



# Make a 3D Contour Model

## **Teacher's Guide**

# Lesson Introduction

In this lesson students will collaboratively design and 3D print a 1:50,000 scale model of Mount Everest and its surroundings. The lesson involves mathematical calculations along with CAD design tasks, mapping skills and 3D printing.

The lesson can be incorporated into the study of mathematics, geography, design technology or ICT and can be adapted for ages 7-15.

The process begins with a short presentation and discussion session, where the teacher will give an overview of topography maps and 3D printing. This will then be followed by the main part of the lesson - the student workbook. Each student will use 3D CAD software to design a section of the contour model and prepare it for 3D printing, whilst the teacher acts as a facilitator in assisting the students.

The final stage will be a 3D printing demonstration of one section of the contour model. Following the lesson, the teacher can send all models to the 3D printer to complete the 3D contour model.

**\*\*the data for the contour model was taken from Google Maps, therefore the scale is an approximation\*\***

# Learning Criteria

In this lesson students will:

- develop contextual knowledge of topographic maps and contours
- understand how geographical features are represented on maps
- develop an understanding of 3D printers, how they operate and how they are used in various industries
- use mathematical calculations to determine the size that a 3D contour model should be at the scale 1:50000
- communicate geographical information using CAD software and 3D printing

# Equipment List

## **Each student will require:**

1 x laptop/computer with mouse preloaded with Sketchup Make 2017 software (free download from <https://www.sketchup.com/>). You will also need the SketchUp STL Plugin and Solid Inspector 2 plugins installed. To install the plugins, open SketchUp and go to window > extension warehouse and search for SketchUp STL. Then follow the onscreen instructions to install. Repeat for Solid Inspector 2.

1 x pen/pencil

1 x 30cm ruler

1 x calculator

## **The teacher will require:**

1 x screen for presentation

1 x 3D printer and PLA filament

1 x laptop/computer preloaded with slicing software for your 3D printer

# Lesson Format

**Presentation/  
Discussion**

10 mins

**Student  
Workbook**

35 mins

**3D Printing  
Demonstration**

15 mins

# Lesson Preparation

Before the lesson, make sure all laptops/ computers have Sketchup Make 2017 with the SketchUp STL and Solid Inspector 2 plugins installed. Print out the 16 contour sheets (make sure when you print, you select “actual size” and not “fit to page”) and save the 16 contour sketches to your school’s server so they can be accessed by the students during the lesson. Request that your students bring a pen/pencil, ruler and calculator to the lesson.

Set up your classroom for the initial ten minute presentation. Load the presentation file in this lesson pack onto the screen.

At the start of the lesson, hand out a different contour sheet and student workbook to each of your students. There are 16 contour sheets so if you have more than 16 students, you can print out the same contour sheets more than once and hand them out (the important thing is that we design at least 1 of each of the 16 contour sheets).

Make your students aware of the folder on the school’s server where the contour sketches are saved (these files will be used during the student workbook section of the lesson).

# Part 1: Presentation

**Look through the “Presentation” file in the lesson pack.** The presentation should last approximately 10 minutes and is intended to incorporate group discussions around topography and 3D printing. You can expand on the text in the presentation in any way you wish - here are some points you may want to use:

**Presentation/  
Discussion** 10 mins

1. In the section what is a contour line, see if your students know what the numbers represent. The number represent the height in metres above sea level - discuss what this means.
2. In the section who might use a map with contour lines, talk about how geologists, engineers and architects might use contour lines in their work.
3. In the section our 3D contour model will be to the scale 1:50,000, talk about how scale bars are used on maps and how they help map readers.
4. In the section then we are going to 3D print everyones design, talk through the components of a 3D printer. You can use your 3D printer and point out the various parts and talk about how they work.
5. In the section 3D printing has many benefits, talk about how 3D printing can be used to print low cost prosthetics that fit a patient perfectly when combined with 3D scanning technologies.

# Part 2: Student Workbook

**Look through the “Student Workbook” file in the lesson pack.** Upon completion of the presentation, students will go through this workbook to design their section of the 3D contour model. They will use the contour sketch files in this lesson pack as the base of their design and their task is to extrude surfaces to create their 3D model. Remember to make them aware of the folder on the school’s server where they can find contour sketches that match the title of their contour sheet. Let them know that they can also save their designs to this same folder.

You will act as the facilitator during this section of the lesson, moving around the classroom assisting students. To enable you to support your students, it may be worthwhile going through the workbook yourself before the lesson. This will ensure you know the steps in the workbook to help your students. If you are unsure about any of the steps, send an email to [hello@weareprintlab.com](mailto:hello@weareprintlab.com) and we’ll be happy to assist.

At the end of this section, each student will have designed a section of the 3D contour model and exported an STL, ready to upload to your slicing software. Students that finish the workbook early are also given the opportunity to design additional features for the model such as 3D text or a scale bar.

**Student  
Workbook**

35 mins



# Part 3: 3D Printing

The final part of the lesson involves a 3D printing demonstration by the teacher. At this stage you should have 16+ STL files designed by your students.

Pick one STL and demonstrate the following to your students:

1. how to upload files into the slicing software
2. basic slicer settings (e.g. print speed, layer height)
3. how to save the GCode

We recommend that you use PLA filament, a layer height between 0.1-0.2mm and a print speed between 30-60mm/s depending on the capabilities of your 3D printer. If you require additional advice, get in touch at [hello@weareprintlab.com](mailto:hello@weareprintlab.com).

Finally, set your 3D printer going and talk through the 3D printing process.

After the lesson has finished you can send the rest of the STL files to print. Load as many as you can onto the build plate in your slicer so you don't have to print 16+ separate files.

**3D Printing  
Demonstration**

15 mins