CLIL Essentials

for Secondary School Teachers

Peeter Mehisto with Y. L. Teresa Ting

Online resource:

Appendices

CAMBRIDGE UNIVERSITY PRESS

Appendices

The following four appendices break down many elements of the academic language of Geography, History, Mathematics and Science. They also draw out related learning skills because the language for using these skills (the language for learning) may also need to be taught to the students (see **Chapter 4**: *Academic language*). In addition, teaching and learning strategies are presented at the end of each table in order to support reflection on how this language can be taught and learned. Inspiration for creating these tables came from reading Cloud, Genesee and Hamayan (2009).

Language of Geography: Examples for learning Geography through English

Characteristics	Related learning skills
• uses graphs, maps, photographs, tables and text • contains many prepositions (e.g. *in* Asia, *on* Cuba, *at* night, resulting *from* urbanisation) • often uses present tense • includes many word colocations (e.g. the social geography of France; manufacturing industries not only help; methods of collecting data) • contains cultural universals to describe human-environmental interaction • uses many acronyms such as MDC (More Developed Country), EMDC (Economically More Developed Country), LEDC (Less Economically Developed Country), NIC (Newly Industrialised Country) and HIC (High Income Country) • uses large numbers of specialist terms such as anemometer, drumlins, exfoliation, horizontal equivalent, nucleated settlements, population pyramid, striations • uses French, Greek, Latin and other foreign words and phrases (e.g. laissez-faire) • takes for granted that the reader has a knowledge of geographical concepts.	Students are ideally supported in learning these functions as well as the language needed to undertake and discuss them: • reading and interpreting graphs (bar graphs, divided bar graphs, line graphs, scatter graphs (including line of best fit), pie charts, proportional circles, triangular graphs, climate graphs), maps (survey, aerial, terrestrial, satellite), photographs (aerial, black and white, colour, terrestrial, satellite), tables and various kinds of text • using GIS such as Google Maps and Google Earth • analysing space arrangement, direction, distance, location, patterns and shape • tracing a path along a specified feature • identifying real and abstract divisional markers (e.g. boundary dividing motorway from housing; postcode divisions) • conducting case studies • accurately and objectively collecting, recording, processing, analysing, interpreting and reporting data in a spatial context • evaluating different types and sources of information • identifying patterns and changes in patterns. NB: For maximum uptake, learning skills are taught, practiced and evaluated in each content subject whilst working with meaningful content.

International/foreign terms

acquifer, algae, barrage, caldera, crevasse, boreal, fauna, Gersmehl diagrams, guyot, halophyte, Hjulstrom curve, inselberg, isostatic, laissez-faire, karst, kolkhoz, levée, magma, nunatak, oligopoly, Paleozoic, Peltier diagram, quadrat, silica, taiga, tombolo, xerophytic

Subject-specific terminology requiring decoding

agglomeration, alluvia, amenities, Atlantic Seaboard fall line, atmospheric pressure, Badlands, barrier, biomass, braided channel, carbonation, chelation, chemical weathering, combine harvester, constraint, core-periphery, divergent and convergent plate boundaries, dust bowl, entrainment, equatorial low pressure, fluvial geomorphology, frost shattering, greenhouse effect, a high dependency ratio, hydrolysis, life expectancy, low pressure, nutrient cycling, organic action, oxbow lake, peak discharge, urban heat island, seismic activity, storm hydrograph, solar radiation, subduction zone, subtropical high pressure, savanna, trade winds, westerlies

Easily confused words/concepts

absorption **vs** adsorption; afforestation **vs** deforestation; ascend **vs** assent; capitol **vs** capital; corrasion **vs** corrosion; *de facto* **vs** *de jure* segregation; emigrate **vs** immigrate; fewer **vs** less; snowline **vs** treeline; transmigration **vs** migration; weather **vs** whether

