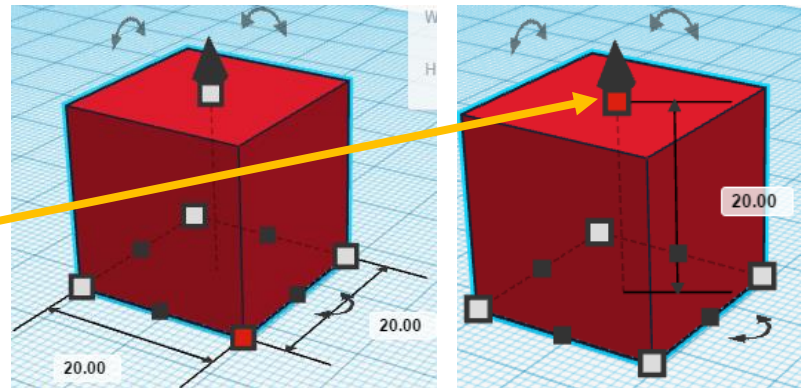
- Another trick to make designing a 3D object easier is to remember to frequently change your view.
- Click or drag the **box labeled top bottom left right front back** on the left side of the interface to rotate around the center. Or hover over the box and click to rotate. *We recommend using an upper corner as shown in the picture to the left.*
- Or, right click and drag in any blank space to rotate.
- Use the **1st circle home** button to return to the original starting view if you get lost or confused.
- Click on a shape and then click the **2nd circle fit view to selection** button to zoom in on what you've highlighted.
- You can also click the + button to zoom in and the – to zoom out, or use the click wheel on a physical mouse or drag up/down with two fingers on laptop trackpads.
- Click on the **5th circle button** to switch between **Orthographic** and **Perspective** view. We recommend the default **Perspective** view.
- To move left and right or forward and backward *without rotating*, hold the **Shift key** and then **right click** and drag in any direction. This pan movement changes your center.

- A downward pointing diagonal view is usually the best. Diagonal views allow you to see multiple sides and most or all of the on-screen controls. You may want to rotate make controls bigger and easier to click.
- Right click and rotate to see 3 sides of your red box.



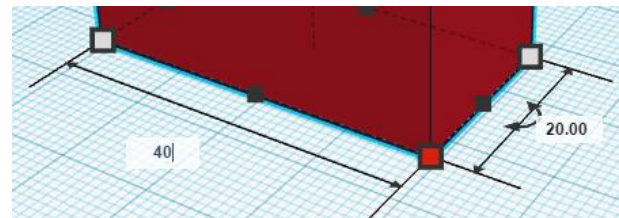
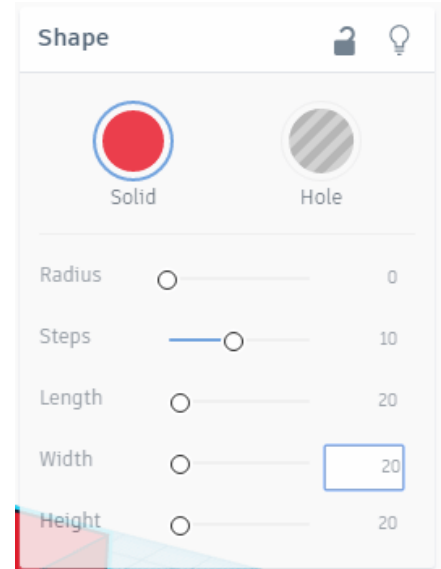
5. Measuring shapes

- Let's see how big the red box is by default.
- Click on the **red box** to select it.
- Without clicking, **place your mouse over any of the square resize handles and wait**. In a few seconds, the measurements of your shape will appear. To see the height of the object, hover on the **white resize square at the top**.
- It should measure 20 x 20 x 20 millimeters.



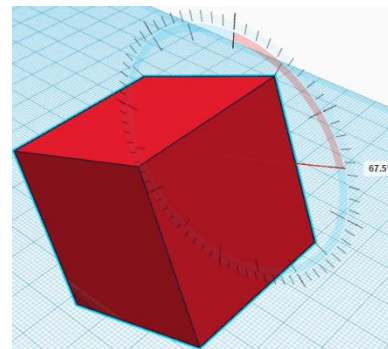
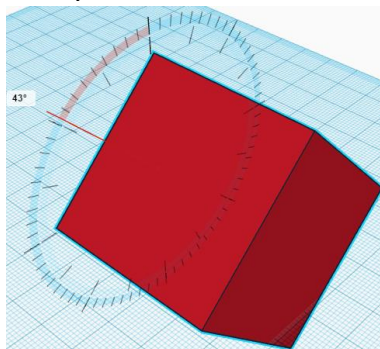
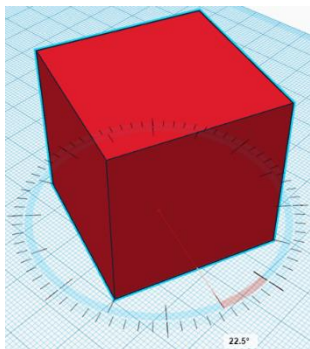
6. Resizing shapes

- Let's make it 40 x 40 x 40 millimeters. There are many ways to resize. Find one that works for you. Click to select the red box.
- Resize handles should appear. Drag them to resize the shape.
- Dragging the black handles resizes *either* length *or* width.
- Dragging the white handles resizes *both* length *and* width.
- To increase/decrease the height, use the top white resize square.
- Or, in the **Shape** menu, you can either drag the **Length**, **Width**, or **Height** sliders or click on the numbers to the right and then type in the size you need and then hit the **Enter** key.
- Or, click on your shape, then click on one of the resize handles, then click on one of the size measurements. Type in 40 and then hit the **Enter** key.
- If you use the **Shape** menu to type in sizes for your shape, remember to use only length OR width. Resizing both to the same amount doubles the size.



7. Rotating shapes

- To rotate a shape, single click on it. If you're looking at this shape from a nice diagonal angle, you should be able to see all **3 curved arrow rotation handles** (pictured above).
- Next, click and hold one of the **handles**, and then drag in the direction you want to rotate. To do 22.5° rotations, rotate your mouse on the **inside** of the circle that appears. To do 1° rotations, move your mouse **outside** the circle and then rotate.

