# **Lesson 4: Making holes**

## Introduction

In this lesson, learners will produce a 3D model of a pencil holder desk tidy. The 3D model will contain a number of 3D objects of specific dimensions, and will use other 3D objects as placeholders, to create holes with them.

## Learning objectives

To identify that physical objects can be broken down into a collection of 3D shapes

* I can identify the 3D shapes needed to create a model of a real-world object
* I can create digital 3D objects of an appropriate size
* I can group a digital 3D shape and a placeholder to create a hole in an object

## Key vocabulary

Dimensions, placeholder, hole, group, ungroup

## Preparation

**Subject knowledge:**

You will need to be familiar with resizing 3D objects to specific dimensions in Tinkercad. Tinkercad’s ‘Size it up!’ tutorial provides a good starting point: <https://www.tinkercad.com/learn/designs>.

In order to use other objects as placeholders to create holes within 3D objects, 3D shapes need to be grouped. The ‘Group it!’ tutorial provides further information: <https://www.tinkercad.com/learn/designs>.

**You will need:**

* [Slides](https://ncce.io/cm6m-4-s) (ncce.io/cm6m-4-s)
* Activities:
  + [A1 3D objects with specific dimensions handout](https://ncce.io/cm6m-4-a1-r3) (ncce.io/cm6m-4-a1-r3)
  + [A2 Pencil holder dimensions handout](https://ncce.io/cm6m-4-a2-rp) (ncce.io/cm6m-4-a2-rp)
  + [A2 Exploratory task handout](https://ncce.io/cm6m-4-a2-re) (ncce.io/cm6m-4-a2-re)
  + [A2 Example of a basic pencil holder resource](https://ncce.io/cm6m-4-a2-ra) (ncce.io/cm6m-4-a2-ra)
  + [A2 Example of an advanced pencil holder resource](https://ncce.io/cm6m-4-a2-rb) (ncce.io/cm6m-4-a2-rb)

## Assessment opportunities

* **Activity 1:** Provides an opportunity for learners to demonstrate their ability to resize shapes to specific dimensions
* **Activity 2**: Provides an opportunity for learners to show their ability to produce a 3D model based on a physical object

## Outline plan

Please note that the slide deck labels the activities in the top right-hand corner to help you navigate the lesson.

*\*Timings are rough guides*

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| **Introduction**  (Slides 2–3)  5 mins | Show learners the objectives and explain that in this lesson they will be creating a 3D model of an object to a given specification.  Show slide 3. Explain to the learners that we will be producing a model of a pencil holder desk tidy, which needs to be of a specific size in order to ensure all stationery will fit into it. Outline that we often use the term ‘dimensions’ to specify the measurements of a 3D shape. |
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| **Activity 1**  (Slides 4–7)  15 mins | **Measurements in Tinkercad**  Display slide 4 and show the learners that in Tinkercad, measurements are displayed in millimetres. Explain that the small squares on the workplane are 1 mm by 1 mm in size, while the larger squares, with a thicker outline, are 10 mm by 10 mm. Remind the learners that 10 mm is the same as 1 cm.  Show slide 5. Explain that Tinkercad displays a 3D shape’s dimensions when resizing the object, also in millimetres. Outline that only the dimensions that are currently being altered are displayed. Ask the learners:   * What does 42.00 mean? How about 34.00? (The length and width of the side in millimetres.) * Could you estimate the 3D shape’s dimension without resizing it? (Count the larger squares to estimate to the nearest 10 mm.) * How could you view the height of the 3D shape? (Change the viewing angle.)   Show slide 6. Show the learners that when lifting objects, the distance from the base, or workplane, is also shown. This can also be useful when placing 3D objects next to each other.  Display slide 7. Explain to the learners they are going to experiment with creating shapes with specific dimensions. Ask the learners to view the Activity 1 handout and to create the 3D shapes outlined with the dimensions specified. |
| **Activity 2**  (Slides 8–12)  20 mins | **3D objects as placeholders**  Explain to the learners that a 3D object can be used to create a hole in another 3D object; this is known as a placeholder. Outline that a placeholder enables us to use a 3D object to reserve a space within another 3D object. If appropriate, remind the learners that when they learnt about desktop publishing in Year 3, they also used placeholders to reserve space for content.  Show slide 8. Discuss how the 3D objects on the slide have been created by placing a solid 3D object on the workplane, followed by placing a ‘hole’ 3D object overlapping it. Explain that many objects we use every day are hollow and therefore contain a hole, such as baked bean tins, money boxes, and pencil cases.  Ask learners what 3D shapes have been placed together to create the 3D objects on the slide, which are (from left to right):   * A cylinder combined with a hole cylinder * A cube combined with a hole cylinder * A cube combined with a hole cube   Display slide 9. Explain to the learners that we can produce a pencil holder by using 3D objects as placeholders to create holes in other 3D objects. Show them the various dimensions for part of the pencil holder’s base and explain that the video on the next slide will show how to combine two cylinders to create a 3D model of the base.  **Note:** There is a two-millimetre difference between the distances in the first image, as the pencil holder’s plastic is one mm thick on each side.  Show the learners the video (slide 10). Emphasise that the solid 3D object needs to be grouped with the hole 3D object in order for the space within the 3D object to be created. Explain that this makes the solid 3D object and the hole 3D object behave as a single 3D object. If appropriate, remind learners that they previously grouped objects when producing 2D drawings in the unit on vector drawings.  Demonstrate the process of grouping a solid and a hole 3D object, as shown in the video. Show slide 11 and ask the learners the following questions, giving an appropriate demonstration as required:   * What happens when you try to move grouped 3D objects? (They move as a single 3D object.) * Can grouped 3D objects be moved in the same way as ungrouped 3D objects? (Yes.) * Once 3D objects have been grouped, can they be ungrouped? (Yes, using the **Ungroup** button.) * How can you alter the size of a hole in a solid 3D object? (Ungroup the 3D objects, alter the size of the hole 3D object, and group the 3D objects again.)   Show slide 12. Explain to the learners that they are now going to create a 3D model of a pencil holder, which should be made to the dimensions shown on the activity sheet. Ask them to discuss how they will create the 3D model and the 3D objects they will use.  **Note:** Learners can use the Activity 2 handout to view the dimensions of each cylinder more clearly. Examples of completed pencil holders can be found in the ‘You will need’ section.  **Exploratory task:** Learners can use the Exploratory task Activity 2 handout to create further cylinders as part of their 3D model. |
| **Plenary**  (Slide 13)  5 mins | **Identifying 3D shapes**  Explain to the learners that the pencil holder was made up of many cylinders, although other real-world objects are often made up of many different 3D shapes, which need to be put together to create a 3D model.  Ask the learners to discuss the 3D shapes contained within the object, which include cuboids, spheres, and cylinders. |
| **Next time**  (Slides 14–15)  5 mins | Review the ‘Assessment’ and ‘Summary’ slides. |

This resource is available online at [ncce.io/cm6m-4-p](http://ncce.io/cm6m-4-p). Resources are updated regularly — please check that you are using the latest version.

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