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.

  Username: __________________       Password: __________________

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

- 6 Shortcuts at the top let you quickly open different groups of buttons, otherwise, you can scroll up and down through the group labels. Click each section label once to open and again to close.

- If you have any shapes you use all the time, you can click the star in the upper right corner of a shape to add it to the Favorites menu.

- Import allows you to bring in pre-made 3D files to add to a design or modify using Tinkercad.

- Shape generators are fancy custom shape builders made by the Tinkercad community. The ProGear shape generator made the Forge 3D logo. The Image Generator shape generator can turn 2D pictures into 3D shapes (quality of 2D→3D conversion varies).

- Helpers includes a ruler tool to measure parts of your design and the workplane tool to change the surface where objects are initially placed.

- Tinkerplay includes shapes for building robots.

- Geometric has many basic shapes such as boxes, cylinders, pyramids, and more.

- Holes has two premade holes (a box and a cylinder), although any shape can be turned into a hole in Tinkercad (more on this later).

- Letters has pre-made letter shapes.

- Numbers has pre-made number shapes.

- Symbols has shapes including @&!? and a few others.

- Extras has a few extra shapes like eggs.
2. Inserting shapes

- We’re going to design a basic house as an example today.
- Open the Geometric 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 place your box.

3. Moving shapes

- As we’ll see later, it’s easiest to design an object when it is 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 on any of the square or arrow handles before dragging. Use a location like this one on the object.
- Labels on the screen will let you know how far left/right and forward/backward you’ve moved the shape.

4. Changing the view

- Another trick to make designing a 3D object easier is to remember to frequently change your view.
- Use the arrows on the left side of the Tinkercad interface to rotate around the center.
- Use the home button to return to the original starting view if you get lost or confused.
- Right click anywhere and drag to rotate around the center.
- Click on a shape and then press the square button to automatically zoom in on only that shape.
- Use the + or — to zoom in/out.

- To move left and right or forward and backwards without rotating, hold the Shift key and then right click and drag in any direction. This pan movement changes the center around which you rotate.
- A 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 the red box at an angle.
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.
- Click on the red box to select it.
- Once you’ve selected it, resize handles should appear. These handles work just like resize handles for pictures in programs like Microsoft Word and PowerPoint.
- Dragging the black handles resizes either length or width.
- Dragging the white handles resizes both length and width.
- To increase or decrease the height, use the white resize square at the top.

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 the 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.
• 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.

8. *Raising and lowering shapes*

• Our house needs a roof.

• Open the **Geometric** section of the right side menu.
• Single left click on the **green roof**.
• Single left click to place it somewhere near the red box.

• Increase its size to 40 x 40 millimeters wide and deep. Don’t change it’s height.

• Click and hold and drag **black up arrow tool** upwards to lift the roof up to 40 mm. The black up arrow tool changes to a red color when you’re using it.
• The **shadow** indicates that the shape is in fact 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 the inspector and Grouping

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

- We can use the inspector 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 edge is what we’re designing.*

- 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 change the green roof to a red roof.

- 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 Holes 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 Group button. This will cut out the part of the box hole that overlaps the red box. And it will also 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.
- 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.
- Click into the **Helpers** section of the **right side menu**.
- Single left click the **Workplane** tool.

- Move your mouse back into the design and hover over the left edge of the house.
- 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. 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.
- **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 ** Helpers** section of the **right side menu**, and then single left click on any blank space that was the original bottom of the design.
11. Snap to grid and Ungrouping

- Let’s increase the size of the roof just a little bit.
- Click on the house/roof, and click Ungroup above the inspector. 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 to 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 drop down 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 house and the hole and press Group.
12. Change measurements to inches or back to millimeters

- Almost all 3D programs use millimeters for measurements.
- But our house is in America, and we use 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.

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 inspector to change its color to black.
- 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 the premade shapes Tinkercad provides.
- **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 by the **Inspector**.
- If you know the Javascript programming language, you can create your own shape generators.
- In **Tinkercad** shape generators, let’s click on the one called **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.*
- We can change the text of the **text shape generator** by simply typing something different in its menu.
- Under **Text** type your last name. Capitalization doesn’t matter.
- 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.

