

# Innovation and Creativity in Mathematics Teaching IV

One-day conference for Mathematics teachers

14th July 2023 – Swansea University



Keynote

## Digital tech in mathematics teaching: changing the see-scape

**Professor Anne Watson  
(University of Oxford)**

*Emeritus Professor Anne Watson has two maths degrees and taught maths in challenging schools before undertaking teacher education and maths education research at the University of Oxford, where she had gained a doctorate that addressed informal maths assessment. She advised on the maths national curriculum in England and also in Wales. She works with educators and researchers worldwide on maths curriculum, task design and pedagogy. She has written and edited numerous books, articles and research papers including 'Key Ideas in Teaching Maths' with Keith Jones and Dave Pratt (Oxford University Press), 'Key Understandings in Maths' with Terezinha Nunes and Peter Bryant (Nuffield Foundation) and 'Care in Maths Education' (Palgrave Macmillan).*

**I will explore some connections between maths topics throughout school that, given easily available digital technology, radically reconstruct the ways in which they can be learnt and the traditional ordering of the curriculum. The audience will have to do some work too.**

Plenary

## Flipping ICT through 6 Modes of Interaction and Being of One Accord

**Professor John Mason  
(Open University and University of Oxford)**

*Retired for some 14 years after 40 years at the Open University writing materials to support the teaching of maths in all phases, John continues to engage in mathematical explorations generated by pedagogical issues.*

**Participants will be invited to engage in some mathematical tasks to do with chords of (graphs of) functions, leading to a discussion of different modes of interaction between learner, maths, and teacher. This in turn will raise questions about different ways to use mathematical software to 'flip' a classroom. The core role of attention, both mathematical and social will anchor the discussion.**

This conference is free of charge.  
Book here.



# Innovation and Creativity in Mathematics Teaching IV

One-day conference for Mathematics teachers

14th July 2023 – Swansea University



Rheolir gan Brifysgol Abertawe, Sefydliad Gwyddorau Cyfrifiadurol a Mathemategol Cymru  
Managed by Swansea University, Wales Institute of Mathematical and Computational Sciences



09:15 - 09:45	Registration & Housekeeping			
09:45 - 10:00	Welcome Address: Sofya Lyakhova			
Keynote 10:00 - 11:00	Anne Watson Digital tech in mathematics teaching: changing the see-scape			
Session 1 11:00 - 11:50	Enjoy doing and working with mathematics James Lewis-Coll	Infinity to Non-Euclidean Geometry Susan Thomas	Desmos Classroom for Beginners Alice Lovett	Experimental (and fun) ways to introduce AS Hypothesis Testing Theresa Hendy & Phil Mackie
11:50 - 12:10	Coffee			
Session 2 12:10 - 13:00	Teaching knot theory in primary and secondary schools in Japan Tomoko Yanagimoto, Ken-ichi Iwase & Akiyo Higashio	Tessellation & Proof Elian Rhind	Geogebra and the Sampling Distribution of the Sample Mean Paul Sanders	Inequalities: Their Solution, Uses and Synthesis Huw Kilner
13:00 - 13:45	Lunch			
Plenary 13:45 - 14:45	John Mason Flipping ICT through 6 Modes of Interaction & Being of One Accord			
Session 3 14:45 - 15:35	STEM PBL: cross-curricular and project-based learning in mathematics Theresa Hendy, Sofya Lyakhova & Stephen Earles	What are fractals? Investigating various fractals using Geogebra Ifor J. Jones	World Environment Day Dominic Oakes & Alice Lovett	Introduction to Maths and Further Maths Risps Jonny Griffiths
15:35 - 15:55	Coffee			
Session 4 15:55 - 16:45	Digging For The Why Andy Lumley	Python for investigating maths problems Francis Hunt	Flipped classroom resources? Absolutely love them! Dominic Oakes	A consideration of teaching strategies for differential equations Adrian Wells
16:45 - 17:00	Closing Address: Mathematics and Music, Dominic Oakes and the FMSPW Team			

CfW	Pedagogy
Enrichment	A-level

This conference is free of charge.  
Book here.



## Session 1

### Enjoy doing and working with mathematics

James Lewis-Coll (Central South Consortium (CSC))

*Worked in the Scottish, English and now in the Welsh education system. Developed and ran PGCE courses. Has worked for CSC as a maths specialist for about 8 years supporting schools with developments in maths.*

**This session will consider a range of tasks that will challenge and support the development of students' mathematical skills via problem solving and contextual work. These tasks will be suitable for students across ks3, ks4 and ks5 linking to real-life contexts, practical applications and mathematical problems. The activities will include links to art through considering the question, "How long is a railway line?" and for those of a more musical disposition, "How do fruit yoyos link to vinyl LPs?" amongst a variety of interesting tasks.**

Key words: Applying, modelling, contexts, mathematical thinking, maths, modelling, KS3, KS4, KS5, practical, applications, GCSE, A-level, cross-curricular, real-life, estimation. CfW: Cross-curricular skills

### Anfeidredd / Infinity to Non-Euclidean Geometry

Susan Thomas (FMSPW)

*Head of Maths at Llanhari (Jan 1992-Sept'96), at Ystalyfera (1996-2010). FMSP Wales since 2011. FMSPW SoW Team.*

**Infinity is something to which we are introduced in our maths classes, and later we learn that infinity can also be used in physics, philosophy, social sciences, etc. The intersection of infinity with geometry can be seen by looking at projective geometry, with parallel lines intersecting 'at infinity'. It could be said that projective geometry involves the taming of infinity. This session looks at infinity and moves via Leonardo da Vinci, Escher, Penrose and Coxeter to Non-Euclidean Geometry in a sometimes strange voyage of discovery.**

Key words: Infinity, art, non-Euclidean geometry, enrichment

### Desmos Classroom for Beginners

Alice Lovett (FMSPW)

*FMSPW South East Wales Area Coordinator. Previous roles include key stage 3 coordinator, key stage 5 coordinator and Head of Maths: as well as qualifying as a specialist leader in education.*

