3D PRINTING

3D PRINTING WORKSHOP

What you need

- One or more 3D Printers. To show what a 3D Printer is and what is does. This allows us to give first hand experience of how a 3D Printer operates and explain the basics behind it.
- 3D Printing Filament. Preferably PLA.
- 3D Printing Kit. Glue Stick, Scraper and other standard equipment.
- Computers/Laptops. These are what the kids will be using to access TinkerCAD
- Google Chrome. Optimal browser to run TinkerCAD
- Computer Mice. Self explanatory.
- Mouse Pads. In case of hostile surfaces.
- Internet Connection. TinkerCAD is cloud based. An active internet connection is required to access the application.
- Power. Adequate power supply and multiboards.

Setting Up

- Make sure the 3D Printer is working.
- Preload 3D Prints to be printed on the day. Aim to have the item printed take up as much time as the event is scheduled for. If the event runs for 6 hours, try to make the print take approximately 6 hours to complete.
- Computers are updated and capable of running TinkerCAD. This web based application uses WebGL and works best in Google Chrome.
- If computers have updates pending make sure there is enough time for them to either update or make sure the computers are not reset.
- Contact TinkerCAD regarding possible maintenance downtime and advise of the event to be run including times/dates. Try and do this in the week leading up to the event. (They're really cool about this)

On the day

Load up all the laptops and open Chrome. Go to www.tinkercad.com and sign in. We prepare all the computers so the kids can get right into it with minimal hassle. To do this we do the following:

- Once logged in, click on Create new design.
- At the top left corner, click on Design and select Properties.
- A window will open labelled Thing properties and have a text field labelled Name.

- Leave this screen open.

When the kids arrive, have them gather around the 3D Printer instead of sitting down at the laptops. Here is where we first expose them to a 3D Printer. Most will never have seen one in action. We generally ask the following:

- Who has seen or used a 3D Printer before? Where?
- How does it work? (You'll get many varied answers, based on the responses maybe ask a follow up question).
- Ask how many have used a Hot Glue Gun before.

Explain **the Science.** (Next page)

Packing Up

- All designs are automatically saved by TinkerCAD on a regular basis. So don't worry about having to save them.
- Close browsers, shut down computers.
- Unplug everything and wind up accordingly.
- Either wait for print to finish or cancel print. Pack down machine.

Post Workshop

Upload designs and make links available.
This is a work in progress as we'll either make them all available via Thingiverse or make them public on TinkerCAD.
When they make their own accounts they can import and continue with their designs.

The Science

Explain the basics of 3D Printing with the hot glue gun analogy. Simplified, a 3D Printer is a computer controlled hot glue gun that melts the plastic in a hot end at around 200C and deposits the plastic in layers. As it deposits each layer of plastic, the object grows. You can do this with a hot glue gun. The difference is that it is computer controlled and very precise. Cross reference Coding and Robotics here. A 3D Printer is a robot. Motors control the 3 axis/directions the nozzle travels. The Code we use is the object we've designed on the computer which is translated by a piece of software into the path it needs to take to make that object. This should take no longer than five minutes or so.

NOTE: For subsequent groups after the first, this time spent explaining the actual machine allows the other volunteers to reset TinkerCAD to the Thing properties screen.

Once the kids are at their computers, get them to enter their group number/colour/name plus their own name into the Name field open in front of them. This allows us to associate the design to the designer and let them find their design online once a system is put in place to upload them.

This is the point where most of the kids will experiment with the program and learn the functions. I have purposefully not set a task or given instruction to make specific things. The reason is that we want the children to explore and program instinctively and see how far they can get on their own. Most of the children will intuitively begin to make something relevant to their interests. The objective here is for them to learn what the manipulators do and how to use them rather than create a specific thing. I'll cover each of the basic manipulators in a separate document.

As they explore the different functions they will get stuck. Try and talk them through the functions and point on screen or describe how to do what they're trying to do. Ask questions like "What if you click and drag that" or "What do you think would happen if we clicked here?" What if and What do you think are great for getting them to think about the results of their actions. Most often you'll get the standard response of "I don't know." To which the best response is "Let's try it and see." One of the best things you can do is take the pretence of learning with them. Feigning that you also don't know what the result will be. In this area, there is no such thing as wrong even if the outcome is not the desired one. Just one of learning and having another go. At some point they'll reach a point where they've exhausted what they can find out on their own or get stuck in a routine of using the same functions. This is a perfect time to show them a new function or an alternative way of using one they've

already found. This gives them new avenues to explore and will usually leave them with the words "See what you can do with that" and come back to them in a few minutes. If a child is struggling to come up with something to do or is hesitant, ask open questions as to their interests. "What kind of things are you into?"

At this point I should mention that when showing or explaining to the children what a function does or how to do a specific task that you should guide them through it verbally or by pointing at the screen with your finger. You may feel compelled to take control of the mouse pointer or do the task for them. This isn't such a good idea, as they lose the tactile control and interactive manipulation of their 3D environment. In other words, they won't get what you've just done as it's been done for them.

What you'll also see often is the kids sitting next to each other replicating what their friends are making or being influenced by it. This also leads to them assisting and collaborating with each other to improve their designs. Often the children will help each other out, especially if they believe they've mastered a certain aspect of the program. This is great for reinforcing their learning.

Now the reasoning behind why we're letting them run free on the application. Instead of setting a specific task, we've thrown the kids in at the deep end without a tutorial. We've let them explore and find the functions of their own accord. A lot of these functions can be considered intuitive and obvious and by finding them on their own they create a better association with them. Another reason we don't set a specific task is that not all kids are into the same thing. Therefore by leaving it open to their imagination, it opens it up to their interests.

One thing you'll be asked a lot is if they can print their designs. Unfortunately due to the number of children and the average print times, we're incapable of doing that. We've tried. This is the reason we set a long print or have the machine constantly occupied. Other than showing off what the machine is capable of, the children usually understand that the machine is busy. The aim here is that we'll be able to upload their designs to a central database for them to download at a later date.

This should take us through to the end of the day.