

Appendix A: English curriculum comparison tables

Table A1: High-level organisation

	England NC (1999)	England (2007)	Alberta (2000 [Y1–10] and 2003 [Y11])	Massachusetts (2001)	New Zealand (1994)	New South Wales (2001 [Y1–7] and 2003 [Y8–11])	Singapore (2001)
<p>High level organisation of curriculum document</p> <p>Definition of curriculum statements</p> <p>Year/ grade/ stage/ levels to the English Year equivalent</p>	<p>‘English’</p> <p><u>Statement type and Year groupings:</u></p> <p>Defines the curriculum by <i>learning outcomes</i> for each key stage: KS1 (Y1-2) KS2 (Y3-6) KS3 (Y7-9) KS4 (Y10-11)</p> <p><u>Typical statement stem:</u> ‘<i>Pupils should be taught to...</i>’</p> <p><u>Attainment:</u> Expected levels of attainment are set out in a separate section ‘Attainment Target Level Descriptors’</p> <p><u>Organisation of content:</u> Programme of study for English is arranged into 3 key domains: -Speaking & listening -Reading -Writing</p> <p>Each domain is further divided into <i>Knowledge, skills</i></p>	<p>‘English’</p> <p><u>Statement type and Year groupings:</u></p> <p>Defines the curriculum by <i>learning outcomes</i> for each key stage: KS1 (Y1-2) KS2 (Y3-6) KS3 (Y7-9) KS4 (Y10-11)</p> <p><u>Typical statement stem:</u> ‘<i>Pupils should be able to...</i>’</p> <p><u>Attainment:</u> Expected levels of attainment are set out in a separate section ‘Attainment Target Level Descriptors’</p> <p><u>Organisation of content:</u> Programme of study for English is arranged into 3 key domains: -Speaking & listening -Reading -Writing</p> <p>Each domain is divided into <i>Key processes, Range</i></p>	<p>‘English Language Arts’</p> <p><u>Statement type and Year groupings:</u></p> <p>Defines the curriculum by <i>learning outcomes</i> on a Year by Year basis.</p> <p><u>Typical statement stem:</u> ‘<i>Pupils will...</i>’</p> <p><u>Attainment:</u> The curriculum statements serve as expected levels of attainment for each Year</p> <p><u>Organisation of content:</u> 5 general outcomes: Students will listen, speak, read, write, view and represent to: - explore thoughts, ideas, feelings and experiences - comprehend and respond critically to oral, print and other media texts - manage ideas and information</p>	<p>‘English Language Arts’</p> <p><u>Statement type and Year groupings:</u></p> <p>Defines the curriculum by <i>learning outcomes</i> generally arranged in two-Year groupings: PreK-2 (Eng. YR-3) 3-4 (Eng. Y 4-5) 5-6 (Eng. Y 6-7) 7-8 (Eng. Y 8-9) 9-10 (Eng. Y 10-11)</p> <p>Learning outcomes for vocabulary, reading and for composition are further divided into PreK-K and 1-1 clusters.</p> <p><u>Typical statement stem:</u> ‘<i>Students will...</i>’</p> <p><u>Attainment:</u> The curriculum statements serve as expected levels of attainment for each Year.</p> <p><u>Organisation of content:</u> Curriculum has 4</p>	<p>‘English’</p> <p><u>Statement type and Year groupings:</u></p> <p>Defines the curriculum by <i>learning outcomes</i> using a grade level system (levels 1 to 8). These levels of learning outcome are not age specific, but the following rough equivalences can be used: Level 1 (Eng. Y 1-2) Level 2 (Eng. Y 3-4) Level 3 (Eng. Y 5-6) Level 4 (Eng. Y 7-8) Level 5 (Eng. Y 9-10) Level 6 (Eng. Y 11+)</p> <p>Levels <u>7 and 8</u> apply to the Years <u>beyond compulsory schooling in England.</u></p> <p><u>Typical statement stem:</u> ‘<i>Students should be able to...</i>’</p> <p><u>Attainment:</u> The expected levels of attainment (“Achievement Objectives”) form the organisational</p>	<p>‘English’</p> <p><u>Statement type and Year groupings:</u></p> <p>Defines the curriculum by <i>learning outcomes</i> which are defined by stages set out in two-Year blocks: Early Stage 1 (Eng. Y1) Stage 1 (Eng. Y 2-3) Stage 2 (Eng. Y 4-5) Stage 3 (Eng. Y 6-7) Stage 4 (Eng. Y 8-9) Stage 5 (Eng. Y 10-11)</p> <p><u>Typical statement stem:</u> ‘<i>A student...</i>’ (e.g. ‘...enjoys creating a range of spoken and written texts’, ‘...responds to and composes texts for ...’)</p> <p><u>Expected Attainment:</u> Learning outcomes are accompanied by a set of “indicators” demonstrating the behaviour students might display once outcome statements have been mastered.</p>	<p>‘English Language’</p> <p><u>Statement type and Year groupings:</u></p> <p>Defines the curriculum by <i>learning outcomes</i> for the end of: primary 2 (Eng. Y3), primary 6 (Eng. Y7), secondary 2 (Eng. Y9), secondary 4 (Eng. Y11)</p> <p><u>Typical statement stem:</u> ‘<i>Students will...</i>’</p> <p><u>Attainment:</u> The Learning Outcome curriculum statements are the expected attainment targets for pupils at the end of each two-Year period.</p> <p><u>Organisation of Content:</u> Content is divided into: - Language for information - Language for literary response</p>

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	<p><i>and understanding, and Breadth of study.</i></p> <p>The breadth of study specifies the increasing range of activities, contexts and purposes through which pupils should be taught the knowledge, skills and understanding.</p>	<p><i>and content and Curriculum opportunities.</i></p> <p>There are detailed guidance notes alongside the Programme of Study statements in the curriculum document.</p>	<p>- enhance the clarity and artistry of communication - respect, support and collaborate with others</p> <p>These are interrelated and interdependent; achieved through a variety of listening, speaking, reading, writing, viewing and representing.</p> <p>Each general learning outcome includes specific outcomes that pupils are to achieve by the end of each Year grade (K-10, Eng. Y1 to 11).</p>	<p>domains: - language - reading & literature - composition - media</p> <p>These are supported by 27 general standards, which are subsequently separated into Learning Standards for each of the age phases.</p>	<p>basis of the curriculum framework (hence the curriculum set out by attainment levels, rather than by ages/ Years).</p> <p><u>Organisation of content:</u></p> <p>The learning outcomes are organised into 3 domains: -Oral language (listening and speaking) -Written language (reading and writing) -Visual language: viewing and presenting.</p> <p>These are further split into <u>functions</u> and <u>processes</u>.</p>	<p><u>Organisation of content:</u></p> <p>Y1–8 curriculum is organised under 3 strands: - talking & listening - reading - writing</p> <p>Y9–11 curriculum is organised under 5 objectives: - speaking, listening, reading, writing, viewing and representing - using language and communicating appropriately and effectively - thinking in ways that are imaginative, interpretive and critical - expressing oneself and relationships with others and the world - learning and reflecting on learning through study of English.</p> <p>The syllabus splits outcome statements into <u>learning to</u> and <u>learning about</u>.</p>	<p>and expression - Language for social interaction.</p> <p>Separates the documents into 2 main areas: skills, strategies and attitudes, and text types.</p> <p>The syllabus is streamed at Primary Six and Secondary. Underlined below are those analysed in this report:</p> <ul style="list-style-type: none"> - Primary Two - Primary Four - Primary Six (EM1 and EM2) - Primary Six (EM3) - Secondary Two (Special / Express / Normal Academic) - Secondary Two (Normal Technical) - Secondary Four / Five (Special / Express / Normal Academic) - Secondary Four / Five (Normal Technical)

<p>Curriculum aims and principles</p>	<p>Statement about the 'Importance of English': <i>'English is a vital way of communicating in school, in public life and internationally. Literature in English is rich and influential, reflecting the experience of people from many countries and times.'</i></p> <p><i>'In studying English pupils develop skills in speaking, listening, reading and writing. It enables them to express themselves creatively and imaginatively and to communicate with others effectively.'</i></p> <p><i>'Pupils learn to become enthusiastic and critical readers of stories, poetry and drama as well as non-fiction and media texts. The study of English helps pupils understand how language works by looking at its patterns, structures and origins. Using this knowledge pupils can choose and adapt what they say and write in different situations'</i></p>	<p>Learning and undertaking activities in English contribute to achievement of the curriculum aims for all young people to become:</p> <ul style="list-style-type: none"> • <i>successful learners who enjoy learning, make progress and achieve</i> • <i>confident individuals who are able to live safe, healthy and fulfilling lives</i> • <i>responsible citizens who make a positive contribution to society.</i> <p>Statement on the importance of English, which is largely the same as the statement in the 1999 document.</p>	<p>The aim of English Language Arts is: <i>'To enable each student to understand and appreciate language, and to use it confidently and competently in a variety of situations for communication, personal satisfaction and learning. Students become confident and competent users of all 6 language arts through many opportunities to listen and speak, read and write, and view and represent in a variety of combinations and relevant contexts. All the language arts are interrelated and interdependent; facility in one strengthens and supports the others'.</i></p>	<p>10 Guiding Principles which articulate a set of beliefs about the teaching, learning, and assessing of speaking, viewing, listening, reading, and writing. The principles are philosophical statements that underlie every domain and standard of the curriculum framework and they should guide the construction and evaluation of English Language Arts curricula.</p> <p>[the full curriculum are too detailed to reproduce as part of this table]</p>	<p>English in the New Zealand curriculum aims to enable students to:</p> <ul style="list-style-type: none"> - <i>engage with and enjoy language in all its varieties;</i> - <i>understand, respond to, and use oral, written, and visual language effectively in a range of contexts.</i> <p>These aims are reflected in and achieved through each of the 3 domains of the English curriculum: -oral language, -written language, and - visual language.</p> <p>The essential skills developed through the English curriculum are: <i>communication, information, social and co-operative, self management, and working and study.</i></p>	<p>Each syllabus sets out broad aims for the teaching of English during that phase.</p> <p>The aim of the English K–6 syllabus is: <i>'to encourage positive attitudes towards learning English, to develop students' ability in using language effectively and to enable critical reflection on how language works'.</i></p> <p>The aim of English, in the NSW curriculum during Years 7 to 10 is to <i>'enable students to use, understand, appreciate, reflect on and enjoy the English language in a variety of texts and to shape meaning in ways that are imaginative, interpretive, critical and powerful'.</i></p>	<p>Describes a 'philosophy of language underlying the syllabus' and six principles that are said to be 'embodied' in the curriculum and underpin all content and its implementation:</p> <p><i>Pupils will be able to:</i></p> <ul style="list-style-type: none"> -<i>Listen to, read and view with understanding, accuracy and critical appreciation</i> -<i>Speak, write and make presentations</i> -<i>Think through, interpret and evaluate fiction and non-fiction texts</i> -<i>Interact effectively with people from their own or different cultures.</i> <p>There are 6 'principles of language learning and teaching': <i>contextualisation; learner-centeredness; interaction; integration; process-orientation; and spiral progression.</i></p>
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Table A2: Reading and Literature

Domain	England NC (1999)	England (2007)	Alberta (2000 [Y1–10], 2003 [Y11])	Massachusetts (2001)	New Zealand (1994)	New South Wales (2001 [Y1–7] and 2003 [Y8–11])	Singapore (2001)
<p>Reading strategies</p> <ul style="list-style-type: none"> - word reading - reading processes - phonics (alphabetic knowledge, blending sounds etc.) 	<p>Introduced in Y1</p> <p>Medium specificity</p> <p>The focus for reading in Year 1 and 2 is on securing strategies for word reading, with the expectation that through teaching pupils will be able to read fluently and accurately, and to “make sense of what they read”.</p> <p>The programme of study sets out reading strategies under the following headers: <i>phonemic awareness and phonic knowledge, word recognition and graphic knowledge, grammatical awareness and contextual understanding</i>. In Years 3 onwards the focus moves onto text comprehension; although reading strategies should still be taught as specified in the earlier Years.</p>	<p>[Secondary curriculum only]</p> <p>Low specificity</p> <p>As the secondary-level curriculum, there is no content connected to word-level reading skills. The focus is on how meaning is constructed at sentence, paragraph and text level. Most of the detail provided on this is in the non-statutory explanatory notes.</p>	<p>Introduced Y1 (to Y3)</p> <p>Medium specificity</p> <p>Reading strategies is within GO2.1 ‘<i>Use strategies and cues</i>’ and later (Year 3) in ‘<i>Enhance and improve</i>’.</p> <p>The curriculum mainly uses phonic strategies for learning to read, but also includes: using cues, prediction and reading-on.</p> <p>Statements are fairly sparse at Years 1 and 2, but increase in Years 3 and 4. By Year 6 pupils are expected to use sight vocabulary, phonics and knowledge of text structure to read words in context.</p> <p>The ‘Phonic and Structural Analysis’ sub-domain continues until Year 10, with students expected to apply earlier reading strategies, rather than new or more complex phonic instruction.</p>	<p>Introduced in Y1</p> <p>High specificity</p> <p>Requirements for reading set out in the ‘reading and literature’ domain.</p> <p>Word reading is set out in a ‘beginning to read’ domain. Expectations are expressed in two-Year blocks for Years 1 to 5. At Year 5 it is expected that the majority of pupils will have met the required standards, with the focus then moving on to understanding texts, making connections, developing knowledge about genre and theme.</p> <p>In achieving the required level in <i>beginning reading</i> a pupil is expected to “understand the nature of written English and the relationship between letters and spelling patterns to the sound of speech”.</p>	<p>Introduced in Y1</p> <p>Low specificity</p> <p>Expectations are set out in the <i>personal reading</i> section.</p> <p>The <i>personal reading</i> levels set out expectations for selecting own texts and sets broad progression goals for word reading, without specifying particular reading strategies. There is basic coverage of the technicalities of word reading in the <i>reading functions</i> section at levels 1 and 2 (approx. Y1–4).</p> <p>In the early Years (levels 1 and 2, approx. Y1–4)) the focus of word reading is on the use of semantic, syntactic, visual, and grapho-phonetic cues. In attaining level 3 (approx. Y5–6) pupils are expected to integrate reading processes with ease, and then move on to use a variety of reading</p>	<p>Introduced in Y1</p> <p>Medium specificity</p> <p>Requirements are set as a sub-domain of the “Reading” section.</p> <p>Reading skills and strategies at primary level are set out at a high level: pupils should “<i>use phonological and graphological cues to decode written texts</i>”; however there is no further specification of exactly what these should be.</p> <p>Expected outcomes, on the other hand, are quite detailed, and give a very full picture of what a pupil who reaches the expected standard will be able to do, for example, “<i>hears a sequence of sounds and blends single sounds in vowel–consonant (vc), consonant–vowel (cv) and consonant–vowel–</i></p>	<p>Introduced in Y1</p> <p>Medium specificity</p> <p>In Year 1 the expectation is that pupils will use phonological awareness strategies to begin to word read alongside meaning-based strategies such as using contextual cues.</p> <p>It is expected that pupils have secure phonological awareness strategies by the end of primary 4. The focus is then on developing wider reading strategies to develop meaning and reading for varying purposes, for example, skimming for gist.</p> <p>Pupils to be able to read common irregular words such as “the”, “have” and “said” by Year 5, which is later than in other curricula.</p>

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					strategies.	<i>consonant (cvc) words</i> ". This level of detail in expected. outcomes creates implied teaching requirements.	
<p>Comprehension</p> <p>Covers:</p> <ul style="list-style-type: none"> - Wide reading - Understanding literary devices - Setting and characterisation - Literal and inferential understanding - Personal opinion - Summarising and synthesising <p><u>Forms/ genres</u></p> <p>Fiction/ Narrative</p> <p>Non- fiction / Non narrative</p> <p>Poetry Plays</p>	<p>Introduced in Y3</p> <p>Medium specificity</p> <p>In Years 1 and 2 the focus is on reading strategies to secure word reading, with pupils developing understanding of different forms of literature.</p> <p>In Years 3 to 6 the focus moves onto comprehension, with a sub-domain detailing expectations for 'understanding texts'. Pupils are required to develop a more sophisticated understanding of texts, using inference and deduction, looking for meaning beyond the literal, and making connections between different parts of the text and other texts.</p>	<p>[Secondary curriculum only]</p> <p>Low specificity</p> <p>The 'Reading' domain of the curriculum covers both extraction of meaning and appreciation of the craft of writing. The content statements are written at a high level of generality, so that there are about 20 statements for reading at each key stage. For example, pupils should be able to "<i>infer and deduce meanings, recognising the writers' intentions</i>", and "<i>recognise and discuss different interpretations of texts, justifying their own views</i>". Linked to these content statements are attainment targets at 6 levels (from 4 to Exceptional</p>	<p>Introduced in Y1</p> <p>High specificity</p> <p>Reading comprehension is a feature of all 5 General Outcomes at the highest level. (<i>Pupils will listen, speak, read, write, view and represent to...</i>).</p> <p>GO2 focuses on comprehension of all types of text (as opposed to just books) (... <i>comprehend and respond personally and critically to oral, print and other media texts.</i>)</p> <p>Main areas where comprehension is concentrated include:</p> <ol style="list-style-type: none"> 1.1 Discover and explore 1.2 Clarify and extend 2.1 Use strategies and cues 2.2 Respond to texts 2.3 Understand forms, elements and Techniques 4.1 Enhance and 	<p>Introduced in Y1</p> <p>High specificity</p> <p>Requirements for reading are set out in the 'Reading and literature' domain. Reading comprehension is detailed in the '<i>understanding a text</i>' sub-domain, which is built upon in further domains, which set out requirements for pupils to make connections to context and background, and explore and analyse a range of genres, themes.</p> <p>Level of demand is high at key stage 1 equivalent; for example pupils are expected to '<i>identify different interpretations of plot setting and character in the same work by different authors</i>' and '<i>identify</i></p>	<p>Introduced in Y1</p> <p>Low specificity</p> <p>Requirements for reading are set out in the 'Written Language' section. The programme of study splits reading functions into 'Personal reading' and Close reading'.</p> <p>Reading and writing are grouped together as parts of written English. The processes associated with the ability to understand and use written language are:</p> <ul style="list-style-type: none"> - exploring language, - thinking critically and -processing information. <p>Personal reading specifies the expectations for pupils to read widely and details the breadth of</p>	<p>Introduced in Y1</p> <p>Medium specificity</p> <p>Requirements are set out within the domain of "Reading".</p> <p>Until the end of Year7 very detailed indicators of attainment are set out for 4 sub-domains in each stage:</p> <ul style="list-style-type: none"> -talking and listening, -skills and strategies, -context and text and -language structure. <p>Years up to Year 7 are covered in the same curriculum document. However, Years 8 to 11 have a separate document with quite a different style; there is far less specific emphasis on</p>	<p>Introduced in Y1</p> <p>Low specificity</p> <p>Reading comprehension is specified as part of general comprehension from Year 1 with a requirement for pupils to respond to a variety of texts, written and oral, formulating questions to clarify meaning.</p> <p>By the end of Year 7 there is a requirement for pupils to use reading strategies to monitor and confirm understanding of texts, developing comprehension skills.</p> <p>By the end of Year 11, pupils are expected to infer and draw conclusions "<i>about characters, their actions and motives, events, setting, atmosphere</i></p>

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	<p>In the secondary phase reading is focused on comprehension, with expectations based on reading for meaning and understanding the author's craft.</p> <p>During the secondary phase, significant emphasis is placed on reading a wide range of texts. The programme of study details the types of texts that pupils are to be exposed to.</p>	<p>Performance) which describe, in general terms, the performance required to reach each level.</p>	<p><i>improve 4.2 Attend to conventions</i></p> <p>In early grades comprehension skills are developed through texts both read and heard read aloud. Very quickly pupils are expected to consider character, textual organisation, and personal preferences. Inference and prediction are introduced at Year 3. By the end of Year 6, a relatively sophisticated grasp of text features is expected.</p> <p>Secondary phase content explores a greater variety of texts in more depth, with Years 10 and 11 focusing on analysis and interpretation of all text types.</p> <p>The range of texts to be covered is not specified, other than the expectation that texts must be from a range of cultures and reflect personal experiences.</p>	<p><i>differences among common forms of literature.'</i></p> <p>Literary texts: during the secondary phase the emphasis is placed on identifying and analysing sensory detail, figurative language, imagery and symbolism, and exploring genre characteristics and themes,</p> <p>Informational texts: during the secondary phase pupils are required to analyse the logic and use of evidence in an author's argument.</p>	<p>reading for both enjoyment and information. The level of sophistication increases, with pupils required to select their own texts and read fluently using a range of reading processes and strategies.</p> <p>Close reading specifies the skills and knowledge for reading comprehension; detailing the progression expected for the way pupils respond to language, meaning and texts, and the skills for analysing language, meaning, ideas and literary qualities.</p> <p>Because progression is set out in terms of outcomes rather than ages, there is no clear break in expectation between primary and secondary phases.</p>	<p>speaking and listening – the outcomes are set out in terms of general language ability.</p>	<p><i>and writer's purpose".</i></p>

<p>Research (finding and using information)</p> <p>Covers:</p> <ul style="list-style-type: none"> - Formulating research questions - Finding information - Using information - Evaluating sources - Organising and presenting ideas 	<p>Introduced in Y1</p> <p>Low specificity</p> <p>Reading for information is developed throughout the curriculum from Year 1.</p> <p>During Years 1 and 2 pupils are taught to use key features to navigate various informational texts sources.</p> <p>In Years 3 to 6 pupils are taught to obtain specific information from reading, distinguishing between fact and opinions and critically analysing information.</p> <p>In the secondary phase requirements for 'research' reading focus on the use of ICT-based resources and media texts, rather than on the strategies and processes for extracting and using information. It is expected that students will compare and synthesise information from these sources and evaluate how the information is presented.</p>	<p>[Secondary curriculum only]</p> <p>Low specificity</p> <p>There is no detail provided on specific research techniques that should be used. Some reference is made to evaluating information, but no detail is given.</p>	<p>Introduced in Y1</p> <p>High specificity</p> <p>Requirements are set out in General Outcome 3, '<i>...manage ideas and Information</i>'.</p> <p>Initially (Years 1 and 2) pupils are taught to understand and use information texts and to categorise and gather information</p> <p>By Year 6 pupils are expected to use a range of strategies to access information and can examine, summarise and evaluate information found.</p> <p>Through Secondary, pupils plan their research methods, obtain information from a variety of sources, use skills such as skimming and scanning and evaluate the success of their research techniques. These areas are not covered in England 2007.</p>	<p>Introduced in Y1</p> <p>High specificity</p> <p>Requirements are set out in a '<i>research</i>' sub-domain, which forms part of the 'Composition' domain.</p> <p>Early requirements (Years 1 to 3) are for pupils to generate questions and collect information using a variety of sources.</p> <p>In later Years, pupils are expected to know how to identify and apply steps for collecting information, organise ideas for emphasis, use the information and evaluate sources.</p>	<p>Introduced in Y1</p> <p>Medium specificity</p> <p><i>Research</i> is covered in reading and writing processes, with a specific domain focused on processing information.</p> <p>At levels 1 and 2 (approx. Y1–4) the expectation is focused on identifying, retrieving and presenting coherent information from more than one source. The requirement becomes more sophisticated by level 5 and 6 (approx. Y9–11 and beyond), with the need to use appropriate technologies, present information accurately and analyse the process used.</p>	<p>Introduced in Y2</p> <p>Low specificity</p> <p>There is very little specification on this topic. Pupils are expected to be able to extract information from texts and discuss the techniques that can be used to present information, but there is no specific guidance on techniques for reading for information.</p> <p>Focuses on the use of technology, both for written and visual language texts.</p>	<p>Introduced in Y1</p> <p>High specificity</p> <p>Expectation for pupils to gather and use information from Year 1, using various cues as signposts.</p> <p>The requirements by the end of Year 7 are that the information is organised and summarised effectively, with reasons to support and evaluative comments.</p> <p>By the end of secondary schooling pupils should also be evaluating sources of information, establishing their own criteria and further exploring factors relating to a topic.</p>

