



# TAISCÉALAI

3D Printing Education for Primary Schools

Teacher's Guide

# WELCOME TO TAISCÉALAÍ

## 3D Printing Education for Primary Schools

**Taiscéalaí aims to inspire children to learn about STEM and manufacturing in the classroom by using 3D printing elements tied to the primary school curriculum.**

The Taiscéalaí project came about through a collaboration between two manufacturing research centres: Irish Manufacturing Research (IMR) and I-Form, Creative Spark Enterprise FabLab and Inspire3D. IMR is an Enterprise Ireland Research and Technology Organisation (RTO) with labs and industrial pilot lines in Dublin and Mullingar. I-Form is a Science Foundation Ireland-funded research centres headquartered at University College Dublin. Creative Spark Enterprise FabLab is centre for creativity and innovation based in Dundalk. Inspire3D are Ireland's professional 3D printing systems provider based in Rathnew. The project has been funded through SFI's Discover Programme Call, an annual programme that supports and encourages the public to engage with science, technology, engineering, and maths (STEM).

The structure and format of Taiscéalaí – 3D Printing Education for Primary Schools curriculum has been designed in collaboration with primary school teachers to ensure that the lessons can be easily incorporated within the primary school curriculum and include the appropriate support for teachers. Eight lessons have been created tied to different subjects within the curriculum. Each lesson can be completed as a self-contained, stand-alone activity within class time. Lessons come with a teacher guide, a student guide, and optional follow-up activities.

The teacher guide provides background information, how Taiscéalaí aligns with the Irish primary school curriculum; skills development; and a detailed overview of the lesson and learning activities.

The student workbook includes a short description of the lesson topic and activities for students to complete with the support of their teachers. These lessons are recommended for children aged 10 – 13 years old. Both the teacher guide and student workbook have been designed to align with the 5th and 6th class Irish primary school curriculum.

We hope you will find these materials both useful and engaging. Our most sincere thanks are extended to the teachers that assisted in the development of the materials, without whose time and input these guides could not have been created.

– *The Taiscéalaí team (Tamara Wierks, IMR; Michael Golden, I-Form; Paul Quinn, Inspire3D, Oscar Diaz, Creative Spark Enterprise FabLab)*

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## Taiscéalaí – 3D Printing Education for Primary Schools

The Taiscéalaí curriculum aims to expand STEM into the primary school curriculum by providing design thinking, modelling, and testing using 3D printing activities linked to the primary school curriculum. It highlights that STEM is around us all the time and provides strategies to include STEM in other subjects within the curriculum.

This teacher guide is divided into 8 lessons. Each one is directly linked to a strand, and each lesson contains learning objectives, links to the curriculum, a hands-on activity and potential follow-up activities. All of the lessons can be delivered as standalone activities or as part of a cycle of activities.

Some of the activities will require printing activity sheets from the student workbook. A feedback cube has also been designed and added to the end of the student workbook to gather student feedback from each lesson. The cube can later be used as decoration for the classroom.

The start of the Teacher Guide contains detailed instructions for the use of the 3D printing and the design thinking methodology which will be used throughout all the lesson plans.

Throughout this guide, you will find various icons to help you deliver each lesson.

### Engage



A short activity that aims to engage the students with the topic of the lesson.

### Continuation



The main activity of the lesson to cover the topic and associated skills.

### Follow-up



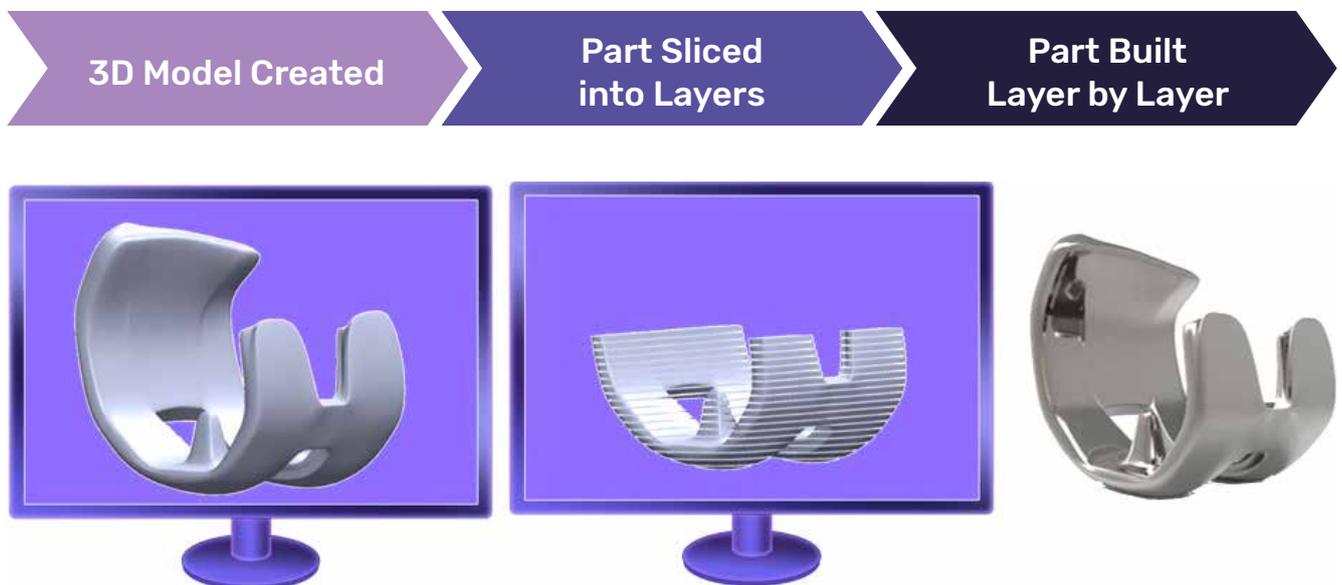
Activities that can be delivered in future sessions to reinforce the topic or explore other skills.

## Instructions for Building Skills in 3D Printing

### Introduction to 3D Printing

Additive manufacturing, also known as 3D printing, is a manufacturing process that involves building three-dimensional objects by adding successive layers of material. This is in contrast to subtractive manufacturing, which involves coring or drilling away material from a solid block to create a desired shape.

The process begins with a 3D model of the object that is to be created (3D modelling). The model is then converted into a series of instructions that a 3D printer can interpret (slicing). The printer follows these instructions to create the object by depositing material layer by layer until the final product is complete (printing).



**Additive manufacturing has many advantages over traditional manufacturing processes, including:**

- 1. Design flexibility:** Additive manufacturing allows for greater design freedom than traditional manufacturing methods. Objects can be created with complex geometries and internal structures that are difficult to impossible to produce with subtractive methods.
- 2. Customisation:** Additive manufacturing can be used to create customised products, such as prosthetic limbs, dental implants, and hearing aids, that are tailored to the specific needs of individual patients.
- 3. Faster time-to-market:** Because additive manufacturing does not require the creation of moulds or tooling, it can be faster to produce small runs of parts or prototypes.
- 4. Reduced waste:** Additive manufacturing is a more effective use of material than subtractive methods, as it only uses the exact amount of material needed to create the objects. This can result in significant reductions in material waste.
- 5. Lower costs:** For small production runs, additive manufacturing can be more cost-effective than traditional manufacturing methods, as it eliminates the need for expensive tools and moulds.
- 6. Distributed manufacturing:** Additive manufacturing allows for the decentralisation of production, as objects can be created on demand at the location where they are needed. This can reduce the need for large centralised production facilities and lower transportation costs.

Overall, additive manufacturing offers a range of advantages that can make it a more efficient, cost-effective, and flexible manufacturing option for a variety of industries including aerospace, automotive, healthcare and consumer goods.

There are two types of software's required to create 3D prints, a design software (e.g., Tinkercad) and a slicing software (e.g., CURA, Prusa Slicer). In the following mini lessons, we will cover the basics of using Tinkercad and CURA as well as discussing some of the design elements to consider when 3D printing.

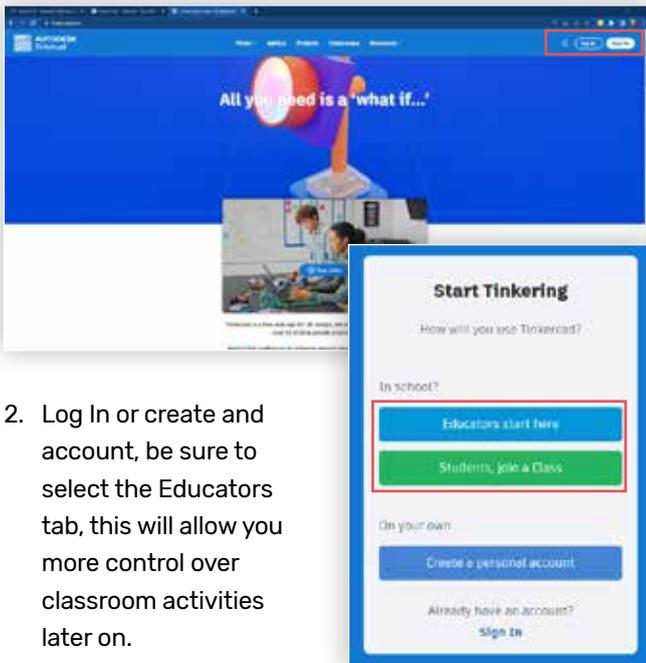
## Tinkercad

### Outline

Tinkercad is an online 3D Modelling tool which can be used by all ages and abilities to create 3D models, using an intuitive method of manipulating basic primitive shapes. Tinkercad is a free to use resource and requires Teachers/Educators to create an account. Pupils are not required to create an account.

