Salisbury 6th Form College
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A- Level Environmental Science at S6C

Course Introduction, Transition Material and Summer Work

Aim of the booklet

This booklet will support your transition from GCSE science to A-level. At first, you may find the jump in demand a little daunting, but if you follow the tips and advice in this guide, you'll soon adapt. As you follow the course you will see how the skills and content you learnt at GCSE will be developed and your knowledge and understanding of all these elements will progress.

We have organised the guide into three sections:

1. Understanding the specification and the assessment
2. Transition activities to bridge the move from GCSE to start of the A-level course
3. Progression of key ideas from GCSE to A-level.

Understanding the Course

Course Specification at a glance

In Environmental Science the subject content is arranged into seven main sections, all of which need to be covered over the 2 years of your A-level course. The section titles are listed here:

3.1	The living environment
3.2	The physical environment
3.3	Energy resources
3.4	Pollution
3.5	Biological resources
3.6	Sustainability
3.7	Research methods

You can find more information about each section on the AQA website.

Command words

Command words are used in questions to tell you what is required when answering the question. You can find definitions of the command words in Environmental Science assessments on the website. They are very similar to the command words used at GCSE.

Subject-specific vocabulary

You can find a list of definitions of key terms used in our A-level Environmental Science specification here.

You will become familiar with, and gain understanding of, these terms as you work through the course.

Transition activities

The following activities cover some of the key skills from GCSE science that will be relevant at A-level. They include the vocabulary used when working scientifically and some maths and practical skills.

The activities are not a test. Try the activities first and see what you remember and then use textbooks or other resources to answer the questions. Don't just go to Google for the answers, as actively engaging with your notes and resources from GCSE will make this learning experience much more worthwhile.

Understanding and using scientific vocabulary

Understanding and applying the correct terms are key for practical science. Much of the vocabulary you have used at GCSE for practical work will not change but some terms like working out uncertainty are dealt with in more detail at A-level so are more complex.

Activity 1 Scientific vocabulary: Designing an investigation

Link each term on the left to the correct definition on the right.

Hypothesis	The maximum and minimum values of the independent or dependent variable
Dependent variable	A variable that is kept constant during an experiment
Independent variable	The quantity between readings, eg a set of 11 readings equally spaced over a distance of 1 metre would give an interval of 10 centimetres
Control variable	A proposal intended to explain certain facts or observations
Range	A variable that is measured as the outcome of an experiment
Interval	A variable selected by the investigator and whose values are changed during the investigation

Activity 2 Scientific vocabulary: Making measurements

Link each term on the left to the correct definition on the right.

True value	The range within which you would expect the true value to lie
Accurate	A measurement that is close to the true value
Resolution	Repeated measurements that are very similar to the calculated mean value
Precise	The value that would be obtained in an ideal measurement where there were no errors of any kind
Uncertainty	The smallest change that can be measured using the measuring instrument that gives a readable change in the reading

Activity 3 Scientific vocabulary: Errors

Link each term on the left to the correct definition on the right.

Random error	Causes readings to differ from the true value by a consistent amount each time a measurement is made
Systematic error	When there is an indication that a measuring system gives a false reading when the true value of a measured quantity is zero
Zero error	Causes readings to be spread about the true value, due to results varying in an unpredictable way from one measurement to the next

Understanding and using SI units

Every measurement has a size (eg 2.7) and a unit (eg metres or kilograms). Sometimes, there are different units available for the same type of measurement. For example, milligram, gram, kilogram and tonne are all units used for mass.

There is a standard system of units, called the SI units, which are used for most scientific purposes.

These units have all been defined by experiment so that the size of, say, a metre in the UK is the same as a metre in China.

There are seven SI base units, which are given in the table.

Physical quantity	Unit	Abbreviation
Mass	kilogram	kg
Length	metre	m
Time	second	s
Electric current	ampere	A
Temperature	Celsius	C

All other units can be derived from the SI base units. For example, area is measured in metres square (written as m^2) and speed is measured in metres per second (written as $m\ s^{-1}$). This is a change from GCSE, where it would be written as m/s.

Using prefixes and powers of ten

Very large and very small numbers can be complicated to work with if written out in full with their SI unit. For example, measuring the width of a hair or the distance from Manchester to London in metres (the SI unit for length) would give numbers with a lot of zeros before or after the decimal point, which would be difficult to work with.

So, we use prefixes that multiply or divide the numbers by different powers of ten to give numbers that are easier to work with. You will be familiar with the prefixes milli (meaning 1/1000), centi (1/100), and kilo (1 × 1000) from millimetres, centimetres, and kilometres.

There is a wide range of prefixes. Most of the quantities in scientific contexts will be quoted using the prefixes that are multiples of 1000. For example, we would quote a distance of 33 000 m as 33 km.

The most common prefixes you will encounter are given in the table.

Prefix	Symbol	Power of 10	Multiplication factor	
Giga	G	10^9	1 000 000 000	
Mega	M	10^6	1 000 000	
kilo	k	10^3	1000	
milli	m	10^{-3}	0.001	1/1000
micro	μ	10^{-6}	0.000 001	1/1 000 000
nano	n	10^{-9}	0.000 000 001	1/1 000 000 000

Activity 4 SI units and prefixes

What would be the most appropriate unit to use for the following measurements?

1. The length of a leaf
2. The distance that a migratory bird travels each year
3. The diameter of a smoke particle
4. The mass of a woodlouse
5. The volume of the trunk of a large tree
6. The flow volume of a river

Activity 5 Converting data

1. Re-write the following.

    a. 0.00122 metres in millimetres
    b. 1 042 000 micrograms in grams
    c. 1120.2 metres in kilometres

2. It is estimated that 33 000 000 000 tonnes of CO_2 was released globally in 2019 from energy-related sources. Circle the correct conversion. Use the prefix table above to help you.

    33 Tt 33 Gt 33 Mt

3. The distance between the Sun and the Earth is 149.6 Gm. In this case, Gm is not a common unit, so we can convert it to km and express it in standard form. Circle the correct conversion. Use the prefix table above to help you.

    1.496×10^6 km 1.496×10^8 km 1.496×10^{12} km

4. The estimated volume of ice stored in the Antarctic ice sheet is 0.027 billion km^3. Circle the correct conversion. Use the prefix table above to help you.

    27 million km^3 2.7 million km^3 270 million km^3

Practical skills

The practical skills you learnt at GCSE will be further developed through the fieldwork and practicals you undertake at A-level. Your teacher will explain in more detail the requirements for fieldwork, practical work, and the research methods.

There is a practical handbook for Environmental Science, which has lots of very useful information to support you in developing these important skills. You can download a copy here:

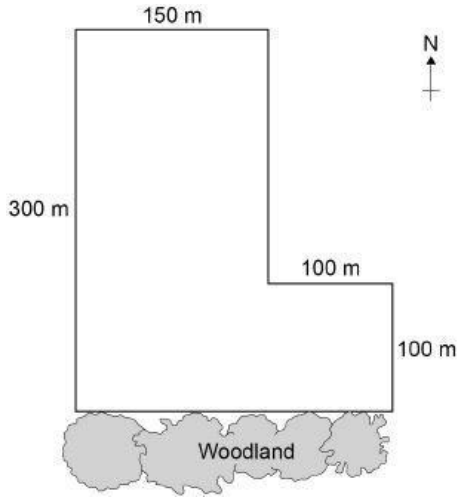
Sampling skills

The following activities are based on GCSE questions. Try and answer the questions about the practical experiments.

Activity 6 Investigating dandelion abundance

Some students investigated the size of a population of dandelion plants in a field.

The diagram below shows the field.



The students:

- placed a 1m × 1m square quadrat at 10 random positions in the field
- counted the number of dandelion plants in each quadrat.

The table below shows the students' results.

Quadrat number	Number of dandelion plants
1	6
2	9
3	5
4	8
5	0
6	10
7	2
8	1
9	8
10	11

1. Why did the students place the quadrats at random positions?

2. Estimate the total number of dandelion plants in the field. Use the information in the diagram and the table to help you answer the question.
   Give your answer in standard form.

Quadrats 5, 7 and 8 were each placed less than 10 m from the woodland. These quadrats contained low numbers of dandelion plants.

The students questioned if light intensity affected the abundance of dandelions, since the woodland created shade on the field.

They made the following hypothesis:

> 'The number of dandelions will increase with distance from the woodland as light intensity increases.'

3. Write a method the students could use to test this hypothesis.

4. Light is an abiotic factor that affects the growth of dandelion plants.

   State two biotic factors that affect the growth of dandelion plants.

Activity 7 Investigating weed killer

Students investigated the effect of a weed killer on the weeds growing in a field.

They used 0.5 m × 0.5 m quadrats.

They sprayed half the field with liquid weed killer and half with water.

1. Explain why the students used water on one side of the field instead of weed killer.

The table below shows the students' results.

Number of weeds per quadrat			
At start		After 2 weeks	
Side A (Weed killer)	Side B (Water)	Side A (Weed killer)	Side B (Water)
8	14	3	8
2	9	4	15
12	3	0	7

	15	16	2	12
	13	3	1	13
Mean				

2. Calculate the mean values in the table.

3. Calculate the percentage decrease in the mean number of weeds on side A after 2 weeks.

4. One student thought the results were not valid.

   Suggest one improvement the students could have made to the method to make the results more valid.

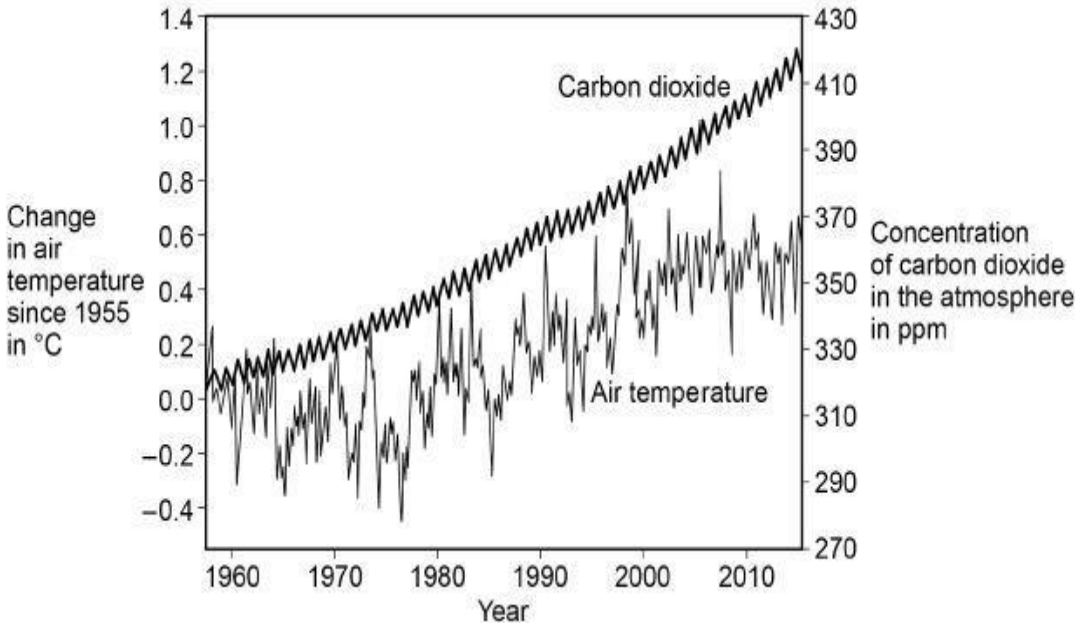
   Give the reason for your answer.

Describing and explaining observations

Activity 10 is based on a GCSE question. Complete the questions to ensure you understand about describing and explaining trends in data.

Activity 8 Climate change

The graph below shows changes in global air temperature and changes in the concentration of carbon dioxide in the atmosphere.



1. Use the graph to describe two trends in carbon dioxide from 1955 to 2015.

2. Many scientists think that an increase in carbon dioxide concentration in the atmosphere causes an increase in air temperature.
   How would an increase in the concentration of carbon dioxide in the atmosphere cause an increase in air temperature?

In each year, the concentration of carbon dioxide in the atmosphere is higher in the winter than in the summer.

3. Give one human activity that could cause the higher concentration of carbon dioxide in the winter.

4. Give one biological process that could cause the lower concentration of carbon dioxide in the summer.

5. Give the name of one other greenhouse gas that contains carbon.

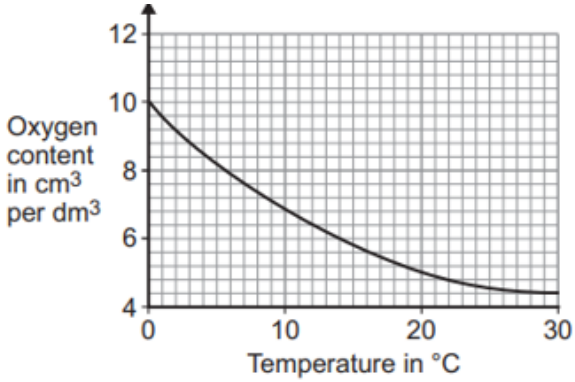
Analysing graphs

Environmental Science is about collecting, analysing, and interpreting data on how our environment is changing. A wide range of different types of graphs are used in Environmental science and you will continue to develop the graph skills you gained at GCSE throughout the A-level course.

When you look at a graph remember to pay attention to the axes, units, key and trends before attempting any questions. At A-level the graphs become more complex than you will have seen at GCSE and may have two axes that you need to consider. You can see an example of this in Question 5 below.

Activity 9 Analysing graphs

Wildlife in rivers is affected by changes in conditions. The graph below shows how the oxygen content of water changes with temperature.



1. Describe the relationship between the oxygen content and temperature.

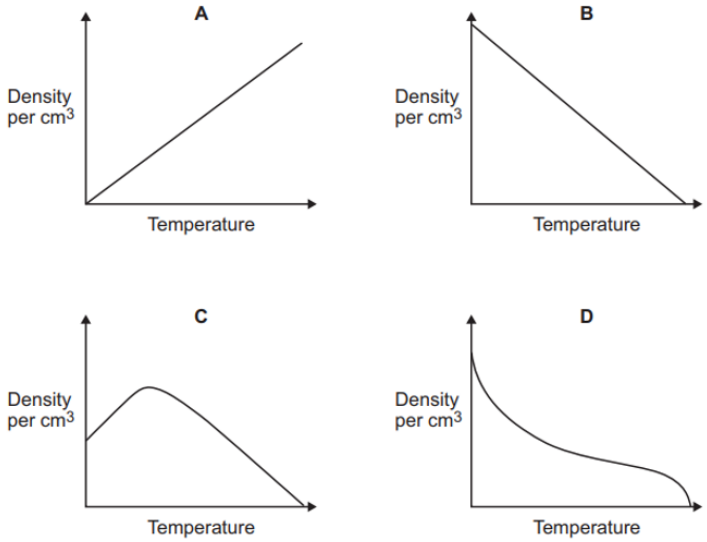
2. Does the data show a positive or negative correlation?

3. Calculate the change in oxygen content when the temperature of water is increased from 0 °C to 14°C.

4. The table below shows how the density of liquid water changes with temperature.

Temperature in °C	0	2	4	6	8	10	12	14	16
Density in g per cm^3	0.9998	0.9999	1.0000	0.9999	0.9998	0.9997	0.9995	0.9992	0.9989

Which of the graphs below A, B, C or D, shows how the density of water changes with temperature?



Extended Writing

The ability to write coherently in a logical, well-structured way is an essential skill to develop. At GCSE the 6-mark extended response questions are used so students can demonstrate this skill. At A-level you need to develop this skill further, and you will be expected to write longer extended response questions. In each Environmental Science exam paper there are questions worth 9 marks and an essay worth 25 marks. You will practice this skill over the next 2 years.

The command word in a question, like at GCSE, is important as it gives you an indication of what to include in your answers. For example, 'explain' means you must give reasons why things are happening, not just give a description. A comparison needs advantages and disadvantages or points for and against. Your teacher will work with you on this skill during the course.

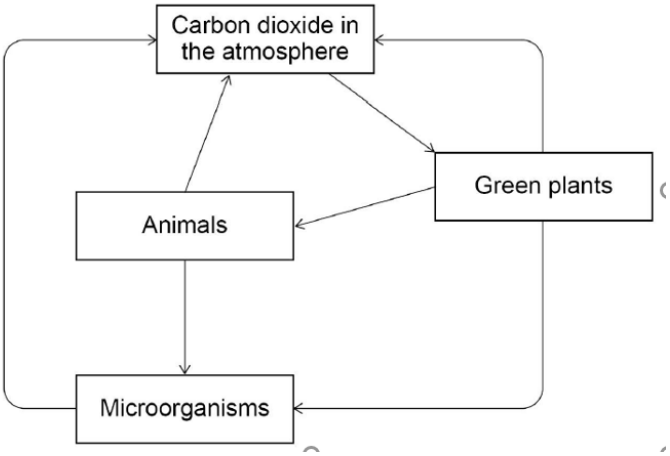
Activity 10 Extended writing

In this activity there are two questions and model student answers. The first question is taken from a GCSE Combined Science Biology paper and the second is the type of 9-mark question you might find on this topic on an A-level Environmental Science paper.

Look at the two questions and see how the demand has increased from GCSE to A-level.

Question 1: GCSE Combined Science Biology (6 marks)

Plants take in carbon dioxide from the atmosphere as part of the carbon cycle.



Explain how carbon from the atmosphere is cycled through living organisms (6 marks)

Question 2: A-level Environmental Science question (9 marks)

Explain how an understanding of the carbon cycle can help us manage climate change.

How the demand progresses

At GCSE you have a question on the carbon cycle that requires you to know how the process works. There is a diagram to help support you and act as a stimulus.
In the A-level question you have to a make the link between the carbon cycle and the environment and apply what you know about the cycle to how it affects a real-life situation. There is no diagram to help you or act as a stimulus.
Environmental science is about applying knowledge and understanding of fundamental scientific ideas, processes and relationships to a variety of real-life environmental issues and situations. It is important for you to use the correct scientific vocabulary when you are doing this.

Example answer: GCSE Combined Science Biology

Carbon dioxide is absorbed by plants through their leaves for photosynthesis.
The plants take in water and CO_2 and make glucose and oxygen.
Animals then eat the plants and use the glucose for respiration and to grow.
During respiration the CO_2 is breathed out by the animals and goes back into the atmosphere.
When the animal dies they begin to decay and the microorganisms eat them and release the carbon.

The microorganism also releases CO_2 so some goes out then as well. The cycle starts again.

Example answer: A-level Environmental Science

Human activities have increased the concentration of carbon dioxide and methane in the atmosphere which has increased the greenhouse effect. This has happened because now, more outgoing infrared radiation is absorbed and doesn't escape out of the atmosphere. This has led to global climate change. Our understanding of the processes that add or remove carbon can help us make management decisions that increase the processes that remove carbon, at the same time as reduce activities that increase the outputs of these greenhouse gases.

One of the main ways we can do this is using our understanding of the role of photosynthesis in the carbon cycle. Photosynthesis absorbs carbon dioxide, and therefore if we reduce deforestation and increase afforestation, we can increase the rate removal of carbon dioxide from the atmosphere by this process. If we then protect these forests, we can ensure that the carbon remains stored in these trees for a long time.

We also understand that the combustion of fossil fuels for the production of electricity releases large amounts of carbon dioxide to the atmosphere and therefore if we use alternative energy resources such as renewables like solar and wind we prevent the need to use fossil fuels and the carbon can remain stored in the Earth's crust as coal, oil and gas. Additionally, if we can conserve energy, for example though home insulation, we can reduce the amount of electricity we use for heating and so reduce the amount of fossil fuels that is need to be combusted to make the electricity, so reducing CO_2 emissions.

One-way methane is released to the atmosphere is when the bacteria living inside the guts of ruminant animals, anaerobically respire. If we can change our diets to eat less meat and therefore reduce the numbers of cattle such as cows and sheep. This way we can reduce the methane emissions, which is a powerful greenhouse gas.

Progression of content

What you learnt at GCSE forms the foundation to your further study at A-level. Ideas will be developed and refined, new concepts and skills will be introduced. Topics from all three sciences are relevant for Environmental science.

Some key concepts from GCSE that are important for A-level Environmental Science are shown in the table.

Biology	Chemistry	Physics
• Factors affecting the rate of photosynthesis • Factors affecting the rate of transpiration • Selective breeding • Ecosystem organization and interactions • Material cycles • The importance of biodiversity • Sampling ecosystems • Human impacts on ecosystems	• Evolution of the Earth's atmosphere • Climate change • Air pollution • Resources and sustainability • Recycling and life cycle assessments • The Earth's water resources and obtaining potable water	• Energy stores and transfers • Power • Energy efficiency • Energy resources • Radioactive materials and half life • EM spectrum

Using this table and notes or resources from your GCSE Science recall and refresh your understanding of these concepts.

Activity 11 Further Reading

Throughout your study at A-Level there is an expectation of doing an equivalent amount of self-guided and directed study outside of the classroom as you do in the classroom. Below are just some resources to get started with.

- TedEd - Environmental Science
- Guardian - Environment
- BBC - Climate
- Conservation.org

Write a short 400-word essay summarizing an article or publication and explain why you think it is interesting or important. Feel free to use the links above or anything you've found yourself that you think it interesting.