Table A3: Writing

Domain	England NC (1999)	England (2007)	Alberta (2000 [Y1–10], 2003 [Y11])	Massachusetts (2001)	New Zealand (1994)	New South Wales (2001 [Y1–7] and 2003 [Y8–11])	Singapore (2001)
<p>Planning writing</p> <p>- organising ideas - planning writing -audience and purpose</p>	<p>Introduced Y1</p> <p>Medium specificity</p> <p>Planning and drafting is a sub-domain of writing in Years 1 and 2. Expectation is focused on assembling and developing ideas, planning and reviewing their writing, with support, and discussing its quality.</p> <p>In Years 3 to 6, the planning and drafting sub-theme is split into <i>plan, draft, revise, proof reading, present, and discuss and evaluate</i>.</p> <p>These themes continue through to the secondary phase, with the additional requirement to analyse critically their own and other’s writing.</p>	<p>[Secondary curriculum only]</p> <p>Low specificity</p> <p>There is no specification of organisational or planning techniques – the only specification is that pupils should be able to organise, plan and proof read their work.</p>	<p>Introduced in Y3</p> <p>Low content level but high specificity</p> <p>Planning for writing appears across the General Outcomes, commencing with recording and experimenting with ideas, which progresses to organising ideas and information in upper KS2.</p> <p>Secondary requires pupils to select the right strategies, plan to write for particular audiences and organising ideas and appropriate text structures.</p> <p>Expectations also cover the planning of spoken texts.</p>	<p>Introduced in Y6 (limited planning required from Y1)</p> <p>Medium specificity</p> <p>Organising ideas is a sub-domain that requires pupils to organise their writing in a way that makes sense for the purpose.</p> <p>During the primary phase pupils are required to organise ideas in a way that makes sense, through sequencing events in their own writing.</p> <p>The secondary curriculum is less prescriptive, simply saying that pupils should “Organize ideas for a critical essay about literature or a research report with an original thesis statement in the introduction, well constructed paragraphs that build an effective argument, transition sentences to link paragraphs into a coherent whole, and a conclusion”</p>	<p>Not specified</p> <p>Planning a written text is not explicitly covered.</p>	<p>Introduced in Y3</p> <p>Medium specificity</p> <p>Requirements are set out as a sub-domain of the “Writing” section. For the primary Years, some guidance is given as to the skills and strategies that should be used in planning writing (e.g. “uses a flowchart”, “uses a ... matrix, flowchart, semantic map”).</p> <p>This guidance becomes much more general for Year 8 onwards (e.g. “use and adapt the processes of planning, drafting, rehearsing, responding to feedback, editing, and publishing to compose texts over time”).</p>	<p>Introduced in Y5</p> <p>Low specificity</p> <p>Expectation for pupils to plan a presentation is introduced in Year 5. By the end of Year 7 pupils are required to plan and organise, considering purpose and audience.</p>

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<p>Composition</p> <p>Covers:</p> <ul style="list-style-type: none"> - Composition - Audience and purpose - Structure of writing (sentence and text) - Use of language (styles and conventions) - Meta-language <p>Genres:</p> <ul style="list-style-type: none"> Literary Non-literary Poetry Play-scripts 	<p>Introduced Y1</p> <p>Medium specificity</p> <p>In Year 1 and 2 the expectation is that pupils will organise their ideas into sentences, with varied vocabulary and writing to suit the purpose and reader, using the texts they read as models for their own writing.</p> <p>In Years 3 to 6 pupils are expected to choose form and content to suit a particular purpose for writing, with broadening vocabulary, flexing the form of writing and using additional features.</p> <p>In the secondary phase, writing for different purposes becomes the focus; with composition split out into: <i>writing to imagine, explore, entertain, writing to inform, explain, describe, writing to persuade, argue, advise, and writing to analyse, review and comment.</i></p>	<p>[Secondary curriculum only]</p> <p>Medium specificity</p> <p>There is a section dedicated to writing in both key stages, with some progression between the two.</p> <p>Pupils are expected to be able to use a range of structures and devices to write for a range of purposes and audiences.</p> <p>By the end of KS4, pupils are expected to “<i>write imaginatively, creatively and thoughtfully, producing texts that interest, engage and challenge the reader.</i>”</p>	<p>Introduced in Y1</p> <p>High specificity</p> <p>Writing is particularly covered in General Outcome4: “<i>...enhance the clarity and artistry of communication</i>” and is also addressed across the other General Outcomes. Most statements include expectations that communication learning will include written, oral and other media texts.</p> <p>Early writing consists of beginning to write punctuated sentences, experimenting with letters and words. By the end of Year 6 the focus has moved to experimenting with language, sentence and text structures to create different effects.</p> <p>Year 7 to 9 focuses on using and experimenting with specific writing techniques to engage the reader, including identifying</p>	<p>Introduced in Y1</p> <p>Medium specificity</p> <p>Composition is set out as a process. Each stage of the writing process is covered and split into:</p> <ul style="list-style-type: none"> -writing, - consideration of audience and purpose, - revising, -standard English conventions, -organising ideas in writing, -research, -evaluating writing and -presentations. <p>The writing standards set out separate requirements for imaginative/literary writing and informational/expository writing from Year 1.</p> <p>Imaginative/ literary texts: during the primary stage pupils are expected to write stories that have a beginning, middle and end, and short poems that have a sense of detail. In the</p>	<p>Introduced in Y1</p> <p>Medium specificity</p> <p>Writing composition split by expressive, poetic and transactional writing. Each of the level statements aim to detail the expectations for each type of composition.</p> <p>Expressive writing: by the end of Year 11, pupils are expected to “<i>write regularly, confidently, and fluently to reflect on a range of experiences, ideas, feelings, and texts, developing a personal voice</i>”.</p> <p>Poetic writing: by the end of Year 11, pupils are expected to “<i>write on a variety of topics, shaping, editing, and reworking texts to express experiences and ideas imaginatively in an extended range of genres</i>”.</p> <p>Transactional writing: by the end of Year 11 pupils are expected to</p>	<p>Introduced in Y2</p> <p>High specificity</p> <p>Requirements are set out as a sub-domain of the “Writing” section. For the primary Years, some guidance is given as to the skills and techniques that should be used in text composition (e.g., “<i>uses a checklist</i>”, “<i>writes paragraphs that contain a main idea and elaboration of the main idea</i>”).</p> <p>This guidance becomes much more general for Year 8 onwards (e.g. “<i>Students learn about considerations in drafting and editing such as content, vocabulary, accuracy, cohesion, linguistic and visual forms, textual structures, tone and style.</i>”</p>	<p>Introduced in Y1</p> <p>Medium specificity</p> <p>The types of texts pupils are to compose are specified Year-by-Year, for example, the types of information texts being produced by the end of Year 3 should be:</p> <ul style="list-style-type: none"> -simple fiction texts - lists -scrapbooks. <p>However, there is relatively little on specific compositional techniques.</p> <p>The range of texts types for composition widens throughout each Year of schooling. The composition process is expected to include draft, edit and revise with or without input from peers or teachers as necessary.</p> <p>By the end of Year 3 the expectation is that pupils should be able to write coherently and cohesively, to suit audience and purpose.</p>

Domain	England NC (1999)	England (2007)	Alberta (2000 [Y1–10], 2003 [Y11])	Massachusetts (2001)	New Zealand (1994)	New South Wales (2001 [Y1–7] and 2003 [Y8–11])	Singapore (2001)
			<p>how others use structures and devices for effect.</p> <p>In Years 10 and 11, writing has a specific focus on being clear about the purpose of their writing and making the correct choices of writing form and style for this. There is high demand in the use of names devices and techniques to be employed in writing (e.g. parallel structure, repetition, subordination and apposition)</p> <p>A number of statements include using other modes to support writing, including camera, voice, and visuals.</p>	<p>secondary phase the level of demand increases with pupils expected to write increasingly well-developed stories which include basic elements of fiction.</p> <p>Informational/ expository: in the earlier Years pupils are expected to produce brief summaries, interpretations and explanations, by the end of the secondary phase the expectation is that pupils are able to write well organised essays, which have a clear focus and logical development.</p>	<p><i>“write clear, coherent instructions, explanations, and factual reports and express and justify a point of view persuasively, structuring material confidently”.</i></p> <p>Because progression is set out in terms of outcomes rather than ages, there is no clear break in expectations between primary and secondary phases.</p>		<p>By the end of Year 11 student are expected to be able to pick text type to suit the purpose and audience; and use appropriate organisation structures, style, register and tone.</p>
<p>Evaluate, edit and proof</p> <p>covers: - own writing - other’s writing (peers)</p>	<p>Introduced in Y3 Low specificity</p> <p>As part of the planning and drafting process from Year 3, pupils are expected to proof and revise their drafts, and discuss and evaluate their own and others’ writing. This continues in the secondary</p>	<p>[Secondary curriculum only] Low specificity</p> <p>This is covered in the “writing” section of the curriculum – there are no specific techniques suggested, but pupils are expected to be able to proof-read and evaluate their work.</p>	<p>Introduced in Y3 Medium specificity</p> <p>covered in GO4: <i>“...enhance the clarity and artistry of communication”</i></p> <p>Reflecting on own writing commences in Year 3, with focus on proof reading for errors and some improvement to</p>	<p>Introduced in Y1 High specificity</p> <p>During the primary phase, pupils are expected to use knowledge of correct mechanics (end marks, commas for series, capitalization), usage (subject and verb agreement in a simple sentence), and sentence</p>	<p>Introduced in Y9 Low specificity</p> <p>At levels 5–6 (approx. Y9–11 and beyond) the expectation is that pupils will interpret, analyse, and produce written texts, identifying and discussing their literary qualities. There are no further expectations setting</p>	<p>Introduced in Y2 Medium specificity</p> <p>Requirements are set as a sub-domain of the “Writing” section. For the primary Years, some guidance is given as to the skills and strategies that should be used in evaluating and</p>	<p>Introduced in Y1 Low specificity</p> <p>By the end of Year 3 the requirement is for pupils to be able to draft, revise and edit a text with their teacher. By the end of Year 11, pupils should be confident in undertaking this process independently or with peers.</p>

Domain	England NC (1999)	England (2007)	Alberta (2000 [Y1–10], 2003 [Y11])	Massachusetts (2001)	New Zealand (1994)	New South Wales (2001 [Y1–7] and 2003 [Y8–11])	Singapore (2001)
	phase with further emphasis on the critical analysis of their own and others' writing.		text. In Years 5 and 6 statements cover setting criteria for evaluation and using this to check own and others' work. Some technical review is required. Year 5 pupils expected to <i>"identify and reduce fragments and run-on sentences"</i> and <i>"edit for subject-verb agreement"</i> . At secondary, the focus is on reflecting on the success of producing whole texts, including consistency, effectiveness, use of devices and meeting intended purpose.	structure (elimination of fragments) when writing and editing. During the secondary phase, pupils should revise writing to improve level of detail and precision of language, combine and vary sentences, rearrange text and improve word choice by using dictionaries or thesauruses. Pupils are expected to evaluate their own work, which in the secondary phase involves developing and applying criteria for different forms of writing.	out how pupils should evaluate their own work, or the work of others. No explicit mention of proof reading or editing.	editing (<i>"uses a checklist"</i> , <i>"redrafts the same text for different audience"</i>). This guidance becomes much more general for Year 8 onwards (e.g. <i>"different ways of using feedback to improve their texts"</i>).	
Grammar - knowledge of the conventions of the written and spoken language - ability to analyse sentences and utterances grammatically - ability to distinguish standard from non-standard	Introduced in Y1 Medium specificity From Year 1 pupils are expected to show basic grammatical awareness when reading texts. From Year 3, expectations are set out in the 'language structure'	[Secondary curriculum only] Low specificity The 'Key Concepts' sets out the importance of <i>'demonstrating a secure understanding of the conventions of written language, including spelling, grammar and</i>	Introduced in Y1 Medium specificity Requirements are set out Year by Year in General Outcome 4.2 <i>'Attend to Conventions'</i> that covers spelling, grammar and punctuation. There is little integration of	Introduced in Y1 High specificity Requirements set out in two-Year blocks, in 3 separate sections of the curriculum that cover vocabulary, grammar, and spelling/punctuation. There is little integration of	Introduced in Y1 No specificity This curriculum contains no specific requirements for grammatical knowledge. There are references to knowledge of the <i>"conventions and structures"</i> of language, but these are not specified.	Introduced in Y1 Medium specificity Requirements are integrated into the three main domains of the curriculum: talking and listening, reading, and writing. Each domain refers to grammatical knowledge.	Introduced in Y1 High specificity Requirements are set out in a separate grammar section of the curriculum. The grammatical content is not integrated into other parts of the curriculum, although there is

Domain	England NC (1999)	England (2007)	Alberta (2000 [Y1–10], 2003 [Y11])	Massachusetts (2001)	New Zealand (1994)	New South Wales (2001 [Y1–7] and 2003 [Y8–11])	Singapore (2001)
English	<p>section of the writing domain. By the end of primary school, pupils are expected to know: “<i>word classes and ... grammatical functions...; the features of different types of sentence...; the grammar of complex sentences...; the purposes and organisational features of paragraphs.</i>”</p> <p>By the end of Year 11, pupils are expected to know: “<i>word classes ... and their grammatical functions; the structure of phrases and clauses...; paragraph structure and how to form different types of paragraph; the structure of whole texts, including cohesion...; the use of appropriate grammatical terminology...</i>”</p>	<p><i>punctuation</i>’ and there is then very little detail about grammar functions in the ‘Key Processes’ section.</p> <p>The explanatory notes provide some additional guidance, about verb agreement, formation of past tense and demonstrative pronouns in relation to standard English (Speaking and Listening). The ‘Writing’ guidance notes give supplementary information about grammar devices when varying sentence structure (KS3) and demarcating paragraphs (KS3&4).</p>	<p>the grammatical content into other parts of the curriculum.</p> <p>The curriculum is minimal in its listing of specific grammar functions for pupils to learn and use; most statements are broader and address the overall use of correct grammar, for example ‘use a variety of strategies to make effective transitions between sentences and paragraphs in own writing’ (Y6), or “edit for subject-verb agreement” (Y5).</p> <p>By the end of Year 6 pupils are expected to be able to write a simple and compound sentences in clearly constructed paragraphs, using verbs and verb tenses correctly.</p> <p>Secondary phase focuses on use of more complex sentences, and correct construction of sentences to achieve clear</p>	<p>the grammatical content into other parts of the curriculum, unlike, for example, Singapore.</p> <p>Pupils are required to learn simple transformational linguistic analysis, and examples of word borrowing, in addition to practical grammar for the pupils’ own use.</p>		<p>Progression is steady up to Year 7.</p> <p>By the end of Year 3, pupils are taught to identify some word types, use conjunctions, and use noun/pronoun agreement. By the end of Year 7, pupils have covered, for example: distinguishing between colloquial and formal language; adverbial phrases and adjectival phrases; word chains, synonyms, antonyms; and relative pronouns.</p> <p>Beyond Year 7, the curriculum documents are much less specific; they talk in terms of “appropriate” language rather than specifying knowledge or particular grammatical features.</p>	<p>guidance on how to use texts to teach grammatical features. The content is specified in great detail.</p> <p>Progression is fast and demanding up to Year 7. After that, the focus is on consolidation of concepts that have already been introduced. In contrast to the other jurisdictions examined here, there is little or no new grammar in the curriculum after Year 7.</p>

Domain	England NC (1999)	England (2007)	Alberta (2000 [Y1–10], 2003 [Y11])	Massachusetts (2001)	New Zealand (1994)	New South Wales (2001 [Y1–7] and 2003 [Y8–11])	Singapore (2001)
			communication.				
Spelling -spelling strategies -encoding -spelling rules -sight vocabulary -affixes -extending spelling repertoire	Introduced in Y1 Medium specificity Requirements in both the reading and writing domain from Year 1. Spelling strategies set out for learning basic spelling, along with strategies for checking spelling. From Year 3 it is expected that pupils understand and apply morphology in spelling. From Year 7 onwards pupils are expected to increase existing knowledge, spell more complex words, and use a range of resources in checking spelling.	[Secondary curriculum only] Low specificity Consistent with the approach taken by other jurisdictions, there is very little specification of spelling at KS3&4. At KS3 pupils are expected to apply knowledge of spelling strategies, for regular and irregular words and increase their knowledge of root words, their derivations and affixes.	Introduced in Y1 High specificity ‘4.2 attend to spelling is a discrete domain within General Outcome 4 ‘...enhance the clarity and artistry of communication’. Spelling also addressed in 2.1 ‘Use strategies and cues’ There is a fairly broad approach to spelling, with statements such as “connect letters with sounds in words (Kindergarten)” and “use phonic knowledge and skills and visual memory to attempt to spell words”. Complexity of demand increases each Year; increasing the number of syllables in words expected to be spelt correctly and with attention moving to application of spelling conventions and meaning and	Introduced in Y2 Medium specificity Requirements for spelling are covered in the ‘Standard English Conventions’ sub-domain. Expectations for spelling are introduced at Year 2, with pupils required to use correct spelling of sight and/ or spelling words. From Year 4 pupils are expected to be able to spell commonly used homophones, and apply letter sound, word parts, word segmentation, and syllabication to monitor and correct spelling. From Year 6, pupils are expected to continue to use standard English spelling when writing and editing. The strategies are a mixture of phonics (mainly) and knowledge of syllable boundaries.	Not specified Spelling is briefly mentioned in the achievement objectives, first appearing at level 3 (approx. Y5–6) with a requirement to use correct conventions in writing. There are no specified spelling strategies contained in the curriculum document.	Introduced in Y1 Medium specificity Requirements are set out as a sub-domain of the “Writing” section. For the early primary Years, there is some specification of grapheme types (“writes letters for double vowels”), but this is not comprehensive. In later Years, the focus is on the skills and strategies used for good spelling, for example, using knowledge of familiar prefixes and suffixes to spell unfamiliar words. Expected outcomes are fairly broad and give a general overview of what a pupil who reaches the expected standard will be able to do.	Introduced in Y1 Low specificity There is a short “starter list” of just over 300 words that pupils are expected to be able to use, spell and understand by the end of Year 5, with the expectation that pupils apply knowledge of spelling conventions and strategies in their own writing. No further expectations for spelling are set out beyond the end of Year 5.

Domain	England NC (1999)	England (2007)	Alberta (2000 [Y1–10], 2003 [Y11])	Massachusetts (2001)	New Zealand (1994)	New South Wales (2001 [Y1–7] and 2003 [Y8–11])	Singapore (2001)
			<p>function of words.</p> <p>There is greater attention to spelling strategies at secondary than other curricula analysed. Year 10 ends with focus on proof-reading using spelling variants for effect and careful attention to spelling in writing.</p>	<p>Overall, the Massachusetts curriculum contains very little detail of spelling.</p>			
<p>Handwriting</p> <p>- Writing number and letters Use of technology</p>	<p>Introduced in Y1 Low specificity</p> <p>In Years 1 and 2 the expectation is for pupils to develop a legible style, in both handwriting and presentation.</p> <p>In Years 3 to 6 pupils are expected to write legibly in both joined and printed styles, using different forms of handwriting for different purposes.</p> <p>In the secondary phase pupils are expected to write with fluency and speed, presenting</p>	<p>[Secondary curriculum only] Low specificity</p> <p>As might be expected at this age level, there is very little detail. Pupils are expected to be able to write legibly and at speed.</p>	<p>Introduced Y1 (to Year 6) Low specificity (but greater than other curricula analysed)</p> <p>Consistent with Eng 99 in correct formation of letters, and correct spacing. Joined writing is introduced in Year 4.</p>	<p>Introduced Y2 Low specificity</p> <p>Requirements for handwriting set out in the 'standard English conventions' sub-domain, which expects pupils to learn the patience and discipline required to polish their final work.</p> <p>In Year 1 pupils are required to print upper- and lower-case letters. In Year 2 the expectation is that they will start to print legibly, using correct spacing.</p> <p>By the end of Year 5 the expectation is</p>	<p>Introduced in Y1 Low specificity</p> <p>Handwriting is included in the achievement objectives for visual language, as part of processing information.</p> <p>Handwriting objectives cover levels 1 to 4 (approx. Y1–8). At levels 1–2 (approx. Y1–4) the expectation is that pupils should write letter and number forms legibly. At level 3–4 (approx. Y5–8) pupils are expected to handwrite fluently.</p>	<p>Introduced Y1 Medium specificity</p> <p>Requirements are set out as a sub-domain of the "Writing" section.</p> <p>There is much more detail provided for expected outcomes than for content. For example, for Year 3, the content section says that pupils should "<i>develop handwriting of consistent size and spacing</i>", while the outcomes section specifies: "<i>starts at the top of every upper-case letter,</i></p>	<p>Introduced in Y1 Low specificity</p> <p>Pupils are expected to use print script, spacing letters, words and sentences appropriately by the end of Year 3.</p> <p>Progression is specified with pupils expected to be writing in a joined script by the end of Year 5.</p> <p>No further handwriting requirements beyond Year 5.</p>

Domain	England NC (1999)	England (2007)	Alberta (2000 [Y1–10], 2003 [Y11])	Massachusetts (2001)	New Zealand (1994)	New South Wales (2001 [Y1–7] and 2003 [Y8–11])	Singapore (2001)
	final polished work.			<p>that the majority of pupils will write legibly in joined style, leaving space between letters in a word and between words in a sentence.</p> <p>From Year 6 onwards, pupils are expected to continue to address these issues, apply the standard English conventions of handwriting.</p>		<p><i>lower-case letter and number, except 'd' and 'e' (which start in the middle) and knows that no letter starts from the bottom.</i></p> <p>By the end of Year 7, pupils should “<i>experiment with personal handwriting style to enhance fluency, speed, legibility and appeal</i>”.</p>	

Table A4: English language variation

Domain	England NC (1999)	England (2007)	Alberta (2000 [Y1–10], 2003 [Y11])	Massachusetts (2001)	New Zealand (1994)	New South Wales (2001 [Y1–7] and 2003 [Y8–11])	Singapore (2001)
<p>Standard & Non standard English and language variation</p> <ul style="list-style-type: none"> - Formal and informal language - Cultural and regional differences in language use 	<p>Introduced in Y1</p> <p>Medium specificity</p> <p>In Years 1 and 2 pupils are expected to be introduced to some of the main features of standard English in speaking and listening, and writing. Through Years 3 to 6 it is expected that pupils should be exposed to the varying degrees of formality of standard English, and some of the difference between standard and non-standard English usage. During the secondary phase pupils should be using spoken standard English fluently and accurately in formal and informal situations. In writing it is expected that pupils will be able to apply variations in written standard English,</p>	<p>[Secondary curriculum only]</p> <p>Low specificity</p> <p>Exposure to the varieties of English is specified as part of the “content” section of the curriculum. In each key stage, the specification says that pupils should be exposed to content that includes “variations in written standard English and how it differs from standard and non-standard spoken language”.</p>	<p>Introduced Y8 (to 10)</p> <p>Low specificity</p> <p>Appears in GO4.1 Enhance and Improve.</p> <p>Pupils are required to identify differences in formal and informal language, effects of technology and popular culture on language use and derivation and use of words.</p>	<p>Introduced in Y1</p> <p>Medium specificity</p> <p>Covered in the <i>Language</i> domain, in the structure and origins of modern English and Formal and Informal English standards.</p> <p>Pupils are required to study changes to the English language through time, in relation to contact with other languages.</p> <p>By the end of Year 11 pupils are expected to be able to identify, describe and apply a range of standard English conventions, and analyse how the language has changed over time.</p>	<p>Introduced in Y1</p> <p>Medium specificity</p> <p>Covered in the processes for speaking and written texts.</p> <p>Pupils are required to explore oral and written languages; becoming familiar with common conventions and developing the ability to discuss how language features are adapted to suit topic, audience and purpose.</p>	<p>Introduced in Y1</p> <p>Low specificity</p> <p>The concept of language variation is introduced in the first Year of schooling and reinforced in later Years. Pupils are expected to distinguish between different varieties of English and to discuss those varieties. Teachers also have to take into account the fact that, for native speakers of Aboriginal English, Australian Standard English will be unfamiliar. However, the curriculum does not give any detail on what might be meant by “variation”.</p>	<p>Introduced in Y1</p> <p>Medium specificity</p> <p>Pupils are required to be able to communicate fluently, appropriately and effectively in internationally acceptable English, with knowledge of how the language system works and how language conventions can vary according to purpose, audience, context and culture. This is expected to be applied in speech and writing in both formal and informal situations.</p> <p>By the end of Year 11 the expectation is that they will write in internationally acceptable English that is grammatically correct, fluent and appropriate for purpose, audience, context and culture.</p>

Domain	England NC (1999)	England (2007)	Alberta (2000 [Y1–10], 2003 [Y11])	Massachusetts (2001)	New Zealand (1994)	New South Wales (2001 [Y1–7] and 2003 [Y8–11])	Singapore (2001)
	recognising the differences from spoken language.						

