SciFest 2023 National Final

SciFest 2023 was funded primarily by Intel Ireland, Boston Scientific and EirGrid, and supported by a number of other organisations and institutions, including the Department of Education. The SciFest STEM fairs were hosted locally in schools and regionally in the Technological Universities (12 venues), Dundalk Institute of Technology, DCU and St Mary's College, Derry. SciFest symbolises a highly successful collaboration between education, Government and enterprise and between the second and third level education sectors.

Foreword from
Norma Foley, TD

Minister for Education

It is with immense pride and anticipation that I extend my warmest greetings to all the finalists, organisers, and especially the young innovators of SciFest's National Final. As the Minister for Education, witnessing the growing interest in Science, Technology, Engineering, and Mathematics (STEM) among our youth is not just encouraging; it is a beacon of hope for the bright future of our country and the world.

This year, I know there has been a large number of entries into SciFest, each a testament to the curiosity, dedication, and ingenuity that thrives within our schools. To every student who has dared to question, to explore, and to innovate, you are the trailblazers in a world where the frontiers of knowledge expand with every technological advancement and scientific discovery.

STEM subjects stand at the forefront of this expansion. They are the tools with which we will build the future, tackling global challenges such as climate change, healthcare, and sustainable development. Your work, showcased here at SciFest, is more than an academic endeavour; it is a vital contribution to a society that increasingly looks to science and technology for solutions to its most pressing problems.

I extend my heartfelt congratulations to SciFest for the key role it has played in igniting a passion for STEM across Ireland. To the mentors, teachers, and families who have supported our students, your guidance is invaluable. And to the young scientists and engineers presenting today, your pursuit of knowledge is the most powerful force for change.

Congratulations to all of those who are participating. Let us celebrate your achievements and the promise they hold. May your curiosity be unending and your creativity boundless as you lead us into a future bright with possibility.

An Roinn Oideachais
Department of Education

Welcome from
Sheila Porter

SciFest Founder and CEO

Welcome to the SciFest 2023 National Final! It is with immense pleasure and excitement that I extend a warm welcome to all the bright young minds, enthusiastic parents and guardians, esteemed guests, and discerning judges who have gathered for the pinnacle of scientific innovation – the SciFest 2023 National Final. As the Founder and CEO of SciFest, it gives me great satisfaction to see the culmination of months of hard work, creativity and dedication that these young people have poured into their projects which they are presenting here today.

SciFest has always been a celebration of curiosity, a platform where the passion for STEM meets the boundless realms of imagination. This year's National Final is no exception, and I am confident that the projects showcased here will not only awe and inspire but also exemplify the incredible potential of the brilliant minds that make up the future of scientific discovery.

Congratulations to the finalists! Your projects are a testament to your boundless curiosity and dedication to pushing the boundaries of scientific understanding. To the parents and guardians, thank you for cultivating an environment where exploration is not just encouraged but celebrated and supported.

The SciFest programme could not take place without the support of our partners: Intel Ireland, Boston Scientific and EirGrid, the Technological Universities, Dundalk Institute of Technology, DCU and St Mary's College, Derry. I would like to thank them, and all our sponsors, for their continued support.

A special word of thanks is due to the judges, not just those here today but the hundreds who have judged at local and regional SciFest STEM fairs over the past year. Not only could the SciFest programme not take place without you, but you are also invaluable role models for the participating students.

Congratulations once again to the finalists! Your achievements at SciFest are a testament to your limitless potential. As you step into the future, may your passion for STEM drive you to even greater heights.

Best of luck on your exciting journey ahead!

A Message from Sarah Sexton

Director of Public Affairs,
Intel Ireland

Intel Ireland is proud to continue its support of SciFest. We are a science and technology company with people at the core of what we do. Every day we use science, technology, engineering and maths (STEM) in pursuit of world-changing technology that improves the life of every person on the planet.

SciFest provides an important platform to promote student-centred, inquiry based approaches to skill development. Students are encouraged to pursue their interests in the fields of STEM, to pursue their own scientific investigations, to create models and analyse data and to defend their results while receiving expert feedback in their investigations.

This competition offers important opportunities for students to create innovative projects while developing a wide range of vital skills. In today's rapidly evolving world, these traits will benefit students in whatever career path they choose in the future.

At Intel, we recognise the value in educating the young people of today to help them to flourish and reach their full potential. It is the inquisitive minds of today that will create the innovations of tomorrow. Having observed the excellent work done by students participating in SciFest, we are confident that the future of the STEM industries in Ireland are in very capable hands.

Congratulations to SciFest for another incredibly successful year and to those participating today, Intel Ireland wishes you all the best of luck. Everyone involved, from students to parents and teachers should be extremely proud of their accomplishments.

intel

A Message from
Philip LeTutour

Director, Manufacturing Engineering,
Boston Scientific Galway

On behalf of Boston Scientific, we would like to welcome everyone to the SciFest 2023 National Final. This is our ninth year sponsoring this event, and we are delighted to see it continue to grow. Year after year, we see students producing exciting, interesting and innovative projects that never fail to impress.

As a medical devices company with a strong focus on research, development and innovation, Boston Scientific constantly looks for top talent in the fields of science, technology, engineering and bio-medicine. It is extremely important to promote the STEM subjects, particularly in second level education. Our aim is to inspire students to develop and pursue a passion for these subjects, thereby ensuring that we have a continuous uptake of the science and engineering disciplines at third level. In this way, we contribute to shaping the scientists and engineers of the future.

SciFest is an excellent opportunity for students to research, explore and develop their own ideas. Events like these allow students to nurture a passion for the STEM subjects and create a positive impact on the world around us. Our commitment at Boston Scientific is to advance healthcare while giving back to the communities in which our employees live and work.

STEM education is a top priority for our business, for our patients and for our communities. We are delighted to see talent of this quality participating in events like SciFest. As these motivated and passionate young people go on to pursue their education in STEM-related fields of study, they will build a brighter society and a brighter future for everyone. We see this reality every day in our business – the diligent STEM students of today turn into the pioneers of healthcare innovation in the future.

We want to congratulate all the students on their excellent projects here today. We wish you all the very best of luck in your endeavours.

Boston Scientific
Advancing science for life™

A Message from
Doireann Barry

Head of Strategy and Sustainability, EirGrid

EirGrid is proud to once again support SciFest and would like to welcome you to the SciFest National Final 2023.

This being our third academic year partnering with SciFest, we have enjoyed watching the programme grow from strength to strength, with students across Ireland taking the time to research and develop exciting and innovative projects.

To be associated with a programme that is so closely aligned to EirGrid's values is incredibly important. SciFest's aim to promote STEM education across the island is something EirGrid sees as hugely beneficial.

As operator and developer of the electricity grid, EirGrid has been tasked with getting the grid ready so that up to 80% of Ireland's energy can come from renewable sources by 2030. To do this, EirGrid requires expertise, ingenuity, and a commitment to make positive and lasting changes to our power system.

Promoting and providing access to STEM subjects which are at the core of engineering and problem solving can only benefit a workforce of the future across many industries, including energy, as we strive to achieve our climate ambitions.

EirGrid is committed to leading the secure transition of our electricity grid to low carbon, renewable energy and is actively engaging in meaningful dialogue with communities and stakeholders across Ireland, and we see our partnership with SciFest as a significant aspect of this engagement.

We want to provide a space for second level students to explore and develop their ideas for a cleaner energy future. To be able to support a programme that is allowing students' ideas to come to life, is something we are incredible proud of.

We would like to congratulate all the students on their excellent projects here today and wish you all the very best of luck.

EirGrid

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SciFest 2023 National Final

A CELEBRATION OF EXCELLENCE IN STEM

PROGRAMME

THURSDAY 23 NOVEMBER
ONLINE: www.scifestfinal2023.ie

7.30pm	*Welcome to the SciFest 2023 National Final* Philip Smyth, Broadcaster and Science Communicator
7.35pm	*How to Study Movement* John S. Butler, TU Dublin and TCD

FRIDAY 24 NOVEMBER
VENUE: Marino Conference Centre, Griffith Avenue, Dublin 9

8.00	Arrival and set up of projects
9.40	**Opening of Exhibition**
9.45	Judging (09.45 - 11.00 – Judges only)
11.00	Judging and viewing of projects (exhibition hall open to invited guests, parents and teachers)
13.00	Lunch
14.00	**Awards Ceremony** ~ Introduction: Philip Smyth, Broadcaster and Science Communicator ~ Prof. David FitzPatrick, President of TU Dublin and Chair of SciFest Board ~ Liam Waldron and Luke O'Sullivan, SciFest STEM Champions 2022
14.35	**Presentation of Awards** ~ Excellence in STEM Awards ~ Main Awards
15.30	~ SciFest STEM Champion 2023 Award ~ Teacher of Excellence Award
15.45	Photographs