- Some characters such as ‘ do not work.

- 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**.
• Next, find the **Voronoi by Tinkercad** shape generator.
• 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 in the middle.
• Make sure the **Z height is 2 mm**.
• After you’ve placed it, look at the inspector.
• Below the normal inspector controls are a list of **parameters**. Parameters are variables this 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.
• Below the Tinkercad-created shape generators, notice that there are community designed shape generators. These are made by other Tinkercad users with Javascript code.

**15. Change the size of the workplane**

• If you want to construct a neighborhood of houses, or use a shape generator to put a mountain range behind your house we can expand the size of our workplane design area.
• Like we did when changing between inches and millimeters, click **Edit grid**.
• Below the **Units** 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.
16. Import pre-made shapes

- Tinkercad allows you to import premade 3D .STL files.
- These can be shapes you’ve made or shapes you’ve downloaded from sources like Thingiverse.

- In the right side menu, click to open the Import section.
- Click the More button to see a detailed description of this tool.
- The Import tool has the ability to import from 3D files on your local computer or 3D files openly available online (URLs).
  
  We recommend using the File function of the Import tool.
  URLs will have to be direct links to 3D files ending in .STL, otherwise importing will fail.

- Today we’re importing a file we’ve loaded on each computer.
- Click File and then click Browse to pull up the window to find a file. In that window click Desktop, and then click Open.
- The location of the file will display in the bar to the left of the Browse button. We’ll leave it at a scale of 100% and units of mm. Click Import to actually insert it in your design.
- As the label says, all imported shapes are put in the middle of the workplane by default. In our experience that’s almost never where you want an imported shape, so you’ll have to move it to the right location after it imports.
- Using the black up arrow makes moving it easiest to get the car out of the way. Then drag it and move it back down to the bottom.

17. Rename and Download to your computer

- Once you’ve 100% completed your design, you can download what you’ve created as a 3D file onto your computer.
- In the upper left side, single left click the Design menu.
- Change the name of your design in Properties.
- Then click Download for 3D Printing
- Or click Download for Minecraft to customize it for that game.
- In the menu that appears, choose either STL or OBJ. Either of these two 3D file formats work with Ela Library 3D printers.
- Make sure to save it somewhere you’ll remember. We recommend the Desktop.
18. Upload a model for 3D printing

- Go to [http://www.eapl.org/create/forge/3d-print-job-submission](http://www.eapl.org/create/forge/3d-print-job-submission) in a web browser.
- Scroll down to see the form. Fill out your name, library card #, email address, phone number. We ask for this contact info so we can get back to you with any questions.
- Click the circle button for the single color you would like your object printed in.
- Click **Choose File** and then find the 3D file you want to submit and click **Open**.

```
File upload *
Choose File yoda.stl
Upload
```

- Click **Upload** to the right once the file name of your 3D model appears. *Uploading may take a while, please be patient.* The file has been successfully uploaded when the **Upload** button changes to say **Remove**.

```
File upload *
Choose File yoda.stl
Upload
```

- Type in any **Comments** you have for us, and decide if you’d like us to display your print before you pick it up.
- Click the button picture right once.

```
Please click once to submit. This may take a moment.
```

- **Our house model is too large to 3D print, models equal to or less than 145 x 145 x 150.7mm (5.7 x 5.7 x 5.9 inches) can be printed.**

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 **Geometric** part of the **right side menu**, click the **orange cylinder**.
- Insert it someplace near the house, maybe to the side of the garage.

```
[Image of tree and house]
```

- Resize the orange cylinder tree trunk to 5 mm wide x 5 mm deep x 25 mm tall.
- 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. From Helpers 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.

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). 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 by clicking the + button can help (Figure 4).

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 the garage, using either 1° or 22.5° degree rotations to your taste. Use the inspector to change the color of the sphere to green.
Tinkercad keyboard shortcuts

### Moving object(s)

<table>
<thead>
<tr>
<th>Key Sequence</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 / - - / 1</td>
<td>Move object(s) along X/Y</td>
</tr>
<tr>
<td>ctrl + 1 / 1</td>
<td>Move object(s) along Z</td>
</tr>
<tr>
<td>shift + 1 / - / - / 1</td>
<td>×10 Nudge along X/Y</td>
</tr>
<tr>
<td>ctrl + shift + 1 / 1</td>
<td>×10 Nudge along Z</td>
</tr>
</tbody>
</table>

### Keyboard + mouse shortcuts (press and hold kbd btn, then move mouse)

<table>
<thead>
<tr>
<th>Key Sequence</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>alt + left mouse button</td>
<td>Duplicate object(s)</td>
</tr>
<tr>
<td>shift + left mouse button</td>
<td>Select multiple object(s)</td>
</tr>
<tr>
<td>shift + hold while rotating</td>
<td>45° rotation</td>
</tr>
<tr>
<td>alt + hold side handle</td>
<td>Scale (1D)</td>
</tr>
<tr>
<td>alt + hold corner handle</td>
<td>Scale (2D)</td>
</tr>
<tr>
<td>shift + hold corner handle</td>
<td>Scale (3D)</td>
</tr>
<tr>
<td>shift + alt + hold corner handle</td>
<td>Scale (3D)</td>
</tr>
<tr>
<td>shift + alt + hold top handle</td>
<td>Scale (3D)</td>
</tr>
<tr>
<td>shift + right mouse button</td>
<td>Pan view</td>
</tr>
</tbody>
</table>

### General shortcuts

<table>
<thead>
<tr>
<th>Key Sequence</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ctrl + c</td>
<td>Copy object(s)</td>
</tr>
<tr>
<td>ctrl + y</td>
<td>Paste object(s)</td>
</tr>
<tr>
<td>ctrl + z</td>
<td>Undo action(s)</td>
</tr>
<tr>
<td>ctrl + shift + z</td>
<td>Re-do action(s)</td>
</tr>
<tr>
<td>ctrl + g</td>
<td>Group object(s)</td>
</tr>
<tr>
<td>ctrl + shift + g</td>
<td>Un-group object(s)</td>
</tr>
<tr>
<td>ctrl + d</td>
<td>Duplicate in-place</td>
</tr>
<tr>
<td>ctrl + l</td>
<td>Lock object(s)</td>
</tr>
<tr>
<td>ctrl + a</td>
<td>Select all object(s)</td>
</tr>
<tr>
<td>del</td>
<td>Delete object(s)</td>
</tr>
<tr>
<td>m</td>
<td>Workplane toggle</td>
</tr>
<tr>
<td>r</td>
<td>Ruler toggle</td>
</tr>
<tr>
<td>s</td>
<td>Fit view to selected object(s)</td>
</tr>
<tr>
<td>d</td>
<td>Drops object(s) to work plane</td>
</tr>
</tbody>
</table>

**Legend**

- `c` = copy
- `y` = paste
- `z` = undo
- `g` = group
- `d` = delete
- `m` = workplane
- `r` = ruler
- `s` = fit view
- `d` = drop

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Go to https://www.tinkercad.com/quests/ and scroll down all the way to the bottom to see the most up-to-date list of Tinkercad keyboard shortcuts.
Recommended Additional Resources:

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

Class handouts
Go to http://eapl.org/events/computer-programs/class-handouts to download copies of class handouts and exercise files.

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 here http://www.eapl.org/DMLhelp to sign up for a Digital Media Lab appointment.
- Go here http://www.eapl.org/one-one-technology-help-appointment-request to request a general tech help appointment.

Tech Tutoring
The last Wednesday of some months, a tech savvy librarian is available for six 30 minute tech tutoring appointments. Bring a list of questions and we’ll help with as many as possible. Limit one tutoring appointment per month per patron. First registered first served, no library card required. Go to http://www.eapl.org/events to register for a session.

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 Ela 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.
- Lynda.com 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 of these databases from the library Research page: http://www.eapl.org/resources

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
  Call Number: 006.686 TINKERCAD
- 3D printing with AutoDesk 123D, Tinkercad, and Makerbot by Lydia Sloan Cline
  Call Number: 621.988 CLI

Free online tech training websites