Table A5: Speaking and Listening

Topic	England NC (1999)	England NC (2007)	Alberta (2000 [Y1–10], 2003 [Y11])	Massachusetts (2001)	New Zealand (1994)	New South Wales (2001 [Y1–7] and 2003 [Y8–11])	Singapore (2001)
<p>Speaking</p> <p>Covers: - Oracy - Language development and vocabulary</p>	<p>Introduced in Y1</p> <p>Medium specificity</p> <p>Speaking is combined with listening and is a separate domain in the Programme of Study for English.</p> <p>Expectations are defined for <i>individual speaking skills</i>, with further expectations defined for <i>group discussions and interaction and drama</i>.</p> <p>In Years 1 and 2 pupils learn to speak clearly, choosing words with precision, organising their ideas and focusing in the main point.</p> <p>In Years 3 to 6 pupils are taught to speak confidently in a range of contexts, with consideration for audience and purpose.</p> <p>By the end of Year 11, pupils are expected to “speak fluently and appropriately in</p>	<p>[Secondary curriculum only]</p> <p>Low specificity</p> <p>There is a section dedicated to speaking and listening in both key stages. Statements on speaking and listening are interwoven within the outcome statements.</p> <p>By the end of KS4, pupils are expected to be able to “speak fluently, adapting talk to a wide range of familiar and unfamiliar contexts and purposes”, as well as presenting confidently and effectively. The types of speaking activity that pupils are expected to undertake are: <i>formal presentations and debates; informal discussions; improvisation and performance; and devising, scripting and performing plays</i>.</p>	<p>Introduced in Y1</p> <p>High specificity</p> <p>Speaking is a feature of all 5 General Outcomes at the highest level. (<i>All pupils will listen, speak, read, write, view and represent to...</i>). Speaking is explicitly covered in:</p> <p>1.1 <i>discover and explore</i> 3.1 <i>plan and focus</i> 3.4 <i>share and review</i> 4.3 <i>present and share</i> 4.1.4 <i>develop and present</i> 5.1 <i>respect others and strengthen community</i>.</p> <p>There is a strong correlation between speaking and writing, as well as speaking and listening; particularly from Y7 onwards.</p> <p>Level of demand is greater than Eng 99 for primary, but more comparable with Eng 07 secondary.</p> <p>Unique focus on the role of oral development in developing respect and community.</p> <p>No drama aspect to speaking in the Alberta</p>	<p>Introduced in Y1</p> <p>Medium specificity</p> <p>Requirements for speaking are covered in the language domain. This domain is comprised of four sub-domains: <i>discussion, questioning, listening, and contributing, oral presentation and vocabulary and concept development</i>.</p> <p>Speaking requirements are embedded within all areas.</p> <p>Expectations are combined for Years 1 to 3 and then in 2 Year blocks.</p> <p>The sub-domain of ‘Vocabulary and Concept Development’ has standards set out for the end of Year 1, in addition to the end of Year 3 (whereas other sub-domains set combined standards for Year 1 – 3). Indicating</p>	<p>Introduced in Y1</p> <p>Low specificity</p> <p>Requirements for speaking are covered in the oral language domain, which is split into speaking and listening.</p> <p>The speaking domain is split into 2 functions: interpersonal speaking and using texts.</p> <p>At <i>Interpersonal speaking</i> level 1 (approx. Y1–2) pupils are expected to converse, and talk about personal experiences.</p> <p>At level 6 (approx. Y11 and beyond) pupils are expected to speak independently, confidently and effectively to suit the audience and purpose.</p> <p>At <i>Using Texts At</i> level 1 (approx. Y1–2), pupils are expected to tell a story, recite, or read aloud. At level 6 (approx.</p>	<p>Introduced in Y1</p> <p>High specificity</p> <p>Speaking is set out within “<i>Talking and listening</i>”.</p> <p>Until the end of Year 7, very detailed indicators of attainment are set out for four sub-domains in each stage: <i>talking and listening, skills and strategies, context and text, and language structure</i>. For example, by the end of Year 7, pupils should “<i>recognise the main organisational structures of spoken text types studied, e.g. exposition, explanation, and rehearse and modify a talk before presenting it to peers or the class, e.g. reorder ideas</i>”.</p> <p>Beyond Year 7, there is less specific emphasis on speaking as the outcomes are set out in terms of</p>	<p>Introduced in Y1</p> <p>Low specificity</p> <p>The curriculum document has a separate and dominant ‘Language for Social Interaction’, which focuses on speaking (and listening).</p> <p>This domain runs parallel to the non-literary and literary domains.</p> <p>Expectation by the end of Year 3 is that pupils speak fluently and expressively on a range of topics,, using clear pronunciation and speech to convey meaning.</p> <p>By the end of Year 11 pupils are required to be able to present and develop ideas effectively in speech for a variety of different purposes and audiences; monitoring and adjusting presentation to sustain audience interest and responding to</p>

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	<p>different contexts, adapting their talk for a range of purposes and audiences”.</p> <p>Drama is specified as a part of speaking.</p>	<p>This curriculum has some mention of drama; setting out dramatic approaches, techniques, factors contributing to dramatic moments and evaluating own dramatic performances.</p>	<p>curriculum.</p>	<p>the level of progression expected in this sub-domain between Years 1 and 3.</p> <p>By Year 11 pupils are expected to be proficient in speaking for a range of purposes and audiences, have the ability to evaluate and analyse their own and others’ speech.</p> <p>Drama is limited to responding to dramatic literature in the ‘Reading’ domain. There is no focus on dramatic performance.</p>	<p>Y11 and beyond) a pupil should be able to use different techniques of speech and delivery on a wide range of texts in an organised and effective manner, drawing on different techniques.</p> <p>The programme of study sets out the processes for understanding and using oral language: <i>exploring language, thinking critically and processing information</i>. The processes cover 2 levels, which roughly equates to 4 teaching Years.</p> <p>There is no specific mention of drama or dramatic techniques.</p>	<p>general language ability.</p> <p>By Year 11, pupils should be able to compose “<i>increasingly sophisticated and sustained texts for understanding, interpretation, critical analysis and pleasure</i>”.</p>	<p>questions.</p>

Topic	England NC (1999)	England NC (2007)	Alberta (2000 [Y1–10], 2003 [Y11])	Massachusetts (2001)	New Zealand (1994)	New South Wales (2001 [Y1–7] and 2003 [Y8–11])	Singapore (2001)
<p>Listening</p> <ul style="list-style-type: none"> - listening - processing information - understanding others and asking questions - responding to stories and information read aloud 	<p>Introduced in Y1</p> <p>Medium specificity</p> <p><i>Listening</i> is combined with <i>Speaking</i> and is a separate domain in the Programme of Study for English.</p> <p>Listening skills are defined separately, with the expectation that pupils listen, understand and respond to others.</p> <p>Listening is also defined as an integral part of group discussion and interaction, and drama.</p> <p>Through the primary Years pupils should be exposed to an increasing range of opportunities to listen</p> <p>By the end of Year 11, pupils are expected to “listen, understand and respond critically to others”, and participate in group discussions.</p>	<p>[Secondary curriculum only]</p> <p>Low specificity</p> <p>There is a section dedicated to speaking and listening in both key stages, with some progression between the two.</p> <p>As with speaking, the types of speaking activity that pupils are expected to undertake are: <i>formal presentations and debates; informal discussions; improvisation and performance; and devising, scripting and performing plays.</i></p> <p>By the end of KS4, pupils are expected to be able to listen to “<i>complex information</i>”, as well as “<i>judge the intentions and standpoint of a speaker</i>”.</p>	<p>Introduced in Y1</p> <p>High specificity</p> <p>Listening is a feature of all 5 General Outcomes at the highest level. (<i>All pupils will listen, speak, read, write, view and represent to...</i>).</p> <p>Listening is closely paired with speaking in all grades and there is significantly less content than that for speaking.</p> <p>Earlier grades focus on becoming a good listener in a range of situations. In later grades this includes asking focused questions to improve and show understanding. At Year 10 Alberta expects pupils to be able to detect subtle nuances when listening, for example ‘<i>differentiate between audience response to the content of a presentation and audience response to the presenter</i>’</p>	<p>Introduced in Y1</p> <p>Medium specificity</p> <p>Requirements for listening are covered in the language domain, specifically in the questioning, listening and contributing sub-domain.</p> <p>Expectations are set for Years 1 to 3 and then in 2 Year blocks.</p> <p>The initial expectation is for pupils to contribute to class discussions, working towards generating questions to develop knowledge. From Year 6 upwards the use of listening skills are more focused; with pupils expected to interview and contribute to focused discussions in order to acquire new knowledge.</p>	<p>Introduced in Y1</p> <p>Low specificity</p> <p>Requirements for speaking are covered in the oral language domain, which is split into speaking and listening.</p> <p>The listening domain is split into 2 functions: <i>interpersonal listening and listening to texts.</i></p> <p>At <i>Interpersonal Listening</i> at level 1 (approx. Y1–2), pupils are expected to listen and respond to others, or texts (relating texts to personal experience).</p> <p>At level 6 (approx. Y11 and beyond) pupils are expected to interact and respond, to deepen their understanding in both communication and of texts.</p> <p>The programme of study sets out the processes for understanding and</p>	<p>Introduced in Y1</p> <p>High specificity</p> <p>Listening is set out within “<i>Talking and listening</i>”.</p> <p>Until the end of Year 7, very detailed indicators of attainment are set out for 4 sub-domains in each stage: <i>talking and listening, skills and strategies, context and text, and language structure.</i> For example, by the end of Year 7, pupils should “recognise when an opinion is being offered as opposed to fact”, and “take notes from a range of spoken texts, e.g. guest speaker, television program, video”.</p> <p>Beyond Year 7, there is less specific emphasis on speaking and listening – the outcomes are set out in terms of general language ability.</p>	<p>Introduced in Y1</p> <p>Medium specificity</p> <p>The curriculum document has a separate and dominant ‘Language for Social Interaction’, which focuses on listening (and speaking).</p> <p>Pupils are required to listen for information from a variety of sources, both literary and informational from Year 1. Expectations are also set out for social interaction. However, specific listening techniques or skills are not covered at all.</p> <p>In Year 1 the focus of listening skills is on sustaining concentration, specifically when a teacher is reading aloud and also demonstrating understanding. Expectations by Year 11 are that pupils can participate fully and productively in group discussions and debates, with knowledge of discourse markers,</p>

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					<p>using oral language: <i>exploring language, thinking critically</i> and <i>processing information</i>. The processes cover 2 levels, which roughly equates to 4 teaching Years.</p>		<p>verbal cues and the use of formal and informal English. Pupils should also be able to process information to take notes on main ideas and details.</p>

Appendix B: Mathematics curriculum comparison tables

Table B1: High-level organisation

	England NC (1999)	England (2007)	Flemish Belgium 2004	Finland 2010	Hong Kong 2000/1999	Massachusetts 2000; 2004 addendum	Singapore 2001
High level organisation of curriculum document	<u>Statement type and Year groupings:</u> Defines the curriculum by <i>learning outcomes</i> for each key stage: KS1 (Y1-2) KS2 (Y3-6) KS3 (Y7-9) KS4 (Y10-11)	<u>Statement type and Year groupings:</u> Defines the curriculum by <i>learning outcomes</i> for each key stage: KS3 (Y7-9) KS4 (Y10-11) <u>Typical statement stem:</u> <i>The study of mathematics should include ...'</i>	<u>Statement type and Year groupings:</u> Defines the curriculum by <i>final objectives</i> by key stages: End of primary (Eng Year 7) Secondary: Stage 1 - (Eng Year 8 -9) Stage 2 - (Eng Year 10-11)	<u>Statement type and Year groupings:</u> Defines the curriculum by <i>core content</i> Preschool (Eng EYFS – Year 2) Grades 1-2 (Eng Years 3-4) Grades 3-5 (Eng Years 5-7) Grades 6-9 (Eng Years 8-11)	<u>Statement type and Year groupings:</u> Defines the curriculum by key stages: KS1 P1-P3 (Eng Years 2-4) KS2 P4- P6 (Eng Years 5-7) Secondary S1-S4 (Eng Years 8-11)	<u>Statement type and Year groupings:</u> Defines the curriculum by two-Year spans. PreK–K (Eng EYFS-Year 1) Grades 1–2 (Eng Years 2-3) Grades 3–4 (Eng Years 4-5) Grades 5–6 (Eng Years 6-7) Grades 7–8 (Eng Years 8-9) Grades 9–10 (Eng Years 10-11)	<u>Statement type and Year groupings:</u> Defines the curriculum by <i>learning outcomes</i> specified Year by Year: P1-P6 – (Eng Years 2-7) S1-S4 – (Eng Years 8 – 11)
Definition of curriculum statements	<u>Typical statement stem:</u> <i>'Pupils should be taught to...'</i>	<u>Attainment:</u> Expected levels of attainment are set out in a separate section 'Attainment Target Level Descriptors'.	<u>Typical statement stem:</u> <i>'The pupils...'</i>	<u>Typical statement stem:</u> <i>'The pupils will...'</i>	<u>Typical statement stem:</u> Primary each domain begins with: <i>'Learners...'</i>	<u>Typical statement stem:</u> Grades 7–8 (Eng Years 8-9) Grades 9–10 (Eng Years 10-11)	<u>Typical statement stem:</u> <i>'Pupils should be able to...'</i>
Year/ grade/ stage/ levels to the English Year equivalent	<u>Attainment:</u> Expected levels of attainment are set out in a separate section 'Attainment Target Level Descriptors'.	<u>Organisation of content:</u> Programme of study for mathematics is arranged into 3 key domains (Range and Content):	<u>Attainment:</u> The curriculum final objectives serve as expected levels of attainment for each Year. N.B. <i>Minimum objectives the educational</i>	<u>Attainment:</u> Expected levels of attainment are set out as <i>Description of good performance at the end of stage X</i> . A set of performance indicators at the end of each stage.	<u>Typical statement stem:</u> Secondary each domain begins: <i>'To develop students an ever-improving capability to';</i> Pri/Sec statements are then followed by a range of opening curriculum statements:	<u>Typical statement stem:</u> At each Year each domain begins with <i>'Students engage in...'</i> followed by the domain heading. Curriculum statements then vary including:	<u>Attainment:</u> The curriculum statements serve as expected levels of attainment for each Year <u>Organisation of content:</u> - Whole numbers - Money, Measures and Mensuration

	England NC (1999)	England (2007)	Flemish Belgium 2004	Finland 2010	Hong Kong 2000/1999	Massachusetts 2000; 2004 addendum	Singapore 2001
	<p>and understanding is arranged into 3 key domains –</p> <ul style="list-style-type: none"> - Number and Algebra (Algebra introduced at KS3) - Shape, Space and Measures - and Handling Data (domain introduced at KS2). <p>The breadth of study specifies the increasing range of activities, contexts and purposes through which pupils should be taught the knowledge, skills and understanding.</p>	<ul style="list-style-type: none"> - Number and Algebra - Geometry and Measures - Statistics <p>Cross cutting processes are included in the following additional domains:</p> <ul style="list-style-type: none"> - Key concepts - Key processes - Curriculum opportunities <p>There are detailed guidance notes alongside the Programme of Study statements in the curriculum document</p>	<p><i>authorities consider necessary and feasible for a particular part of the pupil population. Final objectives apply to a minimum set of knowledge, skills and attitudes for this part of the pupil population</i></p> <p><u>Organisation of content:</u></p> <p>Programme of study for mathematics is arranged into the following domains:</p> <ul style="list-style-type: none"> - Number theory - Algebra - Measurement - Geometry - Statistics (and problem solving skills – primary) - Real functions <p>Cross cutting processes are included within:</p> <ul style="list-style-type: none"> - Procedures - Skills - Attitudes 	<p>Except at end of Grades 6-9 attainment is defined as <i>Final assessment criteria for a grade of 8.</i></p> <p><u>Organisation of content:</u></p> <p>Programme of study for mathematics is arranged into the following domains:</p> <ul style="list-style-type: none"> - Numbers and calculations - Algebra - Geometry - Measurement Data processing and statistics (including probability at Grades 3-5) - Functions at grades 6-9 <p>Cross cutting processes are included within:</p> <p><i>Thinking and working skills and objectives.</i></p>	<p><i>'Develop an understanding..'</i></p> <p><i>'Recognise...'</i></p> <p><i>'Describe...Explore... Perform'</i></p> <p><i>'Formulate...judge... enquire...manipulate'</i></p> <p><u>Attainment:</u></p> <p>The curriculum statements serve as expected levels of attainment for each key stage. Presentation varies by key stage</p> <p><u>Organisation of content:</u></p> <p>Programme of study for mathematics is arranged into 5 key areas that are first introduced at various key stages:</p> <ul style="list-style-type: none"> - Number - Shape and space - Measures - Data handling (P2) - Algebra (P5) 	<p><i>'understand, use, estimate, demonstrate, identify, find, compare, sort and classify...'</i></p> <p><u>Attainment:</u></p> <p>The learning standards (curriculum statements) specify what students should know and be able to do at the end of each Year.</p> <p><u>Organisation of content:</u></p> <ul style="list-style-type: none"> - Number Sense and Operations - Patterns, Relations, and Algebra - Geometry - Measurement - Data Analysis, Statistics, and Probability 	<ul style="list-style-type: none"> - Statistics - Geometry - Fractions - Decimals - Algebra

	England NC (1999)	England (2007)	Flemish Belgium 2004	Finland 2010	Hong Kong 2000/1999	Massachusetts 2000; 2004 addendum	Singapore 2001
<p>Curriculum aims and principles</p> <p>Note: Many statements have been paraphrased for the purpose of this document. It is necessary to view the curriculum documents to see the aims in full.</p>	<p>Statement about 'the importance of mathematics...':-</p> <p><i>Mathematics equips pupils with a uniquely powerful set of tools to understand and change the world. These tools include logical reasoning, problem-solving skills, and the ability to think in abstract ways.</i></p> <p><i>Mathematics is important in everyday life, many forms of employment, science and technology, medicine, the economy, the environment and development, and in public decision making. Different cultures have contributed to the development and application of mathematics.</i></p> <p><i>Today, the subject transcends cultural</i></p>	<p><i>Learning and undertaking activities in mathematics contribute to achievement of the curriculum aims for all young people to become:</i></p> <ul style="list-style-type: none"> • <i>successful learners who enjoy learning, make progress and achieve</i> • <i>confident individuals who are able to live safe, healthy and fulfilling lives</i> • <i>responsible citizens who make a positive contribution to society.</i> <p>Statement on the importance of mathematics, which is largely the same as the statement in the 1999 document.</p>	<p>No reference to curriculum aims and principles within English translation of Flemish Belgium curriculum.</p>	<p><i>The task of instruction in mathematics is to offer opportunities for the development of mathematical thinking, and for the learning of mathematical concepts and the most widely used problem-solving methods. The instruction is to develop the pupil's creative and precise thinking, and guide the pupil in finding and formulating problems, and in seeking solutions to them. The importance of mathematics has to be perceived broadly; it influences the pupil's intellectual growth and advances purposeful activity and social interaction on his or her part.</i></p> <p><i>Mathematics instruction must progress systematically and</i></p>	<p><i>Mathematics pervades all aspects of life, whether at home, in civic life or in the workplace. It has been central to nearly all major scientific and technological advances. Also, many of the developments and decisions made in industry and commerce, the provision of social and community services as well as government policy and planning, rely to an extent on the use of mathematics. It is important for our students to gain experience and build up the foundation skills and knowledge in mathematics that can facilitate their future development in various aspects. It is also important that our students are able to value mathematics and appreciate the beauty of mathematics after mathematics</i></p>	<p>The curriculum document outlines a set of beliefs/philosophical statements that are called <i>Guiding Philosophy (problem solving, communicating, reasoning and proof, making connections and representations)</i> and <i>Guiding Principles</i> set around the mathematical processes and the <i>teaching, learning, technology, equity and assessment</i> of mathematics.</p> <p>Information in the curriculum document is very detailed - the extract above is an illustrative example only.</p>	<p><i>This curriculum framework envisions all students in the Commonwealth achieving mathematical competence through a strong mathematics program that emphasizes problem solving, communicating, reasoning and proof, making connections, and using representations. Acquiring such competence depends in large part on a clear, comprehensive, coherent, and developmentally appropriate set of standards to guide curriculum expectations.</i></p>

	England NC (1999)	England (2007)	Flemish Belgium 2004	Finland 2010	Hong Kong 2000/1999	Massachusetts 2000; 2004 addendum	Singapore 2001
	<p><i>boundaries and its importance is universally recognised.</i></p> <p><i>Mathematics is a creative discipline. It can stimulate moments of pleasure and wonder when a pupil solves a problem for the first time, discovers a more elegant solution to that problem, or suddenly sees hidden connections.</i></p>			<p><i>create a lasting foundation for the assimilation of mathematical concepts and structures. The discipline's concrete nature serves as an important aid in bringing together the pupil's experiences and systems of thought with the abstract system of mathematics. Problems that come up in day-to-day situations, and that can be resolved with the aid of mathematical thinking or operations, are to be utilized effectively. Information and communication technology are to be used to support the pupil's learning progress.</i></p>	<p><i>education in school. In the information explosion era, there are drastic changes both in our society and in the background of our students. It is vital that the curriculum should undergo continuous review and renewal in order to meet the needs of our students and the community.</i></p>		

