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How did we get here? Timelines showing changes to maths education in England and the United States

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Introduction

Timelines enhance comprehension and offer a pictorial aid in organising information in a chronological sequence so that growth, change, recurring events, cause and effect, and key events of historical, social, and scientific significance can be better understood (Moline, 1995). They attempt to offer historical perspectives on theoretical debates, mandates, initiatives and reform movements, standards, bodies, organisations, councils, projects and strategies, as well as key publications, reviews, White papers and Acts at a *National* level.

The timelines presented here show the journey that mathematics education has gone through over time in both England and the United States of America (US). The starting date for the timelines differs in the two countries, because they both start with key events for education in that country. The England timeline starts from 1861, with the investigation of how schooling should be provided to all children in England. The US timeline starts approximately a century earlier, in 1788, with the publication of a set of teaching protocols for arithmetic. The two timelines detail major changes in mathematics education since those respective dates, including the introduction of, and changes to, curricula/standards[1] and changes to major qualifications. The US timeline also shows major themes throughout the history, such as the “keeping maths in the hands of teachers” theme between 1900 – 1930.

The timelines cannot capture everything that has gone on in maths education in both countries, especially as there are fifty states in the US and different events, movements and initiatives might have happened in each state. Instead, the timelines aim to show how rich and complicated the history of maths education is in both countries and what has happened in general over time.

[1] There is a difference between England and the US in the terminology used to describe documents that contain the subject content to be taught. The documents are referred to as curricula in England and standards in the US.

England mathematics education timeline

1860s – 1920s

1861 – The Newcastle report. Investigated extending elementary schooling to all children.

1870 – the Elementary Education Act guaranteed all children elementary school education.

1923 – the first Hadlow report. Suggested same curriculum for boys and girls, but girls given extra year to study content.

1862 – Schools received grants for each child attending regularly and passing reading, writing and arithmetic tests.

1862 – the first national curriculum introduced.

1871 – Maths Association formed to lobby for alternative ways of teaching geometry.

1898 – national curriculum discontinued for financial reasons.

1917 – School (Leaving) Certificate introduced for 16-year-olds.

1917 – Higher School Leaving Certificate (HSC) introduced for 18-year-olds.

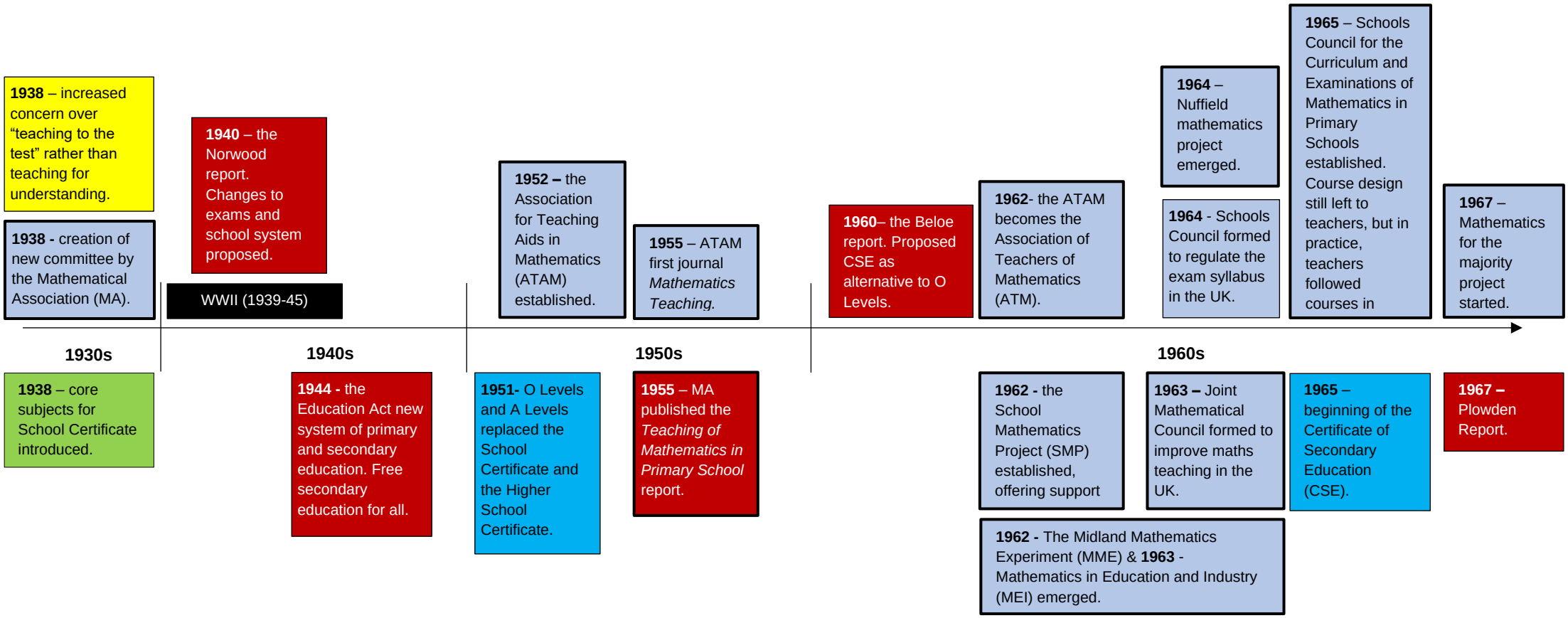
Summary 1860s - 1920s:

Investigations into the introduction of elementary education led to its implementation in 1870.
The first national curriculum was introduced, but later withdrawn for financial reasons (Brown, 2010).
School leaving certificates (the forerunners of GCSEs and A levels) introduced for 16- and 18-year-olds.

