Issue 5

The Sutton Grammar School Biology Magazine

Why Sleep?

What are the evolutionary advantages of maintaining a dormant state when we could simply remain awake and not perform strenuous tasks?

By Jack Cook

Whilst browsing through the rabbit-run that is facebook – exam leave has been *very* stressful, I can tell you – I chanced upon some information in a friend of mine's "Fact of the Day" page. It clearly stated:

Ants do not sleep – FACT!

Firstly I was naturally curious. Surely everything needs to sleep; everything gets tired clearly? Then came denial. It's a trick of the light; my eyes have been staring at the screen far too long – maybe I *should* do some Biology revision – "facebook? More like two-faced lies!" I chuckled at my own witticism. I had won, and I resigned myself to the fact that this must be falsehood. One hour and a wikipedia search later, I discovered that whether ants sleep or not is still not properly understood. I was confused – every animal or insect needs to sleep, otherwise how do they… er…hmm. Then came the realisation that I don't actually know what sleep does. Why do we close our eyes; have strange, phantasmagorical (had to slip that word in) visions and rest our eyes? What makes us tired? Its not just muscle aches, clearly, because I can stay in bed, watch a whole series (well, half a series) of 24 and still feel absolutely knackered (Yes, I am using my exam leave wisely). So what is it?

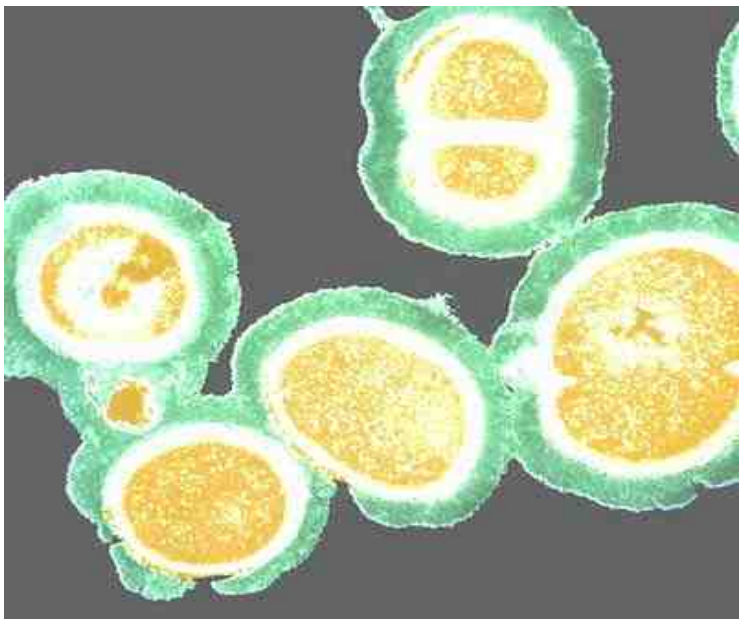
In fact, in my research I discovered that there are still many theories as to what humans need sleep for. One theory is that sleep is necessary for our muscles and organs to compensate for a hard day's work; to allow them to repair and grow. However, as mentioned above, it is generally accepted that it cannot be simply muscle fatigue as I can last a day in bed with literally no movement (save reaching for the fast-forward button) and still feel exhausted. Also, those who are sleep-deprived very rarely suffer from aching muscles or organ failure, so sleep is certainly not necessary from a physical point of view.

Other scientists theorise that sleep was perhaps developed as a defence mechanism for prey. To elaborate, many higher organisms do not need 24hrs in the day to hunt for food, eat food, mate and socialise. In order to escape the predators at night, prey would hide away in a hole or shelter, entering a lesser-active cognitive state. Critics will argue that this is in fact not a defence mechanism at all, but rather the opposite. By lying in a state in which reactions to stimuli are suppressed somewhat negates the advantages gained by hiding. Why not stay awake, but lay very still? And also, why would predators sleep? In effect, this argument has been quashed by critics, and therefore it is generally accepted that sleep was not developed as a defence mechanism.

Perhaps the theory that makes most sense is the "filing system" theory. This states that sleep is necessary for the human brain to process all the information gained during the day and store it to memory. This is akin to saving a file on a really old computer, which takes literally hours and during the process the computer can do nothing else. In trials, it was proved that a night's sleep after study can greatly increase one's score in a test as opposed to being tested straight away. This is good evidence for the "filing system" theory. If this theory is correct, then scientists then query: what are dreams? Sigmund Freud believed that dreams were the workings of the subconscious, showing us our inner desires and needs. He carried out much psychoanalysis into dreams to show that they were a method of communication between the conscious and subconscious self. However, some scientists believe that dreams are simply our brains throwing up scenarios so that we can test out our reactions – 'Which reaction had the greatest effect? What was the outcome of that scenario?' Other scientists theorise that dreams occur in the REM state, when synapses randomly "fire" and send messages of stimuli to the brain. In trying to make sense of these messages, the brain constructs a story, over which we have a certain degree of control. Are you still there? This may explain how we can remember something in a dream that occurred months ago and of which we thought we had no recollection. It also explains how vivid and wild dreams can be constructed with no conscious input from us. I believe that it is up to the individual how to interpret their dreams. Whether thinking of them as your inner consciousness helps you, or disregarding them as random signals allows you to get on with your day, think about it next time you sleep. Sweet dreams.

Inside This Issue of Life.

What is MRSA?



Methicillin-resistant Staphylococcus aureus

By Nick Pepper

MRSA is a bacterium that has been mentioned time after time by the papers, which have used its existence in hospitals as a major criticism of the NHS. After having heard of this unseen killer you may be confused as to what it is, why it is so dangerous and how it is so hard to eliminate.

Firstly, MRSA is a pathogenic bacterium, the same as the bug that gives you food poisoning and a toothache. It is spread by touch and any organism can become a carrier for the bacteria. Now, being a carrier doesn't necessarily mean that you will suffer its effects as it is only dangerous when it is inhaled into the lungs or it enters the blood stream through an open wound. Once into the blood stream it can cause blood poisoning and infections of the lungs, bones and heart valves that may lead to death.

People diagnosed with MRSA are sent to hospital for a lengthy stay while they recover; this can in turn cause a greater danger because the bacteria can be spread easily. The only capable defence against MRSA is prevention, for example all hospital visitors are made to wash their hands so that the bacteria cannot spread to other people that the hospital visitor comes into contact with. MRSA is immune to penicillin and other common antibiotics and so is almost impossible to treat, the reason why scientists haven't been able to find a cure to MRSA is because of the mutable nature of the bacterium.

If we want to know why antibiotics have no effect on MRSA then we must first understand the process of natural selection. This is a key concept in the theory of evolution and is the idea of the survival of the fittest. In other words, the members of the species most suitable to their habitat will flourish and pass on its successful traits in its genetic information. In the case of MRSA the bacterium has achieved resistance to antibiotics and has then passed this crucial genetic information onwards. Conversely, the members of the species that did not have resistance have been destroyed and so the only sets of genes still present in MRSA are those that immunise the bacteria.

The MRSA superbug presents a large threat to the medical community and accordingly, a lot of resources have been spent in trying to find a cure. Nearly two years ago, AcryMed Inc (a medical research company that specialises in wound care and infection control) released research that found silver to be effective in the treatment of MRSA. Since then another company, Oculus, has released research that shows super oxidised water to be effective against MRSA. The water speeds up the time it takes for a wound to heal and destroys viruses and bacteria around the wound. Research to this day continues to find an efficient treatment of MRSA.

Biology and the Media

Scepticism strongly advised

By Sam Gardner

Recently, as those of you who follow other (less important) periodicals may be aware of, a new study by the World Cancer Research Fund has come up with some "radical" new proposals to cut cancer. These include avoidance of red meat and alcohol, a total ban on Ham, Bacon and sugary drinks, not gaining weight (at all) after the age of 21 and, bizarrely, not taking diet supplements designed to reduce the risk of cancer (no, I don't know why either). These can all be found by going to your favourite news site, and reading it.

A fairly accurate synopsis of this study's findings can be compressed into "Don't be fat." This has been going around the usual news sites, papers and magazines, which are all commenting on how interesting and insightful it is. Just like they did in, to list in no particular order, the years 2005, 2006, 2002, 2003, 2004 and 2001. This list isn't exhaustive, but it does comprise every year from 2001 to the present day. What does this show us? Answer, how much fuss the media make about anything new to do with cancer.

This doesn't just extend to cancer. Biology often finds itself being entirely misrepresented for many other reasons as well. The study I've just spent two paragraphs on is just an example of how these things are sensationalised – what it actually recommends is that, given that certain things (Red Meats and Ham/Bacon are given equal consideration here) appear to raise the risk of cancer, further research into them might be warranted and that there may be some value in avoiding them until the risks are fully known. This is just one example that happens to be prominent at the moment – there are many others.

What I'm actually saying by all this is that you might, when next you see a piece of interesting news about Biology (health-related in particular), want to go back through some archives and see whether it's really news. In very short, not everything you hear or read is true, unless it's in this magazine.

Sport Science - Hamstring Injuries

By Adam Gillis

The hamstring muscle is a group of large, powerful muscles and tendons that span the back of the thigh, from the lower pelvis to the back of the shin bone. The hamstring is an important muscle that functions to extend the hip joint and flex the knee joint. The word 'ham' refers to the area behind the knee. 'String' refers to the tendons, and therefore hamstrings are the string-like tendons that can be felt on either side of the back of the knee. The hamstring muscle is important for all movements of the leg, and, if damaged, causes intense pain and can restrict you from walking until healed.

What are the causes of hamstring injuries?

Hamstring strains occur in many different ways, but most often when the muscles are weakened. A hamstring strain most likely occurs during some athletic activity or some sort of exercise. If there is strain on the hamstring and the individual continues athletic activity or exercise on it, the hamstring continues to strain further and further. A hamstring injury can also occur as a result of a direct blow to the muscle, such as being kicked in the back of the thigh, or falling on the back of the thigh. Pulled hamstrings can be seriously painful, like all pulled muscles, but the problems really start if they are torn. Torn hamstrings are very different from pulled hamstrings, and cause many of the same very painful symptoms, but only much worse. They cause intense pain and severe discoloration of the skin. All activity should be stopped immediately, and precautions taken straight away. Medical attention should be found as soon as possible. This tear in the muscle can usually be felt using the victim's hand, a clear signal for attention.

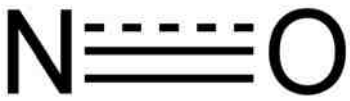
So, how is it treated?

Treating a hamstring can differ depending on the severity of the injury. For a first degree strain, ice and resting it with some elevation is the best way to treat it. For a second degree strain, ice rest, and elevation are also necessary. A second degree strain will take around two to three weeks to heal. However, the torn hamstring (the third degree injury), is to be treated roughly the same, but medical attention would be recommended by most physiotherapists. This can vary in the amount of time that they take to heal, but usually take quite a long time. Crutches may also be needed, once you are able to stand! Waiting the muscle is completely healed before athletics or exercise is the best way to ensure that an injury will not get worse or reoccur.

Athletes

Athletes actually frequently suffer from hamstring injuries. These can be very serious for their sporting careers. Once you have problems with your hamstring, it can trouble you for the rest of your sporting life, as it gradually gets weaker and weaker. Many great players have had problems, and a great example of a sportsman who has suffered from hamstring woes, and even torn his once, is Jonathan Woodgate. He has been on and off with problems with his hamstring for years, a not playing football for sometimes many months at a time. At the present time, he is playing for Middlesbrough. We wish him the best for the rest of his career. Footballers are the most susceptible to hamstring injuries, for obvious reasons, and another player who once had a problem is Michael Owen, whilst he was still playing for Liverpool.

Molecule of the Month - Nitric Oxide



By Richard Morris

Nitric Oxide (NO) is one of the few known gaseous signalling molecules used in the human body. Its main functions are in blood vessels. The inner lining of human blood vessels releases nitric oxide as a signal for the relaxation of the surrounding muscle. It is also used in immune responses, as it is toxic to many pathogens.

Recent research has also discovered that nitric oxide may have a role in desensitisation to drugs. Desensitisation is when a substance loses its effect on the body after continued use. You may have noticed that eating lots of sweet food makes other food seem less sweet, or that a smell becomes less noticeable after a few minutes. These are all examples of receptors becoming desensitised, and it frequently occurs with commercial drugs used to combat heart disease and asthma.

Cells usually respond to external stimuli through receptors on the surface of the cell. These receptors are activated through other molecules binding to them, or stimuli like heat or light. Most asthma and heart disease drugs focus on a certain 'family' of receptors known as G-protein coupled receptors. These receptors respond to a wide variety of stimuli, from adrenaline to smells.

After they have been activated, the receptors' effects are 'turned off' by an enzyme known as a G protein-coupled receptor kinase. If the receptor continues to be stimulated, it is absorbed into the cell itself. This is what causes desensitisation. When the effects of receptor stimulation are desired for treating disease or pain, it can be a major problem.

Researchers have recently found that a lack of nitric oxide can lead to a reduction in receptor activity, and crucially, that by administering specialised forms of nitric oxide, receptor desensitisation could be prevented. It was found that when some diseases reduce nitric oxide function, they also reduced the effectiveness of the drugs used to treat that disease.

The practical applications of this research are that it may be possible for future drugs to have no desensitising properties, so they still to work after continued use. It may also lead to more effective drugs for people with conditions that affect nitric oxide activity.

Sport Science - Cross Country

By John Gorringe, George Butcher, Alex Grimes and Adam Gillis

We have all had to endure the dreaded six weeks in Games; Cross Country. But why do we find it so hard?

When we are not exercising, we respire aerobically. We inhale oxygen and absorb food (glucose) into our bloodstream. These substances react in our cells to form energy which we use to do work – run around or play sport. This reaction can be summarised in the equation below:

Glucose + Oxygen > Water + Carbon Dioxide + ENERGY

However, when we exercise we use up the energy faster and therefore need to respire faster. But during extremely heavy exercise the bloodstream can no longer supply the cells with oxygen fast enough. At this point another form of respiration takes place; anaerobic respiration. This type of respiration is the incomplete breakdown of glucose to release energy without the need for oxygen. Although it releases energy, much less is released in anaerobic respiration. The reaction can be summarised in the equation below:

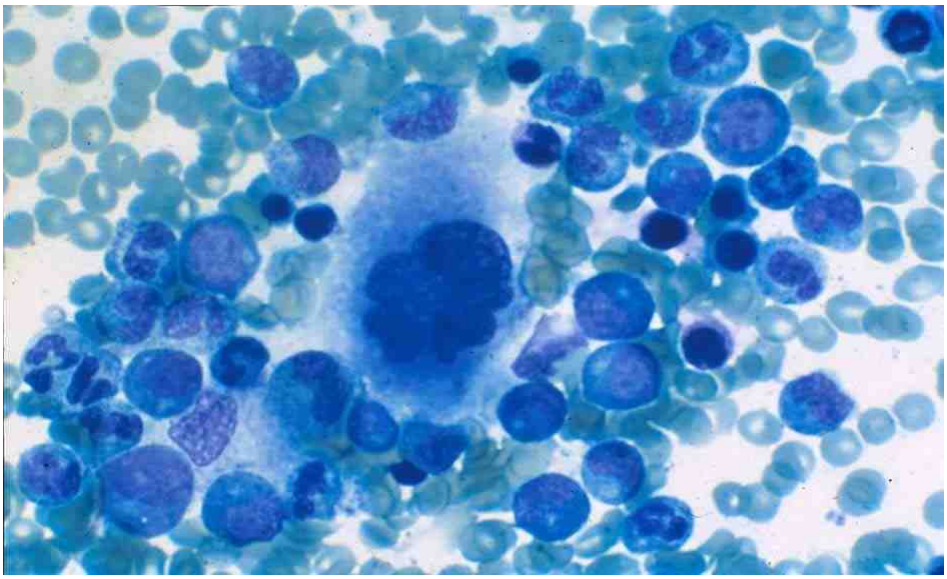
Glucose > Lactic Acid + ENERGY

The lactic acid acts as a mild poison in the body and builds up in the muscles. High concentrations of lactic acid can be painful and felt as cramp. The lactic acid also makes the muscles ache after around two minutes such that you can physically not carry on; this is known as, 'hitting the wall'.

Once we finish the race, the blood can again provide oxygen to the muscles fast enough, and the lactic acid is converted back into water and carbon dioxide. This delay of removal of lactic acid is called the oxygen debt. The lactic acid raises breathing rate which helps repay

the debt faster. This is why we breath heavily even after exercise.

So now when you are in agonising pain, and gasping for a drink of water, at least you know what is happening to your body. You can stop and think to yourself, 'Ah yes, I remember reading that excellent article in Life magazine…'



Science in Crime

The Case: Litvinenko Murder

On November 1, 2006, Litvinenko suddenly feel ill and was taken to hospital after having met two KGB agents earlier that day. Allegedly, Putin, the Russian President, had had one of his agents slip the poison Polonium 210 into Alexander's food at the Itsu restaurant in Piccadilly. Polonium 210 was only classified as a poison after this murder case had taken place. It is found in Uranium Ores and is about 250, 000 times more toxic than Hydrogen Cyanide, a poison used in chemical warfare. The polonium definitely did its job, but it is not a good chemical for use in chemical warfare because it is traceable. Private detectives have traced the polonium used to kill Litvinenko down to the possible laboratories that it was made in.

My Score for this poison: 6/10 – Effective but traceable and therefore not suited for chemical warfare.

Biological Imagery

An active megakaryocyte (bone marrow cell responsible for the production of blood cells) viewed under an electron microscope

Sport Science - Stretching to prevent injury

By George Butcher

A sporting injury is much like losing money. Not only do you lose what you were going to buy with that money, but you also have to work hard again to make up the money that you lost. It can be really frustrating. So what can we do to prevent these annoying and painful occurrences? Simple. Stretch! This is one of the most neglected preparation techniques in athletics and other sports and yet in can reduce your injury chances by up to half.

Stretching works because it increases the length of your muscles and tendons at the same time. This means that you become much more flexible and you can stretch much further and with more force before you damage yourself or cause an injury. Stretching also promotes healing and reduces soreness which reduces your chance of injury by yet further, as fatigued or tight muscles are more prone to harm and can be torn or strained. It keeps your muscles in good working order and makes sure you get as much time playing sport as you want to be.

As you can see there is more to stretching than most people think. It is simple and effective and makes staying fit easy. Don't be fooled into thinking that something so simple can't be effective, so when Mr. Bangs asks you to stretch before athletics don't groan and pretend to do it. Actually stretch because there is an excellent reason for doing so.

That's Life.

By Joe Robinson

Q1. What's the most common bird in the world?

Q2. What is the difference between a rabbit and a hare?

Q3. How long is a goldfish's memory?

Q4. Where is the driest place on Earth?

Q5. Which part of a chilli pepper is the hottest?

A1. The chicken. There are about 52 billion chickens in the world.

A2. The rabbit is born hairless and blind whereas the hare is born with fur and with eyesight. The hare is generally bigger, heavier and has longer legs so can outpace a rabbit easily.

A3. It is definitely not 3 seconds. In the past goldfish have been trained to push a lever when a light comes on to receive a food reward.

A4. Antarctica. Some places on the continent have not received rain for over 2 million years; these are known as the Dry Valleys. Antarctica can also be called the wettest place on Earth and the windiest.

A5. It is not the seeds despite what many TV chefs have said. The hottest part is the central membrane to which the seeds are attached.