Synthetic biology and the rise of the 'spider-goats'

Horizon presenter Adam Rutherford looks at the advances in synthetic biology and genetic engineering that have resulted in, among other things, computer-made life forms and cancer assassin cells

Adam Rutherford
guardian.co.uk, Saturday 14 January 2012 15.20 EST

Article history

Science

Adam Rutherford, left, and Randy Lewis milk Freckles, the silk-producing goat. Photograph: BBC

Freckles looks like a perfectly normal kid. She has bright eyes, a healthy white pelt and gambols happily with Pudding, Sweetie and her five other siblings, exactly as you might imagine young goats do. Until I fend her off, she's very keen on chewing my trousers. To the casual observer, and to goatherds, she shows no signs that she is not a perfectly normal farmyard goat.

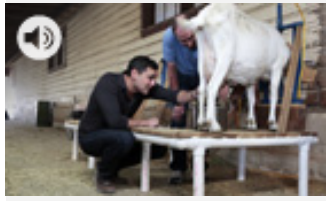
But Freckles is a long way from normal. She is an extraordinary creation, an animal that could not have existed at any point in history before the 21st century. She is all goat, but she has something extra in every one of her cells: Freckles is also part spider.

That is what we can now do with genetics: extreme crossbreeding. If 20th-century biology was about taking living things apart to find out how they work, the current era is defined by putting them back together, but not necessarily as evolution decreed, and certainly without the clumsy constraints of mating. Freckles is the result of genetic engineering. But our mastery of manipulating DNA has evolved into an even more extreme form of tinkering, broadly called "synthetic biology". I've been tracking

Genetics · Biology · Craig Venter · Biochemistry and molecular biology · Microbiology · Medical research

More features

More on this story



Podcast: Playing God with nature
Dr Adam Rutherford introduces his new BBC documentary about the powerful new technology of synthetic biology

On Science

Most viewed | Zeitgeist | Latest

Last 24 hours

1. Acupuncture useful, but overall of little benefit, study

this emerging field since finishing my PhD in genetics 10 years ago, but intensely in the last year as a presenter for the BBC's flagship science strand, *Horizon*.

Freckles is the creation of Randy Lewis, a professor of genetics at Utah State University. The farm is a university outpost where they research modern farming techniques, teach animal husbandry and raise what are inevitably referred to as "spider-goats".Randy, like many of the other scientists here in Logan, Utah, has farming in his blood. So although a creature that is part goat, part spider might seem like an idea born of science fiction, as far as Randy is concerned it's simply advanced farming: breeding animals to produce things that we want.

"We're interested in dragline silk – the silk that spiders catch themselves with when they fall," he tells me in his midwest lilt. "It's stronger than Kevlar. It really has some amazing properties for any kind of a fibre."

In a sense, spider-goats are an extension of the farming we've been doing for 10,000 years. All livestock and arable has been carefully bred, each cross being a genetic experiment of its own. "The trouble is, you can't farm spiders," Randy says with an almost comic deadpan face. "They're very cannibalistic." He and his team took the gene that encodes dragline silk from an orb-weaver spider and placed it among the DNA that prompts milk production in the udders. This genetic circuit was then inserted in an egg and implanted into a mother goat. Now, when Freckles lactates, her milk is full of spider-silk protein.

We milk Freckles together and process it in the lab to leave only the silk proteins. With a glass rod, we delicately lift out a single fibre of what is very obviously spider silk and spool it on to a reel. It has amazing, and desirable, properties, which is why Randy's seemingly bizarre research is so robustly funded. "In the medical field, we already know that we can produce spider silk that's good enough to be used in ligament repair," he tells me. "We already know we can make it strong enough as an elastic. We've done some studies that show that you can put it in the body and you don't get inflammation and get ill. We hope within a couple of years that we're going to be testing to see exactly the best designs and the

shows

2. Astronomy Photographer of the Year 2012 – in pictures
3. Philosophy v science: which can answer the big questions of life?
4. Subconscious cues can trigger the placebo effect, say researchers
5. Alan Turing Monopoly board passes go thanks to Google

More most viewed

Guardian science on Twitter

Follow all the top science stories of the day on Twitter

alokjha: From the Guardian: Can tablet screens disrupt sleep? http://t.co/WeOy6CLY
about 6 hours, 26 minutes ago

guardiansciblog: [Occam's Corner] Academic boycotts, science and hypocrisy | Steve Caplan http://t.co/sAQmjTm8
about 7 hours, 50 minutes ago

guardiansciblog: [The H Word] Thomas Jefferson, science enthusiast http://t.co/Zg78F1lv
about 8 hours, 46 minutes ago

- Follow our science staff on a Twitter list
- Find more tweets from our team

best materials we can make from it."

The instructions for all creatures that have ever lived (as far as we know) are written in the code of DNA tucked away in the heart of living cells. Given the bewildering diversity of life on Earth, this system is incredibly conservative. All life is based on an alphabet of just four letters, which, when arranged in the right order, spell out proteins. And all life is made of, or by, proteins. So what this means is that the code for making silk in a spider is written in exactly the same language as the code for making goats' milk.

Since the advent of genetic engineering, we have been able to exploit the universality of this code and cut and paste bits of DNA from any one species into any other. Identifying the genetic basis of all cancers and inherited diseases came from this technology: human or mouse genes have been spliced into bacteria so we could study and experiment on those damaged bits of code. Now, this editing technology has progressed to the extent that all bits of DNA code are effectively interchangeable between all species. In fact, Freckles and the other spider-goats are not even on the cutting edge. The loosely defined field of synthetic biology has come to incorporate even more extreme forms of genetic tinkering.

The most striking headlines so far came when American biologist Craig Venter announced in 2010 that he had created the world's first synthetic life form. Synthia, aka *Mycoplasma mycoides* JCVI-syn 1.0, was a cell whose genetic code, copied and modified from an existing bacterium, had been assembled not by its parent, but by a computer. That code, including literary quotations and website addresses, was then jammed into the eviscerated chassis of another similar cell and the whole thing booted up. It did live and it hadn't lived before.

But to say that he had "created life" is a stretch that Venter – a master of PR as well as an accomplished scientist – allowed to foment and the press lapped up. It's more accurate to say that he rebooted life, his aim being to create a living template on to which new genetic functions could be built. Nevertheless, it remains an astonishing technical achievement, showing our dominance over DNA; not only can we modify one or two

genes, we can make enough to power up a living thing.

The scientists who work in synthetic biology often take a perfunctory, reductionist view of what they do. Massachusetts Institute of Technology professor Ron Weiss is a founding father of this field, a purist who started fiddling with the code of life while coding computers. "I decided to take what we understand in computing and apply that to programming biology. To me, that's really the essence of synthetic biology."

This may sound glib. Life forms are complex at every level. If there is one concrete thing we have learned from the billions spent on reading our own genetic code, it's that biology is messy. Scientists are often confounded by baffling "noise" in the molecules that make up living organisms, unpredictable variation set among unfathomable sophistication. Weiss and his comrades at the BioBricks Foundation want to strip out all the noise in biology and turn it into pure engineering, where organisms can be treated like machines and their inner workings are component parts.

Genes have evolved over millions of years to bestow survival on their hosts by having very specific functions. By standardising these genetic elements in an online registry, anyone can piece them together in any order to create biological circuits with entirely designed purpose. Even the language used is more the stuff of electrical engineering than traditional biology.

"Imagine a program, a piece of DNA that goes into a cell and says, 'If cancer, then make a protein that kills the cancer cell; if not, just go away.' That's a kind of program that we're able to write and implement and test in living cells right now." What Ron Weiss is describing is a study his team published last autumn showing that, by using the logic of computer circuits combined with BioBricks parts, they had built a cancer assassin cell. The logic of the genetic circuit initially distinguishes a cancer cell from a healthy cell using a set of five criteria. It then destroys the tumour cell if it satisfied those conditions. This sniper targeting is the opposite of the blunderbuss approach of chemotherapy, which can destroy both tumour and healthy cells with reckless abandon.

Over the last few years, BioBricks has grown into a global phenomenon. The Registry of Standard Biological Parts currently contains thousands of bits of DNA, all freely available, and this democratisation of science is built into the BioBricks ethos. Every year, undergraduate students compete in an international competition to think of a problem and design and build its solution, using only the parts available in the registry. 2011's European champions, from Imperial College London, designed a system for preventing soil erosion and the conversion of land into desert. There is a remix culture within these teams; it's serious play (the grand prize is a silver Lego brick) and they come from diverse backgrounds – maths, engineering, even astrophysics – unfettered by the narrowly defined science disciplines under which I did my DNA research.

The ease of access to this bleeding-edge technology is breathtaking. Last summer, in suburban Sunnyvale, California, I hung out at a gathering of synthetic biology weekend hobbyists, self-styled as "bio-hackers" with the excellent name BioCurious. There, high-school students were learning about biology by introducing fluorescent proteins from deep-sea jellyfish into bacteria to make them glow in the dark. In 2009, three scientists won Nobel prizes for this work. Already, it is literally child's play.

As with any great revolutions, there are those who stand to make a killing after the doors are kicked open. At the other end of the scale from the open-source, open-access utopia of BioBricks, synthetic biology commercial enterprises are emerging. The tech may be new, but the fields are not. With synthetic biology only a few years old, the most intense areas of commercialised synthetic biology are in fuel and drug production. California biotech companies such as LS9 and Amyris have ploughed millions of dollars into developing synthetic organisms that will produce diesel. In its futuristic labs in Emeryville, Amyris has modified brewer's yeast so that instead of fermenting sugar to produce alcohol, diesel seeps out of every cell. This synthetic biodiesel is already used to power trucks in Brazil. Amyris's ambition is to scale up from pilot plants to industrial-scale production. When I ask chief science officer Jack Newman if they envisage their biofuel replacing natural oil, he is suspiciously coy: "I'll be excited about a billion litres."

One significant fear has less to do with the science and more to do with the shifting balance of economic power. Technology watchdogs and campaign groups such as Friends of the Earth and ETC Group initially called unrealistically for a total ban on synthetic biology, even though it lacked a workable definition. ETC has modified its stance to focus on the industrialisation of these processes, and specifically the fact that synthetic biodiesel organisms need food.

Jim Thomas, who works for ETC, passionately feels that the control of fuel production is simply shifting from one set of corporate giants to another. "Large companies are buying up bits pieces of land so that they can grow sugarcane and then they're feeding it to vats of synthetic microbes to make fuels," he tells me. "Synthetic organisms at this point should not be out there in the environment; they shouldn't be out there in industry. That's irresponsible and inappropriate."

The culture of biology is rapidly changing and scientists and the public need to keep up. Synthetic biology has the potential to generate a new industrial revolution. It is perhaps the defining technology for the 21st century and it is happening now. Without an informed public discourse, fear of this unprecedented and sometimes unsettling technology may hinder the world-changing promise it harbours.

"Prediction is very difficult, especially about the future," as the great physicist Niels Bohr once said. But science fiction never got close to the outlook that came with the advent of synthetic biology. It is now easy to picture a world in which your torn ligaments are replaced with ones made from spider-silk produced by goats; where medicine is served by living programmable machines that seek and destroy only the cells that cause the disease; and where you will drive a car powered by diesel grown by brewer's yeast. Welcome to the future.

Adam Rutherford is a science writer and broadcaster

GENE GENIES: What is synthetic biology?

Definitions in biology are sometimes fuzzy. The terms "genetic

engineering" or "genetic modification" have come to encompass all forms of our manipulation of DNA, particularly when, as with Freckles the spider-goat, we introduce new genes into an organism.

"Synthetic biology" is the next stage in the evolution of biology as a science. In its purest form, and indeed for purists, it emerged as the idea of applying engineering principles to life science: characterising and cataloguing bits of DNA so they can be assembled into unnatural genetic circuits. But its definition is expanding to include our endeavours to invent, rewrite and rearrange the code of DNA to create biological tools with specific uses, from treating diseases, to manufacturing drugs, fuels and even building materials. AR

Comments

57 comments, displaying Oldest first

g Staff
C Contributor

Comments on this page are now closed.

UserBanned
14 January 2012 8:40PM

Recommend (9)
Responses (2)
Report
Share

Old News

nick9000
14 January 2012 8:42PM

Recommend (91)
Responses (0)
Report
Share

All due to a typo. What the memo meant to say was 'Let's have a *go at* producing spider silk'.

asurattorney
14 January 2012 9:09PM

Recommend (3)
Responses (2)
Report

I've always found it odd to talk of DNA as a 'code'. I mean, each letter of a DNA sequence is an actual chemical compound, isn't it? But a code in the true sense of the word is a series of arbitrary symbols to represent ideas and objects. There's nothing arbitrary about individual strands of DNA.

If DNA is a 'code', then surely nuclear fusion is a 'code' for how stars produce light.

Or maybe I think too much.

Share

simon83
14 January 2012 9:23PM

Recommend (13)
Responses (0)
Report
Share

Well, I really enjoyed that article. Great read.

mjback
14 January 2012 9:30PM

Recommend (2)
Responses (0)
Report
Share

nick900: very funny

yepandthattoo
14 January 2012 9:39PM

Recommend (2)
Responses (0)
Report
Share

Interesting, like it.

FlyingFrog
14 January 2012 9:58PM

Recommend (14)
Responses (0)
Report
Share

Response to asurattorney, 14 January 2012 9:09PM

It is a code in the same way that the binary system is - except replace 0 and 1s with As, Ts, Gs and Cs. As you say, each nucleotide base (ACG or T) is a molecule, but when combined in long strings, the order they are read in is analogous to a code, like binary.

MarnaNightingale
14 January 2012 10:01PM

Recommend (7)
Responses (0)
Report
Share

That is extremely cool. Needs better pictures of the goat.

What? I like goats!

HarmoniousFrog
14 January 2012 10:12PM

Recommend (1)
Responses (0)
Report
Share

> That's irresponsible and inappropriate.

bobsyouruncle1
14 January 2012 10:20PM

Recommend (12)
Responses (1)
Report
Share

Response to UserBanned, 14 January 2012 8:40PM

That's very rude.

If that's all you have to contribute when a learned person shares what they know, then you really shouldn't bother.

Expecten
14 January 2012 10:23PM

Recommend (4)
Responses (0)
Report
Share

> taking living things apart to find out how they work, the current era is defined by putting them back together

Little Professors with hobnail boots?

I also liked nick9000's reverse-engineered typo :D Nice one.

I do hope that these manipulated goats never get mastitis - it could be a tad more

painful for them. Be careful of what you wish for, folks.

anthrop0phobe
14 January 2012 10:37PM

Recommend (4)
Responses (0)
Report
Share

Smashing article. Thanks.

etondictator
14 January 2012 10:46PM

Recommend (8)
Responses (0)
Report
Share

Nightmare.

tomalley
14 January 2012 10:46PM

Recommend (21)
Responses (0)
Report
Share

Spider-goat, spider-goat,
Does whatever a spider... oh forget it.

UserBanned
14 January 2012 10:56PM

Recommend (4)
Responses (0)
Report
Share

Response to bobsyouruncle1, 14 January 2012 10:20PM

The first spider goat was bred in 1999, 13 years ago. That makes it old news.

misterwh
14 January 2012 11:31PM

Recommend (4)
Responses (1)
Report
Share

Response to asurattorney, 14 January 2012 9:09PM

But genes represent proteins, in the sense that they are used as instructions for their manufacture elsewhere in the cell. I don't see any conceptual difference between a strand of DNA on the one hand, and a computer program on the other, which is also read and acted upon. The fact that a computer program is stored on a physical disk and read into physical memory doesn't mean that it isn't also code.

But also, consider that we share most of the same genes. Though our DNA is made of different atoms, they encode genes to make identical proteins. The same information is there: it makes perfect sense to call DNA a code.

ZIZI1001
14 January 2012 11:40PM

This comment was removed by a moderator because it didn't abide by our community standards. Replies may also be deleted. For more detail see our FAQs.

keeponthegrass
15 January 2012 12:05AM

Recommend (3)
Responses (1)
Report
Share

the potential of this sort of work is mind blowing. i think its brill and wish more money/time was spent by all. the benifits to humanity could be huge.

keeponthegrass
15 January 2012 12:07AM

Recommend (12)
Responses (0)
Report
Share

Response to UserBanned, 14 January 2012 8:40PM

it may well be old news to you but not to eveyone and i thought the artical was very interesting.

asurattorney
15 January 2012 12:08AM

Recommend (5)
Responses (2)

Report

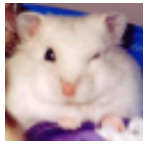
Share

Response to misterwh, 14 January 2012 11:31PM

I guess my difficulty is this: to describe DNA as 'coding for' the design of an organism seems to reify the coded content into a sort of mythical 'pure information', as if it were conceptually (and ontologically) distinct from its material expression in the cell, organism, body, whatever.

But what aspect of genetic code itself 'codes for' a specific trait independent of the context - the environment, or the particular region in which that cell resides in the organism? I don't see any one-to-one relationship here. I mean, DNA isn't even self-replicating in and of itself – it requires the 'machinery' of the cell to perform its transcription/translation processes. It requires proteins as a pre-requisite in order to even exist, before it can reproduce or replicate. Since it's embedded in the cell, then, and the context of the cell is constantly changing within its own context (the environment), surely it's meaningless to refer to the existence of 'information' (akin to binary) as existing independently in the DNA, separate from its context?

It strikes me as a false dualism of matter versus pure information. The notion of information as something that pre-exists its own expression in the cell, that isn't affected by the developmental medium of the organism and environment, sounds like - dare I say it - informational idolatory.



CrepuscularMutant
15 January 2012 12:47AM

Recommend (3)

Responses (0)

Report

Share

I thought they moved on from genetically engineered 'spider-goats' to 'spider silk worms' which are all together much more useful.

(Gud article though and always welcome...)

Alasdair1
15 January 2012 2:40AM

Recommend (16)

Responses (2)

Report

Share

Should we not be concentrating on the fundamental problems in the world that cause illness such as cancer. 'Prevention is better than cure'. Synthetically produced bio-diesel?

Is this not just going to lead to more land devastation in an ever growing population?

How about as a human race trying to live in a more sustainable world by consuming less and making wiser choices about where we spend our money.

I'm not against progress but spending vast amounts of money on research, which will eventually be owned by big corporations is not the answer. How about the simple things such as low impact sustainable organic food production eaten closer to the source meaning a higher level of antioxidants, vitamins and minerals. All of which help reduce the rick of cancer, whilst using less 'biodiesel' to produce and ship around the world.

How about spending all the money that goes towards 'scientists playing god' into an education programme on healthy and sustainable living. Or is this just far too simplistic?

Msomerville
15 January 2012 4:03AM

Recommend (2)
Responses (0)
Report
Share

Spider-goats?

Let's review some prior text from Adam:

> So next time you see a headline that says "Scientists find the gene for x", where x is DIY skills, risk-taking, being a liberal, or even eating a big bag of crisps, the truth is that they have not.

Ahem.

keeponthegrass
15 January 2012 4:44AM

Recommend (3)
Responses (0)
Report
Share

Response to Alasdair1, 15 January 2012 2:40AM

I'm not against progress

yes you are. geneitc advances and scientific progress is the only way forward. push on and to hell with the cost!

musso84
15 January 2012 8:58AM

Recommend (5)

Responses (0)

Report

Share

"And the sons of men in those days took from the cattle of the earth, the beasts of the field and the fowls of the air, and taught the mixture of animals of one species with the other, in order therewith to provoke the Lord" (Jasher 4:18).....

"As it was in the days of Noah, so it will be at the coming of the Son of Man." (Matthew 24:36-39).....

Are we getting too far ahead of ourselves in entering this murky world of 'playing God'?... Yes we are.

Be aware my friends, what is being done now has been done before...

k4ntico
15 January 2012 9:23AM

Recommend (1)

Responses (1)

Report

Share

Response to asurattorney, 15 January 2012 12:08AM

First of all, your objection that is context-dependent the interpretation of DNA by cells is rather surprising in this article frame of the exploitation of a *spider* silk protein gene inside *goat* cells. *"Genetic code"* refers to a mapping from triplets of base pairs (aka codons) to amino-acids, a mapping that's consistent enough across life-forms to permit such a transfer. That mapping is not quite "one-to-one" but is deterministic, iow it is really a mapping, what's sufficient to call it "code".

While we cannot say for sure that the unique mapping selected by nature deserves to be called arbitrary, synthetic genetic code expansion shows that it is arbitrary enough to be somewhat arbitrarily modified.

Second, why do you find it clear that no parallel objection can be exhibited in the case of eg "binary" ?

Third, I see your pseudonym contains "attorney", and I can't help thinking this means that lies just around the corner an interesting explanation of your articulate qualms by a professional bias. Would you care to elaborate on this? You speak of "informational idolatry" - a choice of words which leads me to various tantalizing paths of explanation. It may be that you feel "code" should be to common sense connoted by the example of law and judicial deference. Another interesting possibility is that "idolatry" alludes to the matter of the intellectual property of evolved genes.

TheDefinitive
15 January 2012 9:47AM

Recommend (4)
Responses (0)
Report
Share

> "Synthetic biology" - its definition is expanding to include our endeavours to invent, rewrite and rearrange the code of DNA to create biological tools with specific uses

Spider-goats
Coffee-cows
Chocolate-oranges

The future looks bright.

asurattorney
15 January 2012 11:01AM

Recommend (0)
Responses (2)
Report
Share

Response to k4ntico, 15 January 2012 9:23AM

My point is that the roles played by the many causal factors that affect development don't fall so neatly into two kinds, one exclusively played by DNA elements and other exclusively played by non-DNA elements. For example, the article fails to state that of seven goat kids born in February 2010, only three tested positive for having the silk protein gene. (Also, it remains to be seen whether the goats have any other differences in health, appearance, or behavior compared to goats without the gene - we'll just have to wait and see). In this respect it could be a little more balanced.

As for the binary comparison: consider the temperature surrounding the cell when the DNA is transcribing itself into RNA, and the RNA is being translated into a protein. The rate at which the protein will shoot out of the rhibosome determines how the protein enfolds in three-dimensional space. If it's a cooler environment then it will fold differently compared to if it was a warmer environment. Yes, the cell's metabolism is trying to maintain a constant temperature-wise, but there are always other factors when a strain of nucleic acids become a protein, and then as a trait in an organism. There is no linear informational process involved.

Early proponents of the Human Genome Project fell into this same trap in a big way.

My pseudonym was made up on the hoof, by the way.

g0annahead
15 January 2012 11:28AM

Recommend (3)
Responses (0)
Report
Share

The brave new world.
GMO, cloning, biotech and nanotech, playing good now are we?
With reports of GMO and cloning failures it would appear we have no idea of the outcome of our actions.
Dr Ho speaks of DNA as environmental factor as the dominant criteria for DNA, so just what kind of monstrosities can we create with our "extreme crossbreeding".

provokieff
15 January 2012 11:38AM

Recommend (9)
Responses (0)
Report
Share

It is becoming increasingly obvious that there is no future whatsoever for non human life on this planet unless it can be exploited and abused and its genetic makeup distorted beyond recognition by the one real pest species, otherwise known as Homo Tyranicus.

There is only one hope for other creatures – I understand that a former president of the Royal Society has claimed that humans have less than a 50% chance of surviving the 21st century. What goes around comes around.

muscleguy
15 January 2012 11:49AM

Recommend (12)
Responses (0)
Report
Share

Fears about synthetic bugs going rogue once they are 'out there' are misplaced and display ignorance about modern biotech. Every day in labs around the world 'dangerous' genes: oncogenes, toxins, viral genes are zapped into lab E. coli and billions of bacteria with tens of billions of copies of those genes are grown. This all takes place on open lab benches, the cultures grow in the open, plugged with some 'cotton wool'. This is safe because back when recombinant dna technology (putting genes into bacteria and growing them to make more copies) was invented biologists said 'whoa, let's think about the safety of this'. They got together in Asilomar in California and everyone agreed to a voluntary moratorium on the work while, co-operatively they built bugs that were safe to use, domesticated bugs for the lab, chained to the lab. They partially crippled them by knocking out things like their

ability to have bug sex: swap genes with other bacteria as well as the ability to make essential nutrients etc. etc. Since then all the bugs used for dna work in labs have been these crippled coli. Their growth media contain the amino acid tryptophan, without which they cannot grow because they cannot make it. They are deliberately susceptible to common antibiotics too. The same thing was done to yeast as well.

Synthetic biology bugs are the evolution of this, except that instead of crippling genes to leave them dependent they simply no longer have them. Bugs used to make biodiesel are also so crippled. They cannot escape their factory vats, to them it's like the vacuum of space is to us, just too hostile for life. No rogue environmental bacterium, yeast or virus can rescue them either, no random mutation because there are simply too many ways they are crippled and they cannot exchange dna with them anyway. They are like some breeds of dog who need humans to feed them, brush their coats lest they become dangerously matted and assist both with mating and birth. The successful birth rate in packs of feral street dogs is very low because of this. We have been gelding bulls, horses, dogs and cats for thousands of years. This emasculation of the protists just had to wait a bit.

noughter
15 January 2012 12:05PM

Recommend (0)
Responses (0)
Report
Share

So when do we see it flying through the lawless streets potecting us from evildoers?
Is it a bird, is it a plane?
No it's SPIDER GOAT
randy lewis was his name
f**king goats was his game.

AdamTut
15 January 2012 1:09PM

Recommend (3)
Responses (1)
Report
Share

Muscleguy -

You're right that scientists created crippled strains of bacteria for cloning experiments back in the early days of molecular biology.

But dead wrong in your assumption that these are still used . They turned out to be far too difficult to work with. No-one uses them now.

I'm a molecular geneticist by trade - been in the lab this morning, as it happens,

putting up some cultures of bacteria expressing a recombinant protein for an experiment on Monday - and I can assure you that they don't require tryptophan, and that they are not the same strain as was developed in the Asilomar days. No-one uses those strains any more, including companies who grow these things on the scale of tens of thousands of litres.

They ARE susceptible to antibiotics, as you state, but so are nearly all naturally occurring strains of E. coli, including incidentally most strains of O157:H7.

MajorWhipple
15 January 2012 1:10PM

Recommend (6)
Responses (0)
Report
Share

I'm waiting for the World's first pig-tomato-haricot bean-mushroom-chicken which will lay eggs containing a full English breakfast.

ElQuixote
15 January 2012 3:07PM

Recommend (3)
Responses (0)
Report
Share

So, hear anything from Dr. Moreau about this?

ElQuixote
15 January 2012 3:11PM

Response to ZIZI1001, 14 January 2012 11:40PM

This comment was removed by a moderator because it didn't abide by our community standards. Replies may also be deleted. For more detail see our FAQs.

davidsouthafrican
15 January 2012 3:56PM

Recommend (8)
Responses (1)
Report
Share

Response to keeponthegrass, 15 January 2012 12:05AM

what about the benefits to goats?

harm to the natural world?

anthocentrism rules, hence climate change mass-extinction, massive human overpopulation.

This is not what the planet needs

MSSG
15 January 2012 4:33PM

Recommend (1)
Responses (0)
Report
Share

I can imagine cubs saying:
- Where's my mum?

BadPlan
15 January 2012 7:02PM

Recommend (1)
Responses (0)
Report
Share

Just the kind of thing to reignite interest and curiosity in science.

I can't see anything wrong with this. Genetic codes are not static, we're just taking a bit more control over the way they change. I can hardly wait for the day human body augmentation is as easy to do as downloading apps to your smartphone.

Laudistant
15 January 2012 8:12PM

Recommend (5)
Responses (2)
Report
Share

Bit freaked out by this co-incidence. Am reading Oryx and Crake by Margaret Atwood (2003) at the moment.

Page 234: "At the entranceway was a bronzed statue of the Institute's mascot, the spoat/gider - one of the first successful splices, done in Montreal at the turn of the century, goat crossed with spider to produce high-tensile spider silk filaments in the milk. the main applications nowadays was bulletproof vests. The CorpSeCorps swore by the stuff.."

The book doesn't end well for humans...

Bevan1988
15 January 2012 10:27PM

Recommend (0)
Responses (0)
Report
Share

Response to Laudistant, 15 January 2012 8:12PM

As someone has previously pointed out the first spider-goat splice was bred in 1999 before the book was published. Therefore I would think that Margaret Atwood was aware of this and thus included it. As opposed to correctly predicting it...

Bevan1988
15 January 2012 10:29PM

Recommend (0)
Responses (0)
Report
Share

Response to Laudistant, 15 January 2012 8:12PM

http://edwardwillett.com/1999/05/the-spider-goat-clones-of-montreal/ It looks less and less like a coincidence and more a literary tool using current events.

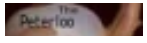
Bevan1988
16 January 2012 12:08AM

Recommend (1)
Responses (0)
Report
Share

Response to asurattorney, 15 January 2012 11:01AM

What is it with the whole pseudo-intellectual mutterings about basic definitions....

DNA encodes for different amino acids when 3bp's are in different combinations. Is morse code not a code because it is basically the same thing? Different combinations = different letter ie with DNA different combinations (more of them with a certain amount of redundancy) = different amino acids. All this stuff about context and environment is besides the point. The environment doesn't come into it or the context, the 3bps will always = glutamine or whatever other amino acid it is. Thus the genetic code, codes for a chemical reaction. Just like a computer programme, morse code etc etc.



muscleguy

Recommend (1)

16 January 2012 7:44AM

Responses (1)

Report

Share

Response to AdamTut, 15 January 2012 1:09PM

Are you saying you are expressing recombinant protein in wild type coli? on the open lab bench?

Either you are in contravention of all biosecurity regulations or you are mistaken as to the status of your bugs (and what is in their media). It may be you have not expressed yourself clearly, but you come across by disputing a claim I did not overtly make as saying you use wild type coli. Can I suggest you think a bit more clearly before putting finger(s) to keyboard lest you unduly alarm people? I was trying to reassure with some facts, then you come along and seem to say you are playing fast and loose. Thanks a bunch.

WClement
16 January 2012 4:55PM

Recommend (0)

Responses (0)

Report

Share

This is REALLY OLD NEWS! The ancients knew about this technology! They called these tinkered with 'creatures' "Chimeras"! It would be interesting and perhaps should be frightening to us if these tinkerers should come up with a Human/Spider Chimera to produce Spider Silk in its urine!

WClement
16 January 2012 5:05PM

Recommend (0)

Responses (0)

Report

Share

Response to davidsouthafrican, 15 January 2012 3:56PM

Perhaps anthro-centrism will lead next to a "Human-Spider" chimera, thereby disposing off the need for a a middle-species.

---

k4ntico
16 January 2012 6:21PM

Recommend (1)

Responses (0)

Report

Response to asurattorney, 15 January 2012 11:01AM

Share

"binary" by itself doesn't denote a code but a representation, just like DNA. ASCII is an example of binary code, that maps codewords of 7 bits to specific characters. The genetic code maps codons - codewords of 3 base pairs - to specific aminoacids. This is completely analogous. Everything you bring against the notion (or name) of genetic code really addresses facts occurring upstream or downstream of this transform, and analogous situations can be exhibited in the case of ascii, when for instance the resulting "text" doesn't properly display because your computer has damaged fonts, or if the file has incorrect meta-data (or "extension*) and gets presented to the wrong program to process it, or if it is meant as a source program in some computer language but contains syntax errors, or failed to be pre-processed (like feeding C++ to a C compiler), etc, etc.

This being said, I can sympathize with your criticisms but what they really address are false or highly reductionist beliefs people tend to cultivate about *the genome* and ***not*** the genetic code in the sense scientists give to these words. Again, this is all due to a (double) quid pro quo whence both the genome and the wrong name for it of "genetic code" get inadequately understood by the equation of the word "code" in "genetic code" and "code of law". Whatever McLuhan said, in the first instance the medium isn't the message.

blammo
17 January 2012 10:21AM

Recommend (0)

Responses (0)

Report

Response to Alasdair1, 15 January 2012 2:40AM

Share

your suggestions are pretty good too, but are by no means mutually exclusive with those proposed in the article. the human and environmental benefits of *a studied and cautious approach* to synthetic biology are immeasurable. and as the article also points out, the techniques involved are becoming ever more available to the smaller scale researcher or even the hobbyist. big corporation ownership is always a danger but as with the internet trends are moving more and more away from that.

the notion of 'scientists playing god' is a whole different argument though...

AdamTut
17 January 2012 6:17PM

Recommend (3)

Responses (0)

Report

Response to muscleguy, 16 January 2012 7:44AM

Share

> Are you saying you are expressing recombinant protein in wild type coli? on the open lab bench?
>
> Either you are in contravention of all biosecurity regulations or you are mistaken as to the status of your bugs (and what is in their media). It may be you have not expressed yourself clearly, but you come across by disputing a claim I did not overtly make as saying you use wild type coli. Can I suggest you think a bit more clearly before putting finger(s) to keyboard lest you unduly alarm people? I was trying to reassure with some facts, then you come along and seem to say you are playing fast and loose. Thanks a bunch.

Lighten up, dude. All I'm doing is telling it how it is in real labs in Universities and companies. You have your facts wrong.

Yes, I am expressing protein in E. coli (K-12, MG1655, as it happens). The standard strains used for expression of recombinant protein (MG1655, DH5-alpha, BL21, JM101 etc etc) are not "crippled" in the way that the original 1774 strain was (which is what you were referring to, whether you knew it or not) though it's true that they would be unlikely to last for long outside the lab. Everyone uses these strains. They are of course not "wild type" E. coli - there is no one strain that is - although MG1655 is often referred to as "wild type".

Take a look at this list of strains, many of which are used (and are perfectly legal to use) for protein expression, and tell me how many are (a) tryptophan auxotrophs (b) unable to transfer their genes to other strains.

I am not contravening any regulations and certainly not playing "fast and loose" - my lab is fully ACGM compliant, in fact we are a Category 2 lab. If you don't know what that means, you are not qualified to comment.

notasfamous
18 January 2012 1:17PM

Recommend (0)

Responses (0)

Report

Share

Questions for the synthetic biologists:
If the 'synthetic' microbes cannot exist outside the specific culture medium, why are some synthetic biologists claiming they will use the technology for environmental cleanup?
Furthermore, groups seems to be suggesting that 'synthetic' organisms will be injected into humans, the guys that are going to cure cancer etc., the culture medium then becomes the human body, does it not?

Comments on this page are now closed.

;