Science Magazine Podcast

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Promo

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Music

Interviewer – Sarah Crespi

Finally today Adrian Cho, staff writer for *Science Magazine* and *Science*NOW, is here to talk about some recent stories from our daily news site. I'm Sarah Crespi. So, Adrian, first up we have a story on reprogramming cells *in vivo*. Researchers have been able to reprogram cells, take them back to a stem cell-like state, since like 2006, but always in a dish, never inside a living animal until now. So let's start with making pluripotent cells in a dish. How is that done?

Interviewee – Adrian Cho

Well, so the breakthrough there was that researchers discovered that you only had to manipulate four genes to actually take an adult cell like a skin cell and make it revert to its kind of primordial form, the so-called pluripotent form where the cell can then differentiate into any different type of cell within the body. So they figured out that they could do this just by manipulating essentially four genes. And that's how it was done in petri dishes. So what's happened now is that researchers have found that they can actually do this inside a living organism. So researchers at the National Cancer Research Center in Madrid used genetically modified mice that had these four key genes in them. The mice were designed in such a way that these genes could be manipulated by giving the mice certain drugs. And so what they showed is that in these mice, they could turn on these genetic switches essentially and make cells within the fully grown mouse go back to their pluripotent stem cell form. In fact, they showed something more than that. They showed that the cells actually go back to an even more variable type of stem cell called a totipotent stem cell, and the difference here is a little bit specialized. A pluripotent stem cell can turn into any cell in the normal grown body, but only totipotent stem cells can form special tissues like placenta.

Interviewer – Sarah Crespi

They were actually able to induce these cells inside of a mouse. How did that actually turn out for the mice?

Interviewee – Adrian Cho

It probably was not a great experience for the mice. So the mice broke out in these tumors and they were very weird tumors. They had placental cells and things like that inside them, so they were very, very strange tumors. One researcher described this advance – researcher not involved in the work – described this advance as a bit creepy.

Interviewer – Sarah Crespi
Right, because they were growing – what was it called… teratomas? They're many kinds of cells all in the tumor.

Interviewee – Adrian Cho
Right.

Interviewer – Sarah Crespi
What's the next step for this research?

Interviewee – Adrian Cho
Well, so the next step is they're actually going to put human cells within a mouse – so in a living organism – and see if they can induce the human cells back into their pluripotent state as well. Looking long into the future, this advance raises some possibility that maybe at some point in the future scientists would be able to reprogram cells within a human being and actually use them to help regenerate damaged tissues, essentially repairing the body from the inside out.

Interviewer – Sarah Crespi
Next up we have a story on the tingly feeling of Szechuan peppers. Szechuan peppers create a unique feeling in the mouth. It kind of starts out as heat and then turns into this weird numbing, tingling feeling. And now a group of researchers is suggesting this might actually be because the peppers stimulate nerve fibers associated with touch. What kind of fibers are we talking about here?

Interviewee – Adrian Cho
So these are nerve fibers known as RA1 fibers. They're mechanoreceptors so they are the kind of thing that sense mechanical movement – you know, if you run your hand across a corduroy, it has a particular distinctive feel and these are the type of nerve cells that are triggered to help you get that sense of sensation of the texture. And so this was a kind of odd experiment. This tingling sensation has been known, and the researchers wanted to know if the tingling sensation had something to do with exciting these nerves, these mechanoreceptor nerves. So they did a kind of curious experiment where they would put the Szechuan pepper on the lips of a subject and then hook the subject's finger to a little gizmo that would vibrate, and then they would tune the vibration until the subject would say that the frequency matched the frequency of the tingling on the lips and tongue. And when they did this they found that apparently, Szechuan pepper has a frequency of about 50 cycles per second, which is a little bit less than if you walk into a room with bad fluorescent lights and you hear that buzz – bzzzz – that's a 60 cycle per second buzz from the electricity. So it's a little bit slower than that. And these particular RA1 fibers are known to react to a frequency of around 50 cycles per second, so the authors infer that the chemical in Szechuan pepper is actually stimulating these nerve cells as well and that's why you get this characteristic frequency.

Interviewer – Sarah Crespi

This doesn't seal it up, though. I mean it still could be that other nerve fibers are contributing to the sensation as well?

Interviewee – Adrian Cho
That's right, that's right. Other researchers point out that this seems to make a pretty strong case that they are exciting the RA1 nerve fibers, but there are other nerve fibers that react to different stimuli or to groups of stimuli, and they could be exciting those as well.

Interviewer – Sarah Crespi
So I thought this was a really neat study because it's looking at Szechuan peppers and it's food and you're looking at senses, but that's actually something that's been done with a couple of other different tastes. What other tastes have been helpful in investigating the senses?

Interviewee – Adrian Cho
Neuroscientists have used menthol in chili peppers to help understand sensations like pain and temperature—one can imagine the cooling sensation of menthol on the tongue. So this is kind of in line with that. In fact, along these lines, this paper raises a kind of interesting possibility according to one researcher. He envisions that an artist or a cook could come up with some sort of experience where you combine sound and sight and the taste of Szechuan pepper – you know, you've got vibrations going at the same frequency that you're tasting – to have a sort of multidimensional experience which sounds like a lot of fun. I mean I would try it, why not?

Interviewer – Sarah Crespi
Finally, we have a story on faster switching LCDs. So LCDs, or liquid crystal displays, are behind most of the screens we stare at day in and day out. Can you give us a quick recap of how these basically common household items work?

Interviewee – Adrian Cho
Sure. Liquid crystal display takes advantage of the weird properties of liquid crystals, which are bonafide liquids. The molecules in them jumble around and move and flow. But the liquid crystals also have some properties like a solid, in particular the molecules are usually kind of rod-shaped and they all tend to point in the same direction like the molecules in a molecular crystal, and that gives us very weird optical properties. In particular it turns out that if you shine polarized light through a liquid crystal, depending on how the molecules are lined up they can turn the polarization, almost like reaching in and turning the hand of a grandfather clock. The reason that that's helpful in a display is you can start out with the display, the lights coming from the back of the display towards your eyes. And in the display there are two polarizers, which will only let light through if it's polarized in a particular direction, and they are actually at right angles. So by default the light can't get through it. The light that gets through the back of the display, the polarizer at the back of the display can't get through the polarizer at the front until you put the liquid crystal in between and then you set things up just right so that if you apply an electric field, you rotate all these molecules, and they then rotate the polarization of

the light to an extent that it will get through to the front of the screen and then come out and hit your eye. So when you watch a video on an LCD display, like something say in a smartphone, what's actually happening is that there are all these little electrical signals that are either rotating the liquid crystal molecules—or not, you know, just leaving them where they are—so that the pixels light up and turn off and form an image.

Interviewer – Sarah Crespi
And so how quickly can these crystals actually be flipped around?

Interviewee – Adrian Cho
So there's an asymmetry here. You can wrench the molecules into the position where the light comes through in a standard display very quickly in just tens of nanoseconds, but what happens when you turn the electric field off is that it takes about a thousand times longer for the molecules to relax back to their original orientation. And that's because that orientation is set by a pattern etched into the screen itself, and it takes time for the subtle effect to sort of propagate through all these molecules. It's almost like moving a crowd of people, right; if you sort of give them a little shove it takes a while for that shove to propagate through the crowd.

Interviewer – Sarah Crespi
And so what did the researchers here do to speed things along?

Interviewee – Adrian Cho
So here they did a kind of twist, if you will, on a liquid crystal display. They found a clever way to return to the default position. They did it using a slightly different effect. They started out with the molecules oriented so that the light actually gets through – so the default position is that the light is going to come through the cell – and then they applied an electric field. But in this case, instead of turning the molecules, what it does is it actually makes them even more ordered than they usually are. And these molecules are elongated but they're not actually like cylindrical rods, they're a little bit more like planks. And what happens is normally the planks are just kind of… they all point in the same direction but they're all twisted in different orientations, and they keep twisting because of thermal motion, and there's this kind of disorder if you look at how they're all twisted around their long axes.

Interviewer – Sarah Crespi
Okay. So they're all, say, pointing the long way towards one thing but they might be, different edges might be facing you.

Interviewee – Adrian Cho
Bingo! That's exactly right. And so then what they do is they apply an electric field that doesn't twist the direction of the long direction. But what it does is that it overcomes this kind of jiggling that's got them twisting edgewise and it makes them stack a little bit like lumber. And it turns out that if you do that, it changes in a subtle way the amount that the liquid crystal rotates the light and less of it gets through so the cell gets slightly dimmer. And the advantage is as soon as you turn that field off the jiggling just comes back and

undoes this sort of extra step of ordering that you've put in, and so the thing turns off very quickly in something like 30 nanoseconds. So the disadvantage is that the effect is relatively smaller, but the advantage is that it's very fast.

Interviewer – Sarah Crespi
So is this going to give us high-speed televisions?

Interviewee – Adrian Cho
Well, so this is not actually likely to make it into your smartphone or your computer screen or your television. Frankly, your eye can't respond to anything close to that speed – 30 nanoseconds is way, way, way too fast for your eye. So it's not the kind of speed that you need for a display that's going to feed the eye. However, it may allow you to do other things with liquid crystals. You may be able to make ultrafast shutters that can come on and off very quickly. You may be able to direct laser beams that are used in communication, say, between satellites, very quickly if you can use very fast switching LCDs and change the contrast very quickly. So it's not going to replace the technology that you've got sitting on your desk every day, but it has potential for other uses. And I think the really interesting thing is it's the new twist on the whole idea of an LCD.

Interviewer – Sarah Crespi
Okay, so what else is on the site this week, Adrian?

Interviewee – Adrian Cho
Well, there's a paper that shows that birds with bigger brains have lower levels of stress hormones, suggesting that smarter birds know how to cope with the trials of day-to-day living better than dumber birds. And scientists have also decoded the DNA from a cave bear that lived 300,000 years ago, and that makes it the oldest DNA ever found outside of the Arctic where the ice keeps DNA frozen, keeps it from degrading. This bests the previous best record for DNA found outside the Arctic, which was 120,000 years. Also on our policy blog, *Science*Insider, our writer Jennifer Couzin-Frankel has been to a conference of the International Congress of Peer Review and Biomedical Publication in Chicago and has filed four reports about what's going on there. For example, there is a study of what happens when papers are retracted and are they really retracted, looking at the oeuvre of one researcher who was found guilty of misconduct. Eighty-eight of his papers were supposed to be retracted, nine of them were not, only five of them met the full criteria for what really should happen when you retract a paper. So apparently peer review, as always, is a bit of a work in progress.

Interviewer – Sarah Crespi
Great. Thanks, Adrian.

Interviewee – Adrian Cho
My pleasure.

Interviewer – Sarah Crespi

Adrian Cho is a staff writer for *Science Magazine* and *Science's* daily news site, *Science*NOW. I'm Sarah Crespi. You can check out the latest news and the policy blog, *Science*Insider, at news.sciencemag.org.