At home materials

Pack 2: Triangles

Session A) Creating triangles
Session B) Triangle symmetry
Session C) Describing triangles
Session D) Angles in triangles
**Pack 2: Triangles**

**Session A: Creating triangles**

**Resources needed:** Ruler, large pieces of paper, scissors

The purpose of this session is to create and describe the properties of lots of different triangles using a variety of language.

### Talk Task

Introduce triangles by asking learners to think about the statement at the top of the sheet. Try out lots of examples to decide if it is sometimes, always or never true. Use this as an opportunity to focus on the skill of using a ruler to accurately draw straight lines. Pay attention to how the ruler is being positioned and held and work with learners to find a position that allows them to be accurate.

Provide large sheets of paper and longer rulers and encourage lots of different triangles to be created. By thinking about the different ways to arrange three dots, learners might realise that if all of the dots are in line then a triangle will not be made and instead a straight line is formed. Therefore the statement is sometimes true.

Use the triangles created and the ones on the sheet to discuss the properties of triangles and any words that learners have prior experience with e.g. *sides, vertices, angles,*... There are some non-examples on the sheet to discuss why they are not triangles. Triangles have three straight sides. The three sides meet to make three angles. Talk about the angles within the different triangles and identify them as acute, obtuse or right angles.

Extend the experience with a ruler by measuring some of the side lengths of some of the triangles. Ask learners to describe and compare the side lengths. E.g. *The same length, nearly the same length, one short and two long,* …

If they have not come up in discussion, introduce the words, equilateral, isosceles and scalene and talk about what they mean, finding examples of each.

- **Equilateral triangle** – all sides are equal length, all angles are equal size
- **Isosceles triangle** – two side are equal length, two angles are equal size
- **Scalene triangle** – no sides are equal length, no angles are equal size

### Activity

The activity sheet provide a grid of dots for learners to create different triangles. Then they describe angle within triangles and you can prompt them to write down other properties such as symmetry. Extend the activity by practising using a protractor to measure some of the angle within triangles.
Pack 2 Session A

Activity: Creating triangles

1) Use a ruler to join dots to create triangles. How many different ones can you make?

![Diagram showing multiple triangles created by connecting dots with rulers.]

2) Describe the angles as acute, obtuse or right angle.

- acute
- obtuse
- right
- acute
- acute
- acute
- acute
- acute
- acute
Pack 2: Triangles

Session B: Triangle symmetry

Resources needed: Scissors, ruler, protractor

The purpose of this session is to describe properties of triangles, using symmetry to find equal sides and angles and classify as isosceles or equilateral.

Talk Task
The sheet provides two sets of triangles. Working with each set in turn, cut them up and discuss what is the same and what is different about them. Encourage learners to think about all the different language they can use to describe them.

The first set contains equilateral triangles of different sizes and orientations. Explore the symmetry of each and use folding and rotating to convince yourselves that all of the sides are of equal length and that all of the angles are equal. Think about different ways to explain how you know. For example, folding along the three lines of symmetry shows how each side lines up with another. They must all be the same length.

You can use this as an opportunity to practise using a ruler and a protractor to measure. Ask learners to explain out loud how to use these tools accurately. Attach the word equilateral to these types of triangles and practise saying: This is an equilateral triangle. All three sides are the same length. All three angles are the same, 60 degrees.

The second set contains isosceles triangles of different sizes and orientations. Explore the symmetry of each and use folding and rotating to convince yourselves that each triangle has two sides that are equal length and two angles that are the same size. Again you may want to take the opportunity to use a ruler and protractor to check. Attach the word isosceles to these triangles and practise saying: This is an isosceles triangle. It has two sides that are the same length. It has two angles that are the same size.

The triangles explored all have either three lines of symmetry or one line of symmetry. Introduce the activity on the sheet by asking learners to think about if there are triangles with two lines of symmetry or zero lines of symmetry or four. Encourage them to sketch examples on the activity sheet.

Activity
The activity sheet provides triangles for learners to identify properties and label as equilateral or isosceles. Then they explore finding triangles with two or zero lines of symmetry. It is not possible for a triangle to have two lines of symmetry. Think about different ways to show and explain why.
Pack 2 Session B  
**Activity:** Triangle symmetry

1) Draw on lines of symmetry. Name each shape as equilateral or isosceles and describe its symmetry.

- This is an **isosceles** triangle. It has **one line of symmetry and rotational symmetry of order 1**
- This is an **equilateral** triangle. It has **three lines of symmetry and rotational symmetry of order 3**

2) Are there triangles with two lines of symmetry? Are there triangles with no lines of symmetry? Use the space below to sketch and write your ideas.

