Deceived Wisdom

Why what you thought was right is wrong

DAVID BRADLEY

An extended sampler

DECEIVED WISDOM

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Introduction

Did your mother remind you to take off your coat when inside or you wouldn't 'feel the benefit' when you leave? Have you ever been informed that what you need to cool down is a nice cup of tea? And are you bored of being told that you have to let that red wine breathe first to improve its taste?

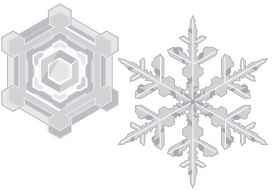
If so then **Deceived Wisdom** is the book for you. Organised into easy-to-read standalone sections, it looks at the things we think we know and examines why we don't know them at all.

There is much **deceived wisdom** in the world – from fitness fallacies to dietary deceptions and countless miscellaneous misconceptions. Given that human beings are inquisitive by nature it might seem odd that so much misinformation is out there swirling around and confusing us, but perhaps it's not that surprising. All too often we expect definitive answers to our questions in an instant rather than having to puzzle over a problem and work it out for ourselves, which means it's very tempting to reach for an instant answer without worrying about whether it's right or not. Moreover, it's often easier to remember a piece of received wisdom – say a memorable aphorism or a soundbite – than to look more closely at a given topic and extract the truth.

Yet to simply accept any statement of fact that comes your way unthinkingly is to miss out on a world of fascinating facts and information, where all too often the received wisdom is simply incorrect. So let me tempt you to avoid an approach to

the world based on hearsay or old wives' tales or whatever you want to call them. Instead why not embrace a science-based approach: read on as we weigh up the evidence and come to a scientific conclusion about reality. With science you can build a complex explanation for an observation as high as a house of cards or you could invoke Occam's razor and shave it down to the essential facts. However, the simplest explanation, rather than the most convoluted, will usually suffice.

So, if you'd like to get the facts straight, read **Deceived Wisdom** and ready your weapons to debunk the know-alls and their misbegotten myths.



A different kind of snow

The Deceived Wisdom:
No two snowflakes are alike

Generations of primary school children have attempted to simulate nature in their classrooms in the run up to Christmas. They carefully cut out circles of white paper, fold them into halves, quarters and even eighths. They eagerly snip away at the edges with safety conscious round-ended scissors. Finally, they unfurl their paper to reveal beautiful eight-sided snowflakes with which to adorn the classroom. At the end of term, they retrieve their decorations and offer doting parents the opportunity to adorn kitchen notice boards and windows around the home in celebration of ancient pagan and religious festivals.

Of course, pedantic parents will not be so keen to accept the snowy offering, perhaps pointing out that snowflakes, or more correctly snow crystals, are never eight-sided. The chemistry inherent in water molecules ensures that all snow crystals form with hexagonal, six-sided symmetry. Those same pedantic parents may also point out that no two snow

crystals are alike, which is a property shared with the paper simulations.

And, they would be right... to a point. If we investigate the structure of those tiny snow crystals down to the microscopic, sub-microscopic, and even atomic levels then it would be impossible for any two snow crystals to be identical. To be identical, each one of countless molecules of water locked into each icy structure would have to be in exactly the same position. A single snow crystal might weigh a milligram (a thousandth of a gram) and so contain a billion billion water molecules; that's 1,000,000,000,000,000,000. The possible variations between two snow crystals are to all intents and purposes infinite - and that's without even mentioning the fact that there is more than one type of oxygen atom (isotopes that differ in the number of neutrons in their nucleus), so any one of the billion billion oxygen atoms in all those water molecules might be an oxygen-18 instead of an oxygen-16 and be in any position. Moreover, the natural abundance of the heavier form of oxygen is about one in 500, so for every 500 oxygen atoms in a snow crystal one of them might be oxygen-18 and it could be in any one of those 500. The chance of the same pattern existing in another snow crystal is much longer odds than the chances of you winning the lottery.

As if that weren't enough, to see those kinds of differences requires powerful microscopes and scientific instruments beyond compare. It would also require that you could gather up all the snow crystals and compare each with the others without damaging them or any of them melting. It would be quicker to leave an infinite number of monkeys with an infinite number of typewriters to come up with "To be, or not to be".

If you're simply taking a look at snow crystals with the na-

ked eye, then chances are you will spot several that are indistinguishable. Indeed, aside from their shape and the substance from which they are made, snow crystals are not too different from crystals of table salt and you would not expect to see much variation in those tiny little crystalline cubes.

As salt crystals grow with cubic symmetry, so snow crystals form with hexagonal symmetry. A tiny speck of dust acts as the nucleation point on which water vapour will condense from the atmosphere and ice form. The ice crystals grow with hexagonal symmetry because loose bonds, known as hydrogen bonds, can form between individual water molecules. These hydrogen bonds exist only fleetingly in the liquid but are locked in place in ice. Water molecules H_2O, or H-O-H where the dash represents a chemical bond between the hydrogen atom and the oxygen, are actually bent at an angle of about 104 degrees. This means that the hydrogen bonds give rise to an overall hexagonal symmetry. Hence the six-sided or six-armed snow crystal. In nature, as opposed to primary school classroom walls, you will never see an octagonal or even pentagonal snow crystal; they are always hexagonal.

Why are snow crystals so important and why do scientists care about them so much? Well, the formation of snow and ice crystals in the atmosphere can affect climate and the health of our planet. For instance, ice reflects light and so can have an effect on how much energy from the sun is reflected back into space. Ice crystals can act as catalysts for the breakdown of ozone. Ozone is a form of oxygen found in the upper atmosphere that absorbs harmful ultraviolet rays from the sun and prevents them from reaching the Earth's surface. Without the ozone layer, life as we know it could not survive. The presence of ice and snow crystals in the atmosphere also play a critical

role in the build up electric charges in clouds, which ultimately leads to lightning storms.

