Project Title: Integrating content and language learning in EMI education – Exploring "thematic patterns" as pedagogical strategies

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Final Report

by

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Integrating content and language learning in EMI education

– Exploring "thematic patterns" as pedagogical strategies

Abstract

This research aims to develop innovative pedagogical strategies to integrate content and language learning in EMI education contexts. Drawing on Lemke's (1990) theory of 'thematic patterns', the research proposes a "Concept + Language Mapping" (CLM) approach to the integration of content and language learning in EMI secondary classrooms in Hong Kong. A pedagogy based on the CLM approach was designed and implemented in EMI classes of Integrated Science, Biology and Geography lessons in both junior and senior secondary schools. A design-based research (Reeves, 2000) was adopted following a mixed-methods strategy (Creswell, 2003) to explore the effect of the thematic-patterns-based CLM approach in facilitating the development of content knowledge and language knowledge in EMI classrooms of different subjects. Lessons based on the CLM pedagogy were observed and documents of CLM teaching materials were collected during the intervention with student/teacher interviews conducted afterwards. A quasi-experimental design was also adopted to evaluate the effectiveness of the CLM approach. Research findings indicated that the CLM pedagogy aroused the language awareness of the students which facilitated meaning-making in their learning of the content subjects in English as an additional language. The CLM teaching materials (i.e. C+L cards, C+L maps, sentence-making tables and essay writing guides) as well as the CLM teaching activities facilitated the development of both content and language knowledge. The impact of the CLM approach on the EMI CLIL classrooms was analysed with significance and implications discussed in the conclusion of the research.

Keywords

"Concept + Language Mapping" (CLM), Content and Language Integrated Learning (CLIL), English medium instruction (EMI), Language Across the Curriculum (LAC), thematic patterns

1. Introduction

In Hong Kong and many countries in the world, English remains the socioeconomically dominant language and the most important medium of instruction in higher education. However, in many English medium instruction (EMI) schools, students are not equipped with due support for learning content subjects in English (Lin & Man 2009). Learning academic literacy is cognitively abstract and linguistically unacquainted, which is virtually learning a foreign language for most students. Hence, in EMI classrooms where content subjects are taught in English as an additional language (EAL), the burden of learning will be doubled as academic literacy becomes a foreign language 'squared' (i.e. 2 foreign languages added up together) (Lin, 2016).

EMI education in Hong Kong represents one variant of the bilingual education programme, Content and Language Integrated Learning (CLIL), where students learn non-language content subjects through a second/foreign language (L2) (Coyle, Hood & Marsh, 2010; Cenoz, Genesee, & Gorter, 2013). CLIL has been developed based on well-grounded second/foreign (L2) language learning theories. However, although it is hypothesized that CLIL can facilitate the learning of both content knowledge and the L2 language; in practice, it remains unclear how content teachers can successfully integrate content and language teaching in their lessons. More in-depth studies of the linguistic demands associated with the processes of concept construction should be conducted. This research attempts to explore an "Concept + Language Mapping" (CLM) approach to integrating content and language teaching by trying out a series of interventions in two EMI secondary schools in Hong Kong based on Lemke's (1990) theorization of "thematic patterns" as pedagogical strategies.

2. Literature review

In this section, the notions of "concept" and "concept mapping", the role of language in content subject learning, the theorization of "thematic patterns" as well as the relationship between "concept mapping" and "thematic patterns" are introduced with relevant studies reviewed.

2.1 Concept and concept mapping

Concepts are fundamental to knowledge acquisition, but are difficult for most learners due to abstractness and complication. According to Merrill, Tennyson and Posey (1992), concepts are "a set of specific objects, symbols or events which are grouped together on the basis of shared characteristics and which can be referenced by a particular name or symbol" (p.6). Concepts exist as interrelated sets that are connected to one another. Therefore, teachers need to guide leaners to go through the cognitive process of content analysis by analysing the interrelationships between concepts and distinguishing the general and critical attributes of each concept.

The emphasis on concept classification and pattern recognition has been reflected in the concept mapping strategy since the 1980s. Concept mapping as a metacognitive learning strategy was originally developed by Novak and his associates (Novak, Gowin, & Johansen, 1983) grounded in Ausubel's (1968) assimilation theory of cognitive learning which focuses on how individuals integrate new knowledge into an existing framework of concepts or propositions they have learned. According to Novak (2010), a concept can be defined as "perceived regularities or patterns in events or objects, or records of events or objects, designated by a label" (p.25). The central premise of concept mapping is to represent knowledge in a hierarchical organization with basic components

of concept terms (nodes) and linking lines. When two or more concepts are "linked" semantically to demonstrate a specific regularity, "propositions" are formed. Concept maps are built by linking concept words and phrases together into propositions. Concept mapping can be represented in a concept taxonomy; that is, a diagram constructed to indicate the superordinate, coordinate, and subordinate relationships among a set of related concepts (Merrill et al., 1992). Figure 1 illustrates an example of an early concept map.

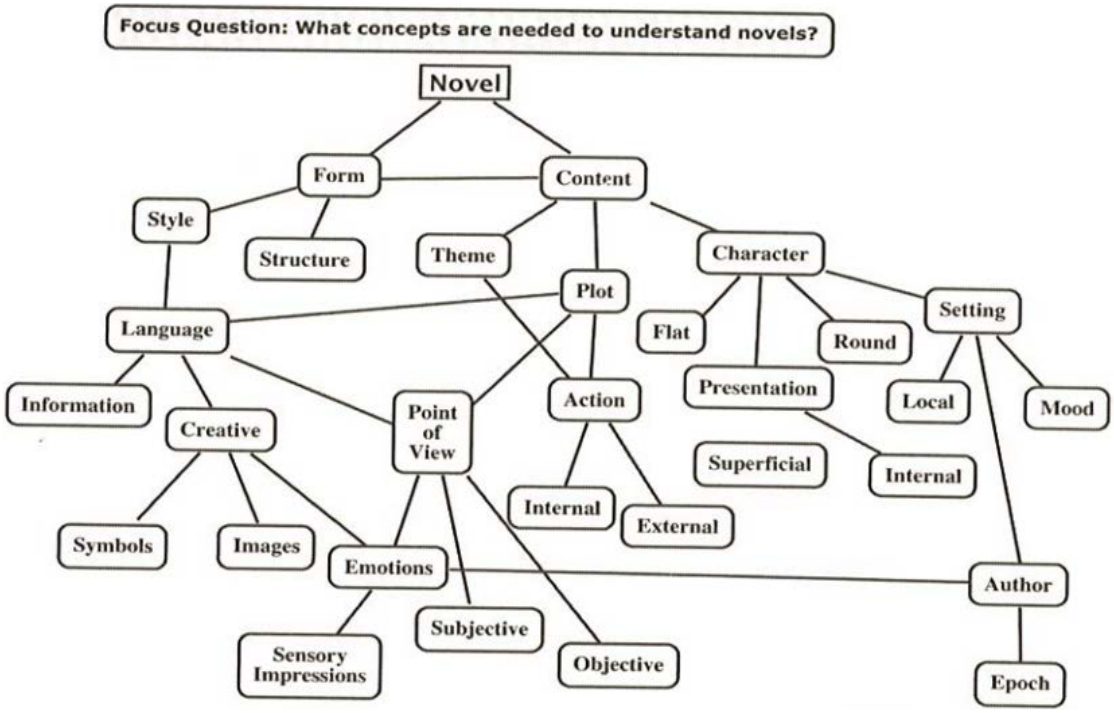


Figure 1: An example of an early concept map (cited Novak, 2010, p. 33)

Novak et al. (1983) emphasized concepts can only be learned through meaningful learning when learners are able to consciously and explicitly link the new knowledge to the existing conceptual framework they have already possessed. This resonates with Merrill et al. (1992), who argued that concept learning does not occur if learners simply recall definitions of previously learned concepts. Concept mapping as a metacognitive learning strategy is believed to facilitate meaningful learning as it constructs the spatial representation of interconnected concepts and visualizes the hierarchical

structure of the conceptual knowledge that is stored in human minds. Thus concept mapping serves as a metacognitive learning tool that helps learners to organize their cognitive frameworks into integrated patterns so that they understand the relationships between concepts by focusing on the hierarchical and propositional nature of conceptual knowledge (Novak et al., 1983).

2.2 Language and content learning

From a socio-semiotic perspective, human learning is a making-meaning process — a semiotic process, and language is the primary semiotic resource to construe (i.e. to construct and understand) content (Halliday, 1993). Therefore, language is indispensable for knowledge construction and interpretation in content learning. According to Systemic Functional Linguistics (Halliday & Matthiessen, 2004), people create meanings by making choices based on three metafunctions of language: the ideational function, the interpersonal function and the textual function. Among the three metafunctions of language, the ideational metafunction is of primary importance as it enables people to express their experience through language, hence construct the knowledge they have experienced in the world. The ideational metafunction can be further divided into the experiential and logical metafunctions. The experiential function is related to how language helps to express the world experience at the clause level, while the logical function shows how language helps to build up logical connections between different sentences to achieve coherence in the whole text.

According to the grammar of functional approach (Derewianka, 2011), language enables people to represent different kinds of experience through three basic meaning components---processes, participants and circumstances, which provide detailed information about "what's happening?", "who or what is taking part?" and "what gives us more information about the activity? when?

where? how? etc." respectively. A clause is a unit of meaning and is basically a group of words that have one verb/verb group. **Processes** are verbs/verb groups meaning "doing", "thinking", "saying", or "relating". Based on the processes, clauses can be expanded by adding various participants to indicate "who or what is taking part" and the details about the "who" and "what". **Participants** may be nouns and pronouns (informing the "thing") or adjectives (showing the "pointers") and other grammatical forms to indicate the details such as "classifiers", "describers", "quantifiers" and "qualifiers". **Circumstances** provide further details surrounding the activity such as "time", "place", "manner", "accompaniment", "cause", "contingency", "role" and "angle", etc. The circumstantial information can be different types of adverbials represented by adverbs or prepositional phrases. It should be noted that processes and participants constitute "the experiential centre" of the clauses while circumstances are relatively more "peripheral" (Halliday & Matthiessen, 2004, p. 176). The meaning components of participants, processes and circumstances function together to form clauses and they constitute the lexico-grammar of the language (Halliday & Matthiessen, 2004). In the grammar of functional approach, clauses can be combined in different ways to elaborate, extend and explain ideas and construct relationships between different aspects of experiences (Derewianka, 2011). For example, conjunctions "and", "but", and "or" can connect words, groups and phrases; they can also combine clauses and build compound sentences meaning "additive", "adversative", and "alternative" respectively. More intricate and subtler ideas can be represented by complex sentences which consist of a "main clause" and a "subordinate clause" introduced by subordinating conjunctions expressing meanings such as "time", "manner", "cause", "condition", "concession", "adding" and "replacing", etc.

The role of language in expressing meaning shows that language is crucial for knowledge development in any human learning domain. As Schleppegrell (2004) summarized, "learning content means learning the language that construes that content as students participate in new contexts of learning" (p.18). The learning of concepts in content subjects and the learning of language should always go hand in hand.

2.3 Thematic patterns and "Concept + Language Mapping"

Although language is essential for content learning, traditional mentalism-based view of concept learning neglects the role of language. Grounded in traditional cognitive psychology, although concept mapping has been reported to be a useful instructional strategy, it is nevertheless cognitively and pedagogically insufficient as "it lacks the necessary vocabulary" to inform teachers how they should guide their students to learn and apply the concepts correctly (Lemke, 1998). Drawing on Systemic Functional Grammar (Halliday, 1985) and the research findings in science education, Lemke (1990) offered an alternative for concept instruction. Rather than conceptualizing "concept" as abstract mental representations of objects or events, Lemke hypothesized that concepts are mediated by "thematic patterns" ---the patterns of semantic relationships that constitute the thematic content of a particular content area; namely,

> "The pattern of connections among the meanings of words in a particular field of science…a pattern of semantic relationships that describes the thematic content, the science content, of a particular topic area…a network of relationships among the scientific concepts in a field, but described semantically, in terms of how language is used in that field" (Lemke, 1990, p.12).

Similar to the cognitive psychological view of concept learning, Lemke (1990) also regarded the semantic relations between concepts as essential for understanding the corresponding content knowledge. However, instead of simply describing the representation of the hierarchical meaning

structures between propositions, Lemke (1990) introduced the notion "thematic patterns" which consists of connections of meanings of words/phrases (thematic items) forming a pattern of semantic relationships that describe the particular thematic content of the subject field. In this sense, Lemke (1990) provided us not only an artifact (through identifying the thematic items) for decoding the concepts within the concept maps (Novak et al. 1983) but also a powerful linguistic tool (through building the semantic relationship between thematic items/patterns) for teachers and students to co-construct the semantic relationship between the thematic patterns, which form a global "Concept + Language" Map. Rather than connecting concepts (nodes) with linking lines to build up propositions which shows the complicated meaning relationship between concepts in an abstract and implicit way, the thematic pattern theory makes full use of language as the primary meaning-making resource to construe the hierarchical meaning relationship within the content subject. Appendix 1 illustrates the common semantic relations for thematic analysis introduced in Lemke's (1990) *Talking Science*. According to Lemke (1990), very little science can get done without the semantic resources of language; above all, the thematic patterns and genre structures specific to science. Therefore, students should be taught both the thematics and the genre of science because reasoning is based on both the use of thematic patterns and genre structure patterns, the former supplies the content and the latter supplies the form of organization of the argument.

It should be noted that recent studies about concept mapping and knowledge organization have started to highlight the critical role of language in concept mapping, as noted by Novak (2010),

> "At first we tried to strip away all text except for concept labels, and to show how these are related in a hierarchical structure, but without linking words…While the relationships may be obvious to one who understands these concepts, there is an obvious lack of clarity for most people. We soon insisted on inclusion of linking words to express the propositional meanings in the clearest possible manner." (Novak, 2010, p. 32)

Apart from emphasizing the crucial function of language in more efficacious concept mapping, recent research also advocated the integration of multimodal representation strategies such as animation and concurrent audio narration into the node-link diagram of concept mapping. For example, Nesbit and Adesope (2011) investigated the effects of learning from animated concept maps with concurrent audio narrations. The results of their research showed that concept map groups performed better than the text group in both free recall and multiple-choice knowledge test. In CLIL classroom contexts, research findings also provided empirical evidence which indicated the important implication of Lemke's (1990) thematic pattern theory on integrating content and language learning in the EMI CLIL classrooms (Lin & Wu, 2015; Lin & Lo 2016). Grounded in Lemke's (1990) thematic pattern theory and the findings of previous studies, we further develop the notion of "concept mapping" (Novak et al. 1983) and propose the thematic-patterns-based "Concept + Language Mapping" (CLM) approach by accentuating the role of language in the meaning making of concept instruction.

3. Conceptual framework

Drawing on concept mapping studies (Novak et al., 1983; Novak, 2010) and Lemke's (1990) thematic pattern theory, the thematic-patterns-based CLM approach was conceptualized into a pedagogy for CLIL classrooms of EMI background (Figure 2). Research findings in CLIL have emphasized the necessity of exploiting language and multiple resources (e.g. verbal, audiovisuals, images, diagrams, actions and gestures, etc.) to facilitate the learning of academic content and academic literacy (Cheng & Gilbert, 2014, 2015; Lemke, 1998; Nesbit & Adescope, 2011; Prain & Tytler, 2012). In EMI contexts, Lin (2016) advocated CLIL teachers to help students to expand

their repertoire of communicative resources by bridging multiple resources (Lin 2012). Inspired by the previous studies, a series of CLM teaching materials and CLM teaching activities were designed for different EMI CLIL lessons.

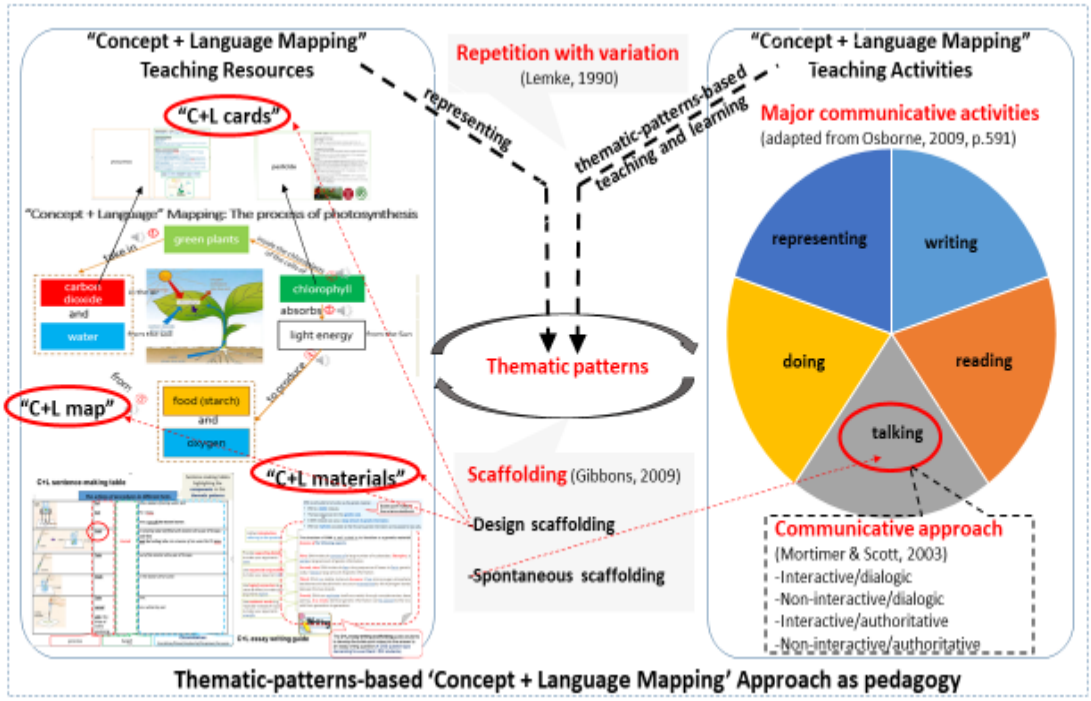


Figure 2: Thematic-patterns-based 'Concept + Language Mapping' (CLM) approach

All CLM teaching materials including C+L cards, C+L maps, sentence-making tables and essay writing guides (See Appendix 2) are essential teaching resources in the thematic-patterns-based CLM pedagogy. These CLM materials represent the key thematic patterns in the topical units of the content subject. With different types of CLM materials applied in CLM activities to facilitate the thematic-patterns-based teaching and learning in the EMI CLIL classrooms, the thematic patterns are circulated again and again in "repetition with variation" (Lemke, 1990) as one of the important "global thematic strategies" (p.227). For example, the same partial thematic patterns in the C+L map of "the process of photosynthesis" are represented in the textbook with both verbal and graphic representations; during CLIL lessons these thematic patterns are introduced by the

teacher and discussed by students, and then are read by students in workbook exercises and references. They are further explored and inquired in the experiments and projects conducted by the students and are finally written out in the assignments and test papers. During the process of major communicative activities --- "representing", "talking", "reading", "doing" and "writing" (Osborne, 2009), the thematic patterns focusing on the same topic "the process of photosynthesis" appear time and again, "with some items and relations similarly expressed and other differently expressed" (Lemke, 1990, p.227). Such repetition of thematic patterns with variation helps students to understand the abstract patterns on the one hand and consolidate both content and language knowledge on the other. It should be noted that both the CLM materials and CLM activities are two essential components in the thematic-patterns-based CLM pedagogy. Effective implementation of such a pedagogy relies on the scaffolding by the teacher who is the designer and instructor of the lessons. The CLM materials are useful "design scaffoldings" (Gibbons, 2009; Lin, 2016) prepared by the teacher before the lessons, while these design scaffoldings take effect only when they are actually activated and applied by students during communicative activities; in other words, the various thematic-pattern-based teaching materials must be fully understood (rather than simply memorized by rote learning) and employed during argumentation and inquiry of the knowledge. The role of the teachers is most significantly reflected in their flexible manipulation of not only the design scaffoldings which they had prepared, but also the spontaneous scaffoldings (Gibbons, 2009; Lin 2016) during which they "talk" about the content and language knowledge with students through a "communicative approach" of classroom interactions which alternate in four different combinations of interactive/non-interaction and dialogic/authoritative styles (Mortimer & Scott, 2003).

4. Methodology

Drawing on the conceptual framework of the thematic-patterns-based CLM approach, the present study attempts to address the following research questions:

1. Does the CLM approach facilitate development of both content knowledge and language knowledge in EMI CLIL classrooms?

2. How does the CLM approach affect the process of content and language knowledge development in the EMI CLIL classrooms?

4.1 Research design

To address the research questions, a design-based research (DBR) was adopted to enhance educational practices through "iterative analysis, design, development, and implementation" grounding in researcher-practitioner collaboration in real-world situations (Wang & Hannafin, 2005, p.6). Following Reeves' (2000) framework of "development research", the study proceeded in four phases: First, research about CLIL education were reviewed to investigate the difficulties faced by EMI students in their CLIL subjects. Interviews were conducted with teachers and students of different subjects (e.g. Biology, Integrated Science and Geography) at different grades (both senior and junior) to identify the problems in CLIL classrooms; good teaching practices and learning strategies were analysed during teacher-researcher discussions. Second, the thematic patterns of different units in textbooks were analysed, and a thematic-patterns-based CLM approach was proposed as the conceptual framework of the research. Based on the conceptual framework, the C+L cards, C+L maps and other CLM materials were designed as CLM resources to be adopted in the CLM activities. Third, the thematic-patterns-based CLM pedagogy was tried

out for the first time in EMI CLIL lessons; pre-test and post-test were administered in both experiment and control classes to evaluate the effects of the CLM approach, lesson observations and interviews with teachers and students were conducted to probe feedback about the merits and potential problems of the CLM approach. Fourth, based on the interview feedback, the researchers reflected on the previous try-outs of the CLM approach and made improvements accordingly before trying it out again in new EMI CLIL classrooms. In this way, the design-based research method made it possible for researchers and teachers to collaborate in co-developing and co-reflecting about the thematic-patterns-based CLM pedagogy. It helped to bridge the empirical research with the theory-driven pedagogical design, and thus provided a method for understanding how, when, and why educational innovations take effect in a dynamic and interactional process.

4.2 Research site and participants

Following the design-based research, researchers started to collect pre-intervention data by interviewing teachers, students and education specialists in corresponding subjects. Two EMI secondary schools agreed to participate in the research, and two CMI secondary schools also offered to try out the CLM pedagogy. Therefore, a total of four schools including eleven classes participated in the research. Except one EMI school which belonged to Band I; the other three were Band III schools. The student participants studied in five grades (S1, S2, S3, S4 and S5) and three subjects (Integrated Science, Biology and Geography). The number of students in the participating classes ranged from 16 to 31. The details of the research sites and participants are summarised in Table 1.

Table 1. Summary of details of research sites and participants

Schools	MOI	Banding	Grade	Subject	No. of students	Teacher	Remarks
School 1	EMI	Band I	S2	Integrated Science	30	Mr H	Data included. The Experiment Class and the Control Class were taught by the same teacher.
	EMI	Band I	S2	Geography	29	Ms L	Data included. The Experiment Class and the Control Class were taught by different teachers.
	EMI	Band I	S1	Geography	31	Ms C	Data included. The Experiment Class and the Control Class were taught by different teachers.
	EMI	Band I	S4	Geography	20	Ms M	Data not included.
	EMI	Band I	S3	Biology	30	Ms S	Data included. The Experiment Class and the Control Class were taught by different teachers.
	EMI	Band I	S4(S5)	Biology	28	Ms T	Data included. The Experiment Class and the Control Class were taught by different teachers, S4 being the Experiment Class and S5 the Control Class.
School 2	EMI	Band III	S5	Biology	16	Ms Y	Data not included.
School 3	CMI	Band III	S3	Integrated Science	19	Mr L	Data not included.
	CMI	Band III	S1	Integrated Science	19	Mr M	Data not included.
School 4	CMI	Band III	S2	Integrated Humanity	31	Ms R	Data not included.
	CMI	Band III	S1	Integrated Science	24	Ms W	Data not included.

Due to different mediums of instruction and the lack of control class, not all data collected in the participating classes were adopted. For example, as this research investigated the effects of the CLM pedagogy in EMI CLIL classrooms, the data collected in the CMI schools were not included. As the research adopted a quasi-experimental design, when there was only one class trying out the pedagogy (i.e. experiment class) but no other class being the control class, the data were excluded. This happened in both the S4 Geography class (taught by Ms M) in School 1 and the S5 Biology class (taught by Ms Y) in School 2. It should be noted that, in School 1 there was only one Biology class in the senior grades (both S4 and S5). The two teachers in S4 and S5 adjusted the teaching pace so that a same Biology unit, i.e. Monohybrid Inheritance, which was supposed to be taught in S5, could be taught at the same time for both S4 and S5. As a result, the research team could try out the CLM pedagogy in S4 (i.e. experiment class taught by Ms T); and S5 was the control class which participated in the pre- and post- tests but did not have lessons following the CLM pedagogy. After excluding the classes which did not fit the research design, the data of the remaining five classes were included in this research. They were all from School 1, a Band I EMI school. Among

the five participating classes, the experiment and control classes in S2 Integrated Science were taught by the same teacher (Mr H), while in the other four classes the teachers in the control and experiment classes were different.

5. Data collection and analysis

To fit the design-based research method, the concurrent triangulation mixed methods strategy (Creswell, 2003) was selected to confirm, cross-validate, or corroborate the findings through both quantitative and qualitative data. A quasi-experimental design was employed to evaluate the effectiveness of the CLM pedagogy in facilitating students' development of content knowledge and language knowledge. The pre-test and post-test consisted of similar content knowledge from the same unit in same question types such as multiple-choice questions, blank-filling, short questions, long questions or essay questions. To avoid testing effects, the teachers did not check answers with the students after the pre-tests.

At the beginning and end of intervention, quantitative data were collected from both pre-tests and post-tests. During each intervention, the researchers observed and videotaped the CLIL lessons taught in the CLM approach. At the end of the intervention, a 30-minute focus group interview was conducted with four to seven students of different academic achievement levels to obtain their feedback about the CLM pedagogy. A semi-structured interview was conducted with the teacher to probe his/her reflection about the intervention as well as suggestions about improving the CLM pedagogy. Since different types of data were collected concurrently in one research phase from both quantitative and qualitative approaches, this made it possible for the researchers to offset the

weaknesses of one method with the strengths of the other. According to Creswell (2003), the concurrent triangulation mixed methods strategy produces "well-validated and substantiated" findings as it generally integrates the results of both qualitative and quantitative methods during the interpretation phase which "can either note the convergence of the findings as a way to strengthen the knowledge claims of the study or explain any lack of convergence that may result" (p. 217). The quantitative and qualitative data are summarised below.

Table 2. Summary of quantitative and qualitative data

Class	Quantitative data	Qualitative data
S2 Integrated Science by Mr H.	pre-test scores post-test scores control: N=30 experiment: N=30	lesson observation (videotape appr.245 mins) focus group interview with students (audiotape appr.30 mins) semi-structured interview with Mr H. (audiotape appr.30 mins) student works of the try-out unit (experiment: N=30)
S2 Junior Geography by Ms L.	pre-test scores post-test scores control: N=29 experiment: N=29	lesson observation (videotape appr.105 mins) focus group interview with students (audiotape appr.35 mins) semi-structured interview with Ms L. (audiotape appr.40 mins) student works of the try-out unit (experiment: N=29)
S1 Junior Geography by Ms C.	pre-test scores post-test scores control: N=33 experiment: N=31	lesson observation (videotape appr.245 mins) focus group interview with students (audiotape appr.40 mins) semi-structured interview with Ms C. (audiotape appr.30 mins) student works of the try-out unit (experiment: N=31)
S3 Biology by Ms S.	pre-test scores post-test scores control: N=27 experiment: N=30	lesson observation (videotape appr.280 mins) focus group interview with students (audiotape appr.30 mins) semi-structured interview with Ms S. (audiotape appr.45 mins) student works of the try-out unit (experiment: N=30)
S4 Biology by Ms T.	pre-test scores post-test scores control: N=30 experiment: N=28	lesson observation (videotape appr.280 mins) focus group interview with students (audiotape appr.50 mins) semi-structured interview with Ms T. (audiotape appr.50 mins) student works of the try-out unit (experiment: N=28)

As indicated in Table 2, the quantitative data in the five participating classes mainly included the pre-test and post-test scores in the control and experiment classes; while the qualitative data consisted of the lesson observation videos, audiotaped interviews, as well as student works in experiment classes such as test papers and written assignments.

The quantitative data were analysed following two steps: First, the pre-tests and post-tests were marked by both research assistants majored in the content subjects (i.e. Science or Geography) and

research assistants who were LAC/CLIL programme MEd graduates. The Science/Geography majored research assistants marked the content knowledge in the tests according to the answer key checked by both the research team and the participating teachers. The LAC/CLIL research assistants marked the language knowledge of the answers in structured questions or short essays according to a marking scheme focusing on the correct use of subject-specific vocabulary, general academic vocabulary, logical connectors, sentence patterns of academic functions, complete sentences and text structures in the test items whose content knowledge was correctly answered. Two LAC/CLIL research assistants marked the language knowledge, and the inter-rater correlation was above 90%. Second, the pre-test and post-test results in the control and experiment classes were compared by independent sample t-tests via SPSS software to examine whether the treatment of the CLM approach made a significant difference between the two classes. To minimize confounding effects of the prior differences between the two classes, ANCOVA was performed to compare the post-test scores in the experiment classes with those in the control classes, using the pre-test scores as the covariate.

The qualitative analysis involved two types of data. First, the observed lessons were analysed reiteratively and the lessons and episodes which most represented the effects of the CLM approach were transcribed verbatim (Appendix 3). The transcripts were then analysed according to the conversation analytic method of sequential analysis (Lin, 2007) to examine how application of the CLM approach facilitated the learning of content and language knowledge in the CLIL lessons. Second, the interview data were also transcribed verbatim to investigate the students' and teachers' elaboration on their classroom performances as well as their perception about the effects of the

CML approach on students' development of content and language knowledge in the EMI CLIL lessons.

6. Results and discussion

Both quantitative and qualitative results showed the thematic-patterns-based CLM approach had facilitative effects on students' development of content and language knowledge. The post-test means in all experiment classes surpassed those of the control classes in both content knowledge (Table 3) and language knowledge (Table 4). To investigate whether the differences were statistically significant, independent sample t-tests and ANCOVA were run to eliminate the confounding effects of the pre-tests. The qualitative data were also analysed to triangulate and elaborate the quantitative results about the development of content knowledge and language knowledge in the EMI CLIL classrooms.

Table 3. Summary of group statistics about the test results of content knowledge

Class	Test	Group	N	Mean	Std. Deviation	Std. Error Mean
S2 Integrated Science Mr H	pre-test	Control	30	5.5667	3.25559	.59439
		Experimental	30	6.3333	3.28354	.59949
	post-test	Control	30	13.0000	4.67385	.85332
		Experimental	30	14.9000	4.78936	.87441
Class	**Test**	**Group**	**N**	**Mean**	**Std. Deviation**	**Std. Error Mean**
S2 Junior Geography Ms L	pre-test	Control	29	9.9310	2.63806	.48988
		Experimental	29	8.5172	3.52157	.65394
	post-test	Control	29	10.6207	3.12151	.57965
		Experimental	27	13.2222	3.64094	.70070
Class	**Test**	**Group**	**N**	**Mean**	**Std. Deviation**	**Std. Error Mean**
S1 Junior Geography Ms C	pre-test	Control	29	5.8103	1.95217	.36251
		Experimental	31	5.1935	2.08037	.37365
	post_test	Control	33	4.5000	2.61606	.45540
		Experimental	29	5.6034	2.56828	.47692
Class	**Test**	**Group**	**N**	**Mean**	**Std. Deviation**	**Std. Error Mean**
S3 Biology Ms S	pre-test	Control	27	6.8519	2.97041	.57166
		Experimental	30	8.5333	3.91049	.71396
	post-test	Control	27	6.4074	2.91230	.56047
		Experimental	28	7.2321	4.04485	.76440
Class	**Test**	**Group**	**N**	**Mean**	**Std. Deviation**	**Std. Error Mean**
S4 Biology Ms T	pre-test	Control	32	11.9375	2.43546	.43053
		Experimental	28	10.2500	3.27307	.61855
	post-test	Control	30	23.6500	6.98663	1.27558
		Experimental	28	30.2500	4.90559	.92707

Table 4. Summary of group statistics about the test results of language knowledge

Class	Test	Group	N	Mean	Std. Deviation	Std. Error Mean
S2 Integrated Science Mr H	pre-test	Control	30	4.1000	2.39756	.43773
		Experimental	30	4.7667	2.69972	.49290
	post-test	Control	30	5.6667	2.65659	.48502
		Experimental	30	9.6000	3.42002	.62441
Class	Test	Group	N	Mean	Std. Deviation	Std. Error Mean
S2 Junior Geography Ms L	pre-test	Control	29	6.1724	1.67052	.31021
		Experimental	29	5.6207	2.16158	.40139
	post-test	Control	29	7.8276	3.17433	.58946
		Experimental	27	10.8148	3.79308	.72998
Class	Test	Group	N	Mean	Std. Deviation	Std. Error Mean
S1 Junior Geography Ms C	pre-test	Control	29	1.9310	1.48639	.27602
		Experimental	31	1.7419	1.43684	.25806
	post-test	Control	33	3.8788	3.62075	.63029
		Experimental	29	7.3966	5.34753	.99301
Class	Test	Group	N	Mean	Std. Deviation	Std. Error Mean
S3 Biology Ms S	pre-test	Control	27	3.3333	3.00000	.57735
		Experimental	30	4.0000	2.42117	.44204
	post-test	Control	27	4.1111	4.25471	.81882
		Experimental	28	5.8571	5.21191	.98496
Class	Test	Group	N	Mean	Std. Deviation	Std. Error Mean
S4 Biology Ms T	pre-test	Control	32	2.7813	1.23744	.21875
		Experimental	28	3.1071	1.77094	.33468
	post-test	Control	30	16.6667	6.30727	1.15154
		Experimental	28	27.7857	6.75419	1.27642

6.1 The CLM approach facilitated content and language knowledge development in EMI CLIL classrooms

Comparing content knowledge of experiment and control classes in the pre-tests, only the mean difference in S4 Biology was statistically significant ($p=0.026 <0.05$) while the difference in the other classes were not. This indicated that there was no significant difference between the experiment and control classes in the pre-tests of S2 Integrated Science, S2 and S1 Junior Geography and S3 Biology. According to Table 3, in S4 Biology, the pre-test mean of the experiment class (10.2500) was lower than that of the control class (11.9375), which revealed that, before the intervention the control class (S5 students) performed better than the experimental class (S4 students) in content knowledge. In the post-tests, although the means of experiment classes of all 5 participating classes were higher than that of the control classes, the t-test results (Table 5) indicated that the effects of the intervention were only significant in the post-tests of S2 Junior Geography ($p=0.006 <0.01$) and S4 Biology ($p=0.000 <0.01$). ANCOVA results (Table 6) showed

that, after eliminating the effects of pre-tests as covariance, the mean differences in the post-tests of S2 Junior Geography and S4 Biology were still statistically significant with both p-values remained less than 0.01, and the mean difference in S1 Junior Geography became also significant ($p=0.007<0.01$). These showed that students in the experimental classes of the three classes outperformed their control class counterparts in the post-tests. It thus proved that the CLM pedagogy had positive effects on the teaching and learning of content knowledge in the three experimental classes. This could also be reflected from the group statistics in Table 3, the group means of the experimental classes in the pre-tests of S2 Junior Geography (8.5172), S1 Junior Geography (5.1935) and S4 Biology (10.2500) were all lower than those of the control classes which were 9.9310, 5.8103 and 11.9375 respectively; however, after the intervention, the group means of the experimental classes in the post-tests had all exceeded their control class counterparts.

Table 5. Summary of independent sample t-test results of content knowledge

			Levene's Test for Equality of Variances		t-test for Equality of Means						
										95% Confidence Interval of the Difference	
			F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
S2 Integrated Science Mr H	Pre-test	Equal variances assumed	.032	.858	-.908	58	.368	-.76667	.84420	-2.45653	.92319
		Equal variances not assumed			-.908	57.996	.368	-.76667	.84420	-2.45653	.92320
	Post-test	Equal variances assumed	.001	.976	-1.555	58	.125	-1.90000	1.22179	-4.34567	.54567
		Equal variances not assumed			-1.555	57.965	.125	-1.90000	1.22179	-4.34570	.54570
S2 Junior Geography Ms L	Pre-test	Equal variances assumed	3.622	.062	1.730	56	.089	1.41379	.81708	-.22301	3.05060
		Equal variances not assumed			1.730	51.899	.090	1.41379	.81708	-.22587	3.05345
	Post-test	Equal variances assumed	.029	.865	-2.877	54	.006	-2.60153	.90434	-4.41463	-.78844
		Equal variances not assumed			-2.861	51.407	.006	-2.60153	.90938	-4.42684	-.77623
S1 Junior Geography Ms C	Pre-test	Equal variances assumed	.741	.393	1.182	58	.242	.61680	.52172	-.42754	1.66114
		Equal variances not assumed			1.185	57.999	.241	.61680	.52060	-.42530	1.65889
	Post-test	Equal variances assumed	.514	.476	-1.671	60	.100	-1.10345	.66022	-2.42408	.21719
		Equal variances not assumed			-1.673	59.243	.100	-1.10345	.65942	-2.42283	.21594
S3 Biology Ms S	Pre-test	Equal variances assumed	.526	.471	-1.812	55	.075	-1.68148	.92786	-3.54095	.17798
		Equal variances not assumed			-1.838	53.553	.072	-1.68148	.91462	-3.51553	.15256
	Post-test	Equal variances assumed	.362	.550	-.865	53	.391	-.82474	.95345	-2.73711	1.08764
		Equal variances not assumed			-.870	49.098	.388	-.82474	.94786	-2.72944	1.07997
S4 Biology Ms T	Pre-test	Equal variances assumed	1.982	.165	2.283	58	.026	1.68750	.73909	.20806	3.16694
		Equal variances not assumed			2.239	49.400	.030	1.68750	.75363	.17333	3.20167
	Post-test	Equal variances assumed	6.504	.014	-4.136	56	.000	-6.60000	1.59579	-9.79674	-3.40326
		Equal variances not assumed			-4.185	52.111	.000	-6.60000	1.57688	-9.76408	-3.43592

Table 6. Summary of ANCOVA results of content knowledge

Dependent Variable: **Mr H_CONTENT_ post_test**

	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Contrast	34.160	1	34.160	1.699	.198	.029	1.699	.249
Error	1146.198	57	20.109					

Dependent Variable: **Ms L_CONTENT_ post_test**

	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Contrast	131.699	1	131.699	14.466	.000	.218	14.466	.962
Error	473.417	52	9.104					

Dependent Variable: **Ms C_CONTENT_ post_test**

	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Contrast	38.682	1	38.682	7.822	.007	.127	7.822	.784
Error	267.059	54	4.946					

Dependent Variable: **Ms S_CONTENT _post_test**

	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Contrast	.000	1	.000	.000	.997	.000	.000	.050
Error	454.712	50	9.094					

Dependent Variable: **Ms T_CONTENT _post_test**

	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Contrast	851.770	1	851.770	26.081	.000	.326	26.081	.999
Error	1763.565	54	32.659					

The F tests the effect of group. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

a. Computed using alpha = .05

Quantitative data analysis also demonstrated a positive effect of the CLM approach on the development of language knowledge. As shown in Table 4, the post-test means were higher in the experiment classes than in the control classes in all participating classes. Independent sample t-tests results (Table 7) indicated that the group differences in the post-tests were statistically significant in four classes: S2 Integrated Science, S2 and S1 Junior Geography and S4 Biology with the p-values (0.000, 0.002, 0.003 and 0.000 respectively) all less than 0.01. ANCOVA (Table 8) also demonstrated similar results with stronger p-values of 0.000, 0.000, 0.002 and 0.000 respectively. This showed that, except S3 Biology, the students in the experiment classes of S2 Integrated Science, S2 and S1 Junior Geography and S4 Biology outdid their control class counterparts, and the CLM pedagogy facilitated the development of language knowledge in these four experiment classes.