A triangle with all sides different will not have a line of symmetry

For there to be a line of symmetry, there must be two or three angles the same size and two or three sides the same length.
## Pack 2: Triangles

### Session C: Describing triangles

**Resources needed:** Geoboards

The purpose of this session is to create, describe and classify triangles using a variety of language.

### Talk Task

Challenge learners to use geoboards to create as many different triangles as they can. There are often two sides to a geoboard, one with pegs arranged in a square grid and another with pegs arranged in triangles. Different triangles can be made on each side and both should be explored. The sheet provides some examples to discuss or recreate and uses the triangular side because it is possible to make equilateral triangles. Across the session, prompt learners to think about why it is hard to make an equilateral triangle on a square grid.

Ask learners to describe the properties of the triangles as they create them. By this session, they have experience with a range of language and properties and you should take the time to ensure learners use the vocabulary lots. Build on the previous session and identify triangles that are isosceles and those that are equilateral. Discuss the word we use to describe triangles that are neither (scalene) and identify lots of examples of these.

Create a triangle that is identical to one already made but in a different orientation and ask learners to decide if this is a different triangle. Challenge them to create a triangle in a different orientation thinking about how to make sure it is the same. These experiences link to future learning on transformations such as reflection and rotation.

Focus on angles within triangles, reviewing the language acute, obtuse and right angles. Find examples of triangles that have right angles and talk about why an equilateral triangle cannot have a right angle. The shapes at the bottom of the sheet can help with this. The regular hexagon is made up of six equilateral triangles that meet to make a full turn of 360°. This can be used to identify that the equilateral triangles have 60° angles. The square shows that two right angles will not meet to make a third angle. Work out the angles of the triangles within.

### Activity

The activity sheet provides dots grids for learners to create different triangles and classify them. Encourage learners to mark on any other properties they can identify. Then learners complete a two-way grid, drawing triangles into each section to demonstrate their understanding of types of triangles.

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**Video guidance**
Activity: Describing triangles

1) Join dots to make different triangles. Write isosceles or scalene to describe each triangle.

Check that triangles are labelled correctly.
Check that each is a different triangle.

2) Try to draw a triangle for each section of the table.

<table>
<thead>
<tr>
<th>Scalene</th>
<th>Isosceles</th>
<th>Equilateral</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Scalene Has a Right Angle" /></td>
<td><img src="image2.png" alt="Isosceles Has a Right Angle" /></td>
<td>Not possible</td>
</tr>
<tr>
<td><img src="image3.png" alt="Scalene No Right Angle" /></td>
<td><img src="image4.png" alt="Isosceles No Right Angle" /></td>
<td><img src="image5.png" alt="Equilateral No Right Angle" /></td>
</tr>
</tbody>
</table>
Pack 2: Triangles

Session D: Angles in triangles

Resources needed: Scissors, paper and ruler to draw triangles.

The purpose of this session is to explore angles within triangles and allow learners to convince themselves that angles in a triangle always sum to 180°.

Talk Task
Across this session you want to provide experiences where learners can convince themselves that the angles in a triangle sum to 180°. This may have already come up in previous sessions and they may already know this as a fact. This session is about giving them time to build this understanding for themselves and explore different ways of thinking about this.

On the Talk Task sheet there are sets of three identical triangles with the matching angles marked in the same colour. Cut them out and ask learners to arrange three triangles to make a straight line. There are different ways to do this and each way involves one of each angle coming together to form 180°. Revise that angles that meet on a straight line sum to 180° and so these angles sum to that amount.

Ask learners if they can convince themselves and you that this is true for all triangles; the three angles will always add to 180°. Link to the previous session where you established that an equilateral triangle has 60° angles and that three of these adds to 180°. The square was split into isosceles triangles that had two 45° angles and a right angle which sums to 180°.

Explore other ways to show this and create your own triangles to investigate with. Another way is to tear each angle off a triangle and arrange them to show that they make a straight line and sum to 180°.

The two blue triangles at the end of the sheet can be used to fold down the angles and see that they meet along a side length to make a straight line. The triangles are marked with the lines you need to fold along to show this.

Practise making use of this knowledge and revise using a protractor. Measure two of the angles within a triangle and then calculate the value of the final angle.

Activity
The activity sheet provides experiences to apply knowledge that angles in a triangle sum to 180°. Learners calculate missing angles and then think of two different ways to work out the missing angles. They then link to previous sessions and think about the triangles within a regular polygon.
Activity: Angles in triangles

1) Calculate the size of each missing angle.

- 40°
- 70°
- 50°

2) Write descriptions of two different ways to find the angles in this isosceles triangle. Write each angle in the triangles.

- The marked angle at the top is 40° because 50° + 90° + 40° = 180°. It is symmetrical so the other side has the same angles.

- An isosceles triangle has two equal angles. The other two angles must be 50° and 80°.

3) This regular decagon is split into ten identical triangles. What information can you write about the triangle?

