RANDOM HOUSE eBOOKS

How Slow Can You Waterski?

The Guardian

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How Slow Can You Waterski?

Edited by Simon Rogers

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CONTROLLED EXPLOSION PACKAGE PROVES HARMLESS
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Do these headlines seem familiar? Have you ever stopped to think about what they really mean? Or do you just glance at the story and turn the page of the paper? Have you ever wanted to find out exactly how you control an explosion? If chocolate is really good for you? Or even what makes a planet a planet? We did, and this is how we came to start up *This Week – the science behind the news*. It began as part of the *Guardian*'s *Life* supplement, launched by Emily Wilson and carried on by me, and swiftly became one of its most popular columns, surviving *Life* to become part of the paper's main news section. And the reason for its success? It answers those nagging questions that lurk behind every news story but rarely make it into the paper.

At one level it is serious stuff. Politicians may claim that the only solution to the energy crisis is to go nuclear, but what exactly are the risks, and can we be sure that new nuclear power stations will deal with them? Every few months there seems to be new superbug set to cause a pandemic, but what is the real threat, and can we protect ourselves if we need to? At the other end, when a royal is forced to take her dog to a pet psychologist, don't you want to know what they actually do there?

Despite the scientific community's obsession with communication, there is a lot of bad, sensationalist science reporting in the UK media. 'Miracle cures' and 'startling new developments' are miraculously and startlingly frequent.

You need a bit of background knowledge to untangle the ends of a story, and *This Week* is part of the attempt to provide that.

Yet all of the articles have their own existence, independent of the story which inspired them. At the time the pieces were commissioned and written, we treated them like news stories, and although they may seem short, enormous amounts of real reporting by the *Guardian*'s science team went into them every week.

We agonised over the currency of the pieces and the issues – would they stand up or just seem dated by the time the *Life* section came out? 'Do books improve your mind?' was written about a celebrity who had never read a book but was writing an autobiography. 'Can acupuncture help you to beat cocaine addiction?' was written as model Kate Moss struggled with the drug.

But current as the pieces were designed to be, most of them live beyond the week they were published. I will always be fascinated by what happens if you drill a hole in your head or how many vaccinations a baby can have.

These are the big questions of life. And the little ones too.

Simon Rogers

About the Book

When the powers that be reduced the speed limit on Lake Windermere to 10 knots, waterskiers complained that their sport was now completely scuppered. So just how slow can you waterski before you start to sink beneath the waves?

And, while we're about it, how long can you survive in a freezer? What are the chances of being struck by lightning in bed? And why is it so esay to raed wrods eevn wehn the lteetrs are mdduled up?

Everyday life can pose some mind-boggling questions – but where do you find the answers? *The Guardian*'s popular 'This Week' column has been looking into the science behind the news for three years, and *How Slow Can You Waterski?* draws together a selection of the most imaginative questions and the most surprising answers. If you've ever wondered what makes a planet a planet, why submarines keep bumping into things or even if it's safe to eat mud, *How Slow Can You Waterski?* will prove irresistible - and enlightening - reading.

All the articles here were written by the *Guardian*'s science team – Tim Radford, Ian Sample, David Adam, Alok Jha and James Randerson – with guest appearances by other *Guardian* and science writers, particularly Kate Ravilious, Ben Goldacre, Sarah Boseley, Steven Morris, Lucy Rogers, Bill Hanage and Laura Bach.

Minds & Bodies

Do books improve your mind?

WE ALL LEARN to read, but what happens in adult life when we fail to keep it up? Does the brain shrink like a withered prune? Studies in America found that continued intellectual activity between the ages of 20 and 60 may protect against dementia in later life. One found that continuing intellectual pursuits reduced the risk of Alzheimer's disease by a third. In another study, relatively inactive patients were 250% more likely to develop Alzheimer's.