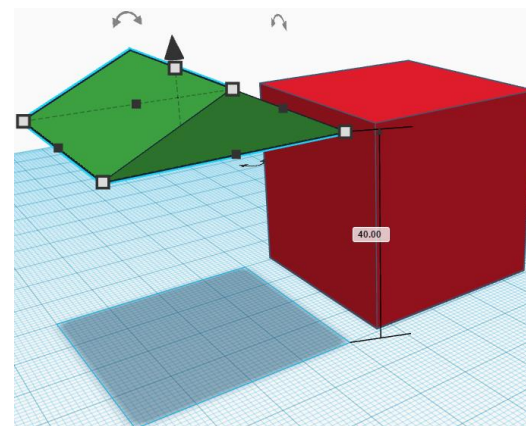
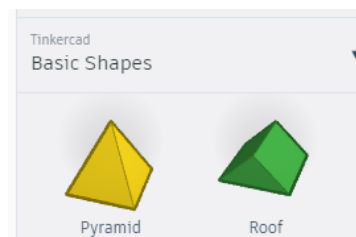


- (If you click on one of the curved arrows, you can type in exact degree numbers to rotate and then hit **Enter** on your keyboard just like we did for resizing before.)
- For now, let's make sure not to rotate the red box at all by setting any rotation you've done back to **0°**. Or, you can use the **Undo button** near the top if you did rotate the box. (**Redo** is to the right of **Undo**.)



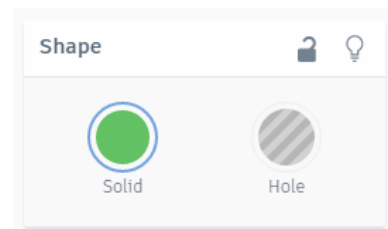
8. Raising and lowering shapes

- Open the **Basic Shapes** section of the right side menu.
- Single left click on the **green roof**. Single click to place it by the red box.
- Increase its size to 40 x 40 mm wide & deep. Don't change height.
- Click and hold and drag **black up arrow tool** upwards to lift the roof up to 40 mm. The black up arrow is filled in red while in use.
- Like with size, rotation, and movement, once the measurements of how far you've raised/lowered a shape appear, you can click on them and type in exact amounts to raise/lower a shape and hit **Enter** on your keyboard to apply them. All heights are relative to the workplane. Type -20 to make a shape 20mm below the workplane.
- Shadows** indicates that a shape is in the air.
- Move the roof so that it is on top of the red box.
- You may need to rotate around to see that you've placed it correctly. Take your time.**
- Hover over the **black up arrow tool** once you've clicked a shape to see how high it is.

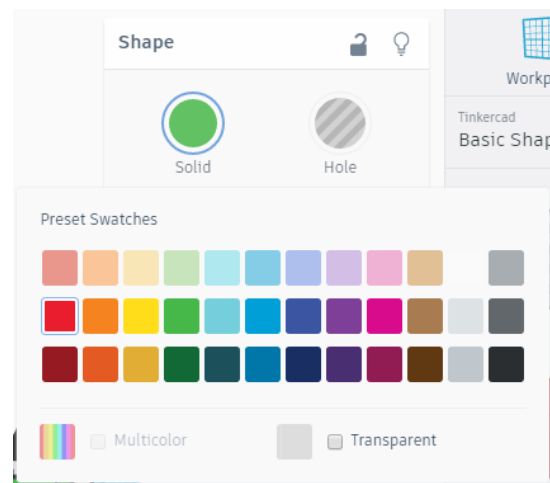


9. Using Shape menus and Grouping

- Click on the **green roof**.
- You may have noticed already whenever you have a shape selected in Tinkercad, the **Shape** menu appears.

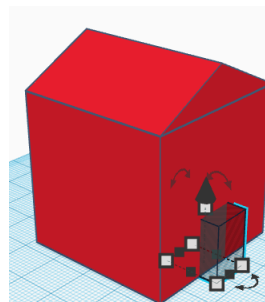


- We can use this **Shape** menu to change the **color** of a shape or to change a shape into a **hole**.
Keep in mind that 3D printers typically only print in one color. And the colors of the shapes in Tinkercad don't transfer to our 3D printer. The shape of the outside edges is our design.

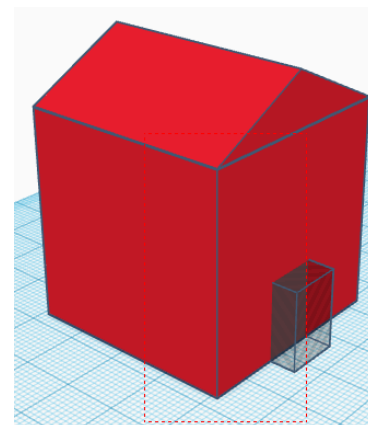


- Let's change the color of the roof to red.
- Click the **Color button** in the inspector, and then click on the **red swatch** to make the green roof red.
- Our basic house needs a door. Let's make a hole for a door to show you how holes work.
- From the **right side menu**, find the **Basic Shapes** section. Let's insert a **box hole**.

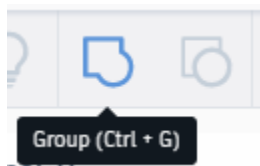
- Place it somewhere near the red box.
- Resize the box hole to be 15 mm long x 10 mm wide x 15 mm tall.



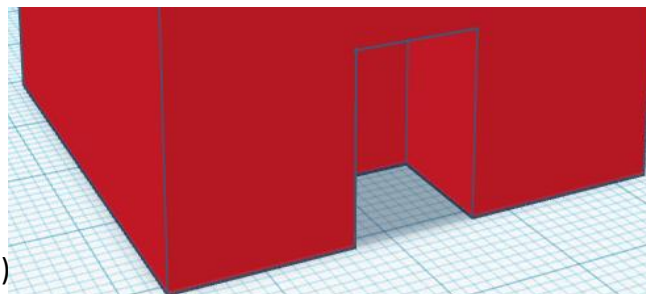
- Move the **box hole** so that about half of it disappears into the **red box**.
- Single left click from somewhere below the **red box** and the **box hole**.
- Next, click and drag to select the **red box**, **hole**, and **roof**.



- Above the inspector tool, click the **joined circle and square Group button**. This will cut out the part of the box hole that overlaps the red box and combine the red box and roof.