- Isosceles triangle
- 1 line of symmetry
- Rotational symmetry of order 1
- Ten of these triangles meet at a point so one angle must be 36°.
- The other two angles must sum to 144°. They are equal angles so each must be 72°.
At home materials

Pack 3: Quadrilaterals

Session A) Creating quadrilaterals
Session B) Quadrilateral symmetry
Session C) Angles in quadrilaterals
Session D) Describing quadrilaterals
### Pack 3: Quadrilaterals

### Session A: Creating quadrilaterals

**Resources needed:** Scissors, paper to sketch shapes on

The purpose of this session is to use triangles to create a range of quadrilaterals and describe their properties using a variety of language.

**Talk Task**

Cut up the two equilateral triangles and use symmetry to convince yourselves that they are equilateral triangles. Fold along lines of symmetry and rotate one triangle on top of the other to show equal angles and sides.

Cut each triangle along the dotted line and talk about the properties of the triangles you now have. Challenge learners to move the triangles around to create as many different shapes as they can. Make sketches of the shapes, naming them and describing their properties.

Focus attention on examples that have four sides and discuss the word quadrilateral. A quadrilateral is a polygon with four straight sides and four angles. Connect to other words with ‘qua’ or ‘quad’ that have a connection with four. A quad bike has *four* wheels, a quarter is one of *four* equal parts.

Take the time to find out which special quadrilaterals learners know the names of and what properties they can identify about these shapes. The Talk Task in session D has descriptions that you can use to support you in finding out how familiar learners are with these shapes.

- Side lengths - when they are all equal, when there are pairs of equal sides
- Parallel or perpendicular sides
- Angle size. For angle size you can write on the angles for each triangle linking to knowledge of equilateral triangles to identify them as 60, 90 and 30. This can deepen discussions of angles beyond saying if they are acute, obtuse or right angles.
- Symmetrical properties are the focus of a later session (it might be tricky to discuss here as the shapes are in bits)

Repeat the experience with the rectangle.

### Activity

The activity sheet provides circles with equally spaced dots for learners to join and create different quadrilaterals. Encourage them to name as many as they can and record properties they can identify. Explore how the different number of dots can change which quadrilaterals you can make.

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**Video guidance**

[QR Code for Video Guidance]
Pack 3 Session A

Activity: Creating quadrilaterals

Answers
**Pack 3: Quadrilaterals**

**Session B: Quadrilateral symmetry**

**Resources needed:** Paper, ruler

The purpose of this session is to create, describe and explore the symmetrical properties of quadrilaterals.

**Talk Task**

Create quadrilaterals by folding paper and making cuts, then opening the cut shape and describing the properties of the shape created. Start by folding a sheet of paper in half and making two cuts into the folded edge. The shapes created will be quadrilaterals with at least one line of symmetry and is therefore a perfect opportunity to review understanding of symmetry. Explore the rotational symmetry of each shape and decide if it has rotational symmetry of order 1, 2 or 4. Repeat this several times challenging learners to decide which shapes they can and cannot make, taking the time to talk about why.

Then fold the paper into quarters and make one cut to remove the folded corner. Again explore the possible shapes that can be made and describe their properties.

The Talk Task sheet in session D has a list of properties of special quadrilaterals that you can use as a reference to guide discussions. If learners do not know these names, then tell them this information and spend time making sense of these words. Ask them to find examples and explain how they know it is an example. Finding and explaining non-examples is also useful because explaining why a shape is not a rhombus involves thinking about what a rhombus is.

Continue to create and discuss quadrilaterals using the lines marked on the bottom of the sheet. Choose four points on the lines and join them, repeating this to explore the different quadrilaterals that can and cannot be made. The marked lines become the diagonals of the quadrilateral and different diagonals can create different shapes. Discuss the properties of the shape providing lots of opportunities for learners to build confidence with the language of geometry.

**Activity**

The activity sheet is an opportunity to consolidate the discussions and experiences in the Talk Task. Learners work out the symmetrical properties of the quadrilaterals and decide where to place them in the table. If two-way tables are unfamiliar, take the time to discuss how it works. Extend the task by sketching different shapes on the grid.
### Activity: Quadrilateral symmetry

<table>
<thead>
<tr>
<th></th>
<th>Rotational order of 1</th>
<th>Rotational order of 2</th>
<th>Rotational order of 4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>0 lines of symmetry</strong></td>
<td><img src="image1.png" alt="Image" /></td>
<td><img src="image2.png" alt="Image" /></td>
<td><img src="image3.png" alt="Image" /></td>
</tr>
<tr>
<td><strong>1 line of symmetry</strong></td>
<td><img src="image4.png" alt="Image" /></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>2 lines of symmetry</strong></td>
<td><img src="image5.png" alt="Image" /></td>
<td><img src="image6.png" alt="Image" /></td>
<td><img src="image7.png" alt="Image" /></td>
</tr>
<tr>
<td><strong>4 lines of symmetry</strong></td>
<td><img src="image8.png" alt="Image" /></td>
<td></td>
<td><img src="image9.png" alt="Image" /></td>
</tr>
</tbody>
</table>
**Pack 3: Quadrilaterals**

**Session C: Angles in quadrilaterals**

**Resources needed:** Scissors, split pins, strips of paper

The purpose of this session is to explore angles within quadrilaterals, revising understanding of acute, obtuse, reflex and right angles and reasoning about when an angle combination is not possible.

