Prifysgol Cymru
Y Drindod Dewi Sant
University of Wales
Trinity Saint David

Yr Athrofa
Centre *for* Education
Addysg i Gymru | Education for Wales

Trawsnewid Addysg,
Trawsnewid Bywydau

Transforming Education,
Transforming Lives

Trawsnewid Addysg, Trawsnewid Bywydau
Transforming Education, Transforming Lives

www.uwtsd.ac.uk

ECAD6008C

Science and Technology

Lecture 3

Helen Williams
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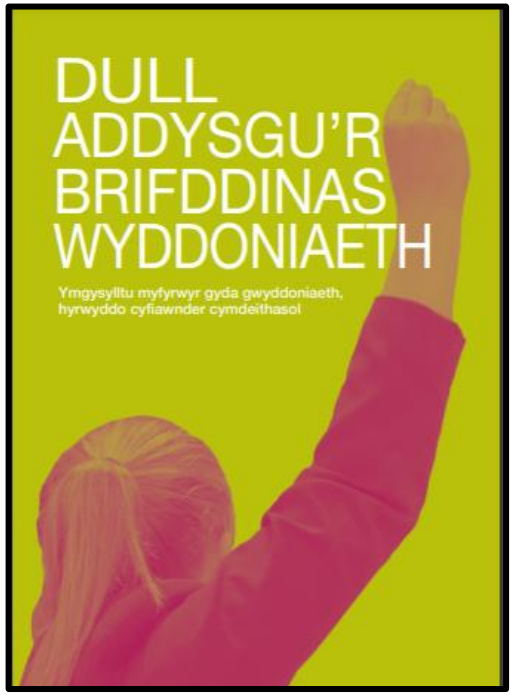
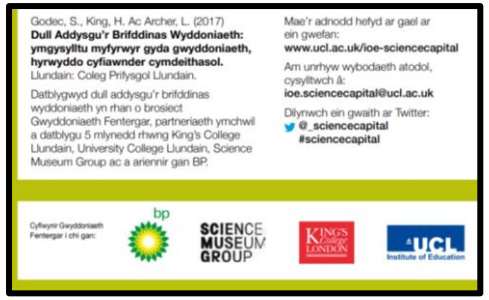
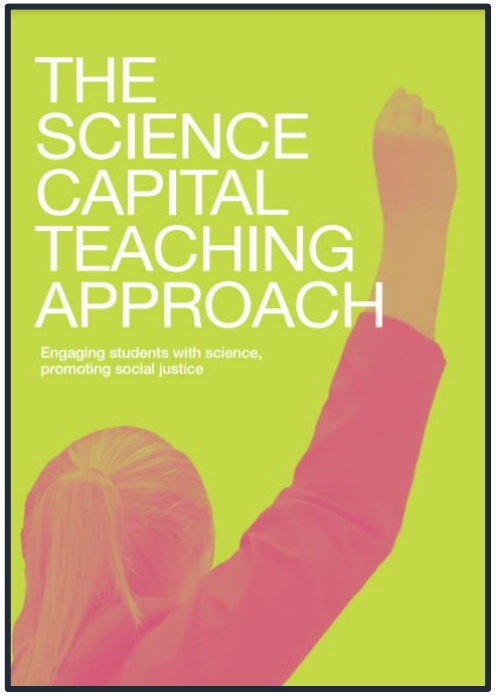
Cyfalaf Gwyddonol : Science Capital

"The Science Capital Teaching Approach is designed to support teachers in helping students find more meaning and relevance in science and, as a result, engage more with the subject."







the-science-capital-teaching-approach-pack-for-teachers-welsh.pdf (ucl.ac.uk)

https://discovery.ucl.ac.uk/id/eprint/10080166/1/the-science-capital-teaching-approach-pack-for-teachers.pdf

Cyfalaf Gwyddonol- Beth ydyw?

Mae rhai dysgwyr yn cael trafferth gweld gwyddoniaeth fel rhywbeth sy'n berthnasol i'w bywydau ac fel rhywbeth sy'n addas iddyn nhw. Gall hyn wneud eu hymgysylltiad gyda gwyddoniaeth yn anodd.

Golyga cynnydd gwyddonol y bydd angen cynyddol i bobl ddeall pynciau STEM er mwyn bod yn ddinasyddion gweithredol sydd â dweud mewn cymdeithas.

I helpu mwy o bobl—a mwy o amrywiaeth o bobl—i ymgysylltu gyda gwyddoniaeth, mae dull addysgu cyfalaf gwyddoniaeth yn adeiladu ar arferion addysgu da.

