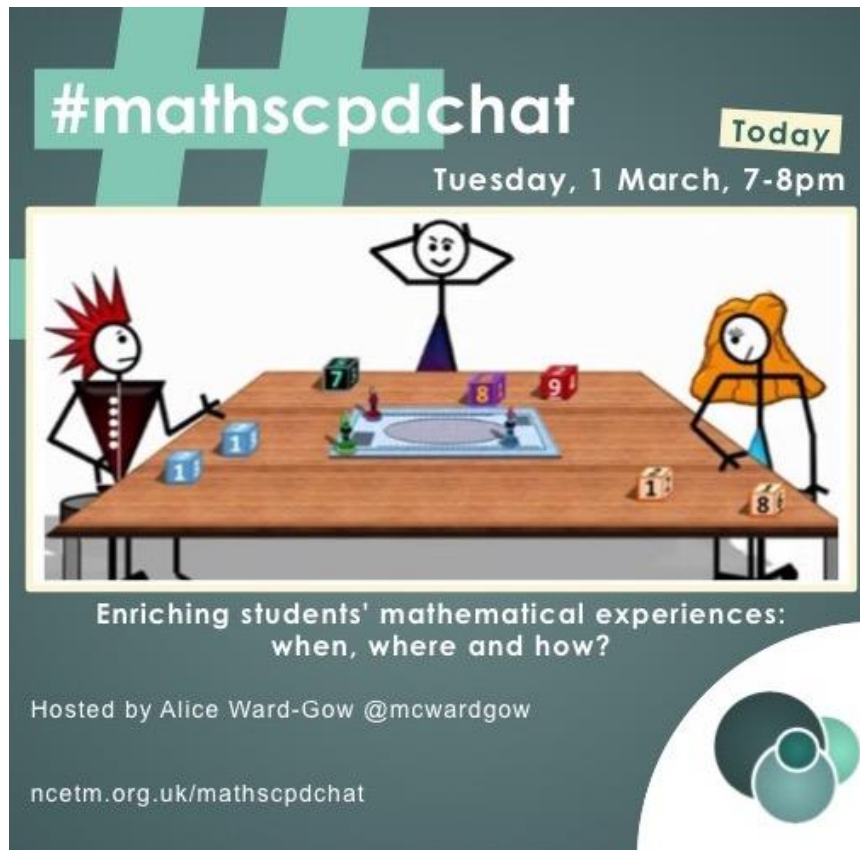# #mathscpdchat 1 March 2022

Enriching students' mathematical experiences: when, where and how?

Hosted by [Alice Ward-Gow](#)

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

The links shared during this discussion were:

[MESME](#) (Mathematics Education for Social Mobility and Excellence) which is an organisation recently established to support students from all backgrounds to achieve mathematical excellence. MESME is presently developing and launching [Maths Circles](#) across the country for students aged 11-16, who come together to grapple with intriguing questions, discover and explore exciting ideas and learn to think like mathematicians. It was shared by [MESME](#)

[Maths is Just Out of This World](#) which is an article in the George Pindar School newsletter (February 2022). It describes the experiences of Year 10 students when, recently, they took part in an ongoing

[webinar](#) (provided by the AMSP, and which at the time of writing students can still join) about some mathematics of space. It was shared by [Alice Ward-Gow](#)

[Snail Race](#) which is an attractive interactive applet from Transum. Players 'roll' two dice, and snails race across a field according to the total score on the dice. It was shared by [Alice Ward-Gow](#)

[Sketchpad](#) which is a collection of a wide variety of resources to support the teaching and learning of mathematics, designed and created by [Charlotte Hawthorne](#). It was shared by [Charlotte Hawthorne](#)

[Artful Maths](#) which contains links to videos that show how to create very many different 'maths-art-objects', such as Celtic Knots, Curves of Pursuit, Fractals, Islamic Art Patterns, and so on. It was shared by [webmathscouk](#)

[Focus on...non-transitive dice](#) which is an illustrated article about using non-transitive dice to support learning about probability. It contains the link to an [illustrated article by James Grime](#) and a [video](#) in which James Grime (SingingBanana) and David Spiegelhalter work with, discuss and explain much of the mathematics of non-transitive dice. It was shared by [Mary Pardoe](#)

[Animated Penrose Tiling](#) which is an animation showing a non-periodic Penrose tiling. It was shared by [Mary Pardoe](#)

[Focus on...perfect shuffles](#) which is an illustrated article about shuffles. It was shared by [Mary Pardoe](#)

A full illustrated summary of the discussions in this #mathsCPDchat follows.

