Little Book of
IRISH RESEARCH

CREATING OUR FUTURE

A National Conversation
on Research in Ireland

Contents

Little Book of IRISH RESEARCH

Tell us your idea for what researchers in Ireland should explore to create a better future

This was the request to the people of Ireland in 2021 - an invitation to consider how research can contribute to the creation of a better future for themselves and their communities.

Following **18,062** submissions from people of all ages, the Creating Our Future Expert Committee identified 16 main themes and made recommendations on how to deliver on them.

It's very clear that no single researcher, discipline or method of research can create the future we hope for. In this book, we present some of the latest activities in Irish research, from teams and individuals working around the country, on the coastline and sea, and in European and global collaborations. These research projects are highlighted, aligned to the 16 main themes identified by the Expert Committee.

Every day, we are making progress towards our shared future. We hope that research can contribute to making it a fairer and better one for everyone.

For more information visit

www.CreatingOurFuture.ie

16 Themes

Enhancing a Human Centred Approach to Health and Social Care

Reimagining Learning and Development across the Life Course

Advancing Solutions for Housing

Safeguarding Public Interest and Trust in the Digital World

Improving Policymaking and the Political System

Promoting Equality, Diversity, and Inclusion in Ireland

Fostering Regional Strengths

Valuing and Connecting Communities

Embedding Climate Action Across Society

Supporting Innovation in Farming and Food

Future-proofing Energy and Water Systems

Connecting Ireland through Green Transport Systems

Nurturing the Humanities, Culture, and the Arts

Harnessing the Benefits of Fundamental Research

Building Resilience and Preparedness: Insights from the Pandemic

Strengthening the Research Landscape and Public Engagement

CoPILOT AI

Forest and bush fires are part of some natural ecosystems, but can be very dangerous if they get out of control.

Climate change is expected to lead to more fires, so researchers at Maynooth University, with guidance from the Irish Air Corps, have been working to optimise firefighting from the air and on the ground. They're testing a Common Operational Picture platform to bring all the available data together – from satellites to drones, to sensors on the ground – giving firefighters the best information to stay safe and protect property, wildlife and people.

copilotai.ie

Embedding Climate
Action Across Society

8

Grain-4-Lab

What if we could reduce industrial waste and single-use plastic in one go?

Researchers at Dublin City University are pioneering a way of using waste products from breweries and distilleries to make a new compostable material to replace certain plastics. They're refining this new energy-efficient manufacturing to create eco-friendly petri dishes, flasks and other laboratory essentials.

Embedding Climate
Action Across Society

9

AI2Peat

About 20% of Ireland is covered in peatland, home to many plants and animals, and an important store of carbon.

This ancient landscape is benefitting from the latest technology as researchers from University College Dublin are developing applied artificial intelligence (AI) to monitor and help protect remote peatlands, and support Ireland's climate action goals. Drones, satellites, and citizen scientists will gather data for an all-Ireland mapping solution.

Embedding Climate Action Across Society

Farm Zero C

Dairy farms face a challenge in reducing their environmental footprint, but research is helping.

A project named Farm Zero C, led by BiOrbic and Carbery Group, is tackling greenhouse gas emissions by changing the plant mixes they use in their fields – to reduce the need for fertilisers and help cows produce less methane as they digest – while also using renewable energy and trapping carbon in soil. With approximately 5% of global greenhouse gas emissions coming from dairy systems, a climate-neutral, economically viable dairy farm could point the way to a much better future for the industry.

Supporting Innovation in Farming and Food

James Webb Space Telescope

The James Webb Space Telescope will look further back in time than any previous observatory.

Irish scientists from the Dublin Institute of Advanced Studies and Maynooth University are at the heart of the mission, working on the Mid-Infrared Instrument that captures light from the very first stars and galaxies, as well as looking for planets in other solar systems.

The launch of the telescope on 25 December 2021 was a tense moment for researchers from all over the world, particularly NASA, the European Space Agency and the Canadian Space Agency.

They got to see their telescope in space thanks to Irish cameras, built by Réaltra Space, who are also working on video telemetry for the next-generation Ariane 6 rocket and on electronics for future reusable launchers.

Harnessing the Benefits of Fundamental Research

The many virtues of
seaweed

Researchers at Trinity College Dublin are investigating seaweed from every angle. Using scientific scuba dives, laboratory and field experiments, they're working to grow seaweed for new treatments for arthritis patients, new sources of clean energy, and to test if seaweed can protect other sea life such as shellfish through expected changes in ocean chemistry.

The Beyond Biofuels project will involve modernising traditional seaweed growing and gathering while finding new ways to use it.

Future-proofing Energy and Water Systems

Fostering Regional Strengths

Mace Head Atmospheric Research Station

Facing out over the North Atlantic Ocean, the Mace Head Atmospheric Research Station often gets the weather first.

But as well as measuring wind speeds and observing weather at the edge of the island, Mace Head also records the natural and man-made gases appearing in small concentrations in the atmosphere.

As part of several international networks, the station measures a wide range of gases linked to ozone depletion and climate change, and has been measuring mercury levels consistently since 1995. Researchers can use the data to understand the composition of our atmosphere and the influence of pollutants around the world.

Future-proofing Energy and Water Systems

Dingle 2030

The Corca Dhuibhne / Dingle Peninsula 2030 initiative has empowered the community to prepare for a sustainable and low-carbon future.

With projects spanning energy, agriculture, marine, transport and tourism, the area has become a living laboratory to demonstrate how we could all live more sustainably in the decades to come. MaREI researchers based at University College Cork took a collaborative, engaged research approach to harness and support the Dingle Peninsula community on their sustainability journey, and to share the learnings nationally and internationally.

DINGLE

Self-Powering Devices

Did you ever rub a balloon on your hair to generate static electricity?

That's an example of the triboelectric effect, and the same phenomenon could power wearable devices in the future.

Researchers at Atlantic Technological University are among those looking at nano-scale manufacturing to create materials that will generate power from mechanical energy around them. So you could avoid charging your devices and instead wear them and power them up at the same time as light, flexible, soft, washable fabrics. The new materials offer great potential for the internet of things, once they are proven outside the laboratory.

Future-proofing Energy and Water Systems

Harnessing the Benefits of Fundamental Research

Listen to your microbes

No stool left unturned - lessons from minority microbiomes

Researchers at APC Microbiome Ireland study how personal microbes in the gut - collectively known as the microbiome - affect human health. When Fergus Shanahan and colleagues recently discovered that an ethnic minority – the Irish Travellers - have a non-industrialised microbiome, there were lessons for everyone. Non-industrialised microbiomes are associated with a reduced risk of chronic inflammatory disorders and lower rates of antimicrobial resistance. The microbiome of Irish Travellers challenge restrictive definitions of a healthy microbiome in a pluralistic society. This is of increasing importance for all minority groups, including migrants. Ethnic groups such as the Irish Travellers represent a human model for understanding how modern life affects the microbiome.

Enhancing a Human Centred Approach to Health and Social Care

Pain relief for the future

Arthritis in the knees affects around a quarter of a million people in Ireland and is very painful.

But relieving that pain can also involve undesirable side-effects.

Researchers in the University of Galway won a future innovator prize in 2018 for their approach to pain relief using hydrogels, which they are now implementing as a start-up company. By engaging with patients, they have identified the biggest problems knee osteoarthritis causes and hope their product, RM010, will help improve quality of life for millions worldwide.

Enhancing a Human Centred Approach to Health and Social Care

The real lives of women as they age

What is the experience of living and ageing in Ireland?

Researchers from the University of Galway worked with Age & Opportunity to investigate representations of older people, particularly women.

Through workshops and life writing, women described their experiences throughout life and, particularly, of ageing. The work created an opportunity to challenge the stereotypical representations of women over 50 and standard narratives of either people in decline or of older, wealthier consumers. The results were shared with researchers, cultural stakeholders and the general public through the Bealtaine Festival.

Nurturing the Humanities, Culture, and the Arts

Promoting Equality, Diversity, and Inclusion in Ireland

Electrifying your taxi trips

Electrifying an entire taxi fleet could help reduce carbon dioxide emissions.
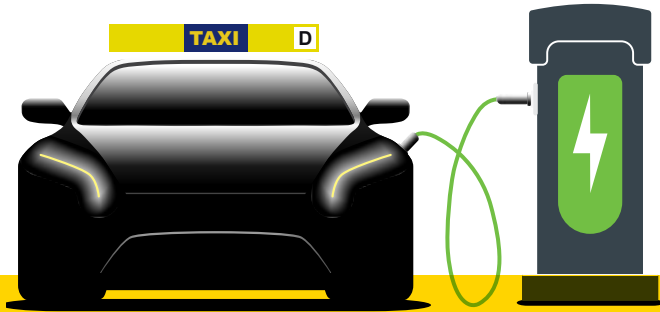
So what are the obstacles?