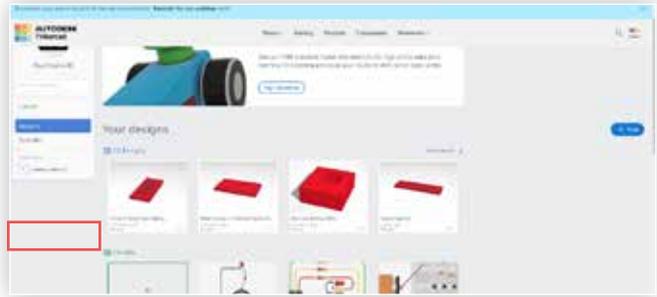
### Getting Started

1. Open Tinkercad [www.tinkercad.com](http://www.tinkercad.com)

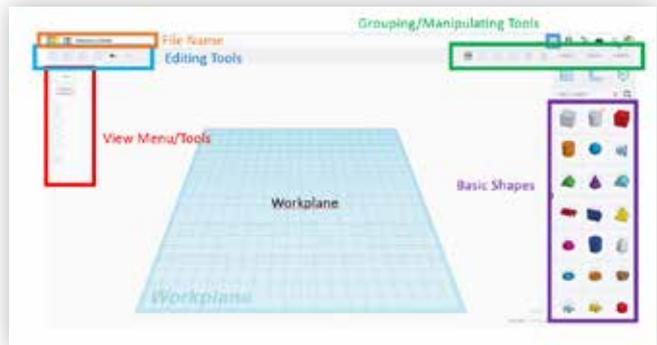


2. Log In or create and account, be sure to select the Educators tab, this will allow you more control over classroom activities later on.

3. To start 3D modelling, select the *Designs* option on the left side of the home screen, you will then be able to select *New > 3D Design*, to start your 3d modelling.



4. This will open the Workspace, where we can create design and features using a series of tools, the following page shows what each of these tools are.



**File Name:** Tinkercad will automatically assign a random file name to each design, you should change this to reflect the project you are working on so you will be able to find it later, encourage pupils to do the same so you can find them afterwards.

**Editing Tools:** A series of tools like copy, paste, cut, un-do etc. these can be very useful when creating more complex 3D models

**View Menu/Tools:** Tools to control how you view the workplane and 3D object.

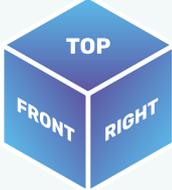
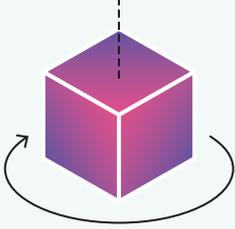
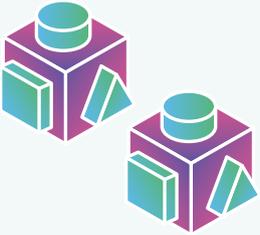
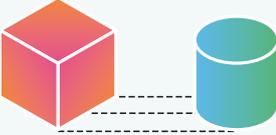
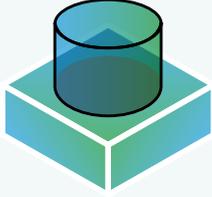
**Workplane:** This is where all of the 3D modelling will be completed, we use this as a base/origin to get started.

**Grouping/Manipulating Tools:** Tools that allow you to combine/group multiple shapes to create a single shape as well as align or mirror shapes.

**Basic Shapes:** A selection of basic primitive shapes that can be simply dragged and dropped anywhere into the work plane.

### Using Tinkercad - Manipulating Shapes

In order to create 3D designs, there are several things we can do with shapes.

<p><b>Place</b></p>  <p>Place a shape to add or remove material</p>	<p><b>View</b></p>  <p>View shape from all sides – front, back, right, left, top and bottom</p>	<p><b>Adjust</b></p>  <p>Move, rotate, and adjust shapes freely in space</p>	<p><b>Combine</b></p>  <p>Group together a set of shapes to create models as detailed as you want</p>
<p><b>Copy</b></p>  <p>Copy shapes or models when you need more than one of the same</p>	<p><b>Align</b></p>  <p>Position objects aligned to each other</p>	<p><b>Hole</b></p>  <p>Turn an object into a hole to create an empty space in another object</p>	

**For help on how to manipulate shapes, watch these videos:**

 <p><b>Getting Started/view</b></p>	 <p><b>Place/adjust</b></p>	 <p><b>Combine</b></p>	 <p><b>Copy</b></p>	 <p><b>Align</b></p>	 <p><b>Hole</b></p>
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### Exporting the Design

We need to convert the 3D Solid Model file into something that our 3D Printing software, Cura, can understand and work with. To do this we use the Export button in the top right-hand corner and select, under the For 3D Print, option STL.

The file will then download and save locally to your PC or Laptop.



**Further Tinkercad Resources:** [Learn 3D Design with Tinkercad](#) | [Tinkercad Shortcuts](#) | [Tinkercad Classrooms](#)

## Basics of Cura

### Outline

There are different version of Slicer software, the most popular being Cura and Prusa Slicer. Both offer similar functionality and achieve similar results. Cura is used mostly with Ultimaker printers and Prusa Slicer for Prusa printers, but both can be used in both cases. Cura is a slicing software that we use to convert our 3D Design into the instructions for the 3D Printer. A Slicing software typically takes a STL file as an input and exports a gcode file, from which our 3D Printer can begin to create our part.

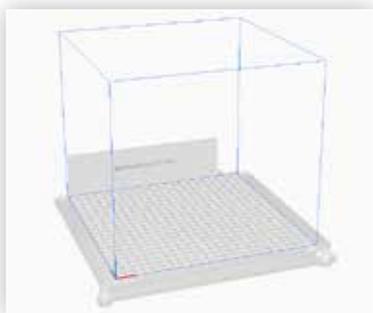
We are going to be using UltiMakers Cura software in this tutorial, although there are other versions are available. Cura is free to download from the following link.

### Getting Started

There are a few steps to be taken in order to get Cura set up correctly.

#### 1. Setting a machine type.

When first opening Cura after installation, it will prompt you to add the printer. Select *UltiMaker Printer > Add local printer > Add non-networked printer > Ultimaker 2+ Connect*.



Once you add the printer, a scene will load which will represent the build plate and build volume of the selected printer. The checkered plate represents the build plate of the machine and the blue outline is the build volume.

**Note:** You can use Cura to slice files for other makes of 3D Printers, just select *Non-UltiMaker Printer* during the setup and search for your specific printer.

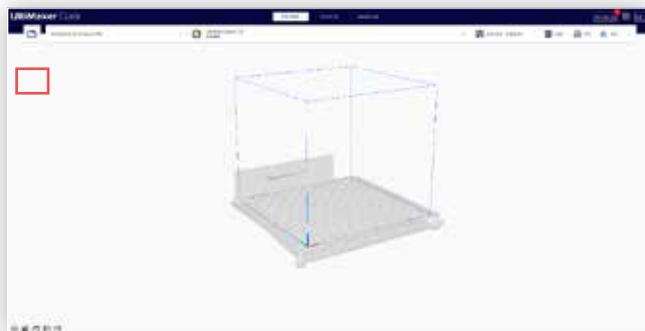
#### 2. Adding a Material profile

Cura comes loaded with a range of profiles for different materials. To add a material profile, select the Material Bar at the top of the page in Cura, from there you can navigate through the drop-down menu to assign the desired profile. If you are unsure of the material brand you can always use the generic profile.



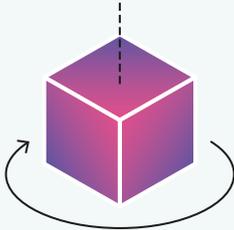
#### 3. Importing and Opening 3D models

To open a file in Cura we use the *Open Files* button in the top left. Navigate to the folder where your file is saved and select it to open it.



### Using CURA - Manipulating Parts on the Build Plate

When we open a file in Cura it will often need to be placed on the build platform or manipulated in some way. This most common manipulations are:

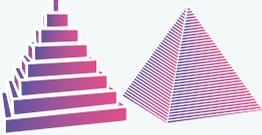
<p><b>Move</b></p>  <p>Move a part around the build platform, Note: keep the Drop Down Model option checked so your part stays in contact with the build plate.</p>	<p><b>Scale</b></p>  <p>Change the size of the model by dragging or inputting a percentage. The Uniform Scale option ensures X, Y and Z scale equally</p>	<p><b>Rotate</b></p>  <p>Change the orientation manually or use the lay a model flat or select a face to orient too. This can minimise supports needed.</p>	 <p>For an introduction in to how to set up and use Cura, watch this video.</p>
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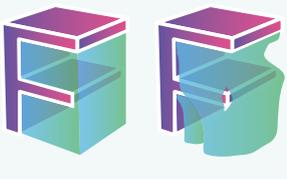
### Print Settings Basics

The print settings are essentially how we develop the set of instructions the machine needs to follow to convert our digital 3D design to a physical 3D Design. These instructions essentially tell the machine various pieces of information such as:

- The material we are printing, its printing temperature.
- What layer height will we use.
- How much infill is needed.
- Where the part is placed.
- Are there support materials.