One question remains when considering the six-armed type of snow crystal, as opposed to the type that are more like hexagons with holes. How does each of those six arms "know" to grow in the same branching way as the other five? How do all those countless water molecules "know" to freeze into place to make the snow crystal perfectly symmetrical? They are growing under almost identical conditions, of course, so one might expect this to be the case. But it is only to the naked eye (and on primary school walls) that snow crystals are perfect – although not necessarily in the eyes of pedantic parents. Under the microscope it is easy to see that six arms of that type of snow crystal are not all identical: there may be a tiny protuberance missing from one or an extra tiny knob of ice on another that make them deviate from perfection.

The science:

To the naked eye, snow crystals look like just so many tiny hexagons or six-sided wheels, with a few variations on the theme. But get a lot closer and it becomes clear that no two snow crystals could ever be exactly the same..

Additional reading

http://www.its.caltech.edu/~atomic/snowcrystals/alike/alike.htm

Infernal combustion and the mobile phone

The Deceived Wisdom:
You must switch off your mobile phone to prevent fires or explosions at petrol stations should it ring

For the best part of two decades, well-intentioned drivers with a strong social conscience have diligently adhered to the golden rule of the garage forecourt: Thou shalt switch off thine mobile communication device before dispensing the amber liquid unto the tank of thine vehicle. Of course, the less diligent boy (and girl) racers, the wide boys and wise gals, and the flippant drivers of white vans, simply flip a digit at the sign and carry on their fascinating phone conversations while filling up.

So, is there any risk that a stray radio wave from a mobile phone activated in a filling station is likely to blow the user sky high should the diffusion of petroleum vapours happen to coincide with that particular cellular airspace? Of course not. It's just another piece of Deceived Wisdom. It has never happened before and it's never going to happen. Never in the

twenty-year-plus history of the mobile phone has a filling station ever burst into flames because someone answered their phone; indeed, there has never been even the tiniest of conflagrations, despite what you may have read in hoax emails circulating since the 1990s.

There are countless opportunities for sparks to ignite inflammable vapours and liquids at any petrol pump, but you'll never see a sign warning you not to switch your vehicle's radio on and off – nor for that matter to start and stop your engine. Mobile phone masts might tower over a filling station where you decide to take that call from your mum, right at the moment the other drivers plunge nozzles into tanks, but there will be no fireball, no flash of white heat.

Petrol and diesel do burn, of course, otherwise all those internal combustion engines would be so many inert blocks, crankshafts and pistons. However, it takes a very special combination of physical conditions to ignite the fuel. In the case of diesel, it has to be hot enough; something that is achieved by compressing the vapour and giving it a boost with the engine's glow plugs. For petrol, a spark from a spark plug can do it, but this occurs best only if the vapour is contained in a small space. Moreover, the 12 volts and large current (20 to 40 amps) from a car battery might be enough, but the 3-4 volts and tiny current (less than 1 amp) of a mobile phone is not.

Sparks come in all shapes and forms – and it's true that you can build up static electricity in the synthetic fibres of your clothes and from the plastics and fabrics of the interior of your car. However, you would have to be very deliberate in your actions to avoid this static simply being discharged to earth as you got out of your car vehicle and grabbed the fuel nozzle.

And even if it were not discharged before then, it would certainly be grounded once you took hold of the fuel cap before starting the filling process.

All emails, anecdotes and spurious media reports about mobile phones causing fires on garage forecourts are nothing more than Deceived Wisdom.

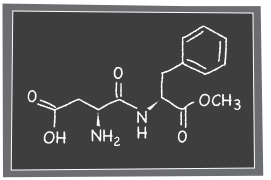
The Science:

Mobile phones do not cause fires at filling stations. There is no recorded fire department report that such an incident has ever happened anywhere in the world. There have never been any serious news reports claiming such a happening. The concentration of fuel vapours and the energy requirements for ignition are never met

Additional reading

http://www.kent.ac.uk/sspssr/staff/academic/burgess.html

'Mobile Phones and Service Stations: Rumour, Risk and Precaution,' *Diogenes* 213 54: 1 (in French: March 2006; English: February 2007; and subsequently in Arabic and Chinese): 125-139. ISSN: 0392-1921.



Sweetener for my sweet

The Deceived Wisdom:
Diet cola containing the artificial sweetener aspartame will cause blindness

For years the artificial sweetener saccharin, beloved of the calorie counters who might choose a diet drink to counteract the doughnut, burger and fries, was the poster child of the anti-chemical movement.

Synthetic and sickly sweet, saccharin soon became anathema in some quarters when laboratory evidence began to emerge that it might cause cancer. Laboratory tests can be deceiving, however. The useful, but notoriously simplistic, Ames test for cancer-causing substances can be used to demonstrate that the most innocuous of chemicals, water even, can cause changes in DNA that might be linked to cancer growth. Nevertheless, the harm was done, saccharin has since been scratched from food and drink ingredients lists in several parts of the world despite it only ever being used in tiny quantities and precluding the tooth rot and weight gain associated with overindulging on sugary food and drinks. The search for alternative

artificial sweeteners with none of the empty calories of sugar was already well underway when things turned bitter.

