Biology A level Summer Work

Welcome to Biology! You have made an excellent choice. Biology is a fascinating and dynamic subject which hits the headlines almost every day (especially recently)! It is wide-ranging and there is a lot to find out about, to know, and to understand.

To stir your biological brain back into action after a long break from school, we would like you to carry out some activities.

There are three activities relating to study skills:

1) Note-making skills

2) Filling in results tables / drawing graphs

3) Maths for Biologists

You will need to complete this and hand it in for feedback in your first Biology lesson.

Activity 1: Note-making skills

Read the following article carefully

The main theory of the cause of atherosclerosis

The lining (endothelium) of an artery becomes damaged (it is a rather delicate layer). This might be caused by harmful chemicals from cigarette smoke (e.g. carbon monoxide), by viral infection, high blood pressure or by a blow to the chest.

Once the endothelium has been disrupted, the following occurs:

1) There is an inflammatory response. White blood cells leave the blood vessel and move into the artery wall. These cells accumulate chemicals from the blood, cholesterol in particular, but also lipoproteins (a form of fat). This mound of swollen, fat-laden cells is called an atheroma.

2) Calcium salts and fibrous tissue (scar tissue) are stimulated to build up in the region of the atheroma, producing a plaque on the inner wall of the artery. As plaques grow they bulge into the lumen of the artery. They also cause a reduction in elasticity of the artery wall. This is known as atherosclerosis ("hardening of the arteries").

3) The plaque can become very large and then tears the endothelium of the artery. Underlying cells come into contact with the blood. This triggers the formation of a blood clot (thrombus). The formation of blood clots within blood vessels is called thrombosis.

4) The narrowing caused by the plaque makes it more difficult for the heart to pump blood around the body. In response the heart has to pump harder, thus raising the blood pressure. This is now dangerous as high blood pressure makes it more likely that further plaques will form, resulting in the blood pressure having to be increased still further etc. This is an example of positive feedback.

Who Is at Risk for Atherosclerosis?

Coronary heart disease (atherosclerosis of the coronary arteries) is the #1 killer of both men and women in the United States. The exact cause of atherosclerosis isn't known. However, certain traits, conditions, or habits may raise your risk for the disease. These conditions are known as risk factors. The more risk factors you have, the more likely it is that you'll develop atherosclerosis.

You can control most risk factors and help prevent or delay atherosclerosis. Other risk factors can't be controlled.

Major Risk Factors

1. Unhealthy blood cholesterol levels. This includes high LDL cholesterol (sometimes called "bad" cholesterol) and low HDL cholesterol (sometimes called "good" cholesterol).
2. High blood pressure. Blood pressure is considered high if it stays at or above 140/90 mmHg over time. If you have diabetes or chronic kidney disease, high blood pressure is defined as 130/80 mmHg or higher.
3. Smoking. Smoking can damage blood vessels, raise cholesterol levels, and raise blood pressure by constricting arteries. Smoking also doesn't allow enough oxygen to reach the body's tissues.
4. Insulin resistance. This condition occurs if the body can't use its insulin properly. Insulin is a hormone that helps move blood sugar into cells where it's used as an energy source. Insulin resistance may lead to diabetes.
5. Diabetes. With this disease, the body's blood sugar level is too high because the body doesn't make enough insulin or doesn't use its insulin properly.
6. Overweight or obesity. The terms "overweight" and "obesity" refer to body weight that's greater than what is considered healthy for a certain height.
7. Lack of physical activity. A lack of physical activity can worsen other risk factors for atherosclerosis, such as unhealthy blood cholesterol levels, high blood pressure, diabetes, and overweight and obesity.
8. Unhealthy diet. An unhealthy diet can raise your risk for atherosclerosis. Foods that are high in saturated and *trans* fats, cholesterol, sodium (salt), and sugar can worsen other atherosclerosis risk factors.
9. Older age. As you get older, your risk for atherosclerosis increases. Genetic or lifestyle factors cause plaque to build up in your arteries as you age. By the time you're middle-aged or older, enough plaque has built up to cause signs or symptoms. In men, the risk increases after age 45. In women, the risk increases after age 55.
10. Family history of early heart disease. Your risk for atherosclerosis increases if your father or a brother was diagnosed with heart disease before 55 years of age, or if your mother or a sister was diagnosed with heart disease before 65 years of age.

Although age and a family history of early heart disease are risk factors, it doesn't mean that you'll develop atherosclerosis if you have one or both. Controlling other risk factors often can lessen genetic influences and prevent atherosclerosis, even in older adults.

Studies show that an increasing number of children, teenagers and young adults are at risk of atherosclerosis. This is due to a number of causes, including rising childhood obesity rates.

Activity 1 - Flow diagram (a great way of summarising, linking and sequencing key bits of information)

If you are not familiar with flow diagrams, there is an example on page 8.

Produce a flow diagram (in the space below) to summarise the sequence of events leading to the development of atherosclerosis.

Activity 2: Filling in results tables / drawing graphs

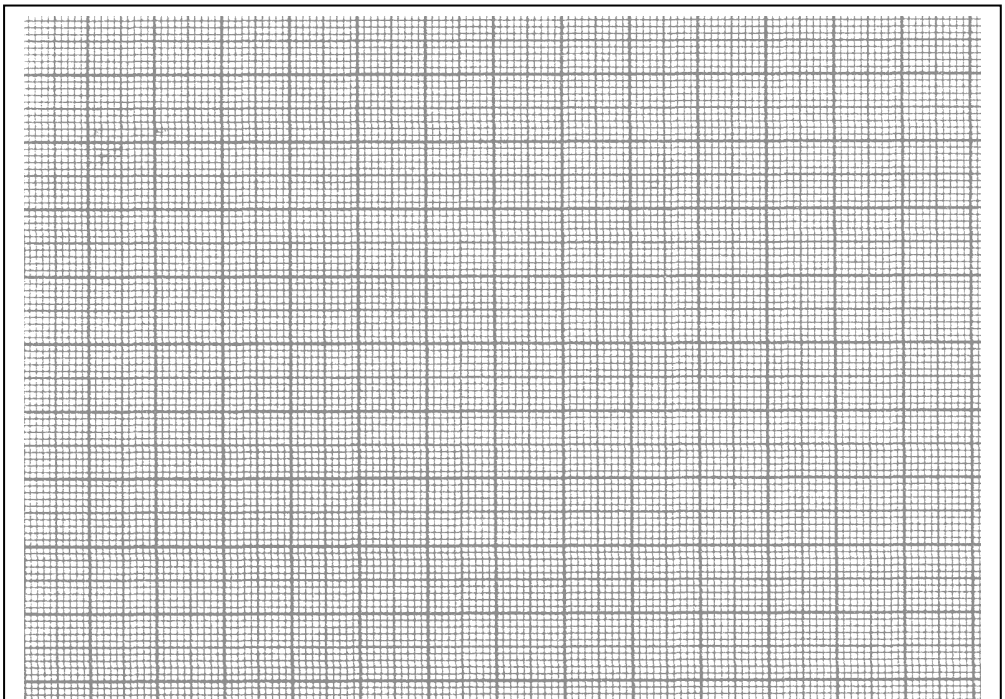
Constructing tables / drawing graphs

The results of any biological practical should be recorded as the investigation is taking place. This leaves you with a list of raw results that need to be presented in a suitable format that can be understood and used to draw conclusions about the experiment. A standard way of summarising data is to construct a table.

Below is an example of a results table for an experiment on the breakdown of starch by amylase.

Temperature / ^{0}C	Time (t) taken for starch to disappear /min				Rate of reaction (1/t x100)
	First Reading	Second reading	Third reading	Mean (average)	
5	42.0	47.0	53.0	47.3	2.1
15	21.5	26.5	27.5		
25	13.0	15.5	15.0		
35	6.0	8.5	8.0		
45	3.5	5.0	6.0		
55	12.0	15.5	17.0		

Calculate the missing data and add it to the table above, then plot the rate of reaction against temperature on the graph paper.



Any graphs, bar charts or histograms should be plotted on graph paper. The horizontal X -axis is usually used for the independent variable (the variable manipulated by the experimenter, e.g. temperature) and the vertical Y-axis is used for the dependent variable (that which is being measured, e.g. enzyme activity). In a scatter graph, where the variables are interdependent, the axes may be orientated either way round. The following mnemonic (memory aid) may help you remember the key features of a graph.

S Scale should be appropriate so that: the graph fits on the paper and is large enough to seen easily; the points can be plotted accurately; values can be easily and accurately read from the graph.

P Plotting should be accurate.

A Axes should be the correct way round and labelled with units.

C Curve should be appropriate: a straight, ruled line joining successive points; or a line of best fit.

K Key should be used to identify the curves if more than one set of data are plotted.

Extrapolation, or extension of the curve beyond the range of your observations is usually unwise. When plotting and drawing curves from the data supplied, only those values given should be plotted as points. Many students make the mistake of extrapolating curves to zero, especially if the data relate to time or temperature.

- Now plot the data below on the graph paper provided and answer the questions on the following page.

Temperature / ^{0}C	Rate of reaction (1/t x 100)
5	1.8
15	3.2
25	8.9
35	24.5
45	4.5
55	0.1

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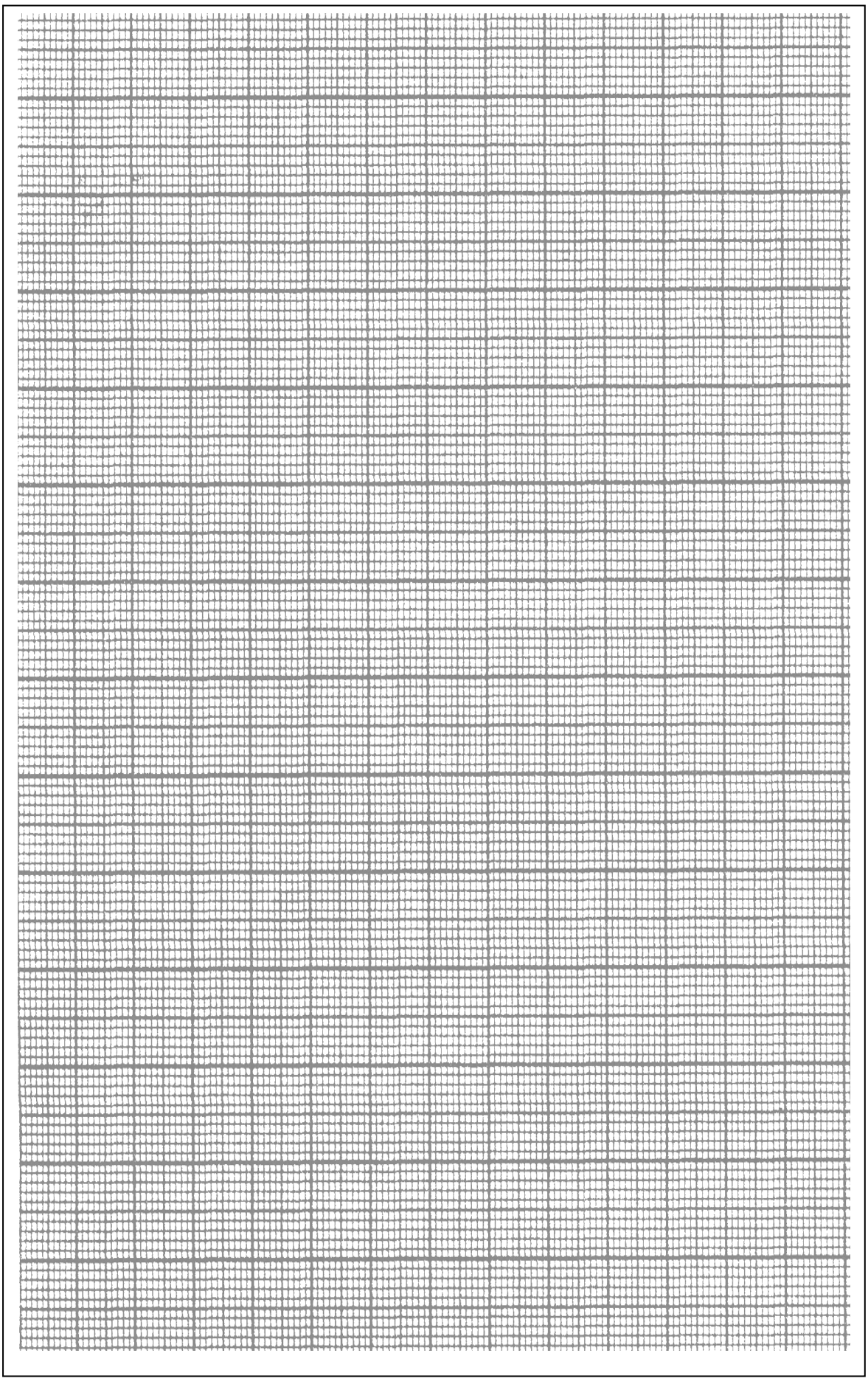


1. Describe (*put into words*) the graph (i.e. describe the general trend, any specific points and quote data – e.g. 'how much has the rate increased at a certain temperature?')

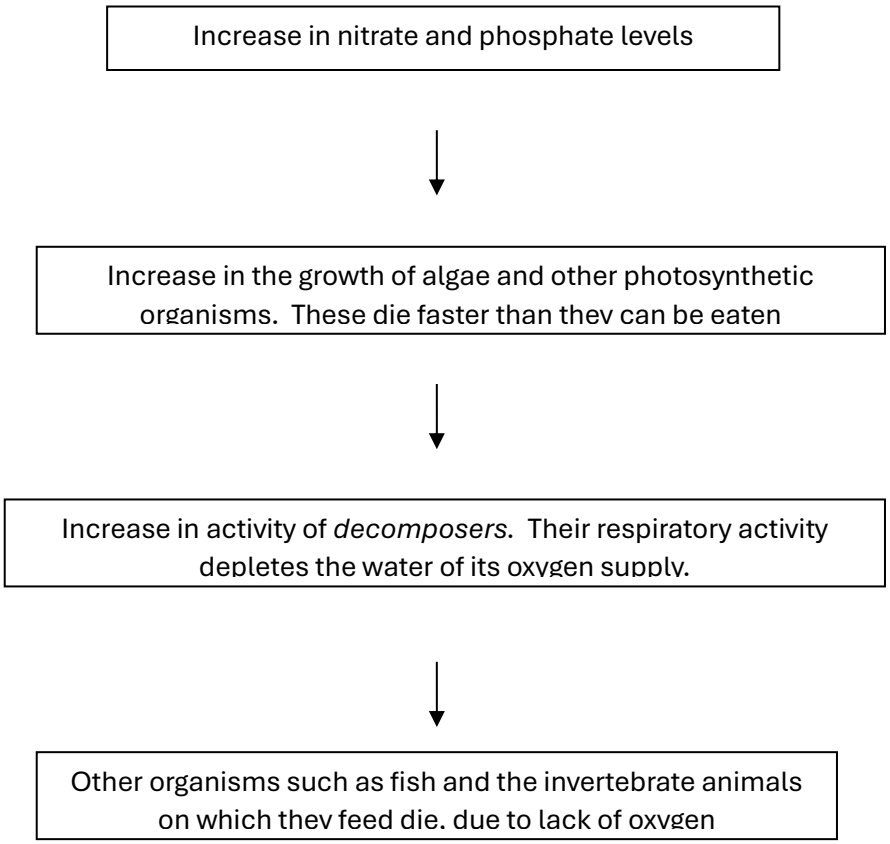
2. Explain (give a scientific reason for) ***each main part*** of the graph – what is happening as the rate alters with temperature?

3. Now use your graph to predict:

   - The rate of reaction at 20^0C _____
   - The temperatures at which the rate of reaction is 10.0_____

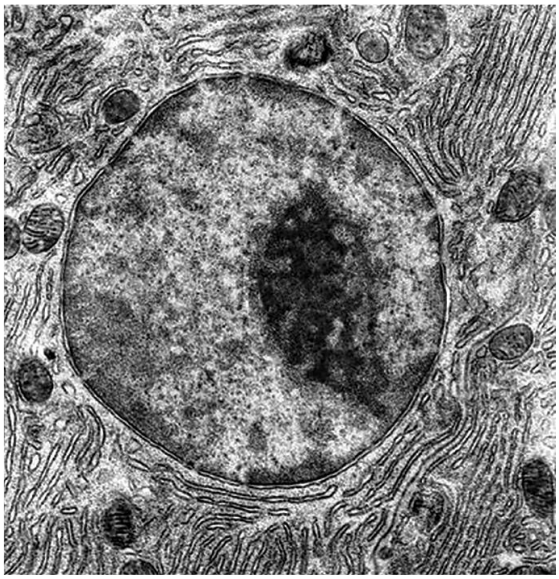
Example of a Flow Diagram for Activity 1

Eutrophication: - an increase in quantity of plant nutrients. The term is generally used when fresh water lakes and rivers are enriched with nitrates and phosphates either as a result of leaching of *fertiliser* from agricultural land or from sewage effluent. The flow chart shows how Eutrophication can cause harm to an ecosystem by causing the death of many organisms.



Activity 3: Maths for Biology

a) The photograph shows a nucleus found in an animal cell. Around the nucleus are other structures such as mitochondria. The cell surface membrane of the cell is not visible in this image.



Magnification: x 6 000

(i) Measure the maximum diameter of the nucleus in mm. (1)

Answer ..... mm

(ii) Calculate the diameter of this nucleus in μm (micrometres). (2)

Answer ..... μm

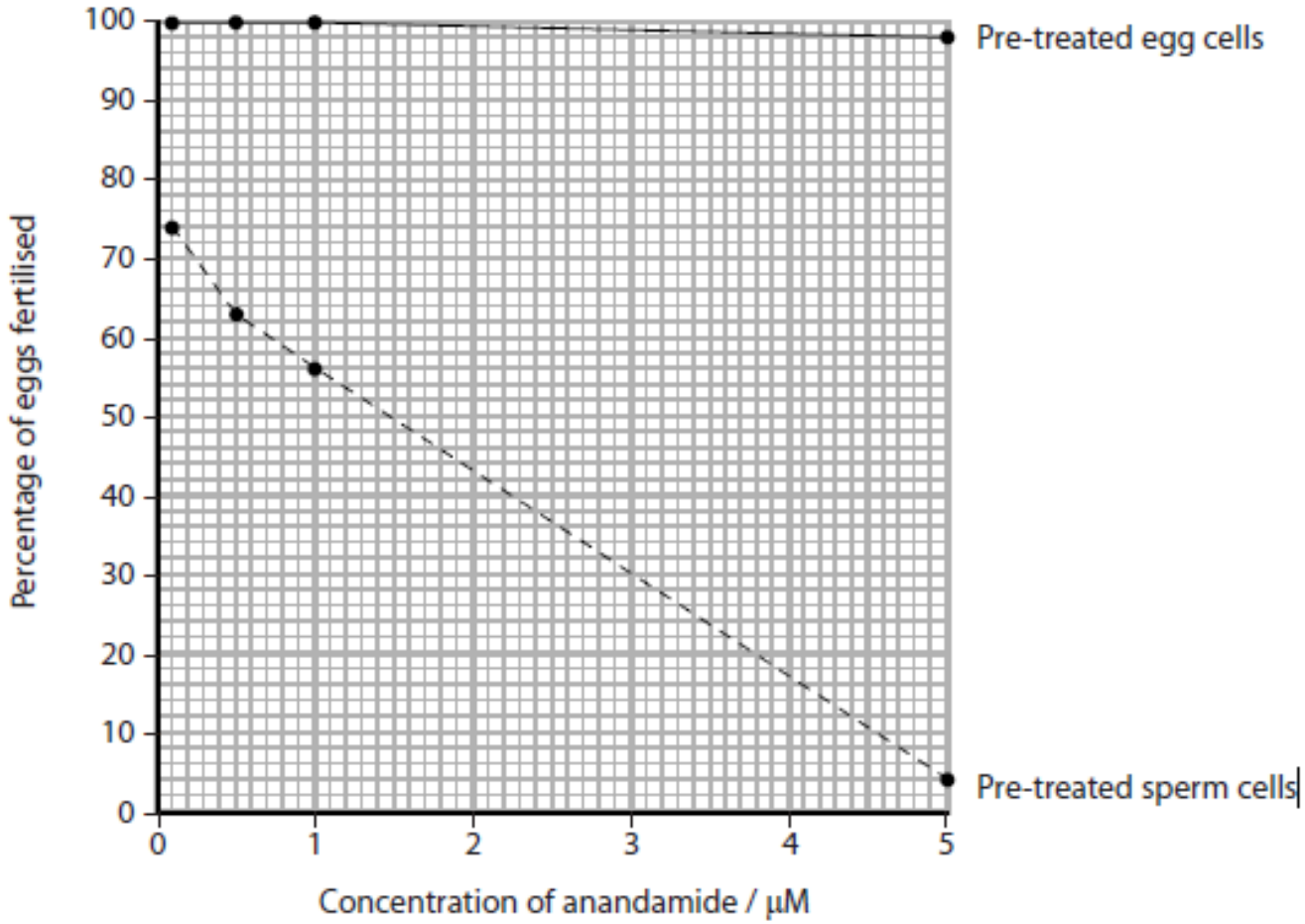
b) Fertilisation can be affected by anandamide, a chemical found in cannabis.

The effect of anandamide on fertilisation in sea urchins was investigated.

Sperm cells were pre-treated with different concentrations of anandamide. These sperm cells were then mixed with untreated egg cells. The percentage of successful fertilisations was calculated.

A separate investigation was carried out using pre-treated egg cells that were then mixed with untreated sperm cells. The percentage of successful fertilisations was calculated.

The graph below shows the results of the investigations.



(i) What is the change in percentage of eggs fertilised using pre-treated sperm cells when the concentration of anandamide increased from 0.1 to 1.0 µM? (1)

Answer .....

(ii) Calculate the percentage change in fertilisation using pre-treated sperm cells when the concentration of anandamide increased from 0.1 to 1.0 µM. (1)

Answer .....%

c) A student measured the diameter of the cut end of an artery and found it to be 9mm.

Calculate the area of the cut end using the formula: (1)

$$A = \pi r^2$$

Answer .....

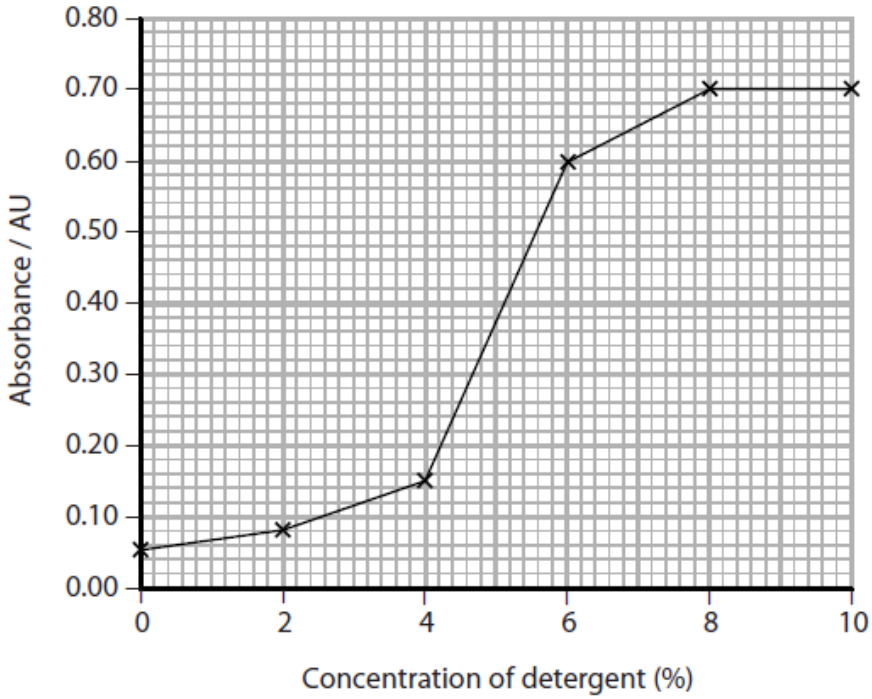
A student investigated the effect of detergent on the permeability of beetroot cell membranes.

A cube of beetroot was placed in water for 20 minutes.

After 20 minutes the beetroot cube was removed and the intensity of the colour of the water was measured using a colorimeter.

The same procedure was carried out for other cubes of beetroot using detergent concentrations of 2%, 4%, 6%, 8% and 10%.

The results are shown in the graph.



d) Calculate the gradient of the line between a detergent concentration of 4% and 6% (2)

Answer .....

One last thing – we are interested to know what you may have been <u>reading</u> relating to Biology, so…

a) Have you read any books relating to Biology (outside of school) in the last couple of years? **Yes/No**

b) If "yes" can you list the titles and authors, and what you thought of them?

Some books we have enjoyed and recommend to you

<u>Last Chance to see</u> – Douglas Adams, Mark Carwardine – Pan 1990

Mark Carwardine was a zoologist working for the World Wildlife Fund when he was hired by a magazine to take Douglas Adams to see the world's rarest nocturnal lemur, the Madagascar aye-aye. The trip was enough of a success that they decided having Adams write funny things about his attempt to visit endangered species was a good way to raise awareness about animal conservation, so they reunited a few years later to track down some other animals whose numbers have fallen into the double digits.

Six degrees: our future on a hotter planet – Mark Lynas – Harper Perennial 2007

It's hard to understand how there could be any climate change "sceptics" remaining. Perhaps they have failed to comprehend the long view of what the circumstances are. What does an increase in global temperatures really mean? Mark Lynas has culled the massive number of reports on the topic and here woven them into a comprehensive picture of likely futures for this planet. In this effective work, he lines out what the changes in our biosphere are likely to be over the next decades. It's a chilling account and one that should be in the hands of every industrialist, policy-maker and tax-paying consumer.

Bad science – Ben Goldacre – Harper Perennial 2009

A thoroughly excellent book from a practising doctor and medical researcher, who is also one of the few science journalists to actually understand scientific method. He is nearly a lone voice in the media, exposing the astonishing journey of 'health news' from the pages of academic journals to the tabloids and broadsheets, without passing through a critical brain in between. Thus, on a daily basis, the papers produce "X CAUSES/CURES CANCER" stories, based on very shaky understanding of experiments done in a petri dish. Whilst these stories may give false hope or fear to thousands of people, which is bad enough, in the case of MMR, they actually caused harm. He also explains how and why science fails to explain itself clearly and loudly in the face of emotionally charged 'my son has autism due to MMR' stories.

The immortal life of Henrietta Lacks – Rebecca Skloot – Pan 2010

Henrietta Lacks was a poor young black woman who was treated at John Hopkins Hospital in East Baltimore, US in the 1950s for an aggressive form of cervical cancer. At the same time as she received treatment a sample of her tissue was taken for research purposes without her knowledge or consent. Most cells die after a short time outside of the body but Henrietta's cells didn't. In fact they multiplied at an astonishing rate and went on to be used around the world for all kinds of medical research including the polio vaccine, IVF and cloning. Known as HeLa cells they are one of the most important and invasive tools in medical history.

Seven daughters of eve – Bryan Sykes – Corgi 2004

Even to a 16 year old teenager, this book was engrossing. The descriptions of the Seven Daughters of Eve were imaginative, and every line was mixed with humour. Even the most scientific parts of the book were very easy to understand, and even enjoyable, which not many popular science books can do. Sykes has a gift of explaining complex notions clearly, and for that alone, he deserves the five stars. But what is most absorbing about this book is the whole idea of all of us being related to one another. It was definitely an

eye opener and made me look at everyone else in the world differently - almost as if I am seeing my brothers and sisters around every corner! The enduring capacity of mitochondrial DNA, and the fact that it stays pure for centuries, was also a gripping concept - and made me realise the power of DNA and our genes. A must read for anyone who is fascinated by genetics. It even made me consider genetics for a future degree!

Life Ascending – Nick Lane – Profile books 2010

I don't think it is an overstatement to say that every one of these ten chapters could be expanded to fill ten books! This book is therefore very fast moving, absolutely packed with information and bang up to date. It is a tribute to the writing skills of the author that the ten separate inventions follow from each other so smoothly and logically. Particularly outstanding chapters included the subjects of DNA, photosynthesis, sight, hot blood and death. Here, the level of understanding conferred far exceeded the average popular science book. A few of the chapters proved quite a challenge, notably the origin of life and consciousness. Whilst these subjects arguably deserve their status in the top ten, the difficulty is possibly that they are less well understood by the current status of science. Some subjects really are more complex than a post-it note explanation, intellectual effort is required, but Life Ascending makes the quest both accessible and richly rewarding. An awesome read!

The Emperor of all Maladies: a biography of Cancer – Siddhartha Mukherjee 2011

The struggle to understand and to cure cancer has consumed medical researchers throughout the twentieth and beginning of the twenty-first centuries. Mukherjee takes a deeply in-depth look at the illness throughout history in this biography of an illness, where cancer is often visualized as a crab scurrying and burrowing away from all reach of therapy. The author adds his own experience to a years-long study of cancer to provide a definitive, insightful book on the way this illness has gripped our modern day lives.

Epigenetics revolution – Nessa Carey – Icon Books Ltd. 2012

I'm no biologist, but Nessa Carey manages to make epigenetics clear and incredibly interesting to me. This is not an easy read, in that it requires one to think and occasionally to do a little mental gymnastics to get one's head around the concepts she introduces, but nevertheless it's the kind of book that can be gulped down in large servings because Carey is skilled at explaining these high-falutin' concepts so well. The topics range from inherited traits to cloning and back again, and I found even the descriptions of how certain experiments were undertaken were such that they read incredibly well. If you are at all interested in science, biology, DNA, and the mystery of how things are and aren't passed on, then this is a must read. Absorbing, educational, and downright fascinating. Brilliant.

This is going to hurt: the secret diaries of a junior doctor – Adam Kay - Picador 2017

The often hilarious, at times horrifying and occasionally heart-breaking diaries of a former junior doctor, and the story of why he decided to hang up his stethoscope.

I'd prescribe this book to anyone and everyone. It's laugh-out-loud funny, heartbreakingly sad and gives you the lowdown on what it's like to be holding it together while serving on the front line of our beloved but

beleaguered NHS. It's wonderful (Jonathan Ross)

Painfully funny. The pain and the funniness somehow add up to something entirely good, entirely noble and entirely loveable. (Stephen Fry)

The Body – a guide for occupants – Bill Bryson – Doubleday 2019

"SCIENCE BOOK OF THE YEAR 2019: so packed with arresting facts (you eat 60 tons of food in a lifetime) and unlikely anecdotes (such as Isambard Kingdom Brunel's six weeks with a half-sovereign lodged in his throat) that you barely notice the sheer volume of anatomical knowledge you're digesting ... makes complex subjects simple and eminently entertaining." (*Sunday Times*)

And finally how about a novel…

Oryx and Crake – Margaret Atwood – Virago 2004

Atwood has strongly denied that Oryx and Crake belongs in the science fiction genre, finding horror a much more suitable home for its content. It is not the lack of blood and guts which is being questioned, but Atwood's clear message that humans are a destructive violent race that enjoys playing God to the world around them, a message that is evident on almost every page. This remarkable novel looks into the future of the human race with Atwood exploiting the technologies that already exist. It is her status as a leading fictional writer that helps create such realism that the novel is hard to define as a fiction, but rather a glimpse into the not too distant future.

There are so many others so if you're interested in more advice on what's good to read just ask us when you arrive at Long Road.

There are some amazing online courses too, such as Future Learn:

https://www.futurelearn.com/subjects/science-engineering-and-maths-courses/biology-and-biotechnology

Do please tell us about any of those you do as well.

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