**The main printer settings are:**

<p><b>Resolution</b></p>  <p>The height of each printed layer. The smaller the layers the more detail is printed and the longer the print will take.</p>	<p><b>Infill Density</b></p>  <p>How much material is used for the infill within the shell of the shape. Note 20% is appropriate in most cases.</p>	<p><b>Infill Pattern</b></p>  <p>The pattern used to create the infill. For most parts Grid or Triangles is appropriate.</p>	<p><b>Shell Thickness</b></p>  <p>The thickness of the external walls of the shape including the top and bottom layers.</p>
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Support Types	Support Placement	Adhesion
		
Print material to support features that are not supported by the designed shape. There are normal supports and tree supports.	Where the support will be placed, only with access to the build plate or all over.	Promotes to sticking of the first layer to the build plate by adding a brim to increase the contact area.

### Applying Print Settings

To apply print settings to a print, select the Print Settings tab in Cura. From there you can set the following print settings:

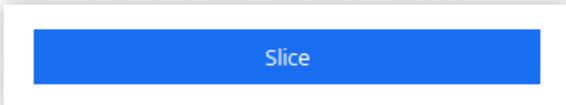
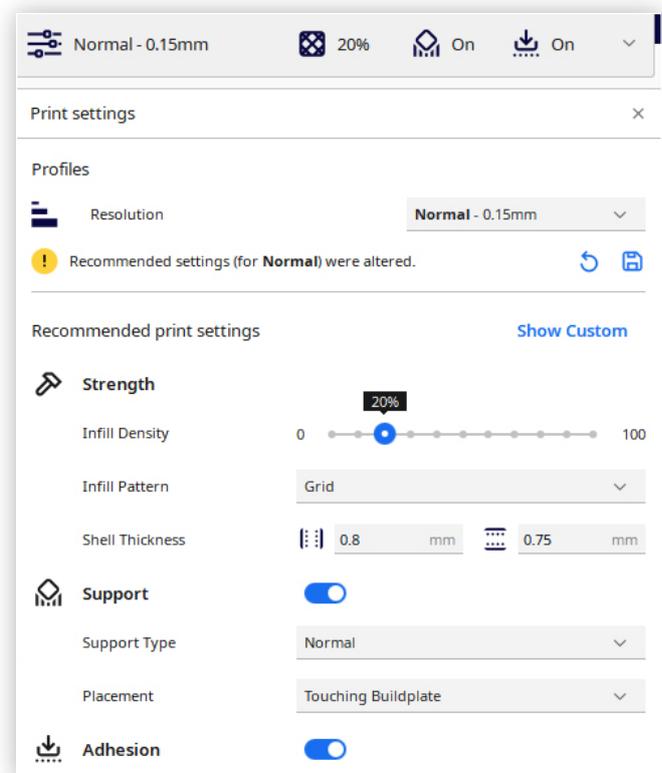
- Resolution (Layer Height)
- Infill Density
- Infill Pattern
- Shell Thicknesses
- Support Type and Placement
- Adhesion

### Slicing and Previewing Files

Once we have our file set up, oriented the part into its print location, and assigned the print settings, we can slice our file. Slicing breaks the part into layer-by-layer instructions that the 3D Printer can interpret and follow. In the bottom right corner of Cura you will see a blue Slice button, this will slice the part and prepare the instruction for the 3D Printer.

Once the part is sliced, you can preview the print and evaluate the layers. You can check where support materials are applied and make sure the settings are correct. An estimate of the print time is also displayed.

Once you are happy with the preview, the file can be sent to the 3D Printer via the network or over USB depending on the method you prefer.





To review all print settings, watch this video

 **1 hour 11 minutes** 

 **12g - 1.50m**

[Preview](#) [Save to Disk](#)

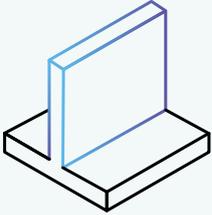
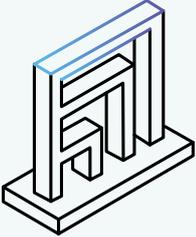
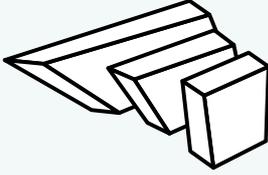
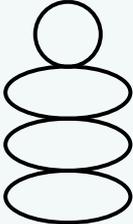
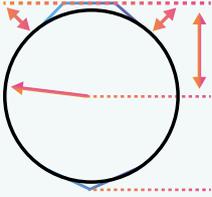
## Journey into 3D Printing: Exploring Design Elements and Rules

In this mini lesson the key design elements and rules for creating digital models for 3D printing are covered.

Watch the following video explaining the basics rules in 3D printing. [https://www.youtube.com/watch?v=raSAhXb2ea4&t=467s&ab\\_channel=Hubs](https://www.youtube.com/watch?v=raSAhXb2ea4&t=467s&ab_channel=Hubs)

### Design Elements

Whenever you design 3D objects to be printed there are several design elements that need to be considered in order to ensure that prints are successful.

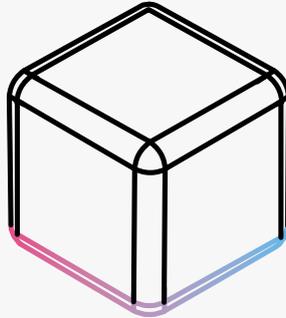
<p><b>Wall Thickness</b></p>  <p>All 3D printers can successfully print components with wall thicknesses greater than 0.8 mm.</p>	<p><b>Bridges</b></p>  <p>Sagging or marks from support material are to some extent always present unless the bridge is less than 5mm.</p>	<p><b>Overhangs</b></p>  <p>Overhangs need support structures to maintain the shape of the object when the angle is approximately 45 degrees.</p>	<p><b>Vertical Holes</b></p>  <p>When designing vertical holes, there is a potential for issues due to compression of the layers.</p>
<p><b>Horizontal holes and arches</b></p>  <p>Design holes and arches to ensure they are printable and structurally sound.</p>			

### Design Rules

There are several design rules that should be followed to ensure that the print is successful.

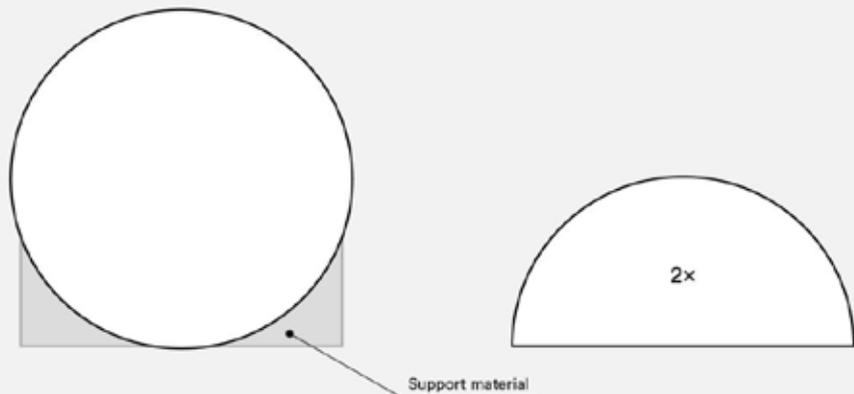
<p><b>Part orientation:</b> It is important to choose the right part orientation (direction of the layers) for printing to optimize strength and surface quality</p>	
<p><b>Bottom part surface:</b> A structure needs a flat and stable bottom surface for proper adhesion to the print bed.</p>	
<p><b>Print orientation:</b> When preparing a print, always choose the print orientation that eliminates the need for supports and limits overhangs. This will create the best overall print quality.</p>	
<p><b>Elephant foot:</b> There is a potential for the creation of an "elephant foot" due to the first layer being squished causing distortion during printing.</p>	
<p><b>Warping:</b> The heating and cooling of material can cause the parts to warp while printing.</p>	
<p><b>Edges:</b> Creating smooth edges will enhance the overall appearance of the printed object.</p>	
<p><b>Minimum feature size:</b> The right size of the objects should be chosen depending on level of intricate features and details. The smaller the part, the more difficult it is to print intricate details.</p>	

**Fillets:** Whenever possible, use fillets (rounded corners) to prevent sharp angles that may cause printing issues.



**Ribs:** Use ribs to add strength and structure to printed objects.

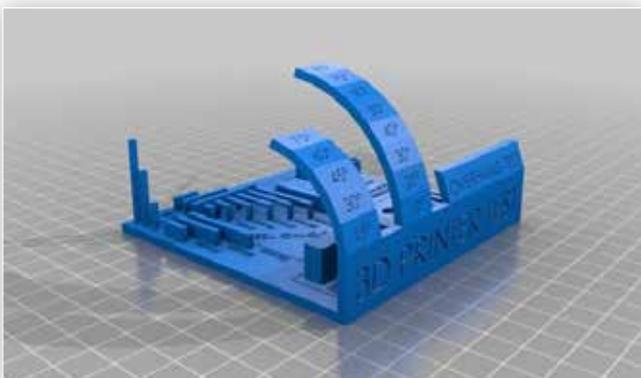
**Splitting the model:** Split larger designs into smaller parts for easier printing and assembly.



