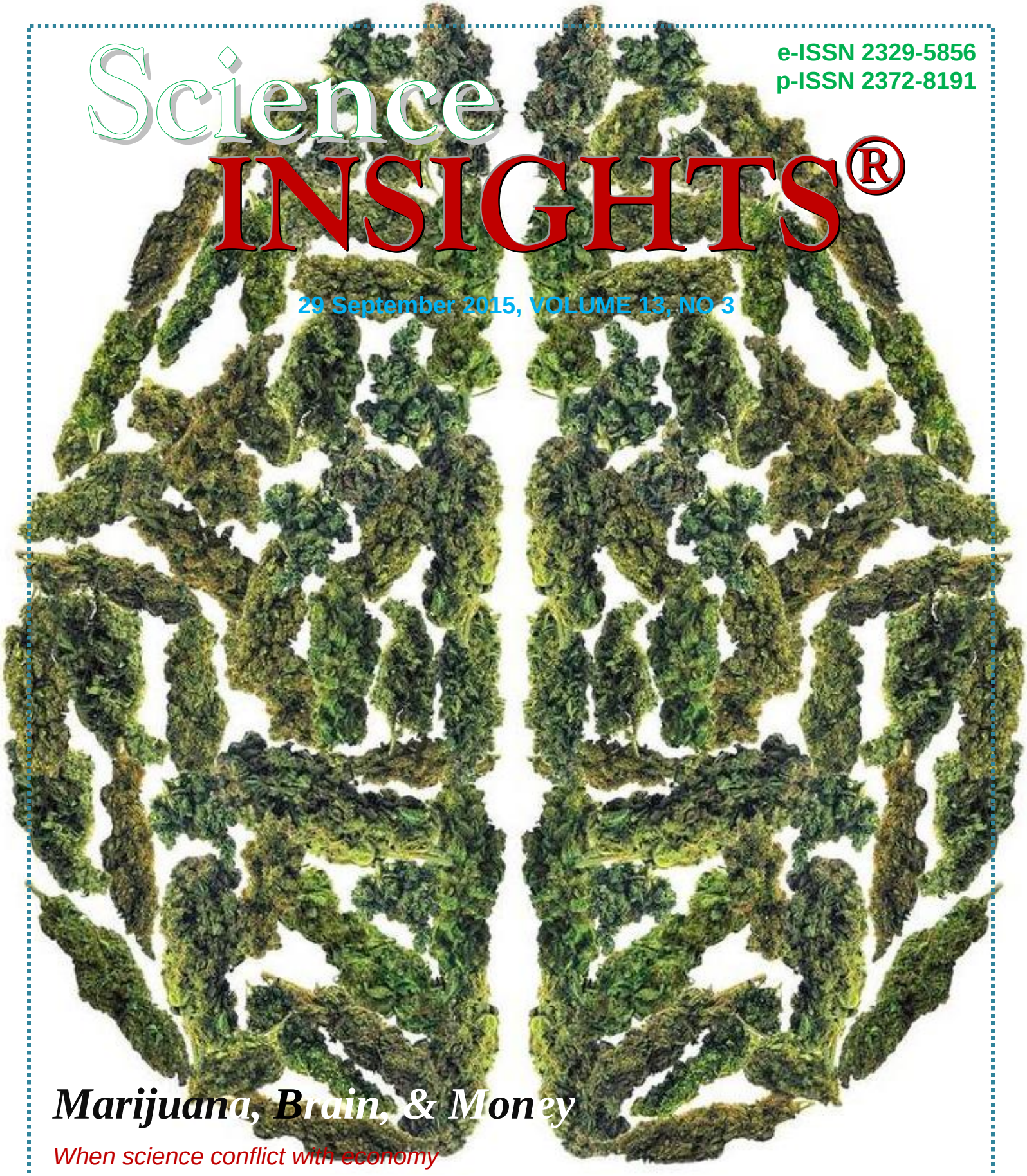
e-ISSN 2329-5856
p-ISSN 2372-8191

Science INSIGHTS®

29 September 2015, VOLUME 13, NO 3



Marijuana, Brain, & Money

When science conflict with economy

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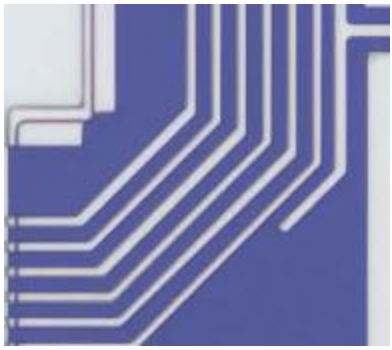
NEWS



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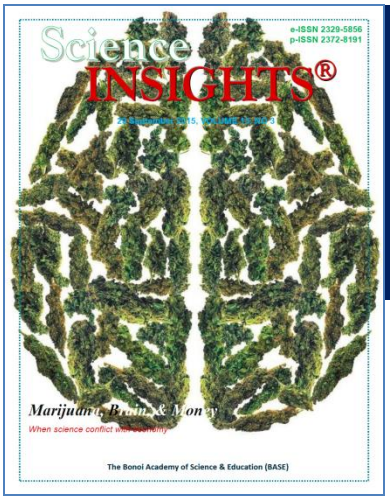

COVER
Marijuana has been being accepted as a medical or recreational drug by states across the United States indicating that this ever debating drug is getting approval by more and more people. Does this mean it is safe for us to accept marijuana as a daily recreational tool? See page 501.
Image: BASE illustrating group

p-ISSN: 2372-8191
e-ISSN: 2329-5856
DOI: 10.15354/issn.2329-5856

BASE

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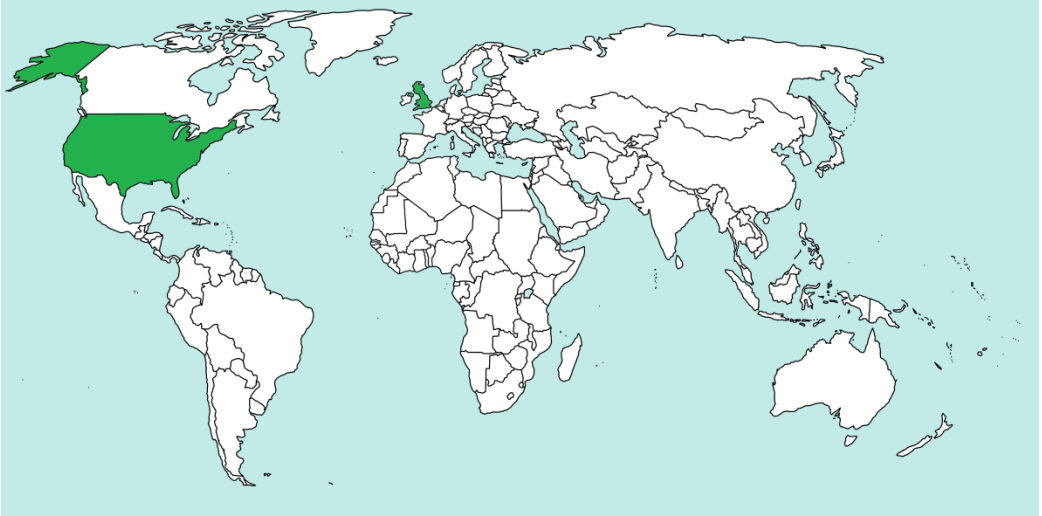
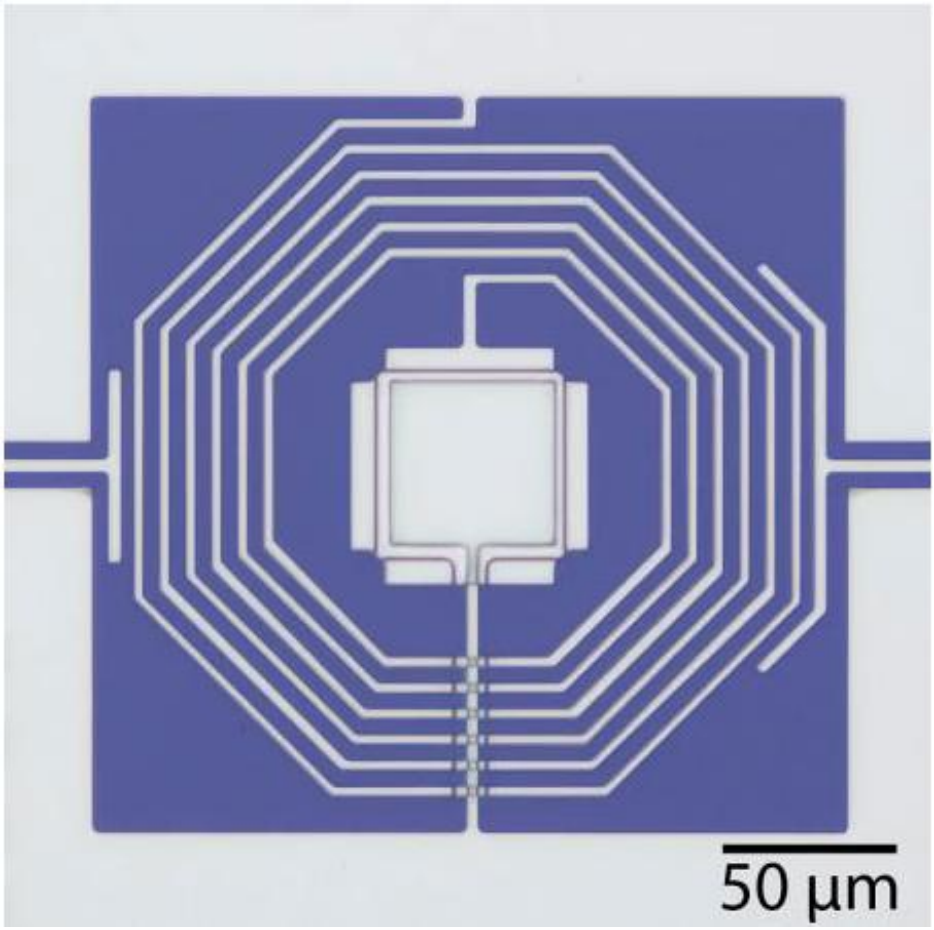
Physics, USA

