SCIENCE BRIEFS

NASA's Spirit down, but has a good Opportunity

The NASA Mars rover Opportunity experienced an unexpected power surge this past month, with its solar cells producing more power than ground control had expected. This is a pleasant surprise for NASA, adding to the fact that the two rovers, Spirit and Opportunity, have been now working for more than six months after their design lifetimes. Opportunity's solar cell output had fallen in June, probably due to Martian dust settling on the panels. The cells began to increase their output a month ago, possibly because wind blew the dust away (scientists aren't sure). Spirit, however, is not in as good shape: with one of its front wheels has been malfunctioning.

–ZOE CORMIER
Source: *New Scientist*

New life for old fungus

Indian researchers were able to grow fungus, estimated to be between 180,000 and 430,000 years old, from sediment cores drilled from a depth of 6,000 metres in the Indian Oceans. This new finding from the National Institute of Oceanography in Goa, India adds to the growing evidence for the remarkable survival capabilities of microorganisms. Some microbiologists were unsurprised, however, as previous scientists were able to grow ancient fungi recovered from ice. Researchers hope that studying the distributions and number of fungal organisms could provide information about past climatic conditions on Earth.

–WENDY GU
Source: BBC News

Monkey cloned, almost

Scientists have come very close to cloning a primate. Researchers created cloned monkey embryos and implanted them into the wombs of 25 monkey mothers. Although none of the pregnancies lasted more than a month, scientists are now one step closer to cloning primates (including humans). They used a method developed in Korea earlier this year for cloning human embryos. Biologists were able to clone human embryos for the first time by gently squeezing the DNA out of a grown-up human cell and implanting the DNA into a human egg cell (the embryos were destroyed after six days).

–Z.C.
Source: *Nature*

Researchers step closer to regenerating human bone marrow

by MIKE GHENU

Many advances in the biological sciences rely on using cunning and deceit to cause an organism to react in a certain way. By using some clever tricks, researchers at U of T have produced bone marrow by enticing blood-borne stem cells to grow inside cozy cellular homes that resemble the interior of actual bones. More than just lab trickery though, this finding points to an alternative to that of traditional bone marrow transplants—a procedure that is difficult and painful, with only a partial rate of success.

Biomaterials seeded with bone cells provided the needed deception, and the whole experiment was carried out inside "nude" mice. These critters differ from their furry kin in that they are genetically engineered such that their immune systems are unable to mount an effective response.

The tricksters were Prof. John Davies and Dr. David Lickorish of the Institute for Biomaterials and Biomedical Engineering (IBBME), as well as several colleagues at Tsurumi University in Japan.

This is the first time that bone marrow has developed inside a so-called biodegradable implant, which acts much like the dissolvable stitches you get after oral surgery: they allow the cells to regrow, and dissolve afterwards, leaving normal tissue.

Bones are not exactly hollow. The humerus (upper arm) and femur (thigh) for instance, both contain trabecular bone, a foam-like material shielded by a load-bearing layer on the outside. Bone marrow cells attach to the walls of the spongy interiors, where they differentiate into many of the commodities that your body needs to survive, such as red blood cells.

Davies' team seeded bone cells onto a scaffold that resembled the trabecular bone. The scaffold is about the size of a Q-tip, made of a biodegradable material, and interspersed with calcium minerals also found in real bones. After the bone cells were implanted in the scaffold, they were implanted in nude mice.

Nude mice lack effective immune systems, and so there is no risk that they might reject the implant. Implant rejection is a common problem when transplanting human organs, because the recipient's body recognizes the organ as foreign and will not accept it.

Stem cells in the blood streams of the nude mice were attracted to the bone sites, where bone marrow is usually found, and began to attach there and grow.

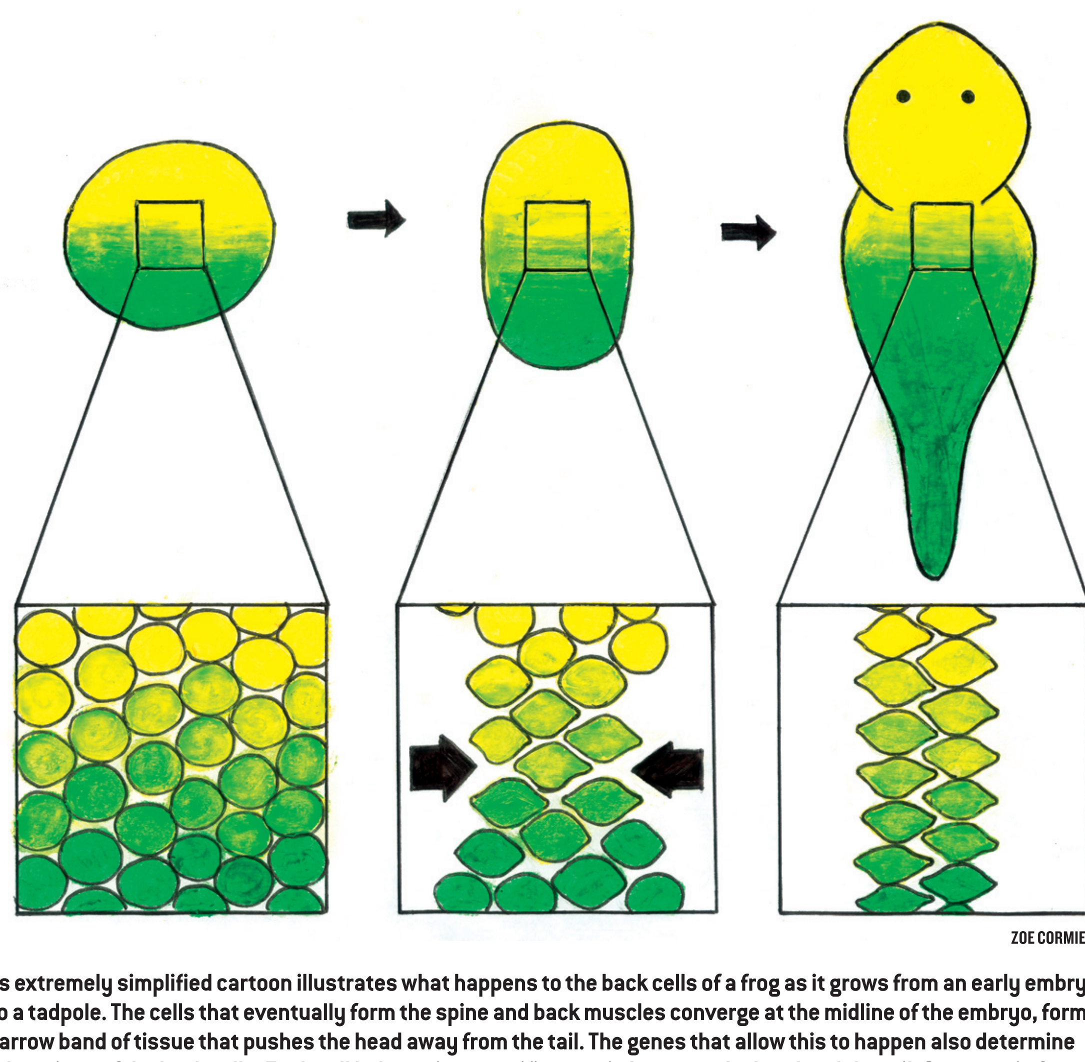
"Not only does the scaffold support bone growth," said Davies, "but the host animal sees the implant as a normal trabecular bone."

Davies believes this technology could one day be used to regenerate human bone marrow, by implanting humans with scaffolds seeded with their own bone cells. It might provide a less invasive alternative to the current marrow transplant procedure, in which a donor's bone is smashed open and marrow scraped out.

Only about 30 per cent of those who need transplants are compatible with a kin donor, according to Beverly Campbell, the director of the donor registry at Canadian Blood Services. At any given time, about 250 Canadians await a marrow transplant from an unrelated donor.

How to get ahead in getting a head

by ZOE CORMIER
VARSITY STAFF



ZOE CORMIER

This extremely simplified cartoon illustrates what happens to the back cells of a frog as it grows from an early embryo into a tadpole. The cells that eventually form the spine and back muscles converge at the midline of the embryo, forming a narrow band of tissue that pushes the head away from the tail. The genes that allow this to happen also determine the locations of the back cells. Each cell belongs in a specific spot, in between the head and the tail. One gene is found primarily at the head (yellow), and the other at the tail (green). Cells that show the most yellow belong near the head, while cells that show the most green belong near the tail. Those showing both belong in between.

Before you had to cope with the mind-numbing drudgery of high school, before you had to write three midterms in a week, before you had to serve no-foam soy lattes to yuppies who treat you like a talking vending machine, you had to accomplish something even more difficult: you had to grow from a ball of cells into an elongated embryo without ending up ass-backwards.

"[Developing as an early embryo] is one of the hardest things you will ever have to do," says developmental biology grad student Mary Kubesh. "Considering its complexity, it's amazing how often it actually succeeds."

Biologists at U of T have uncovered a piece of the incredibly intricate puzzle of embryological development. Dr. Rudolf Winklbauer and his postdoctoral fellow Hiromasa Ninomiya found that the lengthening of the embryo, and the subsequent development of the spine, is intrinsically linked to the designation of the head and the tail at opposite ends. This discovery may aid in the treatment of diseases like cancer and spina bifida, a birth defect where part of the spine is formed outside of the body.

All animals start off as a single cell, the fusion of an egg and a sperm. This single cell divides, creating a sphere of cells shaped a bit like a basketball. Through a number of complicated shape changes, this sphere folds in on itself, expands and grows, and eventually turns into something resembling the adult animal. As the sphere folds in on itself groups of cells that are destined to grow into particular organs, muscles, and other structures are placed in their appropriate locations, and the stage is set for the embryo to grow into a full animal.

"You have thousands of cells, and they all have to know where to go and when to go there; all of these cell movements have to be coordinated," says Kubesh, giving an idea of just how complex the growth of an embryo is.

One of the most important changes that takes place as the sphere folds and grows is a process called convergent extension. The cells of the future spine and back muscles converge at the midline and interlink, creating a narrow band of tissue in the middle of the embryo's back and extending the animal from a ball into an elongated shape.

Ninomiya and Winklbauer showed that the extension of the back is intrinsically tied to the establishment of which end of the animal will become the head and which end the tail.

When they took the soon-to-beback cells of a frog and mixed them up in a petri dish, the cells moved back to their original positions. "These cells know where they come from," said Dr. Winklbauer. Only once the cells were back in their original places, and the head to tail axis had been re-established, did the back stretch out.

Ninomiya and Winklbauer found that the expression of two genes determines the direction of the head to tail axis. One gene, called *Xenopus Brachyury* is expressed the most at the future tail, fading off towards the head. The other gene, called *chordin*, is expressed in the opposite manner: the most at the head, and the least at the tail. This pattern of gene expression, which determines the "head or tail" identity of the back cells, also tells the cells to converge at the midline and extend the embryo (although this mechanism has yet to be determined).

"So this is an elegant way to ensure that you always get the axis elongated in the right way, not perpendicular or at an angle; you always push the head away from the tail," said Winklbauer.

The intellectual credit, he noted, should be attributed to Ninomiya, the lead author of the study. Ninomiya was fascinated by the process of convergent extension even in his undergraduate days and has dedicated himself to studying it for the past several years.