**Interlocking part tolerances:** Clearances between interlocking parts need to be accurate to ensure proper fit. A part fitting in another part should be slightly smaller in dimensions to fit inside the other shape. Usually 2% tolerance will be sufficient.

**Supports:** Supports provide stability for overhangs and bridges during printing.

The “[All in One 3D printer test](#)” file once printed show a summary of all the design rules that should be taken into account when designing and printing a 3D object.



#### Useful Websites

- <https://www.hydraresearch3d.com/design-rules>
- <https://www.hubs.com/knowledge-base/key-design-considerations-3d-printing/>
- <https://www.hubs.com/knowledge-base/how-design-parts-fdm-3d-printing/>
- <https://www.weerg.com/faq/design-guidelines-for-3d-printing>
- <https://all3dp.com/2/best-3d-printing-books/>
- <https://fab.cba.mit.edu/classes/863.20/CBA/people/group/reports/3d.html>

## Lesson **1** Introduction to 3D printing

This is an introductory lesson to introduce the student to designing 3D objects and use the 3D printer. For all other lessons plans, the 3D printer will be required as well as the Tinkercad software. Safety precautions should be considered when working with 3D printers.

### Suggested Class Level

Primary school 5th-6th Class

### Content Strands

- Technology: using 3D printing technology

### Cross-Curricular Links

- Mathematics: Shape and space (2D shapes, 3D shapes), measures (length, area)
- Visual arts: Print (making prints)

### Learning Objectives

- To use design software to create a 3D object
- To identify, describe and classify 3D shapes
- To make prints for functional uses
- To develop practical skills

### Skills

- Applying and problem-solving
- Communicating and expressing
- Integrating and connecting
- Reasoning
- Awareness of shape and form

### Equipment/Materials Needed

- 3D printer
- Electronic devices with Tinkercad installed and access to the internet
- Activity sheets (“Lesson 1: Prototype – 3D Printing”) for students
- Yarn
- 2D and 3D shapes

### Preparation

1. Ensure that the 3D printer is set up and working properly.
2. Set up the computer with Tinkercad.
3. Print 3D objects in the 3D printer that can be shown to the students as examples.

### Background Information

3D printing is the process of making a physical object from a digital model. The 3D object is built layer by layer until it is completed.

This technology has radically changed the prototyping process by enabling the speedy creation of models or physical parts using 3D computer-aided design (CAD). In manufacturing or product development, this is known as rapid prototyping. Different designs of the same product can be printed simultaneously for testing. Once weak spots have been identified and improved, the product is ready for manufacture. Some products can go on to be manufactured using 3D printing, as well as prototyped.

## Activity Trigger Questions (Engage)

Spark students’ interest in 3D printing by showing them different 3D printed figures and asking them the following questions:

- What do you think they are?
- How do you think they are made?
- What do you think they are made of?
- Can you identify any 3D shapes in the figure?

## Learning Activity 1 2D Shapes vs 3D Shapes

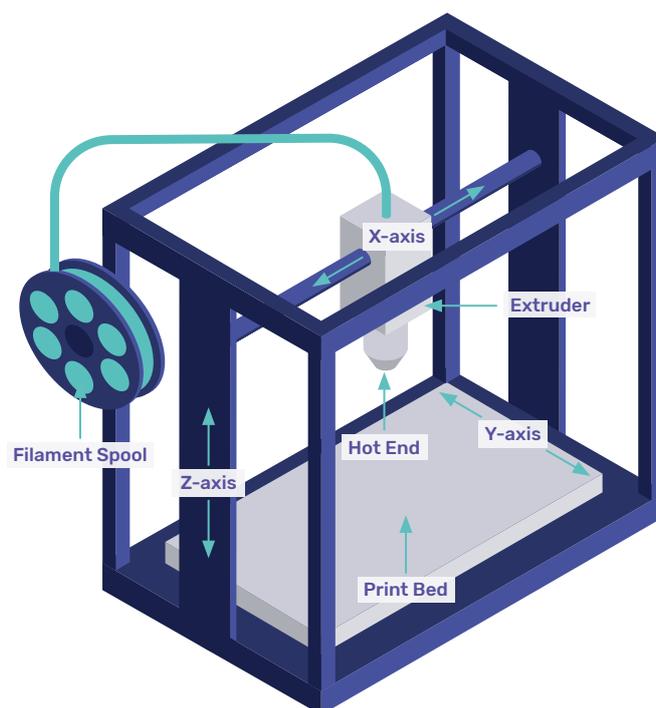
2D shapes are plane figures that are completely flat and have only two dimensions – length and width. For example, rectangles, squares, circles, and triangles. In contrast, 3D shapes have three dimensions – length, width, and height. This includes cylinders, spheres, cubes, and prisms.

During this lesson, students will be introduced to 3D modelling software that will allow them to create 3D objects using basic 3D shapes. This activity aims for students to explore the difference between 2D shapes and 3D shapes to ensure students can recognise and identify 3D shapes.

1. Work with students to sort the 2D shapes and 3D shapes and place them in the correct boxes.
2. Give students pieces of yarn to trace around the 2D shape templates.
3. Work with students to complete the table with the name of each 2D shape, the number of sides and the number of vertices.
4. Work with students to complete the table with the name of each 3D shape, the number of faces, edges and vertices.

## Learning Activity 2 Introducing Students to 3D printing

1. 3D printed objects are created using additive processes. In an additive process, an object is built with layer upon layer of material, until is completed, using 3D printers. The main steps in the 3D printing process are:
  - a. 3D Modelling: Creating a 3D digital model of the object using 3D modelling software.
  - b. Slicing: Slicing the 3D model into several layers using slicing software.
  - c. Printing: The sliced file is printed, layer by layer, by a 3D printer. The following diagram shows the main parts of a 3D printer:

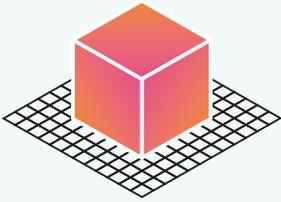
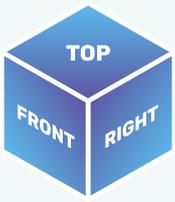
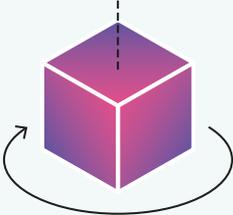


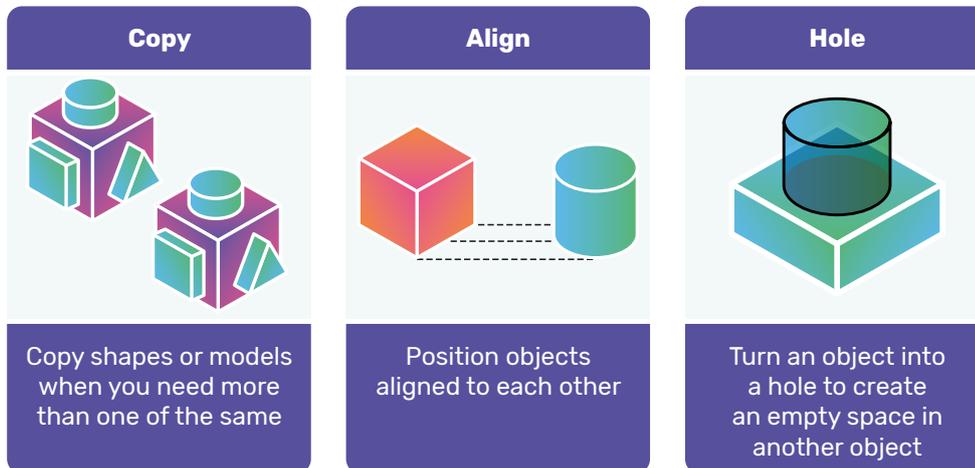
- Extruder: This is the part of the 3D printer that draws the filament, melts it and deposits it onto the print bed.
- Print bed: This is where the models are created. The extruder deposits the filament layer by layer on the print bed until the model is completed.
- Filament: The material used to print objects on this type of 3D printer. The filament is heated to a specific temperature to liquify it before depositing it on the print bed.
- Hot end: This part maintains a temperature greater than the melting point of the filament. The filament is melted in the hot end and comes out of a nozzle for deposition on the print bed.
- Motion components: 3D printers work along the three axes: X-axis, Y-axis and Z-axis. Motion components are the parts in charge of the movement of the 3D printer in the three axes.

**(Optional) Play the following videos to introduce students to 3D printing:**

	
How 3D printers work	Will 3D printing change the world?