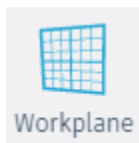
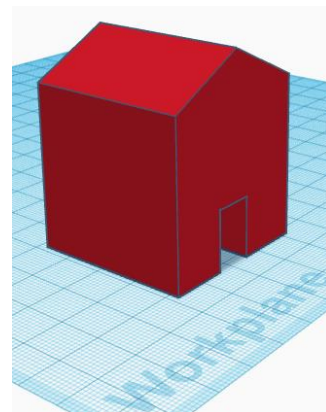


(Sometimes even after grouping Tinkercad still shows lines where parts should be fused together.)

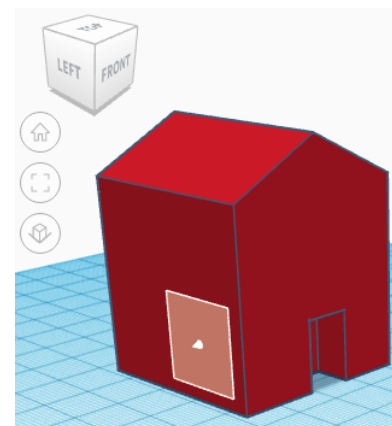


10. Move the workplane

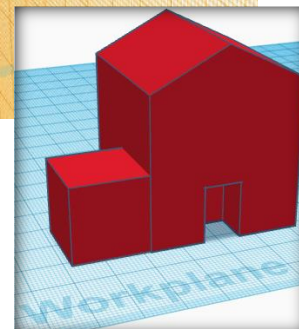
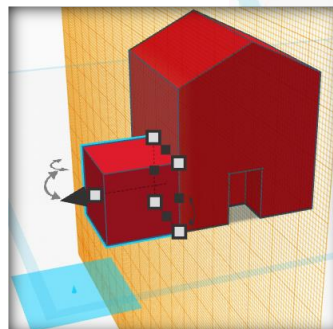
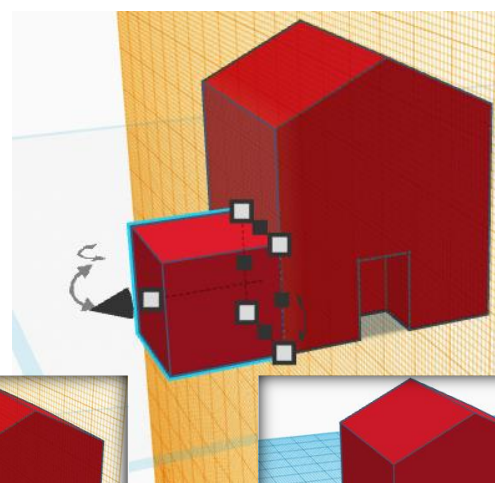
- WARNING: Using the workplane tool can be a bit confusing, even disorienting. Try not to get dizzy. Stop using Tinkercad if you get dizzy.
- The **workplane** is the blue grid base that our parts are automatically placed on in Tinkercad.
- Using the **workplane tool**, we can make one of the surfaces of an object we've designed the new 'base'.



- Let's use this tool to attach a garage to the edge of the house.
- Find the two helper tools above the **Basic Shapes** menu.
- Single left click the **Workplane** tool.
- Move your mouse back into the design and hover over the left or right edge of the house – you can decide which side.
- Single left click on that edge to move the workplane there.

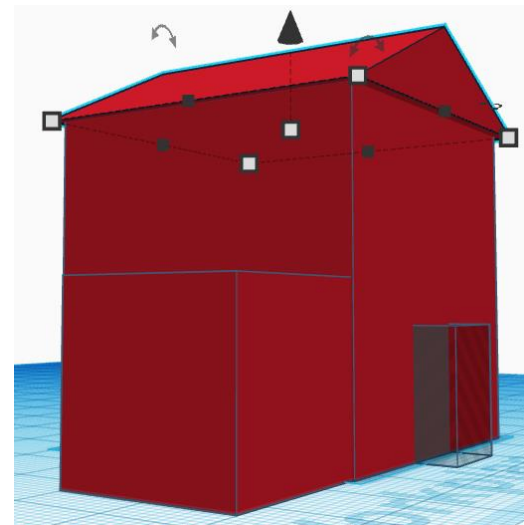
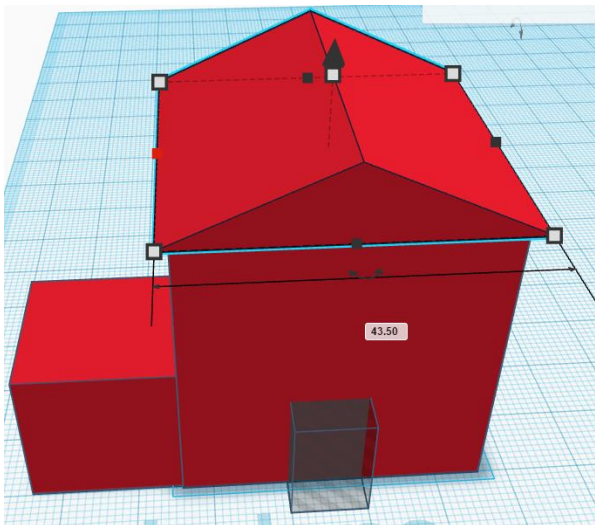
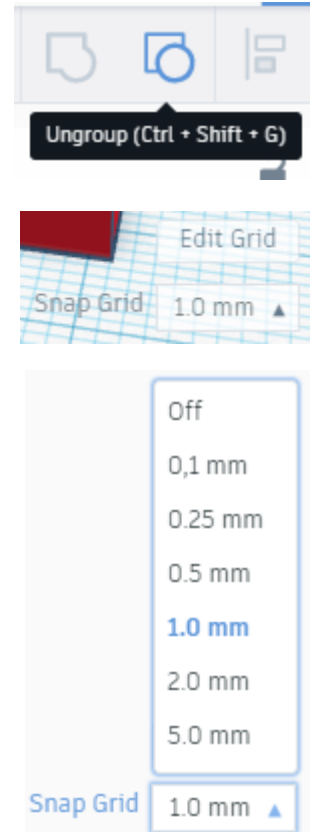


- Any shapes we insert now will automatically insert themselves even with the house, on that geometric plane. Zoom out, right click and drag to rotate around and get a feel of this.
- Tinkercad displays the workplane as an **orange grid** when the workplane is not the default bottom.
- Grab another red box from the right side menu, and carefully place it on the edge of the house. Zoom in if you're having trouble.
- **This can be a bit tricky, take your time. You may need to right click and drag to rotate around to make sure you placed the garage correctly.**
- To return to workplane to its normal position, click the **Workplane** tool from the **right side menu**, and then single left click on any blank space that was the original bottom of the design.



