Remote education lesson example: key stage 3 maths

October 2020

Example maths lesson for remote education

This lesson plan was provided by Cullompton Community College in collaboration with the National Centre for Excellence in the Teaching of Mathematics (NCETM) to help teachers consider how they might adapt their usual classroom practice for remote teaching.

Schools have shared a range of lesson plans annotated with tips and ideas they have found useful when teaching remotely.

The purpose of the lesson plans is to help teachers consider how they might adapt their teaching practice for the remote context. The examples are intended as a source of ideas, not as teaching resources or lessons the department expects schools to teach. They do not reflect departmental endorsement of any particular approach to remote teaching.

The department does not expect teachers to create formal lesson plans.

Lesson overview

This lesson is:

- for year 8
- lesson 3 of the module
- geometry - angles in polygons

Rationale and lesson outcomes

This lesson was planned as part of a series of lessons designed to develop pupils' understanding of angles in polygons in a coherent and meaningful way. The core knowledge for this lesson concerns the relationship between interior and exterior angles in polygons.

The lesson aims to ensure the pupils are able to:

- explain why the sum of the interior angle and adjacent exterior angle of a polygon is 180° (because angles that meet at a point on a straight line sum to 180°)
- explain why the sum of the exterior angles of a polygon is 360° (because when traversing the polygon, a complete turn is made)

Lesson context

I want pupils to understand the key point that the geometrical properties of shapes (and in particular properties of angles) are the result of reasoning and mathematical thinking and not just facts to memorise.

This influences my decision to plan a sequence of tasks which encourage reasoning and deduction. Pupils who have an understanding of this relationship and how it helps to find the sum of interior and exterior angles will retain the key facts they need in subsequent skills-based lessons and be able to solve problems.

The lesson is designed for coherence, not just within this lesson but across a series of lessons.

Angles

Pupils can:

- identify types of angles (acute, obtuse, reflex)
- measure and draw angles accurately using a protractor
- estimate angles with an appropriate degree of accuracy
- know that angles around a point sum to 360 degrees
- understand the angle sum of angles on a straight line

Angles in parallel lines

Pupils can:

- identify alternate, corresponding and co-interior angles
- identify vertically opposite angles
- apply several angle rules in a single question, giving reasons for their answer

Lesson structure

The structure of this lesson is similar to the normal structure of my classroom lessons. This is to continue familiarity with the established classroom routines in our school:

- start task
- review previous knowledge
- new knowledge
- review new knowledge

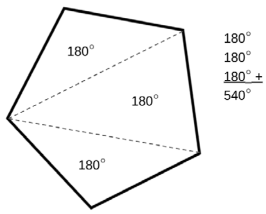
I'm conscious that written feedback can appear very formal. I want to keep my formative feedback as informal as it would be in the classroom (whether verbal or written). Pupils miss out on all my smiles and nods so lots of positive praise helps.

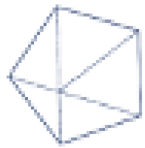
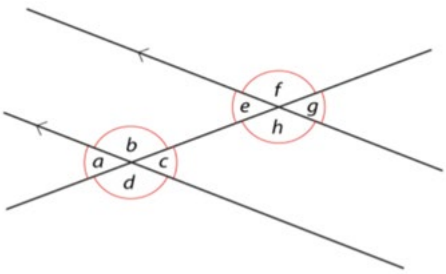
Adapting provision for remote education

Lessons aren't always exactly the same structure in the classroom and for me it's worked to mix up different lesson structures in remote education too. However, what pupils need to do and what they need to be thinking about must be even clearer than in the classroom.

It will be important to retain the same sort of atmosphere I would normally expect in my classroom. For example:

- focus on what needs to be learnt, allowing both teacher and pupil to be aware of progress made
- have a mix of individual thinking and group discussion
- give regular and frequent opportunities for reasoning, thinking practise and discussion
- involve formative as well as summative assessment
- be uncomplicated and easily understood (from both a planning and a teaching and learning point of view)

Task	Adaptation for remote teaching	Notes about adapted provision
Starter (10 mins) Starter: spaced retrieval practice. On whiteboards, pupils answer four questions: 1. Last lesson: What do the interior angles of a pentagon sum to? 2. Last week: Which (from 3 images of triangles) are isosceles? Explain your decisions. 3. Last term: Draw a representation of 2n + 3. Can you draw another? 4. Last year: calculate three quarters times one half. Can you represent this?	 Look at a picture of a regular pentagon and spend a few minutes thinking about the answers to these questions: • why is 180° written inside each triangle? • why have the three lots of 180° been added together? • what is the 540° the answer to? Now load the quizlet and	Pupils are used to instant, formative feedback during the starter. I want to maintain this expectation because this is key to the value of the starter task. **Quizlet** Reformatting this into a quizlet allows me to still add key representations and embed instant feedback within the starter, as I would do in school. Through discussion and focused questioning, draw pupils' attention to the fact that the sum of the 9 angles (3 in each of the 3 triangles) is exactly the same as the sum of the 5 interior angles of the pentagon. Use colour coding or similar to show this. Specifically address the misconception that any partitioning

