

THE SCIENCE SQUAD

SERIES 3



Series Summary

The Science Squad is back!! From the smallest cells in our body, to the far reaches of outer space, Aoibhinn Ní Shúilleabháin, Kathriona Devereux and Jonathan McCrea return to our screens to showcase more of the exciting and innovative scientific research that is currently underway in Ireland.

With the European Space Agency launching the most ambitious civilian earth observation project to date and Irish advances in equine science set to 'light up' the world of horse breeding, it's been another fascinating year for science. And scientific collaboration has never been so important or indeed lucrative. With almost €79billion of funding available to European researchers over the next 6 years through Horizon2020, it's truly exciting to see so many Irish scientists leading the way.

This year, Aoibhinn travels to Uganda to find out about an Irish-led water purification project which could save the lives of millions, Kathriona investigates potentially lifesaving diagnosis for pregnant woman which is being pioneered in Cork, and Jonathan meets the scientists who are planning a one-way trip to Mars!

In Weird Science, Fergus McAuliffe returns to tell us about carnivorous Irish plants, magnetic flips, and tiny remnants of Cold War technology that continue to float in the skies above us even today...

The series also features incredible developments in the world of Stem Cell research, we meet the next generation of computer coding geniuses, and Jonathan goes on a date with a robot only to find out that it's not always what you say that counts!!

(please contact Jen or Nuala on info@newdecade.ie for further details on upcoming episodes and contact details of featured contributors)

www.thesciencesquad.ie

Episode One – TX 27/10/2014

A View from Above...

The European Space Agency's Copernicus Programme is the most ambitious civilian earth observation programme in the world. The first satellite, Sentinel 1a, was launched from Europe's Spaceport in French Guiana in April 2014, and Jonathan meets Barry Fennell from Enterprise Ireland to find out how the data is already being put to use in Ireland: from advances in environmental observation for flooding and coastal erosion, to the monitoring of our coastal borders and homeland security. It's a hugely exciting time for this technology and Jonathan takes to the sea with Ned Dwyer from CMRC and Captain Brian Mathews from the Irish Navy to find out how they are combining satellite imagery with Automatic Identification systems to improve ship detection and tracking capabilities to help monitor drug smugglers and fishing vessels breaking regulations.



What Lies Beneath...

Ireland is renowned for its lush green grass... but lurking between the blades is a dangerous threat. Liver flukes are a parasite present on most Irish farms and they're estimated to cost Irish farmers up to €90 million a year. Most farmers currently do a general douse of their sheep and cattle against liver fluke, but this can be expensive due to required milk withdrawals and the overuse of flukicides has also led to the emergence of resistant strains of liver fluke.

Kathriona meets Riona Sayers from Teagasc to find out exactly what liver fluke is and the damage it can cause, and the intrepid two snap on the latex gloves to analyse a cow's liver that has been home to flukes. It's not for the faint hearted!! Back on the grass, Alan O'Riordan from Tyndall National Institute discusses the new technologies that he and Riona are developing to help farmers instantly diagnose the condition using just their computer or mobile phone, and Kathriona meets farmer Shane Fitzgerald, who had a case of liver fluke on his farm in 2009.

Weird Science - Magnetic Flip?

Ever feel like your world has been turned upside down? You might be more correct than you think...



Saving Lives with Sunlight

Prof Kevin McGuigan in RCSI in Dublin has been working for 20 years on a deceptively simple solution which can convert dirty water into clean water with no chemicals or additives of any kind. Aoibhinn travels to Uganda to meet Kevin and to find out about his latest Solar Disinfection (SODIS) project which is being funded by RCSI and the Higher Education Authority through Irish Aid. The project involves filling



transparent PET-bottles or glass bottles with contaminated water and then exposing them to the sun for 6 hours. During this time, the UV-radiation of the sun kills disease-causing pathogens and while the process doesn't actually make the water clear, crucially, it kills the bacteria in the water and makes it safe to drink. The beauty of this solution is that it requires no technology, very little infrastructure and operates solely on the heat of the sun! Aoibhinn visits Kevin's PhD student Jacent Asimwe to find out about the science behind the process, and the team also meet with lots of schoolchildren who will directly benefit from the technology.

Episode Two – TX 03/11/2014

Pre-Eclampsia

Up to 80,000 women die each year as a direct cause of preeclampsia – a life-threatening condition that occurs during pregnancy. Kathriona meets Prof Louise Kenny from Metabolomics Ltd who is developing breakthrough technologies that could provide predictive diagnosis of Preeclampsia in early pregnancy and revolutionise prenatal care globally. Kathriona visits two pregnant women who are currently enrolled on one of Louise's clinical trials to find out what the trial involves and why they are taking part, and also meets Mary Lyons who suffered from Pre-Eclampsia when she was pregnant with both of her sons. Delivered at 25weeks and 34weeks, thankfully they have now grown into healthy 5 and 3 year-olds, but Mary's heart wrenching story highlights the frightening and dangerous reality of Pre-Eclampsia, and reinforces the vital importance of Louise's continued research in this area.