One of those alternatives was aspartame. Whereas zero-calorie saccharin is a synthetic molecule originally derived from coal tar in the nineteenth century and with a chemical structure that somehow stimulates the tongue into believing it is tasting something sweet, aspartame is a whole lot more 'natural'. This compound also goes by the formal name of N-(L-alpha-aspartyl)-L-phenylalanine, 1-methyl ester. But this worryingly complex Greek-sounding name belies the fact that aspartame is composed of the very building blocks of life from which all proteins are made: amino acids. Indeed, if we take a closer look at that name, the aspartyl refers to the amino acid aspartic acid and the phenylalanine is, well, merely phenylalanine. The L's simply tell us that it contains the natural 'L' form that can be digested by the body like any amino acid from our 'meat and two veg' – or 'nuts and three veg' if you are of the non-carnivorous persuasion. The 'N' and the 'alpha' tell us about how the two amino acids are joined together to form aspartame itself.

Despite its innocuous constitution, aspartame has become the darling of many a scaremongering tabloid story or blame-seeking activist agenda. There is even a Facebook page aimed at banning it. Claims exist for problems ranging from muscle cramps and seizures to headaches and depression… even Gulf War Syndrome. These have been endlessly repeated in email chain letters and poorly researched tabloid stories.

But aspartame's reputation is unjustified. There is only one valid concern. Babies born with the rare genetic disorder phenylketonuria (PKU) cannot process the amino acid phenylalanine, so they must avoid any food with proteins rich in that particular amino acid as they grow into toddlers. If they don't,

the breakdown product of phenylalanine builds up and stops normal brain development. A person with PKU has dietary restrictions throughout their life. Meat, chicken, fish, eggs, nuts, cheese, legumes, milk and other dairy products are permanently off the menu. Diet drinks containing aspartame are the least of their concerns given those restrictions but must also be avoided.

For most of us, phenylalanine is not a problem. In the body, aspartame is broken down into its component amino acids, which are then processed as if they were derived from meat, dairy products or any other protein. The chemical bridge used to hook the pair of amino acids together also means that a tiny amount of methanol is released in the process.

Could it be that methanol is the problem of which those wary of aspartame are so scared? After all, in a large enough dose or with chronic exposure, methanol can cause permanent blindness. Any doctor will testify to the sight problems they see in people drinking methylated spirits as a cheap, but toxic, alternative to alcohol. Methanol's fatal dose can be as low as 25 millilitres, about five teaspoons, but is usually well over 100 millilitres – the equivalent of a teacup of pure methanol. Could people drinking diet cola, for instance, be exposed to toxic doses of methanol as the aspartame is broken down by their bodies?

A standard can of diet cola contains up to about 180 milligrams of aspartame. If it was all broken down and absorbed by the body that would equate to 20 milligrams of methanol per drink. 20 milligrams of methanol is about 0.025 millilitres. That is about one thousandth of the lowest known toxic dose. To put it another way: to be exposed to a dose that could damage your sight, you would have to drink 400 cans of diet cola. A day. Even the most hardened dieter would not be able to drink that much in a misguided quest to lose weight. But is there a risk that drink-

ing two or three cans a day might lead to enough methanol accumulating in the body to cause problems within months?

Methanol is a cumulative poison, which is why people who drink methanol-contaminated hooch gradually succumb to its blinding toxicity. However, if all the methanol released from ingested aspartame is absorbed, it would take just an hour or so for it to reach its peak concentration in the blood. The liver gradually breaks down methanol into aldehyde, which is then converted to formic acid, the substance squirted by stinging ants. It is this acid that blinds the 'meths' drinker rather than the methanol itself. Fortunately, about 90 minutes half of the methanol has been broken down and the formic acid excreted by the kidneys. After another 90 minutes, half again has gone and so on, until after a day or so almost all of the methanol is gone.

Drink a single diet drink and you would, as mentioned, ingest 0.025 millilitres. Drinking a six-pack of diet cola in 90 minutes, a difficult task, you would ingest about 0.15 ml of methanol from the aspartame in the drinks – just over a hundredth of the minimal harmful dose of methanol. But, after an hour and a half, the dose present in your body would be broken down by the liver to 0.075 millilitres. Drink another six-pack of diet cola during the next hour and a half you would ingest another 0.15 millilitres, raising your total to about 0.26 millilitres. That quantity would fall to half in 90 minutes. If you were physically able to drink a six-pack of diet cola every 90 minutes all day long, the maximum amount of methanol that could accumulate would be just under 0.3 millilitres. That is a tiny fraction, just 3%, of the minimal dose known to cause vision problems. Compare that with a person drinking methylated spirits, which is one tenth methanol and 90% denatured alcohol, water and other components. A litre bottle of 'meths' contains about 100

millilitres of methanol – 40,000 times as much methanol as might theoretically be absorbed after drinking a can of diet cola.

The scaremongering about aspartame seems to focus on the breakdown products and most peculiarly on claims that diet drinks exposed to high temperatures are somehow more dangerous; they were even blamed for Gulf War Syndrome, a collective term for various problems faced by veterans of the 1991 war between the US and its allies and Iraq. But, it would make no difference to their effects whether the aspartame was already broken down in the can or once the drink had been drunk. Moreover, once broken down, aspartame no longer tastes sweet and a degraded diet cola would have a very nasty taste without its sweetener.

So, if you're having sugar-free drinks as part of a calorie-controlled diet, the last thing to worry about is whether or not the artificial sweetener is somehow bad for your health and your eyes. It's the sugar-laden doughnuts you need to worry about.

The Science:
Aspartame is composed of two entirely natural amino acids found in meat, dairy and vegetables; it is these that are released and processed by the body. A tiny amount of methanol might also be released by digestion, but you would have to drink hundreds, if not thousands, of cans of diet cola every day to accumulate a toxic dose of methanol.