Alice's first question …

Miss Ward-Gow @mcwardgow · Mar 1   •••
Let's start with an easy question…
1) What's your favourite part of maths to teach? 🙃
#mathscpdchat

… generated several conversations, including this one about using algebra tiles …

Catherine Edwards @Edwards08C · 17h   •••
Replying to @mcwardgow
I have a new love of completing the square since I discovered algebra tiles
#mathscpdchat

Miss Ward-Gow @mcwardgow · 17h   •••
How often do you use algebra tiles? 😃 #mathscpdchat

Catherine Edwards @Edwards08C · 17h   •••
Last year lots, this year not so much with my current timetable. Although I have just got my hands on a proper set instead of the laminate card ones I've been using. #mathscpdchat

Miss Ward-Gow @mcwardgow · 17h   •••
What's changed on your timetable? 🙂 Nice 😎 I do like the online ones, but i've found that some students prefer physical tiles so that they can move them around #mathscpdchat

Catherine Edwards @Edwards08C · 17h   •••
Moved to SLT so less classes, one of them is a numeracy group, then the way the curriculum has fallen I haven't got into much algebra with my other two classes. #mathscpdchat

Miss Ward-Gow @mcwardgow · 17h   •••
Fair enough 🙂 hopefully you'll get some more algebra next year 😁 #mathscpdchat

Catherine Edwards @Edwards08C · 17h   •••
I have a chunk coming up after Easter so hopefully will be able to get the tiles out.
I've enjoyed using loads of other manipulatives with my nurture numeracy group so I don't feel too deprived. #mathscpdchat

… and this conversation …

Mary Pardoe @PardoeMary · 17h

Replying to @mcwardgow

I haven't always loved teaching probability, but non-transitive dice really got me and my students interested!
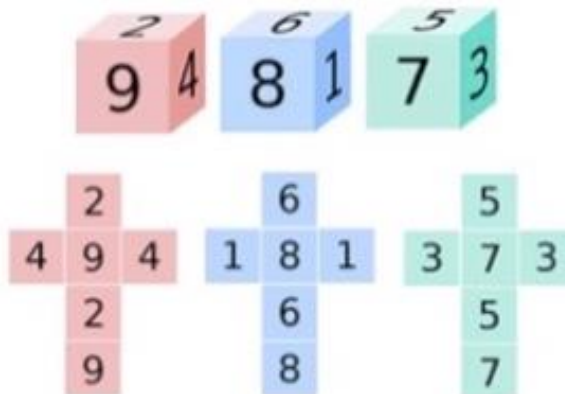
ncetm.org.uk/media/i33nixdp..

#mathscpdchat

Focus on...non-transitive dice

Many students enjoy exploring interesting phenomena that can occur when two people each throw a die and the 'winner' is the person with the highest score.

But, what if the dice are unbiased, but not normal? For example, what happens if the two players each choose a die from this set of three dice?

Eventually they may discover that the second player to choose a die can ***always win*** by adopting this very simple strategy:

– *pick the die that immediately precedes, in this cycle, the die chosen by your opponent…*
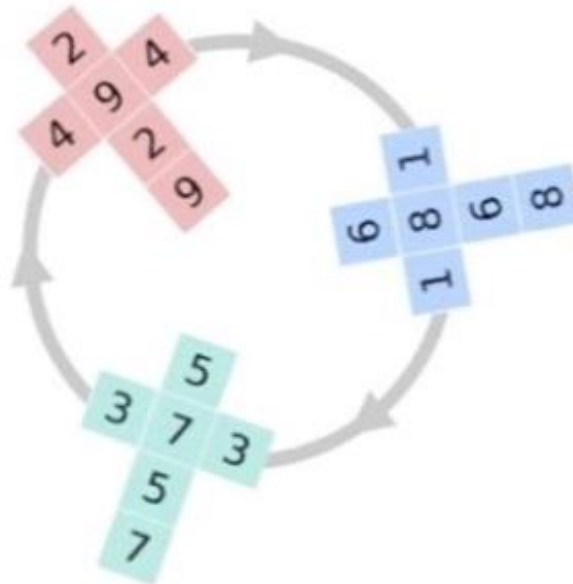
They may 'see' that, as shown in these diagrams, …
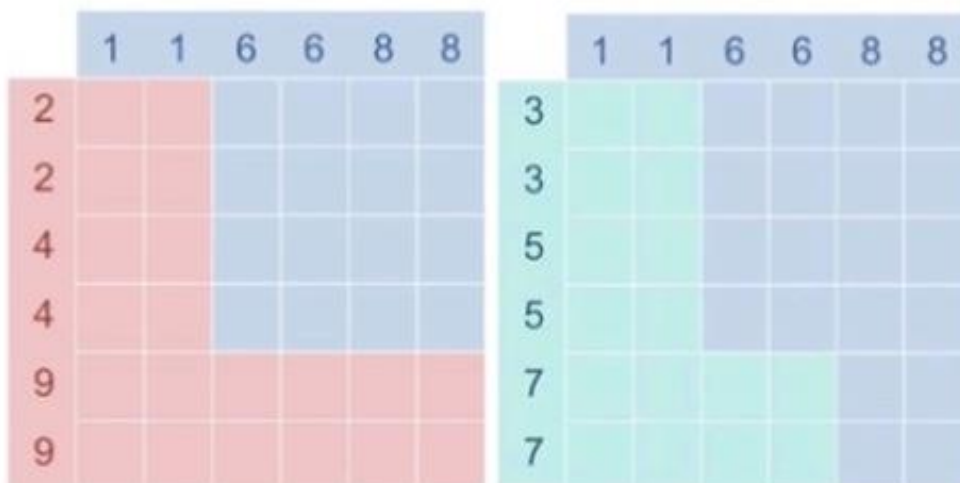
… in the long run …

