

## Level 1- Thingiverse

### What is 3D printing?

- 3D printing is defined as the process of making a physical object from a three-dimensional digital model, typically by laying down many thin layers of material in layers. 3D printing is also known as additive manufacturing.
- The ITC 3D printer takes a feed of plastic filament into an extruder. The extruder is heated to 208 degrees Celsius, (406 degrees Fahrenheit) which melts the plastic filament and converts it to a smaller diameter. The extruder squeezes out this thin line of heated plastic to build the 3D model by fusing layers of the hot plastic together.
- The software we use is an open platform software called Cura. The software reads the object file (.stl file) and automatically determines the path for the printer to take in order to build the 3D model.

### What is Thingiverse

Thingiverse is a free website created by Makerbot. It is the world's largest 3D printing community. Thingiverse allows users to make, discover, and share 3D printable items. The website contains over 610,780 3D models for users to choose from. Anyone can add content to this site, so not all files are printable and useable. This is an important thing to remember when looking here for files to print.

### Do I need an account to access content on Thingiverse?

If you just want to download files, you will not need to create an account on Thingiverse.

If you would like to participate in the social aspect of Thingiverse such as the comments and groups, then you will need to create a free account.

### How can you use the Thingiverse web site to search for pre-made content to download and print?

There two different ways to search for pre-made content on the Thingiverse website.

The first is to search for an item by using the search bar in the top right hand corner. Enter the search term here and then click Enter on your keyboard.

- You will see a grid that displays images of the items along with the item name, creator, and date it was uploaded. You will also see the number of times viewed, loved, and commented on.
- Click on the image from the grid to see more details and information about that item
- It is important at this page to view the "Comments" and "Made" sections so that you can see what other user's experiences have been when trying to print the object. This will help you know if it is worth the time to try to print. If there are negative comments here, or if not many people have printed it, then the file could be bad.

- Click on “Thing Files” and you will see all the files needed to make the model. You can either click on “Download All Files” or just click on the individual file you want to download. Note that some of the objects that you might want to print could take more than one piece to put together for a final product.

The second way to find content is by clicking “Explore” to find more options. After clicking “Explore” a menu will drop down with seven selections to choose from. Do not click “Apps.”

- When exploring different models, Thingiverse also gives you the option to sort the model by using the sort options feature up at the top of the list.
- Once you have selected a model simply click on that it to get more information about it, and you will be taken to a page where you can download the printable files. This page will give you more details on the model you have selected.

### **What file type do I need to download in order to send my item to the 3D printer?**

In order to print on most 3D printers, you will need to download your file as a .stl file. To print, go to the **Design** menu and then to **Download for 3D Printing**. Choose the .stl button to download as a .stl file. Save the downloaded file to the desktop, your documents folder, or a flash drive.

### **How can I print my object?**

Bring your .stl file to the ITC and we will be happy to print it for you.

- We will look at your file first to make sure there is a good chance that it will print correctly
- There is a small fee of \$.05 per gram to help us continue to buy more filament for printing
- Your file needs to be smaller than 6x6x6 inches in order to fit on our printing surface. We can always resize it smaller for you if needed.
- Depending on the size of the object and the demand for printing services, there is a 24-48 hour turnaround time for files brought to us for printing

### **30 minute exploration**

- Explore Thingiverse to find pre-made items related to your content and download them as the correct file type

Challenge: Can you find?

- [Toy Sailboat](#)
- [Eiffel Tower](#)
- [Stackable Battery Holder](#)
- [Self-watering planter](#)
- [Smartphone and tablet stand](#)
- [Pokemon](#)
- [Moveable Elephant](#)

## Level 2 Tinkercad:

### What is Tinkercad?

Tinkercad is a free web based tool that allows you to build 3D objects that can be downloaded and sent to a 3D printer. There are pre-made objects in Tinkercad that you can modify in order to build your objects, or you can start from scratch and build shapes yourself. Because this tool is web based, you can design anywhere, then download your files when you are ready to print them. Your files are stored in the Tinkercad cloud so they will be available for you no matter where you access them from. Tinkercad also allows you to import 3D files and manipulate them in order to modify them for your own needs.

For more information, view this video- <https://www.youtube.com/watch?v=MwjWT-EvKSU>

### How do you create an account in Tinkercad?

There are 2 options for creating an account in Tinkercad.

1. Create a brand new account. Use the [Sign Up](#) link to create a new account.
2. Associate an account you already have in Facebook, Google, Microsoft, or Yahoo. This allows you to use the same username and log in that you already have so that you don't need to create a new account. Use the [Sign In](#) link to link a current account to Tinkercad.

## 30 minute exploration- Complete at least 1-2 tutorials and lessons in Tinkercad to learn how to create objects

### How do you move objects within Tinkercad?

- Click the LEARN link in the main menu at the top of the page
- Go to the Basic Skills Tutorial
- Complete the [Learning the Moves](#) Tutorial

### How do you rotate the view in Tinkercad to see your object from different angles?

- Click the LEARN link in the main menu at the top of the page
- Go to the Basic Skills Tutorial
- Complete the [Camera Controls](#) Tutorial

### How do you make a negative space within a solid object?

- Click the LEARN link in the main menu at the top of the page
- Go to the Basic Skills Tutorial
- Complete the [Creating Holes](#) Tutorial

### **How do you copy and resize solid objects?**

- Click the LEARN link in the main menu at the top of the page
- Go to the Basic Skills Tutorial
- Complete the Scale, Copy, Paste Tutorial

### **How do I know what size object I am creating?**

- When you build an object and select it, you will see the measurement of each piece in millimeters
- The grid where you create your objects is also shown in millimeters
- You can choose to change the measurements to inches by clicking the Edit Grid button in the lower left corner of the web site, but by doing so when you click on an object to see the size, it will show you a fraction of the inch as the measurement.

Example- an object that is 25.00 millimeters in length will be shown as .984 inches when you change the scale of the grid.

Tip: Use the Edit Grid button to change the size of the grid to 6 inches by 6 inches as this is the largest size we can print in the ITC. Once you have changed in to this size, change the unit of measurement back to millimeters to make it easier to size the objects on the screen. As long as you keep your object within the size of the 6x6 grid, it will be small enough for our printer.

Tip: Since the printer prints in plastic, it is possible to make multiple objects, then glue them together. This is helpful if you want to create objects that are larger than 6x6x6 inches.

### **How do you layer multiple objects to build a solid in Tinkercad?**

- Click the LEARN link in the main menu at the top of the page
- Go to the Tinkercad Lessons section and click Show More Lessons
- Complete the Key Ring, Letters lesson

### **How do you create a new project in Tinkercad?**

From the home page, scroll down until you see the My Projects section on the left side of the page, then click the + sign to create a new project



Tip: If you ever get lost in the web site, click the Tinkercad icon  in the upper left corner to return to the home page.

### **Challenge: Can you create an object that?**

- Defines a certain time period
- Floats
- Shows a mathematical concept
- Summarizes the main theme of a novel
- Makes noise

**How do I save my files in Tinkercad?**

Your files will automatically be saved in the Tinkercad cloud. They will automatically be named something funny, so pay attention to the name before you download the file. To change the name of the file, go to Design, Properties and change the name. If you want to know the file is being saved as you work on it, you can also manually save the file by choosing Design, Save from the menu bar.

Tip: If you like something and want to modify it, you can use the Design menu to make a Duplicate of the object, then work on modifying the new one. The new one will be called Copy of... (file name)

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## Curriculum Discussion – 3D Printing

### 30 minute- Small group discussion

Many times it may not be clear how the 3D printer could be used to meet a specific content standard, and it seems very far-fetched to apply the 3D printer to that standard. Instead of trying to think literally about that standard and 3D printing, let's try thinking about the standards a little more abstractly.

### How can you use the 3D printer in your classroom to?

- Solve problems
- Think creatively
- Work collaboratively
- Construct knowledge
- Express an opinion
- Send a message
- Analyze a data set
- Demonstrate learning
- Take risks
- Test prototypes
- Create models
- Sequence
- Examine complex issues
- Investigate solutions

Now that you have thought about using the printer in a different way, see where those ideas might fit into your content standards.

SC Standards- <http://ed.sc.gov/instruction/standards-learning/>

ISTE Standards- <http://www.iste.org/standards/standards/for-students-2016>

List 1-2 standards below and how you think the 3D printer might be used to meet those standards

### **15 minutes- Reflection and Sharing**

Did you come up with any surprising connections between your standards and 3D printing?

What challenges did you face in trying to align standards in your content area with 3D printing?

What benefits do you foresee 3D printing bringing to your classroom?

Does it feel like technology is being forced upon you as a teacher? How can you combat that feeling?

How will you grade 3D printing projects?

What role do you think educators will / should play in a 3D printing curriculum?

Do you think that cross-class, interdisciplinary projects are a possibility? Would they be beneficial?

### **Resources**

If needed, here are some resources to get the creative ideas flowing

10 Ways 3D Printing Can Be Used in Education [Infographic]

- <http://www.teachthought.com/the-future-of-learning/technology/10-ways-3d-printing-can-be-used-in-education/>

Importance of 3D Printing in Education [Video embedded]

- <http://www.educatorstechnology.com/2013/03/importance-of-3d-printing-in-education.html>

Getting Started with 3D Printing Lesson Plan [ELA Aligned!]

- <https://educators.brainpop.com/lesson-plan/3d-printing-lesson-plan-make-moby/?bp-topic=3d-printing>

Kathy Schrock's Guide to 3D printing

- <http://www.schrockguide.net/3d-printing.html>

Makerbot Educator resources

- <http://www.makerbot.com/uses/for-educators>

Or you can just browse through [Thingiverse](#)! There are plenty of cool things to inspire you.

- [DNA/RNA manipulatives](#)
- [Topographical world map](#)
- [Population Density Map](#)
- [Parallel Line/Music Staff Drawing Tool](#)
- [Learn Braille](#)