

Mathematics lessons for Grade 7

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Using these lesson plans

These sample lessons for Grade 7 are suitable for use with a whole class. The lessons are single examples to illustrate different teaching and learning activities. They are not intended to be taught as a sequence. They are drawn from different topics and points in the teaching year to show spread rather than sequence.

The objectives for the lessons are drawn from the standards for Grade 7. Occasionally, a standard from an earlier grade is revised. The relevant standards are shown in the lesson plans.

The lessons are organised in three parts: a starter to introduce the lesson, a main activity, and a final phase to help students to reflect on the lesson and consolidate their learning. Before the starter, you should outline the purpose of the lesson, drawing out for students what they will learn and how this builds on previous work. In the final part of the lesson, you will need to establish the key learning points, what students need to remember and what they will go on to learn next. There is no expectation that students should copy out the key learning points in their exercise books.

The lesson plans do not include homework tasks because the lessons are single examples taken out of sequence. You will need to provide this, since homework is an important part of a lesson.

Each lesson plan has enough material to support about 45 minutes of teaching. You may need to supplement the activities with simpler or more challenging tasks if the students in your class have a range of attainment. You could choose from activities in textbooks or from your own resources. If you wish, different tasks can be given to different groups of students, according to their needs.

There may be too much material in the lesson plan for 45 minutes, since this will depend on the class. In this case, you could designate one of the activities in the lesson as homework, or carry it forward to the next lesson. Be selective about which activity to cut – it does not have to be the last one merely because it comes at the end.

Answers to questions are provided to help you to correct students' responses and give feedback. Sometimes, alternative answers are possible that are equally correct.

7.1

Finding percentages

Objectives

- Estimate and calculate a given percentage of a quantity.
- Find the whole, given a percentage part.
- Solve routine and non-routine problems involving percentages.

Starter

Vocabulary

equivalent
percentage

Resources

Mini-whiteboards

Remind the class that 50%, 0.5 and $\frac{1}{2}$ are equivalent. Ask students to use their mini-whiteboards to answer some questions.

Q What is 50% of 24? of 70? of 120? of 250? of 9000? of 15?

Q If we know 50% of something, how do we find 25%? (halve 50%)

Q What is 25% of 40? of 60? of 100? of 1200? of 10?

Remind the class that 10%, 0.1 and $\frac{1}{10}$ are equivalent.

Q How do we find 10% of something? (find one tenth, or divide it by 10)

Q What is 10% of 560? of 1000? of 53? of 4.7?

Q If we know 10% of something, how do we work out 5%? (halve 10%)

Work through with the class finding 15% of 240, by first finding 10%, then 5%, then multiplying 5% by 3. Show how to jot down the interim steps.

Q Is there another way that we could find 15%? (add 5% to 10%)

Ask students to use their mini-whiteboards for interim jottings and to answer these questions.

Q What is 15% of 300? of 60?

Stress that 100% is equivalent to one whole.

Q 22% of the students in a class wear glasses. What percentage of the class do not wear glasses?

Q 36% of the shapes in a box are red. What percentage of the shapes in the box are not red?

Main activity

Vocabulary

method

Resources

OHP calculator
Calculators
OHT 7.1a

Remind the class that 1%, 0.01 and $\frac{1}{100}$ are equivalent. To find 1% of a number means finding one hundredth of the number, or dividing it by 100.

Ask:

Q What might weigh about 500 grams? (e.g. a large potato, a small bag of flour, a small pineapple, a baby kitten)

Q What is 1% of 500 grams?

Q What might weigh about 1 gram? (a fly, a few grains of rice, a matchstick)

Demonstrate the calculation with the OHP calculator. Record the result on the board: 1% of 500 g = 5 g. Stress that the units must be included in the answer.

Repeat by finding 1% of QR 200, 3500 millilitres, 250 metres. Record on the board, spacing them well apart:

$$1\% \text{ of QR } 200 = \text{QR } 2 \quad 1\% \text{ of } 3500 \text{ ml} = 35 \text{ ml} \quad 1\% \text{ of } 250 \text{ m} = 2.5 \text{ m}$$

Ask students to use this information to work out the answers to the following.

8% of QR 200

2% of 3500 ml

4% of 250 m

Take feedback on each question and discuss the methods used. Draw out that the method is to find 1% by dividing by 100, then to multiply the result by the relevant percentage.

Demonstrate on the OHP calculator how to find 28% of 540 km. Ask students to use their own calculators at the same time. Enter 540, and divide by 100. Ask:

Q How do we interpret the 5.4 in the display? How many kilometres and metres is this? (it means 5 kilometres and 400 metres)

Multiply by 28.

Q How do we interpret the 151.2 in the display? (it means 151 kilometres and 200 metres)

Record on the board: 28% of 540 km = 151.2 km.

Ask students to use their calculators and to work out 13% of QR 550 (QR 71.50), and 4% of 37.5 kg (1.5 kg).

Write randomly on the board a selection of percentages such as:

50%, 25%, 75%, 10%, 1%, 20%, 60%, 90%, 33%

Point to one of them and ask:

Q What strategy or method could you use for calculating this percentage of a given amount? Could you work it out in a different way?

Stress any alternative methods. For example:

90% is 100% minus 10%, or 10% multiplied by 9;

60% is 50% plus 10% or 10% multiplied by 6;

75% is 50% plus 25% or 25% multiplied 3.

Ask the class:

Q You know that 10% of a quantity is 8 kg. So 5% is 4 kg. What other percentages can you work out easily using this information?

Establish that:

20% is $10\% \times 2$, 30% is $10\% \times 3$, and so on;

15% is $10\% + 5\%$, 25% is $20\% + 5\%$, and so on.

Q If you know 10%, how would you work out 100%? (multiply by 10)

Q If you know 25%, how would you work out 100%? (multiply by 4)

Q If you know 30%, how would you work out 100%?

Establish that this could be done in two steps. First, divide by 3 to find 10%, then multiply by 10 to find 100%.

Q If you know 47%, how would you work out 100%?

Establish that this time there is no easy method, and that the first step is to find 1%. So, divide by 47 to find 1%, then multiply by 100 to find 100%.

Work through with the class the questions on **OHT 7.1a**.

Other tasks

If necessary, choose further related activities, selecting from available textbooks or your own materials.

Consolidation

Ask the class what they think these statements mean and to explain them in their own words.

- A shirt is 70% cotton and 30% polyester.
- We spend about 33% of our lives asleep.
- There is a 10% chance of mist today.
- The interest rate on my savings account is 3% per annum.
- I got a 30% discount on these shoes in a sale.

Supplement with questions such as:

- The shirt weighs 200 grams.
About how much is cotton?
- About how many hours do we sleep in a day? In a week?
- It is twice as likely to be misty tomorrow.
What is the chance of mist tomorrow?
- I have QR 500 in my savings account.
How much interest will I get in a year?
- The original cost of the shoes was QR 150.
What did I pay for them in the sale?

Finish by asking questions such as:

Q Would you prefer to climb 20% of a 3000 m mountain, or 30% of a 2000 m mountain? Explain why.

Q Would you prefer to lose 40% of QR 80, or 80% of QR 40? Explain why.

Draw out the key points of the lesson by summarising them for students.

Summary for students

- A quick way to find 20% of a quantity is to find 10% by dividing by 10, then multiply by 2 to find 20%. You can find 30%, 40%, 50%, ... by multiplying by 3, 4, 5, ...
- If there is no quick method for finding a percentage of a number or quantity, first find 1%, then multiply by the percentage.
- When you are finding a percentage of a quantity, always include any units in the answer.

7.2

Algebraic expressions

Objectives

- Write simple linear expressions and formulae to model a situation.
- Simplify algebraic expressions with one or two variables by collecting like terms and multiplying a single term over a bracket.

Starter

Vocabulary

symbol
variable
equals
brackets
term
expression
equation

Resources

OHT 7.2a
Mini-whiteboards

Show **OHT 7.2a**. Ask students to discuss in pairs which expressions are equivalent. Invite students to the projector to help match one expression to another. Ask students to write on their mini-whiteboards suggestions for expressions that could go in the two empty boxes. Choose students to write their expressions on the OHT.

Take feedback. Ask students to explain their reasoning.

Next, read out questions 1 to 5 below. Ask students to write the expressions or equations on paper or on their mini-whiteboards, using algebra.

- 1 A number x , plus 9, and then the result multiplied by 6.

$$(x + 9) \times 6 = 6(x + 9)$$

- 2 Add 7 to a number y , and then multiply the result by itself.

$$(y + 7)(y + 7) = (y + 7)^2$$

- 3 Think of a number t , multiply it by itself, and then subtract 5.

$$t \times t - 5 = t^2 - 5$$

- 4 Think of a number z , square it, add 1 and then double the result.
The answer is 52.

$$(z^2 + 1) \times 2 = 52, \text{ or } 2(z^2 + 1) = 52$$

- 5 Cube a number p , and then subtract 7.
The answer is 20.

$$p^3 - 7 = 20$$

As you work through these examples, check whether students:

- know how multiplication is represented in algebraic expressions;
- understand the meanings of $2n$ and n^2 , $3n$ and n^3 ;
- understand the difference between an algebraic expression and an equation.

Q In question 4, what is the value of z in this equation? (5)

Q In question 5, what is the value of p in this equation? (3)

Remind students that questions like this can be solved by using inverse operations. For example, the inverse of:

Think of a number z , square it, add 1 and then double the result.
The answer is 52.

is:

Take the result of 52, halve it, subtract 1, then find the square root, to arrive at the number.

Main activity

Vocabulary

evaluate
substitute
simplify
coefficient

Resources

OHT 7.2b
Sets of cards made from
Resource/OHT 7.2c,
one set per pair of
students

Show question 1 on **OHT 7.2b**. Point to $2(3d + 7) - 2(d - 4)$.

- Q** Is this an expression or an equation? (an expression)
Q What is the value of the expression $2(3d + 7) - 2(d - 4)$ if d equals 4? (38)
Q What is the value of the expression $-11d$ if d equals 4? (-44)
Q What does this tell us? (that the simplification of the expression is incorrect)

Stress that substituting a particular value for a variable into an expression and its simplification is one way to check if it is correct.

Ask students to work in pairs. They should consider the statements and identify the errors. Ask them to write the expression on their mini-whiteboards and then to simplify it correctly.

Invite students to show their responses and to talk through their reasoning.

- Q** What needs to be done first?
Q What is the coefficient of d ?
Q Which terms can we collect together?

Check students' understanding of the errors:

- the distributive law is applied incorrectly;
- there are errors in signs;
- mistakes are made in collecting terms.

Ask:

- Q** What is the value of the expression $2(3d + 7) - 2(d - 4)$ if d equals 5? (42)
Q What is the value of the expression $4d + 22$ if d equals 5? (42)
Q What does this tell us? (that the simplification is likely to be correct)

Remind the class of examples of grid multiplication using numbers, for example:

$$7 \times (4 - 2) = 14$$

×	4	-2
7	28	-14

$$-5 \times (4 - 2) = -10$$

×	4	-2
-5	-20	+10

Extend the examples to letters.

$$-2(4 - 2p)$$

×	$4 - 2p$
-2	$-8 + 4p$

Refer again to **OHT 7.2b**. Ask students to simplify $5(p - 2) - (4 - 2p)$. Invite them to show their response and talk through their reasoning.

Discuss how useful it is to think of $-(4 - 2p)$ as $-1(4 - 2p)$.

Next, discuss how each of the sets of three expressions in question 3 on **OHT 7.2b** is equivalent.

Give each pair of students the sets of expressions from **Resource 7.2c**. Ask the pairs to sort the cards so that expressions that are equivalent are grouped together.

Q Which expression in each group is in its simplest form?

Explain that, in the simplest form of an expression, brackets will have been removed and like terms will have been collected together.

Other tasks

If necessary, choose further related activities, selecting from available textbooks or your own materials. For example, extend the work to expressions that involve two variables, such as simplifying $2(x + 1) + 5(y + 1) - 3(x + y)$.

Consolidation

Resources

Resource/OHT 7.3c

Display **OHT 7.3c**.

Discuss particular expressions.

Summary for students

- An equation is a statement of an equality relationship between two quantities or expressions.
- An expression can be simplified by multiplying out brackets and collecting like terms.
- One way to check that an expression has been simplified correctly is to substitute a value for the variable into both the original expression and its simplified form.

7.3

Properties of 2-D shapes

Objectives

- Identify, sketch, label and describe the properties of triangles, quadrilaterals and polygons.
- Identify and calculate unknown angles involving:
 - angles of isosceles, equilateral and right-angled triangles;
 - angle properties of squares, rectangles, parallelograms and rhombuses, including angle properties related to their diagonals.

Starter

Vocabulary

diagonal
line of symmetry
vertex
vertices
equilateral
rotate
map

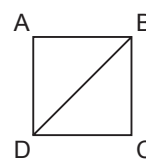
Resources

OHT 7.3a

Show **OHT 7.3a**. Point out the right angles at the vertices of square EFGH (diagram 1). Emphasise that their sum is $90^\circ \times 4 = 360^\circ$.

Q What is the sum of the angles at the corners of a triangle? (180°)

Point to the second diagram. Explain that a square can be folded in half along a diagonal to get two identical triangles.



Q How do we know that the triangles are identical?

Establish that each triangle has two sides equal to the side of the square, and a third side, which is common to the two triangles. One triangle can be folded onto the top of the other triangle, because the diagonal BD is a line of symmetry.

Tell students to look at triangle ABD. Mark the sizes of angles on the diagram as students answer questions.

Q What is the size of $\angle ABD$? (45° , or half a right angle, because the diagonal is a line of symmetry and cuts the angle in half)

Q What are the three angles at the vertices of triangle ABD? (90° , 45° , 45°)

Q What is the sum of these three angles? (180°)

Join AC, the second diagonal of the square. Label the point at which the two diagonals intersect as O.

Q Why does $AC = BD$? (if the square is rotated about its centre O, AC will map exactly onto BD)

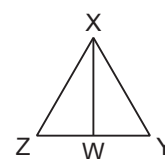
Q Why does $AO = OB$? (each of them is half of the diagonal of the square; for example, BO can fold exactly onto OD, and AO can fold exactly onto OC)

Q What is the size of $\angle AOB$? (90°) How do you know? ($\angle OAB$ is 45° and $\angle OBA$ is 45° , so $\angle AOB$ is 90° , since the three angles of a \triangle add up to 180°)

Q What size are the other three angles at O? (each of them is 90°)

Emphasise that they have proved that the diagonals of a square bisect each other at right angles.

Point to the third diagram. Tell students that triangle XYZ is an equilateral triangle.



Q What is special about an equilateral triangle? (it has three equal sides and three equal angles)

Say that an equilateral triangle can be folded in half to produce two identical triangles. Mark the sizes of angles on the diagram as students answer questions.

- Q What is the size of angle WXY?** (30° , or half of 60° , because the line XW is a line of symmetry and cuts angle ZXY in half)
- Q What is the size of angle XWY?** (90° , because the line XW is a line of symmetry and ZY is a straight line)
- Q What are the three angles at the vertices of triangle XYW?** (30° , 60° , 90°)
- Q What is the sum of these three angles?** (180°)

Point out diagrams 4 and 5. Explain that each of the triangles PQR and LMN has been formed from two triangles from diagram 2 or 3.

- Q What are the angles at the corners of triangle PQR?**

Invite a student to the projector to mark in each of the angles, explaining their reasoning as they do so.

- Q What is the sum of the three angles of triangle PQR?** (180°)

Repeat with triangle LMN.

Main activity

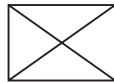
Vocabulary

isosceles
equilateral
scalene

Resources

Plain A4 paper
Scissors for each pupil
Resource 7.3b

Ask students to fold a piece of A4 paper along each diagonal.



- Q How many small triangles do you have?** (four)
- Q Are any of the small triangles the same?** (there are two identical pairs)
- Q Do any of your small triangles have two equal sides?** (each of them)
How do you know that the sides are equal?

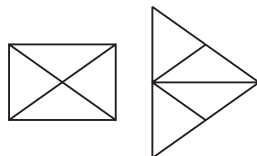
Remind students that the diagonals of a rectangle are equal and cut each other in half, since one diagonal will map onto the other if the rectangle is rotated about its centre. The small triangles have two sides each equal to half of a diagonal.

- Q What type of triangle is a triangle with two equal sides?** (isosceles)

Ask students to cut along the folds of the paper to make the four small triangles. Hold up one of each pair of triangles.

- Q What is different about these isosceles triangles?** (one has a longer base and one obtuse angle; one has a shorter base and all its angles are acute)

Ask students to reassemble the four triangles to form one large isosceles triangle.



Allow time for them to experiment and to assemble the triangle, then ask:

- Q What do we know about the area of the large isosceles triangle?** (it is the same as the original rectangle because it consists of the same parts)
- Q How do we know for certain that we have made a large isosceles triangle with two sides of the same length?**

Establish with the class that two of the sides of the large triangle are the same length as a diagonal of the original rectangle.

Give students copies of **Resource 7.3b**. Ask them to work in pairs and to discuss the solution to each problem before recording it on the sheet. Take feedback on the different ways that the right-angled triangles can fit into the shapes.

Other tasks

If necessary, choose further related activities, selecting from available textbooks or your own materials.

Consolidation

Vocabulary

acute
obtuse
reflex
parallel
perpendicular
quadrilateral
square
rectangle
parallelogram
rhombus
kite
trapezium

Resources

OHT 7.3c
Mini-whiteboards

Use **OHT 7.3c** to remind students of the names and shapes of different types of quadrilaterals.

Q What is a quadrilateral? (a flat shape with four straight sides)

Point to some of the quadrilaterals in turn, and ask:

Q Does this shape have any right angles? Any acute angles? Any obtuse angles? Any equal angles?

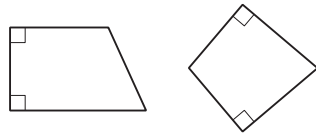
Q Does this shape have any equal sides? Any pairs of parallel sides? Any sides that are perpendicular to one another?

Remove **OHT 7.3c**. Tell students to visualise the quadrilaterals and to discuss the answers to the next questions with a partner.

Q A square has four right angles. Does any other quadrilateral have four right angles? If so, draw it on your whiteboard and write its name.
(rectangle)

Q Can a quadrilateral have exactly two right angles? If so, draw it on your whiteboard and write its name.

Establish that a quadrilateral can have two adjacent right angles (a trapezium), or two opposite right angles (a kite).



Say that any quadrilateral can be cut into two triangles.

Q What is the sum of the angles in a quadrilateral? (360°)

Establish with the class that the sum of the four angles of the quadrilateral is the same as the sum of the angles in both the triangles.

Summary for students

- The angle sum of a triangle is 180° and of a quadrilateral is 360° .
- Triangles with special properties are an equilateral triangle, an isosceles triangle and right-angled triangle. A triangle in which all three sides are different lengths is called a scalene triangle.
- A quadrilateral has four sides. Some quadrilaterals with special properties are a square, rectangle, rhombus, kite, parallelogram and trapezium.
- The diagonals of a square bisect each other at right angles.

7.4

Pie charts

Objectives

- Answer questions by collecting and classifying data, and constructing and interpreting pie charts.
- Compare different representations of the same set of data and determine which are the most useful for a given purpose.
- Use mental methods to find a fraction of a number or quantity.

Starter

Vocabulary

survey
sample
pie chart
sector
category

Resources

none

Say that you are going to carry out a *survey* of a small *sample* of students by asking them about their favourite fruit drink. Write a list on the board, saying that you will use four *categories* of students: those whose favourite fruit drink is:

orange
apple
mango
lemon

Choose four students and ask them which of the four fruit drinks they prefer. Get the students to choose from the list and record the results, for example:

orange	1
apple	2
mango	1
lemon	0

Say that you are going to show the results of your survey in a special chart called a *pie chart*, which you will divide into slices. The slices are called *sectors*. Write *pie chart* on the board and draw a large circle with four equally spaced marks on its circumference.

Q How many prefer an orange fruit drink? (1 out of 4, or one quarter)

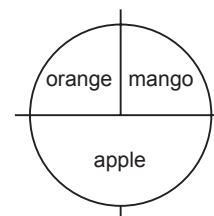
Say that you are going to show this by slicing one quarter of the pie. Draw a quarter of the circle and write 'orange' inside it.

Q How many prefer apple? (2 out of 4, or one half)

Draw a slice which is half of the pie, and write 'apple' inside it.

Q How many prefer mango? (1 out of 4, or one quarter)

Write 'mango' in the remaining quarter. Discuss how the slices of the pie match the number of votes, and that there is no slice or sector for 'lemon' because nobody voted for it.



Now ask eight different students which fruit drink they prefer, and record their votes separately from the original four. Draw a large circle on the board and mark the circumference with eight equally spaced marks. Choose students to draw sectors to match each category. Discuss the resulting chart.

Say that you are now going to carry out a survey of a sample of 16 students to find out which of five colours they like the best. List five colours on the board: for

example, red, white, blue, yellow, green. Choose 16 students to vote for their one preferred colour from the list, and record their votes. Represent the votes by drawing a large circle with 16 equally spaced marks, choosing students to draw the slices. Quickly colour the sectors in the matching colour, then discuss the results.

Main activity

Vocabulary

fraction

Resources

OHTs 7.4a, 7.4b
Copies of Resource 7.4c
Mini-whiteboards

Show **OHT 7.4a**. Say that when we interpret pie charts we may need to estimate the fraction or percentage that one slice is of the whole circle. Ask the class to estimate the fraction that each shaded slice is of the whole (F is one twelfth, G is one fifth and H is one sixth).

Show **OHT 7.4b**. Uncover the three pie charts one at a time. Work through the questions with the class, asking them to estimate the fractional values of the relevant slices, to calculate the number and to respond using their whiteboards.

Ask questions to supplement those on the OHT such as:

Q What was the most popular item that the students chose? Estimate how many of students chose this. What fraction of the students does that number represent?

For each answer, ask students to explain how they decided on their answer. Invite a student to the board to show how to write out an explanation. Discuss how to improve it.

In another example, ask all students to write a short explanation on their whiteboards. Ask several students to read out their explanations and ask the class to decide which of the explanations they think is the best.

Give out copies of **Resource 7.4c**. Say that Huda and Shua carried out some surveys. Shua asked 120 young people what their main hobby is. She made a pie chart to show the data she collected. Huda asked 80 young people what their main hobby is and she too made a pie chart showing her data.

Remind students that the 'slices' of a pie chart are called *sectors*, and that in each of these pie charts the sectors represent the *categories*: swimming, bowling, ice skating and horse riding. Ask:

Q In which survey did more people say that their main hobby is ice skating – Huda's survey or Shua's survey?

It is likely that students will say that it was Huda's survey. Tell them that it is easy to be deceived and you will show them why.

Point in turn to each sector of the pie charts. Get students to estimate the fractional values represented by the sector and to show the answer on their whiteboards. Note any students whose estimates are wide of the mark so that you can give them support during the next task. Agree as a class what each estimate might be (reading clockwise: one half, one tenth, three tenths and one tenth in Shua's chart; one eighth, one quarter, three eighths and one quarter in Huda's chart).

Ask students to work in pairs. They should use their estimates to work out the number of people in each category and to record their answers in the tables. Take the opportunity to give some support to the students you identified earlier.

Q What must the numbers add up to in Shua's table? (120)

Q What must the numbers add up to in Huda's table? (80)

Say that you will now ask again:

Q In which survey did more people say that their main hobby is ice skating – Huda’s survey or Shua’s survey?

Ask students to compare the numbers they have worked out. Explain that in Huda’s survey three eighths of 80 people is 30 people, whereas in Shua’s survey three tenths of 120 people is 36 people. More people said that ice skating is their main hobby in Shua’s survey. Emphasise that even though the sector in Huda’s pie chart is bigger, Shua asked more people.

Other tasks

If necessary, choose further related activities, selecting from available textbooks or your own materials.

Consolidation

Resources

OHT 7.4d

Say that a bar chart and a pie chart can show the same information.

Show **OHT 7.4d**.

Q What is missing from the bar chart?

Establish that the bar chart needs a title, labels on the bars and axes, and a scale. Label one of the bars ‘orange’.

Q What could the bar chart be representing? (possibilities are favourite colours, favourite fruits, favourite fruit drinks, and so on)

Discuss and agree possible labels for the axes, the scale, and the title of the graph. Agree on the names of the other bars, for example, apple, date, lime, and so on.

Refer to the pie chart. Say that it represents the same information. Use the information you have agreed to discuss the sectors of the pie chart.

Q What will the largest sector of the pie chart represent?

Q What will the smallest sector of the pie chart represent?

Q What title shall we give the pie chart? What else do we need to add? (labels for the sectors and/or a key)

Compare the bar chart with the pie chart.

Q Which chart would be more useful if we wanted to find out whether more students like oranges or more like apples? (either)

Q Which would be more useful if we wanted to find out how many more like oranges than apples? (the bar chart)

Q Which would be more useful if we wanted to find out what fraction of the total number of students prefer oranges? (the pie chart)

Summary for students

- The sectors of a pie chart show how the total is divided up into different parts, and what fraction of the whole each part is.
- Each sector should be labelled with the category it represents, or there should be a key. There should also be a title to explain what the pie chart is showing.
- A pie chart can represent the same data as in a bar chart.