KEY:
- primary
- level 3 qualifications (A Levels, T Levels).
- level 2 qualifications (e.g., GCSEs)
- assessments and tests
- general events, initiatives and movements
- mathematics-specific movements
- bodies, organisations, councils, projects and strategies
- major reports, reviews, publications, White papers and Acts

Darker box outline – mathematics-specific changes

1930s – 1960s



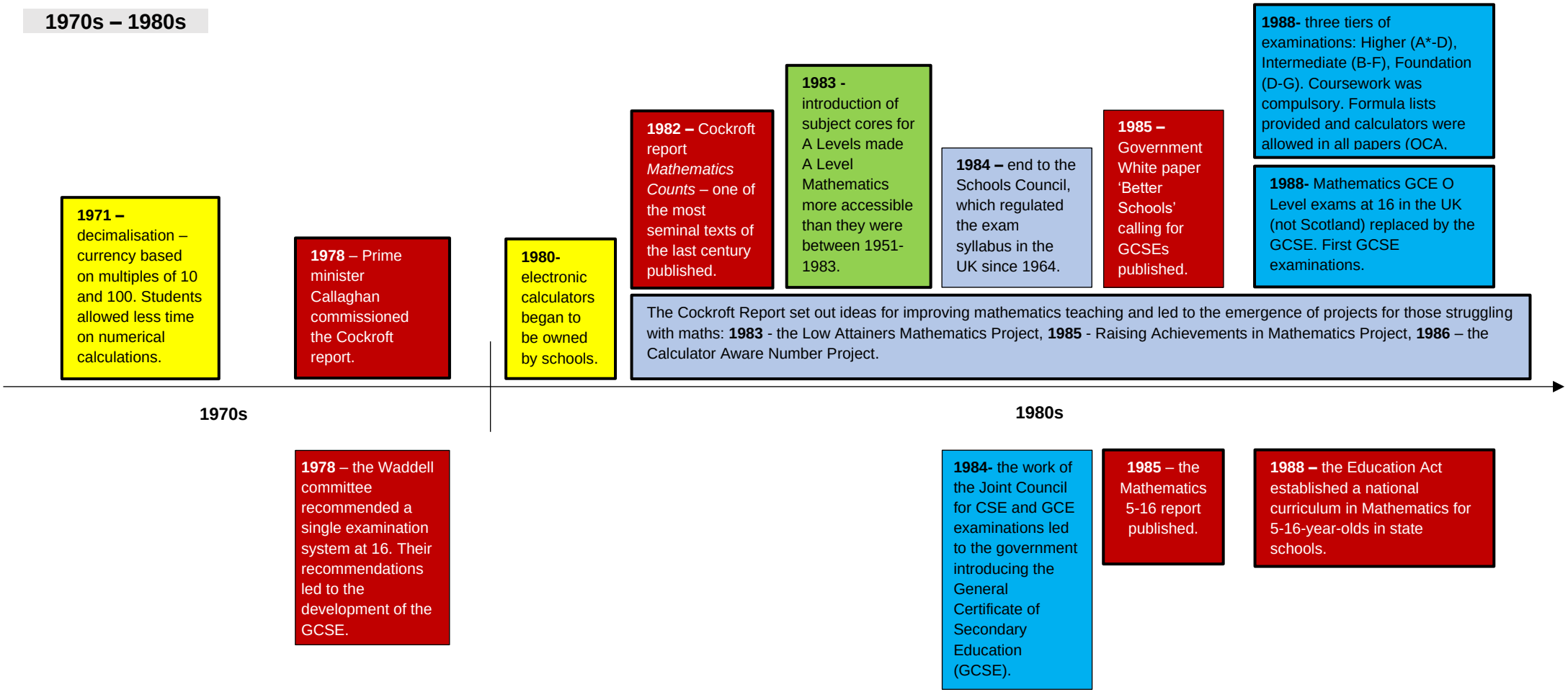
Summary 1930s – 1960s:

Changed practices in primary schools due to changes to teacher training, e.g., introduction of new teaching materials such as Cuisenaire rods, Dienes' Multibase Arithmetical Blocks.
The Curriculum Study Group (CSG) formed in the 1960s, focusing on organising and coordinating studies into the curriculum (Breakell, 2001).

Summary 1960s-:

Changes towards child-centred education (Brughes et al., 2012).
Dissatisfaction with the curriculum continued.
Reforms led to new material, such as co-ordinate geometry, probability and statistics entering the 11-16 curriculum.
Curricular innovations made possible because of the freedom given to schools to create their own syllabuses – led to several assessments including portfolios.
Post 1965 – sets and multi-base arithmetic appeared and disappeared, data gathering and display, more emphasis on geometry and number patterns, less time on learning arithmetic.
Three major projects: The School Mathematics Project, the Mathematics for the Majority Project and the Nuffield Primary Mathematics Project (Breakell, 2001).
Statistics became an alternative to Mechanics at A Level.