2. Go to [www.tinkercad.com](http://www.tinkercad.com)
3. Introduce students to computer-aided design. This activity assumes that the teacher has completed training in 3D printing or has used Tinkercad before. Remember:

<b>Place</b> 	<b>View</b> 	<b>Adjust</b> 	<b>Combine</b> 
Place a shape to add or remove material	View shape from all sides – front, back, right, left, top and bottom	Move, rotate, and adjust shapes freely in space	Group together a set of shapes to create models as detailed as you want



4. Work with the students to complete the "Ruler – cm" project available in Tinkercad.
  - a. Go to [www.tinkercad.com](http://www.tinkercad.com)
  - b. Go to Tinker on the upper bar and click on "Learning Center"
  - c. In the "Learn 3D Design" click View All
  - d. Click "Ruler – cm"
5. Print the ruler for the students!

## Activity Follow-up

- Encourage students to share their experiences with the "Ruler – CM" project.
- Create a class display showcasing the 3D printed models.

### Safety

- Ensure that the 3D printer is used under adult supervision.
- Ensure that the 3D printer is being used in a well-ventilated area.
- Students should not touch the hot extruder or any moving parts of the 3D printer.

### Useful Website

- <https://www.tinkercad.com/>

### Promoting Inclusion

- For students who may struggle with 3D modelling, provide templates or pre-made models for them to customize with Tinkercad. Ensure that all students have access to the necessary equipment and resources.
- Provide additional resources or accommodations for students with special needs, such as audio descriptions or simplified language for the chosen subject and strand.

## Lesson 2 Exploring Ancient Egyptian Structures and Artifacts

This lesson plan should be implemented once the students have completed lesson plan 1 and have learned how to use Tinkercad and the 3D printer.

### Suggested Class Level

Primary school 5th-6th Class

### Content Strands

- History: Early people and ancient society

### Cross-Curricular Links

- Visual Art: designing and creating 3D models
- Technology: using 3D printing technology
- Geography: studying human environments
- Literacy: reading and interpreting hieroglyphics

### Learning Objectives

- Students will learn about the civilization of ancient Egypt.
- Students will understand the use of 3D printing technology in historical education.
- Students will develop 3D modelling skills.
- Students will enhance critical thinking skills through the use of 3D printed artifacts.
- Students will analyse the importance of ancient Egyptian artifacts and art.

### Skills

- Research
- 3D modelling
- Critical thinking
- Artistic expression

### Equipment/Materials Needed

- Cardboard and other appropriate arts materials
- Scissors
- Glue
- 3D printer

- Electronic devices with Tinkercad installed and access to the internet

### Preparation

1. Research the topic and gather images or diagrams of relevant artifacts or structures of ancient Egypt that you like.
2. Create a prototype of an old artifact or structure by cutting and gluing cardboard.
3. Using the cardboard prototype, recreate it in a 3D model using Tinkercad.
4. Test print the model to ensure it is printable and adjust as needed.
5. Print enough copies of the model for each student or pair of students.

### Background Information

Ancient Egypt was a civilization that existed in north-eastern Africa from around 3100 BC to 30 BC. The ancient Egyptians were known for their monumental architecture, hieroglyphic writing system, and art.

They flourished thousands of years ago along the banks of the Nile River. They built incredible structures, leaving behind an extraordinary legacy that still amazes us today. From the mighty pyramids to majestic temples, we will explore the secrets behind these architectural marvels.

Imagine standing in awe of the Great Pyramids of Giza, colossal structures built as burial tombs for powerful pharaohs. Discover how the ancient Egyptians carefully designed and constructed these enormous pyramids, showcasing their incredible engineering skills.

As we venture further, we will unravel the mysteries of magnificent temples like Luxor and Karnak. These temples were not only places of worship but also centres of learning and administration. Learn about the gods and goddesses the ancient Egyptians believed in and the rituals they performed in these sacred spaces.

But our adventure doesn't end with structures alone. The ancient Egyptians were exceptional artists and

craftsmen. We will examine the exquisite artifacts they left behind, from intricately carved statues to beautifully painted burial masks and jewellery. Discover how these artifacts provide us with valuable insights into their daily lives, beliefs, and artistic achievements.

Together, we will learn about the significance of hieroglyphics, the ancient Egyptian writing system, and how it helps us understand their history. We will decode symbols and explore the stories told through ancient Egyptian art.

By delving into the exploration of ancient Egyptian structures and artifacts, we will gain a deeper understanding of this incredible civilization. We will discover how they lived, what they believed, and how their innovations and achievements still influence us today.

So, get ready to embark on a thrilling journey into the world of Ancient Egypt. Let's uncover the mysteries, unlock the secrets, and ignite our curiosity as we explore the wonders of ancient Egyptian structures and artifacts!

## Activity



### Trigger Questions (Engage)

**Spark students' interest by asking them the following questions:**

- What types of artifacts were used in ancient Egypt?
- What are some examples of ancient Egyptian art?
- Which Egyptian structure do you know?
- How can 3D printing technology help us explore and understand ancient artifacts?

## Learning Activity

# 1

1. Introduce the topic of the lesson and show images or diagrams of relevant artifacts or structures from ancient Egypt.
2. Give students time to research ancient Egyptian artifacts or structures and have them pick one structure that they would like to recreate and ask the students to draw a sketch.
3. Work with the students to create a basic structure or the artifact or structure from ancient Egypt using the cardboard.
4. Work with the students to recreate their own 3D printed versions of these artifacts or structures using Tinkercad.
5. Slice the models using Cura and print the models. Options to have the students assist with this or do it overnight.
6. Once the models are printed, ask students to analyse and compare their 3D printed artifacts to real artifacts from ancient Egypt.

## Activity



## Follow-up

- Ask students to write a short summary of their 3D printed artifact and how it relates to ancient Egyptian culture or lifestyle.
- Encourage students to share their 3D printed models and artistic representations with the class.
- Create a class display showcasing the 3D printed models and artistic representations.
- Have students participate in a class discussion about the significance of ancient Egyptian artifacts, structures, and art.

### Useful Websites

- <https://www.tinkercad.com/things/74Mog1eXNLQ>
- <https://www.tinkercad.com/things/I0odDhdeuY7>

### Promoting Inclusion

- For students who may struggle with 3D modelling, provide templates or pre-made models for them to customize with Tinkercad. Ensure that all students have access to the necessary equipment and resources.
- Provide additional resources or accommodations for students with special needs, such as audio descriptions or simplified language for chosen subject and strand.

## Lesson **3** Science - Materials

This lesson plan should be implemented once the students have completed lesson plan 1 and have learned how to use Tinkercad and the 3D printer.

### Suggested Class Level

5th and 6th Class

### Content Strands

- Science: Materials (Properties and characteristics of materials)

### Cross-Curricular Links

- Visual arts: Construction (Making constructions)
- Visual Art: designing and creating 3D models
- Technology: using 3D printing technology

### Learning Objectives

- Identify and describe the properties of different materials.
- Use 3D modelling software to design a simple object.
- Build a physical prototype of their design using cardboard or paper.

### Skills

- Design and making
- Working scientifically
- Communicating and expressing

### Equipment

- Cups made of different materials – glass, plastic, paper, and ceramic.
- Recyclable materials – cardboard, newspaper, cotton balls, tissue or paper towel tubes.
- Craft materials – masking tape, scissors, rulers, cotton string, lollipop sticks, rubber bands.
- Electronic devices with access to the Internet (intermediate level and advanced level).
- 3D printer

- Electronic devices with Tinkercad installed and access to the internet

### Preparation

- Have all the materials and equipment ready for the students.
- Set up the room to allow students to work in pairs or groups.

### Background Information

Materials are substances or compounds that are used to create objects, structures, and products. Different materials have unique properties that make them suitable for various purposes. Some common properties of materials include hardness, strength, elasticity, flexibility, conductivity, and durability. Understanding these properties is essential for engineers and designers who create products and structures.

3D printing and modelling are advanced manufacturing technologies that allow objects to be created in three dimensions using computer-aided design (CAD) software. 3D printing involves creating objects layer by layer using materials such as plastics, metals, and ceramics. 3D modelling involves creating a digital representation of an object that can be viewed and manipulated on a computer screen.

## Activity



## Engage

**Spark students' interest by asking them the following questions:**

- What materials do we use every day?
- Show students different types of cups – paper, plastic, ceramic, glass – and discuss:
  - Which one do they think will last longer?
  - Which one do they think is stronger?
  - Which one do they prefer and why?

## Learning Activity **1** What Is It Made Of? - Starter Activity

- Begin by discussing the importance of materials in our everyday lives.
- Ask students to brainstorm a list of items they use in their everyday lives, the materials they are made and their properties.

## Learning Activity **2** A: Design a Cup - Simple Level

1. Ask students to work in pairs to design their own cups by drawing a sketch.
2. Work with students to build a physical prototype of their design using different recyclable materials such as cardboard, paper, lollipop sticks, and tissue tubes. Remind students to consider the properties of the materials they are using and how they will affect the functionality of their design.
3. After students complete their designs, ask them share with the class and explain their design and materials choices.

## Learning Activity **2** B: Design a Cup - Intermediate Level

1. Ask students to work in pairs to design their own cups by drawing a sketch.
2. Work with students to build a physical prototype of their design using different recyclable materials such as cardboard, paper, lollipop sticks, and tissue tubes. Remind students to consider the properties of the materials they are using and how they will affect the functionality of their design.
3. Work with the students to create a 3D model of their own cups.
4. After students have completed their designs, have them share them with the class and explain their design choices.