Common functions and activities (many call for the use of formulaic language including phraseology)

annotating; avoiding repetition; being succinct; commenting on; comparing; contrasting; describing; devising; drawing; enquiring; evaluating; planning; sketching; synthesising; analysing and explaining the inter-relationships between people's activities and the total environment; extracting information from diagrams, graphs, maps, tables and text; drawing inferences; producing labelled or annotated diagrams and referring to them in the text; explaining scale including spatial scale; calculating lag time; drawing out both negative and positive effects (e.g. impact of refugees); developing and explaining a line of reasoning based on evidence; identifying factors and developing reasoning in more than one dimension (economic, social, environmental and political); explaining cause and consequence (e.g. lack of precipitation limits chemical processes and mechanical processes such as freeze thaw; in the case of human geography explaining both 'causes' and 'consequences' in a reasonably balanced manner); identifying patterns (e.g. surface winds blow from high to low pressure areas producing trade winds, westerlies and the outblowing polar winds); predicting (e.g. demographic shift); defining processes (e.g. flow and slide as well as the impact of rock slides upon slopes); substantiating an argument using evidence; condensing material into a digestible and appropriately structured form for essay writing or revision purposes; weighing up different arguments and forming a supported view; locating points on maps

Common structures and phrases

predicted **vs** actual; originates from; low/high pressure systems are usually associated with …; it is caused by a variety of factors, such as …; the pattern of rural settlement is characterised by …; volcanoes/eskers/deserts are generally found in/where …; earthquakes/weather systems/volcanoes can pose many hazards for …; the current level of economic development is indicated by …; over time, the repeated freeze-thaw action/in and out flow of water/ …; their distribution is strongly dependent on …

For sequencing: the process begins with/by …; first; initially; to begin with; second; third; subsequently; previously; furthermore; from thereon; finally; based on …, it is possible to conclude that …; another issue is a lack of …; in conclusion. **For comparing and contrasting:** however, but, on the other hand, in contrast, in the same way, conversely, on the contrary. **For discussing data:** this table shows …; over 90% of …; a significant increase in …; … has reached an all-time high; The Y-axis runs north-south … **For connecting:** thus, however, furthermore, although, nevertheless, in addition. **For speaking of cause and consequence:** abrasion; absorption; breakdown; bring about, cause; constraint; deterioration; division; impact, influence; pressure; origins; react; reason; responsible for; shift; tensions, unemployment, one of the primary causes of …; the immediate cause is …; a downward spiral is created by …; when unfavourable X conditions are combined with …; this leads to …; … is caused when …

Teaching and learning strategies supporting the learning of academic language

Teachers can: provide the language needed for doing group work or analysis and not just explaining the difficult language in texts being worked on; group vocabulary by theme (troposphere, tropopause, stratosphere, stratopause, mesosphere, mesopause, thermosphere, ionosphere, exosphere); group words and phrases needed for each of the seven key stages of enquiry, and assess their use separately; teach key command words and sets of phrases typically used in responding to them; have students find the 5–10 most important sentences in a text or the 5 key points; have students explain how far they agree with a given point and justify their answers; make connections between geography and students' lives; teach essay writing skills such as how to structure and essay and a paragraph; have students create their own definitions for key terms; prompt (give clues to) students to use language correctly and/or more precisely; recast students' incorrect utterances correctly, have students repeat these and explain their correction; review common errors in logic; not assume that students will intuitively understand a term whose root they know (e.g. deforestation, evapotranspiration, floodplain, malnutrition); test students learning of vocabulary, terms and definitions; help students practise modes of argument; provide students with and support them in using an observation protocol; draw attention to language that is unique to geography; take into account that students need additional time to process highly dense terms being used in their L2* or L3** (e.g. photochemical smog, threshold velocity); have students analyse text to locate collocations and phrasal verbs; expressly teach the development of language learning skills, in addition to general learning skills helpful in learning geography.