	answer these questions.	of the pentagon into triangles will suffice, for example:  Highlight the importance of all lines being drawn from the same point. It's important that pupils understand the reason for this as well as memorising it as a fact.
Recap (20 minutes) In pairs, pupils write statements about pairs of angles. Take feedback. Use a visualiser to show a couple of pairs of related angles, using model answers. For example, 'd = e because corresponding angles on parallel lines are equal'. **Pupils write a statement about any pair of angles**  When they have written one statement, they should write another, and another. Select suitable pupils to feedback their answers, making sure that: ● all the different angles facts are discussed ● identical answers with	Pupils should do this on paper, perhaps as a stream in Google classroom. I then upload a video of my face or voice with a model answer. For example, 'd = e because corresponding angles on parallel lines are equal' Use model answers to: ● draw out all of the different angle facts ● highlight where correct answers can be arrived at through different reasoning	**Create familiarity** Pupils may not love me all year, but there is a nice familiarity about hearing my voice and seeing my face. My most successful lessons throughout lockdown, those with most engagement, have been the ones where I have made a video myself and not just relied on the Corbett maths man. I start the video with, 'Hello 8M4… I was so impressed with your work last week on…' This maintains positive relationships.

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<td>correct but different reasoning are discussed</td>
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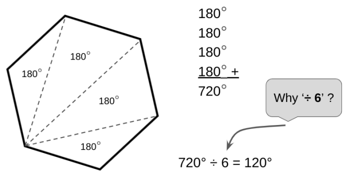
<td>Review of learning from the previous lesson: interior angles of regular polygons. Exemplify calculating the interior angles in a hexagon.

This includes a second opportunity (in addition to the start task) to review finding the sum of interior angles in a polygon - with the extra step of finding a single interior angle.</td>
<td>Show pupils an image of a pentagon with 4 lots of 180° added together. 720° has been divided by 6, which equals 120°



Google Classroom stream

Use a stream in Google Classroom to ask pupils:
why have 4 lots of 180° been added together?
why has 720° been divided by 6?</td>
<td>I need to make sure that I use consistent language and consistent representations throughout. I have found this is even more important when teaching remotely.

Ask, “what is the same and what is different between this example and the pentagon one earlier?”</td>
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<td>Think-pair-share task

This is a secondary mastery assessment materials question from the National Centre for Excellence in the Teaching of Mathematics (NCETM) with lots of formative assessment possible.

Recap the key attributes of behaving like a mathematician (hopefully using examples from so far in the lesson):
conjecture
explain</td>
<td>Share the document as a Google Classroom assignment. Display the picture with a speech bubble attached to allow pupils to submit their answers. This makes it easy to give individual feedback.

I anonymise (or make up my own) and post to the Google stream for others to refine publicly like we</td>
<td>Having all teaching and education resources accessible through one platform allows pupils to manage their workload and enables parents to have an overview of what is required each week.

This approach is based on feedback we had as a whole school after the first 6 weeks of offering remote education.</td>
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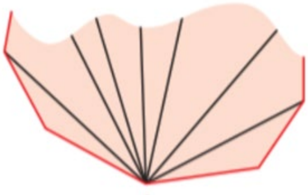
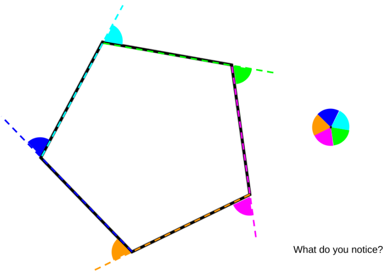
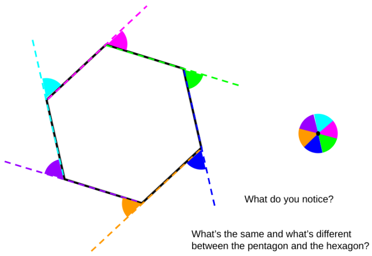
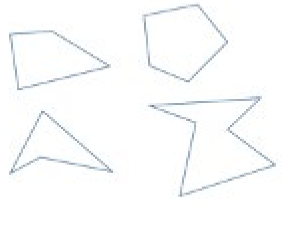
• reason • question • disagree  Show pupils a diagram that shows part of a polygon. This polygon has been divided into triangles by joining every vertex to point A. A part of the polygon has been torn off. How many edges did the polygon have originally? Pupils should explain how they know. Think, pair and share - monitor and then select pupils to answer.	would in the classroom.	
New knowledge (20 minutes) Show an animation of exterior angles of regular polygons. Remind pupils of expectations: • look • watch • think • notice Go through the animation again, with a reminder to notice again (nothing as a whole class yet).	I make a silent video animation of these slides on Screencastify (a free screen recorder for Google Chrome), so pupils can watch it at home as I would have shown it in class. **Google Classroom stream** Ask for responses through the Google Classroom stream. For example, what does the animation suggest about the exterior angles of a pentagon?	Give time to conjecture. To get rich questioning into online lessons, this has to have been well established previously in the classroom. **Refine and reflect** Not everything needs to be evidenced. I model my own thinking to the pupils.