Physicists Observe and Control Quantum Motion



Consider the pendulum of a grandfather clock. If you forget to wind it, you will eventually find the pendulum at rest, unmoving. However, this simple observation is only valid at the level of classical physics - the laws and principles that appear to explain the physics of relatively large objects at human scale. However, quantum mechanics, the underlying physical rules that govern the fundamental behavior of matter and light at the atomic scale, state that nothing can quite be completely at rest. For the first time, a team of Caltech researchers and collaborators has found a way to observe - and control - this quantum motion of an object that is large enough to see. Researchers have known for years that in classical physics, physical objects indeed can be motionless. Drop a ball into a bowl, and it will roll back and forth a few times. Eventually, however, this motion will be overcome by other forces (such as gravity and friction), and the ball will come to a stop at the bottom of the bowl. “In the past couple of years, my group and a couple of other groups around the world have learned how to cool the motion of a small micrometer-scale object to produce this state at the bottom, or the quantum ground state,” says Keith Schwab, a Caltech professor of applied physics, who led the study. “But we know that even at the quantum ground state, at zero-temperature, very small amplitude fluctuations - or noise - remain.” Because this quantum motion, or noise, is theoretically an intrinsic part of the motion of all objects, Schwab and his colleagues designed a device that would allow them to observe this noise and then manipulate it. The micrometer-scale device consists of a flexible aluminum plate that sits atop a silicon substrate. The plate is coupled to a superconducting electrical circuit as the plate vibrates at a rate of 3.5 million times per second. According to the laws of classical mechanics, the vibrating structures eventually will come to a complete rest if cooled to the ground state. But that is not what Schwab and his colleagues observed when they actually cooled the spring to the ground state in their experiments. Instead, the residual energy—quantum noise—remained. “This energy is part of the quantum description of nature—you just can’t get it out,” says Schwab. “We all know quantum mechanics explains precisely why electrons behave weirdly. Here, we’re applying quantum physics to something that is relatively big, a device that you can see under an optical microscope, and we’re seeing the quantum effects in a trillion atoms instead of just one.” Because this noisy quantum motion is always present and cannot be removed, it places a fundamental limit on how precisely one can measure the position of an object. But that limit, Schwab and his colleagues discovered, is not insurmountable. The researchers and collaborators developed a technique to manipulate the inherent quantum noise and found that it is possible to reduce it periodically. Coauthors Aashish Clerk from McGill University and Florian Marquardt from the Max Planck Institute for the Science of Light proposed a novel method to control the quantum noise, which was expected to reduce it periodically. This technique was then implemented on a micron-scale mechanical device in Schwab’s low-temperature laboratory at Caltech. “There are two main variables that describe the noise or movement,” Schwab explains. “We showed that we can actually make the fluctuations of one of the variables smaller—at the expense of making the quantum fluctua-



tions of the other variable larger. That is what's called a quantum squeezed state; we squeezed the noise down in one place, but because of the squeezing, the noise has to squirt out in other places. But as long as those more noisy places aren't where you're obtaining a measurement, it doesn't matter." The ability to control quantum noise could one day be used to improve the precision of very sensitive measurements, such as those obtained by LIGO, the Laser Interferometry Gravitational-wave Observatory, a Caltech-and-MIT-led project searching for signs of gravitational waves, ripples in the fabric of space-time. "We've been thinking a lot about using these methods to detect gravitational waves from pulsars—incredibly dense stars that are the mass of our sun compressed into a 10 km radius and spin at 10 to 100 times a second," Schwab says. "In the 1970s, Kip Thorne [Caltech's Richard P. Feynman Professor of Theoretical Physics, Emeritus] and others wrote papers saying that these pulsars should be emitting gravity waves that are nearly perfectly periodic, so we're thinking hard about how to use these techniques on a gram-scale object to reduce quantum noise in detectors, thus increasing the sensitivity to pick up on those gravity waves," Schwab says. In order to do that, the current device would have to be scaled up. "Our work aims to detect quantum mechanics at bigger and bigger scales, and one day, our hope is that this will eventually start touching on something as big as gravitational waves," he says. These results were published in an article titled, "Quantum squeezing of motion in a mechanical resonator." In addition to Schwab, Clerk, and Marquardt, other coauthors include former graduate student Emma E. Wollman (PhD '15); graduate students Chan U. Lei and Ari J. Weinstein; former postdoctoral scholar Junho Suh; and Andreas Kronwald of Friedrich-Alexander-Universität in Erlangen, Germany. The work was funded by the National Science Foundation (NSF), the Defense Advanced Research Projects Agency, and the Institute for Quantum Information and Matter, an NSF Physics Frontiers Center that also has support from the Gordon and Betty Moore Foundation.

Universe, UK

Knotty Network and Universe'S Early Growth Spurt

It's one of life's minor irritants, but it could explain why we're here. Next time the cable for your headphones ends up in a tangled mess, take a closer look before straightening it out – knottiness might explain the early expansion of the universe, along with why we live in three dimensions. The universe is thought to have expanded rapidly just a fraction of a second after the big bang, undergoing a period of what physicists call inflation. The process helped generate the cosmic structure we see today. Or so the theory goes. It's still not clear what could provide enough energy to drive inflation, and what had seemed the best evidence for this expansion, results from the BICEP2 telescope at the South

Pole, turned out earlier this year to be inconclusive. Now Arjun Berera of the University of Edinburgh, UK, and his colleagues have come up with a new source for inflation that would also explain why the universe has three spatial dimensions. They say the early universe was flooded with particles resembling gluons – the force-carriers responsible for sticking quarks together to form protons and neutrons. As the universe cooled, stringy objects called flux tubes formed between these particles. These tubes are a bit like the field lines you see when scattering iron filings around a magnet, but they are so densely packed together that they become knotted and entangled – a fate that befalls any kind of string. "If you take your headphones and put them in your backpack, they tend to get tangled," says Berera. "That's exactly the picture we're describing." This tightly wound network of flux tubes contains a lot of energy – enough to drive inflation, the team says. And as the universe expands, the network stretches until it eventually breaks, putting a stop to inflation as well. What does this have to do with dimensions? It's a little-known fact that knots can only form in three dimensions. Add more, and the loops can pass through the extra dimensions and unlink. Advanced theories of quantum gravity, like string theory, suggest the universe actually has around 10 spatial dimensions, but most of them are so tightly bound up that we can't see them. Berera's proposal explains why we were left with just the three we see today: they were needed for the flux-tube network to form. "It's only in three dimensions that you have this selection mechanism," he says. "I think it's an idea that's worth exploring," says Alan Guth at the Massachusetts Institute of Technology, one of the founders of inflation theory. But the complexities of Berera's idea mean the team hasn't made testable predictions, so it's early days yet. Their proposal is quite different to other forms of inflation, so could point to a new avenue of research if it stands up, Guth says. "The odds of it succeeding are small, but the payoff is big if it does." But given that there are rival theories for inflation, it's not clear this would explain our three-dimensional universe unless those others are ruled out, he says. The orig-

inal article from http://arxiv.org/abs/1508.01458.

Paleontology, UK

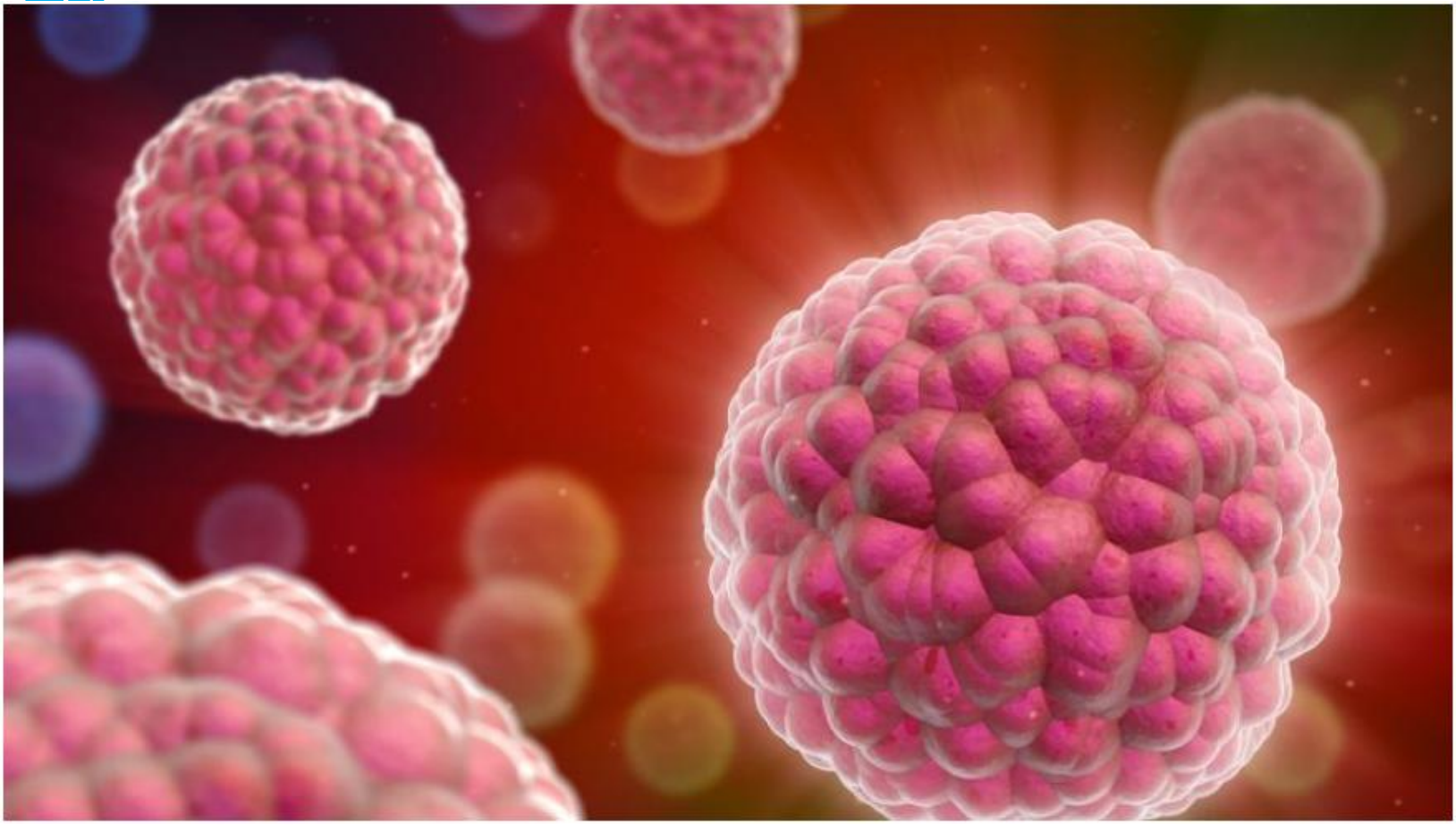
Fossilised Dinosaur's Foot Found on Lavernock Beach

A skeleton of a meat-eating Jurassic dinosaur, the theropod, was uncovered by spring storms at Lavernock beach, Vale of Glamorgan, in 2014. The dinosaur's missing foot was found at the beach by palaeontology student, Sam Davies, of Bridgend, at the beginning of this month. "My first reaction was that I was very lucky," he said. The fossilised skeleton of the theropod - a distant cousin of the giant Tyrannosaurus rex - went on display at the National Museum Cardiff's main hall in June after it was found by fossil-hunting brothers Nick and Rob Hanigan. Mr Davies, who studies at the University of Portsmouth, visited Lavernock, near Penarth, after his tutor told him its cliffs were rich with fossils. He arrived only hours after a cliff fall had exposed the fossil and before it could be washed away by the tide. "It was pure luck that I found it. It was just sitting on top of a slab of rock," he said. His tutor, Dr David Martill, confirmed the find was the missing foot of the recently discovered dinosaur, after the student emailed a picture. Dr Martill said: "This was a chance-in-a-million find and highlights how important it is to encourage fossil hunting in this country." He said the specimen would help chart the evolution of dinosaur feet. The foot has been donated to the Amgueddfa Cymru, which hopes to put it on display with the rest of the skeleton soon. Dr Caroline Buttler, head of paleontology at the museum, said: "The dinosaur found by Nick and Rob Hanigan is the first skeleton of a theropod found in Wales. "Sam's find adds to its significance because we can learn more about the animal and how it is related to the dinosaurs that eventually evolved into birds."

Ocean, UK

"Flying Spaghetti Monster" Caught on Video off the Angolan Coast

This unusual marine animal was recently caught on camera near the seabed off the coast of Angola. A team from BP was carrying out routine operations near an oil well, using a remotely operated underwater vehicle (ROV) at a depth of 1,325 meters, when they spotted the creature, which they nicknamed the flying spaghetti monster. Intrigued, they sent footage of it to Daniel Jones from the National Oceanography Centre in Southampton, UK. A deep-sea animal researcher, Jones is involved with the Serpent project, a collaboration with ROV teams from oil and gas companies to catalogue ocean life. Jones identified it as a siphonophore. Philip Pugh, one of Jones's colleagues, pinned it down precisely. After noticing that the tentacles do not have side branches, he deduced that it was a specimen of *Bathyphysa conifera*. Siphonophores belong to a group of aquatic animals that include corals and jellyfish. Specimens up to 40 meters long have been found, making them among the world's longest animals. Other bizarre-looking animals have recently been filmed underwater. A giant glowing sea worm was caught lighting up the ocean in a rare sighting. The hollow, tube-like invertebrates can sometimes be as big as a whale. At the end of



last year, a never-seen-before fish nicknamed “sea ghost” due to its ethereal appearance, broke the depth record for fish. It was captured on video in the Mariana trench in the Pacific Ocean, a whopping 8,143 meters below the surface.

Cancer, USA

Dietary Supplement May Prevent and Treat Prostate Cancer

Researchers at the University of Miami have found that an over-the-counter supplement is effective in both preventing and treating prostate cancer. The supplement, 4-methylumbelliferone (4-MU), is a non-toxic oral agent used as a dietary supplement in Europe and Asia for improving liver health. Treating mice with the supplement appeared to inhibit prostate cancer from further developing starting as soon as eight weeks after the rodents were diagnosed. “The results were simply amazing,” principal investigator Vinata B. Lokeshwar, a professor of urology and director of the pilot and translational studies component of the Miami Clinical and Translational Science Institute, said in a news release. The team also found that 4-MU halted the metastatic spread of prostate cancer. According to the National Cancer Institute, prostate cancer is the most common nonskin cancer and second leading cause of cancer-related death in men in the U.S. In 2014, there were an estimated 233,000 new cases and about 30,000 deaths. Projections for 2015 are similar. For their study, researchers used a mice model of prostate cancer, treating mice at distinct stages of the disease and stopping treatment at 28 weeks. When treatment started at eight or 12 weeks, it completely inhibited prostate cancer development and growth. At 22 weeks, researchers found that small cancers had stopped growing and in some cases even regressed. “Also, to our amazement, while 60 percent of the animals in the control group experienced metastasis to distant organs, none of the treatment group developed metastasis. 4-MU did all of this without causing toxicity to the host,” Travis Yates, former graduate student of the school’s Sheila and David Fuente graduate program in cancer biology, and current postdoctoral fellow at the University of Pennsylvania, said in the news release. Researchers noted that the earlier the treatment started, the better the protection provided by the 4-MU. According to researchers’ histological studies, 4-MU halted growth of new blood vessels, thus cutting off nutrient supply to prostate tumors and reversing their ability to metastasize.

Cancer, UK

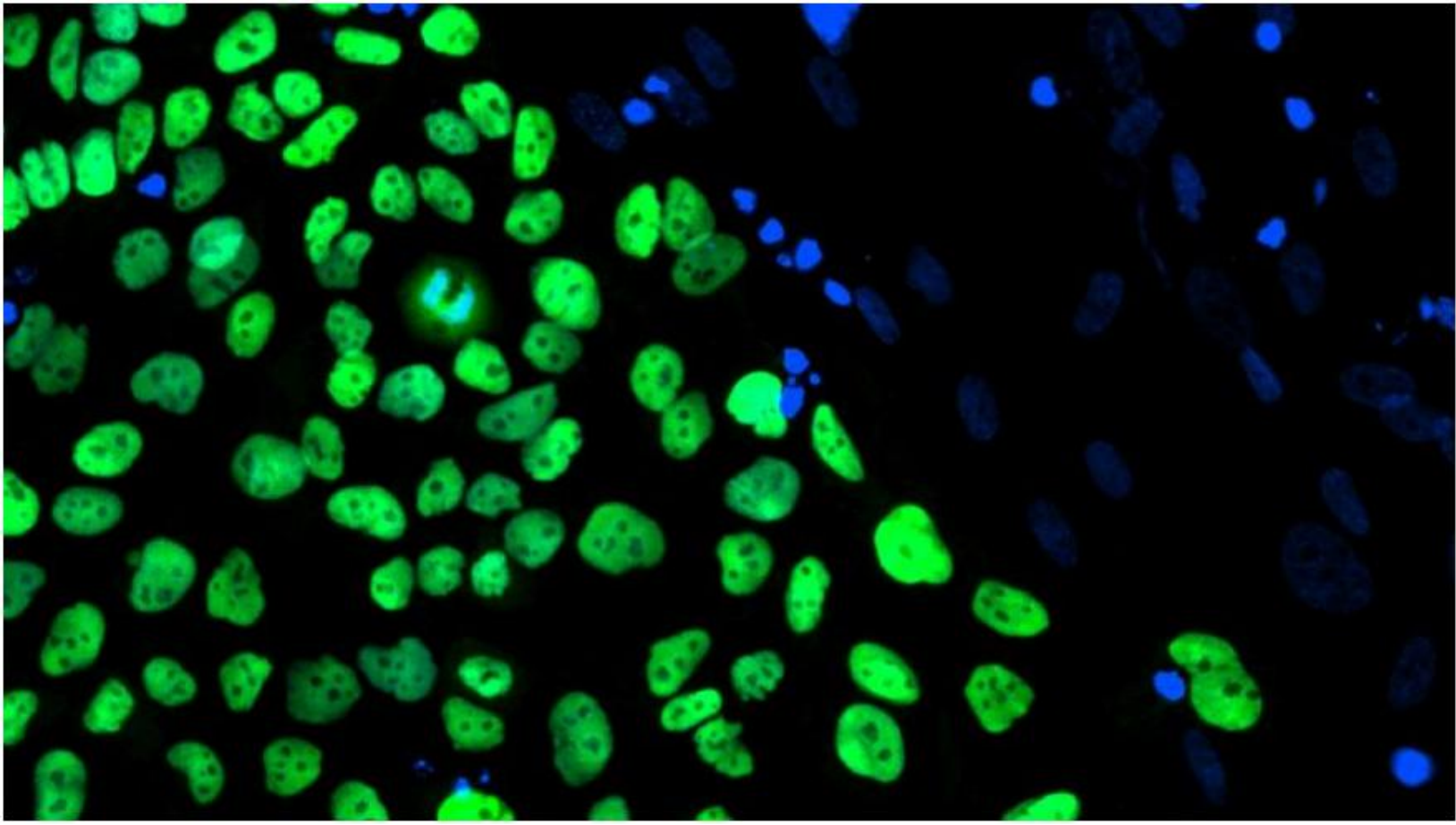
Protein That Boosts Immunity to Viruses and Cancer

Scientists have discovered a protein that plays a central role in promoting immunity to viruses and cancer, opening the door to new therapies. Experiments in mice and human cells have shown that the protein promotes the proliferation of cytotoxic T cells, which kill cancer cells and cells infected with viruses. The discovery was unexpected because the new protein had no known function and doesn't resemble any other protein. Researchers from Imperial College London who led the study are now developing a gene therapy designed to boost the infection-fighting cells, and hope to begin human trials in three years. The study also involved researchers at Queen Mary University of London, ETH Zurich and Harvard Medical School. Their discovery, which has been six years in the making, is reported today in the journal Science. Cytotoxic T cells are an important component of the immune system, but when faced with serious infections or advanced cancer, they are often unable to proliferate in large enough quantities to fight the disease. By screening mice with genetic mutations, the Imperial team discovered a strain of mice that produced 10 times as many cytotoxic T cells when infected with a virus compared with normal mice. These mice suppressed the infection more effectively, and were more resistant to cancer. They also produced more of a second type of T cells, memory cells, enabling them to recognise infections they have encountered previously and launch a rapid response. The mice with enhanced immunity produced high levels of a hitherto unknown protein, which the researchers named lymphocyte expansion molecule, or LEM. They went on to show that LEM modulates the proliferation of human T cells as well as in mice. The researchers now aim to develop a gene therapy designed to improve immunity by boosting the production of LEM. With the support of Imperial Innovations, the technology commercialisation company for the College, the researchers have filed two patents. A company called ImmunarT has been formed with the aim of commercialising the technology. Professor Philip Ashton-Rickardt from the Section of Immunobiology in the Department of Medicine at Imperial, who led the study, said: "Cancer cells have ways to suppress T cell activity, helping them to escape the immune system. Genetically engineering T cells to augment their ability to fight cancer has been a goal for some time and techniques for modifying them already exist. By introducing an active version of the LEM gene into the T cells of cancer patients, we hope we can provide a robust treatment for patients. "Next we will test the therapy in mice, make sure it is safe and see if it can be combined with other therapies. If all goes well, we hope to be ready to carry out human trials in about three years." Dr Claudio Mauro, who led the research from the Centre for Biochemical Pharmacology, based within Queen Mary University of London's William Harvey Research Institute, said: "This study has identified the novel protein LEM and unlocked an unexpected way of enhancing the ability of our immune system to fight viruses or cancers. This is based on the ability of the protein LEM to regulate specific energy circuits, and particularly mitochondrial respiration, in a subset of white blood cells known as cytotoxic T cells. This discovery has immediate consequences for the delivery of innovative therapeutic approaches to cancer. Its ramifications, however, are far greater as they can help explaining the biological mechanisms of widespread human diseases involving altered immune and inflammatory responses. These include chronic inflammatory and autoimmune disorders, such as atherosclerosis and rheumatoid arthritis." The research was funded by the Medical Research Council, the Wellcome Trust and the British Heart Foundation. Dr Mike Turner, Head of Infection and Immunobiology at The Wellcome Trust, said: "The discovery of a protein that could boost the immune response to not only cancer, but also to viruses, is a fascinating one. Further investigation in animal models is needed before human trials can commence, but there is potential for a new type of treatment that capitalises on the immune system's innate ability to detect and kill abnormal cells."

Stroke, UK

ReNeuron Stem Cell Therapy for Stroke

A pioneering stem cell treatment for patients disabled by



stroke has continued to show long-term promise in a clinical trial, the British biotech company behind the project said on Friday. News that two-year follow-up data from a small Phase I study showed improvements in limb function with no worrying safety issues lifted shares in ReNeuron 10 percent by 0830 EDT. The clinical results were presented at the European Stroke Organisation Conference in Glasgow. The company said there had been no cell-related or immunological adverse events in any of the 11 patients treated. The only problems seen were related only to the implantation procedure or the patient's underlying medical condition. Improvements in neurological status and limb function were observed within three months of treatment and maintained throughout long-term follow-up. The procedure involves injecting ReNeuron's neural stem cells into patients' brains to repair areas damaged by stroke, thereby improving both mental and physical function. The Phase I trial is designed primarily to test whether the experimental treatment is safe.

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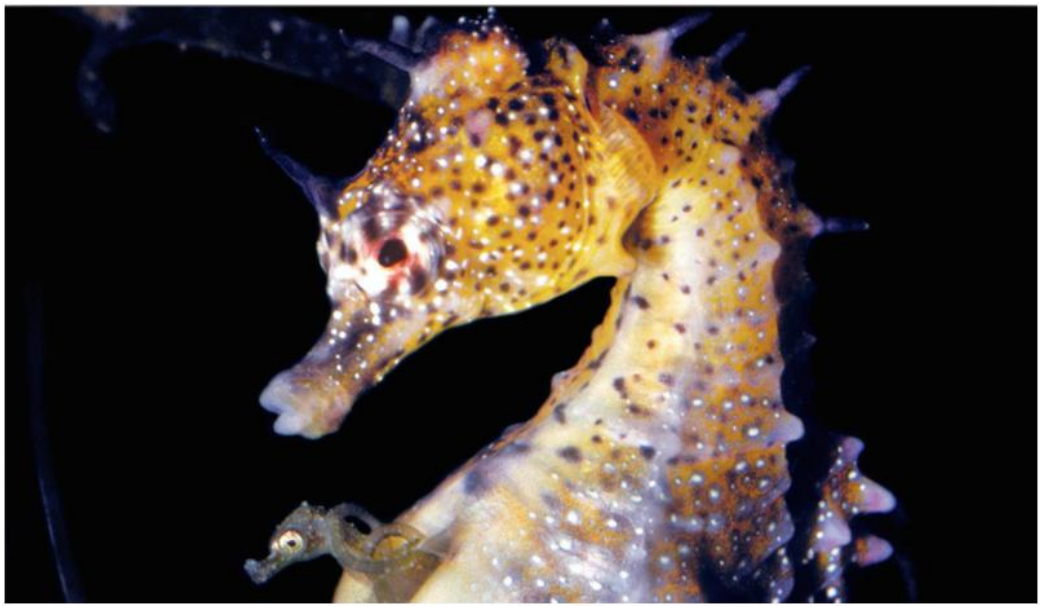
Biology, USA

After the Male Seahorses are Pregnant



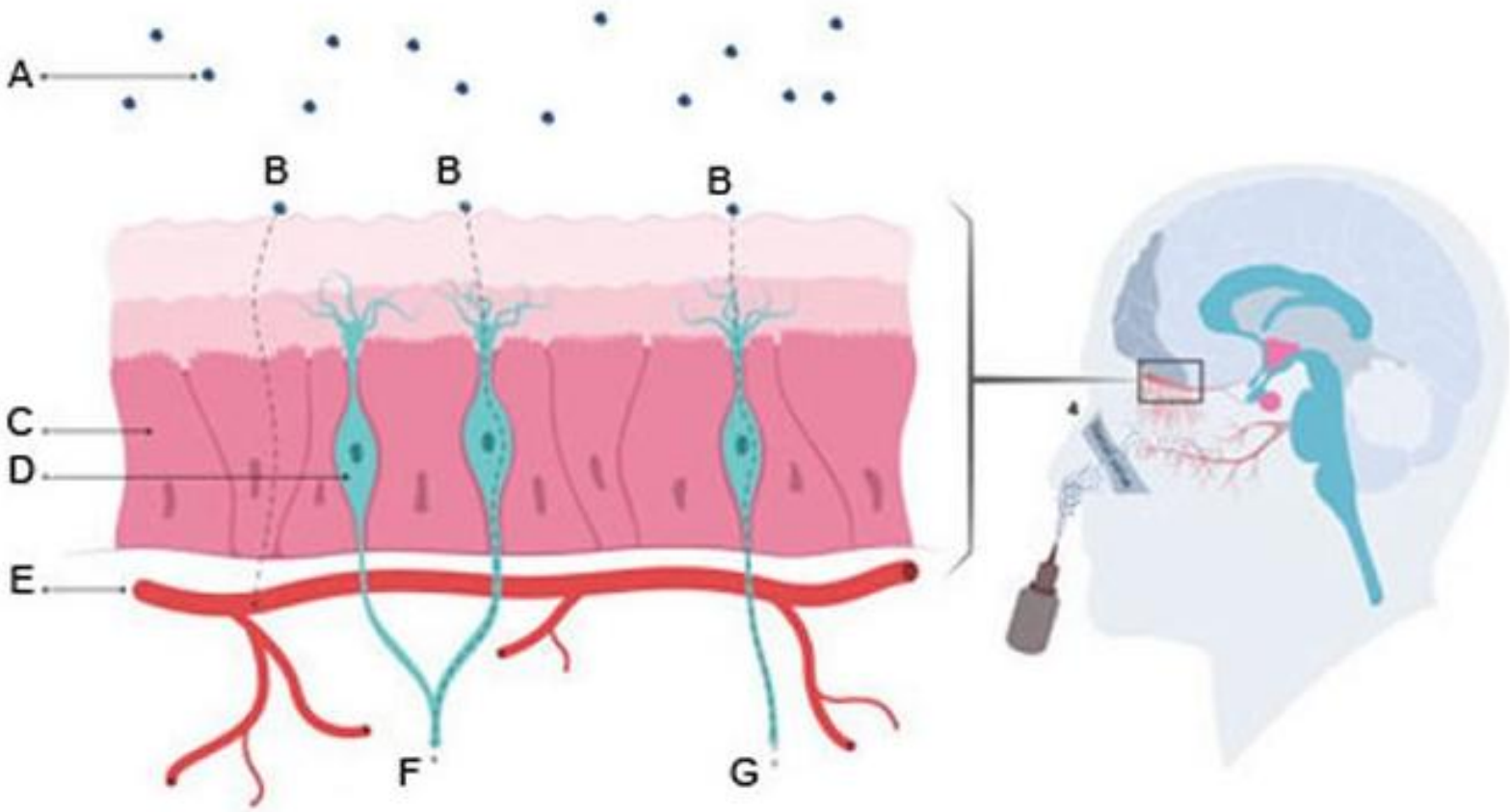
A male seahorse gets pregnant when his mate deposits her as-yet-unfertilized eggs into a pouch on his belly. He fertilizes them, then carries the developing embryos until they're ready to feed themselves. At which point he forcefully shoots them into the world. But his pouch isn't just a bag for keeping baby seahorses safe. A new analysis of the active genes in the pouch lining during pregnancy published in *Molecular Biology and Evolution* suggests he's doing a lot more for his embryos than just hauling them around. Lead author Camilla Whittington thinks seahorse dads are also supplementing their babies' food supply, cleaning up their waste, and protecting them from bacteria inside the pouch. As his pregnancy progresses, a male seahorse turns on genes that help him remodel his brood pouch to make it roomier as the embryos develop. He also turns on genes that make proteins responsible for moving nutrients, carbon dioxide, and urine across those tissues. Genes involved in regulating the immune system function also pop on. Pregnancy isn't unique to mammals like us - it evolved independently in many kinds of snakes and fish as well. Only one group of fish - the seahorses, pipefish, and sea dragons - make pregnancy a male affair. Yet many of the genes the seahorses switch on during their pregnancies are also active in the mammalian uterus. And that's really interesting, because it suggests that when each group evolved their own unique way of becoming pregnant, they took advantage of their shared toolkit of ancestral genes to solve physiological challenges like feeding their embryos, instead of evolving new proteins to solve the problem. By Diane Kelly. Edited by Elia Bousar.

Mol Biol Evol 2015; doi: 10.1093/molbev/msv177

Neuroscience, NORWAY

Oxytocin Delivering Nasal Device to Treat Mental Illness

Researchers at the University of Oslo have tested a new device for delivering hormone treatments for mental illness through the nose. This method was found to deliver medicine to the brain with few side effects. About one out of every hundred Norwegians develop schizophrenia or autism in the course of their lifetime. Moreover, at any one time some 20,000 people are receiving treatment for these problems. Many psychiatric disorders such as autism, schizophrenia and bipolar disorder are characterised by poor social functioning. Oxytocin is a hormone that influences social behaviour and has shown promise for the treatment of mental illness. Researchers at UiO have now discovered that low doses of oxytocin may help patients with mental illness to better perceive social signals. As part of this project, they have collaborated with the company OptiNose, who have developed a new device designed to improve medicine delivery to the brain via the nose. Oxytocin has historically been known to play a crucial role in child rearing as it facilitates pregnancy, birth, and the release of milk during nursing. Further, oxytocin helps regulate cardiac functions and fluid levels. More recent research has revealed the importance of oxytocin for social behaviour. Oxytocin is a neuropeptide and was discovered in 1953. Peptides are a group of molecules that consist of a chain of amino ac-



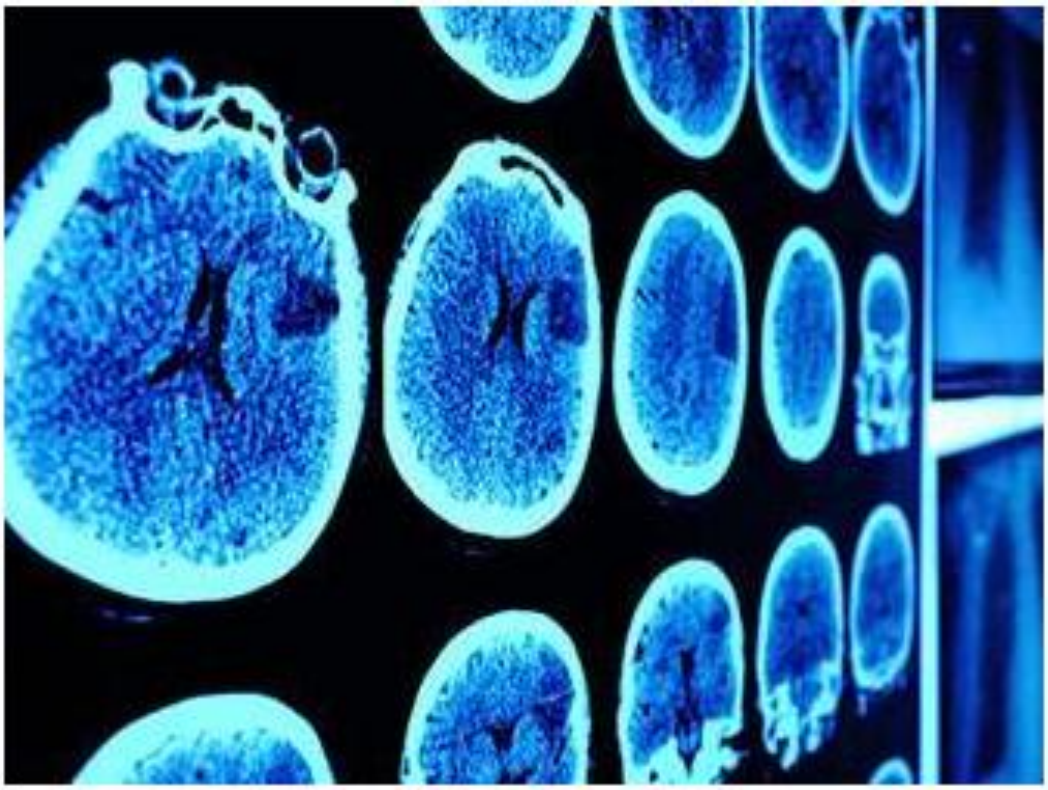
ids. Amino acids are also known as the building blocks of proteins, which we find in all types of cells. Oxytocin is produced in the hypothalamus, which is the brain's coordinating centre for the hormone system. Because of oxytocin's role in social behaviour, researchers have explored the possibility of administering the hormone for the treatment of mental illness. As oxytocin is a relatively large molecule, it has trouble crossing the barrier between the brain and circulating blood. Thus, researchers have administered oxytocin to patients through the nose as this route offers a direct pathway to the brain that bypasses this barrier. However, researchers have a poor understanding of how oxytocin reaches and affects the brain. The most effective dose for treatment has also received little research attention. Professor Ole A. Andreassen and his research team have collaborated with OptiNose on a project that evaluated two different doses of oxytocin and on how they affect the way in which social signals are perceived. Sixteen healthy men received two different doses of oxytocin, along with placebo. Volunteers were also given an intravenous dose of oxytocin, for a comparison of the effects of oxytocin in circulating blood. The research showed that only those administered a low dose of oxytocin experienced an effect on how they perceived social signals. Professor Ole A. Andreassen explains: "The results show that intranasal administration, i.e. introducing oxytocin through the nose, affects the function of the brain. As no effect was observed after intravenous treatment, this indicates that intranasally administered oxytocin travels directly to the brain, as we have long believed. The fact that we have shown the efficacy of a low dose of oxytocin on social perception is even more important. A dose that is lower, but that still influences behaviour, will entail a lower risk of affecting other regulatory systems in the body. Very high doses of oxytocin could, in fact, have the opposite effect on social behaviour." The scientists also discovered that individuals with larger nasal cavities had a stronger response to a low dose of oxytocin. From Neuroscience News

Trans Psych *2015;*
doi:10.1038/tp.2015.93

Medicine, DUTCH

Serotonin Signal Transduction Disturbed in Depression

Depression and anxiety disorders are the most common psychiatric disorders. Over the last few years, molecular brain imaging using Positron Emission Tomography (PET) has helped us to identify important mechanisms involved in the de-



velopment and treatment of these disorders, particularly those associated with the serotonin neurotransmitter system. The drugs that are used for these conditions (SSRIs) were developed 30 years ago. To celebrate this anniversary, a team from MedUni Vienna, led by Siegfried Kasper, Director of the University Department of Psychiatry and Psychotherapy, has summarised the latest status of global research in this field in the leading journal, The Lancet Psychiatry. "People laughed at us when we started treating depression with SSRIs (selective serotonin reuptake inhibitors) 30 years ago," explains Siegfried Kasper, who is also one of the pioneers of this method of treatment. "Today it is State of the Art and we are able to quantify disturbances in serotonin signal transmission in the brain as the cause of depression and anxiety disorders." 80% of those suffering from depression are treated with SSRIs – the success rate is around 70%. Kasper: "Their quality of life is enhanced and there is a significant and lasting improvement in their motivation and mood." Using Positron Emission Tomography (PET) from nuclear medicine, it is possible to quantify receptors, transporters and enzymes, in order to diagnose neurochemical differences in brain disorders but also to make a detailed analysis of the effects a drug has on the brain.

For example, it was also shown that the level of serotonin transporter (SERT) is greatly reduced in certain parts of the brain in patients with depression. At the same time, PET showed that SSRIs are a very effective pharmacological first-line therapy that brings about specific changes in the activity of the serotonin system. The serotonin transporter (SERT) is a cell membrane protein that facilitates return of the neurotransmitter serotonin (commonly known as the "happy hormone") into the cell. The activity of the serotonin transporter influences neural networks in the brain that are changed in depression. The serotonin transporter therefore also serves as a point of attack for the main antidepressants, such as SSRIs. The current study is the result of a collaboration with the Neurobiology Research Unit of Copenhagen University Hospital. Rupert Lanzenberger's research group at the University Department of Psychiatry and Psychotherapy, under the direction of Siegfried Kasper, is one of the leading international research teams in the field of PET brain imaging in psychiatric disorders. The underlying mechanisms for this were investigated in Vienna, in collaboration with the University Department of Radiology and Nuclear Medicine.

Lancet Psych 2015; doi: 10.1016/S2215-0366(15)00232-1


When life starts,
It is so fresh.
Who knows the future?
Sunny
Rainy
Droughty
Or
……

Mysterious Component of Human Hair

A new and surprising component of human hair has just been discovered, according to research recently presented at the annual meeting of the American Crystallographic Association. Remarkably, it's a discovery that could lead to improved hair products. *An electron microscopy image of a human hair cross section. The top region shows the external part of the hair strand (cuticle). The bottom shows the internal "macrofibrils" that exist in the cortex region. (Fabiano Emmanuel Montoro/LNNano, CNPEM)*


Who feeds us?

Deep-Analysis (Narrative)

Marijuana and Brain

The Debating Focus of Science and Economy

Johnson S. Leonard, PhD; Mary K. Pathak, MSc; Fuzhou Wang, MD, PhD

SUMMARY Marijuana has been being accepted as a medical or recreational drug by states across the United States indicating that this ever debating drug is getting approval by more and more people. Does this mean it is safe for us to accept marijuana as a daily recreational tool? The answer is no! Although substantial evidence suggested that marijuana has a lot of beneficial role in many medical conditions, it does not mean its recreational use is acceptable. If you search the web, you can find a huge pile of files discussing marijuana's negative effects on people's life and health, and on society's safety and stability. Of course, there is also plenty of supporting view on marijuana's recreational use, of them the standpoint of view is economy. However, for general people, we need balance the benefits and drawbacks before drawing some conclusions. One thing needs to be considered carefully is the domino effect of the legalization of marijuana's recreational use on the society. However, have we paid enough attention on its potential effect on our daily life, on the social value, and on the society's future? It is too early to conclude the eventual impact of marijuana on people's health and on society's existence if we can take it into consideration in a long-term period of time.■

KEYWORDS Marijuana; Cannabinoid; Brain; Economy; Legalization; Society

Sci Insights. 2015;13(3):501-507. doi:10.15354/si.15.an006

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Although the US Food and Drug Administration (FDA) states that marijuana has "no currently accepted medical use in treatment in the United States.", and it remains illegal for the sale of cannabis under federal law, about 20 US states and the District of Columbia had legalized the use of marijuana for medical purposes by early 2014 (see **Table 1**), and voters in Washington and Colorado passed initiatives to make their states the first in the country to allow recreational use of the drug in November 2012. Regarding the effect of marijuana on health, particularly on the brain function, has been being concentrated on for over several decades, and plenty of data indicate that this drug would undoubtedly cause unexpected impact on cerebral function, especially on adolescents. However, the overwhelming expectation of the wealth-propelling role of marijuana's recreational use has made it overpass piles of scientific evidence and suggestion on its careful use.

The Domino Effect of Marijuana on Society

A large body of scientific evidence has disclosed marijuana's negative effects on people's health. A lot of researchers worry about the potential impact of marijuana's legalization on people's attitudes toward the drug, i.e. perhaps making its recreational use seems more normal or acceptable. If so, the unstoppable distribution of this debating drug over the country would become more common, and it would function like the triggering card of the domino, and no force can stop it because the only thing we can do is to wait for the last card collapsed. Consequently, more and more people will become drug abuser, which leads to more cases with abusing-drug-associated diseases resulting in far more consumption of medical resources and much more social problems like crimes, traffic accidents, suicides, and breakdown of family etc. This would eventually form a vicious circle from which the whole society would lose the basic value and be approaching collapse (see the domino effect of marijuana on society in **Figure 1**).

Nevertheless, the present situation is not that optimistic. The legalization of recreational use of marijuana on the basis of money, which generally dubbed as economy concern, has surpassed everything that related with the negative effect of marijuana's legalization on the existence of our society. Of course, some criticizers would strictly say "no" to my present point of view. It is normal and makes people sense that "money is the first base of society's existence". As the social philosophy "Society has the ability to balance its yin and yang" goes on, we hope the legalization of recreational marijuana is merely a single case, and that would not alter the overall society value. Whether it would be as we expected or not largely depends on people's knowledge on this drug, and on the careful evaluation of its effect on every aspect of the society.

The Debating Focus of Marijuana: Cerebral Health

Marijuana, first it is a drug can induce addiction, which means it can change people's brain by making them craving for it. From the point of medicine, marijuana belongs to cannabinoid, and has its own specific proper-

Figure 1. The Domino Effect of Marijuana on Society

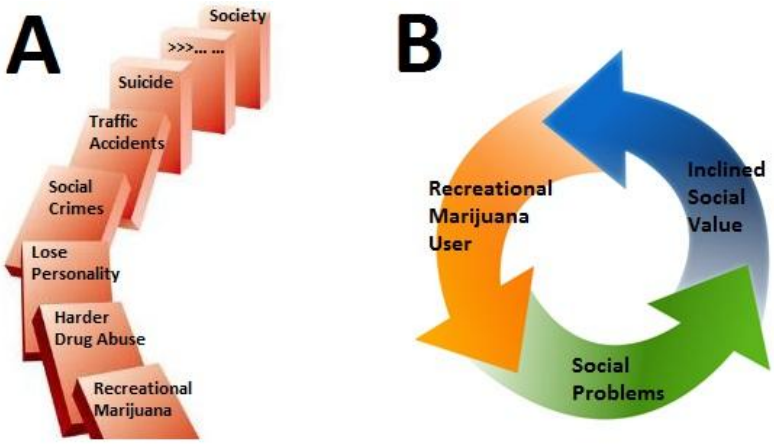


Table 1. States and DC Have Enacted Laws to Legalize Medical Marijuana

State	Year Passed	Possession Limit
Alaska	1998	1 oz usable; 6 plants (3 mature, 3 immature)
Arizona	2010	2.5 oz usable; 0-12 plants
California	1996	8 oz usable; 6 mature or 12 immature plants
Colorado	2000	2 oz usable; 6 plants (3 mature, 3 immature)
Connecticut	2012	One-month supply (exact amount to be determined)
D.C.	2010	2 oz dried; limits on other forms to be determined
Delaware	2011	6 oz usable
Hawaii	2000	3 oz usable; 7 plants (3 mature, 4 immature)
Illinois	2013	2.5 ounces of usable cannabis during a period of 14 days
Maine	1999	2.5 oz usable; 6 plants
Maryland	2014	30-day supply, amount to be determined
Massachusetts	2012	60-day supply for personal medical use
Michigan	2008	2.5 oz usable; 12 plants
Minnesota	2014	30-day supply of non-smokable marijuana
Montana	2004	1 oz usable; 4 plants (mature); 12 seedlings
Nevada	2000	1 oz usable; 7 plants (3 mature, 4 immature)
New Hampshire	2013	Two ounces of usable cannabis during a 10-day period
New Jersey	2010	2 oz usable
New Mexico	2007	6 oz usable; 16 plants (4 mature, 12 immature)
New York	2014	30-day supply non-smokable marijuana
Oregon	1998	24 oz usable; 24 plants (6 mature, 18 immature)
Rhode Island	2006	2.5 oz usable; 12 plants
Vermont	2004	2 oz usable; 9 plants (2 mature, 7 immature)
Washington	1998	24 oz usable; 15 plants

ties under the conditions of intoxication and withdrawal (see **Table 2**).

A lot of people who used marijuana may only seek some kind of euphoria and sense of relaxation. But they denied it numerous side effects, and exactly these very side effects place huge impact on our daily life. For example, marijuana can cause paranoid delusion, which is somehow dubbed as the preface of psychotic disorders like schizophrenia and personality dissociation in vulnerable individuals that were strongly associated with suicide. What is the major chemical in our body that evokes such big reaction? It is tetrahydrocannabinol (THC), a very potent chemical compared to other psychoactive drugs. Once enter your bloodstream through lungs, THC will reach the brain rapidly within seconds after it is inhaled and begin to work.

THC and other endogenous cannabinoid chemicals like anandamide affect different brain regions where the pleasure, thinking, memory, movement, concentration, coordination, and sensory and time perception are related. THC performs these functions through binding molecules named cannabinoid receptors on neurons in these brain regions and activates them. As thus the neural communication network takes an essential part in the nervous system in its normal function by using the THC and other self-produced cannabinoid neurotransmitters.

THC can change the normal function of the hippocampus and orbitofrontal cortex, key brain areas that form new memories. So the use of marijuana would impair the normal thinking and interfere with a user's ability to learn and to conduct complicated tasks. Meanwhile, THC is able to disrupt the function of the basal ganglia and cerebellum, the brain areas that are related to posture, balance, coordination, and reaction time. Therefore, those who have used marijuana cannot drive safely. Furthermore, the reward system, also known as the dopaminergic system, which governs the pleasurable behaviors like sex and eating. Marijuana, like other drugs of abuse, can stimulate neurons in the reward system to release the dominant neurotransmitter "dopamine" at a extremely high level, which contributes to the so-called "high" that marijuana users seek. This undoubtedly affects people's perception of pleasure, and would eventually slide into a common drug abuser who

Table 2. Symptoms of Marijuana Intoxication and Withdrawal

Intoxication	Withdrawal
Euphoria	Depression
Anxiety	Irritability
Paranoid delusions	Insomnia
Impaired judgment	Nausea
Social withdrawal	Anorexia
Slowed perception	
Increased appetite	
Dry mouth	
Conjunctival injection	
Hallucination	

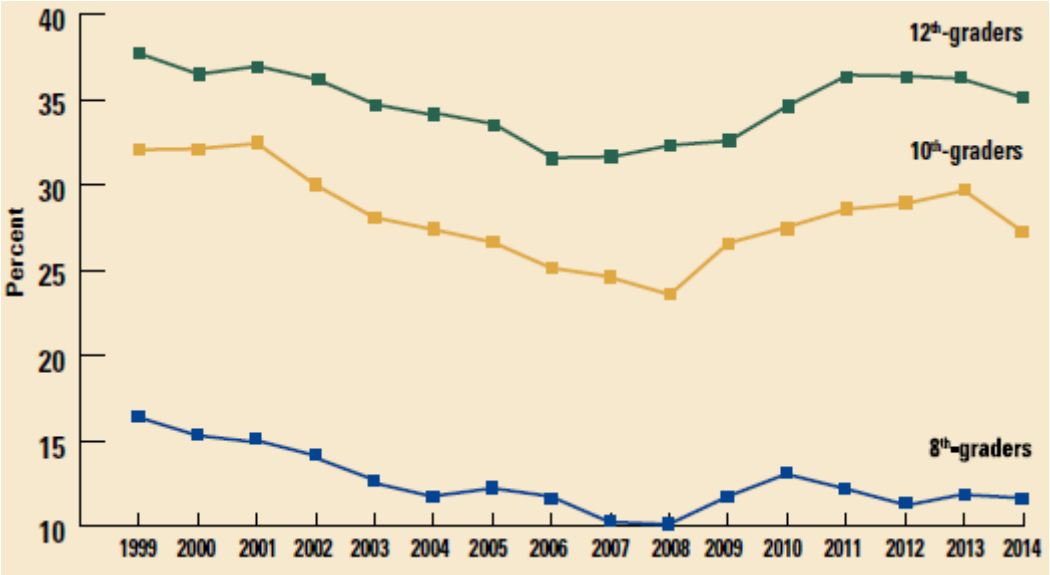
seeks not only marijuana, but also other types of street drugs.

Cumulating evidence indicates that marijuana can be addictive! During a long period of overstimulation of the cannabinoid system, marijuana can cause changes in the brain that finally result in addiction, which is a abnormal living condition in which the user cannot stop him/herself using the drug even though he/she knows it interferes with many aspects of their life. The estimated rate for marijuana-related drug dependence is approximately 10%. If the user started consuming the drug younger, this number will march up to some over 15% and to 25%-50% if they are daily users. In 2013, the National Survey on Drug Use and Health (NSDUH) presented that the overall number of marijuana use reached 4.2 million in 6.9 million Americans who were illicit drug users. Many researchers considered that marijuana-induced drug abuse is majorly from its withdrawal symptoms (see **Table 2**). These uncomfortable withdrawal manifestations like decreased appetite, irritability, restlessness, sleep difficulties, and cravings make the user unwilling to stop it even they might know the bad effects of marijuana consumption on their daily life.

In the long run, marijuana abuse will also produce lots of negative effects on cerebral health. Substantial evidence indicates that marijuana exposure in fetus, neonate, and adolescence all will delay and retard learning and memory function in their youth and late life. In further, molecular and cellular investigations revealed that the long-term impairment of marijuana on brain function was associated with the dysfunction of hippocampal neurons. More interestingly, animal study disclosed that the rodents would prefer to reuse the marijuana-containing foods if they had the chance to take them due to the reward system was activated by previous marijuana exposure. Furthermore, functional magnetic resonance imaging (fMRI) demonstrated that neural connections among different cerebral areas were impaired by frequent marijuana administration in human beings. In addition, a negative correlation exists between marijuana use extent and adulthood IQ scorings, i.e. the more marijuana you consumed, and the lower your IQ would be scored. What is the underlying mechanism of these long-term impactions of marijuana on the brain? It is the synaptic connections that were damaged for the existed ones, and interfered with the would-be newly formed ones.

As expected that marijuana exposure, especially those when they are young when the first marijuana was exposed, would functions as a gateway drug. That means marijuana use will cause the user to become abuser for harder drugs. This prime effect of marijuana on other drugs is dubbed as cerebral "cross-sensitization". From this evidence, the number of drug abuser would undoubtedly dramatically increase in the following years it the recreational marijuana would have been legalized by more states. Although the trend of legalizing recreational marijuana is increasing in more geographic areas in the USA, it also makes a lot of people become alert to its negative effect, especially the families with children. A recent survey revealed that this trend in the youth is slowing down in the view of an overall yearly abuse cases (see **Figure 2**). Besides, a more recent study found almost identical results on marijuana's popularity among adolescents, i.e. disapproval of marijuana use has increased among adolescents (age 12 to 14), although the drug's use continues to become legal in more places. Of course, these findings do not mean that parents no longer need to have the "drug talk" with their young teens, and if a teen has developed

Figure 2. Long-Term Trends in Annual* Marijuana Use in 8th-, 10th-, and 12th-Graders



*: Use in the past 12 months.
Source: University of Michigan, 2014 Monitoring the Future Survey.

an issue with marijuana use, he/she should feel comfortable approaching parents or teachers for help. Yes, it is extremely necessary!

When Science versus Economy

For economists, marijuana's recreational use undoubtedly is a critical event for them because it would become a money machine. The reality is as expected as these economy-advocators. After three-year's legalization of marijuana's recreational use in two regions, the local taxes and selling income have made a lot of businessmen become millionaires. Today, the situation of marijuana's recreational use has being developed far beyond its daily retailing. They are preparing for entering the most-popular commercial platform – NASDAQ exchange. Although two marijuana companies have been listed in NASDAQ stock, they are only medical companies. For the cannabis social media network MassRoots, it is totally unlike these two. MassRoots wants to target on advertisement, even neither Facebook nor Twitter permits cannabis-related businesses and dispensaries to advertise on their social media platforms.

Another thing we need to consider is the impact of recreational use of marijuana on its normal medical administration. Marijuana, as a medication, has many benefits in several medical conditions (see **Table 3**). One thing we need also to remind ourselves is that there are a lot of hurdles would hold the marijuana industry back and keep marijuana-based stocks like GW Pharmaceuticals, a marijuana-based research company, from realizing their potential for years or perhaps even longer, even though marijuana's medical benefits are well established under medical situations. It should be ascertained that the marijuana-associated researcher entities would lose their funding for years when they are performing marijuana's beneficial role in medical conditions in clinical trials.

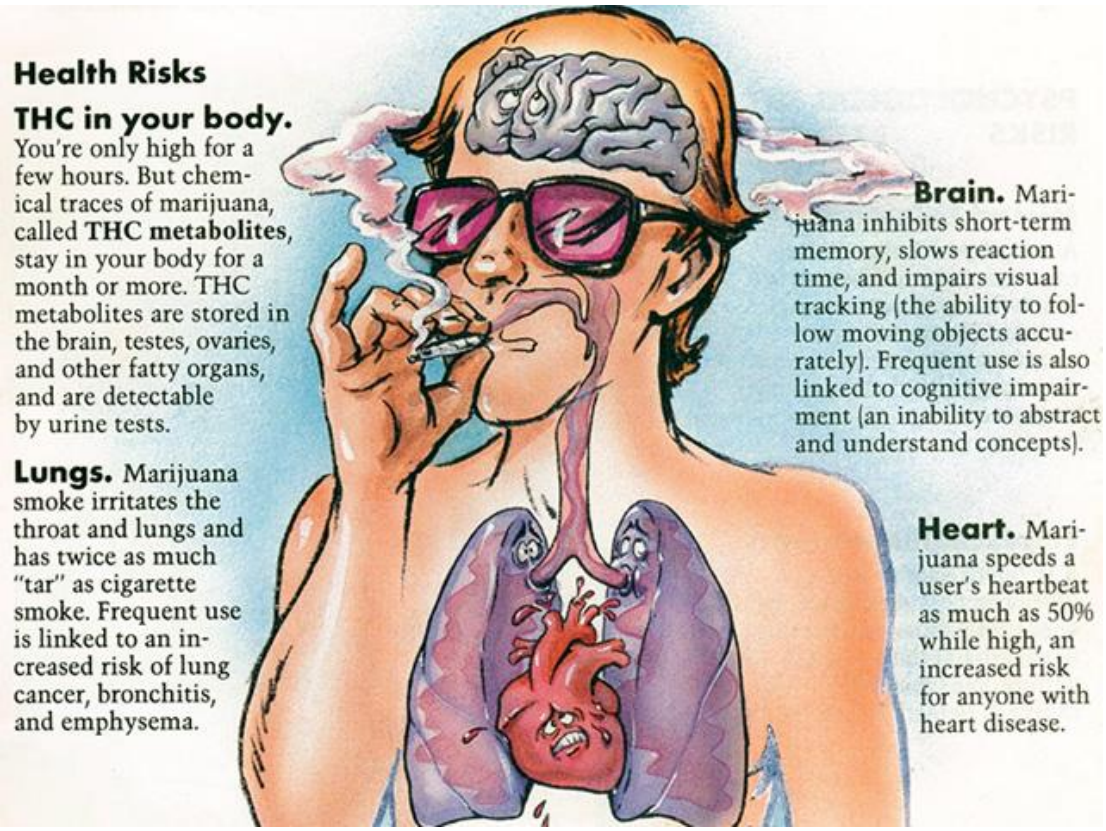
Concluding Remarks

Although it is illegal for marijuana's use under federal law, it is acceptable for some states to use this drug for medical purposes. Since 2012, marijuana's recreational use has been becoming the debating focus regarding its negative versus positive effect on people's cerebral function and on state's economy. It is currently classified as a "Schedule I" drug, meaning the federal government does not recognize it as having accepted medical use. Under the bipartisan proposals, marijuana would be moved to Schedule II, recognizing it has legitimate health purposes, with states determining their own programs and doc-

Table 3. The Benefits of Marijuana Use

Alzheimer's disease - Delta-9-THC can prevent an enzyme called acetylcholinesterase from accelerating the formation of "Alzheimer's plaques" in the brain, as well as protein clumps that can inhibit cognition and memory, more effectively than commercially marketed drugs.
Anxiety - Studies report that about 20 to 30 percent of recreational users experience such problems after smoking marijuana. Here's a story from Patsy Eagan of Elle Magazine, who describes how she prefers marijuana to treat her anxiety over prescription drugs.
Arthritis - Marijuana proves useful for many types of chronic pain conditions, but patients with rheumatoid arthritis report less pain, reduced inflammation and more sleep. However, this is not to say that arthritis patients should exchange their medication with pot; marijuana eases the pain, but it does nothing to ameliorate or curb the disease.
Asthma - Findings demonstrated acute airway dilation after marijuana smoking. Smoking does not appear to be an appropriate long-term method for administration of bronchodilator cannabinoid compounds for potential therapeutic purposes. THC does not appear to be a suitable bronchodilator for therapeutic use because of its systemic psychotropic and possible undesirable endocrine, immunologic and cytogenetic effects.
Cancer, HIV/AIDS and chemotherapy - Though the drug is illegal in the U.S., the FDA and American Cancer Society agree that the active ingredients in marijuana, or cannabinoids, have been approved by officials to "relieve nausea and vomiting and increase appetite in people with cancer and AIDS." The American Cancer Society says that "marijuana has anti-bacterial properties, inhibits tumor growth, and enlarges the airways, which they believe can ease the severity of asthma attacks."
Depression - Those who consume marijuana occasionally or even daily have lower levels of depressive symptoms than those who have never tried marijuana. And weekly users had less depressed mood, more positive affect, and fewer somatic complaints than non-users.
Epilepsy - Marijuana plays a critical role in controlling spontaneous seizures in epilepsy. Although marijuana is illegal in the United States, individuals both here and abroad report that marijuana has been therapeutic for them in the treatment of a variety of ailments, including epilepsy.
Glaucoma - Since the 1970s, studies have called medical marijuana an effective treatment against glaucoma, one of the leading causes of blindness in the world. Researchers say marijuana helps reduce and relieve the intraocular pressure that causes optic nerve damage, but the proponents say it helps "reverse deterioration," too.
Hepatitis C - Marijuana helps improve the effectiveness of drug therapy for hepatitis C, an infection that roughly 3 million Americans contract each year. Hepatitis C medications often have severe side effects like loss of appetite, depression, nausea, muscle aches and extreme fatigue. Patients that smoked marijuana every day or two found that not only did they complete the therapy, but that the marijuana even made it more effective in achieving a "sustained virological response," which is the gold standard in therapy, meaning there was no sign of the virus left in their bodies.
Morning sickness - 92 percent of women found marijuana's effect on morning sickness symptoms as either "very effective" or “effective."
Multiple Sclerosis and Spasticity - Patients had the subjective feeling that they were clinically improved, despite the fact that their posture and balance were actually impaired by smoking marijuana.

Figure 3. Health Risk for Marijuana Use



tors writing prescriptions. It is possible that as time passes we are going to see more concrete evidence of marijuana's benefits profile. It is believable that the legalization of marijuana's recreational use would produce some domino effects on the whole value of society. It is also reasonable for people, especially those with children, to keep their eyes on this drug's fate because it is hard to say what kind of effects would take on their children's development and future if they accidently used this drug. Even though businessmen do not want to see the negative comments on marijuana's impaction on people life, scientist should clearly know each aspect of marijuana's role in user's general health (see **Figure 3**), of which requires the policy-makers could balance marijuana's benefits and drawbacks.■

ARTICLE INFORMATION

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Author Contributions: Dr. Fuzhou Wang had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.
Study concept and design: Leonard, Wang.
Acquisition, analysis, or interpretation of data: All authors.
Drafting of the manuscript: All authors.
Critical revision of the manuscript for important intellectual content: Wang.
Statistical analysis: N/A.
Obtained funding: Wang.
Administrative, technical, or material support: Leonard, Wang.
Study supervision: Wang.

Conflict of Interest Disclosures: All authors declared no competing interests of this manuscript submitted for publication.

Funding/Support: This work is supported by the BASE Basic Investigation Foundation (BASE-BI-14F016).

Role of the Funder/Sponsor: The funding agents did not play any role in conducting and preparing the manuscript.

How to Cite This Paper: Leonard JS, Pathak MK, Wang F. Marijuana and Brain: The Debating Focus of Science and Economy. Sci Insights. 2015;13(3):501-508.

Digital Object Identifier (DOI): http://dx.doi.org/10.15354/si.15.an006.

Article Submission Information: Received, July 08, 2015; Revised: August 10, 2015; Accepted: September 02, 2015.

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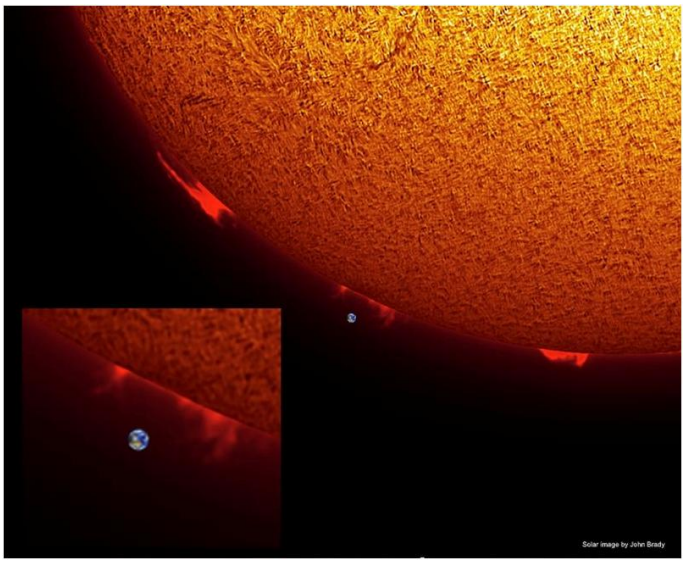
Love the Wave
Love the Earth


Working like a worker bee?
Relax yourself.....

How Big the Space?

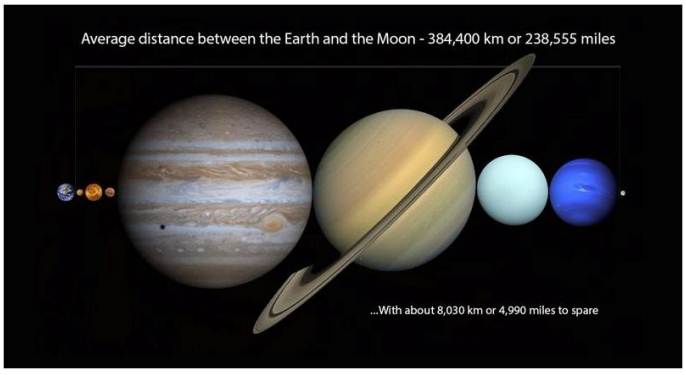
We all know the space is huge, but it is hard for us to imagine how it is really big. Let us enjoy following pictures to form our own picture regarding the hugeness of the space.

The sun is incomprehensibly huge



We all know the sun is big. We think of the Earth as a big place: flying around the equator on a 747 at top speed would take about 42 hours. Flying around the sun at the same speed, by contrast, would take about six months.

The moon is really far away



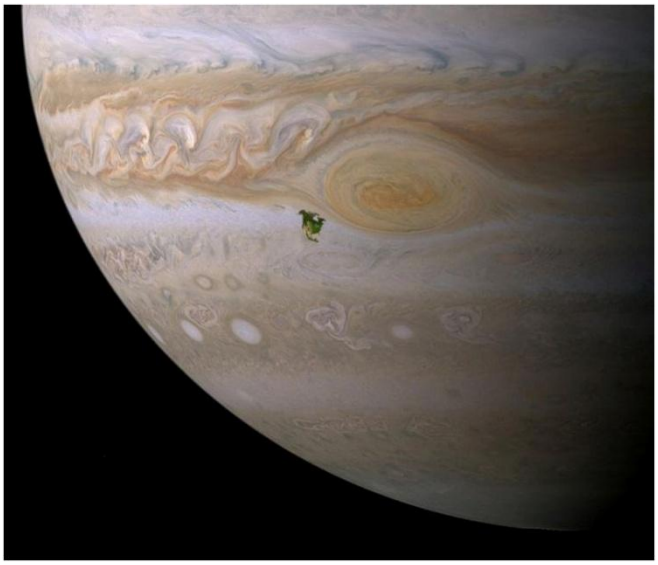
Compared with the overall vastness of space, the moon is very close to us: it's just 238,900 or so miles away. In the gap between us and the moon, you could neatly slide in all seven of the other planets - with a bit of room to spare.

From Mars, Earth would look like a tiny blip in the sky

If you traveled just a little ways away from Earth - say, to Mars, the second-closest planet to us - our home planet would become a tiny blip in the sky. It was actually taken when the two planets were relatively close together: about 99 million miles away.

What North America would look like on Jupiter

Jupiter is famous for being big. But this image, another one of John Brady's great astronomical size comparisons, will overwhelm you with just how big. Jupiter's Great Red Spot - a cyclone that was first spotted in 1655 - is shrinking, but it's still many times wider than North America. Jupiter and the other gas giants are so big because their colder temperatures allowed them to hold on to lighter gases such as hydrogen and helium, which floated away from the hotter, rockier planets closer to the sun.



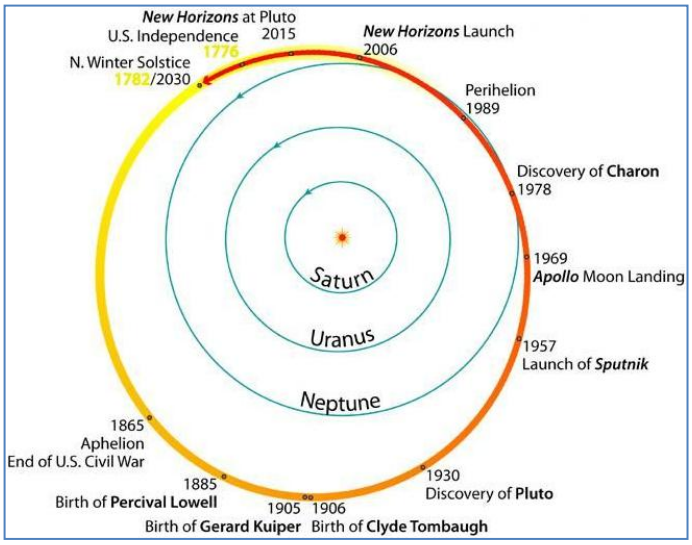
If you replaced the moon with Saturn

Another way to understand how big the gas giants are is to picture what they'd look like to us if they replaced the moon. Illustrator Ron Miller did this with a photo of a full moon over Death Valley, replacing it with each planet in turn. In this location, Saturn would blot out a large swath of the sky, and solar eclipses would last hours.

Even a single comet is pretty darn big

This is the comet 67P/C-G - which the Philae probe landed on in November 2014 - superimposed on Los Angeles. In terms of space, the comet is absolutely tiny: just 3.5 miles wide. But once again, this image shows how most things in space are way bigger than you realize.

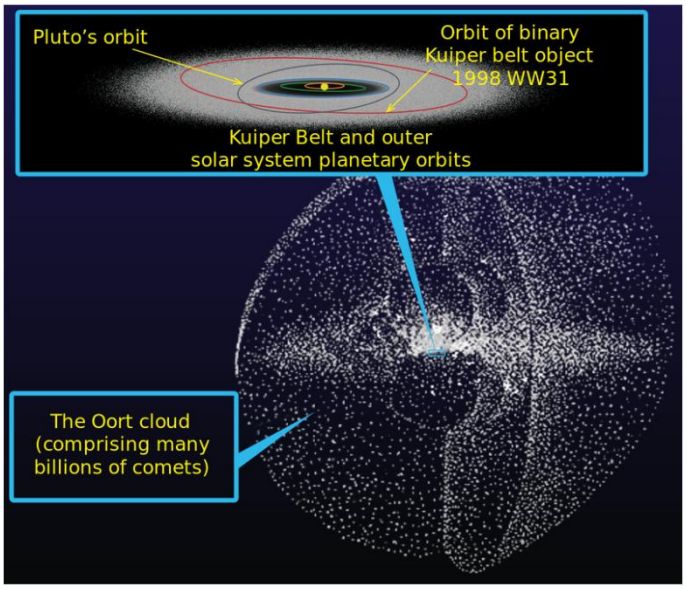
All of US history has occurred within a single Pluto orbit



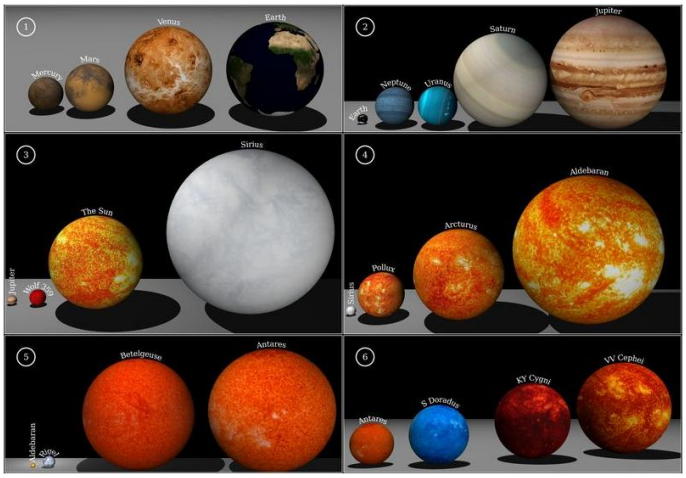
It's not just the size of objects in space that boggles the mind - it's the vastness of the timescales on which events in space occur. Pluto takes 248 Earth years to orbit the sun. To put it another way, the entirety of US history has occurred during a single Plutonian orbit. When Pluto was last in its current location, we hadn't invented aviation, let alone spaceflight. This map was released by NASA's New Horizons team in anticipation of the probe becoming the first spacecraft to visit Pluto in July.

Pluto isn't even at the edge of the solar system

Many of us imagine cold, little Pluto to be at the outer edge of the solar system. But that's far from the truth. Pluto's orbit fits inside the tiny blue box at the center of this map. Beyond it is the Kuiper belt, then the Oort Cloud - which is believed to extend a thousand times farther out than Neptune, about halfway to the next closest star to us.



Other stars are utterly gigantic

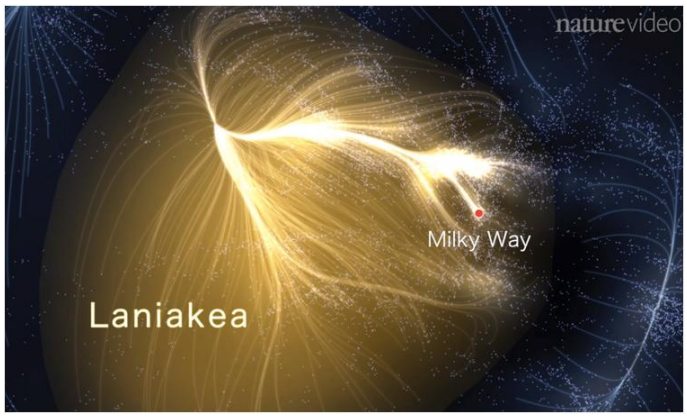


Once you leave the solar system, you once encounter objects - other stars - that dwarf our sun in the exact same way the sun dwarfs Earth. And even bigger stars (like Antares and Betelgeuse, in pane 5) dwarf those stars in the same way. Over and over, as we've looked out at the universe, we've found it exists on a scale that basically makes no sense to the human brain.

Every star you can see is in the yellow circle

Sure, stars are huge. But the Milky Way is, once again, mind-bogglingly bigger. This rendering, which shows the galaxy in its entirety, is a way of seeing that. The yellow circle likely encompasses every individual star you've ever seen in the sky without the aid of a telescope. It's based on the fact that under ideal conditions, people in the Southern Hemisphere can see the especially bright star system Eta Carinae - but in most places, the yellow circle would actually be much smaller.

Our galaxy is one of 100,000



For all its vastness, the Milky Way is just one of billions of galaxies in the universe. Recently, scientists mapped the 100,000 or so galaxies near the Milky Way and found that it's part of a broader supercluster called Laniakea. This

supercluster is made up of several forks, with the Milky Way lying on one distant fringe of it. What's more, it borders another supercluster (called Perseus-Pisces) that's moving in the opposite direction, and both seem to fall in a broader web, made up of dense supercluster networks alternating with relatively empty voids. The original article from the VOX.

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who should pay for this…


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