2D Map to 3D Model
Teacher's Guide

PrintLab

Lesson Introduction

The 2D Map to 3D Model lesson is an extension of our first contour lesson plan, Make a 3D Contour Model. It differs because the project involves the additional step of tracing a 2D contour model and a more advanced software package is used. It is advised to go through the Make a 3D Contour Model lesson prior to this lesson if you are a beginner to 3D printing. To access the first lesson, head to this link: bit.ly123-idlk

In this lesson teachers and students can collaboratively design and 3D print a contour model of their chosen area to the size and scale of their preference. The software package used is Fusion 360, an innovative product development tool used by industry professionals. The software is free for educators and students and consists of a broad range of design tools. For the purpose of this lesson we will only use a small selection of the tools available and if you want to progress further with the software, we highly recommend this online course by HoneyPoint3D: http://bit.ly/2oc2Xye.

The lesson can be incorporated into the study of mathematics, geography, design technology or ICT and can be adapted for ages 9+. The lesson should last between 1-2 hours so if your classes last 1 hour each, it is best to spread the lesson over 2 hours.

The process begins with a group discussion between the teacher and students, where they will analyse their 2D contour map before using various calculations to decide the scale required for the model. There are a range of contour maps to choose from and if teachers would like to select a different location, they simply need to request a map from PrintLab.

The main part of the lesson involves students working through their project workbook to design the 3D model on CAD software. Each student will be allocated a different section to design and prepare for 3D printing. In this section of the lesson 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.

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 and scale the 3D contour model will be

- communicate geographical information using CAD software and 3D printing

Equipment List

Each student will require:

1 x laptop/computer with mouse preloaded with Fusion 360 software (free download from http://autode.sk/1rJXikv)
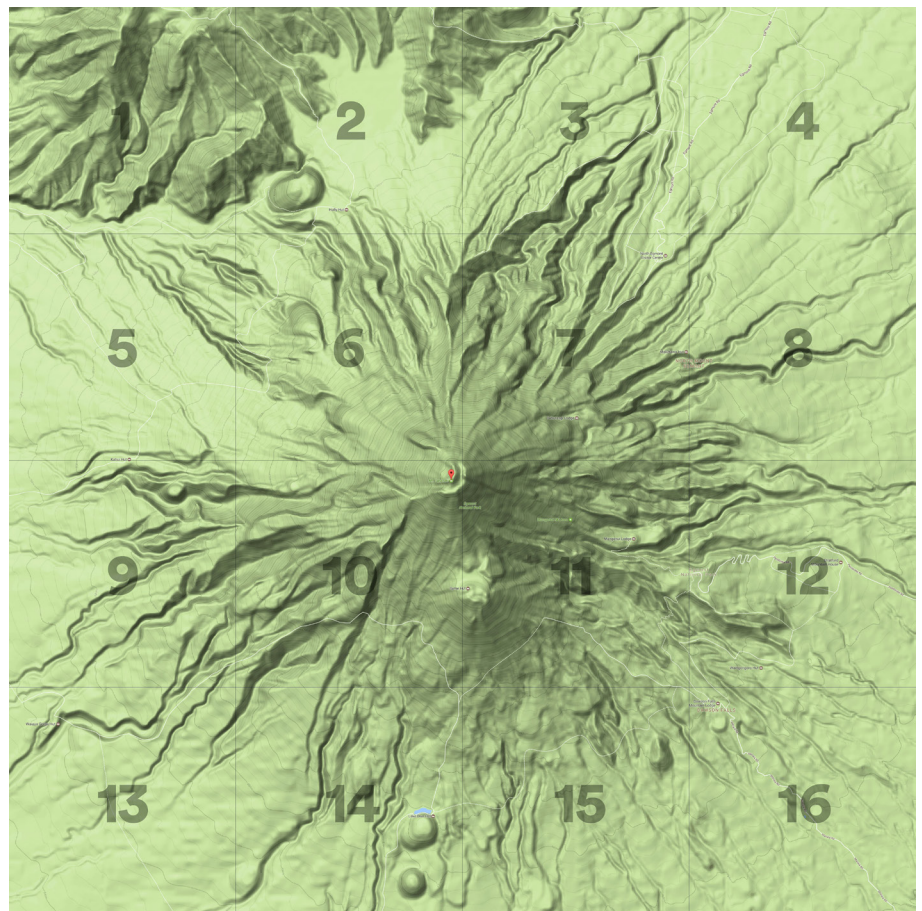
1 x pen/pencil

1 x calculator

The teacher will require:

1 × 2D Contour Map of their choice (see next page)

1 × 3D printer and PLA filament

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

Lesson Preparation

First of all you will need to obtain a 2D contour map image split up into sections like the above image. The image was created using google maps terrain view and photoshop. It is a large image and when you zoom in contours and contour labels can be seen. There are several examples in this lesson pack you can use and if you want an image like this creating for a different location, simply send an email to hello@weareprintlab.com stating the area of your choice. Please allow us a 1 week period to create your image.

Lesson Format

Before the lesson, make sure all laptops/ computers have Fusion 360 installed and are turned on. Save your chosen 2D contour map image provided by PrintLab to your school's server so it can be accessed by students during the lesson. Request that your students bring a pen/ pencil and calculator to the lesson.

At the start of the lesson hand out a student workbook to each student and ask them to open up the contour map image on their laptop/ computer. Any photo viewing software can be used for the first section of the lesson.

Group Discussion & Calculations

Student Workbook

3D Printing Demonstration

Part 1: Group Discussion/ Calculations

In the group discussion/ calculations section, each student and the teacher should have the contour map image open on their computers. The purpose of this section is to teach general information about contour maps and to determine the size and scale that you will create your 3D contour model.

Here are the steps to teaching this section:

1. Explain to the students that they will be collaboratively creating a 3D printed contour model by tracing a 2D contour map image before extruding it to become a 3D model.

2. In an informal discussion format, ask students questions about contour maps. Some you may wish to consider are:
- what do contour lines represent?
- how can you determine where the steepest parts of the topography are?
- why do you think the area of each contour gets smaller as the elevation gets higher?
- what are map scales and how do they work?

3. Tell students to open up their workbook to the first page titled "Analyse your Contour Map". Go through each question as a class and encourage students to openly contribute their thoughts and ideas. As you go through the questions, students should write down the answers in their workbook. Turn to the next page titled "Scale Calculations" and work through this is a class.

4. Finally, allocate a section of the contour map image to each student.

Group Discussion & Calculations

Part 2: Student Workbook

Upon completion of the group discussion and calculations, the class will now have determined some important values needed to design their 3D model. They can now go through the rest of their workbook individually.

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 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. Some students may finish their contour model much sooner than others. This is because each section has a different number of contours on and some may only have a few to trace. Students that finish the workbook early are given the opportunity to start a YouTube Tutorial where they will design a 3D printable lampshade.

Student Workbook

Part 3: 3D Printing

The final part of the lesson involves a 3D printing demonstration by the teacher. At this stage you should have a series of 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.

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