1970s – 1980s

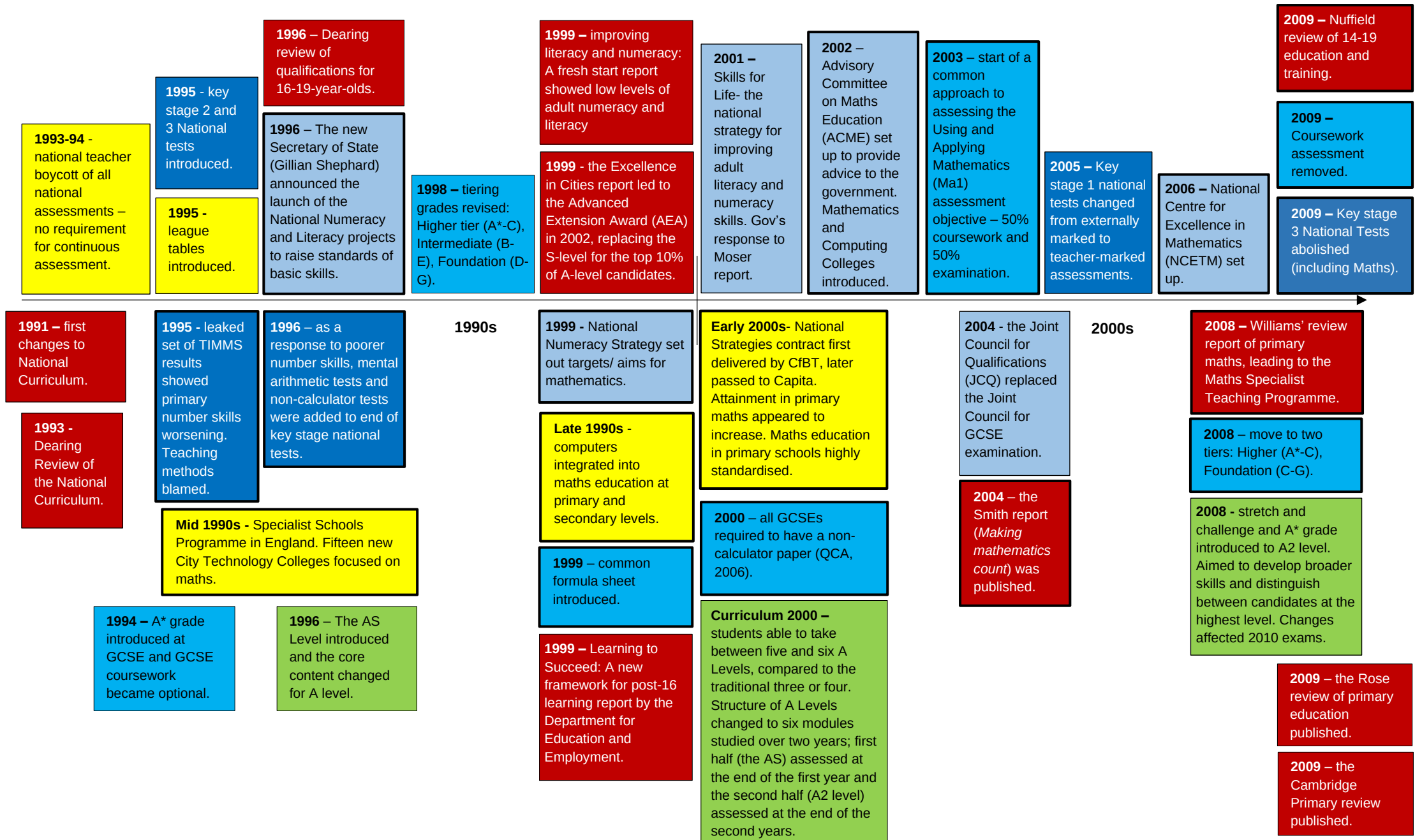


Summary 1970s:

About 1/3 of secondary schools were still following a traditional-style syllabus, 1/3 a modern syllabus and the rest were following hybrid syllabuses.
To consolidate this muddled picture, the government created bodies to oversee examinations, which resulted in lists of 'core' items that had to be present in all curricula.
Differences in what and how it was taught increased, creating greater gaps between students in fee-paying schools and students in state schools.

Summary 1980s:

Over the years of inquiry, a key finding was that of an adult population fearful of maths and incapable of applying maths. This continues and is seen today.
After 1984, the Secondary Examinations Council (SEC) replaced the Schools Council.
The 1988 Education Act led to many changes, including year groups being labelled 1-11 and broken into key stages, a NC with a detailed list of mathematics content to be taught, a Task Group on Assessment and Testing established by Ken Baker to plan a journey through levels of mathematics.
Further steps towards central control taken by requiring tests in the core subjects to be carried out at each key stage.


1990s
2000s
1991 – first changes to National Curriculum.
1993 - Dearing Review of the National Curriculum.
1993-94 - national teacher boycott of all national assessments – no requirement for continuous assessment.
1994 – A* grade introduced at GCSE and GCSE coursework became optional.
1995 - key stage 2 and 3 National tests introduced.
1995 - league tables introduced.
1995 - leaked set of TIMMS results showed primary number skills worsening. Teaching methods blamed.
1996 – Dearing review of qualifications for 16-19-year-olds.
1996 – The new Secretary of State (Gillian Shephard) announced the launch of the National Numeracy and Literacy projects to raise standards of basic skills.
1996 – as a response to poorer number skills, mental arithmetic tests and non-calculator tests were added to end of key stage national tests.
Mid 1990s - Specialist Schools Programme in England. Fifteen new City Technology Colleges focused on maths.
1996 – The AS Level introduced and the core content changed for A level.
1998 – tiering grades revised: Higher tier (A*-C), Intermediate (B-E), Foundation (D-G).
1999 – improving literacy and numeracy: A fresh start report showed low levels of adult numeracy and literacy
1999 - the Excellence in Cities report led to the Advanced Extension Award (AEA) in 2002, replacing the S-level for the top 10% of A-level candidates.
1999 - National Numeracy Strategy set out targets/ aims for mathematics.
Late 1990s - computers integrated into maths education at primary and secondary levels.
1999 – common formula sheet introduced.
1999 – Learning to Succeed: A new framework for post-16 learning report by the Department for Education and Employment.
2001 – Skills for Life- the national strategy for improving adult literacy and numeracy skills. Gov's response to Moser report.
Early 2000s- National Strategies contract first delivered by CfBT, later passed to Capita. Attainment in primary maths appeared to increase. Maths education in primary schools highly standardised.
2000 – all GCSEs required to have a non-calculator paper (QCA, 2006).
Curriculum 2000 – students able to take between five and six A Levels, compared to the traditional three or four. Structure of A Levels changed to six modules studied over two years; first half (the AS) assessed at the end of the first year and the second half (A2 level) assessed at the end of the second years.
2002 – Advisory Committee on Maths Education (ACME) set up to provide advice to the government. Mathematics and Computing Colleges introduced.
2003 – start of a common approach to assessing the Using and Applying Mathematics (Ma1) assessment objective – 50% coursework and 50% examination.
2004 - the Joint Council for Qualifications (JCQ) replaced the Joint Council for GCSE examination.
2004 – the Smith report (Making mathematics count) was published.
2005 – Key stage 1 national tests changed from externally marked to teacher-marked assessments.
2006 – National Centre for Excellence in Mathematics (NCETM) set up.
2008 – Williams' review report of primary maths, leading to the Maths Specialist Teaching Programme.
2008 – move to two tiers: Higher (A*-C), Foundation (C-G).
2008 - stretch and challenge and A* grade introduced to A2 level. Aimed to develop broader skills and distinguish between candidates at the highest level. Changes affected 2010 exams.
2009 – Nuffield review of 14-19 education and training.
2009 – Coursework assessment removed.
2009 – Key stage 3 National Tests abolished (including Maths).
2009 – the Rose review of primary education published.
2009 – the Cambridge Primary review published.