Horizon 2020

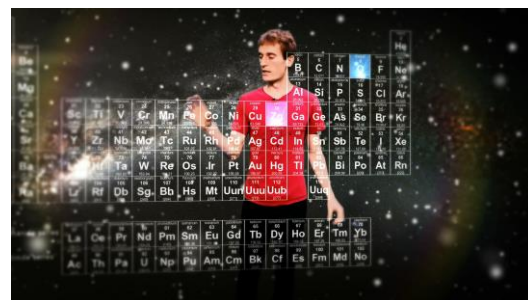
Running from 2014 to 2020 with a budget of almost €79billion, Horizon 2020 is the EU's new programme for research and innovation and is part of the drive to create new growth and jobs in Europe. Aoibhinn meets the former EU commissioner for Research, Innovation and Science, Máire Geoghegan-Quinn, to find out about the exciting opportunities that Horizon 2020 offers Irish researchers.

Innovative Recycling Technologies

Advances in AV technology are moving at an incredible pace and consumers are replacing their TVs every few years. But new LCD screen televisions contain significant amounts of lead, mercury, liquid crystal and other hazardous materials – so how can we dispose of them and what's the impact on our environment? Up to now, the main method recycling LCD screens has been manual disassembly and many recyclers have simply been stockpiling while waiting for the emergence of a viable technology. Aoibhinn meets Dr Lisa O'Donoghue from UL spin-out VOTECHNK who are pioneering the world's first fully automated machine to recycle LCD Flat screens and remove the potentially hazardous materials they contain, while EPA's Caitriona Collins explains why it's so important that these materials are recycled in a safe manner, and indeed how valuable they are!

Weird Science – Made of the Stars

They might be hundreds of millions of miles away, but in many ways the stars are actually much closer than you think...



Robotic Milking

Are the days of Dairy Farmers being tied to the farm set to become a thing of the past with the help of robots? With milk quotas due to be lifted in 2015, farmers will need all the help they can get and Teagasc are examining the viability of robotic milking systems for Irish farms. Robotic milking is a voluntary milking system, which allows cows to present themselves for milking as they wish without the presence of the farmer. Each cow is fitted with a sensor so that when they enter for milking the robot can identify them and the

focus of the trial is to examine how robotic milking can be combined with pasture based grazing. Jonathan tries his hand at milking some cows the old school way (and finds out he won't be giving up the day job!) and meets Teagasc's Bernadette O'Brien to find out how the innovative system works. We also hear from Meghan Halton who discusses how they are applying grass measurement research to the milking system as a way of encouraging the cows to present themselves for milking.

Episode Three – TX 10/11/2014

The Science of Mars

It may sound like something straight out of a science fiction screenplay, but there are plans afoot to establish a permanent human colony on the Red Planet by 2025. “Mars One” is certainly a bold vision – and it’s not short of sceptics – but Jonathan meets the brainchild of the project, Dutch entrepreneur Bas Lansdrop, to ask him about his reasoning for initiating such a mind-blowing project! An incredible 202,500 people from all over the world initially applied, but TCD astrophysicist Joseph Roche is one of 706 candidates chosen to progress to the next phase of the selection process. Incredibly, it’s a one-way ticket, and Jonathan meets Joseph to find out why he would want to be part of such a radical and potentially life-changing mission. And what can the study of Mars tell us about life closer to home? Jonathan meets Mary Bourke from TCD on the sand dunes of Brittas Bay. Mary studies the active processes of the Martian landscape and compares them to environments here on earth to better understand geomorphic processes in extreme environments and during extreme weather events.



CoderDojo “Coolest Projects”

In 2011, teenager James Whelton set up a computer club in his school in Cork and started teaching basic HTML and CSS. Later that year he met Bill Liao, an entrepreneur and philanthropist, who was interested in growing the project into something bigger and the rest, as they say, is history! There are now 480 Dojos in 48 countries where young people learn how to code, develop websites, apps, programs, and games. It has just one rule: “Above All: Be Cool”! We meet James and Bill at the annual “Coolest Projects Awards” in DCU and meet the budding young coders who might well change the world!



Weird Science – The Pregnancy Paradox

Our immune system is an amazing weapon for fighting viruses and infections... but not all foreign invasions are unwelcome...

Innovative Surgical Technologies Saving Lives

Abdominal aortic aneurysms are like silent bombs waiting to explode. An aneurysm is a bulge or “ballooning” in the wall of an artery that carries oxygen-rich blood from the heart to other parts of the body. An untreated patient will usually die of internal bleeding and shock within a few hours, and even if they make it to surgery, the survival rates are less than 50%. The treatment has changed enormously over the last 20 years, moving from the conventional open surgical repair to a minimally invasive or keyhole procedure, known as Endovascular Aneurysm Repair, EVAR which involves miniature cameras and long thin laparoscopic instruments being inserted into the patient through tiny holes. The complications associated with open surgery are dramatically reduced and the mortality rate drops to as low as 1%. Aoibhinn meets Dr Peter Naughton from RCSI as he and his medical team run through the complex and in-depth preparations for an EVAR operation which, crucially, utilises real patient data, before we film with the team as they perform the real thing. Aoibhinn also meets one of Peter’s former patients who underwent the successful surgery to find out how it saved his life.



Episode Four – TX 17/11/2014

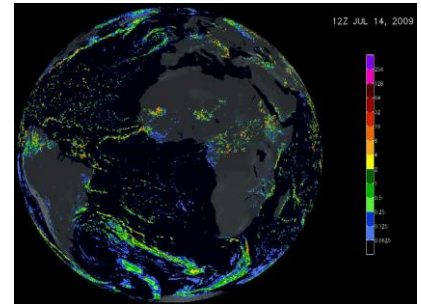
Equilume – Lighting up the world of horse breeding

The Thoroughbred breeding industry operates within the confines of very tight breeding and racing calendars. Breeders try to produce foals as close to January 1st as possible and currently, they artificially advance the mares' breeding cycle by keeping them indoors under lights for 12 weeks from December. Aoibhinn meets Barbara Murphy, head of UCD spinout Equilume who has developed a light mask with tiny blue LED lights set into one of the eye cups of a pair of conventional blinkers routinely worn by horses. The light limits the level of the hormone melatonin which is usually produced in darkness and inhibits the mare's reproductive activity during winter months. The technology is already proving a success around the world and Aoibhinn meets Stud Farm owner Dermot Cantwell to find about the impact of the research at the coal face. She also meets UCD Optoelectronic Engineer John Sheridan, who worked on the design the light mask, and talks about some of the challenges involved.



Weird Weather

The weather is never far from the public consciousness; from what to wear when we leave the house each morning, to planning holidays abroad. But how has our weather changed over the last hundred years, and how will it change in the next? From floods to droughts, and from local transition towns to global strategies to combat climate change, weather is of greater concern than ever. Kathriona meets Paul Nolan from the Irish Centre for High End Computing (ICHEC) who is working with the EPA and Met Éireann to improve regional climate modelling, and meteorologist and weather presenter Gerald Fleming from Met Éireann who explains how this data can help with both short and long term weather forecasting.



Cold Wars and Copper Wires

What would happen if the world's communications networks suddenly stopped working??? We travel back to the 1960s, to a world before satellites and on the brink of the Cold War...

Is YouTube killing the internet??!

When YouTube was launched in 2005 surely nobody could have predicted its meteoric rise in popularity, influence and usage. In less than a decade, viewings of videos on the site have gone from 8 million views a day to a staggering 2 billion views, and the internet may well be reaching the capacity of being able to cope with its own success! The semiconductor industry is crucial to the evolution and success of computer technology and internet development and Jonathan meets Brian Corbett at Tyndall National Institute who is investigating the use of lasers as a light source for fibre connections in computers. Brian is working with Seagate in Derry and his research aims to improve the speed and energy efficiency of data transfer and storage, and crucially, offer potential solutions to the management of the exponentially increasing amount of data on the web.



Episode Five – TX 24/11/2014

Date with a Robot

How close are we to giving personalities to robots and computers? TCD's Prof Nick Campbell research focuses on developing an intelligent user interface to infuse robots with social verbal and non-verbal communication skills like laughter, humour, empathy, compassion and charm. Nick introduces Jonathan to Herme, a LEGO NXT (Mindstorms) robot to try and explain how his research is aimed at improving the emotional side of human interaction with computers and robots. We discover it's not always what you say that counts and Jonathan meets Nick's colleague Naomi Harte to take part in a fun language experiment that reveals how a simple audiovisual experiment can easily trick the mind...



Portable X-Rays

Radiology is at the centre of modern medicine. From dentistry to oncology, x-ray imaging is an indispensable tool; yet remarkably, until now, the vacuum tube x-ray technology used today has remained relatively unchanged for the past 100 years! But now, researchers at Tyndall National Institute in Cork are part of a global network of scientists (which includes researchers from Harwell Oxford Campus in the UK and the University of California, Los Angeles (UCLA)) to develop future X-ray technology and pioneer the world's smallest portable X-ray system. These new flat panel sources will be the size of a laptop and could save local health authorities up to €75,000 per machine. The technology has many applications, portable flat screen (Lap top) X-Ray device for GP surgery – no more going to hospitals, first responders, sports events, dental surgery, security are all possible avenues for the technology.

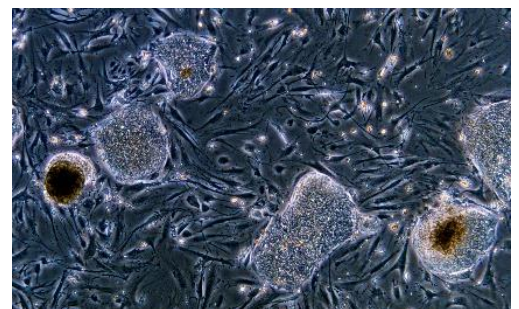


Little Country of Horrors

They mightn't look as terrifying as Audrey II, but Ireland's smaller creatures still have plenty to fear from our native carnivorous plants!

Stem Cells

Regenerative medicine is revolutionising healthcare and Irish scientists are playing a ground-breaking role, as for the first time ever, adult stem cells for human use are now being manufactured in Ireland. Kathriona visits the Irish Centre for Stem Cell Manufacture in Galway and meets Prof Frank Barry to find out how stem cells are grown and incredibly, to find out how researchers can now re-programme adult stem cells backwards to enable them to act like embryonic stem cells. We also and to find out about some of the different trials the centre is running at present that involves culturing adult stem cells to tackle conditions such as diabetes, heart disease, autism and osteoarthritis.



Episode Six – TX 01/12/2014

Bees no More?

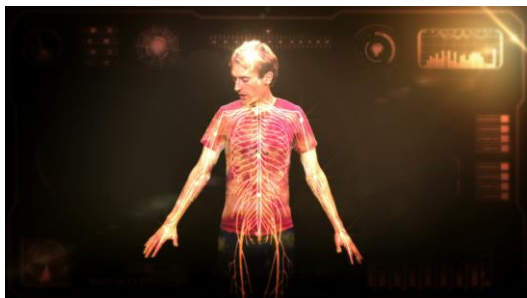
Those who have been paying attention to environmental news over the past couple years know that honey bees have been disappearing at an alarming rate. It has been said that, "If the bee disappeared off the



surface of the globe then man would only have four years of life left. No more bees, no more pollination, no more plants, no more animals, no more man." It's a sobering thought! Aoibhinn meets TCD's Jane Stout in the lush fields of County Wicklow to find out the true extent of the problem and what the consequences might be in terms of biodiversity. And what can be done to stop the decline in bee health? We then head to Galway to visit researchers at Advance Science in Galway who are working on products that could improve the health of honeybees.

Love your guts!

And from the guts of bees, to a gutsy bunch on the rugby field... just what can we learn from the relationship between our diet, exercise, gut bacteria and general health? Teagasc's Paul Cotter recently conducted a study with the Irish Rugby team to examine the impact of exercise and diet on gut microbial diversity. This is the first report that shows exercise increases microbial diversity in humans and while others have previously shown that diet influences microbial diversity, Teagasc can now report that protein consumption, in particular, positively correlates with microbial diversity. The study poses new questions and Kathriona checks in with Paul and his team to have her own gut health analysed and follows Eoin Myers, one of the group's willing guinea pigs, as he takes part in the next phase of the trial!



Weird Science – Axons and the Need for Speed!

Signals move from our brain to our body along vast networks of nerve cells called neurons, but not all these signals travel at the same speed. So what happens when our body requires a faster response?

Lung Health

Ireland has the third highest death rate from lung disease in Europe. Every year, there are as many deaths in Ireland due to respiratory disease as there are from heart disease, yet it does not seem to be prioritised. Chronic obstructive pulmonary disease (COPD) is a collection of lung diseases, the most common being chronic bronchitis and emphysema. It is often seen as a smoker's disease; something people are bringing on themselves, but lung disease can affect anyone regardless of age, health status and walk of life. Jonathan meets Prof Gerry McElvaney from RCSI who has discovered that the high prevalence of COPD in this country could be linked to a genetic lung condition (Alpha-1) which affects 1 in 24 Irish people, 90% of which are undiagnosed. Gerry's research focuses on early diagnosis of COPD which could enable lifestyle changes and medical follow-up to help prevent or at least delay the development of lung disease. Jonathan meets Stephen Smith from Co Cavan who despite never having smoked in his life was diagnosed with Alpha-1 in 2009 and finally received a double lung transplant in 2013. We also meet Josephine McGuirk, a heavy smoker for 20 years, who completely turned her life around after being diagnosed with the Alpha-1 condition in 1998.