a player throwing the red die will win a game against a player throwing the blue die because, when both dice are thrown, in more than half (in 20 out of 36) of the equally likely possible outcomes, the score on the red die is greater than the score on the blue die,

and

for exactly similar reasons, a player throwing the blue die will win a game against a player throwing the green die.

So red beats blue, and blue beats green. Students might, therefore, expect that red would beat green – as it would if 'beats' was a *transitive* relation!

But, as this diagram shows, …
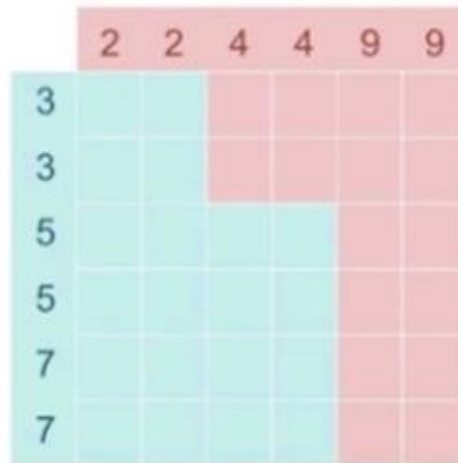

Miss Ward-Gow @mcwardgow · 17h   · · ·

Thanks for sharing 😄 My Year 8s love a snail race when looking at probability #mathscpdchat
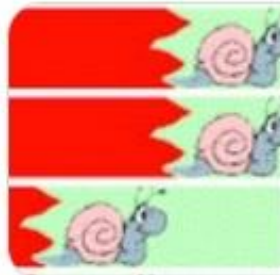
transum.org
Snail Race - Teachers' Version
Twelve snails have a race. Their speed is determined by the sum of two dice. How will probability affect …

Catherine Edwards @Edwards08C · 17h   · · ·

For many years I had a bag of numbered My Little Ponies that I used to race across a course made of rulers
#mathscpdchat

… and this conversation …

MrHawesMaths @HawesMaths · 17h   · · ·

Replying to @mcwardgow

I really like teaching nth term and then straight line graphs and the links between the two. #mathscpdchat

Miss Ward-Gow @mcwardgow · 17h   · · ·

Think @mrshawthorne7 has some nice resources on this 😄👍
#mathscpdchat

Charlotte Hawthorne @mrshawthorne7 · 16h

Oo thanks! Yes, I loved creating these and they've always worked so well.
Activities on sketchCPD.com/resources

Linear relationships
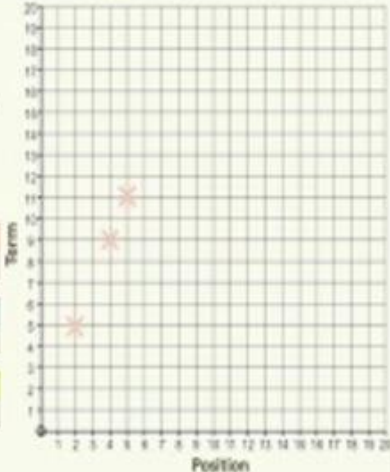
Task 4b

The following sequences have equal steps

Complete the sequences, then plot the position against the term on the graph opposite.

Draw a line through your points for each sequence.

What features of the graph can you 'see' in the tables?

Linear relationships (Sequences to equations of a line)

… and this conversation …

Peter Williams @MathsImpact · 18h

Replying to @mcwardgow

I like the bits where you get to pull loads of different ideas together, like algebraic fractions, or the circle theorem questions which need all the other angle rules too, or bearings questions that need trig.

MAYBE JUST A SMATTERING OF EVERYTHING?

Miss Ward-Gow @mcwardgow · 18h   ···

Like it 😎 have you got a favourite question that links multiple topics? Also... don't forget the hashtag 🙃 #mathscpdchat

Peter Williams @MathsImpact · 17h   ···

My personal favourite is anything I haven't solved yet. It's particularly nice when the other topics leap out of nowhere (like Hannah's sweets).