Table 7. Summary of independent sample t-test results of language knowledge

			Levene's Test for Equality of Variances		t-test for Equality of Means						
										95% Confidence Interval of the Difference	
			F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
S2 Integrated Science Mr H	pre_test	Equal variances assumed	.050	.824	-1.011	58	.316	-.66667	.65921	-1.98622	.65289
		Equal variances not assumed			-1.011	57.202	.316	-.66667	.65921	-1.98661	.65328
	post_test	Equal variances assumed	.643	.426	-4.975	58	.000	-3.93333	.79065	-5.51600	-2.35067
		Equal variances not assumed			-4.975	54.656	.000	-3.93333	.79065	-5.51806	-2.34860
S2 Junior Geography Ms L	pre_test	Equal variances assumed	2.128	.150	1.088	56	.281	.55172	.50729	-.46451	1.56796
		Equal variances not assumed			1.088	52.653	.282	.55172	.50729	-.46593	1.56938
	post_test	Equal variances assumed	1.406	.241	-3.204	54	.002	-2.98723	.93226	-4.85630	-1.11815
		Equal variances not assumed			-3.184	50.876	.002	-2.98723	.93826	-4.87097	-1.10348
S1 Junior Geography Ms C	pre_test	Equal variances assumed	.304	.583	.501	58	.618	.18910	.37743	-.56641	.94461
		Equal variances not assumed			.500	57.406	.619	.18910	.37787	-.56745	.94564
	post_test	Equal variances assumed	3.230	.077	-3.065	60	.003	-3.51776	1.14784	-5.81378	-1.22175
		Equal variances not assumed			-2.991	48.253	.004	-3.51776	1.17615	-5.88226	-1.15327
S3 Biology Ms S	pre_test	Equal variances assumed	.800	.375	-.927	55	.358	-.66667	.71896	-2.10749	.77416
		Equal variances not assumed			-.917	50.010	.364	-.66667	.72714	-2.12717	.79383
	post_test	Equal variances assumed	.089	.766	-1.358	53	.180	-1.74603	1.28562	-4.32466	.83260
		Equal variances not assumed			-1.363	51.615	.179	-1.74603	1.28086	-4.31673	.82466
S4 Biology Ms T	pre_test	Equal variances assumed	2.310	.134	-.834	58	.408	-.32589	.39060	-1.10777	.45599
		Equal variances not assumed			-.815	47.454	.419	-.32589	.39983	-1.13003	.47825
	post_test	Equal variances assumed	.952	.333	-6.483	56	.000	-11.11905	1.71498	-14.55457	-7.68353
		Equal variances not assumed			-6.468	54.948	.000	-11.11905	1.71910	-14.56428	-7.67382

Table 8. Summary of ANCOVA results of language knowledge

Dependent Variable: **Mr H_ LANGUAGE _post_test**

	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Contrast	202.971	1	202.971	23.058	.000	.288	23.058	.997
Error	501.741	57	8.802					

Dependent Variable: **Ms L_ LANGUAGE _post_test**

	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Contrast	139.749	1	139.749	13.812	.000	.210	13.812	.954
Error	526.118	52	10.118					

Dependent Variable: **Ms C_ LANGUAGE _post_test**

	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Contrast	201.697	1	201.697	11.101	.002	.171	11.101	.905
Error	981.103	54	18.169					

Dependent Variable: **Ms S_ LANGUAGE _post_test**

	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Contrast	30.951	1	30.951	1.656	.204	.032	1.656	.243
Error	934.702	50	18.694					

Dependent Variable: **Ms T_ LANGUAGE _post_test**

	Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power[a]
Contrast	1665.721	1	1665.721	39.272	.000	.421	39.272	1.000
Error	2290.400	54	42.415					

The F tests the effect of group. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

a. Computed using alpha = .05

The qualitative data of 10 interviews (with 5 teachers and 25 students) all indicated that students and teachers had positive comments on the CML pedagogy including both the CML materials and CML activities. Students said they would use the CLM materials for revision before the examinations, as they found the C+L maps and C+L cards helped them connect the key concepts which they might "skip" if they learned by themselves. Students in different grades also enjoyed the various CML activities such as jigsaw puzzles, debating and bingo games. All teachers believed the CML materials were beneficial for students' learning of both content knowledge and academic language which were important for the subjects. They found the CML activities interesting and motivating, and believed that, following the thematic-patterns-based CLM approach, the students would be able to study the subjects by self-directed learning. In the next section, more qualitative data from interviews and class observations will be analysed to explore how CLM approach affected the process of content and language knowledge development in the EMI CLIL classrooms.

6.2 Integrating content and language by crossing over design and spontaneous scaffoldings in thematic-patterns-based communicative interactions

To investigate the impact of CLM approach on the content and language knowledge development in EMI CLIL classrooms, the interview reflection feedback of the participating students and teachers about the CLM materials and CLM activities are probed and analysed below.

6.2.1 Thematic-patterns-based meaning construction in EMI CLIL classrooms

C+L cards

According to the interview feedback of the students and teachers, the C+L cards offered useful resources for content knowledge instruction in different subjects. The most recognized features were the completeness (“概括嗮全部所有內容”), concentration (“more focused”, “唔會零散”, “集中”) and conciseness (“清楚明白”, “highlight 咗比較重要嘅嘢”) of information about the concepts represented by the corresponding C+L cards, which turned out to be essential for the secondary school students who were cognitively and linguistically developing and needed scaffolding for learning the abstract concepts in the subjects. The students and teachers in different subjects and different grades believed that the C+L cards were helpful supplementary notes (“補充我哋筆記嘅不足”, “用來溫書測驗考試很有用”) and hence ideal for revision. The following interview illustrated how the students used C+L cards to learn their subjects.

[Interview with students in S2 Integrated Science class]
R: How would you comment on the C+L Cards ?
S2: Well, the (C+L) cards have, for example, the ‘carbon dioxide’ one, it tells you what on earth carbon dioxide is. It helps you to make clear what kind of gas it is at the very beginning.
*R: Oh, the **definition** you mean. Do you think it’s good to have a definition here?*
S2: Yes.
*S3: Uh, like the ‘photosynthesis’ card, it gives you the **words**. If you find it difficult, the **Chinese translation** is just beside the concept and you don’t need to look it up. It also has a **picture**, and, and the, the **word equation** is right there which is so **handy** and you don’t need to search the points page by page. You **pick up everything** by simply reading the card.*
*S1: Well for me, I think the (C+L) card ‘test for carbon dioxide’ is quite good, because it has different, I mean, **the words**, and they give me the idea **how to express** the different actions (in the procedure of the test).*
R: By the way, we underlined some words in the cards. Can you get the ideas of these underlines?
*S1: Oh, they’re **the main verbs**.*
R: Yeah, you’re right. They’re the verbs. What about the bold ones?
*S1: The key, **key words**.*
R: The bold ones.
S2: Key words.
*R: Are the key words **relevant to the topic** of the science itself?*
S3: Yes.
S2: Yeah.
*R: Then do you think it **good to highlight** the **key words and key concept**s?*
Ss: (Nodding)Yeah.

It can be seen from the interview that the C+L cards offered students opportunities of meaningful learning (Merrill et al., 1992; Novak et al., 1983; Novak, 2010) when the concepts were taught. For example, the definition on each card provided students with fundamental ideas about the

concept which helped them understand the basic concept meaning. Both verbal and graphic information were offered in the C+L card to represent the meaning of the concept. The multimodal information including pictures, word equations, tables and diagrams offered visualized information that were supplementary for the verbal texts; hence, both verbal and visual information helped students to better understand the concept (Cheng & Gilbert, 2015; Lemke, 1998; Lin, 2012, 2016). Within the verbal information on each C+L card, the sentences presented the definition and summarized the general and specific attributes of the concept. In this way, the C+L card built up a network of interrelated meaning about the concept and provided a focused structure of the critical attributes scattered at different locations in the textbook. With each sentence narrating abstract and complex characteristics of the concept, language knowledge was provided to facilitate students' understanding of the content knowledge in the sentences. The "language knowledge" section on the C+L card offered word formation details about the difficult subject-specific vocabulary so that students knew how the words were formed by different meaningful parts (prefix and suffix); for example, in "photosynthesis", "photo-" means light and "synthesis" (綜合體) means the combining of constituent elements of separate materials into a unified entity. This helped to smooth away the difficulty in memorizing the spelling of subject-specific vocabulary. In the "content + language knowledge" section, the main verbs in all sentences were underlined and the key words were bolded. As these main verbs and key words represented respectively the processes and the participants and circumstances in each sentence, by highlighting these basic meaning components, the C+L cards helped to raise students' awareness about both the experiential and logical functions of language (Derewianka, 2011; Halliday and Matthiessen, 2004; Hodgson-Drysdale, 2014); hence equipped the students with the "meaning-making resources" and the "tool for thinking with" (Coffin, 2001, p.2). With language being the "meaning-making

resources", the network of interrelated characteristics of the concept were weaved into patterns of interconnected meaning relationships---thematic patterns that constitute the thematic content of the concept (Lemke, 1990). In this sense, each C+L card representing the corresponding concept consisted of different patterns of semantic relationships that elaborate the meaning and characteristics of the concept.

C+L maps

Similar to the C+L cards, the C+L maps were also welcomed by the students and teachers because of the similar reasons---completeness, concentration and conciseness. Again, students found the C+L maps helped them to build up a large network that connected their prior knowledge as represented by the old concepts, and the new knowledge which they had just learned. For example, in S2 Junior Geography, by concentrating on the key topic "scientific farming methods", the large knowledge network represented by the C+L map connected a smaller network of prior knowledge, i.e., "the positive effects of scientific farming methods" in Unit 2.5 and another smaller network of the newly learned knowledge in Unit 2.6 "the harmful effects of scientific farming methods". Each sub-network further linked up concepts such as different scientific farming methods, the positive / negative impacts of scientific farming methods, as well as the limitations of scientific farming methods. Each concept was represented by a C+L card which consisted of meaning networks represented by different thematic patterns about the definition and critical attributes of the concept. Hence, the C+L map weaved a web of meaning networks constituted by thematic patterns. Meaningful learning was thus facilitated among students with the thematic-pattern-based CLM materials provided as design scaffolding (Gibbons, 2009; Lin, 2016) that was essential for learning the content knowledge in an additional language.

[Interview with students in S2 Integrated Science class]
*S4: When I read the C+L map in class, **it helped me remember things more easily**. I mean, **you don't need to spend a whole day reciting texts word by word**.*
R: What can you find between the different parts in a C+L map?
*S4: **Connections**, and **words** too.*
R: Is it good to have these?
*S4: Yeah. It's **good to have the words**.*
*S5: It'll be **more convenient and easier to remember the ideas** if you've read the C+L map.*

[Interview with students in S3 Biology class]
*R: By the way, you said the C+L map is good. Can you tell me **what are the advantages**?*
*S1: Uh, because, if you read the textbook, you need to search different pages to get all the information, but this (C+L) map **gives you everything all at once**.*

[Interview with Ms L of S2 Junior Geography class]
*Ms L: I think the C+L map **is very good**. **The students can follow my explanation about the map** and **finish the exercise** (C+L map blank-filling), **which I didn't expect**... **The content of the map is rich and there are many pictures**...We can print it on a paper of larger size so that **students may review the lessons with the map** and they can read more easily.*

Although the C+L maps as a broader meaning network of concepts shared the completeness, concentration and conciseness characteristics with the C+L cards, they were favored by the students and teachers because of other reasons. Apart from the function of meaning network construction, which can be fulfilled by the concept maps in the textbooks, the C+L maps had other characteristics which the textbook concept maps lacked. During the interviews, students could identify the special features unique for the C+L maps. For instance, besides the concepts (appearing in boxes) and the lines which both concept maps and C+L maps shared, students also paid attention to the pictures, diagrams, arrows as well as the words, logical connectors and sentence patterns in the C+L maps. Some students also pointed out the numbers which marked the animation sequence in the C+L maps.

[Interview with Ms T in S4 Biology class]
Ms T: In fact, I find ***the diagrams*** *(on the C+L map)* ***really help students think****... Maybe some diagrams also* ***appear in the C+L cards or the worksheets. When students see a diagram several times, they know which concept it is about****, and then* ***they can find or even remember the answer*** *and then they can write it down. So, for this summary (C+L map), I think,* ***the part I most appreciate is the related diagrams*** *added, and they* ***remind the students of the concepts****. Another point is that, sometimes students need to draw these diagrams. So, from this map,* ***students not only know the concepts, but can also draw them*** *when they're asked about the structures. So these are* ***the two benefits*** *I can find in the summary (C+L map).*

[Interview with students in S2 Junior Geography class]
R: Have you noticed any difference between the C+L map and the concept map in your textbooks?
S4: It (C+L map) adds some ***diagrams****.*
S5: It (C+L map) also adds some ***arrows****.*
S1: ***When you read the diagrams, you know what they are****. When you find* ***an arrow linking and pointing to a new concept****, you'll think, you'll* ***think about the next situation according to the concept*** *pointed to, and then you know* ***which words to follow****. For example, sometimes you do blank-filling, just like in the other subjects, you probably need to search the answers from different lessons, but in the C+L map blank-filling, you don't need to bother because* ***it links up everything following one direction.***
R: Can the C+L map ***cover everything in Section 2.6****?*
Ss: ***Yes. Yes.***
R: If we make these maps in the following sections, ***can they help you learn geography in English****?*
Ss: ***Sure they will****.*
R: They look ***difficult****, don't they?*
S1: ***Not that difficult****, actually. Because* ***it has a train of thought that connects everything****, it won't suddenly ask you to think of something irrelevant. When you do revision, you only* ***focus on one sheet (C+L map). You don't need to search*** *for the data and the points page after page in the textbook. It's really* ***convenient.***
R: Then, can you ***read out an essay from this C+L map****?*
S2: ***Yeah, just like a presentation****.*
Ss: Yes, yes, yes. We need to jot down the point forms.

[Interview with students in S3 Biology class]
R: Among all these learning materials provided, ***which one do you like most****?*
Ss: ***This one (pointing to the C+L map).***
S2: Uh, actually the materials are all quite good, but ***this C+L map is the best of all.***
R: You haven't seen this before, have you?
S2: No. ***The map is so complete, and it won't overwhelm you with long texts of words****. It* ***shows the ideas one after another, and step by step****, I mean,* ***before our teacher clicks the next word, she may ask us some questions****.*
R: Guided questions.
S2: Right. And then ***we may have some time to think about the questions rather than getting all answers all at once.***

According to the feedback of the students and teachers, the multimodal features of the C+L maps were actually beneficial to learning the subjects in an additional language (Cheng & Gilbert, 2015; Lin, 2012; 2016). For example, the pictures and diagrams offered rich information for the students to better recognize and understand the concepts, as both Ms T and the S2 Junior Geography student commented, *"When you read the diagrams, you know what they are", "When the students see a diagram several times, they know which concept it is about, and then they can find or even*

remember the answer". The arrows provided important clues for the students to figure out the interrelationship between concepts within the meaning network by following the "*train of thoughts*" that "*links up everything following one direction*". According to the S3 Biology student, although the C+L maps were formed based on large and complicated networks of interrelated concepts, she did not find the maps too difficult to learn as she realized that the maps "*won't overwhelm you with long texts of words*" but "*show the ideas one after another, and step by step*". The student's comment also highlighted another special characteristic of the C+L maps ---the sequential animation function. Inspired by the animated concept maps (Nesbit & Adesop, 2011), the e-form C+L maps were designed on PowerPoint slides, so that the interrelated concepts (the nodes and links) appeared following a sequence indicated by the numbers on the maps. Such a special design made it possible for teachers to guide students through a process of knowledge inquiry (Osborne, 2009). Just as the S3 Biology student remarked, "*before our teacher clicks the next word, she may ask us some questions… and then we may have some time to think about the questions rather than getting all answers all at once*".

It should be noted that, there were also observations and comments in the interview about the words, logical connectives and sentence patterns on the C+L maps which the teachers and students believed could also offer essential hints for interpreting the concept meaning or the interrelationship between concepts. Students realized that the C+L maps formed a coherent paragraph elaborating a particular topic of the content knowledge or even a short text which answers an essay question. This was very useful for the EMI CLIL students such as the S2 Junior Geography students who believed the C+L maps will "*surely*" help them learn geography in English. The crucial role of language in learning content knowledge (Halliday, 1993; Hodgson-

Drysdale, 2014) was evident in this research which was not only reflected in the use of the C+L maps but also in the application of the sentence-making tables and essay writing guides.

Sentence-making tables and essay writing guides

Just like the C+L cards and C+L maps, the sentence-making tables were also welcomed by teachers and students. According to the interviews, sentence-making tables offered teachers and students examples of integrating language and the other subjects. Just as Ms C's pointed out, the sentence-making tables helped students to connect knowledge between subjects through language *("打通埋其他柜桶)*". Based on the thematic-pattern theory (Lemke, 1990), all sentences representing key concepts and relationships were selected and classified in sentence-making tables of different academic functions. The key verbs (processes) were highlighted by underlines, other key words (participants and circumstances) were highlighted by bolds, and the logical connectives linking clauses or sentences were colored in red. In this way, the sentence-making tables helped to raise students' awareness of not only the thematic patterns within the clauses or sentences but also the interrelationships (e.g. "cause and effect", "definitions", "classifications" and "conditionals") between the thematic patterns representing different concepts in the unit, hence students knew "*how to classify systematically the knowledge they've learned into parts*".

[Interview with Ms C in S1 Junior Geography class]
R: Can you comment on the sentence-making tables? ***Can they help the students*** *in this class?*
Ms C: ***Yes, they can****. I think it's a teaching material that* ***successfully integrates both the English language subject and the geography subject****. Because when students make sentences, they have the (content)knowledge, but they don't know the way to express the meaning and to put it into words. These sentence-making tables* ***can teach the students how to express****, for example****, the relationship between two parts****, like cause and effect. It* ***teaches the students how to classify systematically the knowledge they've learned into parts like cause and effect****.*
R: They will pay attention to ***the colored words (logical connectors)****, won't they?*
Ms C: Yeah, exactly. ***They'll learn, they can use these words****, which is* ***very good****.* ***The table is well-designed and I really love it****. For example, if students want to express conditionals, they can use the "if" or "when" patterns. And then* ***they learn the sentence patterns here, and also the variation of the sentence patterns****… I think this set of sentence-making tables is* ***tailor-made for our geography subject because all selected sentences were under the same geography topic****.* ***When students learn the sentence-making skills, they can use it to learn other subjects****.* ***Yes, very useful. It helps our students. Absolutely****. For example, in science****, I am sure the students can use it*** *in, like, when water is boiled to 100 degrees Celsius, it turns into… Yeah,* ***the sentence-making table can be applied to other subjects****, it's like what we called* ***"打通埋其他柜桶 (connecting knowledge between subjects through language)"***

[Interview with students in S4 Biology class]
R: Can you use patterns of the sentence-making tables to summarize the lessons?
S4: Yes. ***It's very useful*** *because it* ***tells us many verbs****, some are* ***subject-specific words*** *that we* ***must learn.***
R: Uha.
S4: So, I think ***it's very convenient****.*
S3: I also find it ***quite good****.* ***Because it has patterns like "cause and effect", that means, every result must have a cause****.* ***It explains the relationship clearly****. And also, it* ***highlights some terms,*** *like you should say "replicate", and you can't say "copy". I mean, it* ***has specific highlights about the words so that we can learn them clearly****.*

As pointed out by Ms C, all examples in the sentence-making tables were "*under a same topic*", rather than a collection of unrelated sentences demonstrating certain academic functions and language patterns. When students read the sentences, they reviewed the concepts and the interrelationships between the concepts (i.e. the content knowledge about the subject) meanwhile they learned the relevant language knowledge, and then were able to "*express the meaning (of the concept or the interrelationship between concepts) and to put it into words*".

As accentuated by Lemke (1990), both the thematics and genre of science are fundamental for learners because they reason based on both the thematic patterns and the genre patterns. While the sentence-making tables provided thematic-patterns-based "Concept + Language" support for the students, the essay writing guides offered genre structures to help the students organize their thoughts into systematic text types. As students did not have clear awareness of academic language

knowledge, most of them relied on memorization of bullet-point notes in textbooks or handouts when they were to answer long structured questions or essay questions. To equip students with academic writing skills, the essay writing guides provided sample writing templates which illustrated the phases and stages of the genre structure with academic vocabulary and sentence patterns of different academic functions highlighted. According to Ms C and Ms L, with the scaffolding of the essay writing guides, students no longer wrote their essays "*in one single paragraph*", but realized the genre patterns and started to follow the structures gradually.

6.2.2 Crossing over design / spontaneous scaffoldings through CLM interactions

As analysed above, the CLM materials were well accepted by teachers and students who believed the CLM pedagogy could help teaching and learning the content subjects in English as an additional language. We shall use Ms T's S4 Biology class as an example to further explore how the CLM materials as design scaffolding interacted with spontaneous scaffolding (Gibbons, 2009; Lin, 2016) to facilitate content and language knowledge development in the EMI CLIL classroom.

Before the intervention, Ms T's S4 Biology class (experiment class) were weaker than the S5 students (control class) in content knowledge (pre-test M-experimental=10.2500; M-control=11.9375; $p=0.026<0,05$) while the difference in language knowledge between the two classes was not significant (pre-test M-experiment=3.1071; M-control=2.7813; $p=0.408>0.05$). However, after the intervention, the S4 students outperformed the S5 counterparts with ANCOVA results being $p=0.000<0.01$ in both content knowledge (post-test M-experiment=30.2500; M-control=23.6500) and language knowledge (post-test M-experiment=27.7857; M-control=

16.6667). The following episode (transcript in Appendix 3.1) illustrates how Ms T integrated the teaching of content and language by crossing over design and spontaneous scaffoldings (Gibbons, 2009; Lin, 2016) following the CLM pedagogy.

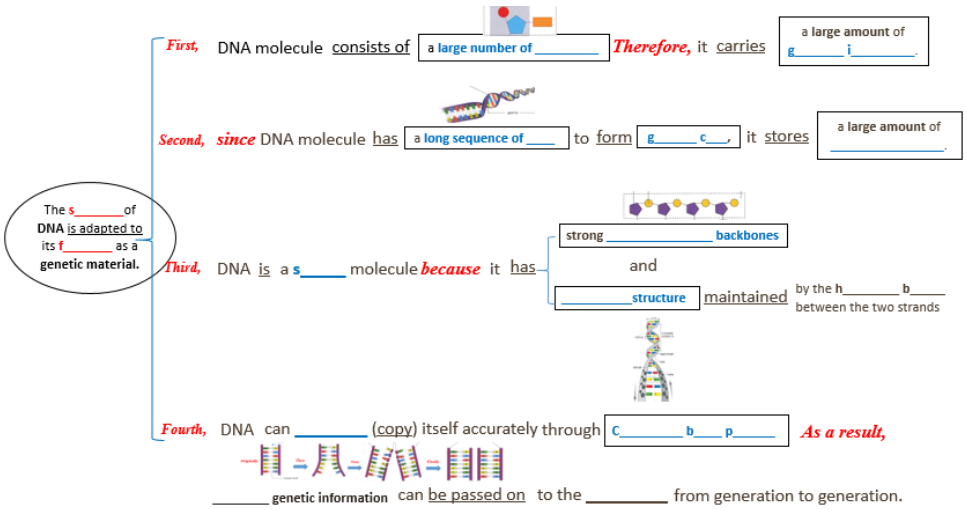


Figure 3: C+L map "The structure of DNA and its functions" in blank-filling exercise

To guide students to summarize the lesson, Ms T changed the C+L map (Figure 3) into a blank filling exercise. She gave students five minutes to review the learned concepts and the interrelationship between concepts by completing the blank-filling C+L map. To facilitate students' self-directed learning, Ms T reminded them to use the C+L cards and pay attention to the diagrams and words on the C+L map. After the individual work, the teacher encouraged students to discuss in groups and emphasized that they should "*discuss and think whether the answers are correct or not*" and should not "*just accept the answer directly*". During peer discussion, students compared each other's answers, questioning and justifying their own answer by showing evidence from the C+L cards or textbook. According to Ms T, the peer discussion, as a kind of "interactive/dialogic" communication (Mortimer and Scott, 2003), was very necessary as it offered students another opportunity to re-think and negotiate their answers according to the C+L map. After the peer

discussion, Ms T started to complete the C+L map with the students through a sequence of interactive/authoritative or non-interactive/authoritative interactions (Mortimer and Scott, 2003).

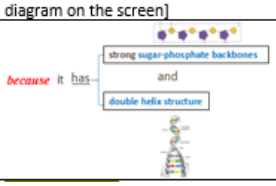
Compared with self-directed learning and peer discussion which were conducted mainly based on design scaffolding ---the CLM materials prepared by the teacher before the lesson (i.e., the C+L map blank-filling worksheet and C+L cards), the teacher-student interactions during answer checking were interspersed with unexpected student answers which needed spontaneous scaffolding (Gibbons, 2009; Lin, 2016) from the teacher to clarify both the content and language knowledge. For example, after self-directed learning and peer discussion, although some students could find the answers correctly based on the C+L cards/maps, other students might find it difficult to figure out the answers not only because of the abstractness of concepts and the complexity of interrelationship in the C+L map, but also because of the diversity in learners' cognitive ability and language proficiency. For example, Ms T tried to guide a student with special education need to find out the answers to the blank-filling exercise through spontaneous scaffoldings.

T	05:27	Second. What will be the answer? MG
MG	05:32	Second, since DNA molecule has a long sequence of nucleotide…
T	05:37	Eh… DNA molecule has a long sequence of nucleotides. We know that it contains a sequence of …
MG	05:44	[correcting himself] A long sequence of genes
T	05:46	A long sequence of genes. But what? Which part in the genes to form the…
MG	05:57	Chromosome.
T	05:58	Form the chromosome? No. You find that you got the wrong answer. You got this answer wrongly. Okay. The DNA molecule has a long sequence of which structure to form the …
MG	06:14	Form the **genetic code**.
T	06:15	Form the genetic code. Very good. But which part of the nucleotide? Which part of the nucleotide form the genetic code? This is the point. The phosphate group? Or the…
MG	06:32	**Nitrogenous base.**
T	06:34	Nitrogenous base. Very good. Here you will find that DNA molecule has a long sequence of …
MG	06:47	Nitrogenous base.
T	06:48	Nitrogenous bases, or a long sequence of bases to form …
MG	06:52	Form the genetic code.
T	06:54	To form genetic code.
MG	06:56	It stores a large amount of…[MG could not continue with the sentence]
T	07:02	It stores a large amount of, if there are many genetic codes, it stores a large amount of …
	07:11	[Seeing that the student could not figure out the answer to the rest of the sentence, the teacher offered another hint.] Just like what WY just now said. It stores a large amount of…
MG	07:16	**Genetic information.**
T	07:17	Genetic information. I am very happy that you listened to what WY said. Okay. You paid attention to what she said. Okay. Sit down.
		[T then showed the answer (the second part of the C+L Map) on the screen part by part during which she elaborated on the concepts.] *Second, since* DNA molecule has [a long sequence of bases] to form [genetic code,] it stores [a large amount of genetic information.]
T	07:29	Second, you will see that, since DNA molecule has, a long sequence of bases like A, T, G, C, T, C, G, these kinds of sequence of bases, to form, genetic code. So it carries, it stores a large amounts of genetic information.

It can be seen that, although the student had read the C+L cards and discussed with his peers about the C+L map, he was still unclear about the basic attributes of concepts "nitrogenous bases" and "DNA molecule". Hence, the spontaneous scaffoldings from Ms T turned out to be very helpful. For example, after she offered the student the first scaffolding ("*But what? Which part in the genes to form the… But which part of the nucleotide? Which part of the nucleotide form the genetic code? This is the point. The phosphate group or the…*"), the student was able to locate the answer "nitrogenous bases"; and after the teacher gave him the second scaffolding by referring to the previous answer mentioned by another student ("*If there are many genetic codes, it stores a large amount of …; Just like what WY just now said. It stores a large amount of…*"), the student managed to utter the answer "genetic information". During the blank-filling exercise, the classroom teacher-student interactions were mainly interactive/authoritative or non-interactive/authoritative (Mortimer & Scott, 2003) as it was mainly the teacher leading the discussion by raising questions or emphasizing knowledge points. However, it turned out that such communicative approaches were efficient and effective in the very tight learning schedule. Such questioning based on the C+L map not only helped Ms T diagnose the potential misunderstandings of the students, but also offered her an opportunity to re-emphasize the correct knowledge about the concepts, as shown in the episode, Ms T recapped the critical attributes of nitrogenous base and DNA molecule by further elaborating its features, "*Second, you will see that, since DNA molecule has, a long sequence of bases like A, T, G, C, T, C, G, these kinds of sequence of bases, to form genetic code. So it carries, it stores a large amounts of genetic information*." According to Ms T, such questioning was very challenging but crucial in CLIL lessons,

> *"If the knowledge is very abstract, the students may be thinking other things rather than the answer you expect, which can be a mess. That's why it's a challenge for the teacher to ask questions; I mean, when you ask a student a question, you can never expect what kind of errors he will make in his answer."*

Ms T's questioning during the answer-checking not only focused on content knowledge, but also raised students' language awareness in learning the content subject. For example, a student mixed up the adjectives "stable" and "strong" when describing a characteristic of DNA molecule, Ms T provided another spontaneous scaffolding, "*DNA is a stable molecule. Stable is better than strong here. Okay. You can say that the bonding is very strong. The covalent bond is very strong but the hydrogen bond is relatively weaker. Okay. But we won't say that the molecule is strong. The molecule is stable.*" In this example, the collocations of the two adjectives with the corresponding nouns were closely related to the specific characteristic of DNA structure and its function which implied a cause-and-effect relationship---DNA is a **stable** molecule because it has **strong** sugar-phosphate backbones and a double-helix structure. Hence, it was very necessary for the teacher to supplement this spontaneous scaffolding to help students clarify the proper collocations of the two adjectives so that they could understand the characteristic of DNA accurately.

T	07:54	How about the third sentence? How about the third sentence? LG. How about the third sentence? Third.
LG	08:06	DNA is a strong molecule because...
T	08:09	Is a ... What molecule?
LG	08:11	Strong.
T	08:12	Is a strong molecule? You use strong here? Um? YY, would you help him?
YY	08:22	DNA is a stable molecule.
		[T showing the third characteristic on the screen.] *Third,* DNA is a **stable** molecule
T	08:25	Is a stable molecule. Stable is better than strong here. Okay. You can say that the bonding is very strong. The covalent bond is very strong but the hydrogen bond is relatively weaker. Okay. But we won't say that the molecule is strong. The molecule is stable. YY. Sit down please. [Turning to LG again and ask another question.] Why the DNA molecule is stable?
LG	08:51	Because it has strong sugar-phosphate backbones.
		 [T showing the words about the reason on the screen.]
T	08:55	Good! It has strong sugar-phosphate backbones. [pointing to the small diagram 'sugar-phosphate backbone' in the C+L Map on the screen] We can see that in this diagram, this is a sugar-phosphate backbone. If the question in examination asks you to draw the sugar-phosphate backbone, you have to draw the diagram like this. Make sure that no nitrogenous bases are added. No nitrogenous bases are added. Okay. This is the strong sugar-phosphate backbone. Besides the strong sugar-phosphate backbone, what help the DNA molecule become stable?
LG	09:33	The double-helix structure.
T	09:34	The double-helix structure. You will see that [Showing the words 'double helix structure' and the diagram on the screen]
		

Scaffoldings on the language knowledge were also provided intermittently during communicative interactions about the C+L map. For example, Ms T asked students to find out the synonyms of "consists of', "contain" and "has" and suggested they use different synonyms to express "composition" which appeared repeatedly in the C+L map. Similar examples also included the paraphrasing of "passed on" and "transmit" which she encouraged students to associate the old vocabulary (e.g. transmission) with the newly learned ones (e.g. pass on). When the teacher explained the concept "complementary base pairing", she asked a student to use an example to explain the key word "complementary" (*"What does complementary mean? Would you give us an example? What does complementary mean here? If the base is A, it should pair with…?")* By doing so, Ms T conveyed to students the message that language use is closely associated with the content knowledge it expresses. She also reminded students to use academic vocabulary, e.g. "replicate", instead of the everyday word "copy" when expressing formal science topics. This, according to Ms T, was a typical weakness in students' essay writing in high-stake tests such as the HKDSE exam.

6.3 Discussion

In this research, as both teachers and students agreed that the CLM materials were useful and suitable for self-directed learning, this special characteristic of the CLM approach was tried out in Ms S's S3 Biology class. Students were encouraged to self-learn the lessons by finishing exercises, conducting experiments and completing experiment reports based on the CLM materials. After students finished the exercises, the teacher checked their answers and explained the questions that were least correctly answered. The ANCOVA results of post-tests (Table 5 and Table 6) did not indicate a significant difference between the experiment and control classes in either content

knowledge ($p=0.997>0.05$) or language knowledge ($p=0.204>0.05$). This showed that the effect of the CLM approach was not significant in CLIL classrooms which only followed a self-directed learning mode. The interview with Ms S revealed that although the CLM materials were helpful, teacher's guidance in understanding the abstract and complicated concepts was necessary. The students might self-learn the relatively easy concepts and finish the exercises that were cognitively and linguistically less demanding, but they needed extra support from teacher guidance and peer discussions to learn the subject effectively. In this sense, we found that only providing the CLM materials as design scaffolding without offering spontaneous scaffolding (Gibbons, 2009; Lin, 2016), i.e., the communicative interactions between teacher and students and the collaborative peer discussions, the CLM approach could not play a significant role in no matter content knowledge or language knowledge development.

Apart from teacher spontaneous scaffolding, teacher's decision about the integration of content and language knowledge was also essential for the CLM approach. In this study, the S2 Integrated Science teacher, Mr H, was also an English language teacher who regarded it necessary to help students improve their language awareness. Mr H taught both the experiment and control classes. During the intervention he shifted the teaching focus of the experiment class to the writing of experiment reports (Appendix 4), and tried to help students to complete the reports by guiding them to read the sentence-making tables and use the CLM materials to finish experiment tasks, and correcting the language errors in the students' experiment reports. ANCOVA results showed, the difference between the two classes in the post-tests were only statistically significant in the result of language knowledge ($p=0.000<0.01$) but not that of content knowledge ($p=0.198>0.05$). This was to some extent explained by Mr H during the interview, *"the focus shifted to completing*

the experimental report or the sentences (sentence-making tables) and the time for content part became less, while the other class (control class) could run very fast in the content knowledge." With most lesson time spent on the completion of the experiment reports, the learning pace of the experiment class lagged behind the control class in content knowledge teaching. With total lesson time being the same for both the experiment class and control class, the presentation and practice about content knowledge in the experiment class became relatively less than the control class.

Judging by the effects of the CLM approach in the EMI CLIL classrooms, it can be seen that teacher scaffoldings, especially spontaneous scaffolding through teacher-student interactions are indispensable during knowledge construction. Concerning the special nature of CLIL lessons, which implies the teaching and learning of a non-language content subjects through a non-native language of the students (Coyle, Hood & Marsh, 2010; Cenoz, Genesee, & Gorter, 2013), teacher scaffolding is essential not only in the guidance of concept knowledge construction but also in the decision making about integration of content and language in the teaching and learning process.

Reflecting on the research findings, we found that the thematic-patterns-based CLM approach facilitated both content and language knowledge development. It is a process of integrating content and language by crossing over design and spontaneous scaffoldings in thematic-patterns-based communicative interactions. The CLM pedagogy, which started with the design of the CLM materials and CLM activities according to the content subjects (e.g. Monohybrid inheritance). The concepts and interrelationships between concepts were represented by the CLM materials in forms of C+L cards, C+L maps, sentence-making tables and essay writing guides which visualized

patterns of meaning relationship network---the thematic patterns of the content knowledge. For example, the C+L map about "the structure of DNA and its functions" in Ms T's lesson could be analysed into a hierarchical structure of thematic patterns with corresponding thematic items and semantic relationships weaved into a large web of meaning patterns.

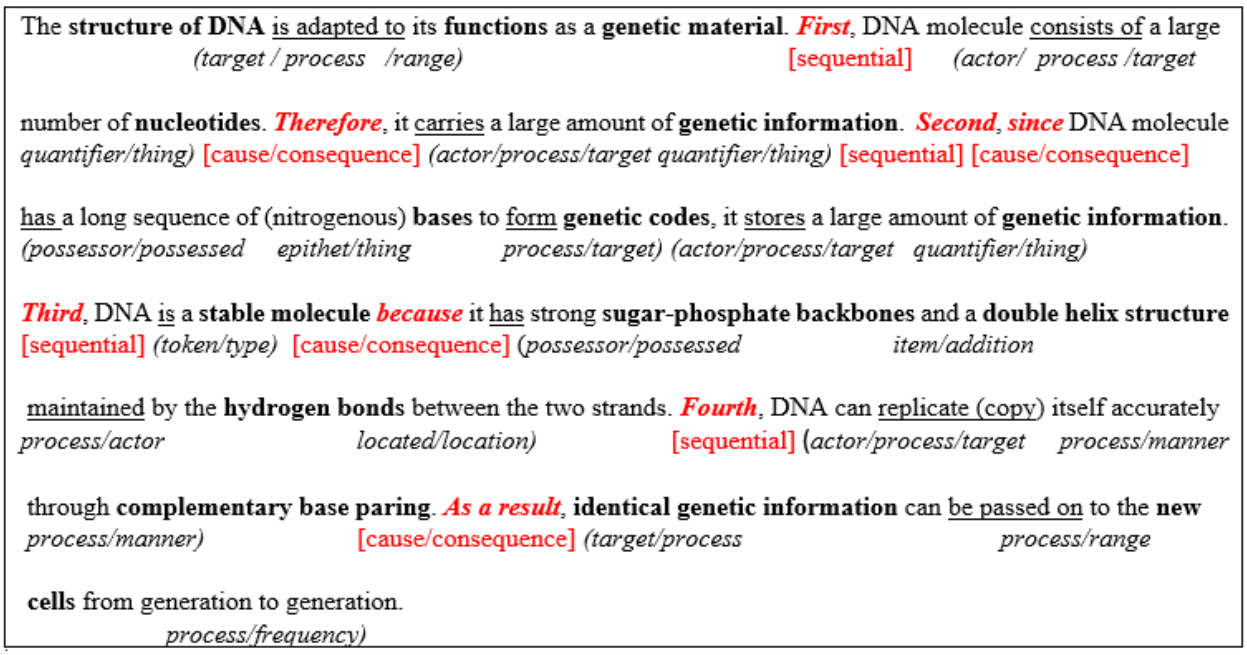


Figure 4: Thematic analysis of C+L map "The structure of DNA and its functions"

During the lessons, the teacher presented new knowledge to students and assigned practice and consolidation activities based on the CLM materials as design scaffolding (Gibbons, 2009; Lin, 2016). The teaching and learning followed the CLM approach which proceeded in a series of communicative activities (Osborne, 2009) such as teacher presenting the new concepts and raising questions, students listening to the teacher, answering the teachers' questions, discussing with peers, reading textbook, handouts (e.g. the CLM materials) or PowerPoint, solving problems on the worksheets, using tables, diagrams or figures to represent experiment designs, conducting experiments, and writing experiment reports, etc. Throughout the lessons, these communicative activities alternated one after another but kept focusing on the subject content knowledge in the

unit in a strategic process of "repetition with variation"; namely, the same partial thematic patterns were mentioned, applied, analysed and discussed repeatedly in different communicative activities during the lessons, each time with some thematic items and semantic relations similarly expressed and others expressed differently (Lemke, 1990). For instance, in the C+L map blank-filling in Ms T's lesson, the concepts (e.g. DNA, nitrogenous bases) in the C+L map had been represented in the corresponding C+L cards. The thematic patterns highlighted in these C+L cards had been introduced in the previous lessons. Then in the consolidation lesson, the concepts were discussed again in the C+L map blank-filling as a summary of previous lessons. When students did the blank-filling exercise, the CLM materials (e.g. C+L cards) served as design scaffolding and were frequently referred to by the students. During self-directed learning and peer discussion, the thematic patterns in the C+L map blank-filling worksheet were activated when the sentences and diagrams representing them were read, thought about, written down, talked about, compared, argued, and confirmed or revised. When the teacher checked the answers with students in a series of questioning and answering, the thematic patterns were again re-activated during their thinking and discussion.

With the overall C+L map designed in an animated sequential meaning structure, the thematic patterns were discussed part by part following a logical thematic order. When discussing each sub-structure, the teacher was able to raise relevant questions based on the verbal (i.e. vocabulary and sentences) and graphic information (i.e., the diagrams) on the map; for example, Ms T helped the students to review related concepts represented by the diagram "the structure of nucleotide" (i.e. 5-carbon sugar, phosphate group and nitrogenous base); she was not only able to diagnose whether students had understood correctly the content knowledge and language knowledge, but

also able to help the students clarify their misunderstandings and recap the key concepts and interrelationships by providing spontaneous scaffoldings (Gibbons, 2009; Lin, 2016). In this sense, the EMI CLIL lesson was composed of crossovers between design and spontaneous scaffoldings which integrated old and new, content and language knowledge in multimodal (e.g. verbal, graphic, visual, audial and gesture, etc.) representation means (Cheng & Gilbert, 2015; Lin, 2016; Nesbit & Adesope, 2011) through communicative interactions (Mortimer & Scott, 2003). During the process of CLM pedagogical teaching and learning, thematic patterns remained core of meaning construction that guided various CLM activities in EMI CLIL classrooms.

7. Conclusions and recommendations

In this study, we developed a thematic-patterns-based CLM approach in EMI CLIL classrooms of different subjects and different grade levels. Both quantitative and qualitative data indicated that the CLM approach had a positive effect on content and language knowledge development. The CLM pedagogy was effective in EMI CLIL classrooms and the CLM materials were welcomed by teachers and students who considered the CLM pedagogy useful for learning content subjects in English as their additional language. Qualitative analyses of classroom observations and interviews revealed that the positive effects of the CLM approach were most evident when teachers emphasize the learning of both content and language and manipulated the CLM materials and activities flexibly through design and spontaneous scaffoldings (Gibbons, 2009; Lin, 2016) to guide students to understand the thematic patterns in concepts and interrelationships between the concepts through a series of communicative interactions in self-directed and collaborative learning.

Future research on the thematic-patterns-based CLM approach may adopt a longitudinal research design. Intervention may be tried out in other subjects with MOIs other than English. Data collection may also include students' design and elaboration on their own CLM materials, e.g. how students express their understanding of the thematic patterns through their own C+L cards and maps. Data analysis may focus on the effects of teacher's questioning and interactive/dialogic communications (Mortimer & Scott, 2003) on students' content and language development.

Judging by the shortage of evidence-based research on CLIL in EMI contexts and the difficulties CLIL teachers have encountered (e.g. the lack of pedagogical support and CLIL teacher education, tight teaching schedule, heavy workload, pressure of high-stake exams, etc.), we recommend more support for the research of CLIL education and CLIL teacher professional development. The thematic-patterns-based CLM pedagogy, research methods as well as research findings of the present study may serve as useful resources upon which further investigation can be developed.