**DC is a fantastic online resource. At FMSPW amongst many varied uses of DC, we developed a course for Additional Maths which has been successfully used as the basis for taking many students through the course successfully. Seeing is believing and the interactive nature of DC activities can accelerate student understanding of a range of mathematical concepts and techniques. In this session you will learn how to set up a DC course, how to make engaging activities for students in KS3-5 and how to use DC in the classroom and for homework.**

Key words: Dynamic software, KS2-5, AfL, ICT, interactive, engagement, depth, problem-solving, play, CfW: use digital technologies creatively

### Experimental (and fun) ways to introduce AS Hypothesis Testing

Philip Mackie and Theresa Hendy (Gower College Swansea)

*Phil and Theresa have both been teaching A level maths for more than twenty years in Further Education.*

**A practical, hands-on, data collecting session where we will look at introducing hypothesis testing with the Binomial Distribution using a variety of statistical experiments; all of which can easily be replicated in the classroom. We will also look at how GeoGebra can support the understanding of decision making when drawing conclusions.**

Key words: AS statistics, hypothesis testing, Binomial Distribution

## Session 2

### Teaching knot theory in primary and secondary schools in Japan

Tomoko Yanagimoto, Ken-ichi Iwase, Akiyo Higashio (Osaka Kyoiku University & Osaka Electro-communication University)

*Maths educators who lead a working group on teaching knot theory in schools in Japan. Group formed in 2004 when Hirokazu Okamori, researcher in maths education, and Akio Kawauchi, leading mathematician on knot theory in Japan, met to discuss the implications of a new mathematical theory for school maths teaching.*

**Maths educators develop content beyond the traditional to cultivate children's understanding and interest. Knot theory became an opportunity for this when a maths education researcher and a mathematician met and formed a vision. They then formed a study group of researchers, mathematicians, and teachers to work on this. We are core members of the study group and invite participants to join this hands-on workshop to learn some knot theory as part of school maths, and to hear about the successes and challenges of teaching it to students.**

Key words: KS3 & KS4, peer work, cross-curricular, enrichment, curriculum

### Tessellations and Proof

Elian Rhind (Further Maths Support Programme Wales)

*Completed a PhD in Maths in 2018. Fixed-term tutor for the Maths Department at Swansea University. Worked with FMSPW as a student helper for many years but joined the programme working in fuller capacity in 2018.*

**The tessellation of shapes is found naturally as well as in man-made and natural situations. We look at tessellations of geometrical objects, using one polygon and using at least two polygons. This ties nicely to geometry-based work at GCSE, with room to abstract ideas as algebra is introduced. There is scope to abstract ideas of semi-regular tessellations as well as three-dimensional polyhedrons. Students benefit from seeing the idea of tessellations literally clicking together in front of them.**

Key words: Geometry, Algebra, Abstraction, Proof

### Geogebra and the Sampling Distribution of the Sample Mean

Paul Sanders (FMSPW)

*After 35 years teaching Maths in 11-18 schools, now in tenth year working with FMSPW and actively involved with development of the PL programme and many of the video resources for A level Maths and Further Maths courses.*

**The real importance of the Normal distribution is the fact that if random samples are taken from a population then the sample mean will in many cases have a probability (or sampling) distribution which is Normal. Such results appear in the WJEC M & FM Specs. Proofs of either of these results is beyond the scope of the A level students, however the importance of the results demands a degree of justification. A Geogebra applet will be developed to motivate these results.**

Key words: Normal Distribution, Sampling Distribution of sample mean, Central Limit Theorem, Geogebra, KS5

### Inequalities: Their Solution, Uses and Synthesis

Huw Kilner (Cardiff Sixth Form College)

*Taught Maths in a comprehensive school for over 30 years. For the last 11 years has taught STEP and MAT classes and is the author of a book that is entirely about STEP questions and their solutions.*

**My aims are to respond positively to an issue raised by the Chief Examiner for STEP and to provide some material that I hope will be of immediate use within the classroom.**

**Using past examination questions, the journey will take us from the simplest inequalities, through methods of solution and the application of inequalities, to the synthesis and proof of the AM-GM inequality and the Cauchy-Schwarz inequality. Buckle up for a high-speed ride!**

Key words: Visualisation, Estimation, Application. STEP, MAT, KS5

Full programme here



## Session 3

# STEM PBL: Cross-curricular and project-based learning in mathematics

Theresa Hendy, Sofya Lyakhova and Stephen Earles (FMSPW)

*Theresa: FMSPW Area Coordinator & PL Lead. Taught maths in a secondary and FE. HoD and Curriculum Leader for maths and science. Taught basic skills and access to HE courses. Teacher-researcher for the NNEM in Wales in 2016.*

*Sofya: associate professor of maths and FMSPW Programme Leader. Worked on research projects in pure maths, and maths education. Trustee of the UK JMC. Member of advisory board of the AMS.*

*Stephen: FMSPW Tuition Lead, Mid and West Wales Area Joint Coordinator. Maths teacher from 1985. Taught FE in London. Moved to West Wales as a classroom teacher for 10 years and then became a HoD for 19 years.*

**Project-based learning connects students to their learning in ways that traditional instruction often does not & provides opportunity for students to apply knowledge to solve a problem, think more deeply about content, and learn to ask questions. In this practical hands-on session, we will explore fascinating problems borrowed from AGGIE STEM, a leading PBL camp in USA and internationally. Prepare for a lot of mess! Participants will be directed to open source resources for PBL and cross curricular activities across all age groups.**

Key words:

Curriculum for Wales, project-based learning (PBL), KS3 & KS4, peer work, cross-curricular, CfW: lead and play different roles in teams effectively and responsibly

## What are fractals? Investigating various fractals using Geogebra

Ifor John Jones (FMSPW)

*Retired Maths & IT teacher with experience of working in Wales (both Welsh & English medium), Zambia and Papua New Guinea – both teaching (Maths & IT) and school management.*

**Using the transformations of enlargement, translation, rotation and reflection along with the integrated use of the spreadsheet in Geogebra to investigate a range of space filling curves and fractals – Peano curve, Hilbert curve, Minkowski curve, Sierpinski triangle, box fractals, Mandelbrot set and Julia sets. Using the trace facility and zooming in to sections of filled Julia sets interesting plots achieved by experimenting with colour will be shown. Participants will be able to produce some of the space filling curves for themselves.**

Key words:

Enrichment, Geogebra, fractals, space filling curves, Mandelbrot set, Julia sets

## World Environment Day

Dominic Oakes and Alice Lovett (FMSPW)

*Dominic: FMSPW Resources and Research Lead, North Wales Area Coordinator. Qualified as Maths teacher in 1992. Previous roles include Head of Maths and on the SLT. Worked extensively as a Consultant. Expert Advisor to the M&N AoLE. Alice: See above*

**Doughnut Economics offers a vision of what it means for humanity to thrive in the 21st century by positioning economics within social aims and environmental ceilings. Studying the Doughnut offers a real context for introducing statistical techniques and visualisation as well as naturally travelling round the data handling cycle – we have created two iterations of this for use in the classroom. This session will introduce the idea of the Doughnut and introduce the first two activities so that delegates are prepared for using them in their own classrooms.**

Key words:

Environment, Doughnut Economics, CfW - data handling cycle. KS3, KS4

## An Introduction to Risps and Further Risps

Jonny Griffiths (Frome College)

*Jonny is the author of the popular Risps website and several others. He currently teaches A Level Maths at Frome College in Somerset. He's studied Maths and Education at Cambridge University, the Open University and at UEA.*

**How can we introduce investigative tasks into our teaching of A Level Maths and Further Maths? This session will introduce you to some tried and tested activities from the Risps and Further Risps websites that could enliven the experience of your students. We will also discuss how they could best be fitted in to a scheme of study.**

Key words:

Investigation, open tasks, A Level Maths, Further Maths, Risps

## Session 4

### Digging For The Why

Andy Lumley (MEI)

20 years as a maths teacher. MEI Head of Learning Technology for MEI's online resources, overseeing the development of Integral. Helps to develop digital strategy. Co-host of the Digging For The Why podcast by MEI.

**Digging For The Why started life as a classroom mantra, then became a podcast based around continuity in the transition from Year 5 to Year 8 in the maths classroom. We look at ideas and findings from talking to various maths educators from primary to secondary. We explore ideas such as curiosity in the classroom, technology, working with your primary schools, and, the need for teachers to ask why as well as students! You will leave with some key nuggets of why we should dig for the why to take, adapt, grow and apply to your teaching and planning.**

Key words: Transition, continuity, curiosity, KS2-3, CfW transition from primary to secondary school

### Python for investigating maths problems

Francis Hunt (FMSPW)

FMSPW post-16 enrichment coordinator and Area Coordinator for Central South Wales. Studied maths, taught and researched at Cambridge University. Software engineer. Maths lecturer at USW between 2006 and 2019. Gives RI Maths Masterclasses at KS3 and Primary level, has tutored A-level and GCSE maths, and mentored for the UKMT.

**This session is for the absolute beginner. It is aimed at demystifying the process of writing a program in Python, giving attendees the information and confidence necessary to embark on teaching themselves how to program.**

**In the session we will introduce and use some key Python constructs; see how many different error messages we can create and fix; and write a few simple programs to do things like convert Centigrade to Fahrenheit, add the odd numbers less than 50, or output the primes less than 100. The session will use conditional statements, looping and debugging, aspects relevant to the progression steps within Data and Computational Thinking in the Curriculum for Wales.**

Key words: Total beginner, Python, CfW – Cross-curricular skills

### “Flipped classroom resources? Absolutely love them!”

Dominic Oakes (FMSPW) & Paul Bedingfield

Dominic: See above. Paul is the Head of Mathematics at Ysgol Uwchradd Caerdybi on Anglesey. Qualified in 1997 teaching in a range of schools in the Midlands, including an EBD referral unit. HoD since 2018. His passion for puzzling and board games enriches his lessons. Has worked with FMSPW to develop the FCA in sixth form teaching.

**Flipped classroom resources are among the most popular this year. But why? According to the teachers, whether your concern is a reduced timetable, teaching topics for the first time, a classroom that is too quiet or exam results, the flipped resources are your solution! Hear from teachers who attended FMSPW PL on the FCA and have used the resources extensively this year. All of your questions answered about why A-level classroom seem to be a perfect place for a flipped approach, how much preparation you need, what to expect from students, how to make sure flipped approach works and tips for using time in the classroom for more problem solving, buzzy discussions and peer-work.**

Key words: Flipped classroom, gapped notes, time-gaining, teachers' experience, KS4, KS5

### A consideration of teaching strategies for differential equations

Adrian Wells (RhGMB Cymru/ FMSP Wales, Swansea University)

Sometime FMSPW Joint Area Coordinator for Mid and West Wales. Senior Assistant Headteacher; Head of Maths; 40+ years teaching experience, Peer Inspector (ESTYN). Examiner/Team Leader for Pearson/EDEXCEL in Further Pure Maths with 30+ years' experience.

**Using M A2 U3 as a starting point with 'variable separable' first order differential equations, is  $dy/dx$  a fraction? Then working into first order integrating factors, second order homogeneous and non-homogeneous forms to arrive at systems of differential equations.**

Key words: Teaching for understanding, another step on the path, KS5

Full programme here



# Cynhadledd Arloesi a Chreadigedd mewn Addysgu Mathemateg

Cynhadledd undydd i athrawon Mathemateg

14eg o Orffennaf 2023 – Prifysgol Abertawe



Prif Siaradwr

## Technoleg ddigidol ym maes addysgu mathemateg: newid y ffurfedd

**Yr Athro Anne Watson  
(Prifysgol Rhydychen)**

Mae gan yr Athro Emeritws Anne Watson ddwy radd mathemateg a bu'n dysgu mathemateg mewn ysgolion heriol cyn ymgymryd ag ymchwil addysg athrawon ac addysg mathemateg ym Mhrifysgol Rhydychen, lle enillodd ddoethuriaeth a oedd yn mynd i'r afael ag asesu mathemateg anffurfiol. Cyngorodd ar y cwricwlwm cenedlaethol mathemateg yn Lloegr a hefyd yng Nghymru. Mae hi'n gweithio gydag addysgwyr ac ymchwilwyr ledled y byd ar y cwricwlwm mathemateg, dylunio tasgau ac addysgeg. Mae hi wedi ysgrifennu a golygu nifer o lyfrau, erthyglau a phapurau ymchwil gan gynnwys 'Key Ideas in Teaching Mathematics' gyda Keith Jones a Dave Pratt (Gwasg Prifysgol Rhydychen), 'Key Understandings in Mathematics' gyda Terezinha Nunes a Peter Bryant (Sefydliad Nuffield) a 'Care in Maths Education' (Palgrave Macmillan).