11. Ungrouping and Snap Grid

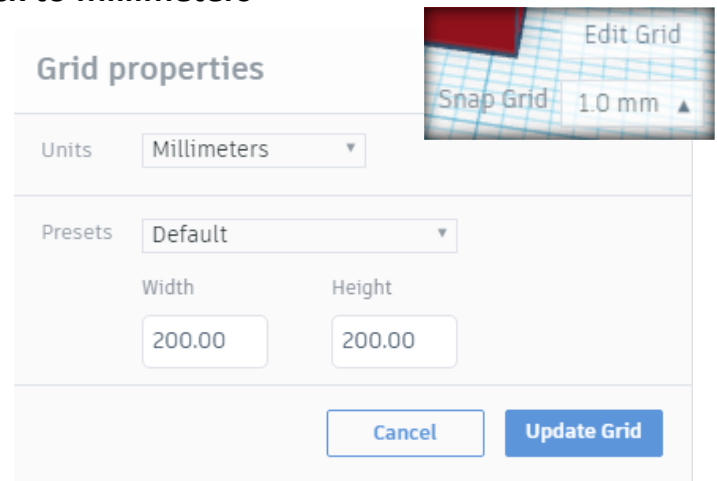
- Let's increase the size of the roof just a little bit.
- Click on the house/roof, and click **Ungroup** above the **Shape** menu.
- The door hole will reappear, but we'll fix that later.
- You may have noticed when we've moved shapes that the smallest movements, by default, are **1 millimeter (1.0)**. We can decrease or increase this using the snap to grid feature.
- Snap grid** is hidden way in the bottom right corner of the design area. At the bottom it's just to the left of the right side menu.
- Click the **black up arrow** to see the snap grid options.
- The lower the number, the higher the precision of where you place shapes. 1.0 is the default. Let's click **.5** for now.
- Now, let's click on the roof at the top of our design.
- Using the **four black square handles in the middle of each side**, move each edge out a few half millimeters so that the roof protects the house better.



- As you get more and more familiar with Tinkercad, you'll realize that the snap grid setting is similar to rotating your view. You'll want to regularly switch the snap grid setting. For large pieces, you might not want to have very high resolution, or you may want a .1mm grid for small details. *We do not recommend turning snap grid off.*
- To fix the hole that reappeared, click away from the roof, and then select just the bottom of the house and the hole and press **Group**.

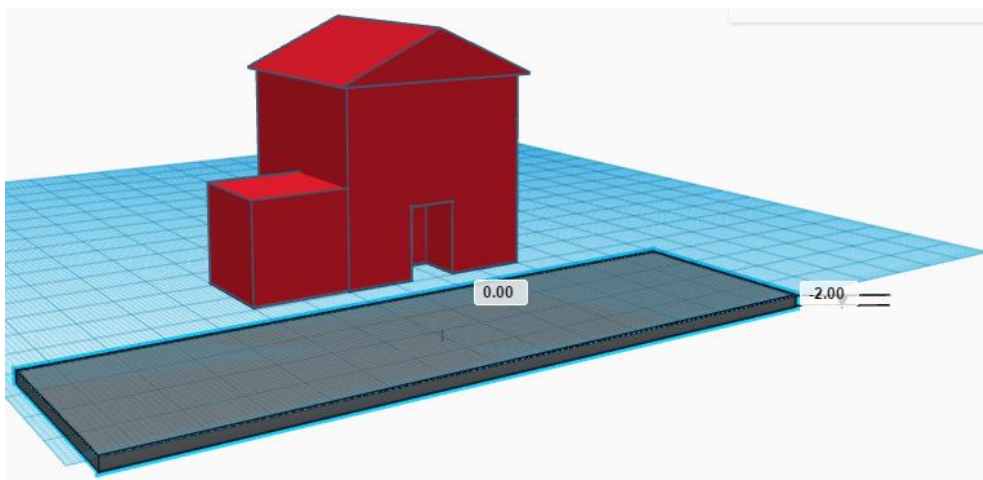
12. Change measurements to inches or back to millimeters

- Most 3D programs use millimeters for measurements. But we're used to inches
- Tinkercad allows you to change measurements with the **Edit grid** button, just above where we changed the **snap grid** settings.
- In the **Grid properties** menu that appears when you click **Edit grid**, click the **drop down arrow** to the right of Millimeters / Inches to see the option to switch to the other.
- **For now, let's keep this setting at Millimeters.** Click **Cancel** to dismiss this menu.



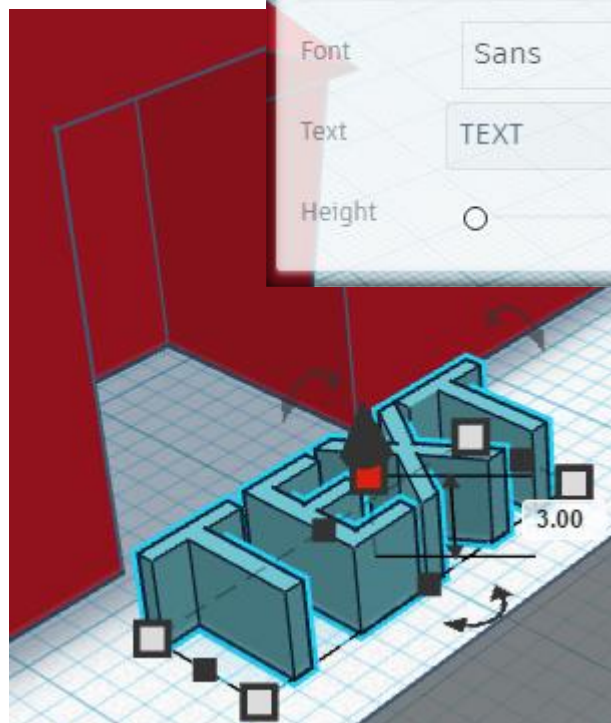
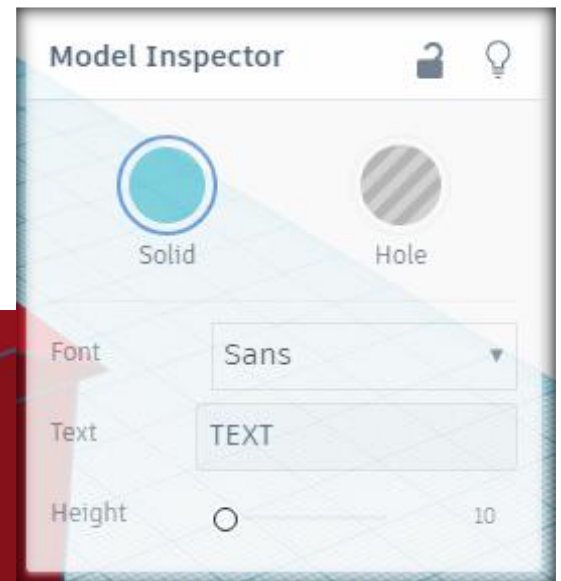
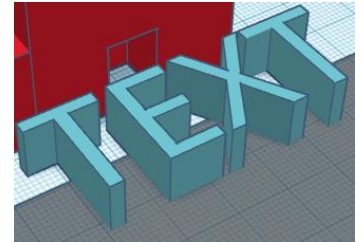
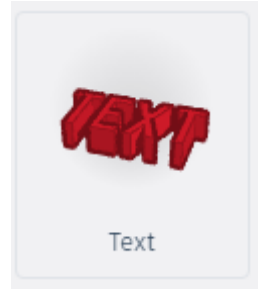
13. Negative height

- As you use Tinkercad more, you may use the **workplane** tool more and more. As you're using that, you may find the need to put something below the workplane.
- We can do this simply by lowering a shape beneath the workplane.
- *Keep in mind that if you put a shape below the default workplane, that will likely cause problems when an object is being 3D printed.*
- As an example, let's make a road in front of the house below the default workplane.
- From the **Geometric** menu, insert a box somewhere in front of the house.
- Use the **Shape** menu to change its color to **black** or **grey**.
- Make its dimensions about 135 mm long x 40 mm wide by 2 mm tall.
- Use the **black up arrow tool** to drag the road you've made down until its height measurement reads -2 mm.

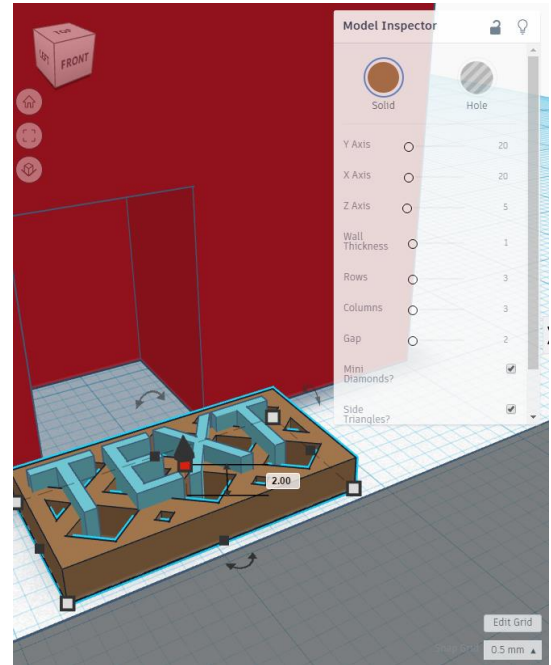


14. Shape generators

- Some shapes cannot easily be made using Tinkercad's premade shapes.
- Shape generators** are fancy custom shape builder tools made by the Tinkercad and the community. Each shape generator has its own controls to mess with which appear in the **Shape** menu. (Sometimes the **Shape** menu goes by an alternate name "**Model Inspector**".)
- In **Basic Shapes** in the right side menu, let's click on **Text**.
- We're going to make a simple doormat for our house.
- Click to place the **text shape generator** somewhere in front of the house door. *It's too big right now, we'll resize it later.*
- In the **Shape** menu, change its color to something other than red.
- We can change the text of the **text shape generator** by simply typing something different in its menu.
- Under **Text** type your last name. Capitalize the text to your taste.
- Shape generators aren't perfect. This text shape generator places all text on one line. If you want text on two lines, such as
THE
LASTNAME'S
you can use the shape generator twice and place them next to each other.
- Once you have your name typed in, use the **X Y and Z square resize handles** to make your text approximately the size of the door.
- Tinkercad allows you to design super small details such as this doormat, but remember that the 3D printer.*
- Make sure the height of your text is **at least 3mm**.

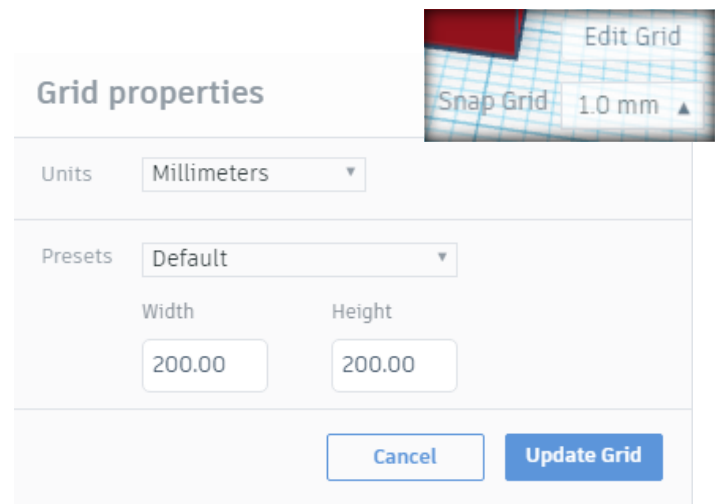


- Switch from **Basic Shapes** to the **Featured Shape Generators** menu in the right side menu.
- Find the **Diamond Mesh** option.
- We're going to use this as a doormat.
- Insert it in front of your door, and then resize it so that your name is roughly in the middle.
- Make sure the **Z height is 2 mm**.
- Change its color to brown or something other than red in its **Shape** menu.
- After you've placed it, look at the inspector.
- Below the normal **Shape** menu controls are a list of **parameters**. Parameters are variables a shape generator understands.
- When you adjust the parameters, the design will automatically change.
- Change at least one of the parameters to practice, but don't go crazy changing all of the parameters – this can cause Tinkercad to slow down or freeze up.