		
Show the second part with a hexagon. Give plenty of silent thinking time at the end to muse on the similarities and differences. Question, then share as a whole class. Encourage agreement, disagreement and the refining of answers. Support and navigate discussion to notice that the sum of adjacent interior and exterior angles is 180° and make connection to previous learning that angles which meet at a point on a straight line sum to 180°.  Hands up for ideas, then cold calling for agreement and disagreement.	Ask what's the same and what's different? Pupils should note at least one of each and contribute to the Google Classroom stream.	
Review (10 minutes) This aspect of the lesson allows pupils the opportunity to summarise the key points from the lesson. It will be important to monitor how well pupils have	**Online survey** Offer the following questions as an online survey to gather class responses: • write down one thing	It's easy to scan these full-sentence responses for whole-class feedback. For example, 'what I noticed about what you noticed was…' **Google Classroom**

appreciated: - that exterior angles sum to 360°, irrespective of how many sides the polygon has (and why) - that for regular polygons this allows you to find the size of each exterior angle (and why) - that adjacent interior and exterior angles, in any polygon, sum to 180° (and why) - that this knowledge allows you to find the sum of the interior angles of any polygon and the size of each interior angle for any regular polygon - the mathematical thinking and reasoning skills that have been used to come to know these things Use the following prompts to guide a class discussion to summarise the lesson and gauge pupil understanding: Think like a mathematician - What do you know about the exterior angles of a polygon? - How does this link to the interior angles of a regular polygon? How does this help to find angles in a regular polygon?	you know about the exterior angles of a polygon - write down one thing that you know about the interior angles in a pentagon - make up a question involving a pentagon which uses this knowledge and answer it	I offer summary comments as an announcement in Google Classroom as I would normally do after taking their books.
Review of knowledge from this lesson	**Complete the sentences** Pupils should write out and complete the following sentences: when I add any interior angle of a	Another opportunity to make connections explicit to pupils. For example, 'what you learned yesterday helped you understand this …' I want something to summarise the

	regular polygon to an exterior angle of the same regular polygon the sum of those two angles will be… ● this is because… ● the sum of the exterior angles of a polygon is… Maybe create an exemplar mind map, including 'focusing skills I've used as a mathematician today' as well as subject specific content. This contains all the things I would have said to them in the classroom to signpost them to their development this lesson.	core knowledge from this lesson to replace the whole-class statement we would have constructed together in school.
Additional tasks Summative information	This is an additional activity from our school's online resource bank which is trackable. Pupils match polygons to their descriptions. Summative information for me as an overview of class progress.	The way the feedback is structured both here and in the Google Form makes it really easy to see who has engaged with the lesson this week. I can also see from here who hasn't engaged for a couple of lessons, or weeks, in a row. I can refer this to a head of year or link person so they can do a safeguarding check-in to see if the individual needs additional support.
Extend learning to new situation.  The teacher displays a picture of		Send this out as a homework task.

4 irregular polygons. Pupils answer the following questions: ● what would the exterior angle sum of these irregular polygons be? ● does this help to find the individual interior angles? Why or why not? ● does this help to find the interior angle sum? Why or why not?		

Annex: Additional information

References

The following resources were used by the teacher who created this lesson plan to inform its contents:

- DfE Mathematics programme of study: key stage 3
    - apply the properties of angles at a point, angles at a point on a straight line, vertically opposite angles
    - understand and use the relationship between parallel lines and alternate and corresponding angles
    - derive and use the sum of angles in a triangle and use it to deduce the angle sum in any polygon, and to derive properties of regular polygons
- NCETM Mastery Professional Development materials 6.1

6.1.1.1 Understand that a pair of parallel lines traversed by a straight line produces sets of equal and supplementary angles

6.1.1.2 Know and understand proofs that in a triangle, the sum of interior angles is 180 degrees

6.1.1.3 Know and understand proofs for finding the interior and exterior angle of any regular polygon

6.1.1.4 Solve problems that require use of a combination of angle facts to identify values of missing angles, providing explanations of reasoning and logic used

- Angles in Polygons
    - Understand the angle sum of angles in a triangle
    - Calculate the interior angle sum of any polygon
    - Calculate one interior angle for a regular polygon
    - Calculate an exterior angle of a regular polygon
- NCETM’s five big ideas in Teaching for Mastery
- NCETM secondary assessment materials
- 100 questions that promote mathematical discourse
- Improving Mathematics in Key Stages Two and Three – Recommendation Summary (EEF)
- Seven recommendations for teaching self-regulated learning & metacognition