Leaving Certificate

Biology

Scientific Method

Please see *Teachers' Notes* for explanations, additional activities, and tips and suggestions.

Learning Support	Vocabulary, key terms working with text and writing text	Pages 3-8, 10-11
Language Support	Vocabulary, key terms, grammar, working with text and writing text	Pages 3-11
Subject class	Key vocabulary	Pages 3-8
Learning focus	Using Biology textbooks and accessing curriculum content and learning activities.	
Levels for Language Support students	Students' English-language skills should be developed to **Level B1** during funded Language Support. Mainstream subject learning will require the development of skills at **Level B2** if students are to cope with public examinations.	
Acknowledgement	The *English Language Support Programme* gratefully acknowledges the permission of Gill and Macmillan to reproduce excerpts from *Biology Now!* by Tommy Murtagh.	

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Using this unit

Learning support, language support and mainstream subject class

The sections ***Focus on vocabulary, Focus on reading*** and ***Focus on writing*** are suitable for **Learning Support.**

The sections ***Activating students' knowledge***, ***Focus on vocabulary,*** and ***Focus on grammar*** have been designed, in particular, for **Language Support** classes.

Focus on vocabulary, Focus on reading and ***Focus on writing*** are suitable for use in **Learning Support**, **Language Support** and **subject classes**.

Answer Key

Answers are provided at the end of the unit for all activities except those based on free writing.

Textbooks

This unit focuses on the section *Scientific Method* of the Leaving Certificate Biology curriculum. Students will need to use their textbooks if they are to gain the most benefit from the activities.

Learning Record

The Learning Record is intended to help students monitor their progress. This can be downloaded or printed from the website in the section *Advising Students and Record of Learning for the Leaving Certificate.* A copy of the Learning Record should be distributed to each student for each Unit studied.

Students should:

1. Write the subject and topic on the record.
2. Tick off/date the different statements as they complete activities.
3. Keep the record in their files along with the work produced for this unit.
4. Use this material to support mainstream subject learning.

Symbols

Symbols are used throughout the unit to encourage students to develop their own learning and support materials.

prompts students to file the sheet when they have completed the activity. This is used for activities which can be used as a reference in the future e.g. for subject classroom, revision, homework etc.

prompts students to add vocabulary, definitions, or examples of vocabulary in use to their own personal glossary for the topic. A personal glossary makes study and revision more efficient.

Keywords

Activities
experiment
experimentation
germination
test
comparison
observation

Theory
hypothesis
hypotheses
theory / theories
assumption

Verbs
to design
to confirm
to prove
can

Nouns
biology
study
results
scientists
method
organisms
seeds
outcome
cells
subject
energy
constant

Adjectives
scientific
experimental
mental
varied
variable
control

Vocabulary file for the topic

Scientific method

Word	Meaning	Page(s) in my textbook	Note
biology			
hypothesis			
investigation			
experiment			
method			
variable			
constant			
control (experiment)			

Word	Meaning	Page(s) in my textbook	Note
theory			
living organism			
germination			
conclusion			
observation			
comparison			
outcome			

Introduction

Activating students' existing knowledge

Use a spidergram to activate students' ideas and knowledge on the key points in this chapter. See **Teachers' Notes** for suggestions.

Possible key terms for the spidergram:

What do scientists do?

How does science affect our lives?

- Invite newcomer students to provide key words in their own languages.
- Encourage dictionary use.
- Encourage all students to organise their vocabulary into relevant categories (e.g. meaning, nouns, keywords, verbs etc.).

All students should record vocabulary and terms from the spidergram in their personal dictionaries.

Language Level: B1
Individual / pair

Focus on vocabulary

1. Missing words

The following sentences are taken from your textbooks but some key words are missing. First, check that you understand the meanings of the key words in the box below, then read the sentences and fill in the gaps.

a) Biology is the study of _____.

b) Biologists use study _____ and processes to lead to worthwhile discoveries.

c) Experiments are designed to test a _____.

d) A _____ is a condition that changes during an experiment.

e) It is important to have a _____ experiment to compare the outcome to.

hypothesis	**life**	**control**	**variable**	**methods**

2. Vocabulary in use

Write a short sentence using each of the following words. Check your text book or dictionary if you need help.

observation _____

results _____

outcome _____

constant _____

assumption _____

3. Matching

Match each term in Column A with a definition in Column B. Draw a line between them. Look at your text book if you need help.

Column A	Column B
to draw a conclusion	to explain the reason or reasons why you believe or do not believe an idea or theory
to disprove a theory	to arrive at an opinion after considering all the information about something
to construct an argument	to choose a theory
to make an observation	to examine or look for differences or similarities between the result of an experiment and another result or control experiment
to adopt a theory	to prove that a theory is not true
to compare the outcome	to say or write about something that you have noticed

4. Key phrases in use

The sentences below are all from your text books. They are missing 4 of the key phrases from exercise 3 above. Select the correct ones.

a) Aristotle preferred to _____to support his case rather than any experimental proof.

b) One of the main features of the scientific method is that it is possible at the end of an experiment to _____.

c) It is important to have a control experiment to _____ to.

d) A theory is never proved but it is possible to _____ as true until a better theory replaces it.

Language Level: B1
Individual / pair

Focus on grammar

5. Verbs and adverbs followed by prepositions

A verb is a word or phrase that describes an action, condition or experience. Every sentence must have a verb.

An adverb is a word which describes or gives more information about a verb.

Example:

Rain fell heavily during the night.

Verb:	**Adverb:**
fell	heavily

Some verbs and adverbs are followed by a **preposition**.

It is important to learn the preposition that is used at the same time as you learn the verb or adverb.

The following examples are from your textbook. Use your textbook or dictionary to find the correct prepositions to complete the sentences.

a) Modern biology *specialises* _____ many different areas of study.
b) In the past, people believed _____ different methods for discovering theories.
c) Nowadays science is based _____ a process of observation and experimentation.
d) The seeds are divided _____ two groups.
e) The scientific method often relies _____ accidental discoveries.
f) The result is compared _____ the control experiment.
g) Results are always communicated regardless _____ how they turn out.

Now complete this list of the verbs and adverbs from the sentences above by writing in the prepositions.

Make sure that you add this to your personal dictionary for Biology.

to specialise _____
to believe _____
to base _____
to divide _____
to rely _____
to compare _____
regardless _____

Language Level: B1 / B2
Individual / pair

Focus on reading

6. Read the text carefully and find the correct statement below. There is one correct answer for each question. Circle the correct answer.

A *variable* is any condition that changes during the experiment. In experiment design, it is important to remember that many variables can affect the outcome. Generally one variable, the subject of the experiment, is allowed to change during the experiment and all others are held constant. This avoids confusion and will prevent criticism of an 'unfair' experiment.

In the case of the germination investigation described above, water availability can be varied in the experiment but light, temperature and oxygen should be kept at constant level. Likewise experimental equipment including glassware should not change and seed samples should be big enough to even out individual differences.

It is also important to have a *control* experiment to compare the outcome to. In the germination example, a sample of seeds without water is *the experiment* and a similar sample *with* water is the *control* (a 'normal' situation for comparison).

a) A variable is

a) an experiment. **b) a condition that changes.**

c) science equipment. **d) the outcome of the experiment.**

b) In an experiment it is usual to have

a) a number of variables. **b) confusion.**

c) one variable. **d) an unfair result.**

c) In the germination investigation water availability

a) is kept constant. **b) is light.**

c) is kept in a glass. **d) is varied.**

d) What is the difference between **the experiment** and **the control experiment**?

_____

_____

e) What is another word for **outcome**? _____

f) Using the text above, find a different way of expressing this:

the control experiment

_____

Language Level: B1 / B2
Individual / pair

Focus on writing

7. Writing a paragraph

Remember!

- A paragraph is a unit of information unified by a central controlling idea.
- Paragraphs should focus on one piece of information.
- The main idea in a paragraph is often expressed in *one particular sentence* (called the topic sentence). This sentence is usually at the beginning of a paragraph, but can come at the end or even in the middle.
- It is important to organise the information logically in a paragraph.

Write a paragraph on the topic **The scientific method.**

Include a sentence about each of the following points:

the scientific method (topic sentence)

the hypothesis

designing an experiment – the experiment and the control experiment

collecting and recording the results

the outcome

Use your **textbook** if you need to check the information.

Answer Key

Focus on vocabulary

1. Missing words

a) Biology is the study of ***life***.
b) Biologists use study ***methods*** and processes to lead to worthwhile discoveries.
c) Experiments are designed to test a ***hypothesis*** .
d) A ***variable*** is a condition that changes during an experiment.
e) It is important to have a ***control*** experiment to compare the outcome to.

3. Matching

Column A	Column B
to draw a conclusion	to arrive at an opinion after considering all the information about something
to disprove a theory	to prove that a theory is not true
to construct an argument	to explain the reason or reasons why you believe or do not believe an idea or theory
to make an observation	to say or write about something that you have noticed
to adopt a theory	to choose a theory
to compare the outcome	to examine or look for differences or similarities between the result of an experiment and another result or control experiment

4. Key phrases in use

a) Aristotle preferred to ***construct an argument*** to support his case rather than any experimental proof.
b) One of the main features of the scientific method is that it is possible at the end of an experiment to ***draw a conclusion***.
c) It is important to have a control experiment to ***compare the outcome to***.
d) A theory is never proved but it is possible to ***adopt a theory*** as true until a better theory replaces it.

Focus on grammar

5. Verbs and adverbs followed by prepositions

a) Modern biology specialises **in** many different areas of study.
b) In the past, people believed **in** different methods for discovering theories.
c) Nowadays science is based **on** a process of observation and experimentation.
d) The seeds are divided **into** two groups.
e) The scientific method often relies **on** accidental discoveries.
f) The result is compared **to** the control experiment.
g) Results are always communicated regardless **of** how they turn out.

Focus on reading

6.

a) **a condition that changes**

b) **one variable**

c) **is varied**

d) In **the experiment** there is a variable (water) but in **the control experiment** this (water) is kept constant.

e) result

f) a 'normal' situation for comparison