SciFest 2023 Judges

National Finalists Judging Panel

Mr Gerard Hughes	*Chair (Sentinus)*
Ms Niamh Barry	*Senior Inspector, Department of Education*
Ms Elizabeth Smith	*Inspector, Department of Education*
Ms Jennifer Egan	*Inspector, Department of Education*
Dr Jennifer McKenna	*European Programme Manager, Intel Research and Development Ireland*
Mr Jonathan Boylan	*Chief Technology Officer at FINEOS*
Mr Jack O'Regan Kenny	*Alumnus, Engineer*
Mr Mark Tattersall	*Software Engineer – Meta*
Mr Jim Cooke	*Teacher of Mathematics*
Ms Áine Woods	*Education and Training Consultant*
Ms Michelle O'Flaherty	*Quality/ Validation Consultant, Consultancy, Griffith College, Ireland*
Ms Edel O'Connell	*Associate Director, Process Sciences at Regeneron*
Ms Paul Nolan	*Group Development Manager, Dawn Meats Group*
Mr Paul Hennessey	*STEM Connex*
Prof. Paul McCabe	*School of Biology and Environmental Science, UCD*
Mr Jamie Bain	*Science Advisor, Oide*
Mr Kevin Logan	*Science Advisor, Oide*
Dr Joe Mac Donagh	*Lecturer, TU Dublin and Research Ethics board at St James's Hospital and Tallaght Hospital*
Ms Rachel Linney	*Education Officer, NCCA*
Mr Mark Lyons	*Alumnus; PhD Candidate, TCD*
Mr Omar Salem	*Alumnus - Co-Founder at Field Of Vision*
Mr Oisín O'Sullivan	*Alumnus - Multiple Award winner at SciFest, UL Final Year*
Dr Manuel Lopez Vernaza	*Laboratory Analyst, Plant Science Division, Department of Agriculture, Food and the Marine*
Dr Ruairí de Fréin	*Lecturer, Electrical And Electronic Engineering, TU Dublin*
Dr Ailbhe Brazel	*Biology Department, Maynooth University*
Dr David Robert Grimes	*Scientist, Broadcaster, and Author*

Boston Scientific Medical Devices Finalists Judging Panel

Mr Rory Geoghegan	*SciFest: Chair*
Mr Eoin Hayes	*Boston Scientific, Clonmel*
Mr Kevin Byrne	*Boston Scientific, Cork*
Ms Mike Walsh	*Boston Scientific, Galway*

EirGrid Cleaner Climate Finalists Judging Panel

Ms Catherine Tattersall	*SciFest: Chair*
Ms Claire Wallace	*EirGrid*
Mr Manuel Hurtado	*EirGrid*
Ms Noelle Ameijenda	*EirGrid*

Awards

SCIFEST STEM CHAMPION 2023
Trophy, €500 and an all-expenses-paid trip for the student(s) to represent Ireland at the Regeneron International Science and Engineering Fair (ISEF) in Los Angeles, California in May 2024.
Supported by Regeneron.

SCIFEST STEM CHAMPION 2023 RUNNER-UP
Trophy and €500.

BERLIN LONG NIGHT OF SCIENCE AWARD
Trophy and an all-expenses-paid trip for the student(s) and their teacher to attend the Long Night of Science in Berlin in June 2024. *Supported by the Department of Foreign Affairs.*

BOSTON SCIENTIFIC MEDICAL DEVICES GRAND AWARD
Trophy and €500. *Sponsored by Boston Scientific.*

EIRGRID CLEANER CLIMATE GRAND AWARD
Trophy and €500. *Sponsored by EirGrid.*

INTEL TECHNOLOGY AWARD
Trophy and €500. *Sponsored by Intel.*

SCIFEST STEM OUTREACH VIDEO AWARD
Trophy and €300.

SCIFEST SOCIAL SCIENCES AWARD
Trophy and €150.

SCIFEST LIFE SCIENCES AWARD
Trophy and €150.

THEA AWARD
Trophy and €75. *Sponsored by the Technological Higher Education Association.*

ISTA AWARD
Trophy and €75. *Sponsored by the Irish Science Teachers' Association.*

SCIFEST JUNIOR SCIENTIST OF THE FUTURE AWARD
Trophy and €75.

SCIFEST JUNIOR TECHNOLOGIST OF THE FUTURE AWARD
Trophy and €75.

EXCELLENCE IN STEM AWARDS
Engraved plaques.

TEACHER OF EXCELLENCE AWARD
This award is presented to the teacher of the student/s who win the SciFest STEM Champion 2023 title. The winning teacher receives an engraved trophy and will accompany the SciFest STEM Champion 2023 to the Regeneron International Science and Engineering Fair (ISEF) in Los Angeles, California, in May 2024.

SCIFEST 2023

NATIONAL FINALISTS

PROJECT ABSTRACTS

SciFest@ATU Sligo 2023

[STAND 1] Title of Project	**INVESTIGATING GENETICS IN GLIOBLASTOMA**
Student	Olívia Rocha da Rocha Brito
School	Mercy College, Chapel Hill, Sligo, Co. Sligo
Teacher Mentoring Project	Lorraine Sherlock

Abstract

Glioblastoma Multiforme is a type of aggressive, malignant brain tumour with a poor prognosis, despite efforts in novel treatments. In this project, I investigated the role of the MGMT gene on patients' health. I hypothesised that MGMT methylation, alongside key correlating factors, positively affects the prognosis of Glioblastoma patients.

To evaluate my initial hypothesis, I analysed data from the open access Ivy Glioblastoma Atlas Project database, from which I used RNA sequencing data to find the effect of methylation on factors such as survival days and age which influence a patient's health. I then created an algorithm to find correlating factors to predicting MGMT methylation, which I also trained to be able to diagnose methylation status in unseen data based on other factors such as age, other genetic factors and KPS, with adequate accuracy.

From my analysis, I concluded that my results supported my initial hypothesis, and I also identified novel factors correlating to MGMT methylation, most notably multifocality and molecular subtype. These findings highlight the potential of MGMT as a prognostic factor, biomarker, and a factor to base personalised and more effective therapies on. Moreover, factors identified to correlate with methylation may be valuable prognostic factors and help to understand the underlying molecular mechanisms of Glioblastoma.

National and Boston Scientific Finalist

SciFest@TU Dublin Blanchardstown 2023

[STAND 2] Title of Project	**AN INVESTIGATION USING SOUND ANALYSIS ON THE IMPACT OF AMBIENT SHIP NOISE ON NORMAL COMMUNICATION AND FORAGING BEHAVIOUR OF THE COMMON DOLPHIN *(DELPHINUS DELPHIS)***
Student	Amy Roche
School	St Joseph's Secondary School, Convent Lane, Rush, Co. Dublin
Teacher Mentoring Project	Kevin Delahunty

Abstract

Cetaceans, a mammalian group of animals including whales, dolphins, and porpoises, exhibit charismatic qualities, drawing attention for study. Echolocation, a vital method for animals like dolphins, aids in locating distant objects through emitted and reflected sound waves. In Ireland, common dolphins, prevalent in Dublin Port, face a rising threat of noise disturbance from the port's bustling economic activities, including fishing, shipping, dredging, and industry exploration. The main concern is the masking effect caused by anthropogenic noise, wherein ship-generated sounds interfere with cetaceans' communication, risking missed opportunities for foraging or communication. Research highlights the highest recorded noise levels during ship departures at 121 decibels, comparable to a military jet takeoff.

I investigated the impact of propeller design on underwater noise generation. Using sound files of echolocating common dolphins, a water tank and a variety of 3D printer propeller designs, I tested the masking effect of ambient propeller noise. SPARKvue and Audacity software was used to complete the analysis, with a standard 3D printed propeller as a control. Research has indicated that there is potential for altered ship propeller designs to mitigate noise disturbance. I have looked at methods to reduce the masking effect, which could benefit common dolphins and other echolocating cetaceans, through different propeller designs. The results indicate that innovative propeller designs can in fact reduce the masking effect on echolocating cetaceans helping, to mitigate against increasing anthropogenic noise disturbance in the marine environment.

National Finalist

SciFest@ATU Donegal 2023

[STAND 3] Title of Project	**USING SILICON NANOPARTICLES TO CREATE A SELF-SUSTAINING ANTIMICROBIAL SURFACE**
Student	Ciara Cannon
School	Abbey Vocational School, The Glebe, Donegal Town, Co. Donegal
Teacher Mentoring Project	Amanda Flood

Abstract

Nanoscience has practical applications in antimicrobial materials and surfaces with a focus on preventing the formation of biofilms on implanted medical devices. Health risks associated with silver and gold nanoparticles are undesirable. Silica is a very safe, biocompatible material that is easier and cheaper to synthesise. My own previous experiments found that, at certain concentrations and size ranges, silica nanoparticles demonstrate very promising antimicrobial activity so this project set out to find a coating material with fewer risks and better sustainability prospects.

This project investigated coating four different materials, brass, aluminium, acrylic and PDMS. These materials were cut into 10 mm squares and submerged into 15 ml of a silica nanoparticle-deionized water suspension of 59.5 µg/mL and left for two days. The coated materials were placed on lawn plates of bacteria grown on standard nutrient agar plates and the visible zone of inhibition around the coated materials was measured after a 48-hour incubation period.

Silica-coated brass was the only effective material against any of the bacteria. It was effective against gram negative *Klebsiella pneumoniae* and *Escherichia coli*. I deduced that the silica nanoparticles on the brass surface showed statistically significant growth inhibition against gram negative *Klebsiella pneumoniae* and *Escherichia coli* by puncturing small holes in the membrane of the bacterial cell allowing the copper (and possible zinc) ions access, causing the visible discolouration and resulting in cell lysis.

National Finalist

SciFest@MTU Cork 2023

[STAND 4] Title of Project	**MYCOREMEDIATION: AN INVESTIGATION INTO THE ABILITY OF OYSTER MUSHROOM MYCELIUM TO BREAK DOWN AND DIGEST MICROPLASTICS**
Students	Eoin McCarthy, Eoin O'Murchú, Jack Chambers
School	Clonakilty Community College, Clonakilty, Co. Cork
Teacher Mentoring Project	Patrick O Keeffe

Abstract

We wanted to solve the problem of microplastic pollution naturally using oyster mushroom mycelium. We investigated if two species of common oyster mushroom, *Pleurotus ostreatus* and *Pleurotus pulmonarius*, could digest microplastics and be a sustainable way of getting rid of microplastics in our environment.

Hypothesis: If oyster mushroom mycelium is grown in the presence of microplastics then it will digest and reduce the amount of microplastics present.

We prepared microplastic particles from different types of plastics to test in the experiment. We grew samples of each species of mushroom by combining cooled boiled sawdust, 3 g of assorted microplastics and 20 g of mushroom spores in sealed bags. The control samples had no spores added. Initially one group of samples was grown for 1 month and another for 2 months.

After the mycelium had time to grow the amount of microplastic left was calculated. This process involved wet sieving, wet peroxide oxidation treatment and density separation. The separated microplastics mass was calculated and then compared to the original mass of 3 g of microplastics added.

The results showed the samples grown for longer time had less microplastics. *Pleurotus ostreatus* removed more microplastics with an average of 1.24 g remaining at the end compared to 1.27 g for *Pleurotus pulmonarius*.

We refined the procedure to achieve more accurate results. We grew further samples containing *Pleurotus osteratus* for 6 months. When we compared these results to the control group, we could see a statistically significant reduction in the amount of microplastics present, supporting our hypothesis.

National Finalist

SciFest@ATU Galway 2023

[STAND 5] Title of Project	**ASSESSING THE PROGRESSION TO STEM COURSES AND CAREERS BETWEEN FEMALE SINGLE-SEX AND COEDUCATIONAL SECONDARY SCHOOLS**
Student	Claire Leuridan-Slevin
School	Dominican College, Taylor's Hill, Galway
Teacher Mentoring Project	Jean Carr

Abstract

The purpose of this project was to investigate the underrepresentation of women in the STEM industry and to determine whether there was a correlation between women working in STEM and the type of secondary school they attended, whether it was single-sex or coeducational.

To examine the impact of attending a single-sex or coeducational secondary school on young women's decisions to pursue STEM careers, I conducted research through surveys targeting various groups. These groups included female Leaving Certificate students in single-sex schools, female Leaving Certificate students in coeducational schools, female students currently in third level education, secondary school teachers teaching STEM subjects, and employees in the Irish STEM sector.

In addition to the primary survey research, I also conducted secondary research to compare the survey data with national statistics.

The survey data revealed that a higher percentage of women currently employed in the Irish STEM industry had attended single-sex secondary schools.

One issue identified among female students in single-sex schools was the limited availability of certain STEM subjects due to insufficient interest, resulting in students being unable to study their preferred subjects and pursue a career in STEM. This problem was less prevalent in coeducational secondary schools, which typically offered a wider range of STEM subjects.

National Finalist

SciFest@TU Dublin Grangegorman 2023

[STAND 6] Title of Project	**METASTASIS *IN SILICO*: COMPUTATIONAL MODELS AND TARGETED APPROACHES**
Student	Vedh Ramalingam Kannan
School	Sutton Park School, St Fintan's Road, Sutton, Dublin 13
Teacher Mentoring Project	Joanne Hanratty

Abstract

This project aimed to investigate two potential strategies for combating cancer metastasis. Firstly, the project assessed the feasibility of utilising arginase, an enzyme, to metabolise arginine as a potential treatment, with a specific focus on pancreatic cancer. This was achieved by fitting the Michaelis-Menten model to arginase, using published experimental data to confirm its potential as a therapeutic agent.

Secondly, the project conducted a comprehensive study of the epidermal growth factor receptor (EGFR) signalling pathway, exploring solutions such as ligand removal and tyrosine kinase (TK) inhibition. A biological model of EGFR dimerisation was developed using the BioNetGen Language (BNGL), and simulation data was analysed using Python. These simulations provided insights into how dimerisation dynamics change under varying ligand concentrations. Additionally, the project identified phosphohistidine as a potential candidate for inhibiting DNA transcription in cancer cells, given its ability to prevent tyrosine phosphorylation.

Furthermore, the project delved into the potential of novel delivery methods, including extracellular contractile injection systems (eCIS) and DNA origami, assessing their effectiveness through computational analysis.

Overall, this project aims to contribute valuable insights into cancer metastasis and potential treatment strategies, with applications in advancing precision cancer therapies.

National Finalist

SciFest@Dundalk IT 2023

[STAND 7] Title of Project	**P.ERIOD: EFFECT OF THE MENSTRUAL CYCLE ON PARTICIPATION AND PERFORMANCE DURING PHYSICAL EDUCATION IN SCHOOLS AND CLUBS**
Students	Mya Doocey, Mia Galligan
School	St Joseph's Secondary School, Navan, Brews Hill, Navan, Co. Meath
Teacher Mentoring Project	Fiona Leavy

Abstract

Our project: P.Eriod is an investigation into the mental and physical effects that the menstrual cycle has on performance and participation in P.E. (physical education). Our project idea came from the fact that we go to an all-girls school and noticed that many girls choose not to participate in P.E. whilst on their period. We wanted to find out why this was and if there was a way we could improve participation in P.E. class. We carried out our testing through physical testing and online surveys.

Our investigation: It involved studying 16 students' P.E. performance whilst on their period (day 1-5) and compared this to when they were not on their period (days 11-15 and days 21-25) to see if there are any physical changes in performance throughout a woman's cycle. We also compiled two surveys; the first survey was for all students in our school and the second survey for all levels of athletes ranging from club to Olympian.

Our findings: Exercise during menstruation can help alleviate symptoms and should be encouraged. During this stage (days 1-5) sprint exercises were completed at the students' best (44% achieved personal best). Strength and endurance exercises were completed at students' best on days 11-15 of their cycle (during ovulation).

Coaches and trainers need to be aware that a female's performance on one particular day may not be easily replicated a week later due to her menstrual cycle.

Raising awareness: In June we were invited to speak about our findings in the Dáil at a joint committee hearing. This was a great experience in which we got to raise awareness on a national level about the many issues that women face in sport. The issues we spoke about will be included in a national report called 'Inclusion in Sport'.

Hopefully our study will raise awareness on an issue that affects half of the human population on earth (Women!) and make this topic more widely discussed in public.

National Finalist

SciFest@TU Dublin Tallaght 2023

[STAND 8] Title of Project	**AN INVESTIGATION INTO THE USE OF HERBAL PLANT EXTRACTS THAT ARE EFFECTIVE AGAINST ANTIBIOTIC-RESISTANT BACTERIA IN SKIN INFECTIONS**
Student	Nikishi Polgolla
School	Our Lady's School, Templeogue Rd, Templeogue Village, Ballyboden, Co. Dublin
Teacher Mentoring Project	Emma Griffin

Abstract

The purpose of my project is to identify potent antimicrobial compounds in herbal plant extracts using high performance liquid chromatography (HPLC) to address the issue of antibiotic resistance.

Methicillin-Resistant *Staphylococcus aureus* (gram-positive bacteria), *Staphylococcus epidermidis* and *Corynebacterium striatum* were the antibiotic-resistant bacteria tested. The agar disk diffusion method was used to investigate herbal and vegetable extracts as natural, sustainable and economical antimicrobials against skin infections. They are not harmful or toxic chemicals, and some are locally abundant. Crude extracts of these herbal plants were prepared and filtered with ethanol to create concentrations of 25%, 50%, 75% and 100%.

For the investigation of *S. aureus, S. epidermidis* and *C. striatum*, agar disk diffusion methods were used by the addition of filter discs saturated in herbal extracts . Bacteria were grown in a CO_2 incubator at 35 °C and then observed for a zone of inhibition.

My main results were that nelli/gooseberry extracts showed the strongest inhibition on the growth of *S. aureus* due to the zone of inhibitions shown.

I then used the high performance liquid chromatography (HPLC) method to analyse the active components in gooseberry extract that are effective against antibiotic-resistant bacteria. I compared the nelli from my homeland, Sri Lanka, and commercially bought in an Asian supermarket in Ireland to complete further comparisons and research.

After identifying compounds such as ascorbic acid and gallic acid, I tested them against *S. aureus* using the disk diffusion method again.

National Finalist

SciFest@TUS Athlone 2023

[STAND 9] Title of Project	**GROWING THE FUTURE: INVESTIGATING THE GROWTH OF MYCELIUM PACKAGING USING BUTTON MUSHROOMS**
Student	Fatima Karimi
School	Tullamore College, Riverside, Tullamore, Co. Offaly
Teacher Mentoring Project	Elaine Howlin

Abstract

The rampant and unchecked proliferation of plastic packaging has reached alarming proportions in recent years. Plastic packaging, designed for its durability, has paradoxically become an enduring global menace. My project aims to produce sustainable biocompatible packaging using agricultural waste and locally sourced mushrooms. Mycelium is a root-like structure of mushrooms and other fungi, consisting of a network of branching, thread-like structures called hyphae. Mycelium can be grown on a variety of agricultural waste products, such as straw, sawdust, and corn stalks, and can be moulded into various shapes to create packaging.

My project uses *Agaricus bisporus*, commonly known as button or portobello mushrooms, which is the most cultivated and consumed mushroom in Ireland with particular attention to portobello mushrooms which are very often a waste product of the button mushroom industry. The straw or other agricultural waste acts as a substrate for the mycelium to grow. Not only does the process of producing packaging from mycelium turn waste into value, but it also absorbs carbon dioxide from the atmosphere making it carbon neutral. In addition, mycelium is non-toxic and biocompatible, making it suitable for use in food packaging and medical applications. Despite all the benefits of this sustainable packaging, the process of growing mycelium is very slow, therefore my project has focused on increasing the rate of growth of mycelium to make the process of making biocompatible packing from mycelium a viable process.

National Finalist

SciFest@SETU Waterford 2023

[STAND 10] Title of Project	**WHERE IS THE TRUTH: THE EFFECTS OF MEDIA PROPAGANDA ON YOUNG PEOPLE IN IRELAND**
Student	Cathal Barry
School	Blackwater Community School, Ballyanchor Road, Lismore, Co. Waterford
Teacher Mentoring Project	Danielle Murphy

Abstract

The rise of social media has had a devastating and unintended consequence: a new rise of propaganda. People are becoming more polarised, hatred is running higher, and false information is constantly being spread. It has never been easier for anyone, anywhere, to contribute to this. Young people, with their impressionable minds and heavy use of social media, are most vulnerable to this and, if not sorted soon, it will have a terrible effect on the political landscape of the future. I hypothesised that young people were indeed affected by propaganda and their use of social media would cause them difficulty in recognising propaganda.

I scoured the internet for real propaganda for use in my survey and found propaganda from sources like the Russian Defence Ministry and far-right website Humans-Be-Free. I carried out extensive surveying of over 850 students, asking a range of questions about their news sources and social media usage as well as their age and the importance they attach to the issue of propaganda. I also included questions which would gauge the participants' reactions to propaganda, and this was where the survey was split into two groups: a treatment group which was shown propaganda, and a control group which was shown regular news. I then cross-tabulated various questions and carried out extensive statistical analysis and statistical significance testing.

I have multiple conclusions, including that young people are indeed most vulnerable to propaganda, despite being fully aware of the issue that faces them, with 84% of participants describing social media as the least trustworthy source.

National Finalist

SciFest@DCU 2023

[STAND 11] Title of Project	**IRELAND'S CARBON SINKS – REMOTE SENSING FOR MONITORING PEATLAND RESTORATION**
Student	Jack Shannon
School	Clongowes Wood College, Kilcock Road, Clane, Co. Kildare,
Teacher Mentoring Project	Yvonne Nolan

Abstract

This study aimed to utilise remote sensing techniques for monitoring peatland restoration in Ireland. Two distinct peatland sites, Clara bog and Keelbanada bog, were investigated to assess the effectiveness of multispectral, LiDAR, SAR, and InSAR analyses in tracking restoration progress and degradation.

Multispectral analysis, employing readily accessible Copernicus and Sentinel Hub software, proved efficient in identifying changes in vegetation cover and moisture content in both restored and degraded areas. LiDAR analysis can be used for high-resolution elevation data, facilitating the identification of surface subsidence in degraded zones. Additionally, SAR analysis can be used to detect changes in land use and subsidence, while InSAR analysis effectively monitored land height alterations over time.

The InSAR analysis of Clara bog revealed promising restoration efforts on the East side, with a mean land growth velocity of +5.5 mm/year, while the West side indicated ongoing degradation at a mean velocity of -9.4 mm/year. Keelbanada bog's multispectral analysis accurately identified reductions in moisture content and vegetation, indicative of rapid degradation.

In conclusion, remote sensing techniques encompassing multispectral, LiDAR, SAR, and InSAR analyses offer a dependable and cost-effective approach for monitoring peatland restoration and degradation in Ireland. These methodologies supply regular and precise data on restoration progress and degradation areas, thus enhancing restoration planning and management.

This study underscores the potential of remote sensing techniques for monitoring peatland restoration or degradation at multiple scales, contributing to Ireland's commitment to the Paris Agreement and the 2030 Climate and Energy Framework by facilitating comprehensive assessments of progress towards restoration and carbon sequestration targets.

National Finalist

SciFest@SETU Waterford 2023

[STAND 12] Title of Project	**SOLAR PANELS: A BRIGHTER FUTURE FOR OUR SCHOOL USING MICROGENERATION TECHNOLOGY**
Students	Leigha Kinsella, Alex Simpson, Daniel O'Sullivan Westphal
School	St Paul's Community College, Paddy Brown's Road, Waterford
Teacher Mentoring Project	Gerard Lohan

Abstract

We want to investigate how our school would benefit from using solar panels. We researched how solar panels work. We built a model of our school showing solar panels on the roof. We calculated how much energy solar panels produce. We found out the amount of electricity our school uses in kW h and calculated how many solar panels would be required to produce this amount. We consulted the Global Solar Atlas to determine Sun intensity for our area to calculate solar panel energy production.

We carried out a survey by questionnaire in our school community of parents and staff to investigate their attitudes to the use of solar panels. We recorded our results on bar charts and in a spreadsheet. We are conducting experiments to see the effects of temperature on solar panels and the effects of light of different wavelengths on solar panel energy production. We believe that significant savings can be made by installing solar panels in our school.

In addition to continuing our experiments we will link in with a local solar energy provider to get further insight into solar energy. We will make a site visit to a solar farm or school/ building which has solar panels installed. We will produce an information leaflet for parents outlining our findings and encouraging them to install solar panels. We will use this to promote a greener school amongst our friends and fellow students.

National and EirGrid Finalist

SciFest@TUS Athlone 2023

[STAND 13] Title of Project	**CAN NATIVE WATERWEEDS SOLVE IRISH FARMERS' FEED AND ENVIRONMENTAL PROBLEMS?**
Students	Students: Nathan Downes, Daniel Lynam, Éanna Maxwell
School	Moate Community School, Church Street, Moate, Co. Westmeath
Teacher Mentoring Project	Mairead Cusack

Abstract

Our project aimed to examine the ability of native duckweed *(Lemna minor)* to remove nutrients from farmyard pollutants. The results were then used to design a prototype remediation tank to facilitate the timely removal of nitrates and phosphates from effluents while allowing farmers to produce a cheap nutritious feed for cattle.

Firstly, fixed masses of *Lemna minor* duckweed were placed into dairy washing and silage effluent solutions of varying concentration for 20 days. The effectiveness of the species at nutrient removal was identified through studies of nitrate and phosphate concentrations while changes in duckweed mass indicated the suitability of each as a growth medium. The impact of duckweed remediation of pollutant water quality was investigated through studies of *Daphnia magna* survival following one-hour incubation with each sample. Feeding trials were carried out to determine the palatability of the duckweed while commercial nutrient analysis was used to identify if the feed was sufficiently nutritious for cattle.

Studies of the nutrient composition of pollutant samples during remediation found that the species effectively removed key nutrients from each solution for use in formation of nucleic acids, amino acids and chlorophyll (nitrates) or for cell division promotion in roots to enhance nutrient uptake (phosphates). Such findings were supported by observations during Daphnia water quality trials with remediated samples showing higher survival rates compared to un-remediated controls. Findings from the investigation on the change in duckweed mass during remediation revealed that low concentrations of both pollutants act as suitable growth media for duckweed.

National and EirGrid Finalist

[STAND 14] Title of Project	**WHICH BEACH SAND IN CO. LOUTH HAS THE MOST MICROPLASTICS?**
Student	Lorcán Garvin
School	Coláiste Chú Chulainn, Marshes Lower, Dundalk, Co. Louth
Teacher Mentoring Project	Deirdre Dunford

Abstract

In recent years plastic pollution has been a large point of contention due to its effects on the environment. The intention for this project was to compare the microplastic content of the sand at different beaches across Co. Louth to determine which beach-sand had the highest and lowest microplastic content. Six beaches were chosen: Templetown, Blackrock, Annagassan, Lurganboy, Clogher Head and Termonfeckin.

The null hypothesis for this project was that there would be no observable difference in microplastic content between the beaches. The alternate hypothesis was that proximity to urban areas would increase microplastic content,creating an observable difference.

The analysis of the microplastic content was done through the sampling of sand across the different beaches, the treatment of the beach-sand samples with a flocculation solution to separate the plastic particles, and the use of a magnifying lens to count the number of microplastic particles in each sample.

After counting the particles from each sand sample, eliminating the outlier from each beach's dataset and taking the average of the number of plastic particles counted, the beaches were ordered from most polluted to least polluted:

(1) Blackrock (2) Clogher Head (3) Annagassan

(4) Termonfeckin (5) Lurganboy (6) Templetown

The results from the experiment showed that Blackrock beach and Clogher Head beach, the closest to dense urban areas, had the highest microplastic content compared to the other locations. This supported the alternate hypothesis and from this it was concluded that there was a positive correlation between proximity to urban areas and the microplastic content of the beach-sand.

National Finalist

SciFest@TU Dublin Tallaght 2023

[STAND 15] Title of Project	**THE EFFECTS OF HARD WATER ON HAIR**
Student	Gabriela Giuliese
School	Blackrock Educate Together Secondary School, The Sandymount Buildings, Simmonscourt Road, Ballsbridge, Dublin 4
Teacher Mentoring Project	Katie Burrowes

Abstract

Objective: To identify the effects of hard water on the hair.

Background: Hard water is found in over 70% of Irish households. Hardness is determined by the amount of salts, calcium carbonate or magnesium sulphate, dissolved in the water. The build-up of salts produces a film on the hair, making it difficult for moisture to penetrate, weakening the hair.

Methodology: Hair strands were collected from a total of 50 volunteers within different age groups, hair colour and type. The hair strands were immersed in different types of hard water with different concentrations. The tensile strength was tested using a Newton meter and a material testing machine. The strands were also examined under a microscope.

Results: In method 1 using a Newton meter, magnesium sulphate hard water had a weak correlation with the hair strength ($R^2 = 0.0034$). Calcium carbonate hard water had a more noticeable correlation ($R^2 = 0.038$). Mixed hard water had the highest correlation in comparison to the previous ones ($R^2 = 0.1022$). In method 2 a material testing machine was used to generate a stress-strain curve for the hair sample immersed in the mixed hard water. The hard water had very little effect on the yield strength ($R^2 = 0.0065$), the Young's modulus ($R^2 = 0.0025$) or the tensile strength ($R^2 = 0.1812$).

Conclusion: A strong correlation between hard water with different concentrations and the tensile strength of the hair could not be found. There was a noticeable pattern on the hair cuticle, indicating that hard water does have an effect on the hair cuticle.

National Finalist

SciFest@ATU Galway 2023

[STAND 16] Title of Project	**SUSTAINABILITY: BIOMATERIALS AND BIOPLASTICS - A FOCUS TOWARDS A CIRCULAR ECONOMY**
Student	Angelina O'Neill
School	Presentation College, Headford, Co. Galway
Teacher Mentoring Project	John Toner

Abstract

Climate change is creating a human crisis that could be irreversible by 2030. Over 1 million of our species now face extinction. We are using more resources than the earth can renew. (electricity.co.uk)

The motivation for my project was to raise awareness and bring attention to the alarmingly dangerous environmental zone we are currently in. Shocking pollution and massive quantities of harmful waste could be avoided by adopting new materials and developing more ecological methods of treatment, design and production of our goods.

My project focuses on researching, exploring and creating novel alternatives to harmful and toxic products. I experimented with different natural materials, paper-making techniques, invasive species, waste products, mycelium and bacterial cellulose and I tested their aerobic and anaerobic biodegradability.

In order to make these biomaterials suitable for the real world, I evaluated different methods of combining their mechanical and chemical properties by using and/or changing the molecular structure of different materials such as agar, chitosan, alginates, cellulose, etcetera. This allowed me to obtain an array of different bioplastics, fabrics, papers, "leathers" and other materials which I further developed to create clothing and household items, packaging, printing paper, bandages and more.

Hence this project illustrates the scientific and industrial potentials of these novel biomaterials, adapting them to suit the requirements of the technological, design, fashion, culinary and medical fields. By doing so I hope to lead the way to a cleaner, more ecological, and sustainable future.

National Finalist

SciFest@MTU Kerry 2023

[STAND 17] Title of Project	**A LYCOPENE BASED SUNSCREEN TO PREVENT SKIN DAMAGE CAUSED BY UV RADIATION**
Student	Yasmine Odugbesan
School	Mercy Secondary School Mounthawk, Mounthawk, Tralee, Co. Kerry
Teacher Mentoring Project	Eimear Nolan

Abstract

With over 12,000 new cases being diagnosed in Ireland alone, skin cancer remains one of the most common types of malignancy, notably in lighter skinned populations. Although skin cancer, including melanoma and non-melanoma skin cancer (NMSC), is easily preventable many modern forms of ultraviolet (UV) protection have many flaws.

This research investigated tomatoes and their potential use as a natural UV blocker in a novel sunscreen without the usage of coral-bleaching UV filters such as oxybenzone, octinoxate and octocrylene.

Lycopene was extracted from *Solanum lycopersicum* using hydrophobic natural deep eutectic solvents (HNADESs) based on fatty acids, capric (decanoic) acid and lauric (dodecanoic) acid. A mixture of capric acid and lauric acid at a 1:2 molar ratio was prepared as the solvent. Then a solvent to solid ratio of 64:1 was used, with 64 ml of solvent per 1 g of solid (tomato). The duration for the extraction process was 62 minutes and the solution was spun at ≈750 rpm at room temperature.

After extraction and analysis an oil-in-water (O/W) nanoemulsion method was used to create a stable lycopene mixture. The mixture was then analysed using various methods and was tested in cultured skin cells to observe oxidative stress levels in the skin cells.

This research aids in the development of natural photoprotective methods and highlights the importance of proper skin protection to prevent malignancy in skin cells. It also displays the importance of lycopene and its potential in cosmetic and pharmaceutical products.

National Finalist

SciFest@NorthWest 2023

[STAND 18] Title of Project	**INVESTIGATING THE EFFECT OF ACID RAIN ON METALS USED IN CONSTRUCTION AND METAL COMPOUNDS FOUND IN SOIL**
Student	Rebecca Lewis
School	St Mary's College, 35 Northland Road, Londonderry, Co. Londonderry
Teacher Mentoring Project	Ann Blanking MBE

Abstract

This project arose from news in the media about the damage that acid rain can do to the environment.

As well as acidifying waterways, killing trees and plants and eroding buildings, acid rain leaches heavy metals from soil and rocks and reacts with metals used in buildings. When the metal ions get into waterways and into potable water and move up the food chain, they can cause health problems in humans such as kidney damage. Acidification also affects the human nervous system (implicated in Parkinson's disease), respiratory system and digestive system.

Acid rain is mainly a mixture of sulfuric and nitric acids depending upon the relative quantities of oxides of sulfur and nitrogen emissions. Due to the interaction of these acids with other constituents of the atmosphere hydrogen ions are released causing an increase in the soil acidity.

This project investigates firstly, the effect of simulated acid rain on heavy metals that are used structurally and secondly, the effect of acid rain on leaching metal ions from soil.

There were 2 parts to the project, (i) metals were exposed to simulated acid rain for ten minutes and (ii) simulated acid rain (SAR) was pumped through columns of artificially contaminated soil.

We found that the SAR affected all the metals tested and that it leached ions from the soil. These results have serious implications for construction and the addition of nutrients to the soil (fertilisers).

National Finalist

SciFest@DCU 2023

[STAND 19] Title of Project	**MAKING WAVES**
Students	Rebecca Cullen, Freyja Cleary, Clementine van Steenberge
School	Loreto Abbey Secondary School, Dalkey, Co. Dublin
Teacher Mentoring Project	David Cullen

Abstract

With fossil fuels accounting for almost 90% of global CO^2 emissions annually, our focus should be on the switch to cleaner and greener forms of energy. One of these forms is wave power which harnesses the natural movement of the sea to generate electricity. As a school situated on the sea, we were particularly interested in the potential of this source of energy and the possibilities of it in our school.

We decided to create our own way of generating current through wave power in our lab. First, we used Lego to build a wave generator so we could have our own ripple tank to replicate the action of the sea. We then created a version of the point absorbers used in wave power out of the materials available in our school lab. Combining these two elements, we had a way of replicating the creation of wave power. Connecting our apparatus to a galvanometer meant that we could show the presence of current, and also how different factors affected the amount produced.

Some factors we investigated were the speed of the waves, the size and weight of the buoy, the use of slits to create constructive and destructive interference and the position of the buoy. We used the outcomes of our investigations to create the most efficient version of our generator that we could.

Our project has left us with knowledge of a new, clean way of producing energy. With further development, perhaps we could even bring in a generator to power our school, using the resource right outside our windows.

National and EirGrid Finalist

SciFest@MTU Cork 2023

[STAND 20] Title of Project	CYCLE4CHARGE
Students	Meabh O Sullivan, Sarah Harte
School	Sacred Heart Secondary School, Convent of Mercy, Clonakilty, Co. Cork
Teacher Mentoring Project	Claire Holland

Abstract

The main aim of our project, 'Cycle for Charge', is to promote the use of sustainable energy sources and to persuade people to use sustainable energy sources in their daily lives. The hypothesis for our investigation is, 'Is it possible to create a sustainable energy source to power an electronic device which can be introduced in an easy and accessible way to society in the future?' We have designed a circuit board dynamo device that converts kinetic energy from a bike into electrical energy to charge a phone. As we know, the battery in every phone has to be recharged in order to use it. This means that fossil fuels are constantly being wasted in order to create electrical energy to recharge phones. As a vast proportion of the population owns a phone and therefore wastes fossil fuels recharging their phone, it is clear that our investigation has the potential to change how thousands, if not millions, of people recharge their phone to a more sustainable way. We have surveyed a number of people to see if our device would have a popular uptake and impact the planet. 92.5% of people said they would use our device for a greener future. Bear in mind that people will not have to continuously use our 'Cycle for Charge' method to have a positive impact on our planet. Even if they use our theory of converting the kinetic energy caused by cycling to electric energy every so often, this can make a big change to the health of the planet and promote sustainable generation of electricity.

National and EirGrid Finalist

SciFest@ATU Sligo 2023

[STAND 21] Title of Project	**THE PERFECT WIND TURBINE**
Students	Sean Jordon, Mark Cranley
School	Coola Post Primary School, Riverstown, Via Boyle, Co. Sligo
Teacher Mentoring Project	Shona Gorman

Abstract

Our project's inspiration was based on the ever-looming climate crisis; we believe that drastic measures must be introduced to curb global warming. We believe that wind turbines are a vital source of renewable energy and stand as a very viable option to curb global warming.

From researching different avenues of renewable energy we found that vertical-axis wind turbines may lead to an increase in electrical output. Along with changing the shape and direction of the blade, we decided to find the most suitable location for the turbine to be situated, whether it be in a high-altitude area or at sea level on the coast. To do this we measured the mass of the air relative to the area to determine which area has the most potential energy.

After investigating the electrical yield for both the horizontal and vertical turbines by subjecting them to wind speeds of 1.5 m/s and 4.5 m/s, we found that the VAWT produced a higher electrical output for both windspeeds.

The mountain location had a greater air mass, but the seaside had the greater wind speed. So, in conclusion we believe this is a disputable matter and that neither location is a clear-cut successor for the wind turbines to be situated.

Further research must be carried out on a larger scale to effectively determine which turbine is the definite successor. Factors such as overall difficulty to construct and funding for these turbines must be considered as ultimately the most effective turbine on paper may not be so in practice.

National and EirGrid Finalist

SciFest@MTU Kerry 2023

[STAND 22] Title of Project	**DESIGNING A HOME BIODIGESTER AND MONITORING SOLUTION TO MEASURE SAFETY AND EFFICIENCY**
Students	Grace Ní Ifearnáin, Emma Ní Ifearnáin
School	Gaelcholáiste Chiarraí, Cloon Beg, Tralee, Co. Kerry
Teacher Mentoring Project	Tríona Uí Mhaolchatha

Abstract

The purpose of the project was to initially design a home biodigester from recycled materials. This led to designing and developing a monitoring solution for the biodigester to measure pH, temperature, safety and efficiency.

The increasing cost of energy bills can be addressed in part by developing a biodigester for use in rural homes in Ireland. Biodigesters are naturally cheap to make using recycled materials. Safety and efficiency are addressed with the monitoring solution which allows real-time insights into the biodigester.

Every home could reduce the cost of bin charges by using organic waste in the brown bin to feed the biodigester. The biodigester in turn produces gas. This is an excellent way of reducing waste and refuse for families. This project can also be adapted for use in developing countries, providing gas for families to cook at least one meal a day.

Research shows that the biggest factors that affect biogas production are temperature, humidity, pressure, pH and depth. Using an Arduino board, the temperature, humidity, pressure, pH and depth sensors were wired to the board and coded using Arduino C. All the sensors were coded separately and then combined into one sensor. A dashboard was designed to monitor and control the Arduino board, allowing real time insights into what is happening live in the biodigester. The second protype is in the development stage. It is believed the readings will be as per the recommended levels. This will change the future of biodigester monitoring.

National and EirGrid Finalist

SciFest@SETU Waterford 2023

[STAND 23] Title of Project	**IRIS: THE INTELLIGENT RECYCLING SORTING SYSTEM**
Student	Surabhi Sathish
School	Loreto Secondary School, Granges Rd, Jamespark, Kilkenny
Teacher Mentoring Project	Fiona McGrath

Abstract

Proper waste segregation is a crucial task for waste management at the household level, yet it is often an error-prone process. According to Repak, in Ireland 100,000 tonnes of recyclable material is sent to landfill every year due to contamination. This project aimed to create a simple device that uses convolutional neural networks (CNN) and robotics to eliminate the problem from the hands of the user, leading to reduced contamination rates.

The CNN was trained on 1000+ images sourced from Kaggle and specific object images were taken locally. Using transfer learning, it achieved an accuracy of 96%, showing that the robot can accurately classify waste materials and perform sorting tasks with high efficiency. The robot utilises an ultrasonic sensor to detect the presence of objects in front of it and a Raspberry Pi running the CNN to classify waste materials into recyclable, general waste, or organic waste categories. The robot's movement is controlled using small servos, and the data collected from the sensor is processed using the Raspberry Pi's GPIO pins. The robot is designed to be portable and wall mountable to accommodate different bin sizes.

The proposed system aims to reduce human involvement in waste sorting and promote efficient waste management practices. Overall, this project provides a promising solution for automating waste sorting and reducing the rate of recycling contamination at the household level.

National Finalist

SciFest@TU Dublin Blanchardstown 2023

[STAND 24] Title of Project	**PROJECT PRESERVE 3.0**
Student	Sachin Mahesh
School	Castleknock College, College Grove, Castleknock, Dublin 15
Teacher Mentoring Project	Tom Tierney

Abstract

Greenhouse gas (GHG) emissions from the agricultural sector have significant environmental impacts, including contributing to climate change and air pollution. Reducing emissions from the agricultural sector is a crucial step in addressing environmental and economic challenges. While several regulatory measures have been put in place, small and medium farms struggle to control their emissions due to a lack of simple, affordable, and user-friendly emission management tools.

Finding effective and scalable solutions that can be widely adopted by farmers and producers is a complex task that requires addressing a range of interconnected factors. In this project we present Preserve, a low-cost solution that relies on in-situ real-time measurements from farms and provides guidance through predictive models while allowing farmers to monitor measurements via a user-friendly cloud interface. Preserve uses predictive analytics and multiple regression models in Python to alert farmers and producers to take preventative measures when the model predicts an impending emissions spike.

National Finalist

SciFest@TUS Limerick 2023

[STAND 25] Title of Project	**PORTANOS: PORTABLE, EXTENSIBLE, MODULAR, DIAGNOSTIC, SYSTEM**
Students	Taha Njie, Aidan Oscar
School	Coláiste Chiaráin, Skagh, Croom, Co. Limerick
Teacher Mentoring Project	Edel Farrell

Abstract

ECG machines are expensive. This high cost can strain healthcare budgets, limiting access to vital cardiac diagnostic tools. It can also affect underfunded facilities in particular parts of the developing world or areas of conflict, potentially affecting patient outcomes and healthcare equity. We wanted to create a device just as reliable as these expensive ECG machines, using 3D printing and coding.

We have designed and built a portable ECG machine using affordable components. We used a raspberry Pi and Arduino processors. We connected an AD8232 heart rate monitor and a SENO334 blood oximeter to the Arduino. Analog signals are processed by the Arduino and converted to digital data. The raspberry Pi receives the digital signals and displays them on a screen. We fully 3D printed our housing for the ECG machine and its electronic components.

We have tested the device on ourselves, and it provides a clear trace of the heart rhythm on the screen. We have compared our output data to ECG trace data found online and it shows excellent accuracy.

National Finalist

SciFest@DCU 2023

[STAND 26] Title of Project	**USING MACHINE LEARNING TO IDENTIFY RADIOLUCENCIES ON PANORAMIC DENTAL RADIOGRAPHS (OPGS)**
Student	Kamaya Gogna
School	St Joseph's Secondary School, Convent Lane, Rush, Co. Dublin
Teacher Mentoring Project	Kevin Delahunty

Abstract

Radiolucencies are problematic for dentists to diagnose. The current method of diagnosis is a confusing and long flowchart. This flowchart alone can lead to inconclusive results. The last resort is a painful biopsy. This inefficient method of diagnosis has led to a misdiagnosis rate of 49%.

I talked to dental science students in their fourth year at TCD, and they complained about this flowchart to me, about its length and complexity. I was studying machine learning on MIT open courseware and was in awe. So, after my discussions with the students, I recognised a gap in the diagnosis procedure and I realised that ML can help mitigate this gap.

My project involves making an algorithm that identifies radiolucencies. My model has been trained on 1,000 radiographs and can diagnose 21 types of radiolucency. After training my model and testing the classification algorithm with test sets, I found that the results were accurate.

The algorithm and the associated website were developed in response to the discussions with the TCD dentistry students. The COVID-19 pandemic put massive stress on the healthcare system and there is still a backlog to this day! The algorithm and website I created will help reduce stress on the healthcare system by quickly diagnosing patients. Ireland is facing a chronic lack of dentists as there are only 44 dentists per 100,000 people. An algorithm could never replace a dentist, but it could definitely be a useful tool. I want to push the boundaries and integrate technology into dentistry.

National Finalist

SciFest@TUS Thurles 2023

[STAND 27] Title of Project	**ANALYSE THE POINT CLOUD MAP FUSION ALGORITHM IN DYNAMIC SCENES AND TRY TO OPTIMISE IT**
Student	Chen HongYu
School	Rockwell College, Cashel, Co. Tipperary
Teacher Mentoring Project	Helen Murray

Abstract

With the increasing maturity of UAV (drone) technology, it has been more and more widely used in many fields because of its flexibility. The aim of my project was to improve the mapping and positioning accuracy of in-flight UAVs.

One of the basic tasks of a drone is to determine its location through its own sensors under a given environmental condition. Most mature existing SLAM algorithms assume that the application scene is static and that no moving objects can appear. This assumption limits the application of most traditional or accessible visual SLAM algorithms.

When an unknown environment is large or complex a single drone cannot stably achieve self-positioning and map construction. My project studied a multi-drone VSLAM technology to solve the problem of self-positioning as experienced by the drone. It aimed to solve the defects of the traditional algorithm. A second major benefit of my project was the replacement of the central processing unit by a more efficient model and the introduction of direct UAV-to-UAV communication. Experiments have showed that the method in this project could solve positioning and mapping problems of drones in dynamic systems and eliminate moving objects with a high success rate to complete the construction of static maps.

Conclusion. As a result of the improvements, the number of point clouds has increased significantly. The drift problem during scanning mapping has been fixed, which makes the algorithm more efficient and accurate.

National Finalist

SciFest@Dundalk IT 2023

[STAND 28] Title of Project	**CAN ARTHRITIS SUFFERERS BENEFIT FROM LEVERAGE?**
Students	Leah Newman, Craig Lawlor
School	St Oliver's Community College, Rathmullan Rd, Rathmullan, Drogheda, Co. Louth
Teacher Mentoring Project	Andrew Donnelly

Abstract

Our project is based on leverage and is focused specifically on how leverage can benefit people that suffer with arthritis. We discovered through our research, both desk and field, that arthritis sufferers struggle with so many simple everyday tasks that non-sufferers may deem as 'easy`.

We conducted a survey to identify what the most difficult tasks are for them. We initially found these to be unscrewing a bottle, peeling tabs and picking up small items, like bank cards, keys and coins. With these struggles in mind, we created the MultiTasker, a 3D printed device made from PLA (Polylactic-Acid). We printed several prototypes and tested them to make any required modifications and improvements. We believe that our one-of-a-kind and innovative product can make a real difference in people's lives and play a vital role in the long-term management of arthritis and other diseases that may result in limited mobility and/or dexterity in one's lower arms/hands.

Following the invaluable feedback that we received at the regional round of SciFest, we have created several new variations of the MultiTasker and have explored the possibility of an application that would allow for the individual modularisation of our tool which allows the user to order a personalised device, suited to their unique needs and struggles.

We thoroughly enjoyed doing this project as we found it remarkably interesting researching the science behind our tool and enjoyed seeing how our device can be of such benefit to arthritis sufferers, and therefore improving their standard of life.

National and Boston Scientific Finalist

SciFest@MTU Kerry 2023

[STAND 29] Title of Project	**CPR PEDAL CHEST COMPRESSION DEVICE MARK II**
Students	Jim Culhane, Paula-Eve Culhane
School	Comprehensive School Tarbert, Listowel, Co. Kerry
Teacher Mentoring Project	Thomas Culhane

Abstract

Our project is an improvement on last year's device which came about by realizing that manual CPR is difficult to do, and rescuer fatigue sets in early and is a known phenomenon in medical scientific literature.

Our research indicated that present-day CPR devices on the market are hospital and ambulance orientated and vastly expensive and need power sources. Our aim was to design a cheap effective intuitive device without requiring an external power source and using recyclable parts. We wanted to postpone rescuer fatigue for as long as possible. We researched various mechanisms and the final device involves bicycle pedals linked to a car piston mechanism design. We tried five different versions of the product to date.

Our CPR Pedal Chest Compression Device postpones rescuer fatigue in CPR for 60 minutes or more. Rescuer fatigue usually occurs within the first 2 minutes. Compression depths are consistent using this device because of its design.

Compression depths are often not done properly in manual CPR. Our device has adjustable height and width so more patients benefit by the use of our device; its ease of use encourages more people to use it, increasing the number of resuscitations carried out.

Our conclusions to date from using our CPR device is that CPR compression depth is consistently accurate and rescuer fatigue is postponed. There is no need for swapping rescuers in/out every 2 minutes. As most cardiac arrest happens in the home an inexpensive CPR device like ours would be a great asset in saving lives.

National and Boston Scientific Finalist

SciFest@TU Dublin Grangegorman 2023

[STAND 30] Title of Project	**PEACEFULPALS: REVOLUTIONISING MENTAL HEALTH WELLNESS THROUGH AI-GUIDED THERAPEUTIC INTERVENTION**
Student	Max Grogan
School	St Andrew's College, Booterstown Ave, Blackrock, Co. Dublin
Teacher Mentoring Project	Laura Brogan

Abstract

This project represents a transformative journey in the realm of mental health services, where the power of technology converges with the essence of compassionate support. At its core, this endeavour is the creation of an AI therapist application designed to provide accessible and responsive mental health assistance.

The project's foundation lies in the utilisation of OpenAI's cutting-edge models, fine-tuned to cater to the unique needs of individuals seeking support and understanding. By leveraging Natural Language Processing (NLP) and machine learning capabilities, the application becomes a digital companion, ready to listen, empathise, and offer meaningful insights.

The deployment of Firebase ensures not only the security of user data but also the seamless operation of the application. User-centric design, ethical considerations, and continuous improvement are at the heart of the app's development.

As of its presence on the Google Play Store, the application has already made a significant impact, with over 30 downloads and an impressive average user engagement of approximately 6.2 minutes per session. This early success showcases the app's relevance and user appeal.

In conclusion, this project is more than just technology; it's a mission to make mental health support accessible, responsive and compassionate. It stands as a testament to the fusion of human creativity with technological prowess, aiming to transform the way we address mental health challenges in today's digital age.

National and Boston Scientific Finalist

SciFest@TUS Athlone 2023

[STAND 31] Title of Project	**A-OK, A DIGITAL COMMUNICATION WRISTBAND FOR STUDENTS WITH AUTISM**
Students	Robert Brennan, Hugh Murtagh
School	Coláiste Mhuire, Saint Mary's CBS, College St, Mullingar, Co. Westmeath
Teacher Mentoring Project	Eva Acton

Abstract

A-OK is a communication wristband for students with autism. We wanted to create a discreet wristband that will aid the student with autism to reduce anxiety within the classroom by offering a means to contact the teacher. Hugh has autism, so we both can relate to what it is like to suffer from these problems and this leads us to want to make some impactful change, not just within our own lives but the lives of every student in mainstream schooling.

We have reviewed international research from North America and Europe and found that 72% of those interviewed said that they suffered in school with autism due to the lack of resources available. AsIAm also conducted surveys and investigations, one of them being called "The Invisible Child" survey which found that an astounding 70% of people surveyed had left school prematurely due to anxiety and sensory overload. This shows a major problem within the education system, both in Ireland and internationally.

The wristband itself was designed using computer aided design (CAD) by ourselves with the intention of the wristband being discreet. We used a Bluetooth shutter button that would connect via Bluetooth to Raspberry Pi. When pressed, the Raspberry PI would receive an input and alert Firebase to send a notification to the teacher's phone. The app was built using the programming languages Flutter and Dart. The app will be available on both IOS and Android devices using a simple design to ensure no miscommunication in its mission.

National and Boston Scientific Finalist

SciFest@TUS Limerick 2023

[STAND 32] Title of Project	REHABILITATION NATION
Students	Emma Greaney, Madison Brouder
School	Comprehensive School Tarbert, Listowel, Co. Kerry
Teacher Mentoring Project	Donal Enright

Abstract

The whole aim of our project was to help improve people's shoulder pain from the comfort of their own home no matter the severity. Most importantly, ensuring they remain independent throughout. Our device offers a more affordable solution to individuals which enables them to have a better quality of life in their homes. 18-26% of adults and the elderly suffer with adhesive capsulitis and other common shoulder complications making it one of the most common pain syndromes in the world. Adhesive capsulitis is a disorder of musculoskeletal tissue surrounding the shoulder joint. It will cause you to experience pain and stiffness in the shoulder joint. There are different stages of adhesive capsulitis, including the inflammatory stage, the freezing stage, the frozen stage and the thawing or recovery stage. Treatment of adhesive capsulitis (frozen shoulder) involves a range of motion exercises and, sometimes in a small percentage of cases, arthroscopic surgery may have to be performed. We conducted two experiments with local people suffering with adhesive capsulitis, one being a 62-year-old male and the other a 39-year-old female, with both of their affected arms improving by over 60%. Our electronic version is made with aluminium, acrylic and a battery pack which powers the micro bit. Two easy foam grip handles ensure that the device is comfortable. It features a strong firm rope which can be securely fastened and adjusted to any standard size door.

National and Boston Scientific Finalist

SciFest@TUS Athlone 2023

[STAND 33] Title of Project	**FROM A DISTANCE, WITH A KIND EYE**
Students	Emma Fallon, Sofia Mc Gorisk
School	Our Lady's Bower, Retreat Road, Athlone, Co. Westmeath
Teacher Mentoring Project	Julie-Anne Greaney

Abstract

Purpose of the Project: This project proposes a personalised risk assessment App. The aim of the project is to create a machine learning risk assessment algorithm in a mobile app that will determine what's normal for a user and alert a caregiver if there are changes from normality.

Description of the Project: There were three main objectives of the project: (1) to understand the inputs that are relevant to a user, e.g. traveling to town, wake/sleep times, contact with family/friends; (2) to develop an adaptive machine learning algorithm to adjust the level of risk for a particular user; (3) to build an app to capture the input data, implement the algorithm and communicate with care givers.

Data: This work is experimentally based. Using the MIT App Inventor we created a demonstration app to detect sensory interactions of the person. The testing sample consisted of a representative sample of family and friends.

We set out three key areas for investigation:

(1) A Baseline Survey of participant interaction and an indication of the need for assistance
(2) Evaluating the effectiveness of crisp boundary logic
(3) Evaluating the effectiveness of multivariate fuzzy logic

Conclusions: Both the crisp boundary and fuzzy logic approaches showed a close correlation between the estimated and survey results: crisp boundaries 66%; fuzzy logic 88%. The fuzzy logic approach had an average 22% performance improvement in comparison to the crisp boundary approach.

National and Boston Scientific Finalist

SCIFEST 2023

BOSTON SCIENTIFIC MEDICAL DEVICES FINALISTS

PROJECT DETAILS

SciFest@ATU Sligo 2023

[STAND 1] Title of Project	**INVESTIGATING GENETICS IN GLIOBLASTOMA**
Student	Olívia Rocha da Rocha Brito
School	Mercy College, Chapel Hill, Sligo, Co. Sligo
Teacher Mentoring Project	Lorraine Sherlock

ABSTRACT: PAGE 16

SciFest@Dundalk IT 2023

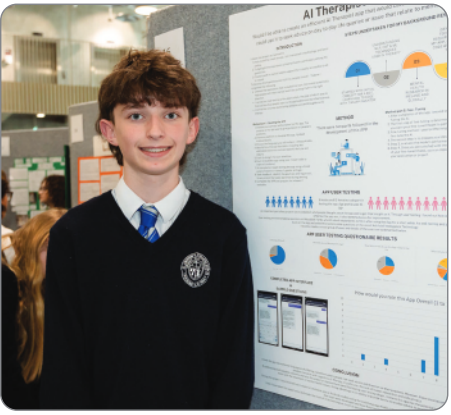
[STAND 28] Title of Project	**CAN ARTHRITIS SUFFERERS BENEFIT FROM LEVERAGE?**
Students	Leah Newman, Craig Lawlor
School	St Oliver's Community College, Rathmullan Rd, Rathmullan, Drogheda, Co. Louth
Teacher Mentoring Project	Andrew Donnelly

ABSTRACT: PAGE 43

SciFest@MTU Kerry 2023

[STAND 29] Title of Project	**CPR PEDAL CHEST COMPRESSION DEVICE MARK II**
Students	Jim Culhane, Paula-Eve Culhane
School	Comprehensive School Tarbert, Listowel, Co. Kerry
Teacher Mentoring Project	Thomas Culhane

ABSTRACT: PAGE 44



SciFest@TU Dublin Grangegorman 2023

[STAND 30] Title of Project	**PEACEFULPALS: REVOLUTIONISING MENTAL HEALTH WELLNESS THROUGH AI-GUIDED THERAPEUTIC INTERVENTION**
Student	Max Grogan
School	St Andrew's College, Booterstown Ave, Blackrock, Co. Dublin
Teacher Mentoring Project	Laura Brogan

ABSTRACT: PAGE 45

SciFest@TUS Athlone 2023

[STAND 31] Title of Project	**A-OK, A DIGITAL COMMUNICATION WRISTBAND FOR STUDENTS WITH AUTISM**
Students	Robert Brennan, Hugh Murtagh
School	Coláiste Mhuire, Saint Mary's CBS, College St, Mullingar, Co. Westmeath
Teacher Mentoring Project	Eva Acton

ABSTRACT: PAGE 46

SciFest@TUS Limerick 2023

[STAND 32] Title of Project	REHABILITATION NATION
Students	Emma Greaney, Madison Brouder
School	Comprehensive School Tarbert, Listowel, Co. Kerry
Teacher Mentoring Project	Donal Enright

ABSTRACT: PAGE 47

SciFest@TUS Athlone 2023

[STAND 33] Title of Project	FROM A DISTANCE, WITH A KIND EYE
Students	Emma Fallon, Sofia Mc Gorisk
School	Our Lady's Bower, Retreat Road, Athlone, Co. Westmeath
Teacher Mentoring Project	Julie-Anne Greaney

ABSTRACT: PAGE 48

SCIFEST 2023

EIRGRID CLEANER CLIMATE FINALISTS

PROJECT DETAILS

SciFest@SETU Waterford 2023

[STAND 12] Title of Project	**SOLAR PANELS: A BRIGHTER FUTURE FOR OUR SCHOOL USING MICROGENERATION TECHNOLOGY**
Students	Leigha Kinsella, Alex Simpson, Daniel O'Sullivan Westphal
School	St Paul's Community College, Paddy Brown's Road, Waterford
Teacher Mentoring Project	Gerard Lohan

ABSTRACT: PAGE 27

SciFest@TUS Athlone 2023

[STAND 13] Title of Project	**CAN NATIVE WATERWEEDS SOLVE IRISH FARMERS' FEED AND ENVIRONMENTAL PROBLEMS?**
Students	Students: Nathan Downes, Daniel Lynam, Éanna Maxwell
School	Moate Community School, Church Street, Moate, Co. Westmeath
Teacher Mentoring Project	Mairead Cusack

ABSTRACT: PAGE 28

SciFest@DCU 2023

[STAND 19] Title of Project	**MAKING WAVES**
Students	Rebecca Cullen, Freyja Cleary, Clementine van Steenberge
School	Loreto Abbey Secondary School, Dalkey, Co. Dublin
Teacher Mentoring Project	David Cullen

ABSTRACT: PAGE 34

SciFest@MTU Cork 2023

[STAND 20] Title of Project	**CYCLE4CHARGE**
Students	Meabh O Sullivan, Sarah Harte
School	Sacred Heart Secondary School, Convent of Mercy, Clonakilty, Co. Cork
Teacher Mentoring Project	Claire Holland

ABSTRACT: PAGE 35

SciFest@ATU Sligo 2023

[STAND 21] Title of Project	**THE PERFECT WIND TURBINE**
Students	Sean Jordon, Mark Cranley
School	Coola Post Primary School, Riverstown, Via Boyle, Co. Sligo
Teacher Mentoring Project	Shona Gorman

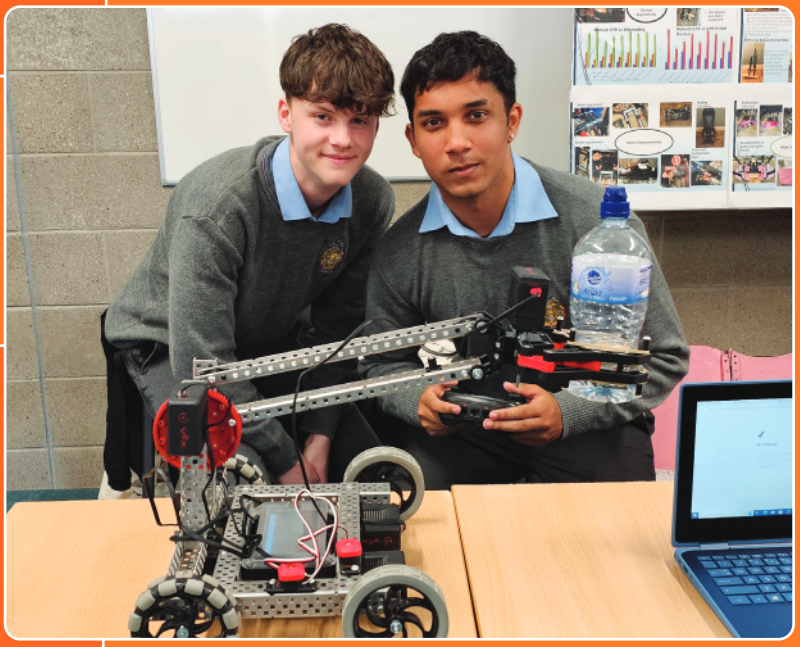
ABSTRACT: PAGE 36

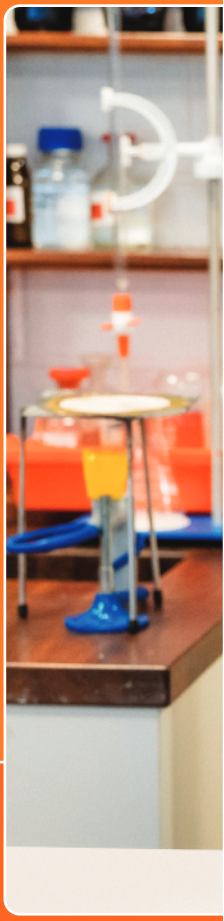
SciFest@MTU Kerry 2023

[STAND 22] Title of Project	**DESIGNING A HOME BIODIGESTER AND MONITORING SOLUTION TO MEASURE SAFETY AND EFFICIENCY**
Students	Grace Ní Ifearnáin, Emma Ní Ifearnáin
School	Gaelcholáiste Chiarraí, Cloon Beg, Tralee, Co. Kerry
Teacher Mentoring Project	Tríona Uí Mhaolchatha

ABSTRACT: PAGE 37


Fast Fashion
effects





PREVIOUS WINNERS

2011-2022

2022
SCIFEST STEM CHAMPIONS

Liam Waldron, Rachel Griffin, Luke O'Sullivan

2021
SCIFEST STEM CHAMPION

Clare Reidy

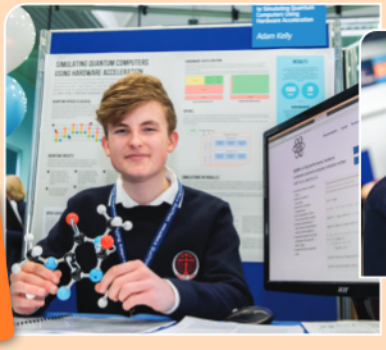
2020
SCIFEST STEM CHAMPION

Caoimhín O'Leary

2019
SCIFEST SFI STEM CHAMPION

Timothy McGrath

2018
SCIFEST SFI STEM CHAMPION



Adam Kelly

2017
SFI Intel ISEF AWARD WINNER

Aaron Hannon

2016
SFI Intel ISEF
AWARD WINNER

Caolann Brady

2015
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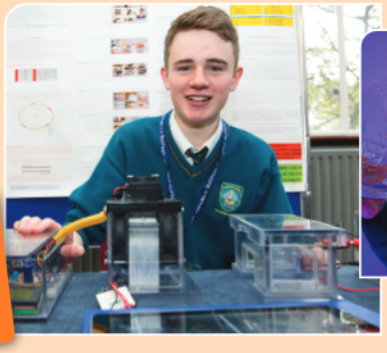
AWARD WINNER



Louis Madden

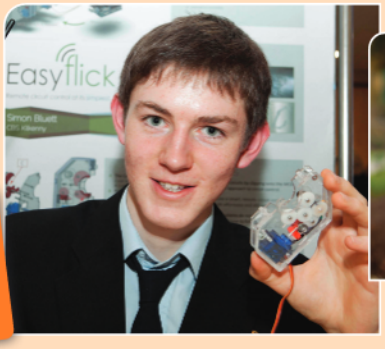
2014
SFI Intel ISEF
AWARD WINNER

Christopher Carragher

2013
SFI Intel ISEF
AWARD WINNER

Paul Clarke

2012
SFI Intel ISEF
AWARD WINNER



Simon Bluett

2011
SFI Intel ISEF
AWARD WINNERS

Eoghan Flynn,
Ruairi O'Neill

The SciFest 2023 Team

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George Porter	Chief Financial Officer
Hugo Rowsome	Project Manager
Clare Atkinson	Senior School Liaison Officer
Seán Foley	School Liaison Officer
Catherine Tattersall	School Liaison Officer
Alan Dunne	School Liaison Officer
Rory Geoghegan	School Liaison Officer

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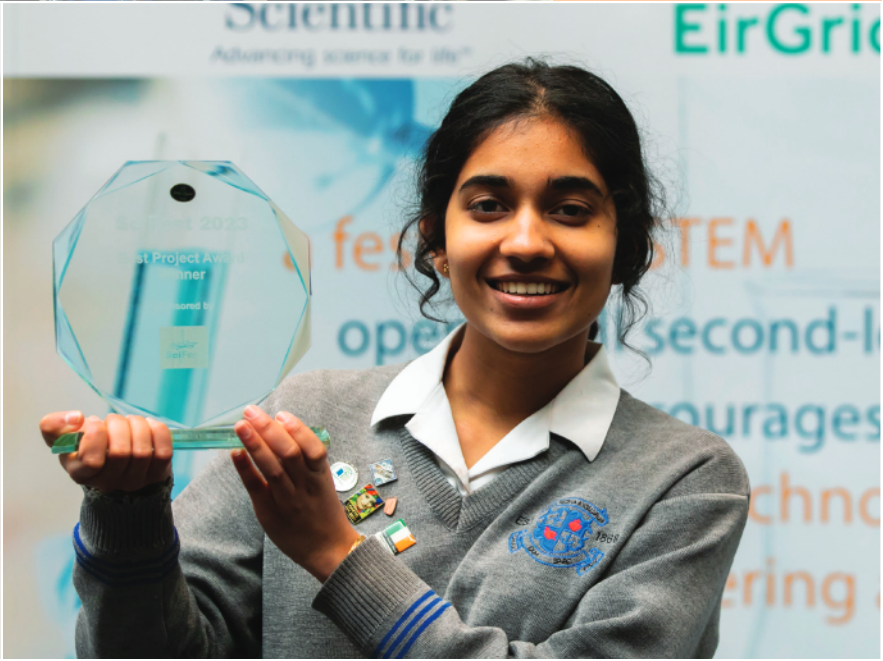
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