

# Litmuspaper

Daily news from The Times Cheltenham Science Festival

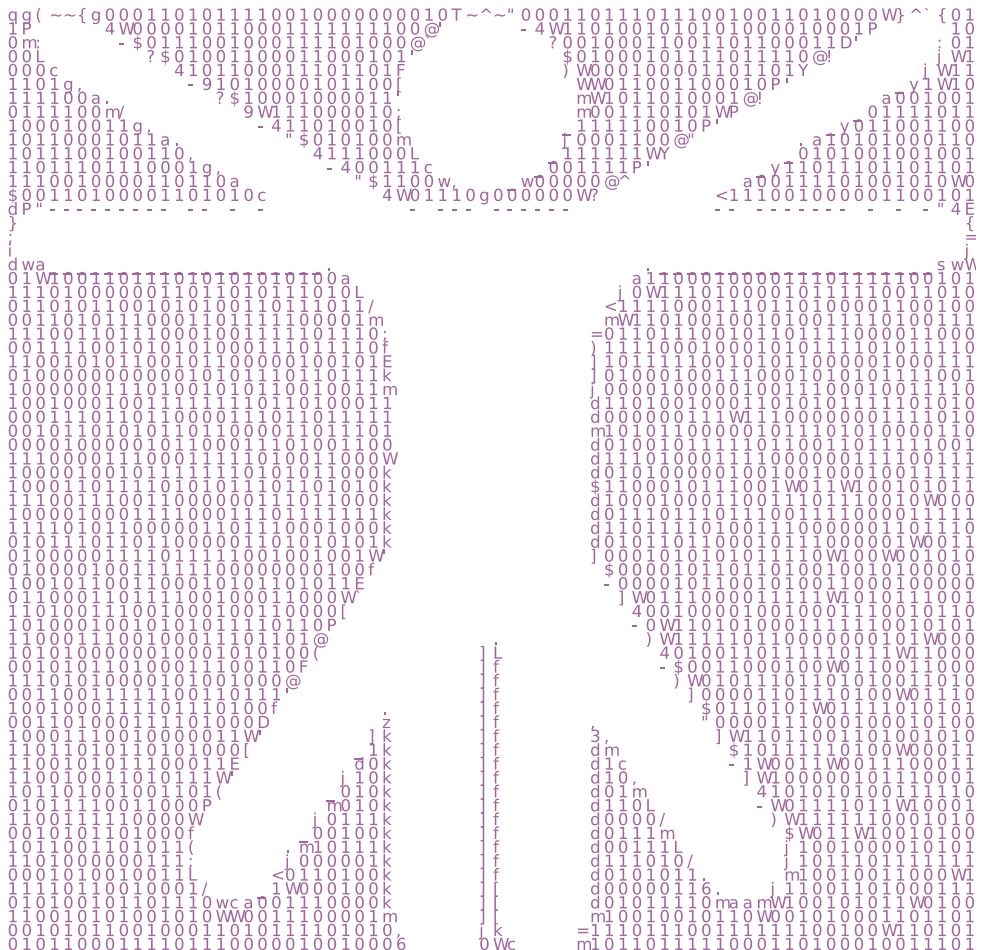
Friday 15 June 2012

News stories from the festival day 3

Science in the digital age

Daisy Ginsberg on synthetic biology

## The changing body



## Dr Michael Moseley presented the BBC series *Frontline medicine*, which explored how medical technology has advanced in times of war.

*While making the series you got very close to some of the procedures. Did the emotional effect surprise you?*

It did, because when I was doing medicine I saw an awful lot of really horrible things; I've seen people die in front of me and indeed under my hands, so I thought I'd be fine. [But I] saw literally dozens of people coming in, and there was one particular guy. He had lost one leg and was about to maybe lose the other foot, and he looked so much like my son Alex. It just got to me at that moment and I started to cry.

*People say that advances in medicine would not be made so quickly if it wasn't for war – what is your opinion on that?*

I think it's absolutely right. [For example], Penicillin was discovered in 1929 by Fleming but he did nothing with it. It wasn't until the Second World War that they put serious effort into it. I think in the case of what they've discovered in Afghanistan and Iraq [the main advance is] changing the amount of plasma you give, as opposed to red blood cells [during a transfusion]. I don't think that they could have done a trial [in the UK] which would have demonstrated what they demonstrated in Iraq. You don't have the number of casualties in civilian life.

*Medical advances on the battlefield are now seen in common practice. How fast do these advances reach our hospitals?*

It is quite fast and feeds both ways. In some case what you see is [advances coming] out of civilian medicine. [For example] if you want to deliver blood fast you stab the person in the chest with a needle. This was originally developed in pediatrics for tiny babies where you can't get into the veins. You stick it in the sternum, it reaches into the bone marrow, and you just pump blood in. When you've got soldiers and you're on a helicopter flying, shaking like hell, and the guy's lost both arms [so] there's nothing to stick a needle into, they just whack it straight in the chest. Now, in the US, certainly in the casualty departments, that's how they are delivering drugs.

### Litmus Paper 2012

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## DesignScience

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# Life support

Most people think bone is just a lifeless piece of material. But they could not be further from the truth. Bone is a living, if rigid, organ, made of bone tissue, blood vessels, nerves and other parts. It carries out important metabolic processes. Bone is also dynamic; it is constantly being made by osteoblasts and degraded by other specialised cells called osteoclasts.

The balance between bone tissue formation and degradation is controlled by many factors, including hormones. Bone tissue forms the rigid parts of the bone – it is the key to the bone's

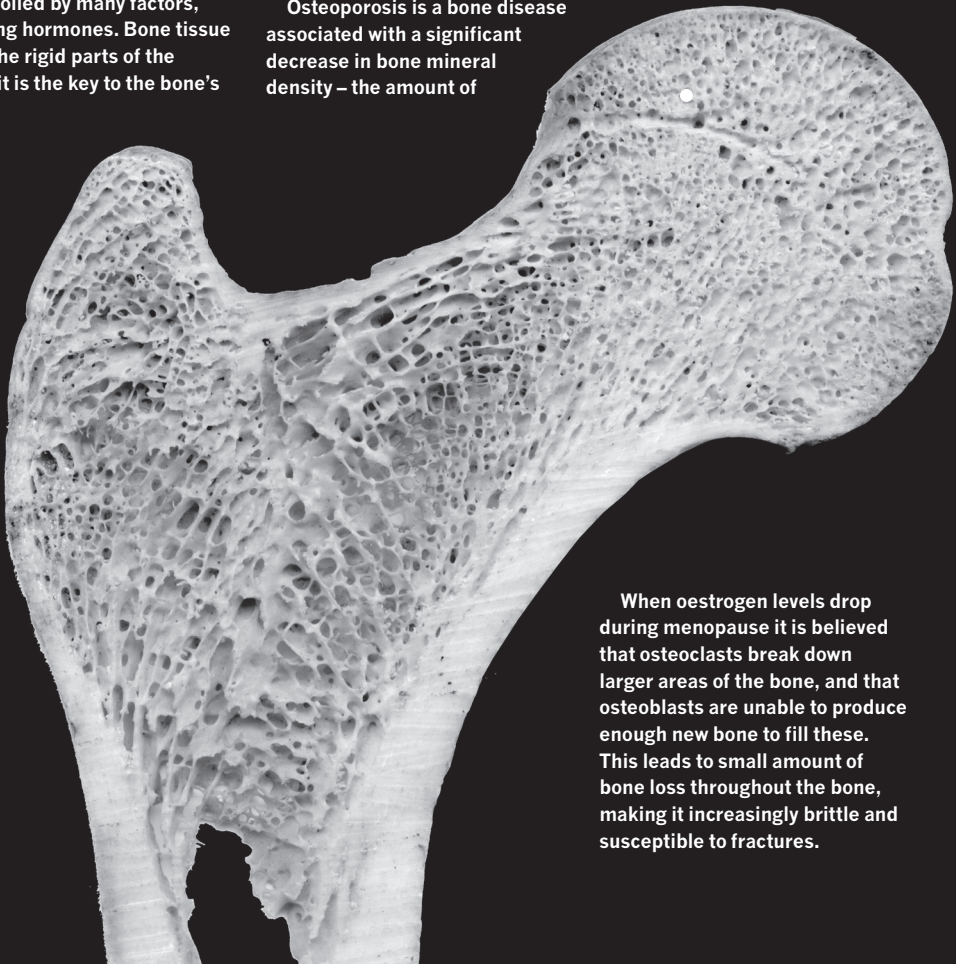
lightweight yet strong structure. Layers of collagen and minerals allow stress to be dissipated throughout the structure, so preventing damage.

There are two types of bone tissue: compact bone forms a hard exterior whilst spongy bone fills the hollow interior. The two are composed of the same substance but arranged in different ways. In osteoporosis, spongy bone is more severely affected than compact bone.

Osteoporosis is a bone disease associated with a significant decrease in bone mineral density – the amount of

mineral per square centimeter of bone. This decrease, along with changes in the proteins in the bone, leads to increased susceptibility to fractures.

Osteoporosis can be caused by many different factors. However, it is well known that postmenopausal women are more susceptible to osteoporosis. In part, this is due to a decrease in the production of oestrogen, sex hormone.



When oestrogen levels drop during menopause it is believed that osteoclasts break down larger areas of the bone, and that osteoblasts are unable to produce enough new bone to fill these. This leads to small amount of bone loss throughout the bone, making it increasingly brittle and susceptible to fractures.



## Does the environmental movement need better PR?

The environmental movement should be 'naming and shaming' large corporations when it comes to climate change, said PR guru Mark Borkowski in *Marketing the Apocalypse* on Thursday. Borkowski described the marketing tactics of large corporations as 'dark arts' and said the climate change campaigners should be outing the 'bad guys' rather than copying them. 'The media wants stories, not necessarily the truth. We need to give them the real stories, the true stories', he told the audience. He added that, in order to get their message across, environmentalists should

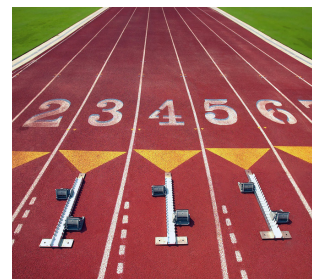
take advantage of social media and make use of the 24 hour news agenda.

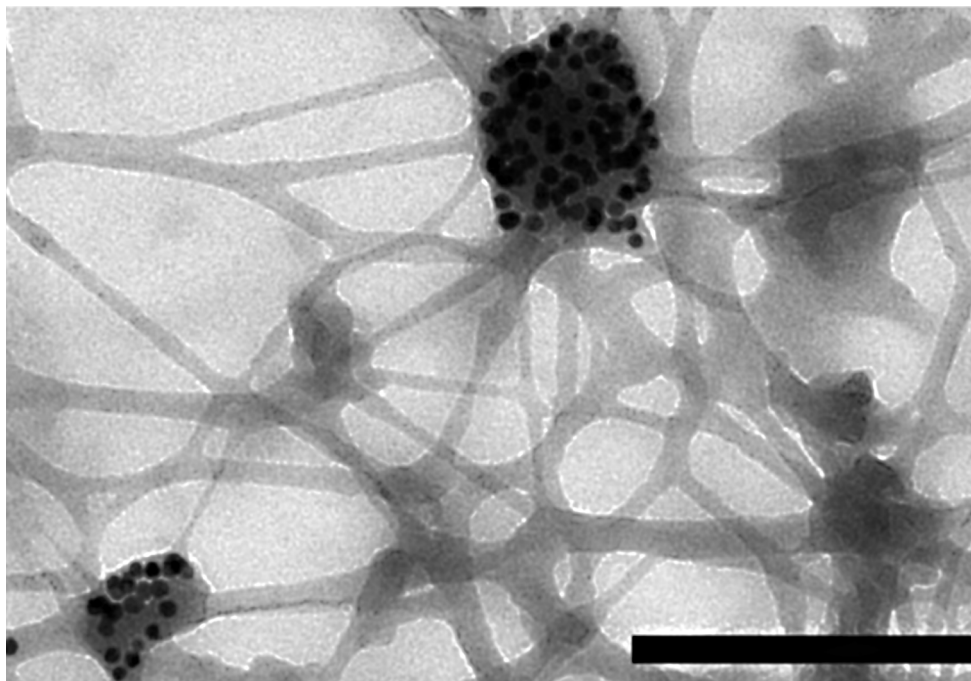
Environmentalist Tony Juniper said it was important for the movement to maintain trust. 'Climate change is a complex subject. You can't sell it the same way companies sell knickers or cars. It's complex, contentious, it's connected with people's behaviour and it's about the distant future, not tomorrow or next week'. He added that environmentalists were not necessarily the best communicators but he was optimistic that the message was getting across, citing the UK Climate Change Act as a positive success.

## A home advantage?

When hosting the Olympics, the home country will win approximately 3 times more medals, compared to their previous performances.

Team GB came fourth in the medals table in 2008 but, with the home advantage, sports psychologists Marc Jones and Iain Greenlees suggest the team could finish even higher this time. But does a home crowd really create a competitive advantage? Research has shown that social elements, such as the size of the crowd and seeing familiar faces amongst supporters, help to optimise performance. Even cheering can influence the outcome. This is particularly seen in sports requiring subjective decisions by judges. For instance in gymnastics, where movement is fast and an immediate decision required.





# Genetic disease treatment causes controversy

A heart-wrenching story of a woman who lost seven children as a result of mitochondrial disease was the backdrop to Thursday's event, *Three-parent babies: myth or reality*.

Mitochondrial disease is caused by defects in DNA in mitochondria. It was thought that the nucleus held all the DNA in our cells, but scientists recently discovered that the power-

generating mitochondria in our cells also contain DNA from our mother. Defects in this mitochondrial DNA can result in severe disability and diseases. Controversial new research takes the nuclear DNA from the mother's egg and transports it into a donor egg that contains healthy mitochondria.

Some question whether this means that a child

would gain a third parent. Only 13 genes from the donor egg would be used; the child would receive around 23,000 from its biological mother and father. Professor Doug Turnbull, the leading figure of this research, believes that the 'benefits to families that this research could bring means it is something we should embrace'.





‘It’s hard, but the key is definitely choice of topic’, says this year’s UK winner, Andrew Steele (pictured), a quantum physicist from Oxford. ‘You could obviously fill a lecture course or a textbook and not cover every facet of the subtle beauty and fiendish complexity of quantum mechanics, but there are a few ideas which can give a taster without requiring loads of prior knowledge. It’s also good to start with something familiar, mundane even – which is why I chose to talk about the colour of carrots!’

But to characterise Famelab as just a competition would be unfair. The organisers put great emphasis on finding talented individuals, giving them new skills and creating a community of scientists with an interest in science communication.

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**The challenge: to get up on stage and, in under 3 minutes, to illustrate a scientific concept**  
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‘Some of the most important things are the people you meet and the exposure to feedback from the of others,’ says CERN physicist Tom Whyntie, who took part in Famelab as a young researcher having done just a few public talks. ‘It felt like there were kindred spirits in science outreach!’

It turns out there are plenty of kindred spirits out there. Since Famelab started in 2005, 4,000 scientists have taken part and through the British Council, the competition has spread to 20 other countries.

Famelab is an important event in the science calendar and the competition has been effective at finding and nurturing new talent. But to former judge Jim Al-Khalili, Famelab has been crucial in paving the way for big initiatives to help scientists communicate what they do. ‘Famelab was the first of its kind and that’s what makes it so important and useful.’

# Nurturing talent

Famelab brings together researchers from around Europe, each eager to communicate science. Anna Perman explains why the event is more than just a talent competition.

**A**cross the festival site today you may be noticing a distinctly international feel. Camera crews and journalists have arrived from all over Europe to discover who will be crowned the eventual winner of an international science communication competition. Like, *Britain’s Got Talent*, but global, and with science.

Today is the final of International Famelab, a competition for young science communicators. The challenge: to get up on stage and, in under 3 minutes, to illustrate a complex scientific concept, making it accessible and engaging without dumbing it down.

# Engaging conversations

Co-founder of the Times Cheltenham Science Festival

Kathy Sykes discusses the new era of science communication.

Communicating science to the public is nothing new – the Royal Institution Christmas Lectures began in 1825 – but the ways that we communicate science are changing. Until quite recently much of science communication involved talking at the public to inform them of things that they didn't know but that scientists thought they should know. Education is often a motivation for communicating science, but the last decade has seen a desire for dialogue and engagement. This is driven by an awareness that the best communication is a conversation, and listening to people's questions, ideas, hopes and concerns.

Science has never been so prominent in popular culture. Science TV programmes are being presented by a wider range of voices and regularly get huge ratings. Science cafés, science centres and popular science books abound. In this time of austerity, science has fared comparatively well and organisations are investing time and resources into developing innovative approaches to involving the public in their work.

But still we hear about an unreliable media that sensationalises and dumbs down science, and a misinformed public

that still remembers BSE and MMR and is suspicious of scientists preaching at them to change their lifestyle habits. For all of the talk about dialogue, is much of science communication more of a lecture than a conversation?

Some of the greatest issues that our politicians face today involve science, whether climate change, an ageing population, energy shortages or pandemics. Scientists and science communicators need to involve the public in helping to solve these problems. Today, endeavours such as citizen science and the campaign for open science aim to show that anyone can contribute to the body of scientific knowledge, and that 'non-scientists' have valuable points to add to the debate.

Crucially, many funders of science are exploring how the public can help to widen their thinking. How listening to the public can help challenge scientists to ask better questions and explore ways that science can have better impacts on society. For me, this is not about the public deciding what kinds of science should happen. It's about scientists and society working out together how we can use science in wiser ways.



# Into the clouds

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Cutting edge research often requires collaborations between scientists across the globe. The British Library explores how putting information online can aid these partnerships.

Nowadays when you say you are part of a large research team modelling the earth's climate, or monitoring the spread of infectious disease, or untangling the myriad of gene expression and protein pathways that underpin how our bodies function, it probably means you are collaborating with scientists from all over the world. Cutting-edge research is increasingly about specialist groups contributing their expertise and skills to tackle big research challenges, and this means sharing research information and data on a large-scale, often in real-time, across great distances. Science is in an era of 'big data' and research rewards can be dictated by how efficiently you are able to 'mine' to retrieve the nuggets of relevant information.

## When science goes online

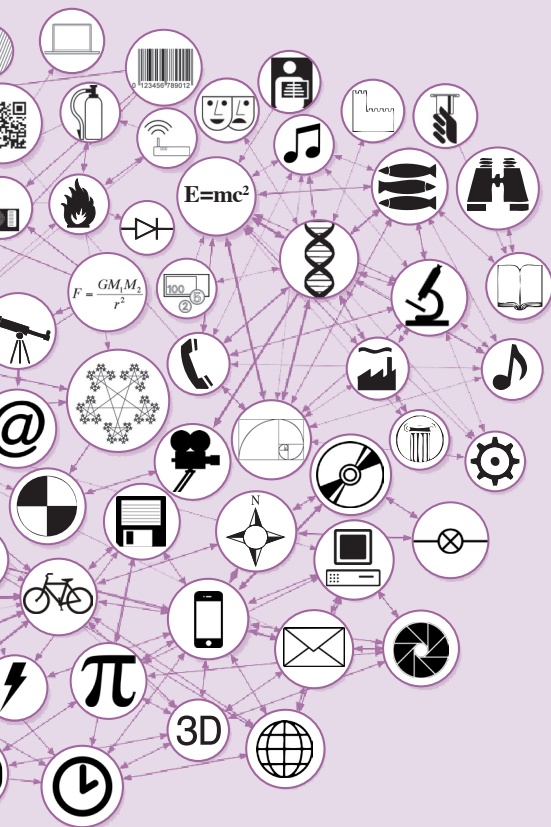
Okay, you've already guessed this involves the web, and for many scientists, this could just mean on-line data file and document



sharing. So far, so boring... It is when scientists online moves to science online, that things start to get more interesting.

The Environmental Virtual Observatory ([www.evo-uk.org](http://www.evo-uk.org)) is just one of a growing number of international initiatives seeking to use the latest cloud computing technologies to improve the outcomes from environmental research. Through shared access, analysis and visualisation of observational data, EVO is aiming to bridge the gap between science and decision making. As well as enabling scientists to work together on big issues that affect us all such as flooding or drought, agricultural sustainability or pollution, EVO is being developed to





allow people in the UK to find out about their local environments and contribute to an understanding of what research needs to be done.

## Mind mapping

The Allen Brain Atlas ([www.brain-map.org](http://www.brain-map.org)) is another example of science online that showcases the power of the web. The project is actually a series of atlases created by combining brain scans, genetic information, and experimental data from research teams and using it to construct the 3-D biochemical architecture of the brain. This publicly-accessible resource is not only visually stunning, but provides

maps of gene expression overlaid on detailed brain anatomy to enable researchers to analyse brain development and function in a way that would otherwise be impossible.

## Playing the game

Like computer games or puzzles? Then you could turn your talents to one of the growing number of on-line science projects that rely on the unique talents of humans over computers – in particular, pattern recognition. Why not compete with the online puzzlers on Foldit ([www.fold.it/portal](http://www.fold.it/portal)) to solve protein structures, help describe our universe on Galaxy Zoo ([www.galaxyzoo.org](http://www.galaxyzoo.org)), or come aboard Old Weather ([www.oldweather.org](http://www.oldweather.org)) to use ships' logs to model Earth's climate.

## Information for all

Why is the British Library interested in all of this? Well, many of our projects and services are about helping people access, use and collaborate around research information and data on-line. In *Litmus Paper* tomorrow you will hear about our involvement in UK PubMed Central, improving access to biomedical research information for all. Envia is a new service we are developing which will improve on-line discovery of environmental science research information, with an initial focus on flooding. Through DataCite we are also working to establishing easier access to research data to allow results to be verified and re-purposed for future study.

Regeneration, this year's festival theme, is what scientists and citizens alike are aiming to do in turning old data and information on-line into new discoveries, and we are thrilled to be part of that.

# Designs on nature

Designer, artist, writer and DesignScience Associate Alexandra Daisy Ginsberg explores the future of synthetic biology and its implications for scientists and designers.

**D**esign is the transmission of ideas through things. Since the industrial revolution, design has become integral to the process of making things. It translates technology into the mass of everyday stuff that marks progress: the spring into the adjustable lamp, the transistor into the personal computer. Design separates what we make from what already exists: the natural, living stuff we want to control. But design is a plastic term with plastic morals. While we enjoy the conviction that 'to design is to be human', design today is mostly concerned with making products for us to consume.

Now the mosquito is becoming a design object. Oxitec's RIDL male mosquitoes progeny die by genetic design. Grown in a factory, sorted by sex and released by the million, they mate with wild female mosquitoes to produce faulty offspring that will never hatch. It is a polite, British design solution to the tricky business of eradicating pathogens, on a geo-engineering scale. Swiss-designed bull sperm are also being trialled, encapsulated in cellulose before being inserted into a cow's uterus, unpackaged at ovulation as her hormones trigger precision-timed conception. Fewer deaths from dengue fever and cheaper dairy products may be the consumer's only experience of these designs. This is death and life as the stuff of design.

These experiments are some of the first non-microbial products of synthetic biology, an emerging field attempting to standardise biology into a machine for the manufacture of materials and systems not

(yet) evolved by nature. Synthetic biology's pioneering engineers, biologists, computer scientists and biochemists see themselves as designers. While industry has used *E. coli* to produce insulin commercially since the 1970s, synthetic biology promises to redesign bacteria more effectively to secrete rubber for tyres, ingredients for drugs, or fuel for cars. If successful, the way we design, build and manufacture materials may shift from synthetic chemistry to biology.

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**We are redefining the boundary  
between what we make and what we are.**  
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Synthetic biology has attracted social scientists, bioethicists, and policy and risk experts, all examining its potential promise and perils. The questioning tends to focus on the same concerns: bioerror (the right technology going wrong), bioterror (the wrong people using the right technology) and ownership (the technology getting lost in 'IP thickets' or becoming subject to monopoly). In 2010, Obama's Bioethics Commission announced that synthetic biology is effectively no different in terms of risk and reward than previous technologies. We may proceed, but with caution. What could be better than a disruptive technology that promises to disrupt nothing?

Progress in design and technology is a route towards an imagined perfection, assuming movement in one direction: forward. Progress and evolution are not the same. Evolution responds to context,

rather than the guaranteed process of improvement. Synthetic biology is not just the iteration of nature for our progress – the selective breeding of plants or animals – or simply a manufacturing revolution powered by biotech. We may be able to design with biology, but the designs are not fixed: living machines remain subjects of evolution. We are redefining the boundary between what we make and who we are.

How will we judge good design from bad? How does synthetic biology fit with design's consumer rules: obsolescence, form, style, uniformity or usability? Things that design has, until now, ignored, such as product lifecycles and disposal, become vital. Our current language of design lacks the tools to help us imagine the unknown. So how do we develop a design discourse for this new biology?

Designed with fellow artist Sascha Pohflepp, Growth Assembly is an investigative future commodity grown, harvested and assembled, inspired by conversations with Cambridge University plant scientist Jim Haseloff. He suggested that, one day, we might grow products inside plants. Could we program and control plants to solve our unsustainable consumption patterns? We asked if living organisms would become industrial robots, replacing today's

mechanical production lines? Diversity and softness would be introduced into a realm dominated by hardness and heavy manufacturing standards. Products would no longer be shipped around the world: only seeds would be transported, since all the manufacturing instructions would be encoded into the plants' DNA.

The technology we pictured appears seductive, but it is also troubling. Here, industry subsumes nature entirely, with human design strategies replacing nature's elegance. Seven designed plants do what evolution 'designs' without intention.

Many more artists, scientists and designers are beginning to explore the implications of this new kingdom of living products. These interdisciplinary collaborations are challenging assumptions, introducing a critical language into the biological design process and encouraging speculative research freed from the usual lab constraints.

Form may follow function, but we can still decide which functions we want. In opening up a space for design to examine ideas outside its commercial remit, we can help it rediscover its role as a transmitter of ideas through things. And in thinking through things, we have a better chance of achieving the progress we so desire.



**CMYK Plaque:** Full set extracted from a 34 year-old man with poor dental hygiene. Replacing artificial colours, modified *E. coli* self-organise into dot-shaped biofilms used in pharmaceuticals and foodstuffs.

## Today's cover by Phillip Kent

Leonardo's 'Vitruvian Man' is first drawn as a 'stick figure', then 'ASCII-fied' – a technique developed in the 1960s to convert images to standard characters which could be readily printed with the computer printer technology of that time (ASCII means the basic typewriter/computer character set of 95

letters, numbers and punctuation symbols). The original image is so representative of an ideal of the human body that I did not need to add much. I imported the ASCII image to Processing, and replaced characters with a random field of '0' and '1', these expressing the binary, digital world of computers. How are bodies physically changing, or changing in our perceptions, as we become immersed in the digital?

As usual, the interactive version

of this cover is at [www.design-science.org.uk/litmus-paper](http://www.design-science.org.uk/litmus-paper). You can run the code interactively and explore some different options, and download the source code to work on. The interactive version reminds me of the movie *The Matrix* (which was not intended, a useful accident of the coding) – a rather smart exploration of where body digitisation could lead us. 'If you can free your mind, the body will follow.' [phillip.kent@gmail.com](mailto:phillip.kent@gmail.com)

# Today's free activities

## DISCOVER ZONE

**Town Hall, 10am – 5pm**

For all ages, the Discover Zone is open every day of the Festival, and gives kids the perfect opportunity to get hands-on with interactive technology and experiments.

[cheltenhamfestivals.com/discoverzone](http://cheltenhamfestivals.com/discoverzone)



## AREA 42

**Imperial Gardens, 1pm – 8pm**

For over 16s, Area 42 is the Discover Zone just for adults. See and get hands-on with some of the best cutting edge research and technology science and engineering have to offer.

[cheltenhamfestivals.com/area42](http://cheltenhamfestivals.com/area42)

## BBC SCIENCE ZONE

**Imperial Gardens, All day**

For all ages, the BBC Science Zone gives you the opportunity to meet the production teams and presenters responsible for some of your favourite BBC science programmes, explore the content further and get hands-on with science.

For the full programme visit [cheltenhamfestivals.com/bbc-science-zone](http://cheltenhamfestivals.com/bbc-science-zone)



## EDF ENERGY ZONE

**Imperial Gardens, 11am – 6pm**

Come to the EDF Energy Zone to pick up quiz forms and stop a while to visit the fascinating interactive exhibits exploring the world of energy.



## GE PAVILION

**Imperial Gardens, 11am – 6pm**

The GE team are offering lots of things to do and see for all ages including a Caterham Formula 1 racing car, the hugely popular flight demonstrator, a model of the first jet engine and much more!



GE imagination at work

## SCIENCE QUESTION TIME

**The Times Eureka Tent, 6pm**

With Jim Al-Khalili, Pallab Ghosh, Lyn Beazley and David Reay.

Explore today's biggest debates, newest discoveries and favourite Festival moments with a selection of the day's speakers, *The Times* journalists and the Festival team.

**THE  TIMES**