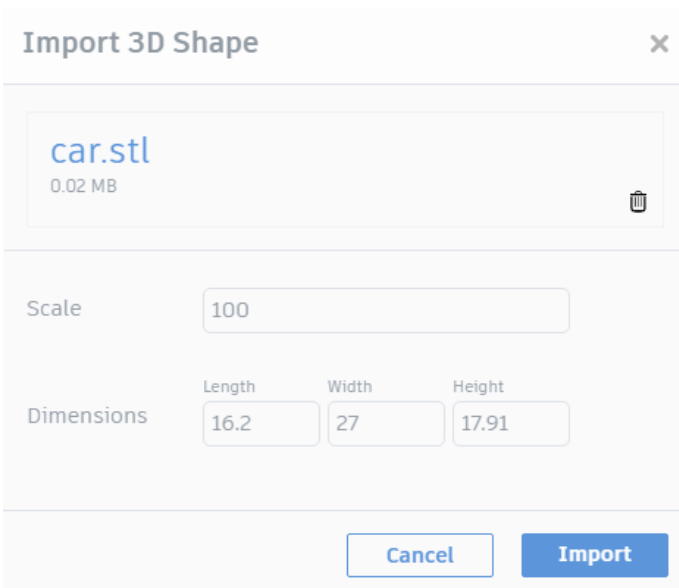
15. Change the size of the workplane

- If you want to make a large or very small design, it can be helpful to change the size of the workplane.
- Like we did when changing between inches and millimeters, click **Edit grid**.
- Below the **Presets** are the measurements of the workplane (by default, 200 x 200).
- The labels **width** and **height**, are super deceptive. There is no *height* to the workplane, since it's a plane. Instead, **width** and **height** mean **length** and **width**.
- Simply type in a larger (or smaller) number into **width** and **height** and then click **Update Grid** to change the size of the workplane. For now, let's do about **145 x 145**. *This is how large Ela Library 3D printers can print – use this to make sure your design isn't too wide/deep. (Check your model height manually and make sure it's less than 150.7mm.)*
- Don't worry – your design will stay the same as the workplane resizes.
- You may have to move parts of your design to keep them on the blue workplane, but this is not required and does not make a difference when downloading your model.

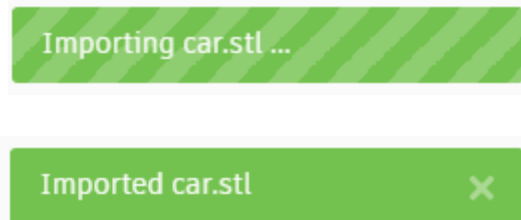


16. Import pre-made shapes

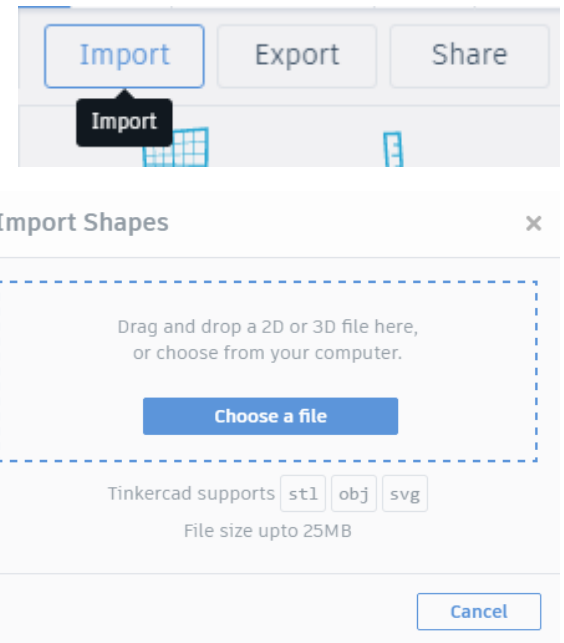
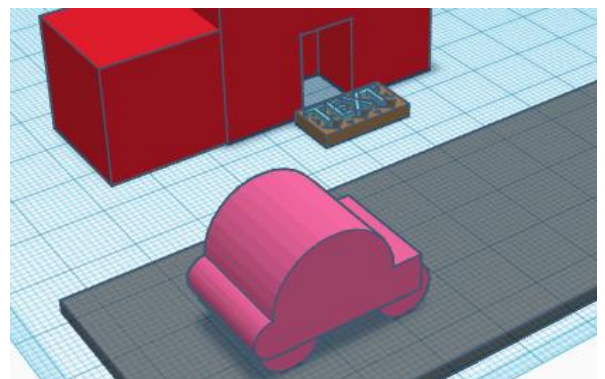
- Tinkercad allows you to import premade 3D .STL files.
- We're importing a file we've put on each computer.
- These can be shapes you've made or shapes you've downloaded from sources like Thingiverse.
- At the top of the **right side menu**, click **Import**.
- Click **Choose a file** to pull up the tool to browse your computer for a 3D file.
- In that window click **Desktop**, find and click on **car.stl** and then click **Open**.
- A menu showing some information about **car.stl** will appear. Click **Import**.



- In the lower left corner, you'll see messages saying **Importing...** and **Imported** once it has been added successfully.

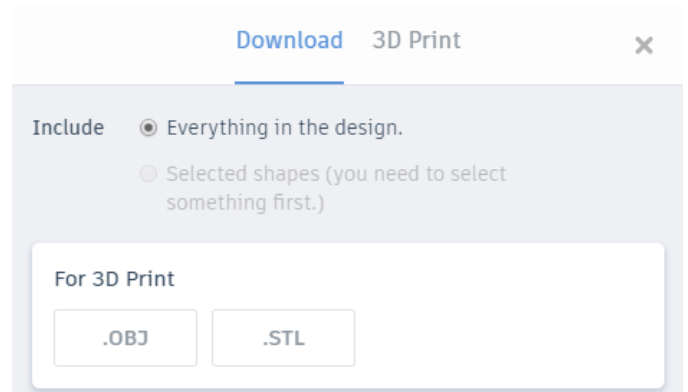
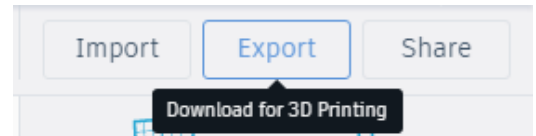


- *Imported shapes are put in the middle of the workplane. In our experience that's almost never where you want an imported shape, so you'll have to move it after it imports. Ask us for help if you have any trouble moving your car out of the middle.*
- *(You may want to change the car's color, too.)*
- Please ask for help if you have trouble moving the car away from the middle of the design area.



