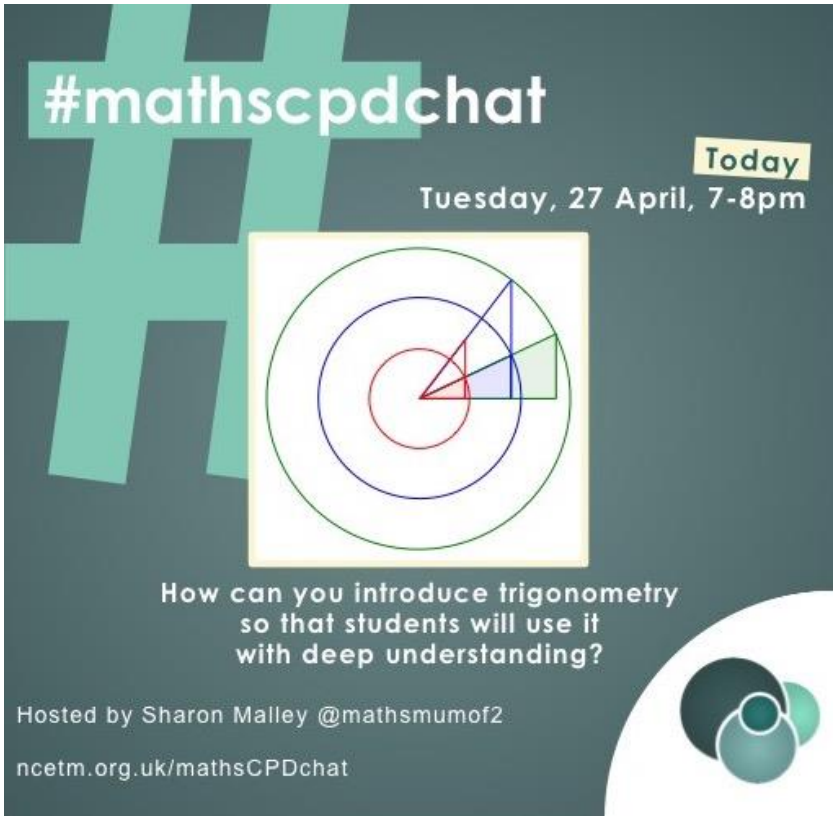
#mathscpdchat 27 April 2021

How can you introduce trigonometry so that students will use it with deep understanding?
Hosted by Sharon Malley:

This is a brief summary of the discussion – to see all the tweets, follow the hashtag ***#mathscpdchat*** *in Twitter*



Among the links shared during the discussion were:

SOHCAHTOA the curse of the expert? which is an article by Izzie Bryant in *Mathematics Teaching 276* from the ATM. The author reflects on taking a different approach to teaching trigonometry. It was shared by Sharon Malley

Round and Round a Circle which is an animation by NRICH. The aim is for learners to look in detail at the underpinning structure of the animation. They can examine the relationships

between the ratios of sides of right-angled triangles, and see how those ratios vary over changing angles. It was shared by Sharon Malley

Why might the word 'ratio' cause confusion for students learning trigonometry? which is an NCETM article by Gwen Tresidder in which she reflects on how, and maybe why, the word 'ratio' often seems to puzzle students when they first encounter trigonometry. It was shared by Sharon Malley

Mastery Professional Development: 3.2 Trigonometry which is an NCETM PDF guidance document for teaching trigonometry in Key Stage 3. It was shared by Sharon Malley

MEI Deeper Maths Trigonometry which is one of MEI's first new *Deeper Maths* units (suites of resources) that are presently being designed to support excellent practice in the teaching of secondary maths to all students. It was shared by Mary Pardoe

Exact trigonometric values which is a part of *Median* (which is the collection of Don Steward's lovely original resources for teaching maths) that contains some of his materials that support students in learning to use trigonometry. It was shared by Mary Pardoe

Grid geometry angles, using arc tan which is another part of *Median* (which is the collection of Don Steward's lovely original resources for teaching maths). It aims to demonstrate how in some circumstances using the tangent of the angle as a measure of the size of the angle can be better than using a protractor! It was shared by Mary Pardoe

Graphing Sine and Cosine using the Unit Circle which is a GeoGebra application by krschreck. Users can choose to trace either or both of the curves of Sin(x) or Cos(x). It was shared by Lee Overy

Trigonometry: choosing the correct trigonometric ratio which is on Craig Barton's *Variation Theory* website. It was shared by Alice Ward-Gow

Teaching Trigonometry which is a blog post on Jo Morgan's large award-winning collection of *Resourceaholic* blog posts. It was shared by Zeenat Kokate

Monkman & Seagull's Genius Guide to Britain on Trigonometry which is a YouTube video in which the use of trigonometry in calculating the heights of tall outdoor things (such as towers and buildings) is demonstrated. It was shared by Zeenat Kokate

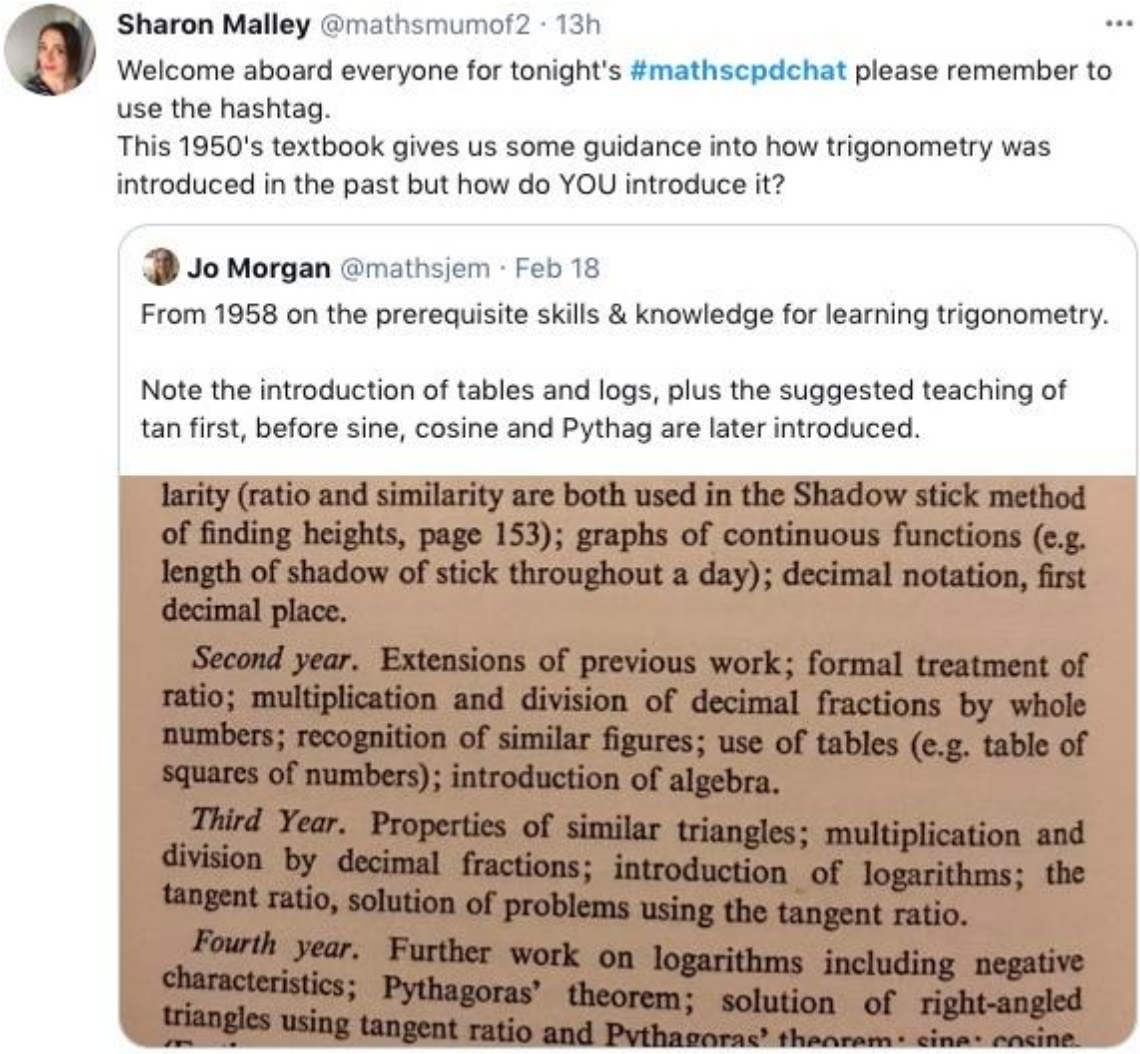
Mathematical Hooks which is a collection of starting experiences for maths learning episodes. It has been created and shared by Julia Smith

History of Trigonometry which is a Wikipedia page. It was shared by Heather Scott

Map of a Nation: A Biography of the Ordnance Survey which is a book by Rachel Hewitt. It was shared by Catherine Edwards

The screenshots below, of chains of tweets posted during the chat, show parts of the conversation that developed about various ways of introducing trigonometry and then beginning to go further. **Click on any of these screenshots-of-a-tweet to go to that actual tweet on Twitter.**

The conversations were generated by this tweet from Sharon Malley:



and included these from Mary Pardoe, Heather Scott, David Helsby, Sharon Malley, Lee Overy and Mr Williams:

Mary Pardoe @PardoeMary · 12h

Replying to @mathsmumof2

This is a summary of MEI's Deeper Maths approach ... #mathsCPDchat

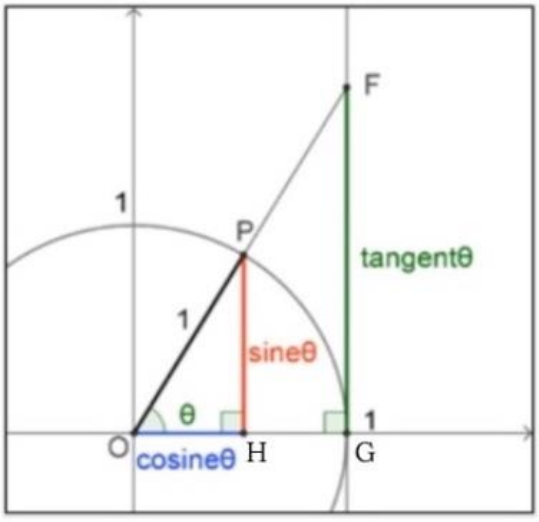
Unit circle There are a number of different ways of introducing trigonometry. For example, 'nested triangles' or "SOH CAH TOA". In these materials we have chosen the unit circle approach because of its strengths in supporting an experience of mathematics as a network of connected ideas, its accessibility via visual representations and its applicability to higher tier and post-16 concepts.
This approach is explained in greater detail in the unit and lesson overviews.

Mary Pardoe @PardoeMary · 16h

Replying to @PardoeMary and @mathsmumof2

... this image ...

... the MEI Deeper Maths trig unit summary which it's from ... so far developed ... is here:
meideepermaths.podia.com



Heather Scott @MathsladyScott · 11h

The visual experience of the dot travelling around the circle and measuring the height at different angles is also an interesting staring point #mathscpdchat

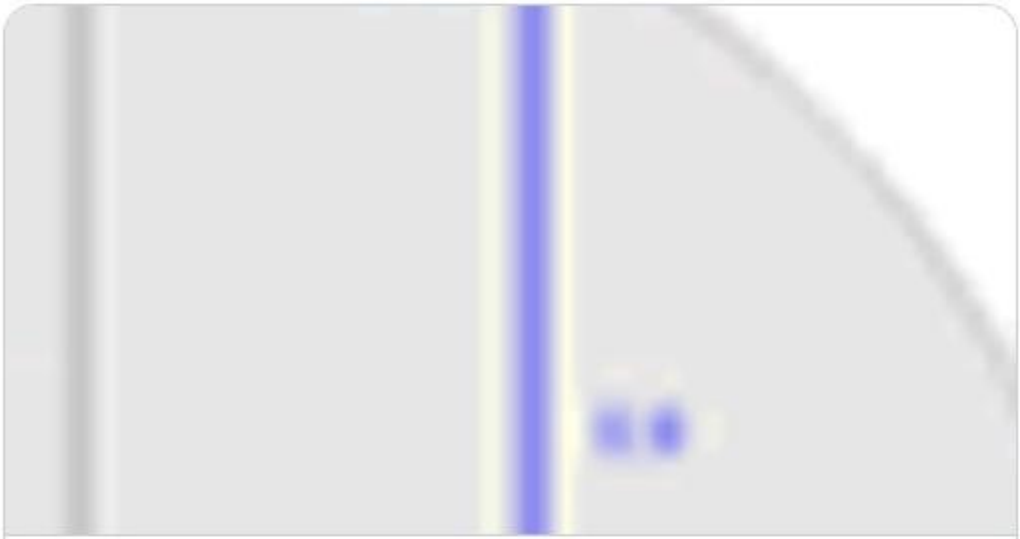
Mr Helsby @MrHelsbyMaths · 16h

Replying to @MathsladyScott @PardoeMary and @mathsmumof2

Ironically we do spend a while staring at the (moving) dot as a starting point when using unit circle (geogebra is my favourite tool for this!) #mathscpdchat

Sharon Malley @mathsmumof2 · 11h

@nrich have a fabulous animation that @ibryantmaths references in her @ATMMathematics journal article this month nrich.maths.org/6084. It builds really gradually #mathscpdchat



Round and Round a Circle

Can you explain what is happening and account for the values being displayed?

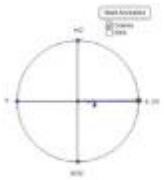
nrich.maths.org

Lee Overy @Lwdajo · 17h

Replying to @MathsladyScott @PardoeMary and @mathsmumof2

Which can be plotted to create a sine and cosine wave:
geogebra.org/m/G9mjcC7D

#mathscpdchat



Graphing Sine and Cosine using the Unit Circle

This is a modification of the GeoGebra applet created by Winzeler_BASIS. Thank you!

geogebra.org

Mr. Williams Maths @MathsImpact · 17h

Replying to @MathsladyScott @PardoeMary and @mathsmumof2

I've never tried striking with circles at GCSE, but at A level I always revisit trig though the lens of the unit circle.
Sin and cos as coordinates, and tan as the gradient of the radius is incredibly helpful once you move beyond triangles and need multiple results.

these from Catherine Edwards, Heather Scott, Gemma Scott and Mary Pardoe:

Catherine Edwards @Edwards08C · 18h

I've always done similar shapes , then ratios one at a time. I'm considering changing the order and doing procedures first then why it works. Want to work in trig tables too #mathscpdchat

Heather Scott @MathsladyScott · 17h

#mathscpdchat - must admit I spend quite a time on naming the sides for different given angles so that this doesn't hold us up when doing the similar triangles (usually draw three to one page) + link to sin cos and tan tables 😀

Director of Maths @DirectorMaths · 11h

🙋 I'm also doing purposeful practice of naming sides and selecting the right ratio before launching into calculating #mathscpdchat

Mary Pardoe @PardoeMary · 11h

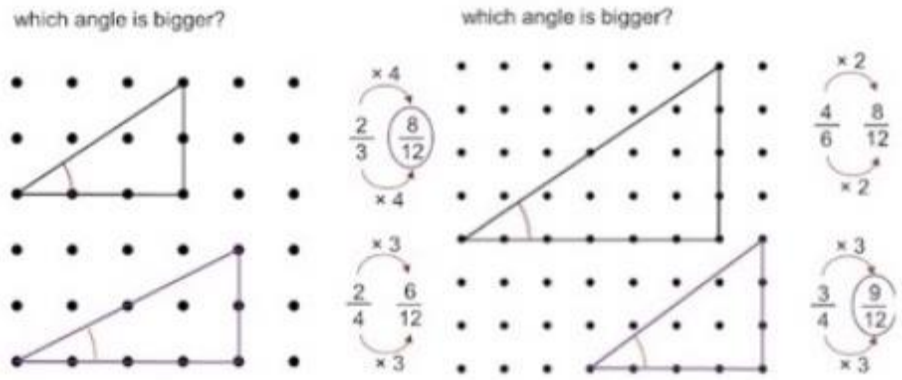
Don Steward's resources include some lovely tasks ... e.g. this, from here:
donsteward.blogspot.com/search/label/g...

grid geometry angles, using arc tan

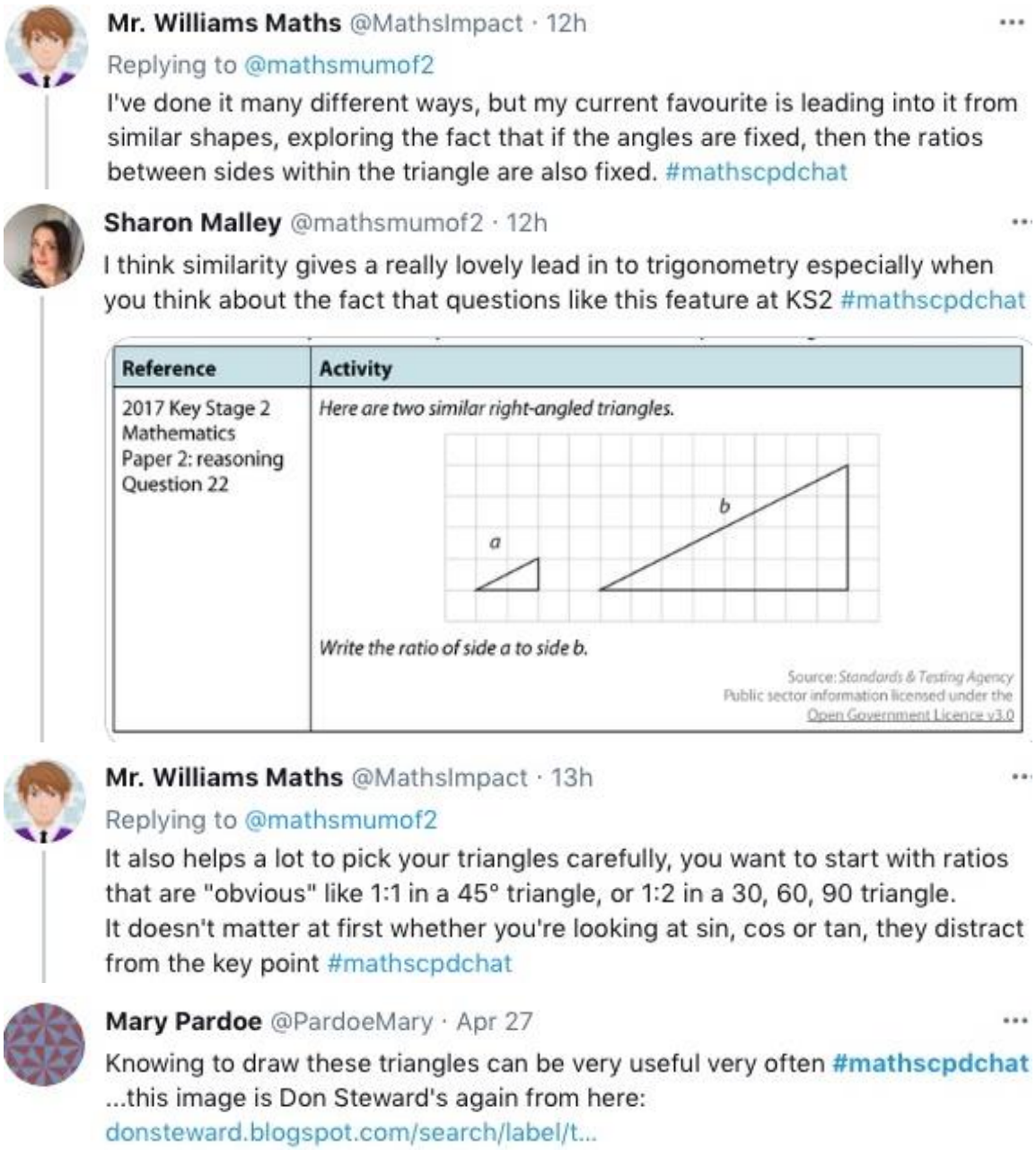
using the tangent of the angle as a measure of the size of the angle
is better than a protractor!
convert an angle into a fraction (inv tan (rise / run), possibly by summing or subtracting) - so that it can be compared in size with other grid angles (i.e. as fractions)

a powerpoint is here

this presentation was part of a session in London, joint ATM/MA on march 16th 2019 and was intended to illustrate how a square grid might be helpful in geometry, an idea proposed by van Hiele in 1986 ('structure and insight') following the research of Dina and he from 1957 onwards



these from Mr Williams, Sharon Malley, Mary Pardoe, Mrs Kilty, David Helsby, Dan Pearcy and Nicholas Anscombe:



Mr. Williams Maths @MathsImpact · 12h

Replying to @mathsmumof2

I've done it many different ways, but my current favourite is leading into it from similar shapes, exploring the fact that if the angles are fixed, then the ratios between sides within the triangle are also fixed. #mathscpdchat

Sharon Malley @mathsmumof2 · 12h

I think similarity gives a really lovely lead in to trigonometry especially when you think about the fact that questions like this feature at KS2 #mathscpdchat

Reference	Activity
2017 Key Stage 2 Mathematics Paper 2: reasoning Question 22	*Here are two similar right-angled triangles.* *Write the ratio of side a to side b.* Source: *Standards & Testing Agency* Public sector information licensed under the Open Government Licence v3.0

Mr. Williams Maths @MathsImpact · 13h

Replying to @mathsmumof2

It also helps a lot to pick your triangles carefully, you want to start with ratios that are "obvious" like 1:1 in a 45° triangle, or 1:2 in a 30, 60, 90 triangle.
It doesn't matter at first whether you're looking at sin, cos or tan, they distract from the key point #mathscpdchat

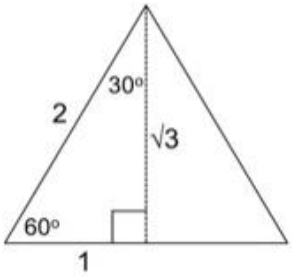
Mary Pardoe @PardoeMary · Apr 27

Knowing to draw these triangles can be very useful very often **#mathscpdchat**
...this image is Don Steward's again from here:
donsteward.blogspot.com/search/label/t...

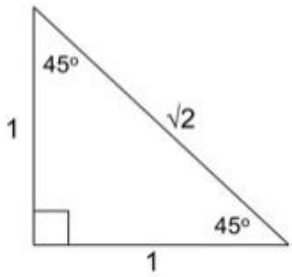
exact trigonometric values

two famous triangles

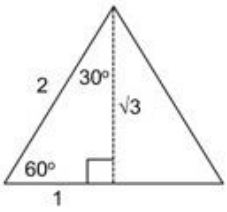
an equilateral triangle

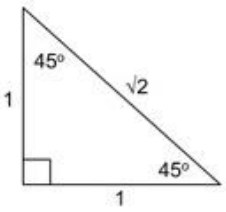


an isosceles, right-angled triangle



exact values in trigonometry





angle	sin	cos	tan
0°			
30°			
45°			
60°			
90°			

Sharon Malley @mathsmumof2 · Apr 27

Replying to @PardoeMary

They are always my go to for the exact trig values. #mathscpdchat

Mrs Kilty @MrsKilty · Apr 27

Replying to @PardoeMary

I loved using the triangles as a student when feeling the pressure of an exam. Just to be sure I'd got the values correct. #mathscpdchat

Mr Helsby @MrHelsbyMaths · Apr 27

So much value in using these; linking to similar shapes, pythagoras, surds... All without resorting to meaningless memorisation **#mathscpdchat**

Dan Pearcy @DanielPearcy · Apr 27

Replying to @PardoeMary

I liked just the small change from @VMN_alex - cut an equilateral triangle in half and cut a square in half. #mathscpdchat

Nicholas Anscombe @NickyAnscombe · 19h

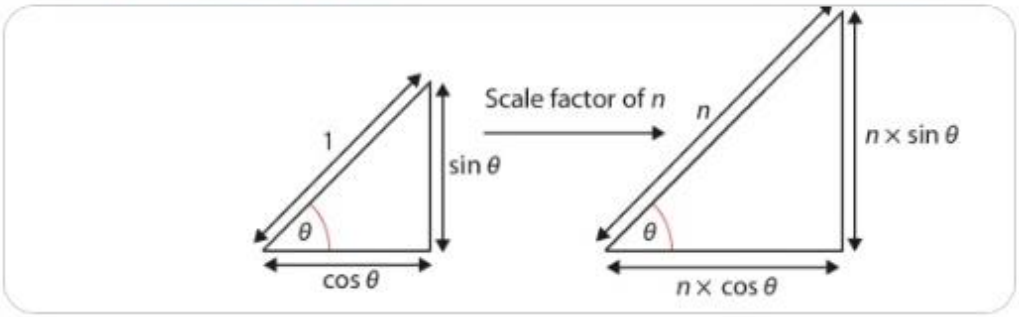
Used them today and it really helped!

these from Sharon Malley, Mr Williams, Heather Scott and Zeenat Kokate:

Sharon Malley @mathsmumof2 · 16h

Replying to @MathsImpact

Then you can build up the scaling? The NCETM guidance ncetm.org.uk/media/11qbq2zu... has these diagrams within it #mathscpdchat



Mr. Williams Maths @MathsImpact · 16h

Yeah, start with some concrete numbers and generalise, then if we're looking at the 1:2 ratio drop in the question, "what about the other side of the triangle, I wonder what that is..." then we can start to meet those weird new sin cos tan things...

Heather Scott @MathsladyScott · 13h

#mathscpdchat - for a higher group they draw their own triangles all with different angles and compare their results to what is in the tables of sin cos and tan values. 😀

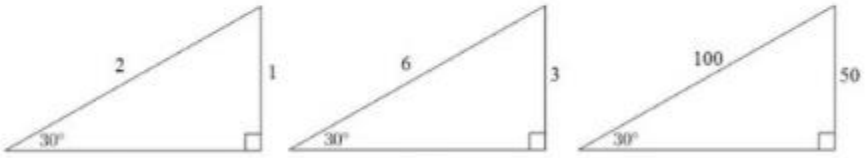
Zeenat Kokate @zee_k20 · 13h

Replying to @mathsmumof2 and @MathsImpact

Similar triangles - I like this approach from @mathsjem as a way of introducing trigonometry resourceaholic.com/2014/10/trig.h...

Introducing trigonometry with similar triangles

When I introduce trigonometry I usually get my students to measure triangles and look for patterns (like this activity from Teachit Maths). Next time I introduce trigonometry, I'm going to try something a bit different. I'll show students these three triangles and ask what they have in common:



(not drawn to scale)

I hope they'll spot that they are similar triangles and that the ratio of the height to the diagonal is 1:2 (this would be a good time to introduce the terminology opposite:hypotenuse).

and these from Catherine Edwards, Mr Williams and Sharon Malley:

Catherine Edwards @Edwards08C · 16h

Replying to @Edwards08C @mathsmumof2 and @MathsImpact

In general I'm focusing more on the ratio/fraction/percent/proportion relationship's. I was saying today we could easily spend all of y7 and 8 playing with this and set up really well for GCSE. #mathscpdchat

Mr. Williams Maths @MathsImpact · 16h

Replying to @Edwards08C and @mathsmumof2

I think it tends to be the ratio that's the main issue.
Students often meet it in the 2:3 format, and don't make the proportional connection well enough to transfer the idea.

Sharon Malley @mathsmumof2 · 16h

Replying to @Edwards08C and @MathsImpact

This lovely article on the @NCETM website ncetm.org.uk/features/why-m.. by @GtGwentr examines why 'ratio' might cause an upset. #mathscpdchat

Why might the word 'ratio' cause confusion for studen...
After watching how a Shanghai teacher approaches it, Gwen Tresidder reassesses her own understanding
ncetm.org.uk

(to read the discussion-sequence generated by any tweet look at the 'replies' to that tweet)