Damaged brains can adapt and learn. Researchers who have used brain scanners have found that other parts of the brain can compensate. But exercising the brain, in much the same way as one would exercise a damaged muscle, perhaps by repeating a list of items, does not help regrowth.

Are you going to benefit more by reading Shakespeare than *Vogue*? It probably doesn't matter as long as the brain is exposed to new information that stimulates your cells. Luckily, physical activity also counts. Whether physical exercise is as beneficial as intellectual activity remains unknown.

Do animals make you feel better?

The idea might sound like new age mumbo-jumbo. But scientists now believe that swimming with dolphins really does alleviate depression.

It supports a theory put forward by the sociobiologist Edward O. Wilson. According to his idea of biophilia, human

health and well-being are dependent on our relationships with the natural environment. This means that animals and natural scenery help us feel better, and our happiness around nature is somehow hard-wired into the brain. A growing body of clinical evidence suggests that Professor Wilson might have a point. In a paper published in the *American Journal of Preventive Medicine* in 2001, public health scientist Howard Frumkin of Emory University, Atlanta, reviewed the evidence for the health benefits of four kinds of contact with the natural environment: contact with animals, plants and wilderness and viewing landscapes.

He pointed to research which concluded pet owners have fewer health problems than non-pet owners. They had, for example, lower blood pressure, improved survival after heart attacks and better ability to cope with life stresses. At Purdue University in Indiana, patients waiting for dental surgery were found to experience a clinically significant drop in blood pressure after staring at fish in an aquarium for 20 minutes. In another study, University of Washington scientists found that children with autism who were allowed to play with dogs became more verbal and engaged with therapists.

In Japan, researchers compared the responses of people who looked at a hedge with those staring at a concrete fence. The former experience caused relaxation, while the latter produced stress. Similar responses occurred when subjects looked at a vase filled with flowers as opposed to an empty pot.

Why any of this should happen is largely unknown but Professor Frumkin had some ideas. ‘Early humans found that places with open views offered better opportunities to find food and avoid predators,’ he said. ‘But they needed water to survive and attract prey, and groups of trees for protection. Modern research has shown that people today, given the choice, prefer landscapes that look like this scenario.’

Can you die from heartbreak?

With the caveat that it is difficult to establish a link between emotional stress and physiological health, all the evidence suggests that the answer is yes.

The first study to look at the issue was published in the *British Medical Journal* in 1969. Researchers followed 4,500 widowers, all 55 years or older, for nine years and found that the risk of dying in the first six months after bereavement was 40% higher than expected, then it gradually fell back to normal.

A bigger study, published in 1996, confirmed these results. Scientists looked at more than 1.5 million people aged between 35 and 84, and found that, in the six months after losing a spouse, the risk of dying from a heart attack increased by 20 to 35%. They also found that the risk of dying from an accident, violence or from alcohol-related problems nearly doubled. And in most cases, the risk of death was greater for men.

Why bereavement might trigger death or illness is largely unknown, but speculations are rife. When people lose the lifetime support offered by a partner, they are more likely to get stressed. This might have acute effects on the body and, the more elderly the person, the more pronounced those effects may be.

People suffering from stress due to losing a loved one have reported a range of health problems – from gastro-intestinal complaints to muscular pains. The sudden stress could also trigger more serious underlying problems, such as heart disease.

How psychological pain turns into a physical problem is also an active area of research. The accepted wisdom is that the brain, after registering the psychological and social variables around it, will signal instructions to release certain

hormones into the bloodstream and these affect mood as well as subsequent health.

Psychologists have found, for example, that people going through a rough patch in their relationship were more likely to catch a cold or flu. In a study of 2,000 people in various emotional states at the Medical Research Council's social and public health sciences unit in Glasgow, researchers found that stress or bereavement was linked to a decrease in the levels of an antibody called immunoglobulin A, which is the body's first defence against foreign microbes.

Why this happens is unknown, but researchers believe it might be down to high levels of the hormone cortisol, which tends to increase during stressful situations.

Does having wonky elbows matter?

That depends. Are you a man? Do you have a wife or girlfriend? And, most importantly, are your ears and fingers as mismatched as your arms?

If the answers to all of the above are yes then your (unbalanced) ears will have pricked up at the news that your partner is most likely to be unfaithful. A study of 54 couples by the University of New Mexico found that women whose partners have mismatching ears, fingers or elbows tend to fantasise about sex with other men when they are ovulating. Those whose men happen to be neatly proportioned do not, and still prefer their partners to other men, even in the middle of their monthly cycle.

Studies of sexual desire are not new. Dave Perrett at St Andrews University suggests that women prefer symmetrical faces because this indicates healthy genes in their partner.

Sex hormones are linked to feminine and masculine facial features – youth and fertility signalling good long-term health. By exaggerating such facial features, researchers have found that women are attracted to strong masculine

faces but too masculine a face can be a turn-off, indicating a cold and dishonest mate.

Can you stop yourself sweating?

If horses sweat, men perspire and ladies glow, then all three have their autonomous nervous system to thank. That means that sweating (or perspiring or glowing) is a reflex action and independent of direct messages from the brain. Some people have a more responsive nervous system than others, so while some are cool under pressure, others may find embarrassing stains on their shirts. And alcohol can effectively reset the nervous system to produce yet more sweat.

But for politicians caught sweating on prime-time news broadcasts, short of crash diets, lowering the lights and asking the audience to leave, is there anything that can reduce the visible proof that politics is 1% inspiration and 99% perspiration?

‘There are a couple of medications that might work,’ says Antranik Benohanian, a dermatologist at Montreal University Hospital, who has treated more than 5,000 patients with hyperhydrosis, the clinical term for excessive sweating. Some of these can be used on specific areas of the body, mainly by targeting a neurotransmitter called acetylcholine, which is produced by nerve endings under the skin and turns on the taps when it reaches the sweat glands. Applying it to the hairline the night before a big speech could prevent a sweaty forehead the next day. ‘But there is no solution without side effects,’ warns Benohanian. Some treatments merely shift the damp patches to other areas, and some induce blurred vision and a dry mouth – hardly inspiring stuff for a would-be prime minister.

Another possibility is the botox injections favoured by the wrinkle-free rich. The toxin knocks out acetylcholine transmission in the target area, offering up to a year of

reduced sweating. Liposuction can also destroy nerve endings beneath the skin, stopping the sweat message from being sent.

Can a blow to the chest stop your heart?

‘It requires a lot of force in one place on the left-hand side of the chest,’ says John Martin, a cardiologist at University College London. ‘It’s very rare.’ Unfortunately, the odds worked against a young cricketer in Liverpool, who was hit in the chest by a ball. He died after his heart stopped beating.

‘One in a million cricket balls hitting you on the chest would have this effect,’ says Martin. ‘Each cardiologist would see one in a career.’

The heart beats because of an electrical impulse generated at the top of the organ in the atrium. This electrical signal passes down the atrium and then into the ventricle, essentially a pump made of muscle. The signal ensures that the heart contracts all at once to force blood out into the bloodstream.

Under certain conditions, the signal is disrupted, most commonly through disease but, very rarely, through an external stimulus.

‘The impact of the ball has caused disorganisation of the electrical signal passing through the heart,’ says Martin. ‘Each little muscle fibre contracts independently of all the others. So there’s a great fluttering of this great muscle instead of a contraction.’ This flutter, or ventricular fibrillation, is the most common cause of death in the hours after a heart attack.

‘The tragedy is that it can be reversed fairly easily by a defibrillator,’ says Martin. Immediately after an accident, keeping the heart pumping until medical attention arrives can save lives. Even if a heart’s electrical activity is disrupted, pumping the patient’s chest can keep blood

flowing to the brain until medics arrive with a defibrillator. This device works by shocking the heart into re-organising its electrical activity.

‘Everybody should learn how to do cardiac resuscitation, how to go to a young man like this with no pulse, to press rhythmically on his sternum.’ says Martin.

How long can you survive in a freezer?

A question that Richard Carter must have asked himself when some kids locked him in his ice-cream freezer.

Carter, who was trapped in the –28°C chamber for 15 minutes, told a newspaper: ‘Another 15 minutes and I’d have been a goner.’

The first sign of trouble is frost-bite, says Bill Keatinge, physiologist at Queen Mary, University of London. In extreme cold, our bodies shut down the blood supply to our skin, and because our fingers are so small, they can freeze quickly if not covered up.

‘In experiments, I’ve frozen my little finger repeatedly, and it only takes about 70 to 80 seconds,’ says Keatinge.

Frozen fingers are a big issue in Yakutsk in eastern Siberia, the coldest town in the world. Drunks who collapse outside often have frozen fingers by the time they are found. ‘The local doctors do between one and three finger amputations a day, and it’s a small town,’ says Keatinge. ‘It’s a problem all over Russia.’

While shivering keeps you warm, boosting your body’s heat production tenfold, it uses a lot of energy, so can be exhausting.

When shivering stops, it’s time to worry. Even if you are fat, you will begin to lose heat quickly, falling into a state of hypothermia once your core body temperature drops below 35°C.

As the body cools further, breathing becomes laboured and it becomes hard to think straight. Ultimately, the heart

muscles begin to seize up, and because blood is then pumped around the body so inefficiently, tissues and organs fail through lack of oxygen. ‘You’d be in real trouble within hours at –28°C,’ said Keatinge. ‘I’d be amazed if anyone survived as long as a day at that temperature.’

How long can someone survive without water?

Not as long as aspiring Buddhas may claim. Reports from Nepal told of a teenage boy meditating for the last six months and said to have not drunk any water for the entire period. Suspicious locals asked for a scientific examination to determine if the boy was managing without water.

The magician David Blaine survived 44 days without food, losing one quarter of his body weight, but keeping a healthy body mass index. In 1976 obese people were put on an experimental starvation diet, with absolutely no food, for 40 days, and none of them had any trouble surviving. ‘It is possible to last much longer without eating than without drinking,’ says Martha Stipanuk, from the division of nutritional sciences at Cornell University in New York. But it does depend on your initial body condition. ‘A weak elderly person or thin young person might not be able to go very long without food,’ she adds.

The problem for wannabe Buddhas is that surviving for weeks without water is not an option. ‘People can last a few days without water depending on the environment in which they find themselves and whether [they are] injured or not,’ says Jeremy Powell-Tuck, professor of clinical nutrition at Barts and the London Queen Mary school of medicine, who supervised Blaine’s recovery.

Someone sitting quietly under a shady tree will be better off than an explorer caught out in the middle of a blazing desert, but none the less they won’t be able to survive for six months without a sip of water.

‘Without water anyone will run into problems pretty quickly. Their blood volume will shrink and their water and electrolyte balance will be upset. Eventually the body will just go into shock,’ says Professor Stipanuk.

How tall can a human grow?

History provides a few pointers. According to the Bible, the tallest man was Goliath at ‘six cubits and a span’, which, depending on whose conversion you believe, puts him somewhere between nine and a half and eleven feet tall. Sadly though, the Bible was not peer-reviewed, so Goliath must be disqualified.

The tallest man on record is Robert Wadlow, an Illinois man who died at 2.71 m (8 ft 11 in) in 1940 at the age of 22. The record may not stand for much longer, however. Leonid Stadnyk, a 33-year-old living in a remote village in Ukraine, hit the news as the world’s tallest living man. At 2.54 m (8 ft 4 in), he is just 17 cm short of Wadlow’s record. In the past two years, he has grown 30 cm.

Like Wadlow, Stadnyk owes his extraordinary height to a tumour on his pituitary gland. The tumour churns out growth hormone but it’s a secondary effect that leads to the runaway growth that doctors call acromegalic gigantism.

Normally, the growth of our bones is limited by our sex hormones. A good burst of sex hormones at the right time tells the ends of our bones to stop growing. In acromegalic gigantism, as the tumour grows it destroys cells in the pituitary gland that stimulate the release of sex hormones. The bones, therefore, never get the signal to stop growing.

But surely there must be a limit to a person’s height? John Wass, a specialist in acromegalic gigantism at the University of Oxford, reckons it would be impressive to survive for long if you grew taller than 9 ft.

First, high blood pressure in the legs, caused by the sheer volume of blood in the arteries, can burst blood vessels and

cause varicose ulcers. An infection of just such an ulcer eventually killed Wadlow.

With modern antibiotics, ulcers are less of an issue now, and most people with acromegalic gigantism eventually die because of complications from heart problems. ‘Keeping the blood going round such an enormous circulation becomes a huge strain for the heart,’ says Wass.

How long can hair grow?

Hair follicles on the scalp rarely push out more than 0.5 mm of new hair fibre a day and a follicle is active for at most six years before falling dormant. After a few months, it re-activates itself and produces a new hair.

Vietnamese man Tran Van Hay has 6.2 m of the stuff at the time of going to press, although its length may be due to infrequent washing – he has not washed his for six years. ‘Hair produces oils and can easily become matted. If you don’t wash it, hairs that would have fallen out may stick to those still attached to the scalp,’ says Mike Philpott, head of the hair biology research group at Queen Mary, University of London.

Some animals, like angora rabbits, have exceptionally long hair because a mutation in a gene called FGF5 causes hair follicles to be locked into the growth phase for longer. ‘Maybe this guy also has a defective gene,’ says Philpott. The existing world record, held by Hoo Sateow of Thailand, currently stands at 5.15 m.

Why do fair-skinned Brits burn while Swedes tan?

People from further north tend to have paler skins, the better to absorb the weak sunlight and trigger vitamin D production. After that any subtle differences in skin type are a matter of genetic inheritance.

‘Your Celtic phenotypes – Brits with pale skin, freckles, red hair – will burn and never tan,’ says Mark Birch-Machin, reader in molecular dermatology at the Newcastle University and a researcher for Cancer Research UK.

Brits of a less Celtic extraction may burn and then tan when young, but will pay for it heavily with wrinkles when older. ‘Each time you go out in the sun and get burned, you damage your DNA. Even before you get sunburned skin, you have damaged your DNA, so it is worse than it looks. You cannot say: “I am safe until I become a lobster.” That is not true.’

But Birch-Machin is dubious about races such as the Swedes having any real advantage over us in the tanning stakes. After all, our blood is extremely muddled up in Europe, and the British public is generally exposed to only a small sample of (famous) Swedes – some of whom may sport artificial tans of course.

‘If you go out in the sun you may get skin cancer,’ he says. ‘But what is sure is that your face is going to look like an old sofa. You will have a 50-year-old face on a 30-year-old body, and particularly if you smoke.’

James Scott, director of the genetics and genomics research institute at Imperial College London, thinks that from a genetic perspective, the British should be more likely to toast to a gentle brown than their cousins from more northerly latitudes.

The genetic differences among northern Europeans are minuscule, he says, and any golden glow from the Baltic could be, he says, an ‘observer artefact’.

But he is not certain of that. ‘Either the genetics is subtly different in Swedes, such that they have blond hair and fair skin but the propensity to develop more melanin when they see the sun,’ Professor Scott says. ‘[Or] maybe there is a form of conditioning in which the genes get set by environmental triggers in a particular sort of way.’

How do you test someone's intelligence?

There are endless methods, each one claiming to have an edge over the others.

Mensa, the UK's high IQ society, prefers to use the Cattel test developed by psychologists in the early 20th century. It avoids using questions that require previous knowledge and tries to measure how quickly and clearly someone thinks. But is it better than the Haselbauer–Dickheiser test for Exceptional Intelligence where each question in the test is a puzzle and the more questions you answer, the more intelligent you are?

'We would say so,' says a spokesperson for Mensa. 'Because it's measuring your speed of thought, which is very important in IQ testing.'

Munder Adahami, a researcher at the Centre for the Advancement of Thinking, King's College London, says that both tests have flaws. 'The problem with IQ tests is that they can be taught,' he says. 'You improve by 10 points by having some practice on them.' In addition, he says, someone's cultural background has an impact on how they interpret, and perform on the test.

Adahami uses the Jean Piaget technique. 'Intelligence is neither a fixed or inherited quality nor is it something you acquire by experience alone. There's some dynamic interaction between the two.'

It is that interaction the Jean Piaget test tries to tease out. The test does not require any previous knowledge and can eliminate the problems associated with cultural references.

But perhaps the biggest problem in measuring intelligence is actually defining what intelligence is. Many argue, for example, that there is a central processor somewhere in the brain governing our ability to interpret the world around us. Others say this function is spread across different parts of

the brain. Working out who is right or wrong is enough to test anyone's head.

Does dyslexia exist?

Not according to some education experts. Instead, they argue, dyslexia is an emotional construct used, in many cases, to save children who are poor readers from embarrassment.

Unsurprisingly, scientists studying the biological basis of dyslexia beg to differ. 'To say it's a myth is pretty far-fetched,' says Tony Monaco, head of neurogenetics at the University of Oxford and an expert on the condition.

According to the professor, children who are simply poor readers may mistakenly be diagnosed with dyslexia if their reading ability is not assessed alongside their general intelligence. The sign of real dyslexia is a reading ability far below that for a child's age and intelligence.

Research is gradually teasing out the developmental glitches that give rise to dyslexia. 'From studies of twins in the UK and Colorado, we know that around 50–60% of the variance in reading ability is due to genetic influences,' says Monaco. The condition is highly hereditary with around half of children born to people with dyslexia also developing the condition.

In a study of 300 families, his group identified a gene on chromosome 6 they suspect is strongly linked to dyslexia. The gene is thought to help neurons in the developing brains of babies move to their correct positions. 'When you knock the gene out in rats, you get no movement of the neurons,' says Monaco.

The finding was bolstered by researchers at Cardiff University who independently identified the same gene as a potential factor in dyslexia. 'In the developing brain, neurons have to move to the right level and it appears that a variant of this gene impairs that movement,' says Monaco.

Brain scans carried out by another Oxford University researcher, John Stein of the Dyslexia Research Trust, have shown that people with dyslexia have underactive brains in several key areas associated with reading and vocal word formation. ‘The evidence so far points strongly to dyslexics inheriting a genetic trait that means they have impaired neuronal migration,’ he says.

Experts believe that other genes will be discovered that also contribute to a person’s susceptibility to being dyslexic. Already, a Finnish group has found a gene on chromosome 15 that impairs neuronal movement in developing humans. And Monaco’s group believes that another contributing gene lies on chromosome 18.

Other research supports the notion that it is a real neurological condition: post-mortem examination of brains of people with dyslexia revealed many neurons were in the wrong place.

Why do suicide rates peak in the spring?

Psychiatrists have been scratching their chins over this one for years. Counterintuitively, the arrival of spring, and the long sunny days it ushers in, mark a staggering rise in suicide rates.

Mental health experts at the Priory group say that May is the peak month for suicides in Britain. ‘The increase can be dramatic, with up to 50% more successful suicides in some cases,’ says Chris Thompson, director of health care at the Priory group. In Britain, about 6,300 people take their own lives each year, 90% of whom are likely to have mental health problems.

The seasonal effect is seen all over the world, with the northern hemisphere witnessing a big rise in suicides in May and June and the southern hemisphere seeing a similar rise in November. While no one has a complete explanation as to