



TEDDIES talks **BIOLOGY**

**THE EVOLUTION OF EVOLUTION?
HOW INTELLIGENT AM I?
TEST TUBE BABIES?**

Editorial:

Welcome to the inaugural issue of “Teddies Talks Biology”; a biology focussed magazine put together by St Edward’s pupils. We hope you find it both educational and thought- provoking.

This Biology Magazine was the brainwave of Olivia Yu (U6th, Jubilee). She proposed the idea to me and it seemed to tick a lot of boxes; pupils of all year groups can write articles on whatever they want, whenever they want, going above and beyond the curriculum in the process. The pupils have come up with the design, written the articles and put the magazine together all with very little support from me. Many thanks to our valued contributors, but particular praise must go to Salmon Lau, Molly van der Heiden, Pitt Vitheethum and Olivia Yu (U6th, Segar’s, Avenue, Segar’s, and Jubilee) for their enthusiasm and creativity in making this project happen. The anticipation is that Lower 6th pupils will take up the leadership reins after Christmas.

If you wish to get involved in future issues please email me and I’ll add to you our mailing list (storeyr@stedwardsoxford.org). It’s great both for your wider biology education and for bulking out your UCAS form!

I hope you enjoy the read,
Mr Rick Storey



Designed and Formatted by: Salmon Lau

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How Intelligent am I?

Julius Nyonyo (F)

Neuroscientific-ally Challenged

Well the answer to that question is entirely determined by you. Ignoring all the whiffle – waffle and the debate on what being smart really is? or what is intelligence? Or what is the difference between being smart and being intelligent? The truth is we, as human beings, have the ability to improve and manipulate our very own intelligence. This is based on an article from Scientific American written by Andrea Kuszewski.

So what is intelligence? Intelligence is the “ability to acquire and apply knowledge and skills”. Psychologist Raymond Cattell established that there were two distinct factors of general intelligence, Crystallized and Fluid intelligence. Crystallized intelligence is knowledge is based on your past experience, for example your vocabulary or recalling facts. Fluid intelligence is how we acquire and interpret new information – so your ability to solve problems and to think and reason creatively. An underlying component to intelligence is our working memory – as this is how we can retain what we learn and can refer to it when attempting to perceive new information.

Fluid intelligence is trainable. How do we know this? Just like every concept in biology; we learnt it from a miraculous study. In 2008 a study conducted by neuroscientists, led by Susanne Jaeggi, testing whether fluid

intelligence can be improved by training on working memory. They gathered their test subjects and put them through a series of intensive working memory tasks with varying lengths of time (a week or two) depending on the group, they then measured to see if they had improved – naturally they had. Next Jaeggi wanted to see if this improvement in cognition was transferable, this is what was key, when she gave the subjects a completely unrelated task they were indeed able to transfer those improvements in cognition to the other task!

This finding showed that their overall cognitive ability improved thus it is possible for our thinking to improve therefore our intelligence can as well. Now that we know that Fluid intelligence is trainable this means that the more we train it the greater it becomes, it also means that anyone can improve their ability to think-intelligence-and that the tasks don't have to be represented in a test format in order to improve cognition.



1. Seeking novelty

Looking for new experiences and being open to them – this is good because new connections (synapses) are being made and built on in the brain – this is how the brain learns- because you are being exposed to new stimuli and new information. When your exposed to these new stimuli your brain dopamine is being released which helps to motivate your learning and aids to consolidate what you are learning.



4. Do things the hard way.

This often involves doing things the old fashioned way. Instead of carelessly typing an email or letter expecting autocorrect to help you out, turn off the autocorrect feature and pay attention to what you are writing. Instead of googling the answer to that question after 10 seconds of trying, stop yourself and give yourself more time to solve that problem. By allowing yourself not to rely on an external factor to help you think, you are forcing your brain to do its job and use its resources to help you out. This cause more synaptic connections to be made which leads to, surprise surprise, an improvement in cognition. Last but not least number

There are five principles that must be followed in order to maximize the training and its effect. It has summarised as such:

2. Challenging yourself.

Doing activities such as puzzles, crosswords, playing games are great, they are very good for training your brain, however once we've gained a mastery for such activities we start to hit a cognitive decline. Our mastery for that task remains for a while (depending on the task) but our improvement in thinking declines – as our brain has become to be efficient in doing the task and not being challenged. However, when you move onto a new task or onto the same task but with a higher difficulty, new synapses begin to form and your brain begins to learn again.



All these principles are major keys to improve your intelligence. They are ways of exercising you brain and its cognitively abilities so that you are always ready and prepared to handle any matter or situation, and are prepared to think 'intelligently'. When you make these principles a habit, you'll soon be the next Einstein amongst us. So to answer the question floating above, I reiterate my original reply: The answer is entirely determined by you.

3. Think Creatively.

Creative thinking has a positive effect on our brain, because it involves gathering information that we already know and trying to mix-and-match them with other, new or old, ideas and concepts. This mixing and matching and formation of links between ideas – leads to new synapses being formed which means more learning, and a smarter you!

5. Networking.

Social interactions are the last key to this puzzle. The role of networking is that is opens you up to the other four principles quite nicely. By having interaction with other people, be it in person or on social media, you are exposing yourself to new ideas, new concepts and new ways to approach issues, you are also challenging yourself by how you interpret those ideas – checking if they make sense with what you know – and encouraging yourself to think creatively, for example by thinking on the spot to defend your idea or concept.



Disproving Diets: What is Healthy and What is just Another Trend?

By Maddie Luke (K)

In recent years, there has been an enormous rise in the number of diet fads and healthy eating trends. They are impossible to escape from and many shops and restaurants are catering for wilder and wider dietary requirements every day, such as, vegans, fruitarians, and gluten-free.

As we all know every few months a new diet trend will appear, from Atkins (carbohydrate-free eating) to the Mediterranean diet. Some people are even having their ears stapled as a form of acupuncture to lessen their appetite. All of this is in the pursuit of weight-loss and a healthier lifestyle. But how much of it is actually healthy? We need to know that we are giving ourselves enough energy to live our hectic lives whilst providing us with all the nutrients we need.

In this article, the diet trend I am focussing on is the detox diet, which is a recent craze. Detoxes are diets that purge the body of processed sugar, alcohol, caffeine and salt. While this detoxification of the body makes you feel cleansed and healthy, there are negatives that people need to be aware of. For example, for people our age, our busy lifestyles require lots of energy.

Our physical, social and mental activity needs energy which comes from eating sugars

(both slow and fast release) and with our growing bodies undergoing reactions, the detox diet does not provide enough energy or nutrients for all of this to occur. This can lead to fatigue and dizziness due to nutrient deficiencies.

An extreme form of this diet is the teatox, which is very popular. This entails drinking tea, which contains senna leaf. Senna leaf is a non-prescription laxative used to clear the body and bowels. While this helps with weight loss, is it worth the possible side effects of stomach cramps and abnormal bowel function?

The advantages to this diet are that you become more aware of what you are eating so you will tend to eat more healthily. People think if it doesn't taste of anything, it must be healthy. Your cravings for salt and sugar decrease and the hunger for snacks fades. You drink more water, which is very important as all the body's functions run from water. As I discovered from a nutrition expert, if you become 5% dehydrated, this affects your academic and physical performance by 30%. Therefore being more aware that

you need to drink more is a positive aspect of the detox.

However, the detox really has no value in the long term as the body and its complicated structure contains all the organs and systems needed to cleanse the body such as the liver, kidneys, skin and digestive system. For these reasons, most people lose weight but as soon as you stop the diet, the body rebuilds its glycogen stores and the weight is replaced. It can also lead to unhealthy patterns of eating and people supplement their diet with extra vitamins, which are expensive.

I would recommend being more aware of what you are eating and to stay hydrated. If you cover all of the food groups and eat in moderation this will have the same, if not better effect on your lifestyle.



Your Mind's Mirror

By Valeria Orlova (D)

Do you remember the last time you saw someone hurt themselves and you suddenly felt really uncomfortable, almost experiencing the pain of the other person? Sympathy, empathy- all those feelings you experience are generated by mirror neurons in your brain.

In 1990s, Italian researchers were studying animal's brain activity during different motor actions. To do this, they used macaque monkeys, in whose brains they had implanted electrodes that detected neuron activity. It was discovered, that a certain pattern of electrical impulses was created in the monkeys' brains when they reached out for a peanut. What was most astonishing was that as the experiment later showed, the exact same patterns were detected in the brain of a monkey that was watching his ancestor grabbing the nut. A recent experiment by Christian Keysers had shown that in both monkeys and humans, the mirror system responds to the sound of actions as well. How

could this happen? Scientists did not have a clear answer then...

Mirror neurons are cells that become active when you are either doing something, or observing someone else executing the action.

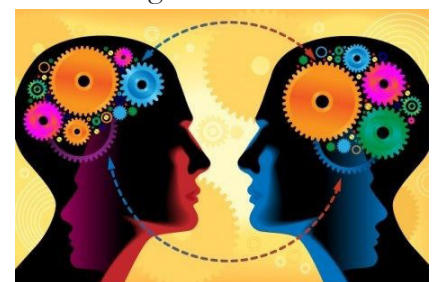
Mirror neurons are thought to be located mainly in the premotor cortex (a part of the brain involved in planning and carrying out movements), as well as several other regions of the brain. The precise role of mirror neurons is not yet clear to us, however it is hypothesized that they are involved in both understanding and predicting actions of others.

Mirror neurons are thought to have transformed the way we perceive social interactions, which include being able to understand others, sympathize for them, and being able to communicate using a language. Before the discovery, scientists believed that we used logical thought processes to interpret and predict people's actions. However, there is something peculiar about the range of actions that mirror neurons respond to- they seem to be designed to recognize actions with clear goals. Now scientists believe that we do so using feelings, simulated by mirror neurons. The mirror neuron system allows us to

decode facial expressions, making it possible for us to distinguish between a frown and a smile for example, and respond to them in a different way.

Scientists have investigated the possibility of there being a link between mirror neurons and autism, a neurodevelopmental condition characterized primarily by impairments in social interaction and communication. In an interview with the Scientific American, Marco Iacoboni, a neuroscientist at the university of California, had said that "Patients with autism have a hard time understanding the mental states of other people" as Iacoboni believes, mirror neuron dysfunction can explain many symptoms of autism, including difficulty in social interaction, as well as motor and language problems.

Research on mirror neurons still continues, as we have only just touched discovered the tip of the iceberg. Next time you cringe when someone shows you a gruesome injury or feel uplifted when a stranger smiles at you, bear in mind, you are reflecting their feelings!



Bacteria found to have resistance to 'Last Resort' Antibiotic

Benjamin Wan (F)

Overview of the Problem

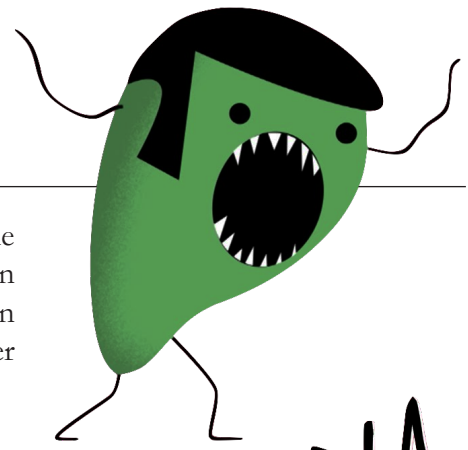
Bacteria have been found with resistance to an antibiotic called Colistin. This antibiotic is used as a last resort for people who cannot fight off severe bacterial infection or several infections.



In Pennsylvania a strain of Escherichia Coli, or E. Coli, has been found to be carrying a gene in the plasmid of the bacterial cell that causes it to become resistant to the drug Colistin. Colistin resistant bacteria has also been found in China, USA, Europe

and Canada. Altogether the existence of bacteria with Colistin resistance has been found in people, animals and meat in over 20 countries.

In China farmers are still using Colistin in food for their animals to prevent or treat bacterial infections. The gene found to cause the Colistin resistance was mcr-1. Although Colistin resistance was found in the chromosomal DNA of bacteria before, this was less of a threat than the resistance gene found in the plasmids of a bacterial cell. This is due to the bacteria's ability to transfer or swap plasmids to other bacterial cells. Now that mcr-1 is found in the plasmids of bacterial cells, this means that bacteria cells with mcr-1 can transfer this Colistin resistant gene to other bacterial



BACTERIA vs.

cells, which can cause a spread of resistance.

So what does this mean?

If the Colistin resistance gene spreads and becomes more abundant in bacteria, this will mean common or routine infections normally treated with common antibiotics will become harder to treat. Overuse and prescribing too much antibiotics means the bacteria are evolving to become resistant to the antibiotics.

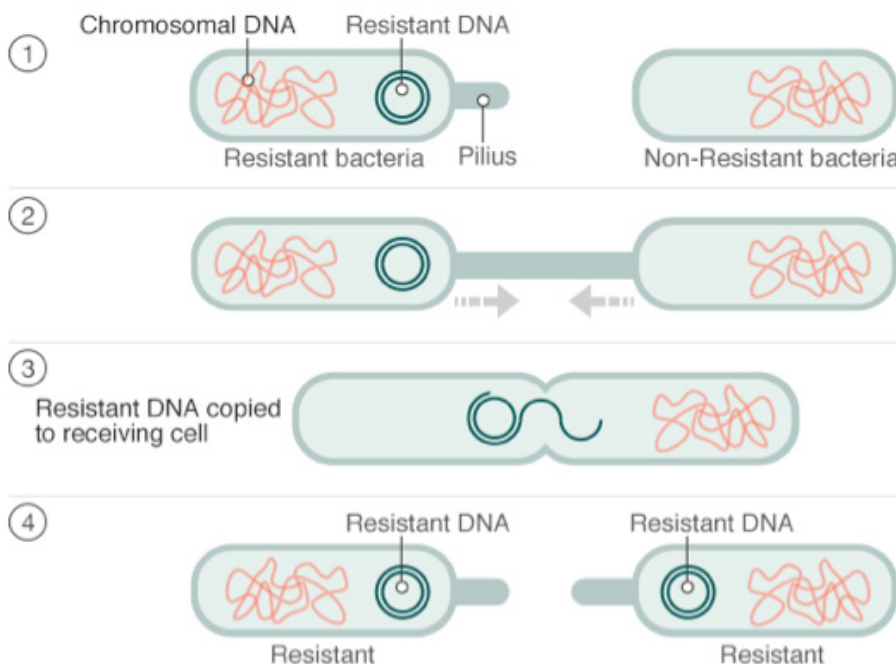
The increasing abundance of antibiotic-resistance bacteria not only means we cannot treat common infections as easily but it also means we cannot do large scale operations such as bone surgery, or any surgery that leaves people vulnerable to infection; this also includes certain cancer treatments. Running hospitals and intensive care units will also become increasingly difficult. It is estimated that by 2050, over 10 million deaths will occur due to anti-microbial resistance.

Deaths

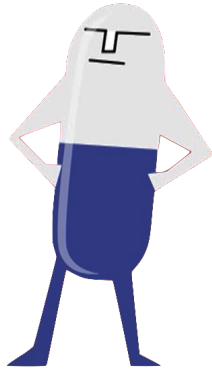
North

Source:

How antibiotic resistance spreads



ANTIBIOTICS



Possible Solutions

One way to reduce antibiotic-resistance in bacteria is to reduce the amount of antibiotics given out or prescribed, and reduce antibiotic or Colistin use on the farm. Another way is to use a combination of two techniques. The first technique is to use faster diagnostic tests and through this we can determine which antibiotics to prescribe.

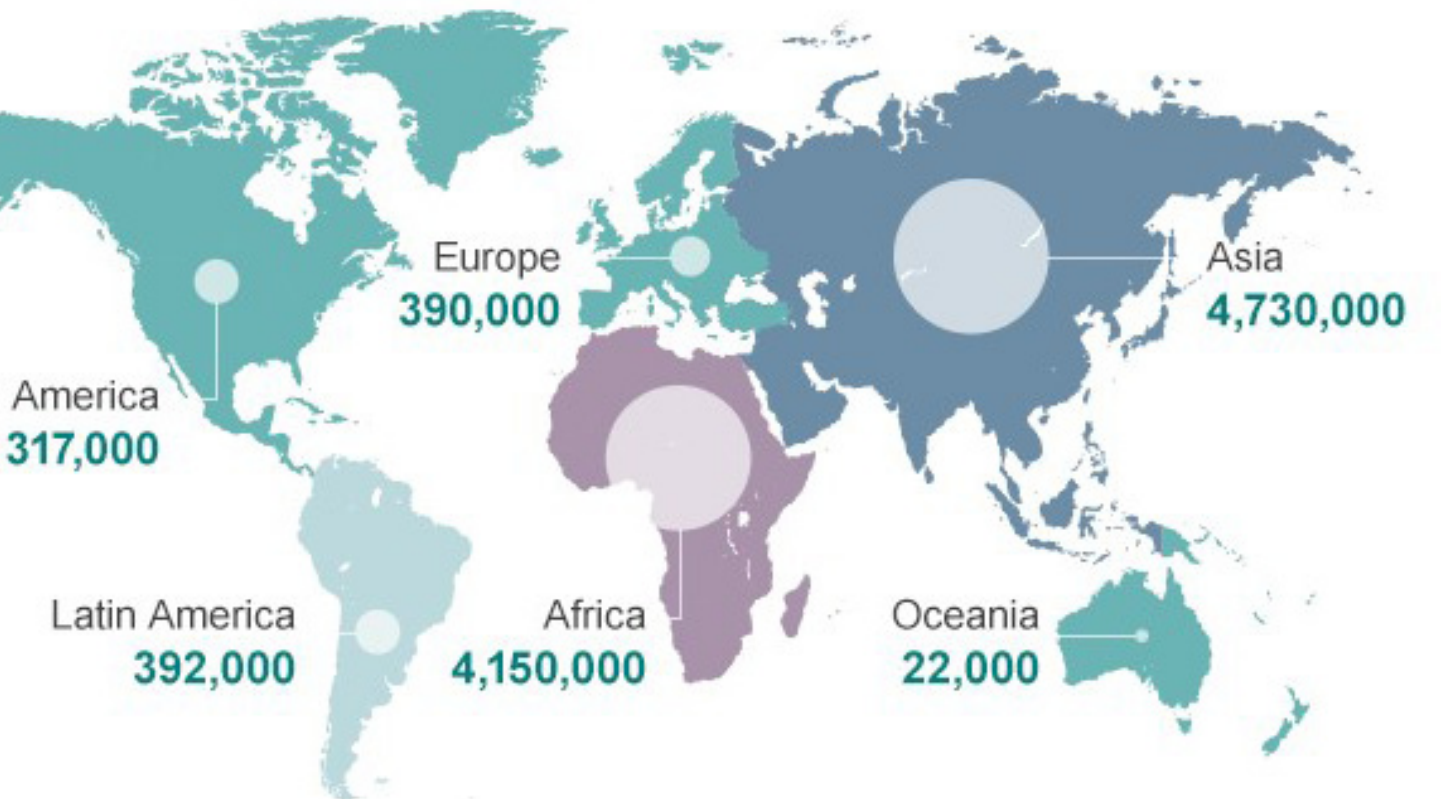
This leads on to the next technique which is to not give out inappropriate antibiotics such as those which will not have any effect on the infection due to the infection being viral and not

bacterial.

Another way of possibly solving this issue is by developing new drugs however, this solution takes a long time as clinical trials can take a long time and the whole process can take upwards of 18 years. There have been studies and research into bacteriophages. These are viruses that inject their DNA into bacteria and use the bacteria's 'machinery' to produce copies of itself. Scientists are trying to remove the harmful effect of the virus and use the virus to attack the bacteria instead of our cells.



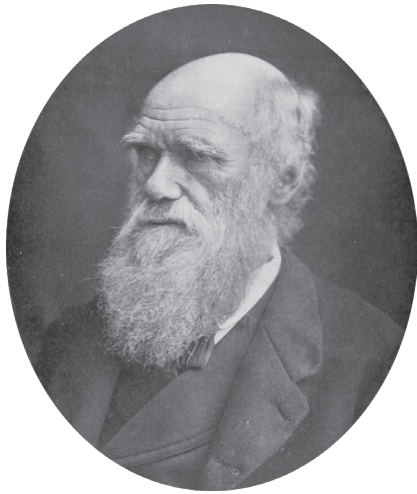
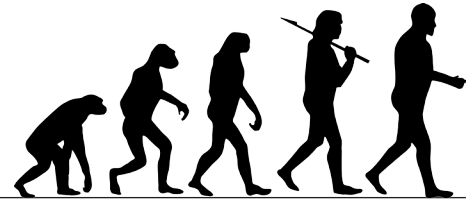
attributable to antimicrobial resistance every year by 2050



Review on Antimicrobial Resistance 2014

The Evolution of the Evolution Theory

Cerelia Caesar (D)



Darwin's insights about evolution and the diversity of species has retained its importance to this present day. However, since the publications of his work there has been huge biological discoveries and new ideas have emerged offering new theories and problems to understanding the natural world around us. Some of these new discoveries and ideas go against the 'selfish gene theory' and propose that organisms are in control of their lives, not their genes; the organisms themselves play a role in their own development and that of their descendants.

Hundreds of species inherit knowledge from their parents. This inherited knowledge is known as cultural inheritance; this natural phenomenon helps species survive as well as creating resemblances or connections between even unrelated species. However, despite the fact that genetic information and inheritance does effect the development of an individual

specie, it is not the only factor.

The environment has a direct impact on an organism as the organism's immune system and nervous system adjusts to its surrounding environment and the potential dangers while it is developing (meaning it continues to evolve after its genetic material has already been determined). Several experiments show that organisms exposed to new environments develop characteristics that are similar to those of related species adapted to the same environments. This implies that organisms are in somewhat control of their own lives and of determining, which features and characteristics to show or use.

A new idea or theory titled developmental bias suggests that specific characteristics can develop more easily than others, contradicting the previous theory of genetic mutation occurring at random. This opens up a new possibility that the diversity of life may not only display the survival of the fittest, but also the arrival of the 'frequent-est'.

A study of cichlid fishes in Lakes Malawi and Tanganyika in Africa showed that the species from one lake had many similarities in body shape with different species from the other lake, regardless of the fact that they were more related to species inhabiting their own lake. This shows that organisms may engage

with the establishment of their own permanent characteristics as they can determine, which characteristics suit them (and are most useful) and their environment best.

Therefore, they create some of their own conditions of existence, which in turn influences their own evolution. This also shows that developmental plasticity (changes in neural connections during development as a result of interactions with the environment) may be a critical factor in determining adaptation and speciation.

This is an exciting time for evolutionary biologists, who can deduce many things about evolution from these new findings. Earlier this year, an international group of 50 biologists and philosophers from eight different universities declared a new research programme to investigate the consequences of developmental plasticity and non-genetic inheritance among others.

The prospect of organisms having a primary role in their own evolution and the indication that the course of evolution does not depend on selection alone goes against the mainstream theories of evolution, and forces us to question and look into the cracks of some of Darwin's theories about evolution and the diversity of life.

In Vitro Fertilisation

Huda Khalaf (J) + Danielle Lim (J)

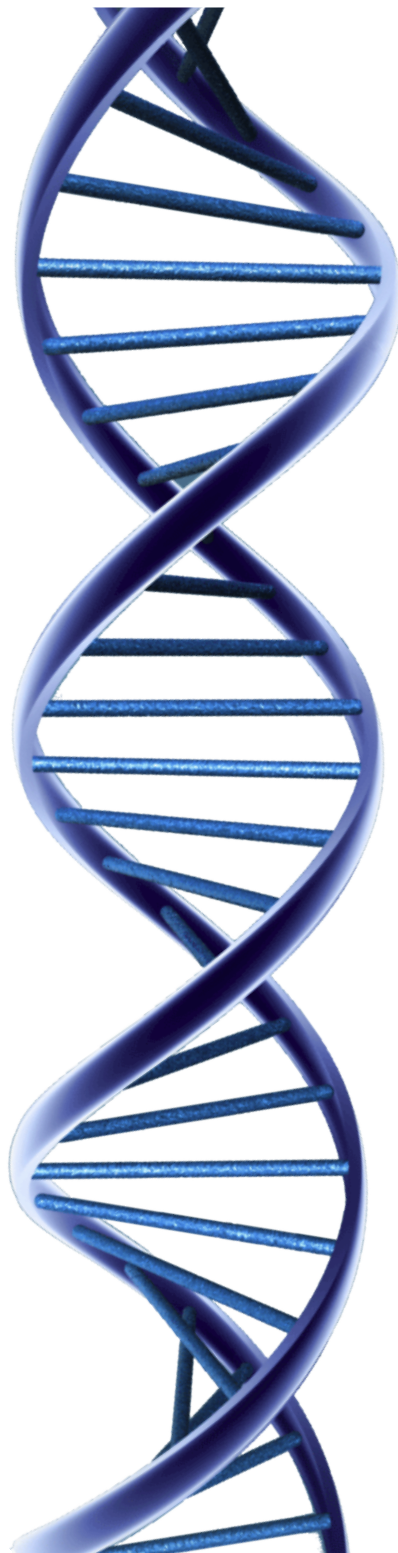
In Vitro Fertilisation (IVF) is the procedure in which the woman's ovary is removed and joined together with a sperm cell through a laboratory procedure. The fertilised egg is then returned to the woman's uterus where it develops into a foetus. IVF is a very controversial topic within the scientific community which can often be scrutinised by the poor outcomes of the procedure and groups such as the Catholic church.

Pro In Vitro Fertilisation

In Vitro Fertilisation is one of the most significant procedures to have ever been developed in science as it allows for a man and a woman to share a special bond in the form of a baby. It is also important to note that it allows for same sex couples and single women to have children and it is especially advantageous as it helps people who are otherwise unable to conceive a baby, achieve this dream.

With a high success rate of 40% and a track record of being safe, it is clear as to why the procedure has been used for decades. Due to technological advances, IVF is constantly being refined to make it safer and more successful, only the safest drugs are used to ensure that the side effects are minimal and harmless. It can help contribute to population growth for countries with a population deficit as it was reported in 2013 that a total of 5 million babies were conceived through IVF, a number that is still growing today.

IVF can also be used to diagnose fertilisation problems which can only be diagnosed after fertilisation is attempted in the laboratory, this is a less known use of IVF but one that is equally important. A number of times, there are unused embryos from IVF which can be donated to other parents, used for research purposes or even save lives.



Against In Vitro Fertilisation

Although there are many positive aspects of In Vitro Fertilisation, there are also many disadvantages. IVF is a very expensive, the standard IVF package can cost £3800, according to the fertility centre in Southampton. This is a lot of money considering that at the moment on 25% of IVF cycles result in live birth.

Furthermore, there are many ethical issues that need to be addressed as well. When doing the IVF treatment multiple embryos are created. However, not all can be implanted into the uterus so many are either discarded or donated to labs where they may be tested on. For many religions such as Catholics it can be seen as inhumane as they believe that life begins at conception therefore by discarding the embryos we are killing a potential life. However, even if you can come to terms with these problems, there are more. Around 20-30% of IVF pregnancies result in multiple pregnancies. This is because there is often more than one embryo implanted at one time. Although the idea of having multiple pregnancies may sound positive, especially if you have been struggling to have a child, it is not. This is because multiple pregnancy poses many health risks to both the child and the mother. For example, there is an increased chance of premature labour, miscarriage, need for a caesarean, stillbirth and infant health problems.

The History of Malaria

Jasper Lai (H)



I am Chinese, and I am really proud of a female scientist called Tu Youyou. She won the 2015 Nobel Prize in Physiology or Medicine due to her research on malaria.



Tu Youyou

Malaria is a global disease that causes 650,000 deaths per year, 90% of which are in Africa. About 50,000 years ago, the protoctist that causes malaria, plasmodium falciparum, evolved. Malaria was blamed for the decline of Roman Empire so it was known as “Roman Fever”. Romans associated the disease with the swamps, but had not realized that marsh provided an ideal place for the reproduction of mosquitos. The mosquito is the living vector for plasmodium. There is some information from ancient Chinese books indicating that malaria had been a common disease from over 2,000 years ago in China.

In 1880, Charles Louis Alphonse Laveran was an army doctor working on malaria. He

observed that there are lots of parasites in the red blood cells of people who had malaria. According to his observation, he suggested that the parasite was the organism causing malaria. Laveran won the Nobel Prize in 1907 due to his fantastic observation.

In 1894, Scottish physician Ronald Ross pointed out that the mosquito is the vector for malaria in humans. First he let the mosquitos bite the malaria-infected birds. Then he isolated the malaria parasites from the



Ronald Ross

salivary glands of mosquitoes. For his work, he received the 1902 Nobel Prize in medicine. The first effective treatment for malaria came from the bark of cinchona, which is from South America and contains quinine. In about 1940s, chloroquine replaced quinine as the primary drug for malaria treatment.

However, chloroquine-resistant malaria soon appeared in South East Asia and South

America in the 1950s and then globally in the 1980s. But luckily in the 1970s, a Chinese scientist Tu Youyou discovered artemisinins which came from the plant *Artemisia annua*. Her inspiration was from a traditional Chinese medical book which was written in 1596 by Li Shizhen who was a wonderful doctor in Chinese history. It became the recommended treatment for severe malaria.

After realizing that the mosquito is the vector of malaria, people hoped to reduce or control the number of mosquitos, therefore reducing the spread of malaria by spraying DDT. DDT was invented to kill mosquitos but it was soon used in the agriculture industry to eliminate other insects which destroy crops. In the 1960s, people realized the huge harm of using DDT. DDT does not harm humans, but this is not the case for other organisms. Most scientists believe that the American Bald Eagle, an apex predator, is dying out because the DDT is not biodegrade so it accumulates up the food chain.

Antarctic penguins have been seen to be struggling for the same reason. With this evidence, most developed countries have already banned DDT. However, in some African countries, DDT is still used today because malaria still poses such a huge health risk.

Hepatocyte Transplants

Chase Flynn (E) + Elsa Robinson (N)

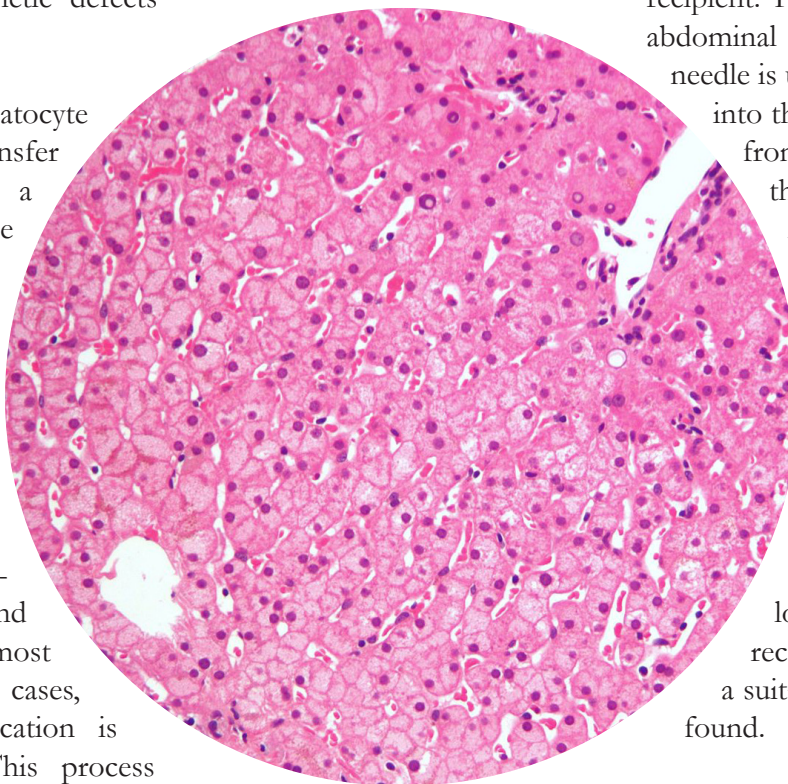
Conditions that affect the liver's ability to function can be extremely difficult to treat, and often lead to a full liver transplant being required if liver function is not regained. Conditions that can be treated with a hepatocyte transplant are mainly ones leading to acute liver failure, although there are some genetic defects that can be cured.

A hepatocyte transplant is the transfer of liver cells from a donor liver to the abdominal cavity to achieve some basic liver function in a patient with liver failure, without the need for surgery.

This is currently a last-resort procedure, and is only used in the most complicated of cases, as risk of complication is intolerably high. This process is being refined and has some significant advantages over full liver transplant; no need for immunosuppression, negligible recovery time and multiple patients can be treated using a sub-prime donor liver. If approved, the process is as follows: Firstly scientists acquire a donor liver and using collagenase, dissolve the intercellular membranes which provide the structure of the liver.

Next, the cells are then

transferred in the progressively more aseptic (sterile) laboratories where they are prepared for transplant. The laboratories are a thousand times more sterile than even an operating room, as numerous air filters remove all particles in the air. This is because even a single bacterium



would contaminate all of the donor hepatocytes, killing them. Every 3 days, the entire room is soaked in hydrogen peroxide, and before touching anything, all instruments are irradiated, then soaked in pure ethanol.

In order to function inside the abdominal cavity, the cells are forced into a sterile mist and targeted at alginate: a gel that protects the cells from the patient's immune system.

The alginate provides protection and nutrition for the hepatocyte cells which will allow the cells to continue their vital processes for liver function. Required cells are prepared for insertion to the abdominal cavity by altering the pH, salinity and temperature of the cells to match those of the recipient. For insertion into the abdominal cavity, a large bore needle is used to inject cells into the hepatic portal vein, from which they implant themselves into the liver.

This procedure usually results in as regeneration of around 10% liver function, and although this seems low, it is sufficient to keep the patient alive long enough for either recovery of their liver, or a suitable donor liver to be found.

Cell diagram above:
Intermediate magnification micrograph of ground glass hepatocytes, as seen in a chronic hepatitis B infection with a high viral load.

Maybe life doesn't require light after all, could this mean a greater chance for finding alien life?

Max Ogden (F)

Many of us believe that all life as we know it relies on the sun either directly when organisms photosynthesis or indirectly through the food chain. For instance, plants are obvious examples of an organism that relies on the sun directly. Plants are producers meaning they're at the very base of the food chain. Their chloroplasts convert carbon dioxide and water into glucose and oxygen. Further on up the food chain if we look at a primary consumer, for example a fish. This is a living organism doesn't rely on the sun directly but indirectly as it ingests plants which rely on the sun for growth, therefore the fish would not exist if the vegetation hadn't existed, and that wouldn't have existed without the sun, therefore more indirectly relies on the sun for its existence. So therefore as all organisms essentially rely on their food supply via the food chain, and as the food chain is reliant on plants everything relies on the sun to be alive. However a species of animal has been discovered which doesn't rely on the sun in any way, but feeds instead using chemosynthesis.

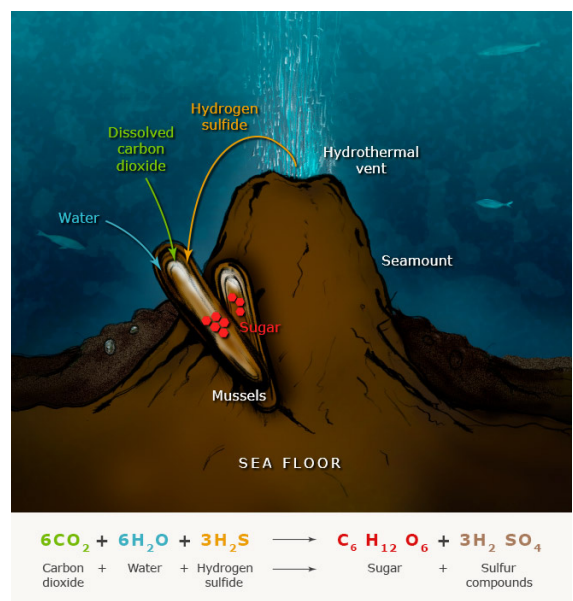
Chemosynthesis is unlike any other way of feeding. A form of feeding deep within the abyss of biochemistry. Instead of living organisms using sunlight to produce organic matter such as glucose, they use the oxidation of inorganic compounds taking hydrogen as an example as a source of energy in order to

convert molecules containing carbon into organic matter. Which is used for growth and respiration of the organism. This awe inspiring concept has been seen used by multiple organisms, primarily discovered in the 1970's when divers in the Galapagos observed swarms of giant tube worms, clams and other such organisms crowding around an undersea volcanic vent. Therefore the very fact that they were huddling around a volcanic vent.

The fact that they were huddling around a volcanic vent, not only suggests that they're feeding using chemosynthesis, but that they don't rely on sunlight at all but hydrogen containing compounds bubbling up from the earth's interior.

How could this insightful and innovative discovery actually contribute to the field of astrobiology? Blatantly, the fact that water, a carbon containing molecule and a hydrogen containing molecule is all an organism may need to respire, grow and carry out living functions, suggests to us that places we thought would be barren and lifeless, now have a possibility of supporting chemoautotrophs.

Chemoautotrophs are organisms that feed using this technique, by oxidising inorganic molecules and transforming carbon containing molecules into food. Thus expanding our horizons for searching for extraterrestrial life. For instance, there may be life under Mars' surface, where evidence suggests there could be liquid water and furthermore gases from Mars' interior. However a more likely environment would be Jupiter's moon Europa, as Mars is geologically inactive. Europa may have liquid underneath its surface, due to the fact it has ice at its surface, and could well be geologically active, thus being a possible environment for chemoautotrophs.



Above: Chemosynthesis



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