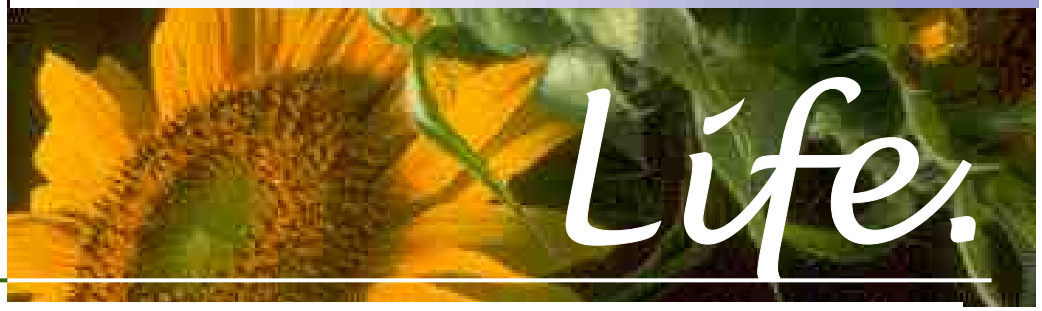
Issue 3

The special 'double feature' issue. Two in-depth articles inside this copy of Life.

The Sutton Grammar School Biology Magazine



Telomeres

The key to immortality?

By Niall Igoe to and Saravanabavaa Vjayakumaraguru.

What is a telomere?

During the process of DNA replication the end of the DNA strand is not copied and as a result its genetic information is lost in future cells. So that the cell does not lose vital genetic information during mitosis DNA has evolved so that there is a sequence of DNA bases at the end of the chromosome called the telomere. The telomere is and can be lost without serious damage occurring.

Telomeres and Cancer.

Most cells can only replicate a certain number of times before they die. Most cells die once their telomere starts to run out. The number of times that they can replicate before they die is called the Hayflick Limit (most cells can replicate around 50 times).
Some people believe that the Hayflick limit is in place to prevent mutations which can lead to heart attacks among other serious ailments including cancer

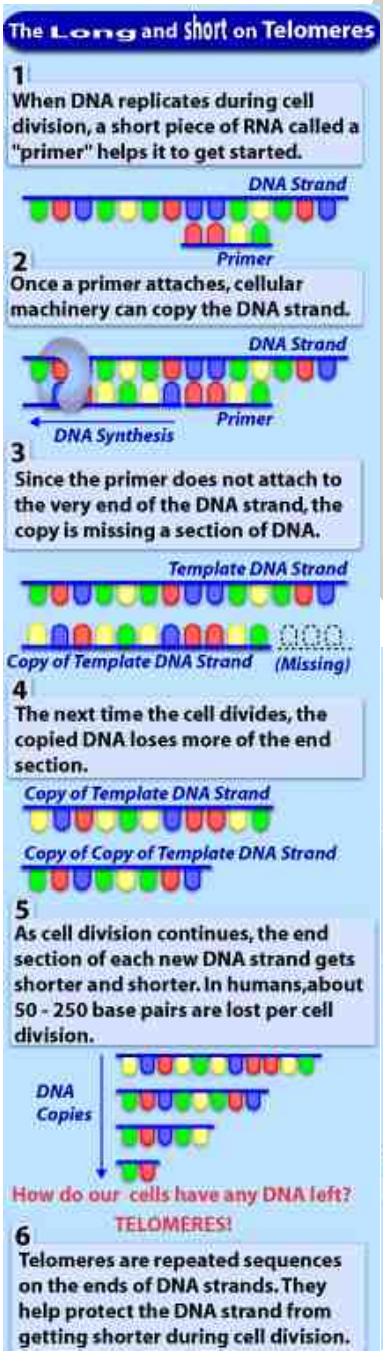
The role that telomeres play in cancer is not yet fully understood, however scientists although telomeres are known to play a key role. In normal cells as they age the telomere shortens and they eventually die. However to avoid dieing it can activate an enzyme called telomerase which can lengthen the telomere. When a cell activates its telomerase it is said to become cancerous.

Active telomerase has been found in a variety of cancers from pancreatic to prostrate cancer. Logically because of the presence of the enzyme in so many cancer cells many scientists are trying to develop ways of inhibiting it from working. However stopping the telomerase is known to have several side effects, most notably stopping the production of red blood cells. Telomerase inhibition is currently one of the biggest areas of research into stopping cancers with drugs, one of the most promising is currently telomestatin.

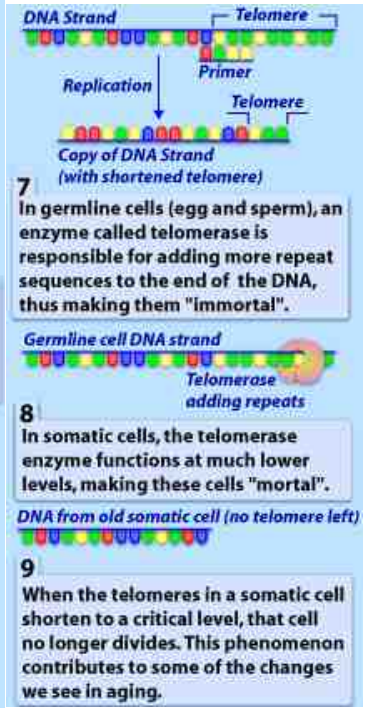
Telomeres and Immortality

Telomeres, because of the role they play are reduced in length, as a person grows older. In a baby the average length of the telomere is approximately 10,000 bases long, but by the time a person is 100 this figure is reduced to just 5000 bases. The reason why this happens is because in a young cell there is enough telomerase (an enzyme that produces telomeres) to replace telomeres that have been lost, but as the cell multiplies there is not enough telomerase to replace the telomeres that have been lost in division. As the telomere length in cells decreases these cells begin to lose genetic information, it is because of this that some scientists say that a person ages. factor equivalent to approximately 100 years in humans.

Telomeres are known to be very important to human life, whether they cut short your life through cancer or end it because of a heart attack. With this in mind there are many scientists currently researching telomeres and telomerase, whether it has to do with cancer or aging. Regardless of the topic there is some debate going on as to whether telomeres might be the first viable answer to immortality.

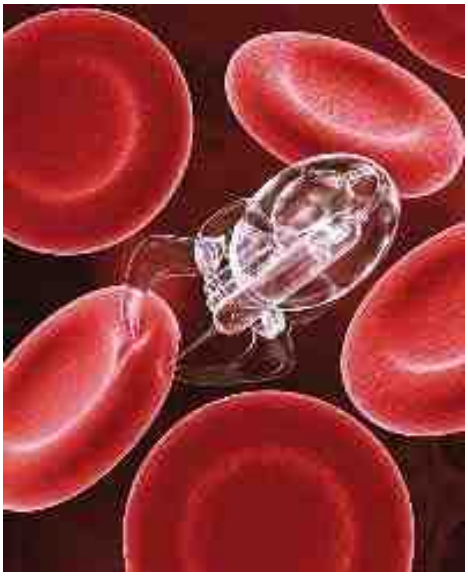


Inside This Issue of Life.



Microscopic Robots

The future of medical treatment?



A prophecy of the potential size of the technology

By Carl Alexander

At the moment, tiny robots that are small enough to enter the human body are being developed by some of the world's top scientists. They are planning to develop these microscopic robots so they can be put to a variety of uses such as: treating cancer, drug delivery and also the growth of new cells and tissues.

Surgeons are often troubled by performing microsurgery on certain parts of the body e.g. to repair blood vessels. Owing to the intricacy of these operations, they are often avoided because they can lead to further problems. This is why all doctors are now in favour of using nanotechnology to design controlled robots, the size of a grain of rice that can travel through the body.

In Japan at Tohuku University, an electrical engineer called Kazushi Ishiyama and his workers have developed a tiny spinning screw that is capable of swimming through veins in the body. They have the ability to possibly, burrow into tumours to kill them or to deliver drugs to a specific organ or tissue. Because of their size, these robots can be injected into the body with a standard hypodermic needle and could be magnetically steered through the body using a 3D magnetic field supply and controller. Many believe that this will be a breakthrough for operating on brain tumours since they are particularly difficult to remove.

Other researchers are creating micro-robots that will not need to rely on a magnetic field but will be powered by a tiny motor so they can swim through the body and help to diagnose and treat various conditions. Dr. James Friend of Monash University in Australia and his team have already built a motor the size of a salt crystal and are now working to create a smaller one that shall be the same size as the width of two human hairs. The mechanism used to propel it will be based on the E. coli bacteria's propulsion system. It will have numerous flagella (tail-like strands) attached to a rotating motor that will rotate them around their axis, and if it is in a liquid, it screws its way through the fluid. The motor will be made to spin 100,000 times a second.

A Window to the Soul?

By Alex Robinson

Can you really tell what a person is like by their eyes? Well scientists and researchers think they know the answer.

Scientists and researchers have now found patterns in the Iris, which could suggest what type of personality a person has ranging from how warm and trusting they are to whether they are spontaneous or neurotic (anxious).

It is now argued that the eyes and personality may be linked because the genes responsible for the development of the iris also play a role in shaping part of the frontal lobe of the brain, and this is what influences someone's personality.

The study looked at three features of the iris: the crypts, wavy threads that radiate from the pupil; furrows, the lines curving round the outer edge formed when the pupils dilate and contract; and the dots of pigment.

The results show people with densely packed crypts were more warm-hearted, responsive to their inner feelings and likely to sympathise with others. The furrows are associated with urges. People with more furrows may find it less easy to control cravings and are more impulsive. The scientists found no link between the pigment dots and personality traits.

The researchers argue that as much as 90% of the differences in people's irises are due to genetic variation. The basis of the association between the iris and personality lies with the Pax6 gene, which is linked with tissue growth both in the iris and the brain. Specifically, Pax6 is implicated in development of the anterior cingulate cortex, a brain region involved in positive emotion and self-control. When reaching the conclusion that they did, they used previous research, which has also shown that a mutation of PAX6 is linked to impulsiveness and poor social skills.

Number Crunch

2 meters

The length of all DNA end to end in one human cell.

1×10^{-7} m

The diameter of the nucleus into which it is all packed.

Did you know…

The kidneys filter up to 50 gallons of blood in just one day!

Heart Disease

The 'epidemic' that's hit the UK

A bypass operation on a patient suffering from heart disease

By Parrthiepan Visvaratnam

Heart disease is costing the UK economy £29billion a year and researchers say the situation looks set to get worse. The NHS spends a fifth of its budget on treating this condition, which is more than any other EU country. Poor diet and rising obesity levels are driving the costs higher. The researchers from the University of Oxford added up the cost of heart disease and they found that the cost to the NHS was £15.7billion, and drug treatments were £2.8billion.

There is a difference between a heart attack and a stroke. A heart attack occurs when the blood supply to part of the heart muscle is severely reduced or cut off altogether. Symptoms include chest pain lasting, more than a few minutes, pain in the arms and neck, sweating, shortness of breath and lightheadedness.

Coronary arteries are responsible for supplying blood to the heart muscle. Approximately the size of a clenched fist, the heart is a living pump that supplies blood to all parts of the body. However, the heart muscle itself requires a generous amount of oxygen, which is transported in the blood.

Blockage in the coronary artery is sometimes caused by the buildup of atherosclerotic plaque. In other cases, a blood clot becomes lodged in the artery. When a blockage occurs, the flow of oxygen-rich blood is interrupted. The area of the heart muscle that the artery had supplied is damaged. The severity of a heart attack is determined by the duration of the blockage and how much of the heart muscle is damaged.

A stroke, however, occurs when the brain's blood supply is disrupted, starving the brain tissue of oxygen and nutrients. Brain cells begin to die within minutes after the blood supply is cut off. As a result, damaged brain cells are unable to send signals to other parts of the body, often resulting in disability or paralysis. Unlike heart attacks, strokes give few symptoms and little or no warning.

There are many types of stroke, for example; the ischemic stroke (blood clot); this is when plaque builds up in the artery (atherosclerosis), which can roughen and narrow the inside of the artery wall. This change in the surface of the wall encourages the formation of a blood clot, or thrombus. A thrombus often occurs in a carotid artery leading from the heart. If the blood flow is blocked, the part of the brain fed by the artery may be damaged.

Another example is the hemorrhagic stroke (ruptured blood vessel); hemorrhagic stroke occurs when a small artery in the brain ruptures. High blood pressure can weaken blood vessel walls, resulting in a hemorrhage in which blood leaks to the surrounding brain tissue. In addition, brain cells deprived of nutrients are damaged.

Furthermore, disability depends on which side of the brain is affected by the stroke. Your brain is divided into right and left hemispheres, with each hemisphere controlling the opposite side of the body. For instance, if a stroke occurs in the brain's left hemisphere, the right side of the body may suffer paralysis.

The risk factors include: high blood pressure, which weakens vessel walls, making them susceptible to hemorrhage; smoking, which encourages the formation of blood clots as well as plaque buildup and increases blood pressure; diabetes, which increases the buildup of fatty deposits and interferes with blood clotting; and finally high cholesterol, this is because high low-density lipoprotein (LDL) blood levels increase the risk of atherosclerosis.

So how do we prevent heart disease? There are several preventions however these depend on monitoring and modifying certain risk factors. These risk factors are inter-related; so if we make moderate changes in one area of life, we may reduce other risk factors at the same time. Check your blood cholesterol levels from time to time (especially adults); according to the (NCEP) National Cholesterol Education Program guidelines, if your cholesterol level is greater than 240mg/dL (or if the level of "bad cholesterol" (LDL, low-density lipoprotein) is above 130mg/dL) immediate measures should be taken to lower it. If you can't lower your levels through diet alone, medications can help. Lipid- and cholesterol-lowering drugs such as statins can reduce the rate of progression of coronary heart disease and also reduce repeat heart attacks. They work by lowering cholesterol and modifying the inner lining of your arteries.

Eating a well-balanced diet is essential for anyone; not only does it help control cholesterol level but weight as well. You should avoid eating large amounts of fat and cholesterol in your diet because these can accelerate the progression of hardening and clogging of coronary arteries. As a result, you should limit the amount of fast food you eat. Although there are some who say this may not be convenient, you will definitely benefit in the long run.

Alcohol should be consumed in moderation. Although some research suggests that alcohol can help protect against heart disease, limit your intake to 1-2 drinks per day. Larger amounts can increase blood pressure, cause heart rhythm disturbances, and damage the heart muscle or liver.

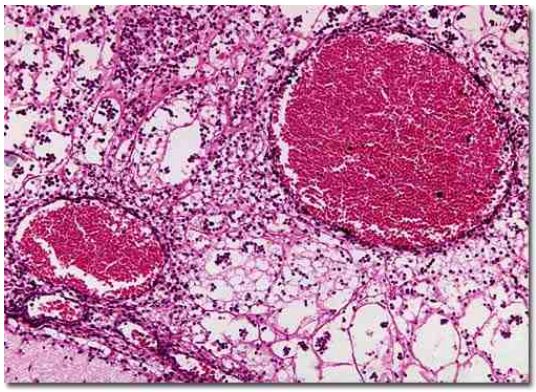
Quitting smoking, if you do smoke, is the single best lifestyle change you can make. Passive smoking, smoking cigars, or chewing tobacco are also dangerous.

Exercise helps to lower the blood pressure, increase the level of "good cholesterol" (HDL, high-density lipoprotein), and control excess weight. Start slowly if you need to, but try to reach the goal of at least thirty minutes of endurance exercise 3-5 times a week. (Such exercises include walking, swimming cycling and aerobics.)

Finally losing extra weight, if necessary, will help because being overweight puts extra strain on the heart and blood vessels. A high-fibre, low-fat diet and regular exercise can help lose weight. Avoid "diet pills", as some of these have been found to cause heart valve disease and other dangerous conditions in some users. Moreover, "natural" weight-loss products such as ephedrine can be very dangerous.

‘Meningitis Enzymes’

By David Crowhurst



The bacteria Neisseria meningitidis

A study has found two enzymes present in the human body which prevent the body from successfully fighting off meningitis viruses. These viruses work together to hamper the white blood cells which try to prevent the virus itself, by altering the DNA of the meningitis virus, preventing the damage done so helping the virus attack the body.

The research team found that the two enzymes, AP endonuclease and 3-phosphodiesterase, when repairing the virus alter the DNA in separate ways.

Professor Paul Freemont from the Imperial College’s division of Molecular Biology, said, ‘our research has now demonstrated that the ability of meningitis to repair its DNA is important for its ability to survive attack from the body's immune system. This work provides an insight into the precise roles of two enzymes in mending DNA and gives us a greater understanding than ever before into why these infections are so hard for the body to fight.’

The team made the discovery by examining enzymes that cut the

DNA of a meningitis virus. Instead they found the two enzymes which help the virus itself. This finding may help scientists find out methods of DNA repair in so advancing medical technologies.

Sport Science

Samuel Eto’o’s Knee injury

By John Gorringe, Adam Gillis and George Butcher

Samuel Eto’o, Barcelona forward and African Footballer of the Year for Cameroon, injured his knee in Barcelona’s Champion’s league clash with Werder Bremen. In September 2006 at the Nou Camp, Eto’o pulled up in the 65th minute of the game and asked to be substituted, having to be stretchered off. Surgeons began exploratory surgery on his knee and discovered that he had torn a cartilage. This same injury accounted for 12% of all injuries in the Premiership in the season 04/05. Although it was expected that he would be out of action for 2/3 months, the usual for this injury, Eto’o didn’t make a return until 5 months later.

Now for the science behind the injury. To start with, you need to know that although the injury is known as tearing a cartilage in the knee, the actual part that is torn is the menis-cus. There are 2 found in each knee and they are made from tough fibrocartilage. They are specifically found in between the thigh and shin bones and if when the knee is bearing weight it is twisted, the can become jammed between the bones. If the force is even stronger, the menisci can be ripped. This can lead to knee swelling and make joint movement fairly difficult. The knee can also buckle and give away and needs to be treated by physiotherapy or maybe even surgery.

Samuel Eto’o received surgery on his injury and made his return to the team in Barcelona’s 0-0 draw with Osasuna on 4th February 2007.

Brave New World

A Scientific Prophecy?

By Dominic S-Brown

Aldous Huxley’s seminal novel was published in 1932 yet the world it warns of is perhaps more like modern society than we would like to think. It tells of how, in a post-apocalyptic future, the ‘World State’ controls humankind by keeping it in a perverse state of drug assisted contentment and devoid of original thought. Sexual promiscuity is not only encouraged; abstinence is regarded as abnormal and dangerous. Despite this, the idea of natural (viviparous) birth is anathema to this ‘Brave New World’. Rather, Huxley cannily foresees the use of the contraceptive pill 20 years before its development and has his characters carry a large supply around with them. Identical embryos are cultivated in their thousands in ‘hatcheries’ using the fictional ‘Bokanovsky’s technique’. In a basic and probably accidental foreshadowing of genetic engineering, they are then physically conditioned to determine what their intelligence, occupation and social class shall be. They are also taught to associated stimuli with certain emotions to prepare them for their vocations – a type of Pavlovian therapy. On ‘maturation’, babies are brainwashed (tactfully called ‘sleep-learning’) techniques, instilling in each the World State’s maxims. The only thing that differentiates people is their societal caste, ranging from the superior Alpha-Pluses to the grunts that are the Gammas and Epsilons. Earth’s people are happy, healthy, law-abiding and happily buy products to sustain the booming economy. Books are outlawed but ‘individuals’ can make use of the time’s extraordinary technological advances and enjoy a round of mindless ‘electromagnetic golf’. Furthermore, death is delayed to near non-existence with frequent replacement of vital enzymes. Huxley implicitly asks how similar this world’s conformity is

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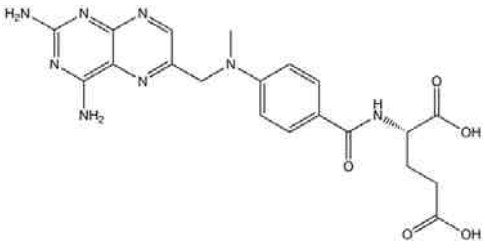
Molecule of the Fortnight - Methotrexate



By Richard Morris

Methotrexate ($C_{20}H_{22}N_8O_5$) was developed in the 1940's by the drug company Lederle after experiments by Sidney Farber in treating cancer with folic acid. It is used in chemotherapy as treatment for cancer.

It is useful for this purpose because it interferes with the action of enzymes normally responsible for replicating DNA. This means it can be used to prevent cell replication in tumours, thus preventing the tumour from expanding.

Methotrexate is an example of an irreversible enzyme inhibitor. This means that in preventing these enzymes from working, it also destroys their active site. Normally with this type of inhibitor, the chemical bonds strongly to the active site of the enzyme, and modifies it such that it can no longer perform its usual task. Other enzyme inhibitors are reversible, and bond by other methods to the enzyme, so neither undergoes a chemical change.

There are three ways that reversible inhibitors can affect enzyme action. Competitive inhibitors bind to the enzyme's active site instead of the substance the enzyme would usually affect. The normal substance then cannot be processed by the enzyme. Mixed inhibitors can bond to the enzyme at the same time as the normal substance, but affect the bonding so as to prevent processing from occurring properly. Finally, non-competitive inhibitors do not affect the normal substance, but instead change the action of the enzyme itself.

Irreversible inhibitors react with the active site of the enzyme and make it useless for its normal task. Unlike reversible inhibitors, which can be removed through dilution, irreversible inhibitors affect the enzyme permanently.

Methotrexate prevents the synthesis of a chemical in the chain of reactions used to replicate DNA, RNA, and proteins. This means it can prevent cell from replicating. It is technically a reversible inhibitor, and acts through the competitive method described above, but binds so strongly to its relative enzyme that it is essentially irreversible.

Brave New World Continued...

to our own; are we becoming an unimaginative society pacified by narcotics, consumer goods and sex, however advanced we may be?

Comparisons can be drawn to the better-written '1984'. The question is posed: which dystopia is worse; one controlled by misery and fear or one where its inhabitants have ignorant joy forced upon them? As a book, 'Brave New World' is quite poor, with characters being shallow representations of concepts rather than developed and expanded individuals This is because Huxley was not writing about individuals but predicting the future of society as a whole. Moreover, description of settings is neither substantial nor evocative. Conversely, Orwell uses the plight of his protagonist to more effectively convey the horror of a potential police state. Nonetheless, Huxley's story is apart from works that supersede it insofar as it portrays an ironic dystopia; one without suffering. What is so compelling about his 'Brave New World' is that it could be superficially considered a utopia, ignoring its absence of creativity, spirituality or any free thought.

That's Life. Take on the biology quiz

By Alex Robinson

1) Which animal can lift 50 times and pull 30 times its own weight?

2) In medicine, brachiotomy is the removal of what?

3) If all the molecules of DNA in a single human cell were laid side by side how far would they stretch?

4) What are/is pronephros, mesonephros, and metanephros?

5) What was Anatolepsis?

6) What does pneumonoultramicroscopicsilicovolcanoconiosis mean?

7) Can a goldfish survive in a thankful of blood?

8) How many times on average does the human eye blink?

9) True or false, Frogs eat their skin after they shed it?

10) What is the home of a squirrel called?

A fossil of the scales of a 500 million year old fish

1)The ant can lift 50 times its own weight and can also pull 30 times its own weight.
2) arm

3) If all the molecules of DNA in a single human cell were laid side by side they would stretch for 2 meters but it is all packed into a nucleus 10 millionths of a metre across.

4) The three different kinds of kidneys found in vertebrates are the pronephros, mesonephros, and metanephros

5) The earliest vertebrate, Anatolepsis, was a jawless fish from China that lived at least 500 million years ago.

6) The human eye blinks an average of 4,200,000 times each year.

7) pneumonoultramicroscopicsilicovolcanoconiosis is a disease of the lungs resulting from the inhalation of very fine silicate or quartz dust.

8)Yes, a goldfish (like most marine fish) can survive in a tank full of human blood.

9) True**,** Frogs eat their skin after they shed it.

10) a drey