2010s –2020

2010 – the English Baccalaureate introduced to encourage the study of English, maths, science, a language and history or geography (DfE, 2017).

2010 – Hodgen et al.'s report showed England as an outlier in its provision of mathematics for 16–19-year-olds in (Hodgen et al., 2010).

2012 – strengthened assessment for GCSE mathematics (specification content did not change).

2012 – adoption of the Maths Mastery curriculum and professional development programmes in many UK schools.

2014 – national curriculum made non-compulsory for Academies.

2015 – new Core Mathematics qualifications introduced for first teaching as an alternative pathway to AS/A Level Mathematics for students with good GCSE pass grade who do not intend to progress to HE courses or employment that does not require significant use of mathematics.

2017 – after a primary assessment consultation, plans made to introduce a statutory Reception Baseline Assessment (RBA) in autumn 2021 (postponed from 2020 due to COVID-19) to show progress from reception to the end of KS2. The RBA to assess language, communication, literary and mathematics.

2017 – new A Levels in Mathematics and Further Mathematics first introduced for teaching.

2019 – first assessment of the new Mathematics A Level.

2020 – the first T Levels (new, more practical level 3 qualifications) available in some colleges in England. More T Level courses to become available in 2021.

2010 - landscape of mathematics teacher CPD became fragmented and confused, replaced by NCETM.

2010 - reduced role of local authorities and rise of Multi-Academy Trusts.

2010 - increased level of centralisation, with guidance on maths teaching disseminated through new Maths Hubs.

2010 - National Numeracy Strategy content pushed out of schools and replaced by other DfE recommended schemes.

2010

2014 – Mathematics free schools opened in some cities and areas of the UK.

2015 – a new curriculum for Maths GCSE and English introduced, with a new grading scale of 1-9.

2017 – the reformed 2015 GCSE has more content and emphasis on problem solving. Examined for the first time in 2017.

2017 – first year for reformed 9-1 graded GCSEs. Subject content changed, new grading system covers higher tier grades (9-4) and foundation tier grades (5-1). Fewer formulae provided and no formulae sheet in exams, additional content, some topics moved from higher to foundation tier.

2017 – the National Reference Test for maths and English language introduced, testing changes in performance standards over time.

2020

2020– intended introduction of the multiplication tables check (MTC) assessment for key stage 2 students, assessing year 4 pupils' recall of multiplication tables. Postponed **to 2022** due to COVID-19.

Summary 2010- 2020:

A Level grading in recent years used a combination of examiner judgement and statistical information, with the process being overseen by Ofqual to ensure comparability of standards between exam boards and over time.
The new A Level in Mathematics has increased emphasis on mathematical modelling, reasoning and problem solving, but did not intend to make the qualifications more difficult.
Despite a large growth of students taking Mathematics and Further Mathematics since 2005, Hodgen et al. (2010) suggested that many students do not choose to continue to study mathematics post-16 compared to the rest of the world.
NFER contracted to develop and deliver the RBA assessment, which was postponed from Autumn 2020 to 2021 due to COVID-19. Schools have 6 weeks to administer the assessment upon students' entry to reception.

US mathematics education timeline

1788 - 1900

IN THE BEGINNING: 'GREAT MATHEMATICS DEBATE'
Establishing and Countering the Dominant Teaching Approach

1788 - Traditional Teaching the *New and Complete System of Arithmetic – Composed for the Use of the Citizens of the United States* by Nicolas Pike provided a scripted set of teaching protocols: first - state the arithmetic rule, then - exemplify the rule, before finally encouraging students to complete a set of practice exercises.

1820 - Discovery Learning Warren Colburn's *First Lessons in Arithmetic* – was one of the first attempts to change the teaching approach from the traditionalist to more progressive ("new math"), encouraging pupils to discover rules themselves.

1831 - *The Southern and Western Calculator* (Bridge) declared that rules are needed, and pupils cannot invent them.

1845 - the *Activity Movement* (drawing on the writings of Kilpatrick) encouraged integration of subjects in elementary schools and argued against separate instruction in mathematics and other subjects.

1892 - **Committee of Ten** National Education Association (NEA) appointed the *Committee on Secondary School Studies*. The Committee of Ten produced a report that established the traditional high school sequence of algebra, geometry, and advanced algebra as separate courses.

Towards 'Teachers-led Education'

Towards 'Child-centred' Education

1832 - *The Common School Arithmetic* (Bates Botham) emphasised direct instruction, memorisation, and skill practice. Other publications at the time strengthened this popular perception.

1845 - societal hope in progress through scientific method applied to classrooms through streamlining mathematics education.

1899 - *The School and Society: Being Three Lectures* (1899) by Father of Progressivism John Dewey promulgated many key precepts of later education reform.

KEY:

- state-specific information
- assessments and tests
- general events, initiatives and movements
- mathematics-specific movements, including standards
- bodies, organisations, councils, projects and strategies
- major reports, reviews, publications, White papers and Acts

Darker box outline – mathematics-specific changes

Summary 1780 – 1900:

Present day mathematics education remains profoundly influenced by the dominant cultural beliefs, ideas and stereotypes about teaching and learning first articulated and developed during the mid- to late-nineteenth century. The pendulum swings between traditional "good old fashioned" maths teaching and the early progressive movement. In 1840s-50s, the American society mostly viewed mathematics as used solely for social utility. In 1880s, G. Stanley Hall's child studies were important for promoting the use of manipulatives and experience in teaching and for motivating research in cognitive development. Period characterised by two questions:

- should teachers offer students rules and facts to memorise (teacher-oriented approach)?

or

- should they give students material to reason about to discover and develop understanding of underlying mathematical principles (student-oriented approach)?