Y gwahaniaeth allweddol yw ffocws penodol ar gydnabod a gwerthfawrogi cyfalaf gwyddonol cyfredol myfyrwyr, tra hefyd yn eu helpu i adeiladu ar gyfalaf gwyddonol newydd

Science Capital – What is it?

Some students struggle to see science as being relevant to their lives and as something that is for them. This can make their engagement with science difficult.

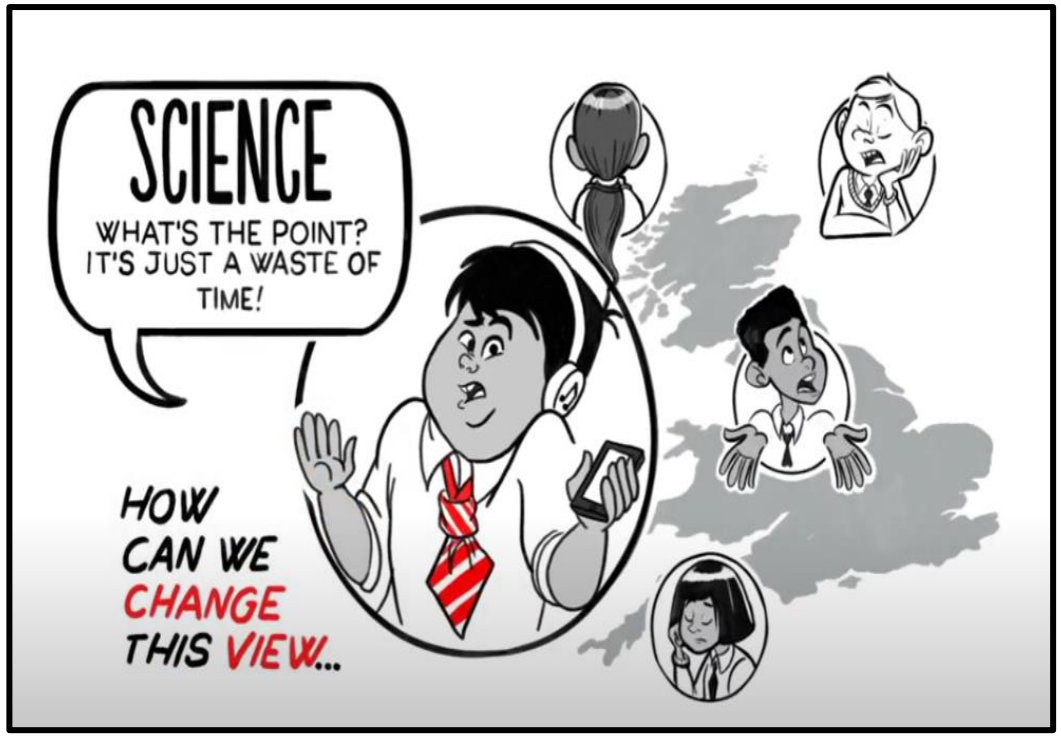
Scientific advances mean that people will need to be increasingly STEM-literate if they are to be active citizens who can have a say in society.

To help more—and more diverse—students engage with science, the science capital teaching approach builds on good teaching practice.

Its key distinction is an explicit focus on recognising and valuing students' existing science capital, whilst also helping them to build new science capital.

Cyfalaf Gwyddonol : Science Capital

https://www.youtube.com/watch?v=A0t70bwPD6Y



https://www.youtube.com/watch?v=hWWPUIK3xZ0

Superhero Scientists: Shining the Spotlight on Diversity in Scientific Professions

teach PRIMARY AWARDS 2021

A Scientist Just Like Me

https://pstt.org.uk/unique-resources/a-scientist-just-like-me/

Datganiadau o'r hyn sy'n bwysig
Statements of what matters

- Mae bod yn chwilfrydig a chwilio am atebion yn hanfodol i ddeall a rhagfynegi ffenomenau.
- Mae meddylfryd dylunio a pheirianneg yn cynnig ffyrdd technegol a chreadigol i ddiwallu anghenion a dymuniadau cymdeithas.
- Mae'r byd o'n cwmpas yn llawn pethau byw sy'n dibynnu ar ei gilydd i oroesi.
- Mae mater, a'r ffordd y mae'n ymddwyn, yn diffinio ein bydysawd ac yn ffurfio ein bywydau.
- Mae grymoedd ac egni yn gosod sail i ddeall ein bydysawd.
- Mae cyfrifiaduraeth yn gosod sail i'n byd digidol.

https://hwb.gov.wales/cwricwlwm-i-gymru/gwyddoniaeth-a-thechnoleg/disgrifiadau-dysgu/

- Being curious and searching for answers is essential to understanding and predicting phenomena.
- Design thinking and engineering offer technical and creative ways to meet society's needs and wants.
- The world around us is full of living things which depend on each other for survival.
- Matter and the way it behaves defines our universe and shapes our lives.
- Forces and energy provide a foundation for understanding our universe.
- Computation is the foundation for our digital world.

https://hwb.gov.wales/curriculum-for-wales/science-and-technology/descriptions-of-learning/

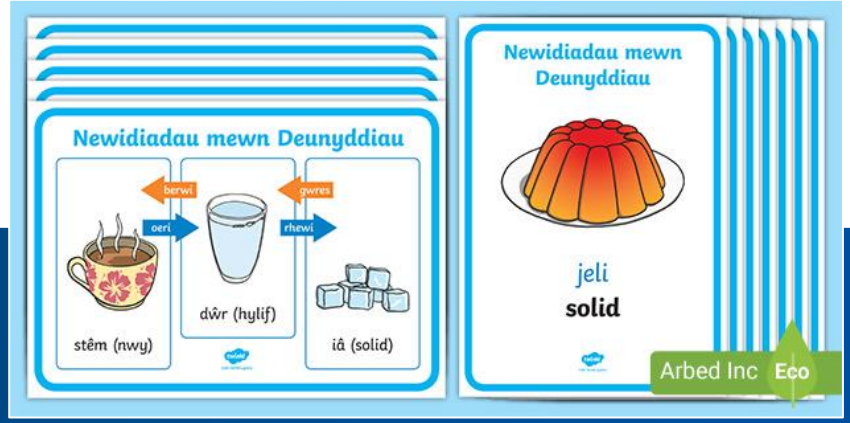
Egwyddorion Cynnydd :Cynllunio ar gyfer cynnydd:

"Caiff cynnydd ym Maes Dysgu a Phrofiad Gwyddoniaeth a Thechnoleg ei ddangos wrth i ddysgwyr archwilio a phrofi syniadau a chysyniadau cynyddol gymhleth sy'n rhan o'r datganiadau o'r hyn sy'n bwysig"

Gwyddoniaeth a Thechnoleg: Egwyddorion cynnydd - Hwb (gov.wales)

Enghraifft YHSB 4: dysgu sut y gellir trin deunyddiau:

- ar gamau cynharach trwy chwarae, cymysgu deunyddiau a gwybod y gall deunyddiau newid, ac o dan rai amodau byddant yn ymateb i ffurfio rhywbeth newydd, yn ogystal â chael eu cyfuno i greu cynhyrchion newydd
- yn nes ymlaen, gellir archwilio gwahanol fathau o adweithiau cemegol



Principles of progression : Planning for progression

"Progression in the Science and Technology Area of Learning and Experience is demonstrated by learners exploring and experiencing increasingly complex ideas and concepts that sit within the statements of what matters."

https://hwb.gov.wales/curriculum-for-wales/science-and-technology/principles-of-progression/

Example WM4: **learning how materials can be manipulated**:

- at earlier steps through play, mixing materials and knowing that materials can change, and under certain conditions will react to form something new, as well as be combined to create new products
- at later steps, different types of chemical *reactions* can be explored

Cysylltiadau allweddol gyda MDaPh eraill?
Key links to other AoLE's?

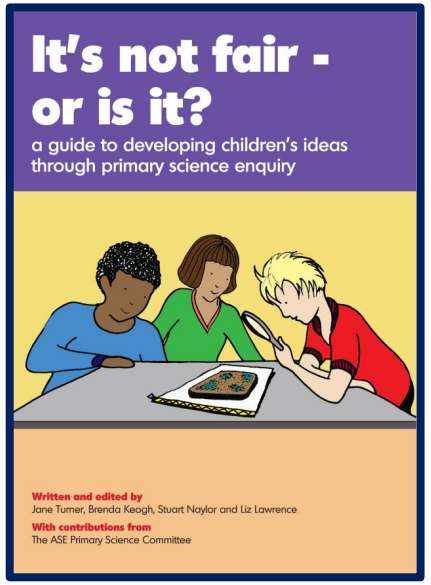
Prawf Teg

Fair test

Prawf teg

- **Mae cwestiynau prawf teg yn gwneud cymariaethau, yn aml maen nhw'n ceisio darganfod beth yw'r "gorau" neu'r "mwyaf".**
- Mae profi'n deg yn rhoi'r cyfle i ddisgyblion ymchwilio'r berthynas achosol rhwng dau newidyn. E.e. ydy uchder y llethr yn effeithio ar gyflymder y car yn rholio lawr os yw popeth arall yn aros yr un peth?
- Mae profion cymharol yn rhoi'r cyfle i ddisgyblion gymharu un digwyddiad gydag un arall E.e. ydy'r car coch yn teithio'n gyflymach na'r car gwyrdd?

Addaswyd y diffiniad o 'It's not fair - or is it?' (Turner, Keogh, Lawrence & Naylor, 2011)



Mae profi'n deg a gwneud cymariaethau yn rhoi cyfleoedd i ddisgyblion:

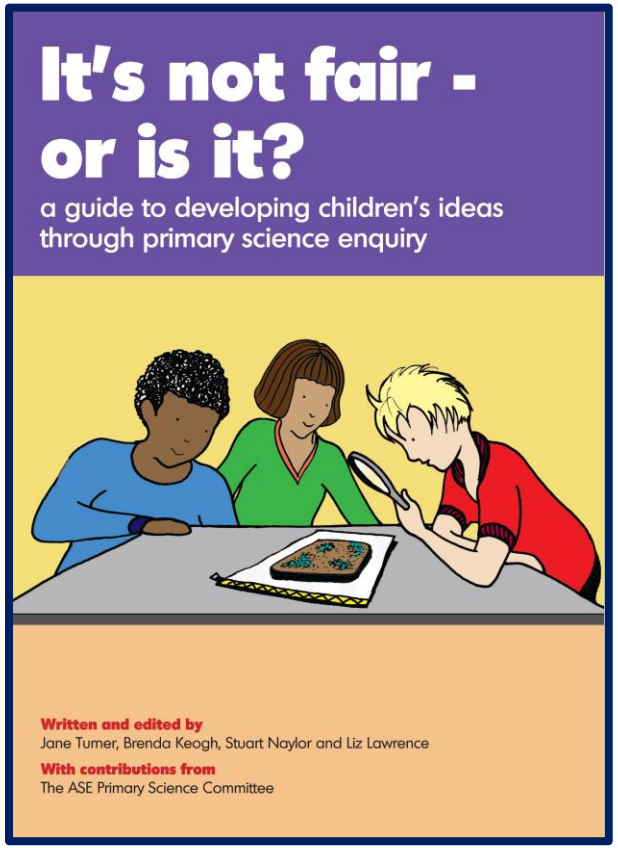
- Adnabod a deall bod un peth (newidyn) yn effeithio ar rywbeth arall
- Adnabod pan fod profion yn deg
- Creu cwestiynau prawf teg eu hunain
- Archwilio'r newidynnau a allai gael effaith
- Adnabod newidynnau
- Adnabod y gwahaniaethau maen nhw wedi'u harsylwi
- Deall sut i fesur neu arsylwi'r effeithiau

Fair test

Fair test questions make comparisons, often trying to find out which is the 'best' or 'most.'

- Fair tests allow pupils to explore relationship between variables. A fair test identifies the causal relationship between two variables e.g. does the height of the ramp affect how quickly the toy car rolls down the ramp and everything else remains the same.
- Comparative tests allow pupils to compare one event with another e.g. does the red car go faster than the green car?

Definition adapted from 'It's not fair - or is it?' (Turner, Keogh, Lawrence & Naylor, 2011)



Fair testing & making comparisons provides pupils with opportunities to:

- Recognise that one thing has an effect on another
- Recognise when tests are fair
- Generate fair test questions themselves
- Explore all the variables that may have an effect
- Identify variables.
- Identifying the differences they have noticed
- Know how to measure or observe the effects

Prawf teg *Fair test*

The Ogden Trust

making physics matter

Age 7-11 years

Working scientifically

Developing children's skills in fair tests

Introduction

Like comparative tests, fair test enquiries are an opportunity for children to explore cause and effect relationships in science. Children find the answers to 'big questions' in fair test enquiries by planning tests to collect data through changing, measuring and controlling variables. Fair tests involve making systematic changes and analysing data to identify how one variable influences another. Due to the increased challenge in this type of enquiry they are introduced in KS2.

Big questions

Here are some examples of 'big questions' that pupils can explore through fair tests in KS2. There is almost one for every area of the curriculum so it is easy to plan opportunities for children to revisit this type of enquiry regularly and develop their skills.

Year 3	Year 4	Year 5	Year 6
How does the length of the carnation stem affect how long it takes for the food colouring to dye the petals?	Does the amount of light affect how many woodlice move around?	How does the level of salt affect how quickly brine shrimp hatch?	How does the temperature affect how much gas is produced by yeast?
How does the angle that your elbow/knee is bent affect the circumference of your upper arm/thigh?	How does the mass of a block of ice affect how long it takes to melt?	How does age affect a human's reaction time?	How does the length of time we exercise for affect our heart rate?

https://www.ogdentrust.com/about-us/news/working-scientifically

Helping children's development of inquiry skills
Wynne Harlen
Inquiry in primary science education (IPSE) 1: 5-19, 2014 © 2014 PRI-SCI-NET

Action that teachers can take

- Stimulate curiosity through classroom displays, posters, and inviting questions through a question board or box.
- Help children to refine their questions and put them into investigable form.
- Provide opportunities for planning by starting from a question to be answered by inquiry without giving instructions.
- Scaffold planning a fair test using a planning board.
- Talk through an inquiry that has been completed to identify how it could have been better planned.

Teachers' questions:

- 'what would you like to know about ...?'
- 'what do you think will happen if your idea is correct?'
- 'what do you think will happen if... or when...?'
- 'why do you think that will happen?'
- 'what will you need to do to find out...'
- 'how will you be make it 'fair'

https://ipsejournal.files.wordpress.com/2015/03/3-ipse-volume-1-no-1-wynne-harlen-p-5-19.pdf

Prawf Teg Newidynnau

Newid
(Newidyn annibynnol)

Mesur
(Newidyn dibynnol)

Cadw'r un fath
(newidynnau rheoli)

Fair Test Variables

Change
(Independent variable)

Measure
(Dependent variable)

Keep the same
(control variables)

Cynllunio Prawf Teg : *Planning a Fair Test*

Ein bwrdd cynllunio ar gyfer Prawf Teg

Byddwn yn newid

Byddwn yn mesur neu'n arsylwi'r effaith a gaiff ar

Byddwn yn cadw'r pethau hyn yr un fath i'w gwneud yn deg

Our Planning Board for a Fair Test

We will change

We will measure or observe the effect it has on

We will keep these things the same to make it fair

1. Plant growth and water

Adding different amounts of water to a plant could affect its growth. To investigate this, plant some seeds and water each plant with different amount over time.

Independent variable?
Dependent variable?
Control variables?

Y Cwestiwn

The Question

Pam fod pengwiniaid yn cwtsio?

Why do penguins huddle?

Cam cynnydd 3

Progression step 3

Tasg

Sut allech chi ymchwilio i pam mae pengwiniaid yn cwtsio, yn eich ystafell ddosbarth?

1. Syniadau: Ymchwil?
2. Dull: Beth ydyn ni'n mynd i'w wneud?
3. Cynllun:
   - Pa gyfarpar?
   - Rhagfynegiad?
   - Prawf teg?
   - Mesur?
   - Cynrychioli data?
   - Casgliad?
   - Myfyrio?

Cofiwch! Strategaeth AagD?

Task

How could you investigate why penguins huddle, in your classroom?

1. Ideas : Research?
2. Method : What are we going to do ?
3. Plan :
   - What apparatus?
   - Predictions?
   - Fair test?
   - Measure?
   - Represent data?
   - Conclusion?
   - Reflection?

Remember ! Afl Strategy?

Adnoddau :Cam cynnydd 1,2 a 3

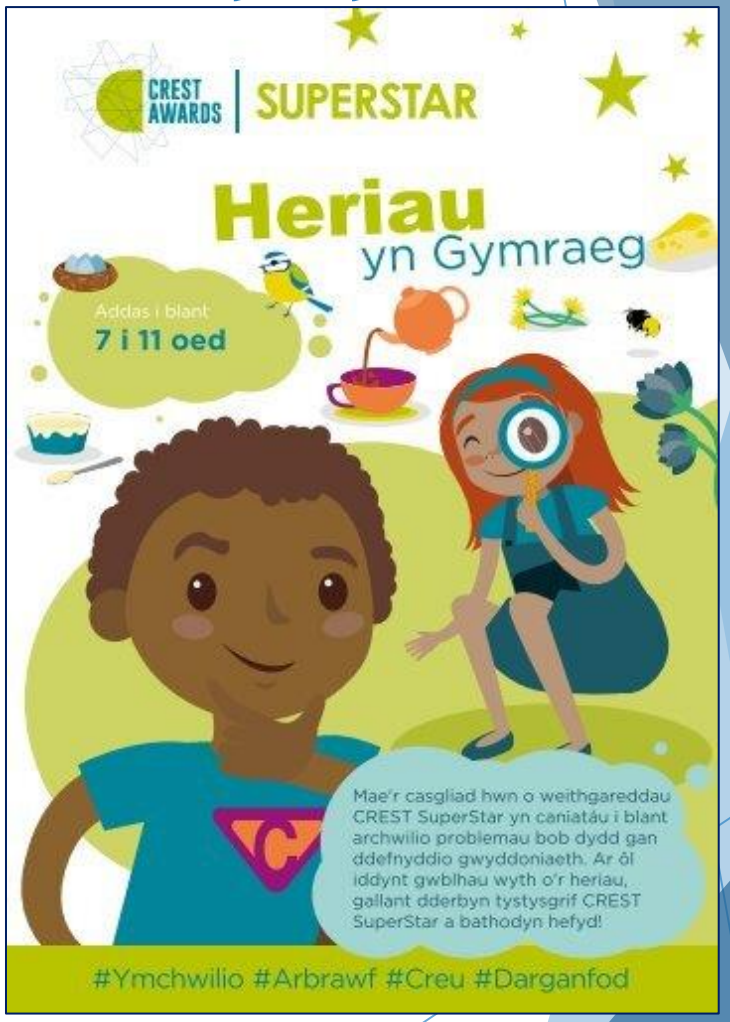
Resources:Progression Step 1,2 & 3

Ymchwilio, Arbrofi, Creu, Darganfod

Cam Cynnydd 1&2

https://primarylibrary.crestawards.org/all-star-challenges-in-welsh/64363075

Cam Cynnydd 2&3



https://primarylibrary.crestawards.org/all-superstar-challenges-in-welsh/64363180

Investigate, Experiment, Create, Discover

Progression steps 1&2

https://primarylibrary.crestawards.org/all-star-challenges/61746949

Progression Steps 2&3

https://primarylibrary.crestawards.org/all-superstar-challenges/61747644

YHSB/SOWM 1-6

Curriculum for Wales

The four principles of the Curriculum for Wales match well with the CREST guiding principles.

The curriculum for Wales aims to help children develop into:

- Ambitious, capable learners, ready to learn throughout their lives
- Ethical, informed citizens of Wales and the world
- Enterprising, creative contributors, ready to play a full part in life and work
- Healthy, confident individuals, ready to lead fulfilling lives as valued members of society

CREST guiding principles:

- Problem solving
- Reflective practice
- Reporting and communicating
- Real-world context
- Decision making
- Practical science
- Independent working

We suggest the following CREST Star challenges for the six science content areas in the Curriculum for Wales for ages 5-7:

Curiosity

- Brilliant bubbles
- Discovery bag
- Muddy mess
- Music maker
- Sneaky shadow

Design thinking and engineering

- Testing timers
- Starting sounds
- Music maker

Living things

- Animal adventure
- Plant detectives

Matter and its behaviours

- Scrapyard scraps
- Sniffley sneezes
- Teabag trouble
- Useless umbrella

Computation and the digital world *

- Slippery slidey shoes
- Speedy scooters
- Music maker

* You can use digital tools such as cameras and microphones to record results in these challenges

Forces and energy

- Confusing cans
- Slippery slidey shoes
- Speedy scooters

YHSB/SOWM 1-6

The following CREST SuperStar challenges map onto the six science content areas in the Curriculum for Wales for ages 7-11:

Curiosity

- A hole in my bucket
- A sticky problem
- Bumblebee mystery
- Camouflaged creatures
- Colorado brown stain
- Over to you

Design thinking and engineering

- Bridge blunder
- Band rollers
- Bowled over
- Crafty rafts
- Discus dilemma
- Kite calamity
- Outdoor gym
- Spinning solutions

Living things

- Making toothpaste
- Buy them and try them
- Colorado brown stain
- Outdoor gym
- Playground games

Matter and its behaviours

- A hole in my bucket
- A sticky problem
- Cheesy challenge
- Get set jellies
- Investigating ink
- Just my cup of tea
- Polymer problem
- Protecting polymers
- Surprising stains
- Testing and comparing tea
- Tomato sauce
- Yummy yogurt

Forces and energy

- Band rollers
- Bowled over
- Bridge blunder
- Super spinners
- Racing rockets

Computation and the digital world *

- Bumblebee mystery
- Drifting dandelions
- Super spinners

* You can use digital tools such as cameras to record and analyse results in these challenges

You can read about the curriculum for Wales in full here:
https://hwb.gov.wales/curriculum-for-wales/

YHSB 2

https://hwb.gov.wales/api/storage/960ea21d-b304-4b8c-af31-9faf2d53de0d/Cardiau%20Her%20Ardal%20Adeiladu%20Wal%20Fawr%20Tsieina.pdf

Repository - Hwb (gov.wales)

SOWM 2

https://hwb.gov.wales/repository/resource/589007d7-48bc-46b9-9ea6-99f049e36e17

https://hwb.gov.wales/repository/resource/3e344fb7-0d42-4c80-8faa-2d2b27e6cd7d

YHSB 3 – Camau cynnydd 1-3

Eco-Schools

Eco-Sgolion

Adnoddau Dysgu yn yr Awyr Agored - Lleihau Gwastraff

https://hwb.gov.wales/repository/resource/2b591435-5fd1-40d1-8d8c-8cf3ad370d77

Adnoddau Dysgu yn yr Awyr Agored - Tir yr Ysgol

https://hwb.gov.wales/repository/resource/656686a2-386c-4b66-87e6-fec940db4241

SOWM 3 – Progression steps 1-3

Eco-Schools

Eco-Sgolion

Eco-Schools Outdoor Learning Resources - Waste Minimisation

Repository - Hwb (gov.wales)

Eco-Schools Outdoor Learning Resource - School Grounds

Repository - Hwb (gov.wales)

YHSB/SOWM 4 & 5 :
Camau cynnydd/Progression steps 1-3

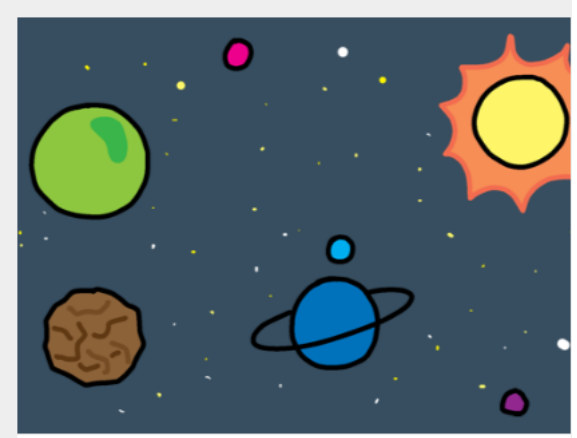
Repository - Hwb (gov.wales)

Repository - Hwb (gov.wales)

YHSB 6 : Mae cyfrifiaduraeth yn gosod sail i'n byd digidol

technocamps
Inspiring | Creative | Fun
Ysbrydoledig | Creadigol | Hwyl

About Us - Technocamps - What We Do at Technocamps



Dysgu sut i godio Scratch: ar goll yn y gofod

Repository - Hwb (gov.wales)

Botio

Repository - Hwb (gov.wales)

Ceisio lansio Minecraft Education Edition?

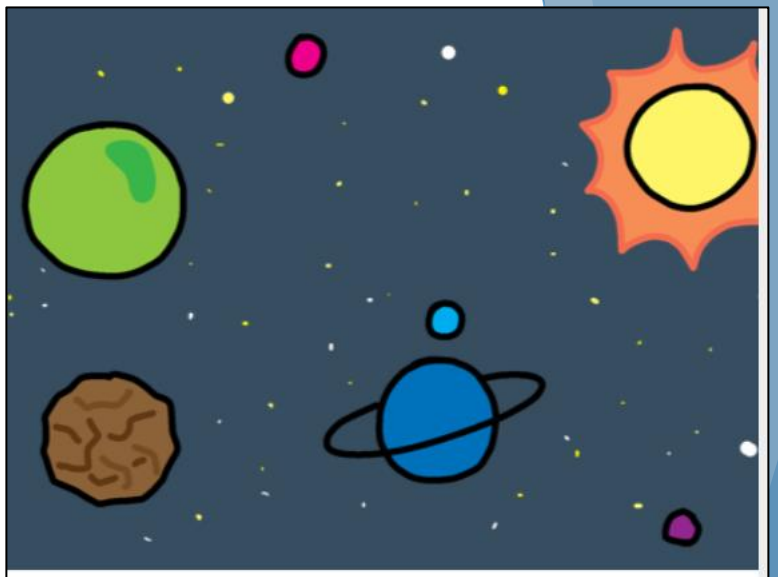
Repository - Hwb (gov.wales)

SOWM 6 :

technocamps

Inspiring | Creative | Fun
Ysbrydoledig | Creadigol | Hwyl

About Us - Technocamps –
What We Do at Technocamps



Learn to code Scratch: lost in space

Repository - Hwb (gov.wales)

Living Sustainably - Minecraft: Education Edition scheme of work

Download | Minecraft Education

Crazy Character Algorithms

An introduction to sequences of instructions

https://www.barefootcomputing.org/resources/crazy-character-algorithms

Testunau diddorol :
An interesting read:

Trainee teachers, **Toni Cain, Jemima Davey, Georgi Colliety, Maddy Hayward, Camilla Robinson, Regan Kerr** *and* **Rob Shaw**, *talk about science and explore their reasons for becoming science specialists*

The trainee teacher journey

The trainees get to grips with making birdfeeders

Sally Hardman *and* **Sue Luke** *develop opportunities for channelling children's curiosity*

HOW CAN YOU MAKE THE MOST OF THOSE 'WOW MOMENTS'?

Gweld Gwyddoniaeth
See Science

“Rydym yn cynnig ystod o gynhyrchion a gwasanaethau sy'n cefnogi addysgu a dysgu pynciau STEM yng Nghymru yng nghyd-destun y byd go iawn.”

https://www.gweld-gwyddoniaeth.co.uk/

See Science
Gweld Gwyddoniaeth

“We offer a range of products and services that support the teaching and learning of STEM subjects in Wales within a real world context.”

https://www.see-science.co.uk/

Books
Science and Technology

Allen, J. et al (2012), Primary ICT: *Knowledge, Understanding and Practice*, London: Learning Matters.

Loxley, P. et al. (2014) *Teaching Primary Science, Promoting Enjoyment and Developing Understanding*. Oxon. Routledge

Futurelab (2008) *Digital Literacy across the Curriculum*

Byron, T. (2008) *Safer Children in the Digital World*

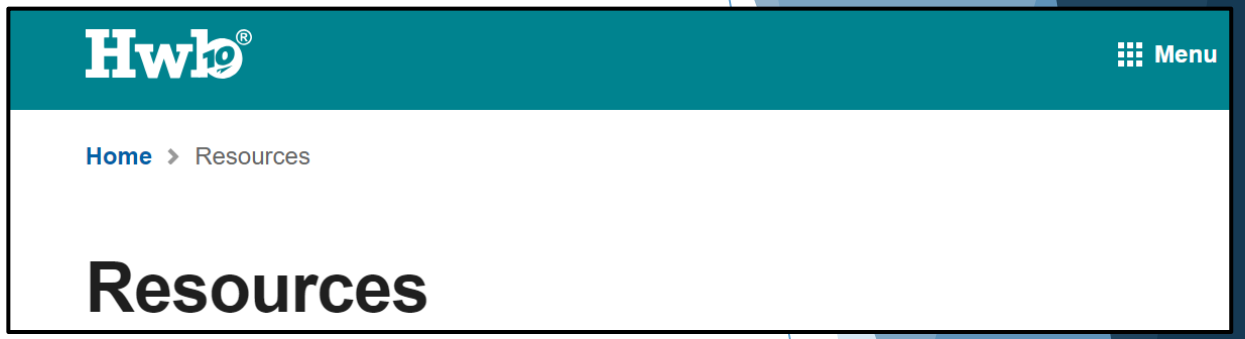
Weavers, G., Keogh, B., & Naylor, S. (2008). Made you look, made you think, made you talk. Sandbach: Millgate House. WELSH

Russell, T. & McGuigan, L. (2016) Exploring science with young children : a developmental perspective 1st ed.

Syniadau ac Adnoddau?

Adnoddau - Hwb (gov.wales)

Resources and Ideas?



Resources - Hwb (gov.wales)

Cysylltiadau defnyddiol Useful links

- https://www.stem.org.uk/resources/collection/3485/teaching-primary-science
- https://www.ase.org.uk/resources/primary-science
- https://wowscience.co.uk/
- https://www.tes.com/teaching-resources
- https://explorify.wellcome.ac.uk/