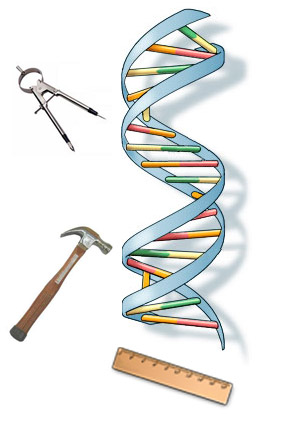
**Biology**

**A-level toolkit**



**Everything you need to succeed**

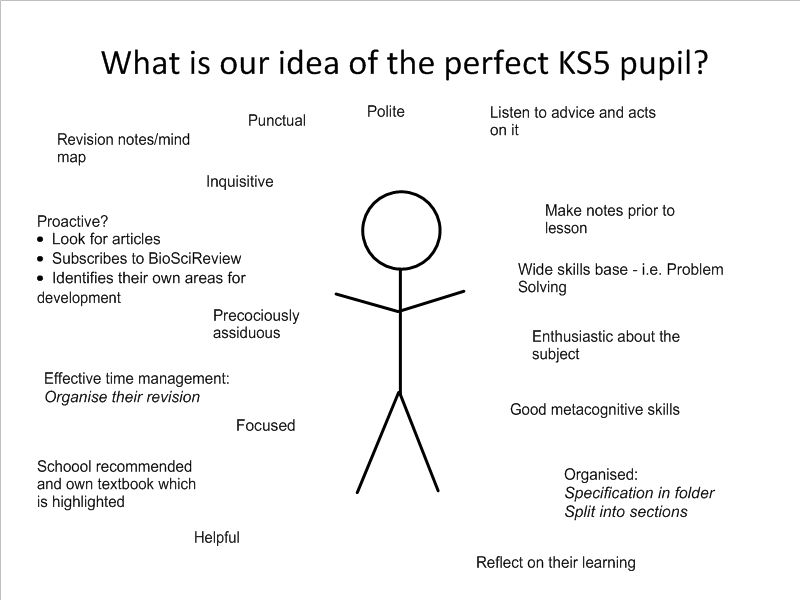
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**Mr J C Gale Head of Biology**

**Contents**

1. [Where to start?](#Wheretostart)
2. [What does the course involve?](#Coursedetails)
   * 1. A2 Biology
     2. A2 Human Biology
3. [How can you beat your target?](#Yourtarget)
4. Grade criteria: how you can beat the exam
5. MEG and targets to help you improve
6. [What should you do in an exam?](#Examtips)
   * 1. Exam tips
     2. Synoptic paper advice
7. [How can you track your progress through the course?](#Topictests)
   * 1. Topic-test self-evaluation sheet
     2. Topic-test scores
     3. Module results
8. [Comments and targets arising from work](#Targets)
9. [How can you use questions to help you learn?](#Questions)
10. [How can you become an independent learner?](#Independentstudy)
11. [What should you read?](#Readinglist)
12. [How can you get the best from the internet?](#Internet)
13. [Smash statistics](#Statistics)

**Where to start?**



**Get organised:**

1. Get a folder for biology – you don’t need to bring this into school every day, leave it at home and bring in the most recent files in a separate holder.
2. Print out pages \_ of the specification and cut out the separate sections to stick onto your folder dividers.
3. Get the course textbook and, if possible, find another textbook and a revision guide from our recommended texts list.
4. Subscribe to Biological Sciences Review – ask Mr Gale about this.
5. Set up a rough homework/reading timetable – this might seem a bit keen, but having particular times when you do your reading and homework will mean that you have more time to play!

**Course details**

|  |  |
| --- | --- |
| Subject: BIOLOGY AS Level 2/3 | |
| Study Units | Subject Commitments |
| AS Unit 1: BIOL1 Biology and disease  Paper style: The paper will consist of 5 – 10 short-answer questions, plus 2 longer questions (a short comprehension and a structured question requiring continuous prose)  THIS PAPER COUNTS FOR 33.3% of the total AS marks  and 16.7% of the total A Level marks    Timings: Time: 1 hour 15 minutes  Disease   * The digestive system and digestion * Transport across exchange surfaces * Plasma membranes * Lungs of a mammal * The functioning of the heart * Mammalian blood possesses a number of defensive functions.   AS Unit 2: BIOL2 The variety of living organisms  Paper style: 5 – 7 short answer questions plus 2 longer questions involving the handling of data and *How Science Works*  This paper counts for 46.7% of the total AS marks and 23.3% of the total A Level marks  Timings: Time: 1 hour 45 minutes  Variation and DNA   * Biochemical and cellular organisation. * Specialised exchange surfaces and mass transport systems. * Classification, Adaptation and selection Biodiversity may be measured within a habitat.   \*Unit 3: ISA Coursework  Paper style: 1h15 Written paper  Date/ Timings: Will be completed on Wed afternoons in March/April | Independent Study (HW)   * Students need to complete an hour of work for every hour in lesson, adding to their notes, completing Q’s and How Science Works Q’s from their text book   Coursework   * This is Unit 3 and is completed outside of lesson time in extra sessions.   Subject Leader’s Additional Advice from: Mr Gale   * Use Biology Resources Room on Fronter, all of the Boardworks powerpoints are on here, as are past papers and How Science Works presentations. * Using past papers is an excellent way of assessing knowledge and using the mark schemes to see exactly what the examiners are looking for is one of the best ways to revise. |