Byddaf yn archwilio cysylltiadau rhwng pynciau mathemateg ar draws yr ysgol sydd, o ystyried technoleg ddigidol sydd ar gael yn rhywdd, yn ail-greu'n radical y ffyrdd y gellir eu dysgu a threfn draddodiadol y cwricwlwm. Bydd rhaid i'r gynulleidfa wneud rhywfaint o waith hefyd.

Siaradwr Gwadd

## Troi TGCh trwy 6 Dull o Ryngweithio a Bod mewn Cytgord

**Yr Athro John Mason  
(Y Brifysgol Agored a Phrifysgol Rhydychen)**

Wedi ymddeol ers tua 14 mlynedd ar ôl 40 mlynedd yn y Brifysgol Agored yn ysgrifennu deunyddiau i gefnogi dysgu mathemateg ym mhob cyfnod, mae John yn parhau i gymryd rhan mewn archwiliadau mathemategol a gynhyrchir gan faterion addysgeg.

Gwahoddir cyfranogwyr i ymgymryd â thasgau mathemategol yn ymwneud â chordiau (graffiau o) ffwythiannau, gan arwain at drafodaeth ar wahanol ddulliau rhyngweithio rhwng y dysgwyr, mathemateg, ac athro. Bydd hyn yn ei dro yn codi cwestiynau am wahanol ffyrdd o ddefnyddio meddalwedd fathemategol i droi ystafell ddsbarth wyneb i waered. Bydd rôl graidd sylw, yn fathemategol a chymdeithasol, yn angori'r drafodaeth.

Mae'r gynhadledd hon yn rhad ac am ddim.  
Archebwch yma.



# Cynhadledd Arloesi a Chreadigedd mewn Addysgu Mathemateg

Cynhadledd undydd i athrawon Mathemateg

14eg o Orffennaf 2023 – Prifysgol Abertawe



Rheolir gan Brifysgol Abertawe, Sefydliad Gwyddorau  
Cyfrifiadurol a Mathemategol Cymru  
Managed by Swansea University, Wales Institute  
of Mathematical and Computational Sciences

Ariennir gan  
**Lywodraeth Cymru**  
Funded by  
**Welsh Government**

09:15 - 09:45	Cofrestru a Trefniadau			
09:45 - 10:00	Croeso: Sofya Lyakhova			
<b>Prif Siaradwr</b> 10:00 - 11:00	<b>Anne Watson</b> Technoleg ddigidol mewn dysgu mathemateg: newid y ffrfwedd			
<b>Sesiwn 1</b> 11:00 - 11:50	<b>Mwynhau gwneud a gweithio gyda mathemateg</b> James Lewis-Coll	<b>Anfeidredd i Geometreg An-Ewclidaidd</b> Susan Thomas	<b>Dosbarth Desmos Classroom i ddechreuwr</b> Alice Lovett	<b>Ffyrdd arbrofol (a hwyliog) o gyflwyno Prawf Rhagdybiaeth UG</b> Theresa Hendy a Phil Mackie
11:50 - 12:10	Coffi		Coffi	
<b>Sesiwn 2</b> 12:10 - 13:00	<b>Dysgu theori cwlwm mewn ysgolion cynradd ac uwchradd yn Japan</b> Tomoko Yanagimoto, Ken-ichi Iwase a Akiyo Higashio	<b>Brithwaith a Phrawf</b> Elian Rhind	<b>Geogebra a Dosraniad Samplu Cymedr y Sampl</b> Paul Sanders	<b>Anghydraddoldebau: Eu Datrysiaid, Defnydd a Synthesis</b> Huw Kilner
13:00 - 13:45	Cinio		Cinio	
<b>Siaradwr Gwadd</b> 13:45 - 14:45	<b>John Mason</b> Troï TGCh trwy 6 Dull o Ryngweithio a Bod mewn Cytgord			
<b>Sesiwn 3</b> 14:45 - 15:35	<b>DSB STEM: dysgu trawsgwricwlaidd a dysgu seiliedig ar brosiect mewn mathemateg</b> Theresa Hendy, Sofya Lyakhova a Stephen Earles	<b>Beth yw fractals? Ymchwilio i fractalau amrywiol gan ddefnyddio Geogebra</b> Ifor J.Jones	<b>Diwrnod Amgylchedd y Byd</b> Dominic Oakes & Alice Lovett	<b>Cyflwyniad i Risps Mathemateg a Mathemateg Bellach</b> Jonny Griffiths
15:35 - 15:55	Coffi		Coffi	
<b>Sesiwn 4</b> 15:55 - 16:45	<b>Cloddio Am Y Pam</b> Andy Lumley	<b>Python ar gyfer ymchwilio i broblemau mathemateg</b> Francis Hunt	<b>Adnoddau ystafell ddsbarth wyneb i waered? Caru nhw!</b> Dominic Oakes	<b>Ystyried strategaethau addysgu ar gyfer hafaliadau ddifferol</b> Adrian Wells
16:45 - 17:00	<b>I gloi:</b> Mathemateg a Cherddoriaeth, Dominic Oakes a thîm RhGMBC			

Cwricwlwm i Gymru	Addysgeg
Cyfoethogi	Safon Uwch

Mae'r gynhadledd hon yn rhad ac am ddim.  
Archebwch yma.





## Sesiwn 1

## Mwynhau gwneud a gweithio gyda mathemateg

James Lewis-Coll (Consortiwm Canolbarth y De (CSC))

Gweithiodd James yn yr Alban, Lloegr a nawr yn system addysg Cymru. Datblygodd a chynhaliodd gyrsiau TAR. Wedi gweithio i CSC fel arbenigwr mathemateg ers tua 8 mlynedd yn cefnogi ysgolion gyda datblygiadau mewn mathemateg.

Bydd y sesiwn hon yn ystyried amrywiaeth o dasgau a fydd yn herio ac yn cefnogi datblygiad sgiliau mathemategol myfyrwyr trwy ddatrys problemau a gwaith cyd-destunol. Bydd y tasgau hyn yn addas i fyfyrwyr ar draws CA3, CA4 a CA5 gan gysylltu â chyd-destunau bywyd go iawn, cymwysadau ymarferol a phroblemau mathemategol.

Bydd y gweithgareddau'n cynnwys cysylltiadau â chelf drwy ystyried y cwestiwn, "Pa mor hir yw rheilffordd?" ac i'r rhai mwy cerddorol, "Sut mae yoyos ffrwythau yn cysylltu â LPs finyl?" ymhlith amrywiaeth o dasgau diddorol.

Geiriau allweddol: Cymhwyso, modelu, cyd-destunau, meddwl mathemategol, mathemateg, modelu, CA3, CA4, CA5, ymarferol, cymwysadau, TGAU, Safon Uwch, trawsgwricwlaidd, bywyd go iawn, amcangyfrif. Cwricwlwm i Gymru: Sgiliau trawsgwricwlaidd

## Anfeidredd i Geometreg An-Ewclidaidd

Susan Thomas (RhGMBC)

Pennaeth Mathemateg Llanhari (Ionawr 1992-Medi 1996), Ystalyfera (1996-2010). RhGMB Cymru ers 2011. Tim Cynllun Gwaith RhGMBC.

Mae anfeidredd yn rhywbeth y cawn ein cyflwyno iddo yn ein dosbarthiadau mathemateg, ac yn ddiweddarach dysgwn y gellir defnyddio anfeidredd hefyd mewn ffiseg, athroniaeth, gwyddorau cymdeithasol, ac ati. Gellir gweld croestoriad anfeidredd â geometreg trwy edrych ar geometreg dafluniol, gyda llinellau cyfochrog yn croestorri 'yn anfeidredd'. Gellir dweud bod geometreg dafluniol yn cynnwys dofi anfeidredd. Mae'r sesiwn hon yn edrych ar Anfeidredd ac yn symud trwy Leonardo da Vinci, Escher, Penrose a Coxeter i Geometreg An-Ewclidaidd ar daith ddarganfod ryfeddol.

Geiriau allweddol: Anfeidredd, celf, geometreg an-Ewclidaidd, cyfoethogi

## Dosbarth Desmos i Ddechreuwr

Alice Lovett (RhGMBC)

Cydllynuddy RhGMBC Ardal De-ddwyrain Cymru. Mae rolau blaenorol yn cynnwys cydllynydd cyfnod allweddol 3, cydllynydd cyfnod allweddol 5 a Pennaeth Mathemateg, yn ogystal â chymhwyso fel arweinydd arbenigol mewn addysg.

Mae Desmos Classroom (DC) yn adnodd ar-lein gwych. Datblygodd RhGMBC, ymhlith llawer o ddefnyddiau amrywiol o DC, gwrs Mathemateg Ychwanegol sydd wedi'i ddefnyddio'n llwyddiannus fel sail i fynd â llawer o fyfyrwyr trwy'r cwrs yn llwyddiannus. A wêl a gred a gall natur ryngweithiol gweithgareddau DC gyflymu dealltwriaeth myfyrwyr o ystod o gysyniadau a thechnegau mathemategol. Yn y sesiwn hon byddwch yn dysgu sut i sefydlu cwrs DC, sut i wneud gweithgareddau difyr i fyfyrwyr CA3-5 a sut i ddefnyddio DC yn yr ystafell ddosbarth ac ar gyfer gwaith cartref.

Geiriau allweddol: Meddalwedd deinamig, CA2-5, Asesu ar gyfer Dysgu, TGCh, rhyngweithiol, ymgysylltu, dyfnder, datrys problemau, chwarae, Cwricwlwm i Gymru: defnyddio technolegau digidol yn greadigol

## Dulliau arbrofol (a hwyliog) o gyflwyno Prawf Rhagdybiaeth UG

Philip Mackie a Theresa Hendy (Coleg Gŵyr Abertae)

Mae Phil a Theresa ill dau wedi bod yn dysgu mathemateg Safon Uwch am fwy nag ugain mlynedd mewn Addysg Bellach.

Sesiwn ymarferol i gasglu data lle byddwn yn ystyried cyflwyno profion damcaniaeth gyda'r Dosbarthiad Binomaidd gan ddefnyddio amrywiaeth o arbrofion ystadegol; gellir ailadrodd pob un ohonynt yn hawdd yn yr ystafell ddosbarth. Byddwn hefyd yn edrych ar sut y gall GeoGebra helpu i wneud penderfyniadau wrth lunio casgliadau.

Geiriau allweddol: Ystadegau UG, profi damcaniaeth, Dosbarthiad Binomaidd



## Sesiwn 2

## Dysgu theori cwlwm mewn ysgolion cynradd ac uwchradd yn Japan

Tomoko Yanagimoto, Ken-ichi Iwase, Akiyo Higashio (Prifysgol Osaka Kyoiku a Phrifysgol Electro-gyfathrebu Osaka)

Addysgwyr mathemateg sy'n arwain gweithgor ar ddysgu theori cwlwm mewn ysgolion yn Osaka, Japan. Ffurfiwyd y grŵp yn 2004 pan gyfarfu Hirokazu Okamori, ymchwilydd mewn addysg mathemateg, ac Akio Kawauchi, a oedd ar y pryd yn fathemategydd blaenllaw ar ddamcaniaeth cwlwm yn Japan, i drafod goblygiadau damcaniaeth fathemategol newydd ar gyfer dysgu mewn ysgolion.

