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Stem cell breakthrough

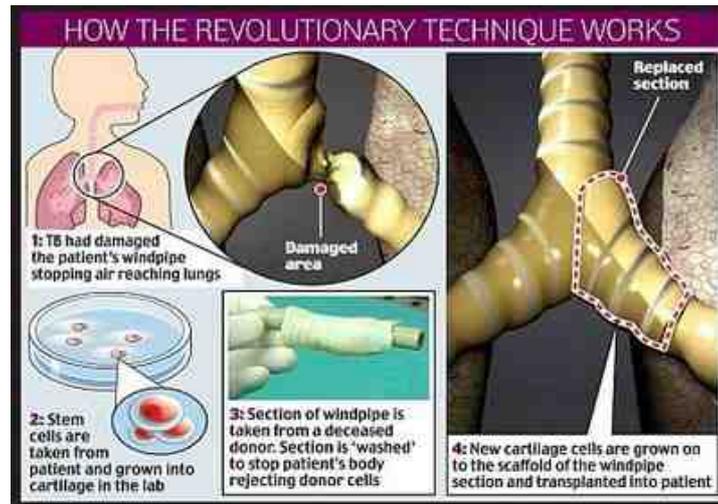
Hope over hype

By Shane Weinmann

In recent years stem cell technology has become one of the most heavily funded and researched topics within biology. There has been intense controversy about how this research is carried out and how far is too far in terms of ethics. However, last week there was undeniable proof of the importance of this technology in the future of medicine as a Colombian woman in Barcelona underwent a life-changing transplant, using her own stem cells.

Claudia Castillo, a thirty year old with two children, had contracted tuberculosis, which had narrowed the left bronchus leading to the left lung. This left her with a chronic shortness of breath and chest pains, which ultimately left her unable to carry out a normal life. Doctors rarely order a transplant to cure this as it means the patient would have had to take immunosuppressants, which come with complications of their own, for the rest of her life. The only remaining option would have been to remove her left lung, which would have prevented the spread of the disease, but severely reduced her quality of life.

Instead, doctors in the Hospital Clinic, in the University of Barcelona decided to take an unorthodox approach to curing her illness – they decided to use stem cells from her hip and implant them in a donor’s trachea. Until then, the procedure was untried on humans, only successfully tested on animals. Surgeons in Barcelona



removed a trachea from a donor, before being treated with chemicals, which tried to remove all of the donor’s cellular material, thus minimising the risk of rejection. This left a trachea with no trace of the donor’s cells. Stem cells were taken from Castillo’s hip and sent to Bristol University, where they were cultivated by technicians until they were ready to differentiate into cartilage.

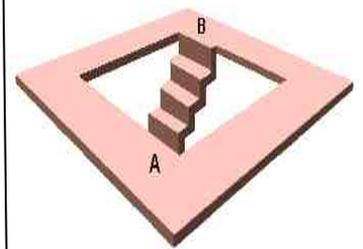
The trachea was then placed in a solution of Castillo’s own undifferentiated cells, which formed cartilage cells on the trachea. Epithelial cells from the mucous membrane were also taken from Castillo’s right bronchus and cultivated, and implanted on the inside of the trachea. Once both sets of cells had grown sufficiently – this took approximately 4 days – it was ready to be transferred to Castillo. This meant that the trachea from a donor had no trace of this donor’s cellular make-up, and instead was entirely made up of Castillo’s cells. Effectively, they

had managed to grow a new organ for Castillo. For it was cut and shaped to fit as a bronchus. Within surgery, the old, narrowed left bronchus was removed and the new one was implanted. The disease then cleared up and Castillo was left with both perfectly functioning lungs with no further complications.

The most obvious advantage of this procedure is that Castillo is able to have a quality of life never before possible when treating this disease, as she is left with perfectly functioning organs, and there is no chance of rejection, and therefore no need to take immunosuppressants, as the new organ is effectively her own.

However, this landmark procedure has been incredibly expensive, due to this technology being relatively new and in early research stages. In addition to this, there were transport costs in moving stem cells to Bristol. In

Mind tricks



B and A seem to be on a plane with each other, yet it also seems possible to “climb” between them

Inside This Issue of Life

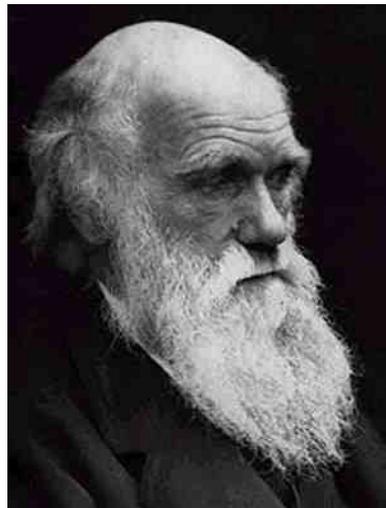
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Evolution explained

By Joe Robinson

Evolution is the progression of species through time where the animal with the most favourable characteristics (determined by its make up of genes) reproduces most and passes on its genetic advantage. Charles Darwin realised and demonstrated this in the 19th century and named the process “natural selection”.

We will take an extreme and fictional example to demonstrate. Cats like to hunt and eat mice, in a garden full of green grass there are two types of mice. The first type of mouse is a light green colour and can run very fast, the second type of mouse is bright orange and does not run very fast at all. The mice can mate with their own variety but can also mate with the other variety. In the garden there are 100 green mice and 100 orange mice. Several cats come into this garden to hunt for mice. They immediately see the bright orange mice and chase after them, the slow orange mice cannot escape the cats and 35 of them are killed and eaten by the cats. One cat sees a few green mice and chases them, the fast green mice run and hide and only four green mice are killed and eaten. This leaves 96 green mice and 65 orange mice. When the mice reproduce the proportion of green mice is much higher since there are more of them and they are much less likely to be caught and eaten by hungry cats. Eventually there are no orange mice left and the green mice continue to reproduce successfully in the garden. The mice’s green coat keeps them hidden from predators and their powerful legs help them escape the predators. The green mice sur-



A famous image of a famous man

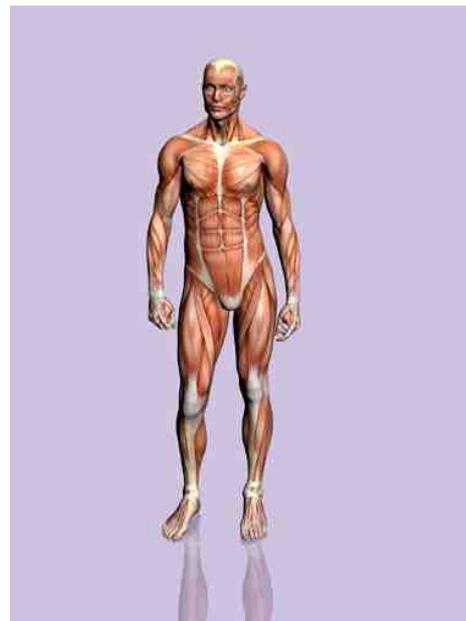
vive in this green environment.

It is said that humans evolved from apes which in turn evolved from a four legged creature which evolved from a sea creature and so on. Ever since the beginning of life, life forms have changed to deal with the environment and ultimately survive at all costs. Giraffes developed long necks to reach leaves on the top of high trees, predators developed sharp teeth and powerful legs and claws to catch and kill their prey. The list is endless and evolution continues in nature as it has done since the beginning of time.

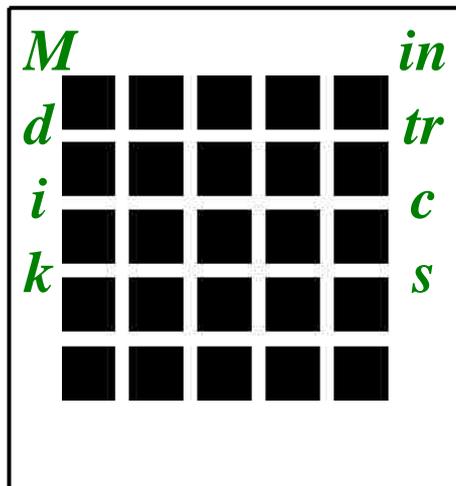
As for humans, it is unknown as to whether we can evolve further. We are the rulers of the planet, take care of ourselves without too many problems and live to very old ages. There are a few problems concerning humans. To walk on two legs we must have

narrow hips but to be so intelligent we need large heads. This poses a problem during the growth and delivery of babies. Women put themselves at huge risk having children, endangering the lives of the child and themselves. Surely this evolutionary “slip up” will be fixed in the next few million years of evolution? Or has science and medicine made any further human evolutionary advance impossible?

Be sure to check in on the next instalment, where we ask: has science halted human evolution?



Do we need to evolve any further than this?



(continued from front page)

the future it is foreseeable that this technology is more widely available in hospitals with companies developing this equipment, and therefore no transport costs would be incurred, and due to commercial production of the equipment, it is likely that the cost of the equipment will be lowered.

Reportedly, this technology is in the very early stages of development and must undergo at least 5 years of further testing before being in more widespread use.

However, with this stem cell treatment the possibilities for treatments are enormous. Presently 8,000 people are currently on the waiting list for a transplant. According to NHS figures, 1,000 people last year died on the waiting list for an organ. These numbers could be drastically reduced with this new treatment, lowering NHS costs for keeping the patients alive whilst awaiting transplants, and reduces the number of immunosuppressants taken, as this “stem-cell transplant” eliminates the risk of organ rejection.

Animal oddities

Evolution moves in mysterious ways

By Matt Grayling

When artists are working on their latest masterpiece they sometimes look to nature for inspiration. They want to create something wonderful, something beautiful. We think about the beautiful things, such as the ocean and the forest. But what about the other end of the scale. Mother Nature has created many things, some very strange and amazing things, but not all the kind we'd look to for inspiration.

Take the *pelochelys cantorii*. It is probably one of the strangest looking things you could ever see. It grows up to

2 metres long and weighs roughly 50 kilograms. That's more than some year eight



Pelochelys cantorii



The star-nosed mole in action

students! It is actually a type of turtle but looking makes you think it was a turtle with no shell that somehow survived being run over by a tank. It is also known as Cantor's soft shelled turtle (hence no hard shell).

The turtle spends 95 percent of its life buried and motionless, with only its eyes and mouth protruding from the sand. It surfaces only twice a day to take a breath and lays 20-28 eggs in February or March on riverbanks. It is an ambush predator, feeding on crustaceans, molluscs and fish although occasionally it eats some aquatic plants. Due to predation by coyotes, the *cantorii* is currently endangered.

But if you think that looked a bit weird, wait for our next entrant, the star-nose mole. It lives in wet lowland areas and feeds on small invertebrates, aquatic insects, worms and molluscs. It is good at swimming and can forage along the bottoms of streams and ponds. Like other moles, this animal digs tunnels for foraging. But unlike other moles often these tunnels

exit underwater. The nasal tentacles are incredibly sensitive and covered with almost one hundred thousand tiny touch receptors called Eimer's organs. These are used to identify food. Adults are 15 to 20 cm in length, weigh about 55 g, and have 44 teeth.

But you can't go off without a cross between two animals, the patagonian cavy, or as most people would like to call it, the Donkey Rabbit. It isn't actually the offspring of a donkey and a rabbit (I'm not sure how that would be possible), merely looks like it. Its head and body length is up to 75 cm, and it weighs between 9 and 16 kg. The patagonian is monogamous which means they mate for life. The females have 3 to 4 litters a year, usually containing two young. They live in central and southern Argentina. In captivity, they live roughly for 5 to 7 years. It is listed as near threatened and their population is decreasing. The young, called pups, live in a burrow called a crèche when young, usually with many other pups. The mother returns several times a day to nurture her pups.

Keep tuned for more weird and wonderful creatures!

Sodium thiopental

By Richard Morris

Whether or not you agree with it, the US still execute some criminals they think too dangerous to be allowed to live, and the most common method today is lethal injection, supposedly the most 'humane' option. Sodium Thiopental is one of the three drugs most widely used.

Of course, it has other applications as well. The most common use is as an anaesthetic: properly administered it can numb pain or knock someone out in a few

seconds. Some intelligence services also use it as a 'truth serum' that relaxes the subject and makes them more vulnerable to questioning.

But how does it work? The drug acts on two important receptors in the human central nervous system (or CNS) that are concerned with neurotransmitters; the chemicals that convey nerve impulses across synapses. The first (known as GABA_A if you're interested) inhibits the action of neurotransmitters, and thiopental stimulates this, causing a reduction in neuron activity. The second receptor (AMPA) has the opposite effect: increasing neurotransmitter activity. However thiopental inhibits this receptor instead of

stimulating it, so synapse activity is doubly reduced.

In small doses (280 to 420 mg for an average adult), it can be used in hospitals as an anaesthetic that will render the patient unconscious (other drugs are then used to prevent them waking up). These doses depress the CNS much like any other painkiller to prevent the brain from feeling any sensation. Larger doses of around 2 to 5 grams can reduce nerve activity to such an extent as to cause coma and death, and are used in most US states for lethal injection.

Square eyes

By Luke Denne

We've all heard our parents saying, 'Stop playing on your computer or it will give you square eyes,' but is this really true? Some people will stare at a computer screen all day and have perfectly good eyes, whereas other's vision will be affected from just short periods of using a computer. Now it is time to find out if there is any truth behind this familiar saying, or if it is just a way for parents to get us off the computer!

Many scientists say that long term use of the computer puts a lot of strain on our eyes. This strain is said to be a consequence of muscle fatigue in our eyes. The tiredness is caused by the constant focus on the computer screen compared to having a variety of different things to focus on. This means that the muscles do not change position and therefore become tired.

In some cases, if you are staring at a computer monitor for quite a long stretch of time, the focusing muscles in your eye can become locked in a certain position. This causes your eyes to be in a constant state of

contraction and as a result of this you may end up with eye cramp. If you stare at your screen for a very long time and then suddenly look away into the distance, it should take a few moments for your eyes to adjust to the new focus. You can try this next time you are at the computer.

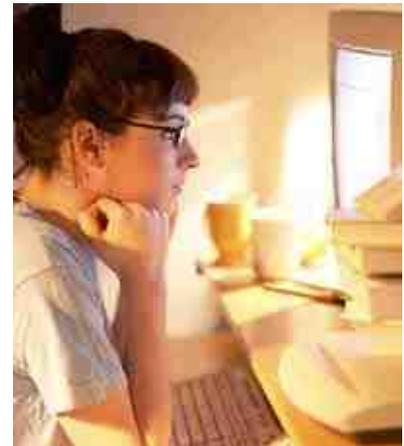
There is quite a lot of advice on how you can avoid eye strain and muscle fatigue even if you have to use a computer for long periods of time:

Focus away from the computer at regular intervals to stop your eyes from becoming locked.

Take regular breaks from the computer to give your eyes a rest.

Or you could just cut back on your computer use and then there would not be such a big issue.

If you do all of these your eyes are much less likely of becoming strained and causing a problem to your vision.



But how come some people appear to not be affected by spending extensive time staring at their computer, even without using the above methods? There is no definite answer to this question and this is due to the fact that every person is different. Everyone is affected in some way by focusing on a computer, but some people just naturally have good eyes and so appear to not be changed by it. They are just lucky! But they may be lucky now, but who knows if that luck will last or if it will run out in the future...

You are what you eat

By Billy Wyatt

The rabbit is one of several animals that eat their faeces. The process by which this happens is called coprophagia. The reason that rabbits as well as other animals from the same family like Guinea pigs or hamsters do this is to maximise the amount of energy that they can get out of a food such as grass which gives off little energy.

The way in which they do this is by producing two types of faeces. The first is called waste pellets, like human faeces these pellets are made up of indigestible, fibrous foods like hay. The second type of faeces that they produce is called caecal pellets. These faeces are normally eaten by the rabbit. The reason they do this is that the caecal pellets still contain vital nutrients and good bacteria. The way in which they can



tell the difference between the waste pellet and the caecal pellet is by firstly knowing what they have eaten, secondly the waste pellets are much larger than the caecal pellets and finally because caecal pellets normally come out in clusters. They can not get the sufficient amount of vitamins, energy and bacteria out of the food in the first place because their colon walls are not strong enough.

Due to this they re-eat their faeces, the colon produces many vitamins but these vitamins can not be absorbed through the colon wall, this means that all of the healthy vitamins are still left in the faeces so they must eat their faeces to get those vitamins into their blood stream. This is why rabbits always seem to have lots of energy, and do not tire easily.



Caecal pellets (left) and waste pellets (right)

Eco-cities

By James Wickenden

An eco-city is a city that is totally sustainable and has little or no dependency on the surrounding area and a minimal carbon footprint. More recently, the need for such cities has increased as the threat of global warming has become more and more real. Many eco-cities are being currently developed because of this problem. A few examples include Masdar in the United Arab Emirates and Dongtan in China.

Another reason for such cities is that worldwide estimates have shown that, as of 2008, over half the world's population now lives in built-up areas. This means that the average carbon footprint of a person living in a city needs to decrease to cope with global warming. The main

difference between these eco-cities and conventional cities is the aim for lower carbon emissions. These aims are fulfilled by a variety of methods such as only electric vehicles will be allowed in Masdar or Dongtan but these will have little use anyway as all the houses are close to public transport and are fairly small areas anyway.

In Dongtan wind turbines and

solar panels will make up 40% of the cities energy needs, which are planned to be 66% less than a conventional city would need. In Masdar solar and wind power will also be used along with what is planned to be the world's largest hydrogen power plant. Also waste rice husks will be burnt to provide energy and the released CO₂ will be pumped back into greenhouses to increase the photosynthesizing ability of the plants growing there. Buildings

will also be made with thinner walls, as the electric cars will be quieter. Finally 60% of Dongtan is parks and farmland so all the food needed can be grown on site. Ten eco-towns were planned in the UK but the credit crunch and local complaints have meant that only one or two look likely.



Masdar headquarters



Artist's impression of Dongtan