## Learning Activity **2** C: Design a Cup - Advanced Level

1. Ask students to work in pairs to design their own cups by drawing a sketch.
2. Work with students to build a physical prototype of their design using different recyclable materials such as cardboard, paper, lollipop sticks, and tissue tubes. Remind students to consider the properties of the materials they are using and how they will affect the functionality of their design.
3. Work with students to create a 3D model of their own cups.
4. Print the 3D models of their cups
5. Conclude the activity by having students present their printed cups to the rest of the class and explain their design process. To close out, ask the students what materials would be best suited for the cups they designed.

**Activity****Follow-up**

- Ask students to bring in an object from home made of a specific material and write a short paragraph explaining why that material was chosen for that object.
- Print out the designs and have students compare the physical object to their digital design.

**Useful Websites**

- You can introduce students to how the different cups are made and discuss where the materials come from. You can use the following videos and articles:

**Paper cup:**

- [How It's Made - Paper Cups - YouTube](#)
- [How Paper Is Made - YouTube](#)
- [How paper cups are made? \(huhtamaki.com\)](#)
- [At our factory: Making of paper cups - YouTube](#)

**Glass:**

- [How is glass made? - YouTube](#)
- [How Glass is Made - YouTube](#)

**Ceramic:**

- [How Are Ceramic Mugs Made? | Australia Online \(planetmugs.com.au\)](#)
- [How Are Ceramic Mugs Mass Produced? - YouTube](#)

**Plastic:**

- [Plastic - Kids | Britannica Kids | Homework Help](#)
- [How Plastic Is Made - YouTube](#)

**Promoting Inclusion**

- Provide extra support and guidance for students who may have difficulty using the 3D printer or modelling software.
- Encourage group work to allow for peer support and collaboration.
- Use visual aids and real-life examples to help students understand the concept of materials.
- Provide written instructions and checklists to assist with task completion.

## Lesson **4** Making 3D Shapes

This lesson plan should be implemented once the students have completed lesson plan 1 and have learned how to use Tinkercad and the 3D printer.

### Suggested Class Level

Primary school 5th-6th Class

### Content Strands

- Mathematics: Shape and Space (3D Shapes)

### Cross-Curricular Links

- Visual Art: designing and creating 3D models, construction (making construction, making prints)
- Technology: using 3D printing technology

### Learning Objectives

- Identify and examine 3D shapes.
- Describe the properties of 3D shapes, including faces, edges, and vertices.
- Explore relationships between 3D shapes.
- Use 3D modelling software or a 3D printer to create 3D shapes.

### Skills

- Applying and problem-solving
- Communicating and expressing
- Integrating and connecting
- Awareness of shape and form

### Equipment/Materials Needed

- Paper and pencils.
- 3D printed shapes (manipulatives of 3D shapes i.e., blocks).
- Playdough (simple level).
- Electronic devices with access to the Internet and Tinkercad (intermediate level).

### Preparation

- 3D print different shapes for students to use during the lesson.

### Background Information

3D shapes are three-dimensional objects that have height, width, and depth. They can be identified by their faces, edges, and vertices. A face is a flat surface in a 3D shape, an edge is where two faces meet, and a vertex is where three or more edges meet. Examples of 3D shapes include cubes, spheres, pyramids, and cylinders.

In 3D printing, a physical object is made from a digital model using 3D shapes. The 3D object is built layer by layer until it is completed.

## Activity Trigger Questions (Engage)

Spark students' interest by asking them the following questions:

- Ask the students to point out differences between real-life objects (e.g., ice cream cone vs tin of beans, dice vs a Pringles tube).
- Ask students why they think objects have different shapes.

## Learning Activity **1** Starter Activity

1. Show students examples of 3D-printed shapes. The complexity of the printed manipulative will depend on the level of the class.
2. Ask students to sort manipulatives and ask them about their reasoning behind the sorting. Emphasise the commonalities and differences between them.
3. Ask students if they know the name of the shapes. Label each of the manipulatives and discuss their features.
4. Have students create their own 3D shapes and label the faces, edges, and vertices.

## Learning Activity **2** A: Simple Level

1. Ask students to work in pairs to create 3D shapes using playdough or any other material available. They should identify and describe the properties of the shapes they create.
2. Conclude the activity by asking students to share their 3D creations with the class and discuss the properties of each shape.

## Learning Activity **2** B: Intermediate Level

1. Have students work in pairs or individually to create their own 3D shapes using Tinkercad. They should identify and describe the properties of the shapes they create.
2. Conclude the activity by having students present their 3D creations, the properties of the shape and the process of creating their 3D shapes.

## Learning Activity **2** C: Advanced Level

1. Ask students to work in pairs to create a 3D model of a chosen object (e.g. pencil, house, pencil holder).
2. Have students identify the shapes used in their 3D model and identify any improvements that could be made.
3. Print the 3D shapes and models and have students examine the physical creations.
4. Conclude the activity by having students present their 3D models to the rest of the class.

## Activity Follow-up

- Ask students to bring in an object from home and identify its 3D shape properties.
- Create a scavenger hunt activity where students have to find 3D shapes around the classroom or school.
- Have students research the use of 3D printing in various industries (e.g. medicine, architecture).

### Useful Websites

- Thingiverse ([Thingiverse - Digital Designs for Physical Objects](#))
- YouMagine ([YouMagine - YouMagine - Where makers collaborate on 3D designs](#))
- Pinshape ([Free 3D Printable Files and Designs | Pinshape](#))

### Promoting Inclusion

- 3D shapes should be made available for tactile exploration.
- Ensure that all the instructions are written on the board or provided in written form.
- Break the lesson into smaller parts and provide frequent breaks.
- Provide clear and structured instructions and allow for extra time for tasks to be completed.
- Allow time to practice handling new equipment.

## Lesson **5** Create a Castle

This lesson plan should be implemented once the students have completed lesson plan 1 and have learned how to use Tinkercad and the 3D printer.

### Suggested Class Level

5th and 6th Class

### Content Strands

- Visual Arts
- History

### Cross-Curricular Links

- Maths: size, shape and measurements
- Science and Technology: 3D Printing technology
- Geography: the local area, castle in the area, evolution of a local area

### Learning Objectives

- Explain the History of the Normans and their castles.
- Understand the features of a Norman Castle.
- Work in groups to complete a project.

### Skills

- Creative Thinking
- Designing
- 3D Modelling
- Research skills
- Teamwork

### Equipment

- Laptop/Tablet with internet access and Tinkercad installed
- Paper
- Pens
- 3D Printer

### Preparation

1. Setup the Tinkercad classroom environment.
2. Ensure 3D Printer is setup and working.
3. Prepare examples of Castles and features of castles from History curriculum.
4. Ensure students have access to drawing material and Tinkercad.

### Background Information

In this lesson the focus will be on creating the features of a castle such as a Norman Castle.

The Normans were descendants of Scandinavian Vikings who settled in Normandy, France. They invaded England in 1066 and a century later they came to Ireland.

The Normans are famous for their castles. Early castles were built mainly of wood on mounds of earth (Motte and Bailey) and then later were rebuilt out of large blocks of stone for increased security. The Norman castle was never just a single building, more of a small village with the main tower (The Keep) overlooking smaller buildings where the workers would live.

The main parts of the castle can be found in the diagram below.

**KEEP**

Strong defensive building – wood or stone

**MOTTE**

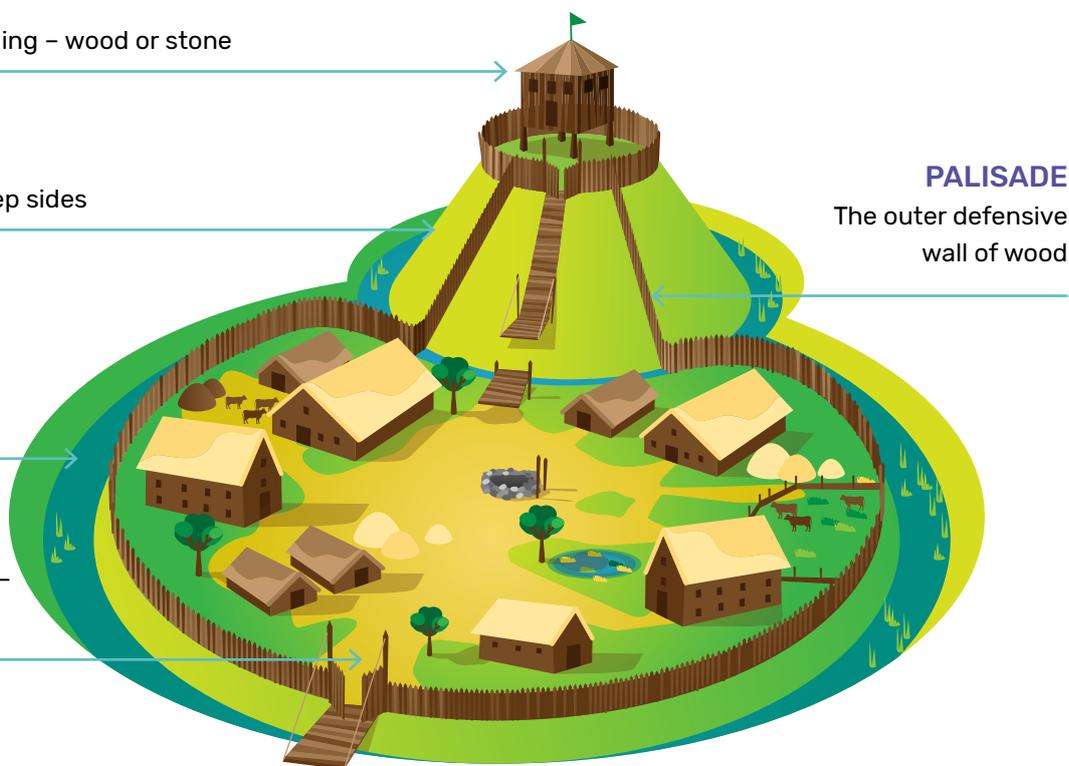
Earth mound with steep sides

**MOAT**

Sometimes a simple ditch, or defensive spikes of water

**BAILEY**

The castle compound – like a small village



**Activity**



Trigger Questions (Engage)

Spark students' interest by asking them the following questions:

- When did the Normans come to Ireland?
- What are the features of a Norman castle?
- Where can you find Norman castles in Ireland?

## Learning Activity

1

## Starter Activity

1. Collaboratively the pupils as a class group will generate a Castle to display within the classroom.
2. Divide the class into 4 groups. Assign each group to create a piece of the castle by drawing it first: the keep, the bailey, the outer wall, the guard tower/drawbridge) using the internet/books as reference.
3. Using these drawings, ask the students to convert them to 3D models using Tinkercad, using basic primitive shapes and modifying them within the platform.
4. Ask the students to record their design process and any design changes that may have been required. Documenting where their ideas came from and how they understood it.
5. Print the finished design.
6. Label each of the different aspects of the castle on the 3D model.
7. Share the finished design with the class and discuss their design process and decision making.

## Activity



## Follow-up

- Students can prepare posters to support the Norman Castle designed, explaining the key features and areas within the model.

## Useful Website

- <https://www.tinkercad.com/>
- <https://www.tinkercad.com/learn>

## Promoting Inclusion

- Tinkercad templates can be developed to ensure all students are able to produce a 3D Model of some description.

## Lesson **6** Make a Local Chess Set

This lesson plan should be implemented once the students have completed lesson plan 1 and have learned how to use Tinkercad and the 3D printer.

### Suggested Class Level

Primary school 5th-6th Class

### Content Strands

- Visual Arts
- History

### Cross-Curricular Links

- Maths: Size, Shape and Measures
- Science and Technology: 3D printing operation
- History: Local history
- Art: Drawing and 3D modelling
- Geography: local area

### Learning Objectives

- Understand the local history and historical features in their area.
- Understand how to convert drawings to 3D Models.
- Research the local area and its history.

### Skills

- Creative Thinking
- Research
- 3D Modelling

### Equipment/Materials Needed

- Laptop/Tablet with internet access and Tinkercad installed
- Paper
- Pens
- 3D Printer

### Preparation

1. Setup the Tinkercad classroom environment.
2. Prepare examples of Castles and features of castles from the History curriculum.
3. Ensure students have access to drawing material and Tinkercad.

### Background Information

In this lesson the focus will be on creating the playing pieces of a chess set, using the local area as an inspiration. The historical features or geography of the area are to be used to create these chess pieces.

There are 6 different chess pieces required to play the game, each group can design and print their own chess pieces that relates to the geography or history of the locality. Groups should be encouraged to research the area, identify possible features to replicate and then as a class develop a local chess set.

The lesson can be further extended beyond chess to other board games.

## Activity Trigger Questions (Engage)

Spark students' interest by asking them the following questions:

- What is the history of our local area?
- What monuments or landmarks are significant to this region?
- What type of pieces are in a chess set?
- What design considerations should we consider for 3D Printing?

## Learning Activity

# 1

1. Introduce the topic of the lesson and get students to identify the following:
  - a. Pieces in a chess set.
  - b. Local historical events or features.
2. Split the class into groups of 3-5 pupils and assign a chess piece to each group.
3. Each group will research their potential chess piece and identify a historical feature to replicate.
4. Each pupil will be assigned or select one of the chess pieces identified to design.
5. Pupils will research local historical people or landmarks.
6. Groups to select/determine what landmark or historical person their chess piece will represents.
7. Pupils using Tinkercad design their chess piece.
8. Once pieces have been designed each group will present their chess pieces to the class describing their design and reasons for selecting them.

## Activity



### Follow-up

- Pupils can prepare a poster on their chosen historical feature that they chose to replicate.
- Class activity can be to complete the local chess set.
- Activity can be extended beyond chess sets to make popular board games more local.

#### Useful Website

- <https://www.tinkercad.com/>
- <https://www.tinkercad.com/learn>

#### Promoting Inclusion

- Templates for Tinkercad can be made available for those groups that may struggle with the 3D Modelling aspect.
- Provide additional resources or accommodations for students with special needs, such as audio descriptions or simplified language for chosen subject and strand.

## Lesson **7** Building with 3D Printing

This lesson plan should be implemented once the students have completed lesson plan 1 and have learned how to use Tinkercad and the 3D printer.

### Suggested Class Level

Primary school 5th-6th Class

### Content Strands

- Visual arts - Construction

### Cross-Curricular Links

- Science and Technology: using machines and software.
- Mathematics: create shapes and use dimensions.
- Language / Arts: learn how to read and present information.

### Learning Objectives

- Understand the basic principles of 3D printing technology and its applications in art and design.
- Develop their ability to design and create 3D objects using 3D modelling software.
- Develop their ability to construct three-dimensional forms using a variety of materials and techniques.
- Analyse and interpret your own and others' artwork.

### Skills

- Design thinking
- Digital literacy

- Fine motor skills
- Critical thinking
- Problem solving

### Equipment/Materials Needed

- 3D printer
- Laptop/Tablet with internet access and Tinkercad installed
- Sandpaper
- Paint
- Markers

### Preparation

1. Create a sample design for the students to view as an example.
2. Prepare background information about 3D printing technology and how it can be used in art and design.

### Background Information

The construction strand emphasizes the ability of students to identify, examine and work with materials and processes in constructing three-dimensional forms. This lesson will introduce students to 3D printing technology, to explore the construction of 3D objects in the context of visual art.

3D printing is a process of creating a physical object from a digital file using a 3D printer. It is a useful tool for artists and designers, as it allows them to easily create and experiment with 3D designs and bring their ideas to life.

## Activity Trigger Questions (Engage)

Spark students' interest by asking them the following questions:

- Can you think of any examples of buildings or structures that could have been constructed using 3D printing technology? What do they look like?
- How do you think 3D printing could be used in construction?
- Have you ever seen a 3D printer making buildings before?
- How could 3D printing be used to create sustainable or environmentally friendly buildings?
- How do you think 3D printing technology could change the way we design and build structures in the future?

## Learning Activity

# 1

1. As the students to work in pairs or small groups to pick a structure or building that they would like to create a draw their design of their construction.
2. Work in pairs or small groups to design their own constructions using 3D shapes using Tinkercad.
3. Print their designs using the 3D printer.
4. Finish their 3D prints using sandpaper, paint, markers or other materials as desired.
5. Share their finished prints with the class and discuss their design process and inspiration.

## Activity



## Follow-up

- Have students write a reflection on their experience using 3D printing technology in art and design.
- Have students create a collaborative sculpture using the 3D prints as building blocks.
- Have students research and present on the different materials that can be used for 3D printing.

### Useful Website

- <https://www.tinkercad.com/>
- <https://www.dezeen.com/2018/04/12/emerging-objects-3d-printed-backyard-cabin-tiles-succulents-oakland-california/>
- <https://www.archdaily.com/794855/urban-cabin-dus-architects>
- <https://www.aispacefactory.com/marsha>
- <https://www.dezeen.com/2021/07/19/mx3d-3d-printed-bridge-stainless-steel-amsterdam/>

### Promoting Inclusion

- Allow for different learning styles by offering visual and hands-on learning opportunities.
- Encourage teamwork and collaboration.
- For students who may struggle with 3D modelling, provide templates or pre-made models for them to customize with Tinkercad. Ensure that all students have access to the necessary equipment and resources.
- Provide additional resources or accommodations for students with special needs, such as audio descriptions or simplified language for chosen subject and strand.

## Lesson 8 Visual Arts – Creating 3D Artworks

This lesson plan should be implemented once the students have completed lesson plan 1 and have learned how to use Tinkercad and the 3D printer.

### Suggested Class Level

Primary school 5th–6th Class

### Content Strands

- Drawing
- Visual arts

### Cross-Curricular Links

- Mathematics: using measuring tools and understanding scale.
- Science and technology: understanding the technology behind 3D printing.

### Learning Objectives

- Use 3D modelling software to create a 3D artwork.
- Incorporate elements of drawing (line, shape, form) into a 3D artwork.
- Experience the process of 3D printing for visual arts.