Students can: develop good language learning habits, and language learning skills; use graphic organisers to guide their analysis of a given topic; write their own definitions and descriptions of processes; work in groups to critique each others' definitions, descriptions of processes and lines of reasoning; create a Frayer Model (term with definition, facts/characteristics, examples, non-examples); develop their own glossaries and phrasebooks; set personal language learning objectives and measure progress against these.

*L2 = second language, ** L3 = third language

APPENDIX 2

Language of History: Examples for learning History through English

Characteristics	Related learning skills
• is dense with important information • uses abstractions such as *the underground economy* (both *economy* and *underground economy* are abstractions in their own right) • summarises events and activities in a single term (e.g. *the industrial revolution*) • uses complex sentence structures • can use the present tense (historical present) to discuss events which occurred in the past (e.g. *Chiang Kai-shek evacuates to Taiwan in December 1949)* • agency is not always clear (e.g. *Regardless of controversies over the sinking of the Belgrano, it had a crucial strategic effect which was the virtual elimination of the Argentine naval threat*.) • uses diagrams, maps, pictures and tables • is steeped in interpretation (e.g. the *American War* as it is known in Vietnam versus the same war being known as the *Vietnam War* in America) • uses French, German, Greek, Latin and other foreign words and phrases • is embedded in cultural economic political and social contexts • takes for granted that the reader has a knowledge of historical concepts • uses large numbers of specialist terms such as *absolute monarch, Intifada, Politburo, prohibition, serf and suffragette* • uses proper noun terminology, with initial capital letters, often denoting events and policy e.g. the Zollverein, the Alliance System	Students are ideally supported in learning these functions as well as the language needed to undertake and discuss them: • placing events in chronological order • organising and undertaking enquiry • examining, analysing and evaluating data • examining, analysing and evaluating images, films, texts and speeches • identifying and questioning generalisations • identifying and analysing simplifications • identifying bias • explaining and criticising lines of reasoning • differentiating between primary and secondary sources and analysing the pitfalls of each • interpreting, evaluating and using a range of sources as evidence, in their historical context • questioning references • examining, analysing, evaluating descriptions and commentary • distinguishing between fiction, faction and historical fact • analysing the editing of film and sound • analysing the use of close-up images • identifying means used by political figures and others to gain popular support • distinguishing the values inherent in an historical text or commentary • interpreting diagrams, maps and tables • using the following concepts/constructs to do their analysis: cause, continuity, chronology, evidence, change, consequence and situation (Nichol, 1999) • making substantiated judgments about the above concepts within historical context(s) • drawing conclusions based on evidence • recalling, selecting, summarising, organising and deploying knowledge • constructing historical explanations using an understanding of: cause and consequence, change and continuity, similarity and difference; and the motives, emotions, intentions and beliefs of people. NB: For maximum uptake, learning skills are taught, practiced and evaluated in each content subject whilst working with meaningful content.

International/foreign terms

asylum, Bolshevik, bourgeoisie, caliphate, Cossack, détente, droit du seigneur, fatwa, guerilla, glasnost, holocaust, intifada, jihad, Kalashnikov, khan, menhir, menorah, monotheism, Neolithic, nomenklatura, perestroika, pharaoh, polytheism, pontifex maximus, pleb, plebeian, putsch, realpolitik, Sputnik, theocracy, toga, WASP, Wehrmacht, yurt, Xenophobia

Subject-specific terminology requiring decoding

abdication, abolitionism, Age of Enlightenment, ambassador-at-large, appeasement, arms race, beaker culture, boycott, civil liberties, code of chivalry, collectivisation, communism, cottage industry, cotton economy, customs barriers, Dark Ages, dictatorship, disarmament, dollar diplomacy, droit du seigneur, economic freedom, emancipation, expropriation of farmers, fundamental rights, Great Depression, hereditary serfdom, imperialism, international relations, land reform, Middle Kingdom, militarism, New Deal, patriarch, patriotism, pile dwelling, post-revolutionary, press gang, primogeniture, puritan, rebel, revisionism, royal sceptre, secret ballot, separation of powers, sextant, slavery, social contract, surrender of authority, totalitarianism, Treaty of Versailles, trench warfare, unification, urbanisation

Words that take on an additional or a different meaning in historical discourse

assembly designating a legislative body **versus** a simple gathering of people; *B(b)attle of the B(b)ulge* describing a major battle during World War II **vs** a person's fight to keep down body weight; *capital* describing punishment or a major city **vs** a type of letter; *democratic* describing an authoritarian undemocratic country such as the former German Democratic Republic (East Germany) ***vs*** a country where adult citizens have a say in how their lives are governed; *epiphany* designating the twelfth day of Christmas vs a moment of enlightenment leading to an innovation; *ghetto* designating the Warsaw ghetto where Jews were forced by the Nazis to live prior to deportation ***vs*** a slum area occupied by the poor; *liberal* designating a member of a political party ***vs*** someone with a liberal point of view; *a standing army* designating a permanent army maintained in time of peace and war

Common functions and activities (many call for the use of formulaic language including phraseology)

analysing historical context; explaining and justifying causes, motives, consequences, changes, roles, factors, significance, responsibility and progress; sequencing events and analysing causes and consequences; distinguishing between description and explanation; finding and selecting primary and secondary source materials while recognising the limitations of some resources in terms of their, relevance, objectivity and accuracy; finding useful websites including recognising sites which are of little value or show heavy bias; reading for meaning by analysing bias, discerning views, checking facts and identifying issues; condensing material into a digestible and appropriately structured form for essay writing or revision purposes; cross-referencing between sources and integrating material from them; posing new questions and/or identifying new issues as reading progresses; weighing up different arguments and forming a supported view; substantiating an argument using evidence; developing a line of reasoning based on evidence

Common structures and phrases

By emphasising …. the author demonstrates bias; The author supports his claim by referring to …; The focal point of the painting is …; This can be considered a primary source because …; The following causes have all been identified by major historians: …; One of the underlying causes was …; A factor contributing to the X was …; The weather played a particularly important role as …; The situation was made worse by/ exacerbated by/aggravated by …; The author justifies her conclusions by referring to …; I would disagree with that conclusion for the following reasons: …; The evidence is questionable because …; The author's stated motive is questionable because …; X acted as a deterrent to …; A consequence of the lack of vitamin C in their diet was …; The main causative factor is …

For sequencing: By the beginning of the Dark Ages …; first; initially; to begin with; second; third; subsequently; previously; furthermore; from thereon; finally; based on … it is possible to conclude that …; in conclusion. **For comparing and contrasting:** however, but, on the other hand, in contrast, in the same way, conversely, on the contrary. **For connecting:** thus, however, furthermore, although, nevertheless, in addition. **For designating time:** AD, antiquity, BC, Bronze Age, century, contemporary, decade, era, epoch, Middle Ages, period, pre-history, Palaeolithic. **For speaking of cause and consequence:** influence, cause, reason, failure, bring about, responsible for, impact, origins, defeat, success, social consequences, tensions, blame, persecute, unemployment, react, achievement, struggle, division; Overt causes include …; Latent causes include …; The mostly likely cause of X is …; This lead to …; This can be considered the cause of …; Another reason why X is considered important is …; This compelled X to undertake …; This triggered a/the …; This bred resentment of …; X discouraged/deterred public protest/the allies from/further investment into …; The origins of the problem lie in/can be found in …

Teaching and learning strategies supporting the learning of the academic language of history

Teachers can: teach essay writing skills such as how to structure and essay and a paragraph; provide sample phrases for unpacking historical concepts such as multi-causality; make connections between history and students' lives; teach how to check for reliability e.g. by consulting and comparing multiple sources; have students create their own definitions for key terms; prompt (give clues to) students to use language correctly and/or more precisely; recast students' incorrect utterances correctly, having students repeat these and explain their correction; review common errors in logic; not assume that students will intuitively understand a term whose root they know (e.g. ceasefire, frontline, rearguard, vanguard); test students learning of vocabulary, terms and definitions; help students practise modes of argument; provide students with and support them in using an observation protocol; draw attention to language that is unique to history; take into account that students need additional time to process highly dense terms being used in their L2* or L3** (e.g. separation of powers, empirical evidence); expressly teach the development of language learning skills, in addition to learning skills helpful in learning history

Students can: develop the habits and skills listed in the above '*Related learning skills*' section and also develop language learning skills; can use graphic organisers to guide their analysis; write their own definitions; work in groups to critique each others' written definitions; choose the definition they understand the best from among a group of student-created and teacher-approved definitions and write that definition in their personal dictionary; create a Frayer Model (term with definition, facts/ characteristics, examples, non-examples)

*L2 = second language, ** L3 = third language

APPENDIX 3

Language of Mathematics: Examples for learning Mathematics through English

Characteristics of the language of Mathematics	Related learning skills
• highly precise (seeks to only allow one possible interpretation, avoids pronouns) • intolerant of ambiguity • concise (definitions do not contain any extraneous information) • highly dense text (one sentence or problem may contain several concepts and terms that are all essential to understanding the problem) • lacks emotion • uses tables, diagrams, formulae/formulas and figures • mixes prose, symbols, and diagrams • uses definitions that are written in complete, grammatically correct sentences, and with mathematical precision. • uses large numbers of symbols • is at times written one way and read in another (≥ becomes 'is greater than or equal to' when spoken; the forward slash used in fractions, such as in 2/3, means 'divided by') • often uses the passive voice (e.g. 'as c is related to d') • adjectives provide essential information • presents information in a logical and sequential manner (in a systematic way) • is at times impossible to understand in isolation (each general concept (*genus proximum* or *genus*) has a subclass of concepts with special features (*differentiae specificae* or *species*) so understanding one concept is often tied to understanding others) • notations are often written from left to right, but special conventions exist in the way mathematical notations are to be read or written which differ across languages	Students are ideally supported in learning these functions as well as the language needed to undertake and discuss them: • getting in the habit of reading texts more slowly and carefully (being attentive to detail) • getting in the habit of reading problems several times • underlining clue/key words • checking to make sure that the language they are using is precise • looking up symbols immediately if they do not recall what they mean (they are usually given at the start of a text or can be found in a glossary) • developing systematic habits, approaches and processes for learning maths (e.g. always checking for the givens and what needs to be found out) • getting help if they do not understand a concept (e.g. *genus* or *species*) or how to solve a problem as further learning may build on these concepts and skills • making notes about how a problem was solved (what they did not understand and steps taken to solve it) so this knowledge can be used in the future • trying to do a worked problem before looking at the answer and/or reading the process used to solve the problem • focusing on the process(es) used to get an answer rather than the answer itself • having to prove verbally or in writing that they understood a concept or process instead of allowing them to just say they understood it • interpreting tables and diagrams • applying formulae. NB: For maximum uptake, learning skills are taught, practiced and evaluated in each content subject whilst working with meaningful content.

Related concepts that are easily confused

area **versus** perimeter; capacity **vs** volume; congruent **vs** similar; convergence **vs** divergence; dependent **vs** independent; direct proportion **vs** inverse proportion; expression **vs** equation; induction **vs** deduction; mean **vs** median **vs** mode; necessary **vs** sufficient; numerator **vs** denominator; perpendicular **vs** parallel; probable **vs** possible; sector **vs** segment; simple interest **vs** compound interest; square **vs** square root

Words that take on an additional or a different meaning in mathematical discourse

bearing (the manner in which one carries oneself, or one structural part that supports another part **versus** a method used to represent the direction of a line); column (a column of a Greek temple **vs** a vertical array of numbers); expression (process of making known one's thoughts or feelings **vs** numbers, symbols and operators (such as + and x) that are grouped together to show the value of something); factor (factors that contribute to accomplishing a task **vs** numbers multiplied together to get another number); identity (the distinct and persistent personality of an individual **vs** an equation that is satisfied by any number that replaces the letter for which the equation is defined); mean (a mean person **vs** average of a set of the numbers); net (tool used for catching fish **vs** net income meaning revenue minus expense); volume (a book forming part of a work or series, or turning up the volume to hear better **vs** the amount of space inside of a solid figure, like a cube, ball, cylinder or pyramid)

Subject-specific vocabulary including terminology

area **versus** inside space; congruent **vs** same, equal **vs** same; greater vs more; intersection vs crossing of lines; perimeter **vs** outside/around; reflection **vs** flip; rotation **vs** turning; subtract **vs** take away; sum **vs** total; transformation **vs** change; translation **vs** slide; alternate, corresponding, exterior, interior, acute, obtuse and reflex angles; computational algorithm; co-ordinates; correct to 1 significant figure; parent graph (linear, absolute value, quadratic, constant); inverse matrix; pattern rules; proper fraction; Pythagoras' theorem; quadrant; quadratic equations; radius (radii); range; rational and irrational numbers; stem-and-leaf plot; synthetic division; tiling/tessellation; vertex (vertices)

Common structures and phrases

if and only if; necessary and sufficient; without loss of generality; the slope is the number in front of the x; find the area of; the square root of; the area of a; the permutation of a set; how did you get that answer?; I got that answer by; least common multiple; in the absence of; the total number of; *rhetorical structures* (definition, theorem, proof); *discourse structures* (if the corresponding sides of two similar figures are in the ratio …, the ratio of their surface areas is …, the ratio of their volumes is …; the volume of a sphere is given by …, where r is the radius of the sphere; can be calculated by …, where X equals …, and Y equals …; The diagram above shows the …, The least number of squares it can be divided into is … These squares have sides …; The Fibonacci sequence begins … where, apart from the first two terms, each term is the sum of the previous two terms; To prove the trig. identity I can use the formulae for …, I then used double angle formulae …, which turn into the given answer on setting …, here … is unchanged when … so

Common functions and activities

approximating; calculating the magnitude of; comparing lengths, weights and capacities using standard units; constructing; deducing new information from existing information; defining; deriving; estimating; explaining reasoning orally and in writing; expressing the vector … in terms of; factorising completely; finding complements to; giving place value; identifying differences and similarities; identifying relationships between numbers and shapes; linking; listing all the prime factors; making hypotheses and testing them out; manipulating directed numbers; naming an appropriate approximating distribution; organising data and objects; predicting; proving the identity; rearranging formulae to make x the subject; representing a word problem using diagrams; rounding off; simplifying; solving a large problem by breaking it down into sub-problems; sorting data and objects; stating what further information would be required to; transforming shapes; using derivatives of; visualising 3D shapes from 2D drawings and nets (e.g. different nets of an open or a closed cube)

Interpreting functions: transcendental functions (e.g. logarithmic, exponential, trigonometric), algebraic functions (e.g. polynomial, rational), domain, image, sign, gradient, turning point, integrals, graph

Common phrases which are often grouped together[1]

Claim: All integers are … **Proof:** Let x be any integer. Suppose x is odd, and …. Then, …. Therefore, the statement is true. Now suppose x is even …. Thus the statement is true/false for all integers. This concludes the proof / Q.E.D.

To prove the square root of 2 is irrational, let us assume that it is rational. Then we can write it in the form … Now, from … it follows that … But we also know that … This is a contradiction. Hence our assumption is false and thus the original statement is true.

Because lines l and k are parallel and …, angles … and … are equal. Now, because … we can use the Pythagorean theorem to show that … and this is the value that was asked.

Teaching and learning strategies supporting the learning of the academic language of maths

Teachers can: teach terminology in a meaningful context so students experience its use and see the connection between maths and their lives; dictate problems as this may help build listening skills and encourage deeper analysis of problems; have students memorise and regularly state formulae and their definitions (if students have understood and internalised these definitions they can better devote their cognitive resources to discussing and solving demanding problems); prompt (give clues to) students to use language correctly and/or more precisely; recast students' incorrect utterances correctly, having students repeat these and explain their correction; have students identify the use of the passive voice; review common errors in logic; not assume that students will intuitively understand a term whose root they know if a suffix is added (e.g. different **vs** differentiability); test students learning of vocabulary, terms and definitions; help students practise modes of argument; draw attention to language that is unique to maths; take into account that students need additional time to process highly dense terms being used in their L2* orL3** (e.g. additive inverse of a number, projective identification); provide trilingual terminology lists; present a word problem in the L1 and have students discuss how to solve it in the L3; expressly teach the development of language learning skills, in addition to learning skills helpful in learning maths.

1 These and similar groups of phrases are used by Finnish teacher Ismo Taltsa to make visible to his students some of the language he expects them to use.

Students can: develop the habits and skills listed in the above '*Related learning skills*' section and also develop language learning skills; create concept circles (e.g. sphere, cone, cylinder, pyramid, etc); write their own definitions; work in groups and present jointly agreed upon definitions; work in groups to critique each others' written definitions; choose the definition they understand the best from among a group of student-created and teacher-approved definitions and write that definition in their personal dictionary of useful mathematical terms and definitions; create a Frayer Model (term with definition, facts/ characteristics, examples, non-examples); illustrate definitions and after teacher feedback/approval students can include the illustration they understand the best in their personal maths dictionary; include non-example illustrations by drawing them in a circle with a slash through it; brainstorm and jointly create definitions and define processes for solving problems; re-present their definitions and illustrations throughout the academic year as mathematical terms re-emerge.

* L2 = second language, ** L3 = third language

APPENDIX 4

Language of Science: Examples for learning Science through English

Characteristics of scientific language	Related learning skills
• special or unique vocabulary • terminological precision, avoiding pronouns • concise (avoids repetition of information) • concrete, exact, seeks to allow only one possible interpretation • unemotional and factual (uses adjectives and adverbs frugally, almost never two adjectives at a time) • maintains the same tone throughout the text • factual (based on evidence), accurate or at least trustworthy data • information presented hierarchically in a logical and sequential manner (in a systematic way) • uses categories and concepts • uses diagrams, formulas, figures, graphs, symbols and tables (students need to translate this information into texts) • uses footnotes and references • refers to validity and reliability • sentences often include qualifying clauses • uses analogies, but also describes their limitations • uses both active and passive voice • use present tense to describe phenomena	Students are ideally supported in learning these functions as well as the language needed to undertake and discuss them: • retrieving information from libraries, reference books, journals and websites • evaluating information • processing, organising and storing information • identifying assumptions and testing them • observing for several different purposes • collecting, organising and analysing data • listening carefully and questioning validity of ideas and data • documenting findings • reading and creating graphs, tables and schemas • building or earlier studies • presenting data and analyses thereof • presenting ideas succinctly in a logical order • checking for the appropriateness of language • explaining how to protect one's own health during experiments and fieldwork. NB: For maximum uptake, learning skills are taught, practiced and evaluated in each content subject whilst working with meaningful content.

Avoids certain terms and words

Expressions of absolute certainty (e.g. this study proves that / it is certain that / it is a fact that / absolute proof) are avoided as any one experiment or study rarely leads to a universal truth.

Subject-specific vocabulary including terminology

acidity; amphibian **versus** an animal that lives both on land and in water; calorifacient **vs** fattening; carbohydrate; DNA; ion; mitochondria; mineral (inorganic); noble gases; Newton's Laws of Motion; nucleus; organic compounds; omnivore **vs** animal that eats all kinds of food; organelles; photosynthesis; pH scale; polymers; potential difference; potential energy; probability; quarks; reactants; refraction; relative atomic mass; saturated; submarine volcano **vs** underwater volcano; thorax **v**s area between the head and abdomen; torque; velocity

Words that take on an additional or a different meaning in scientific discourse

an aerosol (a can that dispenses a liquid mist **versus** a suspension of any solid or liquid droplet in the atmosphere; an assignment (of value **vs** a homework assignment); bed (riverbed **vs** bed for sleeping), bank (a riverbank **vs** an institution), a cell (a cell in the human body **vs** for a prisoner); core (the earth's core **vs** an apple core), face (face of a cliff **vs** a person's face); space (the cosmos **vs** on a hard drive)

International terms (Latin + cognates)

Autotroph, avian, biology, bona fide, bovine, canine, diffusion, electron, energy, equine, feline, fibula, in vitro, molecule, per capita, verbatim, tibia

Common functions and activities + related language

arguing, categorising, claiming, classifying, comparing, communicating findings, concluding, contrasting, distinguishing between evidence and interpretation, defining, describing, experimenting, formulating questions including those a teacher may ask, generalising, hypothesising, identifying, imagining, inquiring collaboratively, interpreting, labeling, linking, listing, observing, opposing, predicting, presenting facts, presenting problems and solutions, presuming, putting in order (time, weight, size, etc.), recommending, referencing, reporting, separating and explaining causes and consequences, summarising, using time and spatial relations,

For example, predicting: *I* predict that …; The following result is likely because …; Based on …, I foresee …; The blotter will absorb …; Scientists believe (think, envisage, calculate) that by the middle of this century … (See Gonzalez, 2008; Smith, 2010; Wei, 2011); By Friday, the plant will likely …; The properties of this chemical will contribute to … ; It may change in colour, size, weight, etc. …; It is usually only found in …

Common phrases

At the start of the experiment I …; Diagram number one shows (that) …; This study gives an overview of …; It is assigned a value of 100 …; Information in the chart has been gathered from …; Based on the first example, it is possible to conclude …; less than, more than, equal amounts; This is likely caused by …; In comparison with a spider, an insect has …; The butterfly's life-cycle can be divided into … stages. The first is named the …, the second …; Trial and error…; By substituting the value of X in equation …; The evidence suggests that …

Transition words, connectives, intensives, bridges

For sequencing: first, second, third, initially, at the next stage, finally, eventually, previously. **For concluding:** doubtless, in summary, in conclusion. **For comparing and contrasting:** however, but, on the other hand, in contrast, in the same way, conversely, on the contrary. **For connecting:** thus, however, furthermore, although, nevertheless. **For intensifying:** particularly, above all, significantly.

Reading and writing strategies
Students can: Analyse the root of words, prefixes and suffixes. Deconstruct compound words. Compare a literary and scientific text. Brainstorm appropriate and inappropriate language required for writing up an experiment. Explain one phenomenon as a lay person, then as a scientist. Put cut-out paragraphs or steps in a logical order. Predict what will happen based on the reading of a heading, a sentence, a paragraph or a picture. Underline words or phrases that build bridges between ideas or paragraphs. Highlight the hypothesis and conclusions. Use diagrams, figures or charts to draw conclusions or write a text. Create subheadings for each paragraph. Identify causes and consequences. Write a précis or summary. Describe an experiment's purpose, required materials, method, stages, conditions, etc. Write questions a teacher could ask about the text. Role-play and do visualisation exercises to create mental images of scientific processes. Draw out scientific language from three different texts. Develop a glossary of useful scientific terms, and of expressions to be avoided. Review common errors in logic.

FURTHER READING

Woodcock, J.(2005). 'Does the linguistic release the conceptual?' *Teaching History*, 119. London: The Historical Association.