

**Genre-based Approach to Enhancing Secondary Students' English Writing Ability in Science Subjects**

**Teachers’ Notes**

City University of Hong Kong, Department of English

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Quality Education Fund

QEF project no. 2017/0884

**Lesson 1: What is scientific research?**

**Introduction**

*Through this course, you will be learning how to write like scientists, which means that you will also be learning something about how to be scientists. You will do some research using scientific methods and afterwards write a report on what you did and what you found. In this first lesson, we will consider what “scientific research” means, by exploring some key words and ideas.*

*NOTE: At various places in these lessons, you will see a Vocabulary Preparation box. The exercises in each box ask you to match words with their meanings by looking at how the words are used. This should give you some useful practice in working out the meanings of words from context. You may also find that you are more likely to remember words you have learned in this way, than by, for example, simply looking them up in a dictionary.*

This first lesson aims to familiarise students not only with some key words and ideas that will be used throughout this course, but also with the format of the lessons and with what will be expected of them as students. In particular, it encourages them to work in groups to discuss various questions, as well as to share their written work and to comment on one another’s work.

How this is managed will of course depend on school policy and the classroom culture. In principle, as this is a course focussing on writing in English, there is no reason why some or all of the group discussion should not be in the students’ mother tongue.

The students will need a way of sharing drafts of what they write, both with the teacher and with their fellow students. In the trials of this course, Google Docs was found to be a very convenient way of doing this. To use Google Docs the students will, of course, need to be able to go online in the classroom. Several schools in the trial provided the students with iPads or similar, but in fact many students seemed to prefer using their own smart phones. If this is not possible, the students can of course simply exchange handwritten drafts, but this will make it more difficult to for them to comment on one another’s drafts and to rewrite them as many times as may be necessary.

VOCABULARY PREPARATION

Having the students first skim through the texts and focus on vocabulary before doing the tasks seemed to work better in the trials than either having vocabulary lists after each text or having a vocabulary list at the end of each lesson. However, different teachers may have their own preferred ways of dealing with vocabulary.

If students don’t know the meaning of **bold,** teachers could explain it by opening a ‘Word’ document and take the opportunity to introduce the three function keys.

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| **B** |  *I* | **U** |
| **Bold** | *Italics* | **Underline** |

For some students, there may be more unfamiliar vocabulary in the texts than is dealt with in the Vocabulary Preparation boxes. However, it is important to note that in most cases the students will not need to understand every word in a text in order to do the tasks.

In these Vocabulary Preparation sections, the students’ attention will be drawn to the word classes (parts of speech) of the vocabulary items. The terms *noun, verb, adjective, adverb* and *preposition* will be used. If students are unfamiliar with these terms or what they refer to, it may be necessary to do some brief revision. The terms *countable noun* and *uncountable noun* will also be used.

1. Investigate is a verb. When we investigate a thing or an event, we look at it in detail to try find out why it happens, or how it behaves, or what it is like.
2. This is a countable noun. The properties of something are the ways it behaves (e.g. changes or moves) in particular conditions (e.g. at certain temperatures or under certain pressure levels).
3. This is a countable noun. Galaxiesare groups of stars and planets. One galaxymay have many billions (1 billion = 1000,000,000) of stars.

There are many different kinds of scientific research. Researchers may test the chemical **properties** of something by doing experiments in a laboratory, or they may trial a new vaccine by giving the vaccine to one group and something else to another group, or they may **investigate** distant **galaxies** using a radio telescope, or they may carefully observe the behavior of certain animals over a long period, or they may watch the behavior of people in a shopping mall. There is probably nothing that cannot be the subject of scientific research. In this course, we will mainly be researching aspects of human behavior.

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|  | **Task 1: *Discussing your experience of scientific research*** |

In groups, discuss the following questions:

1. What kinds of scientific research have you done in your science lessons?

2. What kinds of scientific research have you read about or heard about?

3. What makes these kinds of research scientific?

The main purpose of this task is to get the students accustomed to forming groups, discussing in groups and giving feedback to the whole class. The secondary purpose is to get the students thinking about what scientific research might mean. However, in-depth answers to these questions should not be expected at this stage and not too much time should be spent on this task.

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Although there are many different kinds of scientific research, they normally all have the following characteristics.

* The purpose of the research is to add to our knowledge in some area of science.
* The researchers take results of previous (earlier) research as their starting point.
* They collect *data* in a *systematic* way. (Don’t worry if you are not sure of the meanings of “data” and “systematic”. We will come back to them.)
* They *analyse* and *interpret* the data in ways that are logical. (Again, we will come back to the words *analyse* and *interpret* later).
* They report the results of their research (i.e. what they have found out) to other scientists and sometimes members of the public by publishing in scientific journals and giving talks at scientific conferences.

**Key words in scientific research**

There are five words that express key concepts (ideas) central to scientific research – *hypothesis, data, analysis, interpretation* and *report.*

**Key word 1: *Hypothesis***

A *hypothesis* as used in scientific research is a statement that usually has the following characteristics.

* It may be true or may not be true.
* The researchers would like to know if it is true or not.
* It is possible to collect information that can help the researchers to decide whether it is (probably) true or (probably) not true.

NOTE: The word *hypothesis* comes from Greek. Many words in scientific English are formed from words in the Greek and Latin languages, for example, *oxygen,* *calcium,* *photosynthesis* and *carbohydrate.* It is worth noting such words when you come across them, as their spellings are often a little odd, and they sometimes have irregular plural forms. The plural of *hypothesis* is ***hypotheses****.*

Check the pronunciations of *hypothesis* and *hypotheses*. Practise saying the two forms of the word.

See <https://www.youtube.com/watch?v=FkLY8C2L5QE&t=121s> and <https://www.youtube.com/watch?v=VcRcUmPdN-Q>

You might also like to introduce the pronunciation of the verb *to hypothesize* “to form of make a hypothesis”.

VOCABULARY PREPARATION

Read through Task 2 below. Find the words that are in bold type and use these words to complete the following sentences.

1. Quality is an uncountable noun, although it may be countable in other meanings. The quality of something is how good or bad it is. The quality of something may also be described as high or low.
2. Distilled is an adjective from the verb distil (distill in US English). When we distil a liquid, we heat it until it evaporates and then cool it down again.
3. Alert is an adjective. Someone who is **alert** is paying attention and is ready to react to whatever happens. The noun related to alert is alertness

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|  | ***Task 2: Evaluating hypotheses*** |

Which of the following statements would make good scientific hypotheses? If you think any of them could NOT make good hypotheses, be ready to explain why. Can you suggest ways to make them better scientific hypotheses?

In order to answer the above questions think about:

* How useful or interesting would it be to know whether the statement is true or not?
* What kind of information would you need to discover if the statement is true or not?
* How difficult would it be to collect such information?

There are obviously no single right answers to this task. The comments below may be useful in giving feedback to students’ suggestions. With weaker students it might be best to select just a few of the hypotheses to work on, especially those more obviously good or not good.

Possible hypotheses

1. If you add milk to tea, it spoils the taste. Not a good hypothesis. Whether taste has been spoiled or not is entirely a subjective judgement. No way of objectively testing it.
2. Plants grow better if music is played to them. Good. would be possible to test this (control group and experimental group). Useful for gardeners etc. to have data on this.
3. Girls are better than boys at learning languages. Interesting hypothesis but perhaps difficult to test. Maybe look at test results of male and female students in same classes? But many variables.
4. Drinking tea or coffee after 12 noon affects the **quality** of sleep at night. Quite good hypothesis. Would be interesting/useful to have data on this. But not that easy. How would you measure quality of sleep?
5. Spending more than 5 hours a day looking at a mobile phone is bad for you. Not good or at least needs refining What would count as ‘bad for you’ and how would you measure it?
6. K-pop is more popular than local pop music among young people in Hong Kong. Good hypothesis in that it would be possible to test if you can find a representative sample. Is it something worth knowing? Could it be related to a more general hypothesis about cultural influences in Hong Kong?
7. Students who stop revising the day before an examination generally do better in the examination than students who revise up until the last moment. An interesting hypothesis that would be worth testing but would be difficult to set up an experiment to test it.
8. K-pop is better than local pop music. Too subjective and vague to be testable. What does “better” mean in this context?
9. Getting at least 8 hours of sleep a night makes people more **alert.** Seems a hypothesis worth testing. Should be possible to design an experiment to test alertness.
10. Whether you use **distilled** water or natural spring water to water a plant, it makes no difference to how the plant grows. Good hypothesis. Should be fairly straightforward to test this.
11. You can learn a foreign language faster by studying it for 15 minutes every day than by studying it for 2 hours on one day every week. Interesting hypothesis. Testable if you can find suitable participants for the experiment
12. It is important that all secondary school students should learn a second language. Not good. What makes something important? Who decides? How to measure importance?

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**Research Questions**

Instead of hypotheses in the forms of statements, scientists also often express what they are going to research in the form of research questions. For example, you can express the hypothesis “Getting at least 8 hours of sleep a night makes people more alert” as a question “Does getting 8 hours of sleep make people more alert?”. Research questions are often used when you want to allow for a wider range of possible results, for example “How does duration (= length of time) of sleep affect mental alertness?”

VOCABULARY PREPARATION

Read through Task 3 below and find the words that are in bold type. Use these words to complete the following sentences.

1. Motivation is an uncountable noun, although it may be countable in other meanings. It refers to how keen a person is to do something, i.e. how much they want to do it. A person’s motivation to do something may be high or low.
2. Caffeine is an uncountable noun. It is a chemical substance found in coffee, tea and cocoa. It can make us more awake and active.
3. Pollution is an uncountable noun. It comes from the verb pollute. To pollute air or water means to make them dirty or impure.
4. Relationship is a countable noun. If there is a relationship between two or more things they are connected or linked in some way.
5. Success is here an uncountable noun, but it can also be used as uncountable noun. It means the opposite of failure. The verb related to success is succeed**.**

Now do Task 3

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|  | ***Task 3: Forming hypotheses and research questions*** |

Try to come up with at least one hypothesis for each of the following general research areas.

Obviously, there are many possible answers here. Some suggestions are given below. Note that we are not concerned here with whether the hypotheses are true or not.

1. The vitamin C content of different kinds of food. Oranges contain more vitamin C than mangoes or papayas.
2. The **relationship** between **motivation** and **success** in language learning. The more students are motivated to learn a language, the more successful they will be in learning it.
3. The effects of noise on people. People living in noisy home environments suffer more stress, anxiety and depression than people living in quiet home environments.
4. Air **pollution** in Hong Kong Air quality is worse in urban areas of Kowloon than in urban areas of Hong Kong Island.
5. The effects of different kinds of music on people. If quiet slow music is played to people, their stress levels will go down.
6. The effect of **caffeine** on our body. The effects of caffeine on our body increase with age.

Write out your six hypotheses and share them with one or two classmates (if possible using Google Docs or a similar text sharing application).

Give your classmates feedback on each of their hypotheses. Use the following questions to guide your feedback.

* Is the hypothesis logical and interesting?
* Is it possible to find information to test the hypothesis?
* If it uses an “if” structure, is the structure used correctly? If necessary, check it by comparing it with hypothesis a in Task 2 above.
* Does it have a VERB+*ing* phrase as its subject? If so, is the structure used correctly? Compare it with d, e and i in Task 2 above.
* Does it contain a comparative structure (eg: *x is bigger than y*)? Is the structure used correctly Compare it with b, c, f, g, I and k in Task 2.
* What tense is used? Is it the correct tense? Compare with any of the hypotheses in Task 2.
* Does every finite verb have a subject and does the verb agree with the subject?
* A range of different structures can be used in expressing hypotheses. It is worth taking some time to ensure that the students are able to use at least basic conditional and comparative structures.
* The terms s*ubject* and *finite* will be used often in this course, as they refer to notions basic to producing grammatical clauses and sentences and to editing other students’ work. If necessary, these terms can be revised by having students try to identify subjects and finites in a range of simple sentences. For example:
	+ Music (S) affects (F) people’s moods.
	+ Different **kinds** of music (S) affect (F) people’s moods. (The head of the noun group functioning as subject is in bold)
	+ Does (F) music (S) affect people’s moods?
	+ A person’s **mood** (S) is (F) affected by music.
	+ People’s **moods** (S) are (F) affected by music.
	+ Are (F) people’s **moods** (S) affected by music?
	+ Is (F) a person’s **mood** (S) affected by music?

When you have received your classmates’ feedback, revise your hypotheses as necessary. If you have any doubt, check with your teacher.

Now try re-writing at least two of your hypotheses as research questions.

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**Key Word 2: *Data***

*Data* is information that scientists collect in order to help them discover if their hypotheses are true or not, or to discover what the answers to their research questions are. Data should be *systematic*. This means that it must be collected in a careful and efficient way, according to a method that you have planned in advance (a “system”). Things that you have read about, or something a classmate has told you, or something you noticed while walking around – none of these by themselves are data. However, if you walk along exactly the same route every day at exactly the same time and count the number of people, or dogs or cars that you see, this could be data. Or if you ask every student in your form the same question in the same way, and if you can be reasonably sure that they are telling you the truth, then their answers could be data. Of course, it must be a question that gives you answers that will help you test your hypotheses or answer your research questions. The methods you use to collect data are therefore very important, and need to be planned carefully in advance.

NOTE: The word *data* comes from Latin (it means “given”). In Latin, it is a plural noun and so some writers prefer to use it also as a plural noun in English, for example “The data are clear”. However, as we hardly ever use the Latin singular form *datum*, many writers use *data* as an uncountable noun, for example “The data is clear”. It does not matter whether you use it as a plural noun or an uncountable noun, as long as you are consistent (= always do the same).

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|  | ***Task 4: Collecting data*** |

Take at least two of the hypotheses that you came up with while doing Task 3 above and suggest how you might systematically collect data to test them.

This is just to get students thinking about what good data might be. They should not be expected at this stage to specify detailed data gathering methods.

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**Key Word 3: *Analysis***

Once scientists have collected their data, they need to *analyse* it. When they analyse data, they look very carefully at it in order to find patterns that will help them to understand it or explain it. For example, an analysis (= the noun from analyse) of data may enable scientists to discover ways in which some things are similar and some things are different, so that they can *classify* them, i.e. put them into groups according to their similarities and differences. Analysis may also show how some things change over time. Sometimes the analysis may reveal a *correlation*, i.e. it shows that things are related in some way, because whenever one thing occurs another thing is likely to occur, or whenever one thing changes, another thing is likely to change. Often data will be in the form of numbers, so scientists need to do some kind of arithmetical or mathematical analysis.

NOTE: *Analyse* is a verb. It can also be spelled *analyze*, especially in the US. The noun is *analysis*. Like *hypothesis*, *analysis* comes from a Greek word, and its plural is *analyses*.

Check the pronunciations of *analyse, analysis* and *analyses* and practise saying them.

See <https://www.youtube.com/watch?v=aszUJcF5QQc>

**Key Word 4: *Interpretation***

After scientists have analysed their data, they need to *interpret* the results of their analyses. In other words, they must try to explain the patterns in the data using logical, scientific arguments. They will also normally try to relate the results to the hypotheses or research questions that they started with. It is important not to use personal opinions or guesses. Note that is rare for the *interpretation* (= the noun from *interpret)* to claim that the data proves that a hypothesis is true or not true. In most cases, an interpretation can only give some good reasons for concluding that the results show that a hypothesis is probably true or probably not true.

**Key Word 5: *Report***

If scientists do research and find something interesting, they will want to share their findings with other scientists. This is not only to inform other scientists of what they have found but also to give other scientists a chance to check their results, sometimes by repeating the same experiments to see if they get the same results. Therefore when scientists report on their research, they have to be clear about how they collected and analysed the data, and they have to show that their interpretations are logical and based on the data. Note that the word *report* is both a countable noun and a verb, so we can say both “we will report [*verb*] our results” and “we will write a report [*noun*] about our results”.

Be sure that you are clear about what is meant by *hypothesis/hypotheses; data,*

*analysis/analyses*, *interpretation* and *report* in the context of scientific research, as we shall be referring to these words and concepts frequently throughout this course*.*