Curriculum Considerations

Some prompts for thinking before responding to the national consultation exercise 2024/25

Link to 2025 Education Bill

Today: learning through conversation

Sharing chocolate is not like sharing knowledge

Definitions

The school curriculum comprises all learning and other experiences that each school plans for its pupils. The National Curriculum is an important element of the school curriculum.

2013

2.1 Every state-funded school must offer a curriculum which is balanced and broadly based1 and which:

- promotes the spiritual, moral, cultural, mental and physical development of pupils at the school and of society, and
- prepares pupils at the school for the opportunities, responsibilities and experiences of later life.

2.2 The school curriculum comprises all learning and other experiences that each school plans for its pupils. The national curriculum forms one part of the school curriculum.

2.3 All state schools are also required to make provision for a daily act of collective worship and must teach religious education to pupils at every key stage and sex and relationship education to pupils in secondary education.

2.4 Maintained schools in England are legally required to follow the statutory national curriculum which sets out in programmes of study, on the basis of key stages, subject content for those subjects that should be taught to all pupils. All schools must publish their school curriculum by subject and academic year online.2

2.5 All schools should make provision for personal, social, health and economic education (PSHE), drawing on good practice. Schools are also free to include other subjects or topics of their choice in planning and designing their own programme of education.

A retrospective

1964 – 1984	Schools Council
1984 – 1988	School Curriculum & Development Council (SCDA) + Secondary Examinations Council (SEC)
1988 – 1993	National Curriculum Council (NCC) + School Examination & Assessment Council
1993 – 1997	School Curriculum & Assessment Council (SCAA)
1997 - 2010	Qualifications and Curriculum Authority (QCA) =(SCAA + NCVQ)
1998 – 2003	National Numeracy Strategy
2006	NCETM established as DfE funded initiative to improve mathematics teaching and learning in England.
2008	Early Years Foundation Stage (EYFS) Framework introduced.
2010 – 2011	Qualifications & Curriculum Development Agency (QCDA) National Assessment Agency (NAA) formed to manage school assessments
2010	QCDA regulatory functions to Ofqual
2011	Standards and Testing Agency (STA) took over remaining QCDA functions QCDA dissolved
2010 -	Bonfire of the Quangos (Mark 1). Ministerial reference groups. Emergence of Tsars.
2024	Public consultation on curriculum and assessment reform.

2025 review link

Curriculum Influences

See more

HMI: Curriculum Matters

The Curriculum from 5 to 16

HMI Series: Curriculum Matters No. 2

London: Her Majesty's Stationery Office 1985

[title page]

Department of Education and Science

The Curriculum from 5 to 16

Curriculum Matters 2

AN HMI SERIES

LONDON - HER MAJESTY'S STATIONERY OFFICE

1988 Education Reform Act

Duties with respect to the curriculum

(1) It shall be the duty—

(a) of the Secretary of State as respects every maintained school;

(b) of every local education authority as respects every school maintained by them; and

(c) of every governing body or head teacher of a maintained school as respects that school;

to exercise their functions (including, in particular, the functions conferred on them by this Chapter with respect to religious education, religious worship and the National Curriculum) with a view to securing that the curriculum for the school satisfies the requirements of this section.

(2) The curriculum for a maintained school satisfies the requirements of this section if it is a balanced and broadly based curriculum which—

(a) promotes the spiritual, moral, cultural, mental and physical development of pupils at the school and of society; and

(b) prepares such pupils for the opportunities, responsibilities and experiences of adult life.

1988 Education Reform Act

2 The National Curriculum

(1) The curriculum for every maintained school shall comprise a basic curriculum which includes—

(a) provision for religious education for all registered pupils at the school; and

(b) a curriculum for all registered pupils at the school of compulsory school age (to be known as "the National Curriculum") which meets the requirements of subsection (2) below.

(2) The curriculum referred to in subsection (1)(b) above shall comprise the core and other foundation subjects and specify in relation to each of them—

(a) the knowledge, skills and understanding which pupils of different abilities and maturities are expected to have by the end of each key stage (in this Chapter referred to as "attainment targets");

(b) the matters, skills and processes which are required to be taught to pupils of different abilities and maturities during each key stage (in this Chapter referred to as "programmes of study"); and

(c) the arrangements for assessing pupils at or near the end of each key stage for the purpose of ascertaining what they have achieved in relation to the attainment targets for that stage (in this Chapter referred to as "assessment arrangements").

(3) Subsection (1)(a) above shall not apply in the case of a maintained special school.

1988 Education Reform Act

3 Foundation subjects and key stages

(1) Subject to subsection (4) below, the core subjects are—

(a) mathematics, English and science; and

(b) in relation to schools in Wales which are Welsh-speaking schools, Welsh.

(2) Subject to subsection (4) below, the other foundation subjects are—

(a) history, geography, technology, music, art and physical education;

(b) in relation to the third and fourth key stages, a modern foreign language specified in an order of the Secretary of State; and

(c) in relation to schools in Wales which are not Welsh-speaking schools, Welsh.

(3) Subject to subsections (4) and (5) below, the key stages in relation to a pupil are as follows—

(a) the period beginning with his becoming of compulsory school age and ending at the same time as the school year in which the majority of pupils in his class attain the age of seven;

(b) the period beginning at the same time as the school year in which the majority of pupils in his class attain the age of eight and ending at the same time as the school year in which the majority of pupils in his class attain the age of eleven;

(c) the period beginning at the same time as the school year in which the majority of pupils in his class attain the age of twelve and ending at the same time as the school year in which the majority of pupils in his class attain the age of fourteen;

(d) the period beginning at the same time as the school year in which the majority of pupils in his class attain the age of fifteen and ending with the majority of pupils in his class ceasing to be of compulsory school age.

1988 Education Reform Act

4 Duty to establish the National Curriculum by order

(1) It shall be the duty of the Secretary of State so to exercise the powers conferred by subsection (2) below as—

(a) to establish a complete National Curriculum as soon as is reasonably practicable (taking first the core subjects and then the other foundation subjects); and

(b) to revise that Curriculum whenever he considers it necessary or expedient to do so.

(2) The Secretary of State may by order specify in relation to each of the foundation subjects—

(a) such attainment targets;

(b) such programmes of study; and

(c) such assessment arrangements;

as he considers appropriate for that subject.

(3) An order made under subsection (2) above may not require—

(a) that any particular period or periods of time should be allocated during any key stage to the teaching of any programme of study or any matter, skill or process forming part of it; or

(b) that provision of any particular kind should be made in school timetables for the periods to be allocated to such teaching during any such stage.

2010 v 2025

(6) The characteristics are that—

(a) the school has a curriculum satisfying the requirements of section 78 of EA 2002 (balanced and broadly based curriculum);

(b) if the school provides secondary education, its curriculum for the secondary education has an emphasis on a particular subject area, or particular subject areas, specified in the arrangements;

(c) the school provides education for pupils of different abilities;

(d) the school provides education for pupils who are wholly or mainly drawn from the area in which the school is situated.

47 Academy schools: duty to follow National Curriculum

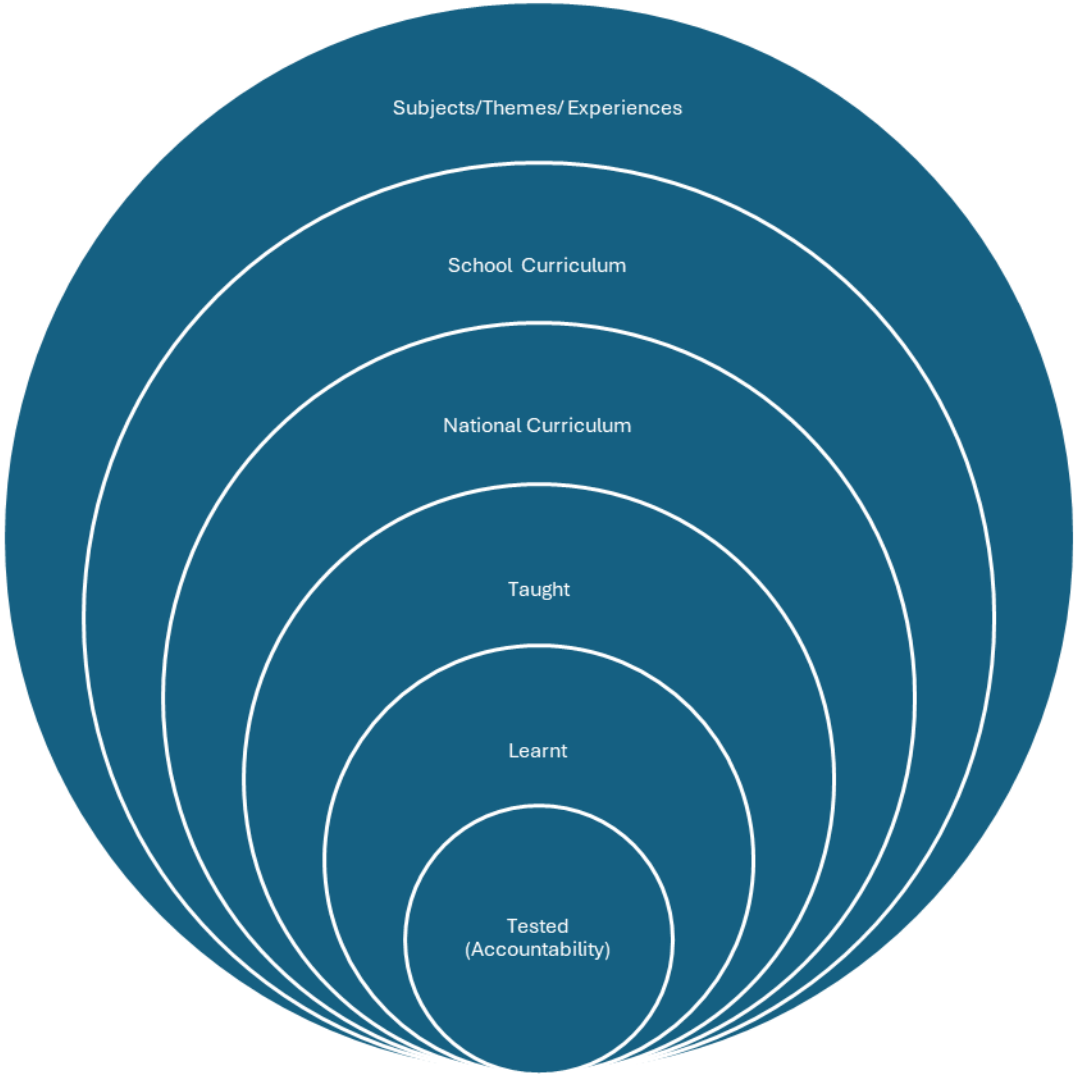
(1) The Academies Act 2010 is amended as follows.

(2) In section 1A (Academy schools)—

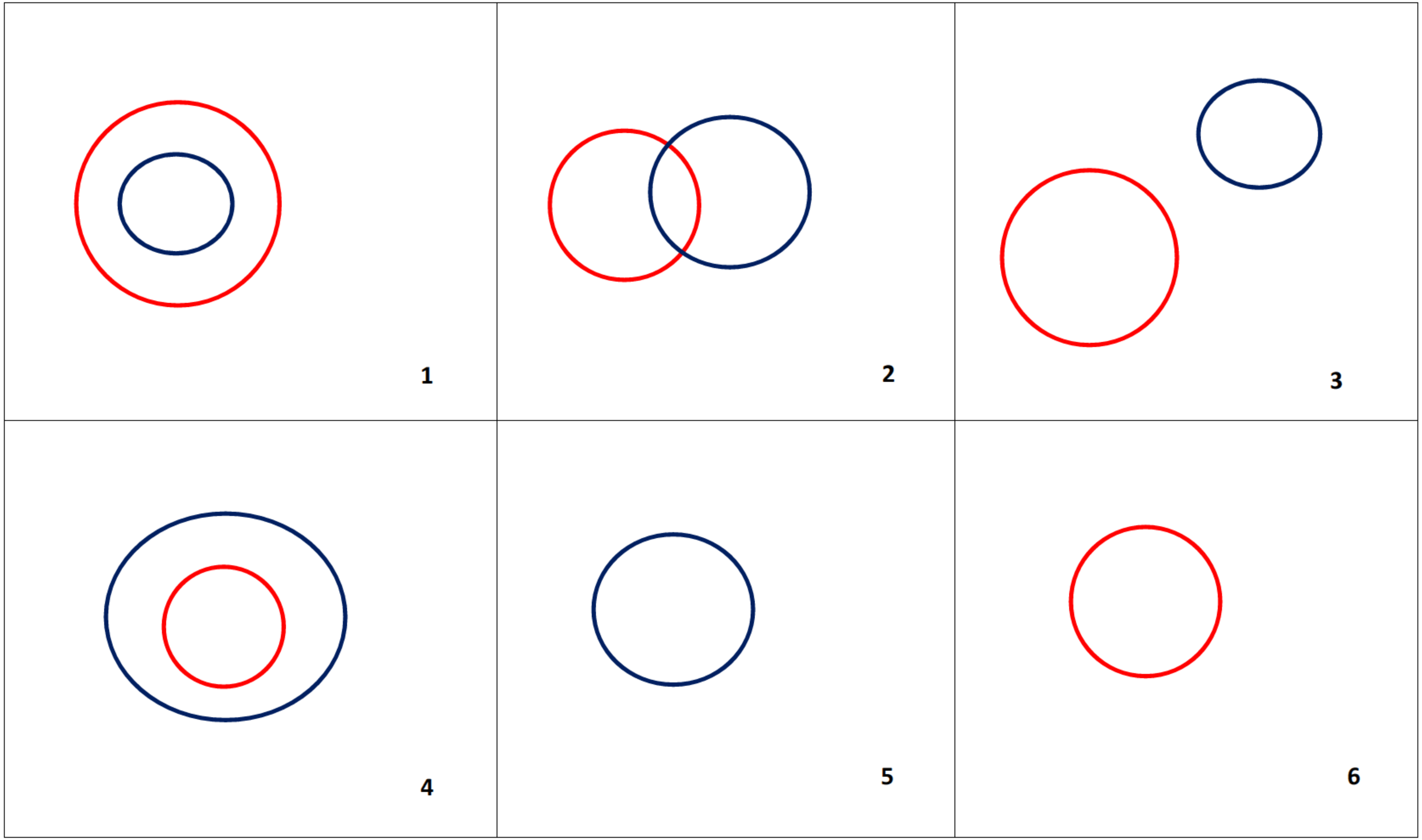
(a) in subsection (1), for paragraph (b) substitute—

"(b) its curriculum— (i) satisfies the requirements of section 78 of EA 2002 (balanced and broadly based curriculum), and
(ii) includes the National Curriculum (see section 80(1)(b) of that Act),";

Curriculum hierarchy?



If RED is what is taught and BLUE is what is learnt, which of the following represents (a) the real, and (b) the ideal? DISCUSS



Aims and values

It is difficult to prove that the aims and values of the earlier version of the national curriculum derived from research and professional consensus have outlived their usefulness.

The National Curriculum – Handbook for primary teachers in England DfE/QCA 1999

2025 version

Aligning curriculum with purpose of education

REALISE OR MOULD

I have here two heads.
One is carved; the other moulded.

The wood carver told me that the carved head had always been inside the wooden branch from which he carved it. What he had done was to reveal it.
There were other heads, similarly carved, on the pavement in Bulawayo, and each was different.

On the other hand, there are thousands of these moulded heads. All identical because they were cast in the same mould.

The two-minute presentation: House of Commons November 20 2024

Aligning curriculum with human endeavour

Our brains are disposed or programmed to make sense of experience; to find pattern and form; to seek connections and relationships. In this sense we are all born mathematical thinkers

If education is about realising human potential, then any educativ process should be structured around this assertion.

Mathematics is more than a list of ‘things to be learnt’; it is about unlocking the infinite possibilities of mathematical thinking.

An enlightened society should be striving to describe a curriculum for the mathematician rather than for mathematics.

Peter Lacey

ATM conference opening presentation 2004

Specificity 1: ingredients or Recipe?

Ingredients

Chicken

- 1 tbsp oil
- 5 oz / 150g chicken breast , thinly sliced (or other protein)
- 1 tbsp kecap manis (sweet soy sauce, Note 1)

Rice

- 1.5 tbsp oil
- 2 garlic cloves , finely chopped
- 1 tsp red chilli , finely chopped (Note 2)
- 1 onion , small, diced
- 3 cups cooked white rice , day old, cold (Note 3)
- 2 tbsp kecap manis (sweet soy sauce, Note 1)
- 2 tsp shrimp paste , optional (Note 4)

Garnishes / side servings (optional)

- 4 eggs , fried to taste
- 1 green onion , sliced
- Tomatos and cucumbers, cut into wedges/chunks
- Fried shallots , store bought (optional) (Note 3)
- Lime wedges

Instructions

1. Heat oil in a large skillet or wok over high heat.
2. Add chilli and garlic, stir for 10 seconds.
3. Add onion, cook for 1 minute.
4. Add chicken, cook until it mostly turns white, then add 1 tbsp kecap manis and cook for a further 1 minute or until chicken is mostly cooked through and a bit caramelised.
5. Add rice, 2 tbsp kecap manis and shrimp paste, if using. Cook, stirring constantly, for 2 minutes until sauce reduces down and rice grains start to caramelise (key for flavour!).
6. Serve, garnished with garnishes of choice (green onions, red chilli, fried shallots).

Specificity 2: Who decides?

This is a metaphor with all the usual limitations. The task is to focus attention on to who decides what is taught over time and in each lesson. The actors range from the State through to the Class Teacher, and maybe beyond. Consider, discuss and then put crosses in the appropriate boxes.

Think of the national curriculum as a warehouse of ingredients - that may be selected as per the instructions in a recipe and then combined and processed in some way to create meals.

Who decides the ingredients? Who selects the ingredients? Who creates the recipes? Who prepares the meals?

The inserted cross is the current statutory requirement.
(and applies only to LA maintained schools)

	WHO SHOULD DETERMINE?								
	National	School group	External provider	Assessment Agency	School	Teacher group	Class teacher	Learners	Other
INGREDIENTS FOR MEALS OVER A KEY STAGE	X								
INGREDIENTS FOR MEALS OVER A YEAR									
INGREDIENTS & RECIPES FOR MEALS OVER A KEY STAGE									
INGREDIENTS & RECIPES FOR MEALS OVER A TERM									
INGREDIENTS & RECIPES FOR MEALS OVER A WEEK									
INGREDIENTS & RECIPES FOR MEALS OVER A DAY									
PREPARED MEALS FOR A KEY STAGE (FREEZER TO DESK)									
PREPARED MEALS FOR A YEAR (FREEZER TO DESK)									
PREPARED MEALS FOR A WEEK (FREEZER TO DESK)									
READY TO EAT MEALS ON THE DAY (MAY NEED TO PLATE UP)									

Schemes of work?

If the curriculum is the territory to be explored, then a scheme of work is a journey planner, stopping off at particular locations on the territory and learning about them, as well as taking and appreciating the roads that connect them.

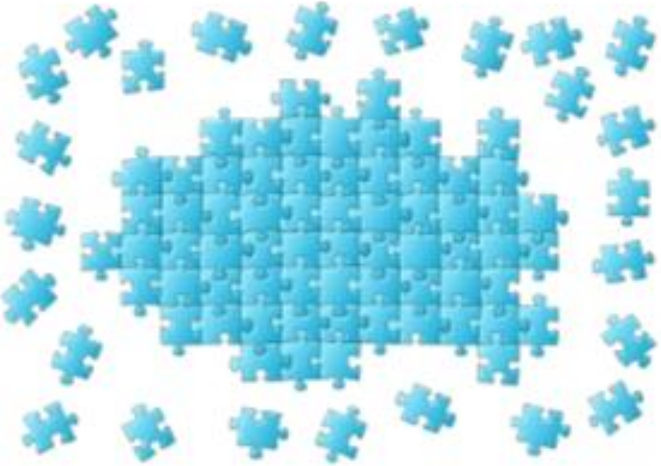
I can do something like this with my car Sat Nav. I put in a destination and stopping off points, and, hey presto, the journey is planned. It is pre-set. I undertake the journey as planned.

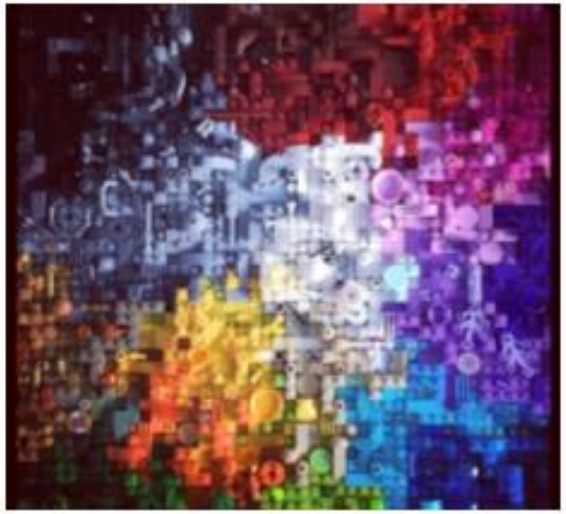
My friend has a different journey planner app called "Waze". She puts in the destination and stopping off places. What makes this so clever is that, whilst on the journey, real time information is used to make modifications to the journey: an interesting event at a location, or an accident to avoid, or an alternative route between locations. Fellow travellers can put this information onto the platform.

I think my scheme of work journey planner should be like "Waze", so that it can be tweaked en route to match the needs and interests of my learners. And also giving them a say in our navigation.

CURRICULUM METAPHORS -1

CURRICULUM METAPHORS -2





?

Weft and warp 1

Just because a curriculum may be presented as subjects to be taught, it does not necessarily mean the curriculum should be taught in subjects. There is likely to be much overlap of knowledge and skills across subjects. And the minds of learners are not compartmentalised into subject areas.

The taught curriculum should exploit these overlaps so that learners' maps of understanding are built up in ways that make sense and are relevant to them.

Weft and warp 2

29. The primary curriculum includes two non-statutory skills frameworks:

- Key Skills, covering communication, application of number, information technology, working with others, improving own learning and performance and problem-solving skills, and
- Thinking Skills, covering information-processing, reasoning, enquiry, creative thinking and evaluation skills.

30. In addition, it includes five non-statutory cross-curricular elements:

- Creativity;
- ICT;
- Education for sustainable development;
- Literacy across the curriculum, and
- Numeracy across the curriculum.

HC 344-I
Incorporating HC 651-i to -viii, Session 2007–08
Published on 2 April 2009
by authority of the House of Commons
London: The Stationery Office Limited

Weft and warp 3

37. The new secondary curriculum includes two skills frameworks:

- the 'functional skills' of English, mathematics and ICT, which are concerned with the application of literacy, numeracy and ICT skills, and
- 'personal, learning and thinking skills' (PLTS), which cover team working, independent enquiry, self-management, reflective learning, effective participation and creative thinking skills.

38. Finally, the new secondary curriculum incorporates seven non-statutory 'cross-curriculum dimensions':

- Identity and cultural diversity;
- Healthy lifestyles;
- Community participation;
- Enterprise;
- Global dimension and sustainable development;
- Technology and the media, and
- Creativity and critical thinking.

HC 344-I
Incorporating HC 651-i to -viii, Session 2007–08
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Knowledge 1

Since we can't know what knowledge will be most needed in the future, it is senseless to try to teach it in advance. Instead, we should try to turn out people who love learning so much and learn so well that they will be able to learn whatever needs to be learned.

John Holt

See also

The Saber-Tooth Curriculum, by J Abner Peddiwell, 1939
https://bit.ly/0519Curr1

Knowledge 2

Knowledge, learning, understanding, are not linear. They are not little bits of facts lined up in rows or piled up one on top of another. A field of knowledge, whether it be math, English, history, science, music, or whatever, is a territory, and knowing it is not just a matter of knowing all the items in the territory, but of knowing how they relate to, compare with, and fit in with each other. It is the difference between being able to say that a room in your house has so many tables, so many chairs, so many lamps, and being able to close your eyes and see that this chair goes here and that table there. It is the difference between knowing the names of all the streets in a city and being able to get from any place, by any desired route, to any other place.

John Holt, How Children Fail 1962

Knowledge 3

[See conceptual position paper 2025](#)

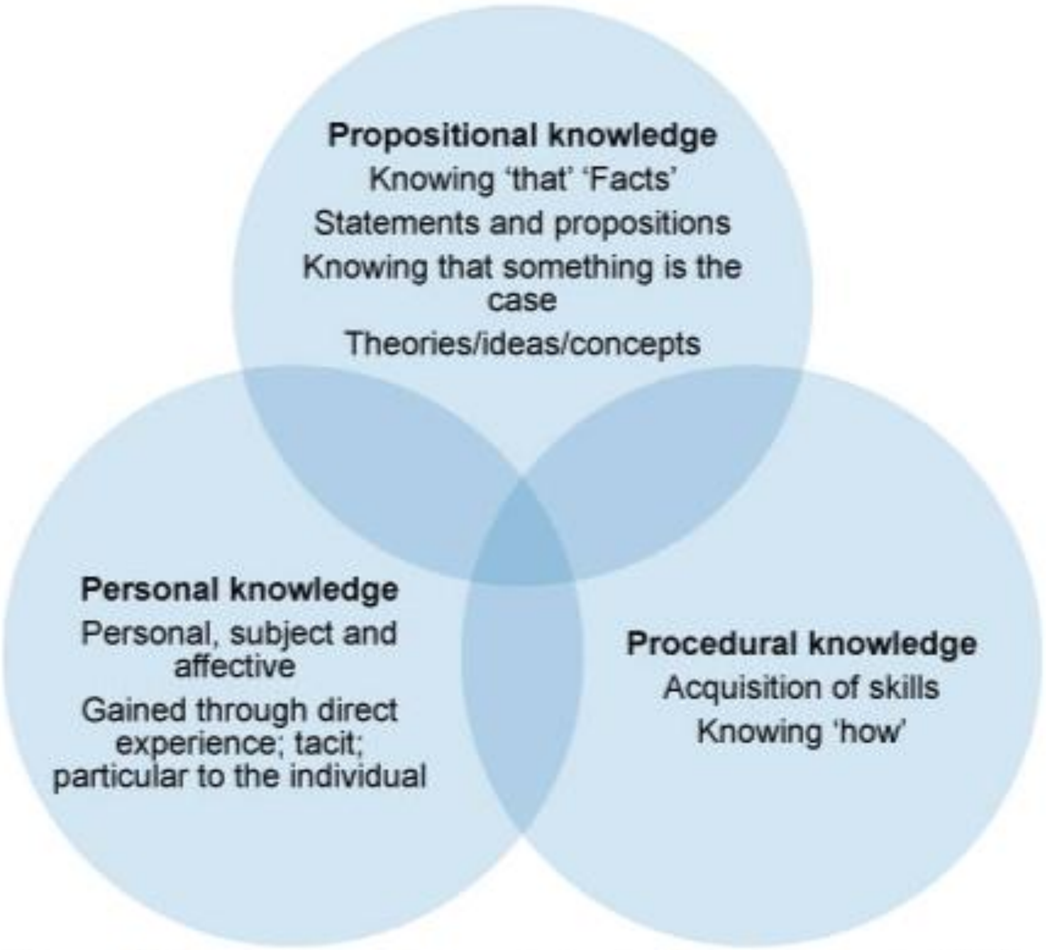


Figure 1 Types of knowledge (adapted from Burnard, 1996)

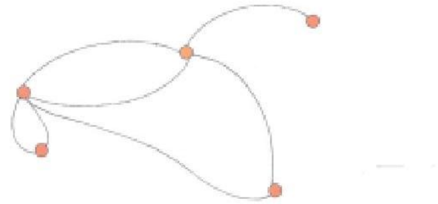
Knowledge 4

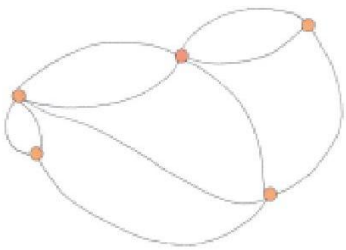
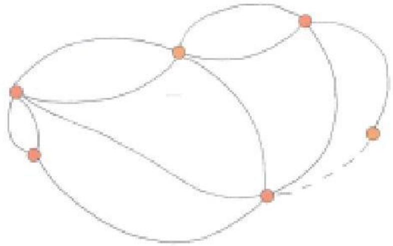
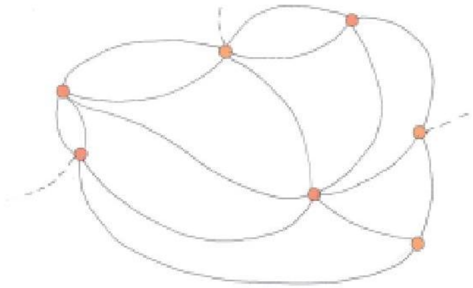
1. Explicit knowledge
2. Implicit knowledge
3. Tacit knowledge
4. Procedural knowledge
5. Declarative knowledge
6. A Posteriori knowledge
7. A Priori knowledge

Reductio ad absurdum

Driver delivers packs of knowledge in sequence from the curriculum warehouse to the teacher. Teacher delivers pack to learners. Learner puts each pack in his store. After a short time the teacher cold calls on learner and asks to see a particular knowledge pack. Learner retrieves said pack from store & shows teacher. Teacher records this performance as successful. Thus the complex and human relational processes of teaching and learning are reduced to the transactional absurd.

MY LEARNING

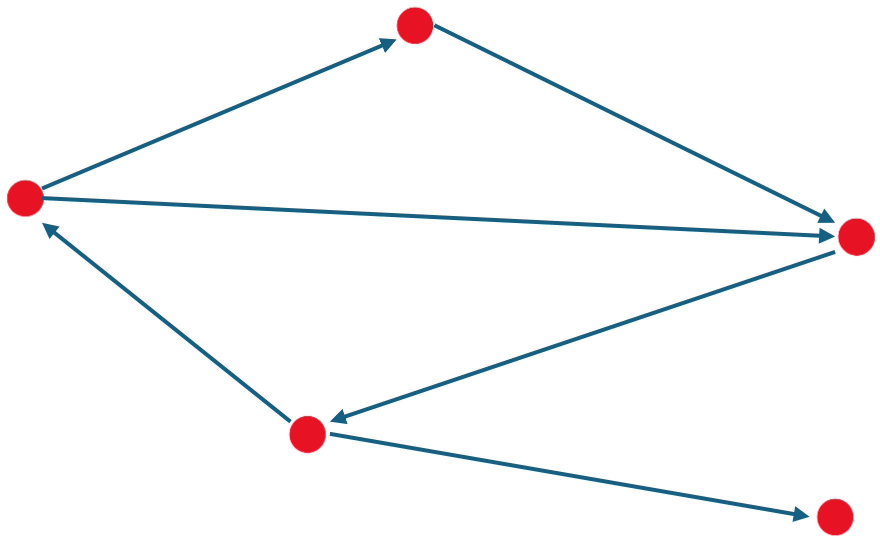
REFLECTIONS ON MY LEARNING MATHEMATICS	I start with some facts or ideas.	I create links across these facts and ideas. I call this MEMBERING.
Mathematics is defined by its interconnectivity, so its learning and teaching should hinge on this feature. Whether it is exploring the links through 3+5=8 to 300+50+800 and 8-5=3 or the evolution of Euler's Identity from De Moivre's theorem, the links are as fundamental as the parts to the structure of mathematics.		
1	**2**	**3**

I come back to my work and re-establish the links. I call this RE-MEMBERING. In doing this I establish new links. I am consolidating and strengthening my mental map of mathematics.	Working more on my mathematics I notice that I am constantly MEMBERING and REMEMBERING. In doing this I am extending my mental map of mathematics.	MEMBERING and REMEMBERING appear to be key to forming, consolidating, reforming and extending my mental map. Perhaps, this is what learning mathematics is about.
		
4	**5**	**6**

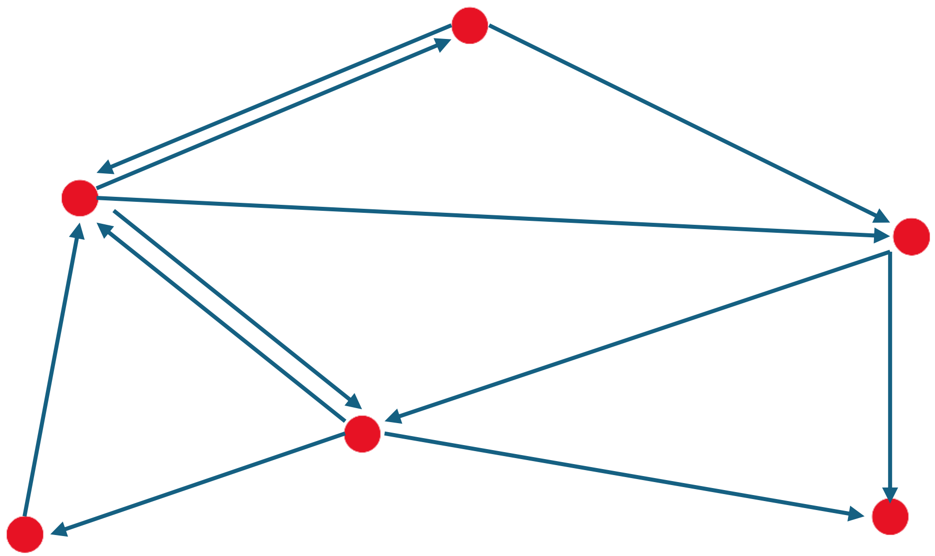
REMEMBERING IS NOT THE SAME AS MEMORISING

ECARDA 2019

Progress 3: Membering



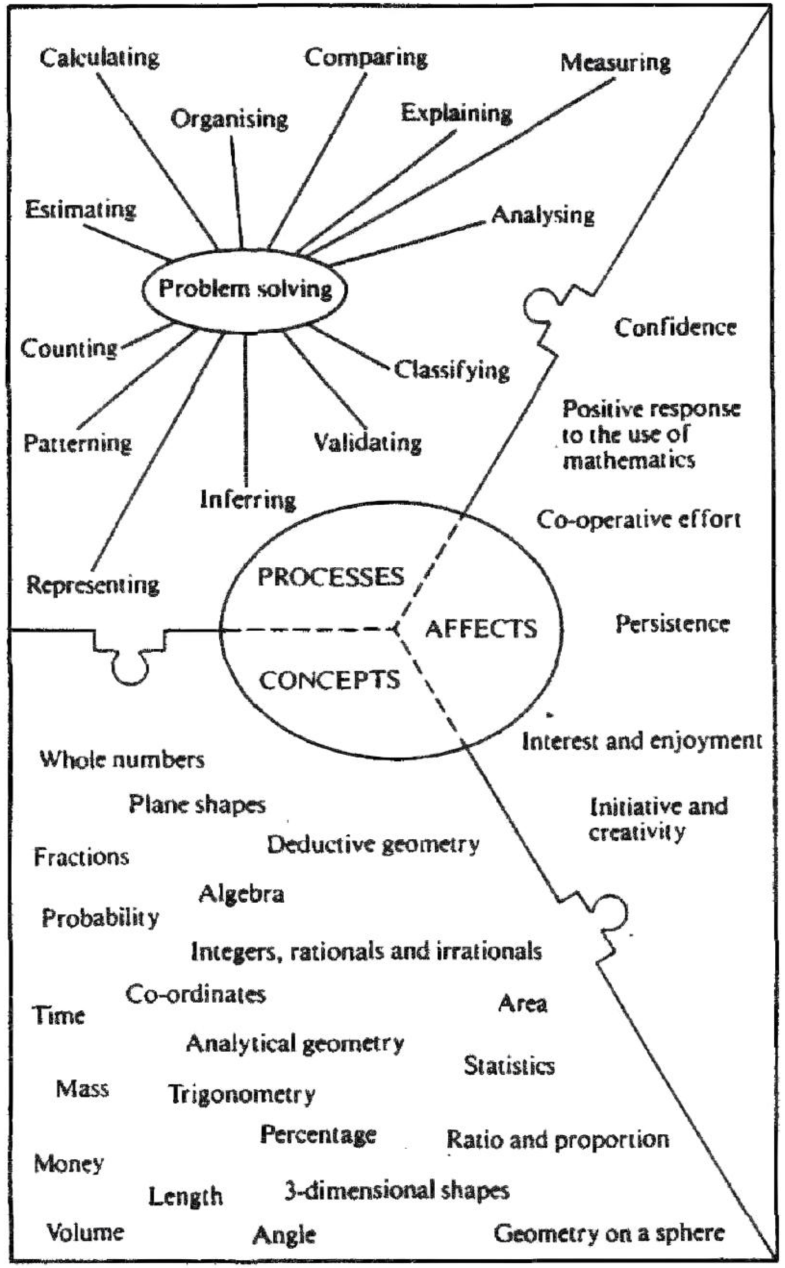
Progress 4: Re-membering



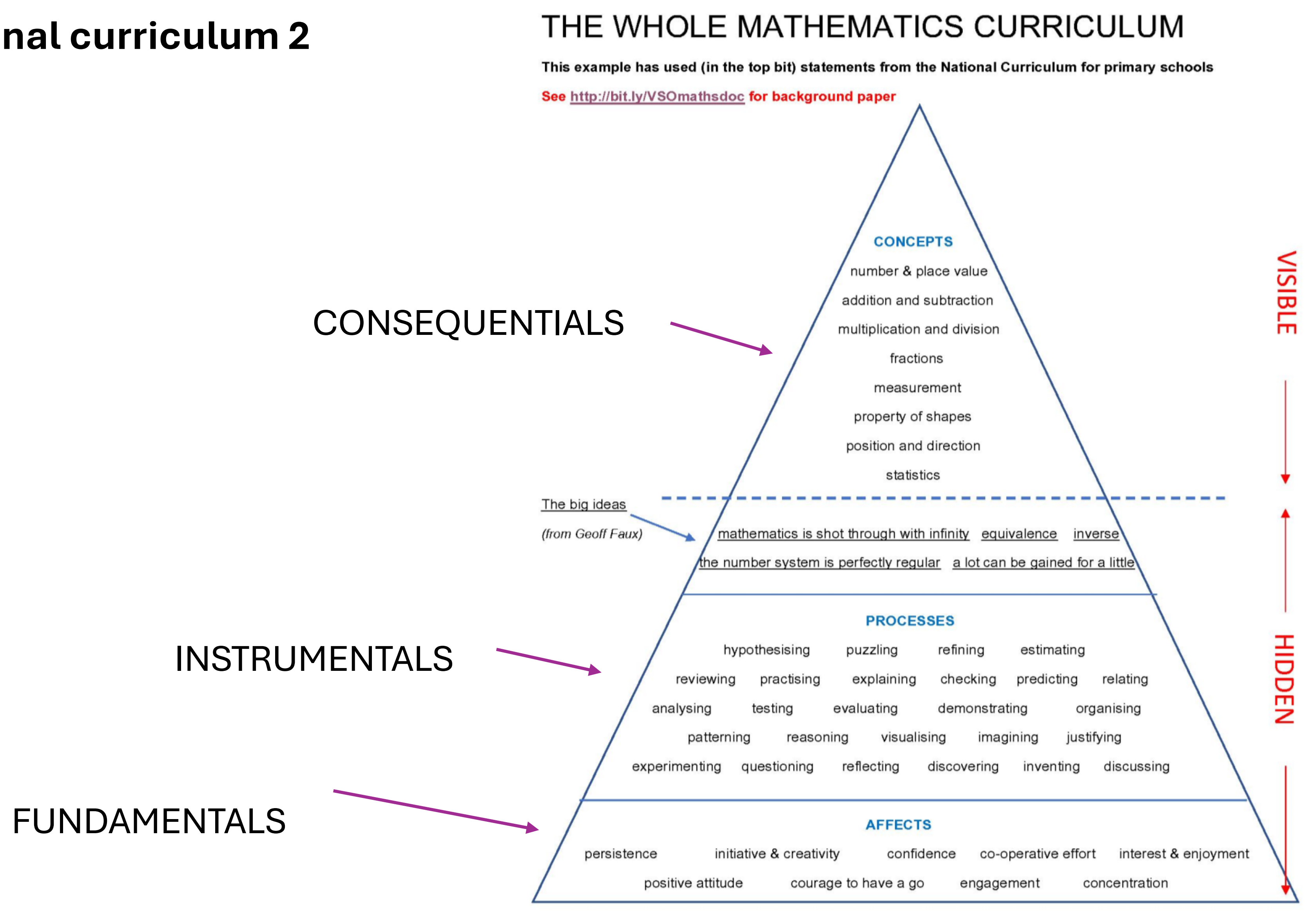
More than knowledge ……

- Attitudes – affects
- Processes – habits of mind
- Skills – generic & subject specific
- Concepts - understandings

A three-dimensional curriculum 1



A three-dimensional curriculum 2



Progress: dimensions 1

PROGRESS IN LEARNING 1	PROGRESS IN LEARNING 2
Knowing more	Knowing more deeply
Understanding more	Understanding more clearly
Acquiring more skills	Applying more widely

Progress: dimensions 2

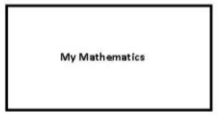
[A curriculum for learning](https://bit.ly/CfL2018)

https://bit.ly/CfL2018

Progress 5

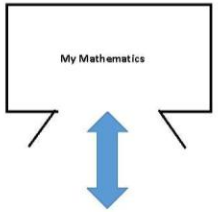
Developing the Twitter thread which (I think!) was about differentiation.
My view is not to alter the mathematics but to make it accessible, then secure it by connectivity, & then extend it. **PL 280422**

Diagram 1



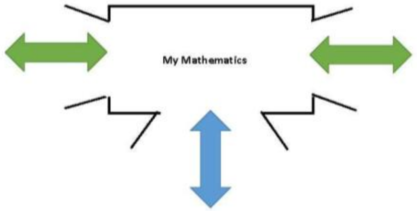
My mathematics is in a box and I might struggle to get into that box.

Diagram 2

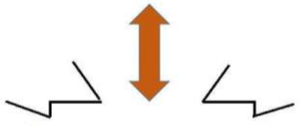


My mathematics is in a box and my teacher has opened the door at the bottom of the box.
S/he doesn't alter the contents of the box.
S/he gives me the confidence and help so I can go through the door.
My mathematics is now **accessible.**

Diagram 3



I am now in my mathematics and the teacher has opened doors on each side of the box.
I can see how my mathematics connects with other nearby mathematics and to other subjects I am learning.
My teacher helps me see and make those connections & applications .
My mathematics is now **connectable & applicable.**



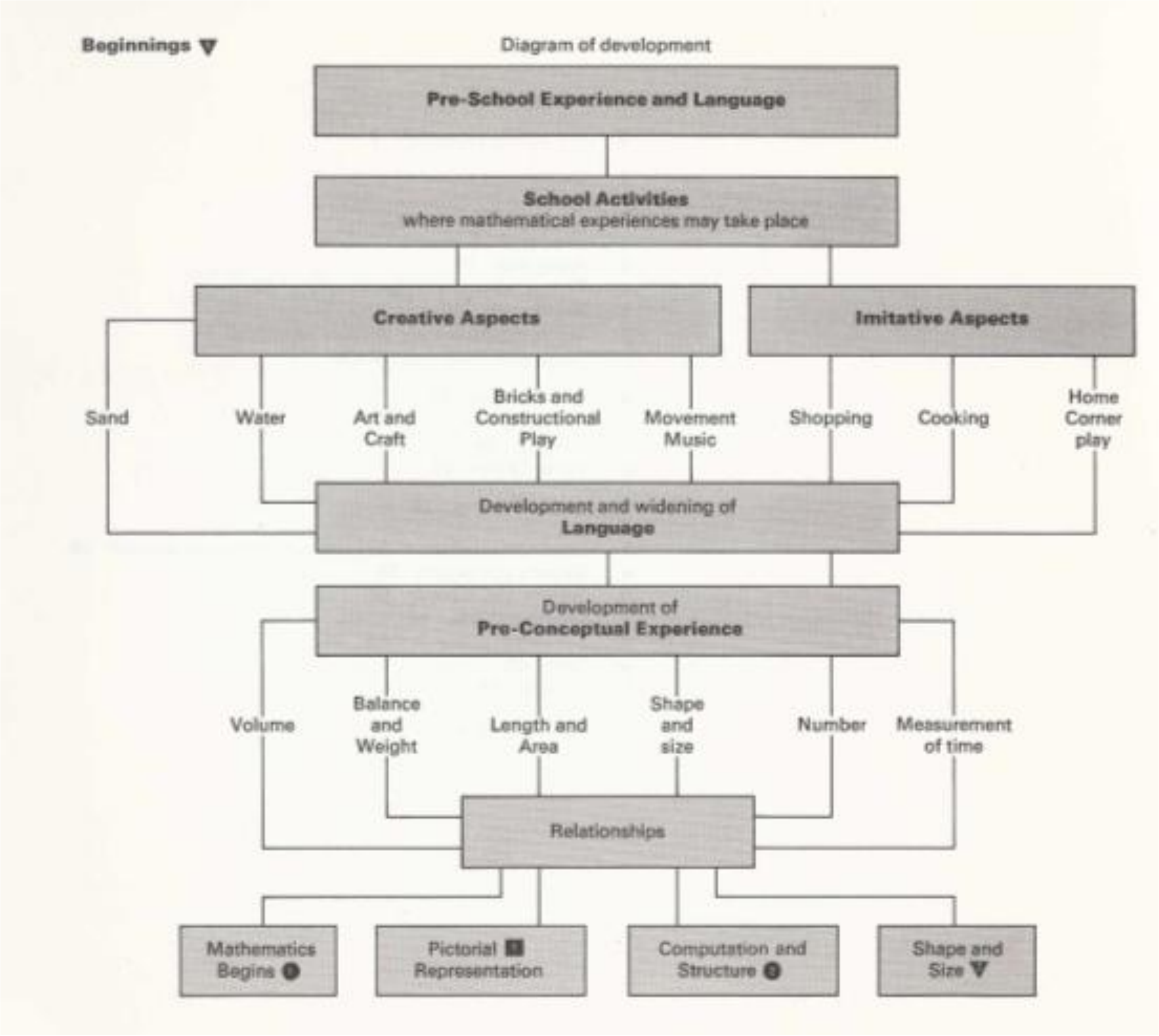
The teacher has now opened the door at the top of the box.
I can see how my mathematics might develop further.

Curriculum construction in sync with cognitive development – building on secure foundations 1

Piaget's four stages of development

Stage	Age
sensorimotor stage	0 to 2 years
preoperational stage	2 to 7 years
concrete operational stage	7 to 11 years
formal operational stage	12+ years

Beginnings



Nuffield Foundation 1967

Curriculum construction in sync with cognitive development – building on secure foundations 1

25. In which ways does the current *primary* curriculum support pupils to have the skills and knowledge they need for life and further study and what could we change to better support this?

As stated in answers to earlier questions, the over-crowded and too-demanding KS1 curriculum risks teachers rushing the teaching from the start of Reception (and earlier). This can lead to insecure learning at the outset with teachers having to re-teach "the basics" in subsequent years and even into secondary school.

Furthermore, the over-demanding KS1 curriculum, which has a deleterious effect on FS2 by putting pressure on teachers to teach at a rate faster than children learn, squeezes out necessary time to develop the social skills and habits of learning that are vital to subsequent educational success.

We recommend reducing the KS1 content and adopting EYFS planning and pedagogies until the age of 7 so that firm foundations are established. Once established, progress through KS2 and beyond is better secured. It is significant that in other educationally successful countries, "formal" education starts when children reach age 7. Redesignating KS1 as FS3 (Foundation Stage 3) is worth consideration.

Assessment 1

The assessment process itself should not determine what is to be taught and learned. It should be the servant, not the master of the curriculum. Yet it should not simply be a bolt-on at the end. Rather, it should be an integral part of the educational process, continually providing 'feedback' and 'feedforward'. It therefore needs to be incorporated systematically into teaching strategies and practices at all levels.

TGAT Report, DES 1987.

Assessment 2

Over-emphasis on examinations is a national disaster. One piece of original work is worth ten times as much as a set of well-worn solutions to someone else's problems. Examination conditions are unrealistic: can one imagine an employer sending for his mathematician and saying, "Look, I want you to solve not more than eight of these problems in the next two and a half hours"?

Dr G Matthews 1962

Assessment 3

It may help to have in our minds a picture of what we mean by understanding. I feel I understand something if I can do some, at least, of the following:

(1) state it in my own words;
(2) give examples of it;
(3) recognize it in various guises and circumstances;
(4) see connections between it and other facts or ideas;
(5) make use of it in various ways;
(6) foresee some of its consequences;
(7) state its opposite or converse.

This list is only a beginning; but it may help us in the future to find out what our students really know as opposed to what they can give the appearance of knowing, their real learning as opposed to their apparent learning.

John Holt, How Children Fail, 1964

And finally

Response to Q 13 in the curriculum and assessment review consultation

13. **In the current curriculum, assessment system and qualification pathways are there any barriers to improving attainment, progress, access or participation which may disproportionately impact pupils based on other characteristics (e.g. disability, sexual orientation, gender, race, religion or belief etc.)**

Scripting in inclusion and aspiration

it is necessary to reintroduce and emphasise the critical cross curriculum dimensions from the original national curriculum (NCC Circular 6 1989) which refer to: provision of equality of opportunity; ensuring curriculum access to all; developing open-mindedness; and preparing for adult life in a multicultural society.

Furthermore, these dimensions should be hard baked into curriculum content itself.

It is important that all groups, especially females, those from ethnic minorities, and those with disabilities, should recognise themselves in the past as actors in the generation of knowledge, as well as creators and inventors in the fields of the arts, sciences and technology.

Examples of hard baking this heritage into the curriculum include:

- In each subject making explicit references to the contribution of these groups to the subject's constitution.
- Ensuring that factual knowledge is not limited to a mono-cultural bandwidth.

In these ways learners would recognise their cultural heritage in all taught subjects. Rather than be recipients of transmitted remote knowledge in, say, mathematics or technology or literature, they may glimpse the possibility of themselves becoming mathematicians, technologists or poets.

Thus, the expression of the curriculum shifts from transmission to invitation and inclusion.

POVERTY

• **Srinivasa Ramanujan:** Born into a poor family in India, Ramanujan's mathematical genius was self-taught, and he made groundbreaking contributions to number theory, elliptic functions, and infinite series. • **Stefan Banach:** A Polish mathematician, Banach was the founder of modern functional analysis and contributed to the development of the theory of topological vector spaces. Raised by his grandmother since his mother abandoned him, being too poor to support him • **Shing-Tung Yau:** A Fields Medal winner and professor at Harvard, Yau's memoir, The Shape of a Life, describes his journey from poverty and petty crime to international renown. • **George Green:** His formal education consisted of one year of school at age 8, and he started working as a baker at age 5. He devoted much of his working life to the operation of a wind mill near Nottingham	• **David Blackwell:** Despite being barred from studying and working at many different universities in the U.S. due to racial prejudice, Blackwell became a great mathematician and statistician, and the first African-American to be admitted into the US National Academy of Sciences. • **Hua Loo-Keng:** Overcame abject poverty, handicaps, and political persecution to become an analytic number theorist. • **Sophie Germain:** Made contributions to elasticity and the theorems that helped build the Eiffel Tower. Germain was forced to study at night by candlelight, as her parents believed studying mathematics was too difficult for women. • **Oliver Heaviside:** An English self-taught mathematician & physicist, born in London. His investigations of electricity, using operational calculus (Laplace transforms) to study transient currents in networks. He had a troubled childhood riddled with a severe case of scarlet fever, which left him partially deaf. It was due to this impairment that he faced difficulties making friends at school

RACE

Elbert Cox was the first Black person in history to receive a PhD in mathematics, in 1925. He turned down a scholarship to study violin at the Prague Conservatory of Music to pursue mathematics, taking a break from his studies after his Bachelor's degree to fight in the first world war.

1895-1969

Elbert Cox

1908-1967

William Schieffelin Claytor

William Schieffelin Claytor was the third African-American to get a PhD in mathematics and the first Black man to publish in a mathematical research journal. He was a student of Elbert Cox, a teacher of Katherine Johnson, and later worked with David Blackwell.

Dorothy Vaughan was a mathematician and human computer for NASA. She was head of a segregated Computing Unit at NASA's predecessor, National Advisory Committee for Aeronautics (NACA) and NASA's first African American manager. When NASA introduced electronic computers she became an expert in the programming language used, Fortran.

1910-2008

Dorothy Vaughan

1914-1979

Marjorie Lee Browne

Marjorie Lee Browne was one of the first African American women to receive a PhD in maths. She worked with maths teachers, encouraging minorities and women into the subject, and taught and researched at North Carolina College for thirty years.

Katherine Johnson was a NASA scientist from the 1950-1980s. In 1962, preparing for astronaut John Glenn's orbital mission, computing machines were a new technology and not yet trusted by everyone. Johnson was called in to hand-check the computers' calculations. Glenn is remembered as saying about Johnson "If she says they're good, then I'm ready to go."

1918-2020

Katherine Johnson

1919-2010

David Blackwell

David Blackwell was the first African American man to be inducted into the National Academy of the Sciences, and only the seventh African American to receive a PhD in mathematics. He was a statistician and mathematician whose work on game theory, probability theory, information theory, and statistics was significant. He wrote one of the first textbooks on Bayesian statistics.

Mary Jackson is best remembered as NASA's first Black female engineer. She joined NASA as a computer under Dorothy Vaughan, then moving to work for an engineer within NASA, before completing training to become an engineer. Unable to get a promotion to manager as an engineer, she left engineering to take a job within NASA that would allow her to influence the hiring and promotion of all of NASA's female mathematicians, engineers and scientists.

1921-2005

1923-2011

Jesse Ernest Wilkins Jr

Jesse Ernest Wilkins Jr. was a child prodigy: at the age of 13, he was the youngest ever student to enrol at the University of Chicago. He became a nuclear scientist, engineer, and mathematician. His work on how nuclear energy is distributed inside reactors is the basis of how all nuclear reactors are designed. Reactors use the approach named for him (Wigner-Wilkins approach) to create plutonium used in weapons. He worked on the Manhattan Project and was the president of the American

Grace Alele-Williams was the first Nigerian woman to be awarded a doctorate, and the first woman to become Vice-Chancellor of any university in Africa, at the University of Benin. She was a professor of mathematical education and received the Order of Niger in 1987.

1932-2022

1965-Present

Katherine Adebola Okikiolu

Kate Okikiolu is a Black British mathematician. She is the daughter of a renowned Nigerian mathematician and a maths teacher. Her research is primarily in elliptic differential operators. She has also worked to improve mathematics teaching for

Anotida Madzvamuse is a professor of mathematical and computational biology. His work is in applied mathematics, exploring how patterns form in nature, and his projects include modelling for COVID-19, which helped the NHS and regional health planners during the global pandemic. His current research looks at unravelling new mathematics for 3D cell migration.

1966-Present

1966-Present

Mamokgethi Phakeng

Mamokgethi Phakeng is a South African Professor of Mathematics Education and Vice-Chancellor of the University of Cape Town. She is the 2022 winner of the Africa Education medal. She founded the non-profit Adopt-A-Learner to help lower-income students engage with education. Since 2018, she donates 20% of her monthly salary to support financially needy women

GENDER

Hypatia of Alexandria

Head of the Platonist School at Alexandria, Egypt, c. 400 CE, where she lectured on mathematics and philosophy. She also assisted her father, Theon of Alexandria, in preparing a new edition of Euclid's *Elements*, which became the source text for all later editions of that work, and wrote commentaries on Diophantus's *Arithmetica* and on Apollonius's *Conics*.

Maria Gaetana Agnesi

An accomplished mathematician and author, her two-volume work on analysis brought together disparate results into a unified exposition. Although invited by academicians and even the Pope to assume the chair of mathematics at the University of Bologna, Agnesi declined to devote herself instead to a contemplative life and works of charity. (1718–1799)

Sophie Germain

The daughter of a merchant, barred from formal study because she was a woman, she studied privately from the age of thirteen, often in secret. In her correspondence with Joseph-Louis Legendre and later Karl Gauss (initially under a pseudonym) she made many important contributions to number theory, particularly regarding Fermat's Last Theorem. (1776–1831)

Ada Byron, Lady Lovelace

Daughter of poet Lord Byron, she was raised to be a mathematician and scientist by her mother to keep her away from poetry. In her collaboration with Charles Babbage on his "calculating engine" she wrote the first formal algorithm (for calculating Bernoulli numbers), thereby anticipating computer science by nearly a century. (1815–1852)

Florence Nightingale

Said to be the most distinguished pupil of mathematician James Joseph Sylvester, she created many of the now common methods of descriptive statistics to quantify the lives to be saved by the sanitation reform she brought to the profession of medicine. Her work earned her an honory membership in the American Statistical Association. (1820–1910)

Sofia Kovalevskaya

Tutored privately by Karl Weierstrass, she earned a doctorate from Göttingen University and became the first woman since Agnesi to hold an academic chair in mathematics. Her brilliant work in mathematical physics, particularly on the dynamics of rigid bodies, was cut short by her untimely death from influenza complicated by pneumonia. (1850–1891)

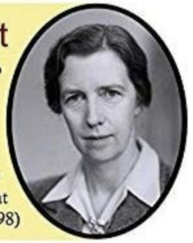
Emmy Amalie Nöther

Granted a doctorate from Erlangen in 1907, as a woman she was denied an academic position until 1915. Her work in theoretical physics led to new conceptualizations of general relativity, while her contributions to algebra, particularly on ideals and what are now universally known as "Nötherian rings," were of fundamental importance to that field. (1882–1935)

Euphemia Lofton Haynes

A Graduate of Smith College, she was the first African American woman to earn a PhD in mathematics, from Catholic University in 1943. Having previously earned a master's degree from the University of Chicago in education, Haynes became a leading figure in education in Washington D.C., and the first woman chair of that district's school board. (1890–1980)

Mary Cartwright

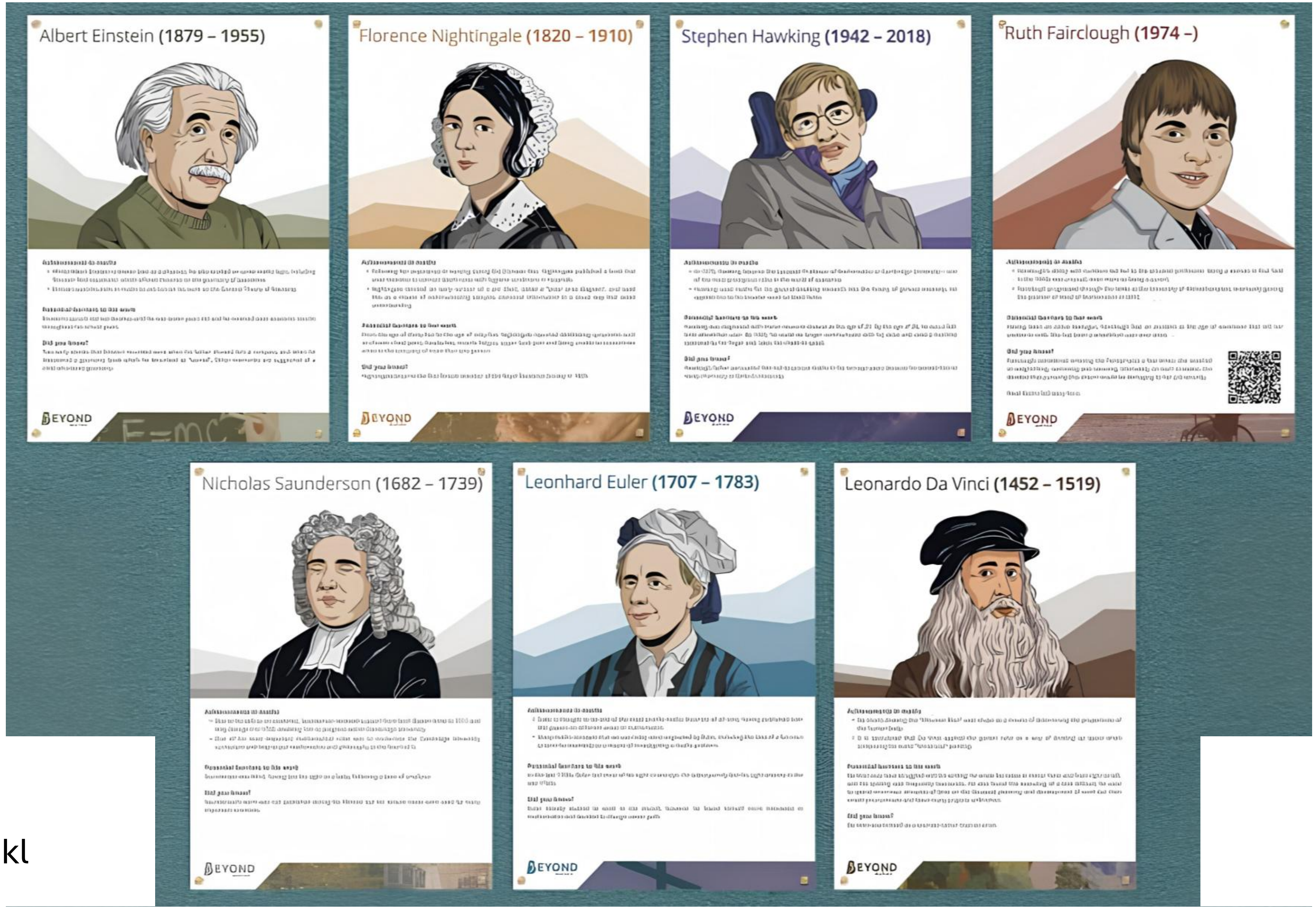


An Oxford graduate, she was the first woman to attain the final degree lectures and to obtain a "first." Her PhD was supervised by G.H. Hardy. As a fellow of Girton College, Cambridge, she formed a partnership with mathematician J.E. Littlewood; the two became the first to analyze dynamical systems that exhibit mathematical chaos. (1900–1998)

Katherine Johnson

The first African American woman to desegregate West Virginia University, she was a math teacher before being hired as a calculator by NASA. When her extraordinary talents were recognized, she became an aerospace technologist and calculated the trajectories of the Mercury and Apollo 11 space missions. She was awarded the Medal of Freedom in 2015. (1918–)

DISABILITY



From Twinkl

NEURO DIVERGENCY

- **Albert Einstein:**

  While not officially diagnosed, many sources suggest Einstein struggled with reading and language as a child, which is consistent with dyslexia.

- **Leonardo da Vinci:**

  Da Vinci, the Renaissance polymath, was known to write in reverse mirror image and had inconsistent spelling in his notes, which some people suggest points to dyslexia.

- **Emma King:**

  An award-winning mathematician with a PhD, Emma King has dyscalculia, a specific learning difficulty with mathematics.

- **Norbert Wiener:**

  A prominent mathematician and cybernetics pioneer, Wiener is another figure often cited as having dyslexia.

- **Sir Isaac Newton:**

  The renowned mathematician, scientist, and astronomer, is believed to have exhibited traits consistent with ADHD and autism. Despite facing personal and social challenges, Newton made groundbreaking contributions to science and mathematics.

- **John Nash:**

  A brilliant mathematician known for his work in game theory and differential geometry, he also struggled with schizophrenia

GENDER ORIENTATION

- **Alan Turing**

  1912 – 1954. An English mathematician, computer scientist, logician, cryptanalyst, philosopher and theoretical biologist

- **Robert MacPherson**

  Born May 25, 1944, is a prominent contemporary gay mathematician. Together with his partner Mark Goresky he invented a new way to study singular topological spaces using intersection homology.

- **Antonia Jones**

  1943 – 2010. A British mathematician and computer scientist known for her work in computational mathematics. She was a professor at Cardiff University and influenced AI and machine learning through her interdisciplinary research. Jones specialized in computational mathematics, with a particular focus on genetic algorithms and neural networks. Her research has had a profound impact on the fields of artificial intelligence and machine learning.

- **Emily Riehl**

  Born is an American mathematician who has contributed to higher category theory and homotopy theory. Much of her work, including her PhD thesis, concerns model structures and more recently the foundations of infinity-categories. She is the author of two textbooks and serves on the editorial boards of three journals.

- **Olga Tsuberbiller**

  1885 – 1975. was a professor at Moscow State University of Fine Chemical Technology for four decades. She published the standard Soviet textbook Problems and Exercises in Analytic Geometry (1927) that is still in use today in Russian high schools and technical institutions. Named one of the Honoured Scientists of the Russian Soviet Federative Socialist Republic (1955). She was partnered with opera singer Concordia Antarova for more than 20 years.

That’s it