**EXAM DATES:**

**BIOL 1:…………………….**

**BIOL 2: ……………………**

|  |  |
| --- | --- |
| Subject: BIOLOGY A2 Level 2/3 | |
| Study Units | Subject Commitments |
| A2 Unit 4: BIOL4: Populations and Environment.  This paper consists of 6 – 9 short answer questions plus 2 longer questions involving continuous prose and *How Science Works.*  This counts for 16.7% of the total A Level marks. Some of the questions will have synoptic elements.  Timings: Time: 1 hour 30 minutes.  Dynamic equilibrium of populations   * ATP * Photosynthesis * Respiration * Energy is transferred through ecosystems. * Chemical elements are recycled in ecosystems. * Ecosystems are dynamic systems. * Genetic variation   A2 Unit 5: BIOL5 Control in cells and in organisms.  This paper consists of 8 – 10 short answer questions plus 2 longer questions (a data-handling question and a synoptic essay - choice of 1 out of 2). This paper counts for 23.3% of the total A Level marks  Timings: Time: 2 hours 15 minutes   * Stimuli and coordination * Skeletal muscle * Homeostasis * Negative feedback and positive feedback DNA, Gene expression and DNA technology.   Unit 6: ISA Coursework  Paper style: 1h15 Written paper  Date/ Timings: Will be completed on Wednesdays in March/April | Independent Study (HW)   * Students need to complete an hour of work for every hour in lesson, adding to their notes, completing Q’s and How Science Works Q’s from their text book   Coursework   * This is Unit 6 and is completed outside of lesson time in extra sessions.   Trips   * Field trip to be completed in Oct and covers critical topics in BIOL4 and BIOL5     Subject Leader’s Additional Advice from: Mr Gale   * Use Biology Resources Room on Fronter, all of the Boardworks powerpoints are on here, as are past papers and How Science Works presentations. * Using past papers is an excellent way of assessing knowledge and using the mark schemes to see exactly what the examiners are looking for is one of the best ways to revise. * Work on Synoptic aspects of the course by practising synoptic essays. |

**EXAM DATES:**

**BIOL 4: ………………………….**

**BIOL 5:…………………………..**

**Your target and how to beat it!**





**WHAT IS YOU CURRENT GRADE (IR/Module grades/topic tests):**

**WHAT IS YOUR TARGET GRADE:**

**What can you do to improve on your current grade?**

***Set yourself three targets to using the grade descriptors above***

|  |  |  |
| --- | --- | --- |
|  | **TARGET** | **COMMENT/ACHIEVED** |
| **1** |  |  |
| **2** |  |  |
| **3** |  |  |

**Exam tips**

* Read the question **carefully** and underline the command words and key pieces of information.
* Always note the **number of marks** available and ensure you answer with enough points; if it is 3 marks make at least 4 points!
* **Manage your time**: you should allow 1 and a half minutes for every mark.

**The synoptic paper:**

**ESSAY**

You should write your essay in continuous prose. Your essay will be marked for its scientific accuracy. It will also be marked for your selectionof relevant material from different parts of the specification and from the quality of yourwritten communication.The maximum number of marks that can be awarded is

* + Scientific content 16
  + Breadth of knowledge 3
  + Relevance 3
  + Quality of written communication 3

**10 Write an essay on one of the following topics.**

**EITHER**

**10 (a) Carbon dioxide may affect organisms directly or indirectly. Describe and explain these**

**effects. (25 marks)**

**OR**

**10 (b) The causes of disease in humans. (25 marks)**

***Examiners report on the responses for Question 10***

There were occasional essays that were a pleasure to read. They had accurate and detailed content and presented the underlying argument lucidly and coherently. Many of the essays seen, however, were of poor quality. The following comments could often be applied to these essays.

* There was no evidence of planning. This inevitably led to much repetition and to the liberal use of footnotes and asterisks which detracted from overall coherence and allowed only limited marks to be awarded for skill Q.
* They were frequently based on content that was superficial and rarely reflected the detail expected at the end of an A-level course.
* There were many fundamental errors and misconceptions. Such phrases as “plants respire by photosynthesis‟, „carbon dioxide creates the diffusion gradient for oxygen‟ and carbon dioxide makes a hole in the O-zone layer‟ were frequent.
* Much of the content was clearly irrelevant. Examiners were left with the impression that once candidates had identified a topic that they considered to be of some relevance, they were determined to extend it far beyond any link with the essay title. There was the occasional suspicion that some candidates were attempting to recall essays that they had written earlier. Thus the effects of carbon dioxide not infrequently became the importance of carbon-containing compounds or even the importance of oxygen while the causes of disease became the immune response or DNA and mutation. While examiners are fully prepared to give credit to any relevant biology that relates, even, distantly to the title, irrelevance inevitable results in withholding marks, not only for skill Rbut also for scientific content.

***Specific responses for each essay***

(a) Carbon dioxide may affect organisms directly or indirectly. Describe and explain these effects. Most of the candidates who attempted this essay, introduced the topic with a reference to the light-independent reaction of photosynthesis. Where they progressed beyond a general equation, their knowledge of biochemical detail was often sound, even though there was often a disturbing degree of confusion between respiration and photosynthesis. The physiological role of carbon dioxide in regulating heart beat and the Bohr shift usually received mention but accounts were often spoilt by confusion between haemoglobin and red blood cells or between carbon dioxide and carbon monoxide. From this point, detail usually fell away. References to the carbon cycle were often followed by superficial and long-winded accounts of climate change. Given the relevance of this topic to the future lives of these students and the emphasis that is placed on it in Unit 4, it was indeed depressing to see that so few could progress beyond the melting of ice caps and the demise of polar bears. Such phrases as “insects would have to migrate to find new niches” raised concerns about fundamental understanding of ecological concepts.

(b) The causes of disease in humans. Most of the candidates who attempted this essay were able to write about pathogens, lifestyle diseases and genetic disease. The section on pathogens was usually based on Biology - AQA GCE Report on the Examination 2010 June series 8 the diseases considered in Unit 1 and marks awarded were closely linked to the accuracy with which candidates recalled basic facts. Fundamental errors were numerous. The terms virus and bacterium appeared freely interchangeable and while understanding of the part played by the cholera toxin was sound, knowledge of tuberculosis was less convincing. Many, indeed, attempted to link tuberculosis with smoking or even with a high fat diet. Many candidates introduced material that was clearly irrelevant at this stage and digressed at great length on the topic of immunology. Better candidates considered genetic disease in considerable detail linking it to cystic fibrosis and sickle-cell anaemia. Others were inclined to produce a lengthy account of DNA structure and mutation finally ending with a phrase along the lines that, if “this goes wrong then you will get a disease.” The section on lifestyle disease, was by far the most poorly answered. Generalisation and inaccuracy were frequently compounded by poor expression such as tar “clogging up” lungs or fats similarly “clogging up veins.”

**Topic-Test Self Evaluation Form**

**Test:** ………………………………………………………………………………………………………………...

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **What mistake caused mark(s) to be lost?** | | **Number of marks lost** | | |
| ***1. Silly mistakes*** | | | | |
| Left out an important word in answer | | |  | |
| Miscalculation | | |  | |
| Knew the answer but ***misread*** the question | | |  | |
| ***Missed*** the question | | |  | |
| Did not use figures to back up description of table / graph | | |  | |
| ***Misinterpreted*** the question (“described” instead of “explained”) | | |  | |
| ***Total marks lost for silly mistakes*** | | |  | |
| ***2. Lack of understanding of what the question was asking*** | | | | |
| Did not originally ***understand the question*** (but once explained knew the answer) | | | |  |
| Did not know how to do the calculation | | | |  |
| ***Total marks lost for lack of understanding of question*** | | | |  |
| ***3. Lack of detail in answer*** | | | | |
| Did not ***understand the theory*** to answer the question | | | |  |
| Did not ***revise the topic*** area which was asked in the question | | | |  |
| ***Total marks lost for lack of detail in answer*** | | | |  |
| ***4. Did not finish*** | | | | |
| Ran out of time | | | |  |
| ***Total marks lost for not finishing the paper*** | | | |  |
|  | ***TOTAL MARKS LOST*** | | |  |

The main reason(s) why I lost marks in this work was because:

………………………………………………………………………………………………………………………

This can be improved by: ……………………………………………………………………………………….............................................

....................................................................................................................................................................

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Target** | **VA** | **4.1 Populations** | | **4.2 ATP** | | **4.3 Photosynthesis** | | **4.4 Respiration** | | **4.5 Energy and ecosystems** | | **4.6 Nutrient cycles** | | **4.7 Ecological succession** | | **4.8 Inheritance and selection** | |  | **5.9 Response to stimuli** | | **5.10 Coordination** | | **5.11 Muscle coordination** | | **5.12 Homeostasis** | | **5.13 Feedback mechanism** | | **5.14 Genetic control of protein structure and function** | | **5.15 Control of gene expression** | | **5.16 DNA technology** | |
| **%** | **Grade** | **%** | **Grade** | **%** | **Grade** | **%** | **Grade** | **%** | **Grade** | **%** | **Grade** | **%** | **Grade** | **%** | **Grade** |  | **%** | **Grade** | **%** | **Grade** | **%** | **Grade** | **%** | **Grade** | **%** | **Grade** | **%** | **Grade** | **%** | **Grade** | **%** | **Grade** |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Target** | **VA** | **1.1 Causes of disease** | | **1.2 Enzymes and the digestive system** | | **1.3 Cells and movement in and out of them** | | **1.4 Lungs and lung disease** | | **1.5 The heart and heart disease** | | **1.6 Immunity** | |  | **2.7 Variation** | | **2.8 DNA and meiosis** | | **2.9 Genetic diversity** | | **2.10 The variety of life** | | **2.11 The cell cycle** | | **2.12 Cellular organisation** | | **2.13 Exchange and transport** | | **2.14 Classification** | | **2.15 Evidence for relationship between organisms** | | **2.16 Adaptation for selection** | | **2.17 Biodiversity** | |
| **%** | **Grade** | **%** | **Grade** | **%** | **Grade** | **%** | **Grade** | **%** | **Grade** | **%** | **Grade** |  | **%** | **Grade** | **%** | **Grade** | **%** | **Grade** | **%** | **Grade** | **%** | **Grade** | **%** | **Grade** | **%** | **Grade** | **%** | **Grade** | **%** | **Grade** | **%** | **Grade** | **%** | **Grade** |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

**Use these pages to track your progress through the individual topics – BIOLOGY**

|  |  |  |
| --- | --- | --- |
| **Date** | **Comment** | **Response/action** |
|  |  |  |
|  |  |  |
|  |  |  |
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|  |  |  |
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|  |  |  |

**6. Creating (putting pieces together to form a coherent whole)**

What is your view of . . . ? How would you prove. . . ? Would it be better if . . . ? Why did they choose . . . ? How would you rate. . . ? What would you select . . . ?

What is your judgment about . . . ? Why was it better that . . . ?

**4. Analyzing (breaking concept/info into parts to explore understandings and relationships)**

Why do you think . . . ? What is the main theme . . . ? What conclusions. . . ?How would you group . . . ? What evidence can you find . . . ? What is the link between . . .?

What’s different between . . . ?

What is the purpose of . . . ?

**3. Applying (using a**

**procedure)**

How would you use . . . ?

How would you show your understanding of . . . ?

What method would you use to . . . ?

What other way would you plan to . . . ?

What facts would you choose to show . . . ?

**2. Understanding (constructing**

**meaning)**

What facts or ideas show . . . ?

What is the main idea of . . . ?

Which statements back up . . . ?

Can you explain. . . ? What is meant by . . .?

What can you say about . . . ?

Which is the best answer . . . ?

How would you sum up . . . ?

.

**5. Evaluating (making judgments based on criteria and standards)**

How would you improve . . . ? What would happen if . . . ? Can you give an alternative . . . ? Can you invent . . . ? What changes to the plan . . . ? How could you reduce/increase . . . ?

What way would you design . . . ? What solutions are there for…?

**1. Remembering (recalling**

**learned info)**

What is . . . ? How is . . . ? Where is . . . ?

When did … ? Why did . . . ? Who were the main . . . ? Can you list three . . . ? Who was . . . ?

**Questioning**

Knowledge isn’t just there in a book, waiting for someone to come along and ‘learn it’. Knowledge is produced in response to questions…once you have learned to ask questions…you have learned how to learn.

(Postman and Weitgartner 1969 cited in Aicken, 1984, p.122)

Some of you may feel that it is the job of the teacher to ask the questions. You may have a variety of views as to why we ask question, some not so positive. However, we feel that questions should be asked by everyone in our classrooms. We should **all** feel confident enough to answer questions, given the time to think about our response, or comfortably admit we are not sure of the answer.

Look at the previous sheet to find out a little more about the type of questions we can ask. They are structured according to bloom’s taxonomy, which suggests that questions that challenge us to evaluate or create are the most challenging.

When you are in lessons, carrying out research, or revising for exams you can use questions to structure your learning and organise your thoughts. Try it out: pick a topic and write down two questions from each category.

**Independent study**

You will need to do independent study. This will not be directed by your teacher. It is for you to decide how best to spend your time, and about how you can learn most effectively. Use your knowledge of yourself, and the work you have done on learning to guide you. To get you started there are some suggestions below:

* **Read through your notes** and write down key words for each study/unit. Put your notes away and try and explain why you chose each word.
* **Create mnemonics** – where the first letter of each word makes a word, or a sentence e.g. Richard Of York Gave Battle In Vain tells you the order of the colours of the rainbow (red, orange, yellow, green, blue, indigo, violet).
* **Create question and answer cards**. Write the question on one card and the answer on another. Mix them all up and then try to find the right pair.
* **Or** **write the answer on one side and the question on the other**. Try to answer all the questions, checking your answers as you go, or try to work out the question from the answer.
* **Use the recommended websites** and search them for more information about your subject.
* **Create a mind map**. Use different starting points each time e.g. title of the unit, strengths/weaknesses, key word/themes, name of key person. How much can you do without your notes? How much can you add once you have your notes in front of you?
* **Practice answering exam questions**. Use the exam board website (they usually publish past papers you can download for free). Do the exam questions with your notes. Do them without your notes and then check your answers.
* **Go to the library and read a book**, or relevant chapters of a book. Look in the index and find relevant pages. Open a book and start reading.
* **Take notes on what you have read.** Find interesting quotes.
* **Write down five questions you could ask the authors**.
* **Write down five things you want to know more about** from what you have read. Find the answers.
* **Find images** to represent key points/units/studies.
* **Organise your file**- make sure there is nothing missing.
* **Plan a lesson** on a particular subject. How would you teach it to someone else?
* **Do any or all of the above with a friend**. Test yourself, and test each other.

**Reading list**

These are the core texts that we recommend:

* AQA Biology AS Student Book
  + ISBN 978-0-7487-8275-8 School price £17.50
* AQA Biology A2 Student Book
  + ISBN: 978-0-7487-9813-1 School price £17.50
* AQA Human Biology AS Student Book
  + ISBN 978-0-7487-8277-2 School price £17.50
* AQA Human Biology A2 Student Book
  + ISBN: 978-0-7487-8278-9 School price £17.50

**Revision guides**

**Journals**

We highly recommend subscription to **Biological Sciences Review**. See Mr Gale to find out how to get a subscription at a discounted rate.

**Great science literature:**

James Lovelock – The Revenge of Gaia

Peter Forbes – The Gecko’s foot

Richard Dawkins – The Greatest Show on Earth

Nick Lane – Life Ascending

Charles Darwin – The Voyage of the Beagle

Ben Goldacre – Bad Science

Armand Marie Leroi – Mutants

Edward O.Wilson - Consilience

**Reading tips**

**Reading and researching hand-outs, documents, the internet and textbooks is a very important skill to learn at A-level. Whilst all of you will be able to read to a good level, it is important to consider what you reading and for what purpose:**

**Reading with a purpose:**

**Firstly we need to remember that books / texts are resources. Reading for academic reasons is very different from reading for pleasure, the texts you are reading are normally more difficult and you should expect to spend much more time on them than you would a fiction book, at A level there is usually never enough time, so you need to learn to become a ‘smash and grab reader’.**

**Why am I reading this text?**

**Usually to answer some sort of question, or complete a research task. We can read to;**

* **Answer a specific question.**
* **Gain a broad overview.**
* **Collect new ideas and facts.**

**The type requires you to scan for information. The second two require you to skim through and select out the meaning of the text as a whole; each requires a different approach.**

**Reading a big book:**

**The Title Page: Tells you.. How up to date the content is and who the author is**

**[Tip: Choose an up to date text]**

**The Table of Contents (at the front) Tells you the scope of the book, how the book is organized the main chapter headings**

**The INDEX (at the back) where you will find specific references to specific topics**

**If you have a specific question the index is a good place to start**

**The Bibliography: Tells you which research papers, texts, are referenced:**

**Harvard referencing order:**

**Author name, date, title, publisher, for example:**

**Gross, R. (1994) Psychology: The Science of Mind & Behaviour (Ed 3) Hodder & Stoughton, UK**

**The Preface: Tells you the author’s intent and approach, where they ‘are coming from’**

**If the book is ‘new to you’ open it at random and read a paragraph. Is the prose style to your liking? Can YOU get into it? Don’t be afraid to find an easy text to start with before you progress to a more difficult one**

**Making notes:**

**After reading through materials, it is important to then make notes. Notes are important, as they can be used for revision, help to organise your understanding of a topic and are the basis of your essays and other project work.**

**Rowntree [1997] identifies 2 types of notes:**

* **Summary notes – these are shortened, re-written notes from lessons, or taken from materials – the basic building blocks of written work.**
* **Skeleton notes – the most basic point put into bullet points – useful for revision.**
* **Diagram notes – e.g. flow diagrams, or spider diagrams – again useful for revision, but also for showing relationships between different pieces of information.**

**For more information on note making see the study skills photo-copy in the back of the pack.**

**Using the library:**

**In the days of the Internet and Wikipedia it is important to remember that the library is stocked with sociology textbooks and topic guides. Make sure that you use it – you can borrow books too.**

**Newspapers:**

**You should read one quality newspaper – Times, Guardian, Independent, or Telegraph once a week – to improve your general knowledge.**

**Use of the internet and Plagiarism**

**Whilst the internet is a useful resource, and there is a list of excellent sociology websites in this pack, it is important to use internet resources with care.**

**Firstly, consider whether the information on the website is factual, or whether it is written from a point of view.**

**Secondly, if information is from a website, especially factual information, please quote the website – work which indicates its sources will receive higher marks.**

**Thirdly, plagiarism i.e. cutting and pasting content directly from websites is completely unacceptable. You are encouraged to quote from texts, but this must be made clear through use of italics, or speech marks and by referencing the quote [author, date, book title].**

**It is usually very obvious when a student has merely copied from a website and/or textbook. Such essays will have to be re-done in the students own words as you will not remember, or fully understand content that has been merely copied.**

**You need to draw on sources to put your own point of view across, not to put someone else’s point of view.****How to get the best from the internet**

The internet is a big place, yet most of you seem to go straight to Wikipedia when you want to know something. Be more adventurous, try different websites and you might stumble across a great resource.

I have recently set up a wikispace at the following location:

<https://gale-force-glyn.wikispaces.com/A-Level+Biology>

Check it out to find useful resources, hints and tips to help you revise. You can become a member of the page, which will allow you to edit files, add files and also join discussions.

Another, very modern, resource is twitter. Many of you will already use twitter but will not have tapped into the wonderful resources that it has to offer. You can find lots of ideas about education; tips to revise; insights to help you overcome the difficulties of studying A-levels; advice about university applications; and you can keep abreast of currentl and science news.

My twitter account for school is:

<https://twitter.com/#!/galeforceglyn>

If you are not sure how to use twitter go onto my wikispace and read through the article ‘twitter for beginners’.

You tube is becoming ever more popular and has some fantastic resources available. I am in the process of setting up a youtube channel which will feature some advice on exams and will discuss particularly difficult exam questions.

Below is the link for AQA page for Biology. You can find the specification and past papers using the key materials tab.

<http://www.aqa.org.uk/qualifications/a-level/science/biology.php?__utma=43460533.311576461.1328111020.1328111020.1328880338.2&__utmb=43460533.3.10.1330516542&__utmc=43460533&__utmx=-&__utmz=43460533.1328880338.2.2.utmcsr=bing|utmccn=(organic)|utmcmd=organic|utmctr=aqa%20biology&__utmv=-&__utmk=265677258>

**Coursework:**

**For a link to an article which explains how to use HSW words:**

[**https://docs.google.com/open?id=0B5G16LdHH5KiYWI3Mjk2YjUtODc2MS00MzY2LTgxNDMtZGJiZWRkZDEzZjMx**](https://docs.google.com/open?id=0B5G16LdHH5KiYWI3Mjk2YjUtODc2MS00MzY2LTgxNDMtZGJiZWRkZDEzZjMx)

[**https://docs.google.com/open?id=0B5G16LdHH5KiMGYzYTExOTItOTZjOC00ZjY5LWE5MjYtOWVhMDJhNTAzN2Yx**](https://docs.google.com/open?id=0B5G16LdHH5KiMGYzYTExOTItOTZjOC00ZjY5LWE5MjYtOWVhMDJhNTAzN2Yx)

[**https://docs.google.com/open?id=0B5G16LdHH5KiMmZlYWRlZTUtMWQwOC00MDA5LTlhMDItOTE2MWM3MmMwMDEz**](https://docs.google.com/open?id=0B5G16LdHH5KiMmZlYWRlZTUtMWQwOC00MDA5LTlhMDItOTE2MWM3MmMwMDEz)

**SMASH STATISTICS**

In scientific investigations, you would usually consider statistical analysis as part of the design of an investigation. This means that you would consider which statistical test would be appropriate when deciding what to measure or record and how many times to repeat an experiment. At A level, you are required to select an appropriate statistical test to apply to data you have already obtained. You are only expected to consider the use of tests given in the specification (and on these sheets).

Unless otherwise stated, five repeats will be considered sufficient for a statistical analysis in A2 assessments. There may be investigations where you are instructed to use as few as three repeats.

The flow chart on the next page takes you through the stages in selecting a statistical test to apply to your data.

The first step is to decide what sort of data you have.

The next step is to decide what you want to know about the data.

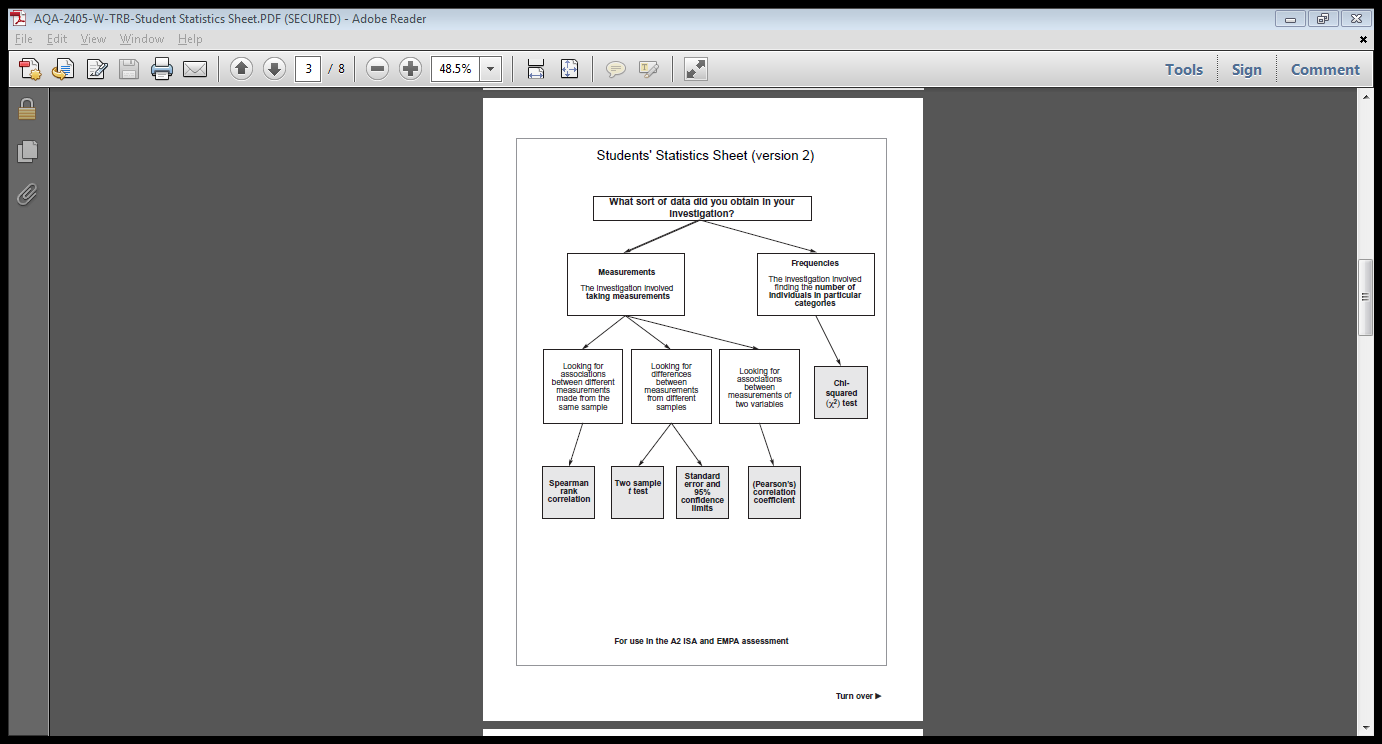
You should then come to an appropriate statistical analysis to use.

**Use of calculators or computer spreadsheets**

In assessments, the important skills being tested are your ability to

* identify the sort of data you have
* select an appropriate statistical test
* and decide whether or not the test statistic obtained has a value which is statistically significant.

**You can use a calculator or computer spreadsheet when calculating the test statistic but you must do this yourself.**



**Statistical tests and tables of critical values**

**Tables of critical values**

A table of critical values is provided with each statistical test. If your calculated test statistic is greater than, or equal to, the critical value, then the result of your statistical test is significant. This

means that your null hypothesis should be rejected.

**Spearman rank correlation test**

Use this test when

* you wish to find out if there is a significant association between two sets of measurements from the same sample
* and you have between 5 and 30 pairs of measurements.

Record the data as values of X and Y.

Convert these values to rank orders, 1 for largest, 2 for second largest, etc. Now calculate the value of the Spearman rank correlation, *rs*, from the equation

6 X ΣD2

*N3 - N*

*rs* = 1 –[ ]

Where *N* is the number of pairs of items in the sample.

D is the difference between each pair (X-Y) of ranked measurements.

**A table showing the critical values of *rs* for different numbers of paired values.**

|  |  |  |
| --- | --- | --- |
| **Number of pairs** | **Critical value** |  |
| **of measurements** |  |
|  |  |
|  |  |  |
| 5 | 1.00 |  |
|  |  |  |
| 6 | 0.89 |  |
|  |  |  |
| 7 | 0.79 |  |
|  |  |  |
| 8 | 0.74 |  |
|  |  |  |
| 9 | 0.68 |  |
|  |  |  |
| 10 | 0.65 |  |
| 12 | 0.59 |  |
| 14 | 0.54 |  |
| 16 | 0.51 |  |
| 18 | 0.48 |  |

**Correlation coefficient (Pearson’s correlation coefficient)**

Use this test when

* you wish to find out if there is a significant association between two sets of measurements measured on interval or ratio scales
* the data are normally distributed.

Record the data as values of variables X and Y.

Now calculate the value of the (Pearson) correlation coefficient, *r*, from the equation

ΣXY – [(ΣX)(ΣY)]/*n*

*r* =X2– [(ΣX)2/*n*]} {ΣY2– [(ΣY)2/*n*]}



Where *n* is the number of values of X and Y.

**A table showing the critical values of *r* for different degrees of freedom.**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **Degrees** | **Critical** | **Degrees** |  | **Critical** |  |
|  | **of** | **of** |  |  |
|  | **value** |  | **value** |  |
|  | **freedom** | **freedom** |  |  |
|  |  |  |  |  |
|  |  |  |  |  |  |  |
|  | 1 | 1.00 | 12 |  | 0.53 |  |
|  |  |  |  |  |  |  |
|  | 2 | 0.95 | 14 |  | 0.50 |  |
|  |  |  |  |  |  |  |
|  | 3 | 0.88 | 16 |  | 0.47 |  |
|  |  |  |  |  |  |  |
|  | 4 | 0.81 | 18 |  | 0.44 |  |
|  |  |  |  |  |  |  |
|  | 5 | 0.75 | 20 |  | 0.52 |  |
|  |  |  |  |  |  |  |
|  | 6 | 0.71 | 22 |  | 0.40 |  |
|  |  |  |  |  |  |  |
|  | 7 | 0.67 | 24 |  | 0.39 |  |
|  |  |  |  |  |  |  |
|  | 8 | 0.63 | 26 |  | 0.37 |  |
|  |  |  |  |  |  |  |
|  | 9 | 0.60 | 28 |  | 0.36 |  |
|  |  |  |  |  |  |  |
|  | 10 | 0.58 | 30 |  | 0.35 |  |
|  |  |  |  |  |  |  |
| For most cases, the number of degrees of freedom is = *n* – 2 | | | | |  |  |

**The *t* -test**

Use this test when

* + you wish to find out if there is a significant difference between two means
  + the data are normally distributed
  + the sample size is less than 25.
* can be calculated from the formula *x1 – x2*

*t* =*s*12/*n*1) + (*s*22/*n*2)



Where *x*1 = mean of first sample

*x*2=mean of second sample

*s*1=standard deviation of first sample

*s*2=standard deviation of second sample

*n*1=number of measurements in first sample

*n*2=number of measurements in second sample

**A table showing the critical values of *t* for different degrees of freedom.**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Degrees** | **Critical** | **Degrees** | **Critical** |  |
|  | **of** | **of** |  |
|  | **value** | **value** |  |
|  | **freedom** | **freedom** |  |
|  |  |  |  |
|  |  |  |  |  |  |
|  | 4 | 2.78 |  |  |  |
|  |  |  |  |  |  |
|  | 5 | 2.57 | 15 | 2.13 |  |
|  |  |  |  |  |  |
|  | 6 | 2.48 | 16 | 2.12 |  |
|  |  |  |  |  |  |
|  | 7 | 2.37 | 18 | 2.10 |  |
|  |  |  |  |  |  |
|  | 8 | 2.31 | 20 | 2.09 |  |
|  |  |  |  |  |  |
|  | 9 | 2.26 | 22 | 2.07 |  |
|  |  |  |  |  |  |
|  | 10 | 2.23 | 24 | 2.06 |  |
|  |  |  |  |  |  |
|  | 11 | 2.20 | 26 | 2.06 |  |
|  |  |  |  |  |  |
|  | 12 | 2.18 | 28 | 2.05 |  |
|  |  |  |  |  |  |
|  | 13 | 2.16 | 30 | 2.04 |  |
|  |  |  |  |  |  |
|  | 14 | 2.15 | 40 | 2.02 |  |
|  |  |  |  |  |  |
| The number of degrees of freedom = (*n*1 *+ n*2*)* – 2 | | | |  |  |

|  |  |  |
| --- | --- | --- |
| **HOW SCIENCE WORKS – A GLOSSARY OF TERMS** | |  |
| **Accuracy** | An accurate measurement is one which is close to the **true value**. |  |
| **Anomalous data** | Anomalous data are those measurements that fall outside the normal, or | |
|  | expected, range of measured values. Variation is a characteristic of all living | |
|  | organisms, and it is often difficult in biological investigations to distinguish | |
|  | between data that reflect this variation and those that are genuinely | |
|  | anomalous. A large number of readings allows anomalous data to be | |
|  | identified with greater certainty. |  |
| **Calibration** | When using a measuring instrument, calibration involves fixing known points | |
|  | and constructing a scale between these fixed points. |  |
| **Causal link** | A change in one variable that results from or is caused by a change in | |
|  | another variable |  |
| **Chance** | Chance is essentially the same as luck. If a coin is tossed in the air, whether | |
|  | it comes down heads or tails is purely due to chance. The results of any | |
|  | investigation could have a genuine scientific explanation but they could be | |
|  | due to chance. Scientists carry out **statistical tests** to assess the |  |
|  | **probability** of the results of an investigation being due to chance. |  |
| **Confounding** | A confounding variable is one that may, in addition to the **independent** | |
| **variable** | **variable**, affect the outcome of the investigation. Confounding variables must | |
|  | be kept constant or the investigation will not be a **fair test**. In some | |
|  | investigations, ecological investigations in particular, it is not always possible | |
|  | to keep confounding variables constant. In such cases, these variables | |
|  | should be monitored. In this way it may be possible to decide whether or not | |
|  | the factor concerned affects the outcome of the experiment. Confounding | |
|  | variables are sometimes referred to as control variables. |  |
| **Control** | A control experiment is one that is set up to eliminate certain possibilities. In | |
| **experiment** | a well designed investigation, the **independent variable** is changed and all | |
|  | **confounding variables** are kept constant. The possibility exists, however, | |
|  | that something else other than the independent variable might have produced | |
|  | the results that were obtained. A control experiment is one that is designed to | |
|  | eliminate this possibility. |  |
| **Control group** | A control group is one that is treated in exactly the same way as the | |
|  | experimental group except for the factor that is being investigated. This | |
|  | allows scientists to make a comparison. It ensures that the data | that are |
|  | collected are **valid** because any differences between the results for the | |
|  | experimental group and those for the control group will be due to a single | |
|  | **independent variable**. |  |

**Control variable** See **confounding variable**

**Correlation** A correlation shows that there is a relationship between two variables,

however, it might not be a causal one.

**Dependent** The dependent variable is the variable the value of which is measured for

**variable** each change in the **independent variable**.

**Double-blind trial** A trial, usually used in the context of medicine, when assessing the effects of

a new drug or treatment on humans. Neither the patients nor the scientists

concerned know which treatment a particular individual is receiving until after

completion of the trial. This helps to avoid bias and increase the **validity** of

the trial.

**Errors** Errors cause readings to be different from the **true value**.

**Evidence** The data or observations that are used to support a given hypothesis or

belief.

**Fair test** A fair test is one in which only the **independent variable** has been allowed to

affect the **dependent variable**. A fair test can usually be achieved by

keeping all other variables constant or controlled.

**Hypothesis** Sometimes known as an experimental hypothesis, this is a possible

explanation of a problem that can be tested experimentally.

**Independent** The independent variable is the variable for which values are changed by the

**variable** investigator.

**Null hypothesis** A **statistical test** requires a clear **hypothesis** to test. It is often difficult to

predict what would happen as the result of an investigation. It is much easier

to phrase a hypothesis in terms of there being no difference or no

association. A hypothesis worded in this way is called a null hypothesis. As

the result of carrying out a statistical test, a decision can be made about

whether to accept or reject this null hypothesis.

**Placebo** A placebo is a dummy pill or injection given to members of a **control group**

in medical trials. Where a placebo is in the form of a pill, it should be identical

to the pill used with the experimental group. The only difference should be

that that the placebo does not contain the drug being trialled. The use of

placebos helps to ensure that the data collected from a trial are **valid**.

**Precision** Precision is related to the smallest scale division on the measuring

instrument that is being used. A set of precise measurements will have very

little spread about the mean value.

**Probability**

**Protocol**

**Random**

**distribution**

**Random errors**

**Raw data**

**Reliability**

**Systematic errors**

**True value**

**Validity**

**Zero errors**

Probability is the likelihood of an event occurring. It differs from **chance** in that it can be expressed mathematically. In **statistical tests**, probabilities are usually expressed as a decimal fraction of one. Thus a probability of 0.05 means that an event is likely to occur 5 times in every 100.

Once an experimental method has been shown to produce **valid** and **reliable** results, it becomes a protocol used by other scientists.

A random distribution is one that arises as a result of **chance**. When investigating, for example, variation in living organisms, the data collected will only be **valid** if they have been collected at random. This avoids observer bias and allows **statistical tests** to be used in an analysis of the results of the investigation.

Random errors occur in an unpredictable way. They may be caused by human error, faulty technique in taking measurements or by faulty equipment.

Raw data are instrument readings and other data collected at the time of the investigation. These data may subsequently be processed and used to calculate percentages and standard deviations.

The results of an investigation may be considered reliable if they can be repeated. If other scientists get the same results, then the results of the initial investigation are more likely to be reliable. The reliability of data within a single investigation can be improved by carrying out repeat measurements.

These errors cause readings to be spread about some value other than the **true value**. In other words, all the readings are shifted in one direction fromthe true value. Systematic errors may occur when using a wrongly **calibrated** instrument.

This is the accurate value which would be found if the quantity could be measured without any **errors**.

Data are only valid if the measurements that have been made are affected by a single **independent variable** only. They are not valid if the investigation is flawed and **control variables** have been allowed to change or there is observer bias. Conclusions are only valid if they are supported by valid and **reliable** data measured to an appropriate level of **accuracy**.

Zero errors are caused by instruments that have an incorrect zero. A zero error may occur when the needle on a colorimeter fails to return to zero or when a top-pan balance shows a reading when nothing is placed on the pan.

**Resources for AQA GCE Biology AS and A2**

**WEBSITES**

**General sites**

ABPI The Association of the British Pharmaceutical Industry http://www.abpischools.org.uk/page/

http://www.accessexcellence.org/ http://www.bbc.co.uk/schools/websites/16/index.shtml http://www.biochem4schools.org/ http://www.biologyguide.net/ http://www.biozone.co.nz/index.html

BUBL LINK - Catalogue of Internet Resources http://bubl.ac.uk/link/b/biologyeducation.htm

http://www.cellsalive.com/ http://www.educypedia.be/ http://www.eduseek.com/topic.aspx?id=1997 http://www.fungi4schools.org/ http://www.healthline.com/ http://www.innerbody.com/htm/body.html

Institute of Biology http://www.societyofbiology.org/home

http://www.ketteringpumpkins.co.uk/ http://www.lungsonline.com/ http://multimedia.mcb.harvard.edu/media.html http://physics.syr.edu/courses/mirror/biomorph/ http://www.practicalbiology.org/ http://revision-notes.co.uk/A\_Level/Biology/index.html <http://www.revisiontime.com/aBio.ht>

S Cool http://www.s-cool.co.uk/topic\_index.asp?subject\_id=3&d=0

http://www.sciencedaily.com/news/plants\_animals/biology/ http://www.spolem.co.uk/alevel\_home.htm http://www-saps.plantsci.cam.ac.uk/index.htm http://www.who.int/en/

http://en.wikipedia.org/wiki/Biology http://www.yourdiseaserisk.wustl.edu/

**Asthma**

http://www.advisorybodies.doh.gov.uk/comeap/statementsreports/airpol2.htm

**Balanced diet**

http://users.rcn.com/jkimball.ma.ultranet/BiologyPages/N/Nutrition.html http://www.hhs.gov/safety/index.shtml#diet http://www.glycaemicindex.com/ http://en.wikipedia.org/wiki/Glycemic\_load http://www.food.gov.uk/healthiereating/healthycatering/healthycatering02 http://www.eatwell.gov.uk/ http://www.nhs.uk/Conditions/Diet/Pages/Introduction.aspx

**Biodiversity**

http://www.ukbap.org.uk/

**Biofuels**

http://news.bbc.co.uk/2/hi/science/nature/6294133.stm

**Cancer**

http://www.aicr.org.uk/?source=Adwords http://cancer.about.com/od/newlydiagnosed/a/whatcancer.htm

**Carbon footprint**

http://www.carbonfootprint.com/ http://direct.gov.uk/en/Environmentandgreenerliving/actonco2/DG\_067197 http://footprint.wwf.org.uk/

**Cells**

http://www.bscb.org/?url=softcell/index

**CHD**

http://www.dh.gov.uk/en/Policyandguidance/Healthandsocialcaretopics/Coron aryheartdisease/index.htm

http://www.nih.gov/news/HealthWise/Jan98/story6.htm http://www.thincs.org/ http://www.guardian.co.uk/science/2007/nov/16/omega3

**Cholera**

http://www.who.int/topics/cholera/en/

**Classification**

http://catdir.loc.gov/catdir/samples/cam031/95216484.pdf

http://mmbr.asm.org/cgi/reprint/25/2/152.pdf

**Cystic fibrosis**

http://www.bbc.co.uk/health/conditions/cystic1.shtml

**Diabetes**

http://www.diabetes.org.uk/

http://themedicalbiochemistrypage.org/diabetes.html

http://www.scienceinschool.org/print/597

**DNA**

http://www.dnai.org/

http://www.dnaftb.org/dnaftb/

**Ethics in Biology**

http://www.beep.ac.uk/content/index.php

http://www.truthinscience.org.uk/

http://www.nap.edu/catalog.php?record\_id=11876

http://www.badscience.net/

http://www.windfalldigital.com/ethicalemporium/

http://www.nuffieldbioethics.org/

http://www.ciwf.org/

<http://www.medicalprogress.org>

**Evolution**

http://darwinpond.com/

http://darwin.eeb.uconn.edu/simulations/jdk1.0/drift.html)

http://physics.syr.edu/courses/mirror/biomorph/

**Gene sequencing**

http://www.scq.ubc.ca/genome-projects-uncovering-the-blueprints-of-biology/

**Genetic counselling – ethical issues**

Search engine http://scholar.google.com/scholar?q=genetic+counselling+%2B+ethical+issue s&hl=en&um=1&ie=UTF-8&oi=scholart

**Genetics**

http://www.biology.arizona.edu/human\_bio/human\_bio.html

http://science.howstuffworks.com/dna-evidence.htm

**GM foods**

http://www.ornl.gov/sci/techresources/Human\_Genome/elsi/gmfood.shtml

**Impact of human activities on biodiversity**

Search engine http://scholar.google.com/scholar?q=impact+of+human+activities+on+biodiver sity&hl=en&um=1&ie=UTF-8&oi=scholart

**MRSA**

http://www.nhs.uk/conditions/MRSA/Pages/Introduction.aspx

http://en.wikipedia.org/wiki/Methicillin-resistant\_Staphylococcus\_aureus

http://www.patient.co.uk/health/MRSA.htm

**Neuroscience**

http://www.tlrp.org/pub/documents/Neuroscience%20Commentary%20FINAL. pdf

**ORT**

http://en.wikipedia.org/wiki/Oral\_rehydration\_therapy

**Practical protocols**

http://www.ncbe.reading.ac.uk/ncbe/protocols/menu.html

**Virtual labs**

http://www.hhmi.org/biointeractive/vlabs/index.html

Association for the study of animal behaviour

http://asab.nottingham.ac.uk/

National Space Centre www.spacecentre.co.uk Education Officer - 0116 258 2113 Information on physiology in space