17. Rename and Download to your computer

- To rename your design, click on the funny name Tinkercad gave it automatically in the top left corner, type a new name, and then hit **Enter** on your keyboard.
- Once you've completed your design, you can download the 3D file.
- Above the **right side menu**, click **Export**.
- Make sure **Everything in the design** is selected.
- Then click **.STL**. Use the next window that appears to pick where to save your model.
- Make sure to save it somewhere you'll remember. We recommend the **Desktop**.

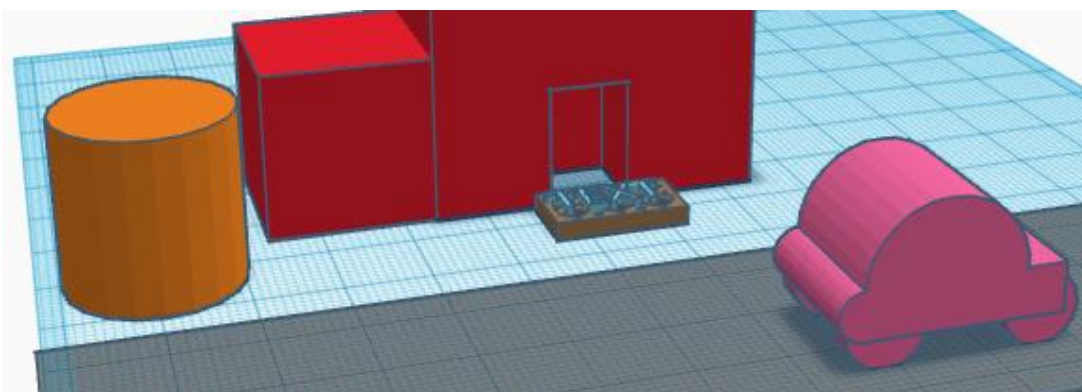
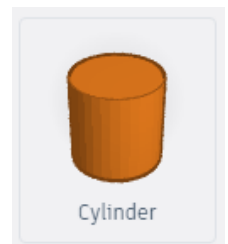


18. Upload a model for 3D printing

- Go to the eapl.org > Forge Makerspace in a web browser.
- Select the 3D Print request form.
- Complete the form and upload your file.
- *Models equal to or less than 145 x 145 x 150.7mm (5.7 x 5.7 x 5.9 inches) can be printed.*
- Please go back to the tab where you were designing your house to start #19.

19. Review exercise

- Let's put it all together to review what we've learned today.
- We're going to add a tree in front of our house.
- From the **Basic Shapes** part of the **right side menu**, click the **orange cylinder**.
- Insert it someplace near the house, maybe to the side of the garage.



- Resize the orange cylinder tree trunk to 5 mm wide x 5 mm deep x 25 mm tall.
- (After resizing the object, you may want to adjust its location.)
- Use the inspector to change the color of the **cylinder** to **brown**.
- Next, we're going to use a **sphere** as the branches/leaves of the tree.
- Before we insert the sphere, let's make it easy to insert using the **workplane** tool.
- In the **right side menu**, click **workplane**. Hover over the top of the tree and click when you have positioned the **workplane tool** like the *Figure 1* below.

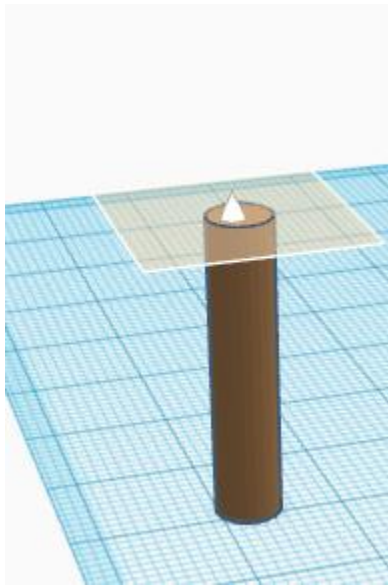


Figure 1



Figure 2

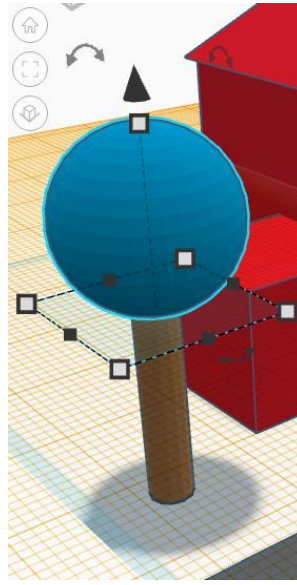


Figure 3

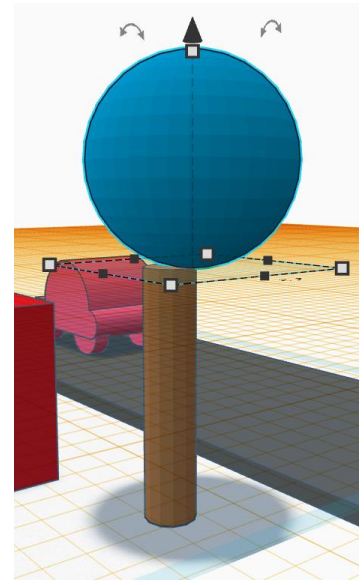
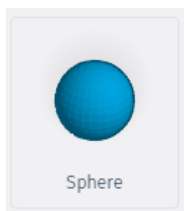
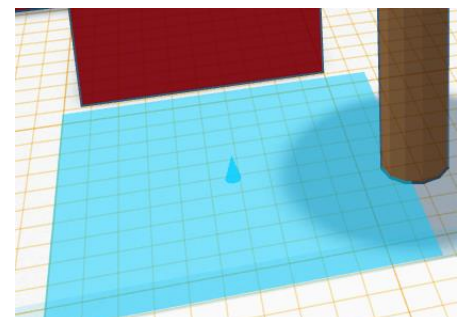


Figure 4

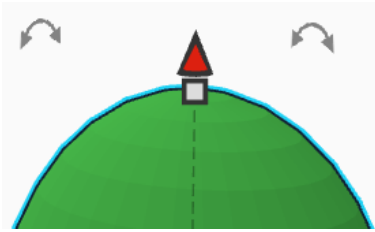
- Once you've clicked to place the **workplane tool**, it will look like *Figure 2*.