Table B2: Sub-Domain: Mathematical processes

Sub-domain definition	England (1999)	England (2007) Y7 – Y11	Hong Kong (Primary 2000; Sec 1999)	Singapore (2001)	Flemish Belgium (2010)	Finland (2004)	Massachusetts (2000; 2004 addendum)
<p><i>*Problem solving is a separate and discrete activity and central to all mathematics curricula.</i></p> <p><i>*The Singaporean curriculum is the most explicit in placing problem-solving at the centre of mathematical learning</i></p> <p><i>*The ability to apply mathematical processes to solve problems in mathematical and everyday contexts was a particular feature in Hong Kong, Finland and Mass</i></p>	<p>Medium specificity</p> <p>Each Key Stage specifies an increasing level of mathematical process under the following three headings: Problem solving; Communicating; and Reasoning.</p> <p><i>Problem solving is also defined as one of a number of over-arching key skills: selecting and using methods and techniques; developing strategic thinking; and reflecting on whether the approach taken to a problem was appropriate.</i></p>	<p>High specificity</p> <p>Each Key Stage specifies an increasing level of mathematical process under the following headings: Representing; Analysing; Use appropriate mathematical procedures; Interpreting and evaluating; and Communicating and reflecting.</p>	<p>Medium to High specificity</p> <p>In the curriculum, fundamental and intertwining ways of learning and using knowledge such as inquiring; communicating; reasoning; conceptualizing; and problem-solving are considered Important.</p> <p>Mathematical processes are to be used to formulate and solve problems in daily life as well as in mathematical contexts.</p>	<p>High specificity</p> <p>The Framework of the Mathematics Curriculum for both primary and secondary places mathematical problem-solving at the centre of the mathematics curriculum involving five separate domains: Concepts; Skills; Attitudes; Processes and Metacognition.</p> <p>Concepts cover: Numerical; Algebraic; Geometrical; Statistical; Probabilistic; and Analytical.</p> <p>Skills cover: Numerical; calculation; Algebraic manipulation; Spatial visualisation; Data analysis; Measurement; Use of mathematical tools; and Estimation.</p>	<p>Medium specificity</p> <p>The specific final objectives for mathematics relate to knowledge, insights, skills and attitudes which pupils use to:</p> <p>-link mathematics and practical applications from everyday life and in doing so relate problems from society, science and technology;</p> <p>-link items within mathematics and in doing so structure their mathematical frame of reference more systematically;</p> <p>-develop a mathematical way of thinking and reasoning, closed and open problems mathematically, analyse them, and argue and discuss</p>	<p>Medium to High specificity</p> <p>The instruction is to develop the pupil's creative and precise thinking, and guide the pupil in finding and formulating problems, and in seeking solutions to them.</p> <p>Problems that come up in day-to-day situations, and that can be resolved with the aid of mathematical thinking or operations, are to be utilized effectively.</p>	<p>Medium to High specificity</p> <p>This curriculum framework envisions all students in the Commonwealth achieving mathematical competence through a strong mathematics program that emphasizes problem solving, communicating, reasoning and proof- making connections, and using representations.</p> <p>To become good problem solvers, students need many opportunities to formulate questions, model problem situations in a variety of ways, generalize mathematical relationships, and solve problems in both mathematical and everyday contexts.</p>

Sub-domain definition	England (1999)	England (2007) Y7 – Y11	Hong Kong (Primary 2000; Sec 1999)	Singapore (2001)	Flemish Belgium (2010)	Finland (2004)	Massachusetts (2000; 2004 addendum)
				<p>Attitudes cover: Beliefs; Interests; Appreciation; Confidence; and Perseverance.</p> <p>Mathematical processes cover: Reasoning; Communication and connections; thinking skills and heuristics; and application and modelling.</p> <p>Meta cognition covers: Monitoring of one's own thinking; and Self- regulation of learning.</p>	<p>solutions; and</p> <p>-communicate about mathematically described situations, including the fluent use of a more specific mathematical language.</p>		

Table B3: Sub-Domain: Whole numbers and four operations

Sub-domain definition	England (1999)	Hong Kong (2000)	Singapore (2001)	Flemish Belgium (2010)	Finland (2004)	Massachusetts (2000; 2004 addendum)
<p>Addition and subtraction</p> <p>Introduction: concept with simple calculations</p> <p><i>*High commonality of content across all curricula.</i></p> <p><i>*Conceptual development, mental recall and written methods separately articulated</i></p>	<p>Covered in Y1-2</p> <p>High specificity</p> <p>The topic is broken down significantly with detailed specification and exemplification, which clearly articulates the level of challenge:</p> <ul style="list-style-type: none"> • conceptual development (e.g. the relationship between both operations) • mental recall (addition and subtraction facts to 10 and use of knowledge to derive facts with totals to 20) • mental methods to derive unknown facts from known facts (addition of 10 to any single-digit number; then addition and subtraction of a multiple of 10 to or from a two-digit number) • <u>use of signs</u> (for recording number sentences accurately) • solving problems <p>Progression is less</p>	<p>Covered in Y2</p> <p>Medium- high specificity</p> <p>Specifies requirements for the Year which clearly defines progression, and breaks down key elements to define challenge. The following are covered:</p> <ul style="list-style-type: none"> • Conceptual development • Mental arithmetic (addition and subtraction within 18) • Written methods (horizontal method with 2 digits) • Problem-solving 	<p>Covered in Y2</p> <p>Medium - high specificity</p> <p>Specifies requirements for a Year which clearly defines progression.</p> <p>Challenge is also clearly defined by specifying addition and subtraction of numbers to 100 and by noting the inclusion of signs, but exclusion of the formal algorithm.</p> <p>Topic is further broken down to specify its key elements which further articulates challenge, including:</p> <ul style="list-style-type: none"> • Conceptual: the relationship between the two operations • Mental recall: number facts - 9+9 number bonds • mental methods: with 1s and 10s • written methods: with 1s, 10s and 2-digit by 2-digits 	<p>Standard expected by end of Y7</p> <p>Low-medium specificity</p> <p>Primary is one key stage with content defined as end of primary outcomes.</p> <p>Early conceptual development is not specified. This topic area is broken down to some extent to define breadth and challenge.</p> <p>Mental recall and arithmetic is distinguished:</p> <ul style="list-style-type: none"> • recall of addition/ subtractions up to 10 • mental arithmetic of addition/ subtraction up to 100 and other large numbers ending in zero • Written methods: addition with a maximum of 5 figures: the sum < 10,000,000; subtracted number <10,000,000 and a maximum of 8 figures 	<p>Covered in Y 3-4</p> <p>Low specificity</p> <p>Introduction to mathematical concepts and basic calculations related to:</p> <ul style="list-style-type: none"> • Addition and subtraction and connections (natural numbers) • Algorithms and mental calculations <p>But these are not specified explicitly. Rather they are implicit in high level statements at this stage.</p>	<p>Covered in Y2-3</p> <p>Medium specificity</p> <p>Specifies requirements for a two Year key stage.</p> <p>Topic is broken down and exemplified to articulate key elements that define level of challenge.</p> <p>The sequence of statements implies a progression:</p> <ul style="list-style-type: none"> • Conceptual development (various meanings of addition/ subtraction – e.g. repeated addition; subtraction as separation; inverse relationship) • Mental recall: addition and related subtraction facts (addends to ten) facts • problem-solving

Sub-domain definition	England (1999)	Hong Kong (2000)	Singapore (2001)	Flemish Belgium (2010)	Finland (2004)	Massachusetts (2000; 2004 addendum)
	<p>clearly defined in programme of study for early primary as the content is set out as a key stage.</p> <p>Supporting attainment target level descriptors (ATs) provide a clearer indication of the expected progression.</p>		<ul style="list-style-type: none"> • problem-solving <p>Some exemplification is also provided, but is limited.</p> <p>Statements are more precise, fewer in number and less descriptive than the England 1999 Programme of Study.</p>			
<p>Addition and subtraction</p> <p>Further development of addition and subtraction – conceptual understanding, recall of facts, written and mental methods</p> <p><i>* Differences emerging in the identification of challenge in curricular using key stages and those setting content out on a Year basis</i></p> <p><i>*Hong Kong, Singapore and Massachusetts articulated on a Year basis setting out in more detail individual</i></p>	<p>Covered in Years 3-6</p> <p>Medium-high specificity</p> <p>The programme of study clearly defines the level of challenge of key elements to be covered by the end of primary for key stage 2:</p> <ul style="list-style-type: none"> • <u>mental recall</u> (addition and subtraction facts for each number to 20; addition and subtraction of positive integers less than 1000, then up to 10,000) • <u>mental methods</u> to derive unknown facts (addition of two-digit numbers to make 100, then addition or 	<p>Covered in Y 3&4</p> <p>Medium - high specificity</p> <p>Clearly articulates challenge by specifying on a Year basis and describing elements/ steps to be covered.</p> <ul style="list-style-type: none"> • Year 3 – within 3 digits • Year 4 - within 4 places 	<p>Covered in Y3</p> <p>Medium - high specificity</p> <p>Clearly articulates challenge by specifying on a Year basis and describing elements/ steps to be covered.</p> <p>For Year 3, limits of challenge are defined as addition and subtraction of <u>numbers up to 3 digits</u> with formal algorithm. Further detail is included to distinguish mental arithmetic requirements of 3 digits by 1s, 10s and 100s.</p> <p>For Year 4, limits of</p>	<p>Standard expected by end of Y7</p> <p>As above</p>	<p>Covered in Y 3&4 and 8-11</p> <p>Low specificity</p> <p>See above for Year 3-4</p> <p>Year 8-11 indicates a strengthening of calculation skills but no further specification.</p>	<p>Covered in Y 2-3 & 4</p> <p>Medium specificity</p> <p>Clearly articulates expectations by generally specifying on a Year basis and breaking down requirements.</p> <p>Specification of mental recall addition and subtraction is limited :</p> <ul style="list-style-type: none"> • Year 2-3: Addition and subtract up to four-digit numbers – <u>conventional algorithm not required</u> • Year 4: addition of two 3-digit numbers and three 2-digit numbers; subtraction

Sub-domain definition	England (1999)	Hong Kong (2000)	Singapore (2001)	Flemish Belgium (2010)	Finland (2004)	Massachusetts (2000; 2004 addendum)
<p><i>steps to be covered.</i></p> <p><i>Low specificity articulated in Finland and Flemish Belgium with outcomes specified at the end of key stage.</i></p>	<p>subtraction of any pair of two-digit whole numbers; handle particular cases of three-digit and four-digit additions and subtractions by using compensation or other methods)</p> <ul style="list-style-type: none"> • <u>written methods</u> (addition and subtraction of positive integers less than 1000, then up to 10000 <p>KS2 is a large key stage (4 Years). Therefore, for middle to upper secondary, progression is less clear in the programme of study. However, ATs indicate a clearer progression:</p> <ul style="list-style-type: none"> • Level 3 AT: 'add and subtract numbers with two digits mentally and numbers with three digits using written methods' Level 4 AT: 'use efficient written methods of addition and subtraction' (number of digits to include in calculations not specified) 		<p>challenge are defined as addition and subtraction of <u>numbers up to 4 digits</u> with formal algorithm. Further detail included to distinguish mental arithmetic requirements of calculations with 2 digits.</p>			<p>of two 3-digit numbers – ability to use algorithm</p>

Sub-domain definition	England (1999)	Hong Kong (2000)	Singapore (2001)	Flemish Belgium (2010)	Finland (2004)	Massachusetts (2000; 2004 addendum)
<p>Multiplication and division Introduction: concept and simple calculations</p> <p><i>* Differences emerging in the identification of challenge in curricular using key stages and those setting content out on a Year basis</i></p> <p><i>*Hong Kong and Singapore articulated on a Year basis setting out in more detail individual steps to be covered.</i></p> <p><i>*Low specificity articulated in Finland and Flemish.Belgium with outcomes specified at the end of key stage.</i></p>	<p>Covered in Y1-2; and Y3-6</p> <p>High specificity</p> <p>Requirements to develop conceptual understanding and basic methods of division and multiplication are very descriptive.</p> <p>For KS1:</p> <ul style="list-style-type: none"> • Conceptual development (e.g. specifies the relationship between halving and doubling; multiplication as repeated addition; division as grouping/ repeated subtraction) • mental recall (recall of multiplication facts for the x2 and x10... and 'corresponding division facts') • use of signs (for <u>recording</u> number sentences accurately) but no written methods included at this level in programme of study • solving problems <p>Early primary KS1 is</p>	<p>Covered in Y 3</p> <p>Medium specificity</p> <p>Articulates challenge by specifying content on Year basis and stating concept of multiplication and division. Content statements are very concise with no exemplification. Statements cover the following:</p> <ul style="list-style-type: none"> • develop conceptual understanding (specifies sharing and grouping for division; commutative property of multiplication; relationship between two operations) • Perform basic calculations (specifies with remainders for division) 	<p>Covered in Y 2</p> <p>Medium - high specificity</p> <p>Articulates challenge by specifying content on Year basis and describing elements/ steps to be covered.</p> <p>For <u>multiplication</u>, level of challenge defined as products no greater than 40. Breaks down topic in more detail, to highlight other essential elements, including meaning of multiplication as repeated addition, simple calculations, and solving problems involving pictorial representations.</p> <p>For <u>division</u>, level of challenge defined as division of numbers not greater than 20 (excluding division sign). Delivery of topic is indicated by specifying division in context of quantities/ objects only.</p>	<p>Not specified</p> <p>Introduction of concept and basic calculations not specified explicitly. But they are implicit in specification described in rows below.</p>	<p>Covered in Y 3-4</p> <p>Low specificity</p> <p>Introduction to concept and basic calculations not specified explicitly, but implicit in high level statements related to multiplication and division so introduction implicit at this stage.</p>	<p>Covered in Y 3</p> <p>Medium specificity</p> <p>Specifies requirements for a two Year key stage. But topic is broken down and exemplification included to articulate key elements, which clearly define level of challenge. Also, sequence of statements implies a progression:</p> <ul style="list-style-type: none"> • Meaning of operations • Basic calculations

Sub-domain definition	England (1999)	Hong Kong (2000)	Singapore (2001)	Flemish Belgium (2010)	Finland (2004)	Massachusetts (2000; 2004 addendum)
	defined as a key stage. Therefore, progression is less clear. However, attainment targets provide greater indication of the progression.					

Table B4: Sub-Domain: Whole number - multiplication and division

Sub-domain definition	England (1999 - 2007 not applicable)	Hong Kong (2000)	Singapore (2001)	Flemish Belgium (2010)	Finland (2004)	Massachusetts (2000; 2004 addendum)
	Year 3-6	Year 3	Year 3; 4	Year 7	Year 5-7	Year 4; 5
<p>Multiplication and division of whole number Times tables and related division facts</p> <p><i>* No nations include times tables greater than 10. Where distinguishable on a Year basis, majority cover in Year 4. The remainder, on a key stage basis, cover by end of primary</i></p>	<p>Medium specificity</p> <p>The programme of study clearly defines the level of challenge to be taught in:</p> <ul style="list-style-type: none"> • Early primary: <u>x2 and x10</u> times tables and related division facts • By end of primary: recall of <u>10 x 10</u> times tables and related division facts <p>The programme of study indicates some progression by phasing the challenge over two key stages. However, the progression is more clearly described in the ATs as the challenge is broken down further into more stages (eg. L3 ATs: 'mental recall of the 2, 3, 4, 5 and 10 multiplication tables and derive the associated division facts').</p>	<p>Medium</p> <p>Defined for a Year. Challenge clearly defined ('Construct multiplication tables to 10'), but sub-domain not broken down further as done in other nations' curriculum.</p>	<p>Medium - high specificity</p> <p>Defined for a Year and breaks down topic area into two levels of challenge over two Years so clearly articulates progression.</p> <ul style="list-style-type: none"> • Year 3 includes times tables and related division facts for 2,3, 4, 5 and 10 (introduces division sign but excludes division with remainders) • Year 4 specifies requirement to memorise all tables to <u>10 x 10</u> and related division facts. 	<p>Medium specificity</p> <p>Challenge at the end of primary is clear (up to 10 x 10) but progression within the key stage is not specified.</p>	<p>Low - Medium specificity</p> <p>Defined for a three Year key stage. 'Multiplication times tables' explicitly specified, but not explicit to number of times tables (i.e. whether 10 x 10 or 12 x 12)</p>	<p>Medium specificity</p> <p>Defined explicitly for a Year. Challenge of sub-domain divided over two Years:</p> <ul style="list-style-type: none"> • Year 4: <u>10 x 10</u> • Year 5: <u>12 x 12</u> <p>Sub-domain not broken down further in earlier Years as in England and Singapore.</p>

Multiplication and division (by one-digit multiplier or divisor)	Year 3-6	Year 4	Year 4 (multiplication); Year 5 (division)	By Year 7 (Implicit)	Year 3-4 and/or 5-7 (implicit)	Year 4-5
	<p>Medium specificity</p> <p>Defined for key stage only, but further information in ATs. Challenge and progression are clear, if in places implicit:</p> <ul style="list-style-type: none"> KS2: 'use written methods for short multiplication and division by a single-digit integer of two-digit <u>then</u> three-digit then four-digit integers' 	<p>Medium - High specificity</p> <p>Defined for a Year. Challenge and progression are clearly defined, in particular by breaking down sub-domain (see previous and next row) and defining on a Year basis:</p> <ul style="list-style-type: none"> Division and multiplication of 2 or 3 digits by 1 	<p>Medium - High specificity</p> <p>Defined for a Year. Challenge and progression are clearly defined, in particular by defining on a Year basis:</p> <ul style="list-style-type: none"> Year 4: Multiplication and division up to 3 by 1 Year 5: Division of numbers up to 4 digits by a 1 digit whole number and by 10 	<p>Low specificity</p> <p>Not explicit, but implicit in statement for end of primary expectations:</p> <ul style="list-style-type: none"> 'multiplier consists of a maximum of three figures'; 'division: the divider consists of a maximum of 3 figures' 	<p>Low specificity</p> <p><i>Not specified explicitly. Implicit in high level statement encompassing multiplication in general ('multiplication' and 'Algorithms and mental calculations') in both grade stages (Year 3-4 and Year 5-7). Therefore, it is assumed this is covered in mid-late primary.</i></p>	<p>High-Medium specificity</p> <p>Defined for a Year and challenge explicitly defined by stating:</p> <ul style="list-style-type: none"> Year 4: Up to 2 digit by 1 digit numbers Year 5: Up to 3 by 1 (with or without remainders) <p>Progression clear by requirements stated in following Year (see row below)</p>
Long multiplication (up to 3 digits by a 2 digit number) <i>*Broadly same sequencing but no nations specify term 'long' multiplication and division. Specificity only goes as far as specifying number of digits in respective calculations</i>	Year 2-6	Year 5	Year 5	Year 7	Year 5-7 (implicit)	Year 5
	<p>Medium specificity</p> <p>Defined for key stage only, but further information in ATs. Challenge and progression are clear, if in places implicit:</p> <ul style="list-style-type: none"> 'use long multiplication, at first for two-digit integer calculations, then for three-digit by two-digit calculations' <p>To note, no explicit</p>	<p>Medium-high specificity</p> <p>Defined on a Year basis. Challenge and progression is clearly presented (see previous row):</p> <ul style="list-style-type: none"> 'perform multiplication with multiplied 2 digits and multiples of 3' <p>To note, no explicit mention of use of formal algorithm.</p>	<p>Medium-high specificity</p> <p>Defined on a Year basis. Challenge and progression is clearly presented (see previous row):</p> <ul style="list-style-type: none"> 'multiply numbers up to 3 digits by a 2 digit number' and '4 by 1' <p>To note, no explicit mention of use of formal algorithm.</p>	<p>Low-medium specificity</p> <p>Defined for end of primary only. Challenge is clear but progression is not explicit:</p> <ul style="list-style-type: none"> 'multiplier consists of a maximum of three figures' 	<p>Low specificity</p> <p><i>Not specified explicitly. Implicit in high level statement encompassing multiplication in general ('multiplication'). Therefore, challenge is not clear (multiplier not defined). 'Algorithms and mental calculations' are also stated to cover generally across operations.</i></p> <p><i>Assumed it is covered</i></p>	<p>Medium-high specificity</p> <p>Defined for a Year. Challenge and progression is clearly presented (see previous row):</p> <ul style="list-style-type: none"> Up to 3 digits by 2 digits (conventional algorithms also included for multiplication at this grade)

	mention of use of formal algorithm but instead states 'an efficient written method'.				<i>at this stage of education as Year 3-4 introduces multiplication and includes times tables and this is generally the next sub-domain progression. Also, Year 8-11 suggests basic multiplication methods have been taught and secondary is used to consolidate and strengthen multiplication skills (Year 8-11: 'strengthen calculation skills').</i>	
Long division (Dividends up to three digits and divisors up to two digits) <i>*Broadly same sequencing but content requirements vary slightly in relation to number of digits specified</i>	Year 3-6	Year 5	Year 6	Year 7	Year 5-7 (implicit)]	Not specified
	Medium specificity 'Extend division to informal methods of dividing by a two-digit divisor'. No explicit mention of algorithm.	Medium –high specificity Defined on a Year basis. Challenge and progression is clearly presented: <ul style="list-style-type: none"> 'perform division with divisor 2 digits and dividend 3 digits No explicit mention of use of formal algorithm.	Medium - high specificity Defined on a Year basis. Challenge and progression is clearly presented: <ul style="list-style-type: none"> 'Division of numbers up to 4 digits by a 2 digit whole number' No explicit mention of use of formal algorithm.	Low-medium specificity Defined for end of primary only. Challenge is clear, but progression is not explicit: <ul style="list-style-type: none"> 'division: the divider consists of a maximum of 3 figures' No explicit mention of algorithm.	Low specificity <i>Same as above – this is not specified explicitly. Therefore, level of challenge is not clear.</i> 'Divisibility' and 'algorithms and mental calculations' are stated and so it is assumed this sub-domain is implicit within these statements.	N/A There is no explicit requirement for division greater than 3 digits by 1 (with or without remainders not included). To note, in Year 5-6 division required for fractions and decimals. Use of conventional algorithm only stated in relation to addition, subtraction and multiplication.

Table B5: Sub-Domain: Fractions

Sub-domain definition	England (1999)	England (2007)	Hong Kong (Primary 2000; Sec 1999)	Singapore (2001; 2007 where stated)	Flemish Belgium (2010)	Finland (2004)	Massachusetts (2000; 2004 addendum)
FRACTIONS: Addition & subtraction - like denominators <i>*UK introduce in secondary, while Hong Kong, Singapore, Flemish Belgium, Finland introduce in primary (NB. F. Belgium and Finland end of primary equivalent to Year 7). Worth noting, Singapore (2007) breaks down challenge into 3 levels which enables aspects of this topic to be covered much earlier than other nations (Year 3 and 4). Singapore generally aims to define the building blocks within a topic.</i>	Year 7-9 Medium specificity	Year 7-9 Medium specificity	Year 5 Medium specificity	Year 3, 4 & 5 High specificity	Year 7; 8-9 Low specificity	Year 5-7 Low specificity	Year 5 & 6 High specificity
	Challenge defined by stating 'like denominators', but topic not broken down further or defined on Year basis.	Associated level (6) of attainment indicated. Challenge defined by stating of 'like denominators', but topic not broken down further or defined on Year basis.	Defined for a Year rather than key stage, which suggests associated level. Challenge of fractions defined by stating 'like denominators', but topic not broken down further. Also specifies requirement to simplify fractions.	Defined for a Year rather than key stage which suggests associated level. Topic broken down to define 3 levels of challenge at different Years. Covered in Year 3 at a very basic level (fractions within one whole); greater challenge in Year 4 (related fractions within one whole); and further in Year 5 (like fractions and related fractions).	Expectation in primary is defined in terms of 'add and subtract simple fractions'. Expected outcome is for end of primary rather than at a Year or smaller key stage basis so associated level is less prescriptive. Also, types of fractions (e.g. 'like denominators') or exemplification are not included so 'simple fractions' is not quantified. By Year 9 (sec 1) – <u>high-level</u> statement covers all calculations with all four operations with 'rational numbers'.	No distinction made between types of fractions i.e. 'fractions with like denominators' not specified. Instead statement encompasses all fractions and is defined for a key stage and not a Year level.	Defined for a Year rather than key stage, which suggests associated level. Topic broken down to define 2 levels of challenge at different Years. Simplification of answer also specified within limits. Year 5 introduces at basic level (using 'common fractions' in practical context with concrete objects); Year 6 is more challenging and goes beyond fractions with like denominators (all positive fractions, including mixed numbers and simplification of answer).

Sub-domain definition	England (1999)	England (2007)	Hong Kong (Primary 2000; Sec 1999)	Singapore (2001; 2007 where stated)	Flemish Belgium (2010)	Finland (2004)	Massachusetts (2000; 2004 addendum)
FRACTIONS: Addition and subtraction – unlike denominators <i>*Only specified in Hong Kong, Singapore, and Massachusetts which introduce towards the end of primary. Other nations do not make a distinction between different types of fractions (ie. fractions with like and unlike denominators). However, implicitly Finland appears to include in primary, while England and Flemish Belgium cover in early secondary.</i>	Year 7-9	Year 7-9	Year 6	Year 5 & 6	Year 8-9	Year 5-7	Year 6
	Low specificity Not specified explicitly	Low specificity Not specified explicitly	High specificity Prescribed for a Year. Limits of challenge well defined – defines basic level by stating ‘simple’ fractions not exceeding denominators of 12, and for sums with not more than two operations. Problem-solving also included.	High specificity Prescribed for a Year. Topic broken down to define 2 levels of challenge over different Years. Limits of challenge well defined - Year 5 basic level (related denominators); and Year 6 is more challenging (‘denominators not exceeding 12’).	Low specificity <i>Same as above.</i> Assumed covered in secondary as ‘simple fractions’ in primary suggests a lower level of challenge that this sub-domain.	Low specificity <i>Same as above –</i> challenge not defined in terms of types of fractions (e.g. unlike denominators) or at a Year level.	High specificity Prescribed for a Year. Limits of challenge well defined (positive and mixed fractions with common related denominators). Simplification of answer also specified within limits.
FRACTIONS: Addition & subtraction – mixed numbers <i>*Not specified explicitly in the majority of nations, with the exception of Singapore.</i>	Year 7-9	Year 7-9	Year 6	Year 6	Year 8-9	Year 5-7	Year 6
	Low specificity Mixed numbers not specified explicitly but implicit in statements in KS3.	Low specificity Mixed numbers not specified explicitly but implicit in statements in KS3.	Low specificity Mixed numbers not specified explicitly but implicit in statements in Year 6.	High specificity Prescribed for a Year. Limits of challenge well defined – (Denominators of given fractions	Low specificity <i>Same as above.</i> Assumed covered in secondary as ‘simple fractions’; in primary suggests a lower	Low specificity <i>Same as above.</i>	High specificity <i>Same as above.</i>

Sub-domain definition	England (1999)	England (2007)	Hong Kong (Primary 2000; Sec 1999)	Singapore (2001; 2007 where stated)	Flemish Belgium (2010)	Finland (2004)	Massachusetts (2000; 2004 addendum)
<i>Arguably, it is implicit in the majority in Hong Kong at the end of primary and not in England, Finland and Massachusetts until early secondary</i>				should not exceed 12; Exclude calculations involving more than 2 different denominators).	level of challenge than this sub-domain.		
FRACTIONS: Multiplication <i>*Included in all nations at end of primary, except England (and Flemish Belgium). However, the level to which the topic is introduced varies – e.g. Finland and Flemish Belgium only introduce multiplication of fractions with whole numbers, while Hong Kong covers more challenging content in primary. Singapore goes even further, but the most challenging content is to be taught with the use of calculators.</i>	Year 7-9 Medium – high specificity Not defined for a Year but specific about steps to cover within sub-topic (multiply by an integer, unit fraction and general fraction)	Year 7-9 Low specificity Not explicit, but implicit in high level statements about calculations with number in KS3.	Year 6 Medium-high specificity Prescribed for a Year. Limits of challenge well defined – sums involving at most two operations and includes simple problems.	Year 5 & 6 High specificity Topic broken down to define 3 levels of challenge at different Years. In 2007 curriculum nuances in relation to calculators are also specified. Covered in Year 5 at basic level (proper/ improper fraction and a whole number); greater challenge in Year 6 (proper fractions and a proper/ improper fraction; and <u>with calculators</u> - improper fraction and an improper fraction/ mixed number and a whole).	Year 7 Medium specificity Defined explicitly within limits to reflect a basic level (simple fractions with whole numbers). But defined as an outcome of a large key stage rather than at a Year level.	Year 5-7; 8-11 Medium specificity Two levels of challenge defined over two key stages. Basic level in Year 5-7 (with whole numbers) and full breadth of challenge in Year 8-11 (fractions with fractions). Topic defined for a key stage rather than for a Year.	Year 6 & 7 High specificity Prescribed for a Year. Topic broken down into 2 levels at different Years and limits of challenge well defined. Simple level in Year 6 (positive fractions with whole numbers, simplification and problem solving); more challenging in Year 7 (positive fractions, mixed numbers and simplification).

Sub-domain definition	England (1999)	England (2007)	Hong Kong (Primary 2000; Sec 1999)	Singapore (2001; 2007 where stated)	Flemish Belgium (2010)	Finland (2004)	Massachusetts (2000; 2004 addendum)
FRACTIONS: Division <i>* even split among nations: Hong Kong, Singapore and Finland introduce at the end of primary but the latter two nations limit challenge to division of fractions by integers and then cover the remainder of this topic in secondary. In contrast, F. Belgium, Massachusetts and England do not introduce until lower secondary.</i>	Year 7-9	Not specified	Year 6	Year 6 & 8	Year 8-9	Year 5-7; 8-11	Year 7
	Medium-high specificity Not defined for a Year, but specific about steps to cover within sub-topic (divide by an integer, unit fraction and general fraction).	Low specificity Not explicit, but implicit in high level statements about calculations with number in KS3.	Medium specificity Prescribed for a Year. Steps within sub-topic not broken down, but challenge limited to sums involving at most two operations. Problem-solving also included.	Medium specificity Prescribed for a Year. Challenge limited in Year 6 (to division by a whole number sums involving at most two operations and excluding more than 2 different denominators). Further challenge for division with fractions is implicit in high level statements about calculations with number in Year 8.	Low specificity Not defined for a Year and not specific about steps to cover within a sub-topic.	Medium specificity Not defined for a Year, but steps within sub-topic broken down over two key stages (Year 5-7 divide by natural numbers; Year 8-11 by fractions).	Medium specificity Prescribed for a Year. Challenge defined by limiting to division with positive fractions and mixed numbers. Sub-topic not broken down further. Simplification requirement also made explicit.

Table B6: Sub-Domain: Algebra and introduction to calculus

TOPIC	England (1999)	England (2007)	Hong Kong (Primary 2000; Sec 1999)	Singapore (2001)	Flemish Belgium (2010)	Finland (2004)	Massachusetts (2000; 2004 addendum)
Introduction of algebraic symbols <i>*The majority of nations introduce letters/symbols in primary, including: England, Hong Kong, Finland and Massachusetts. However, all nations seem to restrict use to represent missing numbers in primary. Singapore and Flemish Belgium do not include until lower secondary.</i>	KS2 & KS3	See 1999	Year 6	Year 7	Year 8-9	Year 5-7	Year 6
	High specificity Not defined for a Year, but breaks down topic into two steps of challenge: KS2 in formulaic context only; KS3 different roles of symbols with exemplification.	N/A	Medium-high specificity Defined for a Year and explicit about introduction of elementary algebra through use of algebraic symbols to represent numbers, including in sentences. Exemplification provided. No mention of breadth of roles of symbols.	Medium specificity Defined for a Year and explicit about application (to represent generalisations and unknowns). No mention of breadth of roles of symbols.	Medium specificity Defined for a Year and explicit about use (to represent unknowns and generalisations). No mention of breadth of roles of symbols.	Low specificity No explicit reference to introduction of symbols/letters and not defined for a Year. Implicit within requirement to teach concept of algebraic expressions.	Medium -high specificity Defined for a Year. Roles of symbols is not referenced, but explicit about how to use (to replace variables with given values). Includes exemplification. No mention of breadth of roles of symbols
Linear equations <i>* All nations cover in secondary (Year 7 and above) with the exception of Hong Kong and Finland which introduce at the end of primary (NB. upper primary key stage in Finland includes Year 7 so this interpretation is based on assumption that</i>	KS3	KS3	Year 6	Year 8	Year 8-9	Year 5-7	Year 8
	High specificity Not defined for a Year, but does break down topic to specify breadth and challenge (integer coefficients; negatives in equations and solution; unknowns on either or both sides). Exemplification provided.	Low - Medium specificity High level statement with some additional notes. Does not break-down topic into finer detail making progression less clear, but further detail included in level descriptors (e.g. L6 with whole number	Medium specificity Defined for a Year. Does not break down topic significantly but does define challenge to some extent (integers and one step problems only).	High specificity Defined for a Year and breaks down topic to specify breadth and challenge (one unknown, fractional coefficients, simple inequality). Includes exemplification.	Low specificity Not defined for a Year. Topic specified, but does not break-down further <i>and</i> exemplification not provided.	Low specificity Not defined for a Year. Topic not broken down or specified explicitly in terms of linearity (only stating 'equations and inequalities'). Exemplification not provided.	Medium specificity Defined for a Year, but topic not broken down significantly. Challenge defined to some extent (one or two variables). No exemplification provided.

TOPIC	England (1999)	England (2007)	Hong Kong (Primary 2000; Sec 1999)	Singapore (2001)	Flemish Belgium (2010)	Finland (2004)	Massachusetts (2000; 2004 addendum)
<i>this sub-domain is introduced by Year 6)</i>		coefficients). No exemplification.					
Quadratic equations	KS4	KS4	Year 11-12	Year 9	Year 10-11	Year 8-11	Year 8; 9; 10-11
<i>* The majority of nations introduce quadratic equations in upper secondary, with the exception of Singapore which introduces in Year 9 (KS3). Worth noting that Massachusetts introduces exploration of quadratic graphs using ICT in Year 8 but equations not taught until upper secondary</i>	Medium-High specificity Not defined for a Year, but topic broken down in detail to specify breadth and challenge explicitly. Exemplification also provided.	Low - Medium specificity Not defined for a Year. High level statement with some additional notes. Does not break-down topic into finer detail making progression less clear, but further detail included in level descriptors. No exemplification.	Medium-High specificity Not defined for a Year, but topic broken down in detail to specify breadth and challenge explicitly. Underlined content statements also included to specify 'enrichment' content for the more able students (non-compulsory).	Medium specificity Defined for a Year. Topic broken down to define key elements and challenge, but relatively parsimonious statements included. However, exemplification is provided.	Low - Medium specificity Defined for a 2 Year key stage. Sub-domain broken down to define key elements and challenge, but very parsimonious statements included that are short and concise.	Low specificity Defined for a 4 Year secondary key stage. High level statements with no description or exemplification. Challenge is defined, but breadth of sub-domain is not.	High specificity Breaks down topic into two levels of challenge over different Years/stages to articulate progression. Year 8 introduces topic through exploring in context of tables, graphs, and ICT, which continues in Year 9. Year 10-11 covers solving quadratic equations and breaks down topic to highlight range and challenge of content (factoring, completing the square, or using the quadratic formula). No exemplification provided.

Calculus <i>*Calculus is not covered in any nations pre-16. However, to note, Singapore includes in their 'additional' mathematics curriculum but this is a non-core (optional) advanced course. Interestingly Massachusetts defines aspects of pre-calculus at a high-level in a narrative overview of the algebra strand.</i>	Not covered pre-16 [Up to Year 10-11/ KS4]	Not covered pre-16 [Up to Year 10-11/ KS4]	Not covered pre-17 [Up to Year 11-12]	Not covered pre-16 [Up to Year 10-11]	Not covered pre-16 [Up to Year 10-11]	Not covered pre-16 [up to Year 10-11]	Not covered pre-16 [Up to in Year 10-11]
	N/A	N/A	N/A	* Calculus is covered in optional ' <u>Additional mathematics</u> ' curriculum in Year 10/11.	N/A	N/A	NB. Pre-calculus is indicated in narrative of curriculum to lay foundations for calculus

Table B7: Sub-Domain: Data, Statistics & Probability

TOPIC	England(1999)	England (2007)	Hong Kong (Primary 2000; Sec 1999)	Singapore (2001; 2002 & 2005)	Flemish Belgium (2010)	Finland (2004)	Massachusetts (2000; addendum 2004)
	KS2	N/A - Secondary	Year 3	Year 2	Year 9	KS1/2	KS1
<p>Introduction of data handling and statistics:</p> <p>Tables Charts Graphs Mean, Mode and Median Standard deviation Range Data sets</p> <p><i>*Introduction of data/statistics varies significantly across nations: - some include in early primary and gradually develop throughout primary & secondary (Hong Kong, Singapore, Massachusetts, UK) -others do not introduce until late primary (Mass/Finland) or late secondary (Flemish Belgium)</i></p>	<p>High specificity KS2; heading 'handling data' used throughout.</p> <p>KS2/Ma4: 'Solve problems involving data; interpret tables, lists and charts used in everyday life; construct and interpret frequency tables, including tables for grouped discrete data; represent and interpret discrete data using graphs and diagrams, including pictograms, bar charts and line graphs, then interpret a wider range of graphs and diagrams, using ICT where appropriate; know that mode is a measure of average and that range is a measure of spread, and to use both ideas to describe data sets; recognise the</p>		<p>Medium specificity Mid Primary Year 3; heading 'data handling' used throughout.</p> <p>P2: 'Compare the quantity of three or more types of objects by arranging them in lines; Read and discuss simple pictograms; construct pictograms, using a one-to-one representation'.</p>	<p>Medium specificity Early Primary: Year 2; heading 'Statistics' used throughout (in 2007 version 'data analysis'; and 'statistics and probability' used in primary and secondary respectively).</p> <p>P1: 'make picture graphs of given data; read and interpret picture graphs'.</p>	<p>Low specificity Brief intro at Sec 1 (Year 8)</p> <p>Can calculate the arithmetical average and the median (for non-grouped data) from tables containing figures and derive relevant information from them.</p>	<p>Low specificity End primary expected standard in Year 6 but first in PoS Year 2-3 (G1-2); different headings used in different sections.</p> <p>Looking for, collecting and storing data.</p> <p>Reading simple tables and diagrams.</p> <p>Presenting assembled data as a bar graph.</p> <p>G3-5 introduction to the concepts of mode and median.</p>	<p>Medium specificity Early Primary: Year 2-3; heading 'Data Analysis, Statistics, and Probability' used throughout.</p> <p>G1-2D1-3: - Use interviews, surveys, and observations to gather data about themselves and their surroundings.</p> <p>- Organize, classify, represent, and interpret data using tallies, charts, tables, bar graphs, pictographs, and Venn diagrams; interpret the representations.</p> <p>c- Formulate inferences (draw conclusions) and make educated guesses (conjectures) about a situation based on information gained from data.</p>

TOPIC	England(1999)	England (2007)	Hong Kong (Primary 2000; Sec 1999)	Singapore (2001; 2002 & 2005)	Flemish Belgium (2010)	Finland (2004)	Massachusetts (2000; addendum 2004)
	difference between discrete and continuous data'.						
	KS2 + KS3	KS3	Year 7 & 8	Year 6 + Year 9	Secondary:	Year 7	
	Medium to Low specificity	Medium to Low specificity	Low specificity	Low specificity	Medium specificity	Low specificity	
	<p>Introduces mode in KS2 Ma4/2d 'know that mode is a measure of average', but doesn't introduce mean/median until KS3 Ma4/4b 'calculate mean, range and median of small data sets with discrete then continuous data; identify the modal class for grouped data'; KS3 Ma4/4g 'find the median for large data sets and calculate an estimate of the mean for large data sets with grouped data'.</p> <p>KS3 Ma4/1a '...decide... what statistical analysis is needed'; KS3 Ma4/1c 'select and organise the appropriate mathematics and resources to use</p>	<p>Statistics:</p> <p>a) the handling data cycle</p> <p>b) presentation and analysis of grouped and ungrouped data, including time series and lines of best fit</p> <p>c) measures of central tendency and spread.</p>	<p>Year 7 (6D1/1 'find the average of a group of data') just refer to 'average'. Cover all three measures in depth in their KS3</p> <p>4.3.3/data handling/analysis and interpretation of data/1 'find mean, median and mode from a given set of ungrouped data'.</p> <p>Low specificity KS3 (Year8-10) 4.3.3/data handling/analysis and interpretation of data/6 'discuss the relative merits of different measures of central tendency for a given situation'.</p>	<p>Year 6 (P5/A1 'calculate the average'). Cover all the measures in depth in Year 9:</p> <p>Secondary 2/Statistics/1 'Averages': find mean, median and mode; distinguish between the purposes for which mean, median and mode are used; exclude grouped data'.</p>	<p>Year 9 (until Year 10/G3 sec); heading 'Statistics'</p> <p>Sec G2: 'explain the importance of the representative character of a random sample to formulate statistical conclusions about the population, with the use of examples; are critical about the use of statistics in the media; formulate, calculate and interpret frequency and relative frequency both in individual and in grouped data in concrete situations; use the terms mean, mode, median, standard deviation, in order to interpret statistical data related to a concrete situation;</p>	<p>G5 good performance description (more detail in PoS): 'data processing, statistics and probability': Know how to gather data, organise, classify and present them as statistics; they will know how to read simple tables and diagrams'.</p>	

TOPIC	England(1999)	England (2007)	Hong Kong (Primary 2000; Sec 1999)	Singapore (2001; 2002 & 2005)	Flemish Belgium (2010)	Finland (2004)	Massachusetts (2000; addendum 2004)
	for a task'.				use and interpret various graphic representations of statistical data, both as regards individual and as regards grouped data, always related to concrete situations'.		
Introduction of probability	End of Primary	N/A	Introduced in Secondary	Introduced in late Secondary	Introduced in Secondary	Introduced end of Primary	Introduced early Primary
Basic concept (e.g. via simple experiments and related vocab) <i>*the majority of high-performing systems studied, , do not include until secondary other than a brief/informal introduction at primary</i>	KS2 Ma4/2f 'draw conclusions from statistics and graphs and recognise when information is presented in a misleading way; explore doubt and certainty and develop an understanding of probability through classroom situations; discuss events using a vocabulary that includes the words 'equally likely', 'fair', 'unfair', 'certain'.					Low specificity Year 6 [including vocabulary, concept, likelihood using language only]; (G5 good performance description): 'Know how to clarify the number of events and numbers; and to judge which is an impossible or certain event'.	Year 2-3 (Exploring more likely, likely, and impossible outcomes and vocabulary) G1-2/D4: Year 4-5 (exploring situations that involve probabilities of equally likely events) G3-4/D4-6 - 'Represent the possible outcomes for a simple probability situation'. - List and count the number of possible combinations of objects from three sets.

TOPIC	England(1999)	England (2007)	Hong Kong (Primary 2000; Sec 1999)	Singapore (2001; 2002 & 2005)	Flemish Belgium (2010)	Finland (2004)	Massachusetts (2000; addendum 2004)
							-Classify outcomes as certain, likely, unlikely, or impossible by designing and conducting experiments using concrete objects such as counters, number cubes, spinners, or coins'.
Probability	<p>KS3 Medium to high specificity</p> <p>a number of developed statements are given covering simple experimental probability, equally likely outcomes and mutually exclusive events e.g.</p> <p>KS3 Ma4/5j 'understand that... increasing sample size generally leads to better estimates of probability and population characteristics.'; KS4 foundation/breadth</p>	<p>KS3 Medium specificity NC 2007</p> <p>3.3 d) Experimental and theoretical probabilities, including those based on equally likely outcomes. Include explanatory notes –</p> <p>Probabilities: This includes applying ideas of probability and risk to gambling, safety issues, and simulations using ICT to represent a probability experiment, such as rolling two dice and adding the scores.</p>	<p>High specificity</p> <p>Year 7 6D2/1 'read and discuss bar charts of large frequency counts'. Sample is introduced in the context of probability KS3.</p> <p>4.3.3/probability/5 (p27) 'calculate the theoretical probability by listing the sample space and counting'</p> <p>Year 8-10 Probability/simple idea of probability 'explore the meaning of probability through various activities; compare the empirical and</p>	<p>Medium specificity Year 10-11</p> <p>Sec 3-4: 'Calculate the probability of a single event as either a fraction or a decimal (not a ratio); calculate the probability of simple combined events, using possibility diagrams and tree diagrams where appropriate (in possibility diagrams outcomes will be represented by points on a grid and in tree diagrams outcomes will be written at the end of branches and probabilities by the</p>	<p>Low specificity Year 9 only</p> <p>G2 Sec: 'Interpret relative frequency in terms of probability'.</p> <p>Second grade (Year 10-11 I think) 51 'interpret relative frequency in terms of probability'.</p>	<p>Low specificity</p> <p>G8 Final assessment criteria (more detail/content in PoS): '<u>Statistics and probability</u>'. Read various tables and diagrams to determine frequencies, average, median, and mode from the given material.'</p> <p>Year 9 G8 Final assessment criteria (more detail in PoS): 'Determine the number of possible events and order a simple empirical investigation of probability; they</p>	<p>Low specificity Year 6 [predicting outcomes; in G6 (Year 7) 2004 specifies using 0-1 scale so assuming here as well]</p> <p>G5D3: Predict the probability of outcomes of simple experiments (e.g., tossing a coin, rolling a number cube) and test the predictions.</p> <p>Extended throughout secondary</p>

TOPIC	England(1999)	England (2007)	Hong Kong (Primary 2000; Sec 1999)	Singapore (2001; 2002 & 2005)	Flemish Belgium (2010)	Finland (2004)	Massachusetts (2000; addendum 2004)
	<p>of study/1g '[taught through] including using appropriate populations and representative samples'</p> <p>KS3 Ma4/4c, d & e 'understand and use the probability scale; understand and use estimates or measures of probability from theoretical models, including equally likely outcomes, or from relative frequency; list all outcomes for single events, and for two successive events, in a systematic way'. KS3 Ma4/4f 'identify different mutually exclusive outcomes and know that the sum of the probabilities of all these outcomes is 1'.</p>		<p>theoretical probabilities; calculate the theoretical probability by listing the sample space and counting'.</p>	<p>side of the branches)'. '.</p>		<p>will understand the meaning of probability and investigations in day-to-day life.'</p>	

Appendix C: Science Curriculum comparison tables

Table C1: High-level organisation

	England (1999)	England (2007)	Hong Kong (1998; 2002; 2007)	Singapore (2001; 2005)	Massachusetts (2006)	Alberta (1996; 2003; 2005)
<p>High level organisation of curriculum document</p> <p>Definition of curriculum statements</p> <p>Year/ grade/ stage/ levels to the English Year equivalent</p>	<p>‘Science’</p> <p><u>Statement type and Year groupings:</u></p> <p>Defines the curriculum by <i>learning outcomes</i> for each key stage:</p> <p>KS1 (Y1-2) KS2 (Y3-6) KS3 (Y7-9) KS4 (Y10-11)</p> <p><u>Typical statement stem:</u> ‘Pupils should be taught to...’</p> <p><u>Attainment:</u></p> <p>Expected levels of attainment are set out in a separate section ‘Attainment Target Level Descriptors’</p> <p><u>Organisation of content:</u></p> <p>Programme of study for Science (Knowledge, skills and understanding) is arranged into 4 key domains: -Scientific enquiry - Life processes and living things (biology)</p>	<p>‘Science’</p> <p><u>Statement type and Year groupings:</u></p> <p>Defines the curriculum by <i>learning outcomes</i> for each key stage:</p> <p>KS1 (Y1-2) KS2 (Y3-6) KS3 (Y7-9) KS4 (Y10-11)</p> <p><u>Typical statement stem:</u> ‘Pupils should be able to...’/‘The study of science should include...’</p> <p><u>Attainment:</u></p> <p>Expected levels of attainment are set out in a separate section ‘Attainment Target Level Descriptors’</p> <p><u>Organisation of content:</u></p> <p>The range and content of the programme of study for Science is arranged into 4 key domains: -Energy, electricity and forces (physics)</p>	<p>Primary – embedded within ‘General Studies’</p> <p>Y7-9 equivalent – ‘Science’</p> <p>Y10-11 equivalent – separate disciplines.</p> <p><u>Statement type and Year groupings:</u></p> <p>Defines the curriculum by <i>learning outcomes</i> on key stage basis: KS1 (Eng Y1-3) KS2 (Eng Y4-6) KS3 (Eng Y7-9) KS4 (Eng Y10-11)</p> <p><u>Typical statement stem:</u> Primary: ‘To recognise, to know etc...’ Y7-9: ‘All students should...’ Y10-11: ‘Students should learn.../Students should be able to...’</p> <p><u>Attainment:</u></p> <p>The curriculum statements serve as expected levels of attainment for each key stage. Presentation varies by key stage.</p>	<p>‘Science’</p> <p><u>Statement type and Year groupings:</u></p> <p>Defines the curriculum by <i>learning outcomes</i> specified Year by Year from P3 (Eng Y4) to Sec 2 (Eng Y9). Science is not taught before P3 (Y4). Y10-11 - separate science disciplines to O level.</p> <p><u>Typical statement stem:</u> Primary: ‘Students should be able to...’ Secondary: ‘Students are expected to...’</p> <p><u>Attainment:</u></p> <p>The curriculum statements serve as expected levels of attainment for each Year.</p> <p><u>Organisation of content:</u></p> <p>Primary-secondary Y9: Curriculum has 6</p>	<p>‘Science and technology/engineering’</p> <p><u>Statement type and Year groupings:</u></p> <p>Defines the curriculum by <i>learning outcomes</i> specified for groups of grades from PreK to high school: PreK-G2 (Eng EYFS-Y3) G3-5 (Eng Y4-6) G6-8 (Eng Y7-9) High school – one Year introductory courses to be studied in Y10 or 11 equivalent.</p> <p><u>Typical statement stem:</u> ‘Learning standard...’</p> <p><u>Attainment:</u></p> <p>The curriculum statements serve as expected levels of attainment for each block of grades.</p> <p><u>Organisation of content:</u></p>	<p>‘Science’</p> <p><u>Statement type and Year groupings:</u></p> <p>Defines the curriculum by <i>learning outcomes</i> which are specified Year-by-Year from G1 (Eng Y2) to G9 (Eng Y10). Senior high school unit Science 10 contains outcomes for first Year of senior high school (Eng Y11).</p> <p><u>Typical statement stem:</u> ‘Students will...’</p> <p><u>Expected Attainment:</u></p> <p>The curriculum statements serve as expected levels of attainment (outcomes) for each Year.</p> <p><u>Organisation of content:</u></p> <p>Primary: Content organised into topics, 5 topics to be taught in each Year. Topics introduce basic</p>

	England (1999)	England (2007)	Hong Kong (1998; 2002; 2007)	Singapore (2001; 2005)	Massachusetts (2006)	Alberta (1996; 2003; 2005)
	<p>-Materials and their properties (chemistry) -Physical processes (physics)</p> <p><i>Breadth of study.</i></p> <p>The breadth of study specifies the increasing range of activities, contexts and purposes through which pupils should be taught the knowledge, skills and understanding</p>	<p>-Chemical and material behaviour (chemistry) -Organisms, behaviour and health (biology) -The environment, Earth and universe (Earth science)</p> <p>Cross-cutting scientific processes and scientific enquiry are specified under additional domains: -Key concepts; -Key processes; -Curriculum opportunities.</p> <p>There are detailed guidance notes alongside the Programme of Study statements in the curriculum document.</p>	<p><u>Organisation of content:</u></p> <p>Varies by key stage: Primary: within General studies, two units mainly relevant, 'Health and living' (HL) and science and technology in everyday life' (STE). Y7-9: science consists of 14 topic units covering basic concepts of biology, chemistry and physics plus one unit on 'introducing science.' Scientific process and enquiry are included as objectives of the syllabus. Y10-11: organisation of content is discipline specific.</p>	<p>domains, covering all the basic concepts of biology, chemistry and physics:</p> <ul style="list-style-type: none"> • Diversity; • Cycles; • Energy; • Interactions; • (Sec Y8-9 only: Models and Systems); • (Sec Y8-9 only) Measurement <p>A seventh domain, science as an inquiry, is to be integrated into the teaching of the other 6 domains. Y10-11: organisation of content is discipline specific.</p>	<p>The learning outcomes are organised into 4 domains: -Earth and Space Science -Life Science (Biology) -Physical Sciences (Chemistry and Physics) - Technology/Engineering (not included for purposes of curriculum mapping)</p> <p>Inquiry, experimentation and design is specified as a separate section, but to be taught integrated into the substantive content of the curriculum.</p>	<p>concepts across the disciplines biology, chemistry and physics. Each topic has either a 'science inquiry' or a 'problem solving through technology' emphasis.</p> <p>G7-9 (Eng Y8-10) and 'Science 10' (Eng Y11): Curriculum structured around 4 'foundations' of science. 'Knowledge' foundation divided into 3 domains: - Life science (biology) - Physical science (chemistry and physics) - Earth and space science. Remaining 3 'foundations' cover scientific processes and inquiry: - 'science, technology and society'; - skills - attitudes</p>
Curriculum aims and principles	<p><u>Primary and secondary</u></p> <p>No specific aims for science curriculum, though science</p>	<p><u>Primary and secondary</u></p> <p>Aim of science is to contribute to achievement of 3 aims</p>	<p><u>Primary</u></p> <p>The aim of General studies STE is: 'To arouse students' curiosity and interest in</p>	<p><u>Primary</u></p> <p>Aims of science curriculum are: • Experiences that build on interest</p>	<p><u>Primary and secondary</u></p> <p>Massachusetts science, technology and engineering</p>	<p><u>Primary</u></p> <p>Purpose is 'to encourage and stimulate children's learning by nurturing</p>

	England (1999)	England (2007)	Hong Kong (1998; 2002; 2007)	Singapore (2001; 2005)	Massachusetts (2006)	Alberta (1996; 2003; 2005)
<p>Note: <i>Many statements have been paraphrased for the purpose of this document. It is necessary to view the curriculum documents to see the aims in full.</i></p>	<p>education is linked to various areas of learning across the curriculum: Promoting pupils' spiritual, moral, social and cultural development ; Promoting key skills; Promoting other aspects of the curriculum e.g. thinking skills, work-related learning.</p> <p>Importance of science specifically is: stimulates pupils excitement and curiosity about phenomena in the world; links practical experience with ideas; spur to critical and creative thought; understanding link between science and technology; recognise cultural significance of science; learn to question and discuss science-based issues.</p>	<p>of curriculum as a whole: • successful learners who enjoy learning, make progress and achieve • confident individuals who are able to live safe, healthy and fulfilling lives • responsible citizens who make a positive contribution to society.</p> <p>Importance of science specifically is: firing curiosity about the world; finding explanations; practical aspects; explanation rooted in evidence; technology; understanding development of science worldwide and its significance.</p>	<p>science and technology through hands-on and minds-on activities.'</p> <p>The aim of General studies HL is: 'To arouse students' awareness of their growth and development, as well as helping them to develop a healthy lifestyle.'</p> <p><u>Y7-9</u> Aims of curriculum include: 1. acquire basic scientific knowledge and concepts; 2. develop ability to enquire and to solve problems; 3. be acquainted with the language of science and be equipped with skills in communicating ideas in science; 4. develop curiosity and interest in science; 5. recognise usefulness and limitations of science; 6. appreciate and understand the evolutionary nature of scientific knowledge.</p>	<p>and stimulate curiosity; • Scientific concepts to help understand themselves and the world; • Opportunities to develop scientific skills, habits of mind and attitudes; • Prepare to use scientific knowledge and skills in making personal decisions; • Appreciate how science and technology influence people and environment.</p> <p><u>Secondary</u> Aims of science curriculum are: • understanding and knowledge to become confident citizens, recognise usefulness and limitations of scientific knowledge and prepare for further study; • abilities and skills (both specifically relevant for science and more widely); • attributes relevant</p>	<p>curriculum has a single statement of purpose for primary and secondary education phases: Investigations in science and technology/engineering involve a range of skills, habits of mind, and subject matter knowledge. The purpose of science and technology/engineering education in Massachusetts is to enable students to draw on these skills and habits, as well as on their subject matter knowledge, in order to participate productively in the intellectual and civic life of American society and to provide the foundation for their further education in these areas if they seek it.</p>	<p>their sense of wonderment, by developing skill and confidence in investigating their surroundings, and by building a foundation of experience and understanding upon which later learning can be based.'</p> <p><u>Y8-11</u> Goals are those for Canadian science education and include: • encourage students to develop a critical sense of wonder and curiosity • enable students to use science and technology to acquire new knowledge and solve problems, • prepare students to critically address science related societal, economic, ethical and environmental issues • provide students with a foundation that creates opportunities to pursue higher levels of study etc</p>

	England (1999)	England (2007)	Hong Kong (1998; 2002; 2007)	Singapore (2001; 2005)	Massachusetts (2006)	Alberta (1996; 2003; 2005)
			<u>Y10-11</u> Aims are discipline-specific.	to study and practice of science; <ul style="list-style-type: none"> • curiosity, interest and enjoyment in science and scientific inquiry; • awareness of co-operative nature of science and the benefits and drawbacks of scientific advance. <u>Y10-11</u> Aims are discipline-specific.		<ul style="list-style-type: none"> • enable students to develop a knowledge of the wide spectrum of related careers.

Table C2: Sub-domain: Biology

Biology	England (1999) [Double award]	England (2007) [Core award]	Hong Kong (1998; 2002; 2007)	Singapore (2001; 2005)	Massachusetts (2006)	Alberta (1996; 2003; 2005)
Classification	<p>Observable characteristics (Y1-2) Living/ non-living things (Y1-2)</p> <p>Use of keys (Y3-6) Intro to classification (Y3-6) Micro-organisms (Y3-6)</p> <p>Classification using major groups (Y7-9)</p>	<p>Classification of living things (Y7-9) Similarities and differences between species (Y10-11)</p>	<p>Observable characteristics (Y1-2) Living/ non-living (Y1-2) Classification using Five Kingdom (Y7-9)</p>	<p>Observable characteristics (Y4) Living / non-living (Y4) Classification using Five Kingdom (Y9)</p>	<p>Difference between living/ non-living things (EYFS-Y3)</p> <p>Use of keys (Y4-6) Observable characteristics (Y4-6)</p> <p>Classification using Six Kingdom (Y7-9 and Y10-11) Hierarchical taxonomic system (Y10-11)</p>	<p>Observable characteristics (Y2) Difference between living/ non-living things (Y2) Classification of common local plants and animals (Y2)</p>
Interactions and interdependencies	<p>Living things live in environments to which they are particularly suited (introduction in Y1-2 and Y3-6)</p> <p>Living things are interdependent (Y7-9) and interact with environment (Y7-9) Reasons for changes in population size (Y7-9)</p>	<p>Living things are interdependent (Y7-9) and interact with environment (Y7-9)</p>	<p>Living things live in environments to which they are particularly suited (Y1-2) How living things respond to their environment (Y7-9) Levels of organisations (Y10-11) Components of ecosystem (Y10-11) Functioning of ecosystem (Y10-11)</p>	<p>Different habitats support different communities (Y7) How living things respond to their environment (Y7) Carbon cycle (Y9)</p>	<p>Habitat provides for basic needs (EYFS-Y3)</p> <p>Living things respond to their environment and cause changes in their environment (Y4-6)</p> <p>Relationships in ecosystem (Y7-9 and Y10-11) Changes in ecosystems over time (Y7-9)</p> <p>Reasons for changes in population size and biodiversity (Y10-11) Functioning in an ecosystem (Y10-11) Cycling of water, carbon and nitrogen (Y10-11)</p>	<p>Living things live in environments to which they are particularly suited (Y2)</p> <p>Ecosystems (Y6, 7 and 8) Organisms effect, and are effected by, their environment (Y8) Energy flow in an ecosystem (Y8) Components of ecosystem (Y8)</p> <p>Habitat diversity (Y10) Niches (Y10) Relationships in ecosystem (Y10)</p> <p>Carbon and nitrogen cycles (Y11)</p>

Biology	England (1999) [Double award]	England (2007) [Core award]	Hong Kong (1998; 2002; 2007)	Singapore (2001; 2005)	Massachusetts (2006)	Alberta (1996; 2003; 2005)
Structure and function - animals including humans	<p>Body parts (Y1-2) Senses (Y1-2) Life processes (Y1-2 and 3-6) Life cycle (intro Y1-2; and main stages Y3-6)</p> <p>Internal organs (Y3-6 and Y7-9) Skeletons and muscles to support, protect and enable movement (Y3-6 and Y7-9) Gaseous exchange system (Y3-6) and its functions (Y7-9) Digestive system in humans (Y3-6) Circulatory system (Y3-6) and blood (Y10-11)</p> <p>Breathing (Y7-9 and Y10-11) Respiration (introduction to word equation Y7-9) and anaerobic respiration (Y10-11) Reproductive system and reproduction (Y7-9) Health – effects of smoking, drugs; bacteria and replication of viruses (Y7-9)</p> <p>Central nervous</p>	<p>Reproductive cycle (Y7-9)</p> <p>Impact of diet, drugs and disease (Y7-9)</p> <p>Life processes (Y7-9)</p> <p>Body's response to internal/ external changes and maintaining optimal state (Y10-11)</p> <p>Health impacts of drugs and medical treatment (Y10-11)</p>	<p>Skeletons and muscles to support, protect and enable movement (Y1-2)</p> <p>Human respiratory and circulatory systems (introduction Y1-2) Functions of gaseous exchange system in humans (Y3-6) Effects of smoking on the respiratory and other systems (7Y-9) Reproductive system and reproduction (Y7-9) Methods of birth control and sexually transmitted diseases (Y7-9) Structure and function of the eye (Y7-9) Structure and function of the ear (Y7-9) Central nervous system (Y10-11) Hormonal coordination and endocrine system (Y10-11) Homeostasis (Y10-11)</p>	<p>Life processes (Y4) Life cycles that include birth, growth, development, reproduction and death (Y4) Skeletons and muscles to support, protect and enable movement (Y4) Digestive system in humans (Y4) Gaseous exchange system (Intro Y4, Y5 Y6) Respiration (Y6) Circulatory system (Intro Y4, Y5) and heart, blood etc (Y10-11)</p> <p>Reproductive system and reproduction (Y9) Sexual and asexual reproduction (Y9) Methods of birth control and sexually transmitted diseases (Y9)</p> <p>Central nervous system (Y10-11) Hormones (Y10-11)</p>	<p>Life cycles that include birth, growth, development, reproduction and death (EYFS-Y3 and Y4-6) Senses (EYFS-Y3)</p> <p>Sexual and asexual reproduction (Y7-9) Functions of major systems (digestions, respiration, reproduction, circulation, excretion, protection from disease, movement, control and coordination) (Y7-9 and Y10-11)</p> <p>Central nervous system (Y10-11) Homeostasis (Y10-11)</p>	<p>Senses (Y2)</p> <p>Life cycles that include birth, growth, development, reproduction and death (Y4)</p> <p>Human body systems - respiration, circulation, digestion, excretion and sensory awareness (Y9) Role of organs, tissues and cells in supporting healthy functioning of human body (Y9)</p>

Biology	England (1999) [Double award]	England (2007) [Core award]	Hong Kong (1998; 2002; 2007)	Singapore (2001; 2005)	Massachusetts (2006)	Alberta (1996; 2003; 2005)
	system (Y10-11) Hormonal control (Y10-11) Homeostasis and removal of waste products (Y10-11) Immune system (Y10-11)					
Structure and function – cells	Structure and function (Y7-9 and Y10-11) Organisation of cells into tissues, organs (Y7-9) Fertilisation (Y7-9) Differences between plant and animal cells (Y10-11) Transport (diffusion, osmosis and active transport) (Y10-11) Mitosis and meiosis (Y10-11)	Organisation of cells into tissues, organs, body systems (Y7-9)	Cells – structure and function (Y7-9) Unicellular (Y7-9) Sub-cellular structure and functions (Y10-11) Cell cycle and processes (Y10-11)	Cells as building blocks (Y6) Cell structure and function (Y6 and Y9) Differences between plant and animal cells (Y8)	Cells – structure and function (Y7-9 and Y10-11) Unicellular to Multicellular (Y7-9) Differences between plant and animal cells (Y7-9) Sub-cellular structure (Y7-9) Organisation of cells into tissues and (Y7-9) and organs (Y10-11) Cell processes (growth, maintenance and reproduction) (Y10-11) Transport (diffusion, osmosis and active transport) (Y10-11) Prokaryotic and eukaryotic cells (Y10-11) Metabolism (Y10-11) Mitosis and meiosis (Y10-11)	Structure and function (Y9) Cells as basic unit of life (Y9) Unicellular to Multicellular (Y9) Difference between plant and animal cells (Y9) Diffusion and osmosis (Y9) Cell theory (Y11) Sub-cellular structure and functions (Y11) Specialisation (Y11) Transport (Y11)
Energy – animals including humans	Requirements for life (Y1-2) Importance of diet and exercise for health		Humans and other animals need food, water and air to stay alive (Y1-2)	Digestion (Y9) Energy in a food chain (Y9)	Food chains – energy transfer, interdependence (Y7-9)	Humans and other animals need food, water and air to stay alive (Y2)

Biology	England (1999) [Double award]	England (2007) [Core award]	Hong Kong (1998; 2002; 2007)	Singapore (2001; 2005)	Massachusetts (2006)	Alberta (1996; 2003; 2005)
	(Y1-2, 3-6 and 7-9) Functions of teeth (Y3-6) Digestion (Y7-9 and Y10-11) Respiration (Y7-9) Food chains – relationships (Y3-6); quantification and food webs (Y7-9)		Digestion (Y7-9)		Energy transfer (Y10-11)	Basics of a food chain (Y3)
Evolution	Adaptation to environment (Y3-6) Variation (Y7-9) Heredity (Y7-9) Causes of evolution (Y7-9) Chromosomes, genes and DNA (KS4) Causes of variation (Y10-11) Asexual and sexual reproduction (Y10-11) Sex determination (Y10-11) Inheritance and disease (Y10-11) Mutations and causes (Y10-11) Fossils as evidence of evolution (Y10-11) Variation and selection as causes of evolution/ extinction (Y10-11)	Variation (Y7-9) Adaptation to environment (Y10-11) Variation within species (Y10-11) Genes (Y10-11) Impact of inherited factors on health (Y10-11)	Adaptation to environment (Y2-6) Variation (Y10-11) Sex determination (Y10-11) Inheritance – Mendel (Y10-11)	Adaptation to environment (Y7) Heredity (Intro Y4, Y9) Variation (Y10-11) Asexual reproduction, clones (Y10-11) Sexual reproduction, genetic variation (Y10-11) Pollination (Y10-11) Sex determination (Y10-11)	Offspring resemble their parents (EYFS-Y3) Fossils as evidence of evolution (EYFS-Y3) Adaptation to environment (Y4-6) Chromosomes and genes (Y7-9) Sexual and asexual reproduction (Y7-9) Heredity (Y7-9) Extinction (Y7-9) Evidence for evolution (Y7-9 and Y10-11) Causes of evolution (Y7-9) Variation (Y7-9) DNA and inheritance (Y10-11) Mutations (Y10-11) Mendel (Y10-11) Natural selection (Y10-11)	Introduction to adaptation (Y1) Adaptation to environment (KS2) Heredity (Y10) Chromosomes, genes and DNA (Y10) Cell division (Y10) Sexual and asexual reproduction (Y10) Extinction (Y10) Causes of evolution (Y10) Variation (Y10) Natural selection (Y10)

Biology	England (1999) [Double award]	England (2007) [Core award]	Hong Kong (1998; 2002; 2007)	Singapore (2001; 2005)	Massachusetts (2006)	Alberta (1996; 2003; 2005)
Structure and function – plants	<p>Recognise parts of plant (KS1)</p> <p>Functions of different parts of plants (Y3-6 and Y7-9)</p> <p>Life cycles (birth, growth, reproduction and death) (Introduction Y1-2 and Y3-6)</p> <p>Life processes (growth, nutrition and reproduction) (Y3-6)</p> <p>Reproduction in plants (Y7-9)</p>			<p>Functions of different parts of plants (Y4)</p> <p>Life cycles (Y4)</p> <p>Reproduction (Y4)</p>	<p>The functions of the different parts of plants: leaf, flower, stem and root (Y4-6)</p> <p>Life cycles (birth, growth, reproduction and death) (EYFS-Y3, Y4-6)</p>	<p>Life processes (growth, nutrition and reproduction) (Y5)</p> <p>Life cycles (birth, growth, reproduction and death) (Y5)</p> <p>Structure and function (Y8)</p>
Energy - plants	<p>Requirements for life (Y1-2 and Y3-6)</p> <p>Transportation of nutrients, water and oxygen (Y3-6 and Y10-11)</p> <p>Respiration and word equation (Y7-9)</p> <p>Photosynthesis and word equation (Y7-9) – reactants in/ products of; how its products used; and effect of varying factors (Y10-11)</p>		<p>Requirements for life (Y3-6)</p> <p>Nutrition (Y3-6)</p> <p>Respiration and word equation (Y7-9)</p> <p>Photosynthesis (Y7-9)</p> <p>Diffusion, osmosis and transport (Y7-9)</p>	<p>Nutrition (Y4)</p> <p>Requirements for life (Y4)</p> <p>Transportation of nutrients, water and oxygen (Y5)</p> <p>Respiration (Y5, 8 and 10-11) and word equation (Y8)</p> <p>Photosynthesis (Y9 and Y10-11) and word equation (Y9)</p> <p>Diffusion, osmosis and transport (Y8)</p> <p>Effect of varying factors on rate (Y10-11)</p> <p>Materials and water transport (Y10-11)</p>	<p>Requirements for life (EYFS-Y3 and Y4-6)</p> <p>How plants use energy from sun (Y4-6)</p> <p>Transfer of energy in food chain (Y4-6)</p> <p>Photosynthesis (Y7-9) and relationship with respiration (Y10-11)</p>	<p>Requirements for life (Y1)</p> <p>Processes of diffusion, osmosis, transport photosynthesis and gas exchange (Y8)</p>

Table C3: Sub-domain: Chemistry

Chemistry	England (1999) [double award]	England (2007) [core award]	Hong Kong (1998; 2002; 2007)	Singapore (2001; 2005)	Massachusetts (2006)	Alberta (1996; 2003; 2005)
Nature of matter and energy (conservation of matter and energy; particulate nature of matter; classifying)	Atoms, molecules and elements (Y7-9) Chemical formula (Y7-9) Conservation of mass in chemical and physical change (Y7-9) Model of the atom (Y10-11) Quantitative interpretation of balanced equations (Y10-11) Conservation of energy when bonds broken/made during reactions (Y10-11)	The particle model related to behaviour of matter (Y7-9)	Atoms, molecules and elements (Y7-9) Model of the atom (Y10-11) Quantitative interpretation of balanced equations (Y10-11)	Matter is what has mass and occupies space (Y5) Atoms, molecules and elements. Chemical formula (Y8) Model of the atom introduced (Y9) Model of the atom revisited (Y10-11) Conservation of energy when bonds are broken/made during chemical reactions (Y10-11) Quantitative interpretation of balanced equations (Y10-11)	Atoms, molecules and elements (Y7-9) Conservation of mass in chemical and physical change inc. weight, mass and density (Y7-9) Model of the atom (Y10-11) Chemical formula (Y10-11) Conservation of matter and energy during physical change, in terms of kinetic molecular theory (Y10-11) Nuclear chemistry (Y10-11) Quantitative interpretation of balanced equations (Y10-11)	Atoms, molecules and elements (Y10) Model of the atom (Y11) Chemical formula (Y11) Conservation of mass in chemical change (Y10-11) Quantitative interpretation of balanced equations (Y11)
Physical change (Change of state; mixtures)	Some materials change when heated or cooled (Y1-2) Liquids, solids and gases as states of matter, including temperature and change of state of water. Mixtures, including dissolving. Substances retain their properties in	The particle model related to different physical properties and behaviour of matter (Y7-9)	Some materials change when heated or cooled (Y1-2) Distinguish between changes that can and can't be easily reversed (Y3-6) The water cycle. States of matter in terms of particles and energy transfer (Y7-9) Dissolving (Y7-9)	Water existing in three states; freezing, melting, boiling etc and the temperatures at which these happen (Y5) Interaction of water with different materials (Y5) States of matter in terms of particles and energy transfer (Y9) Solutions (Y8)	Identifying liquids, solids and gases (EYFS-Y3) Comparing liquids, solids and gases, and relating change of state to temperature (Y4-6) Mixtures (Y7-9) Distinguish between physical and chemical	Some materials change when heated or cooled (Y4) Mixtures; Dissolving; Interaction of water with different materials (Y6) Distinguish between changes that can and can't be easily reversed (Y6) States of matter in terms of particles and

Chemistry	England (1999) [double award]	England (2007) [core award]	Hong Kong (1998; 2002; 2007)	Singapore (2001; 2005)	Massachusetts (2006)	Alberta (1996; 2003; 2005)
	<p>mixtures. Ways of separating out mixtures (Y3-6)</p> <p>States of matter in terms of particles and energy transfer (Y7-9, elaborated Y10-11) Solutions. (Y7-9) More advanced methods for separating mixtures (Y7-9, elaborated Y10-11)</p> <p>Solutions (Y10-11)</p>		<p>Separation of mixtures (introduced Y9, elaborated Y10-11)</p>	<p>More advanced methods for separating mixtures (Y8)</p>	<p>change (Y10-11) States of matter in terms of particles and energy transfer (Y10-11) Solutions (Y10-11)</p>	<p>energy transfer (Y9) Fluids and solutions (Y8-9)</p>
Chemical change (Reactions; bonding; predicting;	<p>Chemical change results in formation of new materials with new properties, and it is usually more difficult to recover the original materials than in the case of mixtures (Y3-6)</p> <p>Periodic table. Rearrangement of atoms in chemical change, compounds, patterns of reaction (Y7-9) Energy transfer and chemical reaction (Y7-9) Acids and alkalis (Y7-9)</p> <p>Different types of chemical reaction: combustion, thermal</p>	<p>Elements and atoms combine in chemical reactions to form compounds (Y7-9) Elements and compounds show characteristic chemical properties and patterns in their behaviour (Y7-9)</p> <p>Chemical change takes place by rearrangement of atoms in substances (Y10-11) Patterns in the chemical reactions between substances (Y10-11)</p>	<p>Acids and alkalis (Y7-9) Burning and oxygen (Y7-9) neutralisation (Y7-9)</p> <p>Different types of chemical reaction: combustion, thermal decomposition, oxidation and neutralisation (Y10-11) Model of the atom and how it relates to the periodic table and predicts how a substance will react (Y10-11) Different kinds of chemical bonds (Y10-11)</p>	<p>Rearrangement of atoms in chemical change, compounds (Y8) Acids and alkalis (Y8) Oxidation (Y9)</p> <p>Different types of chemical reaction: combustion, thermal decomposition, oxidation and neutralisation (Y10-11) Model of the atom and how it relates to the periodic table and predicts how a substance will react (Y10-11) Different kinds of chemical bonds (Y10-11)</p>	<p>Rearrangement of atoms in chemical change, compounds (Y7-9)</p> <p>Different types of chemical reaction: combustion, thermal decomposition, oxidation and neutralisation (Y10-11) Model of the atom and how it relates to the patterns of the periodic table and predicts how a substance will react (Y10-11) Energy transfer and chemical reaction (Y10-11) Different kinds of chemical bonds (Y10-11)</p>	<p>Rearrangement of atoms in chemical change, compounds (Y10-11) Patterns of chemical reactions - different types of chemical reaction: combustion, thermal decomposition, oxidation and neutralisation (Y10-11) Periodic table in relation to atomic structure/model of the atom (Y11) How use of periodic table predicts how a substance will react (Y11)</p> <p>Energy transfer and chemical reaction (Y10-11)</p>

Chemistry	England (1999) [double award]	England (2007) [core award]	Hong Kong (1998; 2002; 2007)	Singapore (2001; 2005)	Massachusetts (2006)	Alberta (1996; 2003; 2005)
	decomposition, oxidation and neutralisation (Y10- 11) Model of the atom, and how it relates to the periodic table and predicts how a substance will react (Y10-11) Different kinds of chemical bonds (Y10- 11) Energy transfer in reactions (Y10-11)					Different kinds of chemical bonds (Y10- 11)
Properties of materials (Properties of materials related to use; properties related to chemical properties; making new materials)	Properties of materials related to their uses; sorting materials based on their properties (Y1-2) Comparing materials based on their properties (Y1-2, elaborated Y3-6) Varying properties of different elements (Y7-9) Reaction of metals with oxygen, water, acids and metal salts to make new substances (Y7-9) Rock formation (Y7-9) Sources of materials, including metals and products from crude oil (Y10-11) Nitrogen and Amonia (Y10-11)	The particle model related to different physical properties and behaviour of matter (Y7-9) Geological activity caused by chemical processes (Y7-9) New materials made from natural resources by chemical reactions (Y10-11) Properties of a material determine its uses (Y10-11) Surface and atmosphere have changed since earth's formation (Y10-11)	Properties of materials related to their uses (Y1-2, elaborated Y3- 6) Varying properties of different elements and compounds (Y7-9) Reaction of metals with oxygen, water, acids and metal salts to make new substances (Y7-9) Properties, extraction and purification of metals; alloys (Y7-9) Plastics as materials made from crude oil (Y7-9) Composite materials (Y7-9) Atmosphere, oceans, rocks and minerals (Y10-11) Sources of materials,	Properties of materials related to their uses; sorting materials on the basis of their properties (Y4) including thermal and electrical conductivity (Y5) Comparing materials based on their properties (Y5) Varying properties of different , materials, elements and compounds (Y8) Metals (Y8) Sources of materials, including metals and products from crude oil (Y10-11) Use of balanced equations and quantitative analysis to determine yields	Sorting materials based on their properties (EYFS-Y3) Comparing materials based on their properties (Y4-6) Identifying materials that are electrical conductors, magnetic (Y4-6) Rocks and their properties (Y4-6) Rock formation and weathering (Y7-9, elaborated Y10-11) Use of balanced equations and quantitative analysis to determine yields (Y10-11) Controlling rate of reaction – catalysts (Y10-11)	Properties of materials related to their uses (Y3) Buoyancy and magnetism (Y4) Properties of rocks and minerals (Y4) Properties and relation to use elaborated, particularly gases and fluids (Y9) Physical and chemical properties of substances and materials (Y9) Rock formation and weathering (Y8) Varying properties of different elements (Y10-11) Properties of elements related to position in periodic table (Y10- 11)

Chemistry	England (1999) [double award]	England (2007) [core award]	Hong Kong (1998; 2002; 2007)	Singapore (2001; 2005)	Massachusetts (2006)	Alberta (1996; 2003; 2005)
	<p>Formation and weathering of rocks, including evidence and dating (Y10-11)</p> <p>Use of balanced equations and quantitative analysis to determine yields (Y10-11)</p> <p>Controlling rate of reaction – catalysts (Y10-11)</p>		<p>including metals and products from crude oil (Y10-11)</p> <p>Important processes: chlorine and sulphuric acid (Y10-11)</p> <p>Use of balanced equations and quantitative analysis to determine yields (Y10-11)</p> <p>Controlling rate of reaction – catalysts (Y10-11)</p>	<p>(Y10-11)</p> <p>Controlling rate of reaction – catalysts (Y10-11)</p>	<p>Bio-chemistry (Y10-11)</p>	<p>Metals and non-metals (Y10-11)</p> <p>Reaction of metals with oxygen, water, acids and metal salts to make new substances (Y10-11)</p> <p>Bio-chemistry (Y11)</p>

Table C4: Sub-domain: Physics

Physics	England (1999) [double award]	England (2007) [core award]	Hong Kong (1998; 2002; 2007)	Singapore (2001; 2005)	Massachusetts (2006)	Alberta (1996; 2003; 2005)
Forces & Motion	<p>Movement; pushes and pulls as examples of forces (Y1-2)</p> <p>Magnetic attraction and repulsion, gravitational attraction; forces act in pairs; measuring forces (Y3-6)</p> <p>Linear motion – speed, distance & time; gravitational attraction; balanced and unbalanced forces; friction. Moments (Y7-9)</p> <p>Force, area and pressure (Y7-9)</p> <p>Force and acceleration - distance, time and speed; speed and velocity, acceleration, velocity and time, force, mass and acceleration, equal and opposite forces (Y10-11)</p> <p>Force and non-uniform motion (Y10-11)</p>	<p>Forces are interactions between objects and can affect their shape and motion – pressure; linear motion; turning moments (Y7-9)</p>	<p>Properties of movement (Y1-2)</p> <p>Patterns and phenomena related to movement (Y 3-6)</p> <p>Forces and motion; measuring forces; friction; gravity and weight; action and reaction (Y7-9)</p> <p>Position, distance and displacement; scalars and vectors; speed and velocity; uniform motion; acceleration; vertical motion under gravity (Y10-11)</p> <p>Objects at rest or in uniform motion; addition and resolution of forces; force, mass and acceleration; action and reaction pair of forces; mass and weight; the principle of moments (Y 10-11)</p> <p>Momentum (Y10-11)</p>	<p>Pushes and pulls as examples of forces (Y3-6)</p> <p>Characteristics of simple machines (Y3-6)</p> <p>Different types of forces; effects of forces (Y7-9)</p> <p>Effects of forces; measuring forces (Y7-9)</p> <p>Speed, velocity and acceleration, graphical analysis of motion, free-fall (Y10-11)</p> <p>Balanced and unbalanced forces; friction (Y10-11)</p> <p>Mass and weight; gravitational field and field strength (Y10-11)</p> <p>Turning effect of forces (Y10-11)</p> <p>Pressure (Y10-11)</p>	<p>Movement of objects; balancing objects (Y1-2)</p> <p>Weight and mass; gravitational attraction. (Y7-9)</p> <p>Motion of objects - position, direction of motion, and speed; distance, time and speed (Y7-9)</p> <p>Displacement, velocity, acceleration force, linear momentum (Y10-11)</p> <p>Distance, speed, energy, mass, work (Y10-11)</p> <p>Gravitational attraction; circular motion (Y10-11)</p>	<p>How simple machines are used to change the speed or force of movement (Y3-6)</p> <p>Aerodynamics – friction, pressure, gravity (Y7-9)</p> <p>Force and mass; measuring forces; frictional forces; stress; direction of forces (Y7-9)</p> <p>Pressure as a force (Y7-9)</p> <p>Transmission of force and energy between parts of a mechanical system (Y7-9)</p> <p>Scalars and vectors; displacement and velocity; acceleration; equal and opposite forces (Y10-11)</p>
Light, Sound and Waves	<p>Light and dark (Y1-2)</p> <p>Making and detecting sound (Y1-2)</p>	<p>Communication through radiation waves (Y10-11)</p>	<p>Patterns and phenomena related to light and sound (Y3-6)</p>	<p>Luminous and non-luminous objects; shadows (Y3-6)</p>	<p>Vibration; pitch and loudness; sound travels through a medium (Y3-6)</p>	<p>Creating colour (Y1-2)</p> <p>Vibration; pitch and loudness; making</p>

Physics	England (1999) [double award]	England (2007) [core award]	Hong Kong (1998; 2002; 2007)	Singapore (2001; 2005)	Massachusetts (2006)	Alberta (1996; 2003; 2005)
	<p>Light travels from a source; shadows; reflecting light; seeing (Y3-6)</p> <p>Vibration; pitch and loudness; sound travels through a medium (Y3-6)</p> <p>Rays; non-luminous objects; reflection; refraction; dispersion of white light; colour filters (Y7-9)</p> <p>Speed of light/sound; vibration, amplitude and frequency (Y7-9)</p> <p>Characteristics of waves (Y10-11)</p> <p>Electromagnetic spectrum (Y10-11)</p> <p>Sound and ultrasound (Y10-11)</p> <p>Seismic waves (Y10-11)</p>		<p>Rays; luminous and non luminous objects (Y7-9)</p> <p>Reflection and angle of incidence (Y7-9)</p> <p>Colour - dispersion of white light; the colour spectrum; colour filters (Y7-9)</p> <p>The other parts of the electromagnetic spectrum (Y7-9)</p> <p>Nature of waves; motion and propagation (Y10-12)</p> <p>Reflection, refraction, diffraction and interference (Y10-12)</p> <p>Further development of the electromagnetic spectrum; lenses (Y10-12)</p> <p>Audible frequency range musical notes; noise (Y10-12)</p>	<p>Light travels faster than sound; reflection; refraction; dispersion of white light; colour (Y7-9)</p> <p>Vibration; pitch; sound travels through a medium; hearing (Y7-9)</p> <p>General wave properties (Y10-11)</p> <p>Reflection; refraction; lenses (Y10-11)</p> <p>Electromagnetic spectrum (Y10-11)</p> <p>Sound waves, speed of sound and ultrasound (Y10-11)</p>	<p>Light travels in a straight line; light can be reflected, refracted and absorbed (Y3-6)</p> <p>Properties, types and motion of waves (Y10-11)</p> <p>Electromagnetic spectrum (Y10-11)</p>	<p>sound; sound travels through a medium; hearing (Y3-6)</p> <p>Sources of light, non-luminous objects; reflection; refraction; dispersion of white light (Y3-6)</p> <p>How light is reflected, transmitted and absorbed; angles of reflection; refraction; lenses (Y7-9)</p> <p>Electromagnetic spectrum (Y10-11)</p> <p>Application of electromagnetic spectrum in technologies and communication systems (Y10-11)</p> <p>Seismic waves (Y10-11)</p>
Electricity & Magnetism	<p>Electrical appliances; components of simple circuits (Y1-2)</p> <p>Constructing simple circuits; diagrams and symbols (Y3-6)</p> <p>Parallel circuits;</p>	<p>Electric current in circuits (Y7-9)</p> <p>Electrical power is readily transferred and controlled (Y10-11)</p>	<p>Patterns and phenomena related to electricity (Y3-6)</p> <p>Closed circuits; conductors and insulators (Y7-9)</p> <p>Current, voltage, and</p>	<p>Characteristics and uses of magnets; difference between magnets and non magnets (Y3-6)</p> <p>Components of circuits; closed circuits (Y3-6)</p>	<p>Closed circuits; conductors and insulators; making electromagnets (Y3-6)</p> <p>Properties of magnets (Y3-6)</p> <p>Electric charge;</p>	<p>Characteristics and uses of magnets; difference between magnets and non magnets (Y3-6)</p> <p>Household electricity, Introduction to electricity and</p>

Physics	England (1999) [double award]	England (2007) [core award]	Hong Kong (1998; 2002; 2007)	Singapore (2001; 2005)	Massachusetts (2006)	Alberta (1996; 2003; 2005)
	<p>current and voltage; energy transfer in electrical circuits (Y7-9)</p> <p>Magnetic fields; electromagnets (Y7-9)</p> <p>Resistance, voltage current and power relationships, mains electricity; electrical charge (Y10-11)</p> <p>Electromagnetic effects (Y10-11)</p>		<p>resistance; circuit diagrams and symbols; series and parallel circuits (Y7-9)</p> <p>Fuses & household electricity (Y7-9)</p> <p>Resistance, voltage current and power; series and parallel circuits; domestic electricity; electric charge and electric fields (Y10-11)</p> <p>Electromagnetism (Y10-11)</p>	<p>Constructing simple circuits; diagrams and symbols; electrical conductors and insulators; electrical safety (Y3-6)</p> <p>Current, resistance, voltage, power; circuit diagrams and symbols; chemical, heating and magnetic effects of an electric current; electrical safety (Y7-9)</p> <p>Electrical charge; resistance, voltage current and power relationships; practical electricity (Y10-11)</p> <p>Magnetism and electromagnets (Y10-11)</p> <p>Introductory Electronics (Y10-11)</p>	<p>current, voltage, resistance ; series and parallel circuits; diagrams and symbols (Y10-11)</p> <p>Electromagnetism (Y10-11)</p>	<p>electromagnets; magnetic fields; conductors and insulators; resistance (Y3-6)</p> <p>Constructing electrical circuits – series and parallel (Y3-6)</p> <p>Potential danger of electrical devices; current and static electricity; electrical conductors and insulators; current, resistance and voltage; circuits; diagrams and symbols (Y10-11)</p>
Energy and matter	<p>Energy resources (Y7-9)</p> <p>Conservation of energy – temperature and heat; transfer of energy (conduction, convection and evaporation & radiation) (Y7-9)</p> <p>Energy transfer and efficient use of energy</p>	<p>Energy can be transferred usefully, stored, or dissipated, but cannot be created or destroyed (Y7-9)</p> <p>Energy transfers can be measured and their efficiency calculated (Y10-11)</p> <p>Radiations, including</p>	<p>Sources of energy (Y1-2)</p> <p>Patterns and phenomena related to energy (Y3-6)</p> <p>Forms of energy; energy changes; fuels; generating electricity, energy sources (Y7-9)</p>	<p>Energy is required to make things work or move (Y3-6)</p> <p>The Sun is our primary source of light and heat energy (Y3-6)</p> <p>Sources of heat; temperature and heat; energy transfer; heat gain/loss; conductors</p>	<p>Sun as a source of light and heat (Y1-2)</p> <p>Basic forms of energy; energy transfer (Y3-6)</p> <p>Density (Y7-9)</p> <p>Potential and kinetic energy (Y7-9)</p> <p>Heat and temperature; energy transfer (Y7-9)</p>	<p>Floating [informal introduction to density] (Y3-6)</p> <p>Thermal energy; particle model of matter; temperature; thermal expansion; change of state; heat transfer; insulation and thermal conductivity; thermal energy sources;</p>

Physics	England (1999) [double award]	England (2007) [core award]	Hong Kong (1998; 2002; 2007)	Singapore (2001; 2005)	Massachusetts (2006)	Alberta (1996; 2003; 2005)
	(Y10-11) Work, power and energy (Y10-11) Radioactivity (Y10-11)	ionising radiations, can transfer energy (Y10-11)	Properties of matter - gas pressure; density, floating and sinking; thermal expansion and contraction (Y7-9) Temperature, heat and internal energy; heat capacity and specific heat capacity (Y10-11) Conduction, convection and radiation (Y10-11) Melting and freezing, boiling, and condensing; latent heat; evaporation (Y10-11) Work, energy and power (Y10-11) Radioactivity (Y10-11) Atomic model (Y10-11) Nuclear fission and fusion (Y10-11)	of heat (Y3-6) Various forms of energy; energy can be converted from one form to another (Y7-9) Sources of energy and storage of energy (Y7-9) Expansion and contraction; conduction, convection and radiation (Y7-9) Density; conservation of energy, work and power; kinetic model of matter; heat and temperature; properties of matter (Y10-11) Radioactivity (Y10-11)	Conservation of Energy (Y10-11) Work, power and energy (Y10-11) Heat and heat transfer (Y10-11)	energy conservation (Y7-9) Density (Y7-9) Efficiency of energy conversions; work, power and energy (Y10-11) Conservation of energy resources; sustainability of energy resources (Y10-11) Evidence for the presence of energy; kinetic and potential energy; gravitational potential energy (Y10-11) Energy conservation and conversion; "useful" energy (Y10-11)
Earth and Space	Sun, earth and moon features and periodic changes (Y3-6) The solar system and artificial satellites (Y7-9) The wider Universe	The nature and observed motions of the sun, moon, stars, planets and other celestial bodies (Y7-9) The surface and the atmosphere of the Earth (Y10-11)	Features and patterns of day and night; basic patterns of objects in the sky (Y1-2) Weather and seasonal changes (Y3-6) Patterns of	Composition of the solar system; regularity in the movements of the Earth and the Moon; artificial satellites (Y3-6)	Weather changes, seasons (Y1-2) Periodic changes (Y1-2) Weather and climate (Y3-6)	Weather and seasonal changes (Y1-2) Weather phenomena (Y3-6) Motion, location and characteristics of stars, moons and

Physics	England (1999) [double award]	England (2007) [core award]	Hong Kong (1998; 2002; 2007)	Singapore (2001; 2005)	Massachusetts (2006)	Alberta (1996; 2003; 2005)
	(Y10-11)	The solar system as part of the universe (Y10-11)	changes/phenomena observable on Earth caused by movement of the Earth and the Moon (Y3-6) Life of an astronaut in space (Y7-9)		The earth and the solar system (Y3-6) The earth; the solar system; the wider universe (Y7-9) The earth; the origin and evolution of the Universe (Y10-11)	planets; seasonal changes; length of the day and night; phases of the moon; Earth, the Sun and the Moon are part of a solar system (Y7-9) Surface of the earth (Y7-9) Space exploration (Y10-11) Climate (Y10-11)

Table C5: Scientific processes – primary (Singapore on page 186)

Aspect of scientific enquiry	England (1999)	Alberta (2003)	Hong Kong (1999)	Massachusetts (2006)	Victoria (2008)
Science is about generating explanation that is supported by evidence.	Y3-6 - thinking creatively about explanation and testing ideas through observation and measurement.		Y4-6 - scientific ideas being used to explain phenomena and importance of evidence for claims.		Y4-5 – learn to describe evidence in support of simple scientific ideas. Y6-7 – understand some questions are open to investigation, some require reason and discussion. How science has changed and developed through evidence, including work of some Aus scientists. Cause and effect. Introduce use of models in science.
Scientists ask questions that can be answered through carrying out investigations.	Introduced Y1-2 Elaborated Y3-6 - asking questions that can be investigated scientifically and decide how to find answers.	Introduced Y2, elaborated Y6-7 with introduction of hypothesis testing and identifying ways of finding answers.		EYFS-Y3 – ask questions about objects, organisms and events in the environment.	Introduced Y2-3, as beginning to generate questions and suggest observations/measurements, make predictions. Elaborated Y6-7 – Frame and investigate questions that interest them; develop skills in identifying evidence needed.
To explore their world using sense data	Y1-2 – use first hand experience and sense data as sources.		Y1-3 – demonstrate interest in exploring environment.		Rec-Y1 – Use their senses to explore the world around them.
To make simple predictions	Y1-2 – Think about what might happen before deciding what to do.	Y2 – predict what might happen, elaborated later in Y6-7 to identify one or more possible answers, which may take form of prediction or hypothesis.		EYFS-Y3 – make predictions. Y4-6 – ask questions/make predictions that can be tested.	
Describe objects and phenomena and sort	Y1-2 – make simple comparisons and identify				Rec-Y1 – sort objects. Y2-3 – observe and

Aspect of scientific enquiry	England (1999)	Alberta (2003)	Hong Kong (1999)	Massachusetts (2006)	Victoria (2008)
them according to basic criteria	simple patterns.				describe.
Participate in designing and carrying out investigations	<p>Y1-2 - Carrying out complete investigations introduced at including recording observations and measurements.</p> <p>Y3-6 - elaborated to include considering for themselves sources of information needed, deciding what might happen, making a fair test, what evidence to collect, selecting equipment and materials etc.</p>	<p>Y2 – manipulating materials and making relevant observations, recognise and describe steps taken.</p> <p>Y4 – identify with guidance, and carry out, procedures to find answers to questions.</p> <p>Y5 – fair test introduced</p> <p>Y6 – identify variables to hold constant for fair test, select materials, modify procedures as needed, and carry them out.</p> <p>Y7 – plan a fair test, identifying all variables.</p>	<p>Y1-6 – plan and conduct simple investigations.</p> <p>Y4-6 –use focused exploration and investigation to acquire scientific understanding and skills.</p>	<p>EYFS-Y3 – name and use simple equipment and tools, record observations and data.</p> <p>Y4-6 – select and use appropriate tools and technology; keep accurate records; conduct multiple trials.</p>	<p>Rec-Y1 – participating in very simple investigations including observation and measurement and recording data.</p> <p>Y2-3 – repeating measurements over time.</p> <p>Y4-5 – plan, design, conduct and report on experiments, in selecting and using simple measuring equipment, and describing and developing fair tests and explaining how variables were controlled.</p> <p>Y6-7 – design simple experiments, draw conclusions and describe their purpose. Approach data collection systematically, understand error in measurement, use a range of measuring instruments.</p>
Have regard to health and safety when carrying out investigations.	<p>Y1-2 – follow simple instructions to control risk and recognise hazards, assess risks and take action.</p> <p>Y3-6 – use equipment correctly, recognise and take action to reduce risks.</p>				<p>Rec-Y1 become aware of and continue to practice safe procedures.</p> <p>Y4-5 – describe safety procedures as with experiments, elaborated at Y6-7 to include considering their own responsibilities and safety requirements.</p>
Interpret the findings of investigations	Y1-2 – communicate what happened, compare what	Y2 – describe what was observed.	Y1-3 – discuss observations and make	EYFS-Y3 – Discuss observations.	Rec-Y1 – make generalisations from data.

Aspect of scientific enquiry	England (1999)	Alberta (2003)	Hong Kong (1999)	Massachusetts (2006)	Victoria (2008)
	<p>expected, and try to explain it.</p> <p>Y3-6 –to include comparing, identifying associations, concluding and explaining.</p>	<p>Y3 – describe and explain.</p> <p>Y4 – identify patterns and order</p> <p>Y6-7 – state an inference based on observation.</p> <p>Y6-7 – cause and effect.</p>	<p>simple interpretations.</p>	<p>Y4-6 – Compare results with predicted results; recognise simple patterns and use data to create an explanation; communicate findings to others.</p>	<p>Y2-3 – recognise and describe simple patterns in data.</p> <p>Y4-5 – comment on trends in data.</p> <p>Y6-7 – reflect on data presentation, begin to design and build models, use understanding of error to consider their inferences.</p>
<p>Begin to use scientific language and terminology correctly</p>	<p>Y1-2 – use simple scientific language.</p> <p>Y3-6 – use appropriate scientific language and terms including SI units.</p>				<p>Y2-3 – use and expand simple scientific vocabulary.</p> <p>Y4-5 – use scientific language in place of everyday language.</p> <p>Y6-7 – explain science using symbols, diagrams and simple equations. Use terms such as relationships, models, systems, cause and effect correctly and appropriately.</p>
<p>Consider their investigation critically and think about the next stage in the investigative cycle</p>	<p>Y1-2 – review their work; recognise when a test or comparison is unfair.</p> <p>Y3-6 – review work and describe its significance and limitations.</p>	<p>Y3 – identify new questions that arise from what was learned/the investigation.</p> <p>Y6-7 – evaluate procedures used and identify possible improvements.</p>			

Singapore introduces science later in primary level (Years P3-6, of which P6 corresponds to England Y7). A section of the curriculum identifies the skills and processes that pupils should learn in science. These are:

1. Basic Process Skills

- Observing
- Comparing
- Classifying
- Measuring and using apparatus
- Communicating
- Analysing
- Generating
- Evaluating

2. Integrated Processes

- Creative problem solving
- Decision-making
- Investigation

Table C6: Scientific processes - Lower secondary level

Aspect of scientific enquiry	England (1999) KS3 Y7-9	England (2007) KS3 Y7-9	Alberta (2003) G7-9 Y8-10	Hong Kong (1999) S1-3 Y7-9	Massachusetts (2006) G6-8 Y7-9	Singapore (2001) S1-2 Y8-9	Victoria (2008) Level 5 Y8-9
Science is about generating explanation that is supported by evidence. Scientists ask questions that can be answered through carrying out investigations.	Interplay between empirical questions, evidence and scientific explanation. Importance of testing explanations by using them to make predictions and collecting evidence. How scientists (have) work(ed), including roles of experimentation, evidence and creative thought.	Scientific thinking as a concept: - using scientific ideas to explain phenomena, generate and test theories; - critically analysing and evaluating evidence from investigations.	'Nature of science' concepts, including goal of science; how knowledge develops; collaboration; changes in response to both new evidence and new interpretations; the process of scientific investigation.	What is science? The work of a scientist. Realising the limitations of scientific knowledge.		Scepticism for generalisations not based on verifiable observation. Recognise products of science are tested data collected over a long time, and explain how scientists have formulated concepts, principles and theories.	Nature of scientific thinking is not static. Expand pupils' knowledge to include abstract concepts, theories, principles and models drawn from traditional and emerging sciences.
Participate in designing and carrying out investigations – decide on the questions to be investigated	Turn ideas into a form that can be investigated and decide on appropriate approach; choose data sources; carry out preliminary work and make predictions.	Use scientific methods and techniques to develop and test ideas/ explanations.	Identify questions to investigate; define and delimit questions; state a prediction and hypothesis.	Identifying the problem to be investigated; identifying factors involved; proposing hypothesis.	Formulate a testable hypothesis.	Define problem/ask question that can be verified by experiment; Suggest possible hypothesis (tentative explanation); make a verifiable prediction based on known data.	
Participate in designing and carrying out investigations – design the investigation	Consider key factors that need to be taken into account, inc contexts in which variables can't be controlled; decide extent and range of data to collect and techniques,	Plan practical/investigative activities.	Select appropriate methods and tools for collecting data and information.	Designing the investigation.	Design and conduct and experiment specifying variables to be changed, controlled and measured; control variables to ensure a fair test.	Determine variables to be measured and controlled; design simple experiments.	Justify selection of equipment and procedures, etc. Controlled studies using appropriate experimental tools. Basic sampling procedures in fieldwork.

Aspect of scientific enquiry	England (1999) KS3 Y7-9	England (2007) KS3 Y7-9	Alberta (2003) G7-9 Y8-10	Hong Kong (1999) S1-3 Y7-9	Massachusetts (2006) G6-8 Y7-9	Singapore (2001) S1-2 Y8-9	Victoria (2008) Level 5 Y8-9
	equipment and materials to use.						
Participate in designing and carrying out investigations – carry out the investigation, including correct use of equipment and taking and recording measurements	Use range of equipment and materials appropriately. Make observations and measurements to appropriate degree of precision, and sufficient to reduce error and obtain reliable evidence.	Carry out practical/investigative activities.	Carry out procedures, controlling the major variables. Use appropriate instruments effectively and accurately, and organize data using an appropriate format.	Proper handling of simple apparatus. Observing and recording the results.	Select appropriate tools and technology. Make quantitative observations and carry out several measurements to minimize sources of error.	Acquire and use scientific practical skills; make careful observations and repeated measurements.	Technical uses of a range of instruments and chemicals and procedures. Develop skills in measuring. Use standard laboratory instruments and equipment and methods. Make systematic observations.
Have regard to health and safety when carrying out investigations.	Use equipment and materials appropriately and take action to control risks to themselves and others. Recognise that there are hazards and assess risks and take action.	Assess risk and work safely	Use apparatus safely.	Laboratory safety rules; safety measures to be observed; coping with common laboratory accidents.	Safe laboratory practices.	Observe laboratory rules at all times.	Practice safe, responsible and ethical behaviour when conducting investigations.
Interpret the findings of investigations and communicate their conclusions	Use diagrams, charts and graphs to show data; Use observations, measurements and data to draw conclusions; decide to what extent conclusions support a prediction; use scientific knowledge to explain and interpret; consider	Obtain, record and analyse data; use findings to provide evidence for scientific explanations.	Interpret patterns and trends in data and infer and explain relationships. State a conclusion based on experimental data and explain how evidence supports or refutes an idea; recommend an appropriate way of summarising and interpreting	Interpreting data; Drawing conclusion.	Present and explain data. Draw conclusions based on data and make inferences.	Describe trends in data, even when patterns are not exact. Infer from data. Advance an explanation and state limits within which it holds.	Present data. Use a range of tools to explain and interpret observations. Justify conclusions drawn against prediction or hypothesis investigated. Prepare and present reports using appropriate diagrams and symbols.

Aspect of scientific enquiry	England (1999) KS3 Y7-9	England (2007) KS3 Y7-9	Alberta (2003) G7-9 Y8-10	Hong Kong (1999) S1-3 Y7-9	Massachusetts (2006) G6-8 Y7-9	Singapore (2001) S1-2 Y8-9	Victoria (2008) Level 5 Y8-9
	whether findings support conclusions or interpretations; communicate findings.		findings.				
Use scientific language and terminology correctly	Use scientific language, conventions and symbols where appropriate.	Use appropriate methods, to communicate scientific information.	Convention of nomenclature and notation. Scientific language terms specific to each field of study.		Communicate using appropriate science and technology terminology.	Use appropriate units.	Use appropriate diagrams and symbols.
Consider their investigation critically	Consider anomalies in observations/measurements and try to explain them. Suggest improvements to methods.	Evaluate scientific evidence and working methods.	Identify and suggest explanations for discrepancies in data.		Offer explanations of procedures and critique and revise them.		

Table C7: Comparison of upper secondary science (Year 10-11 equivalent)

	England	Singapore	Hong Kong	Alberta	Massachusetts	Victoria
Phase of education corresponding most closely to England Y10-11	KS4 defined as school Years 10 and 11	<p>Secondary 3 and 4. 'Special/express' students sit O levels at end sec 4 (aged 15/16). (Route followed by majority of students.)</p> <p>'Normal academic' students sit N levels at end Sec 4 and may progress to O level end Sec 5 (age 16/17).</p> <p>'Normal technical' students complete sec 3 and 4.</p> <p>For majority of students (60%), route is directly comparable with England KS4.</p>	<p>Recent reform. Until 2009, UK pattern of 3 yr KS3 (grades 7-9, sec 1-3) plus 2 yrs KS4 (grades 10 and 11, sec 4&5).</p> <p>Since 2009: 3 yr KS3 (grades 7-9), then 3 yr pre-univ qualifying ending age 17. University is then 4 Years.</p> <p>There is no direct comparison between England KS4 and Hong Kong.</p>	<p>Junior high (grades 7-9, 12/13 yrs – 14/15 Years) ends halfway through UK KS4. Senior high (grades 10-12, 15/16 Years – 17/18 yrs) is equivalent to A level.</p> <p>There is no direct comparison between Alberta and UK.</p>	<p>Junior High School is equivalent to KS4, Grades 9 and 10, age 14/15-15/16 Years. Senior high school is equivalent to A level, Grades 11 and 12, age 16/17-17/18 Years.</p> <p>Directly comparable with England KS4.</p>	<p>Y7&8 (ages 12/13 and 13/14) is equivalent to KS3, and Y9&10 (14/15 and 15/16)</p> <p>Y9 and 10 correspond directly to England KS4.</p>
Is some science compulsory in upper secondary	Yes	Only for students on the 'special/express' route.	<p>Yes at lower sec G7-9.</p> <p>No at senior sec G10-12.</p> <p>Compulsory schooling appears to end at G9. Senior sec sciences are identified in curriculum docs as 'electives'.</p>	Yes, required through to Grade 12 (A level equivalent and necessary to achieve High School Diploma), although compulsory schooling ends at 16 Years so compulsion only applies strictly to G10, consistent with KS4 equivalence.	Yes	Yes

<p>What is stipulated</p>	<p>NC core content equivalent to one GCSE.</p>	<p>‘Special/express’ students must study one science subject from:</p> <ul style="list-style-type: none"> • biology or human and social biology; • physics; • chemistry; • science/integrated science. <p>Science is not compulsory for ‘normal academic’ or ‘normal technical’ routes.</p>	<p>Lower secondary is the curriculum used for comparison with KS3. Organised as general science with content delivered thematically.</p> <p>At senior secondary it appears science is not a requirement, but students can choose from:</p> <p>Separate study of biology, chemistry or physics;</p> <p>Integrated science (scientific literacy);</p> <p>Combined science (single qualification made up of aspects of any two of the main disciplines studied in combination).</p>	<p>Grades 7-9 organised as general science (and used as our KS3 equivalent).</p> <p>Grades 10-12 students select science options required to build up a necessary number of credits. Route is usually a general science course in G10 followed either by specialist courses (in biology, chemistry or physics) or another general science course in G11 and G12.</p> <p>Students appear to be required to study for 15 credits in science subjects out of a required total of 100 credits.</p>	<p>The high school learning standards are for ‘High School Introductory courses’, and ‘express the learning standards for a full first-Year course.’ The learning standards are grouped into 4 strands: Earth and Space Science; Life Science (Biology); Physical Sciences (Chemistry and Physics); and Technology/Engineering.</p> <p>Students take one of four state-mandated tests in science (biology, chemistry, introductory physics or technology/engineering) at the end of G9 or G10. Their G10 STE score is based on their best result on any test taken in G9 or G10.</p>	<p>Victorian Essential Learning Standards (VELS) for Y9 and Y10 are expressed as Level 6. Expressed as general science.</p>
<p>What qualification is awarded at end KS4 equivalent</p>	<p>GCSE or alternative</p>	<p>Students sit O levels or N levels at end Sec 4. A proportion of those who sit N levels go on to convert them to O levels in Y11 equivalent.</p>			<p>Students are required to take Massachusetts Comprehensive Assessment System (MCAS) tests by end G10. Senior high school graduation depends on passing at least one science test.</p>	

Comparison with England NC KS4	N/A	Science is only mandatory for students on 'special' and 'express' courses (60% of students). Students are not required to study across all disciplines, only to take one science subject, which can be a single science discipline or integrated science.	Hong Kong school stages cut across the middle of England KS4. At the Y10 equivalent, science is compulsory for all, but it is stated as general science. At Y11 equivalent science is elective and students can choose either separate sciences or a single qualification in general science or combined science.	Alberta school stages cut across the middle of England KS4. At Y10 equivalent the curriculum is mandatory and expressed as general science. In Y11 equivalent students have to do some science and tend to do a general science course as preparation for specialized study or more advanced general science at A level equivalent standard.	Students have to do science throughout KS4 equivalent and be tested on it, but are only required to pass one of four science tests to achieve senior high school graduation.	Students must study science throughout KS4 equivalent, and the curriculum is stated in the form of general science.
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Table C8: Earth sciences

Earth sciences	England (1999)	England (2007 Y7-9 and Y10-11 only)	Hong Kong (1998; 2002; 2007)	Singapore (2001; 2005)	Massachusetts (2006)	Alberta (1996; 2003; 2005)
Seasons and weather		Changes in the atmosphere since earth's origin and at present (Y10-11)	Simple weather changes (Y1-2) Effects of weather and seasonal changes (Y3-6) Air and atmosphere (Y3-6) Further development of the atmosphere – oxygen and fractional distillation (Y10-11)		Air and wind (Y1-2) Weather changes and seasons (Y1-2) Types of weather and global patterns (Y3-6)	Seasonal changes in atmosphere, plants and animals (Y1-2) Weather phenomena and methods for studying weather (Y3-6)
Rocks and minerals	Properties and groupings of rocks; soil (Y3-6)	Geological activity caused by chemical and physical processes – rock cycle and rock formation (Y7-9)	Rocks as sources of minerals; tests to separate constituent minerals (Y10-11)		Rocks, soil and living organisms (Y1-2) Minerals; rock categories; how soil is formed and soil's properties (Y3-6)	Simple classification of rocks and minerals and constituents of soil (Y3-6)
Changing earth	Physical weathering (Y7-9) Rock formation over different timescales; igneous, metamorphic and sedimentary rocks (Y7-9)	Weathering (Y7-9) Changes to the surface of the earth since its origin and at present (Y10-11)	Features of the natural environment (Y1-2) Changes in the earth's surface –continents and oceans (Y3-6)		Fossils (Y2-3) Introduction to erosion, weathering, earthquakes and volcanoes (Y3-6) Mapping earth's common physical features (Y7-9) Heat transfer in the earth's system (Y7-9) Introduction to plate tectonics (Y7-9)	Geological landforms; earth's surface and interior; metamorphic, igneous and sedimentary rock (Y7-9) Weathering and erosion (Y7-9) Further develop earth's internal structure including plate tectonics, earthquakes, fossilisation (Y10-11)

Earth sciences	England (1999)	England (2007 Y7-9 and Y10-11 only)	Hong Kong (1998; 2002; 2007)	Singapore (2001; 2005)	Massachusetts (2006)	Alberta (1996; 2003; 2005)
					<p>Fossilisation; further development of erosion and weathering; sedimentation; glaciation (Y7-9)</p> <p>Earth's internal and external sources of energy and impact on humans; gravity and electromagnetism of earth; impact of these processes on ocean currents, weather, earth and life systems and seasonal variations (Y10-11)</p> <p>Physical and chemical weathering; nitrogen cycle; processes in rock formations; further develop convection currents, lithospheric plates and relation to earthquakes and volcanoes (Y10-11)</p>	and beyond)
Water systems	The water cycle – evaporation and condensation (Y3-6)		<p>The water cycle (Y7-9)</p> <p>The ocean – composition of sea water; test for components of seawater (Y10-11)</p>		<p>Water cycles both in the atmosphere and underground (Y3-6)</p> <p>Processes of the hydrologic cycle (Y10-11)</p>	<p>Characteristics of saltwater and freshwater systems (Y7-9)</p> <p>Aquatic ecosystems and human impact (Y7-9)</p>

Ecosystems	<p>Relation of life processes to animals and plants (Y1-2)</p> <p>Food chains and feeding relationships in habitats (Y3-6)</p> <p>Microorganisms (Y3-6)</p> <p>Food webs and further development of food chains (Y7-9)</p>	<p>Variation of living things; interaction with each other and environment (Y7-9)</p>	<p>Features of living things and interaction with nature; life processes (Y1-2)</p> <p>Interdependence of living things and their environment (Y3-6)</p> <p>Relationship between plants and the atmosphere (Y3-6)</p> <p>Adaptation of living things to the environment (Y3-6)</p> <p>Plant and animal diversity (Y7-9)</p> <p>Food chains (Y7-9)</p> <p>Biodiversity (Y10-11)</p> <p>Ecosystems – levels; types; components; functioning; biotic and abiotic factors (Y10-11)</p>	<p>Organisms and their environment - energy flow; food chains and food webs; carbon cycle (Y10-11)</p>	<p>Living things in the natural world; life cycles; habitats (Y2-3)</p> <p>Detailed lifecycles of the frog/butterfly (Y7-9)</p> <p>Adaptation of plants and animals to their environment (Y7-9)</p> <p>Biodiversity; changing ecosystems through time (Y7-9)</p> <p>Food webs (Y7-9)</p> <p>Ecology – organisms and population levels (Y10-11)</p>	<p>Living things and what they need to grow (Y1-2)</p> <p>Food chains in relation to small animals (Y3-6)</p> <p>Life cycles of animals (Y3-6)</p> <p>Wetland ecosystems (Y3-6)</p> <p>Forest ecosystems (Y7-9)</p> <p>Further develop ecosystems – components, interactions and interdependencies (Y7-9)</p> <p>Habitat diversity (Y7-9)</p> <p>Food chains and webs; carbon and nitrogen cycle; trophic levels (Y10-11 and beyond)</p> <p>Biotic and abiotic characteristics of ecosystems; population and ecosystem structure (Y10-11 and beyond)</p>
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Earth and beyond	<p>Sun, earth and moon relationships (Y7-9)</p> <p>The solar system (Y7-9)</p> <p>Origins of the Universe, other bodies in the universe e.g. black holes, stars (Y10-11)</p>	<p>Nature and observed motion of the sun, moon, stars planets and other celestial bodies (Y7-9)</p> <p>The solar system as part of the Universe, early and long term changes (Y10-11)</p>	<p>Basic patterns of objects in the sky (Y1-2)</p> <p>Patterns of movements of earth and moon (Y3-6)</p> <p>Space exploration (Y7-9)</p>	<p>Position of earth, sun and moon; composition of solar system (Y3-6)</p>	<p>Earth and the solar system (Y3-6)</p> <p>Earth sun and moon relationships (Y10-11)</p> <p>Further develop the solar system (Y10-11)</p> <p>Origins of the Universe (Y10-11)</p>	<p>Sun, earth and moon relationships (Y7-9)</p> <p>The solar system (Y7-9)</p> <p>Space exploration (Y10-11)</p> <p>Further develop the solar system (Y10-11)</p> <p>The Universe (Y10-11)</p> <p>Development of technologies to understand the earth and space (Y10-11)</p>
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