Researchers from Trinity College Dublin and their collaborators in the UK and Sweden used a data modelling programme to calculate CO_2 emissions on Dublin's FREENOW taxi fleet. If the company switched to electric vehicles only, they could reduce CO_2 emissions by over 77%. But the cars would need charging points, and larger vehicles need heavier batteries.

While the Government of Ireland is investing €100 million into improving the charging infrastructure, researchers at Trinity College Dublin, University of Limerick, and University College Dublin are working in parallel on advancing materials for lighter and better-performing batteries. These new-generation batteries can charge and discharge even under high temperatures, resulting in lighter batteries, better vehicle performance and lower battery costs.

Connecting Ireland through Green Transport Systems

Hot in the City

Cities are often warmer than the countryside because of human activities – but understanding the exact interactions between the built and natural environments is not straightforward.

Researchers at University College Dublin and Dublin City University have been examining the data available about conditions outdoors in cities to help architects and urban planners to make these areas more comfortable to live in and less energy-hungry. They highlighted the need for urban development studies to consider the impact of age and gender in an individual's response to heat, and for advanced simulation models to include these human and environmental factors that affect how hot it feels in towns and cities.

Fostering Regional Strengths

Embedding Climate Action Across Society

Developing new uses for Irish Wool

In recent years, Irish farmers have been dramatically affected by a drop in global prices for wool.

Since sheep must be shorn, researchers and farmers have been working together to find other uses for the wool. Possibilities include using it as a natural soil fertiliser (since wool contains carbon, phosphorus and nitrogen), as home insulation, and as a source of keratin for a range of products. The Circular Bioeconomy Cluster South West at Munster Technological University is providing research, development and innovation support for new ways of working with wool.
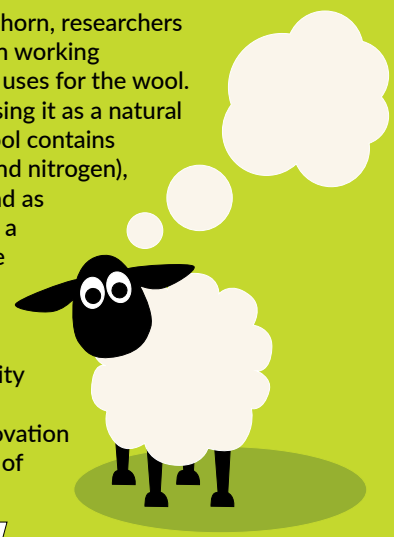
Supporting Innovation in Farming and Food

BIOmarkers to diagnose Pneumonia

A group of researchers from University College Dublin, Mzuzu University, Queen's University Belfast, and the Malawi Ministry of Health are working on identifying new biomarkers to diagnose pneumonia – the number one infectious killer among children under the age of five - more than HIV, tuberculosis, Zika, Ebola and malaria combined.

The project, BIOmarkers TO diagnose PnEumonia 2, follows on from the original BIOTOPE project, funded by the Gates Foundation.

It focuses on the management of childhood pneumonia in Sub-Saharan Africa. BIOTOPE uses an existing database and biobank with cellular networks and smartphone technology to develop models for understanding the severity of pneumonia cases using machine learning. It also develops inexpensive point-of-care tests to reduce the overprescription of antibiotics that can lead to antimicrobial resistance. BIOTOPE will aid clinicians not just working in Malawi and in other developing countries, but also with those working in high-income countries where antibiotic resistance is a growing problem.

Enhancing a Human Centred Approach to Health and Social Care

Robots supporting our health

Ireland's beautiful landscape can sometimes get in the way of delivering healthcare.

People living in remote areas may find themselves travelling regularly for treatment or to collect medicine.

But new technology is helping. Drones and robots combined with high-speed audio and visual connections with doctors and nurses can help patients receive advice and treatment wherever they are.

'Madra' the robotic delivery dog is among the innovations, scrambling over rocks in Clare Island to show its abilities to deliver packages of medicine. Robots are also being used in University Hospital Galway to remind people to clean their hands and also are being used to deliver healthcare information at clinics to improve patients knowledge of chronic disease management. Additionally, robots are taking the role of pets in long-term care facilities, helping to improve the daily lives of people living with dementia. Researchers in the School of Nursing & Midwifery at the University of Galway are working on strategies for the best implementation of robot pets as part of routine care.

Valuing and Connecting Communities

Enhancing a Human Centred Approach to Health and Social Care
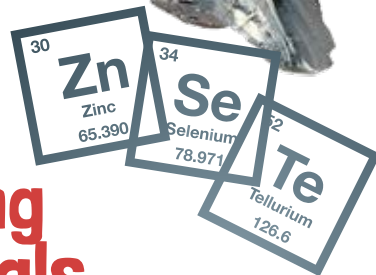
Recycling our metals

To reduce mining and increase recycling, we need to find more ways of reusing metals – particularly the rare and precious ones.

Metals like zinc, germanium and gallium are sought after for superconductors, optical fibres and even medicines. Researchers from the University of Galway have tested different techniques of biohydrometallurgy for recovering the metals from the residues of zinc refineries and other industrial waste. They found that elements such as selenium and tellurium can be used to draw gallium and zinc from a wastewater mix at normal temperatures and atmospheric pressure, whereas, geranium extraction is challenging and may need more traditional and energy-hungry metallurgical techniques.

30 Zn Zinc 65.390
34 Se Selenium 78.971
52 Te Tellurium 126.6

Harnessing the Benefits of Fundamental Research

Groundwater flooding

Flooding can be destructive and dangerous – whether it comes from the ocean, our rivers, or even the ground beneath our feet. Environmental engineers at Trinity College Dublin are studying the karst limestone bedrock in areas like the Gort Lowlands in Co. Galway, which usually channels water away quickly through its many cracks and fissures, but when too much water arrives at once following heavy rainfall events, it can't drain away quick enough. Some of this water appears at the surface as intermittent lakes known as turloughs, but can also spread across a larger area, disrupting normal life.
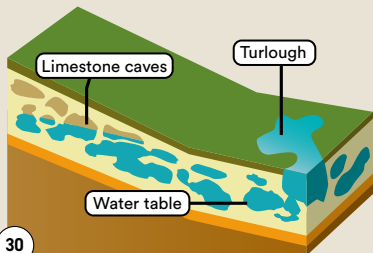
As climate change threatens more flooding, researchers are studying rainfall patterns, the underground water systems and our wetlands to make sure we plan carefully for the future.

Limestone caves

Turlough

Water table

Future-proofing Energy and Water Systems

Rides around Dublin

Electric bikes can provide an effective alternative to cars and encourage active transport, helping Ireland reduce its carbon emissions.

But they are very expensive and come in a variety of models and sizes, such as e-cargo and e-long tails bikes. University College Dublin's School of Architecture Planning and Environmental Policy is piloting bike libraries in schools to give families the opportunity to borrow and trial these different types of bikes to promote a shift towards active mobility, and increase public use of active transport to reduce the 59% of city journeys still made by car.

BIKE LIBRARY

Connecting Ireland through Green Transport Systems

Embedding Climate Action Across Society

Sharing coastlines with wildlife

Cities on seafronts and oceanfronts are attractive for large numbers of people - but what happens when rocky coastline is replaced with concrete?

Researchers are examining what materials and textures are most supportive of marine wildlife if artificial structures dominate the shoreline. These structures need to provide the same or similar shade, moisture, and refuge from predators that natural environments have done for thousands of years. Materials with lower pH and reduced carbon footprint compared to traditional concrete were shown to have a positive effect on early colonisation by barnacles and important microscopic algae.

Fostering Regional Strengths

Advancing Solutions for Housing

Feeling at home in the Irish language

To whom does the Irish language belong?

A cross-border research project led by Dublin City University and Turas in East Belfast brought together a network of experts involved in minority language use and in the Irish language's place in law. The research found that supporting the needs and political rights of Irish speakers sometimes created a tension with the need for Irish to be de-politicised to allow for broader engagement and inclusion. If the Irish language is to continue as a living, inclusive language, it needs cross-community ownership.

Promoting Equality, Diversity, and Inclusion in Ireland

Monitoring the health of our lakes

The European Water Framework Directive is designed to ensure the quality of water – for human users and for the wildlife that depends on rivers, lakes, and groundwater.

Finding the best ways to monitor the many small lakes and rivers of Ireland is a challenge. Researchers from Trinity College Dublin have used microalgae known as diatoms as indicators of the condition of lakes and prevalence of certain pollutants. They also showed that an index of diatoms used to monitor UK lakes could also be transferred to Ireland. Meanwhile, researchers from Dublin City University have been examining how much water still needs to be monitored and whether it could be possible for local citizen scientists to collect the data. Although volunteers from the general public would be able to do the work, they would still need some training and funding, and projects to collect samples on a long-term basis would also need to take account of evolving needs and changes in availability of the citizen scientists and supervisors.