And yeah, I'm terrible at remembering the hashtag! #mathscpdchat

Miss Ward-Gow @mcwardgow · 17h   ···

That's a great point about solving something new 😎 how do we encourage students to be resilient when approaching an unfamiliar problem? #mathscpdchat

… and this conversation …

IanNoakes @maths_noakes · 17h   ···

Replying to @mcwardgow

GCSE only? If so, I love teaching proof. It's like I'm like a wizard 🧙 😊 But more generally I'm a fan of ratio (sharing etc for younger year groups) #mathscpdchat

Miss Ward-Gow @mcwardgow · 17h   ···

Any age range 😎 what's your go-to strategy for sharing in a ratio? #mathscpdchat

IanNoakes @maths_noakes · 19h   ···

I'm now a big fan of modelling, whether that's bar models or manipulatives or both. Allows for easy access to reverse questions, if one person gets more and the like. Place lots of emphasis for written diagrams in Y7/8 to embed the structure #mathscpdchat

Miss Ward-Gow @mcwardgow · 19h   ···

Great point there about accessing reverse questions... we don't just want students to replicate a process, we want them to be able to work backwards and understand what they're doing 😁 have you found any enriching tasks on bar modeling? #mathscpdchat

… with another reply to Alice's question …

MrHawesMaths @HawesMaths · 17h   ···

I really like the idea of placing circles/boxes underneath the ratio and then distributing the amount between these boxes to reveal what each is worth #mathscpdchat

… and finally, this single tweet (after the chat had ended) …

Mr Mattock FCCT NPQSL @MrMattock · 16h

Replying to @mcwardgow

All of it! I love the links between them and how they all reinforce each other. #mathscpdchat

Alice's second question …

Miss Ward-Gow @mcwardgow · 17h

2) How would you define "enrichment"? 🤔🤔🤔 #mathscpdchat

… prompted this conversation in which MathsWeekLDN and magic tricks were mentioned …

Martyn (He/Him) @martynyeouk · 18h

Replying to @mcwardgow

Enrichment for me in a primary school is all the extras that we do with the children to enrich their lives and show them other possibilities.

@maths_week is a good example of this for me

#mathscpdchat

Miss Ward-Gow @mcwardgow · 18h

What did you do for @maths_week ? 😄 we took part in the @sumdog competition 😎 #mathscpdchat

Martyn (He/Him) @martynyeouk · 18h

Best thing we did was an online session with someone (sorry aive forgotten his name!)

He was amazing and really engaged the children with some fun maths magic! #mathscpdchat

Miss Ward-Gow @mcwardgow · 18h

Do like a bit of maths magic 😄👍 we were sharing some maths magic tricks at the Open Evening earlier in the year - they seemed to go down well! 😊 what's your favourite magic trick? #mathscpdchat

Martyn (He/Him) @martynyeouk · 18h

I do like that one that you get in christmas cracker where it looks like you are a mind reader. When children find out the trick they love trying it out on others (whilst also doing some cheeky maths!) #mathscpdchat

Miss Ward-Gow @mcwardgow · 18h   …

That's a good one 😁 👍 I like the calculator trick from @murderousmaths "The Magic of Maths" #mathscpdchat

Mary Pardoe @PardoeMary · 18h   …

Shuffles are interesting …

ncetm.org.uk/media/lymfxrsb..

#mathscpdchat

To perform a perfect riffle shuffle, known as a *faro* or *weave* shuffle, you split an ordered arrangement of objects into two halves, or into two parts as nearly equal as possible, and then alternatively interleave, in order, the objects from the two parts.

Suppose the 'objects' are students standing in a row in the order of numbered cards that they are holding:

Let's see what happens when they perfectly shuffle themselves!

Because eight is an even number the students can move apart into two rows each containing the same number of students:

Now they can decide to do an *out-shuffle*, or to do an *in-shuffle*.

Now they can decide to do an *out-shuffle*, or to do an *in-shuffle*.

If they interleave themselves so that after the shuffle the 'first' and 'last' students, holding respectively 1 and 8, are still 'first' and 'last', they do an out-shuffle. But if the first student becomes second while the last student becomes second from last, they do an *in-shuffle*. An *Out-shuffle*:
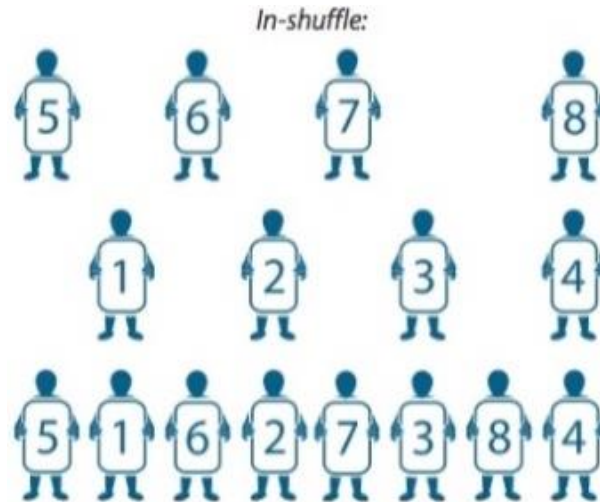
In-shuffle:

Murderous Maths @murderousmaths · 17h   ···

I never knew IN and OUT shuffles before! 😊👍

… and this short conversation …

Miss Ward-Gow @mcwardgow · 17h   ···

2) How would you define "enrichment"? 🤔🤔🤔 #mathscpdchat

Mary Pardoe @PardoeMary · 18h   ···

Replying to @mcwardgow

Mathematical activity that supports/enhances learning?
#mathscpdchat

Miss Ward-Gow @mcwardgow · 18h   ···

Should enrichment activities link with the curriculum in order to "enhance
learning"? 🙂 #mathscpdchat

Mary Pardoe @PardoeMary · 18h   ···

Yes, but need to have a good/wide 'view' of what the maths curriculum is.
#mathscpdchat

… and this single reply:

Writerly.ai Answers Bot @writerlyai_bot · 18h   ···

Replying to @mcwardgow

Enrichment is anything that helps students learn and grow in their academic
pursuits. This could be things like extra help from a teacher, taking extra
classes, or participating in extracurricular activities.

The screenshots below show conversations generated by Alice's fourth question. UKMT (United Kingdom Mathematics Trust) challenges, maths games, bell ringing, the newly established MESME organisation, and an ongoing AMSP enrichment event for Y10 students were mentioned (links provided at the top of this summary). **Click on any of the following screenshots-of-a-tweet to go to that actual tweet on Twitter.** The conversations were generated by this question from Alice Ward-Gow:

Miss Ward-Gow @mcwardgow · 20h   ...
4) Do you have any maths events/clubs in school or outside school that students take part in? 😊 #mathscpdchat

Most responses to this question formed conversations, such as this one between Mr Hawes, Alice Ward-Gow and Catherine Edwards …

MrHawesMaths @HawesMaths · 20h   ...
Replying to @mcwardgow
We run a UKMT maths challenge club where we look at other problem solving tasks from nrich as well. A cheeky 20min club #mathscpdchat

Miss Ward-Gow @mcwardgow · 20h   ...
Was that during a break or lunch time? 😃 #mathscpdchat

MrHawesMaths @HawesMaths · 20h   ...
Beginning of lunch. Each week we set them a task to do over the week and then we go through how we solved them and then we do some other proving questions before handing out the next challenge. #mathscpdchat

Miss Ward-Gow @mcwardgow · 20h   ...
That sounds great 😁 how many students take up the challenge? #mathscpdchat

MrHawesMaths @HawesMaths · 20h   ...
We have around 20 odd. Pretty good turn out each week #mathscpdchat

Miss Ward-Gow @mcwardgow · 19h   ...
That's great 😄 👍 do you sell it to them as puzzles or as problems? #mathscpdchat

MrHawesMaths @HawesMaths · 19h   ...
Problems. #mathscpdchat

![NCETM - National Centre for Excellence in the Teaching of Mathematics]

Miss Ward-Gow @mcwardgow · 19h · · ·

That's interesting 🙂 we're rebranding "problems" as "puzzles" to try and engage more students #mathscpdchat

Catherine Edwards @Edwards08C · 20h · · ·

Replying to @mcwardgow

Used to do the UKMT maths challenge days and also the primary challenge as a transition event. Would be nice to get them going again, but not sure I have time right now. #mathscpdchat

… and this conversation between Martyn Yeo, Alice Ward-Gow and Mary Pardoe …

Martyn (He/Him) @martynyeouk · 20h · · ·

Replying to @mcwardgow

I used to run a maths lunch club where we played maths games. Parents thought I would be maths tutoring! #mathscpdchat

Miss Ward-Gow @mcwardgow · 20h · · ·

Ooo maths games 😁 what's your favourite? #mathecpdchat

Martyn (He/Him) @martynyeouk · 20h · · ·

It was for KS1 so we did simple things - I mostly used resources from @vivientownsend1

She has great ones about 10 ways with calculators, 100 square, cubes etc

#mathscpschat

Mary Pardoe @PardoeMary · 20h · · ·

Replying to @mcwardgow and @martynyeouk

Not exactly a game … but get some hand-bells from the music department and bell-ringing explorations, question-asking and trying to answer them, can be great when looking at permutations …
ncetm.org.uk/media/y5ccl4p4..
#mathscpdchat

One well-known method is called 'Plain Hunt'. The changes in this method when it is rung on four bells are shown in these diagrams, in which each diagram highlights the 'route' of one particular bell:

Students could be challenged to describe in words this system that is followed when the 'Plain Hunt' method is rung on four bells, before investigating the same method on other numbers of bells, or before exploring other methods.

Students could also be challenged to work out the total number of possible orders of four bells (permutations of four objects).

It is possible to adapt the method shown above to create a method that includes every possible order. After seven changes, instead of following the system shown above by swapping the positions of the two central bells and returning to the original round, another pair of bells are made to swap positions. For example, instead of the change from the 8th row to the 9th row being this,

it becomes this,

and then the original system restarts.

There are many traditional change ringing methods that can be explored on different numbers of bells. Or students can be challenged to devise their own methods for particular numbers of bells – perhaps with the added condition that every possible row is included. The patterns traced out through method diagrams by the 'routes' of particular bells are interesting!

… but there was this 'single' tweet (and link) from webmathscouk:

webmathscouk @Dids31 · 19h

Replying to @mcwardgow

I run a lunchtime artful maths club. So far this year we have covered curves of pursuit and celtic knots. I am building a section of resources here

> webmathscouk.wordpress.com
> Artful Maths
> Curves of Pursuit Simple curves of pursuit Simple curves of pursuit 2 Curves of pursuit Equilateral …

… and these interesting tweets (see link at top of summary) from the recently established MESME:

MESME @MESMEmaths · 19h

Replying to @mcwardgow

We are a fairly new organisation, currently building up Maths Circles all over the country, some online, some in school. Some run by teachers, some by tutors, lots by maths undergrads. Our Twitter existence hasn't got going yet but do look at our website

> mesme.org
> MESME — Mathematics Education for Social Mobi...
> Supporting students from all backgrounds to achieve mathematical excellence. We plan to laun...

MESME @MESMEmaths · 19h

#mathscpdchat You can request more info on the website, for your secondary students or for running a circle yourself (support &material provided)

This question from Alice Ward-Gow …

Miss Ward-Gow @mcwardgow · 19h

3) What does enrichment look like in your lessons or in your school? 😄 #mathscpdchat

… received just this interesting reply from Alice herself:

Miss Ward-Gow @mcwardgow · 19h   ...

Replying to @mcwardgow

Some of our Year 10 students took part in a recent @Advanced_Maths online webinar - Maths in Space. The event made it into the school newsletter 😎 @georgepindarsch #mathscpdchat

mailchi.mp/c6a557c68ac8/p...

amsp   Teachers   Students   Leadership   Universities   Employers   🔍   integral

Space!

Overview

These enrichment events are designed to engage your Year 10 students while developing an area of GCSE mathematics beyond the curriculum. They will also inform students about their options for studying mathematics after GCSE. Any mathematics used in the session will be based on that expected at higher tier GCSE.

The events will be repeated at different times through the year to allow you to choose the event which best fits your timetable. It is designed so that the event can either be streamed into a classroom where interaction is managed by the teacher or the link to the event can be sent by the teacher to their students so that they can participate in the event if they are studying at home.

There will be opportunities for interaction during the session.

Key Facts

Audience:	Students
Target year:	Year 10
Curriculum focus:	11-16 maths
Event format:	Enrichment
Event length:	45 minutes
Fee:	This event is free.

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

Alice's last question …

Miss Ward-Gow @mcwardgow · 20h   ...

Last question tonight…
5) Any nice cross-curricular enriching activities that you've seen/used? 😎

#mathscpdchat

… generated the following conversation …

Martyn (He/Him) @martynyeouk · 20h   ···
Replying to @mcwardgow
Love doing cross curricular stuff. Just today we were tasting food from Skegness and making a tally chat of our favourites…turns out cockles are not liked by children! #mathscpdchat

Miss Ward-Gow @mcwardgow · 20h   ···
That sounds great 😁 Have you got any other ideas that we could borrow at Secondary? 🙃 #mathscpdchat

Martyn (He/Him) @martynyeouk · 20h   ···
Think #WorldBookDay 📖 is a great time for cross curricular - get those maths books out! @MathsStories will help! #mathscpdchat

Martyn (He/Him) @martynyeouk · 20h   ···
Replying to @mcwardgow
I think it is a lot harder in secondary as you have the stand alone subjects. In primary we link most things as we have the same children all the time and can make the connections easier!

You would have to discuss things with your other subjects I would say.

#Mathscpdchat

Miss Ward-Gow @mcwardgow · 20h   ···
Think you're right 😬 I took my Year 10s into the Food Tech room to check out some pineapples and hunt for the Fibonacci sequence. Going forward, I need to have more conversations with colleagues and look for more cross-curricular opportunities 😃 #mathscpdchat
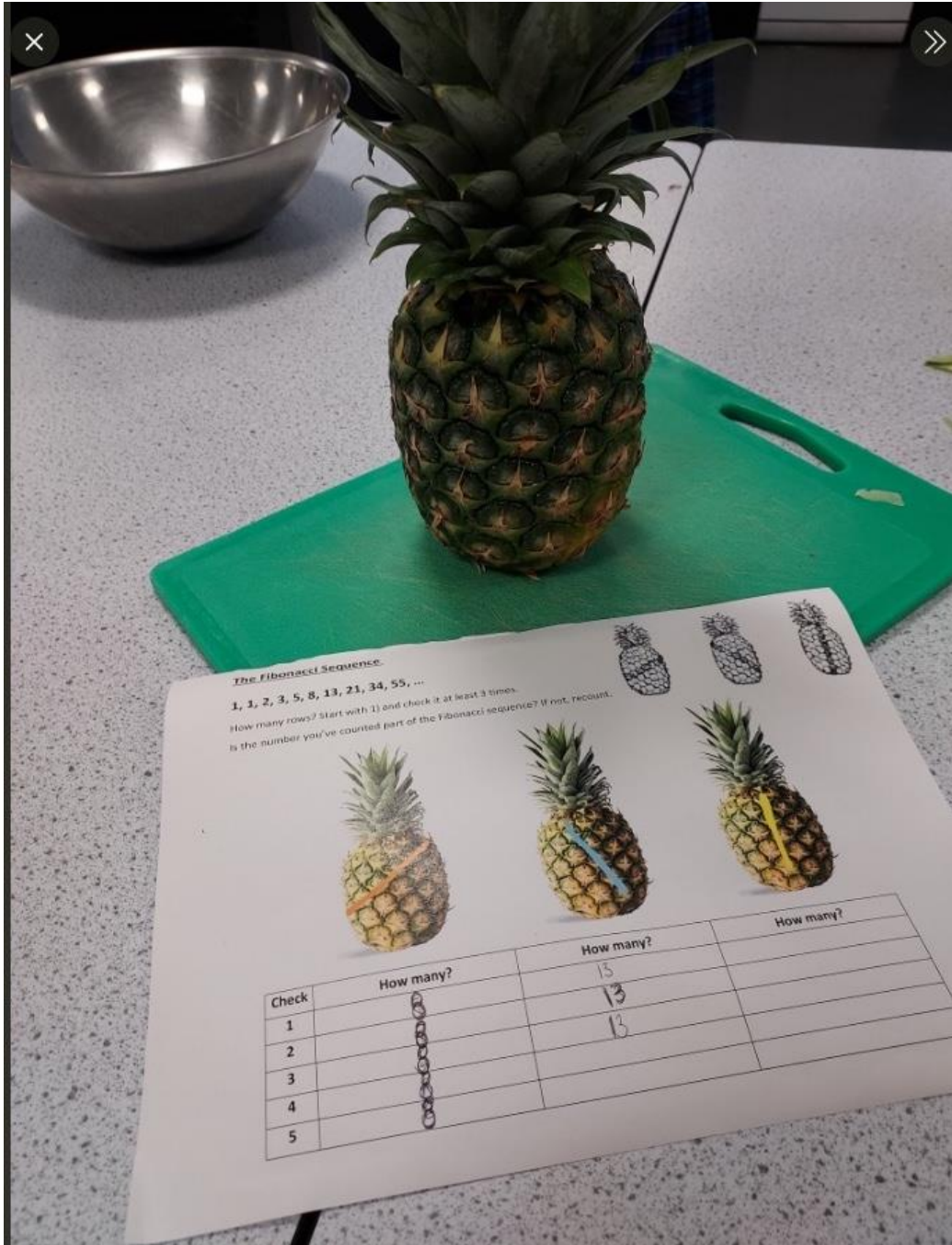
Catherine Edwards @Edwards08C · 20h

We have a lovely maths section in our library. Students keep coming and setting me riddles 😄 #mathscpdchat

… with another reply to Alice's question …

Miss Ward-Gow @mcwardgow · 20h

That sounds great 😄 Have you got any other ideas that we could borrow at Secondary? 🙃 #mathscpdchat

Mary Pardoe @PardoeMary · 20h   · · ·

Replying to @mcwardgow and @martynyeouk

Explore Penrose tilings?

youtube.com/watch?v=yK4P17...

#mathscpdchat

> youtube.com
> **Animated Penrose Tiling**
> See also the second part:
> http://www.youtube.com/watch?v=Pyg0f27kKXw....

… and this conversation …

Catherine Edwards @Edwards08C · 20h   · · ·

Replying to @mcwardgow

I did a fun transition project where they had to build angle measures to do trig calculation on the height of things around the Island. One group wrote a whole plan for a bank heist and escape down the cliffs. #mathscpdchat

Miss Ward-Gow @mcwardgow · 20h   · · ·

This reminds me of an episode of Monkman and Seagull @Bobby_Seagull where they use a protractor and some string to measure the height of a building 😁 #mathscpdchat

Catherine Edwards @Edwards08C · 20h   · · ·

Exactly what they built. It was really fun, then they went away did their projects and we had a big science fair type event with local dignitaries and a telescope for a prize #mathscpdchat