1900 – 1930s

KEEPING MATHS IN THE HANDS OF TEACHERS

1920 - Kilpatrick (protégé of John Dewey) published *The Problem of Mathematics in Secondary Education* (one of the most influential documents for education in 20th Century).

1920 - Reacting to Progressivism National Council of Teachers of Mathematics (NCTM) founded, mostly through the instigation of the *Mathematical Association of America* (MAA).

1920 - First NCTM president (C. M. Austin) promised that NCTM would "keep the values and interests of mathematics before the educational world" and urged that "curriculum studies and reforms and adjustments came from the teachers of mathematics rather than from the educational reformers" (1920).

1922 - Edward L. Thorndike's *The Psychology or Arithmetic* emphasised extensive practice of isolated skills.

1923 - NCTM published *Report of the National Committee on Mathematical Requirements* - exerted some influence on public education. It proposed curricula for schools, documents the training of mathematics teachers in other countries, explored issues related to the psychology of learning mathematics, and justified the study of mathematics in terms of its applications as well as its inherent value. NCTM played an important role in disseminating what became the *1923 Report.*

1925 - *Foundations of Method* (Kilpatrick) became a standard text for teacher education courses across the country.

1935 - Meaning Theory William Brownell's chapter titled *Psychological considerations in the learning and the teaching of arithmetic* appeared in NCTM's *The Teaching of Arithmetic* book.

Heightened Progressivism: The *Progressive Education Movement* helped boost American public schools from a promising idea to the established norm.

NCTM created partly to challenge the progressivist movement in mathematics.

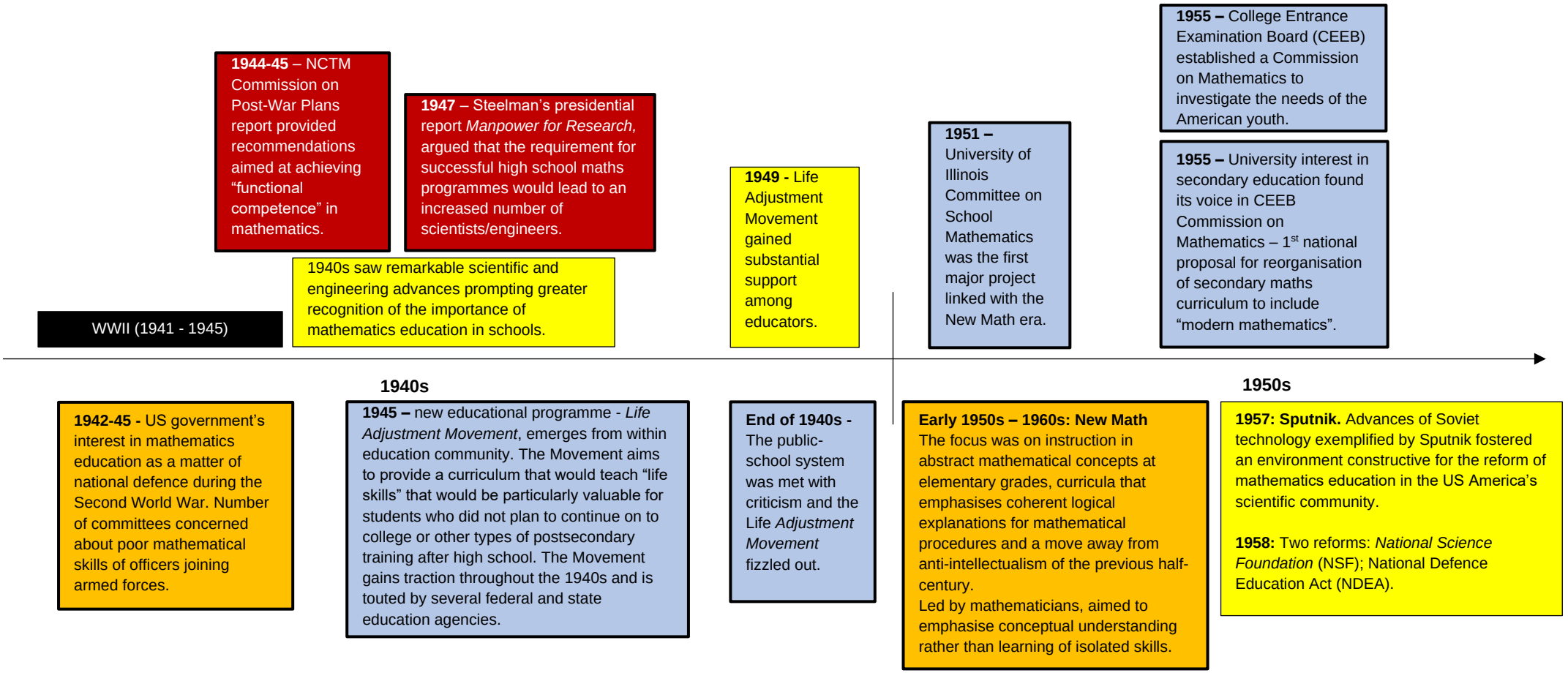
Summary 1900 – 1930s **Teaching as Social Activity:**

In the 1930s, the education, textbooks, and courses for administrators and teachers encouraged the foremost premises of progressivism. The school curriculum was to be determined by the needs and interests of students, as decided by professional educators, and not by academic subjects.

There was a rapid spread of the *Activity Movement* amongst elementary schools though high schools were more resistant because teachers were trained in specific subject areas and less willing to jettison their specialties in preference for a rather vague holism. Some exponents of the *Activity Movement* did not even concede that reading and learning the multiplication tables were genuine activities. However, in light of neo-traditionalist scrutiny and growing public dissatisfaction with life-adjustment education, the *Progressive Education Association*, the principal administrative organ of the *Progressive Education Movement*, closed its doors in 1955.