Additional reading

http://www.sciencemediacentre.co.nz/2008/09/12/aspartame-is-it-safe

Only dedicated practice makes perfect

The Deceived Wisdom:
Just put the hours in and you could be the next Bill Gates, David Beckham or Nigel Kennedy.

Being exceptional at something is often attributed to one's genetics. Talent is passed down from parents or grandparents, it seems: doesn't matter if it is musical or artistic skill, being good with numbers or a dab-hand with the scientific pipette. No doubt there are significant genetic factors involved, but there are almost certainly environmental factors in the mix too. Perhaps the two work together, one boosting the other, so that those remarkable genes give rise to remarkable talent only if the skills are suitably nurtured.

However, many people now recognise that talent is learned and earned through extended and intense practice of a skill. Genes, they say, have little to do with it. This idea is encapsulated in a golden rule made popular by writer Malcolm Gladwell in his book "Outliers". The 10,000 hours of practice rule is based on research by psychologist Anders Ericsson of

Florida State University. Apparently, the rule tells us, a mere 10,000 hours of dedicated practice in your particular field is sufficient to bring out the best in you.

In essence Ericsson's theory suggests that sufficient practice in a particular skill can take anyone to the level of proficiency equivalent to that heard in the playing of a top concert pianist. Gladwell embraces this idea, pointing out that great sportspeople, business leaders and performers all apparently got their 10,000 hours practice in their particular art early in life. This helped them to excel early on, allowing them to shine while their less diligent contemporaries were still grappling with the basics.

Gladwell cites the 10,000-hour with regard to the well-known period in the early musical careers of The Beatles when they played almost endless nights in the nightclubs and bars of Hamburg in Germany between 1960 and 1964. This opportunity gave them something few musicians had during that era - plenty of time to practise. Ultimately, this practice time led to their greatness as musicians and songwriters.

Gladwell also cites Bill Gates, the founder of computer software giant Microsoft, famous for the Windows operating system for personal computers and its "Office" software. Gates is apparently a great example of the 10,000-hour rule. He had access to a computer in 1968 at the age of 13 when most of his school friends would have been striking out at baseball or dreaming of putting flowers in their hair and heading to San Francisco. This gave him a substantial head start in the area of computer programming and apparently allowed him to build his company at a much younger age than he might otherwise have been able to do.

Many of us imagine that our many hours spent with our hobbies are somehow allowing us to fill those 10,000 hours. I've played guitar since the age of 12, but don't imagine I am

anything but a total amateur musically speaking; I've not done the dedicated repetitive practice, you see? Anyone who has heard me strumming might suggest that I plug headphones into my guitar amp and practise for another 10,000 hours before letting anyone ever hear me play again. The psychologist on whose research Gladwell apparently based his discussions of the 10,000-hour, Anders Ericsson might well agree. Not because he has heard me play, but because that 10,000-hour rule is not quite what it seems.

10,000 hours is about 90 minutes' practice every day for twenty years. This might explain why the typical child learning piano will never make it to concert level. Three hours a day gets you there within a decade, so start at age 10 and you're done before you leave your teens. Unfortunately, passing the 10,000 hour point exactly is not a skills tipping point. Learning and gaining expertise are gradual processes; skills evolve with practice and talent grows slowly. There will be a vast range of time periods over which each individual reaches their peak of proficiency – their concert level you might say – in whatever field.

Ericsson is on record as emphasizing that it is not just any old practice for those 10,000 hours that matters. It is dedicated time spent focusing on improvement. Not all of the examples in Gladwell's book qualify as such deliberate practice. It is very different from simply taking part in the activity in question, Ericsson argues. More to the point, for musicians, it seems that the winners of international competitions are not those who have practised for a mere 10,000 hours but for those who have carried out closer to 25,000 hours of dedicated, solitary practice. For sports people, there are physical limits on how much dedicated practice is possible.

The question of whether or not 10,000 or even 25,000 hours

of practice – 25,000 hours is 3 hours' practice every day for more than 20 years - is enough does not tell us anything about whether some people are born with a particular talent. We do not yet know whether or not anyone with strong enough motivation and the spare time could become a virtuoso simply through deliberate practice, year in year out.

Scientifically speaking, 10,000 hours is just a metaphor for "lots of dedicated practice". If you want to achieve "concert level" whether at the piano or at the laboratory bench, 10,000 hours is a good starting point; more than double that and you might even start winning international competitions. However you look at it, it requires a lot of time and effort and not many people want to dedicate so much of their lives to a single pursuit. So, while practice might get some of us close to perfection, it is probably an unattainable goal for many. That is no excuse not to give it a try, of course. Some day I might even unplug those headphones once more.

The Science:

Most people do a relatively limited amount of practice to 'perfect' their art, whether wielding a cricket bat, playing chess, singing or programming computers. It can make you perfectly competent - but not necessarily excellent. Even 10,000 hours of dedicated practice may not be enough to give you the skills of a virtuoso.

Additional reading

http://www.psy.fsu.edu/faculty/ericsson.dp.html

Theory under pressure skates on thin ice

The Deceived Wisdom:
Skaters can skate on ice because their skates melt the surface of the ice and make it slippery

Countless science teachers, textbooks and fans of ice skating will tell you that ice melts under pressure. They explain how applying pressure lowers the freezing point of water so that it has to be much colder to freeze into solid ice, and how conversely ice under pressure will melt. The classic example of this phenomenon in action can be seen every time a skater's blades swish across the surface of an ice rink. The relatively sharp edge of the blade and the weight of the skater pressing down on the ice lower its freezing point so that the ice beneath melts, forming a thin film of liquid water on the surface of the rink across which the skate can glade with almost no friction.

Unfortunately, in common with the Deceived Wisdom that salting the roads in freezing weather prevents ice forming or that adding salt to a pan of boiling carrots makes them cook faster by raising the water's boiling point, it is simply not true. Adding salt

lowers the freezing point of water slightly but if the road is cold enough, ice will form. Similarly, a small amount of salt in the pan will raise the boiling point just a fraction of a degree Celsius.

The behaviour of water has puzzled scientists for centuries. For instance, unlike almost any other material it expands when it freezes. This is why titanic icebergs float: ice is marginally less dense than water, although most of an iceberg will remain below the water line because the difference really is small. It also means that fish can still swim in lakes and rivers that appear to be frozen – because bodies of water effectively freeze from the top down allowing liquid water to remain below the icy surface.

Water is also unusual in that we can experience all three common states of matter – solid, liquid and gas – within a very small temperature range, just 100 degrees Celsius. By contrast, the oxygen in the air that we breathe is commonly a gas, becomes a liquid only at about 183 degrees below zero and freezes at an even chillier –219 Celsius. At the other extreme common table salt, sodium chloride is a solid until it reaches more than 800 Celsius and vaporizes only at a scorching 1413 degrees.

But, back to those ice skaters. Scientists have done the calculations on the change in freezing point of water at different pressures and backed it up with experiments. To lower the freezing point of water from 0 Celsius to -1 Celsius you must apply a pressure more than 121 times the pressure of the atmosphere bearing down on our heads right now.

One of the scientists who has done the watery sums has a solid answer. Chemist Kevin Lehmann of the University of Virginia in the USA first assumes that an ice skater might weigh about 75 kilograms. The blade of their skates in contact with the surface is about 3 millimetres in width and about 200 mm long. Technically, pressure is defined as the force applied to a specific

area. The force pressing down on the ice is 75 kg multiplied by gravity, which has a value of 9.8 Newtons per kilogram.

The Newton is named after Sir Isaac Newton, who never did sit under an apple tree and discover gravity when an apple from said tree fell on his head. He invented that tale merely to publicise his book. Think of him as the original spin doctor.

We now see that 735 Newtons (75 multiplied by 9.8) of force are pressing down on the blade of that skate. To calculate the pressure we need to know the area of the blade in metres. 3 by 200 mm is 0.003 by 0.2 metres, an area of 0.0006 square metres. The pressure is the force, 735 Newtons, divided by this area, 1,225,000 Newtons per metres squared, or Pascals. Named for French scientist Blaise Pascal who never told tales of falling apples, but did invent a mechanical calculator when he was 19 years old in 1642.

That value for the pressure being applied through the skate to the ice sounds enormous. And, in some senses it is: it is about twelve times the value of atmospheric pressure. That's the pressure you experience if you dive under water to a depth of about 10 metres. This pressure is about ten times too small to melt ice. The skater would have to apply a pressure of 120 times atmospheric pressure to do that and to apply that amount of pressure would have to weigh ten times as much as a normal ice skater, and so be about 750 kg.

You might be wondering whether the pressure could be increased by sharpening the blades. After all, dividing the force of a 75 kg skater by a smaller number would mean a bigger pressure. Regardless, the effect would be to lower the freezing point of the ice by a few tenths of a degree. Given that most ice rinks freeze their ice to well below 0 Celsius, this would have little impact. The ice will stay solid.

How do skaters skate over the solid and rough surface of ice if there is no liquid lubricant in the form of water to allow them to do so? Lehmann concedes that as with many other properties of water, scientists simply don't know. There are theories about the water molecules at the surface and how they are not being held as tightly in the solid ice as those within the frozen solid. There are also ideas about defects in the structure of ice that might allow some water molecules to become loose and so enter the liquid state. It might be that the steel of the blade somehow grabs these loose water molecules and promotes melting as more and more water molecules loosen their grip on the ice to form that thin slippery layer of water below the skate. Either way, this has nothing to do with the pressure applied.

One property that quickly becomes apparent to anyone new to ice skating, however, is that when you land on the ice with a bump and struggle back to your feet, your body heat allows the frozen particles of ice to quickly revert to the liquid state … leaving you with a soggy behind.

The Science:

Applying pressure to ice lowers its freezing point, which means it will melt to form liquid water above a certain temperature. However, the pressure on the ice of even the bulkiest of skaters is a fraction of that needed to melt ice at the frozen temperature of an ice rink

Additional reading

http://www.faculty.virginia.edu/lehmannlab/badchemistry.html#ice

The three Rs of sustainability: Reduce. Re-use. Recycle.

The Deceived Wisdom:
Recycling is a waste of time and energy.
It's simpler, cheaper and more efficient to
dump waste in landfill.

ENERGY – Those opposed to recycling often attest that it takes more energy and resources and produces more of the greenhouse gas carbon dioxide to collect, process and recycle glass, paper, metal and plastic. This is dangerously misleading Deceived Wisdom. Mining metal ores, running oil wells and converting crude oil into plastics, felling trees and pulping wood all use far more energy than the relatively simple collection and processing of waste products.

GLASS – Only a fraction of glass bottles can be recycled into new containers. Colourless glass works well but unfortunately, brown and green bottles are less easy to recycle, producing low-quality recycled products. Nevertheless, the waste glass can still be recycled by grinding the glass into industrial abra-

sives, or adding it to building and road construction hardcore and aggregates or using it as filler for concrete and ceramics. This might sound like the glass is wasted, but production of virgin glass is an energy-intensive process, as is the production of cement; both also release vast quantities of carbon dioxide. By using waste glass aggregates and concrete the need for fresh raw materials for those applications can be reduced. The glass is recycled, just not into new bottles.

PLASTICS – Today some recycling centres have highly sophisticated sorting systems that use laser-guided conveyors and air-jet systems to separate the different plastics in a stream of shredded mixed waste. Crossed laser beams scan the plastics and a spectrometer reads their chemical signature, much as a checkout laser scanner scans the barcode on the items from your shopping trolley. A puff of air is then sent from the appropriate jet to send each shard of plastic into the appropriate hopper. As this technology gets cheaper and more widespread the ability to extract different plastics from household and industrial waste will become greater and less plastic will be sent to landfill or wasted.

ALUMINIUM – Until very recently, aluminium was considered a precious metal, so expensive was its extraction and production. Indeed, the statue of Eros in Piccadilly Circus, London, is aluminium as is the cap on the top of the needle-shaped Washington Monument, in D.C. Such was the esteem with which this metal was once held. Indeed, the cost of making aluminium during the nineteenth century made it more expensive than gold. The cost has fallen because electricity for the processing of aluminium ore, bauxite, is much cheaper now

and so today, lightweight aircraft and supercars aside, we tend to use the metal to make nothing more important than cans for drinks and 'tinfoil' sheets for wrapping the Sunday roast.

Despite electricity being relatively cheap, the energy costs and environmental impact of strip-mining bauxite and extracting the metal is very high. A quick calculation shows this to be the case: melting aluminium requires less than 400 kilojoules of energy per kilogram of metal. Breaking down aluminium oxide (from bauxite) uses about 80 times as much energy. So, melting aluminium cans to recycle the metal uses, overall, about 5% of the energy needed to produce virgin metal from bauxite.

PAPER – Paper is made by pressing wet, pulped fibres of cellulose from wood, sugar cane or grasses into sheets and then drying. Should this book ever stop selling the remaining handful of copies left in the publisher's warehouse may well be pulped (perish the thought) and added to the stockpile of recycled paper ready for conversion into the daily newspapers, which millions of people do still read despite the advent of electronic news and the web. Only about one third of the trees harvested each year are used to make paper; the majority are used in manufacturing wooden products, in construction and other areas.

ORGANIC MATTER – Until recently organic waste was simply landfilled and the methane gas released by its rotting underground vented or burned. But many recycling and composting centres can now accept all kitchen and garden waste and process it into useful compost.

LANDFILL – Today, sending waste to landfill should be the last resort, once plastics, metals, paper and organic waste are

extracted. Yet even then, it's not necessarily the end of the matter. It is Deceived Wisdom that once buried in landfill, waste materials are gone forever. This is not the case now, and in the future there will be more and more effective ways to 'mine' landfill sites, digging up and processing the old waste to extract precious metal, plastics and other materials which can then be recycled into new products.

The Science:

We may not be reducing our consumption, but there are many effective ways to reuse products and materials and once they are beyond that, they can be recycled. The three Rs are almost always the best option – certainly better than sending the waste to landfill

Additional reading

http://www.popularmechanics.com/science/environment/recycling/4290631

Red, red wine

The Deceived Wisdom:
The cork must be removed from a bottle of red wine well in advance of drinking to allow the wine to 'breathe'

Any good dinner party host knows that the corks must be pulled on the bottle of red wine well ahead of the meal so that the wine can 'breathe'. Any good wine waiter knows that such an affectation is a pointless act and has no effect on boosting the body, improving the bouquet or removing any bitter aftertaste of the wine. A good red wine will taste fine, provided it is not too cold, even if the cork is removed just before it is poured and quaffed.

What the good sommelier also knows is that sometimes a less than adequate red wine can be improved. This is done not by simply opening the bottle but by pouring quickly it into another container, a decanter, for instance. Under pressure, a sommelier might explain this little trade secret as aiding aeration to 'smooth some of the harsher aspects of the wine'.

However, according to Andrew Waterhouse, professor of enology at the University of California-Davis, even quickly

decanting and leaving the wine to stand for half an hour is not long enough for the astringent tannins in younger and less pricey wines to be broken down. Tannins give 'dryness' to a wine but make you pucker up if the content is too high. Waterhouse explains that it takes at least a day for these natural chemicals to be broken down. Unfortunately, if you leave a bottle of wine to breathe for that length of time not only will your guests have broken down and departed but bacteria, known as acetobacter, will have invaded the wine and started to convert the alcohol content to acetic acid, or vinegar.

As to the idea that a wine becomes smoother over the course of a meal – that is more down to your taste buds and nose than anything in the wine changing chemically. After the first few mouthfuls, you may perceive that the wine is somehow smoother, but really it is merely that your mouth has become familiar and accepting of the taste and the wine's particular level of astringency. As to the evaporation of malodorous compounds, these are rare in modern winemaking. If a bottle is 'corked' it will have a particularly unpleasant, musty odour due to the presence of TCA, 2,4,6-trichloroanisole. This compound is harmless in the quantities present in a corked wine, but it makes the drink unpalatable.

For white wine there is every reason not to let it 'breathe'. White wines have little tannin content and the fruity aromas that often accompany them are usually due to volatile compounds in the wine. Decanting a bottle of white wine will ensure that some of this volatile content is lost and the wine will lose much of the bouquet the wine maker hoped you would experience if it is not drunk immediately it is opened. The same sad loss will happen if the wine is warm or allowed to become warm once it has been opened. If you ever see a

wine waiter decanting a bottle of white wine, it's time to decant yourself from the restaurant and eat elsewhere.

One more piece of Deceived Wisdom about red wine… there are endless claims that red wine contains some kind of medical panacea, whether it is the antioxidant compound resveratrol or one of countless other natural chemicals found in the drink. Certainly, wine contains lots of natural chemicals: one of them is ethanol, which we usually refer to as alcohol. Any marginal benefits of antioxidants or other health-giving compounds in wine are cancelled out many times over by the presence of ethanol, which (despite our enthusiasm for drinking it) is a toxic chemical. Scientific studies from around the world show that more than half of all alcohol-related deaths are due to heart disease, cancer or liver damage. So much for the red wine panacea.

The Science:

The surface area exposed to the atmosphere by removing the cork or unscrewing the cap from a bottle is far too small to allow any significant exchange of gases with the liquid. Simply swirling the wine in the glass once it is poured has little effect, but the sommelier's secret is that decanting a younger wine meant for aging or a lower-quality wine can improve it slightly by helping some malodorous compounds in the wine to evaporate.

Additional reading:

http://wineserver.ucdavis.edu/people/faculty.php?id=14

Highly strung

The Deceived Wisdom:
The classic Stradivarius violin has a unique sound that justifies the reverence these instruments attract, and the million-pound price tags

Buying one of the 600 or so surviving violins made by master luthier Antonio Stradivari during the early eighteenth century will not make you sound better as a violinist. Not because a better instrument will not improve your talents but because there is no evidence that Stradivari's violins sound any different from those made by any other master craftsmen. A Stradivarius violin is often associated with superlative excellence by players, composers and conductors. The sound, they say is exquisite and cannot be reproduced by the most beautifully crafted modern instrument.

There are numerous theories as to why a Stradivarius can produce such a beautiful musical timbre. The design and shape of the violins and craftsmanship used in their creation are considered the most important factors, but there are theories in support of others. In 2003, US scientists suggested that

the wood available to Stradivari may have benefited from the Little Ice Age of the seventeenth century, making trees at the time grow more slowly than usual and so producing denser wood. Others have suggested that the sound might even be linked to the preservatives used at the time to kill woodworm and prevent moulds forming in the wood. There is one theory that says he used wood from ancient churches and that this endowed his violins with an almost spiritual quality.

Another focus of those hoping to explain the secret of the 'Strad' sound is that perhaps there is a secret ingredient in the varnish that somehow shapes the beautiful tone of these instruments. Unfortunately, researchers in Europe have smashed that notion too, demonstrating that there really was no secret sauce in the varnish. They took microscopic samples of varnish from five Stradivarius violins and carried out a highly sophisticated chemical analysis. The instruments were made at different times during a thirty-year period. The analysis revealed that the varnishes contain materials, such as oils and pigments, used widely in decorative arts and paintings of the period. The researchers found no unknown ingredients, no mineral or fossil resin layer as had been suggested by others. There is, it seems, no secret sauce.

The Cremonese creator was certainly a master luthier; he made hundreds of instruments, violins, violas, cellos, harps and guitars. The examples of these instruments that survive do indeed sound beautiful. Unfortunately for those clinging to the idea that there is something nevertheless mysterious about these instruments, in this case beauty is in the ear of the beholder.

Blind studies where the listener cannot see the instrument being played have shown several times that even the greatest experts usually cannot discern which is the Stradivarius when

the same piece is played by a virtuoso on different violins. Similar experiments with violins made by that other great master instrument maker, a contemporary of Stradivari, Giuseppe Guarneri 'del Gesù' revealed the same. Moreover, it seems that violinists themselves cannot tell the difference between playing an old and a new instrument when they are tested under experimental conditions. The fact that a single Stradivarius sold at auction recently for almost £10 million suggests that secret sauce or not, the instruments remain music to the ears of collectors ... and auction houses.

Of course, it is only the very best, elite modern-day violins – ones that are made with traditional craftsmanship and care combined with modern scientific understanding of acoustics, wood properties, etc – that are indistinguishable from a Stradivarius. It is not as if you could take any modern violin and expect it to perform as well as the classic. Stradivarius violins remain a remarkable historical achievement: people pay not only for the remarkable quality of performance they allow, but also for the historical value of the instruments.

The Science:

Scientific analysis of Stradivarius violins reveals there is no secret sauce in the wood or the varnish and that expert listeners and virtuoso players cannot distinguish between high-quality modern instruments and the classic violins.

Additional reading

http://www.jeffsextonwrites.com/2011/03/the-stradivarius-myth

Dozy deceptions

The Deceived Wisdom:
There are many popular claims about sleep, including the belief that your brain and body are less active when you sleep, that older people need less shuteye and that cheese gives you nightmares

Your brain and body shut down when you sleep – When you drift off into the land of nod, you might imagine that your lack of consciousness means that your brain and body are somehow shutting down, but this perception is as far from reality as you could get. Certainly you keep breathing, your heart keeps beating, you continue to digest food and produce urine. Moreover, some brain activity rises during sleep as thoughts are processed into memories and you may even regain some of that awareness in certain phases of sleep through dreams. However, when you sleep your muscles enter a state of hypotonia, (meaning low muscle tension): this seems to be a protective mechanism to preclude potentially hazardous movements if you act out your behaviour in a dream, for instance.

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http://longevity.about.com/od/lifelongenergy/tp/sleep_myths.htm

It is dangerous to wake a sleepwalker – Somnambulists can occasionally hurt themselves and others, so the reverse is true. Waking a sleepwalker could save them from embarrassing situations or worse falling down the stairs. It may confuse the person to be awoken and find themselves out of bed, but that will cause them no physical harm.

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http://www.theregister.co.uk/2007/01/27/the_odd_body_wake_sleepwalker/

You need less sleep as you get older – Unfortunately, this is not the case; you need as much sleep as you need and this does not decline as you get older. Instead what often happens is that you may find you begin to suffer from insomnia or aches and pains that prevent you from falling deeply asleep. Staying up late and rising early is therefore a common way of avoiding a restless and uncomfortable night, rather than an indication that you no longer need the same amount of sleep.

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http://psychiatry.ucsd.edu/faculty/sdrummond.html

Eating cheese before bedtime gives you nightmares – It is often said that eating cheese before bedtime will lead to a fitful night's sleep full of bad dreams, although the mean-spirited character Scrooge from Charles Dickens' A Christmas Carol blames the appearance of ghosts on Christmas Eve on a full meal including a "crumb of cheese". Back in 2005, the British Cheese Board attempted to overturn this particular crumb of Deceived Wisdom by apparently giving 200 willing volunteers different cheeses to eat and then asking them to report on whether they then had nightmares. The

volunteers reported weird and colourful dreams but no nightmares. There was in that Cheese Board study even some spurious link between the type of dreams and the type of cheese but there was no control group in the "study" to compare the number of dreams reported by people who didn't have the cheese.

Slightly more independent research suggests that the amino acid tryptophan, present in milk proteins in small quantities, actually improves sleep, although the amount present in cheese is far less than in meat. So cheese before bedtime, while not likely to stir nightmares, won't help you sleep any better than other foods … particularly if it gives you insomnia-inducing indigestion.

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http://www.merseysideskeptics.org.uk/2011/09/on-cheese-sleep-and-nightmares/

Snoring is a natural part of sleep – It probably will not help those who (try to) sleep in the same bedroom as a snorer to know that snoring, while common, is not really a normal part of sleep as it usually indicates some kind of obstruction of the airways, which is rarely a good thing . Moreover, loud snoring night after night is often associated with a condition known as sleep apnoea in which the person stops breathing for short periods of time. This condition can preclude a good night's sleep for both the snorer and anyone sharing the room, and there is also increasing evidence that sleep apnoea is a risk factor for high blood pressure and even type 2 diabetes.

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http://www.mayoclinic.com/health/sleep-apnea/DS00148

Everyone needs 8 hours' sleep – This is just plain wrong: some people do get away with less than 8 hours, although they may often be chronically tired without realising it; others sleep more than that, especially teenagers. One way to determine how much sleep you "need" is to check how long you sleep when there is no alarm, work or pressing engagement to wake you. If you wake up after having slept 9 hours then you might assume that is how much you need, though you could simply be compensating for a chronic lack of sleep over the course of weeks. On holidays there are often exhausting sporting, walking and drinking activities to take into account.

We do not know how much sleep our prehistoric ancestors had, but evidence from recent history and from studies of remote tribes does suggest that natural sleep patterns tend to fit into the hours of daylight, so will obviously vary throughout the year. What we do know is that sleep deprivation can cause serious health issues, whatever you may hear about certain famous names, such as former British PM Margaret Thatcher and American inventor and businessman Thomas Edison, supposedly needing just three or four hours. In the case of the former, some have suggested that Mrs Thatcher was not necessarily functioning at her best and might have been more effective in some of her duties if only she'd had more sleep.

There is recent evidence to suggest that, throughout history, humans have tended to sleep in shorter bursts, spending time in between awake without worrying about insomnia. The 8-hour sleep shift seems to be a recent phenomenon.

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http://psychcentral.com/lib/2011/do-you-believe-these-10-sleep-myths/

If you die in a dream, you die in your sleep – How would anyone know what the recently departed were dreaming of before their demise?

The Science:
Much of what we assume about sleep is dozy nonsense.

Additional reading

http://healthynole.fsu.edu/Common-Health-Myths/Sleep-Myths

Goal

The Deceived Wisdom:
The team that scores first will generally win the match

Sports pundits commentating on football, hockey and other goal-based games will often argue that scoring the first goal of the match is important and that doing so gives the scoring team the upper hand and an odds-on chance of winning the match. This punditry notion is usually rolled out during 'playoff' games which are often played more defensively than a standard league or cup match.

The problem with this claim is that in hockey and football, the scores are usually quite small, unlike in say, rugby or cricket, which means that the final result can hinge on just a single goal rather than a wider range of points scored. But, researchers in Canada wanted to kick this sporty Deceived Wisdom out of the field once and for all to show that scoring the first goal makes very little difference to the score at the final whistle. They used the mathematics of probability to calculate the chances of the first-goal team winning at specific

points through the course of a match based on the number of minutes left to play. They also counted extra time in their statistical analysis.

The team considered a match between Math United and Stats City that has T minutes to go once the first goal has been scored. They applied a mathematical formula known as a Poisson distribution to see how many goals are then likely to be scored during the remaining T minutes. The team explains that if both teams are playing hard to win then there is an equal chance of them scoring after that first goal. But, position in the league and scoring record from past matches are also taken into account in the formula.

The formula plays out as follows: from the kickoff, Math United has a 50:50 chance of winning, as does Stats City. If United scores within the first five minutes, their chances of winning go up, because City now has to score two goals to win. If they score much later in the first half, their chances of winning go up even more, because there is less time for City to catch up. If there is just 15 minutes of play left, then United are almost certain to win. It's simple statistics.

Of course, probability and statistics are notoriously difficult to pin down in real life: teams are rarely matched equally and there is the weather, injuries and the crowd to take into consideration. It is best to take not to statistical punditry at face value whether you are following the fortunes of the Toronto Maple Leafs in hockey or the Magpies in football.

The Science:

A mathematical analysis of the match shows that the chances of the first team to score winning rise as

time passes, but real-life probabilities
are unpredictable and there is never a
'dead cert' in a match.

Additional reading:

http://www.livescience.com/3637-goal-hockey-raise-odds-winning.html

We hope you enjoyed this free sampler.

Buy your copy of Deceived Wisdom now: