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Supporting students and teachers

to meet the language challenge in content subjects.

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ABSTRACT

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Supporting students and teachers to meet the language challenge in content subjects.

Studies suggest that there is a clear correlation between academic achievement and proficiency in the language of schooling (LPU, 2016). In her discussion on local curricular reform and English Across the Curriculum, Spiteri (2019) argues that a focus on students' literacy skills should therefore be central to Malta's efforts to meet EU achievement targets. This research takes cue from this call and bases itself off the concept of Literacy Across the Curriculum (Bentley-Davies, 2012, p. 5). Firstly, it identifies the literacy requirements of the Science Learning Outcomes Framework and identifies the linguistic challenges of the year 7 coursebook (*KS3 Science, Book 1*). Secondly, it develops ten language scaffold sets designed to accompany this coursebook. Finally, it conducts interviews with four science teachers which reveal a problematic prominence of Maltese in science lessons, an awareness of the lexical difficulties of the subject but a lack thereof in morpho-syntax, a generally positive approach towards all teachers being teachers of language and some willingness towards language sensitive planning. Four conclusions were derived, first, that students need to be supported in viewing English as a tool, rather than a challenge; secondly, collaboration between content and language teachers can ensure that language support does not stop at the lexical level; thirdly, content teachers need to be supported in facing the constraints that incorporating a language focus might pose; and lastly that providing teachers with examples of language scaffolds might be one way of encouraging literacy support across the curriculum.

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Introduction

In the educational context, language is often regarded as a separate curriculum subject existing in and of itself, which means that its role in learning in general is sometimes overlooked. Fortunately, educational organisations and institutions are fast realising the importance of language as a medium for learning in all content subjects. In fact, since 1954, the European Union has been engaged with a Language Policy Programme (LPU) that analyses the role of modern languages both in education and society (Council of Europe, 2020).

A recent recommendation by the Committee of Ministers (CM) is particularly salient, as it expresses 'the importance of preventing underachievement' by drawing 'attention to the key role of language in ensuring fairness in access to knowledge' (LPU, 2016, p. 5). Most importantly, recommendation CM/Rec (2014)5 highlights to member states that 'competences in the language(s) of schooling' are the crux of 'equity and quality in education and […] educational success', adding that language is therefore important 'not just as a separate subject in school, but in all subjects across the curriculum' (LPU, 2016, p. 5).

The focus on languages in recent years is a timely one as several European countries, including Malta, are becoming increasingly multicultural (NSO, 2011, p. 116). This automatically leads to a greater variety of languages being spoken amongst Malta's population, adding pressure on local education systems that had historically catered for Maltese-speaking cohorts. The challenges these new linguistic settings pose to schools seem to be worldwide, and not all education systems have managed to come to grips with them just yet. As Piccardo states, 'the monolingual vision and habit […] still characterizes our societies and education systems, even in countries in which a plurality of languages is codified at the institutional level' (Piccardo, 2016, p. 16). In the face of such linguistically diverse populations, education systems have the important responsibility of educating students into becoming 'plurilingual people, citizens who are not afraid of differences and of various forms of linguistic and cultural contacts, but who see them as a natural social process and as a potential richness' (Piccardo, 2016, p. 16).

Unfortunately, it might be difficult to promote a positive attitude towards language diversity if languages are seen as obstacles rather than tools. In Malta, such a negative attitude might be especially fostered in learners with diverse language backgrounds (Maltese included), who are struggling to build a solid foundation in content subjects being taught in a language (English) that is often not their first.

The local context: Introducing the problem

English as the language of schooling

The language of schooling is defined as 'the dominant language of instruction in school, which is normally the main national or regional language' (Language Division Unit, 2016, p. 8). It is described by the Language Policy Division (LPD) of the Council of Europe (CoE) as having two dimensions: the first being language as a 'system of signs' which 'can be studied as an object in itself' and the second being its role in the exchange of knowledge in all content subjects (LPD, 2009, p. 3). As the LPD (2009, p. 3) expresses, 'pupils and teachers talk, read, and write within the learning processes and pupils need to master language to demonstrate their knowledge in most school subjects'.

The Language Policy Unit (2016, p. 13) has written extensively on 'the role of language in knowledge building' and the centrality, therefore, of 'the relationship between language and thinking' in the learning of 'all subjects.' It is for this reason that special attention is being given to the mastery of the language of schooling. More than ever, teachers are being encouraged 'to support pupils in mastering the specific language competences that their school disciplines demand', reason for which it is being suggested that 'pre-service training courses focusing on the language dimension should be offered to all teachers, and not only to future language specialists, and that such courses should be made mandatory in the long run' (LPU, 2016, p. 8, p. 120).

In Malta, despite the fact that the predominant home language is Maltese (fluently spoken by 93.2% of the population in comparison to the 60% who self-assess themselves as fluent in English, NSO, 2011), English remains an important part of the language of schooling. This is due to the fact that 'a number of subjects' are 'taught and assessed at secondary level mainly in English with books, notes and examinations set in English' (Mifsud & Farrugia, 2017, p. 84). This mismatch between the school and home language is not the norm as the language of schooling is usually equated with the 'mother tongue' of the country (Maledive, Council of Europe, 2020).

A 2016 publication by Camilleri Grima confirms the paradoxes of this dyad, as teachers resort to Maltese to mediate the difficulties that the English language poses for certain students. 'English', she writes, 'has retained an almost exclusive role in reading and writing, while Maltese fulfils fundamental pedagogical functions in classroom interaction' (Camilleri Grima, 2016, p. 207). This confirms a continued trend from the past, as a previous study by Camilleri Grima reveals, for instance, that teachers in Maltese schools feel that English is an appropriate medium of instruction only with 'higher-ability learners' (Camilleri Grima, 2002, p. 115). To facilitate learning for students struggling with sometimes quite complex concepts in their second language, teachers have had to resort to techniques such as code-switching and direct translation. In fact, all teachers interviewed in the study by Camilleri Grima (2002, p. 117) claimed that 'it is necessary to explain the lesson in Maltese to a lesser or greater degree' to avoid students feeling 'lost' and to overcome the language barrier. This is echoed in Mifsud & Farrugia (2017, p. 97), whose research revealed that 'in state schools, 12–13-year-old students were being taught science predominantly in Maltese' despite the fact that 'reading and writing as well as formal assessment were in English'. Camilleri Grima (2016, p. 177) describes how this 'shifting from one language to another to satisfy social and pedagogical conditions results in translanguaging', that is, the 'drawing on all of one's linguistic resources.'

In recent years, translanguaging has been suggested as a way to include students' first languages in the classroom and allow them to strengthen their literacy skills in their entire language repertoire. Translanguaging was first born as 'a purposeful cross-curricular strategy for 'the planned and systematic use of two languages for teaching and learning inside the same lesson' (Conteh, 2018, p. 445). Nowadays, however, it is being employed not only in bilingual settings, but also in multilingual ones, where students and teachers are being encouraged to draw from a plurality of languages in written and oral interaction (García, 2009; Blackledge and Creese, 2010, Canagarajah, 2011; García and Kano, 2014). Translanguaging activities may involve teachers encouraging students to use their first languages during research or production tasks, after which they would be tasked to collaboratively translate their work to the target language (Mertin, 2018).

Although this approach is replete with benefits, it still does not address the fact that ultimately, students need to be proficient in certain valued registers, which unfortunately, do not always correspond to the home language. As Jaspers (2018) well argues:

> [Teachers] have to navigate a single ideology that values the opposing themes of transparent communication and emancipation through a collective standard variety on the one hand, and respect for individual difference, freedom of expression and equality (of languages, among other things) on the other (p. 6).

To be proficient in this 'standard variety', as Jaspers calls it, often means proficiency in the language of schooling, which is what will secure academic success and good job prospects. An additional issue with translanguaging is its reliance on techniques such as translations, code-switching and code mixing (Garcia, 2014). These might not be ideal in Maltese classrooms which now have an extra layer of language diversity due to the influx of immigrants from European and African countries. Statistics released by the NSO for the scholastic year 2017/2018 show, for instance, that 'foreign children [made] up 11.1% of Malta's school-age population' (Sansone, 2020, para. 7). It is evident, then, that resorting to Maltese to support students overcome the difficulties posed by English might no longer be the most inclusive practice.

Academic literacy: An additional hurdle

The challenges posed by the language of schooling become even greater if one takes the concept of academic literacy into consideration. This is defined by the Education Policy Division of the CoE (2016, p. 8) as 'language proficiency that [is] valued and required by the school', which goes 'beyond the spontaneous and generally informal language used in everyday social life of most pupils.' In fact, academic literacy includes the 'ability to communicate competently in an academic discourse community,' a skill which encompasses 'reading, evaluating information, as well as presenting, debating and creating knowledge through both speaking and writing' (Wingate, 2016, p. 350). This gives birth to a 'hidden curriculum' which poses a challenge even to students whose home language is the same as the language of schooling. One can imagine how much more challenging being academically literate can be when competence in the language of instruction ranges from excellent to functional to minimal in Maltese secondary schools.

It might be the case that the issues outlined above are the reason behind some of the problems that Maltese education is currently facing. The *Language Education Policy Profile* (LEPP) for Malta (2015) describes how 'school and university educationalists on the National Languages policy in Education Committee' and Maltese 'college principals, Directors of Education and Education Officers' have observed a 'decline in higher level language use' (LEPP, 2015, p. 29). The same concern was also shared by the 'language associations' ESU (English Speaking Union) and KNM (Il-Kunsill Nazzjonali tal-Ilsien Malti) (LEPP, 2015, p. 29). Other problems, such as pupil failure and drop out add to the pool of issues that must be tackled. Such concerns are unfortunately backed up by international surveys such as PIRLS, the results of which show that the percentage of 15-year-old low achieving students in Malta is significantly higher than that of their European counterparts' average (36.3% compared to 19.7%) (LEPP, 2015, p.30). It is suggested, in the LEPP, that such issues are made even 'more pressing by the challenges of bilingualism' (LEPP, 2015, p. 29). The same document asserts that the priority in language education policies should be that of ensuring 'that language problems of any kind' are not 'an obstacle to the potential for pupils to learn or to express themselves' LEPP, 2015, p. 41). 'This', the authors continue, 'is the minimum condition to ensure that learning takes place' (LEPP, 2015, p. 41).

Addressing the challenges

The National Minimum Curriculum Framework (2012)

Starting from the premise that Maltese and English are 'core languages' in Maltese society and education (NCF, 2012, p. 34), local policy makers have addressed literacy and language concerns in a variety of ways. One of the major aims of the National Curriculum Framework for All (NCF), for instance, is that of developing in students 'mastery in Maltese and English'. This objective has been at the roots of Maltese education ever since the publication of the National Minimum Curriculum (1999), whose tenth principle clearly states that 'bilingualism' (defined as the 'effective, precise and confident use of the country's two official languages: Maltese, the national language, and English'), is 'the basis of the educational system' and is therefore a 'goal' to be reached 'by the students by the end of their entire schooling experience' (NMC, 1999). Additionally, the NCF acknowledges how new multicultural contexts have changed the language dynamics in classrooms, and states that 'Malta has become a multi-cultural society and that all schools should be in a position to provide children and their parents with language support in Maltese and English' (NCF, 2012, p. 4).

The Learning Outcomes Framework

The recent replacement of the traditional syllabi with the Learning Outcomes Framework was also a timely response to these growing issues. All content subjects now have learning outcomes related to literacy skills, subdivided into 'listening and speaking', 'expressive language', 'reading and understanding', 'writing', 'accuracy' and 'planning and reflection' (MEDE, 2015, pp. 70-71). The rationale behind the integration of literacy LOs is the belief that 'literacy development' requires 'a whole-school approach […] in which a community for literacy is promoted throughout the curriculum' (MEDE, 2015, p. 70). Although this is definitely a step towards the right direction, it has also brought about a novel situation where content subject teachers are being faced with LOs that are normally in the realm of language teachers. In the Year 7 LOF for Core Science, for instance, we find an 'expressive language' LO, which sees students '[developing] a presentation to convince [their] peers that eating healthily has a positive effect on our bodies including our circulatory system'. Whereas this LO surely requires content subject knowledge, its achievability is equally reliant on the possession of the right language tools for presenting a convincing argument, such as relevant discourse markers (additionally, however, furthermore, etc.) and phrases (I believe that…, in my opinion, etc.).

A National Literacy Strategy for All in Malta and Gozo (2014-2019).

This project, which spanned a period of five years, sought to analyse the literacy needs of diverse communities in Malta, these being children in the first, early, junior and secondary years; youths; adults; children with learning difficulties and disabilities; and third country nationals (MEDE, 2014). In the publication outlining this strategy, each of these groups' needs were identified, goals were established, and ways to reach these goals were suggested. With regards to secondary school students, which is the age group that is of major interest to this dissertation, the document highlights how despite the fact that by school leaving age, a student is 'expected to read and write fluently and independently, have high levels of expressive and receptive language and use language in a correct manner', this is not reflected in reality (MEDE, 2014, p. 38). Instead, far too many students are leaving secondary school 'with low levels of reading comprehension and writing skills', which prevents them from successfully moving on to further education and to 'cope with employment and daily activities' (MEDE, 2014, p. 38). In order to strengthen the literacy skills in the teenage years, the policy gives multiple recommendations, the most salient of which are the following.

Recommendation 35, for instance, suggests that 'learners who are struggling with literacy may be provided with additional sessions by specifically designated tutors.' (MEDE, 2014, p. 39). There are a number of issues with such a pull-out model, particularly because additional sessions often take the place of other lessons or else need to be provided after school hours, the latter of which is not ideal for a student who has just had to sit through a whole day of classes. Should it be during school hours, there is also the issue of needing more staff to provide all of these students with personalised tutoring. Finally, and perhaps the most problematic of all, the majority of students, who will not be present in the tutoring session, might miss out on important training which could benefit their literacy skills as well. Research shows, in fact, that all students, even 'strong' ones, will benefit from a language focus in content subjects. Meltzer & Hamann (2005, p. 55) write:

> Readers who are competent in one or more areas may struggle with written materials in other areas (an excellent English student may struggle with her science textbook, for example). Even our strongest students require vocabulary development […]. In a real sense, all such students are learners of English.

Other noteworthy recommendations in the *National Literacy Strategy for All* discuss how special attention must be given to underperforming students following the PISA (2009+) results; how pre-service teacher training needs to include a focus on literacy; how the syllabus should be shrunk to allow for more 'Reading Time'; and how Content and Language Integrated Learning (CLIL) should be adopted, thereby involving the teaching of content subjects 'exclusively through English or Maltese' (pp. 39-40).

As of yet, there is no research on whether these suggestions have been implemented and to what extent. Furthermore, the suggestion to use English or Maltese 'exclusively' in a content lesson (with students who could possibly be struggling with the languages themselves) does not come without several implications. The question that arises, at this point, is this: If one had to follow the guidelines recommended by the National

Literacy Strategy for All, how could a non-language subject teacher help his or her students develop their literacy skills, while simultaneously looking out for underperforming students and covering the content required using exclusively English or Maltese?

This study

Rationale

This research stems from the need to answer this question, but also from the recognition of three major issues in education globally, which are core to the Maltese context just described: 1) the heavy language load faced by students whose language of schooling does not match their home language; 2) the difficulties faced by content subject teachers who might not possess the linguistic confidence / know-how to tackle student literacy needs, and; 3) the lack of material (hard resources, clear guidelines) existing locally for how teachers should address the specific language needs of the subjects they are teaching. While much has been written about the need to improve our students' literacy skills, unfortunately there is still very little material provided to teachers so that they may effectively implement the recommendations outlined. This research suggests that one way of tackling the problems identified so far, is by following pedagogical models where English as a Medium of Instruction (henceforth EMI) is paired with language-sensitive lesson planning (LPU, 2016). This, it proposes, provides the language scaffolding required for all students to be able to not only follow the lesson successfully, but also to strengthen their literacy skills across the curriculum.

Research question

The main question that this research addresses is: 'How can content subject teachers design language-sensitive lessons to improve students' academic literacy skills?' To answer this question, this research first discusses the language demands that the Science subject poses on Year 7 students in Maltese state schools. It outlines the language load present in the curriculum, and then develops ten sets of language scaffolds which integrate both content and language aims. These lessons are then presented to five science teachers from State schools around Malta, who are interviewed on their perceived efficiency of pairing language sensitive planning with EMI. This, in an attempt to answer the second research question, that is: 'What are science teachers' responses to language sensitive planning and delivery?' The interviews also seek to present teachers' opinion on the changing educational landscape in Malta, so as to answer a third research question: 'How are science teachers in Maltese state schools experiencing the increase of multilingual classrooms?'. Set sections in the dissertation provide further information on the literature that informs this study and the methodology adopted to conduct the research. Finally, the conclusion presents a summary of the findings, together with suggestions for further research and recommendations moving forward.

Conclusion

Ultimately, this research seeks to provide a concrete, practical, example of how content teachers may be supported by language specialists in scaffolding the linguistic load that students encounter in specific subjects. Through such cross-curricular collaboration, students who are failing to fulfil their potential in content subjects because of undeveloped language competences may be able to strengthen their literacy skills, which will serve them not only in class, but also beyond. As Spiteri (2019, p. 200) puts it: 'The pivotal role of language in education becomes critical and is tied to issues of equity and social justice in contexts where the language of the home and the school are different' as is the case in Malta. At the end of the day, making *the language of schooling* accessible to everyone equates with rendering *learning and education* accessible to everyone. Unfortunately, although this is a scenario aimed for by all educators and educational institutions, it might not be reflecting reality under the present circumstances.

The next chapter gives an overview of the literature on which this research is based, ranging from academic literacy to the genre-specific language needs of science as a content subject. It provides an overview of three models on which the material development aspect of this dissertation is founded, namely SIOP (Sheltered Instruction Observation Protocol) R2L (Reading to Learn) and LDIAS (the Language Dimension in All Subjects). This is followed by the third chapter, which discusses the methodology adopted during data collection and the theoretical paradigms that inform this dissertation. In the fourth chapter, the interview results are presented and discussed, and conclusions are derived about the effectiveness and practicality of the language scaffolds presented to the participants. Finally, the conclusion provides an evaluation of the whole study together with critical analysis of the results obtained and suggestions for future research.

Chapter two: Literature review

> *Mastering the language of schooling is essential for learners to develop the skills necessary for school success and for critical thinking. It is fundamental for participation in democratic societies, and for social inclusion and cohesion. (Language Policy Unit, 2016, p. 5)*

Introduction

In the introduction to this dissertation, three language-related challenges were identified in the local educational context. These were: i) the difficulty that arises when the language of schooling is not the same as students' home language, ii) the difference between basic proficiency and academic literacy, iii) the limitations of code switching, code mixing, and translation in plurilingual classrooms. In this chapter, a fourth and major problem is elaborated upon, this being the genre-specific language difficulties that Science poses.

The first section of this chapter reviews literature related to language of schooling and academic literacy. Firstly, the importance of these two elements in student academic success is outlined, shifting then towards the language load of science, which is the subject chosen for the resource development aspect of this dissertation. This will then be followed by a discussion of three different methods that have been effectively employed in order to deal with language and literacy issues across the curriculum, namely 'Sheltered Instruction Observation Protocol' (SIOP), 'Reading to Learn' (R2L) and 'The Language Dimension in All Subjects*'* (LDIAS), all of which fall under the greater umbrella of 'Literacy Across the Curriculum' (henceforth, LAC). Finally, the last section will focus on this research, describing its connection to other studies and commenting on the usefulness of material development studies.

Language of schooling and academic literacy

Perhaps the best way to understand the importance of the language of schooling in education is by considering the 'tripartite' nature of the curriculum, which consists of 'academic, social, and *communicative* demands' [italics mine] (Verplaetse 2000, p. 33). The latter aspect represents the way in which language is embedded in all subjects across the curriculum, spanning from communication needs in the classroom (teacher instruction, student questions and answers, teacher feedback, etc.) to study materials (teacher's notes, text and workbooks, additional information on the internet, etc.) to assessment methods (written / oral tests and examinations). The language dimension in all subjects is acknowledged by policy makers even in the European context, as recommendation CM/Rec(2014)5 of the Committee of Ministers to member States […] highlights the importance of language not just as a separate subject in school, but in all subjects across the curriculum' (LPU, 2016, p. 5).

Meltzer & Hamann (2005, p. 36), explain how 'successful academic achievement and lifelong learning depend on a student's ability to effectively use language to analyse, synthesize, and evaluate'. These language functions manifest themselves in all content subjects (for example, science, biology, history, geography, etc.) as students are required to engage with the material provided by making judgements, comparing information, asking questions, and finally being able to communicate that which has been learnt through the production of texts, projects and presentations. In the content subject class, students must 'be able to read and understand […] textbooks and reference materials, write persuasively, argue points of view, take notes from teacher lectures or internet sites and articulate their thinking processes' (Echevarría, Vogt & Short, 2017, p. 14).

Competence in the language of schooling is a determining factor for academic success. This has been proven by 'international language benchmarking initiatives (PISA, PIRLS)' which have declared language proficiency to be an 'intervening factor in learning in all areas' (Lorenzo & Meyer, 2017, p. 153). Because of this, the Language Policy Unit (LPU) of the Council of Europe (CoE) has been taking a special interest in what it has perceived as a 'language deficit in many European education systems' (Beacco, 2017, p. 157). There is, in other words, a general agreement across the literature that proficiency in the language of schooling is the crux of 'schooling for equity and quality in education' (LPU, 2015, p. 5).

As discussed briefly in the first chapter, struggles of learning a content subject are rendered even greater when the language in which it is being taught is not a language in which students are competent. Lack of proficiency in the language of schooling might mean students are placed in lower tracks where it is the content that is reduced or simplified, rather than the language in which it is being taught. Such banding is especially ineffective considering that a language focus in content subjects benefits not only those struggling with the language of schooling, but also those who are fluent in it. This is reaffirmed by the LPU (2016, p. 48) with regards to academic literacy, as they write how programmes designed to teach this through 'separate and special courses […] have proved to have little sustainable effect.' What has shown 'promising results', instead, are 'programmes that integrate the language dimension into subject-specific curricular planning and teaching routines' (LPU, 2016, p. 48).

A brief note on academic literacy here can further clarify its difference from the more general 'language of schooling'. Academic literacy encompasses three major components, these being: knowledge of the language of schooling, knowledge of the content being taught, and knowledge of the way assigned tasks are successfully undertaken (Short, 2002). As discussed in the introductory chapter, the first component, that is, knowledge of the language of schooling, goes beyond being fluent in everyday speech, and includes 'the use of higher-level vocabulary, more complex sentence structures, and more sophisticated forms of expression' (Echevarría et al, 2017, p. 13). The second component, that is knowledge of the content being taught, is related mostly to learning that occurs in the specific subject lessons, for instance the concept of 'photosynthesis' in science. Finally, knowledge of the way tasks are successfully undertaken relates to specifically teaching 'the procedures for accomplishing the task'. Short (2002, p. 19) explains for instance, how, one cannot simply ask students to create a 'timeline' without explaining how to do so. Similarly, one cannot expect a science student to hypothesis what will happen in an experiment if one does not equip him / her with the structure for writing a hypothesis.

The tripartite nature of academic literacy means that it is sometimes considered as 'a second language for all students' including those whose home language is the same as the language of schooling. Furthermore, it means that these difficulties could be twofold for those whose language of schooling is not their home language (Echevarría et al, 2017, p. 13). Meltzer & Hamann (2005, p. 30) note for instance, that when attempting to develop competence in academic English, language learners often 'rely heavily on oral language features', which renders their writing 'less fluent', 'less accurate' and 'less effective'. Additionally, Schleppegrell (2004, p. 107), notes that English Language Learners (ELLs) overuse 'because' clauses, leading their writing to appear 'illogical', 'informal' or 'underdeveloped'. Learners, she suggests, should be made explicitly aware of the conventions of academic language, and need to be trained in developing their academic literacy skills (Schleppegrell, 2004). This is reiterated by Echevarría et al. (2017, p. 12), who state that 'programs that do not accommodate the time needed for acquisition of academic language do the students a disservice'.

An additional layer of difficulty is added when one introduces the concept of 'disciplinary literacy', which refers to the language demands specific to different content subjects. Reading and producing texts from different content areas might require a diverse set of skills. Duke and Martin (2015, p. 235) argue, for example, that even the most basic level of text understanding, that is 'comprehension', is 'genre-specific to a significant degree', and 'the ability to comprehend one genre well does not guarantee proficiency at comprehending another genre'. They explain how 'the purpose and characteristics of the genre influence the processes involved in successfully comprehending it' (Duke & Martin, 2015, p. 235). One can see, therefore, how important it is for teachers to nurture genre-specific language knowledge in their students.

This is reiterated by the LPU (2016, p. 12) which explains how different reading strategies may be useful when reading different text types. Skills such as 'browsing [and] reading visual clues', for instance, are handier when reading a magazine article rather than a technical report, which instead requires 'engaging prior knowledge, using knowledge of the likely structure [and] focusing on detail' (LPU, 2016, p. 12). The same goes for writing about a 'science experiment, a field visit for geography, or a drama presentation'; all of these require the literacy skills of their specific disciplines. The situation is no different for science, whose genre-specific literacy demands this research is based upon. The following section is dedicated to outlining the literacy demands of science, an analysis which is foundational to the language scaffolding proposed in the material developed.

Disciplinary literacy in the context of science

Disciplinary literacy is defined as 'the use of reading, reasoning, investigating, speaking and writing required to learn and form complex content knowledge appropriate to a particular discipline' (McConachie & Petrosky, 2010, p. 16). Closely connected to 'content-area discourse', it refers to knowledge of how 'the "big ideas" within a discipline are organized and connect' (Meltzer & Hamann, 2005, p. 48). In other words, to be familiar with the genre-specific literacy of a particular subject means to have access to 'the kinds of resources, tools, and strategies used to think about that discipline; the spoken and written conventions of presentation in that discipline; and the understanding of how to carry out inquiry in that content area' (Meltzer & Hamann, 2005, p. 48). Furthermore, to be familiar with the genre-specific literacy of a particular subject means to be aware of 'context, meaning [and] purpose' of the texts within that subject (LPU, 2016, p. 13). In the light of the above, one can see how cognitive and linguistic development seem to be intricately linked, which proves problematic when considering that in '[m]ost educational systems around Europe, there are 'a considerable number of students who are unable to profit from mainstream education because of their lack of basic skills in the dominant language of schooling' (LPU, 2016, p. 21).

The link between language and learning is of course just as evident in the science subject. This has been highlighted not only through the various research that has been carried out on the nature of the science-specific language load (which shall be explored in the following paragraphs), but also by the fact that students who struggle with the language of schooling are found to lag behind in science, partly due to its 'very specific "dialect"', separate from 'the general academic variety of the dominant language of schooling' (LPU, 2016, p. 73). Fradd & Lee (2001, p. 480), claim for instance, that there exists a very real gap between 'mainstream and non-English language background' students, the latter of which might be fluent enough in daily conversation, but might still be coming to grips with the specific literacy requirements of the subject. They proceed to argue, in fact, that although there is an evident need for specific literacy instruction in the science classroom, these are not catered for in the material developed nor in the lessons provided (Fradd & Lee, p. 480, p. 492).

The question that might follow at this point is: 'What are then, these specific language needs that the science subject calls for? The first set of language needs is related to the process of 'inquiry', deemed by the US National Research Council as the 'heart of science and science learning'. The process of inquiry involves a variety of language functions, as can be discerned from the National Curriculum Framework for All (NCF, 2012). This document describes the acquisition of scientific 'inquiry and critical thinking skills' in terms of students' ability to '*ask* appropriate questions, devise methods for *answering* them, obtain and *interpret* evidence and *communicate* the conclusions and reasoning that led to them [emphasis mine] (NCF, 2012, p. 35). Additionally, students are expected to be able to ‘use their observations to *explain* concepts, principles and theories, and use their skills to *elaborate* on explanations using *appropriate scientific language* and techniques such as tables, charts and mathematical methods’ [emphasis mine] (NCF, 2012, p. 35). The above statements clearly prove the close connection between language and scientific inquiry, as many of the goals set for students at secondary level involve a variety of language functions such as questioning, interpreting, explaining, elaborating, all the while adhering to the ‘appropriate scientific language’ (NCF, 2012, p. 35). Additionally, one might point out that content related LOs which make use of terminology such as ‘to name, define, write, compare, tell, […] illustrate, hypothesize, appreciate, evaluate, argue, deduce, refute, [and] quantify’, all require the mastery of different language forms (Beacco, 2017).

Scientific language is also unique in terms of genre. Whereas normally, students would be accustomed to reading narrative or anecdotal texts, scientific writing is usually ‘factual, hierarchically organised […] and dense’ (LPU, 2016, p. 74). Procedural language and logical connectors are of special importance as with ‘lab directions and reports.’ The same publication outlines how the language load in science encompasses everything from the lexical level, involving the most basic components of language (vocabulary items such as ‘technical terms’ and ‘nominalisations’) to the ‘morpho-syntactical level’, where students encounter such language items as ‘expanded noun phrases, extended [attributive] clauses and subordinate clauses’ (LPU, 2016, p. 74). These provide a challenge at the reception stage, when students are actively grappling with expository texts to gather information, but more so at the production stage, when students must create artefacts which follow the conventions that the genre demands, such as a lab report or a description of a scientific process.

Language analysis of scientific texts has shown that there are specific features which characterise the genre, as summarised by Beacco (2017, p. 167). There is, in scientific discourse, a predominance of indirect speech, with a preference for impersonal and pronominal forms and the use of the passive voice without agents (for instance, ‘it has been proven that…’). Additionally, when presenting or analysing data, quantifiers are often used in conjunction with ‘indefinite or appreciative expressions’ such as ‘a little under half’, or ‘a large number of', etc. The conditional tense is an important contributor to scientific language when presenting possible or probable scenarios, as are quantitative expressions such as 'more often than not' and 'generally' when discussing phenomena and experiment results. Finally, 'expressions of obligation or norms', such as 'we have to' and 'we should' also feature strongly in science reports, particularly when giving recommendations at the end of studies or experiments (Beacco, 2017, p. 167).

The pedagogical response to the language load of content subjects

There is a vast literature covering the issues tackled above and an equally large number of different methods that have been adopted globally in response to the language problem in schools. However, before delving in detail into three of these models (SIOP, R2L and LDIAS), it is pertinent to discuss the umbrella term that connects them all, that is, LAC.

Literacy Across the Curriculum (LAC)

All of the issues described above are, in some way or another, connected to the concept of literacy. LAC is based around the notion that literacy is crucial to student success because it is the key to access all areas of the curriculum (LPU, 2016, p. 5). LAC proposes the integration of a language focus and content in content subjects, through the planning and structuring of language activities into content classrooms (Tan, 2011, p. 327). One way for LAC to be implemented is for teachers to adopt 'strategies characteristic of (English) language teaching to explicitly address the language demands inherent in their discipline' (Spiteri, 2019, p. 203). Pedagogical approaches that operate within the LAC concept consider the language demands of their specific subjects and include activities that strengthen students' literacy skills. This, in turn, allows learners to read and produce texts that match the target genre (be it scientific, historical, sociological, etc.) Ultimately, the goal of LAC is to increase students' ability to engage in 'thoughtful reading, writing, and discussion' within their content subject and be able to succeed in formative and summative assessments (LPU, 2016, p. 22). Proper academic language use is the 'most reliable foundation for success in school, for success in subject learning and success in society at large after graduating from school' (LPU, 2016, p. 22).

As with any other pedagogical approach, the adoption of LAC depends greatly on educators' input. Teachers should be aware of the language demands of their subject, of the literacy level of their students, and of the activities that would most enable their learners. The role of teachers in LAC begins at the preparatory level. Teachers start off by extracting the language demands of their subject, something which is often familiar subconsciously, but perhaps not explicitly tackled. By making this 'tacit knowledge explicit', teachers become aware of which language components must be incorporated in their lessons and can then plan accordingly. In this manner, educators start an important process where they bring students' 'personal epistemologies' closer to the language required of that particular discipline (Briguglio & Watson, 2014, p. 71) There is also an important shift in mindset involved, whereby teachers realise that possessing the bricks (content) in a language is worth little to nothing without having the mortar (language) to piece it all together. Whereby traditionally, teachers may have asked themselves: 'How can I ensure that student knowledge in my content area increases?', now the real questions become, 'How will students in my classes become better speakers / writers / readers of math / social studies / science / business / art as a result of being in my class?' (Meltzer & Hamann, 2005, pp. 54-55) and 'How will students be supported to *think* "like a mathematician or geographer or scientist"?' (Spiteri, 2019, p. 201). Research suggests that the success of such higher cognitive learning, 'hinges on an ability to access and use the specific linguistic features associated with the disciplines,' which in turn 'encourages learners to make connections beyond the classroom and the school subject to the wider context outside the school' (Spiteri 2019, p. 201).

Multiple practices are associated with LAC, some of which overlap and feature in different pedagogical models. Meltzer & Hamann (2005, p. 10) give a good summary of what implementing LAC involves. Teachers must, first and foremost, be supported throughout the process and provided with ongoing professional development. Once they are sufficiently trained, teachers can practise analysing and recognising discourse features which are prominent in their discipline and consequently make their students aware of them. Additionally, LAC also involves having learner-centred classrooms so as to enhance student motivation to read and write. This involves connecting content with students' prior knowledge, having students work in pairs and in groups, and having interactive lessons in general, all of which provides students with the opportunity to not only read, speak and write about the subject but also to properly *think* about it. Embedding 'Reading and Writing

Across the Curriculum' is another strategy that goes hand in hand with LAC. Including a time dedicated specifically to silent reading within the curriculum has been proven to build a 'positive literacy culture' (Meltzer & Hamann, 2005, p. 27). Ways to render reading time more productive include activities such as 'two-column note taking', use of 'graphic organizers', 'recognition of text features' and 'study strategies such as outlining, coding, or underlining' (Meltzer & Hamann, 2005, p. 37).

A study which shows the effectiveness of having a literacy focus in bilingual classes is the one carried out by the Valle Imperial Project in Science (VIPS) in the US (Amaral et. al, 2002). In this project, teachers were professionally trained to teach science through inquiry and implemented scaffolding techniques which allow students to move from guided to independent production. In this project, tenets of LAC were utilised, paired with translanguaging, to allow students to develop both content knowledge and literacy skills. Teachers for instance, developed students' vocabulary by naming items being distributed from the science kit and by keeping a vocabulary bulletin board for each unit, which the students copied down in their notebooks. Students were encouraged to carry out observations in pairs and generate questions in response, aided by visual and linguistic cues provided by the teacher in either the home (in this case Spanish) or school language (English). Furthermore, learners were routinely tasked with writing their observations down in their science notebooks, so as to further develop their 'cognitive abilities and linguistic proficiency at all levels' (Amaral et al., 2002, pp. 235-236).

This is just one example of how LAC may be implemented, however there are other methods that have been developed throughout the years (Windyaningrum & Arini, 2016; Lambert, 2018; Fradd, Lee & Saxton, 2001; Shores & Smith, 2001). As briefly mentioned before, this study homes in on three models which have been successfully implemented in multiple contexts, these being: Sheltered Instruction Observation Protocol (henceforth SIOP), Reading to Learn (henceforth R2L) and the techniques recommended by the LPU in the Language Dimension in All Subjects (henceforth LDIAS). The approach taken by SIOP, R2L and LDIAS are foundational to the language scaffolds developed in this study, which will be based off techniques and activities that have been tried and tested within these three models.

Sheltered Instruction Observation Protocol (SIOP)

The SIOP is a US-based model which stemmed from the growing awareness of the schooling inequalities between (English Language Learners) ELLs and native speakers of English. In the US, ELLs refer mostly to Hispanic, Latino and Asian students who are attending language instruction programmes which will allow them to attend public schooling (US Department of Education, 2014). Although this is different from the Maltese context, a strong parallel may be drawn between the two, which renders the methodology adopted in US schools valuable to this study. In fact, the techniques utilised by SIOP with ELLs to scaffold the language challenges in content subjects may very well be transposed to the local context, where some Maltese and non-Maltese learners might not be sufficiently competent in the language of schooling.

Another element that prompted the creation of SIOP was the distinction made between BICS (Basic Interpersonal Communicative Skills) and CALP (Cognitive, Academic Language Achievement). Whereas the first set of skills, which refers to the use of language for social and everyday purposes, may be acquired by learners of English within one to three years, it may take between four and seven years to achieve the latter and this may never happen without explicit instruction (Echevarría et al, 2017, p. 12). The difference between these two aspects of language is also acknowledged by the Language Policy Unit of the CoE (2016, p. 46), which states that 'bilingual students (with a migrant background) acquiring the dominant language of schooling as L2 as well as monolingual students from educationally distant families of low socio-economic status' benefit from 'authentic opportunities to extend [their] command of language beyond the needs of everyday out-of-school interaction'. Similarly, in Malta, students might have ample exposure to conversational English (be it through television, music or interaction with English speakers) but might still need to strengthen their English for academic purposes.

The goals of the SIOP model, therefore, are to elevate content-subject knowledge levels for ELLs and English native speakers through 'integration of academic language as used in the specific subject area' (Echevarría et al, 2017, p. 16). It may best be described as a 'lesson planning and delivery approach', officially developed in the year 2000 after a seven-year research study entitled 'The Effects of Sheltered Instruction on the Achievement of Limited English Proficient Students (Echevarría, Vogt & Short, 2000). For twenty years, SIOP has been present in schools and has been giving results with students coming from different social backgrounds and who possess different skillsets (Echevarría et al, 2017, p. 24).

Thirty features make up the SIOP strategy, which may be grouped under eight main categories (figure one). The first, 'lesson preparation', is self-explanatory, and involves the planning ahead of both content *and* language objectives, together with activities that will support these goals. The second category is 'building background' and it involves linking material presented in class with students' prior knowledge. Activating students' schema is a basic component of SFL teaching and has been proven to not only increase motivation but also to elevate the quality of engagement and provoke deeper thinking (Roe, B. D., Smith, S. H., & Burns, P. C., 2008). Thirdly, SIOP advocates for 'comprehensible input', whereby teachers adapt their speech to the students' level and use 'multimodal techniques' when presenting new concepts. This is followed by the fourth component, 'strategies', which refers both to the implementation of scaffolding strategies by the teacher, but also to the explicit teaching of studying, reading, and writing strategies to students. The fifth category, that is, 'interaction', is tied to the sixth, 'practise and application'. Students are given the chance to work together and are grouped in such a way as most benefits their language and content development. The seventh, 'lesson delivery', refers to the actual presentation of the lesson and the meeting of all set objectives. Last but not least is the 'review and assessment' component, which in SIOP, focuses mostly on formative assessment and ways in which the feedback garnered from this leads to either a review of the concepts covered or progression to the next aim (Echevarría et al, 2017, p. 19). What is striking about the elements of SIOP teaching is that they are qualities that *all* good teaching should possess, and which therefore benefit *all* students, not just ELLs.

Figure 1: The Eight Pillars of the SIOP Model

Concepts such as 'modelling' and 'scaffolding' also play a crucial role in SIOP. Teachers may support students in the production phase by providing 'sentence starters and language frame scaffolds' (Echevarría et al, 2017, p. 21). There is also a focus on what may be termed 'learning to learn', with students being taught how to tackle certain academic tasks, such as 'solving a two-step math problem or conducting research on the Internet'. Incidentally, 'learning to learn' is also one of the cross curricular themes in the NCF (2012). Teachers may also provide suggestions on how to conduct independent studying. Proper interaction in the classroom is also highlighted, with teachers equipping students with the skills necessary for class engagement (such as politely interrupting, asking questions and negotiating meaning) (Echevarría et al, 2017, p. 21).

Merging the SIOP techniques with content subject teaching is not something that can be accomplished overnight. Research shows that teachers successfully and consistently implement such techniques following one to two years of practice and professional coaching (Short, Fidelman & Louguit, 2012). Additionally, a study by McIntyre et al. (2010) suggests that the final success that teachers have with SIOP depends on 'background teaching experiences' and the quality and availability of continuous professional development. It is within the beliefs of this research, however, that providing teachers with model language scaffolds that cater for specific learning outcomes speeds up the learning process and increases willingness to adopt such quality teaching techniques.

Reading to Learn (R2L)

The Reading to Learn approach has its roots in Australia and is the result of intensive studies carried out by educator and researcher David Rose, now director of R2L. Similar to SIOP, it stemmed from concerns relating to the inequalities in literacy skills amongst students from different backgrounds, which in turn led to academic underachievement and reduced job prospects. Differently from SIOP, R2L gives specific attention to differing *economic* social backgrounds and recognises that students from different classes have a different socialisation and might not have access to the skills necessary to succeed at school.

Following Basil Bernstein's (1996) model of education systems as a pedagogic device, Rose (2007, p. 2) argues that during the re-contextualising process (whereby 'specific pedagogic discourses' are formed and subjects and contents are decided upon), schooling is rendered inaccessible to members from certain social strata. For instance, research shows that learners from middle class families enter school having already experienced reading or being read to. Adams (1990) writes how parents from middleclass families spend around one thousand hours of reading with their children prior to them starting school. On the other hand, children from different social or cultural backgrounds might not come to school equipped with such knowledge and may therefore lag behind in this initial crucial stage, a delay which could have repercussions along their whole schooling journey.

Literacy skills are conceptualised by R2L theory as forming part of an 'instructional discourse that is masked by the overt curriculum of subject "contents" (Rose, 2007, p. 4). In other words, beneath the surface of the 'curriculum' there is a 'crypto-curriculum' that largely depends on reading and writing skills, and which ensures that only the most successful students with the highest-level reading skills are able to successfully engage with and ultimately gain from it (Rose, 2007, p. 4). Although this dissertation is not focused on social inequalities, the pedagogy that has been developed as part of the R2L approach offers valuable insights into making demanding texts manageable to students with poor literacy skills or who struggle with the language of schooling.

R2L can be defined as a 'model of formal education that treats reading as its fundamental mode of learning and learning to read as the underlying goal of its pedagogic practices' (Rose, 2007, p. 1). It seeks to use class time to explicitly prepare students to 'read difficult texts with critical understanding' and to succeed in writing assignments (D. Rose, M. Rose, S. Farrington, S. Page, 2008, p. 169). Based on discourse analysis of 'classroom interactions' and 'written texts' that students are expected to produce, the R2L methodology designed a pedagogical approach which aims to '[redistribute' the symbolic resources that are the basis of middle-class occupations, to social groups that are currently excluded by middle class pedagogic practices' (Rose, 2007, pp. 14-15). Such students, who have not had the same reading exposure at home, typically 'reach the limits of their so-called 'abilities' by Year 9', something which R2L seeks to change (Rose, 2007, p. 6) This change is aimed at in all levels of education, from primary, to junior, to high school; where teachers are rarely given the time or resources to explicitly teach reading and writing skills but are instead 'pressured to cover the curriculum content that the syllabus demands' (Rose, 2007, p. 6). Through a focus on LAC, R2L pedagogy aims at democratising schooling by rendering all areas of the curriculum accessible to all students. This is a goal, which according to their action research programme, can be achieved within one year of implementing R2L methodology during two to three lessons a week.

Three phases make up the R2L approach, these being ‘deconstruction’, ‘joint construction’ and ‘individual construction’ (Martin & Rose, 2005). In the first phase the teacher introduces the texts to the student prior to reading it by orienting them to the genre and the field to which it belongs (Martin & Rose, 2005, p. 7). This phase, which is also termed ‘preparing before reading’, involves the teacher summarising the text’s generic components in easy-to-understand terms and may also include the teacher reading the text out loud to the class (Martin & Rose, 2005, p. 7). This is followed by a critical stage called ‘detailed reading’, whereby students engage with the text first-hand. During detailed reading, students go through a three-step cycle, termed ‘prepare, task, elaborate’. In the preparation phase, the teacher paraphrases each sentence in everyday language and explains its relevance to the lesson’s context. Prior to the lesson, the teacher would have also pinpointed the key vocabulary to be learnt during the lesson and might give clues as to meaning of certain words so that students may look up the term within that sentence. This is the task phase, and students might highlight, underline, or make some form of annotation on the text, targeting the key vocabulary that the teacher points out. Finally, during the ‘elaborate’ phase, the teacher goes into further detail on what the words highlighted mean and adds any relevant technical detail. This phase of the R2L programme is designed so that ‘students are given access to the total complexity of language patterns in the text, but in manageable steps’ (Martin & Rose, 2005).

The next two steps are ‘joint construction’ and ‘individual construction’. In the former, students are guided from the receptive to the productive skills as they are made aware of the text structure and asked to rewrite the text, initially following the same patterns present in the original. At this stage, sentence making activities or re-ordering of sentences may be useful especially for weaker learners. The scaffolding throughout these activities is meant to ensure that all learners are successful in the task, and the teacher might choose to conduct such exercises in groups or whole class. In the ‘individual construction’ phase, students are tasked with producing a text following the same language patterns (within the same genre) but using their own experiences or information (Martin & Rose, 2005, p. 9).

This approach has been successfully used in multiple contexts and with students belonging to vastly different cultural backgrounds. In a 2004 study, Rose gives a detailed account of an R2L lesson observed in the South African town of Sobantu, where secondary school students successfully engage with an English text that would have normally been too difficult for them (Rose, 2004). In another study, the R2L approach is used at undergraduate level, with Indigenous health sciences students in Australia, where the quality of written tasks is seen to dramatically improve for students at all levels (Rose, Rose, Farrington Page, 2008). Countries such as China, South Africa and Latin America are also making use of the R2L methodology with some success (Martin & Rose, 2007a).

The Language Policy Unit of the Council of Europe: The Language Dimension in all Subjects (2016)

First published in 2015, The Language Dimension in All Subjects (LDIAS) responded to the growing need in European countries to tackle an issue that had long been pressing on educational institutions, namely, the increased multiculturalism in schools and the associated difficulties that learners were having with the language of schooling. The aforementioned recommendation passed by the CM of the CoE 'on the importance of competences in the language(s) of schooling for equity and quality in education and for educational success' further highlighted the need for a language focus in content subjects, which is at the core of the pedagogy proposed in the LDIAS (LPU, 2016, p. 5).

At the basis of the LDIAS is the concept of scaffolding, which is the idea 'that children use [the educator's] help for support while they build a firm understanding that will eventually allow them to solve the problems on their own.' (Woolfolk, p.90). In the context of language support, '"scaffolding" means that teachers provide 'successive levels of temporary language support that help students reach higher levels of comprehension and skill acquisition than they would achieve without assistance' (LPU, 2016, p. 77) With time, this assistance is slowly reduced, and students gradually become more independent in the learning process.

The LDIAS distinguishes between two different types of scaffolding, these being 'hard', 'systemic' scaffolding and 'soft' 'point of need' scaffolding. The former refers to scaffolding that is integrated within the lesson planning process and structured into the lesson's various activities, whereas the latter is related to supportive actions that arise spontaneously, according to the need of the moment. Although both are extremely important for learner support, hard scaffolding is of particular relevance to this study, whose primary concern is resource development. This type of scaffolding in fact reflects the ways teachers predict in advance what the language difficulties of a particular topic might be and integrate scaffolding techniques within their planning so that students may acquire the content knowledge without interference from the language load. A four-step scaffolding cycle is suggested by the LPU (2016, p. 78), which is being reproduced in figure two (below) for ease of reference.

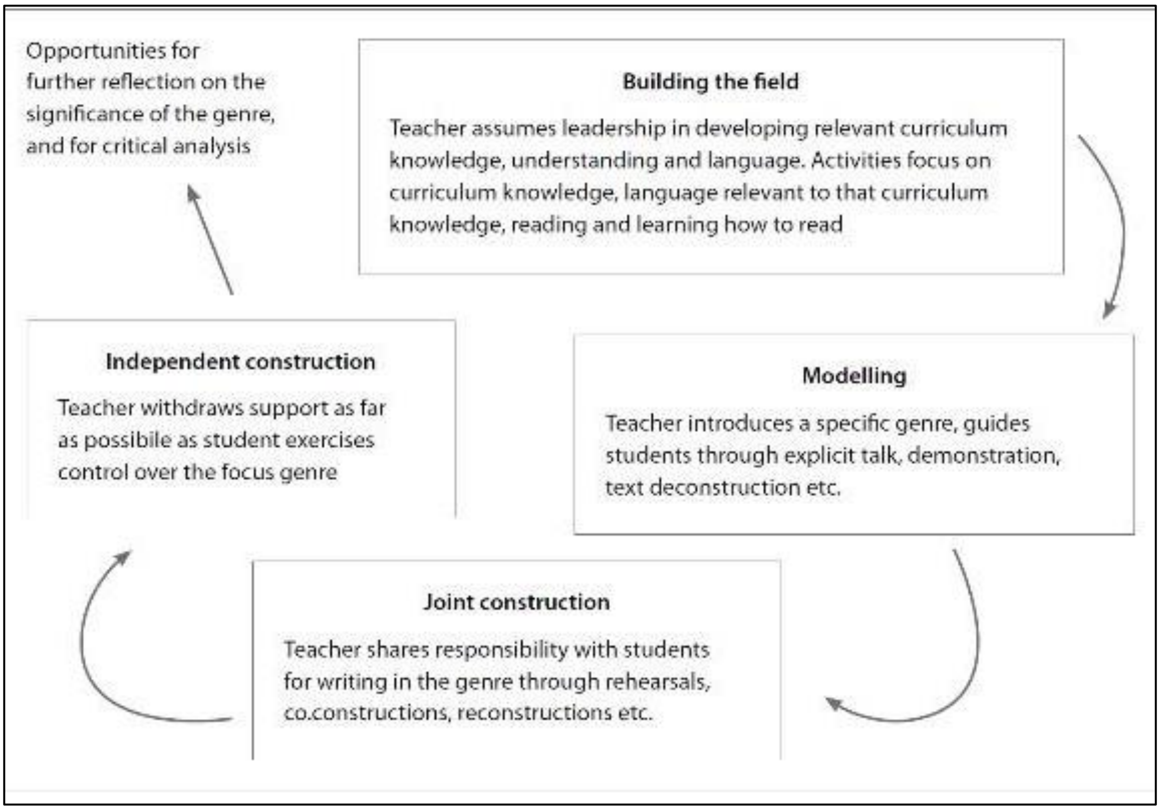


Figure 2: The Stages of Language Scaffolding (LPU, 2016, p. 78)

One can see how with each step, the teachers' presence fades away until in the final stage, that is, 'independent construction', students are able to produce any work assigned with minimal to no support.

Another important element in this model is the way it takes into consideration all the types of interaction that occur in the classroom (from teacher talk and presentation, to students' questions and answers, student feedback, their reading and writing tasks, and even the informal interaction within students) are all part of the knowledge acquisition process. 'These varied verbal productions,' the authors (LPU, 2016, p. 29) explain, allow students ‘to master new genres of an academic nature that are not used in ordinary everyday communication’ (a comment which refers back to the distinction between BICS and CALP, made in the SIOP model). The document expounds on each type of interaction and suggests ways in which scaffolding may be provided at each step of the way. The quality of a teacher’s presentation, for instance, is judged upon ‘clarity of articulation, flow, variations in rhythm and tone [and] gestures (LPU, 2016, p. 30). Additionally, visual aids and structure are important, especially when presenting problem solving methods. Another type of interaction, that is, questioning and discussion, involves the teacher supplying information, clarifying and rectifying doubts, managing learner input and prompting them to do further research (LPU, 2016, p. 31) Notetaking is another action that is considered an important part of classroom interaction, the suggestion for the teacher here being to direct students as to how notes should be taken. Finally, reading and writing are mentioned as further communicative processes that take place in class, both of which offer a venue for scaffolding.

In the case of writing, the LDIAS suggests that tasks should not be over-simplified as this may limit opportunities for higher order thinking skills. Instead of eliminating writing tasks and exchanging them with exercises such as ‘fill-in-the-blanks', teachers may instead assist learning so that the same high-level task is achieved. For instance, during the reading of a model text, teachers might direct students’ attention to language forms (for example, connectives), so that they might be able to use them themselves when producing a similar text (LPU, 2016, p. 83). Another effective method is for teachers to integrate content and language during feedback sessions. The LPU (2016, p.84) argues that ‘[i]t is entirely appropriate that subject teachers focus on content when providing feedback on the final product’. This is because such feedback supports students in developing ‘their grasp of academic types of writing, including recognition of what has been achieved as well as suggestions for future improvement (LPU, 2016, p. 84).’ For this reason, they conclude, ‘[i]t would be wrong to see this as an entirely additional and separate aspect of feedback, for integration of content and form is desirable’ (LPU, 2016, p. 84). An example that is given, for instance, is that when advising students to make use of more paragraphs, content teachers could explain that this would help readers identify the different notions that are expressed in the text (for example the different kinds of rock in a geography essay) (LPU, 2016, p. 84).

As with writing, it is not recommended for teachers to water down or oversimplify reading texts. Students need to experience reading demanding texts, so that they may acquire the skills they need for independent research and studying. Instead, scaffolding occurs by implementing techniques that are part of any standard language reading lesson. For example, pre-reading tasks (such as prediction or discussions) are recommended to motivate students and create interest in the text. During the actual reading, students can be encouraged to interact with the text in various ways, such as through inventing titles and subheadings, annotating (underlining, highlighting keywords) creating diagrams and sorting out jumbled up information (LPU, 2016, p. 86).

Speaking and listening skills are also taken into consideration in the LDIAS. The authors argue that oral skills must be developed and that this can occur by having the teacher draw attention to the different purposes and contexts for speech (which includes considerations of register and audience). Activities that might promote student development are 'prioritising a list of statements about a topic, sorting or matching cards with different statements or pictures, preparing a presentation as a group, or discussing a problem' (LPU, 2016, p. 86). Listening skills also should not be taken for granted, and scaffolding activities recommended here are 'activating prior knowledge, providing a specific goal for listening in advance together with developing active strategies such as forming questions, producing summaries and clarifying the main focus.'

All of the recommendations outlined above have the collective aim of ensuring that students, irrespective of their linguistic background, have access to all areas of the curriculum. Of crucial importance is the following point made by the authors (LPU, 2016, p. 87) that 'the language elements' should be seen as *supporting* rather than *dominating* 'the understanding and learning of subject content, which must be at the forefront of classroom activity'. Finally, for all of these suggestions to be successfully implemented, teachers need to develop a certain 'class culture' where students are made aware of both language and content goals, which will justify and give added value to any instruction and feedback that has a language spotlight. Such a classroom culture is conducive to learning when it develops in students 'positive attitudes of curiosity towards language, a readiness to acquire specific knowledge and relevant terminology, an openness to diversity, a confidence in persevering with challenging texts and a command of strategies and techniques when writing' (LPU, 2016, p. 87).

The pedagogical approaches described above serve as models of how a literacy and language focus can be introduced in content subjects. They are not the only ones, of course, however they were chosen based on their widespread success and their different focus. The language adaptations developed as part of this research are inspired by the techniques recommended by these three models, and by the idea of scaffolded instruction more generally. In the following and final section of this chapter, a general overview of what my research involves is given, together with a discussion of other studies that had the same rationale or followed the same methods. A more detailed description of the methodology adopted in this dissertation is given in the next chapter.

Creating language scaffolds for year 7 science teachers

As detailed in the introduction, this research stems from a growing need to address the difficulties that learners of English in Malta (both Maltese and non-Maltese) face when their literacy and English language levels affect their ability to succeed in content subjects, in this case, science. Following a review of the relevant literature (as summarized above), this research involves the design of ten language scaffold sets, which are based on the Year 7 science coursebook and inspired by the scaffolding strategies in SIOP, R2L and LDIAS. This is followed by the gathering of feedback from four science teachers on their experience with multilingual classrooms, their perceived responsibility for the literacy development of their students and their thoughts on the practicality and effectiveness of the resources developed.

The resource development aspect follows in the wake of studies that focused on the creation of material (Shores & Smith, 2011; Fradd & Lee, 2001; Windyaningrum & Arini, 2016; Amaral, Garrison & Klentschy, 2002). Two studies that particularly resonated with this research were those by Shores and Smith (2011) and Fradd & Lee (2001).

The first was a large-scale project carried out in the US as part of the bigger GEMS (Girls Engaged in Mathematics and Science) educational programme. This project focused on the ALEX online portal which provides educational resources for teachers. After an analysis of this database, the researchers concluded that there was a lack of material for mathematics and science, a gap which they responded to. The study involved the recruitment of fifty K-12 math and science teachers (p. 32), who attended a week-long workshop where they were trained and tasked to produce five quality lesson plans each. A further eighty teachers participated in the review of these lesson plans, out of which one hundred and twenty-eight made it to ALEX. Although this study exists on a much smaller scale, it is pushed by the same rationale as it recognises the lack of hard resources available to teachers and seeks to create practical material as a response.

The second study, by Fradd & Lee (2001), is perhaps even closer to this research, as it focuses on the development of lesson plans specifically for ELLs who are seen as underrepresented by the science curricula. Following an enquiry into the literacy needs of 4^{th} grade ELLs, approximately thirty lesson plans were developed covering two units. Apart from observations of the lesson plans being delivered in class, the researchers also conducted interviews with the teachers on their perceived role and on 'inquiry' as a method for teaching science (Fradd & Lee, 2001, p. 483). Teacher interviews at different stages of the project revealed a change in mentality as openness to scientific inquiry increased with continued delivery of the lesson plans.

Conclusion

This chapter has provided an overview of the literature on which this research is based, from issues surrounding the language of schooling, to academic literacy and genre-specific literacy needs in science, to tried and tested models which introduce a language focus in content subjects. Research which followed similar methods, and which has had successful results was also referenced to further solidify the academic context in which this study is nested. The next chapter outlines the methodology that will be used and the theoretical paradigms that inform this research.

Chapter three: Methodology

The previous chapters offered an insight into the rationale that drives this research forward, namely the way language sensitive lesson planning can help students reach their full potential in content subjects. Discussions of the connections between academic literacy, proficiency in the language of schooling and achievement in science, were presented to contextualise the study. Additionally, a description of language and literacy focused teaching models, with particular attention to SIOP, R2L and LDIAS was provided.

This chapter focuses on the data collection component of this dissertation. In the following sections, the research questions are re-visited, with an added commentary on the pragmatist epistemology that informs this study. Additionally, the methodology that was employed to develop, evaluate, and analyse the material as well as the recruitment of participants, is outlined.

Restating the area of study: the research question

This research follows the tenets of Literacy Across the Curriculum, which valorises the linguistic element in all subjects by drawing attention to the reading, writing and communication skills required to 'learn and access all areas of the curriculum' (Bentley-Davies, 2012, p. 5). It seeks to answer the following question: 'How can content subject teachers create language-sensitive lesson plans to improve students' academic literacy skills?' This question is of great resonance to the local context for two reasons. Firstly, Maltese students receive their education in a context where English is the language of schooling but is rarely their L1, which creates an additional hurdle to content learning. Secondly, student cohorts in Maltese state schools are becoming increasingly multilingual, which means that traditional language support methods such as code-switching and code-mixing might no longer be the most inclusive model. This research proposes that adequate lesson planning may be the key to providing the right environment for Maltese and non-Maltese speaking ELLs (English Language Learners) to succeed in the content subjects, specifically science. Ultimately, the aims of this study are twofold. Firstly, to design a model which showcases how a language focus can be included in science teachers' lessons to benefit student learning. Secondly, to evaluate such a model by gathering teachers' insight into the perceived effects of adding a language focus in content subject lessons.

Process of development

This study locates itself in the pragmatist epistemology, specifically Deweyan theory, in which knowledge is regarded as consisting of 'warranted assertions […] that result from taking action and experiencing the outcomes' (Morgan, 2014, p. 1049). John Dewey's pragmatism reorients philosophy 'away from abstract concerns' to focus instead on 'human experience' (Morgan, 2014, p. 1046). In his commentary on 'pragmatism as a paradigm for social research', Morgan (2014, p. 1047) identifies five steps from Deweyan theory which inform all pragmatist research, as can be seen in figure three below:

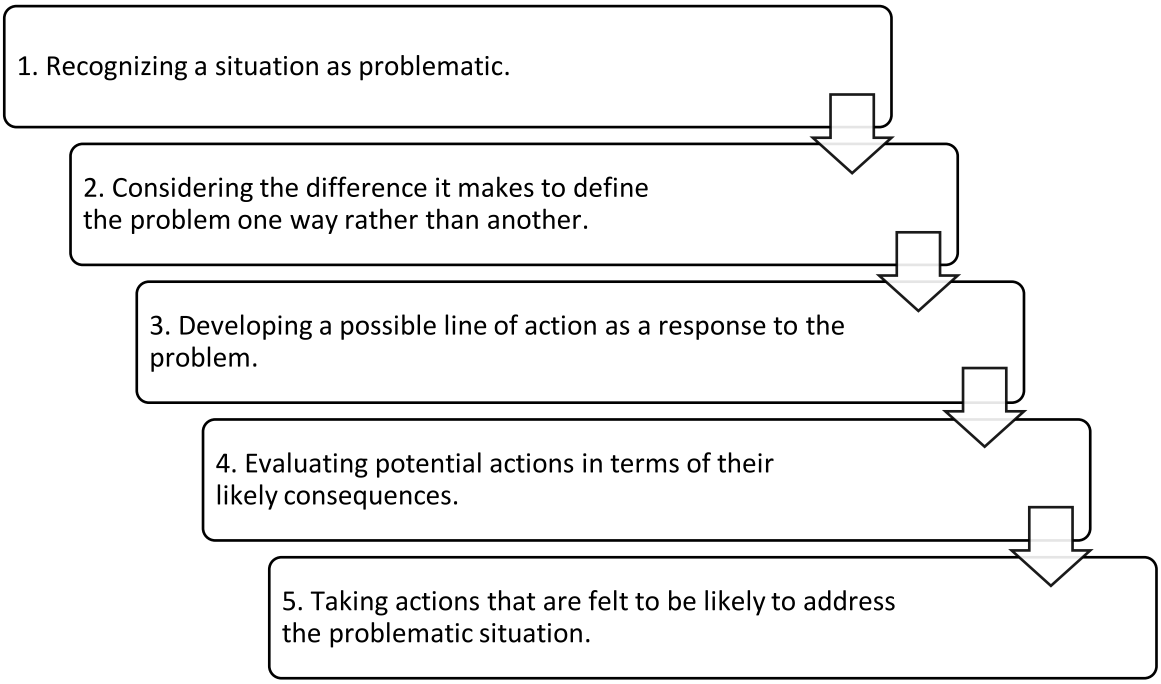


Figure 3: The five steps of pragmatist research according to Dewey.

The design of this research followed a similar trajectory. In the initial phases, research related to the current state of local students' achievement in science, the link between science achievement and literacy, and the language load that comes along with learning science helped formulate a problem that is already locally recognised and that is being addressed by a number of policies. Secondly, underachievement in science, below average literacy skills, and poor language performance in state national exams were interpreted in the context of Malta's bilingualism, specifically the difficulties that arise when the language of schooling (English) does not match the majority of students' home languages (Maltese).

The third step, corresponding to Dewey's model, was the development of ten sets of language scaffolds to accompany the Year 7 science coursebook, *KS3 Science, Book 1*. Prior to the design of these scaffolds, extensive research was carried out on three models which integrate a language focus as a means of supporting content learning (SIOP, R2L, LDIAS). The Content-Related Learning Outcomes (LOs) upon which the lesson plans were based were extracted from the Learning Outcomes Framework (LOF) for science (MEDE, 2015). The Language-Related Learning Outcomes were based on two sources: the literacy LOs present in the aforementioned LOF for science, and the researcher's analysis of the language requirements of the topics chosen.

The language requirements of the coursebook and those of the science LOs were analysed through a three-step process, following the text difficulty analysis method suggested by Spiteri (2019). First, the researcher relied on personal language expertise to note text organisation, culture specificity, and to predict students' familiarity with the topic (Spiteri, 2019, p. 49). Secondly, texts were run through the Coh-Metrix *Text Easibility Assessor* tool, which analyses texts on five counts, these being 'narrativity', 'syntactic simplicity', 'word concreteness', 'referential cohesion' and 'deep cohesion' (*Graesser & McNamara, 2012*). The text was inputted using the online tool, which assigned a score to each of the five features mentioned above (as can be observed in figure four). The higher the score, the more accessible the text is. Texts that are high in narrativity, for example, are easier to read as 'story-like' writing is associated with everyday speech and the style is therefore accessible to most learners. Likewise, words that are concrete rather than abstract, and texts that have familiar syntax structures are easier to process. Referential cohesion and deep cohesion also affect readability, as the repetition of certain key words and discourse markers aids the reader make logical connections.

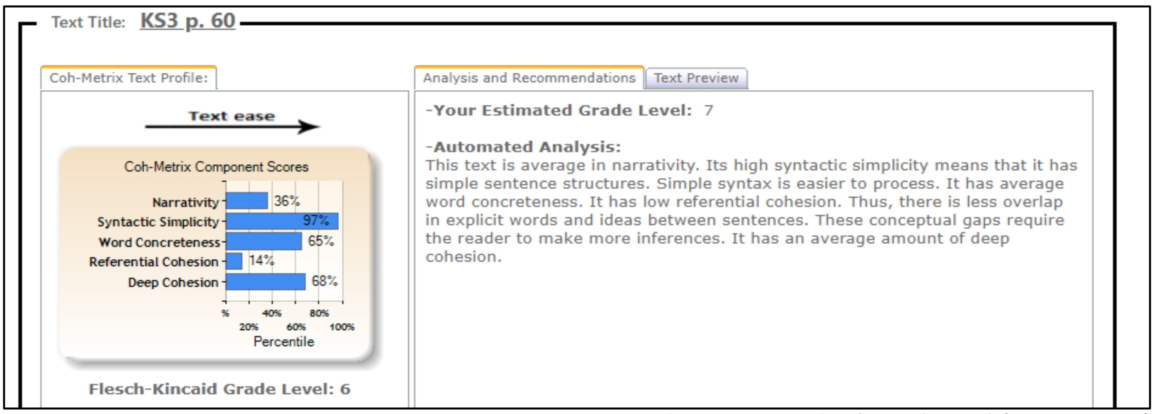


Figure 4: Cohmetrix results from 'Set B' (Appendix 1)

Vocabulary was also analysed through a web tool called *Compleat Web Vocab Profile* (henceforth, *CWVP*) (Cobb, n.d.) *CWVP* (*5*) analyses words according to how frequently they are used (as can be seen in figure five below). Vocabulary items that fall under the K1 bracket are part of the thousand most common words that feature in modern language use. These are followed by the K2 (the second 1000 most frequently used words) and K3 categories, both of which make texts more difficult to read, especially if the latter is present at a frequency of 10% or more. Once these texts were run through these programs, appropriate language scaffolds were designed based on the difficulties that emerged from the analysis.

Figure 5: CWVP results from ‘Set G’ (Appendix 1)

The language scaffolds in this study were based on the methods proposed in the previously discussed SIOP model, R2L and the LDIAS. All of the techniques incorporated in the lesson plans were aimed at strengthening integrated language skills (reading, listening, speaking, writing), increasing academic and content-specific vocabulary, refining teacher instructional methods, generating deeper understanding of texts, and providing effective ways of reviewing and assessing learning. A detailed account of the rationale behind the techniques employed can be found in the annotations accompanying each language scaffold designed (Appendix 1).

Following Dewey's model, the fourth step was to evaluate the material developed through the collection of four science teachers' reviews gathered during 30-minute, semi-structured online interviews. The interviews also focused on teacher familiarity with language sensitivity, their willingness to discover more about it and general attitude towards language and literacy in the content subject classroom. The evaluation process focused on the potential of the developed material and the hypothetical effects that implementing such an approach would have on student learning. The fifth and final step of this research was analysing teachers' suggestions and attitudes. Although the lesson plans were not actually put to the test (a limitation that is also discussed at a later stage) suggestions for possible action in Maltese state schools were given based off the findings in this study.

Data collection methods: interviews

The choice to use qualitative methods for data collection, specifically interviews, was based off multiple considerations. Firstly, was the inherent usefulness of the interviews to 'gain a better understanding of people's experiences' and the fact that it is the best way to record teachers' opinions, which at the end of the day form 'an integral part of any educational reform' (De Groot, 2002, p. 42). In the local context, introducing the concept of language scaffolding in content subjects would be dependent on teacher opinion of their duties towards literacy development and their feelings towards investing further time on planning. For this reason, it was important to be able to personally interview teachers in order to get a better feeling of their attitudes and perceptions. Additionally, Wellington (2015, p. 137), writes how 'interviews can reach the parts which other methods cannot reach'. During interviews, the researcher can 'probe an interviewee's thoughts, values, prejudices, perceptions, views, feelings and perspectives. [He] can also elicit their version or their account of situations which they may have lived or taught through […]' (Wellington, 2015, p. 137). The interview questions in fact featured a strong focus on participants' perspectives on multilingual classrooms and their feelings on cross collaboration with language teachers.

Studies in the field that collected their primary data through interviews proved to have impactful results. Skinnari & Nikula's 2017 study, for instance, utilised interviews as a way of discovering teachers' opinions on LAC in the light of related changes in the Finnish curriculum. Results showed that the idea is still conceptually quite new to most teachers, which indicates that further training is required before the ideas published in the new curriculum, particularly in relation to every teacher being a language teacher, can be truly put into practice. Similarly in this research, it is essential to hear teachers' opinions on literacy needs and their perceived role in scaffolding language demands to better understand what actions are most needed, be it teacher training, material development, curriculum amendment, etc.

The second reason as to why interviews were preferred over other methods, such as online questionnaires, was due to the greater opportunity that is provided to the interviewee to share their perspective. Wellington (2015, p. 139), describes how 'the research interview's function is to give a person, or a group of people, a "voice"'; 'to provide them with a "platform", a chance to make their viewpoints heard and eventually read.' Since there was a large number of language adaptations to review, collecting feedback through interviews was the best way to ensure that the interviewee could focus on the parts that most interested him / her or that seemed most relevant to his / her experience. This is also the reason why a semi-structured interview format was chosen. Wellington (2015, p. 141) comments on how in semi-structured interviews, the interviewer 'has the flexibility to decide the range and order of questions within a guide or framework'. In the case of this study, this would allow the interviews to take on a more natural flow and give the teachers the possibility to open up on those specific language adaptations that elicit the strongest responses.

Limitations

A number of limitations accompany the research design method that was adopted. The choice to interview participants, for instance, rather than collect data through an online questionnaire has its setbacks as the sample must necessarily be smaller. However, adopting an idiographic approach rather than a nomothetic one in this case was more feasible, both because of the time and length constraints of this study, and because it seemed more appropriate to focus on subjective experience rather than collect statistical information.

Another limitation of this research was the fact that no observations took place in the participant teachers' classrooms, meaning that there could be no cross-checking between their perceived views and actual practice. Observations of the classes could have provided space for more in-depth interviews, where specific parts of the language scaffolds developed could have been tied to any difficulties noticed in class.

Finally, an alternative evaluation method could have been that of asking teachers to carry out lessons based off the language scaffolds provided, rather than verbally evaluate them during an interview. However, when considering the scale of this study, it was decided that teachers in the field with some years of experience would be more than equipped to provide an expert review of an activity through reading it, without necessarily needing to perform it in class.

Selection of participants

This research used a non-probability sampling plan, specifically the 'typical case' approach where participants were chosen from a specific demographic and expected to be generally representative of the rest of their group (Wellington, 2015, p. 118). A letter was sent out the Education Officer for science, with the request to act as an intermediary and forward an information letter to Year 7 teachers of science in state schools. The letter informed prospective participants of the aims of the research and of what their participation would entail, namely, a thirty-minute online interview whereby they would be asked to evaluate two language adaptation sets and share their opinions with regards to issues related to language and content learning. The information letter also indicated that participants needed to have at least four years of teaching experience. This ensured that the participants had a solid teaching background which would render their reviews valid and based on years of practice.

It was decided that the first five participants to come forward would be chosen, to ensure that the sampling was random and avoid any bias. Potential participants were invited to get in touch with the researcher via email to voice their interest in participating in the interview. Unfortunately, only four participants came forward, which did not severely impact the results, but which diminished the opportunity for comparing and contrasting views. Once they got in touch, communication via email ensued and a date was set for the online interview. Three out of the four online interviews were recorded, with the signed consent of participants. In the one case where consent was not given for recording, notes were taken. The following paragraphs outline some important details about the participants, which will help contextualise their responses in the next chapter. Pseudonyms were used throughout, to protect teachers' identities.

Mr Chetcuti

Participant one, who will be referred to as Mr Chetcuti, has been teaching science for nine years. He graduated as a Bachelor of Science in Physics and Maths, and he achieved his teaching qualifications by completing a Pedagogical Certificate in Education (PGCE). Later, he also completed a Master of Science. He has had experience teaching both mainstream classes and Core Curriculum Programme (CCP) ones, which often require more care and support. He has also had experience teaching students whose first language was neither English nor Maltese. Mr Chetcuti consented for the interview to be recorded and the data gathered from his interview was analysed after transcription.

Ms Formosa

Participant two, who will be referred to as Ms Formosa, has been teaching science for twenty-six years. She graduated as a Bachelor of Education in Biology and Primary Education, and in 2011 she completed a Master of Education in Science. She has had experience teaching mainstream and CCP classes and has also taught students whose first language was neither English nor Maltese. Ms Formosa consented for the interview to be recorded and the data gathered from her interview was analysed after transcription.

Ms Attard

Participant three, who will be referred to as Ms Attard, has been teaching science for fourteen years. She initially pursued a career in Pharmacy and graduated in this subject, and then completed a Pedagogical Certificate in Education (PGCE) to switch to teaching. She currently only teaches mainstream classes, however, a few years back, she had experience teaching CCP and had one or two students whose first language was neither English nor

Maltese. Ms Attard opted out of having the interview recorded, so the data gathered from her interview was analysed based on the notes taken by the researcher.

Ms Bonnici

Participant four, who will be referred to as Ms Bonnici, has been teaching science for six years. She graduated as a Bachelor of Education in Science, with specialisation in Biology. She currently teaches mainstream classes, the majority of which are multicultural. In fact, four out of her six classes are predominantly composed of foreign students who do not share a common first language. Ms Bonnici consented for the interview to be recorded and the data gathered from her interview was analysed after transcribing it.

Data processing and analysis

The data collected was processed first by transcribing the interview audio files, and then by following the three-step qualitative analysis model described by Miles and Huberman (1994) consisting of 'data reduction, data display and conclusion drawing' (Wellington, 2015, p. 260).

In the data reduction stage, the information was 'summarized, coded and sorted out into themes, clusters and categories', as described by Wellington (2015, p. 260). Initial *a priori* categories which were predicted to be featuring themes were (i) positive attitude towards a language focus and (ii) negative attitude towards a language focus (Wellington, 2015, p. 268). *A posteriori* categories that arose as the data was engaged with can be divided into four: (i) the role of English and Maltese in science education; (ii) teachers' awareness of the language requirements of science; (iii) their opinion on the role that the science teacher should play in mitigating students' language difficulties, (iv) their opinion on the language scaffolds (Appendix 1) developed in this research.

In the second stage, that is, 'data display', the data was organized and categorized according to the four different themes that came out of the data reduction process. Afterwards, the data was interpreted and conclusions were drawn on the perceived applicability of the techniques proposed and the revisions required. The processed data was then discussed in relation to the literature and its implications for the local context.

The quality of the data analysis depends strongly on the validity of the data collected, and in order to ensure high quality responses, the questions were drafted with care. Wellington (2015, p. 147) suggests for instance, to avoid five types of questions to ensure quality response, these being: 'double-barrelled questions', 'two-in-one questions', 'restrictive questions', 'leading questions' and 'loaded questions'. As far as possible, such question types were avoided, and the interviews were conducted in such a way as to allow the interviewees to share their honest views.

Ethical considerations

One of the most important aspects in an interview is the human dimension. When a study adopts qualitative methods, data is directly derived from human subjects, which means that there is a social and ethical responsibility on the part of the researcher. 'Ethical concerns', writes Wellington (2015, p. 4), 'should be at the forefront of any research project and should continue through to the writeup and dissemination stages.' Prior to contacting the Education Officer as intermediary and sending out the information letter to prospective participants, the research proposal and the interview questions were thoroughly reviewed first through a self-assessment checklist, then by the University of Malta's FREC (Faculty of Education Research Committee) and finally by the MEDE Research Ethics Committee. Some important factors that needed to be ensured were the absence of physical, moral or emotional harm to participants, honesty in the collection and processing of data and sensitivity to cultural, gender and ethnic issues. The information letters clearly explained what would be required of participants were they to come forward, and interviewees were given the option to refuse audio recording if they preferred to.

In the case of this dissertation, all necessary actions were taken to ensure ethical behaviour at all stages, starting from the research question (whose aim is ultimately to help underachieving learners) to the data analysis and presentation (where the views of the interviewees were faithfully represented, and not distorted by the researcher's perspective). Additionally, during the interview process, all care was taken to retain the participants' anonymity, to inform them of the aim of the study, to respect the time limit, and to create a productive rapport that balances task and social involvement.

Conclusion

This chapter gave a detailed overview of the theoretical paradigm that informs this research, of the various steps involved in its design and of the limitations that were faced. Additionally, it outlined important details such as the data collection method and the process through which participants were selected. Finally, it introduced the participants who took part in this study and described ethical considerations that went into the planning of all aspects of this research. The next chapter focuses on the presentation and analysis of the data collected from the interviews, together with a detailed discussion of the implications of these findings for the local educational context.

Chapter four: Findings and discussion

Introduction

The aim of this study, as its very title indicates, is to investigate how teachers and students of science may be supported to meet the language load of their subject. To reach this aim, this research involved designing ten sets of language scaffolds to be used in combination with the science coursebook distributed in State schools *(KS3 Science, Book 1)*. In this chapter, the effectiveness of the language scaffolds designed is discussed by presenting the data gathered from semi-structured interviews with four experienced science teachers. Although the main goal of the interviews was to gather teachers' views on the effectiveness of the language scaffolds, other relevant topics were also discussed, such as their experience with language in the science classroom and the coping strategies that they are currently adopting.

Prior to the interviews, all participants were sent a copy of two language scaffold sets that were designed (Appendix one). Each set included pages from the coursebook, the language scaffolds clearly highlighted, and a short explanation of their aim. Additionally, participants were presented with a copy of the questions that would be guiding the interview (Appendix two). The previous chapter provided a description of the participants which is being briefly summarized in the table below:

Pseudonym	Qualifications	Years of teaching experience	Experience with CCP classes	Experience with multilingual classes	Mode of data analysis
Mr Chetcuti	• Bachelor of Science in Physics and Maths. • Pedagogical Certificate in Education (PGCE). • Master of Science.	9	Yes	Yes	Interview was recorded and transcribed.
Ms Formosa	• Bachelor of Education in Biology and Primary Education. • Master of Education in Science.	26	Yes	Some experience in the past, not currently.	Interview was recorded and transcribed.
Ms Attard	• Bachelor of Science in Pharmaceutical Science. • Pedagogical Certificate in Education (PGCE).	14	Yes, but not currently.	Some experience in the past, not currently.	Notes were taken during the interview and then analysed.
Ms Bonnici	• Bachelor of Education in Science, with specialisation in Biology.	6	Yes	Yes (6 out of 4 classes are non-Maltese in their majority)	Interview was recorded and transcribed.

Table 1: An overview of the information about participants

This chapter provides a detailed reporting of the data followed by a discussion that emerged from the interviews with the participants above, and is subdivided into four key topics that encapsulate the findings, namely; (i) the role of English and Maltese in Science Education; (ii) teachers' awareness of the language requirements of science; (iii) their opinion on the role that the science teacher should play in mitigating students' language difficulties and (iv) their opinion on the language scaffolds that were designed as part of the resource development aspect of this dissertation. All interviewees expressed their preference for conducting the interview in Maltese, which means that the direct quotations in English throughout this chapter were a result of translation for better readability. However, in order to maintain transparency, a table with the original and translated quotes was included in Appendix three. To facilitate reference, each translated quote in the discussion that follows is followed by a number typed in superscript, which matches the corresponding original quote in the table.

I. The role of English and Maltese in science education

One of the initial questions that was asked during the interviews was: 'What role does English play in your lessons?' Interestingly, despite being asked specifically about English, all participants brought in Maltese, evidence that the latter plays a significant part of science education in local state schools.

Findings

Mr Chetcuti expressed great frustration with regards to the issue of English versus Maltese in science education, aptly referring to it as a 'sacred cow'[1] – an issue whom everyone's inability or unwillingness to address it renders it untouchable. He claimed that the question of whether to teach in English or in Maltese is one that arises each year and it is also one that is never resolved. He commented that if students 'are going to pursue science, the only option is English', as 'science books are written in English' and it is therefore teachers' responsibility to think ahead and 'prepare [them] for the future as well'[2].

This opinion was mirrored by Ms Bonnici. She explained that although her Maltese students indicate that they prefer the science lesson to be delivered in Maltese, she believed that English would be more useful in the teaching and learning of science as 'handouts, worksheets, PowerPoints, notes [and] everything else is in English'. It is for this reason that she codeswitches, to 'mix a little bit of both' and get children 'used to science in English'[3].

Ms Formosa agreed that English was important for future studies, however, Maltese was central to her lessons. She explained how even though she is aware that ultimately, the examination is in English, if students cannot understand a concept, she resorts to Maltese as 'the most important thing [for her] is that the student has understood'[4]. These views were shared by Ms Attard, who explained how she usually starts her lessons in English, and then soon after switches to Maltese when she notices students are struggling.

Discussion

A brief look at the answers of all participants reveals interesting patterns. All interviewees agreed that English is necessary both for doing well in the exam, and for pursuing science at secondary level and beyond. Furthermore, they all concurred that English is strongly present in the content they must deliver. However, this presence of English in content and assessment did not necessarily parallel its presence during delivery. In fact, all four teachers differed in their delivery methods. While Mr Chetcuti and Ms Bonnici relied more on code switching and English, Ms Formosa and Ms Attard relied much more on Maltese.

A number of variables among participants might be responsible for this diversity in opinion. The nationality of their assigned students is one of them. From the interviews, it emerged that Maltese students feel more comfortable learning in Maltese rather than in English, which influences the language choices teachers make. Both Mr Chetcuti and Ms Bonnici for instance, despite their acknowledged preference of English to Maltese to teach science, use Maltese in response to students' requests. In the instances where they delivered the majority of their lessons in English, it was mostly due to the presence of a high number of foreigners in class. This is something which Ms Formosa and Ms Attard had little experience with, and which might account for their reliance on Maltese.

The first problem that emerges from this set of interviews, therefore, is that of Maltese science students' relationship with English. English, rather than a tool, is seen as a 'barrier' (Mr Chetcuti, Ms Formosa) and a 'problem' (Ms Bonnici) by students. Ms Attard described students as feeling 'disheartened' by long texts as did Ms Bonnici, who quoted students saying, 'Wow miss, do we need to learn all these words?'[5] Ms Formosa categorised students' relationship with English as one of fear, stating that 'they would be evidently scared of the question'[6]. Changing students' views of English requires a joint effort from teachers across the curriculum in order to facilitate its understanding and transforming it into a tool with which students can access near universal knowledge.

II. Teachers' awareness of the language requirements of science and the coping strategies used

Having the content (such as science) teacher be aware of the language requirements of their subject is the first step towards having them provide language support to students. Although there was no interview question that explicitly asked teachers whether they were aware of the genre-specific difficulties of science, it was a topic that emerged naturally during discussion.

This section discusses the level of awareness teachers showed at the level of lexis, morphosyntax, and the four language skills (reading, writing, listening, and speaking). Additionally, their current coping strategies are discussed. As many of the participants addressed similar issues, their responses have been grouped accordingly.

Findings

General language issue:

The participant who showed most awareness of a general communication issue in science education in Malta was Mr Chetcuti. As mentioned above, he expanded in some length on the question of whether science should be taught in English or Maltese and commented on how 'the idea of language, in science, arises often'[7] and is 'crucial'[8].

This contrasted somewhat with the opinions of Ms Formosa and Ms Attard, both of whom claimed that middle school students can get by with limited English. Ms Formosa, for instance, described how in 'form one, form two, you don't need lengthy answers, not like when you are teaching biology and you need certain length and certain depth...'[9] Similarly, Ms Attard stated that she 'was not interested in the role of English in the science book'[10] and did not comment further on the language load of the subject.

Ms Bonnici was the only teacher who showed awareness of the importance of acclimatising students to the idea of thinking, speaking and writing like a scientist. She explained, how she often jokes with students that ‘scientists always want to sound smart,’ which is the reason why simple words like ‘bubbles’ are often turned into harder ones like ‘effervescence’. From her experience, this helped students see ‘the fact that they have to learn all these new words’ in a more positive light.

Lexis:

Despite the differing views on there being a general language issue, three of the participants referred to the lexical difficulties that students encounter during lessons. Mr Chetcuti, for instance, mentioned students ‘messing up’ when identifying and labelling the parts of a Bunsen Burner, such as ‘a sliding collar [and] an airhole’.[11] Ms Formosa, despite her claiming that English was not a major issue in the middle school years, commented on how words such as ‘organism’ prove confusing to students. Ms Bonnici’s comments were particularly pertinent to the central role played by literacy across the curriculum, as she referred to the trouble her students have understanding words such as ‘perforation’, ‘nuclear fuels’, and the difficulty in distinguishing keywords with the same root, such as ‘solute’, ‘solvent’, ‘solution’, ‘solubility’, ‘soluble’, ‘insoluble’. With regards to the latter set, she confessed she was ‘at a loss’ as to how to clarify them for students.

Syntax:

Only two of the participants showed awareness of how syntactic difficulties might affect student performance in science. Ms Formosa expressed how students with good levels of English manage to discuss answers more effectively using conjunctions like ‘whereas’, ‘on the other hand’, and ‘alternatively’. She also explained how such students have an advantage over others as poor language and literacy skills affect student performance in formal assessment situations. She felt that well-developed language skills help students ‘overcome a certain fear’.[12] Furthermore, she pointed out that she often advises students to take care of their spelling and their sentence construction as examiners will not take the time to try and understand what they are trying to say, in the way that she does for them.

Ms Bonnici was the second participant who referred to syntax, as she pointed out that higher ability students may be recognised through their sentence structures, such as the ability to start a sentence with conjunctions other than ‘and’ or ‘because’.

Reading:

Three out of the four participants mentioned reading when asked about the effect of language proficiency in science. Ms Attard described how at times, students ask whether they can just write a short answer, which she interprets as a sign that they have not understood the question properly. Such an observation goes against her comments reported above, where English was not seen to be an influencing factor at years 7 and 8. Mr Chetcuti echoed the difficulty that students have with understanding questions, stating that they 'understand the question however they like, and not as it is posed to them'[13].

Ms Bonnici diagnosed problems in reading through their inability to understand the questions on their worksheets despite having understood the concept in class. She explained that 'sometimes they don't know how to pronounce the word, it's like, if they listen to it, once I say it, they know what it is, but to read it, it's something else.' This, she proceeded to explain, means that 'they don't perform as well then in tests and worksheets, as they do in class discussions. And the problem would be English, not science.'[14]

Writing:

Another skill that was consistently mentioned was writing. When asked in what way language difficulties impede students, Mr Chetcuti commented how it is their writing skills that suffer most. He explained that 'when it comes to writing, you start to realise that these children's problem is not a lack of science knowledge, but truly because there is a barrier, and that barrier is language'.[15] Ms Formosa too pointed out her concerns with regards to students' inability to formulate answers independently, explaining how 'smart children' end up 'failing' because 'they know how to explain it in class, but they don't know how to write it down in English'[16]. Ms Attard also mentioned difficulties in writing, as she explained how students will sometimes ask her how to formulate a certain answer.

Speaking:

Only one teacher mentioned difficulties in speaking during science, and that was Ms Formosa. She explained how, during an annual science week, students are asked to prepare a presentation on a topic of their choice and present it in English. She admitted that they often notice students struggling during the presentation, which leads her, and the other science teachers at her school to tell them to proceed in Maltese.

Listening:

Although no teacher specifically mentioned listening skills, difficulties in this area were implied in answers given elsewhere. The fact, for instance, that Ms Bonnici's students request her to deliver the lesson in Maltese, is proof that there are difficulties understanding spoken English. This is also the case with Ms Attard's students, whom she notices struggle understanding her when she delivers in English, leading her to quickly shift back to Maltese.

Discussion

Interesting links emerged between the interviewee's perceptions of the language load of their subject and the coping strategies they use to address these difficulties. All participants, for instance, notice the lexical load of science which leads them to adopt various strategies to facilitate understanding of the key terminology. Ms Bonnici, for instance, made use of code-switching as did Mr Chetcuti, who was quick to point out its disadvantages, explaining that 'once you are done with English, you are helping the Maltese language students, but you are losing the English language students'.[17] Additionally, Mr Chetcuti made use of translation by preparing quizzes on *Teams*, in both Maltese and English, something which he described as time consuming. Ms Bonnici and Ms Attard mentioned pointing out the root of certain words (such as 'carne' in 'carnivore') and all mentioned the effectiveness of accompanying explanations with visuals.

Another important connection was the fact that the teachers who relied most on Maltese were Ms Formosa and Ms Attard, who have been teaching the longest, and who believed that English played a more important role in science in the later years, not in middle school. Having achieved their teaching qualifications some years back, their experience with the traditional syllabi rather than the more skill-based approach of the Learning Outcomes Framework might be the reason why this view contrasts so starkly with those of Mr Bonnici and Mr Chetcuti, both of whom have been teaching for less than ten years. The question that arises here is whether a factor of such weight should be left to the personal opinion of teachers. The sole reliance on Maltese may be putting students at a disadvantage, as instructing students to 'write in what they think is correct English'[18] may not necessarily be providing them with any concrete support in addressing the language difficulties of their subject. It is also distant from the principles of the NCF, where 'literacy is defined to be a cross-curricular learning area, meaning that 'all educators need to see themselves as guarantors of the language mastery required of their learners in their particular area of knowledge' (NCF, 2012, p. 37).

Another observation worth noting is that as a result of teachers' focus on the lexical difficulties, rather than the morphosyntactic ones; the coping strategies that they adopted were mostly targeted at easing the burden of difficult terminology and aiding them with mnemonics. There was no further focus on supporting students to improve at the level of sentence construction. Although teachers were well aware of the difficulties encountered in the productive skills (especially writing), their focus seemed to be exclusively on supporting students in the receptive skills. Students are aided with translations, pictures, the provision of word banks, but are not supported in strengthening their literacy skills when it comes to speaking and writing. This may be an indication that content subject teachers need further support in not only diagnosing their students' language difficulties, but also in providing effective support that target all aspects of academic literacy.

III. What role should the science teacher play in the mitigation of students' language difficulties during the science lesson?

In this section participants were specifically asked if they believe the science teacher has a role in helping students not only learn science content, but also learn how to communicate their knowledge effectively. Additionally, all teachers were asked if they believe that collaboration between the science and the English teacher would do anything to facilitate the former's role in strengthening student literacy skills.

Findings

Throughout the interview, Mr Chetcuti explained how language plays a very important role in science learning and education and agreed that the science teacher has a responsibility to mitigate these difficulties. When asked about collaboration, he described collaborative experiences his department has already had with the English department. He explained, for instance, how the science teachers at his school ask the English ones if they could cover certain topics in advance, through reading comprehensions, for instance. On one occasion, students were given a reading comprehension on dolphins by their English teacher, which meant that during science, students ‘already knew what a dolphin was, whether it was a mammal or a fish’ and that is because they had ‘already covered [it] in English”[19].

Ms Formosa also agreed that science teachers are responsible for the way students communicate their science knowledge, however, throughout the interview she often pointed out the limitations of taking such an active role in students’ language development. Towards the end of the interview, she explained that she’s ‘either going to correct [their] “because” and “without”’ or else focus on the concept.[20] Ms Formosa felt that collaboration with English teachers would be ‘ideal’. She suggested that English teachers could observe science lessons, go over students’ science scripts (whether they are tests, worksheets, etc.) and identify language issues, so that they can address them later during the English lesson.

Ms Attard had different views on the role the science teacher should play in students’ literacy skills. She stated that what was important for her was that students understood the concept, not English. She slightly modified this thought towards the end of the interview, where she claimed that this is dependent on the context. At middle school level, she preferred that students had a solid grasp of the concept, as certain topics that they cover, such as ‘Cells and Reproduction’ are important even for their personal lives. However, she stated that Year 11 Biology would be a different story, and one would need to decide what to focus on depending on the context. With regards to collaboration, Ms Attard said that she recalled having an English teacher once prepare flashcards for students to use during science. She commented how collaboration could take place also with teachers of other subjects, such as Geography.

Ms Bonnici agreed that it is part of the science teacher’s responsibility to aid students to develop their language and literacy skills during science. She commented on how the communication difficulties in science persist even among professionals in the medical field, and that intervention, starting from early science education, would help. With regards to inter-departmental collaboration, Ms Bonnici said that it was a good idea, but that it did not often happen, and the problem lay in ‘time constraints’ and the fact that ‘it takes a lot of work, and [teachers] don’t have that much time.[21]’

She also expressed how her experience of collaboration with teachers of other subjects still did not feel like she was gaining much from their expertise, as they all ‘stayed in [their] own field'[22] when working in groups. This point is reminiscent of Ms Formosa and Mr Chetcuti's ideas of collaboration, where there is support in between departments but where working relationships remain distinct (for instance, by having the English teacher tackle language issues in her own class, rather than providing suggestions as to how they can be tackled during science). Ms Bonnici suggested that an interesting idea for collaboration would be that of organising field trips together, where teachers from multiple subjects would be present and students could have a cross-curricular experience.

Discussion

The majority of teachers agreed that teaching language and literacy skills in science is an important part of being a science teacher, however, they also saw limitations, mostly related to time. This was the same for the question of collaboration between science and English teachers: time and effort were seen as the main challenges. Interestingly, the limitations were mostly mentioned by the two teachers who have been teaching the longest, and who might, perhaps, be furthest away from the tenets of the more recent NCF, which clearly point towards a communicative aspect to content learning (NCF, 2012, p. 35). Perhaps an initial step towards encouraging content teachers to take on a more active role in developing students' literacy skills would be that of providing them with allotted time frames dedicated to inter-departmental meetings with language teachers, where strategies for improving student language and literacy skills can be discussed.

The second challenge is that of communicating the importance of nurturing students' proficiency in the language of schooling even at a young age. Two of the four teachers interviewed mentioned that at middle school level, students were not expected to formulate well written answers since this would become a need later on in years 9-11. The point that is being glossed over, however, is the fact that language and literacy skills are developed over time and require a strong foundation. In order for Year 11 students to do well in their Biology SEC exam, they require language skills which need to be built starting from Year 7. In order for the Year 8 student to choose to pursue the science subjects, they need to feel confident that their success will depend on how well they study, not on their ability to understand the language of the book, the notes, or the test questions. It is the responsibility of educators to open up the opportunity for further study to all students by equipping them with the necessary skills, which is something that can only be achieved if a holistic view of education is taken.

IV. The language scaffolds and teachers' opinion

To provide a relevant model on which to discuss language support, the researcher created language scaffolds that make the Year 7 coursebook more accessible to English language learners (Appendix 1). The creation of the language scaffolds that form part of this research followed the methodology for material design described in chapter three, and the literature outlined in chapter two.

Careful consideration went into deciding which format to use when presenting the language scaffolds to teachers. Early drafts of the study involved presenting the language scaffolds on a word document and asking teachers to refer to the relevant page and exercise from a digital copy of the book. This format was abandoned as it was not very reader-friendly, was time consuming, and it did not clearly show what was already present in the book and what was being added to it. For this reason, a more visual format was adopted.

An A3 sized paper was chosen as it allowed for the placement of the relevant coursebook pages in the centre and the addition of yellow text boxes all round, that included a brief diagnosis of the language issue and a suggested action. To provide practical examples of how the recommended action may be implemented, the suggestions inside the yellow boxes were translated into PowerPoint slides which model how they may feature in class, and these slides may also be found on the same page. So as to ease understanding, colour coding was used throughout, with scaffolding techniques inside the yellow boxes being highlighted in the same colour as the border of the corresponding PowerPoint slide. Additionally, at the beginning of each set of language adaptations, a cover page was added to highlight the relevance of the coursebook pages to the science LOF and the language Learning Outcomes that could be achieved through the scaffolds.

Despite the fact that *KS3 Collins, Book 1* is the official textbook for Year 7 science students in Maltese state schools, during the interviews, it transpired that not all teachers use the book, because of a variety of issues. A brief note on their stance with regards to the textbook at the beginning of each interviewee's section will help the reader better understand their reactions to the adaptations.

Findings

Mr Chetcuti was one of the teachers who did not use the coursebook. He explained that neither did his colleagues, and in fact, in their school, the librarians were thinking of not distributing the books anymore. Mr Chetcuti said that the issue lay in the fact that the book is targeted at a British context. For this reason, there are a few topics that are missing from the book (such as forensic science) and it has some topics that go beyond the local curriculum. However, he did point out that when preparing his own notes, he extracted a lot of material from the book and used some of its PowerPoint presentations and virtual experiments, adapting them to make them easier for himself and his students. When looking at the language scaffolds presented to him, Mr Chetcuti could refer to his own adaptations when creating the notes.

Mr Chetcuti was shown lesson plans A, and B (Appendix 1), both of which focus on SCI LOF 7.1 'What do Scientists do?'

The first thing that Mr Chetcuti pointed out was that certain terminology which had been marked as difficult, such as *Bunsen Burner*, did not usually prove hard for students, however its various components did provide a challenge. When asked on the effectiveness of providing sentence starters to model a particular language structure (such as making a suggestion), Mr Chetcuti mentioned that he used something different, but did not comment on its perceived effectiveness. He mentioned how he provides students with jumbled up steps which need to be put in logical order, with half sentences which need to be continued and finally assigns free writing. Another scaffold that was discussed was the transformation of open-ended questions into gap fill exercises. Mr Chetcuti confirmed that he used this often, and also provided word banks for lower ability students, methods which he found useful.

Differently from Mr Chetcuti, Ms Formosa did make use of the coursebook. Ms Formosa commented on how it has the potential to widen students' view and is therefore useful to the higher-ability students. She did mention, however, that she finds it is too challenging for the lower-ability students, for whom she 'pick[s] and choose[s]'[23].

Ms Formosa was shown lesson plans C, related to SCI LOF 7.1, ‘What do Scientists do?’ and D, related to SCI LOF 7.2, ‘Life on Earth’ (Appendix 1).

The first strategy that was discussed was that of accompanying explanations with video clips and providing students with a word chart (in this case, for lab equipment). Ms Formosa commented that a vocabulary bank is important and that this aids students in identifying the safety hazards in the lab. The second strategy, that is, of providing sentence starters with a target language structure, was new for Ms Formosa, and she was positive it would be helpful for students. Another strategy that was discussed with Ms Formosa was that of focusing on morphology, for instance: the prefix ‘in-’ in ‘invertebrate’ to explain word meaning. This was not a strategy that was normally adopted by Ms Formosa, and she shared the way she uses colours to aid students memorise terminology instead.

Similar to Ms Formosa, Ms Attard also made use of the book with her students, however she was aware that most teachers do not use it because of the British context, such as the presentation of foreign flora and fauna. She did not identify the issue as lying in the language load of the book as even teachers’ notes are in English. She mostly uses the book to assign it as independent reading to students.

Ms Attard was shown lesson plans E and F, both of which tackle topics related to SCI LOF 7.2, ‘Life on Earth’ (Appendix 1).

The first strategy that was discussed with Ms Attard was that of using images. Similar to Ms Bonnici, Ms Attard confirmed that she made frequent use of images and that they greatly helped understanding. She also found colour coding (on the PowerPoint) effective to aid student memory and help them build ‘connections’ in their brains, and commented on how she translates this concept, on handouts, by writing words in bold.

When asked about paraphrasing in simpler English instead of switching to Maltese, Ms Attard expressed that she sometimes tries this, but eventually always switches to Maltese, as she feels that students still do not understand the point. Another strategy that was presented to Ms Attard was that of doing some morphology work, such as focusing on ‘carne’ in ‘carnivore’. Ms Attard confirmed that she uses this technique as well and finds that it helps students since all of them would be learning a foreign language at school and will therefore have a varied linguistic background to draw from.

The final strategy that was discussed with Ms Attard was to leave text unmodified and provide students with attractive reading aids that would help them move along when reading independently. Ms Attard felt that this adaptation would not work because of the amount of text present, which would discourage students. Instead, she adapts texts by shortening them and adding diagrams.

Ms Bonnici was the second teacher who did not make use of the coursebook. She presented a similar argument to Mr Chetcuti, explaining that the contents do not match the syllabus exactly, and that it was easier to make notes herself. She commented that the level of English in the book seemed to match the one that she uses in her own notes, meaning that she could refer to her own experiences designing notes to comment on the effectiveness of the language scaffolds.

Ms Bonnici was shown lesson plans G and I, both of which included pages in the coursebook related to SCI LOF 7.7, 'Cells and Body Systems' (Appendix 1).

The first adaptation that was discussed with Ms Bonnici was that of paraphrasing difficult text in more accessible English, as opposed to code switching to Maltese. Unlike Ms Attard, Ms Bonnici explained that she frequently uses this strategy and that she finds that it works well. For instance, when explaining the word 'perforation', she will say: 'Listen, perforation is when something tears, or it breaks apart, [...] for example, when you're running, and you fall down and you hurt your knee, you have a graze, it cuts open, similar to that'. She explained that 'they understand it like that, when I say it in that way.[24]'

Another language support strategy that was discussed with Ms Bonnici was that of sensitizing students to the different forms of the same word. In this case, for instance, it was suggested that during the teacher's explanation, the teacher highlights, through the use of a slide, how 'magnify' may feature in the active voice (to magnify), passive (to be magnified) and as a noun (magnification). Ms Bonnici commented that she had never explicitly highlighted the different forms on a slide but would still reinforce the connection between words and the different way they are used in speech, which she finds helpful.

Another strategy that was discussed was accompanying explanations which include new terminology with images on the screen. Ms Bonnici explained that '[she thought] it does help' and that 'another thing that [she] sometimes [does] is that apart from showing them images, [she] show[s] them things, actual things', such as a three-pin plug when discussing electricity[25].

Ms Bonnici had experienced using also other scaffolds, such as putting steps in order, and presenting students with diagrams which they could then label. She also utilised groupwork and found it to be effective. Ms Bonnici explained that she had never tried one strategy, which involved familiarising students with a language structure (such as the comparative) through a multiple-choice exercise, however she believed it would benefit students. She also responded positively to the suggestion of focusing on the morphology of the word (in this case, '*optis'* in 'optical') and explained that she used this technique with other words, such as 'herbivore' and 'renal'.

Discussion

This part of the interviews was crucial to understanding whether the language scaffolds created for this study were i) accessible to teachers, ii) practical, iii) perceived as effective. In most cases, the language scaffolding strategies presented to teachers were well-received and some had tried something similar before, although as consistent with previous findings, teachers who are most recently qualified and who have multilingual classes tended to be more resourceful.

On the whole, the scaffolds were immediately understood by the teachers, however the interviewees were more familiar with those that were related to providing lexical support, something that mirrors the findings of section two. In fact, all of the strategies that were 'new' to teachers were ones related to the morpho-syntactical aspect, such as providing model sentences with target language structures, focusing on the different word classes that emerge from one root (such as 'divide' and 'division' or 'magnify' and 'magnification') and providing them with sentence starters to prompt production of sentences with specific language functions (such as making predictions, or hypothesising).

Another important finding from the data gathered was teachers' creation of note packs for their students, to either replace or supplement the coursebook. This has multiple implications. First and foremost, it reveals that teachers are already going through the works of adapting the coursebook into their own notes, meaning that the inclusion of proposed language scaffolds would not create extra work for teachers, but could instead be part of the core process of resource creation. Secondly, it has an important effect on what sort of language support teachers require. Whereas analysing the courseware for language difficulties and creating language scaffolds based on the book was the optimal means for initiating this research, further work on this subject could take a different form, such as the creation of a handy booklet with a list of language strategies to use for the four skills as they are present in science.

Thirdly, it is of some concern that a large number of teachers have strayed away from the coursebook. Although the creation of supplementary material is to be commended, the coursebook is what ensures, first and foremost, that students in *all* state schools have access to the same quality material. This uniformity also translates to the level and the quality of the English language with which the content is being communicated. Although there might be a great number of teachers whose English is of a good level, there is no means of checking whether all note packs are of equal quality, which in turn will affect what kind of language input students are getting when they read their notes. The coursebook ensures that, irrespective of the teachers' personal abilities, the scientific content is being transmitted in language that is of good quality and that starts acclimatising them to the genre-specific requirements of science.

Finally, research has shown that 'Comprehension of a text depends on at least four factors; readability, illustrations, hands/minds on activities and previous knowledge' (Hussain, 2012, p. 431). As students leaf through the colourful pages of the book, everything, from 'the quality of paper and ink used, [to] font size' to 'illustrations' increases text comprehension. Additionally, the varied tasks present in the coursebook, such as 'practical observations', 'surveys', 'measurement and information research activities' 'engage students' mind for better comprehension' and also fulfil the credo of science learning which is inquiry-based learning (Hussain, 2012, p. 431). Giving up on the coursebook might lead to deficiencies in certain aspects and inequality of opportunity between students with different teachers.

Conclusion

These interviews revealed important insights about the current situation through which science teachers are navigating, the difficulties they experience and the means to best support them. As stated in the introduction of this chapter, the aims of the interviews were those of investigating how teachers and students of science may be supported to meet the language challenges of their subject, and to check whether the language scaffolds designed were a useful means of providing this support. The data above, together with the discussion of that data, paints a clearer picture as to what is needed moving forward. The final chapter discusses the relevance of these findings to the local context and offers suggestions for future studies.

Chapter 5: Conclusion

This study was inspired by educational research on the correlation between student achievement and their proficiency in the language of schooling (LPU, 2016; CoE, 2020; Spiteri, 2019). Its aim was to find out how science teachers may be aided in supporting their students meet the language load of their subject. To reach this aim, the study involved designing practical language scaffolds to be used in conjunction with the science coursebook currently adopted by Maltese state schools *(KS3 Science, Book 1)*.

Findings

The first thing that the interviews showed was that Maltese is still the language of delivery that is preferred by Maltese students, despite the fact that English is the language of assessment and the language of the content material. This confirms the persistence of a state that has been consistently quoted in studies on language-use in Maltese classrooms over the past twenty years (Camilleri Grima, 2002, 2016; Mifsud & Farrugia, 2017). The challenge that educators are faced with here, is that of making English more accessible across the curriculum, so as to allow students to stop considering it a barrier and start profiting from it as a tool.

Secondly, the data gathered showed that although all teachers interviewed had a general awareness of the genre-specific language requirements of science, which was a positive finding, most of their observations were related to lexical difficulties and not to morpho-syntactical ones. It is of some significance to note that one may only provide support for difficulties he or she is able to diagnose. The key here could be collaboration between English and science teachers where both sides share their expertise to identify and address the language barrier. As the CoE affirms, 'the formulation of a school language policy should be the result of dialogue and negotiation among *all* teachers [emphasis mine]', meaning that this is not an enterprise that content subject teachers should be expected to embark on, on their own (LPU, 2016, p. 69).

Thirdly, although three out of four teachers agreed that the science teachers should play a significant role in easing the language burden, they were also wary of the limitations, specifically, time. The issue of time constraints was one that was expected to arise, and in fact, during the design process of the language scaffolds (Appendix 1), one of the key considerations was that of ensuring that the activities developed would not take away from content learning time, but rather act to enhance it. The language scaffolds presented seemed to have been effective in this sense, as time issues only popped up when discussing giving content and language integrated feedback to students, rather than when discussing the activities themselves. This proves that the scaffolds were not seen as extra appendages, but as a *means* of teaching of science, which is the way they were intended by design.

Finally, and most importantly, the interviews revealed that the language adaptations designed were mostly effective, either because they had already been tried in class, or else because they were deemed so based on the teachers' professional judgment. Teachers also generally understood the purpose of the language scaffolds and the rationale behind them, meaning that an in-depth specialisation in language is not required to provide the necessary support in content subjects. The overall discussions held throughout most of the interviews showed that the proposal by the LPU (2016) to have all teachers be language teachers is not as radical as it might sound, as the majority of the interviewees were already aware of their students' struggles with language and were also employing coping strategies to address them.

As one nears the end of this dissertation, it is important to note that although the aims of this study were reached, and important conclusions were derived, a number of challenges were also faced. The following section gives an overview of some of the limitations faced by this study and provides some recommendations for future work in this area.

Limitations and recommendations for future research

One of the first limitations faced was the number of participants found. Initially, the recruitment of five participants was sought, however only four participants came forward. The fifth participant would have allowed for all the scaffold sets to be reviewed, as participants were given two sets each, reviewing a total of eight out of ten. This did not affect findings greatly, as the unreviewed sets used similar techniques to the other eight.

Another element which proved challenging was the fact that two out of the four teachers were quite unfamiliar with the textbook, having abandoned it in lieu of their own personal notes. For this reason, their feedback on the effectiveness of the scaffolds was often separated from the context of the book and interpreted in the context of their own resources. Despite the dangers of abandoning coursebooks (as previously discussed), perhaps an idea for future studies would be to focus on the creation of more general language adaptation strategies which may be transferred across different contexts (whether it is ‘Safety in the Lab’, or ‘Animal Kingdoms’) and across modes (whether they are creating notes from scratch or adapting the coursebook).

A significant finding for future research is that the majority of interviewees agreed that the science teacher should take an active role in facilitating the genre-specific requirements of their subject and were positive about integrating language scaffolds within the lesson. The next step, therefore, could be that of investigating another recommendation by the LPU, that is of having teachers ‘provide combined content and language-specific feedback on written work’ across the curriculum (LPU, 2016, p. 81). This would have the twofold function of raising teachers’ awareness of students’ language struggles, and of providing students with triple or quadruple the amount of language input that they normally receive from just the language teachers.

Conclusion

This research was inspired by the understanding that language exists across the curriculum, which creates a tangible challenge for students whose L1 does not match the language of schooling. As was extensively discussed, this is the case for the majority of students in Maltese state schools, whose daily encounter with English in study material, notes and tests posits a barrier to learning.

This research sought to tackle this problem and provide a practical solution by designing a set of language scaffolds to facilitate access to the language of science and strengthen students’ literacy skills. Although these were designed with the science LOF in mind, they are a tool that can be transferred across the curriculum and which can be adopted by all teachers whose content subject is delivered and assessed in English.

Perhaps the most significant role played by this study was that of raising more awareness on the language-related difficulties that science teachers and students encounter daily. A comment that resonated with me was one made by Mr Chetcuti, who described the issue of language in science teaching as an untouchable ‘sacred cow’, whom no one dare approach, but who continues to persistently hold students back from reaching their full potential. Teachers' general enthusiasm at discussing the topic during the interviews was evident proof that it is a very pertinent matter to their profession. Content subject teachers should not be left alone in dealing with an issue that is having a significant impact on student achievement, and that is ultimately limiting learners' chances to further their education successfully.

References:

Adams, M.J. 1990. *Beginning to read: Thinking and learning about print: A summary*. Urbana-Champaign: University of Illinois.

Amaral, O. M., Garrison, L., Klentschy, M. (2002). Helping English Learners Increase Achievement Through Inquiry-Based Science Instruction. *Bilingual Research Journal, 26*(2), 213-239. https://doi.org/10.1080/15235882.2002.10668709

Beacco, J. (2017). Language in all subjects: The Council of Europe's perspective. *European Journal of Applied Linguistics, 5*(2), 157-176.

Bentley-Davies, C. (2012). *Literacy Across the Curriculum Pocketbook*. Hampshire, HAM: Teacher's Pocketbooks. (Tan, 2011, p. 327).

Bernstein, B. (1996). *Pedagogy, Symbolic Control & Identity: theory, research, critique.* London: Taylor & Francis

Blackledge, A. and A. Creese. (2010). *Multilingualism: Critical Perspectives*. London: Continuum.

Briguglio, C., Watson, S. (2014). Embedding English language across the curriculum in higher education: A continuum of development support. *Australian Journal of Language and Literacy*, *37*(1), 67-74.

Camilleri Grima, A. (2002). Bilingualism across the curriculum: an aim and a means. In C. Bezzina, A. Camilleri Grima, D. Purchase & R. Sultana (Eds.), *Inside secondary schools: Maltese reader* (pp. 108-122). Retrieved from https://www.um.edu.mt/library/oar/handle/123456789/32735

Camilleri Grima, A. (2016). Bilingualism in education in Malta [Editorial]. *Malta Review of Educational Research, 10*(2), 177-179.

Camilleri, A. (1995) Bilingualism in Education. *The Maltese Experience*. Heidelberg: Julius Groos Verlag.

Canagarajah, S. (2011). 'Codemeshing in academic writing: identifying teachable strategies of translanguaging'. *Modern Language Journal 95*(3), 401–17.

Cobb, T. (n.d.). *Compleat Web VP*. (v.2.5). https://www.lextutor.ca/vp/comp/

Council of Europe. (2020). *Language Policy, Milestones.* Council of Europe. https://www.coe.int/en/web/language-policy/milestones

De Groot, E. (2002). Learning Through Interviewing: Students and Teachers Talk About Learning and Schooling. *Educational Psychologist, 37*(1), 41-52

Duke, N. K. & Martin, N. M. 'Best Practices in Informational Text Comprehension Instruction'. In Gambrell, L, B. & Morrow, L. M. (Eds) *Best Practices in Literacy Instruction*, *5th edition* (234-249). The Guilford Press.

Echevarria, J., Vogt, M. & Short, D. (2017). *Making Content Comprehensible for English Learners: The SIOP Model*. Pearson.

Fradd, S. H., Lee, O. (2001). Promoting Science Literacy with English Language Learners Through Instructional Materials Development: A Case Study. *Bilingual Research Journal, 25*(4), 479-501. https://doi.org/10.1080/15235882.2001.11074464

García, O. (2009). *Bilingual Education in the 21st Century: A Global Perspective*. Oxford: Wiley-Blackwell.

García, O. and N. Kano. (2014). 'Translanguaging as process and pedagogy: developing the English writing of Japanese students in the US' in J. Conteh and G. Meier, (eds.). *The Multilingual Turn in Languages Education: Opportunities and Challenges*. Bristol: Multilingual Matters, 258–77.

Garcia, O., Wei, Li. (2014) *Translanguaging: Language, Bilingualism and Education*. Palgrave Macmillan. https://doi.org/10.1057/9781137385765

Graesser, A. C. & McNamara, D. S. (2012). *Coh-Metrix Text Easability Assessor.* (T.E.R.A. direct link). http://cohmetrix.com/

Greenway, T., Oliver, R., Taylor, D. (2008). *KS3 Science Book 1* (E. Walsh, Ed.). Harper Collins Publishers.

Hussain, R. (2012). Students' views of impact of textbooks on their achievements. *In Search of Relevance and Sustainability of Educational Change: An International Conference at Aga Khan University Institute for Educational Development, November 1-3, 2012*, 430-438.

Jaspers, J. (2018). The transformative limits of translanguaging. *Language & Communication, 58*, 1-10.

Lambert, J. (2018). Big ideas for expanding minds: teaching English language learners across the curriculum. *International Journal of Bilingual Education and Bilingualism, 21*(4), 520-522, https://doi.org/10.1080/13670050.2016.1187327

Language Policy Division, Council of Europe. Language(s) of Schooling. (2009) Languages in Education, Languages for Education. https://rm.coe.int/CoERMPublicCommonSearchServices/DisplayDCTMContent?documentId=09000016805a2238

Language Policy Unit, DGII – Directorate General of Democracy, Council of Europe. (2016). *The Language Dimension in All Subjects: A Handbook for curriculum development and teacher training*.

Language Policy Unit, Education Policy Division, Education Department / DGII, Council of Europe, Strasbourg. (2015). *Language Education Policy Profile, Malta, March 2015*.

Lorenzo, Francisco, & Meyer, Oliver. (2017). Languages of Schooling: Explorations into Disciplinary Literacies: An Introduction. European Journal of Applied Linguistics, 5(2), 153-156.

Maledive Team. (2020). *Teaching the language of schooling in the context of diversity, study materials for teacher development.* Maledive. http://maledive.ecml.at/Home/tabid/3598/language/en-GB/Default.aspx

Martin, J. R. & Rose, D. (2005) Designing Literacy Pedagogy: scaffolding asymmetries. In J Webster, C Matthiessen & R Hasan (eds.) *Continuing Discourse on Language* (251-280). Continuum.

McConachie, S.M., & Petrosky, A.R. (2010). *Content matters: A disciplinary literacy approach to improving student learning*. San Francisco, CA: Jossey-Bass.

McIntyre, E., Kyle, D., Chen, C., Muñoz, M., & Beldon, S. (2010). Teacher learning and ELL reading achievement in sheltered instruction classrooms: Linking professional development to student development. *Literacy Research and Instruction*, *49*(4), 334–351.

McNamara, D.S., Graesser, A.C., McCarthy, P., & Cai, Z. (in press). *Automated evaluation of text and discourse with Coh-Metrix.* Cambridge: Cambridge University Press.

Meltzer, J. & Hamann, E. T. (2005). *Meeting the Literacy Development Needs of Adolescent English Language Learners Through Content-Area Learning – Part Two: Focus on Classroom Teaching and Learning Strategies*. Faculty Publications: Department of Teaching, Learning and Teacher Education. University of Nebraska: Lincoln.

Mertin, P. (2018). *Translanguaging in the Secondary School*. Woodbridge: John Catt Educational Ltd.

Mifsud, J. & Farrugia, J. (2017). Language choice for science education: policy and practice. *The Curriculum Journal 28*(1), 83-104.

Ministry for Education and Employment. (1999). *National Minimum Curriculum*.

Ministry for Education and Employment. (2012). *A National Curriculum Framework for All*. Salesian Press.

Ministry for Education and Employment. (2014). *A National Literacy Strategy for All in Malta and Gozo 2014-2019*.

Ministry for Education and Employment. (2015). *Educator's Guide for Pedagogy and Assessment Using a Learning Outcomes Approach, Core Science Levels 7,8,9,10.* Directorate for Quality and Standards in Education.

Morgan, D. L. (2014). Pragmatism as a Paradigm for Social Research. *Qualitative Inquiry, 20*(8), 1045-1053. https://doi.org/10.1177/1077800413513733

National Statistics Office, Malta. (2014). *Census of Population and Housing 2011, Final Report*. National Statistics Office, Lascaris Valletta.

Piccardo, E. (2016). Plurilingualism: Vision, Conceptualization, and Practices. *Handbook of Research and Practice in Heritage Language Education*, 1-19. https://doi.org/10.1007/978-3-319-38893-9_47-1

Roe, B. D., Smith, S. H., & Burns, P. C. (2008). *Teaching reading in today's elementary schools* (10th ed.). Belmont, CA: Wadsworth Publishing

Rose, D. (2007). A Reading based model of schooling. *Pesquisas em Discurso Pedagógico*, *4*(2), 1-17.

Rose, D. (2004). *Reading and Writing Factual Texts*. Teacher Training Video. Sydney: Learning to Read: Reading to Learn. For copies (VHS or DVD) contact author d.rose@edfac.usyd.edu.au (Rose, Rose, Farrington Page, 2008).

Rose, D., Rose, M., Farrington, S. & Page, S. (2008) Scaffolding academic literacy with indigenous health sciences students: An evaluative study. *Journal of English for Academic Purposes 7*,165-179.

Sansone, K. (2020). *Italian pupils are largest foreign community in Maltese schools*. Malta Today. https://www.maltatoday.com.mt/news/national/100547/italian_pupils_are_largest_foreign_community_in_maltese_schools#.Xz_MWsgzZPb

Schleppegrell, M. J. (2004). *The language of schooling: A functional linguistics perspective*. Mahwah, NJ: Lawrence Erlbaum.

Shores, M., & Smith, T. (2011). Designing and Developing Lesson Plans for K-12 Classrooms. *Computers in the Schools, 28*(1), 27-38.

Short, D. (2002). Language learning in sheltered social studies classes. *TESOL Journal*, *11*(1), 18–24.

Short, D., Fidelman, C., & Louguit, M. (2012). Developing academic language in English language learners through sheltered instruction. *TESOL Quarterly*, *46*(2), 333–360.

Skinnari, Kristiina, & Nikula, Tarja. (2017). Teachers' perceptions on the changing role of language in the curriculum. *European Journal of Applied Linguistics, 5*(2), 223-244.

Spiteri, D. (2019). English for All: Repositioning English across the curriculum. *Malta Review of Educational Research 13*(2), 194-208.

Spiteri, D. (2019). *Examining an Examination: A Practical Guide to Evaluating a Language Examination*. Merlin Publishers.

Tan, M. (2011). Mathematics and science teachers' beliefs and practices regarding the teaching of language in content learning. *Language Teaching Research, 15*(3), 325-342.

U.S. Department of Education. *Our Nation's English Learners*. (n.d.) https://www2.ed.gov/datastory/el-characteristics/index.html#intro

Verplaetse, L. S. (2000). How content area teachers allocate turns to limited English proficient students. *Journal of Education, 182*(3), 19–36.

Wellington, J. (2015). *Educational Research, Contemporary Issues and Practical Approaches*. New York, NY: Bloomsbury Academic.

Windyaningrum, S., Arini, R. (2016). Redesigning English Syllabus and Lesson Plan for The First Graders of Elementary School. *Journal of English Language Education 2*(1), 38-54.

Wingate, U. (2016). Academic literacy across the curriculum: Towards a collaborative instructional approach. *Language Teaching 51*(3), 349-364. https://doi.org/10.1017/S0261444816000264

Woolfolk, A. (2016). *Educational Psychology.* Pearson Education Limited.

Appendix one: The Language Scaffold Sets

Language Scaffolds, Set A

Year 7 // SCI LOF 7.1

Unit title: Scientists at Work

LOF Subject Focus: What do Scientists do?

Related Content Objectives. Teacher will:

1. Guide the students to identify safety issues in the laboratory.
2. Introduce the students to simple apparatus (glassware).

Related Content Learning Outcomes:

1. I can recall and follow important laboratory safety rules.
2. I can identify hazard symbols on chemicals and suggest safety procedures

Key Vocabulary: glassware, instruments, apparatus, test tube, test tube rack, beaker, flask, funnel, measuring cylinder, microscope, Bunsen burner, heat-proof mat, safety rules, poisonous (toxic), irritant, flammable, corrosive, explosive, harmful to the environment.

Related Language Learning Outcomes:

1. I can give suggestions.
2. I can evaluate and respond to texts which include visuals and graphics.

Key vocabulary: Athlete, damaged, protective clothing, hazard, risk assessment, refuelling, hazcard, concentrated, dilute.

Recommended Materials: *KS3 Science Book 1*, pp. 48-52.

Supplementary Materials:

'Lab Safety Video': https://www.youtube.com/watch?v=N0QqLVUDkvA

T.'s PowerPoint.

Word Bank Chart.

①

Identified problem: '==Bunsen burner==' is a new term that Ss have never encountered. '==Flame==', which is a key term, is classified as K3.

<u>Suggested solution</u>:

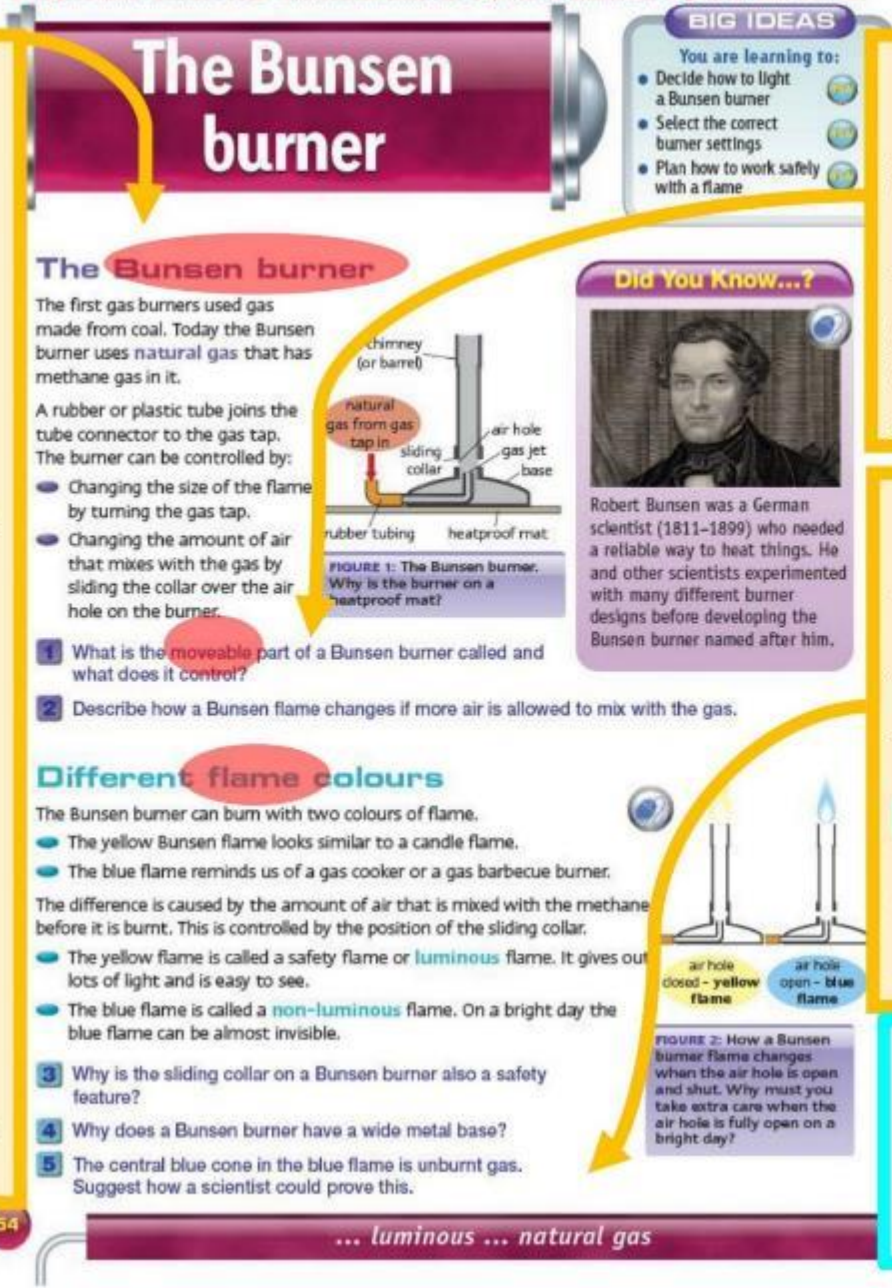
T. starts the lesson by addressing these two key words.

T. shows ==GIF of a Bunsen burner== with a flame being switched on and off.

The Bunsen burner

T. asks if Ss have ever heard of a Bunsen burner. T. explains that a Bunsen burner is used to light up a **flame**, as is shown in the GIF.

T. asks Ss to scan p. 54 to find out who was the inventor of the Bunsen burner and why he invented it.



The Bunsen burner

BIG IDEAS

You are learning to:
- Decide how to light a Bunsen burner
- Select the correct burner settings
- Plan how to work safely with a flame

The Bunsen burner

The first gas burners used gas made from coal. Today the Bunsen burner uses natural gas that has methane gas in it.

A rubber or plastic tube joins the tube connector to the gas tap. The burner can be controlled by:
- Changing the size of the flame by turning the gas tap.
- Changing the amount of air that mixes with the gas by sliding the collar over the air hole on the burner.

FIGURE 1: The Bunsen burner. Why is the burner on a heatproof mat?

Did You Know...?

Robert Bunsen was a German scientist (1811–1899) who needed a reliable way to heat things. He and other scientists experimented with many different burner designs before developing the Bunsen burner named after him.

1. What is the moveable part of a Bunsen burner called and what does it control?
2. Describe how a Bunsen flame changes if more air is allowed to mix with the gas.

Different flame colours

The Bunsen burner can burn with two colours of flame.
- The yellow Bunsen flame looks similar to a candle flame.
- The blue flame reminds us of a gas cooker or a gas barbecue burner.

The difference is caused by the amount of air that is mixed with the methane before it is burnt. This is controlled by the position of the sliding collar.
- The yellow flame is called a safety flame or luminous flame. It gives out lots of light and is easy to see.
- The blue flame is called a non-luminous flame. On a bright day the blue flame can be almost invisible.

FIGURE 2: How a Bunsen burner flame changes when the air hole is open and shut. Why must you take extra care when the air hole is fully open on a bright day?

3. Why is the sliding collar on a Bunsen burner also a safety feature?
4. Why does a Bunsen burner have a wide metal base?
5. The central blue cone in the blue flame is unburnt gas. Suggest how a scientist could prove this.

54

... luminous ... natural gas

②

Identified problem: Ss might not be familiar with the adjective 'moveable' stemming from the verb 'to move'.

<u>Suggested Solution</u>: T. reads questions 1 and 2 out loud and mimes 'moveable'.

③

Identified Problem: *To answer question 5, Ss must know how to give a suggestion.*

<u>**Suggested Solution**</u>:

T. provides Ss with ==sentence starters== (below) projected on the PP. T. asks them to brainstorm possibilities in pairs and then write down their suggestion using the sentence starters on the board.

p. 54, Q5.

- The Scientist should...
- The Scientist could...
- It would be a good idea if he...
- If I were him, I would...
- I think the best thing would be to...

Getting to know your Bunsen burner

The table summarises the differences between the two types of Bunsen burner flames.

Yellow, luminous flame	Blue, non-luminous flame
closed air hole	open air hole
silent	makes a sound
leaves **soot**	no soot in the flame
wavy flame	flame has a regular shape
flame is less hot	flame is very hot

You are going to investigate how a Bunsen burner flame changes when the position of the sliding collar is changed.

Your teacher will provide you with the apparatus that you may need for your investigation.

Method:

1. Light your Bunsen burner — *always* light the Bunsen burner with the air hole closed. It is easier to light and it gives the safety flame.
2. Experiment with the gas pressure by turning the gas tap very slowly. Can you see the way the flame size changes?
3. Place the end of a metal spatula in the yellow flame for a few seconds and then look at the spatula. Note down in your notebook what you see.
4. Open the air hole completely by sliding the collar. Can you see the central blue cone and hear the sound?

How Science Works

Discuss with your partner how you would determine the key steps in using a Bunsen burner safely. Devise a short list of checks you would make when testing someone else. Decide how many of the test points you need to score before being awarded your Bunsen burner driving licence.

Questions

1. Test yourself by naming all the parts of the Bunsen burner (*Hint:* use Figure 1 if you need help).
2. Why is it a bad idea to heat things with a luminous flame?
3. Why do you think that burning candles a lot makes the ceiling dirty?
4. Gas heaters always use a blue flame. Some heaters have a small ceramic rod that glows red in the flame. How might this idea be useful in the laboratory?

5. a) Why is the blue flame hotter?
   b) Why is air needed for a hot flame?
   c) Why is there no soot with a blue flame?

①

Identified problem: *Some Ss might not be confident enough in English to come up with the steps of how to light the Bunsen burner from scratch.*

Suggested solution:

High Level of Support: T. provides Ss with image cut-outs showing the steps involved in safely lighting a Bunsen burner. All images are labelled. Ss must independently try to put them in the correct order, and then they review in pairs.

Medium level of Support: T. provides Ss with two sets of cut-outs: one showing just the images, and the other showing the steps. Ss must first match the step to the image, and then place them in the correct order. Ss. work independently and then assess in pairs.

Low level of Support: T. provides Ss with the images, but without the steps written down. Students must first label each picture with a description of that step, and then place them in order.

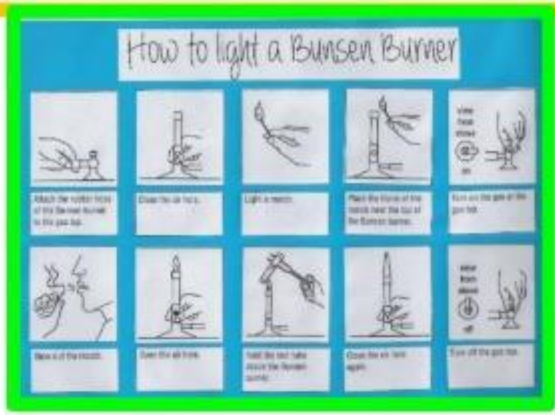


Figure 1: Image reproduced from a teacher-created resource on http://year7sciencewithmisszammit.weebly.com/bunsen-burner.html

①

Identified problem: *The word 'filament' is categorised as K9 (VocabProfile). It is a technical term which students will not have previously encountered.*

Suggested solution: Ss. identify which part of the light bulb is the filament and mark it on the image in their books.

The best flame

BIG IDEAS

You are learning to:

- Identify the hottest part of the flame
- Explain what we mean by burning
- Evaluate the evidence for different flame temperatures

Glowing filaments

Old-fashioned light bulbs have a wire filament that glows white-hot. If you watch stage lights being switched on, they get brighter. The metal filament changes from red to white hot. A similar idea can be used to show how hot a Bunsen flame is. Not all parts of the flame are equally hot.

1. Where is the hottest part of the blue flame?
2. Explain what you can see with the lowest wire in Figure 2.

FIGURE 1: A light bulb showing the wire filament.

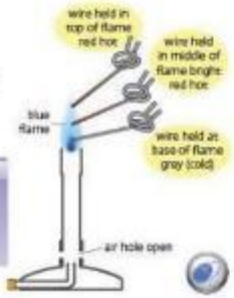


FIGURE 2: Three different wires were held one at a time in a blue Bunsen burner flame in three different parts of the flame — top, middle and at its base.

Comparing blue and yellow flames

If the Bunsen burner flame is yellow, the gas has not burnt completely. This is why carbon particles (soot) are left over. It is these particles that make the flame luminous. Heating with a yellow flame covers the apparatus in black soot. It is also wasteful because less heat energy is given out by a yellow flame.

The scientific name for burning is combustion.

- In a blue flame, combustion is complete.
- The yellow flame is an example of incomplete combustion — a wire held in a yellow flame glows less brightly.

3. Explain what 'combustion' means.
4. Describe how the temperature of different flames could be investigated using wires.
5. Why is a yellow flame an example of incomplete combustion?

... combustion ... complete

②

Identified problem: *Differentiating question types would be useful. The book relies heavily on open ended questions which require extensive sentence formation.*

Suggested solution: T. differentiates questions 3-5 by turning them into T/F, multiple choice and gap fill. Ss. can then take note of the open-ended questions in their notebooks, after having engaged with the questions in the PP. Ss are nominated to read out their answers.

p. 56: (5) Comparing blue and yellow flames

3. 'Combustion' is the scientific way of saying ____________ (heating, burning, cooling).

4a. The parts of a flame (top, middle and base) are all equally hot. True / False

4b. We can *prove* this by holding three different ________, one at a time, in three different parts of the flame, ________, ________, and base. The wires will turn a ________ colour because they will reach different ______.

5a. A yellow flame is an example of complete combustion. True / False.

b. A yellow flame is an example of ____________ combustion, because if we hold a wire in a yellow flame, it glows ______ brightly.

Science in Practice

① *Identified problem: Students might be still getting used to the names of the different apparatus.*

Suggested solution: T. uses this exercise as an opportunity to revise the apparatus names learnt in the previous lesson. T. reinforces vocabulary learnt by setting up an example of the apparatus needed on the front desk. Ss make a list of the apparatus needed for the experiment and can check the word bank if required. Ss. may only collect the apparatus after providing T. with their list.

Using a Bunsen burner

You are going to investigate how fast water can be heated using a Bunsen burner. Your teacher will provide you with the apparatus you need for your investigation.

Method:

1 Set up the apparatus.
2 Half fill with cold water, noting the volume used.
3 Measure the starting temperature of the water.
4 Predict the shape of the graph you will get by plotting time in minutes against temperature.
5 Light the Bunsen with the air hole closed. Open to give a blue flame.
6 Note the time and start heating. Measure the water temperature every minute until the water boils. Switch off.
7 Record the data in a table then plot the graph.

How Science Works

Discuss how using a data logger might produce more reliable results for this experiment.

Questions

1 Discuss with your partner the real graph and the one you predicted. Note any differences.
2 What hazards are involved in this experiment?
3 Describe the energy transfers in this experiment.
4 How would the graph differ if you used
(a) twice as much water
(b) two Bunsen burners?
5 How might you reduce the energy losses in this experiment?

P. 57, ex. 4

4a. If I used twice as much water, the graph would …

4b. If I used two Bunsen burners, the graph would…

57

② ***Identified problem:*** Making predictions involves using a particular language structure.

Suggested Solution: As this is the first time, encountering the concept of prediction, T. first elicits the meaning of 'to predict' by referring to pictures.

T. asks Ss what the photos have in common. They are all predicting what will happen in the future. Some of the predictions are based on science, others are not. T. asks which ones are based on scientific data / evidence and which one is not. T. asks which method is the least reliable.

T. introduces the language structure of predictions. T. explains that making predictions involves: 1. Formulating a question and 2. Stating a hypothesis.

Making Predictions!

What do these pictures have in common?
Which picture shows the least reliable predictions?

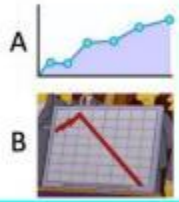
How do we make predictions?

1. Formulate a question.
For example: What will my hair look like when I am 70 years old?
2. State a hypothesis.
For example: I predict that my hair will be short and grey.

P. 57.

1. Formulate a question.
For example: What will my graph look like if I plot time in minutes vs temperature?

2. State a hypothesis.
For example: I predict that my graph will look like graph A / graph B because …



③ ***Identified Problem:*** *Answering question 4 requires the use of the second conditional.*

Suggested Solution**:** T. provides sentence starters:

If I used twice as much water, the graph would …

If I used two Bunsen burners, the graph would…

Language Scaffolds, Set B

Year 7 // SCI LOF 7.1

Unit title: Scientists at Work

LOF Subject Focus: What do Scientists do?

Related Content Objectives. Teacher will:

1. Engage students to explore combustion and use the fire triangle to describe fire.
2. Guide students to use the fire triangle to describe a safe way of putting out a fire.

Related Content Learning Outcomes:

1. I can identify the three components needed to start a fire by using a fire triangle.
2. I can use the fire triangle to identify ways of putting out a fire.

Key Vocabulary: fire triangle, fuel, oxygen, heat, fire extinguisher, fire blanket.

Related Language Learning Outcomes:

1. I can use the zero conditional to link cause and effect.
2. I can speak about a hypothetical situation by making use of the modal 'would'.
3. I can use inference and deduction to understand meaning of unfamiliar words.
4. I can use conditionals to express possibilities (may, might, could).

Key vocabulary: increase, decrease, alight, jar, limited, predict, devise an improvement, dense, electrical fire, cut off supply, properties, spread, factor, may, might, could, precaution.

Recommended Materials: KS3 Science Book 1, pp. 58-63

Supplementary Materials: PowerPoint Presentation.

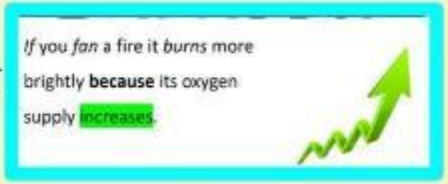
① ***Identified problem:*** *In order to answer questions 1-4, students need to know how to use the zero conditional (if + present simple + present simple).*

Suggested solution:

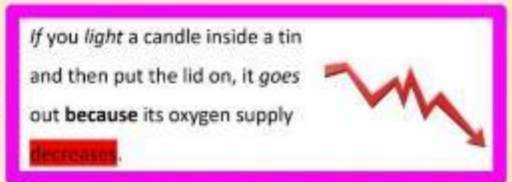
T. asks Ss to read the text 'Fuels need oxygen to burn'. T. introduces the zero conditional by asking concept checking questions (CCQs) about the text. The CCQs are presented in the format of incomplete sentences which they must match to their ending. During this step, T. is both checking content understanding and modelling the zero conditional. With each CCQ, T. reveals the right combination on the mix and match exercise on the slide 1.

1. If you burn fuel…	a. …it burns.
2. If we don't have oxygen…	b. …it gives out heat energy.
3. If a fire has oxygen…	c. …we cannot breathe.

T. asks Ss to think in pairs about the answer to question 1. T. asks a few pairs what their answer would be. T. reveals the answer on the slide 2. T. mimes the word 'increase'.

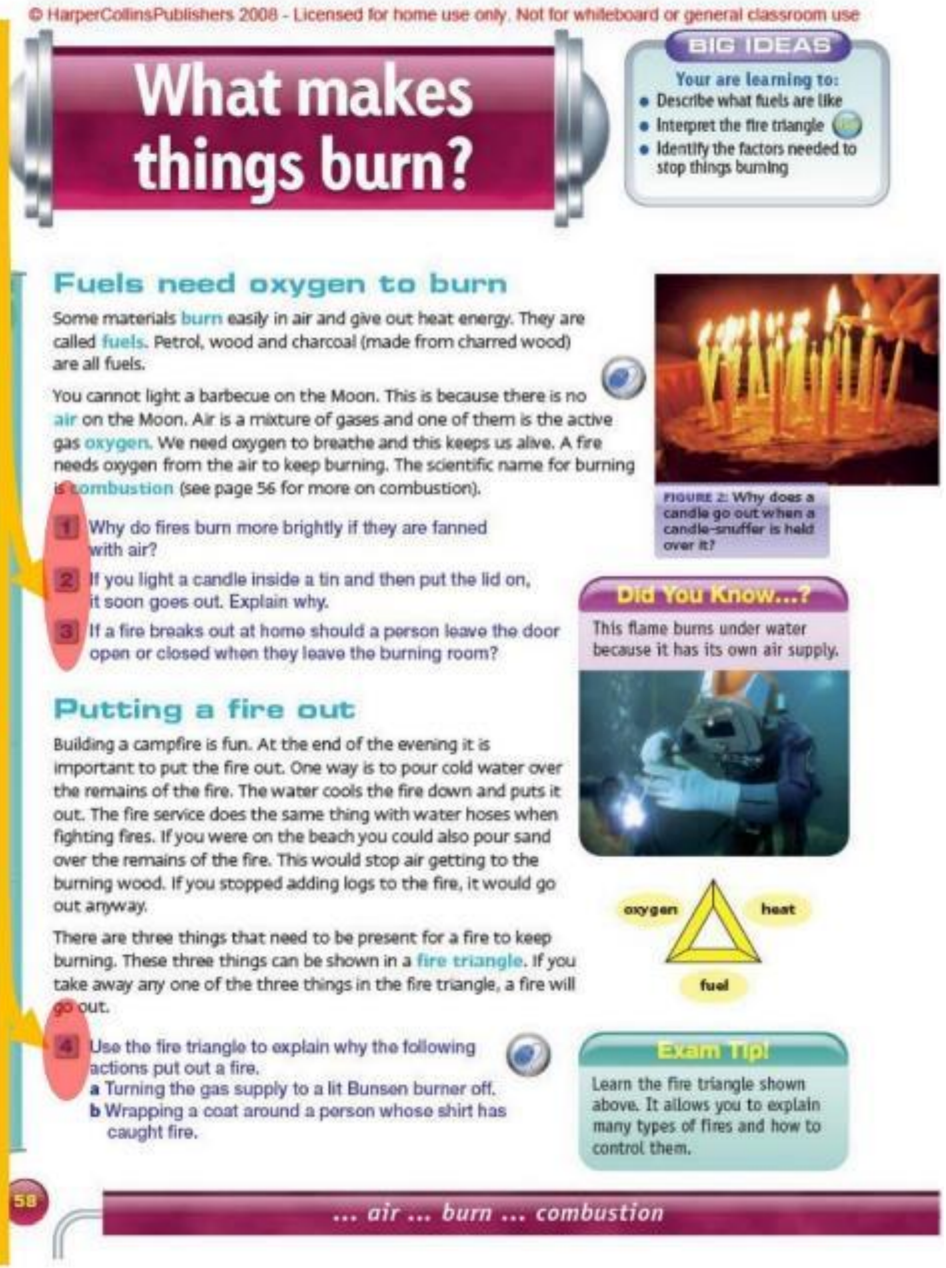


T. elicits what the opposite of 'increase' is: 'decrease'. T. asks Ss to repeat the exercise for quetion 2. This time, Ss must try and answer in English in full, using the example of question 1 as reference. After taking answers, T. shows slide 3 to reinforce the language model.



T. shows slide 4. Ss think, pair, share and fill in the blanks. This acts as a revision to the language focus in the previous lessons, where they practised giving suggestions.

Ss. should now have more linguistic



Science in Practice

① ***Identified problem:*** *The introductory text has words which might prove difficult for students (Vocabprofiler).*

Suggested solution: T. reads the text out loud to model pronunciation, provide alternative ways of saying difficult words such as synonyms, and accompany her instructions with realia.

T. says: You are going to *observe* closely what happens when a candle burns. Your teacher [I] will place a floating candle in a bowl of water, and then carefully light it. Once *alight* [so once the candle has been lit, once it is burning], a glass jar [shows jar] will be placed on top to see what happens next once the candle's air supply is *limited* [what do we mean when we say something is limited? Have you ever heard of anything that was limited edition? What is a limited-edition play station for example? *give students time to think and contribute* It means there are not many of them around right? In this case what is a *limited air supply* then? There is not a lot of air that's right!]

Burning a candle

You are going to observe closely what happens when a candle burns. Your teacher will place a floating candle in a bowl of water, and then carefully light it. Once alight, a glass jar will be placed on top to see what happens next once the candle's air supply is limited.

Questions

1 Predict what will happen to the candle when the jar is placed on top.

2 Observe any changes to the candle and to the water levels both inside and outside the jar.

3 Explain your observations.

4 Devise one improvement to the experiment that would allow you to take some relevant measurements.

② ***Identified problem:*** *In order to answer question 1, students need to use the language structures for predictions. Students have already encountered this structure once in the previous lesson but need to revise and reinforce.*

Suggested solution: T. asks Ss if they remember what examples of 'predictions', they had mentioned during a previous lesson. T. takes some answers whole class. T. ensures here that she models the form one more time with accessible content, for instance: yes we mentioned weather forecasts, for instance: '*I predict that* tomorrow the weather *will be* sunny'. T. emphasizes the italicized words to emphasize the verb form.

T. then projects the sentence starter on the board: I predict that when the jar is placed on top of the candle … Ss. must work on their observations individually and then peer review.

P. 59, EX. 1

- I predict that when the jar is placed on top of the candle ...

③ ***Identified problem:*** *To 'devise one improvement' students need to speak about a hypothetical situation by making use of the modal 'would'. For example: I would use a beaker to measure the water level before and after the candle burns out.*

Suggested solution: T. asks Ss to think of means of improving the experiment in pairs and jot down their thoughts. T. gathers feedback and for each students' suggestion, she writes down: [Ss.' names] **would** use a stopwatch to measure time', etc. Ss then decide which suggestions are the most pertinent. Through the repetition of the language form, students are both brainstorming ideas and familiarising themselves with speaking about hypothetical situations using the modal verb 'would.

(1) ***Identified problem:*** *This two-page spread has quite a lot of text, but the vocabulary is manageable if the teacher pauses on a few key words:* *dense, electrical fires, conduct electricity, cutting off supply, properties, spread, factors*

<u>Suggested solution</u>: Ss find the vocabulary in the text and then they use inferencing to connect the word to the right meaning. T. projects table on the board. T. asks Ss to scan the text on both pages, find the words in Column A and circle them. Ss then work individually to work out the meaning of the words from the text to complete the definitions. Ss. are now equipped with the key terms to understanding the whole text and answer the questions.

Putting out a fire

BIG IDEAS

Your are learning to:

- Explain why carbon dioxide is used in extinguishers
- Select the correct extinguisher for a fire
- Explain the kinds of decisions fire-fighters must take

Gas fire extinguishers

The gas called **carbon dioxide** is much heavier (more dense) than air. Carbon dioxide stops air reaching a fire and so the fire goes out. This is a much safer way of putting out electrical fires than using water.

Soda-acid fire extinguishers also rely on carbon dioxide gas. When the two separate chemicals inside mix together, the carbon dioxide released forces out the water on to the fire. This type of extinguisher cannot be used for electrical fires since water is released.

1. Use the fire triangle on page 68 to explain how a soda-acid extinguisher puts out a fire.
2. Why is a soda-acid fire extinguisher unsafe to use on a burning television?
3. Suggest why a colour code is used for different kinds of fire extinguisher.

Did You Know...?

The 'eternal flames' in the Middle East are mysterious flames that just seem to escape from the ground. They are called the 'eternal flames'.
It used to be thought they were magic but it is now known that the flames are really burning natural gas leaking out from underground deposits, perhaps set on fire by lightning.

FIGURE 1: A fire extinguisher that uses carbon dioxide. Why does it put out a fire?

What to do if there is a fire

Pouring water over a burning electrical device is very dangerous. The water can conduct electricity and give you an electric shock. Cutting off the air supply is one possible solution. Some fire extinguishers work like this. Most homes do not have a fire extinguisher.

4. This man has called for the fire-fighters. What should he do to control the fire before they arrive?
5. Which is the correct action, fighting a fire yourself or warning others and leaving a burning room?

Foam and fire blankets

There is a problem with burning oil. Oil is less dense than water and floats to the top. If you pour water on to burning oil it carries on burning. Aircraft carry enormous amounts of fuel in their wings. If an aircraft has an accident, terrible fires can break out. **Foam** is less dense than the burning oil and so it lies on top of the oil and cuts off the air supply.

At home, you can put out a burning pan of oil by covering it with a damp cloth. Some people have special **fire blankets** in the kitchen or in their car.

FIGURE 2: Foam being used to put out an aircraft fire. How does it work?

6. a) Explain, using your knowledge of the properties of foams, why it is suitable to put out oil fires.
   b) Give several factors that might influence the spread of a fire at home.
   c) What precautions should fire fighters take when controlling a dangerous bonfire?

Dry-powder fire extinguishers

Sometimes a fire can occur in a car engine. These fires are very dangerous since they can spread quickly and the fuel in the tank may explode. Some cars are fitted with **dry-powder extinguishers**. The powder is sprayed over the fire and stops oxygen getting to it.

7. To put out a burning car engine fire-fighters must first open the bonnet. Why is this a problem?
8. When might you use a dry-powder extinguisher at home?

How Science Works

On 5th November, large bonfires are built, often in unsuitable places. Some people include old car tyres in their bonfires, even though they release toxic fumes when they burn.

FIGURE 3: In December 2005 an oil storage depot in Hertfordshire caught fire. Fire crews brought the fire under control as quickly as possible but a cloud of pollution hung over the area for several days after.

9. Give three factors that might affect a decision to build an oil storage depot near a town.

...guisher

INSERT THE WORDS / PHRASES IN COLUMN A TO COMPLETE THEIR MEANINGS IN COLUMN B

Column A	Column B
Dense	An ______________ starts off from an electric device, for example a fridge freezer or a TV.
Spread	___________ of something means to stop providing it or stop it being provided.
Factor	In science, a __________ substance is very heavy when compared with its volume (how big it is).
To cut off the supply	________________ means to carry electricity along.
Properties	When there is a fire ________, it means it is moving, getting bigger, to reach a larger area.
To conduct electricity	__________ are qualities, or features of anything, for example, a property of fire is that it is hot.
Electrical fire	A _______ is one of the things that affects an event, decision, or situation.

(2) ***Identified problem:*** *To answer question 3, students must be able to use the language form to express possibilities.*

<u>Suggested solution</u>: T. asks Ss to think quietly about question 3. T. takes feedback whole class. T. translates ideas being generated into the correct form. For example:

[S1]: "To recognise them easily."

[T. writes]: It *may* be so that we can recognise them easily.

[S2]: "To show what is inside of them."

[T. writes]: It *could* be so that we can recognise them easily.

[S3]: "To show us what kind of fire they can put out."

[T. writes]. It *might* be so that they show us what kind of fire they can put out.

T. circles the italicized modals and points out that these words allow us to express possibilities: things that we are not certain of, that we are guessing. We usually use this when we are asked to *suggest* why something is so. T. confirms the accurate answer and Ss. copy the full sentence on their journals.

①*Identified problem:* *In question 2 students are again being asked to express possibilities. This is a good opportunity for students to practice the language form introduced by the teacher on the previous page (using may, might and could).*

Suggested solution: T. asks Ss if they can *suggest* one thing you *might* notice if a fire has started. T. takes care to leave the 'may, might, could' sentences from the previous page boarded, so that she may point to them for reference and ask students to follow the same model.

It may be so that we can recognise them easily.
It could be so that we know what is inside of them.
It might be so that they show us what kind of fire they can put out.

T. asks Ss to refer to the board, and use 'may, might or could to express their thoughts. T. gives example: 'You may hear the fire alarm.'

If Ss do not use the form correctly, T. reinforces the correct model by rephrasing, for example:

[S]: You smell smoke.

[T]: Good yes, you *might* smell smoke. What else?

Fire precautions at school

BIG IDEAS

Your are learning to:
- Decide why fire precautions are important
- Use a model fire extinguisher to demonstrate how it works

Fire at school

Fire damage may close a school. Fire-fighters can spend many hours trying to control a major fire. Luckily most fires at schools start when the schools are closed. When the fire has been put out a forensic scientist can try to find out exactly how the fire began. Fires can spread quickly once they start.

1 What is the worst time of day for a school fire to break out?

2 Give **one** example of something you might notice if a fire has started.

Did You Know...?

Some of the doors in your school will be fire doors. These are specially designed heavy fire-resistant doors with self-closing hinges. They often have the following warning sign on them.

Fire door Keep closed

Fire precautions

Do you know about the fire precautions at your school? Every classroom should have most of the following things.

- Fire notice — tells you what to do if you discover a fire. It also gives you the route to follow to leave the building safely.
- Green fire exit sign with an arrow showing the direction to take when you leave.
- Fire blanket with pictures explaining how to use it.
- Fire extinguishers filled with carbon dioxide or with a mixture that produces foam.

Fire Door Do Not Block

Fire Assembly Point

Fire exit

Keep clear

FIGURE 1: All these notices give people advice in the event of a fire. They can save lives.

Outside the room there may be a fire alarm where you break the glass to set off an alarm. Fire notices and arrows are often coloured red and yellow and are luminous (glows in the dark). Once safely outside the building, students go to the assembly point where registers are read.

How Science Works

Slow-burning fuses are used in fireworks to give people time to stand back after lighting a firework.
They are made by soaking paper or fabric in a special chemical called potassium nitrate. When it dries, it burns in a slow and controlled way.

3 Why is it important that all students understand the fire precautions in their school?

4 Which gas is often helpful in putting out fires?

5 Why are luminous signs especially useful in fires?

62

... assembly point ... fire alarm

② ***Identified problem:*** *Precaution is a word that students are not likely to be familiar with, however it may be understood through context with some guidance.*

Suggested Solution: T. writes 'pre-order' on the board. T. asks Ss if any of them has ever pre-ordered a game and if they could explains what this means. T. asks Ss if the 'pre' in '**pre-order'** means that the order is happening *before* or *after* the game is released. T. elicits '*before*'. T. writes **precaution** on the board. T. asks Ss if they can spot anything in common between pre-order and precaution. T. elicits the prefix '**pre-**'. T. asks Ss: Do you think a precaution is something we do *before* or *after* an accident? T. elicits *before*. T. confirms it is something that we do beforehand, to stop an accident from happening. T. tells Ss that in the paragraph at the centre of the page there is a list of four fire precautions. T. asks Ss to read what these precautions are.

T. asks Ss to think of other precautions we take for example, before we use the Bunsen burner (from previous lesson).

Language Scaffolds, Set C

Year 7 // SCI LOF 7.1

Unit title: Scientists at Work

LOF Subject Focus: What do Scientists do?

Content Objectives. Teacher will:

1. Teach students to light and use a Bunsen Burner safely.

Content Learning Outcomes:

1. I can label and identify the main parts of the Bunsen burner.
2. I can light and use a Bunsen burner safely.

Key Vocabulary: Bunsen burner, yellow flame, blue flame, safety flame, heat-proof mat.

Language Learning Outcomes:

1. I can make use of skimming and scanning to help me read effectively.
2. I can give suggestions.
3. I can make predictions by formulating a question and stating a hypothesis.
4. I can use the second conditional to speak about an alternative course of events.

Key vocabulary: moveable, filament, to predict, to make a hypothesis, reliable.

Recommended Materials: KS3 Science Book 1, pp. 54-57

Supplementary Materials: PowerPoint, Bunsen Burner Activity Cut outs, Word Bank.

①

Identified problem: *The word 'hazard' is key to understanding the LOs of this lesson. As is 'protective clothing'. Ss might not be familiar with them.*

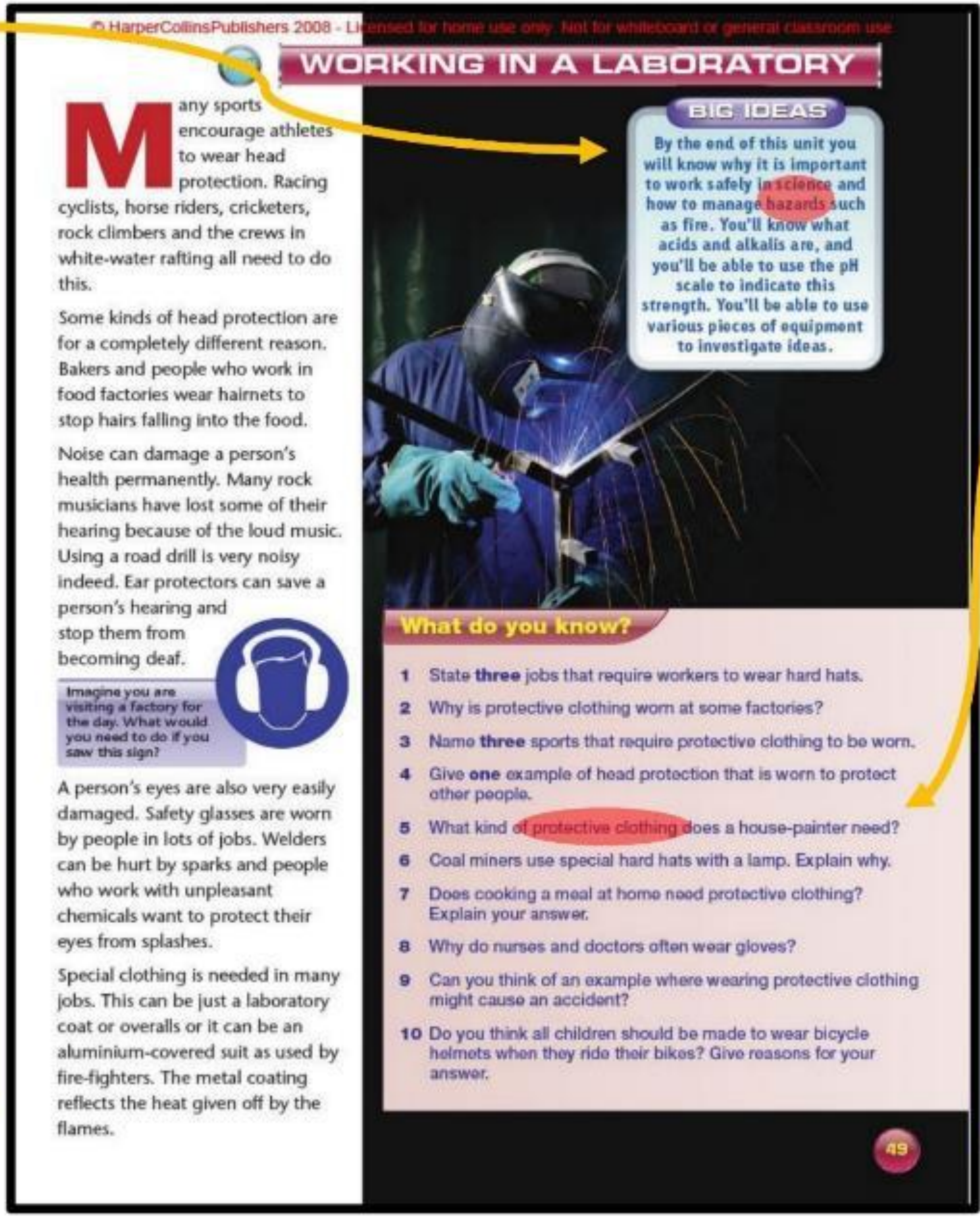
<u>Suggested Solution</u>: Elicit the meaning of 'hazard' and 'protective clothing'. T. asks Ss to read the text to check what the lesson will be about. T. elicits the keywords by asking:

i. What is the text about? What kind of clothing is mentioned? Do cyclists wear helmets to be fashionable? *No, they do it to* ***protect*** *themselves. That is why helmets are a kind of* ***protective clothing.***

ii. Why does the text say that some jobs require **protective clothing?** *Because of accidents, dangers, etc.*

iii. Does anyone know another word for things that are dangerous to our health and safety? ***Hazards.***

iv. Can you mention some **safety rules** that are listed in the article? What **safety rule** do you think the blue icon is indicating? Why are **safety rules** important?



WORKING IN A LABORATORY

Many sports encourage athletes to wear head protection. Racing cyclists, horse riders, cricketers, rock climbers and the crews in white-water rafting all need to do this.

Some kinds of head protection are for a completely different reason. Bakers and people who work in food factories wear hairnets to stop hairs falling into the food.

Noise can damage a person's health permanently. Many rock musicians have lost some of their hearing because of the loud music. Using a road drill is very noisy indeed. Ear protectors can save a person's hearing and stop them from becoming deaf.

Imagine you are visiting a factory for the day. What would you need to do if you saw this sign?

A person's eyes are also very easily damaged. Safety glasses are worn by people in lots of jobs. Welders can be hurt by sparks and people who work with unpleasant chemicals want to protect their eyes from splashes.

Special clothing is needed in many jobs. This can be just a laboratory coat or overalls or it can be an aluminium-covered suit as used by fire-fighters. The metal coating reflects the heat given off by the flames.

BIG IDEAS

By the end of this unit you will know why it is important to work safely in science and how to manage hazards such as fire. You'll know what acids and alkalis are, and you'll be able to use the pH scale to indicate this strength. You'll be able to use various pieces of equipment to investigate ideas.

What do you know?

1. State **three** jobs that require workers to wear hard hats.
2. Why is protective clothing worn at some factories?
3. Name **three** sports that require protective clothing to be worn.
4. Give **one** example of head protection that is worn to protect other people.
5. What kind of protective clothing does a house-painter need?
6. Coal miners use special hard hats with a lamp. Explain why.
7. Does cooking a meal at home need protective clothing? Explain your answer.
8. Why do nurses and doctors often wear gloves?
9. Can you think of an example where wearing protective clothing might cause an accident?
10. Do you think all children should be made to wear bicycle helmets when they ride their bikes? Give reasons for your answer.

49

②

Identified Problem: *Individually, not all students might have enough linguistic / background knowledge (for example, jobs that require workers to wear hard hats and terms such as coal miner) to answer questions 1-10 at such an early stage in the lesson.*

<u>Suggested Solution</u>**: Group work**: students pool in their knowledge and can discuss these questions more effectively.

T. puts Ss in groups of 4 and gives them a challenge. How many of the questions on p. 49 can your group answer in 3 minutes? Ss. must circle the ones that they have an answer to. T. asks how many Ss got 10, 9, 8, etc. right and applauds the winners. T. addresses questions that the groups found the hardest to answer.

①

Identified problem: *Before Ss can proceed with understanding and expressing lab hazards / safety rules, they need knowledge of the key vocabulary related to lab apparatus.*

Suggested Solution:

Option 1: If access to the lab is available, T. might have the apparatus lined up and may refer to them as she goes along. T. might choose to label the apparatus on the desk.

Option 2: T. may hang a vocabulary bank on the wall. This might be particularly useful since these are terms that will be referred to throughout the year, and students can easily refer to them if they are hung up on the classroom walls.

Safety in the laboratory

BIG IDEAS

You are learning to:

- Recognise hazards in a laboratory
- Decide which hazards are most dangerous
- Explain the importance of clear instructions

Hazards in the laboratory

Once you have worked in a science laboratory, you will understand the hazards. Ignoring the hazards can lead to accidents and people being injured. We can easily spot most of the hazards in the lab. They can involve using water, chemicals, heating or other things. Sometimes we cause hazards by the way we behave. Loose clothing can be a hazard if it falls into a flame.

1. Give **two** examples of how water could be dangerous in the laboratory.
2. Give **two** examples of the ways clothing could be dangerous in the laboratory.

FIGURE 1: How many hazards can you spot?

Some of the hazards shown in Figure 1 are connected with apparatus being used incorrectly and others with the way in which students are working.

- Eye protection is essential to protect your eyes. When glass containers break, you can be injured by the glass fragments and by the chemicals inside.
- Using the gas flame of a Bunsen burner has the risk of burning yourself.

50

... hazard

②

Identified problem: Before conducting the task in Figure 1 (*How many hazards can you spot?*), Ss should be exposed to some of the vocabulary / content knowledge that they will need to describe what is being done wrong.

Suggested Solution:

Students watch a video where some lab safety guidelines are presented, accompanied by visuals: https://www.youtube.com/watch?v=N0QqLVUDkvA

T. asks Ss to take a look at Figure 1 in the book.

T. tells Ss to quietly think what the Ss in the picture might be doing wrong.

T. explains that they will now watch a video where some safety rules are being explained.

T. asks Ss to watch the video and check which rules the students in the photo are not following. Ss use their pencils to circle them on the photo.

①

Identified problem: *Evaluating which label contains the most dangerous fluid is impossible without knowledge of the words 'concentrated' and 'dilute'.*

Suggested Solution

Option 1: T. introduces the keywords **concentrated** and **dilute** through demonstration of two solvents with different concentrations of solutes.

Option 2: T. projects the bottles on the board already in the correct order of 'danger' (1. Concentrated Acid, 2. Acid, 3. Dilute Acid). Ss must now figure out why this is the correct order. They may use an online / printed dictionary if the resource is available.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Use the picture on the right to answer these questions.

3 Which bottle do you think has the worst label in safety terms?

4 Develop a short list of 'Golden Rules' for use in a school laboratory.

5 Design a screen saver based on the theme of laboratory safety.

CONCENTRATED ACID | DILUTE ACID | ACID

Listen!

Things can go wrong if students do not listen to instructions. They may mix two chemicals in the wrong order or set up apparatus in an unsafe way so that it falls apart. If students don't give their full attention to their practical work, accidents may happen.

Using safety information

To make copper sulphate solution you first need to stir some of the powder with water in a beaker. The powder can be as fine as dust and is easy to spill. If you stir too fast, the solution may spill out.

6 What safety precautions would be best to prepare this solution safely.

7 What would you do if you spilt some of the solution on your hand?

8 Safety statistics show that most school accidents occur in corridors or playgrounds. Suggest reasons for this. Are schools dangerous places? Justify your answers.

How Science Works

Before starting an investigation, scientists carry out a **risk assessment**. They consider all the possible dangers and how to reduce them to a minimum. Talk to your partner about how to assess the risks of using a Bunsen burner to boil some water. Think about what might go wrong and how to prevent accidents. Compare your ideas with those of another group and see how many ideas you have in common.

Did You Know...?

Some chemicals are used by artists to etch patterns on metal and glass. The artists must take safety precautions to protect themselves, just like scientists in a laboratory.

... risk assessment

②

Identified problem: *The non-familiarity with the appearance and the function of a Bunsen Burner will prevent students from understanding the key term 'risk assessment'.*

Suggested Solution: T. removes the barrier of the unknown by presenting a Bunsen Burner. Students can now focus on understanding 'risk assessment'.

T. demonstrates how to use a Bunsen Burner safely to boil water.

T. asks Ss to take notes of the safety measures that they can observe while she is conducting the procedure. Ss. take note on their journals.

T. discusses Ss' observations whole class and boards them so that Ss who have not identified everything may take note. For each precaution observed, T. discusses what the risk (or possible danger) was. T. explains 'risk assessment'.

Hazard warning signs

BIG IDEAS

You are learning to:
- Recognise warning signs
- Decide how to protect yourself from hazards
- Locate and use safety information from hazcards

Hazard symbols in the laboratory

Laboratories are exciting places but they can be dangerous too. Some chemicals catch fire easily. We call them **flammable** materials. Others may be **toxic**. Toxic substances can harm you if you breathe them in or swallow them or even touch them.

FIGURE 1: Hazard-warning signs. Can you think why they don't have any writing on them? (Hint: imagine you were working in a laboratory in Russia and you didn't speak the language.)

Some materials can damage our environment, harming plants and animals. The hazard-warning signs are simple and clear.

1 Why do we need hazard-warning signs in science laboratories?

2 The chemical copper sulphate can be harmful. Look at the hazard-warning signs in Figure 1 and choose the best one for it.

Signs need to be quickly understood

One of the most hazardous chemicals in daily use is petrol. Car engines need a liquid fuel that vaporises and burns easily. In the wrong place, these same properties can cause a major hazard.

How Science Works

Look at the warning signs in the photo. Explain to your partner the reason for each of them. Ask your partner to suggest one way to make it safe when you put petrol in a car's petrol tank.

FIGURE 2: Fuels can be dangerous

52

... flammable

①

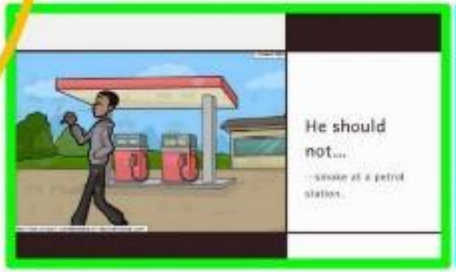
Identified problem: *The exercise in Figure 2 (How Science Works) assumes that Ss are equipped with the language form needed to give suggestions. It also assumes that Ss are familiar with the vocabulary used such as: approved containers, spillages,*

Suggested solution:

T. asks Ss to read through the hazard signs on the book (p.52).

T. projects slide showing someone smoking at a gas station. T. asks Ss to match it to the relevant hazard sign. T. asks Ss: So what should he do? (T. accepts number of answers as long as they are in the 'He should … / he should not … form, for example, 'He should not smoke, he should put out the cigarette,' etc. T. repeats this with an image of a man using his phone.

T. projects images related to the other 5 signs. Ss work individually to match the image number to the hazard sign in Figure 2. Ss. practice giving suggestions to each other based on the pictures.



Language Scaffolds, Set D

Year 7 SCI LOF 7.2

Unit title: Living things and the Environment

LOF Subject Focus: Life on Earth

Content Objectives. Teacher will:

1. Show that living things are grouped into plants, animals, fungi and small microbes.
2. Teach students to sort animals into vertebrates and invertebrates.
3. Teach students to sort vertebrates into fish, amphibians, reptiles, birds and mammals.

Content Learning Outcomes:

1. I can group a variety of living things based on similarities and differences in structural features.
2. I can group living things as animals, plants, fungi and small microbes.
3. I can name some examples of micro-organisms (microbes) and invertebrates.
4. I can sort animals as vertebrates and invertebrates.
5. I can describe the five groups of vertebrates.

Key Vocabulary: plants, animals, vertebrate, invertebrate, living characteristics, skeleton, fish, reptiles, birds, amphibians, mammals.

Language Learning Outcomes:

1. I can make use of the prefix in- to change the meaning of a word.
2. I can use conjunctions (while, whereas) and conjunctive adverbs (in contrast, on the other hand, on the contrary) to compare and contrast two animal kingdoms.
3. I can suggest possible scenarios using might, may and could.
4. I can identify sequence in an unfamiliar text about a familiar topic in which the information is presented sequentially.

Key vocabulary: classifying, organisms, vertebrates, invertebrates, mammals, scales, reptiles, amphibians,

Recommended Materials: KS3 Science Book 1, pp. 160-163.

Supplementary Materials: PowerPoint, Animal Kingdom Charts, Animal kingdom characteristics cut outs, glue.

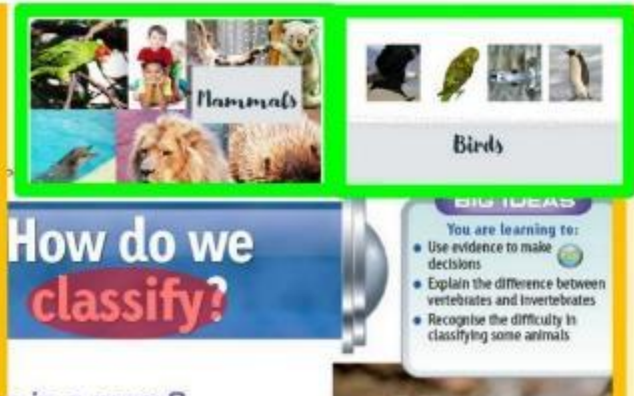
① ***Identified problem:*** *Words such as classifying, organisms, might prove difficult for students to pronounce, understand and memorise.*

Suggested solution: T. models pronunciation and aids comprehension by paraphrasing. When speaking about classifying organisms, T. includes explanations for those words during speech. T. says: '*Organisms* can be divided into animals and plants. Therefore, when we say *organisms*, we mean both plants and animals. Animals are then *classified*, or *sorted*, or *placed into different groups* according to things they have in common.'

② ***Identified problem:*** *Words such, vertebrates and invertebrates, might prove difficult for students to pronounce, understand and memorise.*

Suggested solution: T. models pronunciation and provides a morphology focus. T. asks Ss to bring their hand to their backs and press. What do they feel? (the bones, the spine, the backbone… T. may accept answers in all languages. T. says: 'That's right. Another word for it is *vertebrae*.'

T. writes down 'Vertebrate' and 'Invertebrate'. T. says: 'All animals can be divided into two: *vertebrates* and *invertebrates*. If *vertebrae* is the backbone, what is a *vertebrate*? T. elicits: 'animals that have a backbone'. T. asks Ss to turn to the word '*invertebrate*'. 'What do you think it is?' T. elicits: animals without a backbone. T. asks: 'What part of this word is showing us that the animal is *not* a vertebrate?' T. elicits "in-". T. asks Ss if they can think of more words that use in- to show the opposite of something. T. elicits: 'complete' and 'incomplete', 'expensive' and 'inexpensive'.



What's in a name?

Using names for things helps other people know what you are talking about. However problems can arise! For example the viper and the adder are two different names used to label the same snake!

Now study the two photographs of bluebells in Figure 2. The plants shown are different but they have the same name.

1 Why is it better to have one name for a plant rather than two different ones?

2 Why is it difficult if two different animals have the same name.

Classifying

Organisms can be sorted into the plant kingdom and the animal kingdom. The animal kingdom is then sorted into groups — 'with a backbone' and 'without a backbone'. This is called classifying. Each group is split into smaller groups. For example:

As the groups get smaller the features become more similar between the group members.

3 Study Figure 3 above and answer the following questions.
a Do all animals have a backbone?
b Do all mammals have a backbone?
c Do primates have hair?

FIGURE 1: A European viper or an adder? They are actually the same snake.

FIGURE 2: Both plants have the name bluebell, but they are different.

FIGURE 3: Classifying organisms into groups.

160

… amphibian … animal … bird … classifying … fish … group

③ ***Identified problem:*** *This page introduces a lot of possibly new vocabulary: mammals, scales, reptiles, amphibians.*

Suggested solution: T. has a pre-reading exercise where students encounter these words in a visual context and discover their meaning. T. divides students into five groups. T. tells Ss that they will now look at five groups of animals which are *classified* into one group because they share similar characteristics or qualities: they have things which are the same for all of them. Ss must compile a list of things that they predict these animals have in common. They have 1 minute per slide. T. projects slides. Ss put their points aside. Ss are then assigned an animal kingdom each. They are given a chart of that kingdom with the characteristics of the members of that group in the shape of cut outs. Ss must match the property to the relevant part of the chart and stick it with glue once the teacher has given feedback. Ss hang the charts on the walls and take turns going round the class to check the qualities of the different kingdoms, checking whether their predictions were correct or not.

(1) *Identified problem:* *To answer questions 6-7 effectively students need to make use of conjunctions (while, whereas) and conjunctive adverbs (in contrast, on the other hand, on the contrary).*

Suggested solution:. Q. 6: T. asks Ss to think of differences between fish and reptiles. T. projects slide and reads the model answers out loud. T. asks Ss to check if these are the differences they had thought of. T. converts question 7 from an open-ended question to a gap fill following the same language structure and projects it. Ss. fill in the blanks.

T. provides opportunity for free practice by giving students a third question comparing another two kingdoms.

6. Give two differences between fish and reptiles.

- The first difference between fish and reptiles is that **whereas** fish have scales, reptiles, have dry, scaly skin.
- Secondly, **while** fish have gills and fins, reptiles do not.
- Another difference is that reptiles lay eggs with tough shells, **in contrast** to fish who do not.

7. Give two differences between mammals and birds.

- The first difference between mammals and birds is that **whereas** mammals ______________, birds ______________.
- Secondly, **while** mammals __________________, birds __________________.
- Another difference is that mammals ________________, **in contrast** to birds who ______________.

Vertebrates and invertebrates

Animals can be placed into two major groups:

- vertebrates — animals with a backbone
- invertebrates — animals without a backbone.

In general the invertebrates are simpler animals that have few complex organs. One success story of the invertebrate group is the insects. They are some of the most successful animals in the world. They can survive by eating paper, wood and oil. They are difficult to kill because they build up resistance to pesticides and reproduce quickly.

FIGURE 4: A rhinoceros beetle can carry up to 850 times its own weight! Why are insects so successful? Are they invertebrates or vertebrates?

Did You Know...?

In order to keep warm, warm-blooded animals need more energy than cold-blooded animals. This means they respire more and eat more regularly.

4 Why is an ostrich put into the vertebrate group?

5 Why is an ant put into the invertebrate group?

Vertebrate groups

There are five vertebrate **subgroups**. Each group has different features.

Fish – have gills; scales; fins; cold blooded

Reptiles – have dry, scaly skin; lay eggs with tough shells; cold blooded

Amphibians – have moist skin; live on water and land; breathe through their skin in water; cold blooded

Birds – have wings; beak; feathers; lay eggs with brittle shells; warm blooded

Mammals – have hair; give birth to live young; suckle their young; warm blooded

6 Give **two** differences between fish and reptiles.

7 Give **two** differences between mammals and birds.

FIGURE 5: One of these is a fish and one is a mammal. Which is which?

What group do these belong to?

Figure 5 shows a whale and a shark. They both have fins, a tail and a streamlined shape. The shark has gills and the whale gives birth to live young and is warm blooded. The shark is therefore a fish and the whale is a mammal. It is sometimes necessary to look at several features before an animal can be placed in its correct subgroup.

8 The photographs on the right show a duck-billed platypus and a turtle.

a Explain, giving clear reasons, which subgroup of vertebrates each of the animals belongs to.

b Explain, giving clear reasons, which other groups they could be put in.

invertebrate ... mammal ... plant ... reptile ... subgroup ... vertebrate

① ***Identified problem:*** *The table is only 63.6% readable when equipped with the thousand most common words in English. To ease students into discovering the new vocabulary it presents, T. could first provide images of every group (cnidaria, flatworms, true worms, molluscs, arthropods, insects, arachnids, crustacea and myriapods).*

Suggested solution:

Then, T. could provide concept checking questions in the form of a True or False exercise to guide students in reading the information in the table and work out the meaning of certain words: hollow, flattened, cylindrical, segmented, exoskeleton, jointed limbs, muscular, myriapods, at least. Ss work these out either on a worksheet or by referring to the questions on the PowerPoint slide. Ss now have been guided through the more difficult vocabulary and can proceed to answer the open-ended questions 1 and 2.

The five kingdoms

BIG IDEAS

You are learning to:
- Recognise the wide range of organisms that exist
- Use evidence to make decisions
- Explain why changes have occurred in the way organisms are classified

Invertebrates

A **kingdom** is one of the major groups organisms are split into. The vertebrates and invertebrates are parts of the animal kingdom. The table shows the key **characteristics** of some of the invertebrate groups.

Cnidaria (Jellyfish)	Flatworms	True worms	Molluscs	Arthropods (all have an exoskeleton and jointed limbs.)			
				Insects	Arachnids	Crustacea	Myriapods
Jelly-like bodies. Tentacles. Hollow bodied.	Flattened. No segments to the body.	Cylindrical body. Segmented.	Soft body. Muscular foot. Many have shells.	6 legs. 3 body parts.	8 legs. 2 body parts.	Most have gills and antennae.	Many segments. At least one pair of legs on each segment.

1 Identify which of the groups the organisms below belong to, give reasons for your choice.


a


b


c


d

2 Give **one** other example of each major group.

... cell wall ... cellulose ... characteristics ... chlorophyll

Are these statements true or false?

1. Something that is hollow has an empty space inside it. Jellyfish have an empty space inside of them. [T / F] What word/s show/s you this? **Hollow-bodied**

2. Flatworms are segmented: they are made up of tiny parts connected to each other. [T / F] What word/s show/s you this? **No segments to the body**

3. True worms have the shape of a cylinder. [T / F] What word/s show/s you this? **Cylindrical body**

4. The body of true worms is made up of tiny parts connected to each other. [T / F] What word/s show/s you this? **Segmented.**

Are these statements true or false?

5. *All* crustaceans have gills and antennae. [T / F] What word/s show/s you this? **Most**

6. Myriapods may have more than one pair of legs on each segment. [T / F] What word/s show/s you this? **At least one pair**

7. An **exoskeleton** is a skeleton that is **outside**, on the **exterior** of the animals' body (think of the word **exit**, which also refers to going outside). Most arthropods have an exoskeleton. [T / F] What word/s show/s you this? **All have an exoskeleton**

Are these statements true or false?

8. Limbs are hands and feet. Jointed limbs are hands and feet that are connected by joints. Humans and Arthropods both have jointed limbs, which they can move in and out.

Not all Arthropods have jointed limbs.

[T / F] What word/s show/s you this?

All have jointed limbs.

9. The foot of a mollusc is made up of a muscle.

[T / F] What word/s show/s you this? **Muscular foot.**

The Plant Kingdom

Organisms were placed in the plant kingdom if they have a **cell wall** (made of **cellulose**), they can change light energy to chemical energy and contain **chlorophyll**.

Mosses	Ferns	Conifers	Flowering plants	Algae
Lack complex leaves, stems and roots.	Reproduce by spores.	Produce seeds in cones.	Seeds produced in flowers. Pollination by wind or insects.	Very simple organisms. No roots, stems or leaves.

3 Identify which groups the two plants in the pictures below belong to and give reasons for your choice.


a


b

4 Why is grass classified as a flowering plant?

5 Some scientists do not think algae should be classified as plants. Suggest why.

The Final Kingdoms

In the nineteenth century, scientists only used the plant and animal kingdoms for **classification**. It was found some organisms did not fit.

Fungi	Protista	Bacteria (Prokaryotes)
Cell wall not made of cellulose. Obtain energy from living or dead organisms. Produce spores. No chlorophyll.	Mainly single celled. Able to move. Some have cell walls. Some can transfer light energy to chemical energy.	Cell wall not made of cellulose. No nucleus just genetic material. Obtain energy from living or dead organisms. No chlorophyll.


FIGURE 1: Mould, amoeba and bacteria.

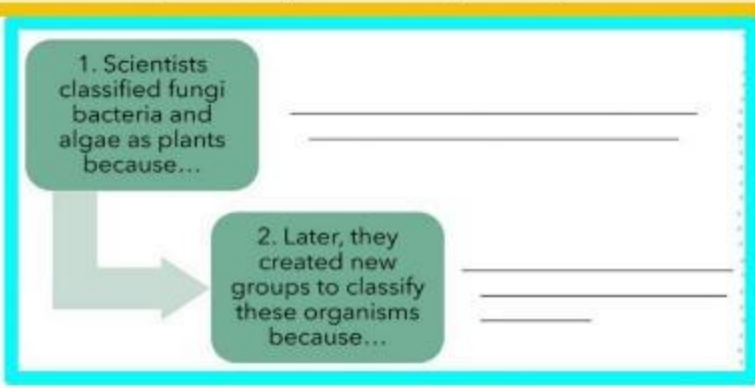
6 Use the evidence to explain why:
a fungi **b** bacteria and **c** algae were originally classified as plants.
Explain why they created new groups to classify these organisms.
Which organism appears to be the simplest? Explain your choice.

①***Identified problem:*** *In question 5 students are being asked to express possibilities. This is a good opportunity for students to practice the language form introduced by the teacher in a previous lesson (using may, might and could).*

Suggested solution: T. reminds Ss that they often answer questions where they have to 'suggest' something. T. reminds Ss that we can use 'may', 'might' and 'could' to suggest possibilities. T. provides the following sentence starters on the board:
Scientists might think that because…
Scientists may think that because….
Scientists could think that because…
Ss use the sentence starters to answer the question.

②***Identified problem:*** *To answer question 6 must both understand the fact that 'originally' is used when 'you are saying what happened or was the case when something began or came into existence, often to contrast it with what happened later' (Colins Dictionary). They must also provide evidence to back up their statements.*

Suggested solution: T. provides Ss with a visual template that both indicates the chronology of the events in the questions and provides a foundation for wording the answer. These scaffolds will eventually be internalised by the student and will provide him with the skills to answer open-ended questions independently.



Language Scaffolds, Set E

Year 7 // SCI LOF 7.2

Unit title: Living things and the Environment

LOF Subject Focus: Life on Earth

Content Objectives. Teacher will:

1. Engage students to explore plant and animal adaptations.

Content Learning Outcomes:

1. I can link some plants and animals with their habitats.
2. I can describe the function of some animal and plant adaptations.

Key Vocabulary: adaptation

Language Learning Outcomes:

1. I can use the zero conditional to link cause and effect.
2. I can make predictions and give reasons for them.
3. I can suggest possibilities using 'may', might and 'could'.

Key vocabulary: adapt, adaptations, conditions, dandelions, grassland, sample size, reliable, distort, leaf litter, source, extremes, successfully, features, predator, prey, biodiversity, conserve, lack of, varied, resources, habitat, adapted.

Recommended Materials: KS3 Science Book 1, pp. 170-172, 174.

Supplementary Materials: PowerPoint.

(1) ***Identified problem:*** *Ss might not be familiar with the word 'pores', which might distract students from the main purpose of the text, that is, the function of leaves and pores on the plant.*

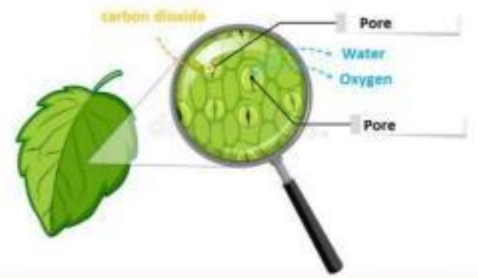
Suggested solution: T. provides graphical representations so that students discover the meaning of pores and their function before discovering it in written format.

T. projects diagram of a leaf with the pore functions clearly showing, on the board.

T. says: 'Look at the image on the board. The leaf has tiny pores, or holes on it which *do* two things, they have two *functions*. Look at the arrows and at the text surrounding the leaf. Discuss, in pairs, what you think the two functions of pores are.'

T. asks Ss to open their books and read the text 'The leaf'. T. asks Ss to check if they had guessed the functions right.

Look at the diagram below. What do you think pores *do*? What are their *functions*?



Are leaves bigger in the shade?

BIG IDEAS

You are learning to:

- Understand how a plant responds to different conditions
- Present data in tables and graphs
- Interpret patterns and make conclusions from the data

The leaf

A **leaf** is an organ on a plant that traps light energy to make food. It has small pores on it that allow carbon dioxide to enter the leaf. These pores also let water out of the leaf.

1. Where does a plant get its water from?
2. Name **one** other factor that a plant needs to grow.

What affects leaf size?

The size of leaves is affected by the following:

- Amount of light. Bigger leaves trap more light energy to transfer to chemical energy in food than small leaves
- Amount of water. Big leaves lose more water than small leaves. If a plant loses too much water it starts to **wilt**
- Weight. Big leaves weigh more and need supporting.

FIGURE 1: Plants (such as the one shown on the left above) that live on the floor of rainforests need large leaves to be able to trap what little light reaches them to use to make their food. The giant redwood tree (above right) can grow to heights of 115 m. It has small, oval-shaped leaves as it is not shaded by other plants or trees.

Did You Know...?

The giant water lilies (*Victoria amazonia*) in Kew Gardens in London have a diameter of 2.5 m and weigh up to 45 kg. Each leaf is supported by strong rib-like structures on its underside. The leaf provides a large area for photosynthesis.

3. What happens to a plant if it loses too much water?
4. Predict whether a leaf grows bigger in the shade or the light and give reasons for your prediction.
5. The light energy is transferred to what form of chemical energy in the cell?

170

... adapt ... conditions ... distort ... leaf

(2) ***Identified problem:*** *Questions 3 requires the use of the zero conditional question 4 requires the language structure for making predictions. Students have already come across these language forms and been scaffolded but might still not be able make the connection independently.*

Suggested solution: T. encourages Ss to write down the answers in full so that they practise using these two language forms.

T. provides Sentence starters on the board:

3. If a plant loses too much water… it …

4. I predict that … will … if…because…

① ***Identified problem:*** *It is at the core of the LOs for this lesson that students understand the terms adapt, adaptations and conditions.*

Suggested solution: *T. could introduce these new words by preparing a slide with text to accompany her explanation. The keywords are highlighted in the same colour as their paraphrases / explanations, so that students may visually see the connection between the word and its meaning. The new words are introduced a step at a time, rather than both in the same sentence as in the textbook.*

T. projects the slides on the board and slowly reads through them, pausing to gauge understanding and point at the supporting pictures. T. finishes explanation with a question that directs students to the text. Students are now equipped with the language needed to engage with and understand the text.

② ***Identified problem:*** Words such as sample size, reliable, and distort could be unfamiliar to students.

Suggested solution: Teacher talk includes paraphrases and concept checking questions and is scaffolded to build understanding of the three new vocabulary items.

T. shows slide introducing investigations.

T. says: When we carry out an investigation, we need to make sure that the results we are getting are reliable. Reliable results are results that you can trust – they are as close to the truth as possible. One way to get reliable results is to have a big sample size.

For example: I want to know if Netflix is popular with teenagers. Do you think I will get reliable results if my sample is just one teenager, if I ask just one teenager?' *T. elicits 'No'.*

What if I ask two? *T. elicits 'No'.*

Because the sample will be too small, it will not represent, or show, the opinion of most teenagers. If it is not representing, or showing, the truth, it is distorting it. Am I telling the truth if I distort it? (T. elicits no). So what should I do? If I increase the number of teenagers that I ask, I have a bigger sample and my investigation will be more reliable. We are now going to investigate if plants that grow in the shade and those that grow in the light have leaves of different sizes. Read through the method and then tell your partner: What do you think makes this investigation reliable?

① **Identified problem:** To answer questions 1 and 2, students need to be familiar with the term leaf litter and know how to make suggestions using modal verbs 'may', 'might', 'could'.

Suggested solution: T. provides an image of leaf litter and asks concept checking questions to ensure understanding. Concept checking questions are worded so as to elicit the use of may, might and could, so that students may practise this language form that they have already encountered in previous lessons.

T. projects photo of leaf litter. T. asks: 'Look at the picture. What condition are those leaves in?' T. elicits that it is leaves that have fallen from trees and piled up underneath them. By asking, 'Where *might* you find leaf litter?', T. elicits: 'a forest, a garden, a park'. T. writes down students' contributions on the board using the modals:

You *might* find leaf litter in a forest.

You *may* find it in a garden.

You *could* find it in a park.

T. tells students that one of questions 1-3 requires them to make use of 'might', 'may', and 'could'. T. asks Ss if they can recognise which one and which word tells them that. T. elicits: 'Question 2, because of the word 'suggest'.

What conditions do animals prefer?

BIG IDEAS

You are learning to:
- Plan an investigation into the conditions woodlice prefer to live in
- Present and interpret data

Where are woodlice found?

Woodlice are animals that are found in leaf litter. They are able to detect their environment with antennae, which are extensions at the front of the head.

1. In which areas are most woodlice found?
2. Suggest what conditions the woodlice might prefer.
3. Which **one** feature shows the woodlice are not insects?

FIGURE 1: A woodlouse. Can you see the antennae at the front of its head?

How Science Works

Design a simple investigation to explore the idea that there are more birds on the school playing field after lunch than before. Explain how you would collect reliable evidence.

① ***Identified problem:*** *Students might need some support with the following words: source, extremes, successfully, features, predator, prey, biodiversity, conserve, lack of, varied, resources, habitat, adapted.*

Suggested solution: T. asks Ss to look at the pictures in the book and read the captions. T. asks Ss to quickly skim through the text (ignoring the questions for now) and find out:
1) What the text is mainly about (animal survival, adapting to different conditions, different habitats and biodiversity).
T. tells Ss that before they attempt to answer the questions they will tackle some words which might be new to them. T. projects the word list on the board and asks Ss to scan the text and either circle or highlight the words in the text. T. now gives Ss a short vocabulary exercise where the meaning of some words is clarified. Ss infer which meaning matches which word through contextual clues. Ss are asked to look for definitions for 'adapted', 'biodiversity' and 'habitat' as these may be found in the text. Ss. can now proceed to work out the questions and further engage with the content.

How plants and animals survive

BIG IDEAS

You are learning to:

- Describe the basic needs for survival of animals
- Identify adaptations shown by animals and plants to their environment
- Explain what is meant by biodiversity

Animal survival

Animals are found in many different environments.

They have basic needs:

- source of food
- source of water
- an area of protection, from other animals or from extremes of the environment.

They need to live successfully in their environment so they survive.

1 Describe the conditions in Figure 1.

2 Name **one** animal other than the camel that lives in this environment.

3 What does the animal you have named feed on?

FIGURE 1: How does a camel survive in its environment?

Adapting to cold – or hot

Success in surviving means that an animal must have special features that makes it suited to the conditions it lives in. This means it is adapted.

The polar bear is adapted to living in the cold and also to being a predator.

FIGURE 2: The polar bear – adapted to cold and to hunt.

4 Which features adapt the polar bear for:
a the cold
b being a predator?

The cactus lives in the desert where it is very hot and there is a lack of water.

5 How is the cactus adapted to surviving in the desert?

FIGURE 3: Cacti are one of the few plants that can survive in the desert. How do they do it?

Did You Know...?

The cheetah is one of the fastest land animals. It can run at speeds up to 70 mph. In 2 seconds it can reach 45 mph. This makes it superbly adapted to catching its prey.

Many different habitats

The place an organism lives in an area is called its habitat. In woodland there are many different places for an organism to live. For example, different birds will feed on nuts, berries, caterpillars, insects and even mice. They will nest in different places. Some animals live underground, others in the trees, in leaf litter or under rocks. This means animals do not compete for the same sources of food or living space. Therefore the more varied the habitat, the more different types of plants and animals.

FIGURE 4: Badgers build dens under the ground in woodland.

6 What would happen to the numbers of birds if all the different birds ate the same things? Explain your answer.

7 What resources do plants in the woodland compete for?

FIGURE 5: Wildlife in a woodland.

Biodiversity

The number of different types of animals and plants in an area is called the biodiversity. An area with a high biodiversity, such as the rainforests, is rich in different plants and animals and would be an important area to conserve. Some areas are low in biodiversity but they contain very rare plants or animals. They also need to be conserved.

8 Why is the biodiversity greater in a rainforest than in open fields?

9 The Nature Conservancy uses a biodiversity measure to decide which areas should be conserved and which areas not. What are the advantages and disadvantages of doing this?

Scan the text and circle these words:

- Source
- extremes of the environment
- Successfully
- Predator
- Prey
- Conserve
- lack of
- Varied
- resources

Fill in the blanks in the text with the words below. Use the text in the book to help you figure out the meaning of words you are not sure of:

source, extremes of the environment, successfully, predator, prey, conserve, lack of, varied, resources

When you do something successfully you achieve what you set out to do. For example, if a lion goes hunting and catches a zebra, he is successful. He has found food. In this case, the lion is the predator because it is chasing the zebra, and the zebra is the prey because it is running away from the lion.

It is important for animals to live in biodiverse environments, as a varied habitat means that all animals have the opportunity to find food and shelter. A lack of food, water, or places to nest in would mean that animals don't have enough resources to survive.

- Organisations like Greenpeace and World Wildlife Fund try to conserve habitats where animals live, which means they try to save them from harm. Conserving habitats is important, because they are the source from which animals get their food and shelter. Some animals can survive successfully even in extremes of the environment, when habitats are very hot or very cold. That is because they are adapted to live in these extreme conditions.

- ***Can you find the meanings of these words from the text on your book? Write them down in the space provided.***

- Biodiversity: The number of different animals and plants in an area.
- Habitat: The place an organism lives in.
- Adaptations: Special features that an animal has that help it survive.

Language Scaffolds, Set F

Year 7 SCI LOF 7.2

Unit title: Living things and the Environment

LOF Subject Focus: Life on Earth

Content Objectives. Teacher will:

1. guide students to identify types of feeding relationships.
2. guide students to interpret food webs.

Content Learning Outcomes:

1. I can sort some feeding relationships as herbivores, carnivores and omnivores.
2. I can categorize animals as consumers and plants as producers.
3. I can sort some feeding relationships as herbivores, carnivores and omnivores.
4. I can categorize animals as consumers and plants as producers.

Key Vocabulary: producer, consumer, food chain, food web, herbivore, carnivore.

Language Learning Outcomes:

1. I can work out what unfamiliar words mean.
2. I can read more complex texts across genres for different purposes e.g. to find out new information, to learn new things.
3. I can evaluate and respond to texts which include visuals and graphics.
4. I can make use of skimming and scanning to help me read effectively.

Key vocabulary: grasshopper, fragile, likely, wiped out, optimum, overgrazing, savannah, antelopes, thrush, laxative, stinging, prickles.

Recommended Materials: KS3 Science Book 1, pp. 158-159; 176-177; 168-169.

Supplementary Materials: PowerPoint.

FEEDING RELATIONSHIPS

Some animals feed directly on other animals. These animals are called carnivores. They are also called predators. What features make them successful predators?

Some animals feed on plants. These animals are called herbivores. What features make them successful herbivores?

The Sun is the source of food for all organisms. Firstly the sunlight is used by plants to obtain food. Plants are green because they have a chemical that traps the sunlight.

Food chains show what animals eat. In simple terms, big animals eat smaller animals, smaller animals eat plants. In all habitats we can find out what an animal eats and what might eat it. Some animals will eat only one type of food e.g. koala bears will eat only eucalyptus leaves, others will eat one type of food but can change to a different food source if the first one runs out.

There are many places animals and plants can live

Old railway lines are quickly colonised by plants then animals. In cities, plants start to grow in the cracks on the pavements, animals such as pigeons, sparrows, foxes and rats feed off food that humans have thrown away.

Even the ice-cold conditions of the Arctic provide a home for penguins, seals and polar bears. Fish at the Arctic live in water that has a temperature of −10°C, they need a special type of 'anti-freeze' in their blood to stop them freezing.

The depths of the sea contain spectacular animals such as the anglerfish and giant squid. It seems if animals put their minds to it they can colonise nearly everywhere.

The cockroach is sometimes shown in science fiction as the 'beast' that survives nuclear fallout. This is not that far from the truth. It can survive ten times the level of radiation that we can. The cockroach is in fact very adaptable. It can eat glue, leather, books and it is reported to have eaten the plastic off the wires in television sets.

① ***Identified problem:*** *Students can understand the key information in this text, however some group work before they answer questions 1-10 will consolidate understanding for the weaker learners.*

Suggested solution:

T. projects slide on the board showing the rabbit, the lion, the dandelions and the key words from the text / LOs. Ss use the text on the slide to infer meaning and work together to match the key word cards to the picture. Ss are now ready to tackle the questions individually. T. may also make connections with other languages tat SS might be familiar with, for example by pointing out the 'carn' in carnivore (from *Italian* 'carne', and the 'herb' in herbivore ((from *Italian* 'erba'.)

CLASSIFICATION AND FOOD WEBS

In November 1963, the island of Surtsey emerged in a fiery eruption from the Atlantic, it was 2.5 km² and rose to a height of 560 ft. The island has already been colonised by gulls, which have also brought moulds and bacteria. Seaweed and algae are now found there. Grasses, rushes and several flowering plants have been washed there. Over 20 species of plants and 20 species of animals, for example, mussels, butterflies and midges are now found on the island. It is a testament to the persistence of nature that some of these life forms came to Surtsey less than a year after it emerged.

BIG IDEAS

By the end of this unit you will know how living things are classified according to observable features. You will understand how some living things prey on others and how food webs indicate the flow of energy. You will be able to take evidence from different sources and produce explanations.

THE CARDS ON THE LEFT DESCRIBE THE EATING HABITS OF THE THREE ORGANISMS IN THE PHOTOS. MATCH THEM.

- Carnivore
- Herbivore
- Consumer
- Consumer
- Producer
- Predator
- Prey

Consumer – What is consumption? What do people consume, or *use up*?
Producer – What happens when someone produces something? They create something new. Which of the organisms above do you think is *producing* energy instead of consuming it from other organisms?

What do you know?

1 Write down the name of a plant in the pictures.
2 Write down the name of **one** herbivore in the pictures.
3 Write down the name of **two** carnivores in the pictures (secondary consumers).
4 Draw **two** food chains shown by the pictures.
5 What else could the lion eat?
6 What is the name of the process by which plants make food?
7 How are the buffalo adapted to feed on grass and escape the lions?
8 How is the rabbit adapted to escape from the fox?
9 How is the lion adapted to be a predator?
10 What might happen to the foxes if a disease wipes out the rabbits?

① ***Identified problem:*** *Ss might find it difficult to understand what a food chain is representing, as it is metaphorical in meaning.*

<u>Suggested solution</u>: T. could contextualise food chains by introducing the topic using elements from students' personal experience.

T. shows images of some redworms, a leaf, a chicken and a girl eating a burger.

T. asks Ss what they think the connection between these four pictures is. T. asks: How do you think they form a chain? What connects them?

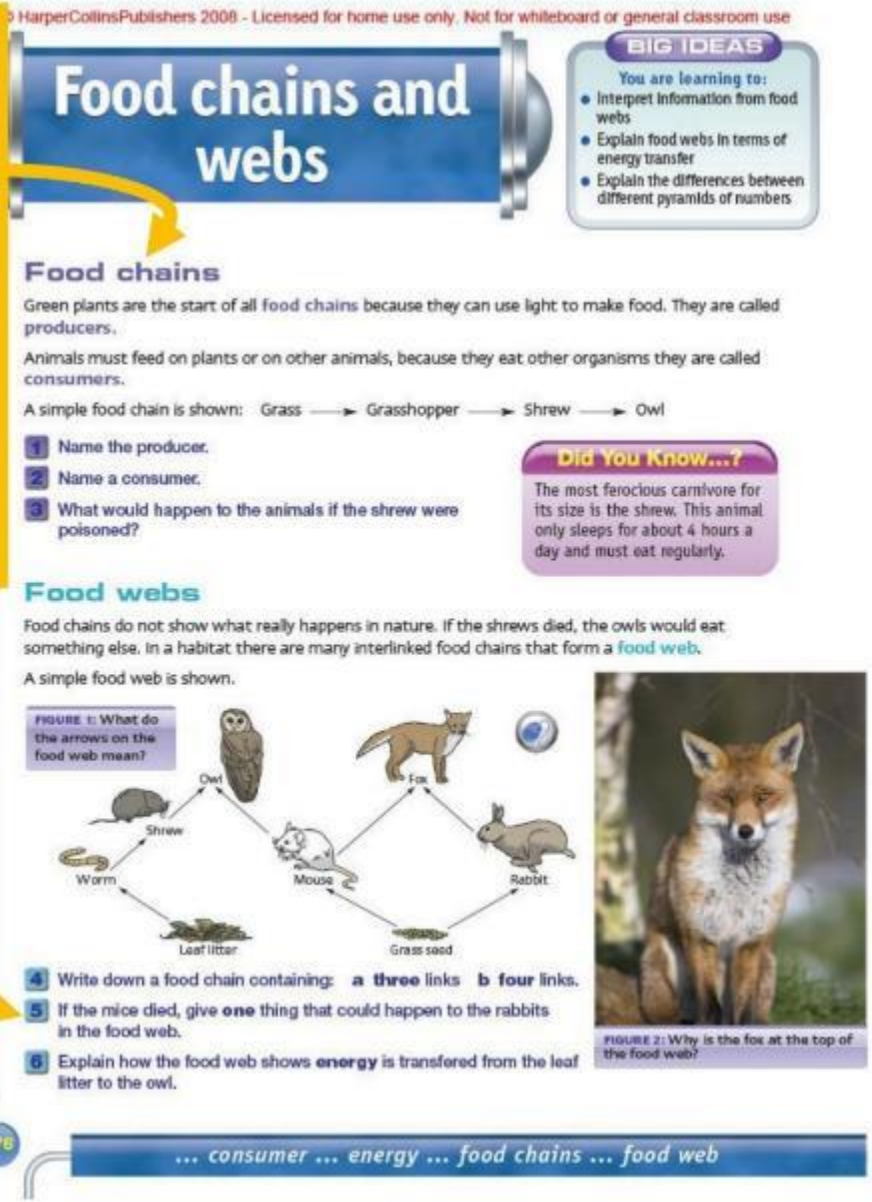
T. directs Ss to think of these creatures' diets and the food that they consume. T. confirms that they are linked because they form part of the same food chain – each of the creatures in these photos will either eat another or be eaten themselves.

T. writes the food chain that the photos represent (leaves → red worms → chicken → human. T. proceeds with the lesson.

② ***Identified problem:*** *Question 5 requires the use of the second conditional if answered in full.*

<u>Suggested solution</u>: T. provides Ss with language guidance in the form of a gap fill.

If the mice died, the number of rabbits would increase / decrease because ….



Food chains and webs

BIG IDEAS

You are learning to:

- Interpret information from food webs
- Explain food webs in terms of energy transfer
- Explain the differences between different pyramids of numbers

Food chains

Green plants are the start of all **food chains** because they can use light to make food. They are called **producers**.

Animals must feed on plants or on other animals, because they eat other organisms they are called **consumers**.

A simple food chain is shown: Grass → Grasshopper → Shrew → Owl

1 Name the producer.

2 Name a consumer.

3 What would happen to the animals if the shrew were poisoned?

Did You Know...?

The most ferocious carnivore for its size is the shrew. This animal only sleeps for about 4 hours a day and must eat regularly.

Food webs

Food chains do not show what really happens in nature. If the shrews died, the owls would eat something else. In a habitat there are many interlinked food chains that form a **food web**.

A simple food web is shown.

FIGURE 1: What do the arrows on the food web mean?

FIGURE 2: Why is the fox at the top of the food web?

4 Write down a food chain containing: **a** **three** links **b** **four** links.

5 If the mice died, give **one** thing that could happen to the rabbits in the food web.

6 Explain how the food web shows **energy** is transfered from the leaf litter to the owl.

176

... consumer ... energy ... food chains ... food web

(1) ***Identified problem:*** *Students should be familiar with a good 87% of the words in this text (Vocabprofile). Students might need support with fragile, likely, wiped out, optimum, overgrazing, savannah, antelopes.*

Suggested solution: T. models pronunciation and supports understanding by readings the text out loud, and pausing to paraphrase in simpler English, insert synonyms or definitions and use images on the PowerPoint.
T. tells Ss that he / she is going to read the text out loud. T. will stop at some important words and explain more about them. If the word is one which Ss do not know, they should highlight it and take down some notes from what the teacher is saying. By annotating the text students learn new vocabulary and can understand the notes during independent study.

Text A: Fragile webs

Some food webs are very complex and contain many different food chains. This makes the food webs less likely to be affected if one animal is wiped out, [or completely destroyed, removed] as there may be many other sources of food.
So we said when something is wiped out, it is completely destroyed, or removed. If the food web is complex, and has many food chains, is it likely: is it probable, that it will be affected if one animal is wiped out? For example, let us look at the food web from page 176.

A COMPLEX FOOD WEB

If I wipe out the whole population of rabbits, so no more rabbits are left will the owls die? No, because they will have another source of food: they will eat the mice instead. So that means that this food web is not very fragile, it is not easy to damage. It will probably not be damaged if one animal is wiped out or removed.
Some of our habitats have simple food webs and are very fragile and easily affected by humans e.g., through pollution or hunting.

Fragile webs

Some food webs are very complex and contain many different food chains. This makes the food webs less likely to be affected if one animal is wiped out, as there may be many other sources of food. Some of our habitats have simple food webs and are very fragile and easily affected by humans e.g. through pollution or hunting.

How Science Works

Farmers need to know the optimum number of animals e.g. sheep or cows that a field can support. Too many animals will lead to overgrazing.

7 Why are some of our habitats fragile and easily damaged by humans?

Pyramid of numbers

In order to have enough food, an owl will catch several mice. This means there must be more mice than owls. The mice will also need to eat a lot of grass seed to survive.

f the number of plants and then the umber of animals at each feeding evel of a food chain are counted we vill make a pyramid with the plants at the base. This is called the pyramid of numbers.

FIGURE 4: Pyramid of numbers for a woodland area.

The number of producers is always along the base of the pyramid, then the herbivores (first consumer), secondary consumer and then the tertiary consumer.

A pyramid is not always formed, it depends on the size of the organisms.

9 For each food chain in Figure 5, match the pyramid of numbers formed and explain your reasoning.

Text B: How Science Works:

Farmers need to know the optimum number of animals e.g. sheep or cows that a field can support. Too many animals will lead to overgrazing. What do you think the optimum number means? If I have a room with ten chairs, what is the optimum number of students that that room can support? Yes *ten*, so optimum means 'best' or 'ideal'. How about overgrazing? T writes down over-grazing. Do we know what grazing is? It's when sheep or cows eat grass in the fields, they are grazing. What do you think overgrazing is then? Yes it's when they graze too much, they eat too much grass. There are other words with the word 'over' that show us that something is above the limits, for example, over-eating.

8 In the African savannah, why are there fewer lions than antelopes?

Question 8: T. projects slide to clarify key words. T. encourages Ss to use words from previous lessons (for instance, predator)_.

Food chain	Cabbage → Caterpillar → Thrush	Grass → Rabbit → Flea	Grass seed → Mouse → Owl

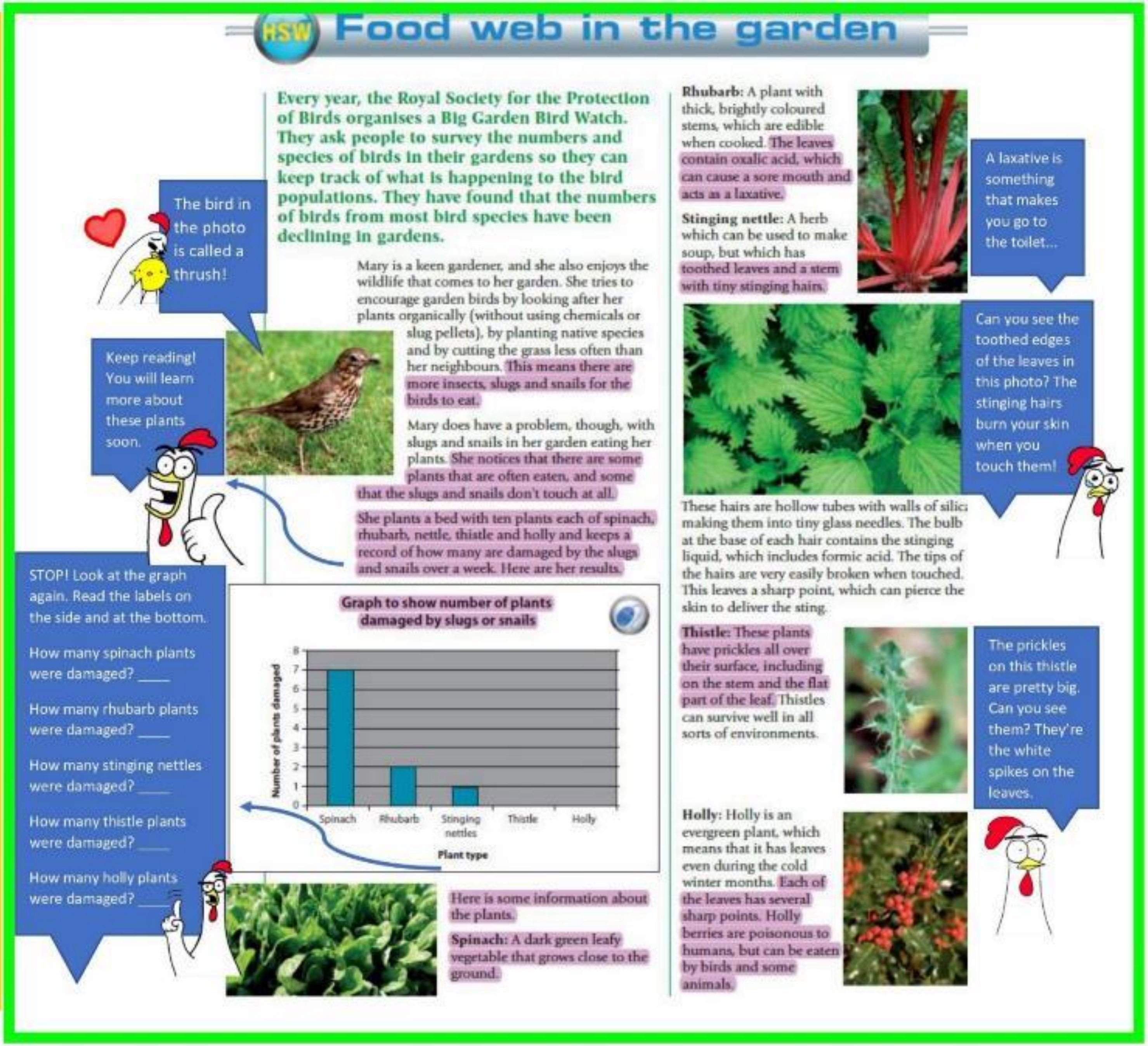
FIGURE 5: Food chains and pyramids of numbers – can you match them up?

... producer ... pyramid of numbers

177

① ***Identified problem:*** *This is quite a long piece of text which is only rated as 78% readable (Vocabprofile). However, the most significant details of the text (which the students need to answer the questions on the page that follows) are comprehensible. Ss might have issues separating the necessary from the additional information (the lack of familiarity with more than 5% of the text may cause reading difficulties).*

Suggested solution: If students are required to work on such a text independently, perhaps as classwork or at home, T. could provide support by providing a photocopy of the text with the most important parts highlighted. Students are told that they should read the whole text, but that the most important parts which they will need to answer the questions have been highlighted in purple. T. may also doctor the text by providing definitions of words that pop out or reading tips as seen on the right. In this case, the reading aid has been presented in a child friendly form in the shape of a cartoon chicken giving reading tips. Language problems should now not prevent them from answering the questions on page. 169 (see next page).



HSW Food web in the garden

Every year, the Royal Society for the Protection of Birds organises a Big Garden Bird Watch. They ask people to survey the numbers and species of birds in their gardens so they can keep track of what is happening to the bird populations. They have found that the numbers of birds from most bird species have been declining in gardens.

Mary is a keen gardener, and she also enjoys the wildlife that comes to her garden. She tries to encourage garden birds by looking after her plants organically (without using chemicals or slug pellets), by planting native species and by cutting the grass less often than her neighbours. This means there are more insects, slugs and snails for the birds to eat.

Mary does have a problem, though, with slugs and snails in her garden eating her plants. She notices that there are some plants that are often eaten, and some that the slugs and snails don't touch at all.

She plants a bed with ten plants each of spinach, rhubarb, nettle, thistle and holly and keeps a record of how many are damaged by the slugs and snails over a week. Here are her results.

Graph to show number of plants damaged by slugs or snails

Here is some information about the plants.

Spinach: A dark green leafy vegetable that grows close to the ground.

Rhubarb: A plant with thick, brightly coloured stems, which are edible when cooked. The leaves contain oxalic acid, which can cause a sore mouth and acts as a laxative.

Stinging nettle: A herb which can be used to make soup, but which has toothed leaves and a stem with tiny stinging hairs.

These hairs are hollow tubes with walls of silica making them into tiny glass needles. The bulb at the base of each hair contains the stinging liquid, which includes formic acid. The tips of the hairs are very easily broken when touched. This leaves a sharp point, which can pierce the skin to deliver the sting.

Thistle: These plants have prickles all over their surface, including on the stem and the flat part of the leaf. Thistles can survive well in all sorts of environments.

Holly: Holly is an evergreen plant, which means that it has leaves even during the cold winter months. Each of the leaves has several sharp points. Holly berries are poisonous to humans, but can be eaten by birds and some animals.

Note: The language support shown in the previous page was aimed at helping students face the language load in answering the questions of this 'Assess Yourself' exercise, specifically:

a) Understanding that 'thrush' is a type of bird.

b) Interpreting the data in the graph and identifying a pattern.

c) Understanding the self-defence mechanisms that the rhubarb, nettle, thistle and holly have.

d) Identifying the most important details that will help students answer the questions.

Assess Yourself

1 Why do slugs and snails need to eat food?

2 Explain why slugs and snails prefer some of Mary's plants to others by referring to the features of the plants.

3 Explain the pattern in the data on the graph.

4 Write a food chain that names the producers, consumers, herbivores and carnivores in the garden.

5 Explain how energy is changed from light energy to energy in the thrush.

6 Suggest another plant that has 'self-defence' and explain how it deters herbivores from eating it.

7 Create a table of the plants mentioned in the text and summarise the features that each plant has to defend itself. Find out about other plants with self-defence and include them in the table.

8 Draw a food web of plants, insects and animals that are found in a garden. Show where the energy in the food web comes from. Choose one of the carnivores and describe what would happen to its population numbers if one of its prey items was removed.

9 There are some problems with Mary's data. Explain what these are and then explain what she could do to make sure her results were accurate and reliable.

10 Mary wants to encourage more thrushes to come to her garden to control the slugs and snails. Find out what habitat and food thrushes need and give Mary advice about how to manage her garden to attract more thrushes. Use what you know to explain why intensive farming methods threaten some bird species more than others.

ICT Activity

Using Microsoft PowerPoint, create a presentation to encourage people to manage their garden for wildlife.

Level Booster

8 You can transfer your knowledge of food webs to a wider context, for example by using what you know to suggest why intensive farming methods might create threats for some bird species more than others.

7 You can analyse, describe and explain what would happen to different organisms within a food web if one species was removed. You can use your knowledge of food webs to make suggestions about how to manage population numbers of a species.

6 You can link the process of photosynthesis to the energy flowing through a food chain. You can summarise information and research your own relevant information.

5 You can explain why the slugs and snails ate some plants more than others by relating the amount eaten to the characteristics of the plant. You can turn your food chain into a food web.

4 You can construct a simple food chain and use the keywords producer, consumer, herbivore and carnivore correctly.

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Language Scaffolds, Set G

Year 7 // SCI LOF 7.7

Unit title: Cells and Reproduction

LOF Subject Focus: Cells and Body Systems

Content Objectives. Teacher will:

1. teach students to use a light microscope effectively.

Content Learning Outcomes:

1. I can use magnifying glasses to observe small things.
2. I can use the microscope to magnify small things such as cells.
3. I can recall the basic parts and function of a light microscope.
4. I can perform simple calculations regarding magnification.

Key Vocabulary: microscope, slide.

Language Learning Outcomes:

1. I can recognise the logical sequence of a set of steps and put them in the correct order.
2. I can compare the size of magnified objects with the original specimen, using expressions like 'twice as big', or 'three times bigger'.

Key vocabulary: microscope, magnification, through the ages, chemist, technologist, engineer, crystal, silicone chip, metal structure, optical structure, optician, optometrist, ophthalmologist, hold, place, adjust, turn, product, specimen, rough estimate, twice as big / three times bigger.

Recommended Materials: KS3 Science Book 1, pp. 6-9.

Supplementary Materials: PowerPoint.

① ***Identified problem:*** *This might be students' first encounter with terms like microscope and magnification and expressions like 'through the ages.'*

Suggested solution: T. projects grain sand on the board. T. asks Ss to brainstorm in pairs what they think it is. T. takes answers. T. reveals that it is a grain of sand. T. asks Ss how they think it is possible to make something so small look so big. T. takes answers (Ss might say something like, by 'zooming in'). T. can build on this concept and say that in science we can do the same thing, make things bigger, or in other words, *magnify* things, by using a special tool. Does anyone know what this tool is called? T. elicits or says: 'Microscope'.

We use microscopes to magnify things, which means to make them look bigger. [T. writes to magnify on the board] When things are magnified, we can see them in more detail. [T. writes 'to be magnified' on the board] Magnification has led to important discoveries in science. [T. writes magnification] on the board. T. projects PowerPoint slide showing the three forms emerging from the root word 'magnify'.

T. proceeds to show the full image, including the words 'Microscopes through the ages'. T. asks Ss what they think they will be reading about based on the title. What does through the ages mean? T. may link this with students' knowledge of history. It means through history, along the years, so they will be reading about the history of microscopes.

T. says that before they continue, Ss should open their books on p. 6, look at the pictures of the microscopes and read the introduction. Can they find out what power of magnification was used to make the sand look this big? Ss scan the text and answer (x100).

① ***Identified problem:*** *This might be students' first encounter with terms like chemist, crystals, technologists, silicon chips, engineers, metal structures, optical structures.*

Suggested solution: T. provides Ss with a matching exercise where this new vocabulary is introduced. T. does a morphology focus on 'optical'.

Before reading the text, T. tells Ss that they are going to discover three uses of microscopes. T. projects slide showing three pictures pairs A: an engineer and a metal structure; B: a chemist and crystals and C: technologist and a silicon chip. Ss work in pairs to match the image set to the sentence. T. collects feedback from Ss. As she goes over the sentences, T. explains word meanings by paraphrasing and pointing to the pictures, for example: Chemists [whose job is to study chemicals] could study crystals [we can see crystals in the picture here].
Technologists [who are experts of what, do you think? Technology that's right] could check silicon chips used in computers. Engineers could look at faults in metal structures [such as the one shown in the photo right here].

Match the picture set to the sentence which best describes it.

A B C

Because of the microscope...

1. Chemists (whose job is to study chemicals) could study crystals.
2. Technologists could check silicon chips used in computers.
3. Engineers could look at faults in metal structures.

CELLS, TISSUES AND ORGANS

Microscopes opened up a previously unseen world to scientists. This was a very exciting time for scientists – they used their microscopes to study all forms of small animals, body fluids and water. Then scientists in other areas of science realised that microscopes would be useful to them – chemists studied crystals, technologists checked silicon chips used in computers and engineers looked at faults in metal structures.

Today scientists use microscopes to trace very tiny particles entering the body as part of their research into cures for diseases such as cancer.

1938 Ernst Ruska develops the electron microscope to improve the magnification and resolution. Viruses and molecules are studied

1932 Frits Zernike invents a microscope to study transparent and colourless specimens

18th Century improvements in microscopes result in their greater use by scientists

1675 Anton van Leeuwenhoek uses a simple microscope to look at blood, insects and pond water. He was the first person to describe cells and bacteria

1667 Robert Hooke makes a microscope to study various objects

1590 Dutch lens grinders Hans and Zacharias Janssen make the first microscope by placing two lenses in a tube

BIG IDEAS

By the end of this unit you will know more about the various organs in the body and their functions. You will be able to describe how they are composed of tissues, and how the tissues are composed of cells. You will also be able to explain how and why some cells are alike, and others are different. You will have developed your skills of observing and interpreting what you see.

What do you know?

1. What is a microscope used for?
2. Name **three** jobs where a microscope is used.
3. When were the first microscopes used?
4. Why did scientists only find out more about the blood in the 1670s?
5. Why could viruses not be seen before 1938?
6. What optical structure do all microscopes contain?
7. Which microscope would be used to study the contents of a nucleus?
8. Look at the timeline above for the development of the microscope. How have microscopes changed over this time?
9. Why do schools not have electron microscopes?
10. Briefly explain how improvements in microscopes may have benefited scientists.

② ***Identified problem:*** Optical structure might be a difficult term for students to grasp.

Suggested solution: T. breaks 'optical structure' down into its two components and points out the significance of the beginning of the word 'op'.

T. asks Ss to read through questions 1-10.

T. asks Ss to look at number 6, where it mentions optical structure.

T. tells Ss that they have just looked at a metal structure [points to metal structure on slide]. T. asks Ss what they think an optical structure is. T. asks Ss if anyone knows what a person who makes glasses is called. T. elicits or else states: 'optician. T. writes optician on the board. T. says that the beginning of the word 'op' [underlines 'op'] comes from the Greek *opsis*, which means 'sight', 'vision' – to see. That is why many words starting with 'op' are related to eyesight. T. projects slide with examples. In this case then, an optical structure is a structure related to how we see through a microscope.

Opsis = Sight

- Cyclops: (Greek mythology) one of a race of giants having a single eye in the middle of their forehead
- Optician: a worker who makes glasses for remedying defects of vision.
- Optometrist: a person skilled in testing for defects of vision.
- Ophthalmologist: a doctor who diagnoses and treats diseases of the eye.

① ***Identified problem:*** *Ss need to understand the logical order of the steps of using a microscope, together with important action words such as 'hold', 'place', 'adjust' and 'turn'.*

<u>Suggested solution</u>: T. goes through the steps one by one and demonstrates on a microscope as he / she goes along.

T. says: First of all, always *hold* the microscope by its *base* [T. points to the bottom of the microscope and demonstrates handling it.

Then, you must place it near a light source. Never look directly at the sun.

You adjust the mirror [T. demonstrates action] until the light is reflected up the microscope [so the light coming down is being *reflected* back up, like in a mirror.

Finally, turn the objective lens to its lowest magnification.

T. may also show a video of someone setting up and using a microscope and then discuss the steps with the students using the target language.

T. then provides opportunity for deeper reading by giving students jumbled up steps and asking them to put them in the correct order.

The steps to set a microscope up have been jumbled up! Put them in the correct order.

- Turn the objective lens to its lowest magnification.
- Adjust the mirror until light is reflected up the microscope. (Check this by looking down the microscope.)
- Place it near a light source. (Do not look directly at the Sun.)
- Hold the microscope by its base.

Using a microscope

BIG IDEAS

You are learning to:
- Set up a microscope
- Calculate the magnification for a microscope
- Make observations using a microscope

Setting up a microscope

There are two lenses in a simple microscope – the eyepiece lens and the objective lens.

To set up a microscope in order to look at an object you need to follow these steps.

- Hold the microscope by its base.
- Place it near a light source. (Do not look directly at the Sun.)
- Adjust the mirror until light is reflected up the microscope. (Check this by looking down the microscope.)
- Turn the objective lens to its lowest magnification.

1 What is meant by magnification?

2 Why must you not look at the sun?

3 How many lenses are used to focus on an object?

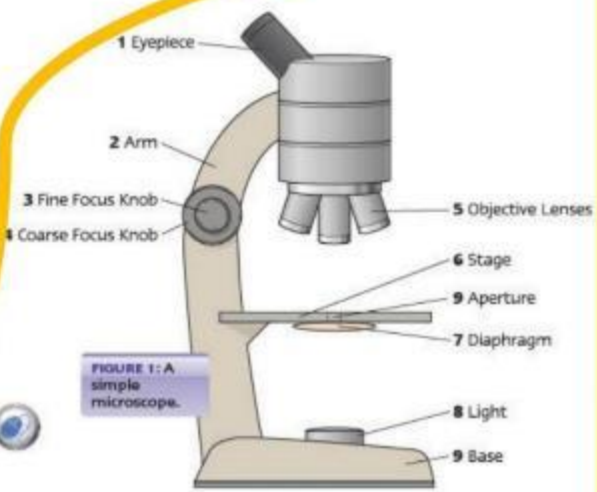


FIGURE 1: A simple microscope.

Magnification

The magnification of a microscope is the product of the objective lens and the eyepiece lens magnifications:

Total magnification = objective magnification × eyepiece lens magnification

4 Work out the magnification for the objects when the eyepiece is ×10 and the objective lens is:
a ×20 **b** ×40.

5 Which lens is changed on a microscope when the magnification is changed?

Exam Tip!

Remember the magnification is worked out by multiplying the lens sizes together, not by adding them.

② ***Identified problem:*** *Students might not know that the 'product' in mathematics is the result of a multiplication, and not any other sum.*

<u>Suggested solution</u>: T. writes down: 3x2=6. T. explains that 6 is the product of 3 and 2.

T. writes down: Objective magnification x Eyepiece lens = Total magnification.

T. asks: So if the product of 3 and 2 is 6, what is the product in the second example,? T. elicits 'total magnification'. T. reinforces meaning by repeating that the product is, therefore, the answer to any multiplication sum.

① ***Identified problem:** Specimen is not a word that students will be familiar with.*

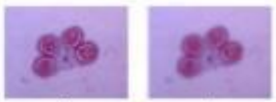
Suggested solution: T. introduces and explains specimen prior to the students reading the text. T. tells Ss that they will be looking at some objects first through a hand lens and then through a microscope. T. says that we will looking at specimens of a coin, of a newspaper print and of a scale on a ruler. We call them specimens, because they are examples which give us an idea of what others like them are like. For example, this 50c coin is a specimen of all 50c coins. T. asks what specimens they will be looking at in question 2. T. elicits 'coin / newspaper print / lined paper / tissue paper'.

② ***Identified problem:** Students might not understand what it means to have the specimen be 'in focus'.*

Suggested solution: T. shows images beforehand to demonstrate students what they should aim for when they regulate the focus knobs. T. projects slide and explains that 'a specimen that is in focus is clearly seen. A specimen that is not in focus is blurred, not clearly seen.' T. asks Ss which picture do they think shows a specimen in focus (A), and which one is not in focus.

A specimen that is in focus is clearly seen.

A specimen that is not in focus is blurred, not clearly seen.



Science in Practice

Using hand-lenses and microscopes

Scientists use microscopes to help them develop new materials that combine desirable features. GORE-TEX® is a material used a lot in clothing for climbers and walkers. It is waterproof and breathable.

You are going to use a hand-lens (or a twisted wire) and a microscope to look at some objects.

Your teacher will provide you with the apparatus that you may need for your observations.

Method:

1 Use a hand-lens to look at the following objects. Write in your notebooks what you see for each one.
- coin
- newspaper print
- scale on a ruler

2 Now use a microscope to study the following objects. Follow steps 3 to 6 carefully. Write in your notebooks what you see for each object.
- coin
- lined paper
- newspaper print
- tissue paper

3 Place a slide on the microscope stage.

4 Looking at the side of the microscope, carefully move the objective lens down (by turning the knobs) so that it is as near to the slide as possible. (Watching from the side as the lens comes down stops you breaking the slide.)

5 Looking down the microscope, slowly turn the focusing knob so the lens moves up and away from the slide. Do this until the specimen is in focus.

6 Keeping the tissue paper slide on the microscope stage, switch to a higher power by carefully turning the objective lens until the higher power lens 'clicks' into position directly above the slide. Slowly turn the focusing knobs to bring the tissue paper into focus at the higher magnification. Write in your notebook what you see.

Questions

1 Roughly how much bigger did the hand-lens appear to make the objects?

2 The hand-lens has a magnification of ×10. Explain what this means.

3 What was strange about the writing in the newspaper that you looked at?

4 What might happen if you wound the lens down towards the glass slide rather than away?

5 When you look at objects under high magnification what happens to the brightness?

6 What problem is caused when you look at an object that is not flat?

③ ***Identified problem:** To answer question 1, students must know how to use expressions like 'roughly, approximately' and to express magnification (for example: it looked twice its size).*

Suggested solution: T. provides language aid for question 1 by giving students multiple options to choose from. T. tells students that question one is asking us for a rough estimate. We have to say how much bigger the hand lens made objects. We do not need to be very precise about it. T. tells Ss they may choose from the phrases on the slide to help them word their calculations. T. asks students: 'Why do you think I only included a few options, and not all the numbers from 1 to 10?' T. explains that it is because it is a 'rough' estimate, we do not have to be exact.

The hand lens made the objects appear...

- Twice as big (x2)
- Three times (as big / bigger) (x3)
- Five times (as big / bigger) (x5)
- Ten times (as big / bigger) (x10)

④ ***Identified problem:** Ss might not understand the meaning of 'wound' (past tense of 'wind') in this context.*

Suggested solution: T. asks Ss to work in pairs to look for a synonym for '**wound** the lens down' in point 6. T. confirms it is: *turning / turn.* T. points out correct pronunciation and differentiates it from 'wound' meaning injury.

Language Scaffolds, Set H

Year 7 SCI LOF 7.7

Unit title: Cells and Reproduction

LOF Subject Focus: Cells and Body Systems

Content Objectives. Teacher will:

1. teach students to understand that cells are the basic unit of life.
2. help student to recognise plant and animal cells and be able to observe simple cells under a light microscope.

Content Learning Outcomes:

1. I can describe that cells are the basic unit of life.
2. I can identify a typical plant and animal cell as seen under the light microscope.
3. I can draw and label typical plant and animal cells as seen under the light microscope.
4. I can state the function of the nucleus, cytoplasm, cell membrane, cell wall, vacuole and chloroplast.
5. I can identify some examples and function of specialized cells.

Key Vocabulary: cell, body, animal, plant, microscope, slide, nucleus, cell membrane, cytoplasm, cell wall, vacuole, chloroplast, tissue, organ, system, organism, magnification, eyepiece lens, objective lens, stage, specialized cells (such as muscle, nerve, sex, blood),

Language Learning Outcomes:

1. I can make use of affixes to build new words.
2. I can find evidence and extend my own thinking based on background knowledge and clues from the text.

Key vocabulary: 'cell', 'structure', 'root cell', 'root tip', 'buds', 'growth rings', 'protective layer', 'rigid', 'pigment' irregular', specialized, role, chisel, saw, streamlined, spinal, cord, spinal, injuries.

Recommended Materials: KS3 Science Book 1, pp. 10-15.

Supplementary Materials: PowerPoint Presentation.

① ***Identified problem:*** *Students encounter some new / difficult terms: 'cell', 'structure', 'root cell', 'root tip', 'buds', 'growth rings', 'protective layer', 'rigid', 'pigment'.*

Suggested solutions:

a) T. builds on students' background knowledge for the words cell, structure, and protective layer.

Cell: T. asks students what we use blocks or Lego pieces for. T. elicits that they are used to build something bigger. T. tells students that today they will be speaking about the Lego bricks of all living things: 'cells.'

Structure**:** T. asks Ss if they remembered what kind of structures they mentioned in the previous lesson. If Ss do not remember, T. reminds them: 'metal structures' and 'optical structures.' T. tells students that a structure is something of many parts that is put together. A structure can be a skyscraper, your body, or the Lego house we just mentioned. Today we are speaking about cell structures. So, what am I going to speak about? What are the cells made up of? [Yes]

Protective layer: When T. explains that the cell wall is a protective layer, T. tells students that the cell wall acts just like the *protective clothing* that we wear when we conduct experiments. It keeps the insides of the cell safe. It also keeps the cell *rigid*, or hard.

Pigment: Have you ever heard of something 'pigmented' (students may have heard this in the context of pigmented hair dye, or eyeshadow tints, or in the context of art). If yes – T. builds on this and explains that if you buy red hair dye, to make your hair red, what makes it red is the red pigment in it. The pigment gives something its colour. In this case, the green pigment also has another function, that of trapping light to produce food energy.

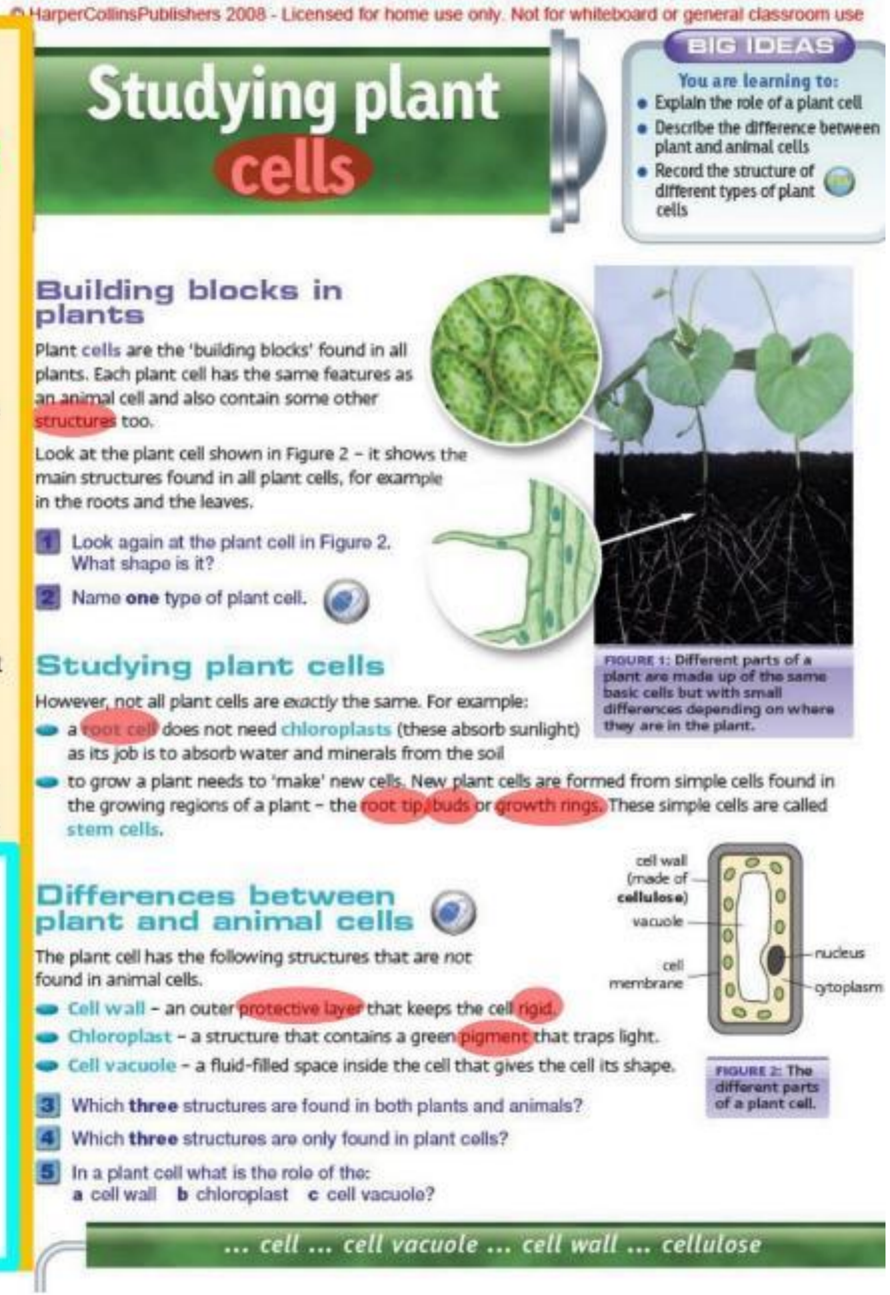
b) T. breaks down the word to explain meaning.

Root cell: T. asks Ss: 'What do plants use to 'drink' water: to uptake water? T. elicits / says: roots. T. writes down: 'root cell'. We know what a root is, and we know what a cell is, what do you think is a root cell? A cell that makes up the roots, that is right.

Root tip: T. may repeat the same method for root tip, first explaining what a tip is (the end of something usually long and narrow, maybe by demonstrating on a pen or pencil) and then joining it with the word 'root'. Or else:

c) T. uses visuals to support student understanding.

'root tip', 'buds', 'growth rings': T. shows diagram with these parts clearly pointed out. T. may ask stronger classes to work in pairs or groups and label the image instead, to uncover the meaning themselves. T. explains what the function of each part is after the image is shown.



Studying plant cells

BIG IDEAS

You are learning to:
- Explain the role of a plant cell
- Describe the difference between plant and animal cells
- Record the structure of different types of plant cells

Building blocks in plants

Plant cells are the 'building blocks' found in all plants. Each plant cell has the same features as an animal cell and also contain some other structures too.

Look at the plant cell shown in Figure 2 – it shows the main structures found in all plant cells, for example in the roots and the leaves.

1 Look again at the plant cell in Figure 2. What shape is it?

2 Name **one** type of plant cell.

FIGURE 1: Different parts of a plant are made up of the same basic cells but with small differences depending on where they are in the plant.

Studying plant cells

However, not all plant cells are *exactly* the same. For example:
- a root cell does not need chloroplasts (these absorb sunlight) as its job is to absorb water and minerals from the soil
- to grow a plant needs to 'make' new cells. New plant cells are formed from simple cells found in the growing regions of a plant – the root tip, buds or growth rings. These simple cells are called stem cells.

Differences between plant and animal cells

The plant cell has the following structures that are *not* found in animal cells.
- Cell wall – an outer protective layer that keeps the cell rigid.
- Chloroplast – a structure that contains a green pigment that traps light.
- Cell vacuole – a fluid-filled space inside the cell that gives the cell its shape.

cell wall (made of **cellulose**)
vacuole
cell membrane
nucleus
cytoplasm

FIGURE 2: The different parts of a plant cell.

3 Which **three** structures are found in both plants and animals?

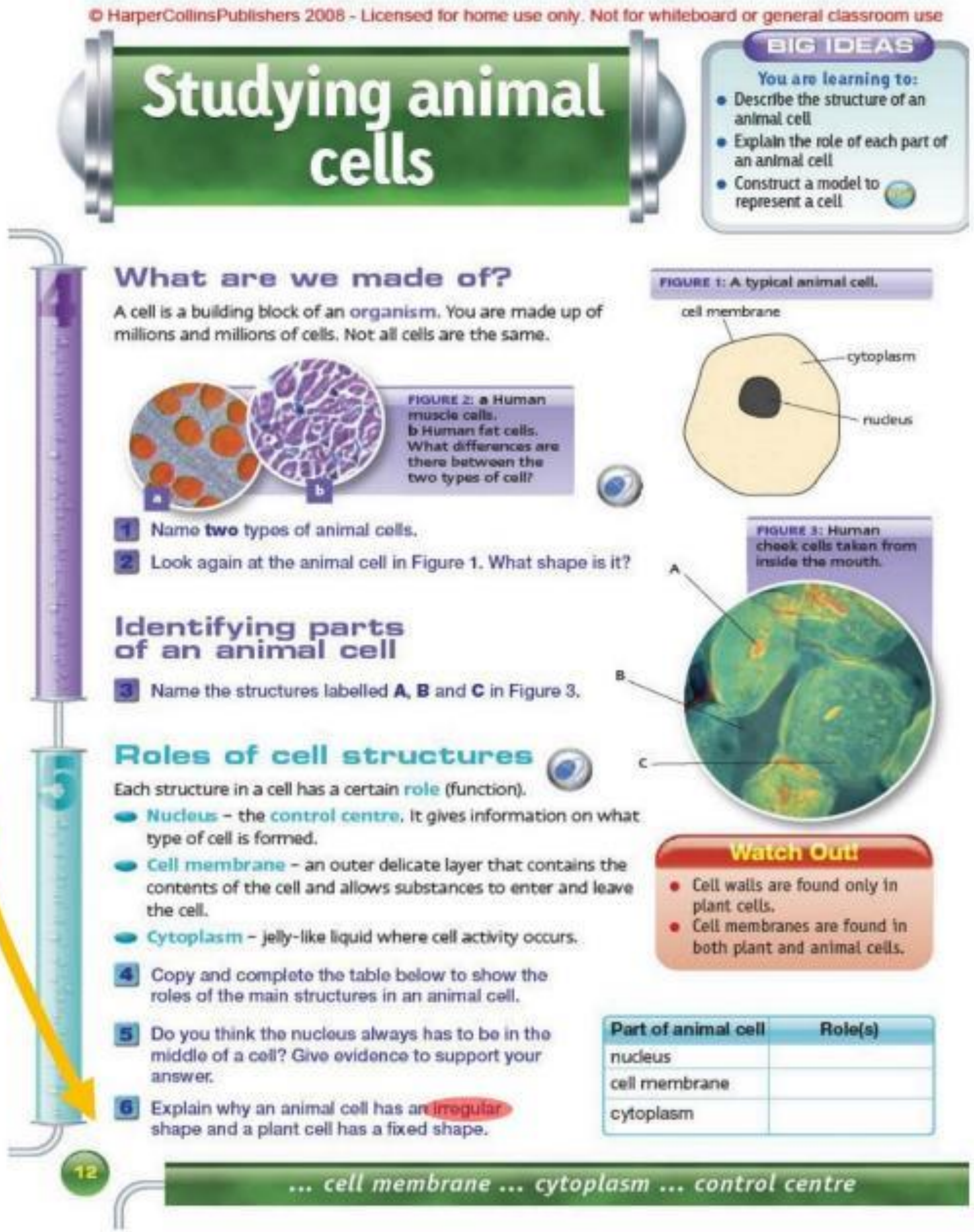
4 Which **three** structures are only found in plant cells?

5 In a plant cell what is the role of the:
a cell wall **b** chloroplast **c** cell vacuole?

... cell ... cell vacuole ... cell wall ... cellulose

(1) ***Identified problem:*** Question 6 provides the opportunity for a short morphology focus on the formation of the word 'irregular', which benefits both students understanding of the shape of an animal cell but also boosts their literacy skills.

<u>Suggested solution</u>: T. asks students if they can remember what shape the plant cell was form the previous lesson. T. elicits that it was rectangular. T. asks Ss what kept it in that shape. T. elicits cell wall. T. says that the cell wall always holds the plant cell in that shape. It is a regular shape because it never changes, just like when students have their regular tables in class – they always sit at the same place. T. writes down regular. T. says: Now, look at question 6, it tells us that the animal cell has an 'irregular shape'. T. writes down 'ir' in a different colour in front of regular. What does the word mean now? It means the opposite – it means that the animal cell does not always hold the same shape, it is flexible – it shifts around because it doesn't have what? That's right a cell wall. What other words can you think of which become the opposite when you add 'ir'? (responsible, irresponsible, relevant, irrelevant, replaceable, irreplaceable.



Studying animal cells

BIG IDEAS

You are learning to:
- Describe the structure of an animal cell
- Explain the role of each part of an animal cell
- Construct a model to represent a cell

What are we made of?

A cell is a building block of an organism. You are made up of millions and millions of cells. Not all cells are the same.

FIGURE 2: a Human muscle cells. b Human fat cells. What differences are there between the two types of cell?

FIGURE 1: A typical animal cell.

1 Name **two** types of animal cells.

2 Look again at the animal cell in Figure 1. What shape is it?

Identifying parts of an animal cell

3 Name the structures labelled **A**, **B** and **C** in Figure 3.

FIGURE 3: Human cheek cells taken from inside the mouth.

Roles of cell structures

Each structure in a cell has a certain role (function).

- Nucleus – the control centre. It gives information on what type of cell is formed.
- Cell membrane – an outer delicate layer that contains the contents of the cell and allows substances to enter and leave the cell.
- Cytoplasm – jelly-like liquid where cell activity occurs.

Watch Out!
- Cell walls are found only in plant cells.
- Cell membranes are found in both plant and animal cells.

4 Copy and complete the table below to show the roles of the main structures in an animal cell.

Part of animal cell	Role(s)
nucleus	
cell membrane	
cytoplasm	

5 Do you think the nucleus always has to be in the middle of a cell? Give evidence to support your answer.

6 Explain why an animal cell has an irregular shape and a plant cell has a fixed shape.

12 ... cell membrane ... cytoplasm ... control centre

① ***Identified problem:*** *Students might have trouble with understanding the concept of a specialized role. Students might not be familiar with 'chisel', 'chipping away', 'saw' and 'serrated' which are the foundation of the analogy the book uses to explain the ideas of specialized roles and special features.*

Suggested solution: T. leads students from the context of specialized roles of tools to the specialized roles of cells using visuals.

T. shows image of a toolbox. T. asks Ss if they can tell him what it is – what is kept in it. T. elicits 'tools'.

T. tells Ss that each tool has different roles – they *do* different things, they have different functions (T. writes down roles and functions). T. tells Ss that tools have special features [characteristics] that make them specialized – there is one special function that they are really good at. T. shows images and moving GIFs of chisel and saw. T. says that the chisel is good for chipping away at things, as can be seen by the GIF. The saw is good for cutting things. What special features do they have that makes them good at their job? [T. elicits the sharp edge and the serrated edge respectively. T. explains that the same thing counts for cells: they have specialised roles within the body – they have special features that prepare them for special jobs.

Designed for a purpose

BIG IDEAS

You are learning to:

- Recognise the cell structure in different cells
- Draw appropriate diagrams of different types of cell
- Explain how the cell structure is related to its function

Different cells suit different roles

Very young cells start out all the same but then they grow and change their shape and structure to become suited to a certain role. They become specialised.

This applies to many other areas, for example in Technology there are different tools to carry out different jobs. Each tool is suited to a different job – a chisel has a sharp edge at the end for chipping away at a surface, a saw has a serrated edge to help it cut through things.

1 How is a hammer suited to its job?

2 How is a pair of scissors suited to its job?

Specialised cells

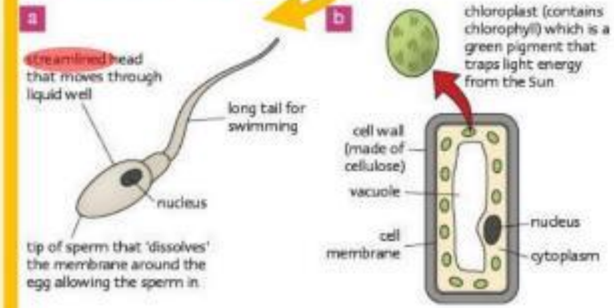


FIGURE 1: a A sperm cell's function is to fertilise an egg. **b** A leaf cell's function is to make sugar (chemical energy). In what ways are the cells shown here adapted to their functions?

Each different type of cell has different **key features** that make it suited to the different role(s) that it carries out. The role(s) a cell carries out is called its **function**. For example, a nerve cell is very long and is surrounded by a fatty substance so that it can carry a signal quickly to where it is needed in the body.

3 Give **two** structures in a sperm cell that are found in all cells.

4 Give **two** structures that indicate the leaf cell is a plant cell.

14

... function ... key feature

② ***Identified problem:*** *Students might have difficulty understanding 'streamlined'.*

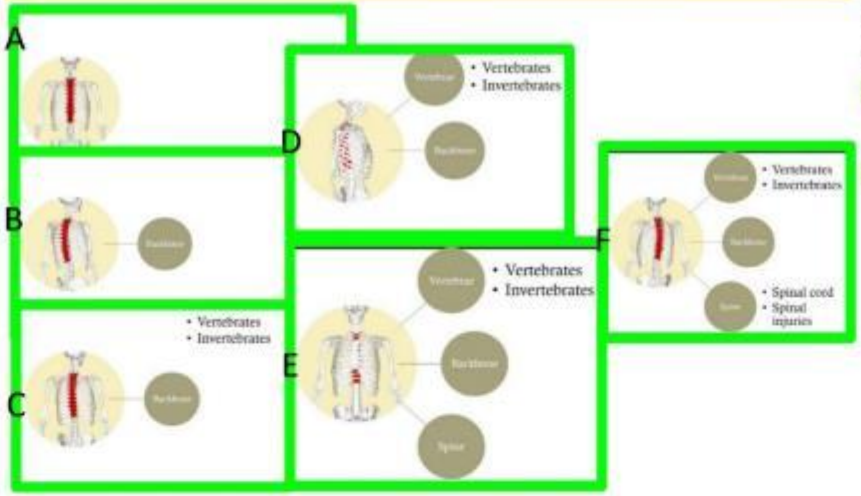
Suggested solution: T. explains streamlined through analogies with more familiar concepts.

T. projects images of a Formula one car and swimming penguins. T. asks Ss if they can find out one thing that these two things have in common (that are the same). T. elicits 'fast'. T. says that one of the things that allows them to move very fast is the fact that they are 'streamlined'. When the formula car moves, it has to push through the air, and penguins have to push through water. Their shape helps them move through air [T. points to the car] and water [T. points to the penguin] faster. That is why they are streamlined – their shape helps them to move quickly or efficiently through air or water. This is the same for the sperm cell [T. proceeds with explanation].

① ***Identified problem:*** *Students might not be familiar with 'spinal cord' and 'spinal injuries', thus missing out on the context within which nerve cells are presented.*

Suggested solution: T. draws from students' background knowledge and breaks down the words to uncover meaning.

T. projects image of the backbone [A]. T. tells student that when they were covering animal kingdoms, they divided the animals into two: those who had a backbone and those who did not, what did we call those? T. elicits (vertebrates and invertebrates) [B]. T. confirms and tells students that that is correct and that the words 'vertebrates' and 'invertebrates' came from the word 'vertebrae', which also means backbone [C]. T. says that another word for backbone and vertebrae is spine [D]. T. asks ss to read through the HSW paragraph at the top of the page. T. asks Ss to scan the text and identify which two phrases (made up of two words) they think are related to 'spine'. T. elicits: 'spinal cord' and 'spinal injuries'[E]. T. explains that the spinal cord is the whole backbone. T. asks students what an injury is – for example when a footballer has an injury and can't play anymore. T. elicits that it is when a footballer has damaged a muscle or a nerve, when he is hurt. T. asks – so that would a spinal injury be? Damage to the spine [F].



HSW How Science Works

When a person breaks their neck or back they can become paralysed because the nerves of the spinal cord are damaged. The nerve cells are not easily repaired. Research scientists have shown they can 'train' cells to grow, one by one, along a chemical trail. Many believe that one day scientists can 'persuade' nerve cells to grow again in order to repair spinal injuries.

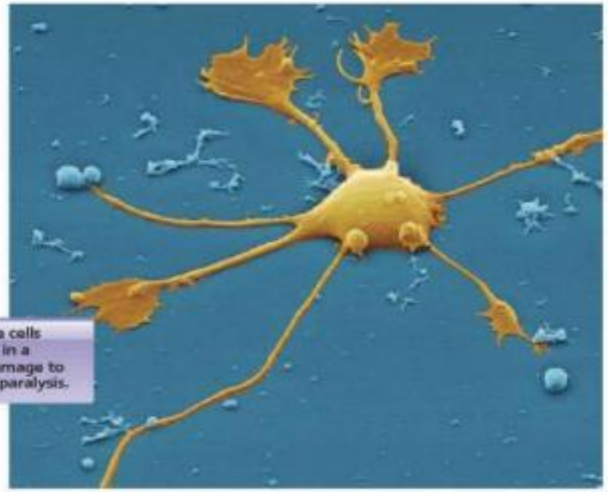


FIGURE 2: Why are nerve cells compared to the wiring in a house? Consider why damage to nerve cells can result in paralysis.

Why does a cell look like that?

Plants and animals have many other specialised cells.

FIGURE 3: a A root hair cell's function is to take in water from the soil. **b** A red blood cell's function is to carry oxygen.

5 Draw a root hair cell and label its main structures. Explain how it is adapted for taking in water from the soil.

6 Draw a red blood cell and label its main structures. Which structure is missing? How does this allow it to carry more oxygen?

... role ... specialised

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Language Scaffolds, Set I

Year 7 // SCI LOF 7.7

Unit title: Cells and Reproduction

LOF Subject Focus: Cells and Body Systems

Content Objectives. Teacher will:

1. guide students to identify the main human organs and systems and their function.

Content Learning Outcomes:

1. I can name some human organs and body systems (such as brain/nervous system; heart/circulatory; lungs/breathing system)
2. I can identify the position and the function of the main organs on the human torso.

Key Vocabulary: cell, organ, body, animal, plant, organ, system, organism, main body organs.

Language Learning Outcomes:

1. I can make use of affixes to build new words.
2. I can find evidence and extend my own thinking based on background knowledge and clues from the text.

Key vocabulary: ultra-violet light, uncontrolled, abnormal, leaf, stem, roots, lungs, liver, stomach, intestines.

Recommended Materials: KS3 Science Book 1, pp. 18-23

Supplementary Materials: PowerPoint Presentation.

① ***Identified problem:*** *Students would benefit from understanding the different transformations of the verb 'to divide'.*

Suggested solution: T. assigns a gap-fill exercise which involves the target vocabulary (divide, divided, division). The aim is to sensitise students to connection between words and to how the same word can be transformed to fit different sentence structures.
Then, T. asks Ss to look at the three questions on the slide and reads them out loud (to model pronunciation).
T. asks Ss to think of what the answer might be.
T. tells Ss to read the first paragraph, 'cell division' to find out what the answers are.
T. takes feedback.

Fill in the blanks with the words below: division, divide (x2).	When we hurt ourselves, the cells in our body .... or split into two so that the new cells take the place of the damaged cells. The same process happens in all organisms; the cells .... and so the organism can grow. This process is called cell ....

Cell division

1. There are two reasons why cells *divide*. These are:

a. ______________________________

b. ______________________________

2. When a cell *is divided* into two new cells, each new cell is (the same as / different from) the original.

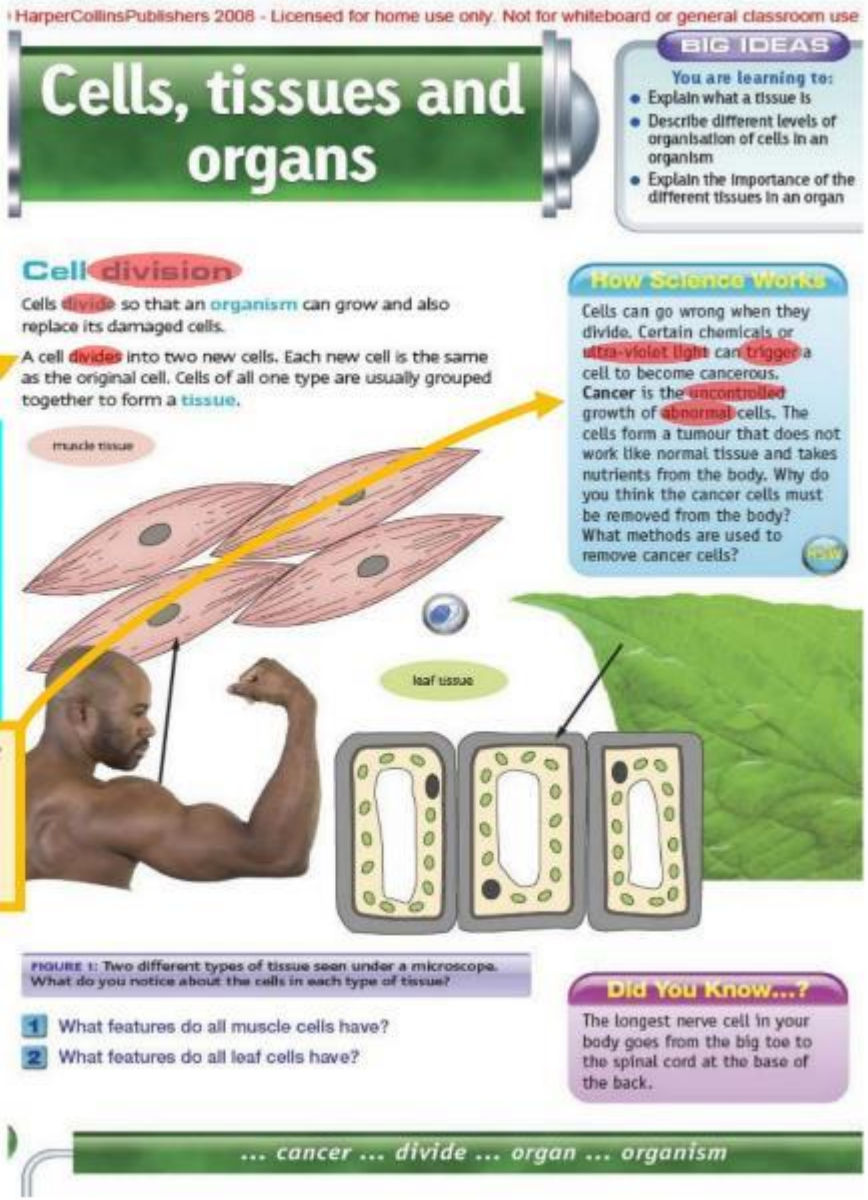
3. After cell *division* takes place, cells of the same type are grouped together to form a ___________.

② ***Identified problem:*** *Students might not recognise that ultra-violet light is the UV light they might be familiar with. Students might also find 'uncontrolled', 'abnormal' and 'trigger' unfamiliar.*

Suggested solution: T. encourages discovery of words and improves literacy skills. T. reads the paragraph (HSW) out loud and then beams up comprehension questions on the board, that target the identified vocabulary.

Find the answer to the questions below in the paragraph we have just read together (How Science Works, p. 18).

1. Who can tell me a source of ultraviolet light?
2. What can we do to avoid the UV light from damaging our cells?
3. Why type of cells are cancer cells?
4. Can their growth be controlled? How do you know that?
5. Why do you think the cancer cells must be removed from the body?
6. What methods are used to remove cancer cells?



Cells, tissues and organs

BIG IDEAS

You are learning to:
- Explain what a tissue is
- Describe different levels of organisation of cells in an organism
- Explain the importance of the different tissues in an organ

Cell division

Cells divide so that an organism can grow and also replace its damaged cells.

A cell divides into two new cells. Each new cell is the same as the original cell. Cells of all one type are usually grouped together to form a tissue.

How Science Works

Cells can go wrong when they divide. Certain chemicals or ultra-violet light can trigger a cell to become cancerous. **Cancer** is the uncontrolled growth of abnormal cells. The cells form a tumour that does not work like normal tissue and takes nutrients from the body. Why do you think the cancer cells must be removed from the body? What methods are used to remove cancer cells?

FIGURE 1: Two different types of tissue seen under a microscope. What do you notice about the cells in each type of tissue?

1 What features do all muscle cells have?

2 What features do all leaf cells have?

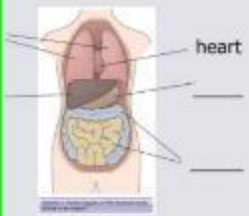
Did You Know...?

The longest nerve cell in your body goes from the big toe to the spinal cord at the base of the back.

... cancer ... divide ... organ ... organism

(1) ***Identified problem:*** *Students might not have the linguistic / content knowledge to answer question 3 without any support.*

Suggested solution: T. provides a list of organs and their functions and students use them to label the missing parts of the diagram in pencil. T. gives feedback and Ss correct any mistakes.



Read the function of these important organs. Work with your partner to label the diagram on the left.

Lungs - Lungs bring oxygen into our blood stream. They are placed at the top of the torso.

Liver - The liver helps us to break down food in digestion and removes toxins from our body. It is the largest solid organ in our body.

Stomach - The stomach holds our food when we first eat it and secretes enzymes that help to break down our food before it goes to the small intestine. You can see it underneath the liver.

Intestines - They help break down food so that the body can use it for energy. This is part of the process called digestion. The intestines also remove wastes from the body. They are found at the bottom part of the abdomen.

Organs

A tissue is made up of a group of similar cells that carry out the same role. Our body is made up of many different types of tissue for example, muscle tissue, bone tissue and nervous tissue.

Sometimes several tissues are grouped together to form structures with set functions. These structures are called **organs**. Our body has many organs. Some examples are:

- heart – pumps blood to the cells
- kidneys – clean the blood and balance water in body
- brain – allows us to control all parts of our body quickly.

3 Name **three** organs shown in Figure 2 that are not listed above.

4 Name **two** organs found in plants.

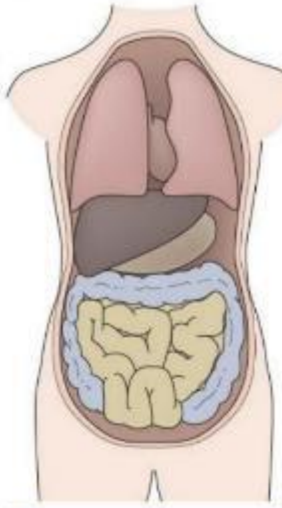


FIGURE 2: Some organs of the human body. What is an organ?

Systems

The next level of **organisation** within an organism is a **system**. A system is a series of tissues and organs that work together and carry out a set function.

System	Function
circulatory	transports material around the body in the blood
respiratory	takes oxygen into the body
digestive	breaks down and absorbs food
nervous	detects the environment; controls the body
reproductive	produces new individuals
skeletal	allows movement
excretory	removes waste from the body

(2) ***Identified problem:*** *Question 4 poses the same issue as question 3. Students might not come up with the name of plant organs unprompted, but they do have the linguistic knowledge if guided.*

Suggested solution: T. provides students with differentiated linguistic support according to student needs. T. provides students with content support in the form of definitions.

With high achievers: T. provides a list of plant functions without the organ name, to elicit 'leaf', 'stem' and 'roots'.

Mid-range: T. provides jumbled up organ names and students work together to restructure the words and label the correct function.

With lower achievers, T. provides students with the definition ready matched to the organ name and students label the diagram.

Read the function of these important plant organs. Can you think of the names of these organs?

•__________ keep a plant in the ground. They also take in water and nutrients from the soil.

•__________ absorb sunlight and make food for the plant by photosynthesis. The waste product of photosynthesis, oxygen, escapes through tiny holes in the leaves.

•The __________ supports the leaves and flowers. It also transports water and nutrients between the roots and the leaves.

•Reproductive organs allow a plant to produce new plants. In a plant, the reproductive organs are ________ (which grow from buds) and __________.

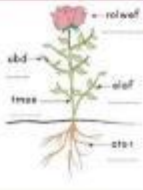
Read the function of these important plant organs. Unscramble the letters in the image to make up the names of these organs.

•__________ keep a plant in the ground. They also take in water and nutrients from the soil.

•__________ absorb sunlight and make food for the plant by photosynthesis. The waste product of photosynthesis, oxygen, escapes through tiny holes in the leaves.

•The __________ supports the leaves and flowers. It also transports water and nutrients between the roots and the leaves.

•Reproductive organs allow a plant to produce new plants. In a plant, the reproductive organs are ________ (which grow from buds) and __________.



5 Which organs are found in the following systems:
a digestive **b** circulatory **c** respiratory?

6 Copy the following and place them in increasing order of organisation.

tissue cell system organism organ

7 Organs are made up of several different types of tissue. Each tissue plays an important role in the organ function. The heart has to pump blood around the body. It must be able to contract when a nerve impulse reaches it.

a) Suggest **two** types of tissue found in the heart. Give evidence for your answer.

b) The heart also contains elastic tissue. Suggest why.

c) Explain why the stomach contains muscle and elastic tissue.

Read the function of these important plant organs. Then label the diagram on the right with the name organs (they have been highlighted for you).

•Roots keep a plant in the ground. They also take in water and nutrients from the soil.

•Leaves absorb sunlight and make food for the plant by photosynthesis. The waste product of photosynthesis, oxygen, escapes through tiny holes in the leaves.

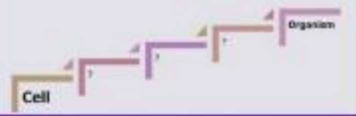
•The stem supports the leaves and flowers. It also transports water and nutrients between the roots and the leaves.

•Reproductive organs allow a plant to produce new plants. In a plant, the reproductive organs are flowers (which grow from buds) and fruit.

(3) ***Identified problem:*** *Students might not understand what question 6 is asking of them, what the meaning of 'increasing order of organisation is'.*

Suggested solution: T. scaffolds this by breaking it down and using visuals. T. writes down cell and organism some ways apart on the board. T. asks Ss to think: which one has the simplest structure, and which one the most complex. T. takes feedback. T. elicits cell = simplest, made of one unit, organism – most complex, made up of many different structures. T. tells students that these different structures make organisms more organised – they have to make many different parts work well together. T. says that from cell, to organism, therefore, we have *increased* [T. mimes upwards] *the order of organisation*. T. projects slide to aid concept understanding, with arrows showing the increasing order of organisation, and spaces where students can complete the exercise.

With each step, the order of organization (how complex the structure is) increases. Use the words in question 6 to fill in the missing structures.



Language Scaffolds, Set J

Year 7 // SCI LOF 7.7

Unit title: Cells and Reproduction

LOF Subject Focus: Cells and Body Systems

Content Objectives. Teacher will:

1. Introduce students to the topic of reproduction.
2. help students to understand that fertilisation is the fusion of the male and female reproductive cells.

Content Learning Outcomes:

1. 17. I can describe that fertilisation is the fusion of the male and female reproductive cells.

Key Vocabulary: fertilisation, incubation, reproduce, offspring.

Language Learning Outcomes:

1. I can hypothesise on why something is the case by using adverbs that express possibility: 'perhaps', 'maybe' and the modal auxiliaries 'may, might'.
2. I can make use of affixes to build new words (-al, -hood, un-)
3. I can find evidence and extend my own thinking based on background knowledge and clues from the text.

Key vocabulary: tough job, offspring, incubation, reproduce, fertilised, fertilisation, parental, constant, measure, adulthood, perhaps, maybe, it could be that, may, might, could, adulthood.

Recommended Materials: KS3 Science Book 1, pp. 26-27.

Supplementary Materials: PowerPoint.

① ***Identified problem:*** *the introduction of this unit is based off the idea of parenting being a 'tough job'. This is the attention grabber. Students might not be familiar with the word 'tough' in this context.*

Suggested Solution: T. starts off with a pre-reading activity which addresses the definition of 'tough job' and prepares students for the concepts to be encountered.

T. says: 'Today we're starting off by looking at some 'tough jobs'. T. says: 'Do you think tough jobs are easy or hard to do? [T. elicits hard].' T. moves on to consolidate meaning by projecting a slide showing a set of activities. T. asks students: 'On the slide there are four activities. Which ones would you say are tough? Discuss with your partners: i) Which ones are tough and ii) Why.
T. focuses on the 5th statement. T. tells students that they will read how some animals have a tough time being parents.

Which of the following would you say are *'tough jobs'?*

1	2	3	4	5
Cleaning your room when it is messy	Doing your Science homework	Listening to music	Playing on the PlayStation	Parenting (being a parent)

② ***Identified problem:*** *It might be the first time that students are encountering the terms: offspring, incubation, reproduce, and fertilised / fertilisation.*

Suggested solution: T. reads texts out loud and asks students to follow along from the book. T. pauses after target vocabulary and explains meaning. T. encourages students to annotate the text if they are not familiar with the meaning of the word. T. concept-checks understanding of target vocabulary through a fill in the gaps exercise.
T. reads: Does your mum or dad ever tell you that being a parent is a ***tough*** job? They are not wrong … but as a species, humans have it fairly easy! These male Emperor penguins carry the eggs of their offspring in a pouch above their feet for about 65 days [We have the word ***offspring*** here. *T. writes down offspring on the board.* Offspring is another word for children, or babies. An animal's offspring are its children. For example a puppy is the offspring of a dog]. If they drop the egg – even for a few seconds – the chick may die because of the extreme cold in the Antarctic. That's dedication to the job!

T. reads: Another example of 'extreme parenting' is the sea turtle. Females lay up to 190 eggs high up on the beach in the hope that even one of these may survive incubation and the journey down the beach and into the sea [T. says: reread this last sentence. What do female turtles hope that their ***offspring*** will survive? Incubation that is right. T. writes down ***incubation*** on the board. ***Incubation*** is the time before the egg hatches and the baby turtles or baby penguins come out. Another example is chickens. During incubation, the baby chick develops and grows inside the egg. When the chick hatches – exits the egg, incubation is over.]

T. reads: All living organisms reproduce [T. writes down reproduce. T. says: when animals ***reproduce***, they produce, make, young. They have ***offspring***, or children]. In animals, the number of offspring produced varies between one to several hundred thousand. All eggs have to be fertilised [T. writes down: fertilised / fertilisation. T. says: for an animal to reproduce, to have children, an egg inside the mother has to be fertilised. When an egg is fertilized, the life of a new organism begins inside of it. We will speak more about this later]. Different animals use different methods of fertilisation and development. An egg may be fertilised inside the mother who then either: – lays the egg protected by an outer shell or tough 'skin' – or keeps the egg inside her where it develops. Eggs may be fertilised outside of the female by being released into water and mixing with sperm. When the offspring are produced the mother may give parental care until the babies can survive on their own, but this is not always the case. This can be very important to help the baby survive.

③ ***Identified problem:*** *Students' literacy skills might benefit from a morphology focus on the word 'parental'.*

Suggested solution: T. pauses briefly on parental after finishing reading. T. asks students: 'what is parental care? Care that is given by who? [T. elicits 'parents']. T. asks students if they can think of other words which end in '-al'. [national, musical, comical etc.] T. may provide them with examples instead of eliciting. T. explains that that the '-al' ending is turning a noun into an adjective. It means: 'related to'. For example parental care: care related to parents; national team – team related to the nation; musical – a show related to music. T. explains it is useful to notice these things because it helps them understand and build new words more easily.

Have they got what it takes?

Does your mum or dad ever tell you that being a parent is a tough job? They are not wrong … but as a species, humans have it fairly easy! These male Emperor penguins carry the eggs of their offspring in a pouch above their feet for about 65 days. If they drop the egg – even for a few seconds – the chick may die because of the extreme cold in the Antarctic. That's dedication to the job!

Another example of 'extreme parenting' is the sea turtle. Females lay up to 190 eggs high up on the beach in the hope that even one of these may survive incubation and the journey down the beach and into the sea.

All living organisms reproduce. In animals, the number of offspring produced varies between one to several hundred thousand. All eggs have to be fertilised. Different animals use different methods of fertilisation and development.

- An egg may be fertilised inside the mother who then either:
  - lays the egg protected by an outer shell or tough 'skin'
  - or keeps the egg inside her where it develops.
- Eggs may be fertilised outside of the female by being released into water and mixing with sperm.

When the offspring are produced the mother may give parental care until the babies can survive on their own, but this is not always the case. This can be very important to help the baby survive.

① ***Identified problem:*** *In order to answer questions 3, 8 and 9a, students need to suggest theories. To do so, students must be equipped with adverbs that express possibility: 'perhaps', 'maybe' and the modal auxiliaries 'may, might'. Ss. might not be familiar with the word 'constant' (question 8) and 'measure' (question 9).*

Suggested Solution: T. accompanies questions with linguistic aid on PowerPoint which addresses both the language functions (of expressing possibility and suggesting reasons why) and the vocabulary issues. Practising the language in context and having repeated exposure to a language structure is the best means of acquiring language.

Procedure: T. may go through the questions one by one, reading some out loud, and referring to the PowerPoint for questions 3, 8 and 9. Alternatively, T. may provide the help in the form of a printed worksheet – copying the questions from the book and including the linguistic aid shown on the slides on the sheets.

3. Suggest why fish produce high numbers of offspring (choose one of the following sentence starters to help you).

Perhaps fish produce high numbers of offspring because ____________.

Maybe fish produce high numbers of offspring because ____________.

It could be that fish produce high numbers of offspring because ____________.

8. A scientist is investigating the following question. 'How many baby sea turtles need to survive in order to keep the number of sea turtles constant (unchanging)?' What other information might the scientist need to be able to work this out? (Choose one of the following sentence starters to help you).

The scientist ***might*** need ____________.

The scientist ***may*** need ____________.

The scientist ***could*** need ____________.

9 a. In China the government is trying to limit the number of children in a family to one. Suggest why the government has introduced this measure (action /procedure). (Choose one of the following sentence starters to help you)

Perhaps the government has introduced this measure to ____________.

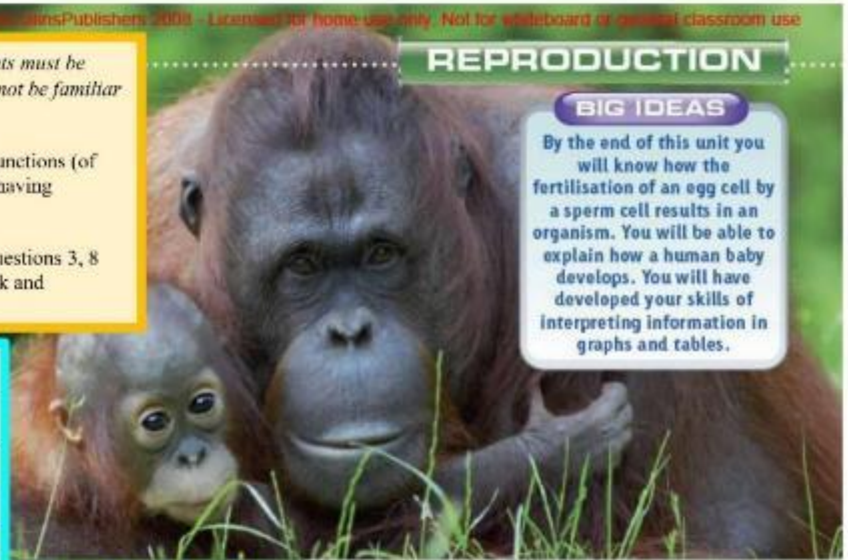
Maybe the government has introduced this measure to ____________.

It could be that the government has introduced this measure to ____________.

② ***Identified problem:*** *Students' literacy skills might benefit from a morphology focus on the word adulthood.*

Suggested solution: T. reads through 9c. T. tells students that they will stop for a minute and focus on the word 'adulthood'. T. tells students: We use 'adulthood' when we want to say: 'being an adult'. For example, 'Being an adult is difficult'. 'Adulthood is difficult'. The last part of the word, the suffix '-hood' is used with many other words to mean: 'being something'. For example: parenthood. What does parenthood mean? 'Being a parent yes'. Can you think of any other words? (Students might say childhood, for example). Ss. continue to work on the exercise.

REPRODUCTION



BIG IDEAS

By the end of this unit you will know how the fertilisation of an egg cell by a sperm cell results in an organism. You will be able to explain how a human baby develops. You will have developed your skills of interpreting information in graphs and tables.

What do you know?

1. Name **two** organisms that produce a high number of offspring.
2. Name **two** organisms that produce a low number of offspring.
3. Suggest why fish produce high numbers of offspring.
4. What evidence is there that vertebrates produce high and low numbers of offspring?
5. Do you think mammals produce high or low numbers of offspring?
6. Which of the creatures shown on this page provide parental care?
7. In which of the creatures shown do the offspring develop inside the mother?
8. A scientist is investigating the following question. 'How many baby sea turtles need to survive in order to keep the number of sea turtles constant?' What other information might the scientist need to be able to work this out?
9. a In China the government is trying to limit the number of children in a family to one. Suggest why the government has introduced this measure.
   b What are the advantages and disadvantages of controlling the number of children born in this way?
   c How many babies per family need to reach adulthood to maintain the population size in China?

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Appendix two: The interview questions

Background:

1) Which years do you teach?

- Do you have any CCP classes?

2) How is English used in your lessons?

- In PowerPoint Presentations, Handouts, the Coursebook, Delivery…?

3) What do you think are your students' feelings towards English?

- Do they ever show signs of language difficulties during the Science lesson?

4) What is your opinion of the coursebooks available?

- Do you find that you have to edit them / rewrite them for your students?

The Lesson Plans

1) Would you see yourself using the language scaffolds highlighted in the lesson plans that I have forwarded to you?

- What do you think would be the benefits?

- What do you think would be the constraints?

2) What do you think are the strongest language scaffolds in these lessons? Why?

3) What do you think are the weakest language scaffolds in these lessons? Why?

4) How do you think the students would react to the language support that is highlighted in the lesson plan? Why? Do you think these modifications / adaptations will be useful to some / all students?

- If you are already adopting a language support strategy, what has been the response of the students so far?

6) Is there anything you would like to add?

Multilingual Classes

1) Have you ever experienced a multilingual classroom? If yes, how has it affected your teaching?

English Across the Curriculum

1) To what extent do you think literacy skills are important in science?

2) To what extent is competence in English a determining factor in learning Science?

3) What helps you perceive that a student has strong literacy levels?

4) How does it manifest itself when a student has low literacy levels?

5) From your experience, how possible is it to collaborate across the curriculum (language teachers working with science teachers).

- Can you see yourself collaborating?
- What might be the benefits?

6) Do you think it should be up to the Science teacher, or the English teacher, to support students' language needs when engaging with scientific texts and material?

7) Do you think that supporting the middle school students with the language load in Year 7 and 8 would encourage them to choose a science subject in year 9?

Final information:

1) How many years of experience in teaching do you have?

2) Which teacher's qualification do you hold?

Appendix 3: Translated and original quotations

	English	***Maltese***
1	[…] sacred cow […]	[…] baqra sagra […]
2	If they are going to pursue Science, the only option is English. Why? Because many Science books are written in English. I have never encountered a Science book in Maltese. The terminology… If we are going to teach them in Maltese, in the future, we must not think just of the present, we need to prepare for the future as well.	Jekk se jkomplu fis-science, bilfors l-Ingliż. Għaliex? Għax ħafna kotba huma miktubin bl-Ingliż tas-science. Ma nsib l-ebda ktieb li hu bil-Malti. It-terminoloġija. […] Jekk se ngħallmuhom bil-Malti, meta se jiġu 'l quddiem, aħna rridu naħsbu wkoll mhux biss għalissa, imma rridu naħsbu wkoll għall-ġejjieni.
3	Basically, in class I code switch. In classes where the majority are foreigners, I use English more, I conduct nearly the whole lesson in English. In the others, where there are more Maltese students, I still code switch, I use Maltese more, but I include some English as well. One of the reasons is that Science questions are in English anyways, keywords and in English, handouts, worksheets, PowerPoints, notes, everything else is in English and some terminology… It's like English automatically lends itself more, so I mix a little bit of both, sort of. Even for the children's sake, so that they try and get used to Science in English as well.	Basically, fil-klassi bħala lingwa li nuża, I code switch, fil-klassijiet fejn għandi l-iktar foreigners, nitkellem iktar bl-Ingliż, kważi lesson nagħmilha kollha bl-Ingliż, tista' tgħid, fl-oħrajn, fejn għandi l-iktar Maltin, xorta I code switch, nagħmilha iktar bil-Malti, imma wkoll nibda ndaħħal bl-Ingliż. Waħda mir-raġunijiet hi li xorta l-questions ikunu bl-Ingliż, tas-science, il-keywords bl-Ingliż, il-handouts, worksheets, PowerPoints, notes, everything else, kollox bl-Ingliż u qisni ċertu terminoloġija, qisek bla ma trid issir bl-Ingliż so I mix a little bit of both, sort of. Anke t-tfal, they try and get used to science in English ukoll.
4	[…] the most important thing for me is that the student has understood […]	[…] jiena l-iktar ħaġa importanti li t-tifel fehemha jew it-tifla fehmitha […]

5	'Wow miss, do we need to learn all these words?'	'Illaħwa miss, dawn irridu nkunu nafuhom, dawn il-kliem kollha?'
6	[...] they would be evidently scared of the question [...]	[...] juru li qed jibżgħu minnha [...]
7	[…] the idea of language, in science, arises often […]	[…] l-idea ta' language fis-science tqum ħafna […]
8	[…] the language issue is very crucial […]	[…] l-issue tal-lingwa hija kruċjali ħafna […]
9	Form 1, form 2, you don't need lengthy answers, not like when you are teaching Biology and you need certain length and certain depth.	*Dal-livell, form 1, form 2, m'għandekx għalfejn tul, mhux bħal meta qed tgħallem Biology tkun trid ċertu tul u ċertu fond.*
10	I am not interested in the role of English in the Science book.	M'inix ikkonċernata mill-livell tal-Ingliż tal-ktieb.
11	The parts of a Bunsen Burner is when we start messing up... yes... Meaning, what a sliding collar is... what an airhole is...	Mbagħad il-parts of a Bunsen Burner fejn nibdew inkorru... Hemmhekk iva... Iġifieri x'inhu sliding collar, x'inhu airhole...
10	When it comes to writing, you start to realise that these children's problem is not a lack of science knowledge, but truly because there is a barrier, and that barrier is language. Most of the times I would say that English is the barrier, the English language.	Meta niġu għall-kitba, tibda tinduna illi dawn it-tfal il-problema m'hijiex għaliex ma jafux is-science, imma, għaliex proprju hemm barrier, u din il-barrier tkun il-lingwa. Ħafna drabi jkolli ngħid li tkun l-Ingliż il-barrier, il-lingwa Ingliża.
11	[…] at times there are students who get lost, as once you are done with English, you are helping the Maltese language students, but you are losing the English language students […]	[…] xi kultant ikun hemm min jintilef, għaliex malli inti lestejt mill-Ingliż, lil dawk tal-Malti, allright qed tgħinhom, imma tlift lil dawk tal-Ingliż […]
12	Let me tell you, it helps them immensely. Truly. Because they will have overcome a	Ħa ngħidlek, tgħinhom immens. Ħafna. Għax ikollhom ċertu biża' mirbuħ. Hekk

	certain fear. That's the way I see it. Even when you refer, for example, even when you write, when you prepare the PowerPoint, our PowerPoints are in English, when it comes to, even KS3 […]	naraha jien. U anke meta tirreferi eżempju, aħna meta niktbu, anke tipprepara PowerPoint, aħna l-PowerPoint bl-Ingliż nagħmluh, meta tiġi biex... anke l-KS3 […]
13	Because they understand the question in whichever way they like, and not as it is posed to them).	Għax id-domanda jifmuha kif iridu huma, mhux kif ġiet mistoqsiha lilhom.
14	If they have a worksheet, when they are reading, it's very different [to when they are participating in class]. Sometimes they don't know how to pronounce the word, it's like, if they listen to it, once I say it, they know what it is, but to read it, it's something else. Meaning that they find it difficult, they don't perform as well then in tests and worksheets, as they do in class discussions. And the problem would be English, not Science.	Jekk għandhom worksheet, when they are reading, it's very different. Sometimes they don't know how to pronounce the word, speċi jekk jismgħuha, once li I say it, they know what it is, but to read it, it's something else. Iġifieri wkoll isibuha diffiċli, jmorru agħar imbagħad fit-testijiet u l-worksheets milli jekk qed nagħmlu discussion fil-klassi. U l-problema tkun l-Ingliż, mhux is-science.
15	When it comes to writing, you start to realise that these children's problem is not a lack of science knowledge, but truly because there is a barrier, and that barrier is language.	Meta niġu għall-kitba, tibda tinduna illi dawn it-tfal il-problema m'hijiex għaliex ma jafux is-Science, imma, għaliex proprju hemm barrier, u din il-barrier tkun il-lingwa.
16	They know how to explain it in class, but they don't know how to write it down in English. If I could, I would like to… I say this boy, if he were here with me, I would lead him to it, with me, one to	They know how to explain it in class, but they don't know how to write it down in English. Kieku nkun nixtieq, ngħid ara dan it-tifel, kieku qiegħed miegħi u nwasslu għaliha, miegħi, one to one,

	one, he would get it for sure. Alone, however, and with this fear of English accompanying him, he doesn't manage. And they fail, they would be very smart children, but because of English, they fall behind. It worries me, I say it in every in service. It is something that I have seen a lot over the years.	jagħmilha żgur. Imma waħdu, u bl-Ingliż miegħu, qed jibża' minnu ma jasalx. U jeħlu e, ikunu tfal bravi ħafna, imma għax l-Ingliż iwaqqagħhom lura. Tinkwetani ta, jiena f'kull inservice ngħidha din. Vera xi ħaġa li ilni ħafna naraha.
17	[…] once you are done with English, you are helping the Maltese language students, but you are losing the English language students.	[…] għaliex malli inti lestejt mill-Ingliż, lil dawk tal-Malti, allright qed tgħinhom, imma tlift lil dawk tal-Ingliż.
18	[…] write in what you think is correct English.	[...] ikteb kif taf bl-Ingliż.
19	[…] once they had to learn about dolphins, and the teacher gave them a reading comprehension on dolphins. When they came to us [Science teachers], they already knew what a dolphin was, whether it was a mammal or a fish, because many times, this confuses students, right? And then we could... they said: "Sir, it's because we already covered this during English".	[…] darba kellhom fuq dolphins, u t-teacher għamlet il-comprehension fuq dolphins. Meta ġew għandna, kienu diġa jafu, dolphin x'inhu, jekk hux mammal jew fish, għax dik ħafna drabi, l-istudenti jitfixkluha, tajjeb? U stajna mbagħad... qaluli "Sir, għax għamilniha fl-Ingliż din il-ħaġa.
20	[…] but then, let me tell you, in science you cannot... for instance, let's say a student didn't write 'because' correctly, I underline it, if I have time, I correct it, but... you need to keep the time in mind... I'm either going to correct the 'because' and 'without'... but then you	[…] imbagħad aħna ħa ngħidlek, f'Science ma tistax toqgħod... pereżempju 'because', ma kitibilix sewwa, nagħmillu line taħtha, jekk ikolli ċans nikkoreġihom, imma... mbagħad trid tara l-ħin... jew ħa noqgħod nikkoreġi l-'because' u l-'without'...

	add a fullstop, a comma, you need to keep the time in mind. What you should mostly look out for are the Scientific concepts.	imma mbagħad tagħmel il-fullstop, comma, trid tara l-ħin. Imma l-iktar li trid tfittex huma l-concepts li huma scientific.
21	I think time retraint is one issue, that you don't have as much time to collaborate, it takes a lot of work, and we don't have that much time.	Naħseb time restraint, hija one issue, li ma tantx ikollna qisek ħin biex tagħmel collaboration hekk, it takes a lot of work, u ħin ma tantx għandna.
22	Again, it wasn't like... I mean... not that they did not help, how do I say this, but we all still sort of stayed in our own field. There wasn't really, not the way you did it, not like that, as as obvious as collaborating that clearly with each other.	Again, ma kinitx forsi, qas naf, fis-sens, mhux għax, m'għenunix, kif taqbad tgħid, imma xorta qisu kollha bqajna fl-area tagħna. Ma kienx hemm daqshekk, jien naf... mhux bħal ma għamilt inti, mhux hekk, as obvious as collaborating that clearly between each other.
23	This book [KS3] has a wider view, that's what's good about it, it helps the strong students. With the weaker students, you have to pinpoint, for example, I don't use all of it with the weaker students, I pick and choose, for example, I tell them: "Here, refer to this page".	Dan [KS3] għandu wider view, dan dak li għandu, sabiħ, jiftaħlek, allura mat-tajbin, jgħinhom, imma mal-bgħatuti, you have to pinpoint, per eżempju, ma nużahx kollu mal-bgħatuti, u lanqas ma nużah kollu, nagħżel minnu, per eżempju, ngħidilhom: "Ara, irreferu għal dil-page".
24	[...] I told them: "Listen, perforation is when something tears, or it breaks apart, this is a type of skin, so it breaks apart", and then I told them, "for example, when you're running, and you fall down and you hurt your knee, you have a graze, it cuts open, similar to that", and when I explain like that, yes, I find it very	[…] għidtilhom: "Listen, perforation is when something tears, or it breaks apart, this is a type of skin, so it breaks apart", mbagħad għidtilhom jien naf, "eżempju when you're running, and you fall down and you hurt your knee, you have a graze, it cuts open, similar to that", ehm , u qisni nagħmilha bl-explanation

	effective. They understand it like that, when I say it in that way.	imbagħad imma eħe [...], I find it very effective. Mbagħad jifmuha hekk, once li ngħidilhom hekk.
25	I think it does help. Another thing that I sometimes do is that apart from showing them images, I show them things, actual things. They are either present in the lab, or I bring them myself. So, for instance, if I'm speaking about a three-pin plug, and the wires that come out of it, I get a plug myself and I show them.	I think it does help. Xi ħaġa oħra li ġieli nagħmel huwa li apparti li nurihom images nurihom affarijiet, actual things. Jew ikollna affarijiet fil-lab, jew inġibilhom affarijiet jiena. So, jien naf, jekk qed nitkellem fuq three pin plug, u l-wires li ħerġin minnu, I get a plug myself and I show them.