… and this conversation generated by a quote-retweet …

Miss Ward-Gow @mcwardgow · 20h   · · ·

Any maths book recommendations? 😃 #mathscpdchat

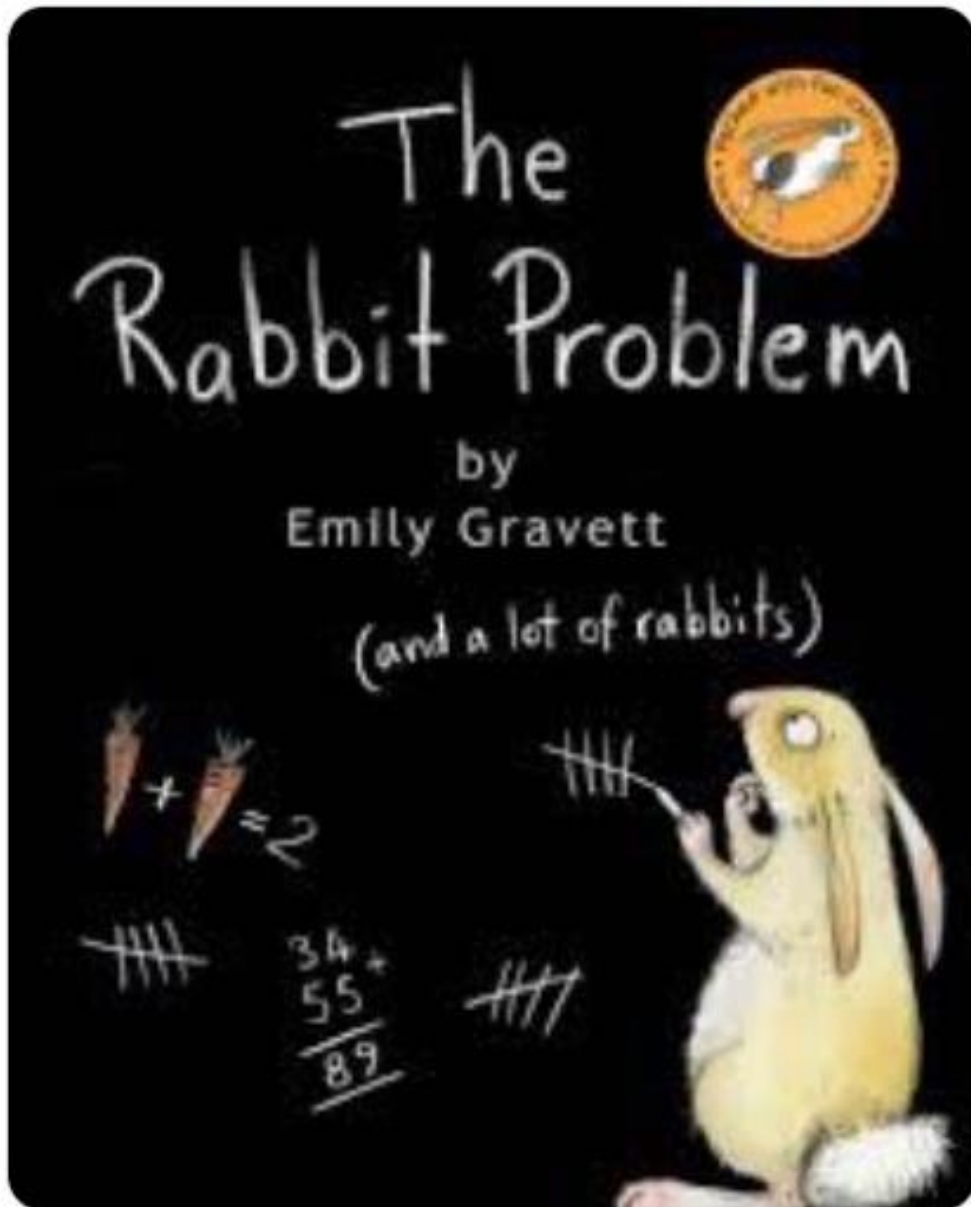> 🧑 **Martyn (He/Him)** @martynyeouk · 21h
>
> Replying to @mcwardgow
>
> Think #WorldBookDay 📘 is a great time for cross curricular - get those maths books out! @MathsStories will help! #mathscpdchat

Martyn (He/Him) @martynyeouk · 20h
Replying to @mcwardgow
Now you said about the Fibonacci sequence I would say The Rabbit Problem #mathscpdchat

The
Rabbit Problem
by
Emily Gravett
(and a lot of rabbits)

$+$ $=2$

$\begin{array}{r}34 \\ + 55 \\ \hline 89\end{array}$

Martyn (He/Him) @martynyeouk · 20h   ...
Did a whole half term with this book as it went through each month with more rabbits following the sequence! #mathscpdchat

Catherine Edwards @Edwards08C · 10h

Replying to @mcwardgow

This is our little maths library

… and finally, this conversation:

MrHawesMaths @HawesMaths · 20h

Replying to @mcwardgow

We have in the past (pre covid) linked with science, different year groups to investigate speed distance time. Using measures, constructing conversion graphs and posing problems. Worked very well. Hopefully be able to do it this year. #mathscpdchat

Miss Ward-Gow @mcwardgow · 20h

That sounds exciting 😃 do you find that it supports some level of consistency between subjects on those topic areas? #mathscpdchat

MrHawesMaths @HawesMaths · 20h

Yes. We have purposefully coordinated our year 6 and 8 sow so that it goes in. Year 8s can do all of the formula work and construct the graphs. The year 6s do the measures and use the graphs to do some conversions. Quite interlinked. #mathscpdchat