**Talk Task**
Cut out the strips on the sheet and connect them together with split pins. Use this to explore angles within quadrilaterals, playing around by moving the three sides and connecting with a fourth strip.

Make and describe a variety of different quadrilaterals, revising the properties and names explored so far in this pack. Create sketches of the different shapes you create labelling them with information to show the properties you notice.

Focus attention on the angles being formed within the shapes you make. Create a rectangle and identify right angles using this as the basis for adjusting to explore smaller acute angles and larger obtuse angles.

Look at the statements on the sheet and find examples of quadrilaterals with each types of angle. Creating quadrilaterals with a reflex angle can be tricky to visualise at first and the lengths of the strips might make it awkward to create.

The statements are true, however if you vary them and make them more precise you can explore further. Can a quadrilateral have …all acute angles? …all obtuse angles? …all reflex angles? There are lots of opportunities to encourage learners to explain why or why not, using the strips and sketches to support their reasoning.

Encourage them to explore and try to decide what the limits are for each type of angle, including right angles. Is it possible to have …exactly one right angle? …exactly two? …exactly three?

Throughout this activity, take the opportunity to revise the names and properties of the different quadrilaterals you create, including symmetric properties.

**Activity**
The activity sheet provides further statements for learners to explore with space to record their thoughts. Encourage them to explore how they might decide if each statement is possible and think about what knowledge of quadrilaterals they can use to help them.
Pack 3 Session C

**Activity:** Angles in quadrilaterals

Which of the following angle combinations are possible? Sketch examples and label with information.

<table>
<thead>
<tr>
<th>3 obtuse angles, 1 acute angle</th>
<th>3 acute angles, 1 obtuse angle</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Diagram" /></td>
<td><img src="image2.png" alt="Diagram" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>2 acute angles, 2 obtuse angles</th>
<th>2 acute angles, 2 reflex angles</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image3.png" alt="Diagram" /></td>
<td><img src="image4.png" alt="Diagram" /></td>
</tr>
</tbody>
</table>

A complex quadrilateral can have two reflex angles and two acute angles. These are not yet expected to be understood.

Learners will be able to find examples with one reflex and one obtuse.

What other angles are possible? What angles are not possible?

Encourage them to explore and reason. Do not worry about being certain about any, the purpose is to explore, think and describe properties.
Pack 3: Quadrilaterals

Session D: Describing quadrilaterals

Resources needed: Ruler

The purpose of this session is to bring together the sessions in this pack by describing and defining special quadrilaterals, noticing connections.

Talk Task

The names we use to label special quadrilaterals do not reveal the connections between them. For example, a square is a rectangle. It is a rectangle that has equal length sides. We give a different name to this group of rectangles.

There are lots of other examples of this and discussing definitions provides great opportunities for learners to think about the importance of precise language.

Read the short description of a rectangle and use this to discuss the least amount of information that is needed to define a special quadrilateral. Identify other properties of a rectangle that could be included in a description (opposite sides are parallel, opposite sides are equal, two lines of symmetry, rotation symmetry of order two) and talk about if you need any of that. Do you even need to know if there are four right angles? Is it enough to know that there are three?

Read the other descriptions, sketching a few examples of each and identifying other properties that could be included in the description. Language to clarify: equilateral, like with triangle, means equal sides; adjacent means 'next to'.

Discuss if the speech bubble statements are always true, sometimes true or never true, thinking about what information you need to help you decide.

- As already discussed above, a square is a rectangle.
- A square has two pairs of parallel sides and equal opposite angles and so it is a parallelogram. It is a parallelogram with right angles and equal sides.
- A rhombus is an equilateral parallelogram. A square is a rhombus. It is a rhombus with all angles equal.
- As above, a rectangle (square) is always a parallelogram. This statement is sometimes true because a parallelogram is not always a rectangle.

Activity

The activity sheet provides space for learners to return to the activity in session A, building quadrilaterals with triangles. This time there is more choice as they are using dots on circles as their options. Encourage them to explore options and record information about the shapes they create.
Pack 3 Session D

**Activity:** Describing quadrilaterals

Draw another triangle to create a quadrilateral and label with information.

Build different quadrilaterals with two triangles and label with information.