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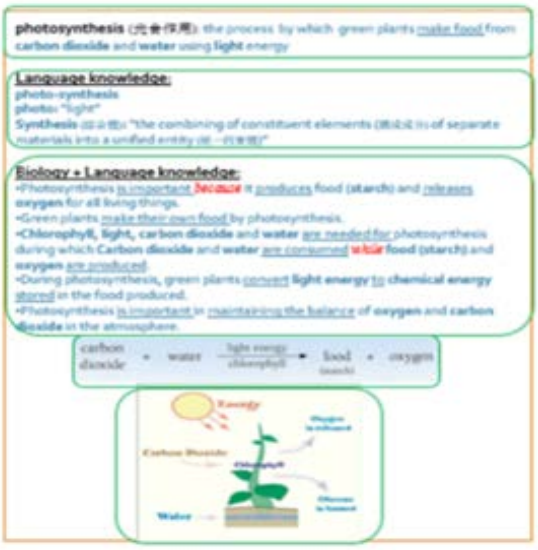
Appendix (1) Semantic relations for thematic analysis (Adapted based on Lemke, 1990, p.221)

Semantic relationships	Types	Grammatical relationships	Analysis of relationships between thematic items	Meaning
Nominal relations	Attributive	Attribute/Carrier Epithet/Thing	the apple (carrier) is red (attribute). the red (epithet) apple (thing)…	A descriptive characteristics; quality, qualifier, modifier
	Classifier	Classifier/Thing	a winesap (classifier) apple (thing) the 2s (classifier) orbital (thing)	A type or kind of; an identifying characteristic of a subclass
	Quantifier	Quantifier/Thing Numerative/Thing	the three (quantifier) apples (thing)	A quantitative characteristic like a number
Taxonomic relations	Token	Token/Type Member/Class Instance/Category	John (token) is a student (type).	An individual example of a type or class
	Hyponym	Hyponym/Hypernym Subset/ Set Co-hyponyms	Any dog (hyponym) is a mammal (hypernym).	Name of a category that fits inside some more general category. Two subcategories that belong to the same more general category.
	Meronym	Meronym/Holonym Part/Whole Co-meronyms	the drawer (meronym) of a desk (holonym).	Name of a part belonging to some whole Two parts of the same whole
	Synonym	Synonym/Synonym Equivalence pair	Please go (synonym). Please leave (synonym).	Two expressions that have the same meaning in context
	Antonym	Antonym/Antonym Contrast pair	Please leave (antonym). Please stay (antonym).	Two expressions that have contrasting meanings in context
Transitivity relations	Agent	Agent/Process Subject/Transitive verb	The man (agent) built (process) the house.	The entity that does or acts; the cause or instigator of a process
	Target	Process/Target Verb/Object	The man built (process) the house (target).	The entity that is done to or acted on: the object of the action
	Medium	Medium/Process Intransitive subject/ Intransitive verb	The jar (medium) broke (process). The rain (medium) poured (process) down.	The entity in relation to which a process takes place
	Beneficiary	Beneficiary/Process Indirect object/ Transitive verb	He gave (process) my aunt (beneficiary) the jar.	The participant to which or for which the action is done.
	Range	Process/Range Extent	He walked a mile (range).	The limits, extent, or nature of what the process does
	Identification	Identified/Identifier	The white part (identified) is the 2s orbital (identifier).	
	Possession	Possessor/Possessed	My aunt (possessor) has the jar (possessed).	
Circumstantial relations	Location	Location/Located Extent	The pen (located) is in the box (location). It rained (rain=located) outside (location). How much space is involved? (Distance, Volume, etc.)	Expresses the spatial relationship of entities or processes.
	Time	Time/Event Duration/Frequency	I built (event) it yesterday (time). How much time is involved/or how often?	Expresses the temporal relationship of processes, events, entities
	Material	Material/Process	I built (process) it of wood (material).	The matter or material involved in the process (mass nouns)
	Manner	Manner/Process Quality, Means, Tools	I made (process) it with a saw (manner). I made (process) it slowly (manner).	How, in what way, and by what means/instrument the process occurred
	Reason	Process/Reason Cause, Purpose, Goal, Need	I left (process) to get warm (reason).	Why or for what reason the process took place

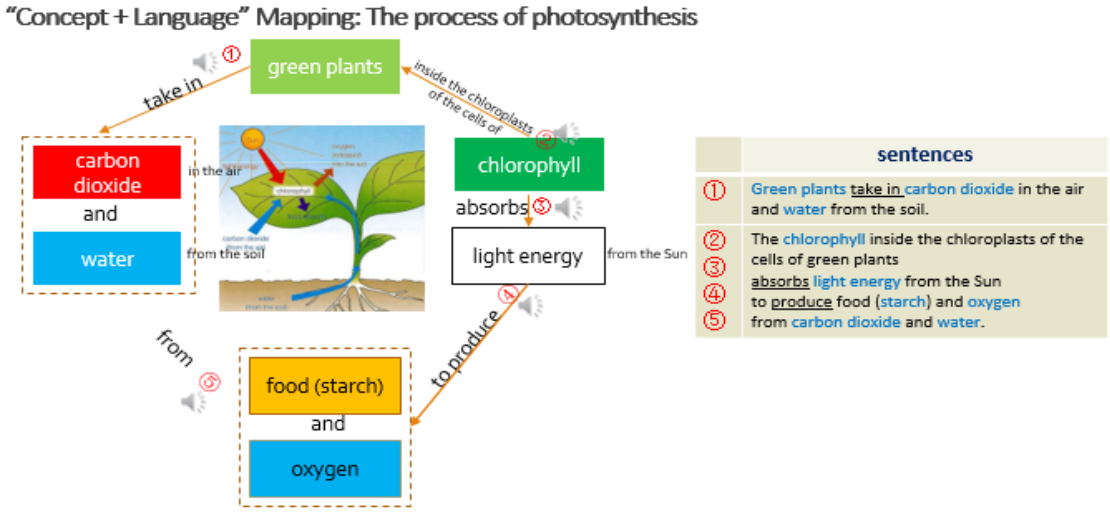
Logical relations	Elaboration	Item/Elaboration	“A, i.e. B”; “A, e.g. B”; “A, viz B”	Exposition, exemplification, and clarification
	Addition	Item/Addition	“A, and B”; “not A, nor B”; “A, but B”	Conjunctive, negative conjunctive, and adversative
	Variation	Item/Variation	“not A, but B”; “A; but not B”; “A or B”	Replacive, exceptive, and alternative
	Connection	Cause/Consequence; Evidence/Conclusion; Problem/Solution; Action/Motivation; etc.		A miscellaneous category that includes the relations of the parts of various forms of argument

Appendices (2) CLM Teaching Materials (Examples)

C+L Card



C+L Map

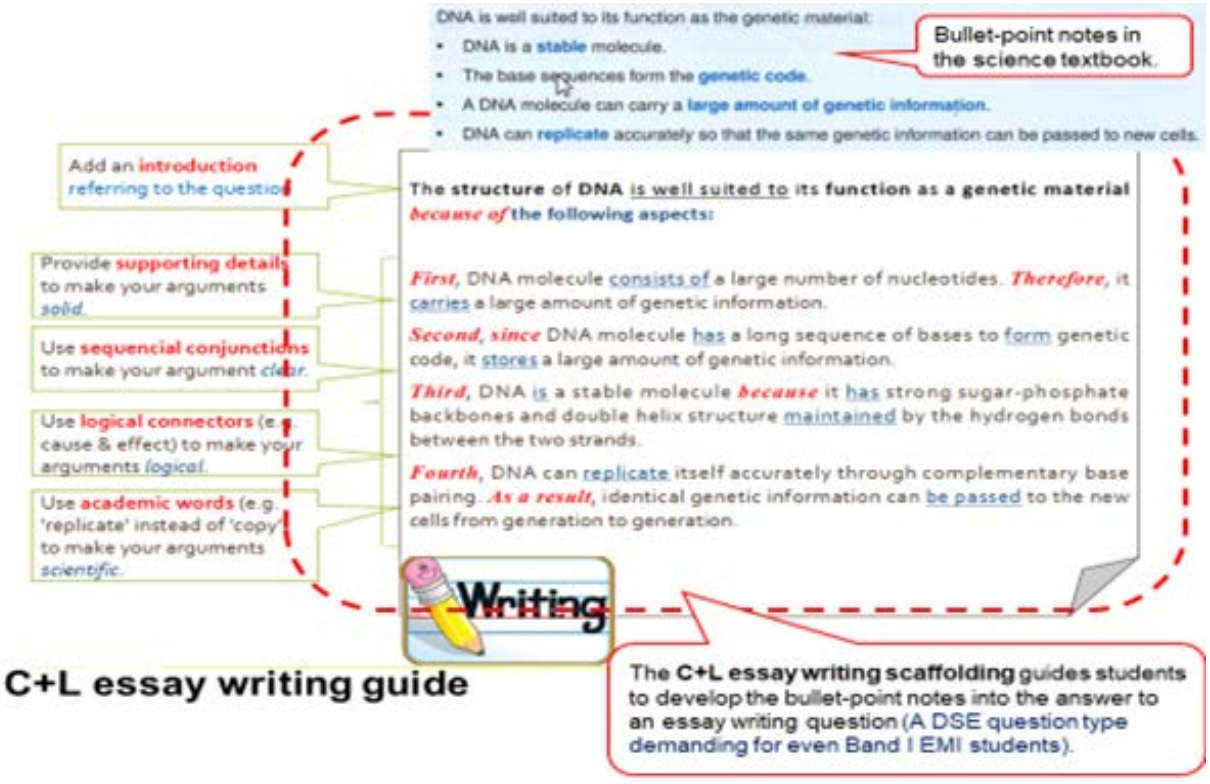


C+L sentence-making table

Sentence-making tables highlighting the **components** in the **thematic patterns**

The actions of procedures in different tests

process	target	Circumstances: location/time/material/manner/reason
Put boil	the leaf	*into a beaker of boiling water*; and for 2 mins; then, turn off the Bunsen burner.
Soak		*in a boiling tube half-filled with alcohol* with a pair of forceps, and then put the boiling tube *into a beaker of hot water* for 10 mins.
Take		*out of the alcohol* with a pair of forceps.
Wash		*in the beaker of hot water.*
Take spread add a few drops of iodine solution to		Out; *on a white tile*; and



C+L essay writing guide

Appendices (3) Lesson transcripts

		Biology _Mr. H
		1 Introducing C+L cards
T	00:00	……. Is it Okay?
T	00:02	But this time we've got some nice stuffs. Over here… and each of you will get a set of this picture cards… picture and content cards, here. [give students cards]
	00:11	You've got pictures and you get explanation on some of very important concepts for the topic that you have currently studied.
	0:18	[talk to one student at the front] Okay, so… can you please help give them?
T	00:20	Shall we give you a name? We call it C&L cards because there is content as well as language.
	00:28	Let's take out our C&L cards. What do you have? Can you briefly tell me what you have? You have…?
Ss	00:34	[respond to the teacher]
T	00:35	You have photosynthesis. What's next? You have…?
Ss	00:38	[try to respond to the teacher]
T	00:38	Also, you also have lights… Anything else?
Ss	00:43	[respond to the teacher]
T	00:43	Carbon Dioxide, Oxygen, Water, Starch…
T	00:49	And you also have more complicated concepts that I will explain …… What is that?
S	00:54	esage
T	00:55	Esage… You have esage, anything else?
S	00:59	Tests.
T	01:01	Test for oxygen, urr, test for, test for food, which is starch. And you also have more tests. Wish we will …… later.
		2 C+L mapping
T	00:00	We have all these separate ideas, like starch, water, carbon dioxide, oxygen. These are very simple concepts or objects, right? When we put these things together, it builds our… it very builds our concept and allows us to understand more of the complicated ideas.

	00:18	[turn to the slide] So…, can you look at the screen? Can you actually see clearly? Okay, this is what? And… we all read together? The…
Ss	00:27	The process of photosynthesis.
T	00:30	Okay, so now I will explain how you would make use of this power point. [operating the slide] See? No.1 here, and you see a picture, alright? So, what is that? That is a …? Green plants. And then, it… takes in carbon dioxide. Where is carbon dioxide? Takes in carbon dioxide… in here… and water… where?
Ss	00:59	[answer the teacher's question]
T	01:01	Water from …?
Ss	01:03	Soil
T	01:03	Soil… You know where the soil is?
Ss	01:05	Yes
T	01:05	Yes. Here or there? Okay, down there, Okay?
	01:10	And then, what happened? And then, chlorophyll. Do you see No. 2 here? Do you see No. 2 here? And there goes another sentence. Chlorophyll… inside the chloroplasts of the cells of… what?
Ss	01:28	[try to respond to the teacher]
T	01:28	[point at the slide] Of green plants, you see the arrow here? Because arrow points from chlorophyll to green plants, so construct the sentence like that.
	01:37	[turn to the slide] And chlorophyll also absorbs light energy from the sun to produce what? Now you know that already.
Ss	01:50	[give an answer] Oxygen
T	01:51	Prevision, chlorophyll absorbs energy from the sun and produce…? Any other products as well? Oxygen?
Ss	02:00	[try to answer the question] Starch.
T	02:01	[operating the slide] Starch, oxygen, and oxygen, starch. And then the last of sentence we have from carbon dioxide one, is that Okay? [point at the slide] So, the entire sentence goes like chlorophyll absorbs energy from the sun to produce food and oxygen from carbon dioxide one, is that Okay? So you see the cycle and you see how you can actually construct sentences in this way.
	02:29	[turn to the new slide] Okay, urr, [point at the slide] you will not find this in your C&L cards, but I can actually print it in large forms for you, so you know the correlation, is that Okay? So, sentences are here, so can we all read together? 1, 2, 3 … go [point at the sentence]

Ss	02:42	[read the 5 sentences shown on the slide together]
T		[read together with the students]
	03:08	Okay, tell me anything special about the words underlined. They are …? They are action words, is that Okay?
Ss	03:17	verbs
T	03:17	They are verbs, they are action verbs. How about the… the words in blue? They are?
Ss	03:24	Nouns
T	03:25	They are the nouns, is that Okay? They are the nouns and the key points, is that Okay? So that is how you make use of that.
	03:34	[turn to the new slide] And the other important concept, can you all read? [point at the slide] The…
Ss	03:38	[read the sentence on the slide]
T	03:43	Okay, the necessary condition for photosynthesis. Okay, the conditions necessary for photosynthesis. We have…? What?
Ss	03:56	[try to give an answer]
T	03:57	[operating the slide] Can you look at the equation and tell me? Urr, you can go back to your test form right now. Take a look at that … mouse on page… urr, [talk to one student] Can you tell me the page number? Ah, 31, can you tell me, the necessary conditions. Now, I'm not gonna show you here, you need to tell me before I show you, Okay? Before I show you. So, what are the things on the reacting side… and those are things necessary for … for photosynthesis. Tell me one of them.
S	04:32	Carbon dioxide.
T	04:33	Carbon dioxide, yes. Carbon dioxide is one of them. MG, you look at the equation and you look at this side, and you know.
MG	04:38	[stand up and answer the question]
T		[give hints to MG] Carbon dioxide is one of them and then you see something above or below the arrow. Those are useful things as well. Can you tell me what they are?
MG	04:55	[give the answer]
T	04:58	Water, very good. And urr… what else? Ken?
Ken	05:04	[stand up and answer the question] Light
T	05:05	Light. And urr, what is the remained one? Light and? Light and?
Ken	05:12	Chlorophyll.

T	05:13	Chlorophyll, very good. Sit down. So, we have 4 things, chlorophyll, lights, energy, that means lights, water and carbon dioxide. We are going to test whether these are really necessary for photosynthesis. Now textbook tells you this way, this mean is always correct. So, we will be doing experiment to test whether these things are necessary. Is that Okay? There is one thing that we cannot test. You will find out later and you will need to think about why that particular object here cannot be tested. Is that Okay?
	05:42	[turn to the new slide] So now, include carbon dioxide here, water from the soil. [point at the slide] These are what we called raw materials. Is that Okay? Raw materials. And, [operate the slide] light energy and … and urr… chlorophyll. Is that Okay? Light energy and chlorophyll. Okay, basically, there is so many equation. [point at the slide] So, photosynthesis produces food, which is starch and oxygen. Is that Okay? So, you know the concept already. Let's move on
		Mr H _3 C+L card game
T	00:00	So, this is how we run the revision. Now you are in a group. I would like the group leader to … actually pick one from this set without looking at it. And then the entire group will be reading aloud from the card. Is that Okay?
	00:15	So, urr… which group want to try first? So, who is the group representative? Move the … clip and then make sure the title faces down and you ……
	00:26	[talk to one group leader] What is that?
S	00:27	Destarch.
T	00:28	Destarch. Oh, you pick a challenging one. Anyway, destarch. Okay. So… can you whole group stand and explain what destarch is? I give you, urr, a very easy question because that is a little bit complicated. Because it is a little bit complicated, you have ……the…… . Please tell us what exactly "destarch" means. Are you ready? 1, 2, 3, go.
Ss	00:54	[the whole group explain]
T	01:02	Okay, yes, so we move off starch. And they tell you. You all know why we move off starch. It's important in our common environment. So, Okay, thank you.
	01:12	Group 6. So, can you pick another one?
S	01:15	Starch
	01:16	Starch, Okay. Starch… tell me a test for starch, please. Ten, nine, eight, seven, six, five… three… one, zero. All right, now.
S	01:34	[the whole group stand up and explain]
T	01:36	Starch, can you tell me a test for starch? Like…?
Ss	01:43	[the group keep explaining]

T	01:52	Thank you, sit down. Okay, so now you know how make use of these C&L cards, yes or no? Do you find this one?
S	02:01	Yes
T	02:02	Yes. Okay. As long as you do revision. Now try to do revision relying on this, this card.
		Mr H 4_pre-experiment discussion
T	00:00	So, you know the concept already, let's move on and design our experiment. Is that Okay? But now, which one do you want to do first? Let's start something that is easy first. Light and energy. You think that is easy. How do you make sure you remove that?
S	00:19	[answer the question]
T	00:24	No light? How about carbon dioxide? How can you remove? I'm not talking about … urr… keeping it out of contact with surrounding it. I'm talking about removing carbon dioxide. Do you have any idea? Not yet. How about removing chlorophyll? How do we remove chlorophyll? Can you remove chlorophyll from them? Yeah, by what kind of ways?
Ss		[try to give an answer]
T	00:51	Can you test that already?
Ss		Yes.
T	00:53	Yes. We did that already, right? We removed chlorophyll from the entire leaf. But, but before that we ……, right? We … the leaf, basically infilled it. Is that Okay? There is a better way to find out whether chlorophyll is needed for photosynthesis without tearing leaves off the plant. Is that Okay?
	01:17	Now we will be using a plant, which has a special type of leaf. We call it … [write on the board] Can you put it down on your science notebook. We make use of potted plants of which they are … [point at the words written on the board] How do we …?
Ss		[try to pronounce the words on board]
T	01:42	Yes, yes, very close. [underline the words] We got these two syllables, right? Variegated leaf. How about this [circle the first syllable]. You know the word "various", right? You know the word "various"? [write on the board] v-a-r-i-o-u-s. Do I spell it correctly, various? You know the word "various", right? That means different, different types. Then we take this down. [separate the syllables of the word "various"]. We take these two syllables. [point at the word] va- ri, and then this is … "variegated". Whole class, variegated. Variegated leaf. Variegated leaf.
Ss		[pronounce the words on board after teacher]
T	02:39	Very good. Okay. So now, [show picture on the slide] let's check what variegated leaf is. Okay, so, this is variegated leaf. [point at the picture] How does this look like? Does it

		look green? Does it ……green? No. Here is … green and here is white. It can be the other way around. [turn to new pictures]. Okay, it can be something like that. Green on the inside, white on the outside. If you turn to your book. Page 36. Page 36, you will see variegated leaves. Is that Okay? So, we will be conducting an experiment using that leaf, urr, tomorrow. Okay, so can you describe the leaf, which part is green color? Outside, outer part is green color. The inner part is …? White color. Is that Okay?
	00:35	So, now, you will be designing an experiment. Do you still remember how to destarch the leaf? Yes or no?
Ss		Yes.
	03:43	Yes, Okay. You will be designing an experiment to test whether chlorophyll is detarched. We all know that if the leaf is like that, which part contains chlorophyll, which part does not? Only the …? Green parts. Only the green parts contain chlorophyll. So, we do not basically, do not do anything special. We just need to test … you will try first. Is that Okay? You will try first. I'll give you 5 minutes. I'll give you a short 5 minutes. You shall discuss with your group members how to design your own experiment. Is that Okay?
		Mr H 5_pre-experiment discussion
T	00:00	So, now you will be designing an experiment. You still remember how to destarch a leaf, yes or no? Yes, Okay. We will be designing an experiment to design whether chlorophyll is …. We all know if the leaf is like that, which contains chlorophyll? Which part does not? Only the green parts, is that Okay? Only the green parts contain chlorophyll. So, we basically will not do anything special. We just need to test. You will try first. I'll give you 5 minutes. You shall discuss with your group members on how to design your own experiment. Is that Okay? Complete this page. Maybe each of you will complete different parts. You can talk to each other. Share with one and other. Remind one and other
Ss	00:44	[discuss]
T		[go around the classroom to help] [talk to one group] Yeah, title of the experiment test or you can say test whether …… Yes, that would be a nice title.
	00:55	[talk to another group] How about this? This investigates whether…? Okay, so, now please …. There are green parts and white parts, yes or no? And then, only which part contains chlorophyll? Only the green part contains chlorophyll, we know that the white part doesn't contain chlorophyll. If that is the case, how do we do with it? There is a very, very special characteristic of this leaf between … We remove, we only remove the chlorophyll only at the very beginning of this experiment, Okay? As the leaf has that characteristic, that part of the leaf contains chlorophyll, part of it does not. So, what do you do with that?

	02:01	Do you need to destarch the part? Do you need to destarch it? Yes, you need to destarch it. Why is it important to destarch the part, find it out yourselves in your C&L cards? Why is it important to destarch the part?
	02:17	[talk to the other group] Yes, darkness, 24 hours, write it down. There is one important concept.
	02:30	First, you have to destarch. And what is the next one? How do you know whether photosynthesis being carried on? How do you know whether photosynthesis happens or takes place? You'll test for something. You'll test something to find out whether photosynthesis takes place.
	03:00	Two more minutes.
Ss		[keep discussing]
T	03:43	Last minute to go. Do as much as you can. It is all right. As long as you talk to your classmates, that will be enough.
Ss		[keep discussing]
T	04:54	Okay, I guess, I guess at least you guys talked some very, very basic ideas.
		Mr H 6_Pre-experiment discussion summary
T	00:00	Let's hear what you have talked. Is that Okay? So, title of the experiment, somebody got a good one, JS? Can you tell us title of the experiment?
JS		[stand up and answer the question]
T	00:20	Yes. To test whether chlorophyll is needed. Is that Okay? Urr, that is very much the objective as well. This experiment aims to test whether chlorophyll is needed. So, any materials and apparatus needed? Basically, there are 2 parts of this experiment. The 1st part is to, is to…, destarch the part. Is that Okay? Can you take a look at the C&L card …… destarch? Do you see destarch? Yes or no? Okay, destarch, to remove all starch. Why do we need to remove the starch before the experiment? Why? Can we all find out? Under biology knowledge, why? Because…? Shall we all read together? Plants…should be destarched to ensure that any starch found in the iodine test is newly formed during the experiment.
Ss	01:09	[read together]
T	01:21	Now use your … to highlight "newly formed". Is that Okay? "newly formed". "newly formed". So, the 1st step is destarching, is that Okay? Because we have to make sure that, urr, the experiment is a fair one. Is that Okay? We do not want starch to be present before the experiment. Otherwise, will the experiment result …? No, we have to make sure before the experiment, there is no starch at all. Okay? Then we later on … The next step is that we … we now reproduce starch. How do we … reproduce starch?

Ss		[try to answer the question]
T	02:07	Let it carry out photosynthesis. Is that Okay? And then, the 2nd part is that something you did already, before. So, after destarching and putting it under the sunlight, we'll test …
S		[respond the teacher]
T	02:25	[talk to the student] We test whether it will …? No, we do not test these things. We will test what? How do you know that photosynthesis has taken place? We will use …, we will test for …?
S		Starch.
T	02:41	Yes, so we will test for starch. We will do the all the test exactly. We'll conduct the …?
S		Iodine test.
T	02:45	Iodine test to test the presence of the starch. Is starch present? That means … photosynthesis takes place. Otherwise, photosynthesis doesn't take place. Is that Okay? Tonight, we will be sending you a link about a video that ……. And then, you will watch that video at home and complete Part B. Is that Okay?
T	03:15	[grab the test from the desk] Can you turn to Page 2? This is your homework tonight. I'll send you a link through E-class. You watch the video and then you'll complete this --- The experiment I observed. What materials and apparatus you need to prepare? What are the procedures, Okay? Make sure that you start with a verb, Okay? And what is the result and your conclusion. So, you will become very familiar, become very familiar with the experiment that you are going to do tomorrow by doing some preparation at home tonight. Any questions? If not, can you get packed up. There is one more thing you need to bring. These C&L cards, is that Okay? Always bring these.
		Mr H 2.1_Review iodine test
T	00:00	Let's do a very, very quick revision on this screen together. [turn to the new slide] Okay, so, so can you see the words clearly? Yes or no? All right. So that is the test for, urr, the products of photosynthesis. And we are testing for starch. What is another, another product again? Apart from the starch, another product that is produced during the photosynthesis, will be? Here are the two things--- one is starch, the other thing is?
Ss	00:32	Oxygen
T	00:33	Oxygen, very good. So, we are looking at starch first. Can be tested by…? … test. [operate the slide] And this is the material. What material do we have? Let's read them together, shall we? The first one is…?
Ss	00:46	Boiling tube.

T	00:47	Boiling tube, then? Beaker, forceps, Bunsen burner, insulating mat, tripod and wire gauze, white tile, matches, water, alcohol, green potted plant, iodine solution.
Ss		[read the words on the screen]
T	01:14	……Everything is here, yes or no? How about the steps? We got all …….. materials. [point at the plant on the desk] This is the potted plant. And this time, the potted plant looks a little bit different. How does this apply? Let me introduce a new friend to you today. [walk to the students with the potted plant]. How is that different? How is that different from the plant we did experiment on last time? How is that different?
S		[try to tell an answer]
T	01:44	The center of the leaves? … white, is that Okay? This is what we called …? I told you yesterday. How would you call these leaves?
S		[give an answer]
T	01:54	Very good. You seem to remember how to read it. Very … leaves. Is that Okay? That is …urr… this new friend, here is the name. Do you know its name?
	02:06	[write on the board] That is the coleus. Urr, in Chinese, we call it … Is that Okay? Of course, you have all other…, because the center part of the leaves is white. So that's why we call it … How about… Okay, it comes in other variations. For example, if the center part of the leaves appears purple, how do we call it? Yes, good try, it's called… Is that Okay? Do you think the purple part contains chlorophyll? Do you think that the purple part contains chlorophyll? Mm, let's find out. Is that Okay? Whether only the green parts contain chlorophyll. Okay, I will show you all the steps first.
	02:52	So, the 1st step is to … Let's read aloud together…1, 2, 3, go [read with the students] 1. Remove a green leaf from a potted plant that has been put under sunlight for several hours. 2. Put the leaf into a beaker of boiling water and boil it for two minutes.
Ss		[read the words on the screen aloud]
T	03:14	Why? Now, I'm gonna show you the … the explanation. You've got to tell me why do you need to boil it… to …?
Ss		[try to give an answer]
T	03:28	Cell… cell man. Very good. Cell man, right. Next, whole class, 1, 2, 3, go.
Ss		[read step 3]
T		Why? Because…? I'm gonna show you this. Because of alcohol? Why?..... like constantly remind you to turn off the Bunsen burner first before dealing with alcohol. Because alcohol will…?
Ss		[try to give an answer]

T	03:55	What is the word that I told you when, I'll check the word with you. Because alcohol is…
Ss		[try to give an answer]
T	04:03	Flammable. Is that Okay? Alcohol is flammable and it catches fire. That is why we need turn off the Bunsen burner first before we bring closer the alcohol. Is that Okay? Next, No. … that should be No. 4. 1, 2, 3, go.
Ss		[read step 4]
T		[read with the students from the middle part] and the purpose here is …? AD. What is the purpose of soaping the leave inside the alcohol?
AD	04:44	To test… [give an answer]
T	04:49	That …? We removed some at first. Then?
AD	04:54	[keep answering the question]
T	04:58	No, my question is "what is the purpose of putting the leaf inside the alcohol?" I can give you a hint. What happened after 10 minutes, the alcohol turns to a color? The alcohol turns…?
Ss		Green
T	05:14	Green, why? That's…?
AD		[keep answering the question]
T	05:18	The leaf turns…? Pale green or white? So why, why do you need to do that?
AD		[keep answering the question]
T	05:32	Yes, we need to remove like the chlorophyll from the leaf so that will be easy for us to…?
AD		[keep answering the question according to the teacher's hint]
T	05:40	See the result of the iodine test. Is that Okay? So… that is the purpose. Okay? [go back to the desk to continue the experiment] We will wash the leaf in the beaker full of water, because…? Because why?
Ss		[give an answer]
T	05:58	There is a better action word. [write on the board] How would you read? How would you read? To rinse, that means to wash with. Why? Because there is…?
Ss		[give an answer]
T	06:16	There is alcohol. We need to remove alcohol from the leaf. Because we are afraid that it will affect the result of iodine test. Is that Okay? So, we removed alcohol from the

		leaf and then …? Lastly, …… put the leaf on it. That's why. So that is to remember how to test a leaf on starch. Yes or no?
		Mr H 2.2_Checking worksheet1
T	00:00	Okay. So now, look at your worksheet. Look at your worksheet. So, now I need somebody to share with us. The title of the experiment, the objective, materials and apparatus.
	00:19	[talk to one student] Okay, so can you share with us the title of the experiment?
S	00:19	[stand up and answer the question]
T	00:27	Okay, how about the objective? They observe the experiment …? Can you read the entire thing?
S	00:32	[keep answering the question]
T		[try to correct the student's pronunciation] aims… investigate …
	00:47	Thank you. Well answered. How about materials and apparatus? Every thing will be the same …, every thing will be the same as… this…step… [turn around and operate the computer] except what? … and one more thing, or that is… that comes with more detail. Remember what we have introduced to you? Remember your new friend? Is that the same potted plant we used last time…no … that is what we called [point at the slide] … coleus, is that Okay? So, you can say, you can put down "coleus". Or you can say potted plant with what kind of leaves? Potted plant with…
Ss		[try to give an answer]
T	01:35	With middle leaf? With what? How do you call that special kind of leaf? DK.
DK		[answer the question]
T	01:42	Potted plant with …?
DK	01:44	[answer the question]
T	01:46	Very good, Variegated. Is that Okay? So, can you put it down? Can you check whether everything is the same? Here, materials and apparatus. And also, a potted plant with Variegated leaves. Variegated leaves. Is that Okay? That would be materials and apparatus.
	02:11	Procedures. How about procedures? AM. Procedures. What is the 1st step? Can you read aloud to us?
AM		[stand up and answer the question]
T	02:31	Take the leaf from the plant. Okay, then?
AM		[keep answering the question]

T	03:05	Wow, you seem to remember everything. Go on, go on.
AM		[keep answering the question]
T	03:17	Okay, so that is the process of … starch, right? Mm, has Emily forgotten something?
		Has Emily forgotten something? Twenty-four, twenty- four. No. 24, all right? ET, has Emily forgotten something?
ET	03:36	[stand up and answer the question]
T	03:38	Yesterday I told you this experiment comes in two parts. The 1st is …., and the 2nd is processing of the starch. So, Emily has already told us that … has already elaborated to us the steps for testing for starch. But it seems that one important step before still missing.
ET		[give an answer]
T	04:03	Very good. Yes, by putting it in darkness for 24 hours, well done. So, can we see the step? No, because these were put in darkness for 24 hours, already. Yes or no? He has already put this, put our new friend under the sunlight. Ah, today we have a sunny day. He put it under the sunlight for several hours already. Is that Okay? For several hours, already. So that's why the step has already been done. So, the 1st thing, a starch; 2nd thing, … for starch. Can you write it down? Basically, 2 main steps…
		Mr H 2.3_Action verbs
T	00:00	After that, I'd like you to move to the write part. The writing side of this worksheet. And then, there they said, "I found the experimenter uses the following action verbs in his/her experiment steps." So, what action verbs do you hear from Emily? YD, what action verbs do you hear from Emily? That you start the sentence with?
YD	00:35	[stand up and answer the question]
T	00:38	"pick", very good. "pick", this one, sit down. JS, go on.
JS	00:46	[stand up and answer the question]
T	00:49	Sorry, oh, "burn", Okay. Burn what? What do you need to burn? Do we burn the leaf?
	00:59	Yesterday you got a very nice set of cards. Do you still remember? Can you look for answers from that, from that set of cards? You will be able to find more instructions.
	01:12	[talk to JS] Which card will you be able to find the answers from?
JS		[keep answering the question]
T	01:22	Yes, test for chlorophyll, as the … You haven't finished. You haven't finished, JS. You haven't finished saying the whole phrase. … test… for chlorophyll…
JS		[finish the answer]

T	01:48	Okay, well done. Sit down. So, let's take a look at that card. Test for chlorophyll as a necessary condition for photosynthesis. Is that Okay And… It should be this one.
	02:04	Okay, so, what are the action verbs …. They are being used. Can you tell me again?
	02:11	BS, can you please tell us all the action verbs?
BS	02:18	[stand up and answer the question] destarch, remove, draw, put …
T		Very good, next? [repeat after BS] Yes, remove and draw as well. Okay? So, basically these are what we call action words and then we use that to write our procedures. Is that Okay? We always start with a verb and that is what we call imperatives. Is that Okay? We use that to write our procedure.
	02:51	Okay, now everybody, look at the procedure and then I would like you to cross out 2 steps which does not apply to our experiment today. There are 2 steps which we will not do today. There are 2 steps that we will not do today. Can you find out which 2 steps that we will not do today? That we will not do either or being done by Mr. XXX. Don't cross out the step that has been completed by Mr. XXX already. The starch Mr. XXX put there already, please do not cross it out. But there are 2 steps we will not do it today. Destarch the potted plants are ……. already. Which step, please tell me the number, Joy.
Joy		No. 3
T	03:58	No. 3… No. 3 is what? Ah, is No. 6. Oh, we haven't done. We will do that, Okay? We will draw the color pattern of the leaf later. Okay? We will not do No.3. Let's take a look at No.3 first. Draw the color pattern of the leaf after the iodine test. Oh, iodine test. So, what is step 2? Can we all read step 2? Shall we all read step 2 together? 1, 2, 3, go. [read with the students]
Ss		[read step 2 together]
T	04:36	Okay, so now the answers being put in darkness for 24 hours. Can you predict the experimental results? Will there be any color change? Yes or no? Will there be starch in the leaf? After being put in darkness for 24 hours, will there be starch in the leaf? No, then? The iodine test will give you a positive or negative result? Okay, when you put the iodine solutions on that starch leaf, will it change color? Will the iodine solutions change color?
Ss	05:11	Yes.

T	05:12	Yes. Why? Because there is …? You just told me, you just told me that there wouldn't be starch. Do you understand what I am saying? Where the starch……. and we take the leaf out, will some starch remain. Suppose it. The leaves supposed not contain any starch, so when we test with iodine, the iodine changed color. Can you tell me the answer once again? Will iodine change color? No. What is the purpose of that before we put the plant on somewhere else again? What is the purpose of that? This is very important. We didn't mention it today. We assume that a plant has been destarched. But we may want to be more accurate, we want to be very, very justified and fair. Why do we do that? After destarching, we pick a leaf of iodine test, why? We want to make sure of something.
S	06:22	[give an answer]
T	06:24	We want to make sure there is …?
S	06:25	[try to give an answer]
T	06:26	No starch before we put it under the sunlight again. Is that Okay? Can you write it down? Next two, step 2. We want to make sure the destarching is successful. We want to make sure the destarching is successful. And there is no more starch left on it.
		Mr H 2.4_academic functions
T	00:00	This is your homework of this weekend and you complete 3 experimental reports. So, the objective, it will be the same. In order to have you understand better, I make useful academic functions in science subjects. ……. Each are the languages you need for you to utilize to finish the experimental report. If you have either get them ready and then …… No. 3--- Expressing objectives/purposes. And we use the verb "aim to". Okay, let's read an example sentence and we will study together. Are you ready? 1, 2, …
Ss	00:54	[read the sentences using "aims to"]
T	01:03	[read with the students] … aims to test whether starch is produced in the process of photosynthesis. Okay, we need to write to report in complete sentences. That means should be the subject, verb and object. Can you tell me what subject is in the sentence? LS, can you tell me the subject in this sentence?
LS	01:16	[stand up and answer the question]
T	01:18	The experiment. Very good. Can everybody put … in bracket? That is the subject. Then the 1st assignment
S	01:32	[stand up and answer the question]
T		[repeat after the student] test, investigate, find out. Urr, those are very, very frequent. But your answer is incomplete. But, anyway, sit down. Can somebody perfect this answer? The verb actually contains more than that. WL, can you tell? The verb in the sentence? The verbs in the sentence?

WL	02:02	Sorry, I don't know.
T	02:04	What is the subject? I just told you, class, this experiment, right? So, where is the verb? Action words. A-I-M-S, whole class, aims. Again, aims.
Ss		[read after the teacher]
T	02:23	Okay, aims, something, for example, when you are … [ask students] Do you have a piece of tissue? Do you have tissue or … ? Use tissue, use tissue. Do you have tissue or …?
WL		I have
T	02:42	Okay, so now WL is supposed to throw in …… Throw in …… [WL going to the ……] [talk to WL] No, no, no, not by that. In your seats. Try.
T	02:57	In or out?
Ss		In.
T	03:00	Okay. So, the action that ……[show in gesture] What is that? Before WL threw the rubbish. Shaked a bit. What is the purpose of shaking? Is to …?
Ss		Focus.
T	03:16	Focus and aim. Is that Okay? That is the verb. Because he needs to aim. He needs to make sure that the rubbish goes in. So, he aims first and estimates how much course he needs to …. Is that Okay? So, aims first. So, that is the protest. This experiment has a focus, too. Is that Okay? So, this experiment aims to test, aims to test the entire phrase is the verb. Is that Okay? Can you bracket the entire thing and write down …? That is the verb.
	03:51	This experiment aims to test with a focus on testing something. So, what does this experiment test? This experiment tests whether starch is produced in the process of photosynthesis. So, we can … whether starch is produced in the process of photosynthesis. And then, why, oh, over there. So, that is the object. So, we have subject, verb, object. And this makes up a complete sentence.
	04:19	Now, let's move on to talk about another one. You can also say the purpose of. Can … as well. The purpose of. That means why do we conduct the experiment. Why do we conduct the experiment? The purpose of. Let's read together, the purpose of … 1, 2, 3, go.
Ss	04:43	[read the sentence]
T		[read with the students] The purpose of adding iodine solution to the leaf is to test the presence or absence of starch in the leaf. Is that Okay? So, the purpose of adding iodine solution to the leaf is entire something. It is the verb. And then, to test the presence or absence of starch in the leaf is the object.

		Hung2.5_inner or outer part
Ss	00:00	[do experiment]
T	00:01	[talk to one group] The inner part. Don't …… The outer part actually looks like blue black, that means, where is the sunshine? The starch is … in the outer part or in the inner part?
Ss	00:22	Outer.
T	00:24	Outer part, very good.
	00:27	…., yes or no? So, can you all tell me which part of the leaf turned blue black?
Ss	00:39	Green.
T	00:40	The green part, which is also the outer part. Yes or no? How about the white part? Remains…?
Ss		Amount.
T	00:51	Remains amount, is that Okay? Not remains a gentle, but remains amount. That is also the white part and the inner part. Is that Okay?
	01:00	So, now I'd like you to remember … try to remember how the leaf works like. Okay? Because you need to draw. Is that Okay? You need to draw the pattern of the leaves.

		Ms L_ Lesson 1
L		This one. OK, stand up. Take out your hands please from your pocket. OK, everybody, let's do some revision. Last time, maybe last week, we have studied about scientific farming method, right? Can you name some scientific farming methods? Everybody?
S1		GM Course.
L		What is the full name of GM? Genetically? M stands for? Genetically Modified Course. OK, can you read after me, please? Genetically-
Ss		Genetically-
L		Modified Course.
Ss		Modified Course.
L		Yes, GM food is one of the scientific farming methods. Can you name more?
S2		Using large-scale machines.
L		Yes, using machines. OK, sit down. You, sit down please. And can you name two more, scientific farming method?
S3		House seeding.
L		House seeding, good try. Can you name more? Sit down please.
S4		Using pesticide.
L		Using pesticide, very good. OK, sit down. And what's more? How about f-e-r-t-
S5		Fertilizer.
L		Everybody!
Ss	02:09	Fertilizer.
L		Very good. But you only answer me in one word, one single word. Can you make a complete sentence? The courses, the product we use, ok, we apply in our farming industry. And the result, what is the result of using scientific farming method? We use pesticide, we use fertilizers, ok. What do we expect in our products?
S6		Pollution.

L		Pollution, very good. Sit down. Pollution is the negative impact. Can you give me some positive impacts? Others? Let's do some revision. Open your book , page 38, first. And they give you some pictures, they show some pictures, four pictures. You have already answered most, but can you try to make a sentence, 38? Ok, fill in the blanks, please? If you know the answer, please raise up your hand. Let's try the first one. How to increase farm output? This is a result, ok, students, this is a result. It is to increase farm output by using what?
Ss(boys)	04:18	Scientific farming methods.
L		OK, boys table 1 sit down. Very good, by using scientific farming methods. How about girls, can you try No.1? What's this in picture No.1?
S7(a girl)		Irrigation.
L		Very good, girls table 2 sit down. Irrigation, irrigation. What's the result of using irrigation method? Can you describe farming area? Increase or decrease farming area?
S7		Increase.
L		Very good. Boys table 2 sit down. Increases farming area. Everybody write down "increases farming area". Increases. And what about the amount of crop?
S8		Waste.
L		Very good. Girls table 3 sit down. ……the amount of …… How about No.2? Use of
S6		Machines
L		Very good, use of machines. And the result is? Farming efficiency, lower or higher farming efficiency?
S9		Higher.
L		Higher. Boys table 4 sit down and boys table 3 sit down. And No.3 : use of- (whisper: all girls sit down) What's this? Can you recognize your pictures?
S10		Fertilizers.
L		Fertilizers. And?
S10		Pesticides.
L	06:42	Very good. Use of technical fertilizers and pesticides. OK, last table. Yes, so control what, and makes the soil what?
S1		Pests.
L		Very good. Control pests. Sit down, all sit down. And makes the soil rich. No.4 is the last one. No.4: Growing new species. All of them can increase farm output. Can you get it? Any questions? So let's move to a new topic 2.6 next page. What harmful effects do scientific farming methods bring? OK, close your books now when you finished. Now I will distribute you C&L card. Do you know what is C&L card? Can you take a guess what is C&L? C stands for?
S2		Scientific.
S3		Creative.
L		Scientific? Creative? I need your creativity, to be part of the game, ok? This is C&L card, C stands for content, our content today. How about L, L stands for?

S4		Language.
L		Very good, language. OK, when you receive it, you can write down your name and class number and take a look.
		(Miss Lau was distributing the cards to the students.)
L		OK, we just learned about scientific farming method, four main areas. Tina, turn off the light please. We just did a revision. Now take it out- scientific farming methods. Are you ready? (Miss Lau called a student's name.) Take out scientific farming methods C&L card. Positive effect of using scientific farming methods. We can learn some positive words or phrases in the first column. Can you tell me some positive words when we describe scientific farming methods and the can increase farming areas or productivity? We just look at the first column and then see the positive impacts. That means the good things and then can you tell me or highlight the- take out your highlighter- verbs? Highlight some verbs. Look outside- words or phrases that express the advantages or positive impact of something. Today is about scientific farming methods. OK, can you try now? There are hints on the blackboard, please try. This is a very new method we never try. Please try your best to answer. Can you find out the positive words or phrases in the first column when we describe the scientific farming methods?
		(Miss Lau came down from the stage and saw how well did students do this task)
L		Girls have already highlighted many words about positive side of scientific methods. Yes, very good. How about boys? Increase. Waste. Very good.
		(Miss Lau checked the answers of the students and discussed with them)
L		OK, look at the second … We try to practice, ok, to use the words- positive words or phrases. We just did revision about farming machines. Can you read aloud please? Farming machines- ready, one two three, go.
Ss		Farming machines such as tractors and combine harvesters help to improve farming efficiency, boost productivity and raise farm output.
L		So which word is positive, which is positive word?
Ss & L		Improve, boost and raise.
L		Tractors and combine harvesters are large-scale machine, ok? Can you get it? Ok, you can close it now. Look here. Let's move to a new chapter- what is the negative impact of using scientific farming methods. We just studied the positive side and how about the negative? This affects us human and the environment. Let's take a look. Here is a river. Close all your books, please. So here is a river, some pesticides are left on crops. What's the negative impact? Can you describe this picture and guess what happen next?
S5		Drought.
L		Drought is wrong.
S6		Water pollution.
L		Water pollution. But you just only give me one or two words. Can you describe more, ok? Stephan Li, try to do.

		(Stephan Li stood up.)
L		What happen next? Some pesticides are left on crops. Your answer is already correct, it makes water pollution. But can you further describe? How about people eat the crops? They feel- Li Zhuoxin

Li		They may feel sick, they may have stomachache or something.
L		Ok, sit down. Very good. When people eat the crops, they may get sick. You can describe they will go …. or diarrhea, health is threatened, ok. How about the environment? Wang Chengyu.
		Wang Chengyu stood up.
L	02:12	When the pesticides are washed into the streams, what happened? Xiao Zhongxian stand up.
		Xiao Zhongxian stood up.
L		The water will?
Xiao		Polluted.
L		It will make water?
Xiao		Pollution.
L		It will cause water pollution. Can you describe the fish and other species? They may?
Ss		Die.
L		Even fished in the streams are killed. Ok, the last one. How about the pests? They kill the pests, but some of them are good. They all kill the good pests and it will upset the natural environment. And then this is the pest, when too much pesticides, they already have resistance. "I'm strong! I can resist pesticides!" Resistance is developed in pests. Ok, they become more powerful and also make the negative impact on the environment. Do you understand? Any questions for this page? Ok, we will give you a card. Every table will have a card. Please sit in a circle, move your chairs please.
	04:54	*Miss Lau was distributing the cards to the students.*
L		And you can close your book first. Try to make a sentence. Ok, please look up. Look at the blackboard. Each group will be given some pictures with key words or phrases. Try to make sentences according to the pictures or words/phrases provided. Ok, you have to work together in 5 minutes and then we will check the answer. The group that gets the most correct sentences is the winner of the game. Ok, now you will have 5 minutes to work out together. Tina, can you turn off the light? Try to make a sentence.
		Students were having a discussion.
L		The first one I give it to you, the first one. Your job is trying to make a sentence based on some key words or phrases give to you. The first one you see: …be left on… so you try to make a sentence. First, see and decide what it is. Pesticides, fertilizers or machines? What is this?
Ss		Pesticides.
L		Pesticides, very good. Pesticides may be left on- this is the key word that is given to you- where? Vegetables or crops, up to you, when they are used too much, something like this, ok. Now you use your card to make a sentence but work out together. You must try, ok?
		Students were having a discussion again.
L	09:07	Ok, you can write it down on your paper, or maybe you can write down here, ok?
		Students discussed and write down their answers.
		One group in discussion(girls)
		The pest becomes strong and can resist the pesticide that is not powerful.
L		Everyone, look at the blackboard. The second one is "eat". Take out this game card. What is your sentence and share it to everybody.
S1		Human may find the ……

L		Not petrol.
S1		Pest… Pesticide.
L		Very good, pesticide. And then?
S1		Then they will feel sick -
S2		After they eat.
L		Very good. Ok, everybody look here. Boys table one did a good sentence. Let's read aloud, everybody. This is your sample, ok? The pesticides- ready go!
Ss		The pesticides may remain on crops and be eaten by people.
L		And be eaten by people. Ok, now, they get sick, "affect". What is your sentence? Please.
S2		After people eat the vegetables, the pesticides affect their health such as omitting.
L		Very good. It may affect people and then they may get sick, omitting or diarrhea. Ok, let's look at the sample sentence. Can you read aloud, please? If- this is a conditional sentence- ready go!
Ss		If people eat food with pesticides, their health will be affected.
L		The result is their health will be affected. Next, can you take out this game card about river, environment and wash? Tina, please turn off the light in the front. Pesticides may be washed into rivers and streams when they are overused. So you try to use the key words and form a sentence. Ok, please make this sentence.
		S1 raised his hand.
L		Let other groups try. Girls table one can you try? Rivers/streams-pollute-kill.
S3		Streams-
L		May be polluted.
S3		And the living creatures in the river will be killed.
L	16:18	Very good. May be killed. Ok, everybody. Xiao Zhongxian, stand up, please read aloud this sentence, ready go!
Xiao		If pesticides are washed into streams, they will pollute the water and kill the fish and the animals in the streams.
L	17:00	Very good. Ok, the last one. Everybody ready? Can you turn around and face the blackboard? Girls table three, yes please, face to the blackboard. Everybody read aloud, please. And ready go!

Ss		If pesticides are used excessively, they not only kill the pests, but also the good insects that kill pests.
L		Ok, the last one.
Ss		If pesticides kill the good insects, it upsets the nature's control on pests.
L		The key word is upset. Ok, next one, if-
Ss		If pesticides are misused, they become ineffective because some pests can resist the pesticides and become very strong.
L		I think this is the last one. Ready go!
Ss		If more and more pests can resist pesticides, more powerful pesticides need to be developed/invented. This will be harmful to both people and the environment.
L		Good job, everyone. Collect the game card and give it back to me, ok. The picture card, give it back to me. And then the C&L card, ok? You keep it in your geography book. We will use next Monday.(said it twice) Please keep it well. One, two, three…nine.

		(Counting the cards) Ok, I will keep the C&L card, please put in your geography book. We will use next Monday. Ok, goodbye class
Ss	02:17	Goodbye.

		Ms L_ Lesson 2
Ms L		I give you one minute to do quick revision and prepare your paper, ok?
		(Students talked and discussed.)
Ms L		Please dictation (dictate) this point form only, point form only. You don't need to write the paragraph, point form only.
		(Students talked.)
Ms L		Ok, please put all the things in the corner. Take out pens and a piece of paper. I will check your paper as well. Please raise up, ok? And then interact, don't like anything at this moment. Paper, paper, paper, paper. Ok, put down. Write down your name, class and class number. You have five to ten minutes to do your dictation. You may start now.
	11:04	(Students did the dictation.)
Ms L		Look at the blackboard and get prepared today's our lesson. Today we are going to talk about scientific farming method- pesticides, fertilizers and how to make a good essay. Last Friday, I asked you to hand out (in) your essay writing. Today I will give you back, and look at how to better your essay writing. Ok, times up. One representative of each table, please pass out your dictation. And you have received three papers and do not talk. Can you take a look of three pieces of papers I just sent to you. Take this paper please- Scholar Project Teaching Materials _ Sentence making tables. Please do not talk and start our lesson. Our lesson is too tight and please pay attention. These three paper(s) is(are) about sentences making tables, about food problems. And at the same time, can you also take out your C&L card. C for "content", L "language" , C&L card. If you forget to bring, please raise your hand. Raise your hand if you do not (have). Very good.
Ms L	14:28	Let's do a revision with your C&L card. Please take out, ok? If you know the answer, please raise your hand. Let's start, are you ready? Yes or no?
Ss		Yes.
Ms L		Very good. Ok, now turn the page at "Pesticide", pesticide. OK, let's search the answer. What is pesticide? Table 2 stand up please and read aloud.
S1		A chemical used to kill pests, especially insects.
Ms L		Very good, whole class can you find the answer? Can you read aloud please? A chemical used to- one, two, go!
Ss		A chemical used to kill pests, especially insects.
Ms L		OK, the second question- what does pest mean? Vey good, stable 2 stand up, please.
S2		An insect or a small animal that harms or destroys plans, trees, etc.
Ms L		Vey good. Can you find the answer, everybody? Yes or no? What does "-cide" c-i-d-e mean? Can you give one… Listen, listen first. Can you give one more word ending with cide c-i-d-e? If you don't understand me, look at the blackboard- what does -cide mean? Can you give one more word ending with "–cide", ok? Let girls try, table 2 please? First, you answer the first part, what does –cide mean?
S3		Killer.

Ms L		Killer, very good. Act of killing, used to form compound words. Now the second part is- Can you give one more word ending with "–cide"?
S4		Suicide.
Ms L	17:01	Very good, suicide. And also? And also herbicide.

Ms L		I spell for you, h-e-r-b-i-c-i-d-e. What is herbicide? Anybody know? Herbicide?
S5		杂交。
Ms L		No. Herbicide means kill the grass. Kill grass. How about homicide? Jiao Zhongxian, stand up.
Jiao		唔知喔。
Ms L		You may meet this word, homicide. Ok, sit down. Homicide, the spelling is h-o-m-i-c-i-d-e. That means kill people, kill people, homicide. Ok, what are the positive impacts of pesticides as a scientific farming method? We know we have positive and negative impact, can you find positive impacts? Can I ask girls table no.3 to find the answer about positive impacts of pesticides as a scientific farming method? Good things of pesticides. Yes? Please stand up and answer.
S6		Pesticides can help control pests in the farmland.
Ms L		Control pests. So make sure you have a good product. Very good. Control, the key word is control, control pests in the farmland. Ok, what are the negative impacts of pesticides? Negative impact, can you find now? Girls table one, please. Negative impacts.
S7		Water pollution
Ms L		It causes water pollution. That's point No. B. Very good. How about A? How about A? Yes?
S1	02:57	Pesticides kill all insects, including the good insects that kill pests. This will upset the nature and the nature's control on the amount of pests and results in the increase of pests.
Ms L		Ok, very good. Negative impact. And C, look at C. If people eat food with pesticides, their health will be affected. This card can help you to do revision. OK, now look at the blackboard. From these paragraphs, a, b and c, can you find the words expressing "influences"? What's the meaning of influence? I give you an example. Our chief executive CY Leung influences Hong Kong people or HK economy, something like that. Can you give me some examples that the (whose) meaning the same as influence? Can you find the answer here? You can find the answer here (Ms L pointing at the blackboard). The same meaning as influence. Let's try. You can read your C&L card, a, b and c of negative impacts. Find the influence. I give you some tips. One of the answers is on the first line. You can note more words, same meaning to form a sentence. So besides "influence", you can understand five more words, the same meaning as "influence". Affect, a-f-f-e-c-t, very good. Can you give one more word?
S2		Lead to. (in a low voice)
Ms L		Sorry?
S2		Lead to.
Ms L		Good try. Good guess. Can you find one more? One more? A, the first question.
Ss		Impact.

Ms L		Impact. Very good. That means CY Leung influences HK people, and CY Leung affects HK people. The meaning like this, impact and affect are both correct. More difficult, find the words/phrases expressing “cause-and-effect”.
Ss		Result in.
Ms L		Very good, result in. What’s more? Result in…cause-and-effect. Leads to and cause, Very good. Ok, find the words expressing ”something negative”.
Ss		Upset.
Ms L	07:15	Very good, upset. You can underline, ok? Underline on your notes or your card for you to better revision (revise). Find the words expressing ”something negative”. Upset and …negative! For example, the first line, negative impact and… upset! And negative (word) is (are) pollution, death, damaged, many words, ok? Any question?
Ms L		In last lesson, you have made sentences according to the meaning of the pictures and the words/phrases provided. Now, it is time to do the essay. Last week, I gave you the essay writing. I ask monitors (to) come out and pass it out. Monitors? You have already completed the task and now I distribute you the essay writing. How to brighten your writing skills? Ok, now take out your essay. This is your last-time essay without guideline. First, before you write an essay, you have to think about the organization. Actually, we have three parts. Can you take out the hamburger, ok? Hamburger paper. An essay is like a hamburger. The top we call it the top bun, b-u-n, top bun, the same as introduction. You already wrote the introduction part. Please read your introduction. How to get better? Ok now, take a look. At the beginning, it will be helpful to give a brief introduction about the phenomenon/problem you are going to discuss. In this essay, you are discussing about negative impact. So, in the first paragraph, you have to mention negative impact of pesticide. For example, overuse of pesticide.
Ms L	11:15	Ok, in how many aspects, can you tell me how many paragraphs you have to write? First, second, third and forth. You decided you have to write four main body. And the first sentence, the first paragraph, you have to mention four aspects. You have to explain, ok? So the following, the first, this is the connective word, you have to write … at the beginning. And then you have to give examples to support your point. Some of you just write one sentence or two sentences. Your topic sentence, and …, and then the second paragraph, but this is wrong. You have to give more examples to support your point. Here, ok, we call it the main body. Look at your hamburger paper. This is a supporting paragraph. We call it the meat, the meat- explain your ideas with examples. Please underline examples. You must write examples and support your paragraph. And underline signaling words. What are signaling words? Can you give me examples, signaling words? To indicate the sequence of the points. Use signaling words to indicate the sequence of the points. Example, please? What is signaling words? Please underline first, second, third, fourth. These are signaling words to the sequence of the points. And you have examples. Talking about the organization of the content. Lastly, to underline “to sum up”. Don’t forget to draw a conclusion to sum up your points. Ok, now last lesson I gave you the game card. Do you remember the game card about when the pesticides washed into the river, how to affect people and the environment? And then you have to classify different aspects of the main issue. Now I do it for you, ok? Look at your essay, four paragraphs. Each paragraph explains one idea. The first idea is about how do pesticides affect people’s health. Can you get it? So, you use the three game card

		idea to form an essay. This is your first paragraph. And the first paragraph is about people's health, ok? The second paragraph talks about the quality of water. The third paragraph is about "affect the nature's control on pests". And the last paragraph talks about pests' resistance.
Ms L		Now you read the sample essay, sample writing carefully, and you need to circle some key words. This is the sample writing, ok?
		(*Monitors distributing the samples to students.*)
Ms L	17:02	Ok, before you write your essay, you know the organization right? You know we have the introduction part.

Ms L	01:25	You have to select the main body, how many paragraphs you want write and you write the conclusion. Now, we focus on content. Highlight the words and phrases expressing "impacts" in the sentence making table. Ok, take out your scholar project- sentence making tables. During dictation, I pass it to you- "Teaching materials _ sentence making table." And then you see the impacts. Can you underline the second column? Impact, the words expressing impacts. Now, I come to your table and check you know which table. And please underline and then I check your answer, impacts. We have X column, and the center column, the middle part is "impact words". Please underline.
		Students did the task asked by Ms L.
Ms L		Interpreting influence, influence, here. Underline. Underline the words expressing impacts. Here, impact. Underline the words expressing impact. Ok, impact. And the what is the other word?
		Ms L instructing students to do the task.
Ms L		Ok, next page. Can you find conditions, the table shows conditions. Ok, underline condition sentences. Here, expressing conditions, please underline "if". For example, if there is not enough time for pesticides to decompose before harvesting, and then the result- it will be left on crops. Ok, let's try to do one. In your essay example, can you use the red pen to underline signaling words? Do it now, signaling words. If you (are) correct, you may leave. In essay example , if the answer (is) correct, you may leave.
		Students doing the task.
Ms L	06:33	Signaling words, highlight with red. Academic meanings or words, you use the blue pen to highlight. And we talk about the food problem, about geography, use the green pen. If you don't have green (pens), use the black pen. Come on, hurry up! Very good, very good, very good. Girls done well. How about here? No, no, no, signaling words. Highlight in red. Academic words in blue. About food problem, you highlight in green. Correct. Here, first, second, third, fourth. These are signaling words.
Ms L		Ok, I want to stop here. Now, take a look. If you know how to select the right words. It must help you write your essay better. For example, the red color are signaling words. "Although, because, not only, but also". How about the yellow color, yellow color is conditional sentence, conditional sentence. Because I ask you to write the main body, you have to give examples to support, ok? It is good for you t use conditional sentences, ok? I will show it to you later, no need to do it now. Ok, we end at here. You have one homework tonight and bring it tomorrow. It is about what are chemical fertilizers, what are the waste form? Goodbye.

		Ms L_ Lesson 3
Ms L		Take out your essay. Good morning, class.
Ss		Good morning, Ms L.
Ms L		Ok, keep standing. Submit your essays. Remember to write down your name and class number. Ok, one representative please pass it out. Thank you. And then I want to do some revision. Thank you. Ok, stand up. Girl's …, last table, are you ready? Ok, let's do some revision. What scientific methods are used in China?
S1		Fertilizers.
Ms L		Fertilizers, very good. Fertilizers and also pest-
Ss		Pesticides.
Ms L		Pesticides, can you give me one more?
S1		GM crops.
Ms L		GM crops, it helps farmers do farming, for example, have a very big-
Ss		Machine.
Ms L		Machine and also irrigation. The question is, if you were a farmer in China, do you think it is easy for you to use these methods?
S2		No.
Ms L		Very good. And why? Can you give me some hits?
S3		The farmers are usually poor, … (in a low voice)
Ms L		Can you louder, please? I can't hear. It is because the farmers were-
S3		Poor. They cannot afford the expansive machines.
Ms L	02:48	They cannot afford the expansive machines. Very good, sit down. Table 1 sit down.
Ms L		The last table, please.
S4		They don't have much education, and they don't know how to use the machine.
Ms L		They don't have high education, and they don't know how to use the machine. Very good, excellent! Sit down, please. We also talk about the irrigation, GM crops. What's the constraint? That means what's the difficulty or something you can not control? Ok, what's the constraint, or we call it limitation of using these scientific farming methods? Farmers were poor and lack of education. What's else? How about GM crops? Genetically modified crops. Because the farmers were poor, can you complete the sentence? can you complete the sentence about GM crops. Because the farmers were poor- Ok, everybody, can you take out the C&L card about scientific farming methods, can you see a table? You can do a revision first. What is the good and bad side? Positive and negative impacts of scientific farming methods. And can you tell me the limitations of these methods? The first column is positive impacts, you have already mentioned irrigation, farming machines, fertilizers and GM crops. This is the first column, talking about the good ways to use scientific farming methods. And the second column- negative impacts. The third column is limitation. Can you tell me more about limitations?
Ms L	05:26	The limitations of scientific farming methods? Yes.
S5		The use of …(*Read the answer in the table.*)
Ms L		About the GM crops, farmers have to pay more to buy the GM crops. Please sit down, very good. So this table, it is easy for you to do revision, and the words underlined that you can pay attention to are about geography words, academic words and important points, you can find there. Table 2 please sit down. You can imagine if were farmers, ok, any difficulties to use scientific farming methods? Yes.
S6		(*Read the answer in the table.*)

Ms L		Yes, farmers do not know how to run the machines and use the new technology. Girls table 1, sit down. Table 2, please.
S7		(*Read the answer in the table.*)
Ms L		Very good, sit down. They have to buy fertilizers and pesticides, ok. And the last one, farmers need to pay a lot for the patented GM seeds. Ok, let's take a look what is patent? Ok, all the students please sit down.
Ms	07:35	Two lessons before, you played the game card to make a sentence based on this picture. No. 1, this is about the pesticides, ok? If too much pesticides, overuse of pesticides will affect our health and environment. This picture (shows they) affects us people, affect people. And this one affects the environment, very good. Ok, no. 3, "upset the nature's control on the amount of environment," we call it the pests become-
Ss		Stronger.
Ms L		But in academic words, we can say "resistance". Resistance is developed in pests. That means the pests become stronger. They are no longer afraid of pesticides. Ok, the next one, if we use too much fertilizers, what will happen in the ocean, in the river? Let's take a look. If we use too much fertilizers, based on this picture, the fertilizers are washed into the ?
Ss		Water.
Ms L		Very good, washed into the river. And one thing will grow more and strong? Can you guess what is it? Start at A, ok? More nutrients for water plants, for example, algae. Can you read after me please, algae.
Ss	09:31	Algae.
Ms L		Ok, the Chinese is here. Fertilizers are washed into rivers and supplied to the algae. Can you tell me the size of algae? More or less?
Ss		More.
Ms L		More. The algae becomes more. Grow rapidly. If it grows rapidly, what is the result? They use a lot of oxygen. However, how about the fish? Xiao Zhongxian, stand up please. Can you tell me about other living things, if algae uses up the oxygen? Look at this picture, the algae grows bigger and more, and they take up all the oxygen, how about other living things in the water? What is the result?
Xiao		Sorry, I don't know.
Ms L		Ok, you don't know. Can you describe the fish in the water? Other people can help Xiao Zhongxian.
S5		Because there is not enough oxygen, the fish die.
Ms L		The fish die, very good. Ok, now you can see the picture, the fish will die, that of all living things, because algae grows more and takes up all the oxygen. This is the negative impact of using too many fertilizers?
S2		Ms L, how about photosynthesis? Photosynthesis releases oxygen…
Ms L		We are not talking about photosynthesis. We talk about the algae and the fertilizers in the water, ok? What is wrong with GM crops? Do you know what is wrong with GM crops? Sorry, I don't know. (Laughed) I don't know. No research proved that GM crops must be harmful for us. GM crops are new species created using biotechnology. These new species may, remember this word, may, not must, affect our environment, no one knows, and then affect people's ___ Can you try to fill the blank?

Ss & Ms L	12:27	Health.
Ms L		But some people are against this kind of farming methods and do the demonstration, that means they don't like it, ok? So they voice up and don't want GM crops. What price do we pay to create more farmland and increase farm outputs? Look here, look here, ok? This is a poor farmland. The land was already dry and (had) poor soil. The nutrient is nearly used out. But the farmers want to grow more and more crops. So what is the result? Let's take a look. When farmers grow crops on poor soil, the crop will use nutrients in the soil. After a long period of time, soil becomes poorer than before. This process, remember, is called soil degradation. Can you read this word, soil degradation.
Ss		Soil degradation.
Ms L		In the long run, farmers can not do farming in this piece of land. Now, take a look. Ok, what price do we pay to create more farmland and increase farm outputs? Growing crops in semi-arid areas, normally, near the dessert area. The land becomes poorer and drier, but farmers keep growing crops there, growing crops in semi-arid areas. Can you tell me high or low evaporation rate if the sun is strong?
Ss & Ms L		High evaporation rate.
Ms L		And then farmers do more irrigation and salts in the soil are no good for farming, no good for farming. Salts in the soil will be (pause) dissolved, dissolved and carried up to the surface. And then soil becomes salty. As you know, that salt is no good for farming, so it affects crop growth and lowers farm production. In the long run, the farmland becomes more or lower?
Ss		Lower.
Ms L		Yes, lower. And this one is easy and we have studied before. Animals eat up the grass and soil is exposed to the surface. What happens? What happens? Animals (are) eating all the grass, soil (is) exposed, what happens? And soil without protection, what occurs? Soil ___, start at e.
Ss		Erosion.
Ms L		Ok, we studied this one before. Soil erosion occurs. Both soil degradation and soil erosion will make the land less___, more productive or less productive?
Ss		Less productive.
Ms L	17:01	Less productive or even ___, the worse case is unproductive, unproductive, ok? At the beginning, we ask you this question. What sre the limitations of scientific farming methods? No. 1- Expensive, expensive to buy crops, to buy machines, ok? And to build the infrastructure. For example, the farmers want to save the water, they have to build the dam and irrigation pipelines.

Ms L		(continued) It is expensive infrastructure. How about the second one, farmers have to buy machines, but most of the farmers were poor, they cannot afford to buy the machines and build the infrastructure, or the government was poor. They cannot afford to build the infrastructure. And then the patents, ok? Look at your C&L card. Please underline patents, the new word, patents. The third column, the last square, can you highlight the patent? Farmers need to pay a lot for the patented GM seeds. 专利权，专利权。 The last column, the last square. Actually, the farmers cannot afford it. Ok, sentina, please turn on the light.

		(Ms L were distributing materials to the students.)
Ms	02:29	Please pass it out. Ok, now you will get a summary, summary about the scientific farming methods. Please work in pairs. Discuss with your classmates and complete the table, this summary table. You can open your C&L card, because you can find the answer very easily in one page, the C&L card, scientific farming methods.
Ms		You can work in pairs. Sit down, yes. Try to find the suitable answers. You can open your C&L card, books and notes to fill the words. Start from the left. Start from…, you can read the number, start from no.1, no.2 and no.3.
		(*Students were working on the table and Ms L was giving some hits.*)
Ms L		Please raise your hands if you need any help.
		Ms L was guiding a student: "Here, if the place has more water and is suitable for farming, how to describe it, increases? Before the land is dry, and it is not suitable for farming, now it has the irrigation system, that means more what to provide for farming? More what?
Ms L	07:15	If the picture is not here, look at the blackboard. You can look at the blackboard, because of the color … or you can go out to see the picture.
		(*Ms L was checking whether the students figure out the table or not* .)
Ms L		Students please look at the blackboard. Hello, hello, everybody. Here, one, two, three, the picture is not very clear. Over-i __, you can compare with this picture, over- start with "i", here, ok? It is easy for you to compare. And here over-, you see a piece of farming area, the geography word is over_ , the meaning is like farming, overcult-,
Ss		Cultivation.
Ms L		Over-cultivation, very good. Over-cultivation. You try to use more geographical words, ok? If too much farming, how to say it? Here, too much (many) animals is our daily use language. How to use geographical terms? Too much animals, anybody, can you try?
Ss & Ms L	09:31	Over-grazing.
Ms L		Very good. Over-grazing. And this part, today we just learnt this part. The soil becomes more poor (poorer), but what is the geographical word to describe soil becomes poor and loses the nutrients? And the last part is limitation we just leant today. Limitation about the money, about the knowledge, about the government, about the patent of GM crops.
		(*Students were doing independent work and Ms L was giving a special tutorial to less-able students.*)
Ms L		You just learnt too much plants in the water, the plants we call them ? your table, the scientific farming card, C&L card about scientific farming method. Here, the plant in the water we call it al-. Negative impact- here, you can find it here. What becomes more and uses up the oxygen? The name of the plants, you find it here and fill in the blanks here.
Emily		Finished?
Ss		No.
Emily		Which one seems to be the problem?
		(*Students continued to fill in the blanks.*)
Ms L		I see some of you really finished, ok? The last one is limitation. Some of you nearly done, ok. Sentina, can you turn off the light, let's check the answer. Actually, take a

		look. Sentina, turn off the light please. This one, look here. This is the first column, first part. This is the second part. Pay attention to the number. The third part is limitation. And try to use these materials, you can write an essay, ok, with organization. Let's take a look. Scientific farming methods such as, you give an example of scientific methods, for example, irrigation system. And then anybody? Machines, and then?
Ss		Pesticides and fertilizers
Ms L		Everybody, please. Because this is the sum up, ok, you can do a revision here. Pesticides and fertilizers, what is the fourth part? And technology, biotechnology. For example, GM crops. All these, read the word here. All these have – everybody! Underline, you can use the red pen and highlight the key words. How to link a sentence, ok? Have what?
S7		Positive.
Ms		This is positive. You mentioned positive effect on farming. Key words, increases. Describe the trend, you can use increase. This word describes the trend, increase or decrease, more or lower. Increases farmland and raises production. Underline "raises", ok? The word describe the trend and is useful for your essay writing. Improve, positive word, positive word. (Improve) efficiency, boost productivity or you can say raise, higher, this is the positive word. Underline "increases" and "speed up", positive words, "help", "resist". The first part, any question? Now we look at second part, what is second part about? Second part, use different color to highlight "also have negative impact". Please take a look, negative impact. So when you read the essay, you have to know which part you are asked about, maybe the essay only ask you the positive impacts, or negative impacts or both, ok? Let's take a look at negative impacts.

Ms L		No.1, these are geographical terms. Do not say over-water, you will get low mark. And over-cultivation, you can not say too much farming land. Too much farming land is no good. Try to use over–cultivation or over-farming. Over-grazing means too much live stock and they eat too much grass. What is the result, everybody? The result is soil- ,today we leant this word, soil de-
Ss		Degradation.
Ms L	02:22	Degradation, very good. And soil erosion. Very small word, so I read for you. Soil degradation, the blue color, blue color, soil erosion. Ok, again, negative word is less and unproductive, unproductive. This part is last lesson, damage health and poor environment, example is pollution. And today we learnt this word- algae bloom. Algae, here, more algae, too much algae will kill the what? Kill the fish. GM crops, people don't like it and do demonstration, demonstrate against GM crops. And some people report that GM crops can be, not must be, can be poisonous and cause the death, death.
Ms L	04:12	The last part is limitation, ok? Most of you can do the first part, now the second part is limitation. Same as your C&L card, not enough money. We have divided it into two parts. Economically, that means about the money. The second part is technology, technology. Low technology and their knowledge in China is low. They have to buy the patent of GM crops and the GM seeds are more expensive. They can not afford to buy. Can you get it? Ok, now, I will give you the sample answer. Don't need to copy now, do not copy now. ok, monitors, please pass out the

		answer. Next, everybody, geography exercise book. It's about the essay. Remember our exam has essay. And this is the marking scheme, marking scheme. Please put in your geography book. And tonight (have) homework. Because next week is our Christmas holiday, please do your homework so I can mark it before your Christmas holiday, ok? Monitors, come up.
Ms		Sentina, come up. 嗱， 你地功课有两版，我依家俾两版纸你，我依家俾两版纸你。听日交，听日交。今晚嘅功课係要形容嗰趋势，describe the trend。用你地嘅 notes，用你地嘅 notes。 知唔知你地有啲 table 啊，有 describe the trend， 用你地嘅 notes 哈。知唔知道？今日派好多， 你地嘅 model answer，你地睇一睇地理簿啊，睇一睇地理簿。你地师兄师姐做嘅 good work，睇咗佢。你地师兄师姐嘅 answer，唔使贴落地理簿，参考。嗱，讲一次，今晚嘅功课係要 describe，你睇一睇你地嘅功课，係要 describe 嗰 graph 噶。咁你就可以用我地啱啱派嘅 table，嗰啲字眼去做。譬如 increase，decrease，得唔得？
Ss		得。
Ms L	07:20	第二，我地有两张嘅功课纸，收唔收到？第三，啱啱地理簿改嘅 essay，有 model answer，同埋有 marking scheme，marking scheme 即係点样同你比分嘅，咁你嗰一张纸就贴落地理簿。Students' good work 係唔使贴落地理簿，Students' good work 係唔使贴落地理簿，因为太晒位啦，纯粹係晒位。（student asked a question.）呢个要贴。望一望我只手，呢张要贴。等你知道係点样比分，点样比分嘅，ok？好啦，有无人漏纸，无咩嘢出声留低。无嘅出声留低。Students' good work, 两张工作纸，marking scheme。好，走得，goodbye，class。

		Ms. C_6
S1	**Debate:**	Good morning, I am President and Representative of Biofuels Development Corporation. Here, I'd like to introduce to you the biofuels energy we are developing. Biofuel is a kind of fuels produced from organic materials. Biofuel is a good resource energy because, first, it is clean. It won't release a lot of air pollutants. Second, it is cheap to produce. Third, it can reduce both carbon dioxide emission and fossil fuels imports. Therefore, I strongly recommend that the Hong Kong Government consider our Biofuels Development Plan and cooperate with us.
S2	**Opinion:**	In my opinion, I will support the plan by the Nuclear Energy Resource Development Corporation. Because, firstly, it's efficient. Uh, very little bit of nuclear, uh, I mean, uranium can generate a lot of electricity. And it's very clean. It won't produce any greenhouse gases. Secondly, it is competitive in cost. Lastly, there is a large global reserve of uranium, so it can be (used for) generating electricity for a long time. Although it has some disadvantages, it also has a lot of advantages, a lot of good points. So, to sum up, I think Hong Kong Government should support the plan by Nuclear Energy Resource Development Corporation.

		Ms. S_1
T	00:00	Okay, you should already receive the worksheets that you've done last time, you will see there are some marks. Urr… writing with pencil. Okay, the first one is the mark for the content, content. And the second was circled, is the mark for your language. Okay, language. So, you can have a look on this exercise and I will collect back. Okay? I will give you about 1-2 minutes. Have a look and I will collect back the exercise.
Ss	00:41	[look at the worksheet]
T	01:12	Okay, if you've already gone through the exercise, you can pass the exercise to the front and I will collect back.
	01:37	[answer one student's question] You should be not using because it's not the one marked, the exercise, I will ask them later.
	01:54	[collect the exercise]
	02:08	Okay, let's go back to the powerpoint. Okay? Put down your pen. Pay attention here. Let's see what did we learn in the past few lessons about food and humans. [turn to the new slide and point at the slide] You will see from the questions --- What do we need to know about food substances? What do we need to know about food substances? From this powerpoint, you will find all the summary, all the things that you've already learned in these few lessons. Okay? And you can also find all this information from your textbook and also from your C&L card, Okay?
	02:58	The first one, definition for food substances. You've already done the essay-type questions asking you about … what are the structures of liquid. Asking you something about liquid, Okay? So, you should know about definition of that.
	03:20	[turn to the new slide] But when you start, when you start to write the answer for that question, do you think about that you can use these kind of sentence structures or you can use these kinds of word, especially those colored words. Okay? Let's go through some of them. The 1st one, [point at the slide] organisms that make their own food, Okay, they are called autotrophs. We can use the word "that" "are called". Or you can see some of the other examples --- "during", "which" or "refer to". Okay? When we talk about definition, we can use some of these words, can help you to make the sentence. If you have the content already, Okay, the exercises we've just distributed to you. You have content already, you can also have some language to help you to pack all the things that you've learned. Okay? This is definition.
	04:28	[turn to the new slide] How about the 2nd thing we need to know about food substances, characteristics, characteristics. [point at the slide] For example, when we talk about carbohydrates, when we talk about lipids, we know that they are organic substances. Okay? They are organic substances. What can they provide? They can provide some of the things. Some of the words that you can see from here, "taste", "form" … we can use this kind of words to show the characteristics of something. Okay,

		from this powerpoint, the characteristics of carbohydrates, Okay? Characteristics of monosaccharides, disaccharides and polysaccharides.
	05:29	Okay, and then we can move on, we can move on to the 3rd thing. It's about the classification, the classification about food substances. When we talk about classification, also look at the colored words. Focus on the colored words. What can we use to help us to tell us about classification of food? For example, [point at the slide] they contain… you can see the 1st one, food contains seven types of substances, and they are blablabla… Okay? You will see that we can use the words "contains" and "types of", Okay? We can also use the words "be classified into", "include" or "there are something like that". Okay? In fact, these colored words you've learned in this lesson, you can also use in other subjects. Okay? When you are writing some answers, even though some essay-type questions, these colored words can help you, Okay, to make your answer more fluent.
	06:47	[turn to the new slide] How about composition? Composition of food? When we need to talk about composition, [point at the slide] we can use carbohydrates are made up of protein, starch, … "are made up of something", Okay, "are made up of". And also, you can say "consist of", "contain", you can use these words.
	07:16	[turn to the new slide] Next, formation and decomposition. Formation, this thing is formed from something. [point at the slide] "is formed", "are formed", "is produced by something". Or you can use this, "disaccharides can be broken down into something?" So, you can learn from this, "is formed", "can be broken down", and "is produced", Okay? These are formation and decomposition
	07:54	[turn to the new slide] And next, function and importance, function and importance. When we talk about function, Okay, function and importance. For example, carbohydrates are something can provide … is stored or served as. And the last one, you can say lipids, lipids, the one you've just done in essay-type questions. Lipids transform or store something in our body, Okay?
	08:29	[turn to the new slide] Let's move on. Consequences, cause and effect. You've learned this word, you know "lead to", "lead to". For example, [point at the slide] a lack of protein in the diet may lead to a deficiency disease, cause … which disease, some of disease, Okay? "Lead to", "Lead to". And the last table, "because of", "due to". You just use "because", you give reason about consequences.
	09:09	[turn to the new slide] How about the last one? Sources. Sources of something, you can use this kind of word. For example, … and … are found, is found, or is stored. Or this one, cellulose is the main component ◦ Or you can just use very easy "come from", "come from", or "obtained from", "can be obtained from". Okay, these are the sources.

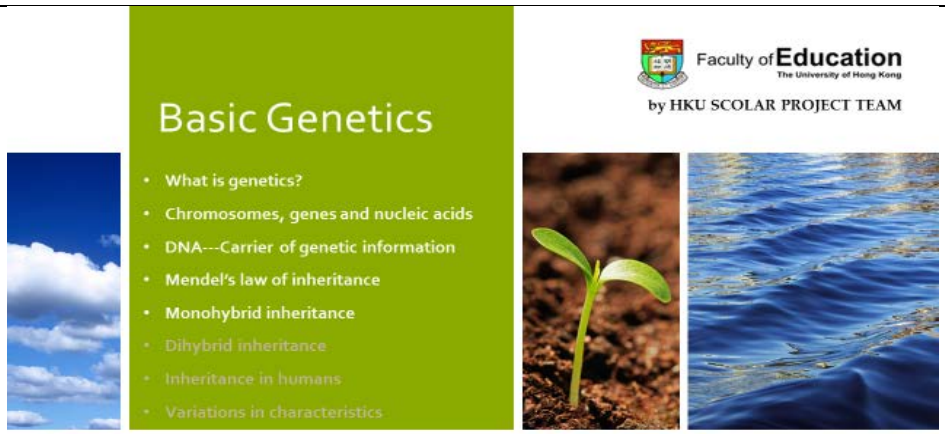
	09:43	[turn to the new slide] So, after we go through all these, what do we need to know about food substances? You will find that there are many words, the colored words that can help you, Okay, to show what did you learn.
	10:03	[turn to the new slide] Let's go through… urr, you should have this exercise already. Can you take it out? Okay, this one. Okay, can you take it out? Last time, we've already done this page [show class the page]. Okay, I've already asked you try to do this. Oh, if not yet, just try to that together, Okay? Food contains 7 types of food substances. They include…? Can you tell me?
Ss		[give an answer]
T	11:00	Carbohydrates. And then? Read loudly, Okay? Carbohydrates, and then? Read loudly, Okay?
Ss		Lipids.
T	11:09	Lipids. And then?
Ss		Protein.
T	11:11	Proteins, minerals, vitamins and dietary fibers. And the last one? Water. [turn to the new slide] And we've already gone through them one by one. For carbohydrates can be classified… Can you see the underlined word? "can be classified" is about classification, Okay? Into 3 types… And also, also from these carbohydrates, you can also see "is formed", Okay? The underlined word, "combine" "is joint together". Okay, from these words, you will know more about carbohydrates and link their relationship. How about lipids? Okay, can you see the word "has", "called" and also "are formed from". Okay? And the content for lipids. That means they are formed from fatty… and ….? These are the content, you can use some of the words to link them up. Okay? Protein consists of amino acid, dipeptide and polypeptide. Okay? Two amino acid join together to form a dipeptide. Many amino acids join together to form a polypeptide. And you know amino acid is the building block for protein, building block for protein. And when they join together with another amino acid, they will form a dipeptide. Okay, and the reaction we call "condensation". We call this "condensation"
	13:28	How about dipeptide? Okay, two amino acids join together to become a dipeptide and they will join together with another amino acid or some more amino acids to become a polypeptide. Okay?
	13:48	And vitamins. Vitamins, such as vitamin A, C and Vitamin D. They are essential for humans.
	13:59	And for minerals, can be divided into over 10 types and you've already learned some examples, calcium, iron… Because they are the most important, so we'll learn these two examples.

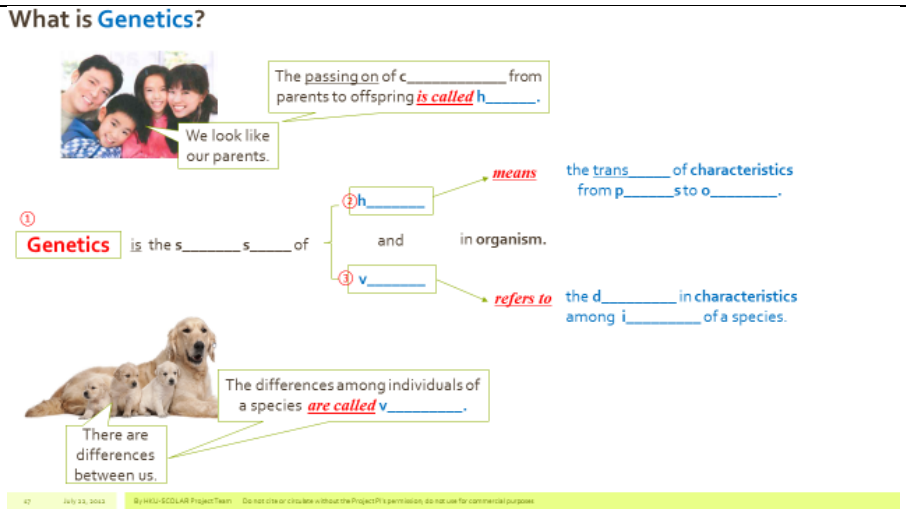
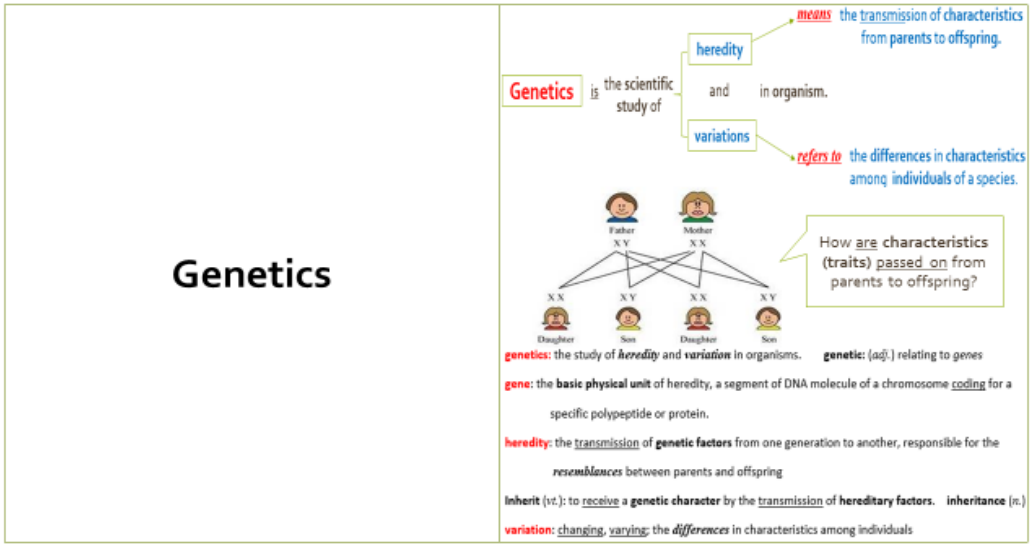
	14:23	Dietary fibers, consists of main, consists mainly of cellulose from plant cell walls. [point at the slide] You will find that from NO.6 and NO.7, the underlined word, can be divided into, can be divided into. And how about this? Consist of, consist of.
	14:46	And the last one, water. You will see the word, obtained from, obtained from. Okay, in this lesson, try to focus on these words. Okay? Because you've already learned about the content. In this lesson, try to focus on these words.
	15:15	After that, please take out your essay. Take out your essay about lipids. I would like to collect the essay now. Please pass it to the front. And then, take out this worksheet I've just given you. Okay? Pass the essay that you've done to the front.
Ss		[pass their essays to the front]
T	15:57	Also, pass the C&L questions. Should be this one. Pass this one to the front. And remember to put down your name, class and class number. Check! Did you put down your name, class and class number? Just pass it out if you have it. You do not have, remember to bring it back tomorrow. Okay? I will collect again tomorrow.
	17:22	[point at the slide] Before I discuss these questions with you, take out some highlight pens. Take out some highlight pens. If you find that there are some points that you need to highlight, maybe not the content… is the word I've asked you to focus today. For example, some word just like combine, consist of, that… the word like that. If you find that is useful for you to answer these questions, you can use your highlight pen. Okay? You can use your highlight pen to highlight these words. Okay? Let's go through these questions together. For the questions, [point at the slide] discuss the structure and functions of lipids in humans. I think it's not difficult for you to find out the answer. The structure and functions of lipids. Because all of them are in your textbook, in your C&L card. Okay? But how to make it into an essay? Let's see.
	18:42	[show an example on the slide] The 1st part, you've already had the worksheet, Okay? If you need to highlight, just highlight some of the important words that can help you to write this essay. Okay? The 1st one is about definition, importance and characteristics. For this question, it's talking about lipids. Okay? So, we need to try to define, try to talk about what is important, what are important, what are the characteristics of lipids. So, you can find out from this paragraph, maybe you can read this paragraph together. Lipids, … read this together, 1, 2, 3, lipids …
Ss		[read the paragraph together]
T	19:49	So, from this paragraph, [point at the slide] it's telling you what is lipid. Okay? What are lipids. So, lipid is something which is composed of … Okay? You can see from the colored words that you know what you should highlight. Okay? Lipids are something that doing something, can help something, Okay? And then, go to the 2nd part, you will find that from this part, from this paragraph, there is … should be from these two paragraphs. There are some topic sentences, some topic sentences. That means when someone needs to mark you essay, they will see from, they will find from these topic

		sentences--- what are you going to tell them, Okay? From this topic sentence, very short is enough, Okay? Very clear. The one needs to mark your essay, they will know what are included in this paragraph. Okay? So, in this paragraph, what is that? The structure of lipids. Because from the question, you will…is asking you about … discuss the structure. So, this is about structures.
	21:13	How about the 2nd paragraph? Lipids have the following functions, which is important for human life and activities. So, for this paragraph, should be structures, talking about structures. And this paragraph, talking about functions. Okay? And then, after that you will find that lipids are mainly made up of, those words that we've just learned in this lesson, "are made up of". And then, you need to give some example if you have, when you talk about structure of lipids, if you have some examples, you need to mention some of them. It is very important when you need to write an essay. If you have an example, you need to give out some of them.
	22:01	How about the 3rd paragraph? From the 3rd paragraph, it's asking you about functions. Maybe you know many functions of lipids. So, how can you answer this logically? Here are some logical connectors. You will see "first, second, third, fourth, fifth …" Very easy. But you need to know you can use. So that will be, you will present these functions logically. Okay? So, this is the example for you. You will see the total marks--- 10 marks. If you can use these things properly, you will get the other 3 marks, Okay, if you got all the points correct. If you make it messily, maybe you cannot get 3 marks. Okay? You only get 10 marks out of 13, Okay?
		Ms S_2
T	00:00	Let's go to the other questions. Contrast, contrast. The structure and functions of triglycerides and phospholipids. [point at the slides] Maybe I will not go through this now. You try to highlight, you try to highlight what are the important words that can help you to present these questions. Use your highlight pen, try to highlight. I think you can do that. In fact, there are some clues for you. It's not difficult to find out these words from this page.
Ss		[highlight the words]
T	02:06	Okay, finished? Let's look at the question together. [point at the slide] Contrast… Look at the question together. Contrast the structure and functions of triglycerides and phospholipids. Questions, total, 11 marks, Okay? Communication, 3 marks. Okay? Contrast the structure and functions. You know, you need to list out the structure, you need to list out the functions. How about contrast? Contrast? Okay, [show example on the slide] here is the …, [point at the slide] how to say this sentence? This is the …?
S		Topic sentence.

T	02:49	Topic sentence. Very good. Topic sentence, the structure and functions of triglycerides and phospholipids are different in the following aspects. Maybe when you answer different kind of questions, you can just also use these words --- They are different in the following aspects. And you list out how they are different, Okay? And then, [point at the slide] use these words again. How to say this? Logical … connector. Okay, first, second, third. Ah, this is first, secondly, third, fourth, Okay? And then, when you talk about the and function, there are some content, Okay, the noun. [show more on the slide] You need to contrast, you need to contrast. [point at the slide] Okay, list comparison pairs one by one. This is very important. Don't just use one paragraph talking about triglycerides, one paragraph talking about phospholipids. Okay, now from the question, it's asking you to contrast these two things --- triglycerides and phospholipids. So, you need to compare them one by one. Each one in one paragraph, Okay? So, here, first, second, third… like this. This is the 1st thing. And the 2nd thing, really, I always focus this word "contrast". So, you can use this. Did you highlight it? "while". If I don't want to use "while", is there any other word that you can choose when you are answering questions. Like this, if I don't want to use "while" …
S		When.
T	04:43	"When"? Any other suggestions?
S		However.
T	04:50	"However", very good. "However", or even we can use…?
S		But.
T	04:54	"But". Okay? [point at the slide] When we talk about contrast, we need to use this kind of words to help us to compare. And each paragraph, different points. Okay? Logical connect "while" to express the contrast. And these are ……. It's about the, about the… topic sentence. Okay? Or introductory sentence to this paragraph. Okay? Any questions for this part? About using this kind of words? Later, maybe you will have an exercise, similar to this. Okay? So, you need to try to use this kind of words to help you to finish exercises like this. Okay? Of course, you need to know about content. You need to know about content. But after you know about content, how can you connect all of them? Okay? So, that's all for today.

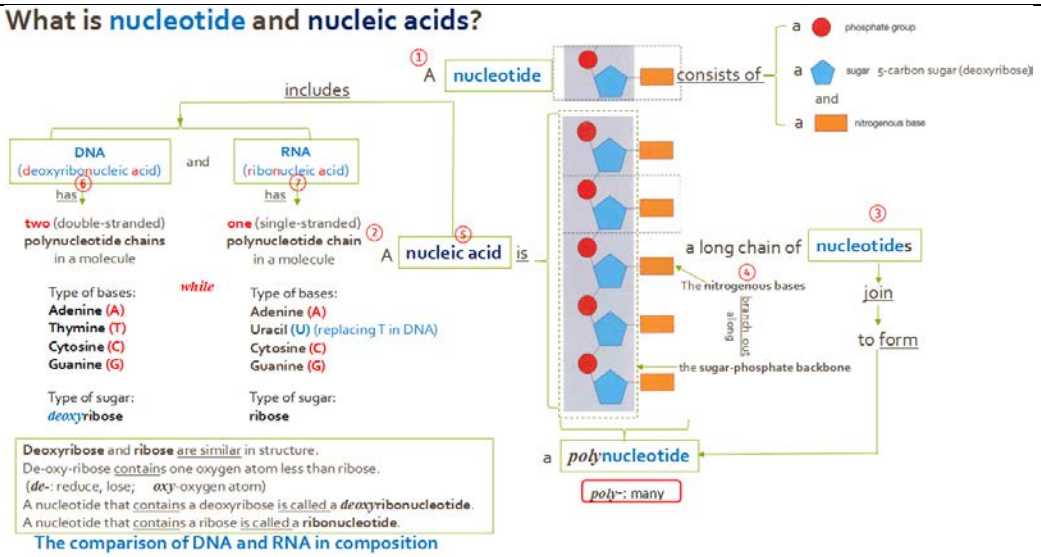
		Ms T_1.1
T	0:20	Today we are going to talk about a new chapter which is "Basic Genetics". Basic Genetics covers many areas. You see that on the screen.

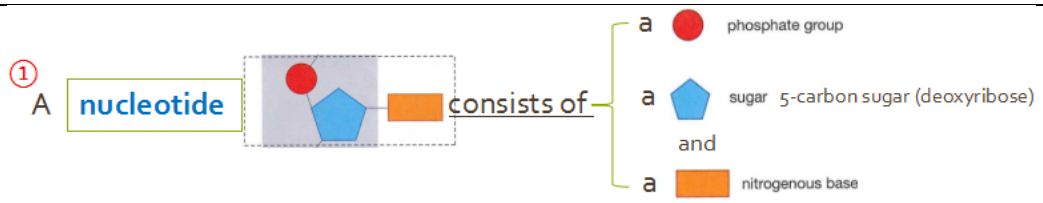
		
	0:40	[*Pointing to the PPT slide on the screen*]
T	0:42	And then today we'll go through the first three areas in this topic. Can you see what these three parts of this topic? Can you see these words? Yes or no? So the whole class please read these out. What are the first three areas we are going to cover?
Ss	0:58	What is genetics?
T	01:02	Good. And then the second area is about?
Ss	01:04	Chromosomes, genes and nucleic acids.
T	01:07	Yes. Very good. We will talk about the structural and functional relationship between the chromosomes, genes and nucleic acids. And then the third area we are going to cover is?
Ss	01:21	DNA---Carrier of genetic information.
T	01:25	Very good. And then later, in the later lessons we will cover other areas. So, let's go to the first area. "What is genetics?" Okay.
	01:28	[*Changing to the next slide which shows the topic "What is genetics?"*]
T	01:41	And then before we go through this part, please use the cue card ("C+L card") you have [showing the "C+L card"], use the cue card "genetics" to finish the first page of the worksheet on your own. No discussion is allowed. Do it by yourself first. Okay. I'll give you five minutes, for you to use the cue card about "genetics" to finish the worksheet page One. You may now start.
	02:13	[*Students started to do the worksheet (a "C+L map" about "What is genetics?") by reading and searching information on the "C+L card"*.]

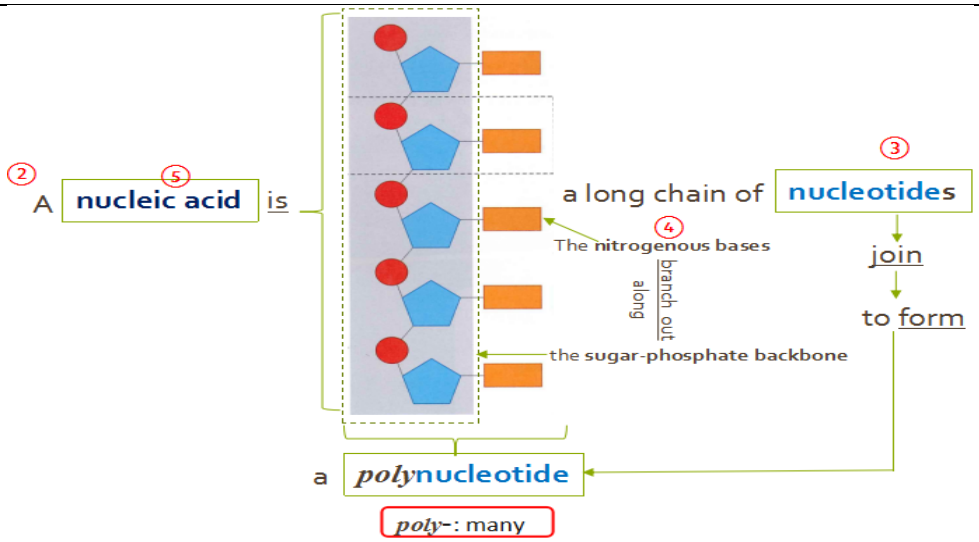
		
		
T	2:18	If you have any problem, you can raise up your hand. I'm going to help you.
T	2:39	After finishing the worksheet, make sure that you know how to read the words. And then I'll ask some of you to give us the correct answer.
	2:50	[*Students were doing the worksheet. The teacher walked around observing how they finished the exercise. She then wrote on the right-hand side of the blackboard "C+L cards C-concept L-language"]*
T	5:42	[*Talking to one student who had finished Ex.1 and started to do other exercises in the worksheet*] I just asked you to finish the first page. There is no need for you to finish this part. Okay?
	5:50	[*Talking to whole class*] What you need to do is just Ex.1, Exercise page 1. There is no need for you to do the other pages right now.

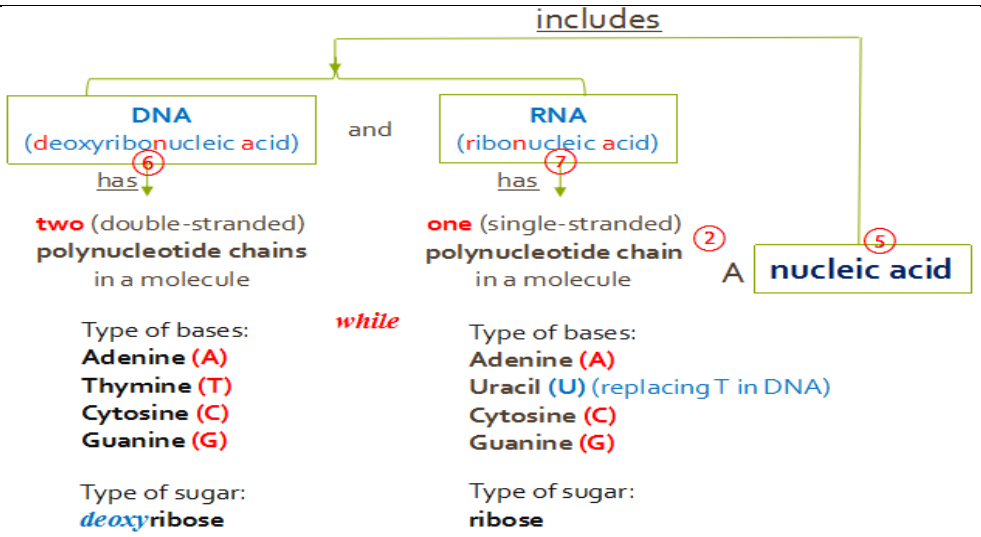
	6:05	Alright. Who do not finish the first page please raise up your hand. No? All finished? Very good. Put down your pens first. Put down your pens first. And then I'll give you one minute to discuss with your classmate about your answer. One minute. Do it now.
		[*Students started to discuss with their peers about the answer to Ex.1*]
T	6:47	Just find out if there are any differences between the answers of yours and your classmates'.
T	7:15	And you can ask your classmates how to read the words.
T	7:23	Okay. Time is up. Time is up. Take out your green ball pen. Okay? Take out your green ball pen to correct your answer.
T	7:32	Okay. Eva, would you please tell me what is the definition of "genetics"? You will see that, we, family members usually look alike. Why? Because there is something about genetics. Stand up first. What is genetics? The…
		[*Student stood up, reading out the answer from the worksheet in her hands*]
S	7:50	Genetics is the scientific study of heredity and variation.
T	7:56	Yes. Genetics is the scientific study, sit down please, of heredity and variation. And I would like to know, I would like to know what is heredity? What is heredity? Hm, uh, Keung Gor.
		[*Student stood up, reading out the answer from the worksheet (C+L map) in her hands*]
S	8:16	Heredity means the transmission of characteristics from parents to offspring.
T	8:24	Yes. Heredity means, sit down please, the transmission of characteristics from parents to offspring. If I forget the word "transmission", if I forget the word "transmission", what word can we use instead of "transmission"? You can find this word in this page of exercise. If I forget how to spell "transmission" and I am required to write down what is heredity, you'll see heredity means the… What word can we use instead of "transmission"? Okay, Zoey.
S	9:03	Passing on.
T	9:05	Louder please.
S	9:06	Passing on. [*Trying to sit down*]
T	9:07	Passing on. Stand up. Stand up. Would you please give us the answer about the first sentence? The passing on …
S	9:16	The passing on of characteristics from parents to offspring is called heredity.
T	9:23	Good. So the passing on or transmission of characteristics from parents to offspring, offspring means the next generation. If I don't know how to, uh, if I forget to use "means", I can use "refers to" instead of "means". So offspring refers to the next generation. Okay? Offspring means or refers to the next generation. So you'll find that the passing on of

		characteristics from parents to offspring is called heredity. How about variation? We find that there are some differences between you and your brothers, there are differences between you and your sisters. You see that there are variations between us. So what is the definition of variation? Uh, Michael Fung.
S	10:26	[*Reading out the answer from his worksheet(C+L map).*]Variation refers to the differences in characteristics among individuals of a species.
T	10:32	Very good. Variation refers to or means the differences in characteristics among individuals of a species. Sit down. Thank you. So you will see that among our brothers and sisters there are differences, although we look alike, but there are still some differences between us.
	10:55	And… please take out the C&L card about genetics. I find there are some words on this C&L card. C means "concept", and L refers to "languages", OK?
	11:14	So let's look at this C&L card about the genetics. Genetics is different from "genetic". Please note that "genetics" is a subject … "genetics" is a subject. It's the study of heredity and variation what you learned long long before on the exercise, right? It's the study of heredity and variation enominisms . But "genetic" without an "s" is an adj., something relating to genes. You may ask what is gene, you may ask what is gene. So whole class please read the definition of genes to Mr.? Please, the...
S	12:00	*[whole class reading the definition of gene].* Genes are the basic unit of heredity. The sequence of bases on a gene provides the genetic code or instructions for making a particular polypeptide or protein
T	12:15	Very good. You learn what is polypeptide and protein when you were in Form 3, right?
	12:22	*Turning back to the blackboard and writing "coding for".* Here is the word coding for ,right? [*Turning back to the students.]*We can still use the other word instead of this*. [Turning back to the blackboard again and writing].* e-n-c-o-d-i-n-g. [*Facing the students again].* You can use these two words. Use the one you can remember, OK?
	12:38	Coding for is a specific polypeptide or protein and encoding for is …….OKay.
	12:50	Heredity and variation, you learned it from the exercise. I won't repeat them. But what is 'inherit'? "Inherit" is the verb. It means that you receive a genetic character led your ….led the size of the eyes. OK? Um, genetic character, by the translation of heredity factors… Uh, if I just forget how to spell "translation", what word can we use instead of ….
S	13:22	Hereditary factor……..
T	13:25	Very good passing on to hereditary factor. "hereditary" is an adj., OK? "hereditary" is the adj. "inherit" is the verb. OK? "inheritance" is the noun for this thing. OK? Now would you please follow me to read these three words? Inherit, hereditary, inheritance.
S	13:47	reading the three words after the teacher

T	13:56	If you know how to read the words, you will know how to spell the words and you won't mistake them, OK?
	14:04	And we find that… *going back to the computer*
	14:14	Here are some substances in our body that determine the patterns of inheritance of some characteristics. Why you have big eyes? Why I have small eyes? What substances determine the patterns of inheritance of characteristics?
	14:32	*Turning to the computer desk*
	14:34	We ……..something you know that. About DNA, OK?
T	14:43	[pointing to the subtitle of lesson on the PPT slide shown on the projection screen]
	14:43	So let's go to the second area of basic genetics. It's about "The structural and functional relationship of chromosome, genes and DNA". Okay.
	14:58	[Shifting to a new PPT slide A 'C+L Map': "What is nucleotide and nucleic acids?"]
		
	15:01	Let's look at the PowerPoint here please. Okay.
		[pointing to the title]
	15:04	What is nucleotide and nucleic acids? You learned these chemicals when you were in Form 3, right? Okay.
	15:13	[pointing to the thematic pattern about 'nucleotide' in the 'C+L Map']

		
	15:15	A nucleotide, nucleotide consists of three parts. What are these three parts? Can anyone of you tell me? WY.
WY	15:26	Phosphate group
T	15:27	Phosphate group, very good. And then the second part? [Pointing to the figure followed by the words '5-carbon sugar(deoxyribose)']
WY	15:31	Ribose.
T	15:32	Ribose. How about if it is the DNA? [Pointing to the figure again] It should be...
WY	15:41	Deoxyribose.
T	15:43	Deoxyribose. Very good. And then?
	15:45	[pointing to the figure for 'nitrogenous base']
WY	15:46	Nitrogenous
T	15:49	Nitrogenous...? [circling around the word 'base' in the term 'nitrogenous base' beside the figure on the screen] Can you, can you try to read this word?
WY	15:57	Base.
T	15:58	Base. Good. Sit down.
	15:59	So you'll find that a nucleotide consists of, con-si-sts of...
	16:02	[pointing to the underlined phrase 'consists of' in the thematic pattern on the C+L Map.]
	16:03	If I don't know how to use 'consists of', you can use 'has' instead. H-A-S has instead of 'consists of'.
	16:11	[pointer moving along the thematic pattern of 'nucleotide' and read out again the complete sentence as shown by the thematic pattern.]

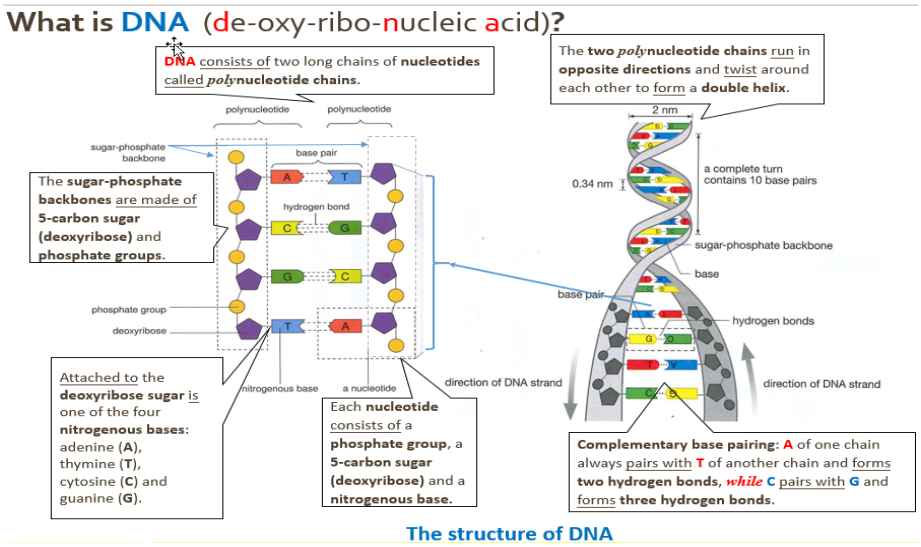
		
	16:14	Okay. A nucleotide consists of three parts: the first part is the phosphate group, and then second part is the, is a 5-carbon sugar, it may be ribose, it may be deoxyribose, depending on it is RNA or DNA. Okay? And then they must have, they must have the nitrogenous base.
		[pointer circling around the relevant figures and words in the thematic pattern of 'nucleotide']
	16:35	If these three parts compose together, a nucleotide is formed.
		[pointer moving along the thematic pattern of 'nucleic acid']
	16:42	How about a nucleic acid? Nucleic acid is a long chain of nucleotides, join, to form, a polynucleotide. You can see that, simply speaking, a nucleic acid is a polynucleotide.
		[pointing to the prefix of polynucleotide (i.e. 'poly-') with the explanation of its meaning in a red square below 'poly-: many']
		Ms T_1.2
T	0:00	What does 'poly-' mean here? Poly-saccharide is formed from many many mono-saccharide. So you will see that 'poly' means? Whole class.
Ss	0:18	Many.
T	0:19	Many. Very good. So, a nucleic acid, simply speaking, is a polynucleotide.
		[pointer moving along the semantic items within another thematic pattern on the C+L map about the comparison between RNA and DNA.]

		
T	0:26	You'll see that, nucleic acid has two types, or nucleic acid 'includes' (the underlined verb on the C+L Map) two types: One is DNA and the other is RNA.
		[Pointer circling around the square in the thematic pattern within which there is the Acronym 'DNA' and its full name '(deoxyribonucleic acid)'. The letters 'd', 'n' and 'a' in the full name are highlighted in red.]
	0:35	Can anyone of you tell me the full name of the DNA? Full name of the DNA. KT
KT	0:41	Deoxyribonucleic acid.
T	0:44	Good. Deoxyribonucleic acid. How about the RNA? The whole class.
Ss	0:50	Ribonucleic acid.
T	0:54	Good. Ribonucleic acid.
		[Pointing to the highlighted title on the C+L Map 'The comparison of DNA and RNA in composition']
	0:58	If there is a question, asking you, to do the comparison of the DNA and the RNA in composition. How can you write the sentences? [pointing to the words again] How can you write this essay about the comparison of DNA and RNA in composition? I'll ask some of you, to use the information on this screen to give me the sentences about this comparison. Okay. I give you one minute, to look at this information, [pointer circling around the relevant information in the thematic pattern] to look at this information, and then I'll ask some of you to do the comparison for Miss T. Let's use the information now. You can discuss with your classmates, okay, in this one minute. You may now start.
S-S	1:44	[Students discussing in pairs or in groups with the relevant C+L map and C+L cards at hand]
T	2:44	Ten seconds left.

T	3:03	Okay. Let's start with the first characteristics between the DNA and RNA. Okay. Um, LG. Please give one comparison, one difference between the DNA and RNA.
		[While the student was answering the question, the T moves the pointer along the corresponding thematic items in the thematic pattern.]
LG	03:25	DNA contains, [seeing T moving the pointer to the verb 'has' in the thematic pattern, LG changed the verb 'contain' to 'has'] has two polynucleotide chains in a molecule [T moving the pointer circling the logical connector 'while'] while RNA has one polynucleotide chain in a molecule.
T	03:31	Very good. Sit down.
		[pointer moving to the corresponding semantic items in the thematic pattern to explain the sentence again]]
	03:40	DNA has two polynucleotide chains in a molecule, WHILE RNA has one polynucleotide chain in a molecule. How about the second comparison? Um, JK
JK	04:00	Uh...
		[T moving the pointer to the semantic item 'DNA' suggesting that the student may start the comparison with the characteristics of the concept]
T	04:03	DNA ...
		[As the student sat relatively far away from the screen, she could not read the words on the screen clearly.]
JK	04:10	Sorry I can't see it.
T	04:11	Oh you can't see it. Can you find the information from the C+L card about the Deoxyribonucleic Acid?
	04:21	[Student reading the C+L card about DNA in her hand]
T	04:22	[T giving hint about the location of the related information in the C+L card]DNA has bases like...
JK	04:27	Thymine.
T	04:28	Good. Thymine.
JK	04:29	Cytosine.
T	04:29	Cytosine, very good.
JK	04:31	Gran::: guanine ([gwa:nain])
T	04:35	[gwa:nain]? ['gwɑ:ni:n]
JK	04:35	['gwɑ:ni:n]

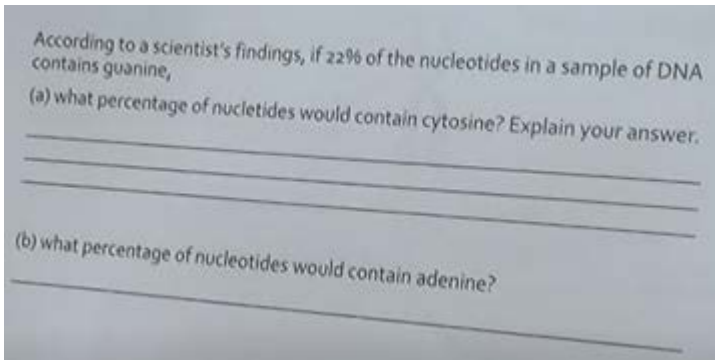
T	04:37	And...
JK	04:38	Adenine.
T	04:39	Adenine. Very good.
	04:41	[pointer moving to the corresponding semantic items in the thematic pattern to explain the sentence again]]
	04:44	DNA has bases like adenine, thymine, cytosine and guanine.
		[T then moving the pointer around the logical connector 'while']
JK	04:52	While
T	04:53	While. Very good.
JK	04:54	RNA
T	04:56	RNA...
JK	04:57	Consists
T	04:58	Has
JK	05:01	Bases like...Adenine
T	05:06	Adenine, good.
JK	05:10	Cytosine
T	05:11	Cytosine, good.
JK	05:13	Guanine.
T	05:14	Guanine, and...
JK	05:15	U:::
T	05:20	Try to read this out. U:::
JK	05:21	[still cannot read out the word 'Uracil']
T	05:27	How do you read 'R-A-T'? R-A-T
JK	05:30	Rat.
T	05:31	Rat. And then C-I-L?
JK	05:33	[S::::]
T	05:35	How do you read I-L-L?
JK	05:36	Ill.

T	05:39	Ill. So this word should be...
JK	05:40	Uracil.
T	05:41	Good. Uracil. So, the whole class. Read these phrases out. First adenine.
Ss	05:47	Adenine.
T	05:48	Thymine.
Ss	05:49	Thymine.
T	05:50	Cytosine.
Ss	05:51	Cytosine.
T	05:52	Guanine.
Ss	05:53	Guanine.
T	05:53	And in the RNA, you'll find that, uracil.
Ss	05:57	Uracil.
T	05:59	Instead of the Thymine. So very good. You've made the second comparison. How about the last comparison between DNA and RNA? Um, ZH
ZH	06:11	DNA has deoxyribose while RNA has ribose.
T	06:18	Good. Sit down. DNA has the deoxyribose while the RNA has the ribose. So if you make these three sentences, these three comparison, you can write a short essay about the comparison of DNA and RNA.
		[T went on explaining the differences between deoxyribose and ribose by moving the pointer along the notes on the C+L Map.]
	06:38	Deoxyribose and ribose are carbon sugar. They are similar in structures. They are 5-carbon sugar. But, for the deoxyribose, they contain one oxygen atom less than ribose. So this is why we say that deoxyribose, 'de-' means reduce, "de-" means reduce; 'oxy-' means oxygen, 'oxy-' means oxygen. So deoxyribose, you will see that there is one oxygen atom less. There is one oxygen atom less. A nucleotide that contains a deoxyribose is called a deoxyribonucleotide. A nucleotide that contains ribose, [pointing to the figure of 5-carbon sugar in the C+L Map], if this is the ribose, it is called the ribonucleic acid. So you'll find that there are three differences between the DNA and RNA. Okay.
T	7:44	And this time, it's your job now. Okay, use the C+L card, about the gene and the chromosome. Okay. Oh, sorry, use the C+L card about the DNA to finish the worksheet, to finish the worksheet page 2. Okay. To finish the worksheet page 2 now. Use the information given on the C+L card 'Deoxyribonucleic Acid'. Finish the second worksheet now.

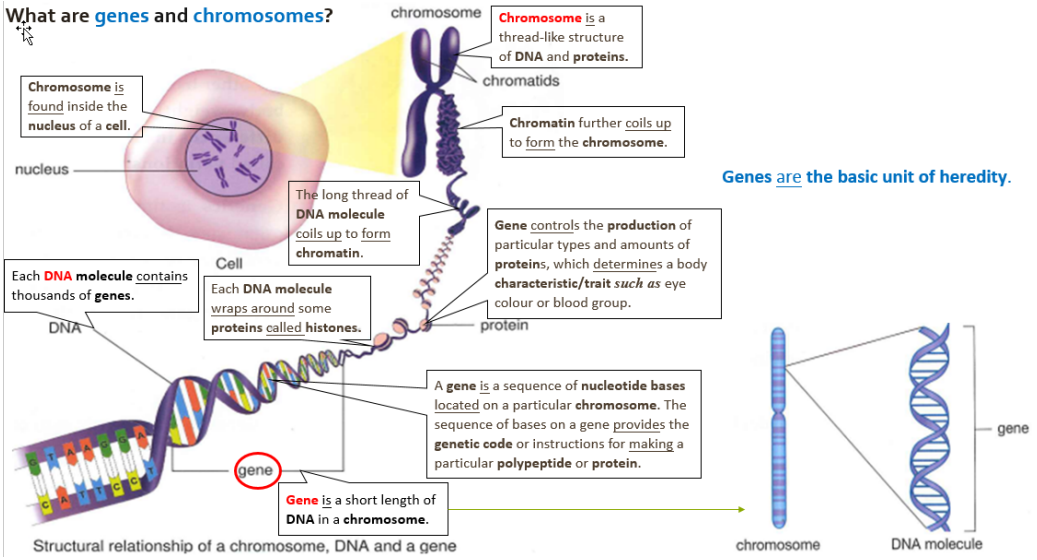
S	08:13	[Students filling in the worksheet (a C+L Map about 'What is DNA?')] by consulting the relevant information on the C+L card 'DNA']  The structure of DNA
T	11:40	Do you need more time to finish the worksheet? Have you all finished? Very good. Okay. Let's look at the answer. Um. MD, please tell me, what is DNA?
MD	11:58	[Reading out the answer from her worksheet] DNA consists of two long chains of nucleotides called polynucleotide chains.
T	12:05	Very good. DNA consists of two long chains of nucleotides called polynucleotide chains. If I don't know how to use consists of, what word can I use instead? Um. KK
KK	12:23	Contains
T	12:26	Contains …
KK	12:26	Has.
T	12:27	Or has, very good. You can use contains or has instead of consists of.
		[Asking more questions with the worksheet at hand]
	12:34	Okay. You'll see that, in the DNA, it is made up of, or it consists of two chains of nucleotides. And you'll see that one nucleotide consists of three parts: One is the phosphate group, the other is the 5-carbon sugar and the nitrogenous base. Okay.
	13:03	Can you tell me the sugar-phosphate backbone? What are sugar-phosphate backbones made up of? Ah, DJ
DJ	13:18	The sugar-phosphate backbone is made up of 5-carbon sugar
T	13:24	And…?
DJ	13:25	And phosphate group

T	13:27	Very good. You will find that the sugar-phosphate backbone is made up of 5-carbon sugar and phosphate group. Okay. And then, in the DNA molecule, attached to the deoxyribose sugar, what are the nitrogenous bases? What are the nitrogenous bases you can find in the DNA molecule? LO.
LO	13:54	[reading out the answer on his worksheet]Attached to the deoxyribose sugar is one of the four nitrogenous bases: Adenine
T	14:03	Good.
LO	14:03	Thymine.
T	14:04	Thymine.
LO	14:05	Cytosine.
T	14:06	Cytosine.
LO	14:06	And Guanine.
T	14:07	And Guanine. Very good. In a DNA molecule, you can find these four kinds of bases. And each nucleotide consists of three parts. As I've told you many times before, what are these three parts? Okay. TB.
TB	14:30	Each nucleotide consists of a phosphate group.
T	14:34	Phosphate group.
TB	14:35	5-carbon sugar.
T	14:36	5-carbon sugar.
TB	14:37	And nitrogenous bases.
T	14:38	And nitrogenous bases. And I would like to know, what kind of 5-carbon sugar you can find in a DNA molecule?
TB	14:46	Deoxyribose.
T	14:47	Good. Deoxyribose. Sit down. So you'll see that the two... Please look at the worksheet. The top of right-hand side. The two polynucleotide chains, one in opposite direction. One in opposite direction. Or you can say, one in anti-parallel way. You can write it down. [students write down the term 'anti-parallel' in the margin of the C+L Map worksheet]. Run in opposite, these two chains run in opposite directions or run in anti-parallel pattern, anti-parallel way. Okay. Do you know how to spell 'anti-parallel'? Uh. The whole class. Spell it out. A…
Ss	15:35	A-N-T-I P-A-R-A-L-L-E-L

T	15:41	Good. Anti-parallel. And these two chains twist, twist around each other to form a double helix.
		[right hand fingers showing the gesture of 'twisting']
	15:54	Because it is made up of two chains, we say that it is a double. Because it twists around, we say it a helix. So you'll find that the DNA has a double-helix structure.
	16:08	Complement… You'll find that the bases paired up in a regular way with each other. Complementary base pairing. What (base) of the chain always pair up with which base? Which base will pair up with which base? Can you tell me the answer? Okay. KT
KT	16:26	Adenine always pair up with thymine, and cytosine always pair up with guanine.
T	16:44	Very good. Adenine always pairs up with thymine, guanine always pairs up with… What did I say before? Guanine always pair up with…
Ss	16:54	Guanine always pair up…
T	16:55	Guanine always pair up with…
Ss	16:57	Cytosine.
T	16:58	Cytosine. Very good. Thanks for your reminder.
		Ms T_1.3
T	0:00	But in-between the adenine and thymine, how many hydrogen-bonds are formed? Between the adenine and thymine, how many hydrogen-bonds are formed between them? Um. ZY.
ZY	0:18	Two.
T	0:19	Louder please.
ZY	0:21	Between adenine and thymine
T	0:22	Adenine and thymine, how many hydrogen-bonds?
ZY	0:24	Urr…Two.
T	0:26	Two. How about guanine and cytosine?
ZY	0:30	Three.
T	0:30	Three hydrogen-bonds. Thank you very much.
T	0:34	So you'll know that in a DNA molecule, in a DNA molecule. Please look at your worksheet or your C + L card about DNA. You'll see that A pairs up with T, G pairs up with C. If we know this, if we know this theory, we can finish the question (that) always appears in examination. On page 3. Turn your exercise to page 3. Please do this exercise now. If you

		know this clearly, you'll know how to answer this question which appears, always appears in examination. Of course simple mathematics, simply calculation is required. Do it now.
	1:24	[Students started doing the exercise] 
T	01:27	No discussion right now. Do it by yourself.
T	02:31	For the first question, you are required to give the reason, okay. For the first question, you are required to give the reason.
T	03:11	For the second question, please don't just give the answer. Please show your calculation. For the second question, please don't just give the answer. Please show your calculation. Sometimes the calculation is worth marks.
	4:45	I'll give you one more minute to finish the worksheet.
	5:36	Fifteen seconds left. Anyone needs more time? I see some of you are still writing.
	6:26	Anyone of you still needs more time? No. Put down your pens. Discuss your answer with your classmate now. And see which part you don't understand. Ask your classmate first. One minute for the discussion.
	6:40	[Students discussing in pairs or groups the answers to the exercise, pointing to the worksheet and exchanging opinions]
T	7:01	No writing is allowed at this moment. Put down your pens. You can only do the discussion with your classmates. No writing. No writing. No writing. That's no need for you to write anything.
T	7:38	Okay. Let's check the answer. Okay. Let's check the answer. KT, what answer did you give to this question?
KT	7:53	For question A, my answer is 22%.
T	7:55	The answer is 22%.
		[Reading out and elaborating the question]
	07:57	You can find that there are 22% of cytosine in the DNA molecule. Explain your answer.

KT	08:05	Because cytosine pairs with guanine to form 3 hydrogen-bonds by complementary base pairing.
T	08:11	Very good. Because guanine pairs with cytosine. If there is 22% of guanine in this DNA molecule, there must be 22% of cytosine in this DNA molecule, right? Sit down please. Thank you. Very good. If there is 22% of guanine in this DNA molecule, there must be the same amount, 22% of cytosine in this DNA molecule, because guanine pa:::irs with cytosine, right? This is the main point. And you'll find that in this molecule, the remaining, the remaining nitrogenous base, the remaining percentage of nitrogenous base will be… Ah, SK. Stand up. Listen to the question from Miss T.
		[SK stood up and listened to the teacher's question carefully]
T	09:11	If there is 22% of guanine in this DNA molecule, there is 22% of cytosine in this DNA molecule, what is the remaining percentage of the remaining bases?
SK	09:25	Urrr…[SK had very brief mental calculation] Fifty:::six.
T	09:29	Fifty-six. Very good. One hundred percent minus forty-four percent. Thank you very much. Very good.
		[T moving the pointer in the air miming the writing of the equation 100%-44% and repeated the expression again]
	09:38	One hundred percent minus forty-four percent. You'll see that there is fifty…Fifty what?
Ss	09:45	Fifty-six.
T	09:46	Fifty-six percent of nitrogenous base left in this DNA molecule. So, what will be the answer for Question B? DM
DM	10:01	Ur, twenty-eight percent.
T	10:02	Louder please.
DM	10:03	Twenty-eight percent.
T	10:04	How did you make this twenty-eight percent for your answer?
DM	10:08	Urr, first of all, um, um, divide, uh, I meant using the remaining percentage. [DM was moving his hands trying to show his calculation process with the help of the gesture] Using the percentage of cytosine and guanine to, uh, minus, uh, one hundred percent. Therefore, there's, there're uh, the answer would be fifty-six percent. Then…
T	10:32	Fifty-six percent. And then?
DM	10:33	Fifty-six percent, and then divided by two.
T	10:35	Divided by two. Thank you very much. A hundred percent minus forty-four percent, you'll have the fifty, fifty-six percent. And then this fifty-six percent must be adenine and thymine, right? This fifty-six percent must be adenine and thymine. And the question asks

		you [pointing to the question on the worksheet] what is the percentage of the adenine? You just divide the fifty-six into 2, divide the fifty-six into 2. You'll have the percentage of the adenine for the answer. Okay. It will be twenty-eight percent. And the answer will be twenty-eight percent. Do you understand that? It that clear to you all? Okay. Very good.
T	11:23	We know what is DNA. What is the relationship between DNA and genes and chromosome? So please use the C+L card about the genes and the chromosome to finish the exercise on page 4 now.
		[Students were flipping the piles of C+L cards trying to find out the cards about genes and chromosome]
	11:44	We know the structure of DNA. But what is the relationship between the DNA and the gene and the chromosome? Please use the C+L cards to finish the exercise on page 4. Do it now.
	11:57	[students were doing the exercise by searching for relevant information from the C+L cards] 
T	13:10	[A student was trying to ask the T a question about the previous exercise which he could not understand clearly. The T reminded him to ask the question in English.]
		Could you ask your question in English?
		[T tried to explain the answer of the exercise to the student after he rephrased the question in English.]
T	13:23	Guanine pairs up with the cytosine. Adenine pairs up with thymine. In the DNA molecule, they should, you'll find that only these four kinds of nitrogenous bases can be found in a DNA molecule. Only these four kinds. So if, guanine and cytosine has fifty-six per…Sorry forty-four percent, the remaining bases that means, adenine and thymine must have the fifty-six percent, right? As adenine pairs up with thymine, so, just for these two kinds of bases, they have fifty-six percent. So this is why we divide the fifty-six percent into two. It

		should be either the adenine or thymine, not other bases, only these two types of bases. And A must pair with thymine. A will not pair up with Adenine, right? A will not pair with A, G will not pair with G. A only pairs up with T. So for this fifty-six percent bases, or nitrogenous bases, you'll find that the adenine, the amount of adenine is the same as the thymine. So this is why we divide the fifty-six percent into two.
		[When the student showed his understanding, the T stopped and started to check whether the students had finished the exercise.]
T	15:09	Okay, do you finish your worksheet? Anyone needs more time? TB, do you finish? Thank you.
T	15:24	Okay, let's look at this worksheet. Genes. What are genes first? Okay. What are genes first? Uh…EV. Would you please tell me what are genes?
EV	15:41	Genes are the basic unit of heredity.
T	15:44	Genes are the basic unit of heredity. Where did you find the answer? On the C+L card? Which card you can find the answer? The C+L card about? About? About genes or chromosome or …?
		[The student searching her cards for the answer]
EV	16:07	Genes
T	16:08	About genes. Where you can find the answer? In the first paragraph? Or in which (dialogue) box?
EV	16:35	[read carefully]Above the cell.
T	16:36	Above the… the what diagram? What diagram you can see here? What is it? It is a …
EV	16:48	Animal cell.
T	16:49	Animal cell. Very good. EV found the answer above the animal cell. Why EV said that it is an animal cell I wonder? Why isn't it a plant cell? Why is it an animal cell? You learned it when you were in Form 3, right? Why it is an animal cell? DN
		Ms T_1.4
DN	00:15	It is because, uh, it does not have cell wall.
T	00:19	Very good. Because it does not have cell wall. So it is an animal cell. And EV found that genes are the basic unit of heredity. Please look at the bottom part of this exercise. The gene. So, genes are the basic unit of heredity. How is it made of? How is the gene made of? Please give me the answer above the bottom box to us, okay? Uh…TD. Would you tell me gene? What is gene made of?
TD	00:58	[Reading out the answer from his C+L card] Gene, is a segment of the DNA molecule of a chromosome encoding a specific polypeptide or protein.

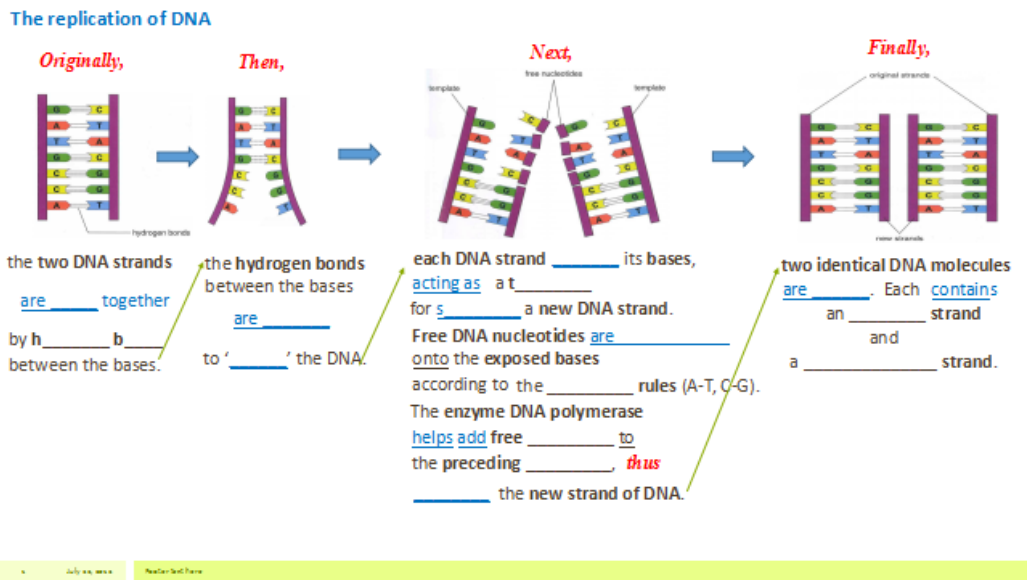
T	01:08	Yes. Gene is a segment of DNA. Sit down. Gene is a segment of DNA or gene is a short length of DNA, a segment of DNA in the chromosome, encoding or coding for a specific polypeptide or protein. How can the gene…Also look at the box at the right-hand side, at the bottom of the right hand side. A gene is a sequence of nucleotide bases located on a particular chromosome. Of course a chromosome contains many genes. The sequence of bases on the gene provide the genetic code. The sequence of bases: A, A, T, T, G, G, C, this sequence of bases may be the genetic code or instructions for making a particular polypeptide or protein. So different organisms will have different base sequence to make different types of protein, to code for different kinds of protein. Okay. So we have different characteristics. Also, look at the box in the middle or the exercise on the right-hand side. Genes control the production of particular types and amounts of proteins, which determines the body characteristics or traits, such as the eye colour, or the blood group. Okay. Or the blood group. We know that, because the bacteria in the cow has some sequence of bases, some specific sequence of bases, this specific sequence of bases help the bacteria in the cow to make the cellulase. How about we people? We people do not have this sequence of bases, so we cannot make this kind of cellulase. This is why we do not have cellulase to digest the cellulose. Okay. We just have the base sequence to produce the protein amylase to digest the starch. Okay. So this is why we eat starch instead of the cellulose to obtain glucose. Okay.
T	3:46	And then look at the box in the middle. Each DNA molecule wraps around some proteins called histones. You can find that the histone is like a macaron. Okay. The structure, the size of the, the shape of the histone is just like a macaron. Ah, (which) you eat always. And the long thread of DNA coils up to form chromatin. Chromatin is not visible under the microscope. Okay. And then the chromatin further coils up to form the chromosome. You can see the chromosome under the microscope. It is visible. Okay. And chromosome is a thread-like structure of DNA and protein. Chromosome consists of DNA and protein. Where you can find the chromosome? Can you tell me where you can find the chromosome? Um…MG
MG	04:52	We can find the chromosome…[Reading the worksheet (C+L map) and searching for the answer]
T	04:57	We can find the chromosome in the …
MG	05:00	In the cell
T	05:01	Louder please.
MG	05:02	We can find the chromosome in our cell.
T	05:04	In our cell. Yes, I know that. In which structures in our cell?
MG	05:09	In the nuclear.

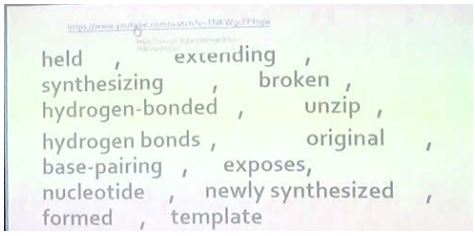
T	05:10	Nucleus of our cell. That's very good. Sit down. Chromosome is found inside the nucleus of a cell. So you'll see that these are the structural and functional relationship between DNA, genes and chromosome. Okay.
T	5:35	[The T shifting the PPT slides to a new topic]
	5:36	Ah, the answers for this part, and this is the C+L card about the genes, this is the C+L card for the chromosome. And the let's take the C+L card about the allele, the allele. Okay.
		[holding the C+L card 'allele', the T started to elaborate on the knowledge about the concept allele]
	05:57	What are alleles? Allele is one of the alternative forms of gene. We all know that, half of the chromosomes are given from our mother. Half of the chromosomes are given from our father. Okay. So, you'll find that the chromosomes will pair up, will pair up. And then this pair-up of chromosome, we call them homologous chromosome.
	06:35	[turning to the blackboard and write down 'homologous']
	06:36	Okay. This pair-up of chromosome, we call them homologous chromosome.
	06:47	[pointing to the word 'homologous' on the board and ask]
	06:47	Did I spell the word (homologous) correctly? Homologous? Yes or no?
Ss	06:56	Yes.
T	06:56	Thank you very much. So this pair-up chromosome, we called them homologous chromosome. The homologous chromosome be::::ars many genes. The homologous chromosome consists of many genes. Okay. [pointing to the C+L card 'allele'] You'll see that the genes combine to form the chromosome. And then the position of the gene on the chromosome is called the gene locus. The position of the gene on the chromosome is called the gene locus. [students were highlighting key terms on the C+L card 'allele'] That determines a certain characteristic. Like the example on the left-hand side. There is a large capital letter 'A' and a small letter 'a' here. These two genes, we call them allele. These two genes, we call them allele. Why? Because they have same gene locus in the homologous chromosome. They have the same gene locus on the, on this pair of homologous chromosome [Students marking and making notes on the C+L card 'allele']. And this pair of genes determine the certain characteristics like the blood group; for example, these two allele, we don't call them genes anymore, because these two alleles together control, or determine the certain characteristics. Okay. And you'll see that gene exists in two or more alternative forms, if they are in the same gene locus. If they control or determine the same characteristic, we call them alleles. Okay. The alleles of any given gene lie at the same position. That means at the same gene locus, on both members of homologous chromosome. Each characteristic, each inherited characteristic is controlled by one or several genes. And then, one characteristic may be controlled by one or several genes. Genes also often work together, and environmental factors may also influence the ultimate phenotype. You'll see that the external appearance or the characteristic you have

		in your body. Okay. This is phenotype. Can you tell me which characteristic can be controlled by the genes? But this characteristic is also controlled by the environmental factor? Can you give me one characteristic of you that is controlled by the genes, that is controlled by the alleles from your mothers and fathers? More than that, this characteristic is also controlled by the environmental factor. What characteristic you can tell Miss T? Um…CT. You smiled. You must know the answer. Stand up first. [The T smiled encouraging the student to say out his answer.]
CT	10:22	[The student stood up]
T	10:23	What characteristic?
CT	10:25	Skin colour.
T	10:26	Louder please.
CT	10:27	Skin colour.
T	10:28	Skin colour. [moving the pointer along the skin of her left forearm] Why you say that the skin colour is one of the examples of the characteristic that is controlled by the gene and is also controlled by the environmental factor? We all know that our skin colour will be similar to the skin colour of our parents, right? Okay. I accept that. This characteristic is controlled by the genes. How the skin colour is controlled, is determined, is affected by the environmental factor? [T pointing to the student CT smiling and encouraging him to think further about the question]
CT	11:04	Urrr…
T	11:06	If you have the sun…
CT	11:09	If the sun, expose, if exposed under the sun [CT showing his hands trying to explain what happens to his skin if he is exposed under the sun]
T	11:14	If you are exposed under the sun…
CT	11:18	Then the skin colour will be darker.
T	11:20	The skin colour will be darker. Ah, sit down. For Chinese people, for Chinese people, this may happen. But for the white people, it does not happen. If the white people are exposed to the sunlight, their skin colour will not be darker. [Smiling] Ah, let's discuss this later. Okay. We will discuss this example later in this chapter. Okay. This is not a very good example. CT. Any other better example you can give me? Ah, GG. Any other example of characteristic that is affected by the genes and it is also affected by the environmental factor.
GG	12:00	[heit] (pronouncing word 'height' in a wrong way).
T	12:14	The…
GG	12:15	[heit]

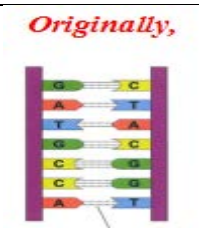
T	12:16	How do you spell it? The…
GG	12:17	H-E-I-G-H-T
T	12:18	The height. YES. This factor, the height, the height [putting the pointer on her head showing one's height] is affected by the genes given by your mother and your father. More than that, what other environmental factor will affect the height? GG. [Trying to give hints to GG] If you do more…
GG	12:39	Exercise.
T	12:40	If you do more sports, you will be….
GG	12:44	Taller.
T	12:45	Taller. Okay. Thank you. Sit down. If you do more exercise, if you do more sports, you'll find that you become taller. So, the height is a very good example here. It is a characteristic not only affected by the gene but also affected by the environmental factor. Very good.
T	13:11	Okay. Before the end of the lesson, would you please tell me, what did you learn in these two lessons? Um. Would you please tell me what did you learn in this lesson?
	13:21	[Students started to sort out their C+L cards to double-check the concepts that have been covered in the two lessons]
	13:24	What three area of basic genetics you have learned in these two lessons? Hahaha… AD. Stand up first. What did you learn, what three areas you've learned in these two lessons?
AD	13:52	Genetics
T	13:53	Genetics. What is genetics. Very good. Sit down. The second area is about? Um YY
YY	14:03	What is DNA
T	14:05	What is DNA, anymore? What is DNA…
YY	14:09	What are the genes and chromosome
T	14:12	What are the genes and chromosome, AND…. Some more. We not only learned the genes, the DNA and the chromosome, but we also learned…the…
	14:26	[YY was trying to search what other aspect has been covered in the lesson]
T	14:28	Ah. Many of your classmates give you the hints.
YY	14:34	The relationship
T	14:35	Louder please. We have also learned the
YY	14:40	relationship

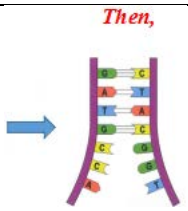
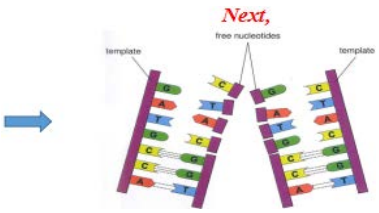
T	14:41	Relationship between
YY	14:43	Genes and
T	14:45	Genes..
YY	14:48	And DNA
T	14:49	DNA …
YY	14:50	And chromosome.
T	14:51	And chromosome. Yes, we also learned the relationship between these three structures: DNA, genes and chromosome. Anymore? Which one (student) does not stand up before? Okay. ZW
ZW	15:20	Allele.
T	15:22	Allele? But this is not the third area. Okay. We've learned in these two lessons. Okay. You learned that DNA is a…. kind of… [hearing that MD utter the answer] Okay. MD, you help ZW.
MD	15:47	DNA is a carrier of genetic information.
T	15;50	Very good. DNA is a carrier of genetic information. Okay. You understand that? Sit down. Okay. Before the end of the lesson, let's watch a video. This video is about what you have learned in these two lessons. Okay.
		[walking towards the computer and play a video about DNA]
		Ms T_1.5
T	0:01	[video about DNA being played]
	4:17	I need to stop the video here because there are some people mention that there's knowledge to learn in this lesson. Okay? If you are interested to watch this video, you can go home, um, just go to Youtube and find "The Structure of DNA". You can find this video. But the further information that there's no need for you to learn is ... ……..
	4:39	Okay, this is the end of our lesson and Ms.T is will talk about other areas of basic genetics, Okay.
		Ms T_2.1
T	0:32	Okay. Before our lesson, please make sure that you'll have a new set of exercise, and you'll have a new set of C+L cards today. Any missing? Please raise up your hand. If no, let's start our lesson. Okay.
	0:57	[turning to the projector screen, pointing to the bullet points in the overview slide]

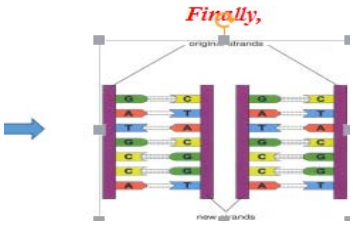
	0:58	In this lesson, we have three different areas of basic genetics we are going to learn. Okay. Let's read out what areas of basic genetics we are going to learn today. The first area is…
Ss	01:13	The replication of DNA.
T	01:16	The replication of DNA. And the second is…
Ss	01:19	What mono-hybrid inheritance is?
T	01:23	Mono-hybrid inheritance again.
Ss	01:27	Mono-hybrid inheritance.
T	01:32	Good. And then the third area is... Mendel's
Ss	01:35	Mendel's experiments on mono-hybrid inheritance.
T	01:41	Okay. Very good. Let's go to the first part. The replication of DNA first. You can find these diagrams and paragraphs on page 1 of the worksheet.
		[Shifting the PPT slide to the worksheet (C+L Map 'The replication of DNA') and explaining the replication of DNA while pointing to the corresponding diagrams in the C+L Map.] 
	01:52	You will see that, originally, this is the original DNA molecule. And then you will find that the two strands of the DNA molecule start to separate. And then, next, you will find that this separated strand of DNA acts as a template. And the free nucleotides will join together complementarily to the bases on the original DNA molecule. Okay. And then another strand also acts as the template, the free nucleotides join the base contemporarily and then finally you will see that there are two identical, two identical DNA molecules are produced. For the details, I hope that you can find the details in the video I am going to show you.

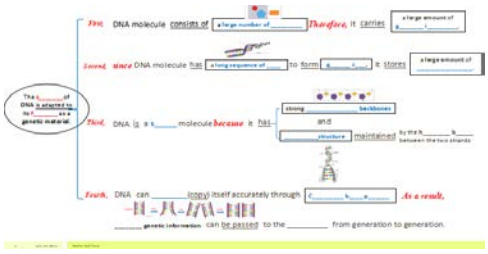
		[T Showing some words as scaffolding for completing the worksheet exercise, a C+L map about 'the replication of DNA'. The Students were reading the words provided on the PPT slide] 
T	03:01	After watching this video, you can use the words I give you later. You can find them on this screen to complete the worksheet by yourself. So you may do some writing. But the most important thing is, please pay attention to the video. Okay.
	03:40	[T Showing the video 'DNA Replication] 
T	07:11	[T showing the PPT slide on the screen with the scaffolding words again]
	07:12	Okay. After watching the video, you will know the whole process of the replication of DNA. Now using the words I give you on the screen. Complete the worksheet by yourself. And I will give you 5 minutes to finish it. Do it now. At this moment, no discussion is allowed. Do it by yourself first.
	07:33	[Students started doing the worksheet exercise while searching for answers among the words on the PPT slide.]
	14:31	Any student needs more time to finish the worksheet please raise up your hand. Any student needs more time, to finish the worksheet?
	14:44	Okay. Now put down your pens first. And then discuss with your classmates to see any differences between your answers to your worksheet. No writing is allowed. There is no need for you to write anything but just discuss.
		[Students were discussing their answers to the worksheet. T was walking by one student and noticed that he could not fill in the right word in the worksheet.]
T	15:43	Do you know this word?
S	15:44	[the student shook his head indicating that he did not know the word]

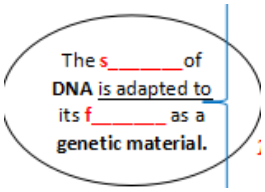
T	15:47	[T moving the pointer around the words on the worksheet] This word means 'the previous one', 'previous'. So the answer should be…
	15:53	[the student was trying to write down the answer but the T stopped him.]
T	15:53	No writing. The new free nucleotide to the previous, to the preceding…act on the previous… What is this answer? What should be this answer?
		[The T moved her pointer around the diagram above the words in the worksheet trying to give more hints to the student]
	16:10	The nucleotides act on the preceding… [pointer pointing at the nucleotides in the DNA molecule diagram]
S	16:20	Nucleotide.
T	16:21	Yes. So the new free nucleotide adds to the preceding nucleotide thus form a new strand of DNA. Do you see? Can you understand that?
S	16:30	[Student nodding his head indicating he had understood the answer.]
T	16:33	So the answer should be…
S	16:34	Nucleotide
T	16:35	Louder please.
S	16:36	Nucleotide.
	16:37	Yes.[Seeing that the student had found out the answer, the T left his desk and started to check the answer of the exercise with the whole class.]
T	16:42	Okay. After checking the answer with your classmates, let's check the answers by yourself. Take out the green ball pen please. Take out the green ball pen please. DC, what are you writing? There is no need for you to write with your pen. Just take out the green ball pen to do the correction.
		Ms T_2.2
T	0:00	[T shifted the PPT slide to the C+L Map about 'the replication of DNA' which was the answer to the worksheet. Rather than showing the whole C+L Map all at once, this time the T showed the C+L Map bit by bit while asking questions according to the diagram and text shown in the map.]
	0:02	Okay. This part is talking about the replication of DNA. Originally [the logical connector 'Originally' popped up on the screen]

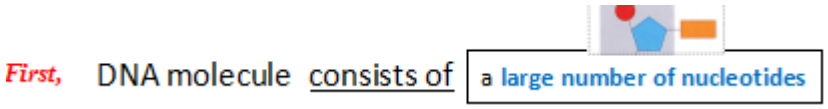
		
	0:13	You'll see that there is a molecule of DNA, right? [the diagram of DNA molecule appeared on the screen] You'll this is the original molecule of DNA. And each DNA molecule consists of how many strands? How many strands does a DNA molecule consist of? DZ. Stand up. Tell us.
DZ	0:40	Two strands.
T	0:41	Two strands. So that is why we say that it is a double-helix structure. Okay. So the two DNA strands [The words 'the two DNA strands' appeared under the diagram of DNA molecule] are… [The words 'are held together' appeared next with the verbs 'are held' underlined] held together, held together. Use your green ball pen to correct your answer. Okay. If you don't know the answer, just write them down. Okay. I think that you can do it by yourself. Okay. The two DNA strands are held together by what structure? By what chemical structures? CK
CK	1:20	By hydrogen-bonds.
T	1:21	By hydrogen-bonds. So let's see. [T clicked the mouse to show the words following the text 'by hydrogen bonds between the bases'] Yes, you are right. By the hydrogen bonds between the bases. How many hydrogen-bonds are formed between the bases adenine and thymine? Let me ask you. How many hydrogen-bonds are formed between the bases adenine and thymine? AD
AD	1:57	Two
T	1:51	How many?
AD	1:52	Two.
T	1:52	Sit down. How about guanine and cytosine? How many hydrogen-bonds are formed between guanine and cytosine? CC
CC	02:03	There are three hydrogen-bonds.
T	02:05	Good. There are three hydrogen-bonds. So you will see that in the diagram given to you on the worksheet. Okay. And then…
	02:16	[T clicked the mouse and an arrow pointing to right appeared next to the first diagram with the logical connector 'then' also appearing indicating the shift to a next step of DNA replication]

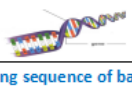
		
	02:16	The DNA molecule, you will find that [a new diagram appear under the logical connector 'Then'] there are some changes. So you will find that [the words 'the hydrogen-bonds between the bases' appear under the newly appeared diagram on the screen] the hydrogen-bonds between the bases, what happened? WY
WY	02:34	[Reading out the information from her C+L Map worksheet]The hydrogen-bonds between the bases are broken.
T	02:39	Yes. You will see that the hydrogen-bonds between the bases are broken to…
WY	02:48	To unzip the DNA
T	02:49	Yes. Very good. To unzip the DNA. [clicking the mouse to let the words 'are broken' and 'to unzip the DNA' appear on the C+L Map one by one under the corresponding diagram] So you will see that this double-helix structure is separated into two strands.
	03:00	[Showing another arrow and the logical connector 'Next, ' on the C+L Map and then followed by a new diagram indicating the shift to a next step of DNA replication] 
T	03:02	Next, you will see that two new DNA molecules are forming right? And each DNA strand [T showing the words 'each DNA strand'], what happened to this two DNA strands? Um, SK
SK	03:20	[Reading out the information from the C+L Map at hand] Each DNA strand exposes its bases
T	03:24	Exposes its bases… and…
SK	03:27	Acting as a template.
T	03:29	Acting as a template. Its bases acting as a template. Very good. Sit down. And then the free DNA nucleotide, you will see that, line up in order to synthesize or for synthesizing a new DNA, for synthesizing a new DNA.
	03:43	[Showing the words 'Free DNA nucleotides' on the screen below the diagram] Free nucleotides, free nucleotides, what do they do? For the free nucleotides, what do they do? [showing the next few words 'are hydrogen-bonded'] Okay. Are hydrogen-bonded, hydrogen-bonded [further showing the words 'onto the exposed bases'] onto the exposed

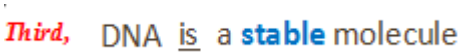
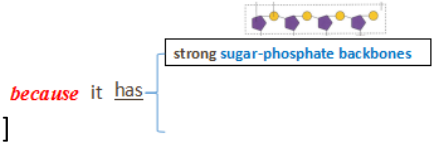
		bases. [moving the pointers around the corresponding diagram 'exposed bases'] You will see that this is the exposed bases; this is the exposed bases. [pointers moving twice around the diagram demonstrating how the free nucleotides are hydrogen-bonded to the exposed bases.] And then these free nucleotides are hydrogen-bonded onto the exposed bases; these free nucleotides are hydrogen-bonded with the exposed bases. Okay. And then, you will find that there is a rule. They pair up. They are hydrogen-bonded. What is the rule they follow? What is the rule they follow? Um. YY.
YY	04:51	Base-pairing rules.
T	04:52	Base-pairing rules. [T showed on the screen the words 'according to the base-pairing rules (A-T, C-G).] Let's see, according to the base-pairing rules, very good.
		[Further showing words 'The enzyme DNA polymerase']
	04:59	And then the enzyme DNA polymerase [showing the next few words 'helps add free nucleotides to' and 'the preceding nucleotide' one by one] helps add free nucleotides to the preceding nucleotide. I know that some of you may not know what is the meaning of 'preceding' [pointer moving around the word 'preceding' on the screen] Preceding, you can see that the previous, the one, the nucleotide here and then the one before. The one before is the preceding nucleotide. So, you will see that a new nucleotide will join the preceding nucleotide and this nucleotide join the preceding nucleotide here. You will find that it becomes longer and longer. What word would we use to show that the DNA strand is longer and longer? HY. Thus…
HY	05:56	Thus extending the new strand of DNA.
T	06:00	Yes. [showing the word 'thus' and then 'extending'] So you find thus extending, it means that the DNA strand becomes longer and longer. [Showing the following words 'the new strand of DNA']Extending the new strand of DNA.
T	06:11	[Showing an arrow, the logical connector 'Finally,' and a new diagram about the last step of DNA replication] 
T	06:11	Finally, you will see that two molecules of DNA are formed. Two molecules of DNA are formed. They are identical DNA molecules. Let's look at your worksheet (C+L Map 'the replication of DNA') Maybe the words on the screen is very small [pointing to the diagram and the words on the screen]. But please look at your worksheet. Look at the base sequence. Look at the base sequences of these two DNA molecules. Just do it now.
		[Students read the diagram on their worksheet ('C+L Map') very carefully.]

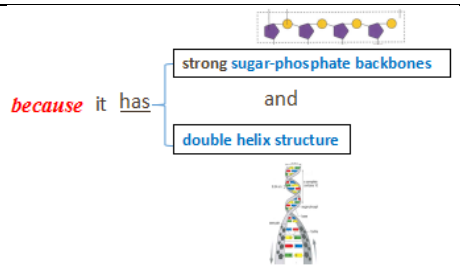
T	06:44	Are the bases identical to each other? For these two DNA molecules. Are the bases, are the base sequences the same, or identical to each other? Yes or no?
Ss	07:00	Yes.
T	07:00	Yes. You will find that, in this process, two identical DNA molecules [showing the words 'two identical DNA molecules are formed' under the corresponding diagram on the screen.] two identical DNA molecules are formed. And each contains, each contains… ZY, would you please tell us, for each DNA molecule, it contains…
ZY	07:21	Each contains an original strand and a newly synthesized strand.
T	07:28	Yes. You will see that [showing the words 'Each contains an original strand and a newly synthesized strand' on the screen] it contains an original strand and a newly synthesized strand.
T	07:36	In the video, in the video, it does not use 'original' to describe one of the strand in the DNA. What word or what term the video used? It said that, it said that the new DNA molecule is…[trying to give prompts to the students] formed? Is formed with one… The video does not use the 'original'. What word is used instead? [walking to the board and wrote the word 'old'] Do you remember it is formed from one old [further wrote the word 'conserved' behind 'old'] conserved DNA strand [Then wrote 'new' under 'old'] and a new DNA strand. Do you remember that? [students taking notes on the worksheet about what the teacher wrote on the board] In the video, it is said that [pointer moving around the diagram in the C+L Map again] the new DNA molecule is formed from one old conserved strand and a newly synthesized strand. Do you remember that? If you don't remember, it doesn't matter. [Showing the link of the video website on the screen] Just go back home and then watch the video again through this website. Understand? Very good.
T	9:15	[Shifting the PPT slide to a new C+L Map about the 'relationship between the structure and the function of DNA'] 
	09:17	Here, you will find that there is another exercise on page 2. It is a summary about what you've learned in the last two lessons and what you learned about the replication of DNA. This is a summary worksheet about what you've learned in the last two lessons and the replication of DNA. Use your C+L cards please, to find out all the answers on this worksheet. Okay. Use your C+L cards I gave you last time and I gave you in this lesson to find the answer of this worksheet. Do it now. I'll give you 5 minutes. Okay. Just see that if you understand what we were talking about in these lessons.

	10:03	[students started to finish the worksheet individually, searching information by flipping, turning and reading card by card.]
T	12:39	May I have your attention please. [pointing to the small diagrams next to the key concepts in the C+L Map in the screen] These diagrams. Look at these diagrams will help you find out the answers. These diagrams given to you will help you to find out the answers. Okay. With the diagrams, you will understand more about the sentences, and then find out the answer from the C+L cards. Okay.
		[T walking around the classroom observing how the students finish the exercise]
	15:26	Very good.
	15:32	Do it by yourself.
		Ms T_2.3
T	0:18	Okay. I'll give you one last minute to finish the worksheet. One last minute.
T	1:15	Okay. Put down your pens. Put down your pens. Okay. Let's see. Check your answer with your classmates. And see, the answers that you don't know, ask your classmate if they know. Of course you should discuss that and think that the answers are correct or not. Don't just accept the answer directly.
		[Students were discussing the answers to the worksheet (C+L Map), pointing to each other's worksheet, flipping and searching for information from the C+L cards and exchanging ideas about the answers.]
T	01:48	Just discuss the answer. Whether the answers are correct or not. JK. What are you writing?
T	02:07	Although your classmate may have the answers, but the answers may not be correct. So you need to discuss it.
T	3:03	Okay. Let's check the answers here. Okay.
		[Again, the teacher did not show the answers in the whole C+L Map all at once. She showed the Map part by part which allowed her to elicit questions to check students' understanding of the corresponding knowledge.] 
	03:10	The first answer will be given by me. Okay. The structure of DNA is adapted to its function as a genetic material. Okay. The first, who give the first answer? Uh, EV

EV	03:31	[Reading out the answer on her worksheet] DNA molecule consists of a large number of nucleotide.
T	03:37	Nucleotide. Thank you. Sit down. Very good. Let's see…
		[Showing on the screen the words in the first part of the C+L Map] 
	03:42	First, DNA molecule, consists of, or you can see, contain, or you can say… what word you'll use instead if we don't know 'consist of', if you don't know 'contains', what can you use instead?
Ss	04:00	Has.
T	04:01	Has. Very good. Has a large number of nucleotides, as EV said, large number of nucleotides. And it is very obvious that [pointing to the small diagram above the concept nucleotides] this diagram shows you the structure of a nucleotide. What three parts? Which three parts are used to compose? Are used to compose of one nucleotide? Um. KG. Which three parts? Different parts are composed of a nucleotide.
KG	04:40	5-carbon sugar.
T	04:41	5-carbon sugar. Which diagram represents the 5-carbon sugar?
KG	04:46	The blue…
T	04:47	The blue one. And how about this circle?
KG	04:51	Urr, phosphate group.
T	04:53	Phosphate group. And then what about this yellow rectangle ?
KG	04:55	Nitro-… Nitrogenous base.
T	04:59	Nitrogenous base. Very good. So you will find that this DNA molecule consists of a number of nucleotide. [Further showing the logical connector 'therefore'] And therefore… Um. WY again.
WY	05:13	Therefore, it carries a large amount of genetic information.
T	05:19	Good. It carries, a large amount of genetic information. [showing the rest of the words in the first part of the C+L Map] 
T	05:27	Second. What will be the answer? MG
MG	05:32	Second, since DNA molecule has a long sequence of nucleotide…

T	05:37	Eh… DNA molecule has a long sequence of nucleotides. We know that it contains a sequence of nucleotide…
MG	05:44	[correcting himself] A long sequence of genes
T	05:46	A long sequence of genes. But what? Which part in the genes to form the…
MG	05:57	Chromosome.
T	05:58	Form the chromosome? No. You find that you got the wrong answer. You got this answer wrongly. Okay. The DNA molecule has a long sequence of which structure to form the …
MG	06:14	Form the genetic code.
T	06:15	Form the genetic code. Very good. But which part of the nucleotide? Which part of the nucleotide form the genetic code? This is the point. The phosphate group? Or the…
MG	06:32	Nitrogenous base.
T	06:34	Nitrogenous base. Very good. Here you will find that DNA molecule has a long sequence of …
MG	06:47	Nitrogenous base.
T	06:48	Nitrogenous base, or a long sequence of bases to form …
MG	06:52	Form the genetic code.
T	06:54	To form genetic code.
MG	06:56	It stores a large amount of…[MG could not continue with the sentence]
T	07:02	It stores a large amount of, if there are many genetic codes, it stores a large amounts of …
	07:11	[Seeing that the student could not figure out the answer to the rest of the sentence, the teacher offered another hint.] Just like what WY just now said. It stores a large amount of…
MG	07:16	Genetic information.
T	07:17	Genetic information. I am very happy that you listened to what WY said. Okay. You paid attention to what she said. Okay. Sit down.
		[T then showed the answer (the second part of the C+L Map) on the screen part by part during which she elaborated on the concepts.]  *Second,* *since* DNA molecule has [a long sequence of bases] to form [genetic code,] it stores [a large amount of genetic information.]

T	07:29	Second, you will see that, since DNA molecule has, a long sequence of bases like A, T, G, C, T, C, G, these kinds of sequence of bases, to form, genetic code. So it carries, it stores a large amounts of genetic information.
T	07:54	How about the third sentence? How about the third sentence? LG. How about the third sentence? Third.
LG	08:06	DNA is a strong molecule because…
T	08:09	Is a … What molecule?
LG	08:11	Strong.
T	08:12	Is a strong molecule? You use strong here? Um? YY, would you help him?
YY	08:22	DNA is a stable molecule.
		[T showing the third characteristic on the screen.] 
T	08:25	Is a stable molecule. Stable is better than strong here. Okay. You can say that the bonding is very strong. The covalent bond is very strong but the hydrogen bond is relatively weaker. Okay. But we won't say that the molecule is strong. The molecule is stable. YY. Sit down please. [Turning to LG again and ask another question.] Why the DNA molecule is stable?
LG	08:51	Because it has strong sugar-phosphate backbones.
		 [T showing the words about the reason on the screen.]
T	08:55	Good! It has strong sugar-phosphate backbones. [pointing to the small diagram 'sugar-phosphate backbone' in the C+L Map on the screen] We can see that in this diagram, this is a sugar-phosphate backbone. If the question in examination asks you to draw the sugar-phosphate backbone, you have to draw the diagram like this. Make sure that no nitrogenous bases are added. No nitrogenous bases are added. Okay. This is the strong sugar-phosphate backbone. Besides the strong sugar-phosphate backbone, what help the DNA molecule become stable?
LG	09:33	The double-helix structure.
T	09:34	The double-helix structure. You will see that [Showing the words 'double helix structure' and the diagram on the screen]

		
T	09:38	Maintained by…
LG	09:40	The hydrogen bonds between the two strands.
T	09:41	[showing the words 'maintained' and 'by the hydrogen bonds between the two strands.'] Good. Maintained by the hydrogen bonds between the two strands. Sit down. [pointer pointing to the diagram] So these two structures will make the DNA molecule stable.
T	09:57	And then fourth. What will be the answer? Um. YY.
YY	10:04	[Reading out the answer on her worksheet] Fourth, DNA can replicate itself accurately.
T	10:08	DNA can replicate itself accurately. Very good. Don't write replication, because replication is a noun. You use replicate, the verb instead here. Very good. YY. DNA can replicate itself accurately.
		[showing on the screen the words] *Fourth,* DNA can **replicate**(copy) itself accurately ]
	10:27	Although the meaning of replicate is copy, but don't write copy in the exam. It is supposed that you are a senior form student, you need to use a better word: replicate instead of copy. Okay. Although Miss T gives you that, the meaning of replicate is copy, but you use replicate instead of copy in the examination. Accurately. Let's continue. YY.
YY	11:02	Through complementary base pairing.
		[T showing the words and the diagram through **complementary base pairing**]
T	11:06	Through complementary base pairing. What does complementary means? Would you give us an example? What does complementary mean here? If the base is A, it should pair with…
YY	11:26	T
T	11:27	So the whole sentence is… If the base on one strand is A…

YY	11:33	If the base on one strand is A…[T made gesture encouraging her to continue] it would be
T	11:40	It should pair with….
YY	11:43	T
T	11:44	T. So this is what we say complementary. How about G? T pairs with …[pointing to YY encouraging her to follow]
YY	11:53	G pairs with C
T	11:55	Good. Sit down. We've learned 'pair with' in the C+L card I gave you last time. Do you remember that? Pair with. Okay.
T	12:04	And then you will find that through the complementary base pairing. As a result, [showing the logical connector 'As a result'] As a result, the identical information [showing the words 'identical genetic information'] can be passed to the new cells from generation to generation. [showing 'can be passed, 'to the new cells' and 'from generation to generation'] How about if I don't want to use 'be passed'? What other words can be used instead of 'be passed'? Um. 'What other words can be used instead of 'pass on'? This is what you learned from the C+L cards last time. CC.
CC	12:48	Can be transferred to
T	12:50	No. Not 'transfer'. Trans…
CC	12:56	[Think carefully about the word she learned in the previous lesson 'transmission'] Transmit.
T	13:08	Transmit. Very good. You can use 'transmit' instead of passed on. Thank you very much. Sit down.
	13:15	Okay. Let's start the new part here before we go to learn what monohybrid inheritance is. That will be some basic genetic vocabulary first.
	13:35	[Turning to the new slide of the vocabulary]
	13:39	Please take out the C&L card about the…, about the Mendel's. Do you have the C&L card about the Mendel's experiments on monohybrid inheritance? Yes, take it out, please.
		[Checking if the students get the right card]
	14:01	Mendel's experiments on monohybrid inheritance. Take it out, please.
	14:09	You'll find the word "statemens" in this part
		[pointer at the key words on the slide]
	14:17	Let's take out the C&L card about Mendel's experiments on monohybrid inheritance. You all find that? Okay.

	14:29	If you could find that, you find the word “statemens” on this top. Yes or no?
		[pointer at the word “statemens”]
Ss	14:36	Yes.
T	14:37	Yes. Okay. Statemens is male reproductive organs that produce pollen grains, Okay? And pollen grains inside containing male gametes. Just like the spurs in human male’s body. Just like the spurs in the human male’s body. Okay? The pollen grains containing male’s xxx, sorry, males gametes.
	15:08	And do you find the word “stigma”? On this top, yes or no?
		[pointer at the word “stigma”]
	15:14	Stigma is the part of the female’s reproductive organ. Female, Okay. So, part of female reproductive organ receives pollen grains containing the male’s gametes. You will see that pollen grains containing the male gamete, Okay?
	15:32	And then, what is “dominant”? You can find the meaning from the C&L cards, Okay? I’ll ask one of you to tell us. What does “dominant” mean? Find it, please. Find the C&L card about the “dominant” and “recessive”. What does or what do these two terms mean?
		[pointer at the word “dominant”]
	16:05	What does “dominant” mean? Um? Read your C&L card.
	16:12	Okay, MD. Would you please tell us what does “dominant” mean on the C&L card?
MD	16:18	[Standing up and read the card] It is a term used to describe an allele that can express itself only in the homozygous condition.
T	16:35	Good. Dominant is a term, used to describe an alle, um, allele is a gene. Okay? ---Allele that can express itself in the homozygous condition.
	16:52	And you will see that the dominant allele will mask the effect of the recessive allele, Okay? How about the meaning of “recessive”? Um? AN?
		[Pointer at the slide]
		Ms T_2.4
AN	0:02	**[**Read the definition of “recessive” from her C&L card]
T	0:15	Yes. “Recessive” is a term used to describe an allele that can express itself only in the homozygous condition. You may ask what is “homozygous”. What is “homozygous condition”?

	0:31	OKay, let's take out the C&L card about "homozygous" and "heterozygous". Okay, what does "homozygous" mean? What is "homozygous condition"? CT.
CT	00:49	[Reading out the answer on her worksheet] "Homozygous" refers to the condition in which the organism has two identical alleles for a particular characteristic.
T	1:02	Very good. "homozygous" refers to the condition in which the organism has two identical alleles. One allele is from the male parents, do you remember that? The other allele is from the female parents. Each of them has certain characteristics. And organism usually has two alleles to determine that characteristic, Okay? And if these two alleles are the same, we say that condition is homozygous. Okay? But if we find that the organisms have two dominant alleles, we say that, urr, this is the homozygous condition. And if the organism has two recessive alleles for certain characteristic, we also say that this is homozygous condition.
	2:03	How about "heterozygous"? How about "heterozygous"? ZT.
ZT	2:08	[Reading out the answer on his worksheet] "Heterozygous" refers to the condition in which the organism has two different alleles for a particular characteristic.
T	2:18	Good. Sit down."Heterozygous" refers to the condition in which the organism has two different alleles for a particular characteristic. So, what does that mean? What does that mean? It means that in a ratio has a… has a dominant allele and a ...? MG, stand up. That means the condition is heterozygous
MG	2:44	[Stand up and listen to teacher's directions]
T	2:45	That means if the condition is heterozygous, that in a ratio must have one dominant allele and one...
MG	2:56	recessive
T	2:57	Louder please
MG	2:58	recessive
T	2:59	Good. One recessive allele for certain characteristic, Okay. So this condition is ''heterozygous'.
	3:11	[Turn to the slide and point at the terms] And then, you'll find that there are two more terms here , one is "genotype", one is "phenotype". If I ask you what is the genotype of that in the ratio for that certain characteristic, what does "genotype" mean? Let me see, GG, would you tell us what is "genotype"?
GG	03:36	It is the genetic makeup of an organism.
T	03:40	It is the genetic makeup of an organism. More than that?

GG	03:45	It describes the alleles each cell has for a certain characteristic.
T	03:52	It describes the alleles each cell has for a certain characteristic. Sit down.
	03:58	If, urr, can you use the terms to describe the "genotype" of a certain characteristic? One is homozygous dominant. What does that mean? It means that this person has… has how many which kinds of alleles for a certain characteristic? Urr, SM.
SM	04:31	[Stand up and listen to teacher's directions]
T	04:32	If I say this person has genotype which is homozygous dominant, what does that mean? It means he has how many?
SM	04:43	Two
T	04:44	Two, you get the first one "two", dominant or recessive or which kinds of alleles?
SM	04:54	Dominant.
T	04:54	[Writing on the blackboard]Dominant. Very good. So this person must have two dominant alleles, so the genotype is homozygous dominant. How about if I say that the genotype of a person is homozygous recessive, how many… which kind of allele does this person have? How many, which kind of alleles does this person have? Mmn, GC.
GC	05:29	[Stand up and listen to teacher's directions]
T	05:30	If I say that the genotype of this person is homozygous recessive, it means that how many? The first question is how many.
GC	05:47	Two.
T	05:48	Two. Because one is from the female parent and the other comes from the male parent, Okay? So, two which kinds of alleles? Two...
GC	06:03	Recessive alleles.
T	06:04	Recessive alleles, thank you very much. Sit down. Two recessive alleles for that certain characteristic, Okay? How about if I say the genotype [writing on the blackboard]of this person is heterozygous, is heterozygous, how many and which kind of allele does this person have? TB. Stand up first.
TB	06:35	[Stand up and listen to teacher's directions]
T	06:36	Heterozygous. The genotype of this person is heterozygous, how many? One from the male parent and the other comes from the female parent, two which kind of alleles? If the two alleles, the one is ...
TB	06:57	The one is...[look at his C&L card] dominant
T	06:59	One is dominant allele and the other is...

TB	07:05	Recessive
T	07:06	Please read the whole sentence, please.
TB	07:09	One is dominant allele and one is recessive allele.
T	07:14	Good, good. You say that one is dominant allele and the other is recessive allele. So we say that the genotype of this person is heterozygous. There is no need for you to write“dominant” or “recessive” here, you understand? There is no need for you to write “dominant” or “recessive” here, why? Because for this kind of genotype, he must have one...
Ss	07:45	One dominant
T	07:46	[writing on the blackboard]One dominant allele and one...
Ss	07:48	Recessive
T	07:49	Recessive alleles. So there is no need for you to write “dominant” or “recessive” here. Okay? Don’t write these things in the examination.
	07:57	[pointer at the slide] And then, F1, it’s not the car racing. It’s not something about car racing here, Okay? F1, not Formular One. Okay? F1 here, in biology in genetics, is first filial generation, first filial generation. That means any generation resulting from a genetically controlled mating following parental generation, the next generation, Okay?
	08:30	Okay, after learning its basic genetic vocabularies, we can go to learn something about monohybrid, especially experience stand by the scientist, Mendle, Gregor Mendle.
	08:51	[operating the computer and turn to the new slide] So here, we will watch a video first. You will see that there are 2 questions on this worksheet. Can you find this worksheet? There are 2 questions here. During the video, during the your watching of the video, you need to, you are required to find the answers for these 2 questions. Okay? The speed of this video is a little bit fast, so please pay more attention to this video, OKay?
	09:27	[play the video] This video...
	10:00	[video cannot be played well] AT, come on, come on to fix it.
	10:15	Let’s start again. I have a xxx in this class. (smiling). [video being played]
Ss	10:16	[carefully watching the video]
T	13:52	[walking around the classroom]Okay, through this you know? Do the first question, you know? Assuming tallness is dominant, what xxx would you use? What xxx would you use to represent the dominant allele? What xxx would you use for the recessive allele? No discussion is allowed. This is the first question asking you that what genotype a man

		should be? If he is homozygous for “tall”? If you don’t know the answer, the C&L card may help you.
	14:46	Nucleotide of letter represents the dominant allele? What kind of letter for the recessive allele?
Ss		[work carefully on the worksheet]
T	15:06	[give hints to the students]For the green piers, the genotype for the green piers? The genotype may be this or this? [write key words on the blackboard]. For the yellow, yellow piers, in a ratio, the genotype for the yellow piers are in...case letters, are in case letter. For the green piers, the genotype must have one large capital letter. That means the large represents the dominant allele, the case letter represents the recessive allele. So in this case, if the man is tall, if this man reduces the gamete and the gamete pass on to the babies , what alleles will appear in the gamete?
Ss		[keep on working on the worksheet]
T	16:40	[talk to one student] Are we good? How about this? If the gamete contains 2 alleles, the father gives 2 alleles to baby, the mother gives 2 alleles to the baby, there are 4 alleles for the baby for this characteristic . Is there anything wrong?
		Ms T_2.5
Ss		[keep on working on the worksheet]
T	0:11	[talk to one student] How about this? If the gamete, if the male gamete passes two alleles, he’s gonna give two alleles to the baby, mother gives 2 alleles to the baby, there are totally 4 alleles for this characteristic. For this characteristic, only 2 alleles determine the characteristics. For this gamete from the father, say that it contains 2 alleles, how many alleles should the gamete contain?
	00:56	It seems that it’s quite difficult for you to find the answer to the first question, right? Okay, put down your pens, your ball-point pens. This is the one , the video is going to tell you, Okay?[play the video]
	01:32	[pointer at the slide]You will see that because the man is homozygous for tall, so the genotype must consist 2 large capital letters to represent the genotype, Okay? But for the formation of the gamete, only one of the alleles will be passed on to the offspring, right? Only one of the alleles will be passed on, will be transmitted to the offspring, so you will see that the gamete combination can only be one type. Just one capital letter “T”. Okay? You understand that? Only one of the alleles will be passed to the offspring, will be transmitted to the offspring.
	02:20	How about the second question?[continue to play the video]
	02:38	Right. If you don’t know the answers for the first question, I thinks it’s more difficult for you to answer the second question. How about if a woman, who is heterozygous for tall,

		heterozygous for tall, what will be the genotype? What will be the genotype? Represent it in letters, Okay? Don't write "heterozygous" for this question, Okay? Because "heterozygous" is given to you in the question, just writer down the letters for you to use. Letters in use represent "heterozygous". Ahh, I know that CC gets the idea. CC gets the idea. Don't write "heterozygous", don't write the term. Just write down the letters to use to represent the genotype. What kind of gamete it produced? if one of the alleles can be passed on, can be transmitted to the offspring, you remember that? One allele is from the parent, from the male parent, and the other allele comes from the female parent, so the gamete only contains one allele. The gamete only contains one allele. Okay? Nearly all of you getting the answer, right? PJ, do you finish the work? Yes or no? So what will be the genotype for this woman? Stand up, first. What will be the genotype for this woman? Don't tell me that heterozygous in this case, because "heterozygous" has already appeared in this question. So you need to use letters to represent the genotype. Stand up
PJ	04 43	[stand up and answer]Large 2 capital letter
T	04:45	Large capital letter "T",
PJ	04:48	Small case letter "t".
T	04:51	Small case letter "t", very good. So the genotype, for this woman, should be one large capital letter "T" and one small case letter "t", Okay? How about the gamete? Let's watch the video.
	05:11	[play the video]
	05:28	So you'll find that there are two possible gamete combination. There are two possible gamete combination, so you will find that the baby may receive this allele, [pointer at the slide] for tallers. The baby may receive this allele from the aid for shorters, Okay? So there are two possible gamete combination. One is, urr, one is or tallers, which is represented by the large capital letter "T"; and one gamete with the characteristic of shorters, which is represented by the small case letter "t". Two possible gamete combination and the genotype is heterozygous, that means it has one large capital letter "T" for tallers and one small case letter "t" for shorters.
	06:32	Okay, let's continue. [video played again] Okay, this is the end of the video, Okay. Let's go back to the… urr...Next time, next time, we will talk about how the Mendles do the experiment, how the mendles use the genetic diagram and common square to solve some genetic problems. Okay
	07:10	Please take out your exercise I gave you in this lesson. Please take out your exercise I gave you in this lesson. The exercise 4 on Page 4, Okay? You learnt, you've learned what is genotype, what is genotype; what is homozygous dominant, homozygous recessive and heterozygous in these two lessons. And you need to do the exercise before the next lesson. You have to do some preparation about the genetic diagram and common square before the lesson, Okay? There are two things you need to do--- one is the summary about genotype, genotype. The homozygous dominant, homozygous recessive and heterozygous

		condition. And you have to do some preparation that you did not know before, about the genetic diagram and common square before you have the lesson. Is that clear for you all?
Ss	08:14	Yes.
T	08:15	Thank you very much. Okay, this is the end of the lesson.
		Ms T_3.1
T	00:13	Okay, make sure that you have two C&L cards. About the genetic diagram and puna square. And you also have a new set of exercise with 4 pages, Okay? If you don't have any missing, let's start our lesson.
	00:36	Today, we will review Mendle's experiments on monohybrid inheritance. And you will know how to solve genetic problems involving monohybrid inheritance. Okay, please take out the C&L card about Mendle's experiment on monohybrid inheritance. Take out this C&L card.
Ss	01:07	[get cards ready]
T	01:09	Before we talk about, before we talk about how Mendle carried on the experiment, please read out "What monohybrid inheritance refers to ", 3, 2, 1, go.
Ss	01:24	[read out the definition]
		Monohybrid inheritance refers to the inheritance of a single pair of contrasting characters which involves a single characteristic controlled by a single gene.
T	01:38	[Ss find it difficult to read]Tall stem or short stem
Ss		[continue reading the definition]
T	01:52	So, how Mendles xxx this conclusion? So he did a lot of experiments. Let's look at your C&L card. First, he remove the stamens. Stamens, the male reproductive part of the flower. You may pick up, you may need to pick up your pen and write down some information on the C&L card, Okay? Because you don't learn the chapter of reproduction, so you don't know "reproductive" means or "the reproductive pass" in organisms. So here he removed the stamens, that male reproductive part of the flowers from the immature flowers. Here a literal spelling mistake, it should be "flowers", not "flows". So correct the word "flowers", not "flows". He removed the male reproductive part of the flowers from the immature flowers to prevent self-pollination. So there will be no male gametes, no male gametes in this flower, reaching the female gametes on the flower. And then he used a brush, do you know what is a brush? Yes, he used a brush to dust the pollen grains. Pollen grains contain the male gametes. Pollen grains contain the male gametes. He dust the pollen grains of the pure-bred tall pea plants onto the stigma, stigma is the female reproductive part of the flower. Stigma is the female reproductive part of the flower. He dust the pollen grains which contain the male gametes of the pure-bred tall pea plants onto the stigma of pure-bred short plants, Okay? And then, he also used the brush to dust

		the pollen grains of the pure-bred short pea plants onto the stigma of pure-bred tall plants. So we see that at least, he did two experiments about grossing a tall pea plant with a short pea plant. Here he did two experiments and then he enclosed the flower in the bag to prevent further pollination, to prevent further pollen grains coming on the stigma of the flower. And then he waited for fertilization to occur. What is fertilization? Fertilization means the fusion of the male gametes and the female gametes. The fusion of the male gametes and the female gametes. After some time, he found that, of course… after some time, he found that furs and seeds are formed… furs and seeds are formed. He collected and sowed the seeds produced. He put the seeds in the soil. Later, he found that all the plants in this generation, we call F1 generation, do you remember this term? So you will find that, he found that are all plants in F1 generation are tall. It's so surprising that no short plants appeared. It's so surprising that no short plants appeared in this generation. And then, he continued the experiment. He continued to do the experiment to allow F1 tall plants to self-pollinate. He allowed the male gamete of this flower fills with the female gamete of the same flower. So, after some time, he collected the seeds and sowed the seeds produced. He grew the seeds, he put the seeds in the soil and grew some new plants. Finally, he found that the offspring in the 2nd filial generations contain 787 tall plants and 277 short plants. The ratio of tall to short plants is … Leo, what is the ratio about 3:1
LO	06:54	about 3:1
T	06:56	about 3:1, very good. And more than that, short plants may appear, why? In these 2 crosses, why short plants disappear in the 1st filial generation but only appear in the 2nd filial generation? Of course, Mendle repeated his experiment many, many times. And for different characteristics, or we can call them traits, to find out the genetic relationships between the parents and the offspring, in other words, next generation. He wants to find out relationship between the parents and the offspring
	07:39	Let's take out the C&L cards about the monohybrid inheritance.
Ss		[take out the C&L cards]
	07:53	We will see that Mendle explained the genetic relationship between the parents and the offspring in a genetic diagram. On the lower part of this C&L card, you will see that there is a genetic diagram, at the bottom part of this C&L card. We will also see how to solve the genetic problem in monohybrid process. So please look at the genetic diagram for the formation of the 1st filial generation. First, we should state clearly the parental phenotypes first.
	08:38	What are parental phenotypes of the parents in the 1st genetic diagram? Would you please tell me what are the phenotypes of the parents in the 1st genetic diagram? MD.
MD	08:59	[answer the question]
T	09:02	Very good. You need to say clearly the parental phenotype. They are pure-breeding tall and pure-breeding short. And then, from the phenotype, you need to think about, what

		are the parental genotypes of these parents? What are the parental genotypes of these parents? So, would you please tell me what is the genotype of the pure-breeding tall plants? KM?
KM	09:40	[stand up and listen to the question]
T	09:41	What is the genotype of this pure-breeding tall plant?
KM	09:48	Two capital letters “T”
T	09:49	Very good. Two capital letters “T”. It means that this plant, this plant contains two dominant alleles for tallers. It has two dominant alleles for tallers. How about the genotypes for the pure-breeding short plant? ZY.
ZY	10:14	Two small case letters “t”
T	10:16	Two small case letters “t”, two small case letters “t”. Very good. What does the meaning, what does the meaning, urr, what does the meaning behind? It means the pure-breeding short plant has two recessive alleles. Two recessive alleles, two recessive alleles for shorters.
	10:46	Okay, for the pure-breeding tall plant, only one type of gamete is produced. Only one type of gamete is produced. Why? Urr, the question first. What is the possible gamete produced from this pure-breeding tall plant?What it the possible gamete , types of gamete or the gamete combination from this pure-breeding tall plant? YY.
YY	11:20	A capital letter “T”
T	11:25	A capital letter “T”
	11:27	Yes
	11:28	I mean the gamete, not the genotype of the 1st filial generation. What allele does this gamete contain from the pure-breeding plant? Of course, the answer should not be, should not be a large capital letter “T” and the small case letter “t”. Because, please look at the law of segregation from the, from the Mendle. Urr, YY made a very good mistake. Gamete should not contain two alleles, gamete should not contain two alleles. YY, sit down first. Let’s look at the law of segregation. Because YY made this mistake and we look at this theory. The characteristics of an organism are determined by heredity factors which occur in pairs. Like in 1860s, there’s no concept about genes and alleles. In 1860s, there’s no concept about genes and alleles, so the people at that moment think that the characteristics of an organism are determined by heredity factors which occur in pairs. One from the male plant, and the other from the female plant, Okay? During gamete formation, separation of each pair of heredity factors occurs, so each gamete receives only one factor from each pair. Gamete will not receive two factors from the parents. So, YY, do you understand what mistake you made? Gamete should only contain one factor

		from the parents. YY, again, stand up. Would you please tell me what gamete, what allele, does the gamete contain from the pure-breeding tall plants?
YY	13:51	[stand up] one capital letter “T”
	14:04	One capital letter “T” only, yes or no?
	14:06	Yes.
	14:07	Yes, so you understand that now. Sit down.
	14:11	So, only one type of gamete is produced from the pure-breeding tall plant and the gamete only contains the large capital letter “T”. It means that it only contains “one dominant allele”. And how about the pure-breeding short plant? What type of gamete does it produce? What kind of gamete does this pure-breeding short plant produce? CC.
CC	14:45	[stand up and answer the question]
T	14:49	Small case
	14:50	Small case letter “t”, not small capital letter “t”, Okay? So, you’ll find that only one type of gamete is produced which contains a small case letter “t”. In other words, this gamete contains which kind of allele? CC?
CC	15:18	Contain the recessive allele.
T	15:21	Very good. It means that this gamete contains the recessive allele.
	15:27	Okay, after the cross-pollination and fertilization, because the cross-pollination occur, don’t miss the “cross”. Can you see the “cross” here? Don’t miss the “cross” between the genotypes of the parents. When you draw the genetic diagram, don’t miss the “cross” here[pointer at the slide]. It means these two parent plants carry on the cross-pollination and fertilization, Okay? When this gamete fills with this gamete, [pointer at the slide], the offspring will have this genotype. What kind of genotype does the 1st filial generation obtain? Okay, can you tell me what is the genotype of this 1st filial generation? ZT
	16:32	[stand up and answer the question]The genotype is small, urr, capital letter “T”
	16:39	A large capital letter “T”
	16:41	...and a small case letter “t”
	16:43	a small case letter “t” in words . How do you describe this combination of this genotype? In words, which words you will use to describe the combination of this genotype?
	17:00	Heterozygous
	17:02	Heterozygous. Very good, sit down. So you will find that all the 1st filial generation are heterozygous, if they are …...

		Ms T_3.2
T	00:06	What characteristic is expressed in the 1st filial generation? CT. What characteristic does the 1st filial generation show or express
CT	00:21	[stand up and answer the question]
T	00:23	If they are heterozygous, they are all tall plants. Sit down. Very good. They are all tall plants because they are heterozygous. They all contain one dominant allele. And here you will find that there is a 2nd genetic diagram. [pointer at the slide] There is a 2nd genetic diagram. You will see that two of the first two filial generation plants are used to carry out the self-pollination, oh, sorry, one plant that will be in love, but the flower, only one flower is used to carry out the 2nd pollination and fertilization. Can you tell me how many types of gametes are produced from this heterozygous parent? How many types of gametes are produced from this heterozygous parent? GG.
GG	01:31	Four
T	01:33	Four?
GG	01:35	Four types
T	01:36	Four types? The parent only has two types allele, how many types of gametes are produced from this parent?
GG	01:52	Two
T	01:53	Two types. What are these two types? One gamete contains
GG	01:56	[try to answer the question]
T	02:03	Please read out the complete sentence. Okay, one gamete...
GG	02:08	[read out the sentence]
T	02:14	One gamete contains one capital letter “T”, and ...
GG	02:21	[continue to answer the question]
T	02:23	And another gamete, good.
GG	02:26	[continue to finish the question] contains the small case letter “t”.
T	02:29	... contains the small case letter “t”. Very good, sit down. [pointer at the slide] So, for this heterozygous parent, it can produce two types of gametes. One contains the large capital letter “T”, which is the dominant allele. And then, they also produce another type of gamete, it contains the small case letter “t”, which is the recessive allele. So in this case, if this gamete, look at here, look at the screen here, if this gamete fills with this gamete, you will find that the 2nd filial generation, the 2nd filial generation, this kind of plant is

		produced. It is…, if you use the words, how do you describe the genotype of this plant. SK, stand up. How do we use the words to describe the genotype of this plant?
SK	03:35	… homozygous
T	03:37	Homozygous?
SK	03:40	[try to answer the question]
T	03:42	What? Yes, I know that these two alleles are same, so we use homozygous. But homozygous, what kind of alleles it has?[pointer at the slide]
SK		Dominant allele.
T		Yes, dominant allele. So the whole word used to describe the genotype is dominant, sorry, homozygous...
SK	04:05	[continue to answer the question]
	04:09	Where comes the homozygous dominant allele, this term? I haven't taught you about this before. Okay? Once again, I know that this plant has two alleles. They are dominant alleles.[pointer at the slide] What word is used to describe the genotype of this plant?
	04:37	Homozygous dominant.
	04:39	Homozygous dominant, yes, sit down. The adj., we used to describe. [pointer at the slide]This , this offspring is homozygous dominant, it is homozygous recessive. How about if this gamete fills with this gamete, we'll find that what kind of genotype, what kind of genotype, what is the word we use to describe the genotype of this offspring? DZ.
DZ	05:12	[stand up and listen to the question again]
T	05:12	[pointer at the slide]If this gamete fills with this gamete, what genotype is from here?
DZ	05:20	[try to answer the question]
T	05:28	I know that, one large capital letter "T" and one small case letter "t". If we use the words to describe this kind of genotype, what word would you use?[pointer at the slide]
DZ	05:45	…….
T	05:47	Be confident, your answer is correct. You can read it aloud, there is no need to ask your classmate, Okay? This time just read out the answer. Be confident, be more confident, Okay? Sit down.
	06:01	[pointer at the slide]Heterozygous, Okay. We use "heterozygous" to describe this kind of genotype. And you will see that if this gamete fills with this gamete, two small case letters are formed. What word will we use to describe this kind of genotype? Okay? What word will we use to describe this kind of genotype? MG.
MG	06:31	Heterozygous.

T	06:33	Hetero? These two alleles are the same.
MG	06:36	Homozygous...
T	06:39	Homozygous? Homozygous what?[pointer at the slide]This is homozygous dominant.
MG	06:47	Homozygous recessive.
T	06:49	Homozygous recessive. Sit down. [pointer at the slide]Okay, so this is why some plants will appear. What characteristic does this plant have?What characteristic does this plant have?RY?
RY	07:09	[stand up and try to answer the question]
T	07:12	[pointer at the slide]What phenotype does it show or what phenotype does it express, for this plant?
RY	07:32	They are shorts
T	07:34	[pointer at the slide]They are shorts, very good, sit down. They are short plants. Phenotype means? What does phenotype mean? GK?
	07:45	If you forget the meaning of phenotype, please find the answer from your C&L card.
GK	07:51	[stand up and answer the question]
T	08:00	Yes, it is the observable characteristic. Sit down, very good. Observable characteristic of the individual. So this is why RY said this plant [pointer at the slide] If it has this kind of genotype, it is short plant, it is the short plant. Shortness is the phenotype of this plant show. Okay?
	08:29	Then let's watch the video to consolidate what we learnt from the genetic diagram. [operating the computer]
	08:50	[video being played and introduction being given] Garmen Peas and …. for investigating the inheritance of characteristics. Peas park and con.. thinker of characteristics can be easily recognized. Some plants are tall, some plants are short.Let's see how the stem hide in this monohybrid cross. First, we carry on a cross between the pure-breeding tall and short pure plants. Pure-breeding short and tall pea plants. As the parent plants differ in only one characteristic, this is the example of monohybrid cross. How about if the parents differ in two characteristics, how do we call this kind of cross? If the parent plants differ in two characteristics, how do we call this kind of cross? GM? This is a logical question. A lot about logical question
	10:06	[stand up and thinking]
	10:10	Okay, I repeat once only. If the parents differ in two characteristic. Let's repeat it again. Let me repeat it again. As the parent plants differ in only one characteristic, this is an example of monohybrid cross. How about the plants differ in two characteristic, this would be an example of...

GM	10:38	[try to answer the question]
T	10:39	Loud, please
GM	10:42	Di...
T	10:43	Di.. what? Diamen? No. Di...
GM	10:49	Dihybrid
T	10:52	Very good. Dihybrid cross, Okay? Let's continue. [video being played]And we will learn the dihybrid later., Okay? And each parent produce gametes by special kind of self-division xxxx. You will see that only one kind of gamete is produced from this parent and the only one kind of gamete is produced from this parent. After fertilization, gametes from each parent fills together to form the 1st filial generation. And you will see that the genotype of the 1st filial generation is… the whole class, would you read this loud? The genotype of this filial generation in words should be
Ss	11:51	Heterozygous
T	11:52	Heterozygous. Good. For this kind of genotype, the plants are…?
Ss	12:00	Tall
T	12:01	Tall, they are tall because they have the dominant allele. They all have this dominant alleles for tallers. So the plants in the 1st filial generation are tall. And then? Mendle used the plants of the 1st filial generation to do the experiment again and the genotype for each of the parent is heterozygous. And heterozygous plant is cross with other heterozygous plants. And this time, after this special kind of self-division xxx , you will find two types of, two kinds of gametes are produced from this parent. And at the same time, the two kinds of gametes are produced from this parent. The 1st fertilization can be like that,[pointer at the video] this gamete fills with this gamete. You will see that the plant with homozygous dominant genotype is produced. If this gamete fills with this gamete, you will see that this plant is heterozygous. How about if this gamete fills with this gamete, a heterozygous plant is also produced. Please remember that, although you see that the small case letter "t" seems to come first. But you still need to write the large capital letter "T" first for the genotype, Okay? Although it seems that the small case letter "t" comes first, but when you write the genotype of the plant, please make sure that the large capital letters come first. Okay? And then, how about if this gamete fills with this gamete, you will see that a homozygous recessive plant is produced. What are the genotypes of this plant? What are the genotypes of this plant? And what are the ratio of the genotype? What are the racial of the phenotype? This genetic diagram shows you. So you will see that for the 2nd filial generation, some tall plants and short plants are produced. A-n-d, you will see that these are the genotype of the plants, these are the phenotype of the plants. When the question in the examination asked you, what is the geno- typical ratio? What is pheno-typical ratio? In this question, you will need to find the geno- typical ratio, homozygous dominant to heterozygous to hetero, sorry, homozygous recessive should be 1:2:1. The answer can be found from the result of the genetic diagram, Okay? This ratio can be found

		from the result of the genetic diagram, Okay? What is pheno-typical ratio? What is phenotype? You need to know what is phenotype first. HY.
HY	15:53	[stand up]
T	15:55	Please take out your C&L card. Would you please find out what does phenotype refer to?
HY	15:58	[try to answer the question]
T	16:08	Louder please.
HY	16:09	[read the answer loudly]
T	16:15	Yes. Observable characteristics. Sit down. We know that this is said by HY. But I want everyone of you know the meaning of each word we learnt, Okay? So the pheno-typical racial, you see are tall to short, tall plants to short plants is 3:1. How come this result from the genetic diagram of course? You will see three tall plants are produced one short plant is produced. So you will see the ratio would be 3:1. This is the end of the video. And now it's time, besides the genetic diagram, what other diagram can be used to show the parent…..
		Ms T_3.3
T	00:06	[turning to the new slide and pointer at the slide] This is punnett square. This is punnett square. You will see that if the pure-breeding plants, its genotype is homozygous dominant, so only one type of gamete is produced. For the pure-breeding short plants, the genotype is homozygous recessive. So only one type of gamete is produced. If this gamete fills with this gamete, the offspring must be heterozygous and the offspring must be tall plants. You will see the genotype and phenotype in this punnett square. And then you can find out the relationship between the parents and offspring. Okay, you can use the punnett square inside the genetic diagram. Of course, if the expression in the examination asked you to write the genetic diagram, it's no use for you to write punnett square. You may get no marks. So please read the question carefully. If the question asked you to draw the genetic diagram or to draw a punnett square, the show between the parents and the offspring, Okay? It's time for you to do something, to tell me what you learnt in this lesson. So, go to the exercises, P1. I give you 5-6 minutes to finish this exercise, Okay, by yourself. To see how much you learnt in this lesson, Okay? Do it now.
Ss	01:58	[begin to do the exercises]
T	01:59	[go around the classroom to check]
	08:18	Well, who did not finish the exercise? Please raise up your hand. Who did not finish your exercise, please raise up your hand. If no, take out, Okay, give you one more minute.
	08:45	Other students, you can use your time to read your C&L card about genetic diagram and punnett square. If you have time, you can read the C&L card about genetic diagram and punnett square.

	10:11	Okay, take out your green ball-pen, let's check the answer. Take out the green ball-pen, let's check the answers. Okay? For the 1st cross, for the 1st cross, you will see that two pure-breeding plants are crossed.[show the diagram on the slide] One is the pure-breeding tall plant, and the other is pure-breeding short plant. And they are the parent plants in the 1st cross, Mendle let them have cross-pollination and fertilization. Remember to put a "cross" between the phenotype of the parent plant. And then seeds are collected and sown. First filial generation are produced. You will see that F1 seeds are formed, Mendle grew the seeds in the soil and grew the green formula plants, Okay? And are the first filial generation plants. In order to represent this relationship in genetic diagram, we have to let some lactis for the dominant allele and recessive allele. But in the semination, we write the dominant allele and recessive allele like this, [pointer at the slide] you cannot get the marks, Okay? So please write this out, [write on the blackboard]you have to "let the large capital letter 'T' " be the… you have to write this sentence, not just tell me that [pointer at the slide] large capital letter "T" is equal to dominant. You cannot get marks. [continue to write on the blackboard] "Let T be the dominant allele (for what characteristic?) for tallness" and then, " Let t be the recessive allele (for what characteristic?) for shortness (here is the shortness) ". You need to write these two sentences, allele (add "e"), I missed the letter "e", Okay? You need to write these two sentences down as the answer for the same questions.
	13:14	And then, in the genetic diagram,[writing on the blackboard] you need to write the phenotype of the parent plants, you can see the parental phenotype. Where is duster?[find the duster behind the screen and erase the wrong words on the blackboard]. In the genetic diagram, you need to write the parental [write on the blackboard] phenotype first, and then the genotype, sorry, parental genotype, and then the gametes… what type of gametes are produced? Answer is fertilization. What is genotype of the 1st filial generation? You need to write this clearly as the answer for your examination. Okay.
	14:29	And then , what will be the answer for this cross? Let me ask.. SK,you come out, draw this genetic diagram to us.
SK	14:22	[go to the blackboard]
T	14:23	Take out your exercise and draw the genetic diagram you did on the blackboard. Be quick, be quick, be quick.
SK	14:53	[draw the genetic diagram on the blackboard]
T	14:57	[help SK] Phenotype, the first, good, and then the genotype of the parents. Very good, there is a cross between the genotype of the parents. Only one kind of gamete is produced from each parent.
SK		[keep drawing]
T	15:33	[help SK]This is the gamete? You need to put them correctly, in correct position. Yes, here you put the gamete.

	15:47	[finish drawing]
	15:47	Okay, thank you. If you have time, you'd better write the oral to show the direction of genetic diagram.[pointer at the blackboard] Very good, SK did a very good job. You will see that the parental phenotype is tall and short in this case, and then the parental genotype is homozygous dominant for this tall plant, homozygous recessive for this short plant. And only one kind of gamete is produced from this parent, only one kind of gamete is produced from this parent. [write on the blackboard] And when these two gametes fill together, to form the 1st filial generation. And this is the genotype of the 1st filial generation. What is the genotype of this plant? From this genotype, can you tell me what is the phenotype of this plant? KN.
KN	16:45	[stand up and answer the question]
T	16:47	Very good.The complete sentence, sit down. The phenotype of this plant is…[write on the blackboard] tall. Tall plant, Okay? So, as you will find that this genetic diagram is very good.
	17:04	And then, [turn to the slide] let's check if the answers are correct.
		Ms T_3.4
T	00:01	[show the slide]What kind of gamete is produced? And then after the fusion of this gamete, the 2nd filial generation is produced. The 1st filial generation is produced and the genotype is heterozygous. And they are all plants, they are all plants. And then, Mendles continue the experiment. He used F1 generation and allow them to self-fertilize. Of course, seeds are also produced. Seeds are collected and sown. F2 generations are produced. And then he grew the seeds in the soil to grow some new plants. And this time you will see that the short plants here reappear. And what will be the genetic diagram? That can represent this relationship between F1 generation plants and F2 generation plants. Okay, mmn, TD, it's time for you to write the genetic diagram to us.
TD	1:22	[go to the blackboard to write the diagram]
T	3:12	Please go back to your seat. I think that ...TD… doesn't know what happens here, right?[write on the blackboard] two parents here. [pointer at TD's answer]This parent has this genotype, it can produce two types of gamete. From TD's answer, this gamete will become the genotype of the offspring without any fertilization of fusion. If it is true, the sperm of TD will become one individual, will become one small TD one day. No fertilization is required.
Ss		[laugh]
T	04:05	Do you know why you get wrong? TD? In your diagram, [pointer at the slide] this gamete will one day become an individual with this genotype, Okay? Do you know why you get wrong? If this is true, one day, each of your sperm will become one small TD. It's so, it's so horrible. Maybe this is new science discovery. Okay. So, look at here,[erase the wrong

		answer on the blackboard] these are the two parents, Okay?[write on the blackboard] If this gamete fills with this gamete, you can see if this plant, this plant is male, this plant is female. The male gamete fills with this female gamete, will form a new individual, which is homozygous dominant, right? If this gamete fills with this female gamete, an individual, which is heterozygous is produced. You understand that, TD? If this male gamete fills with this gamete, the individual should be like this, but...in our habit, we usually write "T" first, and then "t". If this male gamete fills with this female gamete, an individual of homozygous recessive is produced. Do you understand that? Okay. If this is male plant, this is female plant, male plants will produce male gamete, female plants produce female gamete, Okay? If this male gamete fills with this female gamete, this individual will be produced. If this gamete fills with this gamete, this individual will be produced. You understand that, TD. Okay, so you will see that how many tall plants are produced in this cross? How many tall plants are produced in this cross? EV?
EV	06:52	[stand up and answer the question]
T	06:55	Three, good. And how many tall plants and short plants are produced in this cross?
EV	07:02	[continue to answer the question]
T	07:03	One short plant, good, sit down. So the genotypic ratio [write on the blackboard] should be, should be…?MF, what is the genotypic ratio?
MF	07:28	[stand up and answer the question]
T	07:29	2:1:1 or 1:2:1?[pointer at the blackboard]
MF	07:31	[try to identify the answer]
T	07:32	Because there are...
MF	07:34	[keep answering the question]
T	07:36	Because there are 2 heterozygous. [pointer at the blackboard] This is a trap, made by yourself, sit down. I write this genotype first, here. So the answer should be [write on the blackboard]2:1:1 in this case. You are not trapped, very good.Okay, then, what will be the phenotypic ratio? What...? TB.
TB	08:03	[stand up and answer the question]
T	08:05	3:1? What to what? Short to tall? The tall plants to short plants is…?
TB	08:12	[keep answering the question]
T	08:15	Complete sentence, please.
TB	08:17	[keep answering the question]

T	08:20	Good. [pointer at the blackboard] Tall plants, one, two, three...to short plants, one; is 3:1. This is the phenotypic ratio in this cross.
	08:34	And now, it's the time for you to use Mendle's monohybrid inheritance concept to solve the genetic problem by yourself. So turn your exercise to P2, Okay? Now I'll give you 3 minutes to finish the exercise, P2, do it now.
Ss	09:03	[do the exercise]
T	09:04	It's time for you to solve genetic problem involving the monohybrid process
	09:05	[go around the classroom to help]
	11:37	You only need to do the exercise on P2, Okay?
	12:10	[talk to one pair of students] No discussion is allowed
	12:30	[talk to the students who finished the exercise] If you have time, read the C&L card about genetic diagram and punnett square, Okay?
	14:32	Okay, who did not finish your work, please raise up your hand. If no, I invite CK, com out and write your genetic diagram on the board.
CK	14:43	[go to the board to write]
T	14:44	And then, I'll ask… GS,come out, do the punnett square, right now. About the relationship between this, between the parents and F1 generation.
GS	14:56	[go to the board to write]
T	15:01	You do the punnett square right now. You also need to write the phenotype of the parents, genotype of the parents, the gametes produced for the 1st cross.
	15:20	[go to GS] Which question you are doing? I mean this question. [show the right page to GS]
	16:08	I allow you to go back to your seat and take the C&L card about punnett square.[GS go back to fetch her C&L card] I think you'll do some amendments for your punnett square. You can take the C&L card about punnett square. And come out, do some amendment for your punnett square.
GS	16:27	[go to the blackboard again]
CK	16:27	[finish the question and go back to her seat]
GS	16:58	[intend to go back to her seat]
T	17:00	[talk to GS] Anything missing? Or you think you finished this punnett square?
GS	17:05	[turn back to the blackboard again to check]

		Ms T_3.5
GS	00:01	[keep checking]
T	00:03	So this is why you have time. Please read the C&L card about genetic diagram and punnett square. I'll ask you to the exercise immediately.
GS	00:34	[finish the question and intend to go back to her seat]
T	00:34	[talk to GS]]Anything want to add?
GS	00:36	[shake her head]
T	00:37	No? Okay. Just go back to your seat
GS	00:38	[go back to her seat]
T	00:38	Okay, let's look at the genetic diagram first. [pointer at the blackboard] The parental geno… first, let the letter be which kind of allele? For what characteristic first? Although the question gives you the letters to represent the allele, for which kind of characteristic. But it could happen for you [write on the blackboard] to write "B" be the dominant allele for black fur and "b" be the recessive allele for the chocolate fur. Okay. [pointer at the blackboard] And then in genetic diagram, you need to show the parental phenotype. One mice is black fur and one mice is chocolate fur. And then, the parental genotype should be homozygous dominant for the black fur and heterozygous recessive for… sorry, homozygous recessive for the chocolate fur. And remember to put a cross here. Why I aks SK to draw this genetic diagram? Originally, she missed this cross. But I don't know finally she is careful enough to add this cross back. Okay, don't miss the cross here to show that they have fertilization, Okay? And then, the type of gamete produced from this parent is only one, one type of gamete produced, which is "B"; and only one type of gamete produced from this parent is "b". And then, the fusion of these two gametes from two different individuals, Okay? TD, do you understand that? Gametes from two different individuals fill together to form this genotype. And you will see that something is missing, which is the phenotype of this offspring. So you need to [write on the blackboard]write that this mice must have the black fur, Okay? You should write the phenotype for the offspring here. Okay?
	03:13	And then for the punnett square, [pointer at the blackboard] if you say that the one with black fur is male, so you will [write on the blackboard] say that the phenotypic.. the phenotype of this individual is black fur and its genotype is homozygous dominant. If you say that the individual has the chocolate fur, its genotype should be homozygous recessive. And then, only one type of gamete is produced from this parent and only one type of gamete is produced from this parent. If this gamete fills with this gamete, allele-individual with this heterozygous, heterozygous combination is produced. Okay? So this is punnett square used to represent the relationship instead of the genetic diagram. Is that clear to you all?

	04:16	Okay, we know that for the… for the mice, which have the black fur? They can be homozygous and heterozygous. Genotype. Please turn your exercise, worksheet P4 first. P4.
Ss	04:42	[turn to the exercise]
	04:45	The exercise asks you that if the phenotype for all the F2 black mice, it asks you to determine the genotype F1 and F2 generation, which have the black mice? Which are the black mice? Resulting from the 2nd cross. [pointer at the blackboard]From the 2nd cross, you will see that … you will see that some black mice may be heterozygous, some black mice may be heterozygous dominant. What can you do to tell me the mice is homozygous dominant or heterozygous? So go back home, go back home. Read the C&L card about the test cross. Finish the exercise on P3&4, Okay? Finish the exercise on P3&4. And tell me how you can identify the mouse with black fur is homozygous dominant or heterozygous. Read the C&L card about the test cross. This is the technique for you to identify the individual is homozygous dominant or heterozygous. Okay? One more thing, after checking the answers of the exercise on P3&4, tomorrow you will have an exciting game to see how much you learnt in these lessons. So you'd better do some revision at home with C&L card and then we will have a game tomorrow. Okay, is there any question?
Ss	06:49	No
T	06:50	No? Sit down first, what did you learn in these two lessons?

		Ms T_4.1
T	00:30	Okay, before we have lesson, please take out all the C&L cards and exercise I gave you yesterday. Did you finish the exercise at home yesterday? Yes or no? Yes …
Ss	00:42	Yes.
T	00:43	Yes. Very good
Ss	00:47	[handouts being given]
T	01:27	[talk to the student who helped pass out the handouts] Thank you.
	01:29	Okay, in these two lessons, [pointing at the slide] we continue to solve the genetic problems involving monohybrid process and then I will introduce the test cross and essay writing skills to you today, Okay?
	01:46	Let's go back to your exercise, P3, right? P3, right? Go back to the exercise B1. Let's go back to the question B1. [turn to the slide] Okay, draw a genetic diagram to show the cross and the results between two mice of the F1 generation. Now I want to invite… AN and CC… come out to write the genetic diagram you drew yesterday, Okay? Take the question out, please draw the genetic diagram you did yesterday. Ah, AN, yesterday you were absent, right? Okay, EV, your turn. Come out, be quick.

EV & CC	02:42	[go to the blackboard to write]
T	02:43	Write down or draw the genetic diagram for the question B1
	03:01	[go to EV] EV, would you mind using this white one? Thank you.
	03:10	Please check your answer with EV's and CC's and see any difference between the answers of yours and theirs. And use the green ball pen, please, to correct your answer. Use the green ball pen, please, to correct your answer
Ss	03:36	[check the answer]
T	03:37	And after these two lessons, I will collect your work. I will collect your exercise work and see how well you did.
EV & CC	06:14	[finish the question and go back to their seats]
T	06:16	Okay, for these answers, these two answers, [point at the blackboard] it's very good that both of the answers consist of the parental phenotype. It's very good that to show clearly that the parental phenotype is black and the other mouse is also black. Okay, this one, the mouse has black fur and the other mouse also has black fur. Okay, this part is correct [tickle on the answer]. And then, they also say clearly that parental genotypes here, parental genotypes here. You can see F1 genotype or parental genotypes, that would be Okay. And the genotypes are also correct ... the genotypes are also correct. What is that? [point at the blackboard] You see that there is a cross, a cross between the parental phenotypes here. And then, you see a cross between the parental genotypes here, both are Okay. But you remember to put a cross here. Just remember to put a cross here. So… this part is Okay [tickle on the answer] you can get marks. And then, for the gametes produced, you will see that for this kind of parent, two types of gametes are produced. For this kind of parent, two types of gametes are produced. So you will see that this part is also correct. [tickle on the answer] And then, after fertilization, let us see these arrows are correct or not. [write on the blackboard] If this gamete fills with this gamete, this offspring is produced. If this gamete fills with this gamete, this offspring is produced. If this gamete fills with this gamete, this offspring is produced, correct. And the last one, this gamete fills with this gamete, the offspring is correct here. So you will find that CC's answer up to here is quite good, right?
	08:37	How about EV's? Okay, this gamete fills with this one, we get this, we get this offspring, correct. This gamete fills with this gamete, we get this offspring. This gamete fills with this one, we get this offspring, EV did a good job. He put, she puts, she puts a "B" first, and then, finally, this gamete fills with this one, the offspring here is produced. So you will find that our two classmates did a very good job here. [tickle on the answer], they are correct.

		But there is some difference between the answers afterwards. You will see that CC say the geno… genotype ratio… we use correct this word in adj. [write on the blackboard] ge-no-ty-pic ratio. We change the noun into the adjective. Genotypic ratio. [point at the blackboard] Urr, homozygous dominant to heterozygous and to heterozygous, is there, is there anything wrong here? Heterozygous to heterozygous? CC, anything wrong here?
CC	10:06	urr, [stand up and answer the question]it should be...
T	10:07	It should be… [point at CC's answer] For the 1st, 2nd and 3rd, which one should be changed?
CC	10:10	The 3rd...
T	10:11	The 3rd one should be changed to ...
CC	10:14	Small case letter "b"
T	10:16	Small case letter "b",[correct CC' answer on the blackboard] and what kind of genotype it is?
CC	10:25	Homozy-gous
T	10:28	Good, homozygous recessive, sit down. [point out the mistake] Then the ratio is also not correct, it's wrong. What is the ratio of genotypic here? CC, again?
CC	10:42	1:2:1
T	10:44	1:2:1. I think that you are a little bit nervous about coming out to do this question, sit down.
	10:53	It's good that you finally did the answers correct. How about this? [point at the blackboard] You will see that EV puts the phenotype of F2 generation here. Urr, she states that if the genotype is homozygous dominant, the offspring must have black fur. If the offspring is heterozygous, these two offspring have the black fur. And if the genotype is homozygous recessive, this mouse has chocolate fur. [tickle on the answer] So you'll see the answer is correct. When will we need to answer the genotypic ratio and phenotypic ratio? It depends on, it depends on what question you are asked. If the question asks you to state the genotypic ratio and even the phenotypic ratio, you are required to write this kind of answer, Okay? [point at the blackboard] And in this case, in this case, [write on the blackboard] what is the phenotypic ratio here, phenotypic ratio? YY, phenotypic ratio should be...
YY	12:14	[stand up and answer the question]
T	12:24	The… the ratio of black fur to.. to chocolate fur [write on the blackboard according to what YY said] should be… sit down. CT, please continue. The genotypic ratio, black fur to chocolate fur should be...
CTT	12:48	[stand up and answer the question]

T	12:49	Should be 3:1, [write on the blackboard] very good. So, we find that we have a complete answer here. Let's look at the suggested solution xxx gives you
	13:06	Here, there is a suggested solution given by xxx. [show ss the slide] Can anyone of you tell me that? Please raise up your hand if you know, please raise up your hand if you know. Any information, any important information is missing in this diagram? Anyone wants to try… to tell us, to tell me what important information is missing in this genetic diagram? Please raise up your hand if you know.
Leo	13:39	[raise up his hand]
T	13:40	Okay, Leo. What information is missing?
Leo	13:42	[stand up and answer the question]
T	13:44	F1…
Leo	13:45	phenotype.
T	13:46	...phenotype, so where should you put F1 phenotype? Where will you put F1 phenotype?
Leo	13:53	The top of the diagram
T	13:55	[point at the diagram] The top of the diagram, above the...
Leo	13:58	F1… urr, the genotype
T	14:00	[point at the diagram] Genotype. Very good. So what is the phenotype of this parent?
Leo	14:07	Black fur.
T	14:08	Black fur, very good. [pointer at the diagram] So we should put the black fur here. How about this genotype? Above the genotype, we also put the…?
Leo	14:14	Black fur.
T	14:15	Black fur, here. Very good, Leo. You will get this gift. Yes, very good. Sit down. Okay, [pointer at the diagram] this is not a very good genetic diagram because the phenotype of this parent is missing, Okay? So… how about this question? Question B(iii)? You are required to describe and explain how you can determine the genotype of the F2 black mice resulting from the cross in b(i). You will see that [pointer at the blackboard] we get the black mice in this cross, but some… some are homozygous recessive, sorry, some are homozygous dominant and some are heterozygous. How do we determine the genotype of this black mice? How do we determine the genotype of this black mice? So, now, it's time we will introduce this test cross to you. [turn to the new slide]Take out the C&L card about test cross please.
Ss	15:32	[Take out the C&L card]
T	15:43	You find it?... yes… C&L card about test cross.

	15:59	MJ, do you find it? If you cannot find it, just share your card with CT first. Share your card with CT first, Okay?
	16:16	The whole class, please. Tell me what is test cross? Count 3,2,1… go.
	16:23	[read the C&L card about test cross] Test cross is a cross between an individual exhibiting a dominant phenotype of a trait and an individual that is homozygous recessive for that trait.
	16:38	"exhibiting"... if you don't know this word, what word can you use instead of "exhibiting"? DG, if I don't know the word "exhibiting", what word will you use , instead?
DG	16:59	[stand up and try to answer the question]
		Ms T_4.2
T	00:01	show…[try to give hint]
DG	00:03	show way
	00:04	show way. Thank you, sit down. Very good. We can use "show way" instead of "exhibiting". [pointer at the blackboard] So, if we don't know the genotype of tested organism, we can cross this organism with an individual that is homozygous recessive for the train, Okay? [turn to the slide] So here you will see that for this question, [pointer at the slide]if the genotype for the tested mouse is homozygous dominant, here, and then we cross this tested mouse with the mouse that is homozygous recessive for the fur color. And then, we will find that all the offspring have black fur or chocolate fur? All the offspring have black fur or chocolate fur?
Ss	01:00	Black fur
T	01:01	Why black fur? MG?
MG	01:05	[stand up and listen to the question again]
T	01:05	[pointer at the slide] Why all the offspring have black fur?
MG	01:10	[answer the question]
T	01:11	Because they...?
MG	01:13	[keep answering the question]
T	01:15	[pointer at the slide] Because they are…?
MG	01:17	[try to answer the question]
T	01:22	[pointer at the slide] What genotype do they have?
MG	01:25	[keep answering the question]

T	01:28	[pointer at the slide]The genotype is the same? No.
MG	01:31	[keep answering the question]
T	01:37	[pointer at the slide] Because...the genotype is...
MG	01:40	[answer the question] ...
T	01:42	[pointer at the slide] Genotype, the genotype consists of two alleles. One from the male parent and the other comes from the female parent. So we can't just say it's dominant or recessive. The genotype is…?
MG	02:02	Heterozygous
T	02:04	[pointer at the slide] Is heterozygous, Okay? Because it is heterozygous, what, which allele make them have black fur?
MG	02:16	[keep answering the question]
T	02:18	[pointer at the slide] Which allele? There are two alleles here, which allele? Look at here, which allele .... them have black fur?
MG	02:29	[keep answering the question]
T	02:34	[pointer at the slide] Which allele?
MG	02:38	[keep answering the question]
T	02:40	[pointer at the slide] "B" means it is a...
MG	02:43	[keep answering the question according to the hint]
T	02:45	[pointer at the slide]A…? What kind of allele… it means?
MG	02:48	[cannot give the right answer]
T	02:53	You have two choices for the alleles. [pointer at the slide] What kind of alleles it possess, it possesses, so it has black fur? What allele?
MG	03:06	[keep answering the question according to the hint]
T	03:10	[pointer at the slide] No black allele? RY, would you help him?
RY	03:18	[stand up and answer the question]
T	03:20	[pointer at the slide] Because it has the dominant allele, so the mouse has black fur. Understand? Sit down. You will see that in this genotype, MG, please listen carefully. For this genotype, it consists one dominant allele and one recessive allele. Because the genotype consists of one dominant allele, the mouse has dominant character that means it has black fur. Okay, understand?
	03:56	Oh, oh, and then, if the genotype of the tested mouse is heterozygous, [pointer at the slide] like this, you will find that two types of gametes are produced. And when it crossed

		with mouse with hetero.. with homozygous recessive genotype, you will see that two types of offspring are produced. One mouse with chocolate fur is produced, one chocolate fur mouse is produced. It means that the genotype of the tested mouse must be heterozygous. Understand? Because this mouse… inherit, pass on this recessive gene to this offspring, so this offspring has chocolate fur. Understand that? If in all offspring, there is one offspring has chocolate fur, it means that this tested organism, this tested mouse is heterozygous. Okay?
	05:06	And it is your turn now. Please use the C&L card about test cross. Describe and explain in words, not the genetic diagram, in words. How you determine the genotype of F2 black mouse from the cross in b1, do it now. Use the information on C&L card about test cross. Describe and explain in words, not the genetic diagram that you determine the genotype of F2 black mouse in the cross b1. I give you two minutes to finish it.
Ss	05:54	[start to do b1]
T	06:04	I know that some of you finish it at home, yesterday. But practice again with your C&L card about test cross. Check the answer with C&L card about test cross.
Ss	06:19	[keep checking the answer]
T	06:49	One minute left.
	07:46	Okay, time's out. Let's listen to KG's answer. Stand up, what is your answer? Louder, please.
KG	07:55	[stand up and answer]
T	08:03	A is determined by carrying out the test cross... [repeat KG's answer]
KG	08:08	[keep answering]
T	08:15	No… between which individuals? You need to explain more. Don't just tell us the result. Explain more about the experiment about the test cross. It is determined by carrying out the test cross … between which individuals?
KG	08:35	[explain more about the answer]
T	08:43	Ah, between black mice and chocolate mice. And what will be the result?
KG	08:50	[keep explaining]
T	08:55	If all the offspring are black or if all the offspring have black fur, Okay? Which one do you choose? Repeat this sentence again.
KG	09:07	[repeat]
T	09:11	If all the offspring have black fur...
KG	09:17	[keep answering the question]

T	09:23	The offspring? Or the tested mice?
KG	09:28	[try to finish the answer according to teacher's hint]
T	09:35	Good. So the parent, the tested mice, must be homozygous dominant. Sit down. And then, GT, please continue.
GT	09:48	[stand up and answer the question]
T	09:55	If the ratio of the black fur to chocolate fur is 1:1, would you say that if the, if the mice with black fur to the mice with chocolate fur is 1:1? Okay? You repeat this sentence again. If the mice....
GT	10:19	[repeat the sentence]
T	10:34	The black mice… the offspring of the parent. We find that some offspring are, are also black in color. So if the mice with black fur to the mice with chocolate fur is in the ratio 1:1...
GT	10:54	[try to finish the answer according to teacher's hint]
T	11:05	Very good. The parental black mice is heterozygous. Very good, sit down.
	11:11	So, you will get the answer similar to Mr.G. [turn to the slide] To find that cross, each of the F2, black mice with chocolate mouse and check the phenotypes of the offspring. If all the offspring are black, the F2, black mice must be homozygous. If some of the offspring are black and some are chocolate, the F2 black mice must be heterozygous. This is the suggested solution Mr.G gives you. But there is a mistake I find in this answer. Anyone can tell me what mistake I made here? It seems perfect, but it is not perfect actually. What mistake Mr.G made in this answer? Can anyone raise up your hand and tell us?
Ss	12:10	[discuss]
T	12:20	After discussion with your classmate, can anyone of you tell me what mistake is made? Anyone wants to try? Okay, AD.
AD	12:33	[stand up and answer the question]
T	12:37	Very good. The black mice must be homozygous dominant. And here is your gift. [walk to AD]. And this is the end of how we solve the genetic problem with the monohybrid process [turn to the new slide]. Thanks to Ms. Emily, thanks to Ms. Emily, she prepared these notes for us about the essay writing skill. If there is a question asking you---explain how the structure of DNA is adapted to its function as a genetic material. Yes, you may get some notes here [pointer at the slide], you may get some notes here. But how can you change the notes into a SHORT ESSAY by improving the text structure and using appropriate language features? That is Emily gave us this… very useful information to us. So here you will find that there is an essay. Using the notes, using the notes to see before. So in the essay, [pointer at the slide], we should add an introduction referring to the question. There is a minus xxx to the referring, Okay? So please get one more 'r' for this word. There is a minus xxx to the referring. Because the previous letter is "a, e, i, o, u",so

		double “r” is required, Okay? [pointer at the 1st aspect] First we need to add an introduction referring to the question here. And then, provide the supporting details to make your argument solid. Why… why DNA carries a large amount of genetic information? Because DNA consists of a large number of nucleotides. [pointer at the 2nd aspect] Why the DNA stores a large amount of genetic information? Because DNA molecule has a long sequence of bases. [pointer at the slide] You need to give the supporting details to make your answer, to make your arguments solid and correct. Okay? More than that, you will use the sequential conjunctions to make your argument clear. Like “First, Second, Third, Fourth” to make your argument clear and in sequence. And use the logical connectors, cause & effect to make your argument logical. Like, ……, because …… So you will use “because… therefore...”, this kind of words to connect the cause and effect. And finally, use the academic words… it is usually, always playing by the HKEA, the examination of xxx. You usually use some common English words instead of some biological words. So here, [pointer at the slide], use the academic words, not biological words. Like “replicate”, instead of “copy”, to make your arguments scientific because biology is a kind of science. Okay? You need to use the academic words.
	16:37	Okay, before the end of the lesson, we will have a game. We will have a game here, a game here to test how well you understand the concept we learn in these lessons in this week, Okay? I will give you these… MD, please give these to your classmates.
MD	17:00	[give the handouts to the class]
		Ms T_4.3
T	00:01	Please take out your C&L cards first. Take out all your C&L cards first
Ss		[get prepared]
T	00:47	[talk to MD] Thank you.
	00:48	I prepare a lot of gifts for you if you win this game, Okay? This is a BIngo Game. [turn to the slide] I think you played this kind of game before. How do you play the game today? Please… make it simple first, make it simple first. Turn your paper with “my grades”, please. Turn the paper with “my grades” , please. And then, select “My words for phrases” from the C&L card about basic genetics. And these words and phrases I used to describe or explain important concepts of the basic genetics, Okay? And then, try to find if you think that… Gregor Mendle is very important, so I must put this in one grid, and then, if you think that Mr. G is very important in basic genetics, one of the teachers in the world teachers use basic genetics, you can put Mr. G in another grid. Okay, if you think that Ms. Emily helps us a lot understand this chapter, you can also put Ms. Emily in the grid, Okay? But, unfortunately, you cannot put Mr. G and Ms. Emily for your C&L cards. I give you at least that all the answer must appear in this C&L card, Okay? And then, you choose nine items to write in this grid. And later, I will give you some concepts about the basic genetics. And then, we will xxx use to describe this basic concept. If you get this term, you

		can circle, circle the words or phrases until you find that 3 circles of vocabularies turn in the straight line. If the circle turns in the straight line, you can get the gift. I give you 5 minutes, Okay? Which concepts you think very important in this chapter? Do it now. I just give you 5 minutes. Do it. Because you all know that today we have summer time table. We have shorter classes. ……..simple game, first.
Ss	03:16	[start to play the game individually]
T	06:00	Have you all finished? Yes or no? Have you all finished? Anyone needs more time? Now, please change the worksheets with your classmates. Please change, exchange the worksheets with your classmates. Why? Because you are required to get the term correctly and you are required to spell the words correctly. Let your classmates help you to check the words. Not just you get the word terms correctly, but also you need to spell the words correctly, Okay?
	06:47	[turn to the slide] The 1st concept is … dang dang dang dang… 'The transmission of characteristics from parents to offspring.' What term match this concept? What term? The whole class, please
Ss	07:06	Heredity.
T	07:07	Heredity… let's see if it's heredity or not. Yes, you get this ---Heredity. Circle the term for your classmate. Circle the term for your classmate.
	07:20	Let's go to the next concept--- A term used to describe an allele that can express itself only in the homozygous condition. What kind of allele it is? What term you will use?... The whole class?
Ss	07:44	Recessive.
T	07:45	Recessive. As see if your classmate made out this answer, make sure that he/she spells the word correctly. Make sure that he/she spells the word correctly. If you spell it wrongly, you cannot circle the term, Okay? [turn to the slide]And the answer should be recessive. Very good.
	08:07	And then, for the next concept--- The observable characteristic of an organism. What is this? The whole class?
Ss	08:19	Genotype.
T	08:20	Genotype. Okay? Already 3 concepts given to you. Anyone xxx in the straight line? Still not, yet?
	08:37	Let's go to the 4th concept. [pointer at the slide] The whole class read this out.
Ss	08:42	[read the words on the slide]
T	08:50	So what term you will use to describe this definition?

Ss	08:54	Homozygous
T	08:55	Homozygous? [pointer at the slide] For a particular characteristic. So which term you will use?
	09:04	Homozygous
	09:05	Homozygous… Let's see if you get the correct answer. Yes, homozygous.
Ss		[exciting discussion about the answer]
T	09:15	No one's answer is correct? No one's answer… Ahh. PG, get the straight line first.
Ss		[cheer for PG]
T	09:28	[give the gift to PG] Congratulation! You can share with CT. Okay, let's continue, the whole class read this out. [pointer at the slide]
Ss		[read the words on the slide]
T	09:47	What is this concept? --- A thread-like structure of DNA and proteins that is found inside the nucleus of a cell. … What is it? Homo, yes homo. You get the straight line? Let me check. Yes, you get the straight line. Congratulations for HG! Anyone gets the straight line?... No, no straight line, yet.
Ss		[warm discussion]
T	10:27	[pointer at the slide] And then, this question, the whole class read this out.
Ss		[read the words on the slide]
T	10:40	Should be…? The genotype should be…?[pointer at the slide] … pure-bred short plant? And this is recessive character. For the genotype, should be...
Ss		[try to give the answer]
T	11:00	If you use the words to describe…. Don't use the letter to describe.
Ss		Homozygous recessive.
T	11:08	Louder, please.
Ss		Homozygous recessive
	11:12	Good. So the answer is homozygous recessive.
Ss		[some are excited to clap their hands]
T	11:19	Still no straight line? Okay. Then, whole class, [pointer at the slide] attention please. The inheritance ...
Ss		[continue to read the words out]

T	11:35	[pointer at the slide] contrasting characters.
Ss		[repeat after the teacher and finish the reading]
T	11:50	What term did you use to describe this concept? So, the whole class?
Ss		[try to give the answer]
T	12:02	Let's see… SK, you get the straight line?
SK		Yes.
T	12:09	Let me check. [walk to SK and give her the gift] Yes, you get the straight line. Anyone more? Ahh, ZY, get the straight line?[walk to ZY and give her the gift]. And MG, pass this to her, please. Okay, Okay, let's turn your worksheet to another side. Write down another 24, write down another 25. Concepts here, a little bit more…….
Ss		[excited]
T	13:07	You may read it please.
Ss		[read and do the question]
T	13:20	Let me ……. The concept will love you…...Let me …. The concept will love you... ...So you will have a higher chance to get the gifts.
Ss		[try to finish the question]
T	16:50	Be quick, please. Because we will have summer time today. We don't have much time left.
		Ms T_4.4
Ss	00:00	[continue their Bingo Game]
T	01:45	Only one minute to go. One minute… We don't have enough time, we don't have enough concepts for you to circle the terms. One minute left.
	02:28	[talk to one student] No, no regrets for the concept. You can write, but you know that, you will not be circled. …… No concept will be …...
	02:58	Okay, the last 10 seconds.
	03:24	Okay, exchange your worksheet with your classmate. And then, please pay attention to the spelling of the words, Okay? Please pay attention to the spelling of the words.
	03:42	Okay, [turn to the slide] the 1st question here, the 1st concept here is… dang dang dang dang… One of the alternative forms of a gene, what is this? One of the alternative forms of a gene. Whole class? The whole class? --- Allele.
Ss		Oh...

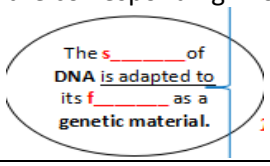
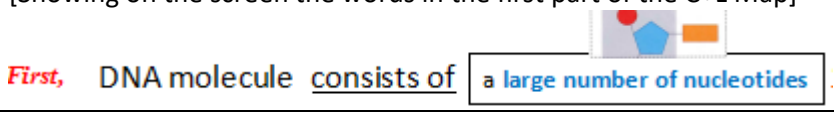
T	04:09	Yes, Oh… you get this all right.
	04:18	And then [turn to the new slide]the 2nd one--- A segment of the DNA molecule of a chromosome coding for a specific polypeptide or protein. What is this?
Ss		Gene
T	04:28	Louder, please
Ss		Gene
T	04:30	Gene.
Ss		Oh...
T	04:32	Getting correct?
	04:39	And then, [turn to the new slide] the 3rd definition, the 3rd concept is .. the whole class… [pointer at the slide]
Ss		[read out the concept]
T	04:51	What is the answer?
Ss		[murmuring]
T	04:54	Louder, please.
Ss		Heterozygous
T	04:56	Heterozygous… yes…
Ss		[excited]
T	05:06	Okay, the 4th concept [turn to the new slide]. A type f nucleic acid. Each molecule consists of two polynucleotide chains coiled round ...
Ss		[murmuring the answer]
T	05:19	Louder, please.
Ss		DNA.
T	05:20	DNA. Ahh, CT again. CT again. CT again. [give gift to CT] And GG, in the straight line? You do get the spelling correctly? Yes, yes. They all get the spelling correctly
	05:57	Okay, Okay, let's continue. [turn to the new slide] A nucleotide that contains a deoxyribose.
Ss		DNA
T	06:08	DNA? Ahh, you find that you are required to spell the whole word here, deoxyribonucleic acid. Anyone gets it? And then the nucleotide.

	06:23	Next question, [turn to the new slide] the whole class
Ss		[read the words on the slide]
T	06:36	What is it? The genetic makeup of an organism. It describes the alleles each cell has or a certain characteristic. What is the answer? Anyone knows? Louder, please.
S	06:52	Genotype
T	06:53	Genotype...Let's see if the answer is correct. [turn to the slide] Yes, genotype… genotype.
Ss		[warm discussion]
T	07:07	MG, MG, MG, so please, remember the concepts here [pointer at the slide]. That sounds……, because you are all familiar with this concept, right? Listen carefully, please. xxx, what does it mean? It means that for all xxx, you are familiar with, so you must remember this concept. The genetic makeup of an organism, that means "genotype"
	07:42	Okay, [turn to the new slide] the next question--- A term used to describe an allele that can express itself in both homozygous and heterozygous conditions. What term it is used?
Ss		[murmur the answer]
T	07:58	Louder, please.
	08:02	You got that. Let's see. [turn to the slide] Yes, xxx the answer. No one get the straight line?
	08:12	Okay, one more question. [turn to the new slide] The differences in characteristics among individuals of a species
Ss		Variation.
T	08:19	Variation. Very good. Still no one get the straight line? Okay, the next one, [pointer at the slide] the whole class...
Ss		[read out the words on the slide]
T	08:41	What is the term? I asked you before.
Ss		[try to tell the answer]
T		[give some hints]
T	08:58	The whole class...
Ss		[tell the answer]
T	09:01	Once again, dihybrid inheritance
Ss		Dihybrid inheritance

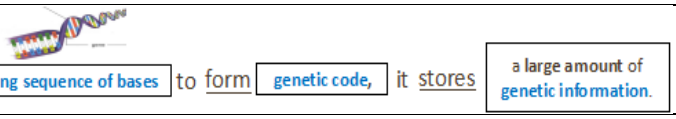
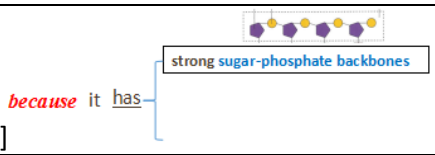
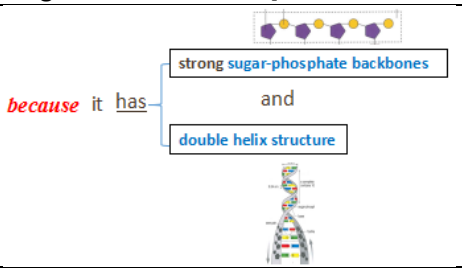
T	09:07	We will learn about this later. [turn to the new slide] And then, this question, the genotype of a pure-bred tall plant (dominant character) should be...
Ss		Homozygous...
T	09:22	Homozygous...dominant. Anyone get a straight line? Still no? Unlucky you are.
	09:38	Okay, pay attention here. [turn to the new slide] Attached to the deoxyribose sugar is one of the four….? [pointer circle the blank and the choices] xxxxxxxxx If you write down the "base", that'll be Okay. If it is in a singular form, I accept it. Still no one get the straight line?
T	10:10	[turn to the new slide and point at the question]
Ss		Punnett square
T	10:14	Punnett square. Yes. Who get this correct? LG? [walk to LG] Did you spell the words correctly? Okay, just one more student get the straight line? How unlucky you are...
	10:40	[turn to the new slide and pointer at the slide] A nucleotide that contains a deoxyribose. Repeat, yes, you are right.
	10:53	[turn to the new slide and pointer at the slide]] Read this carefully. Test cross? Oh, Leo, you get the answer. [give the gift to the students who get the right answer] CK… we have more lucky students. More lucky students come out finally. Leo, again. [throw the gift to Leo]
Ss		[who get the right answers raise up their hands]
T	11:44	[turn to the new slide and pointer at the slide] We are more passionate. Yes, one more. Pay attention here, please. What term is used to describe this concept? What segregation?... Law of segregation. Anyone get the straight line?
Ss		Oh...
T	12:09	[turn to the new slide and pointer at the slide] The scientific study of heredity and variations in organism...the answer should be… genetics. Still no straight line?
Ss		Oh...
T	12:26	[turn to the new slide and pointer at the slide] DNA consists of two long chains of nucleotides called…. two long chains, two [try to give some hints]
Ss		[try to guess the answer --- 'double xxx']
T	12:42	Double xxx? ... Polynucleotide chains, polynucleotide chains.
	12:51	Okay, one more question again. [turn to the new slide and pointer at the slide] Read it carefully
S	13:06	Genetic diagram.

T	13:07	Genetic diagram? Right.ZY, you the the straight line? …. Congratulation! [walk to the student and give the gift] Congratulation!
	13:31	[turn to the new slide] Let's see if there is any question left? What will be the answer?
S		Double xxx
T	13:45	Double xxx. [walk to Leo because he raised up his hand] You get the straight line again? Oh, AD. AD get the straight line. No, Leo get the straight line.
	14:01	[turn to the new slide] Which xxx are made of 5-carbon sugar (deoxyribose) and phosphate groups? The whole class, please.
S		[try to give the answer]
T	14:18	You get the line? Oh, you get the line. Wow... I only have … two more left. [give gifts the students]GG get the line, AN get the line. So this is the end of the game.
Ss		[who get the line raise up their hands]
T	14:49	Okay, before the end of the lesson, please, please give our big hands to Ms. Emily for all the information she recapped for us, Okay.
Ss		[applause]

Appendices (3.1) Selected transcript for discussion

		Ms T_2.2
	09:17	Here, you will find that there is another exercise on page 2. It is a summary about what you've learned in the last two lessons and what you learned about the replication of DNA. This is a summary worksheet about what you've learned in the last two lessons and the replication of DNA. Use your C+L cards please, to find out all the answers on this worksheet. Okay. Use your C+L cards I gave you last time and I gave you in this lesson to find the answer of this worksheet. Do it now. I'll give you 5 minutes. Okay. Just see that if you understand what we were talking about in these lessons.
	10:03	[students started to finish the worksheet individually, searching information by flipping, turning and reading card by card.]
T	12:39	May I have your attention please. [pointing to the small diagrams next to the key concepts in the C+L Map in the screen] These diagrams. Look at these diagrams. They will help you find out the answers. These diagrams given to you will help you to find out the answers. Okay. With the diagrams, you will understand more about the sentences, and then find out the answer from the C+L cards. Okay.
		[T walking around the classroom observing how the students finish the exercise]
	15:26	Very good.
	15:32	Do it by yourself.
		Ms T_2.3
T	0:18	Okay. I'll give you one last minute to finish the worksheet. One last minute.
T	1:15	Okay. Put down your pens. Put down your pens. Okay. Let's see. Check your answer with your classmates. And see, the answers that you don't know, ask your classmate if they know. Of course you should discuss that and think that the answers are correct or not. Don't just accept the answer directly.
		[Students were discussing the answers to the worksheet (C+L Map), pointing to each other's worksheet, flipping and searching for information from the C+L cards and exchanging ideas about the answers.]
T	01:48	Just discuss the answer. Whether the answers are correct or not. JK. What are you writing?
T	02:07	Although your classmate may have the answers, but the answers may not be correct. So you need to discuss it.
T	3:03	Okay. Let's check the answers here. Okay.
		[Again, the teacher did not show the answers in the whole C+L Map all at once. She showed the Map part by part which allowed her to elicit answers to the questions to check students' understanding of the corresponding knowledge.] 
	03:10	The first answer will be given by me. Okay. The **structure** of DNA is adapted to its **function** as a genetic material. Okay. The first, who give the first answer? Uh, EV
EV	03:31	[Reading out the answer on her worksheet] DNA molecule consists of a large number of **nucleotides**.
T	03:37	Nucleotides. Thank you. Sit down. Very good. Let's see…
		[Showing on the screen the words in the first part of the C+L Map] 
	03:42	First, DNA molecule, consists of, or you can see, contain, or you can say… what word you'll use instead if we don't know 'consist of', if you don't know 'contains', what can you use instead?

Ss	04:00	Has.
T	04:01	Has. Very good. Has a large number of nucleotides, as EV said, a large number of nucleotides. And it is very obvious that [pointing to the small diagram above the concept nucleotides] this diagram shows you the structure of a nucleotide. What three parts? Which three parts are used to compose? Are used to compose of one nucleotide? Um. KG. Which three parts? Different parts are composed of a nucleotide.
KG	04:40	5-carbon sugar.
T	04:41	5-carbon sugar. Which diagram represents the 5-carbon sugar?
KG	04:46	The blue…
T	04:47	The blue one. And how about this circle?
KG	04:51	Urr, phosphate group.
T	04:53	Phosphate group. And then what about this yellow rectangle?
KG	04:55	Nitro-… Nitrogenous base.
T	04:59	Nitrogenous base. Very good. So you will find that this DNA molecule consists of a number of nucleotides. [Further showing the logical connector 'therefore'] And therefore… Um. WY again.
WY	05:13	Therefore, it carries a large amount of **genetic information**.
T	05:19	Good. It carries, a large amount of genetic information. [showing the rest of the words in the first part of the C+L Map] ***Therefore,*** it carries [a large amount of **genetic information**.]
T	05:27	Second. What will be the answer? MG
MG	05:32	Second, since DNA molecule has a long sequence of nucleotide…
T	05:37	Eh… DNA molecule has a long sequence of nucleotides. We know that it contains a sequence of…
MG	05:44	[correcting himself] A long sequence of genes
T	05:46	A long sequence of genes. But what? Which part in the genes to form the…
MG	05:57	Chromosome.
T	05:58	Form the chromosome? No. You find that you got the wrong answer. You got this answer wrongly. Okay. The DNA molecule has a long sequence of which structure to form the …
MG	06:14	Form the **genetic code**.
T	06:15	Form the genetic code. Very good. But which part of the nucleotide? Which part of the nucleotide form the genetic code? This is the point. The phosphate group? Or the…
MG	06:32	**Nitrogenous base.**
T	06:34	Nitrogenous base. Very good. Here you will find that DNA molecule has a long sequence of …
MG	06:47	Nitrogenous base.
T	06:48	Nitrogenous bases, or a long sequence of bases to form …
MG	06:52	Form the genetic code.
T	06:54	To form genetic code.
MG	06:56	It stores a large amount of…[MG could not continue with the sentence]
T	07:02	It stores a large amount of, if there are many genetic codes, it stores a large amount of …
	07:11	[Seeing that the student could not figure out the answer to the rest of the sentence, the teacher offered another hint.] Just like what WY just now said. It stores a large amount of…
MG	07:16	**Genetic information.**
T	07:17	Genetic information. I am very happy that you listened to what WY said. Okay. You paid attention to what she said. Okay. Sit down.
		[T then showed the answer (the second part of the C+L Map) on the screen part by part during which she elaborated on the concepts.]

		
T	07:29	Second, you will see that, since DNA molecule has, a long sequence of bases like A, T, G, C, T, C, G, these kinds of sequence of bases, to form, genetic code. So it carries, it stores a large amounts of genetic information.
T	07:54	How about the third sentence? How about the third sentence? LG. How about the third sentence? Third.
LG	08:06	DNA is a strong molecule because…
T	08:09	Is a … What molecule?
LG	08:11	Strong.
T	08:12	Is a strong molecule? You use strong here? Um? YY, would you help him?
YY	08:22	DNA is a stable molecule.
		[T showing the third characteristic on the screen.] *Third,* DNA is a **stable** molecule
T	08:25	Is a stable molecule. Stable is better than strong here. Okay. You can say that the bonding is very strong. The covalent bond is very strong but the hydrogen bond is relatively weaker. Okay. But we won't say that the molecule is strong. The molecule is stable. YY. Sit down please. [Turning to LG again and ask another question.] Why the DNA molecule is stable?
LG	08:51	Because it has strong sugar-phosphate backbones.
		 [T showing the words about the reason on the screen.]
T	08:55	Good! It has strong sugar-phosphate backbones. [pointing to the small diagram 'sugar-phosphate backbone' in the C+L Map on the screen] We can see that in this diagram, this is a sugar-phosphate backbone. If the question in examination asks you to draw the sugar-phosphate backbone, you have to draw the diagram like this. Make sure that no nitrogenous bases are added. No nitrogenous bases are added. Okay. This is the strong sugar-phosphate backbone. Besides the strong sugar-phosphate backbone, what help the DNA molecule become stable?
LG	09:33	The double-helix structure.
T	09:34	The double-helix structure. You will see that [Showing the words 'double helix structure' and the diagram on the screen]
		
T	09:38	Maintained by…
LG	09:40	The hydrogen bonds between the two strands.
T	09:41	[showing the words 'maintained' and 'by the hydrogen bonds between the two strands.'] Good. Maintained by the hydrogen bonds between the two strands. Sit down. [pointer pointing to the diagram] So these two structures will make the DNA molecule stable.
T	09:57	And then fourth. What will be the answer? Um. YY.

YY	10:04	[Reading out the answer on her worksheet] Fourth, DNA can **replicate** itself accurately.
T	10:08	DNA can replicate itself accurately. Very good. Don't write replication, because replication is a noun. You use replicate, the verb instead here. Very good. YY. DNA can replicate itself accurately.
		[showing on the screen the words] *Fourth,* DNA can **replicate**(copy) itself accurately ]
	10:27	Although the meaning of 'replicate' is 'copy', but don't write 'copy' in the exam. It is supposed that you are a senior form student, you need to use a better word: 'replicate' instead of 'copy'. Okay. Although Miss T gives you that (the verb 'copy' in bracket on the C+L map as a hint), the meaning of 'replicate' is 'copy', but you use 'replicate' instead of 'copy' in the examination. (T went on reading the words on the C+L map) Accurately. Let's continue. YY.
YY	11:02	Through **complementary base pairing**.
		[T showing the words and the diagram through **complementary base pairing**]
T	11:06	Through complementary base pairing. What does complementary mean? Would you give us an example? What does complementary mean here? If the base is A, it should pair with…
YY	11:26	T
T	11:27	So the whole sentence is… If the base on one strand is A…
YY	11:33	If the base on one strand is A…[T made gesture encouraging her to continue] it would be
T	11:40	It should pair with….
YY	11:43	T
T	11:44	T. So this is what we say complementary. How about G? T pairs with …[pointing to YY encouraging her to follow]
YY	11:53	G pairs with C.
T	11:55	Good. Sit down. We've learned 'pair with' in the C+L card I gave you last time. Do you remember that? Pair with. Okay.
T	12:04	And then you will find that through the complementary base pairing. As a result, [showing the logical connector 'As a result'] As a result, the identical information [showing the words 'identical genetic information'] identical information can be passed to the new cells from generation to generation. [showing the phrases 'can be passed', 'to the new cells' and 'from generation to generation' one by one on the C+L map] How about if I don't want to use 'be passed'? What other words can be used instead of 'be passed'? Um. 'What other words can be used instead of 'pass on'? This is what you learned from the C+L cards last time. CC.
CC	12:48	Can be transferred to
T	12:50	No. Not 'transfer'. Trans…
CC	12:56	[Think carefully about the word she learned in the previous lesson 'transmission'] Transmit.
T	13:08	Transmit. Very good. You can use 'transmit' instead of 'pass on'. Thank you very much. Sit down.

Appendices (4) Experimental report templates

A. My own experiment design

Title of the experiment: _____

Objective: [Why do I carry out this experiment?]

This experiment aims to investigate _____.

Materials and apparatus: [What do I need for this experiment?]

-I'll need (material A) to ...

-I will need (apparatus B) to ...

Materials: _____

Apparatus: _____.

I need to check my glossary for **vocabulary** about ***materials & apparatus***:

Procedures: [How do I conduct the experiment? In what sequence? What to do in each step?]

-First, I'll do... (Step X). **The purpose of doing ... is to**...

-Then, I'll do... (Step Y) **The purpose of doing ...is to** ...

1. _____.
2. _____.
3. _____.
4. _____.
5. _____.
6. _____.
7. _____.

I'll write **instructions** of the experiment steps:

1) I need some ***verbs about actions***;

2) I'll ***begin*** each sentence ***with the action verb***.

Drawing of the set-up: [How to indicate the experiment set-up in a diagram?]

B. The experiment I observed

Title of the experiment: _____

Objective: [Why do I carry out this experiment?]

The observed experiment aims to investigate _____

Materials and apparatus:

-The experimenter uses (material A/apparatus B) to ...

I'll do (the same/differently) **because**...

Materials: _____.

Apparatus: _____.

Procedures:

- The experimenter follows the same/different steps as/from those in my design. I will/will not change my experiment procedures **because**...

1. _____.

2. _____.

3. _____.

4. _____.

5. _____.

6. _____.

7. _____.

I found the experimenter uses the following **action verbs** in his/her experiment steps:

_____

Results:

- **A turns to/changes to/ becomes**...

while B turns/becomes...

_____.

_____.

Analysis:

The results **show/indicate that**...

This shows that _____

_____.

It can be concluded that...

Conclusion:

It can be concluded that _____.

Experimental Report

Name: Class: Date:

Objective:

This experiment aims to investigate whether _____

Materials and apparatus:

Materials: _____.

Apparatus: _____.

Procedures:

1. _____.
2. _____.
3. _____.
4. _____.
5. _____.
6. _____.
7. _____.

Drawing of the set-up:

Results:

_____.

_____.

Analysis:

This shows that _____.

_____.

Conclusion:

It can be concluded that _____.