### Skills

- Creative thinking
- Problem-solving
- Spatial awareness
- Visualization
- Digital literacy
- Fine motor skills

### Equipment/Materials Needed

- 3D printer
- Laptop/Tablet with internet access and Tinkercad installed
- Paper
- Pencils
- Rulers and measuring tools

### Preparation

1. Prepare examples of 3D artworks to inspire students
2. Ensure students have access to paper, pencils, rulers and measuring tools

### Background Information

This lesson will introduce students to the basics of 3D printing and how it can be used in the context of visual art. Imagine being able to create your very own three-dimensional masterpieces that you can touch and hold in your hands.

In this lesson, the focus will be on creating 3D artworks that incorporate elements of drawing, such as line, shape, and form. Students will learn how to use a simple 3D modelling software to design their own 3D artworks, which will then be printed on a 3D printer.

So, what exactly is 3D art, and how do we bring it to life? 3D art is like regular art but with a magical twist. Instead of drawing or painting on a flat surface, we will use special computer software called 3D modelling software to sculpt and shape our creations in the digital world. It's just like moulding clay or building with blocks, but in a virtual space!

Once we have crafted our 3D designs using the computer, we will use 3D printing technology to turn our digital creations into physical objects. Imagine having your artwork transformed from a computer screen into a real, tangible sculpture that you can hold in your hands – it's like bringing dreams to life!

Through this class, you will learn how to design your own 3D artworks step by step. We will start with simple shapes and gradually move on to more complex designs, giving you the chance to let your creativity soar. Along the way, we'll also learn about important design principles, such as balance, symmetry, and harmony, which will help make your 3D creations even more amazing.

So, get ready to unleash your imagination and dive into the world of 3D art. Let's embark on this creative adventure together and see the art unfold as we turn our ideas into reality through the wonders of 3D modelling and 3D printing!

## Activity



### Trigger Questions (Engage)

Spark students' interest by asking them the following questions:

- What is 3D printing?
- How do you imagine a 3D printed artwork?
- How can we use 3D printing in visual art?
- Can we consider a 3D printed product as an artwork?

## Learning Activity

### 1

1. Show examples of 3D artworks.
2. Ask the students to brainstorm ideas for 3D artworks using paper and pencils. Encourage students to incorporate elements of drawing into their designs.
3. Ask students to create their own 3D artworks in Tinkercad.
4. 3D Print out the 3D artworks.

## Activity



### Follow-up

- Have students display the 3D artworks in a class exhibition.
- Have students reflect on the process of creating a 3D artwork and the challenges involved.
- Have students explore other applications of 3D printing in different subject areas.

### Useful Website

- <https://www.sculpteo.com/blog/2018/05/29/top-6-of-the-best-3d-printed-art-projects/>
- <https://www.3dnatives.com/en/top-10-3d-printing-art-141020174/>
- <https://formlabs.com/eu/blog/3d-printed-art/>
- <https://weareprintlab.com/blog/5-steps-to-creating-beautiful-visuals-in-tinkercad>
- <https://www.instructables.com/3D-Geometric-Art-Impression-Tile-Tinkercad-Scratch/>

### Promoting Inclusion

- Provide support for students who may have difficulty with spatial awareness and visualization
- Encourage collaboration among students to help each other with the 3D modelling software
- Provide alternative methods of creating a 3D artwork for students who may have difficulty with fine motor skills

## Lesson 9 Local Buildings and Landscapes

This lesson plan should be implemented once the students have completed lesson plan 1 and have learned how to use Tinkercad and the 3D printer.

### Suggested Class Level

Primary school 5th-6th Class

### Content Strands

- Geography: Human Environments
- Visual arts: Designing and Making

### Cross-Curricular Links

- Mathematics: using measuring tools and understanding scale.
- Science and technology: understanding the technology behind 3D printing.
- History: Continuity and change overtime; local studies.

### Learning Objectives

- Identify local buildings and landscape
- Explain how the landscape or building is being used now and in the past by humanity
- Design a replica of a landscape or building which can be found in your local area

### Skills

- Creative thinking
- Problem-solving
- Spatial awareness
- Visualisation
- Digital literacy
- Fine motor skills

### Equipment/Materials Needed

- 3D printer
- Laptop/Tablet with internet access and Tinkercad installed
- Paper
- Pencils
- Rulers and measuring tools

### Preparation

1. Prepare examples of buildings and landscapes that can be shown to the students for inspiration
2. Ensure students have access to maps or images of the local surroundings

### Background Information

In this lesson, the students will learn about buildings and landscape within their local surroundings.

The students will research their local community to identify key characteristics of their local community.

Most towns in Ireland developed from Celtic Monasteries or Norman and Viking settlements. Often towns were built around a focal point (a monument, monastery, church, or a landlord's house) with the market square becoming a focal point for the development of the street network that would intersect with the main square. Towns usually grew due to their being a cattle mart or market, waterways and ports and later due to the addition of canals and railroads.

Most Irish towns still show a lot of these initial features of establishment and growth.

In this lesson the students will explore their local areas for key landmarks, buildings or landscapes that have or had a significant impact on their local area.

## Activity



### Trigger Questions (Engage)

Spark students' interest by asking them the following questions:

- What are some interesting buildings or places that you know around this area?
- What is the purpose of the building or natural environment?
- Was the purpose of the building or natural environment different in the past?
- Can you describe what the building or natural environment looks like?

## Learning Activity

### 1

1. Ask the students to work in groups of 4 or 5 to research buildings and landscapes in their local area, what they are used for, has that changed throughout history? Ask each group to pick one that they would like to learn more about.
2. Ask each group to draw a model of the building or landscape that they have picked, ask the students to identify some of the basic shapes that are needed to create this building or landscape (spheres, pyramids, cubes etc.). Use geometric solids to help if needed.
3. Create a 3D design of the building or landscape in Tinkercad
4. 3D Print out the building or landscape.

## Activity



### Follow-up

- Display the buildings or landscapes. Ask the students to build the display based on where the buildings/ landscapes are located in their local area.
- Have students reflect on the process of creating the model and the challenges involved.

#### Useful Website

- <https://www.theirishroadtrip.com/famous-landmarks-in-ireland/>
- <https://theboutiqueadventurer.com/famous-ireland-landmarks/>
- <https://www.thingiverse.com/thing:3241021/files>
- <https://www.3erp.com/blog/how-3d-printing-helps-reconstruct-historical-artifacts/>

#### Promoting Inclusion

- Provide support for students who may have difficulty with spatial awareness and visualization for example by providing a model already partially built
- Encourage collaboration among students to help each other with the 3D modelling software
- Provide alternative methods of creating a model for students who may have difficulty with fine motor skills
- Use geometric solids to help students understand how shapes make up buildings and landscapes

## General Debrief Activity for 3D Printing Lessons

### Suggested Class Level

All levels

### Background Information

The objective of this peer-to-peer experience review activity is to provide primary school students with an opportunity to engage in a collaborative evaluation of a 3D printing lesson. Through this activity, students will actively participate in the assessment of their learning experience, share feedback, and contribute to the enhancement of the lesson for future students.

This feedback will be also interesting for the Taiscéaláí project team to improve into the lesson creation.

### Materials Needed

1. 3D printing lesson materials (provided by the teacher)
2. 3D printed objects created during the lesson
3. Writing materials (pens, markers, sticky notes, etc.)
4. Evaluation rubric (TBC)

### Activity Plan

#### Introduction (10 minutes):

1. Begin the activity by introducing the concept of peer-to-peer review and its purpose.
2. Explain that the students will be reviewing a 3D printing lesson they have recently completed and will have the opportunity to provide constructive feedback to improve the lesson.

#### Exploration and Reflection (30 minutes):

1. Provide the students with the 3D printing lesson materials and the objects they have created during the lesson.
2. Encourage students to explore and interact with the objects, recalling their experiences during the lesson.
3. Ask students to reflect individually on their learning process and jot down their thoughts, both positive aspects and areas for improvement.

#### Peer Discussion and Feedback (40 minutes):

1. Divide the students into small groups of 3-4 students each.
2. Instruct the groups to share their experimentations, mistakes and experiences related to the 3D printing lesson.
3. Encourage students to provide specific examples and write it down in a sticky note to evidence to support their feedback.
4. Remind students to be respectful and constructive while offering suggestions and recommendations.

#### Group Presentation and Synthesis (30 minutes):

1. Bring the students back together as a whole group.
2. Ask each group to nominate a spokesperson who will present their group's feedback and recommendations to the entire class.
3. Allow time for questions and discussions after each presentation to promote an interactive learning environment.
4. Facilitate a class-wide discussion to synthesize the feedback and identify common themes or areas for improvement.

#### Action Plan and Implementation (20 minutes):

1. Based on the feedback and recommendations from the peer review, guide the students in creating an action plan to improve the 3D printing lesson.
2. Encourage students to identify specific changes or additions they believe will enhance the learning experience.
3. Discuss the feasibility of implementing the suggested improvements and assign responsibilities to students or groups who are interested in contributing to the enhancements.

#### Reflection and Conclusion (10 minutes):

1. Conclude the activity by allowing students to reflect on their participation in the peer-to-peer experience review.
2. Ask students to share their insights, lessons learned, and how they believe this activity can benefit their future learning experiences.

### Evaluation Rubric Proposal

This template will help to get an accurate validation of the 3D printed examples.

Feature	Excellent	Good	To improve
Quality			
Aesthetic			
Geometry			
Form			
Design			
Creativity			
Fabrication efficiency			



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