1940s – 1980s

'CRISIS-REFORM-REACTION'



Summary 1950s-1960s:

For more than a century, between the 1840s and the 1950s, American society predominantly regarded the function of mathematics as exclusively for social utility.
The Second World War revealed that many American army recruits did not have adequate basic computational and problem-solving skills. The army provided training in arithmetic needed for basic gunnery and bookkeeping.

The 1950s and 1960s witnessed a significant upheaval in the content and perspective of school mathematics. The disturbance coincided with the increasing influence of educational psychology.

THE 'NEW MATH'

1958 - American Mathematical Society set up the School Mathematics Study Group (SMSG), led by Edward G. Begle (Yale), to develop new high school curriculum.

1959 – NCTM set up its own curriculum committee – Secondary School Curriculum Committee.

1963 - **Cambridge Conference**
First phase of reform movement aimed at college students. The Cambridge Conference marked a second phase which saw the redesign of instruction for all grades and all levels as important.

1965 – the Elementary and Secondary Education Act continued to offer funding for new developments.

1970: Two important questions in mathematics continued:

- What mathematics should students learn – facts, skills and procedures or concepts and understanding?
- How should students learn: teacher-directed with focus on memorisation or student-centred through reasoning and discovery?

1958 - Congress passed the National Defence Education Act to increase the number of science, maths and foreign language majors as a response to the Sputnik launch.

1950s

1960s

Mid-1960s - half of all high schools adopted New Math.
The New Math initiative generated hundreds of new textbooks in order to facilitate quick and radical curriculum changes.

New Math: steered by mathematicians who aimed to usher in a new era in which school mathematics would be brought into line with the maths taught at university, New Math attempted to emphasise the underlying structure of mathematics and conceptual understanding rather than the learning of isolated skills and facts.

Problems with New Math: need to re-train teachers who were not used to new curriculum. Parents struggled to understand new-style mathematics, were no longer able to help their children with the new material.

1970s

BACKLASH TO 'NEW MATH'

Mid-to late-1970s: many education experts conceded New Math as not a success. New Math failed because it was unable to raise computational skills. Though not an objective of New Math developers, perception popularised in books like *Why Johnny can't add: The failure of new math* (Kline, 1973).

Summary 1950s – 1960s:

New Math, which focused more on conceptual understanding of mathematics over rote memorisation of arithmetic.

Throughout 1950s and 60s, backlash against New Math continued due to a belief that it lowered computational skills.

Many important National Science Foundation (NSF) funded projects, including School Mathematics Study Group (SMSG), University of Maryland Mathematics Project (UMMaP), University of Illinois Committee on School Mathematics (UICSM).
The SMSG was very influential and created junior and senior high school maths programmes and elementary curricula. They also developed textbooks.
The New Math movement introduced calculus courses in high schools. Although there were important successes, some of the New Math curricula were seen as very formal and not helpful in developing basic skills or applications of mathematics. Many teachers did not appear equipped to deal with the demanding content of the New Math curricula and public criticism grew.

Summary 1970s:

This time saw emphasis on procedural arithmetic skills, direct instruction aimed at students, mastering the objectives, extensive use of local and national standardised assessments to measure student attainment of mostly low-level, skill-oriented objectives.

The NSF discontinued funding programmes.
A call to "go back to basics" in mathematics and in other subjects.
Progressive education regained its momentum with books such as *Summerhill.*

Open Education Movement – a repetition of progressivist programmes promoted in 1920s encouraged the idea of letting children choose what to learn.

Effects of the Open Education Movement on children with limited resources, from inner-schools or low-income families, were criticised by some due to lack of access to supplementary education or tutoring in basic skills out of school being available to those children and families.

STANDARDS-BASED REFORM

1970 - A. S. Niell's *Summerhill: A Radical Approach to Child Rearing* (1960) - an account of a radically progressive school in England. Hugely influential, by 1970, *Summerhill* had sold 200,000 copies and is regarded as required reading on 600 university courses.

Early 1970s - development of the Open Education Movement - especially pronounced in relation to disadvantaged and low-income students.

1980 - Agenda for Action (NCTM) recommended that problem solving should become main instruction of school mathematics curriculum.

1983 - Missouri Mathematics Effectiveness Project explored efficacy of experimental teaching programme.

1986 - NCTM established Commission on Standards for School Mathematics (CSSM).

1989 - NCTM's *Curriculum and Evaluation Standards for School Mathematics* promoted a variation of progressivism - "constructivism". By the end of the 1980s, a number of cognitively-oriented mathematics researchers were already inclined towards constructivist theory. Their labours resulted in attempts to re-emphasise the meaning and role of conceptual understanding in mathematics. National Science Foundation was the primary driver for implementing the NCTM Standards across American schools.

1970s

1980s

1972 - National Institute of Education (NIE) established then transferred to Office of Educational Research and Improvement, US Department of Education in 1980. Provided leadership in conduct and support of scientific inquiry into educational process of the time. NIE generated educational research and development and sponsored several studies including the Beginning Teacher Evaluation Study (1972-1978).

1983 - *A Nation at Risk* (NCEE) fashioned an environment that made it possible to attempt to reform mathematics education.

1987 - *The Psychology of Learning Mathematics* (Skemp) contended that progress in the areas of learning and teaching mathematics can only be made when such factors as the abstract and hierarchical nature of mathematics, the relation to mathematical symbolism and the distinction between intelligent learning and rote memorisation are considered and instituted in the classroom. Skemp's thinking underscored the standing of knowledge organisation and function of conceptual understanding in well-developed schema.

End of 1980s - re-emphasised the meaning and role of conceptual understanding in mathematics. Other standards created by the NCTM:

- Professional Standards for Teaching Mathematics,
- Assessment Standards for School Mathematics (NCTM, 1995),
- Principles and Standards for School Mathematics (NCTM, 2000).

Summary 1970s-1980s **'Back to the Basics' – A New Reactionary Phase:**

Over this period, cognitive research was becoming a dominant framework in mathematics education.

In the mid-1980s, cognitive research was the dominant framework in mathematics education.

The end of 1980s saw a number of cognitively-oriented maths researchers move towards more constructivist theories. Cognitive researchers demonstrated efforts to re-emphasise meaning and role of conceptual understanding in mathematics, which coincided with broader education policy statements.

The 1989 NCTM *Curriculum and Evaluation Standards for School Mathematics* inaugurated the first set of voluntary content standards in any subject and underlined understanding and reasoning.
The cumulative influence of the various sets of standards during this period were responsible for engendering the Standards-Based Education Reform initiative.

1990s

STATE-WIDE SYSTEMIC INITIATIVES, BACKLASH TO & REVISION OF 1989 STANDARDS

1991 - wide-state systemic initiatives – grants designed to encourage state education institutions to align state mathematics standards to the NCTM standards, resulting in uniformity and adherence to these standards at state level.

1990s - NSF was responsible for K-12 mathematics programmes:

- Contemporary Mathematics in Context (Core-Plus Mathematics Project) (9-12),
- Interactive Mathematics Program (9-12),
- MATH Connections: A Secondary Mathematics Core Curriculum (9-11),
- Mathematics: Modelling Our World (ARISE) (9-12),
- SIMMS Integrated Mathematics: A Modelling Approach Using Technology (9-12).

1994 – NSF launched Urban Systemic Initiative (USI). Grants aimed at implementing the NCTM agenda at school district level in large cities. Followed by a program for Rural Systemic Initiatives.

1994 - 600+ parents signed a petition asking the school district Palo Alto in California to retain a traditional pre-algebra curriculum.

1995 - 41 states created state standard or curriculum frameworks consistent with NCTM standards.

1995 - Mathematically Correct emerged and challenged the NCTM agenda.

1995 - Assessment Standards for School Mathematics released.

1998 – final TIMSS report compared students at the end of high school. Maths achievement of US 12th grade students along lowest of participating nations.

1997 - second TIMSS report compared 4th grade students in maths. US students slightly above international average.

1996 - first available results of the Third International Mathematics and Science Study (TIMSS), in which US 8th grade students scored slightly below international average in mathematics.

INTERNATIONAL COMPARISONS

1991 - Professional Standards for Teaching Mathematics released.

1990s – growing criticisms from professional mathematicians of NCTM aligned reform curricula raised possibility that real focus of reform movement was constructivist classroom techniques rather than "high-level mathematical thought." Textbooks during the 1990s, for example, appeared to contribute to Piaget's ideas about developmental stages of learning, and Vygotsky's concept of the "Zone of Proximal Development" – philosophies that appear to be consistent with child-centred, co-operative learning approaches to education long favoured by colleges of education.

1997 - NSF sponsored the K-12 Mathematics Curriculum Centre.

Summary 1990s:

Widespread recognition that the quality of mathematics and science education has been deteriorating. Further calls for "excellence" in schools and a few experimental programmes in some schools for some students occurred.
Problem solving became a central theme in mathematics education.

1990s saw support for constructivism from the writings of Piaget and Vygotsky. "Integrated" high school maths books contributed to this child-centred approach by encouraging student discovery and problem solving.

By the mid-1990s, 41 states constructed state standards or curricular frameworks consistent with the NCTM Standards.

1996 - results from the *National Assessment of Educational Progress* (NAEP).

1996 - MathLand – one of the most controversial programmes aligned to the NCTM Standards.

1996 - NSF clarified its assumptions about effective, standards-based education. NSF clear in its support of the *NCTM Standards* and of progressive education – supported the creation of commercial maths curricula aligned to the *NCTM Standards.*

1997 - Academic Content and Performance Standards Commission (Standards Commission) asked to write mathematics standards for California and submit draft to the State Board of Education for final approval.

1997 - most states adopted mathematics standards closely aligned to the *NCTM Standards.*

1997 - NSF sponsored *the K-12 Mathematics Curriculum Centre* organisation. It aimed to support schools in building an education programme using curriculum materials developed for the NCTM's Curriculum and Evaluation Standards for School Mathematics.

1998 – Framework for standards in California adopted by California State Board of Education. System relying on mathematicians and teachers developed for textbook writing. Despite identifying textbooks that aligned to the new state standards, resistance to California standards at local school district level was significant.

1998 – more than half of all LAUSD schools using maths curricula aligned to NCTM Standards.

1999 – Liping Ma's *Basic Skills Versus Conceptual Understanding: A Bogus Dichotomy in Mathematics Education* released. The book argued that it is not possible to teach conceptual understanding in mathematics without the supporting basic skills, and that basic skills are weakened by a lack of understanding.

1999 – The Urban Systemic Initiative evolved into Urban Systemic Program, which allowed renewals of awards made under the USI system.

1996 – LAUSD (Los Angeles Unified School District) /LASI maths standards paved way for dissemination of textbooks and curricula aligned to those standards.

1996 – Achieve (reform organisation aiming to raise academic standards) founded at the National Education Summit (Achieve, 2015).

1997 – systemic initiatives like LAUSD in Los Angeles successful in promoting *NCTM Standards.*

1997 – LAUSD standards weak and vague and a source of controversy.

1997 – Noyce Foundation actively promoted NCTM-aligned maths curricula in Massachusetts and parts of California.

Summary 1990s continued:

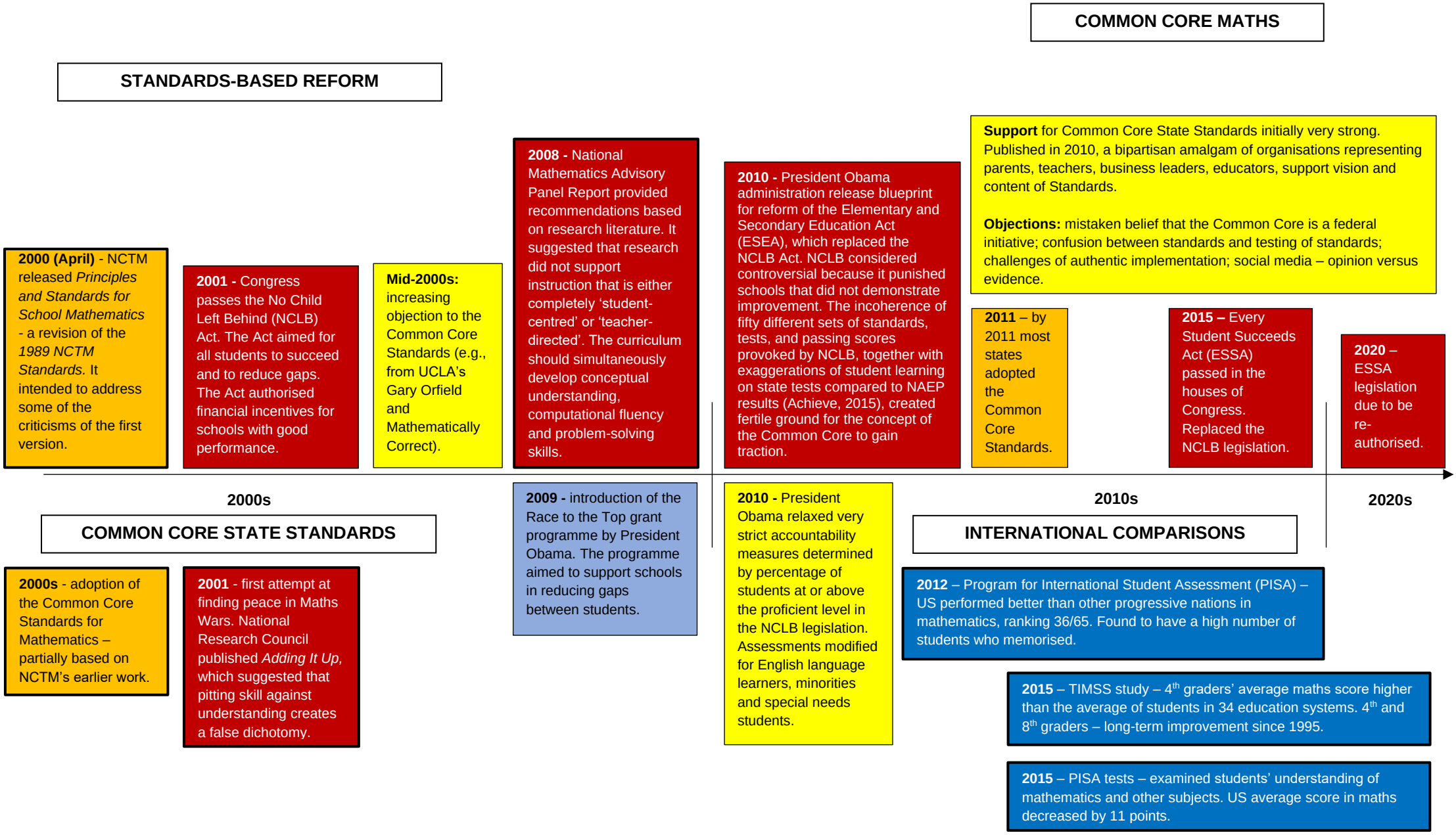
NSF sponsored several mathematics programmes for K-12.
In addition to aligning state maths standards to the NCTM Standards, NSF attempted to encourage approaches up to university level. Its funding of a "reform calculus" book (*Harvard Calculus)* encouraged calculators and discovery work by students. It minimised the level of high school algebra needed for the programme.

Mid 1990s saw a focus of attention on international comparisons of student maths achievement.
The late 1990s saw criticism of the Standards, with claims that the new standards did not sufficiently emphasise procedural skills, direct instruction, practice and memorisation.

California's 1997 standards were met with severe criticism from both NCTM and NSF immediately after their release. Standards received support from parent and mathematician groups. By the end of 1990s, California's mathematics programme threatened the progressive movement of the last century.

At the end of 1990s, mathematics education policies in public schools were in a state of fluidity, with tensions between parents/mathematicians and professional educators. Widespread implementation of NCTM reforms created resistance, resulting in some schools/districts replacing standards-based curricula.

2000s – 2020s: Resolving the Mathematics Wars



Summary 2000s – 2020s:

Between 2002 and 2010, mathematics instruction was focused more on content that is assessed on state tests. This time saw a system of 50 different sets of standards, tests and passing scores across the states.

The time period between 1967 – 2010, from First International Mathematics Study to ongoing developments and implementation of the Common Core Standards constituted most unbroken time period of K-12 curricular focus in mathematics education history in the US.

With increased societal aspirations, government legislation encouraging college readiness for all emerged. US high schools and colleges/universities became more outcome-based and focused on student growth measures.

Common Core as a 'Scapegoat':

The Common Core continued to be the focus of a growing countrywide resistance from an unusual coalition of right-wingers, liberals, teachers, and parents with pockets of defiance uniting into a national movement to eradicate the Core standards. The political 'Tea Party' once labelled the Standards as "Obamacore", portraying the new Core assessments as an intolerable intrusion of the federal government into local control of schools. Parents were increasingly tired of the testing culture and drew a line with the new Core assessments. Some states even recoiled at the increased time and costs of the assessments. Surprisingly, teachers' unions were split. On the one hand, some local groups, including the Chicago Teachers Union and the New York State United Teachers, disputed the new standards unreservedly. On the other, the two national unions - the National Educators Association (NEA) and the American Federation of Teachers (AFT) - supported the Core standards but wanted delays in their implementation.

Breaking the Cycle of Resistance: Bringing the Pendulum to Rest

The two historic, yet obdurate and seemingly interminable questions still require answers that will satisfy a potential raft of stakeholders (in particular, parents):

1. What should be the nature of mathematics that students learn – facts, skills, and procedures or concepts and understanding?
2. How should students learn mathematics – teacher-directed with a focus on memorisation, or student-centred through reasoning and discovery?

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