# Percentages and cylinders

Students investigate cylindrical food in cylindrical jars to consolidate calculating the volume of a cylinder and revisit percentages.

## Visible learning

### Learning intention

* To be able to solve problems involving cylinders.

### Success criteria

* I can calculate the volume of a cylinder.
* I can calculate a percentage of a volume.

### Syllabus outcomes

A student:

* develops understanding and fluency in mathematics through exploring and connecting mathematical concepts, choosing and applying mathematical techniques to solve problems, and communicating their thinking and reasoning coherently and clearly **MAO-WM-01**
* applies knowledge of volume and capacity to solve problems involving right prisms and cylinders **MA4-VOL-C-01**

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Table 1: lesson summary

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| --- | --- | --- | --- |
| Section | Summary of activity | Teaching strategies | Teaching points |
| **Launch** | Students guess how many cylindrical chocolate treats are in a jar, shown on slide 3 of the PowerPoint *Percentages with cylinders* (PWC PPT)*.* Students are given the dimensions of the jar (height = 16 cm, diameter = 13 cm) and the cylindrical chocolate treats  (height = 3 cm, diameter 0.6 cm) and asked to refine their guess each time. | Mini whiteboards  Turn and talk | This section aims to start students thinking about cylindrical items in cylindrical containers. |
| **Explore** | Students learn why jars and cans are cylindrical ([bit.ly/cannedcylinders](https://bit.ly/cannedcylinders)) before finding as much information as they can about cylindrical food products and their containers in [Appendix A.](#_Appendix_A_–) Students reflect on what they expect to see when opening a can or jar, and how this affects the percentage of food contained in the can. Students investigate 2 different products. | Pose-Pause-Pounce-Bounce  Goal free problems  Visibly random groups of 3  Gallery walk  Vertical non-permanent surfaces | The purpose of this section is to have students calculate the volume of different food containers and the volume of the food products they hold. Students should start to think about the logistics of packing food into containers. |
| **Summarise** | The percentage of food in each tin is revealed (slide 5 of the PowerPoint) and students revisit their products to calculate how many of each item are in the containers. | Pose-Pause-Pounce-Bounce  Think-Pair-Share | Students calculate percentages and use this to calculate the number of each product in the can or jar. |
| **Apply** | Students apply their knowledge of packing cylindrical items into cylindrical jars to refine their estimate of the number of cylindrical chocolate treats that are in the jar from slide 3. Students learn there are 521 treats in the jar and use this number to calculate the percentages. | Turn and talk | Students apply their knowledge to calculate the percentage of the volume for a different scenario. |

## Activity structure

Please use the associated PowerPoint *Percentages with cylinders* (PWC PPT) to display images in this lesson.

### Launch

1. Display slide 3 of the PowerPoint (PWC PPT) and ask students to guess how many cylindrical chocolate treats are in the jar. Have students record their estimates on mini whiteboards ([bit.ly/miniwhiteboards](https://bit.ly/miniwhiteboards)).

An alternative to using the PowerPoint slide would be to create a jar of cylindrical items and ask students to guess how many are in the jar.

1. Inform students that the jar is 16 cm high and has a diameter of 13 cm and ask if this changes their answer. Give students time to create a new estimate and record it on their mini whiteboards.
2. Ask students to turn and talk ([bit.ly/classroomtalkmoves](https://bit.ly/classroomtalkmoves)) about how the measurements changed their estimate.
3. Inform students that each chocolate treat is about 3 cm long and has a diameter of 6 mm. Again, ask them if this changes their estimate and record it on their mini whiteboards.
4. Ask students to turn and talk about how the measurements changed their estimate.
5. Tell students we will be revisiting the jar of treats later in the lesson.

### Explore

1. In a Think-Pair-Share ([bit.ly/thinkpairsharestrategy](https://bit.ly/thinkpairsharestrategy)), ask students to consider ‘Why are jars and cans cylindrical in shape?’

Students previously discussed reasons for cylindrical packaging in Lesson 1 – prisms and cylinders.

1. Assign students to visibly random groups of 3 ([bit.ly/visiblegroups](https://bit.ly/visiblegroups)) at vertical non-permanent surfaces ([bit.ly/VNPSstrategy](https://bit.ly/VNPSstrategy)).
2. Display the article ‘Scientific reasons canned goods are always cylindrical’ ([bit.ly/cannedcylinders](https://bit.ly/cannedcylinders)) and read the first 2 paragraphs to students.
3. Leaving the article on display, have students write the mathematical terminology used in the article on their vertical non-permanent surfaces.
4. Choosing non-volunteer students from around the room, ask students to define one of the terms their group identified. Continue until students cannot identify any more terms.

Terms include ‘cylindrical’, ‘cross-section’, ‘spherical’, ‘elongated’, ‘cube’.

1. Distribute a canned good from Appendix A ‘Different cylindrical products’ to each group and have them find as much information as they can using the dimensions provided.

Appendix A should be cut into cards prior to the lesson.

Students should be able to find the volume of each can or jar, the volume of the food product and the number of goods that will fit into each.

1. Allow students time to do a gallery walk ([bit.ly/DLSgallerywalk](https://bit.ly/DLSgallerywalk)) to observe other group’s work before returning to their vertical non-permanent surface to calculate more information.
2. Distribute a different canned good from Appendix A to each group and have them find out as much information as they can using the given dimensions.
3. Once students have completed 2 different products from Appendix A, use the Pose-Pause-Pounce-Bounce questioning strategy (PDF 557 KB) ([bit.ly/posepausepouncebounce](https://bit.ly/posepausepouncebounce)) to discuss:

* What do you expect to see when you open the can or jar?
* What calculations will change as a result of this?

Students should identify that the can or jar will not be filled to the top, the food items are not all the same size or shape and that the products are not tightly packed into the container. Students may also note that there is liquid filling the space between the products.

1. By considering the volume of each item of food, have students estimate what percentage of the can is taken up by produce. Students should calculate the percentage of produce for their 2 products.

### Summarise

1. Reveal slide 5 of the PowerPoint (PWC PPT) displaying the labels of each of the products in Appendix A.
2. In a Think-Pair-Share, have students discuss the following questions:

* Was your estimate more or less than the actual amount? Why?
* Why do cans only contain about 55% food produce?
* Why is the percentage of pineapple higher than the other foods?

Cans only contain about 55% food produce because they don’t want to squash the food and the labour cost to pack them uniformly to fit more is too high. The percentage of pineapple is higher as it is uniform in shape and stacks more closely.

1. Have students return to their group and using the percentages from the cans and jars recalculate how many of each food item is in their containers.

### Apply

1. Display slide 3 of the PowerPoint (PWC PPT) and ask students to calculate the number of cylindrical chocolate treats they think is in the jar.
2. Reveal to students that there are 521 treats in the jar.
3. Ask students to calculate the percentage of the volume taken up by the cylindrical chocolate treats using the measurements supplied in the Launch.
4. Pose the following question for discussion in a turn and talk: ‘Why are there only 521 cylindrical chocolate treats in the jar?’

Students might reason that they are different shapes so don’t pack together nicely, they have not been shaken to fit tighter or that they are actually spherical at the ends, making them even more difficult to fit together.

1. Reveal to students that 91% of the volume would be filled with chocolate treats if they were stacked in the jar and were uniform in shape.
2. Ask students to calculate how many more chocolate treats would fit in the jar if they were packed more closely.

## Assessment and differentiation

### Suggested opportunities for differentiation

**Launch**

* Students may benefit from being able to see and manipulate the container rather than viewing the jar on the PowerPoint slide. The teacher could make their own jar and adjust the dimensions accordingly.
* As students are estimating in the Launch and there is no correct answer, all students are encouraged to participate.

**Explore**

* Appendix A is a goal-free problem allowing for all levels of readiness.
* The corn and carrots are the same size. Less ready groups could be given this pairing.
* The pineapple requires students to find the volume of an annulus. This would be suited to groups who are ready for a challenge.
* Dimensions could be varied to include the diameter instead of the radius and measurements could be provided in a variety of units.
* Students may benefit from revising how to find a percentage of a quantity.

**Summarise**

* Students could calculate the percentage error of their guess.
* Rich discussion could establish the need for uniform shapes for food to avoid food wastage.

**Apply**

* Students could be challenged to find the size of the can or jar needed to contain a certain number of treats.

### Suggested opportunities for assessment

**Explore**

* The teacher could observe students’ contribution to locating mathematical words from the short passage to assess their mathematical literacy skills.
* The teacher should observe students’ contributions to the goal-free problem to assess their understanding of calculating the volume of a cylinder.
* When placed in groups of 3, students provide and receive peer feedback on their understanding.
* Working mathematically can be assessed by observing students’ justifications in class and group discussions.

**Summarise**

* The teacher could observe students’ responses to class discussions to check students’ understanding of percentages.

**Apply**

* The teacher could distribute a different food product to each student and have them find the number of each food items in the container as an exit ticket for the lesson.
* The teacher could collect students’ calculations from the apply section to form part of the summative assessment for this unit.

## Appendix A

### Different cylindrical products

|  |  |  |
| --- | --- | --- |
| **Jar of gherkins**  A jar of pickles.  Height of jar = 13 cm  Radius of jar = 4.2 cm  Length of gherkin = 9 cm  Radius of gherkin = 1.3 cm | **Can of carrots**  A can of carrots on a table.  Height of can = 11 cm  Radius of can = 3.7 cm  Length of carrot = 6 cm  Diameter of carrot = 1 cm | **Can of corn**  A can on mini corn spears.  Height of can = 11 cm  Radius of can = 3.7 cm  Length of corn = 9.5 cm  Diameter of corn = 1.5 cm |

|  |  |  |
| --- | --- | --- |
| **Jar of cornichons**  Jar of gherkins.  Height of jar = 13.5 cm  Radius of jar = 4.2 cm  Length of cornichon = 3.5 cm  Diameter of cornichon = 1 cm | **Can of pineapple**  Can of pineapple rings.  Height of can = 9 cm  Radius of can = 4.2 cm  The outer radius of pineapple = 3.7 cm  The inner radius of the pineapple = 1.5 cm  Height of the pineapple piece = 1 cm |  |

## Sample solutions

### Appendix A – different cylindrical products

|  |  |  |
| --- | --- | --- |
| Jar of gherkins  Volume of the jar  Volume of one gherkin  Number of gherkins that would fit into the jar    gherkins  Applying the percentage  Number of actual gherkins | **Tin carrots**  Volume of the tin  Volume of one carrot  Number of carrots that would fit into the tin    carrots  Applying the percentage  Number of actual carrots | **Tin corn**  Volume of the tin  Volume of one corn  Number of corn that would fit into the tin  corn  Applying the percentage  Number of actual corn |
| **Jar of cornichons**  Volume of the jar  Volume of one cornichon  Number of cornichons that would fit into the jar  cornichons  Applying the percentage  Number of actual cornichons | **Tin pineapple**  Volume of the tin  Volume of one pineapple ring  Number of pineapple rings that would fit into the tin  rings  Applying the percentage  Number of actual pineapple rings |  |

### Apply – jar of cylindrical chocolate treats

Volume of the jar

Volume of one cylindrical chocolate treat

Expected number of treats in the jar

Volume of 521 treats Percentage of treats

Number of treats if 91% of volume

this is 1753 more than the current number in the jar.

## References

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