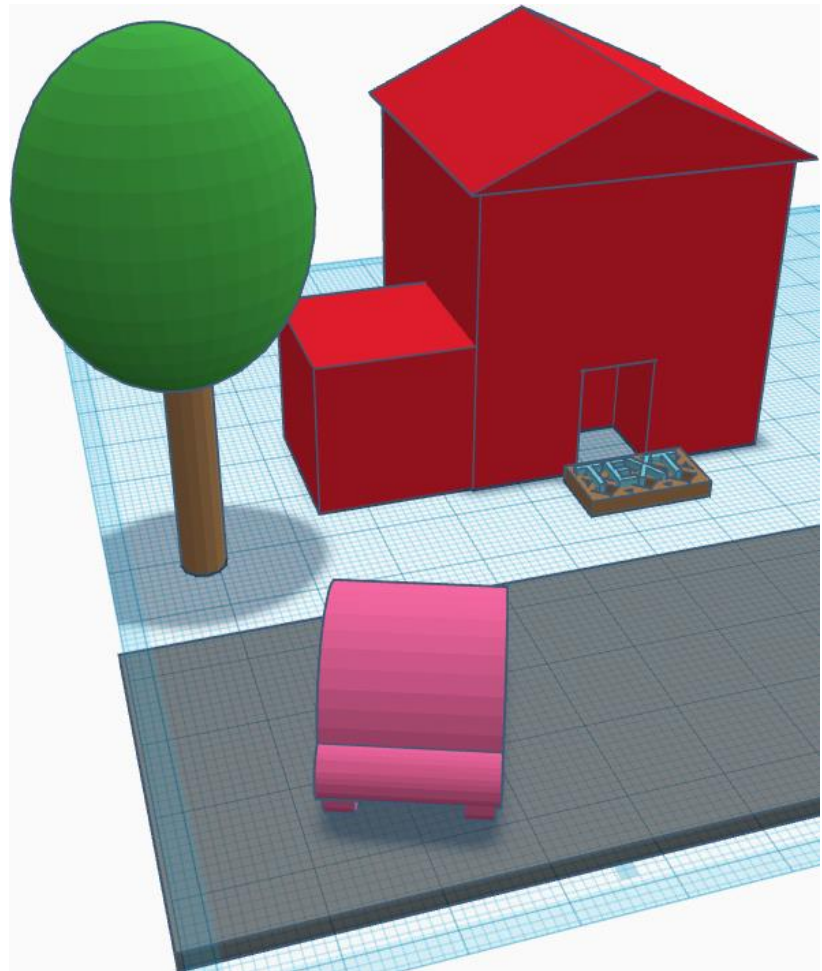
- From the **Geometric** part of the **right side menu**, click the **blue sphere**.
- Carefully place it on the trunk.
- Take your time, this can be difficult because the workplane can be a bit disorienting.
- Right click and drag around to check the location of the sphere.
- Double check using the **shadow** (*Figure 3 above*).
- You may need to click and drag to nudge the sphere a few millimeters one way or the other. These movements unfortunately require very precise mousing. Zooming in using your **mouse scroll wheel** or rotating around can help (*Figure 4*).
- Change the color of the **sphere** to green.
- Remember to replace the workplane to the default bottom – try using the keyboard shortcut **W then click** to place the workplane.



- Next, lower the sphere with the **black up arrow tool** a few millimeters to make sure it intersects with the trunk.



- Make the sphere larger – the exact dimensions are up to you. Don't make it exactly 40 x 40 x 40 millimeters long wide and tall or something like that, make it something like 38 x 40 x 30 mm since the upper parts of trees aren't perfect spheres. Hover over a corner to check shape dimensions.
- Move and rotate the car so that it is coming out of or going in to the garage, using either 1° or 22.5° degree rotations to your taste.
- Your design should look something like the picture to the right in the end.



Basic 3D Design



Recommended Additional Resources:

Other technology classes

Go to <http://www.eapl.org/events> to view and signup for other computer classes.

Librarians, Computer Aides, and Makerspace Assistants

We are glad to help you out at the second-floor reference desk or in the Makerspace as best we can while helping others.

Help appointments

Ela Library cardholders can schedule one-on-one appointments with librarians for further help. We can help with our Digital Media Labs or with general technology questions in our areas of expertise. Appointments last up to one hour. Paper appointment request forms are available at the 2nd floor reference desk. You can also request appointments online:

- Go to eapl.org > digital media labs for a Digital Media Lab appointment.
- Go to eapl.org > Forge > appointment request for a Forge appointment.

Databases

The library offers card holders access to many premium databases. These include two which can help you learn more about technology.

- **Gale Courses** offers a wide range of highly interactive, instructor led courses that you can take entirely online. As an El Area Public Library card holder in good standing, you are entitled to these courses at no cost. Courses run for six weeks, and new session begin every month.
- **LinkedIn Learning** offers technology training with over 20,000 training videos on over 300 topics with exercise files included. The library pays for you card holders in good standing to access this resource, however you will be required to create a free account. **Please remember to log out when you are finished.*

Access both databases from the library's databases page under eapl.org > Learn & Explore.

Books

A few books in the library collection related to this book are:

- **3D modeling and printing with Tinkercad: create and print your own 3D models** by James F. Kelly
- **3D printing with AutoDesk 123D, Tinkercad, and Makerbot** by Lydia Sloan Cline

Free online tech training websites

<http://www.gcflearnfree.org/> and <https://techboomers.com/>

Forge Class Evaluation

Class Title: Basic 3D Design with Tinkercad

Date: 7/13/2021

In terms of your skill with technology, how do you consider yourself?

- ☐ Absolute Beginner (no or little experience with computers, *NOT* yet comfortable using a mouse and keyboard)
- ☐ Beginner
- ☐ Intermediate
- ☐ Advanced

In terms of your skill doing *3D design* or using *Tinkercad*, how do you consider yourself?

- ☐ Absolute Beginner (no experience)
- ☐ Beginner (some experience, but not comfortable using)
- ☐ Intermediate (some experience, comfortable with the basics)
- ☐ Intermediate/Advanced (experienced with basic and intermediate functions, but require training on advanced functions)

How much do you feel that you learned?

- ☐ I learned a lot
- ☐ I learned some
- ☐ I didn't learn much
- ☐ I learned nothing

How did you perceive the pace of the class?

- ☐ Too Fast
- ☐ Just Right
- ☐ Too Slow

Were the handouts helpful?

- ☐ Yes ☐ No If no, why not?

What did you like most about the class?

What did you like least about the class?

What other topics would you like to see in a future Forge classes?

How do you normally find out about library computer classes?

- ☐ Footnotes (Library Newsletter)
- ☐ Library Website
- ☐ Other _____

If you are not an Ela Area Public Library card holder, where is your home library?

Any additional comments: