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March/April 2010

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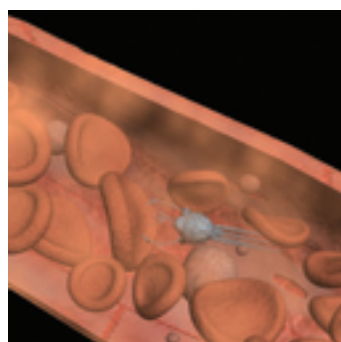
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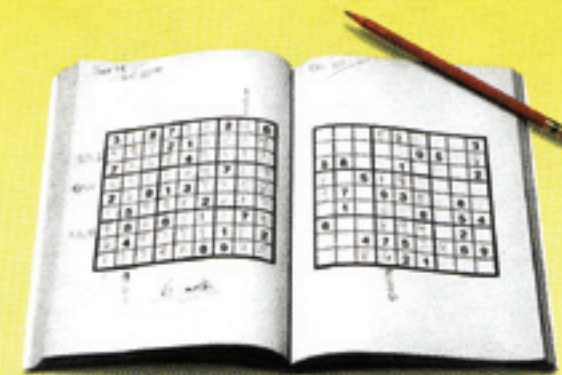
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# FUN LIKE SUDOKU

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# SPEAKING JAPANESE.

Watch anyone solving a Sudoku puzzle and you see a brain on fire: eyes transfixed, pencil (or pen for the audacious) skittering across the squares, a number scribbled in place, done! Surprisingly, what looks like work is actually fun. Not so surprising say cognitive scientists because your brain loves solving puzzles. That's how it learns. It thrives on the bursts of pleasure that are part of the brain's reward system when you solve problems and challenges.

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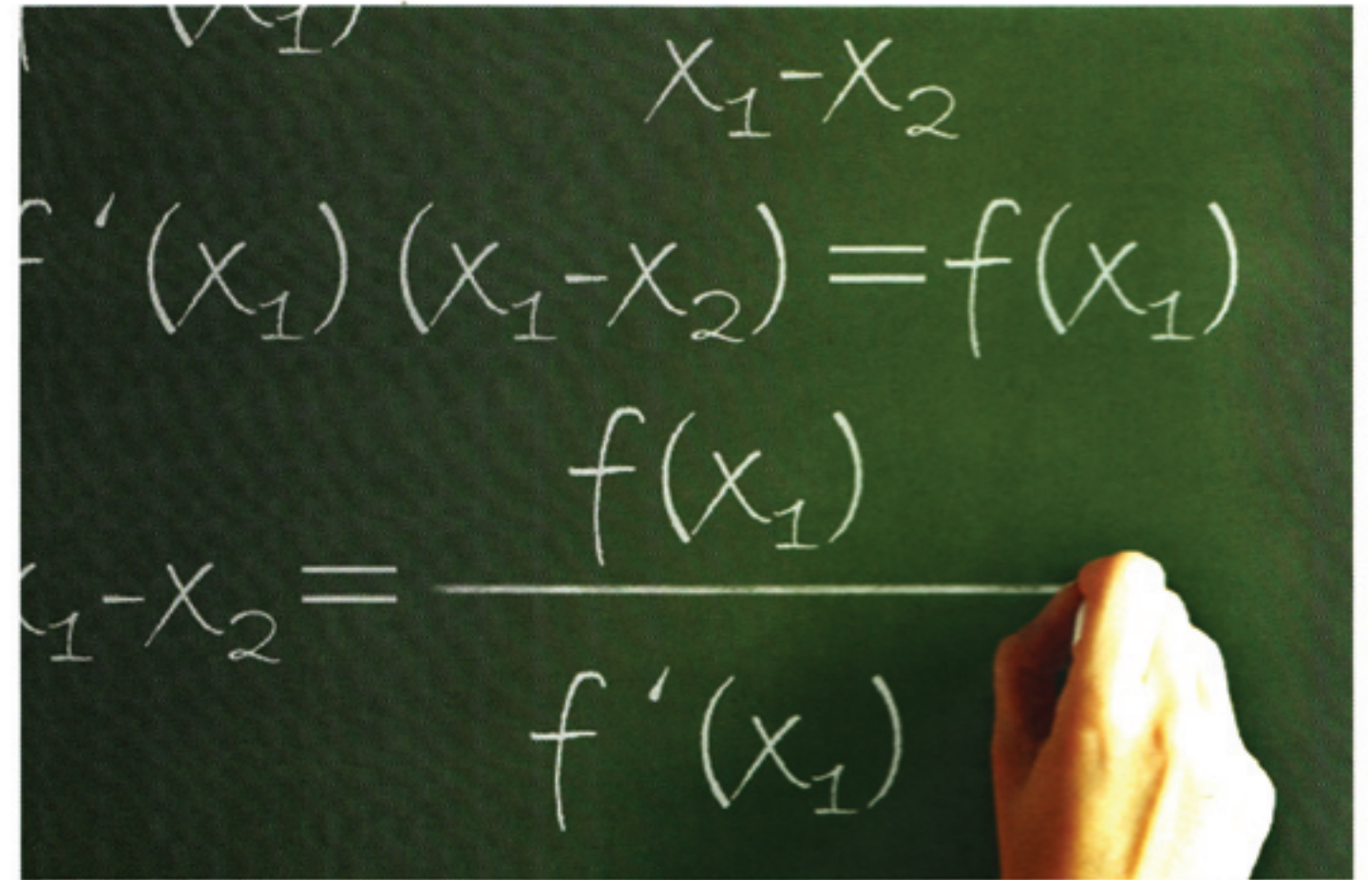


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# Science Update

THIS ISSUE: Stem Cell Contact Lens » Teen Plastic Bag » LHC Fault » Student Balloon Space Cam

## HEALTH

# Stem Cell Contact Lenses Cure Blindness in Less Than a Month

Contact lenses coated with stem cells could help cure some forms of blindness.

The humble contact lens has long been used to improve people's vision, but now researchers have restored sight in patients suffering corneal damage using a groundbreaking technique where contact lenses are cultured with stem cells.

The idea stemmed from the observation that stem cells from the cornea (the thin, transparent barrier at the front of the eye) stick to contact lenses. Employing three patients who were blind in one eye, the researchers obtained stem cells from their healthy eyes and cultured them in extended wear contact lenses for ten days. The surfaces of the patients' corneas were cleaned and the contact lenses inserted. Within 10 to 14 days the stem cells began to recolonize and repair the cornea.

"The procedure is totally simple and cheap," said lead author of the study, UNSW's Dr Nick Di Girolamo. "Unlike other techniques, it requires no foreign human or animal products, only the patient's own serum, and is completely non-invasive."

Of the three patients, two were legally blind but can now read the big letters on an eye chart, while the third, who could previously read the top few rows of the chart, is now able to pass the vision test for a driver's license.

» Unlike other techniques, it requires no foreign human or animal products.



The research team isn't getting over excited, still remaining unsure as to whether the correction will remain stable, but the fact that the three test patients have been enjoying restored sight for the last 18 months is definitely encouraging. The simplicity and low cost of the technique also means that it could be carried out in poorer countries.

The procedure also works in patients who have had both eyes damaged. "One of our patients had aniridia, a congenital condition affecting both eyes," said Dr Di Girolamo. "In that case, instead of taking the stem cells from the other cornea, we took them from

another part of the eye altogether the conjunctiva, which also harbors stem cells."

Diseases affecting the cornea are one of the main causes of blindness around the world. The World Health Organization estimates that corneal disease could be responsible for 1.5 million people losing sight in one of their eyes every year.

Although at the moment the treatment can only help people with damage to the edge of the cornea, the researchers say that in the future the technique could be used to help people blinded by other causes. As well other parts of the eye such as the retina.

## EARTH

# Teen Decomposes Plastic Bag in Three Months

Teenager discovers a way to cut plastic bag decomposition time

Plastic takes thousands of years to decompose — but 16-year-old science fair contestant Daniel Burd made it happen in just three months.

The Waterloo, Ontario high school junior figured that something must make plastic degrade, even if it does take millennia, and that something was probably bacteria.

The Record reports that Burd mixed landfill dirt with yeast and tap water, then added ground plastic and let it stew. The plastic indeed decomposed more quickly than it would in nature; after experimenting with different temperatures and configurations, Burd isolated the microbial



munchers. One came from the bacterial genus *Pseudomonas*. Burd says this should be easy on an industrial scale: all that's needed is a fermenter, a growth medium and plastic, and the bacteria themselves provide most of

the energy by producing heat they eat. The only waste is water and a bit of carbon dioxide. This form of technology is now being developed to decompose other harmful materials, in hopes to someday save our planet.

## PHYSICS

# LHC shuts down for a year to address design faults

World's largest and highest-energy particle accelerator takes a break

The Large Hadron Collider (LHC) must close at the end of 2011 for up to a year to address design issues, according to an LHC director. Dr Steve Myers told BBC News the faults will delay the machine reaching its full potential for two years.

The atom smasher will reach world record collision energies later this month at 7 trillion electron volts. But joints between the machine's magnets must be strengthened before higher-energy collisions can commence.

The Geneva-based machine only recently restarted after being out of action for 14 months following an accident in September 2008 involving a bird.



Dr Myers said: "It's something that, with a lot more resources and with a lot more manpower and quality control, possibly could have been avoided but I have difficulty in thinking that this is something that was a design error or something similar."

» The standard phrase is that the LHC is its own prototype. They are pushing the new technologies towards their limits.

## The Petri Dish

» There is enough salt in the world's oceans to cover all the land on all the continents to a depth of nearly 500 feet.

» The interstellar gas cloud that comprises Sagittarius B contains a billion billion billion (yes, that's three orders of billion) liters of alcohol.

» The average person manages to consume about 430 insects every year of their lives.

» The interstellar gas cloud that comprises Sagittarius B contains a billion billion billion (yes, that's three orders of billion) liters of alcohol.

» While both humans and alligators depend on their teeth in order to chew food, humans only get two sets of natural teeth to last them a lifetime. Alligators get from 2,000 to 3,000 teeth during their lifetime.



» A cloud to ground bolt of lightning carries between 100 million and 1 billion volts. It can reach 50,000 degrees Fahrenheit. That's 3-4 times hotter than the surface of the sun!

» The density of the planet Saturn is lower than water, so if you could put it in the ocean it would float.

» The acceleration rate of a flea jumping off a dog is 20 times the acceleration of the space shuttle during launch.

» A solar panel array covering an area of 100 by 100 miles in the US Mojave Desert would produce enough electricity to replace all the coal fired power plants in America.

## Blindness Facts



- » 2.5 million people in the United States are "legally blind"
- » Only ten percent of blind children are taught Braille in the US
- » Just over 7,000 Americans use dog guides
- » Average number of years of education for blind adults is 11.4
- » The causes of blindness in the US are primarily age related eye diseases

# Student Balloon Space Cam

UK Student financed satellite imaging

Teenagers with a £56 camera and latex balloon have managed to take stunning pictures from 20 miles above Earth. Proving that you don't need Google's billions or the BBC weather centre's resources, the four Spanish students managed to send a camera-operated weather balloon into the stratosphere. Taking atmospheric readings and photographs, the Meteotek team of IES La Bisbal school in Spanish Catalonia completed their incredible experiment at the end of February this year.

Building the electronic sensor components from scratch, Gerard Marull Paretas, Sergi Saballs Vil, Martm Gasull Morcillo and Jaume Puigmiquel Casamort were able to send their heavy duty £43 latex balloon to the edge of space and take readings of its ascent.

Under the guidance of teacher Jordi Fanals Oriol, the budding scientists, all aged 18 to 19, followed the progress of their balloon using hi-tech sensors communicating with Google Earth. 'Meteotek was our experiment to see if we could accurately measure the Earth's atmospheric conditions at 30,000 metres, take pictures to prove the experiment and then recover the instruments attached to the balloon after its deflation,' said team leader Paretas, 18.

'We were overwhelmed at our results, especially the photographs. To send our hand-made craft to the edge of space is incredible.'

To successfully conduct the experiment, the team had to account for a wide variety of variables and rely on a lot of luck. 'The balloon we chose was inflated with helium to just over two metres and weighed just 1,500g,' said Paretas. 'It was able to carry the sensor equipment and digital Nikon camera which weighed 1.5kg. Due to the changing atmospheric pressures, the helium weather balloon carrying the meteorological equipment was expected to inflate to a maximum of nine and a half metres as it travelled upwards at 270 metres per minute.'



**Balloon Cam**  
105,600 feet

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**Passenger Jet**  
37,000 feet

**Mt. Everest**  
29,023 feet



## Info Circuit

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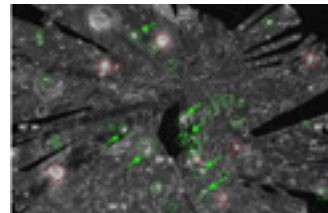
### ANTARTICA BLOOD FALLS

The source of the blood red water is an intensely salty lake trapped under 1,300 feet of ice, microbes have carved out a niche for themselves in that inhospitable environment, living on sulfur and iron. The bacteria colony has been isolated there for about 1.5 million years, in an oxygen-poor ecosystem.



### WATER FOUND ON MOON

Vast pockets of water ice numbering in the millions of tons have been discovered at the north pole of the moon, opening up another region of the lunar surface for potential exploration by astronauts and unmanned probes. Water could be mined to produce oxygen to support a future moon base.



➤ 40 small craters with water ice. The craters range in size from 1 to 9 miles in diameter

### BLACK PENGUIN EXISTS

This King Penguins seems unafraid to defy convention. In what has been described as a "one in a zillion kind of mutation," biologists say that the animal has lost control of its pigmentation. Other than the penguin's monochromatic outfit, the animal appears to be perfectly healthy.



### HUMAN BRAIN SHRINKING

Our brains are shrinking, according to scientists who have recreated a 28,000-year-old skull from remains found in France. The team, which claims to have produced one of the best replicas yet of an early modern human's cranium, says it is up to 20% bigger than ours. No one is suggesting this means our

ancestors were more intelligent as studies have found there is only a minor link between brain size and IQ.



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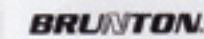
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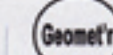
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### Nightvision 2.5x-42mm Binoculars with Infrared Illuminators

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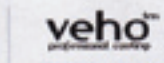
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## HEALTH

# Nanotech robots deliver gene therapy through blood

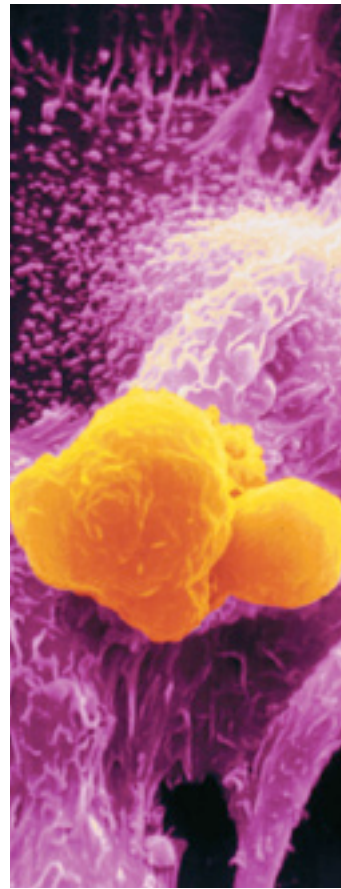
Nanoparticle robots able to inhibit important cancer gene

The finding, reported in the journal *Nature* on Sunday March 13 2010, offers early proof that a new treatment approach called RNA interference or RNAi might work in people. RNA stands for ribonucleic acid -- a chemical messenger that is emerging as a key player in the disease process. Dozens of biotechnology and pharmaceutical companies including Alnylam, Merck, Pfizer, Novartis and Roche are looking for ways to manipulate RNA to block genes that make disease-causing proteins involved in cancer, or AIDS. But getting the treatment to the right target has presented a challenge.

A team at the California Institute of Technology in Pasadena used nanotechnology to create tiny polymer robots covered with a protein called transferrin that seek out a receptor or molecular doorway on many different types of tumors. "We're excited about it because there is a lot of skepticism whenever any new technology comes in," said Davis, a consultant to privately held Calando Pharmaceuticals which is developing the therapy.

In a phase 1 clinical trial in patients with various types of tumors, the team gave doses of the targeted nanoparticles four times over 21 days in a 30-minute intravenous infusion. Tumor

samples taken from three people with melanoma showed the nanoparticles found their way inside tumor cells. And they found evidence that the therapy had disabled ribonucleotide reductase, suggesting the RNA had done its job. Davis could not say whether the therapy helped shrink tumors in the patients, but one patient however did get a second cycle of treatment, suggesting it might be. Nor could he say if there were any safety concerns or other possible implications of danger on the horizon. Davis said that part of the study will be presented at the American Society of Clinical Oncology in June.



## SPACE

# Lunar Orbiter Spots Lost USSR Rover

Recent Moon Images Reveal Missing Rover

NASA's Lunar Reconnaissance Orbiter (LRO) -- with the help of a Canada-based researcher -- spotted the tracks made by the 1,850 lb Lunokhod 2, leading to the dead rover itself, next to a crater where it broke down after 4 months of hard moon driving.

"We can see where it measured the magnetic field, driving back and forth over the same route to improve the data. Also see where it drove into a crater, and accidentally covered its heat radiator with soil as it struggled to get out again. That ultimately caused it to overheat and stop working. The rover itself shows up as a dark spot right where it stopped."

On June 4, 1973, it was announced that Lunokhod 2 had stopped communicating with its controllers in Soviet Russia. It was believed that the rover's open lid (which was closed during lunar night to retain heat) dug into the side of a crater wall, collecting a mound of dust. When it was closed during night, the dust was dropped over its radiators.



## BIOLOGY

# Always lost? It may be in your genes

Williams syndrome maybe linked to genetics

A new study suggests that skillful navigation just may be in your genes. Previous scientific research suggests that humans, rats, chicks, chimps and even fish use geometry to reorient themselves in space. They mentally visualize the geometry of their surroundings, corners and walls, to figure out where they are. But the new study indicates that genes may play a part in that ability.

"We found that people who suffer from the genetic disorder Williams syndrome have trouble reorienting themselves, a basic process that is shared among human children and adults, and a variety of non-human species,"

Lakusta said. "Our finding that individuals with Williams syndrome show this kind of impairment suggests an important link between genes and the system that is used for reorientation." said lead author Laura Lakusta.

Williams syndrome, a rare condition which occurs in one in 7,500 people, is caused when a small amount of genetic material is missing from one human chromosome. Individuals with Williams syndrome have strong language skills and they are extremely social, but they have trouble with tasks like doing puzzles or copying patterns or navigating their bodies through the physical world.

## BIOLOGY

# Make a Perfect Baby

US Doctor Offering Couple to Choose Child Sex

Doctor Steinberg provoked danger earlier this year when he said his fertility clinic could allow parents to produce "designer babies" - choosing eye, hair, skin colour and gender. Under American law, he is allowed to use pre-implantation genetic diagnosis (PGD) to reveal an embryo's sex. In Britain, it can only be used in screening for genetic diseases. "Britain is far more conservative than it used to be. They were the innovators but now they've got handcuffs on," Dr Steinberg said.

America has allowed sex selection - known by its supporters as "family balancing" - since 2001, but US pro-life groups have criticised the destruction of embryos deemed undesirable. Earlier this year, the Pope attacked the "ob-

sessive search for the perfect child" and said a "new mentality is creeping in that tends to justify a different consideration of life and personal dignity". In Britain, officials have warned parents who go overseas for treatment - often after spotting advertisements on the internet - that they should understand the relevant laws and the impact of the selection on any child who is subsequently born.

Other American medical centres have reported receiving interest from British couples, including the Genetics and IVF Institute in Virginia. The institute said that up to 15 per cent of the 400 PGD cases it handles a year come from abroad. It said it counsels parents before the procedure.



## The Sun and Climate Shift

Terry Sloan Interview

**Helen** > Thanks for joining us. What is this theory that there could be a link between solar activity and cloud cover?

**Terry** > In Denmark I observed that the satellite data on cloud cover decreased. At the same time they observed cosmic ray intensity, galactic cosmic ray intensity also decreased. They hypothesized that the ionisation from the cosmic rays was causing cloudstt If this is true, since the cosmic ray rate is decreased over the years then we have less cloud cover now than we had 100 years ago. Therefore that allows more sunlight to come to the Earth to warm the Earth and cause the global warming.

**H** > How did you start looking at that? How did you go into detail?

**T** > Well one of the things we did was just mentioned a few minutes ago. The solar flare of 1989 and the one in 2003. Not only did this cause huge changes in the aurora, it spewed out a whole load of particles that interacted in the atmosphere and caused a big increase in the ionisation in the air.

**H** > Crucially did you see a big change in clouds? If so that was the clincher then?

**T** > No, That was the first nail in the coffin. Then we looked at a couple of other things. Cosmic rays occasionally go through quite a big decrease over the period of a week.

**H** > If cosmic rays are having this effect, how are they having this effect? Could that change over time?

**T** > No. Can I interrupt you there? We didn't say cosmic rays are having this effect, we tried to check the effect that was seen by the Danish scientists. All the evidence that we looked at did not corroborate their hypothesis. It could be as high as 20% within the measurements that we made.

**H** > So the bottom line here is that the efforts we're making to try and cut carbon dioxide are appropriate because that's our best contender for climate change.

**T** > Yes, that's correct. The Danish group which effectively had challenged the conclusions of the IPCC had no right to challenge the IPCC. That's the international panel on climate change.

## SPACE

# The Wizard Nebula

Williams syndrome maybe linked to genetics

This image of the open star cluster NGC 7380, also known as the Wizard Nebula, is a mosaic of images from the WISE mission spanning an area on the sky of about 5 times the size of the full moon. NGC 7380 is located in the constellation Cepheus about 7,000 light-years from Earth within the Milky Way Galaxy. The star cluster is embedded in a nebula, which spans some 110 light-years. The stars of NGC 7380 have emerged from this star-forming region in the last 5 million years or so, making it relatively young.

WISE, the Wide-field Infrared Survey Explorer mission, scans the entire sky in infrared light, picking up the glow of hundreds of millions of objects and producing millions of images. The

mission is designed to uncover objects never seen before, including the coolest stars, the universe's most luminous galaxies and some of the darkest near-Earth asteroids and comets. Its vast catalogs will help answer fundamental questions about the origins of planets, stars and galaxies.

WISE joins two other infrared missions in space -- NASA's Spitzer Space Telescope and the Herschel Space Observatory, a European Space Agency mission. WISE is different from these missions in that it will survey the entire sky. It is designed to cast a wide net to catch all sorts of unseen cosmic treasures, including rare oddities. All four infrared detectors aboard WISE were used to make this image.





# Don't Worry! Be Happy

The Science of Happiness

By Douglas Richards

Happiness is the meaning and the purpose of life, the whole aim and end of human existence.—Aristotle



**Okay!** We get it. Happiness is important. But what exactly is happiness? And how would we know where to even look for it? Does money make one happy? Not necessarily. There are plenty of miserable millionaires. In my own case I have often found an inverse correlation between my happiness and the state of my wealth.

When I had nothing, I had few responsibilities and wasn't in constant fear of a falling stock market. I lived in an apartment at which the landlord fixed broken appliances and mowed the lawn. Life was great. But if money isn't the key to happiness, what is?

In 1990, Mihaly Csikszentmihalyi ("MC"), then Chairman of the Department of Psychology at the University of Chicago (a school I

graduated from the year before), came out with a book entitled, "Flow: the psychology of optimal experience." MC was a pioneer in developing the science of happiness, and this book is a great place to start looking for answers. MC and numerous others have expanded this field over decades, studying thousands and thousands of subjects around the world. And, like the study of

human facial expressions, their findings seem to be universally applicable across every culture they have yet examined.

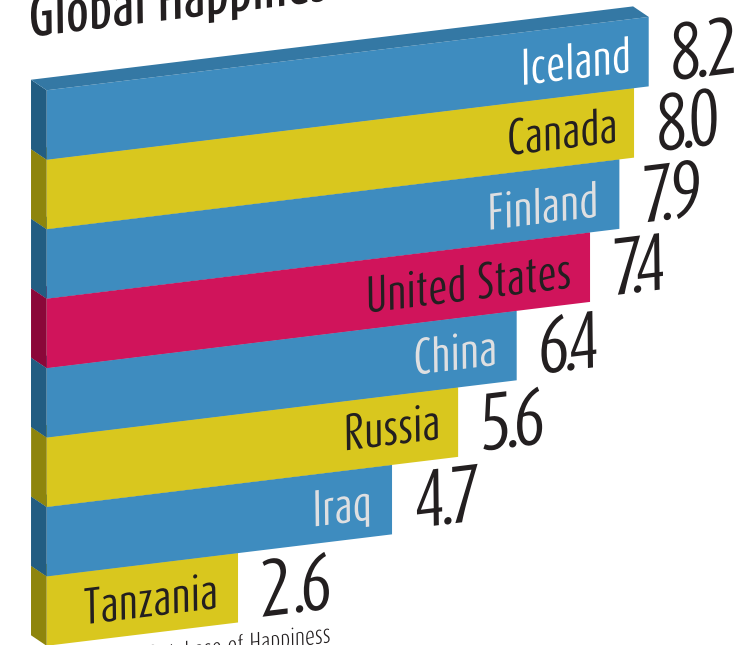
Basically, what MC and others have found is that people are the happiest — not when they're sitting mindlessly in front of the television for hours on end (even when it's a 60-inch plasma set) —but when they're making mental or physical efforts that engage them in a challenging activity that requires skill. An activity that isn't too easy (which would get boring) or too difficult (which would cause anxiety and frustration). An activity for which you have clear goals and receive

clear feedback, and one for which your skills can continue to improve, allowing you to grow as a person. According to MC, "Contrary to what we usually believe ... the best moments in our lives are not the passive, receptive, relaxing times — although such experiences can also be enjoyable—the best moments usually

**"people are the happiest when they're making mental or physical efforts that engage them in a challenging activity that requires skill"**

occur when a person's body or mind is stretched to its limits in a voluntary effort to accomplish

## Global Happiness on a scale of 1 to 10



Source: World Database of Happiness

something difficult and at the end of the day worthwhile."

During activities such as these, you achieve a state of what MC calls "flow," a state in which your attention is so totally absorbed by what you're doing there is no room in your consciousness for fear or worry. In fact, you become completely unselfconscious; for once not caring about such trifles as your appearance or what others think of you. Your hair could be standing on end as though you'd just stuck your fingers in power socket but you're far too engrossed to notice—or care. You're so focused on the task at hand that you even lose your sense of time. For example, when I'm writing, which I love to do, five hours can fly by like five minutes. On the other hand, when I'm with my wife while she's shopping for shoes, five minutes can seem like an eternity. In the words of MC, "Struggling to overcome challenges, and then overcoming them, are what people find to be the most enjoyable times in their lives. People typically feel strong, alert, in effortless control, unself-conscious, and at the peak of their abilities." And while it is true that

we relinquish our sense of self while engaged in flow-producing activities, when our sense of self returns we realize that we've been enriched; that our skills have grown and so has our sense of achievement.

Any activity that requires energy, can be focused upon, and is challenging can create flow.

**"I had thought the secret to happiness involved food, wine, sex, cars and gadgets"**

The list of such activities is endless and includes reading, writing, performing, playing sports, learning, playing chess, engaging in stimulating conversation, dancing, and so on. Let's use tennis as a specific example. It is challenging, but not impossible, offers clear goals, immediate feedback and the chance to improve. While playing you can feel good about your mastery of the game, and you're so absorbed you have no time to worry about your mother-in-law's upcoming visit, your high cholesterol, or the ex-inmate named Slasher who's dating your daughter. Surgeons are in flow during surgery and shop keeps are in flow when they

are artfully closing a sale. In many ways, flow is the opposite of boredom and anxiety.

Although these findings now seem obvious to me, when I first learned of them they came as a bit of an epiphany. Like most people in our society, I had thought the secret to happiness involved great food, wine, sex, cars and gadgets; that the fastest way to happiness was the maximization of status, wealth, and pleasure. And while pleasure is undeniably something to be valued, research has shown that equating pleasure with happiness is a fallacy. Pleasure can be experienced with little effort on our parts, and does not result in any growth in our sense of self. But in study after study, when people contemplate what really makes their lives rewarding, they report it is the process of making focused efforts; efforts that add complexity to the self and lead to psychological growth. In short, our greatest enjoyment and satisfaction comes from a sense of accomplishment. A New York Times review of "Flow" summed it up best, "The way to happiness lies not in mindless hedonism, but in mindful challenge."

So if the above are signposts for happiness, what are the signposts of the opposite condition? After all, unhappiness is on the rise. The average person today lives better in many ways than the kings of old, given the availability of air-conditioning, nearly unlimited entertainment and food choices, hot showers, speedy transportation, undreamed of methods of communication, and so on. Despite this vast increase in comforts, many of us lead lives of anxiety and frequent depression. "With affluence and power come escalating expectations," writes MC. "And as our level of wealth and comforts keep increasing, the sense of well-being

## Happiness Facts

- ▶▶ If you do 20 minutes of exercise, 3 days per week for 6 months, your general feeling of happiness will improve 10-20%.
- ▶▶ In the USA clinical depression is 3-10 times more common today than two generations ago.
- ▶▶ Having 100-200 belly laughs a day is the equivalent of a high impact workout, burning off up to 500 calories.
- ▶▶ Several studies have shown that a pet can reduce blood pressure and stress, promoting health and happiness.
- ▶▶ People in steady relationships are overall happier than singles.
- ▶▶ When people get married their happiness peaks, but after a while it returns to the level it was before they got married.
- ▶▶ Women tend to experience their all-time lowest life satisfaction at age 37, and men typically experience this at 42.
- ▶▶ A smile is a universal expression of happiness and recognised by all cultures.
- ▶▶ Not taking things so seriously can bring hope and happiness. People with a hopeful outlook are also good at laughing.
- ▶▶ Very happy people watched 20% less TV than unhappy people
- ▶▶ A person who studies laughter is called a 'gelotologist'
- ▶▶ A smiling person is judged to be more pleasant, attractive, sincere, sociable, and competent than a non-smiling person
- ▶▶ Although we have seen great advances in our world over the past 50 years, our "happiness" as a society has not increased
- ▶▶ The rate of depression and suicide does not increase during the holidays as most think
- ▶▶ The fastest growing segment of the anti-depressant market is pre-school children
- ▶▶ People are born with the ability to smile, even babies who are born blind can smile



we hoped to achieve keeps receding into the distance. There is no inherent problem in our desire to escalate our goals, as long as we enjoy the struggle along the way. The problem arises when people are so fixated on what they want to achieve that they cease to derive pleasure from the present. When that happens they forfeit their chance of contentment." Activities that are truly enjoyable are those that we do for their own sake; because they are intrinsically, not extrinsically, rewarding. Unfortunately, striving for the trappings of success can cause us to turn solely to extrinsically rewarding activities at the expense of those with a far greater ability to foster joy within us, causing us to completely miss thousands of potentially fulfilling experiences. According to MC, the best way to avoid this is to learn how to "find rewards in the events of each moment... to enjoy and find meaning in the ongoing stream of experience, in the process of living itself."

I would argue that given how vitally important the quest for happiness is to all of us, this is a subject that we, as a society, should be introducing to our children at a young age (perhaps 5th or 6th grade). Surely schools can spare a few hours to make our kids aware of concepts that could have a profound impact on their lives. And a general knowledge of the subjects of flow and happiness among our educators might lead them to consider curricula and homework in a different light, improving how both are handled, how both can be modified to enhance their potential to create flow in students. Before they reach school age, our children are little sponges, soaking in information at a fantastic rate. Their delight as they learn an entire language from scratch is clear to see, as are their expressions of joy whenever they master new skills or knowledge. But as we all know about human nature, when an activity is imposed ex-

ternally we often rebel against it. Kids will happily pore over a book of puzzles for hours in rapt attention, but label these same puzzles "homework" and what could have been joy can transform into drudgery.

**"I've played tennis all my life, and there are nights I feel sure I can't possibly pry my carcass from the couch to play a scheduled match, but there has never been a time I wasn't glad I did."**

Those of you reading this article are (hopefully) enjoying it, but would this enjoyment be diminished if your boss forced you to do so? Probably so. People report being in flow (and thus happier, more active, more creative and more satisfied) far more often at work — even those on assembly lines — than during their free time, when they aren't using any skills and often report feeling

passive, dull, and dissatisfied. Despite these findings, it will come as no surprise that these same people long for leisure while at work, even when they're challenged and happy. And what do they long for during their leisure

time? You guessed it — more leisure! — even when they're bored and dissatisfied at the time. In this same way, I'm convinced that most kids are happier, on average, during the school year — constantly surrounded by friends in a structured, challenging environment — than during the summer, when they often whine of being bored. Yet many of these same kids wish their

summer break would never end; that school would never begin. Perhaps members of a society schooled in the science of happiness and alerted to this phenomenon would be better able to embrace the challenging, flow-producing activities encountered at work or school, even when these activities have been selected by others.

Teaching even the rudiments of the science of flow might encourage kids to be introspective; to consider if they are happier when mindfully challenged than when watching television. This is not to say that television and other entertainment can't be worthwhile, or that a certain amount of time relaxing in front of the television can't be an important, pleasurable part of our lives. But television is a low energy, passive medium, whose main benefit stems from occupying our consciousness enough that we don't dwell on our anxieties and we aren't entirely bored. Achieving flow on the other hand, by its very definition, requires effort; a requirement that can often make low energy alternatives seem more appealing. But by teaching our kids about happiness, perhaps we can help them recognize that the exertion of energy required to read or write or play sports, rather than sit in front of the TV, offers disproportionate rewards. I've played tennis all my life, and there are nights I feel sure I can't possibly pry my carcass from the couch to play a scheduled match, but there has never been a time I wasn't glad I did. I come back feeling energized and satisfied, far beyond what the couch and television could have offered. This is the sort of insight maybe able to help our kids.

Many of today's kids are pampered, praised, and made to believe that the universe revolves around them — that their happiness is the ultimate priority — without having any understanding of the true nature of happiness. To them, happiness is

about leisure, and pleasure, and the minimization of effort, when the truth is that working hard, finding ways to bring flow to this work, learning, perfecting skills, growing and achieving are far better avenues to happiness than endless free time.

In tennis, a beginner matched against another beginner can achieve flow and contentment. A beginner matched against Andy Murray can only achieve frustration, hopelessness, and a swift and sure thrashing. Perhaps tomorrow's generation will better understand that when they begin their careers there may be greater opportunity for them to find flow and happiness in the mail room than in the board room. But if they can find happiness in the challenges present at whichever level they find themselves, it won't be long before they earn their way to the boardroom, with skills now commensurate to the challenges they will find there.

All this being said, as with everything else in life, happiness requires a balance. Educators will need to stress the importance of not selfishly pursuing flow at the expense of responsibility. Flow can be addicting, and can be

**"Flow can be addicting, and can be brought on by activities our society considers negative as well as positive, such as war, theft, juvenile delinquency and the like."**

brought on by activities our society considers negative as well as positive, such as war, theft, juvenile delinquency and the like. But if this subject is taught correctly, I believe we can have quite a positive impact on our kids. Not all of them, certainly, but at least some of them. I firmly believe this because I have practiced what I am preaching here. When I speak at schools, I invariably discuss my books (of course) and encourage

kids to appreciate and use the power of the Web, but the majority of my time is spent on the science of happiness. I review the signposts of happiness for my young audience and explain how they can achieve this state by

reading books, playing chess, performing, taking dance classes, and playing soccer — but not sitting around staring at the ceiling. Happiness requires effort — but it is well worth it in the end. Maybe not fully, but they can all relate to engaging in activities for which time seems to fly, or remember when they turned off the television to good result. If we can help our children see the connection between happiness and

effort, and get them to question the link between happiness and passivity, than I believe we will have truly done them a service that will benefit our society — and perhaps even inspired some of them on to greatness.


## Chess Happiness

»The goal of joining and participating in a chess club will bring more happiness than the goal of buying a beautiful chess set. Once you've purchased the chess set, you're done. The chess club activity continues forever.

»The goals set forth as you train to become a better player will make you happy as they are achieved. The progression as a player will continue to increase as you defeat more challenging opponents; each win giving you satisfying accomplishment.





how bomb-proof suits save our soldiers lives 

# THE REAL-LIFE HURT LOCKER: THE SCIENCE OF BOMB PROOFING

By John Pavlus

Say you're a professional bomb defuser, like the soldiers in the Oscar-winning film *The Hurt Locker* — and the bomb you're working on suddenly goes off. Do you just kiss your adrenaline-addicted ass goodbye? No — odds are you're wearing an EOD (explosive ordnance disposal) suit, which means you actually have a fighting chance of walking away alive.

I had to know how these blast-resistant suits worked in real life — so I called up Pravit Borkar, a ballistics engineer at HighCom Security, a firm that manufactures EOD suits for the military, and asked him to explain.

### How a Bomb Kills You

The “EOD ensemble,” as Borkar calls it, is not simply a body-conform version of a Kevlar vest: “It’s a complex composite product consisting of both rigid and soft armor systems.” These two fundamental layers are designed to defeat the two main threats in an explosion: the overpressure pulse, or shockwave; and the fragmentation, known as shrapnel.

The overpressure wave is actually the more dangerous of the two. A microsecond after a bomb goes off, the explosion compresses the surrounding air and blows it outward in a lightning-fast shockwave that ripples through clothing and literally flattens internal organs. Guy Pearce’s character experiences it firsthand at the end of *The Hurt Locker*’s tense opening:

“You see that the technician gets knocked down well before the debris hits him,” says Borkar. “But how is he killed? That’s power of the overpressure wave: because he was relatively close to the device when it exploded, the pulse has probably collapsed his lungs.”

### How the Suit Keeps You Alive

The EOD suit’s rigid outer armor layer, the first and most important defense against this threat, is composed mainly of aramids: high-tech synthetic materials that are “strain-rate sensitive.” In other words, “the faster something hits them, the harder they become,” says Borkar. (Kevlar is simply the brand name of an aramid manufactured by DuPont.) The entire front-facing portion of the suit is reinforced from head to toe with hardened composites

of two or more aramids, optimized for strength and lightness. This rigid layer can literally reflect or bounce some of the overpressure energy away from the technician, while also repelling flying fragmentation.

But the overpressure wave inevitably passes through the rigid armor layer. It then encounters the “anti-coupling material”: a foamy layer of polyurethane or synthetic rubber that absorbs as much of the pulse as possible, like the crumple zone on a car. “It breaks the blast wave,” says Borkar. “These materials will not



▶ **The suit has no gloves because if you are close enough to be touching a bomb when it goes off nothing is going to save your hands.**

allow the pressure to pass through without dramatically attenuating it — ideally down to a level that is actually survivable when it reaches your body.”

Behind the anti-coupling layer, closest to the wearer, lies the soft armor: flexible fabric woven or knit from aramid fibers and other

materials, which Borkar refers to as the “catcher’s mitt.” By now the overpressure wave has been reduced as much as it’s ever going to be, so this layer mainly acts like a traditional bulletproof vest — it stops any remaining fragmentation that may have penetrated the rigid outer armor. NASA’s space suits also contain soft aramid layers to resist impacts from flying micrometeoroids — the astronaut’s shrapnel.

This three-layer system is amazingly effective, but no EOD suit is perfect. With every step you take closer to the bomb, the destructive force of its blast increases by an exponent of three. “So the difference between being just a small distance away from the explosive device — even a few feet — versus being right next to it, can save your life.”

### The Helmet and Collar

The “strike face” of the helmet is where the action happens: it’s transparent so the technician can see what he’s doing, and it also takes the brunt of the explosion should anything go wrong. It’s made of a hardened acrylic on top of a softer polycarbonate “catcher’s mitt” layer facing the wearer. (If the faceplate were simply constructed of rigid acrylic all the way through, an explosion could shatter it into the technician’s face.) The helmet is also equipped with anti-fog coating, a lamp, camera, and a two-way link with the technician’s commander.

The fin-like appendage on the helmet houses a forced ventilation fan, which blows fresh air over the technician’s face to relieve perspiration. But Borkar says that this might be one detail that *The Hurt Locker* got a bit wrong. “In our helmets we try not to add extraneous devices that will change the its geometrical configuration, because the blast wave will just knock that off,” says Borkar. “I don’t know what manufacturer they got that helmet from, but it was a little surprising

to see that extending out and up. Normally it would be placed behind the helmet so it wouldn’t face the brunt of the blast.”

### The Body Armor

The hard-armor plates that cover the tech’s torso, groin and thighs act as the primary absorbers of fragmentation, but their main function is to deflect the deadly overpressure wave. “The suit in the movie didn’t show it, but in the real world, these plates are shaped like flattened boomerangs to literally reflect the pulse energy out and away from the technician,” says Borkar. Since techs usually squat or sit on their knees while working, this rigid armor is thickest around the groin and inner thighs (to protect the femoral artery).

These plates can also be switched in and out depending on the requirements of the mission at hand and the expected blast force of the bomb. The military keeps copious records on the “survivability” of various organs under different magnitudes of overpressure, so EOD techs in the field can configure their armor to provide the optimal amount of protection to each specific area of the body while reducing the overall weight of the suit. “There’s a strategy to configuring the armor before deploying it,” says Borkar. “It’s highly modular, not ‘one size fits all.’”

Current suits on the market weigh anywhere from 60 to 70 pounds, and all that armor plating makes moving around pretty difficult. If there’s any gripe that Borkar has about in *The Hurt Locker*’s mostly-accurate portrayal of the EOD suit, it’s this: “The techs just walk far too easily.” That opening scene where Guy Pearce hoofs it away from the exploding bomb? Fat chance: according to Borkar, just walking in these suits feels like carrying an anvil between your legs. The current world record for running one mile in the suit is nine minutes and 58 seconds flat!



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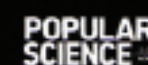
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