Pythagoras' Theorem (50 minutes)

Industry Participant

Ideal Industry Participant:
A confident Project Manager or someone who has site experience, potentially someone who is at the start of their career and the students can relate to.

Example Job Titles:

Apprentice/Graduate Quantity Surveyor

Apprentice/Graduate Site Manager

Description

This session aims to get students thinking about how their maths studies relate to the world of work. It includes a practical 'setting out' activity that tackles Pythagoras' Theorem and the importance of right angles in construction. The activity is supplemented by worksheet-based calculations.

What Year Group or Key Stage is the session targeting?

This session should be delivered to KS3 students.

Maximum number of students?

30 students.

What is the goal of the session?

To bring students' maths learning to life in the context of site-based construction work and to raise students' awareness of careers within construction and routes into the industry.

Role of the Industry Participant

The industry participant will deliver the session and manage activities.

Resource Checklist

USB
Hard copy of PowerPoint
Electronic copy of PowerPoint
Resource 1 Pythagoras' Theorem booklet – print as booklet
Resource 2 Pythagoras's Theorem PowerPoint
Pencils
Paper
Ruler
Clipboards
Tape measure
Meter rule

Blue-tac
String
Scissors
Road measurer (depending on the size of the room the session will take place in)

Facilities Required from School

- Computer and projector in classroom to deliver a PowerPoint presentation.
- The session could be adapted to take place in a larger room/school hall. The practical activity is intended to be desk-based, but it may have an even greater impact if it was carried out on a larger scale using the floor space of a school hall. See the Timings section below for details on how to do so.

Learning Objectives:

Learners will be able to…

- Understand how their maths learning can and will apply to their future careers
- Show accurate measuring skills
- Show calculating skills
- Understand the relationship between Pythagoras' Theorem and right angles

Gatsby Benchmarks	National Curriculum Links
Gatsby Benchmark 2: Learning from Career & Labour Market Information (LMI). Gatsby Benchmark 4: Linking curriculum learning to careers. Gatsby Benchmark 5: Encounters with employers and industry employees.	1. Students will use integer powers and associated real roots (square, cube and higher), recognise powers of 2, 3, 4, 5 and distinguish between exact representations of roots and their decimal approximations. They will also use the four operations and apply them to integers and decimals. 2. Students will substitute numerical values into formulae and expressions. 3. Use and interpret algebraic notions, including a^2 replacing a x a. 4. Change freely between related standard units (time, length, area, volume, mass). 5. Use the standard conventions for labelling the sides and angles of triangle ABC. 6. Derive and illustrate properties of triangles. 7. Apply angle facts, triangle congruence, similarity and properties of quadrilaterals to derive results about angles and sides, including Pythagoras' Theorem and use known results to obtain simple proofs.

	8. Use Pythagoras' Theorem and trigonometric ratios in similar triangles to solve problems involving right-angled triangles. 9. Interpret mathematical relationships both algebraically and geometrically.

Teaching Strategies

Real Life Links: Activity focused on real-life duties of a Project Manager.

Visual: Estimation activity uses visual demonstrations to explain techniques.

Kinaesthetic: Practical measuring task is main focus of the session.

Auditory: Instruction provided verbally throughout.

Risk Assessment

Check with school regarding their DBS policy.

Students will be working with sharp edges – use of scissors and tape measures.

Students will be working with string – potential to cause harm if misused.

Duration	Tutor/Industry Participant Activity	Learner Activity	Resources
5 minutes	Slides 1-6: Industry participant to deliver Overview of Construction presentation. This is to provide students with an insight into the industry and information on the range of careers that are available. Edit Slide 3: All About Me After this slide, insert a new slide with images of projects that you and your company have worked on so students can find out more about your work.	Listen to introductions	Resource 2 Pythagoras' Theorem PowerPoint
2 minutes	Industry participant to hand out student workbooks and instruct students to focus on the first page which introduces Pythagoras himself. Ask the students if they have heard of Pythagoras or his theorem and take answers. Then proceed to read	Raise hands and answer questions when prompted. Read along and listen to facilitator reading.	Resource 1 Pythagoras' Theorem booklet Pg.1

	out the information on this page of the workbook.		
3 minutes	Before students turn to page 2 of the workbook, explain that square numbers are very important to Pythagoras' Theorem. Slide 12: Then, use slide 12 of PowerPoint to go through the questions below – ask for student participation to answer the questions. Animations will reveal the answers on the PowerPoint slide. The questions and answers: • What is a square number? The product of a number multiplied by itself. • What is the inverse of squaring a number? Finding the square root of a number. • What is the first square number? 1. (1 multiplied by itself = 1). • What is the fourth square number? 16. (4 multiplied by itself = 16). • What is the twentieth square number? 400. (20 multiplied by itself = 400) • What is the square root of 64? 8. (8 multiplied by itself = 64)	Raise hands to answer questions when prompted.	Resource 2 Pythagoras' Theorem PowerPoint
5 minutes	Next, instruct the students to turn to page 2 in the booklet, entitled 'Square Thinkers' Explain that you will be pose a problem to the students around square numbers. Then read out the content on page 2 of the handout. Ask the class the question at the bottom of the page and get students to shout out their ideas.	Raise hands to answer questions when prompted.	Resource 1 Pythagoras' Theorem booklet Pg.2 Resource 2 Pythagoras' Theorem PowerPoint

	If students do not grasp the question right away, tell them to look at the bottom of the page, and ask them to think about it using the blank formula i.e. *blank* squared + *blank* squared = *blank* squared. Ask the students "which three numbers would make this formula work?" Slide 13: The first set of numbers the students should have come up with is 3, 4, and 5. Prove that this works using slide 13 of the PowerPoint. This slide spells it out by showing that: 9 + 16 = 25 Tell the students that any multiples of these numbers (e.g. 6, 8, and 10) would also have worked.		
5 minutes	Instruct the students to turn to page 3 of the student handout and explain that you will now introduce Pythagoras' Theorem. Read out the sentence at the top of this page. If you sense that students are not understanding, rephrase it like so: "Any triangle whose side lengths are all multiples of 3, 4, and 5, will be a right angle triangle." If necessary, clarify that a right angle triangle is one which contains a 90 degree angle. Then read out the second part of this page – beginning "So, the most simple example is…" Explain that a triangle with three sides which are 3cm, 4cm, and 5cm long will therefore be a right angle. Encourage the students to look at the example triangle at the top-right of the page and explain that we can call it a "3, 4, 5 triangle." Then read out the two sentences below the bullet points and explain that the 3, 4, 5 rule also works with	Listen and ask questions if anything is unclear.	Resource 1 Pythagoras' Theorem booklet Pg.3

	triangles which haves sides that are all multiples of 3, 4, and 5. Then read out the examples in blue. Encourage students to look at the example triangle at the bottom of the page, and explain that sides with these three lengths (6cm, 8cm, and 10cm) will always be right angles – because of Pythagoras' Theorem.		
10 minutes	Instruct the students to turn to page 4 of the student handout. Explain to the students that you will now explain the second part of Pythagoras' Theorem. Read through this in the worksheet handout, which explains the formula $a^2 + b^2 := c^2$. Ask the class to raise their hands to answer the question at the bottom of page 3. It may be necessary to give the students a moment to write down their workings for this question. If no student can answer quickly, provide the below answer and explanation: Length of side c: 15cm Hopefully students will shout this out quickly, due to the fact we have just discussed using multiples of 3, 4, and 5. If not, explain that that the given lengths, 9 and 12, are multiples of 3 and 4 – 3x3 is 9 and 3x4 is 12. Therefore, 3 times the remaining number (5) gives 15. So, c = 15cm. Explain to the students that they can check this number using the formula $a^2 + b^2 = c^2$: $9^2 + 12^2 = 225$. $c^2 = 225$ $c = \sqrt{225}$ $c = 15$	Listen and participate in answering questions when called upon.	Resource 1 Pythagoras' Theorem booklet Pg.4

5 minutes	Instruct students to turn to page 5 of the handout. Explain that now they are going to take part in a practical session. Read out the first two sentences on this page, and encourage them to step into the shoes of a member of Josh's team. If the industry participant is a project manager, then you can remind the students of what they were told about the role of a project manager. Tell the students that they are helping Josh plan out the shape of a house – it is very important that the houses have four perfect right angles. Using the 3, 4, 5 rule, they are going to create a two right angled triangles to form a perfect rectangle. It is important that they use 3, 4, 5 triangles, as doing so is the only way that students will know that they have created exact right angles. Ask the students: "How can we create a perfect right angle using triangles?" Take answers and potentially spell it out with drawings on the whiteboard if they are unsure. Tell the students that they will be using string, scissors, and blue tack to create their triangles and show them the image on the bottom of page 5, which is an example of a finished rectangle. Slide 15: Inform the students that they will now watch a video to illustrate the practical activity. Play the video using slide 15 of the PowerPoint.	Listen to introduction of practical task and think about how 3, 4, 5 triangles work in real life.	Resource 1 Pythagoras' Theorem booklet Pg.5 Resource 2 Pythagoras' Theorem PowerPoint
10 minutes	Instruct students to turn to page 6 of the handout.	Listen to explanation of task.	Resource 1

	Demonstrate how to safely use scissors and tape measure – show them show to hold the tape measure at certain distances. Tell the students to be sure that they are not looking at the inches side of the tape measure when taking their measurements – they are to use centimetres. Slide 16:Read out the step-by-step instructions to the task. Also display them to the class using slide 16 of the PowerPoint: 1. To create a perfect right-angle triangle, you need to construct a 3, 4, 5 triangle. 2. So, cut your lengths of string into 30cm, 40cm, and 50cm using your tape measure and scissors. 3. Use blu-tack to secure the sides of the triangle to the table tightly. Hand out 3m of string to each pair. Hand out a pair of scissors to each pair. Hand out a tape measure to each pair. Hand out a decent amount of blu-tack to each pair. Instruct the students to begin constructing their rectangles, and supervise throughout.		Pythagoras' Theorem booklet Pg.6 Scissors, string, blu-tack, ruler, calculator Resource 2 Pythagoras' Theorem PowerPoint
5 minutes	Rounding up the session: When students are finishing, begin to hand out protractors so they can measure the right angles they have created. Some students may require an explanation as to how to use them.	Check that they have created perfect right angles and think about how they were able to do so without using a protractor to	Protractors

	At this point, explain to students that the only way that they could have created their perfect right angles without a protractor is by creating a 3, 4, 5 triangle – because 3, 4, 5 triangles are always right-angle triangles. Instruct students to stop working, and tell them that you will now talk about the importance of right angles in construction. Slide 17: Bring up the final slide of the PowerPoint and ask the students the questions that are up there. Take suggestions and ideas. Then the industry participant can explain why right angles are so important in construction, and talk about why students are seeing so many right angles around the classroom. Right angles ensure that buildings have even surfaces, which ensure pleasing design and personal safety for people within buildings. This is why it was so important that you helped Josh by creating two 3, 4, 5 triangle, which is the only way you could have ensured that you created a rectangle with four exact right angles.	create their rectangles.	Resource 2 Pythagoras' Theorem PowerPoint
5 minutes Extension – if needed minutes	If individuals, or the whole group, finishes early, move on to the worksheet-based activity on page 7 of the handout. IP either to explain activity to finished individuals, or to the entire group if appropriate. Read through the questions on page 7 and ask the students to work out the calculations in questions 1 and 2. Answers and explanations below:	Listen to instructions and carry out questions.	Resource 1 Pythagoras' Theorem booklet Pg.7

	1. 4 and a half homes. To work out how fast the homes need to be built, divide 6 (the number of homes needed) by 8 (the number of months allowed). This gives you 0.75, the number of homes that needs to be built each month in order for the deadline to be met. You know that the work is currently on track, so multiply 0.75 by 6 (the number of months which have passed) to work out how many homes have been built = 4.5. 2. 1 month after the deadline. The full workforce was delivering the homes at a rate of 0.75 per month. So, as the workforce is now 2/3 as big, it will only be able to deliver homes 2/3 as quickly. 2/3 of 0.75 is 0.5, so the new rate of homes built per month is 0.5. There are 1.5 houses still to build, meaning the remaining work will take 3 months to complete. This would mean the project lasts 9 months, which is 1 month longer than the arranged deadline.		

To-Do List	
<u>Before Session:</u> • Check with teacher whether they wish to allow the students to use calculators during the session. Request that the session take place in a good sized classroom • Print all resources before you arrive to the school • Go over the session plan. • Make sure the relevant files are on a USB/sent to the school contact	<u>After Session:</u> • Collect in resources at the end of the session.

Hints & Tips
Here is the type of question that you may get asked in the Q&A: o What do you do on a daily basis? o How did you get into your career? o How much do you get paid? o What are the best and worst things about your career? This session is intended for higher Year 8 sets or lower Year 9 sets.
Delivery Management
• The session could be delivered by one industry participant • The teacher will handle behaviour management • Refer to 'How To Contextualise Curriculum' for more guidance on how to deliver this session