Mae athrawon ac addysgwyr mathemateg bob amser yn ceisio datblygu cynnwys addysgu sy'n mynd y tu hwnt i fathemateg ysgol draddodiadol er mwyn meithrin dealltwriaeth plant o'r pwnc a'u diddordeb ynddo. Cyflwynodd damcaniaeth cwlwm ei hun fel un cyfle o'r fath pan gyfarfu ymchwilydd addysg fathemateg a mathemategydd a ffurio gweledigaeth ar gyfer hyn. Ffurfiwyd wedyn grŵp astudio o ymchwilydwr mathemateg, mathemategydwr, ac athrawon i weithio ar hyn. Dechreuodd y grŵp trwy ddysgu hanfodion theori cwlwm ac ymchwilio i'w goblygiadau addysgol. Rydym yn aelodau craidd o'r grŵp astudio ac yn gwahodd cyfranogwyr i ymuno â'r gweithdy ymarferol hwn i ddysgu rhywfaint o ddamcaniaeth cwlwm fel rhan o fathemateg yr ysgol, ac i glywed am lwyddiannau a heriau ei haddysgu i fyfyrwyr.

Geiriau allweddol: CA3 a CA4, gwaith cyfoedion, trawsgwricwlaidd, cyfoethogi, cwricwlwm

## Brithwaith a phrawf

Elian Rhind (RhGMBC)

Cwblhau doethuriaeth mewn Mathemateg yn 2018. Tiwtor tymor penodol i'r adran Mathemateg ym Mhrifysgol Abertawe. Wedi gweithio gyda'r RhGMBC fel myfyriwr am ychydig flynyddoedd ond wedyn ymuno â'r rhaglen yn gweithio mewn rhôl fwy llawn yn 2018.

Caiff y brithwaith o siapau ei weld yn naturiol yn ogystal ag o fewn cread dynol ar hyd amryw o sefyllfaoedd. Edrychwn ar y brithweithiau o wrthrychau geometregol, gan ddefnyddio un polygon a defnyddio o leiaf dau bolygon. Clyma'r gwaith yma'n dda i waith yn seiliedig ar geometreg yn TGAU, gyda lle i gyffredinoli syniadau wrth i algebra gael ei gyflwyno. Mae yna lle i gyffredinoli syniadau o frithweithiau lled-rheolaidd yn ogystal â pholyhedronau tri-dimensiwn. Mae myfyrwyr yn elwa o weld y syniad o brithwaith yn llythrennol yn clicio gyda'i gilydd o'u blaenau.

Geiriau allweddol: Geometreg, Algebra, Cyffredinoli, Prawf

## Geogebra a Dosbarthiad Samplu Cymedr y Sampl

Paul Sanders (RhGMBC)

Ar ôl 35 mlynedd yn dysgu Mathemateg mewn ysgolion 11-18 rwyf bellach yn fy 10fed flwyddyn yn gweithio gyda RhGMBC ac wedi chwarae rhan weithredol yn natblygiad y rhaglen dysgu proffesiynol a llawer o'r adnoddau fideo ar gyfer cyrsiau Mathemateg a Mathemateg Bellach Safon Uwch.

Gwir bwysigrwydd y dosraniad Normal yw'r ffaith, os cymerir hapsamplau o boblogaeth, yna mewn llawer o achosion bydd gan gymedr y sampl drosraniad tebygolrwydd (neu samplu) sy'n Normal. Mae canlyniadau o'r fath yn ymddangos ym Manylebau M & MB CBAC. Mae profenni o'r naill neu'r llall o'r canlyniadau hyn y tu hwnt i gwmpas myfyrwyr Safon Uwch, fodd bynnag mae pwysigrwydd y canlyniadau yn gofyn am rhywfaint o gyfiawnhad. Bydd rhaglennig Geogebra yn cael eu datblygu i ysgogi'r canlyniadau hyn.

Geiriau allweddol: Dosbarthiad Normal, Samplu Dosbarthiad cymedr y sampl, Theorem Terfyn Canolog, Geogebra, CA5

## Anghydraddoldebau: Eu Datrysiaid, Defnyddiau a Synthesis

Huw Kilner (Coleg Chweched Dosbarth Caerdydd)

Dysgodd Fathemateg mewn ysgol gyfun am dros 30 mlynedd. Am yr 11 mlynedd diwethaf mae wedi dysgu'r dosbarthiadau STEP a MAT ac yn awdur llyfr sy'n ymwneud yn gyfan gwbl â chwestiynau STEP a'u hatebion.

Fy nod yw ymateb yn gadarnhaol i fater a godwyd gan Brif Arholwr STEP a darparu rhywfaint o ddeunydd gobeithio y bydd o ddefnydd uniongyrchol yn yr ystafell ddosbarth.

Gan ddefnyddio cwestiynau arholiad blaenorol, bydd y daith yn mynd â ni o'r anghydraddoldebau symlaf, trwy ddulliau datrys a chymhwyso anghydraddoldebau, i synthesis a phrawf o anghydraddoldeb cymedr rhifyddol a chymedr geometrig ac anghydraddoldeb Cauchy-Schwarz. Daliwch yn dynn am reid gyflym!

Geiriau allweddol: Delweddu, Amcangyfrif, Cymhwysiad, STEP, MAT, CA5

## Sesiwn 3

## DSB STEM: Dysgu trawsgwricwlaidd a dysgu seiliedig ar brosiect mewn mathemategu

Theresa Hendy, Sofya Lyakhova and Stephen Earles (RhGMBC)

*Theresa: Cydlynnydd Ardal De a Chanolbarth Cymru ac yn arweinydd Dysgu Proffesiynol. Dysgodd fathemateg mewn ysgol uwchradd ac AB. Pennaeth Adran ac Arweinydd Cwricwlwm mathemateg a gwyddoniaeth. Dysgodd sgiliau sylfaenol a mynediad i gyrsiau AU. Athro-ymchwilydd ar gyfer yr NEM yng Nghymru yn 2016.*

*Sofya: Athro Cyswllt Mathemateg ym Mhrifysgol Abertawe ac yn Arweinydd Rhaglen RhGMBC. Mae hi wedi gweithio ar ystod o brosiectau ymchwil mewn mathemateg bur ac addysg mathemateg. Mae'n ymddiriedolwr cyfetholedig o Gyd-gyngor Mathemategol y DU ac yn aelod o fwrdd cyngori Academi'r Gwyddorau Mathemategol.*

*Stephen: Arweinydd Dysgu RhGMBC, Cydlynnydd Ardal Canolbarth a Gorllewin Cymru. Athro Mathemateg ers 1985. Dysgodd AB yn Lundain ac yna symudodd i Orlewin Cymru fel athro dosbarth am 10 mlynedd ac yna dod yn Bennaeth Adran am 19 mlynedd.*

**Mae dysgu seiliedig ar brosiect yn cysylltu myfyrwyr â'u dysgu mewn ffyrdd nad yw cyfarwyddyd traddodiadol yn aml yn ei wneud. Mae'n rhoi cyfle i fyfyrwyr gymhwyso gwybodaeth i ddatrys problem, meddwl yn ddyfnach am gynnwys, a dysgu gofyn cwestiynau. Yn y sesiwn ymarferol hon, byddwn yn archwilio problemau hynod ddiddorol a fenthycwyd gan AGGIE STEM, gwrsyll DSB blaenllaw yn UDA ac yn rhyngwladol. Paratowch ar gyfer llawer o lanast! Bydd cyfranogwyr yn cael eu cyfeirio at adnoddau ffynhonnell agored ar gyfer DSB a gweithgareddau trawsgwricwlaidd ar draws pob grŵp oedran.**

Geiriau allweddol:

Cwricwlwm i Gymru, dysgu seiliedig ar brosiect (DSB), CA3 & CA4, gwaith cyfoedion, trawsgwricwlaidd, arwain a chwarae rolau gwahanol mewn timau yn effeithiol ac yn gyfrifol

## Beth yw ffractals? Ymchwilio i ffractalau amrywiol gan ddefnyddio Geogebra

Ifor John Jones (RhGMBC)

*Athro Mathemateg a TG wedi ymddeol gyda phrofiad o weithio yng Nghymru (cyfrwng Cymraeg a Saesneg), Zambia a Papua Gini Newydd – yn dysgu (Mathemateg a TG) a rheolaeth ysgol.*

**Gan ddefnyddio trawsnewidiadau ehangu, cyfieithu, cylchdroi ac adlewyrchiad ynghyd â defnydd integredig o'r daenlen yn Geogebra i ymchwilio i ystod o gromliniau llenwi gofod a ffractalau - cromlin Peano, cromlin Hilbert, cromlin Minkowski, triongl Sierpinski, ffractalau blwch, set Mandelbrot a setiau Julia. Gan ddefnyddio'r cyfleuster olrhain a chwyddo i mewn i adrannau o setiau Julia wedi'u llenwi, dangosir plotiau diddorol a gyflawnwyd trwy arbrofi â lliw. Bydd cyfranogwyr gallu cynhyrchu rhai o'r cromliniau llenwi gofod drostynt eu hunain.**

Geiriau allweddol:

Cyfoethogi, Geogebra, fractalau, cromliniau llenwi gofod, set Mandelbrot, setiau Julia

## Diwrnod Amgylchedd y Byd

Dominic Oakes a Alice Lovett (RhGMBC)

*Dominic: Arweinydd Adnoddau ac Ymchwil RhGMBC, Cydlynnydd Ardal Gogledd Cymru. Cymhwysodd fel athro Mathemateg yn 1992. Ymhlith y rolau blaenorol mae Pennaeth Mathemateg ac ar yr UDA. Mae wedi gweithio'n helaeth fel Ymgynghorydd ac mae'n Yngynhorydd Arbenigol i'r Maes Dysgu a Phrofiad Mathemateg a Rhifeddu. Alice: Gweler uchod*

**Mae Economeg Toesen yn cynnig gweledigaeth o'r hyn y mae'n ei olygu i ddynoliaeth ffynnu yn yr 21ain ganrif trwy leoli economeg o fewn nodau cymdeithasol a nenfyddau amgylcheddol. Mae astudio'r Doesen yn cynnig cyd-destun go iawn ar gyfer cyflwyno technegau ystadegol a delweddu yn ogystal â theithio'n naturiol o amgylch y cylch trin data - rydym wedi creu dau adnodd i'w defnyddio yn y dosbarth. Bydd y sesiwn hon yn cyflwyno syniad y Doesen ac yn cyflwyno'r ddau weithgaredd cyntaf fel bod y cynadleddwyr yn barod ar gyfer eu defnyddio yn eu dosbarthiadau eu hunain.**

Geiriau allweddol:

Yr Amgylchedd, Economeg Toesen, Cwricwlwm i Gymru - cylch trin data. CA3, CA4

## Cyflwyniad i Risps a Risps Bellach

Jonny Griffiths (Coleg Frome)

*Jonny Griffiths yw awdur gwefan boblogaidd Risps a sawl un arall. Ar hyn o bryd mae'n dysgu Mathemateg Safon Uwch yng Ngholeg Frome yng Ngwlad yr Haf. Mae wedi astudio Mathemateg ac Addysg ym Mhrifysgol Caergrawnt, y Brifysgol Agored ac yn UEA.*

**Sut gallwn ni gyflwyno tasgau ymchwilol i'n addysg Mathemateg a Mathemateg Bellach Safon Uwch? Bydd y sesiwn hon yn eich cyflwyno i weithgareddau profedig o wefannau Risps a Risps Bellach a allai fywiogi profiad eich myfyrwyr. Byddwn hefyd yn trafod sut y gellid eu ffitio orau i gynllun astudio.**

Geiriau allweddol:

Ymchwiliad, tasgau agored, Mathemateg Safon Uwch, Mathemateg Bellach Safon Uwch, Risps

## Sesiwn 4

## Cloddio am Y Pam

Andy Lumley (MEI)

20 mlynedd fel athro mathemateg. Pennaeth Technoleg Dysgu MEI ac yn arwain gwaith adnoddau ar-lein MEI, sy'n cynnwys goruchwyllo datblygiad Integral, ac yn helpu i ddatblygu strategaeth ddigidol yn y maes hwn. Mae'n gydwesteigr podlediad Digging For The Why gan MEI.

Dechreuodd Digging For The Why fywyd fel mantra ystafell ddosbarth, yna daeth yn bodlediad yn seiliedig ar barhad yn y pontio o Flwyddyn 5 i Flwyddyn 8 yn yr ystafell ddosbarth mathemateg. Nod y sesiwn hon yw dod â'r syniadau a'r canfyddiadau o siarad ag addysgwyr mathemateg amrywiol o'r cynradd i'r uwchradd. Byddwn yn archwilio syniadau fel chwilfrydedd yn y dosbarth, technoleg, gweithio gyda'ch ysgolion cynradd, ac, yn bwysicaf oll, yr angen i athrawon ofyn pam yn ogystal â'r myfyrwyr! Ar ddiwedd y sesiwn hon, byddwch yn gadael gyda darnau allweddol o pam y dylem 'gloddio am pam' i gymryd, addasu, tyfu a chymhwyso i'ch addysgu a chynllunio.

Geiriau allweddol: Pontio, parhad, chwilfrydedd, CA2-3, pontio Cwricwlwm i Gymru, pontio o'r ysgol gynradd i'r ysgol uwchradd

## Python ar gyfer ymchwilio i broblemau mathemateg

Francis Hunt (RhGMBC)

Cydlynu'r cyfoethogi ôl-16 yn y RhGMBC, ac mae'n gydlynedd ardal Canolbarth De Cymruz. Astudiodd fathemateg, dysgodd a gwnaeth ymchwil ym Mhrifysgol Caergrawnt. Peiriannydd meddalwedd. Darlithydd mathemateg ym Mhrifysgol De Cymru rhwng 2006 a 2019. Mae'n rhoi Dosbarthiadau Meistr Mathemateg y Sefydliad Brenhinol ar lefel CA3 a Chynradd, tiwtora mathemateg lefel A a TGAU, ac wedi mentora ar gyfer yr UKMT.

Mae'r sesiwn hon ar gyfer y dechreuwr pur. Ei nod yw dadansoddi'r broses o ysgrifennu rhaglen yn Python, a rhoi'r wybodaeth a'r hyder angenrheidiol i fynychwyr i ddechrau dysgu eu hunain sut i raglennu.

Yn y sesiwn byddwn yn cyflwyno ac yn defnyddio lluniadau Python allweddol; gweld faint o wahanol negeseuon gwall y gallwn eu creu a'u cywiro; ac ysgrifennu ychydig o raglenni syml i wneud pethau fel trosi Canradd i Fahrenheit, ychwanegu'r odrifau yn llai na 50, neu allbynnu'r cysefiniau llai na 100. Bydd y sesiwn yn defnyddio datganiadau amodol, dolennu a dadfygio, agweddau sy'n berthnasol i'r camau cynnydd o fewn Data a Meddwl Cyfrifiadurol yn y Cwricwlwm i Gymru.

Geiriau allweddol: Dechreuwr pur, Python, Cwricwlwm i Gymru – Sgiliau trawsgricwlaidd

## “Adnoddau ystafell ddosbarth wyneb i waered? Caru nhw!”

Dominic Oakes (RhGMBC) a Paul Bedingfield

Gweler uchod.

Mae adnoddau dosbarth wyneb i waered ymhlith y mwyaf poblogaidd eleni. Ond pam? Yn ôl yr athrawon, boed eich pryder yn amserlen lai, addysgu pynciau am y tro cyntaf, ystafell ddosbarth sy'n rhy dawel neu ganlyniadau arholiadau, yr adnoddau wyneb i waered yw'r ateb! Clywch gan athrawon a fynychodd Ddysgu Proffesiynol RhGMBC ar y Dull Ystafell Ddosbarth wyneb i waered ac sydd wedi defnyddio'r adnoddau'n helaeth eleni. Atebir pob un o'ch cwestiynau pam fod ystafell ddosbarth Lefel A yn ymddangos yn lle perffaith ar gyfer y dull wyneb i waered, faint o baratoi sydd ei angen arnoch, beth i'w ddisgwyl gan fyfyrwyr, sut i wneud yn siŵr bod y dull yn gweithio ac awgrymiadau ar gyfer defnyddio amser yn yr ystafell ddosbarth ar gyfer mwy o ddatrys problemau, trafodaethau bywiog a gwaith cyfoedion.

Geiriau allweddol: Dosbarth wyneb i waered, nodiadau â bylchau, ennill amser, profiad athrawon, CA4, CA5

## Ystyried strategaethau ar gyfer hafaliadau differol

Adrian Wells (RhGMB Cymru Prifysgol Abertawe)

Ar un adeg Cyd-drefnydd Ardal Canolbarth a Gorllewin Cymru, Uwch Bennaeth Cynorthwyl; Pennaeth Mathemateg gyda 40+ mlynedd o brofiad addysgu, Arolygydd Cymheiriaid (ESTYN). Arholwr/Arweinydd Tim ar gyfer Pearson/EDEXCEL mewn Mathemateg Bur Bellach gyda 30+ mlynedd o brofiad.

Gan ddefnyddio M A2 U3 fel man cychwyn gyda hafaliadau differol trefn gyntaf 'newidiol gwahanadwy', a yw  $dy/dx$  yn ffracsiwn? Yna gweithio i ffactorau integreiddio gradd gyntaf, ffurfiau homogenaidd ac anhomogenaidd ail radd i gyrraedd systemau o hafaliadau differol.

Geiriau allweddol: Dysgu er dealltwriaeth, cam arall ar y llwybr, CA5

Rhaglen llawn yma