Strengthening the Research Landscape and Public Engagement

Future-proofing Energy and Water Systems

Improving Ireland's housing

Researchers led by Professor Lisa Ryan at University College Dublin showed that landlords may be less inclined to make properties energy efficient when their tenants pay the heating bills.

Tenants may choose a good location ahead of an energy-efficient home, but policy could help incentivise landlords and tenants to use less energy.

How can we balance property as an investment with the need for people to have homes? Professor Michelle Norris at University College Dublin is one of an international group advising the United Nations on housing and policy to help support affordable housing provision and a climate-neutral future.

Dr Rory Hearne in Maynooth University highlights that researchers use the European Typology of Homelessness and housing exclusion, or ETHOS, to measure not just homelessness, but housing exclusion and insecurity. Housing policy needs to include not only those who lack shelter, but all those in 'hidden homelessness' and whose housing situation is unstable or inadequate –such as those in domestic violence refuges, 'couchsurfing' with relatives or friends, in overcrowding, or at risk of eviction.

Advancing Solutions for Housing

Healthy pregnancy

Pre-eclampsia is a serious complication in pregnancy and warning signs can be difficult to spot.

Helping to categorise whether a pregnant woman is at a low, medium or high risk of developing pre-eclampsia will help in their diagnosis and continuing care. That's the goal of AI_PREMie, a tool that combines biomedical and clinical expertise with machine learning to assist clinical decision making and reduce the number of serious complications linked to pre-eclampsia.

Enhancing a Human Centred Approach to Health and Social Care

FINTECHNEXT

Technology has transformed the financial world – from online and contactless payments to the advent of digital currency.

Researchers such as those at FINTECHNEXT coordinated by University College Cork are anticipating the next steps in financial technology – or fintech – such as reducing costs on foreign exchange transactions and preparing for the low-carbon economy.

A healthy data ecosystem

Our lifestyles depend increasingly on smooth and secure flows of data around the EU and beyond.

Researchers across disciplines in computer science, data analytics, neurology and health sciences, and software are collaborating to explore the requirements and impacts of data platforms, data governance, and ecosystems of the future.

The Empower programme will work to help citizens, the Government, and industry maintain access to the best possible quality of data to inform decision making.
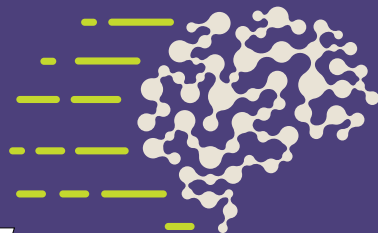
Next-generation medical devices

The SFI Research Centre for Medical Devices, Cúram, brings together researchers from around the country and works with industry to realise the medical devices of the future.

They work to improve patients' lives by enhancing drug-delivery systems, developing internal devices that can biodegrade safely over time, and finding ways of limiting the adverse effects of chemotherapy. Many people in Ireland and worldwide stand to benefit from their work on health challenges such as diabetes, cardiovascular disease, and chronic and acute respiratory diseases.
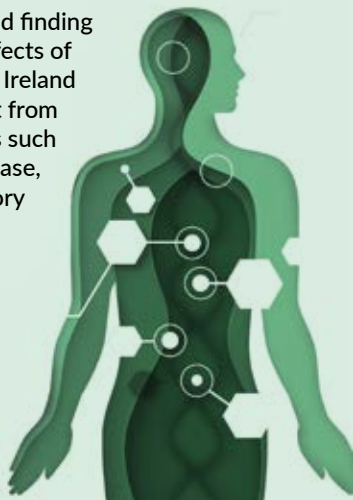
Enhancing a Human Centred Approach to Health and Social Care

Harnessing the Benefits of Fundamental Research

Most of our universe is missing

All the galaxies we can see – even with advanced observatories like the James Webb Space Telescope – only make up about 5% of the matter in the Universe.

The rest is thought to be composed of dark matter (25%) and dark energy (70%), which reflect no light but affect the distribution and movement of objects in the Universe. Maynooth University Professor Peter Coles is among those working on the European Space Agency's Euclid mission to study the large-scale structure of the Universe. Their goal is to reveal the nature of dark matter and dark energy.

Harnessing the Benefits of Fundamental Research

The right time for a vaccination

Most of us don't love needles, but appreciate the life-saving power of vaccinations.

Some studies have shown that people respond differently to vaccines such as the flu vaccine depending on the time of day they were given, but it wasn't immediately clear why. The ChronoVac project is working to find the answers – researchers have seen that certain immune cells in mice behaved differently depending on the time of day; they're now trying to figure out if it's the mitochondria within the cells that are causing this variability.

They think they could eventually provide an extra boost in immunity based on an optimal vaccination timing. And even better – researchers are working on painless microneedles for delivery!

Building Resilience and Preparedness: Insights from the Pandemic

Enhancing a Human Centred Approach to Health and Social Care

The genes behind flowers

Genetics researchers at Trinity College Dublin are working to understand which genes are active, and how, in flowering plants.

They've been studying the plant Arabidopsis thaliana, which is a member of the mustard family related to cabbage and radishes.

They are exploring the mysteries of flowering using DNA sequencing and figuring out which genes are active in the regulation of growth. Their research into the fundamental processes in plants will contribute to more sustainable agriculture in the future – for example, by identifying genes that code for characteristics that make crops more resistant to insect pests.
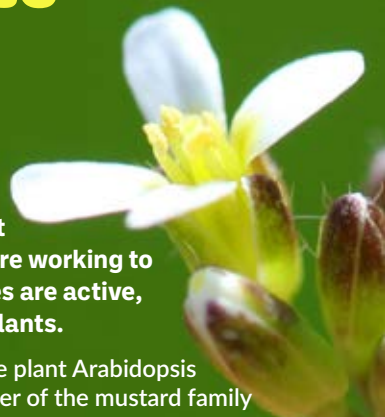
Harnessing the Benefits of Fundamental Research

Containing microplastics

Small fragments of plastic are escaping into the environment from a myriad of sources and don't biodegrade.

These 'microplastics' can then be ingested by small animals and get into the food chain. Researchers are working to find ways to capture microplastics – or to prevent their escape in the first place. A team from the AMBER SFI Centre for Advanced Materials and Bioengineering Research led by John Boland discovered that plain tap water – rather than purified water used in labs – was surprisingly helpful.

The small amount of copper ions in tap water that are picked up as it runs through pipes can help create a protective layer on plastics, something that the researchers are working on to develop a safe coating technology that reduces microplastic pollution.

Embedding Climate Action Across Society

Future-proofing Energy and Water Systems

The psychology of public health
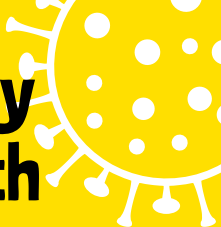
The sudden emergence of COVID-19 called on communities to work together to protect each other.

Researchers at the University of Limerick investigated how to make public health guidelines relevant and trustworthy across different groups of people, engaging with diverse groups.

Promoting Equality, Diversity, and Inclusion in Ireland

Building Resilience and Preparedness: Insights from the Pandemic

While solidarity was a significant driver of COVID-19 messaging, the researchers found that diverse solidarity was important – inclusive language about 'us', 'we', 'our community'. Visual examples should include an ethnic mix so that minority group members feel included; these groups then reported greater adherence to public health measures. Vaccine uptake internationally was directly linked to trust in governments, science and healthcare.

Neosepsis: Reducing deaths from sepsis

Sepsis accounts for 20-25% of all neonatal and maternal deaths in Uganda every year.

As many as 6,500 babies die every year from sepsis in Uganda. Researchers from Maynooth University and Makerere University, Uganda, along with collaborators from the Irish Neonatal Health Alliance, are investigating how NeoSep-SAA, an easy-to-use 15-minute test developed by Accuplex Diagnostics, can help to better diagnose sepsis in environments with limited healthcare resources.

The test requires just a single drop of blood, obtained through a simple heel prick. The NEOSEPSIS consortium, spanning biology, business, medical and technological expertise, secured funding from Science Foundation Ireland and Irish Aid. Initial clinical evaluations have yielded positive results in Uganda and could usher in a future of improved sepsis diagnosis and healthcare access.

Enhancing a Human Centred Approach to Health and Social Care

Finding the true cost of domestic violence

It is a terrible statistic that one in three women globally will suffer domestic violence.

The impacts on individuals and families are far-reaching, but sometimes not enough by themselves to encourage legislators and the judiciary to take action. Researchers from the University of Galway worked with partner researchers in developing countries to demonstrate that domestic violence also affects homes economically and can negatively affect the national economy.

The impacts include women needing to pay for healthcare, and needing time away from work, as well as replacing broken or damaged property. The research has prompted governments in four countries to change their services or introduce new services to support and protect survivors of domestic violence.

Improving Policymaking and the Political System
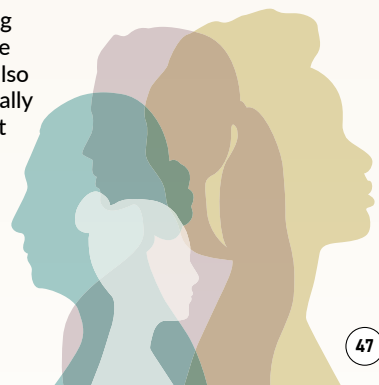
Lifelogging
for health and well-being

If a picture is worth a thousand words, what might a thousand pictures be worth?

Researcher Dr Cathal Gurrin has been a pioneer of lifelogging, taking photographs of what's in front of him every 20 seconds for a decade.

Cheaper computer memory and better AI processing means that large datasets like these will lead to personal assessments for improvements in personalised healthcare and education. For example, understanding how your diet and activity are leading to raised blood glucose levels, or how vulnerable people might avoid risks as diverse as accidents in the home or even support them to live independently for longer. He even sees new models of data-driven education on the horizon in which we will all have personalised textbooks and learning strategies.

Enhancing a Human Centred Approach to Health and Social Care

Engineering the metaverse

The metaverse is a general term for an immersive online world using virtual reality and augmented reality, where humans are represented by avatars.

Many of the current projected uses are for online entertainment and enhancing live entertainment. But the metaverse offers more opportunities for bringing together remote parties – whether that's for telemedicine, tele-education or teleworking.

To function well with high-quality visualisation, the metaverse needs fast connections.

Reimagining Learning and Development across the Life Course

Harnessing the Benefits of Fundamental Research

Researchers at University College Dublin are exploring the best ways to make those connections to save bandwidth and keep data moving quickly. They've proposed and modelled system architectures using edge computing – bringing processing and data storage physically closer to the user – to operate faster, securely, privately, and more effectively than cloud-based computing.
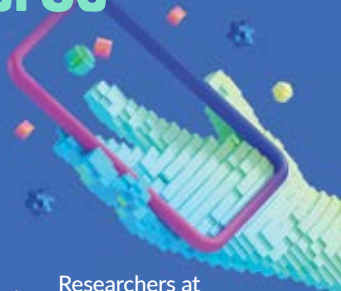
Zooming in: unveiling the invisible

To be able to study tiny objects like cells, crystals, and atoms, Ireland hosts world-class microscopy facilities such as the Advanced Microscopy Laboratory at CRANN, Trinity College Dublin. AMBER, the SFI Centre for Advanced Materials and BioEngineering Research, uses electron microscopes to image material surfaces and structures at atomic scale resolutions. At the Bernal Institute at the University of Limerick, a confocal microscope is available for high-resolution deep tissue imaging.

Microscopists use their knowledge and skill to contribute to research across areas as diverse as fundamental physics and climate change. For example, imaging and manipulating atoms is essential to help develop quantum computing systems.

Strengthening the Research Landscape and Public Engagement

The mathematics of coffee

Researchers at the Mathematics Applications Consortium for Science and Industry – or MACSI – at the Department of Mathematics & Statistics of the University of Limerick, specialise in mathematical and statistical modelling that helps to describe the world around us.

Their work helps explain behaviour in complex systems and they were instrumental in preparing modelling of the spread of the SARS-CoV-2 virus during the COVID-19 pandemic. They also apply their skills to surprisingly everyday activities – they can reveal the most successful fantasy football strategies based on millions of public webpages, and provide equations that predict how good a cup of coffee will be based on the water, coffee grounds, and brewing settings used.

Building Resilience and Preparedness: Insights from the Pandemic

Harnessing the Benefits of Fundamental Research

Fish where the fish are

Ireland has a billion-euro seafood industry and fish is an important part of many people's diets.

Fishing sustainably, and in line with European Union law, takes time and effort.

Researchers on the IFISH project are working with trawler operators and the fishing industry as a whole to collect and share information to help trawlers avoid unwanted catches including non-target species, small fish or quota-limited species.

The project aims to add real-time information to maps of historic catch patterns already available.

Supporting Innovation in Farming and Food

Fostering Regional Strengths

Year-round water management

We can all see and feel rain as it's falling, but some effects of heavy rainfall are only felt days later - for example, when flooding reaches its crest downriver.

Understanding and planning for our rainfall patterns is important for ensuring our water supplies in times of drought, and for protecting property from flooding after rainy days. Researchers at Maynooth University are looking at rainfall records and modelling techniques from around the world to evaluate the possibilities of better forecasts by season through all of our freshwater systems.

Future-proofing Energy and Water Systems

Our creative relationship with research

While working to improve our world, researchers also want to connect with a wider audience about how we experience science and the world around us.

Recent projects have brought researchers and artists together to explore questions about our environment and its future – resulting in books like 'Earth Writings' that started in Maynooth University, and The Changing Planet programme of diverse art conducted by the iCRAG SFI Research Centre in Applied Geosciences.

Strengthening the Research Landscape and Public Engagement

Nurturing the Humanities, Culture, and the Arts

Quick thinking for computers

Prof. Damien Thompson at the SSPC SFI Research Centre for Pharmaceuticals, at the Bernal Institute, University of Limerick, is part of an international effort to unlock ultra-fast decision-making for computers.

The team synthesised a 77-atom, metal-organic molecule that could serve as a new fundamental electronic circuit element, inspired by the brain's computing architecture. The material could help make computers smaller, faster and more energy efficient, opening up more ways to integrate artificial intelligence into everyday life.

Harnessing the Benefits of Fundamental Research

Working together to protect the planet

Bringing science, our communities, our policymakers and the media together for meaningful dialogue on climate change is a challenge, and can be an obstacle to climate action.

Researcher Prof. Jane Suiter in Dublin City University is examining how knowledge from science communication, political psychology and deliberative democracy, where each individual can be heard, might be combined to find ways to overcome climate inaction.

Improving Policymaking and the Political System

Embedding Climate Action Across Society

New ways of treating cancer

One in two people in Ireland will be diagnosed with cancer at some point in their lifetime.

Researchers such as those at University College Dublin are harnessing the power of big data and computational approaches to take new treatments from the laboratory to the patient as quickly as possible. Initiatives such as Precision Oncology Ireland, which works on diagnostics and personalised cancer treatment, and the All-Island Cancer Research Institute, are bringing researchers together to advance science and medicine. They are working particularly to help identify cancers early, when they are at their most treatable.

Enhancing a Human Centred Approach to Health and Social Care

Powering your life

Do you ever wonder how much energy goes into your daily life?

Researchers at University College Dublin worked through data covering everything from the electricity and heat used in our homes and workplaces, to how we travel around, to the energy used to make and transport the things we buy. They found that an average Irish person uses about 70 megawatt-hours per year (equivalent to the electricity needed for about 100,000 loads of washing in your machine). More than 70% of the energy we each use is not sold to us directly but is 'embedded' in the goods and services we buy, including our food.
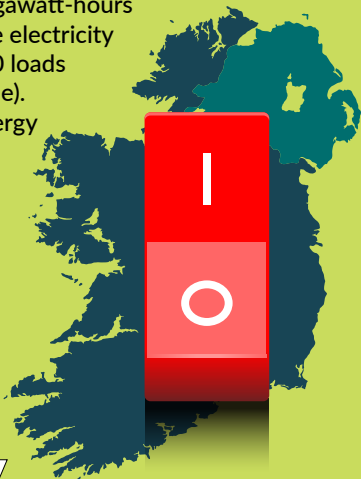
Future-proofing Energy and Water Systems

Embedding Climate Action Across Society

Keeping our online lives secure

Every day, we are generating more data and become more aware of its value and importance.

Cyber attacks that reveal sensitive data or hold organisations to ransom are a danger to organisations of every size.

Researchers from Munster Technological University are working to build Ireland's cyber resilience across different populations – for example, helping small and medium enterprises to be cyber safe and examining ways in which data needed for national activities such as farming can be protected.

Safeguarding Public Interest and Trust in the Digital World

Growing food in a changing climate

The Tracking Adaptation Progress in Agriculture and Food Security Using an AI-powered Satellite Remote Sensing Platform – TAPAS – is a response from researchers at the University of Galway to the pressures put on food production in a changing climate.

Failing harvests threaten individual health, as well as raising geopolitical tensions. The team uses artificial intelligence to measure changes in biomass production linked to climate change, using data from satellites. This helps to quantify climate stress and identify the regions most in need of intervention.
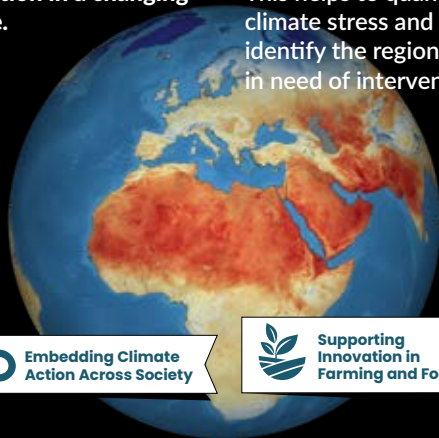
Embedding Climate Action Across Society

Supporting Innovation in Farming and Food

Leaf no waste

How do you tackle the twin problems of food waste and packaging waste?

In Ireland alone, we generate an estimated 61kg of plastic waste each year per person, and as a nation we throw away about one million tonnes of food annually.

Researchers at Technological University Dublinand Teagasc joined forces to grow and package spinach more sustainably. They explored how to treat spinach plants to reduce respiration after harvest – which can accelerate spoiling. Simultaneously, they are working to find the most suitable alternative packaging to keep the spinach at its best before it's eaten. This research continues to examine methods to optimise sustainability from farm to fork for a broad range of Irish fresh produce.

Embedding Climate Action Across Society

Supporting Innovation in Farming and Food

Improving life for people with epilepsy

Epilepsy is one of the most common neurological conditions in the world today.

More than 45,000 people in Ireland are among 50 million people living with epilepsy. Even so, diagnosing epilepsy can be difficult, with multiple electroencephalogram (also known as EEG) recordings needed. Researchers at the FutureNeuro, The SFI Research Centre for Chronic and Rare Neurological Diseases, based at RCSI University of Medicine and Health Sciences, are working on improving diagnosis and treatment. Potential new treatments for epilepsy, as well as biomarkers that can be used for diagnosis, may be linked to chemicals cells use to communicate with each other.

Another study has used patients' genetic make-up to create an an epilepsy-specific electronic patient record. Clinicians can use this information to learn more about the genetic origins of epilepsy and to develop tailored treatments. The module facilitates multidisciplinary discussions among experts, including geneticists, clinicians, and bioinformaticians, to pinpoint genetic causes for patients' epilepsy.

Enhancing a Human Centred Approach to Health and Social Care

Combatting obesity-related cancer

Ireland is projected to become the most obese country in Europe this decade, and obesity brings with it increased risk of disease.

Up to 40% of certain cancers are now due to obesity, and researchers here are trying to break that link. At the RCSI University of Medicine and Health Sciences, researchers are examining the link between obesity and oesophageal cancer, which is one of the most deadly. They're trying to find out if a particular protein is missing and allowing fat cells to help tumours to grow. In Trinity College Dublin, researchers are examining how the body's immune system can be compromised by obesity – particularly a reduction in Natural Killer cells that would normally find and kill cancer cells.

Enhancing a Human Centred Approach to Health and Social Care

Stroke prediction and rehabilitation models

Stroke is one of the leading causes of death globally.

In Europe, healthcare for stroke patients in 2017 alone cost an estimated at €27 billion - not counting the loss of productivity and the human cost of premature deaths.

As part of the PRECISE4Q project, researchers from ADAPT, the SFI Research Centre for AI-Driven Digital Content Technology, have developed a new AI-driven prediction model that helps identify people under 60 years of age who are at high risk for stroke, but may not be identified using a traditional stroke risk prediction model. While increasing age is an important factor in stroke risk, the research uses age groups to weight the model more carefully for other factors such as sex and co-morbidities. Since people can't do anything to change their age, the model offers help in addressing other factors that might reduce stroke risk for individuals, and helps medical professionals in advising and treating patients at the highest risk of stroke.

There's also innovation for patients going through stroke rehabilitation. Researchers at University College Dublin are investigating how to expand rehabilitation options using eXtended Reality (XR) platforms.

They are achieving this by translating neuroplasticity paradigms to rewire the brains of patients. The STROHAB project aims to supply survivors with a technology that works in tandem with conventional rehabilitation techniques and supplement patients with additional physical therapy needs with an XR-powered medical device. To achieve this, the team focuses on a user-centric approach with patient engagement in hospitals and the Irish Heart Foundation.

The intended vision is that patients will be enabled by digital transformation to actively participate in their rehabilitation journey beyond the grounds of the hospital, while being remotely monitored by healthcare staff using a secure AI-based platform. To this end, the team at STROHAB will create value for medical professionals in Dublin to leverage data to enhance the lives of stroke survivors.

Enhancing a Human Centred Approach to Health and Social Care

Our wildlife at sea

Ireland's waters extend to 10 times the area of our landmass, and there's a lot of wildlife to monitor and protect there.

The ObSERVE programme combined aerial observations with acoustic monitoring, watching and listening to the wide variety of species living in or visiting the oceans around us. At least 24 species of cetacean (whales, dolphins and porpoises) have been recorded here, as well basking sharks, blue sharks, marine turtles and 52 different species of seabirds.

Most of these species are protected species under national, EU and international legislation. The follow-up ObSERVE II project, led by University College Cork, is conducting surveys to estimate and describe animal density, abundance, and distribution. This will be used to highlight areas of particular importance for conservation.

Harnessing the Benefits of Fundamental Research

Fostering Regional Strengths

Mapping the seafloor

With more than 3,000 kilometres of coastline, Ireland enjoys a wide variety of marine environments.

The Integrated Mapping for the Sustainable Development of Ireland's Marine Resource – or INFOMAR – programme has been surveying our unmapped marine territory since 2006. A joint programme between the Geological Survey Ireland and the Marine Institute, INFOMAR is creating a range of integrated mapping products of the physical and biological features of the seabed, as well as detailed maps of the coastline available to download.

An ocean environment on dry land

Munster Technological University hosts test facilities for equipment and for people who will ultimately need to withstand the challenges of the open seas.

The National Maritime College of Ireland (NMCI) has a survival pool where trainees can experience storm conditions simulated through fans, thunderstorms featuring light and sound, and nighttime rescues. At the LIR National Ocean Test Facility, equipment such as offshore energy devices and structures to be used at sea are tested in various depths of water with ocean-strength waves.

Discover Centres

It's never too early to become a researcher. Discover Centres all over Ireland cover topics from archaeology to zoology, with plenty of hands-on opportunities.

Reimagining Learning and Development across the Life Course

Strengthening the Research Landscape and Public Engagement

Discovering through play

From building and smashing sandcastles to going on imaginary adventures, we all know what it's like to play.

But how this play actually feeds into learning and development is still being studied. Researchers want to know how play in our education system helps to encourage young minds.

Equal opportunities to learn

Historically, education in Ireland was largely controlled by religious orders. Secondary education only became free to students in 1966.

How has education historically benefitted certain groups over others? University College Dublin researcher, Professor Judith Harford, is working to reveal inequalities in Irish society that act as barriers to education.

Her award-winning projects include widening participation in education for students from disadvantaged backgrounds and fostering gender equality at all levels of the education system, including in STEM. She works closely with a range of stakeholders, including policy makers and industry, in order to create a more equitable and inclusive education system.

Digital family literacy

Literacy has important effects on employment, health and civic engagement.

For many reasons, people in Ireland can reach adulthood with low literacy levels, but the National Adult Literacy Agency, NALA, is working to help improve their skills. The Digital Family Literacy project, led by researchers in Trinity College Dublin and funded by the Irish Research Council, explored how to use technology to help develop literacy among parents. Not only did the participants improve their digital literacy skills, they also reported improvements in their self-confidence and social connection with their peer groups.

Reimagining Learning and Development across the Life Course
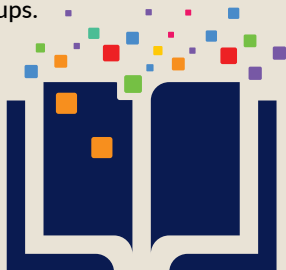
Evidence against e-cigarettes

The Health Research Board funded studies to find out how e-cigarettes affect people who are trying to give up smoking, and those who might be tempted to start.

The evidence points against the use of e-cigarettes, showing that young people who tried e-cigarettes were three to five times more likely to take up smoking.

For older people trying to give up smoking tobacco, there were no signs that e-cigarettes were any better than other replacements for nicotine.

The long-term safety of e-cigarettes is not yet well understood since consumers have been using them for a relatively short time, but the acute effects include poisonings, burns, blast injuries, lung injury and asthmatic attacks.

Improving Policymaking and the Political System

Enhancing a Human Centred Approach to Health and Social Care

Water fluoridation

Fluoride helps to protect teeth, and for this reason, has been added to water supplies in Ireland since 1964.

As part of the process set down by law, the Health Research Board regularly reviews fluoridation to assess any impacts on health outside of preventing cavities. The study found no significant health impacts relating to bone health or cancer, which were areas of particular interest, and recommended ongoing high-quality research into possible neuropsychological and endocrine outcomes.

The World Health Organization recommended the review to other countries considering community water fluoridation.

Future-proofing Energy and Water Systems

Improving Policymaking and the Political System
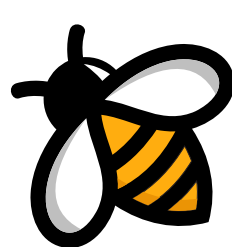
Wild honeybees back from the brink

In recent years, we've been reminded regularly to protect the pollinators.

The wild honeybee Apis mellifera was thought to have gone extinct in Ireland through a combination of a destructive parasitic mite and hybridisation with other species. However, the bee was discovered to have survived with colonies living in roof, wall and tree cavities, both in towns and in the countryside. Researchers from the Galway Honey Bee Research Centre (GHBRC) at the University of Galway are among those working to find out how these bees survived and how to protect them in the future. For more information please visit www.galwayhbrc.com/otb

Improving Policymaking and the Political System

Embedding Climate Action Across Society

Invasive alien species

Ireland's native biodiversity can be threatened by plants and animals from overseas.

Some of these are introduced by accident, while others may have started out being introduced to a garden, park or pond, or as an exotic pet.

Once in the wild, these species can compete for resources, or introduce new diseases, making life harder for our native species. Researchers in Ireland work with peers around the world to find ways to minimize spread and impact of invasive alien species, while all of us can play our part by keeping our pets well controlled, reporting escapes, and taking actions to reduce our risk of introducing and spreading invasive alien species.

Strengthening the Research Landscape and Public Engagement

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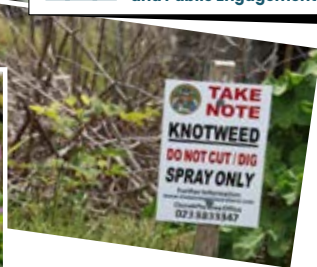
Capturing heat from data centres

Ireland is home to dozens of data centres belonging to companies around the world providing everything from streaming services to shopping.

Between them, these data centres use a comparable amount of electricity to all the homes in Ireland, which means we need to find a way of making them more sustainable.

One idea is to use the heat generated by the processors in the data centres and convert it to useful energy for other purposes. Researchers are examining the technical possibilities, while also exploring the policies needed to ensure that the global need for online speed does not over-exploit Ireland's resources.

Embedding Climate Action Across Society
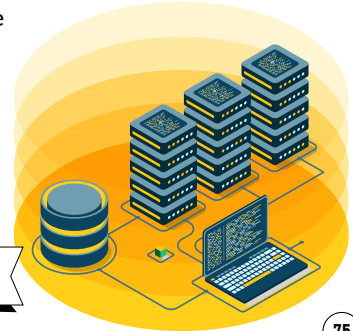
Motor neuron disease
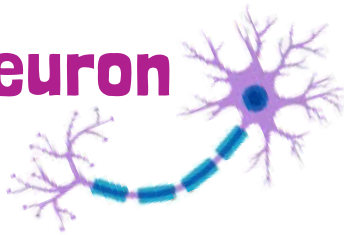
Motor neuron disease, or MND, causes motor neurons – the nerve cells responsible for controlling our muscles – to stop working.

It is a rare condition, but around 150 people in Ireland are diagnosed with MND each year. Amyotrophic Lateral Sclerosis (ALS) is a specific type and the most common form of motor neuron disease, often referred to as Lou Gehrig's disease.

Professor Orla Hardiman is a world authority on MND and continues to treat patients alongside research work with groups at Trinity College Dublin, Royal College of Surgeons in Ireland, and FutureNeuro, The SFI Research Centre for Chronic and Rare Neurological Diseases.

They have made several significant discoveries including genes that may indicate susceptibility to motor neuron disease, electrical activity in the brain linked to different forms of ALS, and biological links between schizophrenia and ALS. While there are no cures for motor neuron disease, researchers hope that in the future, there could be therapies that would help people to slow the progression of the disease and make it a chronic, rather than a fatal, condition.
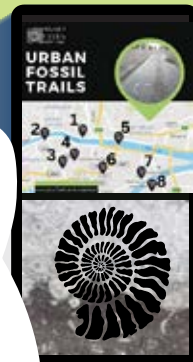
Enhancing a Human Centred Approach to Health and Social Care

Older than dinosaurs

Life from hundreds of millions of years ago is recorded in rocks all around Ireland.

The rocks of Ireland include limestones, sandstones and siltstones that preserve the fossilised remains of ancient plants and animals that lived here millions of years before humans.

Some of these fossils are globally important, such as the Valentia Tetrapod Trackway (Co. Kerry), the oldest land plant Cooksonia (Co. Tipperary) and the earliest fossil forests (Co. Wexford). We can find fossils in rocks along the Irish coastline, on mountains, and even embedded in stone used for footpaths, walls and buildings. University College Cork palaeontologists have created maps and fossil trails to help you find your local fossils and imagine the environment on Earth half a billion years ago.

Strengthening the Research Landscape and Public Engagement

Smart cities

In the future, our cities will be more sustainable and easier to live in.

The Academy of the Near Future is helping students prepare for, and with, the city of Dublin for the changes and improvements to come, while the ADVANCE Centre for Research Training is preparing the next generation of researchers who will work in a hyperconnected world.

Connecting Ireland through Green Transport Systems

Advancing Solutions for Housing

Citizen centric: real-time communication with the city administration and access to city services

Sensors for air quality, traffic monitoring, temperature, emergency services

5G/6G networks for faster communication

RENEWABLE ENERGY

Bike lanes and bike stations

Self-driving e-buses or trains and electric vehicle charging stations

Green spaces with smart irrigation systems

Smart streetlights that adjust brightness

Dogs and AI working together to predict seizures

Dogs can predict epileptic seizures in their owners. They can smell warning chemicals produced by the human body. Sensors and AI can convert that prediction into action.

Professor Alan Smeaton and the team at Insight SFI Research Centre for Data Analytics use wearable sensors on dogs to convert predictive behaviour into real time reporting. The technique uses Machine Learning and AI to interpret data produced by a dog's physical reactions.

If the dog has been trained to respond by spinning around, for example, that movement can be 'read' by a collar sensor and reported directly to the owner or carer via another device.

Harnessing the Benefits of Fundamental Research

Protecting human rights for mental health patients

People experiencing poor mental health may find themselves in situations where their human rights such as the right to liberty, the right to protection of property, and the prohibition of discrimination, are under threat.

By talking to mental health patients, their families, and carers, and examining the law in Ireland, researcher Darius Whelan and colleagues in University College Cork produced a toolkit to help people understand and assert their rights. It can be found on the Mental Health Reform website.

Improving Policymaking and the Political System

A sea of numbers

The rolling waves of Galway Bay combine forces from the tides, from wind, from the depth of the water, and even from the rotation of the Earth.

Capturing all of the different influences on the currents of the bay is complicated, but can be rendered mathematically to help inform decisions for industries such as fishing and fish-farming, and for potential flooding in Galway City. Researchers from the Marine Institute and University College Dublin have worked to model the behaviour of the currents in the bay, and show how larger waves in stormy weather can disrupt them.

Based on the Aran Islands, the University College Dublin HIGHWAVE project applies fluid dynamics to study the physical mechanisms underlying destructive breaking waves on the ocean's surface and develop accurate wave models. Such models could help improve criteria for the design of ships and coastal and offshore infrastructures, help to quantify seabed erosion, and help to quantify air-sea CO_2 transfer, which is key to predicting future climate.

University College Dublin have operated their research station on Inis Meáin since early 2019, capturing never-before-seen real-time data on breaking ocean waves and maritime climate conditions that has far-reaching potential for impact in multiple sectors including maritime communications.

Harnessing the Benefits of Fundamental Research

Future-proofing Energy and Water Systems

EIRSAT–1

Irish technology and software are regularly flown in space, but researchers and students at University College Dublin have built the first spacecraft to be wholly developed here. Part of the European Space Agency's Fly Your Satellite! educational programme, EIRSAT-1 carries a gamma-ray detector to spot bursts of high energy radiation from the cosmos and a magnetic attitude control testbed for improved pointing capability. As well as the experiments that have been designed, built, tested and qualified for spaceflight, EIRSAT-1 carries a poem co-created by University College Dublin writers and secondary school pupils across Ireland.

Harnessing the Benefits of Fundamental Research

Supporting careers with STEM

Jobs requiring skills in science, technology, engineering and maths (STEM) are on the increase, and most jobs incorporate digital skills. How do we make sure everyone has a fair opportunity to learn these skills?

The STEM Passport for Inclusion is a project from Maynooth University that helps girls who are socioeconomically disadvantaged to connect with STEM careers. The project has devised STEM training and mentoring programmes and facilitates access to opportunities, allowing students in Transition Year who might not otherwise be able to study the subjects to explore a future in STEM.

Promoting Equality, Diversity, and Inclusion in Ireland

Reimagining Learning and Development across the Life Course
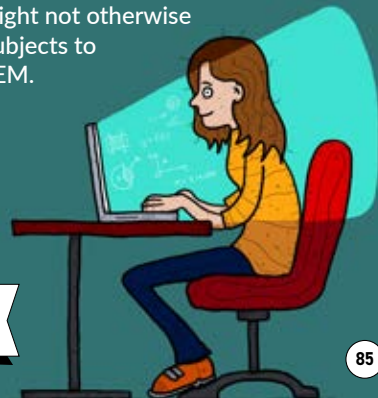
Food for the future

We eat protein to help our bodies to grow and repair themselves properly.

As the world population increases, we need to identify sustainable sources of protein to manage our health and that of our planet. Researchers from around the island of Ireland have joined forces in the five-year Protein-I project to investigate plant-based proteins and their use to secure food supply in Ireland. Our future food will need to be attractive to consumers, as well as protecting the planet and supporting rural economies.

Supporting Innovation in Farming and Food

ÉireComposites

Lightweight, strong and flexible materials are needed for all sorts of industries from sports equipment to spacecraft.

ÉireComposites grew out of the University of Galway and operates in the Gaeltacht at Inverin. The company is working alongside researchers at the MaREI SFI Research Centre for Energy, Climate and Marine to develop composite materials particularly suitable for renewable energy from offshore wind turbines and tidal energy.

Harnessing the Benefits of Fundamental Research

Future-proofing Energy and Water Systems

Wastewater monitoring for viruses

Ireland's researchers responded rapidly when the SARS-CoV-2 virus that causes COVID-19 arrived on our shores.

One way to monitor the prevalence of the virus was through wastewater – infected people shed the virus in their faeces. It was particularly important for the monitoring systems to be consistent all over the island of Ireland. Researchers from University College Dublin and Queen's University Belfast brought together talent from different disciplines to keep track of the virus in wastewater systems and help give early warnings when infections were on the rise.

Building Resilience and Preparedness: Insights from the Pandemic

Avoiding Food waste
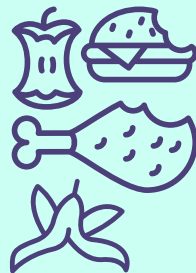
Food waste is a significant contributor to food shortages, water stress, biodiversity loss and greenhouse gas emissions.

Ireland has committed to reducing food waste by 50% by 2030, but there's more to the science of food loss and food waste than just clearing your plate.

Researchers at Munster Technological University and University College Dublin supported the Environmental Protection Agency and the Department of the Environment, Climate and Communications in informing the National Food Waste Prevention Roadmap. Consideration was given to food that is lost during production, to food that is harvested, but ultimately not consumed. The roadmap details that prevention of food waste is the best approach, but that re-use of food for animals, or incineration are preferable to food going to landfill. Researchers from Technowct individual household waste to help plan for the future.

Supporting Innovation in Farming and Food

Embedding Climate Action Across Society

Scalable graphene

is a special material made of one layer of carbon atoms arranged in honeycomb structure.

It's strong, flexible, and an excellent conductor of heat and electricity, and is a key material for sustainable solutions, enabling the development of energy-efficient devices, lightweight composites, and environmentally friendly technologies.

Manufacturing high-quality graphene on a large scale with consistent properties is challenging and expensive, particularly because of the energy-intensive processes and specialised equipment required.

Researchers from AMBER, the SFI Research Centre for Advanced Materials and BioEngineering Research, led by Professor Jonathan Coleman, and their international collaborators, have developed a new inexpensive method to scale up graphene production by exfoliating graphene from graphite using a kitchen blender and a household inkjet printer.

The process involves engineering fluid dynamics to reduce turbulence that helps minimise defects in the graphene flakes. This method from using abundant graphite has the potential to slash production costs to UK£20 per litre with the ability to produce multi-tonne quantities to meet global demands.

Harnessing the Benefits of Fundamental Research

Your kind of town

Irish towns are home to around one third of the population and need to be resilient and adapt to change.

The University College Dublin Centre for Irish Towns brings together researchers and stakeholders from different disciplines and sectors, and from across the island of Ireland, to explore the best ways of revitalising our towns for sustainable communities. Problems like long-term vacancy, a lack of investment in infrastructure, a dependence on cars, and a general lack of data all need to be tackled to allow our towns to play a key role in the just transition to a post-pandemic and low-carbon society.

Nurturing the Humanities, Culture, and the Arts

Fostering Regional Strengths

Understanding inflammation

Inflammation is an important component of immune response.

You've probably experienced an injury swelling while it heals, or your skin becoming red with a rash. It's a natural reaction to injury and to infection with viruses or bacteria and normally helps us to heal. But there are times when inflammation can itself cause us to feel unwell, through a a whole range of diseases such as multiple sclerosis, lupus, and Parkinson's disease.

A group of researchers led by Professor Luke O'Neill at Trinity College Dublin is investigating the biochemical processes our bodies carry out and how inflammation is stimulated. Their objectives are to understand the processes better and to develop new anti-inflammatory medicines.

**Enhancing a Human Centred Approach to Health and Social Care**

A happy social medium

Our increasingly connected lives and the expansion of social media have brought their own challenges.

Researchers are examining how we all process information received on social media – and how selective algorithms may be influencing what we consume. University of Limerick researchers Daragh Bradshaw and Anca Minescu worked with a group of teenagers to see how they would monitor online behaviour and develop their own 'digital detox'. Researchers in Munster Technological University are working on cyber safety for other potentially vulnerable groups.

Safeguarding Public Interest and Trust in the Digital World
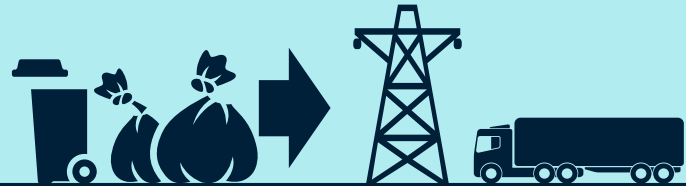
From wastebin to fuel tank

Ireland generates millions of tonnes of waste per year, much of which is exported for recycling or incineration.

There are significant economic and environmental gains to be made if waste can be turned to fuel. Researchers at South East Technological University are working alongside colleagues in Vietnam to investigate biofuels for heavy-duty transport. Synthetic biofuels from non-crop resources are planned to meet 45% of biofuel demand by 2030, compared with 7% in 2020. The international team is focusing on thermochemical techniques that can use different varieties of waste to produce fuel and generate electricity.

Future-proofing Energy and Water Systems

Embedding Climate Action Across Society

Death and burial data Ireland 1864–1922

Ireland's social structures have changed a lot in the last 150 years.

Researcher Ciara Breathnach from the University of Limerick is studying how civil organisation and religious power were represented through death registrations and burial data from 1864-1922, to reveal how people and families engaged with power structures in the community.

Valuing and Connecting Communities

Signs for science

Irish Sign Language is the first language of around 5,000 people in Ireland. When the language does not have a sign for a particular term, the person has to use fingerspelling – slowing down their conversation.

Responding to needs from schools and professional scientists, researchers at Dublin City University have been working on a glossary of signs for useful scientific terms such as 'erosion', 'isobars' and 'astronaut'. The team works with deaf people who use ISL to find out what signs they are already using for different terms and provides videos of signs for hundreds of words and scientific terms to help improve access to STEM for everyone.

erosion

astronaut

isobars
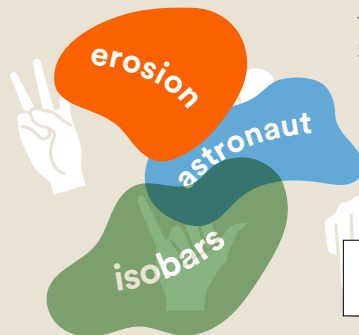
Promoting Equality, Diversity, and Inclusion in Ireland

Strengthening the Research Landscape and Public Engagement

Is there a way to raise beef sustainably?

There are more cattle than there are people in Ireland, and the agri-food industries have been investigating ways to reduce their carbon footprint.

Researchers from Teagasc established the BovINE project working across 10 European countries to connect farmers with innovation to boost sustainability in beef farming. The research brought together areas such as biodiversity to reduce fertiliser, improving beef quality through diet, improving animal welfare, and protecting water courses and soil nutrients, into a single knowledge hub for European farmers and share information across borders.

Supporting Innovation in Farming and Food

Embedding Climate Action Across Society

Mutual benefits of beekeeping

Researchers from the RCSI University of Medicine and Health Sciences discovered that beekeeping improves Irish farmers' wellbeing.

The 'Let It Bee' biodiversity project started in Roscommon in 2020, to encourage Irish farmers to change their agricultural practices and become more aware of the damage that pesticides do to our local water sources and biodiversity. A follow-up project is studying the impact of the 'Let It Bee' project on the well-being of farmers, their families and the wider community. The long-term goal is to expand the project nationally and to help further promote biodiversity and water awareness.

Valuing and Connecting Communities

Supporting Innovation in Farming and Food

The role of sex and gender in research

Sex and gender can have significant effects on research.

For example, it's been found that male ornithologists are less likely to study female birds, which may have contributed to the erroneous belief that only male birds sing.

Many Irish Funders requests scientists and other researchers to address sex and gender analysis in their research content and presents case studies on a regular basis. Areas that include gender dimensions include facial recognition and other artificial intelligence, biological differences affecting prescription drug effects, access to innovation processes, and adaptations in built environments.

Promoting Equality, Diversity, and Inclusion in Ireland

Aerosolised poo

The COVID-19 pandemic made us all more aware of spreading germs – one perhaps unexpected source being the flush of a toilet.

Look away now if you're squeamish, but droplets and aerosols escape the bowl when you flush, even with the lid down. Researchers from University College Cork using their Wideband Integrated Bioaerosol Sensor found that although putting the lid down did reduce the number of particles escaping, those that did make it into the air stayed around for longer – more than a quarter of an hour.
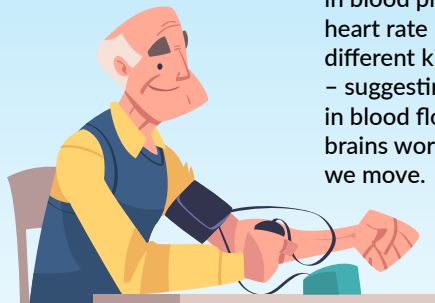
Building Resilience and Preparedness: Insights from the Pandemic

Informing healthy ageing

The Irish Longitudinal Study on Ageing (TILDA) at Trinity College Dublin is working on a range of research into how we age, with the goal of understanding the factors that affect the ageing process.

One recent study looked at how blood pressure and blood flow to the brain change with age. Low blood pressure can increase the risk of falls and lead to serious injuries, such as fractured hips. The study examined the relationship between these changes in blood pressure and heart rate behaviour and different kinds of dementia – suggesting that problems in blood flow may affect our brains work as well as how we move.

Valuing and Connecting Communities

Enhancing a Human Centred Approach to Health and Social Care

A software breakthrough shared with the world

Bioinformatics is the science of creating software and other tools for understanding biological data, and Ireland's Professor Des Higgins is a giant in the field. Although a biologist by training, he became one of the most-cited researchers in the world in computer science for developing CLUSTAL in 1988.

The software, which he has maintained and updated along with researchers in University College Dublin, allows biologists without bioinformatics training to align DNA and protein sequences. The software has been used in cancer and vaccine research and helps reveal evolutionary relationships.

Strengthening the Research Landscape and Public Engagement

Harnessing the Benefits of Fundamental Research

Quantum

Several questions lurk at quantum mechanical levels.

Do elementary particles truly behave the way we visualise them? How do their wave functions alter under external stimuli? On an atomic scale, do insulators still insulate? What happens to electronic structures in ultra-cooled magnetic fields? Can we harness any of these properties to build better technology?

We have the answers to many of these questions, and a lot more remain elusive. Mysterious, even.

J.C. Seamus Davis and team of researchers, along with their international collaborators, are finding answers to several of these questions and, in the process, are discovering new physics.

For instance, the team discovered that at ultra cold temperatures – close to absolute zero where all activity stops - certain insulators have localised 'metallic puddles', nanometre-scaled localised metallic conduction electrons that make otherwise insulating materials behave like metals in an applied magnetic field.

These are conducting insulators. We didn't know they existed until now.

In another study, these researchers are investigating how electrons on copper sites of specific copper oxide materials interact. The team can move around and change the positions of oxygen atoms to understand how the energy exchange between electrons affects their pairing behaviour. Their results suggest that a specific type of interaction, called charge-transfer superexchange, is responsible for the way these electrons pair up and enable the material to become a superconductor when 'holes', or electron vacancies, are introduced. This helps better understand how different materials work and could potentially lead to improvements in superconductivity technology.

Harnessing the Benefits of Fundamental Research

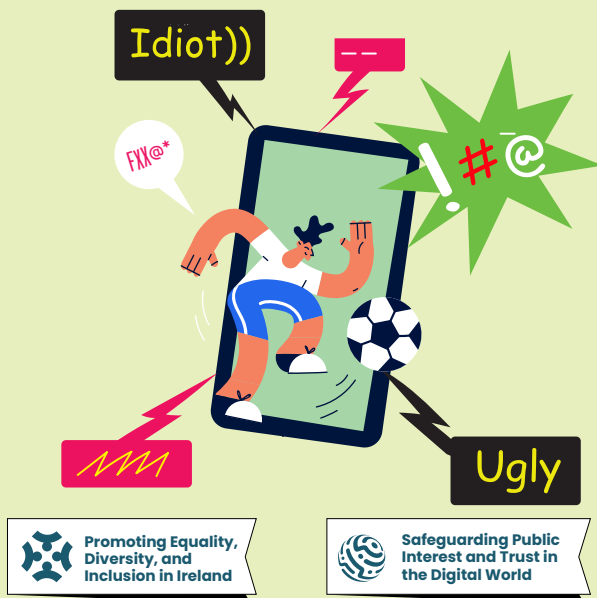# Stopping the beautiful game from turning ugly

Researchers at Dublin City University are teaming up with sports organisations to focus on kicking online hate to the sidelines.

The Tackling Online Hate in Football or TOHIF project is examining online communications during eight European Football Championships from 2008 to 2022, revealing how football (soccer) and online hate intersect.

The research probes fans' digital conversations, unearthing the roots and characteristics of hate speech. Using machine learning, the researchers are able to identify hate speech and abusive text. Furthermore, the project has also conducted interviews and focus groups with over a hundred different football stakeholders in the UK and Ireland. Both qualitative and quantitative analyses have been used to develop educational workshops and inform policy.

By working with fans' organisations in Ireland and the UK and partners such as Sport Against Racism in Ireland, the project is engaging face to face with those working to stop hate in football.

The researchers hope that by changing behaviours in football, the project will also influence society more broadly.

Idiot))

FXX@*

!#ˉ@

Ugly

Promoting Equality, Diversity, and Inclusion in Ireland

Safeguarding Public Interest and Trust in the Digital World

Software without the coding

Need new software in a hurry?

New approaches where you code less or not at all are helping governments and other users to produce software faster and with greater quality - something that is going to change the way we use IT when under pressure, like in the COVID times. The low-code/no-code approach means that developers and non-developers alike can use models to design, develop, verify and roll out applications. Researcher Tiziana Margaria at the University of Limerick is producing a new generation of low-code/no-code development platform and designing toolkits and applications with their industry and government partners to make sure Ireland is ready for this incipient revolution.

Harnessing the Benefits of Fundamental Research

Strengthening the Research Landscape and Public Engagement
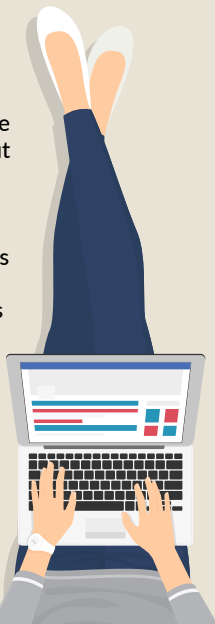
Medieval medicine

Researchers at Maynooth University are among those exploring manuscripts created in Ireland from the years 1350-1700, uncovering more about people's lives and how they saw the world around them.

For example, the manuscripts examined using new digital tools can tells us what Irish people of the time knew about illnesses and ways of curing them.

The research will also help to reveal how such texts were produced and shared – including with other Gaelic cultures in Scotland – and how these early texts influenced the development of scientific writing.

Strengthening the Research Landscape and Public Engagement

Nurturing the Humanities, Culture, and the Arts

Connecting body and mind

Our mental health can be affected by environmental, biological and behavioural risk factors.

It can be difficult to figure out how these combined factors result in mental health conditions in about one-in-four people worldwide, and not in the rest of the population. To try to amass more data to solve this problem, and work towards better prevention and treatment of mental health conditions, the Neureka project is gathering hundreds of thousands of measurements from people around the world. With more than 25,000 users in more than 120 countries, the team is collecting cognitive and clinical measurements to investigate the dynamics of mental illness and late-life cognitive decline.

Enhancing a Human Centred Approach to Health and Social Care

A telescope the size of Europe

Birr Castle in Co. Offaly was famous in the nineteenth century for having the world's biggest optical telescope.

The 'Leviathan Telescope' was built by William Parsons, the 3rd Earl of Rosse, and was the largest telescope in the world for 75 years. But there's a new kind of telescope at Birr, the Low Frequency Array (LOFAR), which puts Ireland back on the map for massive telescopes. LOFAR is being used by Irish scientists to search for huge explosions on the sun and stars, to test Einstein's theories using rapidly rotating stars called pulsars, and even to find evidence for extraterrestrial intelligence around nearby stars.

Harnessing the Benefits of Fundamental Research

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