

accelerate journal

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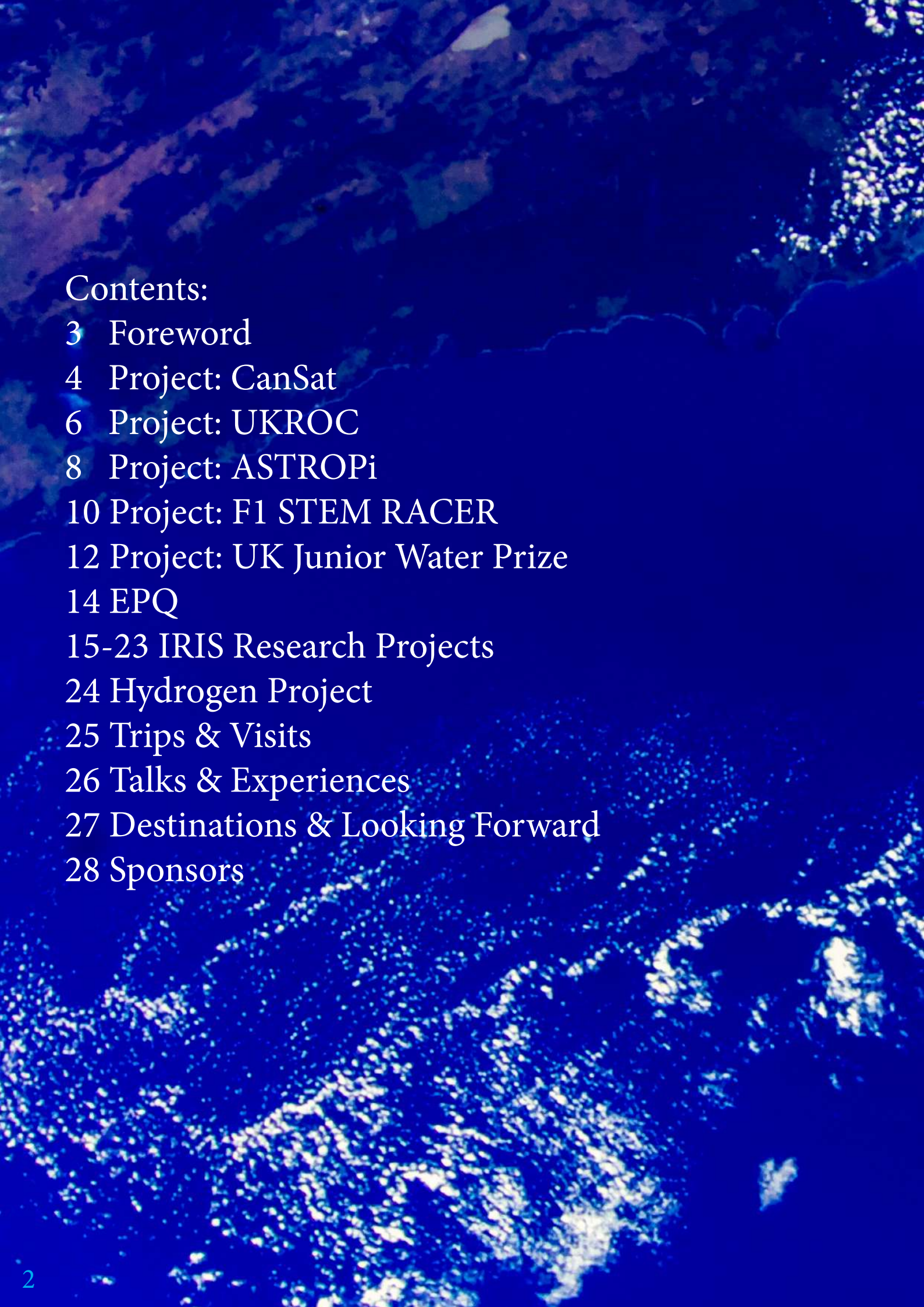
A photograph of a rocket launch. The rocket is a small, dark, cylindrical object with a pointed nose, ascending vertically. A bright, white plume of smoke and fire trails behind it, extending down to the ground. The launch is taking place in a grassy field with several trees in the background. The sky is filled with large, white, fluffy clouds.

PROTOTYPING PROPULSION & PROFESSIONALISM

CANSAT 2026
“Most Professional Team”

IRIS & EPQS
From the lab to the
conference floor

ASTROPI
High-res images from
low Earth orbit



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Foreword

It is a privilege to introduce this year's Accelerate Journal and, as someone relatively new to Truro and Penwith College, to see in one place just how much our students have accomplished over the past year.

The range of experiences represented in these pages is remarkable. Accelerate students have taken part in national engineering competitions, conducted and presented original research, worked with universities and industry, and seen code they developed run aboard the International Space Station. They have travelled from Cornwall to some of the country's leading universities and research facilities, as well as to CERN in Geneva.

These are impressive achievements, but what stands out to me is the level of responsibility the students themselves have taken. They have designed, built, programmed, researched, presented and, importantly, solved problems when things have not gone according to plan. The results are evident throughout this journal, but so too are the skills and confidence developed in getting there.

I believe strongly that our students should be at the centre of everything we do at Truro and Penwith College. Part of that means ensuring that they have access to experiences which broaden their horizons and allow them to see where their interests and abilities might take them.

Accelerate provides exactly that kind of opportunity. It connects students in Cornwall with universities, researchers, employers and organisations working at the forefront of their fields, while giving them the chance to undertake ambitious work of their own.

None of this happens without considerable commitment. I would like to congratulate the students featured in these pages and thank the staff who have supported them, together with the many organisations, speakers, partners and sponsors who have given their time and expertise throughout the year.

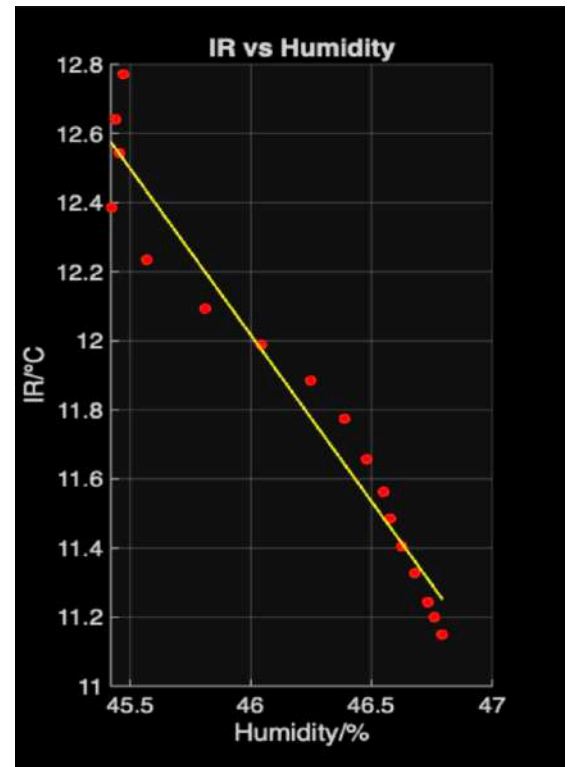
This journal is an impressive record of what they have achieved. I hope you enjoy reading it as much as I have.

Carl Riding
Principal & Chief Executive
Truro and Penwith College

PROJECT: CANSAT

"Most Professional Team"

Two Accelerate teams took on the CANSAT challenge this year, designing, building and programming miniature satellites capable of carrying out their own scientific missions. CanWeFixIt designed a CanSat to investigate atmospheric conditions at different altitudes, capturing images of cloud cover while measuring humidity and light intensity. COYAC developed a different mission, measuring ultraviolet and infrared radiation alongside humidity to investigate the effect of water as a greenhouse gas.



But getting a satellite ready for launch involved far more than choosing what to measure. Both teams designed their CanSat in 3D, selected and soldered their electronic components, programmed the satellite and its ground station, and even designed and manufactured their own printed circuit boards. As with any real engineering project, things didn't always go to plan; including some frantic last-minute soldering and PCB track repairs to get the systems flight-ready.

Regional Finals

Both teams travelled to Upottery Airfield for the regional competition. Unfortunately, strong winds prevented CanWeFixIt from launching their satellite, but their engineering work was recognised with an Engineering Excellence Award, alongside an Industrial Cadets Silver Award.

COYAC progressed through the regional competition to become one of just six teams nationally invited to the UK final - and one of only two state-sector teams to make the final six.

GOLD INDUSTRIAL
CADETS AWARD

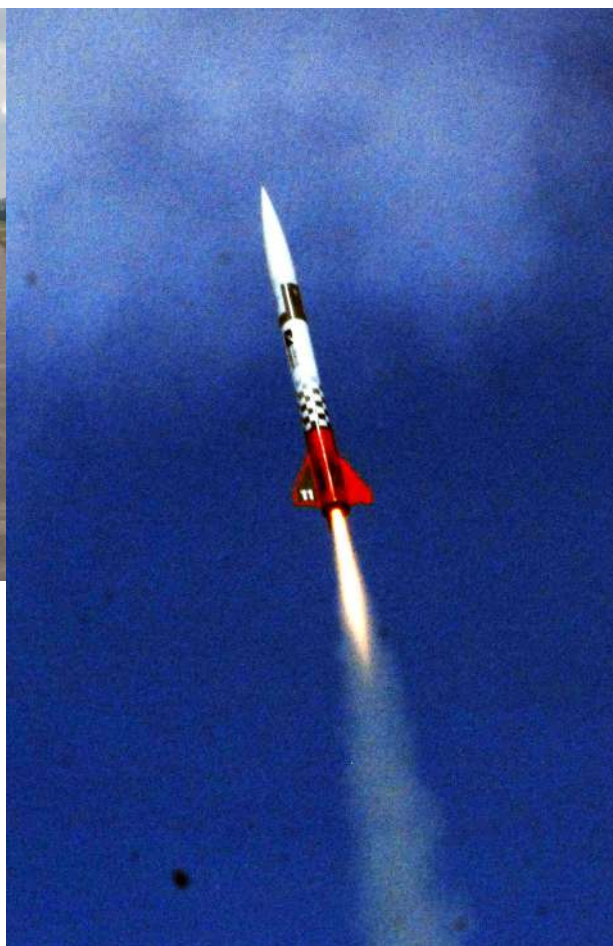
6 NATIONAL FINALISTS

MOST PROFESSIONAL
TEAM

UK NATIONAL FINAL



COYAC AT THE NATIONAL FINAL (Yilin, Charlie, Cayden and Ollie)



The UK Final

The national final took COYAC to the UK STEM Learning Centre in York for several days immersed in space engineering: meeting teams from across the country, hearing from people working in the space industry and, finally, putting their satellite to the test.

The CanSat launched successfully, the parachute deployed and the complete system operated in flight, allowing the team to carry out the mission they had spent months designing and building.

200mph rocket during ascent captured by Ollie with no tripod.

Although they didn't take the overall title, COYAC returned to Cornwall with the trophy for Most Professional Team, an Engineering Excellence Award and Industrial Cadets Gold Awards - an exceptional result in one of the programme's toughest national competitions



Regional Launch COYAC and CANWEXIT (Yilin, Ollie, Jacob, Lola, Phoebe, Bridget, Charlie, Cayden, Afton)

PROJECT: UKROC

3...2....1.... Liftoff!!

Two Accelerate teams - “ROCSTARS” and “THRUSTMASTERS” - took on the UK Youth Rocketry Challenge, designing and building rockets from scratch to meet an exacting set of competition requirements.



Successful parachute deployment for “RocStars”

The challenge was deceptively simple: launch a rocket carrying a raw hen’s egg to a target altitude of 750 ft, keep it airborne for 36–39 seconds, and return the egg safely to Earth.

Doing that while keeping the complete rocket below 650 g, within strict dimensional requirements and using no more than 80 Ns of total motor impulse required months of design, testing and calculation.

Both teams designed virtually every aspect of their rockets themselves: from the fins, nosecones and structural components to the parachutes, egg-protection systems and overall flight plans. CAD, 3D printing, resin work, painting and decals were all completed by the students.

Engineering for flight

The two teams approached the challenge very differently.

One found themselves with more powerful motors than their design ideally required, forcing them to find ingenious ways of increasing aerodynamic drag without unnecessarily increasing mass. The other developed an impressive screw-fit nosecone and integrated egg chamber.

Both teams also designed and manufactured their own parachutes, rather than relying on commercially available recovery systems; attracting plenty of attention at the competition.

With no opportunity for a test launch before the regional event, their first competition flights doubled as their first real-world tests.

The second flights demonstrated exactly why real-world engineering doesn’t always follow the simulation.



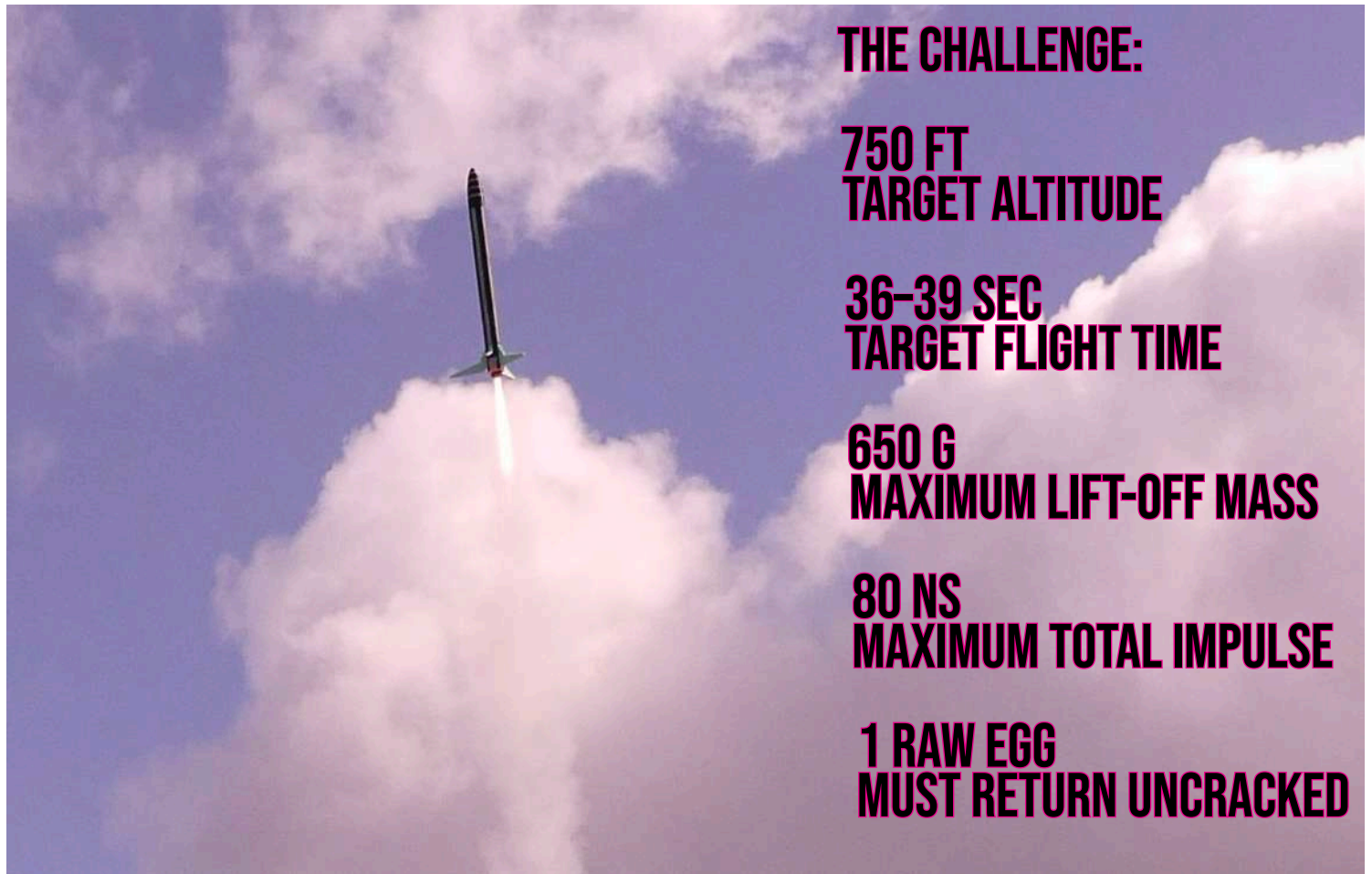
Successful parachute deployment for “Thrustmasters”



“ROCstars”: Lola, Liv, Sree, Matt & Tate



“Thrustmasters”: Dylan, Caspar, Lewis, Elias, Bill & Jakob



ROCSTARS appeared to be heading for an excellent flight when the motor's parachute ejection charge failed to fire. With no recovery system deployed, the rocket returned to Earth at terminal velocity.

The rocket didn't fare particularly well. The egg fared considerably worse.

Crucially, the failure was traced to the motor's ejection system rather than the team's rocket design - a frustrating end to what had otherwise looked like an extremely promising flight.

THRUSTMASTERS had almost the opposite problem. Their rocket reached what appeared to be an excellent altitude and successfully deployed its parachute, only to encounter an updraft. Instead of descending on schedule, the rocket seemed to hang in the air, eventually putting them around 10 seconds beyond the target flight time.



Matt with the "RocStars" rocket after flight 1



Liv with the same rocket after flight 2, and a 750ft freefall

PROJECT: ASTROPI

High-Res Images from Low Earth Orbit

Six Accelerate students (Dory, Phoebe, Yilin, Charlie, Jacob and Ollie) took part in the Astro Pi challenge, writing code that would run aboard the International Space Station.

Their primary mission was to use the Astro Pi's instruments to calculate the speed of the ISS. But the team decided to go further: programming the onboard camera to photograph the Earth while automatically recording the nearest city to each image.

Their code was successfully run aboard the ISS twice, returning speed measurements, location data and an incredible collection of photographs from orbit.

By combining this information, the students were able to plot the course of the ISS during their experiment - while capturing spectacular images of Australia, the Strait of Hormuz and the journey between them.



Lake Yama Yama - Australia (4th May 2026)



Strait of Hormuz (4th May 2026)

PROJECT: F1 STEM RACER

Engineering at Race Pace

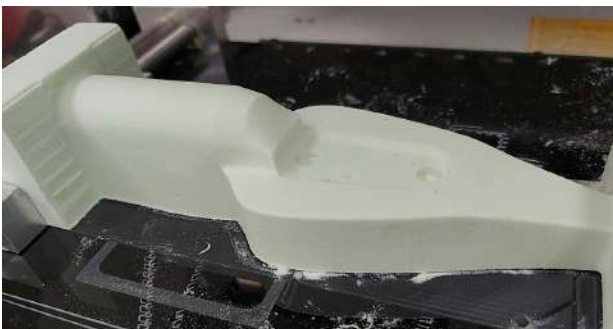
Team Venturi took on the F1 STEM Racing challenge for the first time this year, designing and manufacturing their own CO₂-powered model racing car.

Working within strict competition regulations, the team used CAD and computational fluid dynamics (CFD) to develop their car from a block of competition-supplied material, refining the aerodynamics and airflow before manufacture.

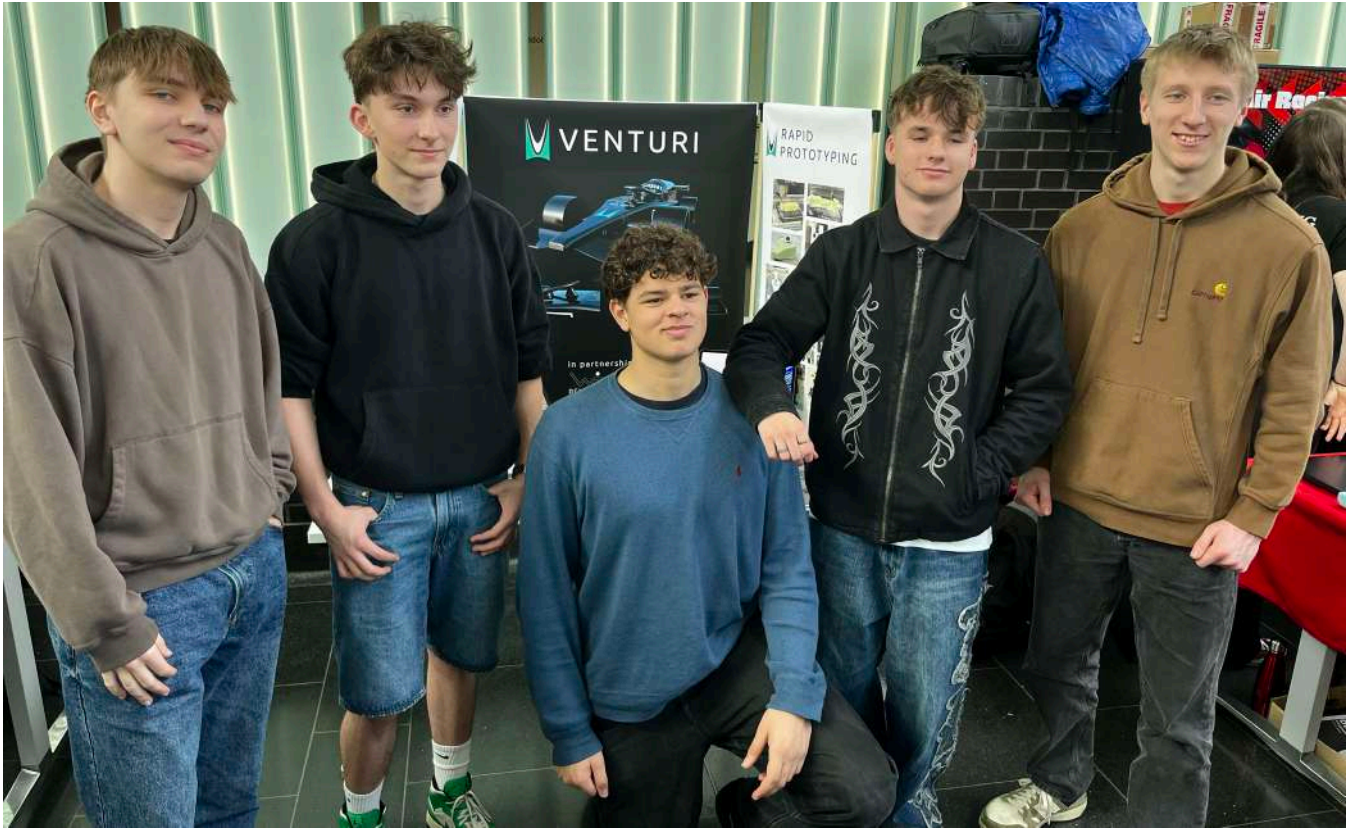


But performance on the track was only part of the challenge. Venturi also created engineering and enterprise portfolios, developed their own team identity and branding, secured sponsorship and built a professional pit display. At the competition, they had to defend their engineering decisions in front of judges before putting the finished car onto the track.

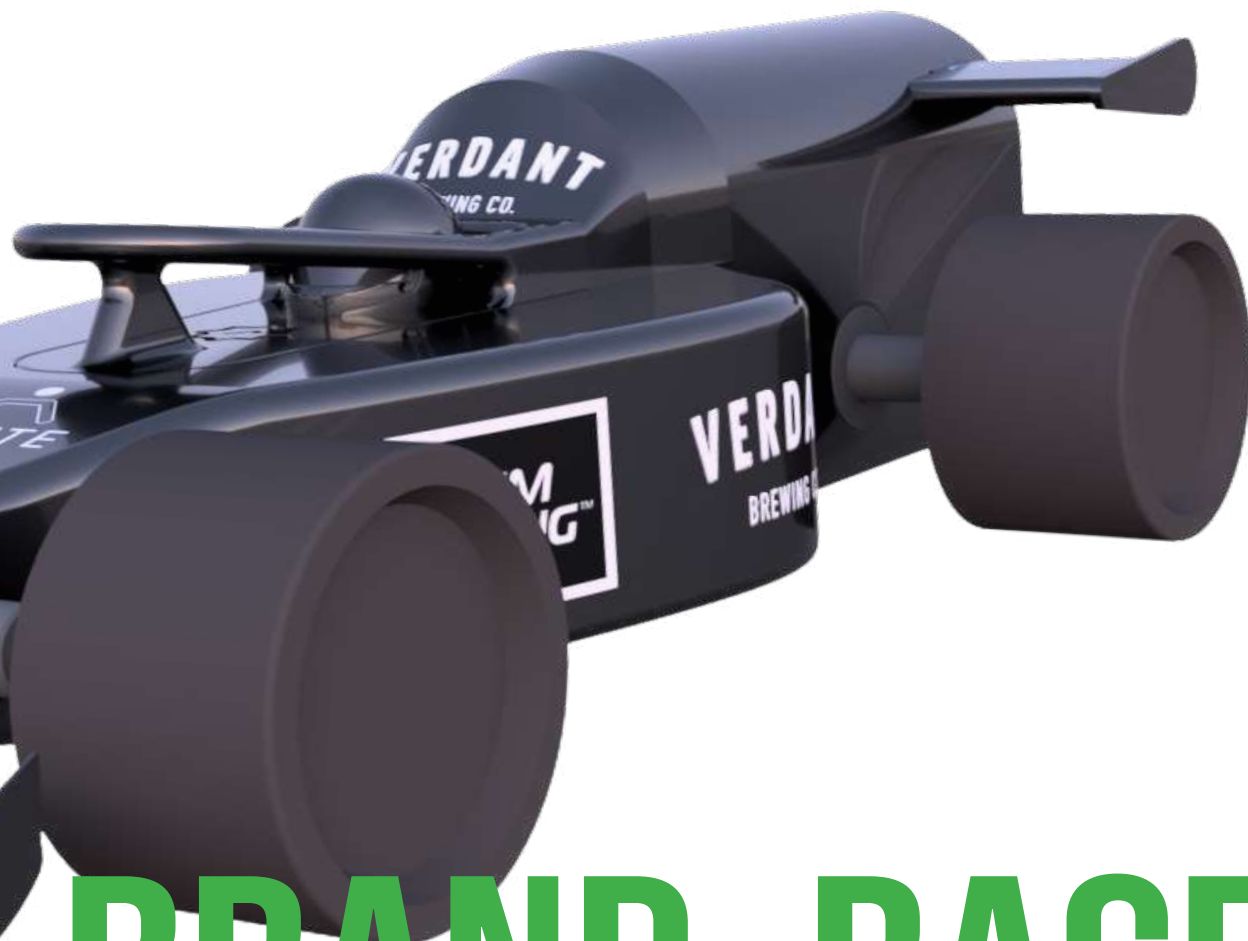
Although Venturi didn't progress to the national finals in our first year of the competition, their pit display scored particularly highly and the team produced a strong first entry to build upon in future years.



DESIGN. BUILD.



Team Venturi: Jakob, Cayden, Caspar, Rory, George



BRAND. RACE.

PROJECT: UK Junior Water Prize

Independent Research on a National Stage

Two Accelerate research projects were shortlisted for the UK Junior Water Prize 2026, earning three students an invitation to the national judging day in Birmingham.

There, they presented and defended their research to a panel of water-industry experts.

Optimising Wetlands

Charlie investigated whether constructed wetlands could help remove nitrate pollution from agricultural runoff. He built a model system using different masses of hornwort and used a colorimeter to track nitrate concentrations over seven days.

His results suggested that moderate amounts of plant matter were more effective than simply increasing plant density, highlighting the potential, and complexity, of using constructed wetlands to reduce agricultural pollution.



Open-source colorimeter used in Charlie's research

Purification by Plants

Sithula and Evan investigated the water-purification potential of extracts from five different plant species, including oak, chestnut, willow, neem and arjuna.

Using a Pioreactor, they measured the effects of the extracts on chlorella growth and water turbidity. Grey willow and arjuna produced particularly striking results, reducing turbidity by 92.9% and 90.6% respectively at their optimal concentrations.

Both projects were conceived, designed and carried out by the students themselves, who assembled their experimental equipment and learned to use unfamiliar scientific instrumentation as their research developed.

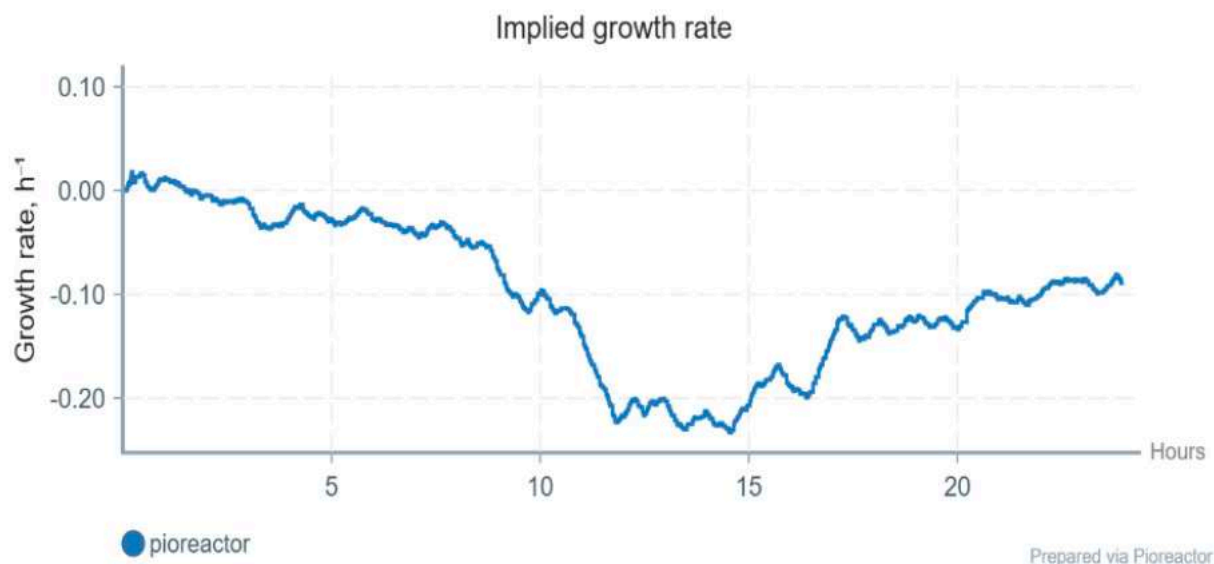


Pioreactor used by Sithula & Evan

Excerpt from Sithula & Evan's UK Junior Water Prize Report:

Conclusion

In conclusion, willow acts as the most effective local antimicrobial plant extract in the UK, while arjuna poses as a strong alternative for regions with more contaminated water sources, although the reach of these extracts could be expanded via its distribution in powdered form. This is all something which could be achieved by introducing awareness campaigns in the regions of interest, encouraging volunteers to become involved in the cultivation of these plants, while research must extend to more specific components of contaminated water.



Excerpt from Charlie's UK Junior Water Prize Report:

ABSTRACT

Agricultural runoff causes excess nitrates to enter rivers leading to eutrophication and biodiversity loss. This investigation aimed to determine how plant mass effects nitrate removal using hornwort in a modelled constructed wetland system. Different masses of hornwort (0g, 2g, 4g, 6g and 8g) were placed into nitrate solutions for 7 days and nitrate concentration was recorded daily using a colorimeter. Results showed that there was an initial increase in nitrate concentration across all samples, likely due to decomposition and microbial activity. After this there was a sharp decrease across the moderate plant masses before levelling off and becoming relatively consistent. The 8g sample decreased but then fluctuated before drastically increasing on the final day in nitrate concentration. These findings suggest that moderate plant mass is the most effective at nitrate removal, indicating the need for moderate plant densities in a constructed wetland system to help reduce the impacts of agricultural runoff.

BOTH PROJECTS
NATIONALLY SHORTLISTED

EPQ

Go beyond the curriculum

Alongside their projects and A Level studies, Accelerate students have had the opportunity to pursue questions of their own through the Extended Project Qualification (EPQ).

This year's research spans space exploration, medical imaging, behavioural genetics, teenage health, media representation and the fundamental nature of our universe. Each project challenged students to investigate complex ideas independently, evaluate evidence and develop a sustained argument of their own.

Scan the QR codes to explore a selection of this years EPQ research.



What are the main challenges of colonising Mars
- Olivia Retallick



What are the potential effects of the current advances in clinical imaging technology
- Ruby Norfolk



To what extent should behavioural genetics influence judgements of criminal responsibility
- Sithula Wickramathunga



To what extent does sleep deprivation affect physical and mental health in teenagers?
- Megan Laval



How could self-injury representation in the media be improved, and why does it need to be?
- Lowena Wills-Heath



To what extent do we live in a deterministic universe?
- Herbie Greenslade

IRIS RESEARCH PROJECTS:

Accelerate Research is “Highly Commended”

Throughout the year, Accelerate students have undertaken their own independent research projects through IRIS (Institute for Research in Schools) developing original research questions and experiencing what it means to carry out research beyond the curriculum.

Six Accelerate students attended the IRIS Conference, joining young researchers from across the country to exhibit their work, discover other projects and meet people working across science and research.

Accelerate student Sithula Wickramathunga was also invited to take to the stage and present his research on DNA origami, exploring the stability of DNA nanostructures and their potential use in targeted drug delivery. His project involved designing DNA structures and using computational simulations to investigate how they might behave under different physical and chemical conditions.

Following the conference, Sithula was awarded **Highly Commended** in the **IRIS Young Researcher of the Year Award 2026** for his DNA Origami project. (One of only two Highly Commended researchers from 267 completed DNA Origami projects nationally).

You can explore their research on the next few pages.



The next generation of researchers: Charlie, Ollie, Alex, Phoebe, Rudy, Sithula

DNA Origami

To What Extent Do Physical and Chemical Influence DNA Origami Formation and St

Truro and Penwith College

Abstract

The structural stability of DNA origami structures are affected by its environmental conditions. This study considers how specific these conditions must be, and whether these structures could withstand common biological environments, applying these ideas in the context of medical drug delivery treatments.

Three DNA origami designs were to be tested in a variety of standard experimental and physiological conditions, in relation to temperature (the physical factor) and Mg^{2+} ion concentration (the chemical factor). The list of simulations to be conducted are incomplete and there were several challenges faced when using the simulations, including the extended simulation timeline and several initial instabilities in the structures that were tested.

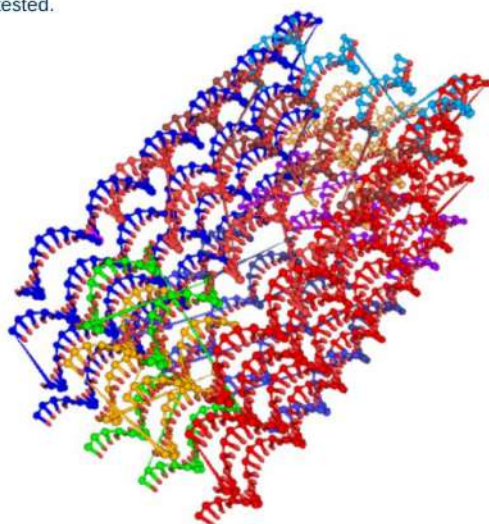


Figure 1: A 3D box structure with a hollow interior, as shown in oxView, which is one of the DNA origami structures tested under different environmental conditions.

Introduction: The Futility Dilemma

While not widely used in a contemporary sense, DNA origami structures are becoming strongly prevalent, with early-clinical investigations suggesting prospects. Studies concerning chemotherapy drug delivery attached a well-known anti-cancer drug, Doxorubicin, via intercalation to set DNA origami structures. They were applied to the context of drug-resistant cancer cells, showcasing an increase in uptake of doxorubicin, compared with the use of the free drug, suggesting how encapsulating the drug in a DNA structure circumvents resistive mechanisms in these cancer cells.¹ However, this investigation was conducted on cell cultures and not in a whole human system, thus the study does not fully address the immune responses and the stability of the DNA structure in the bloodstream, due its limitations of going beyond the grounds of studies that are *in vitro* and some *in vivo* (animal models).

With its ever-growing potential in drug delivery, it is important to consider whether this is at all practicable at the end of the day. Else, it would be a waste of financial attention when attempting to integrate this into the process of drug delivery – a futile venture in the complete wrong direction. Thus, with the use of simulations that consider the conditions in the human body, there should eventually be an initial insight into how the scaffolds and staple connections would hold up in realistic biological conditions. If there are significant limitations in the process of DNA-based drug delivery but the potentials such as the case against drug-resistant cancer cells are considered irreplaceable, then the industrial development of the technology must actively pursue an effective conjugated component.

Physiological conditions in humans:

- Normal body temperature is estimated to be around 37°C, with daily variations ranging from 0.25 by 0.5°C.²
- Mg^{2+} ion concentration in the blood plasma ranges from 0.75 to 1 mmol/L.³

These features are especially important to consider since, despite the body temperature solely not being a factor for denaturation, the bloodstream's low Mg^{2+} ion concentration is already established to be relatively unideal, especially when the ionic instability is amplified by temperature. This study is limited to one aspect from each of physical and chemical conditions, so to top these elements there's concentration of nucleases (causing DNA degradation) and immune responses that must be accounted for.

Method: scadnano and oxDNA

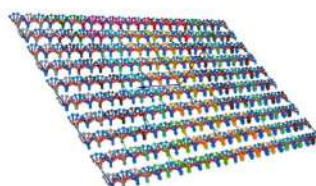


Figure 2: A rectangular design that allows me to assess the stability of one face of a potential DNA box.

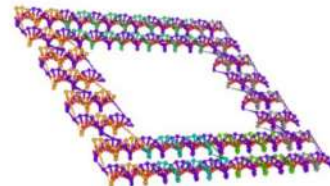


Figure 3: A hollow square design, considering the impact of vacant space in a singular structural plane.

Using scadnano, a main 3D design was constructed, as shown in Figure 1. Two supplementary designs that were developed alongside this were also selected (shown in Figure 2 and 3), all of which will be simulated on oxDNA. The supplementary designs were tested since the main 3D box was slightly more complex in overall spatial arrangement and likely to manifest a greater tendency of instability. In contrast, the supplementary designs were simpler – with more detail in terms of the oligonucleotide staples – so were more likely to showcase stability in a wider range of conditions; a limitation of these designs were that the interactions with the other components of an entire box were not considered. The two major environmental factors these were tested under were temperature (a physical component) and Mg^{2+} ion concentration (a significant chemical component).

However, one issue was that oxDNA did not have a specified simulation for Mg^{2+} concentration; instead, it simulates 'salt concentration' (more specifically, monovalent ions like Na^+ or K^+) using a Debye-Hückel approach to mimic ionic screening effects. Therefore, since Mg^{2+} ions have a stronger stabilizing effect on DNA structures than monovalent ions, increased monovalent salt concentrations were used to reproduce comparable electrostatic screening and structural stability.

The first set of simulations were based on approximate standard experimental conditions for DNA origami: 0.5 mol/L salt concentration and a temperature of 300K.⁴ This would assess the relative stability of the DNA structures in ideal conditions.

The next set of simulations were based on the physiological conditions in humans. The average conditions used in the simulations were temperatures 310K and salt concentrations of 0.15 mol/L (an approximate value that mimics the average Mg^{2+} ion concentrations in the human body,⁵ one of which was a constant when assessing the impact to the structure when changing the other variable around its average value. The range of values considered for each component would revolve around these averages: the range of temperature values used would be 308K to 312K at increments of 0.2K; and the range of salt concentrations would range from 0.10 to 0.20 mol/L at increments of 0.01M. These wide ranges would take into account possible extreme conditions in the human body that might occur, thus enabling observations on the reliability of these structures in the face of unpredictable environments. The greater the specificity for the structure's optimal conditions, the more volatile it would be in constantly altering atmospheres.

al Conditions ability?

Sithula Wickramathunga

Results (To be concluded...)

Simulations so far involved the rectangular design, with a main focus on changes in energy of the experimental system over time. Figure 4 shows the energy-time profile of the simulation system at 300K and 0.5M, where the energy levels drop significantly, showing relaxation, while the graph starts to plateau, perhaps approaching equilibrium, meaning there is partial stabilisation – the simulations should have been longer to confirm whether there would be complete stabilisation. Tests of the structure were repeated in the mentioned condition ranges, ultimately showing relatively similar trends in the energy-time profile. The simulations will be continued in the other two structures and the additional phase beyond simply assessing energy levels would be to evaluate the visual look of the final configuration, concluding whether a small molecule could be reliably contained during transport.

Next steps...

While certain readings have been obtained, final visual configurations of each structure simulated under variable conditions are yet to be obtained, the only downside to this being that the simulations run for an extended period on oxDNA before providing a visual output of the end-product, which was one of the main challenges faced. Figure 5 shows an example of the rectangular structure's end-layout after being tested under 310K and 0.15 mol/L salt concentration. It shows its assembly has been dismantled, most likely due to the conditions. Therefore, I'll be looking into ways to develop my current designs and using CanDo to reconfirm the stability of my structures under standardised experimental conditions. Furthermore, some of the energy plots simulation didn't produce meaningful time-varying data – suggesting that either it didn't run long enough, didn't evolve or only managed to record a single state – so a lack of sampled dynamics would be another challenge to overcome.

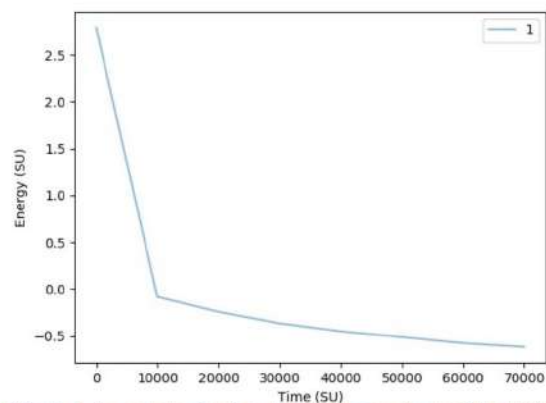


Figure 4: A graph showing how the total energy levels of the DNA origami system evolves over time

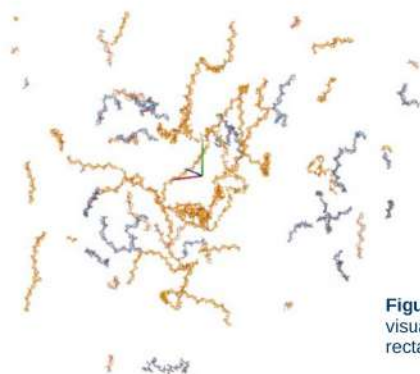


Figure 5: An example of a final visual configuration of the rectangular design

Conclusions: The Possible Scenarios

This study is of course limited to observations of energy levels in the system, which doesn't necessarily confirm structural stability, and the mimicry of Mg^{2+} ion concentrations via other salt concentrations available in oxDNA. Moreover, the box design requires the incorporation of more sophisticated elements like a standard lock mechanism, which cannot be accurately and realistically designed on scadnano.

Once the simulations are concluded, the major question becomes specificity. The obtained data could perhaps be detailed into an assessment of percentage retention of the original structure (visual or calculable observation), degree of bending and the time to destabilisation, which is important when analysing the durability of these complexes in the bloodstream setting. If it could be concluded that there is flexibility in the conditions for a DNA origami structure's composure, then the applications of its use in a clinical setting becomes more realistic. From the data acquired from the simulations so far, there is a relatively constant trend in the energy-time profiles, suggesting the system is in a stable state; the only alternative observations were the occasional fluctuations in distances between nucleotide groups, suggesting the structure may not be fully locked in a firm shape. In contrast, if there is rigorous specificity for temperature and Mg^{2+} ion concentration evident for optimal structural stability, then there should be second thoughts given to the full-scale investments into its development in medicine.

However, there are features beyond these aspects that must be acknowledged as well, such as nuclease degradation and controlling biodistribution, further issues that must be accounted for over these more predictable factors in the human body.⁶ Currently, the scale of DNA origami manufacturing is limited due to its complexity and necessitated precision, equating to high production budgets even for a small batch, challenging the idea whether these medical investments could be directed at something far more promising and reliable: these include liposomes and polymeric nanoparticles, which are more stable and already used clinically.

Alternative drug delivery techniques to consider:

- **Liposomes:** Lipid-based vesicles that carry both water- and lipid-soluble drugs, notable for its biocompatibility.
- **Polymeric Nanoparticles:** Made from natural or synthetic polymers, allowing controlled and targeted drug delivery.
- **Inorganic Nanoparticles:** Made from non-organic metals, such as gold and iron oxide – highly stable and consist of useful properties, despite toxicity concerns.

On the other hand, there are a multitude of strengths in the DNA origami approach over these other techniques, including precise structural control and programmability, alongside a better site-specific functionalisation. However, it is important to acknowledge that the negatives do not represent a fundamental limitation, but rather a design challenge that can be mitigated through optimised surface functionalisation and protective coatings – perhaps supplemented from already existing drug delivery techniques. Coats derived from polymers (reducing enzymic degradation and immune detection), lipid bilayers (mimic cell-surface membranes) and proteins (such as albumin) are prime candidates. Ultimately, there is a vast multifactorial model, involving conditions and conjugated components, that must be resolved before elevating DNA origami's wide-scale applications in a human clinical setting.

References

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Investigation of the Effects of Varied Plant Mass on Nitrate Concentration

Truro College

Abstract

Agricultural runoff causes excess nitrates to enter rivers leading to eutrophication and biodiversity loss. This investigation aimed to determine how plant mass affects nitrate removal using hornwort in a modelled constructed wetland system. Different masses of hornwort (0g, 2g, 4g, 6g and 8g) were placed into nitrate solutions for 7 days and nitrate concentration was recorded daily using a colorimeter. Results showed that there was an initial increase in nitrate concentration across all samples, likely due to decomposition and microbial activity. After this there was a sharp decrease across the moderate plant masses before levelling off and becoming relatively consistent. The 8g sample decreased but then fluctuated before drastically increasing on the final day in nitrate concentration. These findings suggest that moderate plant mass may be the most effective at nitrate removal, indicating that moderate plant mass may be useful in a constructed wetland system to help reduce the impacts of agricultural runoff.

Introduction

Agricultural runoff is a problem not currently managed enough as mainly nitrates, but also phosphates from crop fertilisers, manure and other nitrogen-based compounds are washed into local rivers and lakes [1]. These nitrates can cause increased risk of eutrophication and biodiversity loss. Eutrophication occurs when there are excess nitrates in water, leading to algal blooms. The algae eventually die, leading to increased decomposition by bacteria which increases oxygen demand causing hypoxia where oxygen levels drop too low for aquatic organisms to survive [2]. Constructed wetland denitrification systems utilise aquatic plants to help remove nitrates from contaminated water [3]. The plants absorb nitrates while also creating anaerobic conditions allowing denitrifying bacteria to break down nitrates into nitrogen gas. Constructed wetlands incorporating aquatic plants have significantly higher denitrification rates than systems without plants. Hornwort was selected as it is able to absorb nitrates directly from its surroundings into its leaves and doesn't rely on a root system so works well in a constructed wetland system. Nitrate uptake from the plants combined with the denitrification from the bacteria lead to the most effective nitrate absorption. Constructed wetlands that also incorporate biochar have also been seen to have significant nitrate removal properties and the biochar enriches the genes which code for specific enzymes involved in carbon and nitrate metabolism [4], decreasing nitrate concentration. An initial nitrate concentration of ~30ppm was used as it simulated a highly polluted agricultural runoff environment and to see whether hornwort can handle extreme nitrate concentration [6].

Method

1. A 30ppm stock solution was prepared by diluting approximately 7ml of liquid NPK fertiliser (0.43% nitrates) with water to produce a 1 litre solution. The NPK fertiliser was measured out using the measuring cylinder to 7ml.
2. The hornwort was rinsed using water to remove contaminants such as soil particulates and then patted dry to remove excess water. Hornwort was cut to reach their desired masses (2g, 4g, 6g and 8g). Each weight of hornwort had approximately the same length and was in the same condition with no discolouration of the stem or any leaves.
3. The identical beakers were all filled with 200ml of the stock solution and each mass of hornwort was added to a beaker. A line where the water level reached was marked.
4. All beakers were tested to find their initial nitrate concentration. 5ml of solution was removed using a syringe and placed into a test tube and tested using 2 nitrate reagents. 10 drops of the first API nitrate reagent were added to the test samples to dye the solution; the sample was inverted to mix. Then, 10 drops of the second API nitrate reagent were added to the samples and then shaken vigorously for 30 seconds and left for 5 minutes for a colour change to appear.
5. A colorimeter fitted with a 630nm wavelength LED board (red light) was blanked using a cuvette filled with distilled water to calibrate. Then, each test sample was added to a cuvette and placed into the colorimeter and the concentration was measured. The colorimeter has an internal algorithm which converts absorbance readings into concentration readings (ppm). The initial concentration was recorded.
6. Each beaker was positioned together and exposed to the natural light to minimise variation due to light intensity and samples were kept at room temperature conditions (~20C) as closely as possible. Each beaker was filled with water to the marked line to account for evaporation before testing.
7. Every 24 hours the beakers were all tested for their individual nitrate concentration using the nitrate reagent and colorimeter and the concentration was recorded.
8. After the 7 days graphs of the data were produced to allow comparison of nitrate concentration over time.

Acknowledgments

I would like to thank Alex Wyld for his continued support with tasks such as planning and carrying out the investigation to achieve accurate results.

Results

Mass of hornwort (g)	Nitrate concentration (ppm)							
	Day 0	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
0	21.95	30.12	30.38	4.11	0	0.04	7.4	2.36
2	21.95	34.09	42.36	16.93	7.41	6.15	8.24	7.83
4	21.95	33.75	39.14	15.96	6.84	4.2	11.41	8.58
6	21.95	33.34	44.24	16.88	10.05	4.07	10.9	12.77
8	21.95	34.09	44.52	15.65	18.62	17.78	20.54	40.12

Fig 1: Raw data table of results collected over the investigation.

The initial nitrate concentration was 21.95ppm rather than the 30ppm as stated in the method. This is likely due to uncertainty in the equipment used to measure out the NPK fertiliser leading to a concentration smaller than the desired concentration.

Across all the tests, nitrate concentration initially increased between days 0 and 2, reaching a peak on day 2. Between days 2 and 4 there was a drastic decrease in nitrate concentration. After day 4 nitrate concentration remained relatively consistent with tests either increasing or decreasing by a few ppm per day. The 8g sample didn't really follow the general trend as it did decrease in nitrate concentration on day 4 like the other samples but it didn't reduce by as much reaching 18.62ppm by day 4. After day 5 the 8g sample increased in nitrate concentration rather than decreasing compared to the other samples reaching 40.12 ppm by day 7.

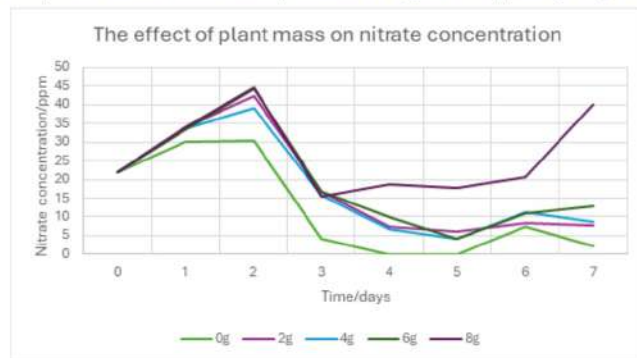


Fig 2: Changes in nitrate concentration over the 7 days starting from its initial nitrate concentration of 21.95ppm.

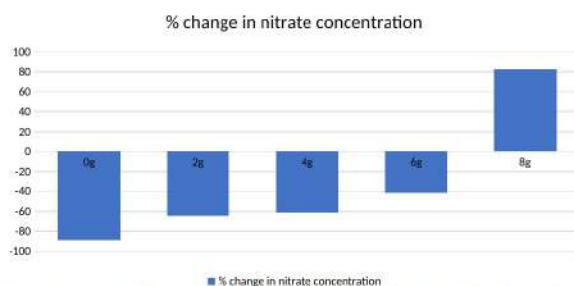


Fig 3: Percentage reduction in nitrate concentration over the investigation.

Discussion

Moderate plant masses (2g, 4g and 6g) appeared to reduce nitrate concentration more effectively than the 8g sample. The initial increase in nitrate concentration across all samples may have been caused by decomposition and ammonification. Microbial breakdown of stressed or damaged hornwort could have released nitrogen compounds into the water which were later converted into nitrates by nitrifying bacteria [5]. Brown discolouration observed on the hornwort supports the possibility of decomposition occurring. This decomposition could have occurred due to the initial nitrate concentration being too high to begin with leading to the hornwort dying due to the extreme conditions. It may have been better to start with a lower initial nitrate concentration so the hornwort didn't become shocked and start dying. This could potentially have led to more consistent results.

The 8g sample showed reduced nitrate removal and a large increase in nitrate concentration by day 7. This may have resulted from overcrowding, plant stress or increased decomposition due to reduced nutrient availability. The 0g control also showed an unexpected nitrate decrease suggesting that factors other than plant uptake, such as denitrification or algae growth, may have influenced nitrate concentration.

A major limitation of the investigation was the lack of repeats which reduced reliability and made it difficult to determine whether anomalies represented true trends. Future investigations could incorporate repeats, longer time periods and biochar substrates to further optimise nitrate removal. Also, equipment uncertainty led to large differences in nitrate concentration as seen with the starting concentration being 21.95 ppm rather than 30ppm. Due to this difference, it is likely that other results collected could also be incorrect and could be a reason why the 0g control sample was inconsistent with expected results.

Conclusion

The investigation suggests that moderate hornwort masses may improve nitrate removal efficiency in a modelled constructed wetland system. However, variability in nitrate concentration and unexpected behaviour in the control reduced confidence in the observed trend. These findings suggest that hornwort could potentially be implemented into engineered constructed wetland systems to help reduce nitrate pollution from agricultural runoff.

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Big Data: ATLAS Our Search for the Higgs Boson

Truro and Penwith College

Summary

While the Higgs boson cannot be directly detected by ATLAS due to its short lifetime, its decay products can be analysed to suggest the presence of the Higgs. Two possible Higgs decays were analysed: $H \rightarrow \gamma\gamma$ and $H \rightarrow WW$ where the Higgs decays into two photons and two W bosons respectively.

For the $H \rightarrow \gamma\gamma$, cuts were applied to collision data⁽⁴⁾ containing at least two photons to ensure they had the correct characteristics to be the result of a Higgs decay. The invariant masses of the two photons were calculated and summed for each event and plotted to a histogram (Fig 4). However, any variation to suggest the presence of the Higgs is too small to confidently declare that the Higgs boson has been found.

For the $H \rightarrow WW$, a non-resonant search was used to show the excess in transverse mass of detected decay products compared with simulated background data. The W boson's short lifetime means it cannot be directly detected by the ATLAS, so the transverse mass of the sum of its decay products, a lepton and missing energy from a neutrino, are calculated from both collision data and simulated data⁽⁴⁾ with at least two leptons with relevant cuts, and latter set of data was subtracted from the former to remove background decays. The results were plotted to a histogram (Fig 5). The excess transverse masses shown strongly indicate a presence of the Higgs boson.

However, further analysis should include stricter cuts and data with more events.

Introduction

The Higgs Boson is a fundamental particle which was first predicted by Higgs, Englert and Brout in 1964 when considering the question, "From where do particles obtain their mass". It was then discovered by the LHC at CERN in 2012. The Higgs has a mass of approximately $125\text{GeV}^{(2)}$ so this will be the expected result for our resonant search. We will use Lorentz Vectors (4-momentum vectors to combine the detected energies and momentums of the particles by the detectors) to find the sum of the invariant masses of the decay products for the Z^0 boson and Higgs boson to create histograms for these particles so that we can see whether the bump is at the expected values for each particle, in which case we may claim to have found these bosons.

Method for our Discovery of Higgs Boson

We began this by using the Jupyter Notebooks⁽³⁾ to guide us through finding the Z^0 Boson as an introduction to using Python to process CERN data.

To begin with we opened a .Root file from the CERN database⁽⁴⁾ containing the ATLAS data. We then accessed a TTree object containing the data which we will plot in our histograms. In order to construct the Histogram of the Z^0 Boson Invariant Mass, we had to identify which Leptons in our data were produced by Z^0 Boson decay. To do this, we made cuts to our data to isolate the pairs of leptons which are of the same flavour opposite charge, given that the Z^0 Boson decays into pair of leptons of this type (see Feynman diagram representing this in Fig 1 below).

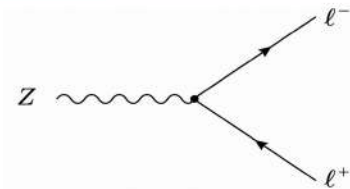


Fig 1: Feynman Diagram indicating Z^0 Boson decay into two leptons of the same flavour and opposite charge

After this we constructed a Lorentz Vector for each lepton, the sum of which gave us the invariant mass of the Z^0 Boson from which they decayed. Then we filled a histogram with this remaining data so that we could display it and determine the invariant mass of the Z^0 Boson. From our histogram (see Fig 2), we can observe a clear spike at approximately 90GeV , which is the accepted value⁽⁵⁾, indicating that our processing was successful.

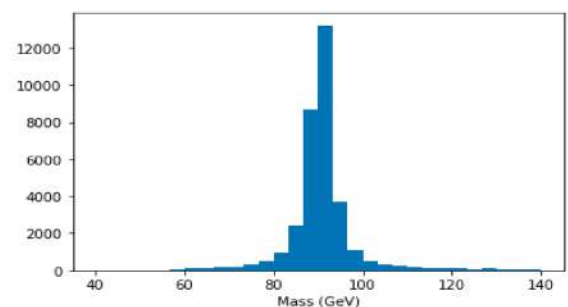


Fig 2: Histogram showing distribution of the invariant mass of the Z^0 Boson

After this we used a similar method to perform a resonant search for the Higgs Boson. We analysed data for the Higgs to gamma-gamma decay channel ($H \rightarrow \gamma\gamma$) (see Fig 3 below). The main procedural distinction between this and the Z^0 decay is that we had to initially check that the photons are good quality - verifying that they likely to be photons which are the result of Higgs Boson decay. These parameters are as follows:

- Photon has $p_T > 25\text{ GeV}$ (this ensures we include minimal photons from background interactions)
- Photon must also have $|\eta| < 2.37$ (this means we will only be using data from the most precise part of the detector - beyond this point photon detection is unreliable)
- Photon has $1.37 \leq |\eta| \leq 1.52$ (this excludes photons which lie in the transition region between the inner detector barrel and the endcap because in this area the resolution also significantly decreases)

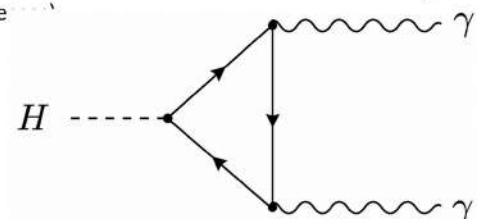


Fig 3: Feynman Diagram showing Higgs Boson decay into two Photons

Oliwier Baczura, Charlie Brammer, Isaac Hutchings, Alex Teff

After we had made cuts to our data, we were able to construct Lorentz Vectors for the good quality photons we are left with. From this we constructed a histogram to show the invariant mass of the Higgs Boson (Fig 4).

Another way of searching for the Higgs is by analysing the 'Higgs to two W boson' ($H \rightarrow WW$) channel above the background 'WW diboson from two quark' events. However, alternatively to the other methods, we cannot perform a bump-hunt search because the sum of the invariant masses of the products is greater than the mass of the decaying particle. Instead, we must perform a non-resonant search. This entails histogramming the transverse mass for both the data and Monte-Carlo simulations of the background, then subtracting the background events from the data and seeing whether there are any remaining results. If the resulting histogram shows any remaining results, then this indicates the presence of the Higgs. (See our histogram in Fig 5)

Results

$H \rightarrow \gamma\gamma$ Decay Channel:

We can see that in our Histogram that there is no significant bump at 125 GeV where we would expect one to be as this is the approximate invariant mass of the Higgs Boson⁽²⁾.

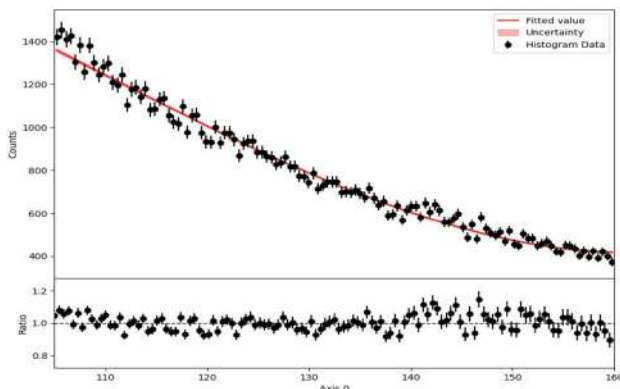


Fig 4: Histogram showing invariant mass distribution of Higgs Boson

$H \rightarrow WW$ Decay Channel:

We can see clearly that there is excess data after we have subtracted the background events, this may indicate the presence of the Higgs Boson.

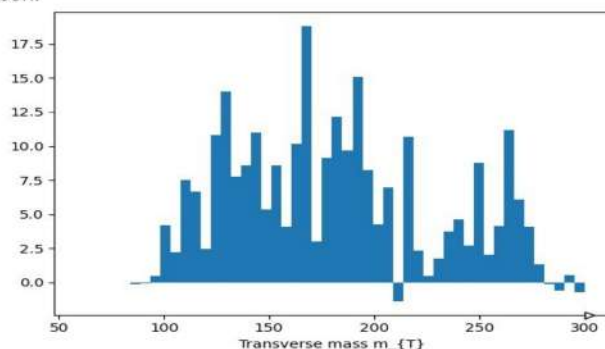


Fig 5: Histogram showing transverse mass distribution of two W bosons

Conclusions

From the $H \rightarrow \gamma\gamma$ channel, we can conclude that we have not found the Higgs. We suspect that if we had been able to import more data, then we may have been able to observe a more significant bump at 125 GeV. The expected Histogram, extracted from Jupyter Notebook 6⁽³⁾ is attached below for comparison (Fig 6).

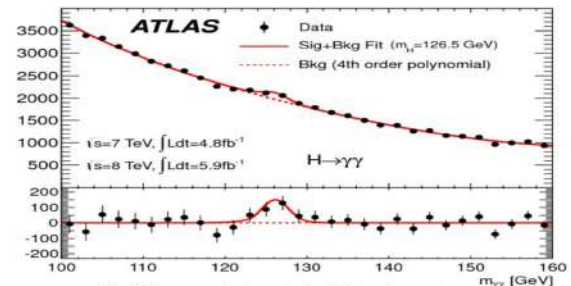


Fig 6: The expected results for $H \rightarrow \gamma\gamma$ decay channel

From the $H \rightarrow WW$ boson, there is clearly an excess of leptons of the correct form in the real ATLAS data when compared to data from the Monte Carlo simulations. So long as the model of our background data is accurate enough to not leave out a significant other decay that produces 4 leptons with the same charges, flavours and energies, we can conclude that our calculations suggest that we have evidence for the existence of the Higgs boson. The Histogram showing the expected distribution of the Higgs boson's transverse mass taken from the ATLAS Open Data website⁽⁴⁾ is attached below for comparison (Fig 7). Had we used a set of data with many more events, our graph would likely more closely resemble the one shown below.

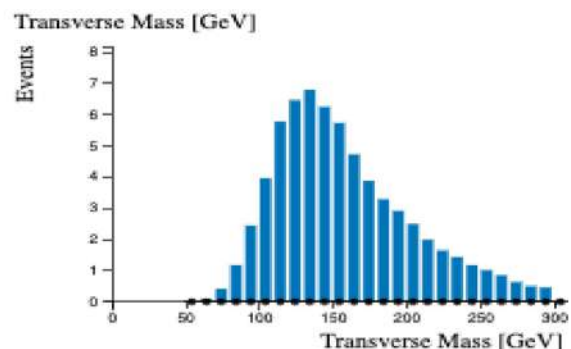


Fig 7: Expected results for $H \rightarrow WW$ decay channel

Acknowledgments

We would like to acknowledge our lecturer Naomi for supporting us throughout our project.

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Original Research Are Some People More Susceptible To Phishing Scams Than Others?

Truro College

Phoebe O'Neill

Abstract

The aim of this piece of research is to investigate whether different demographics of students are more or less likely to spot phishing scams.

I gathered some students that study predominantly STEM subjects or arts subjects (to represent different demographics of people) and tested each student's ability to differentiate between genuine emails and phishing scam emails. For this, I used a program called the Phishing Email Suspicion Test (PEST), which allows the participant to rate 20 emails depending on how 'suspicious' each email seems to them.

After carrying out the experiment, I found that there was essentially no difference in score between the two demographics. This could suggest that it is not one specific 'type' of person who is more at risk of falling for scams than others, but instead people of any background are at risk of being scammed; meaning it is equally as important for everyone to be aware of who they are communicating with online, and what they are clicking on.

Introduction

Social engineering is generally defined as the practice of obtaining unauthorised access to information through human interaction. It is very common for 'hackers' or 'scammers' to use social engineering as a tool to gain passwords/other login details to access private data, or convince their victims to give them money. To the average eye, many of these kinds of scams can be relatively obvious, however they are ever-evolving and some more sophisticated methods (including using AI) can catch even the wariest of people out, with potentially drastic consequences.

For example, 43% of businesses in the UK reported data breaches or cyber attacks within the past 12 months. 86% of those attacks were phishing attacks, demonstrating their prevalence in the current digital landscape. Furthermore, a successful cyber attack or data breach costs a business, on average, £3,660 in the short term. However, this number of attacked businesses has decreased since 2024, where 50% of businesses reported data breaches. This is largely due to a rise in companies with cyber security strategies such as risk assessments, insurance and employee training.^[1]

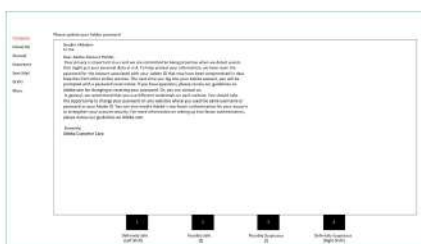
Many people fall victim to these scams simply because they are not aware of the signs that suggest an email or text message is ingenuine. These include misspelled domains, grammar mistakes, and unnatural language.

My research set out to find out more about the differences in ability to spot phishing scams between different demographics and highlight the importance of raising awareness to ensure people are not caught out by these scams, as their effects can be devastating for companies and individuals alike.

Experimental Method

To investigate whether some people are more likely to fall for scams, I chose to test two different demographics of students – STEM and arts students. For this test, I adapted a piece of software called the PEST test (Phishing Email Suspicion Test), developed by Hakim et al. at Arizona university in 2020.^[2]

Participants were collected via opportunity sampling – those who were available and willing to participate over the course of the experiment. They were determined to be in either the STEM student condition or the arts student condition using a list of STEM and arts subjects – to be considered part of one condition, a student must take 2 or more subjects from one list, and none of the other. Those who took one or more from both lists were excluded from the study.



Above: The screen that the participant sees when reading each email.

Right: the list of subjects used to determine participants' condition in the experiment

STEM
• Maths
• Further Maths
• Statistics
• Physics
• Chemistry
• Biology
• Medical Science
• Environmental Science
• Geography
• Computer Science
• Engineering
• Electronics
Arts
• English Language
• English Literature
• Fine Art
• 3D Design
• Fashion
• Textiles
• Illustration and Graphics
• Photography
• Music
• Drama and Theatre
• Film Studies
• Dance

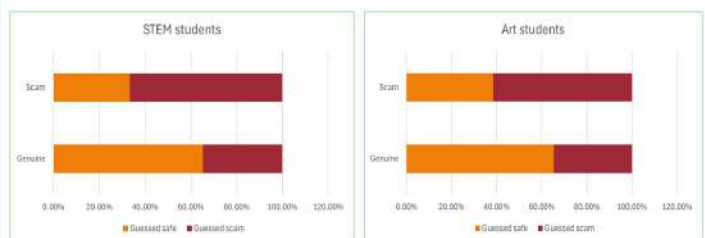
At the beginning of the test, each participant entered a subject ID (names and other personally identifying details were not recorded), their age and which condition they belonged to (STEM or arts).

The program uses a database of real emails - both genuine and scam - and presents the participant with 20 emails chosen randomly. The participant must decide whether each email is 'safe' or 'suspicious'. If they decide correctly, they gain points, and if they decide incorrectly, they lose points.

There are four options to select for each email: 'Definitely Safe', 'Possibly Safe', 'Possibly Suspicious', and 'Definitely Suspicious'. If they select the 'Definitely' option, they gain/lose 2 points, and if they select the 'Possibly' option, they gain/lose 1 point. Therefore, the scores for each participant range from 40 to -40.

Due to some issues with the laptop used, the program crashed frequently and was unable to get a full set of 20 emails from every participant. As a result, I chose to split the complete sets of data into two groups of 10 emails, and using only the first 10 results from the incomplete sets. This resulted in 10 sets of results per condition, or 100 emails.

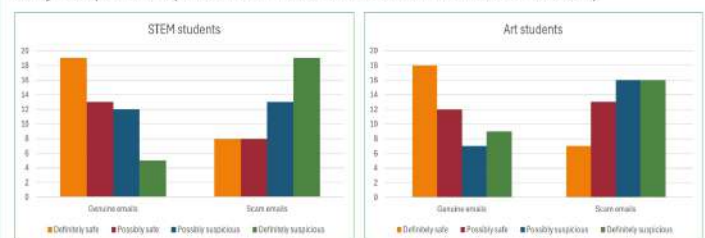
Results



Percentage of 'safe' and 'suspicious' answers per type of email

According to these results, STEM students were able to guess correctly 66% of the time on average, and arts students were correct about 63% of the time. The average score in the STEM condition was 5.7 (standard deviation was 4), and the average for the arts condition was 4.6 (standard deviation was 3.4).

As shown in the graphs below, the results are very similar: both conditions were equally as confident (STEM chose 'definitely' 52% of the time, arts 51% of the time), and equally as cynical (STEM suspected emails were scams 50% of the time, and arts 49%).



Answers for each email categorised by whether they were actually genuine or scam emails

Analysis and conclusions

I found it interesting that for both conditions, the results were not skewed in a particular way – participants tended to choose the 'definitely' and 'possibly' options equally as often as each other ('definitely' 52%, 'possibly' 48%).

I used the individual scores in a student's t test to determine whether the difference in average score between the two conditions was significant.

As there were 10 sets of data per condition, I used 18 as the degrees of freedom. The calculated t value was 0.659, which, at the 10% significance level (df = 18), was not greater than the critical value 1.734. This suggests that there is not enough evidence to support the idea that there was a significant difference in mean scores between STEM students and arts students.

While this piece of research was small, and only conducted on students of one college, it could suggest that a person's ability to identify a phishing attack does not correlate to their choice of career (or in this case, area of study), and that whether someone falls for a phishing scam is more down to the individual's own experiences and knowledge.

Acknowledgments

Thank you to the fellow students who agreed to participate in the study, and to my lecturer Naomi, who encouraged me throughout this project.

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Optimising Oligonucleotide Origami for Targeted Drug Delivery

Rudy Fine | Truro and Penwith College | IRIS Conference 2026

Introduction

DNA origami is a technique in which a long single-stranded scaffold DNA (M13 bacteriophage, 7,249 bases) is folded into precise nanoscale shapes using hundreds of short synthetic 'staple' strands (1). The resulting structures can be designed at sub-nanometre resolution, making them ideal candidates for targeted drug delivery.

This project asks: which DNA origami geometry offers the greatest structural stability and efficacy for drug delivery applications? Three novel structures were designed using scadnano (2) and submitted to IRIS for thermal stability analysis (3).

Research Aims

- Design three distinct DNA origami nanostructures (~7,000 bases each) using scadnano software
- Assess the thermal stability of each design using IRIS computational analysis
- Compare structural stability, drug encapsulation potential and targeted delivery capability
- Propose refinements for the designs

Method

1. Scaffold Design

- Loaded empty template in scadnano
- Added 24 helices in square lattice grid
- Set maximum offset: 288 bases per helix (divisible by 32)
- Drew scaffold domains and connected crossovers
- Ensured scaffold forms one continuous loop

2. Staple Routing

- Placed seam staples (8-24-8 base pattern)
- Added edge staples (16+16 bases)
- Placed S-shaped staples (8-16-8) in interior
- Verified no overlapping domains
- Assigned M13 (p7249) scaffold sequence

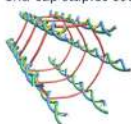
3. Export & Analysis

- Verified helix length divisible by 32
- Staples coloured by structural role
- Exported cadnano v2 (4) .JSON and .CSV
- Submitted designs to IRIS via researchschools.org

Designed Structures

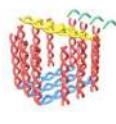
Nanotube

- 6,912 bases, 24 helices in 4x6 grid
- Cylindrical hollow channel structure
- Drugs loaded via intercalation into base pairs
- Open ends allow passive drug release
- Well-studied in cancer therapy research
- Open ends may allow unwanted drug leakage – addition of end-cap staples could prevent



Drug Delivery Box

- 6,912 bases, 24 helices
- Hollow cuboid with aptamer locked lid; high encapsulation potential
- Opens on binding target protein; high targeted drug capability
- Based on Andersen et al. (2009) Nature design (5)
- Lid (gold), walls (red), base (blue), locks (green)



Geodesic Sphere

- 6,912 bases, 24 helices in circular layout
- Truncated icosahedron geometry (C60)
- Skips at pentagon vertices induce curvature
- Loops at inner helices balance geometry
- Spherical shape distributes stress evenly
- Potentially most stable – no weak hinge regions



Results & Analysis

Predicted Stability Comparison

Structure	Bases	Stability (predicted)	Drug release
Nanotube	6,912	Moderate	Passive
Box	6,912	Moderate-High	Triggered
Sphere	6,912	High	Passive

Key Findings

- All three designs achieved ~6,912 bases, meeting the ~7,000 base target
- Helix lengths set to 288 bases – divisible by 32, satisfying software requirements
- The box design offers the most clinically relevant drug delivery mechanism via aptamer-triggered release
- The geodesic sphere is predicted to be most structurally stable due to even stress distribution
- Simulation run by IRIS researcher revealed staple strands detaching from scaffold – due to overstretched crossover bonds across all three designs

Iterative Design & Refinements

- Simulation feedback from IRIS revealed that staple strands detached from the scaffold across all three designs. The cause was overstretched crossover bonds – staples had been routed between helices that were too far apart in 3D space. Scadnano does not prevent geometrically impossible placements, so this was a design error rather than a software fault. My next iteration will use shorter, localised crossovers between immediately neighbouring helices, with full scaffold coverage throughout. Importantly, this misstep highlights the iterative nature of DNA Origami research, which routinely requires multiple design cycles.
- Beyond routing corrections, this project also proposes incorporating **triplex DNA (Hoogsteen base pairing)** at key structural regions. This involves a third oligonucleotide strand binding within the major groove of the double helix, physically blocking nuclease access and significantly extending the structural lifetime of the nanostructure in vivo (6). This has major benefits for the clinical viability of DNA origami drug delivery systems.
- The use of a honeycomb lattice, rather than a square lattice, will allow closer packing of helices (7), preventing drugs from escaping through gaps in the structures, improving the accuracy of delivery.
- The addition of a lipid bilayer would seal gaps between helices, further reducing drug leakage – whilst also working to reduce enzyme degradation of the DNA (8).

Conclusion & Limitations

Conclusion

- The box is most clinically promising due to aptamer-triggered release mechanism, where the short, synthetic oligonucleotide aptamer binds to a specific, complementary target and releases the 'lock' opening the box
- The sphere structure will likely be the most stable due to even stress distribution across its surface
- Routing corrections necessary for future simulations
- I have proposed several refinements for optimisation of drug delivery

Limitations

- Scadnano approximates spherical geometry on a flat, square lattice – may not replicate real behaviour
- All analysis is computational, not experimental. Since physical synthesis (~£1,000 per design) is beyond project scope
- Cannot incorporate triplex DNA using scadnano

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Is there naturally occurring hydrogen gas in Cornwall?

TRURO & PENWITH COLLEGE

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Summary

In the second year of our ongoing research, we aim to find if there is naturally occurring hydrogen (H₂) being produced in the granite and serpentine in Cornwall through the processes of radiolysis, redox reaction of biotite and serpentinisation respectively. So far, we have collected 22 gas samples at sites of interest around Cornwall, we have had them analysed at the Royal Holloway University of London's (RHUL) climate science laboratory and Bristol University's atmospheric chemistry research group. From our analysis we have evidence that the St Austell and Cammenellis granites may be releasing natural H₂ at depth, as seen by our anomaly at Eden and United Downs Geothermal power plants which are about 50 times larger than any other reading. We are planning to revisit all sites and expand our research area in the future.

Introduction

The need to go green to protect our environment is evident. H₂ gas will be part of the solution but producing it requires a huge amount of energy. It does occur naturally in rocks and if we can find it in large enough quantities, it could be part of the sustainable solution. Cornwall may be the answer as it's granite and serpentine may be producing H₂. 80% of the world's natural hydrogen is produced by serpentinisation, and a lot of the rest by radiolysis and hydrolysis of biotite in granite. In this study we aimed to identify whether naturally occurring hydrogen exists in Cornwall by collecting samples around the county and having them analysed. Following on from last years pilot study we have conducted more sampling around Cornwall.

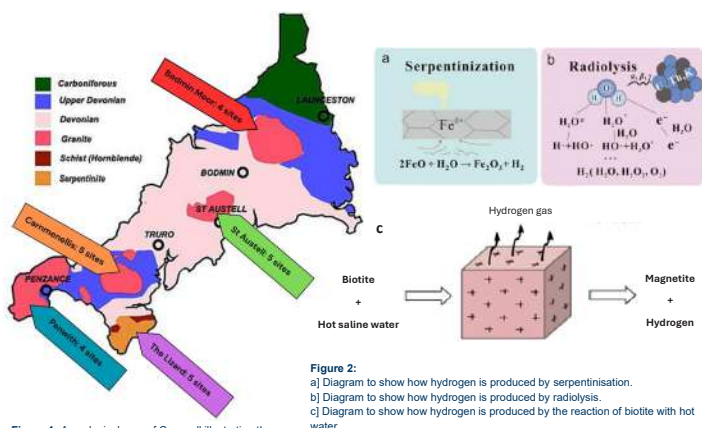


Figure 1: A geological map of Cornwall illustrating the locations of our chosen sampling sites and the target rocks.

Method

We chose our sites based on lithology (presence of granite and serpentine), and a lack of pollution sources (town / road proximity and wind direction). A control site – a westerly-facing cliff with onshore, prevailing wind – was chosen to record background levels of hydrogen. So far, we have sampled each site up to 4 times. We collected air samples at each site using a gas pump and canister, ensuring we were not sampling over soil as H₂ is created by soil microbes.

We used an environment meter to record air pressure, temperature, wind speed and direction, location coordinates, and any notable features. These were recorded as this is brand new science as no one really knows what might be affecting the amount of H₂ emitted from the ground. For example, high air pressure may stop H₂ from coming to the surface.

Samples were sent for laboratory analysis, testing for H₂, carbon monoxide (CO), carbon dioxide (CO₂), and methane (CH₄). The carbon-based gases were recorded as hydrogen can be created during combustion of fossil fuels along with these carbon-based gases. If the carbon-based gases are low and the hydrogen is high, we can be more confident that the H₂ is not from a pollution source



Figure 3: Sampling in at South Crofty mine.

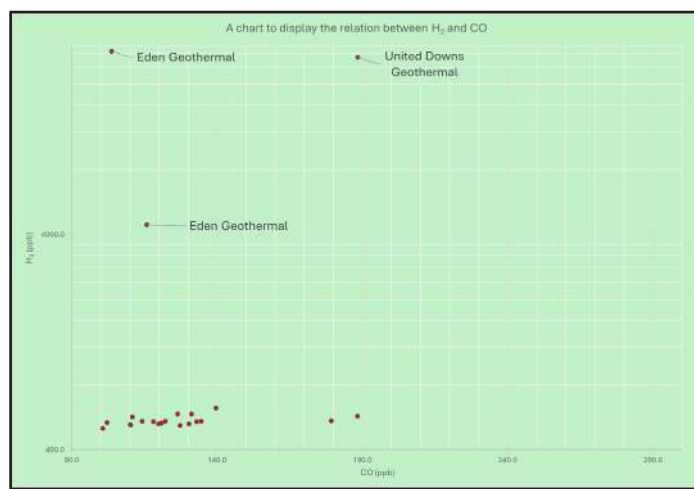


Figure 3: The pump and gas canister used for taking samples.

Erin Bryant, Miles Townsend, Maisie Tutt, Henry Cooper, Caisie Mullen, Freya Smith, Tom Jago, Andrew Root, Bill Armstrong, Edward Halton, Alyssa Pellow, Sophie Priddle, Maisy Blomfield and Adam Ashwin.

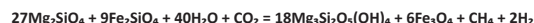
Results

As shown in Figure 5, on average across all our sites we are finding approximately 550ppb, however when we sampled from just above the filter flush water at Eden and United Downs geothermal power plants, we found over 26,000ppb at both. Filter water was sampled (this comes directly from depth in the borehole) to capture any H₂ exsolving from it. Eden is over the St Austell granite, and United Downs is over the Cammenellis granite. At both sites, the levels of CO and CO₂ were similar levels to other sites across the county. Methane at both, however, is much higher, in fact more than twice the levels of elsewhere. Eden geothermal has now been sampled a total of 4 times, background here is the same as the county average. Further samples have been taken at increasing time from the start of the filter flush, and this shows the H₂ decreasing over time, as we would expect the gas is exsolving from the water very quickly as soon as the pressure is released during the flush.



Analysis and conclusions

Our Eden and United Downs geothermal results show that H₂ could be being produced by radiolysis and / or redox reactions in the granite, due to the elevated amount of radioactive material found in the granite in the past (shown by historical records) and the fact that it is very biotite rich. This is a very exciting development and is something we are going to pursue. Both sites are boreholes for small / medium scale geothermal powerplants that help to run the biomes at The Eden Project and supply energy to the national grid at United Downs. The depth of both boreholes is approximately 5km and they descend to intersect fracture zones. This allows saline water to percolate through the granite, react with minerals, such as biotite to produce magnetite and H₂. The geothermal water must be filtered before it goes to the heat exchangers to avoid clogging. We tested the black powder in the filters with a magnet to prove it was magnetite, indicating that this H₂ could be produced by a redox reaction such as the one below.



These huge anomalies could be due to a pollution source but because of low levels of CO, and CO₂ this is unlikely.

The CH₄ concentrations were elevated at both locations; we believe due to the reactions with the biotite, see the reaction above. It could also indicate extremophiles at depth, which could be using the H₂ as an energy source and producing CH₄ as a waste product. Therefore, reinforcing the idea this anomaly is naturally occurring H₂.

The areas where the H₂ is low could of course mean that the rocks producing H₂ are capped in some way trapping the hydrogen underground. This could result in economic quantities of the gas.

The future: we aim to take more samples at all sites and expand our area to include more sites. We would like to pursue a campaign of more underground samples from boreholes and mines etc. We hope that this will identify any trends in hydrogen levels and ultimately prove that Cornwall could be part of the natural hydrogen revolution.

Acknowledgments

We would like to thank the following for their help and support: The Royal Society, RHUL, Bristol University, Professor David Waltham, Dr Rebecca Fisher, Isaac Standen, Dr Valentin Laurent, Dr Kieran Stanley, Samuel Wieck, Dr Alan Taylor and Mandy Winstanley.

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Trips & Visits 2026

GO FURTHER

Accelerate students have travelled from Exeter to Geneva this year, visiting universities, research facilities and some of the world's leading scientific institutions.

At the University of Exeter, students built their own STEM taster day from three subjects, experiencing university-level lectures in areas including physics, mathematics, engineering and computing.

A visit to Rutherford Appleton Laboratory took students behind the scenes of major scientific research, from its data centre to detector technology used at CERN and the Super-Kamiokande neutrino observatory in Japan.



The visit supported an IRIS research project investigating the detection of the Higgs boson.

Further afield, our Geneva residential took students to CERN, where they visited the data and control centres and explored superconductivity through a hands-on laboratory workshop. The trip also included visits to the United Nations and Patek Philippe Watch Museum.

Closer to home, students travelled to Pembroke College, Cambridge for a residential during the University Open Day, followed by a visit to Oxford on the journey home.

Accelerate competition teams also travelled to Upottery Airfield for the regional CanSat launch and to the STEM Learning Centre in York for the CanSat UK final, where students also heard about new technologies being developed to safely deorbit satellites.



Talks & Experiences

MEET THE PEOPLE DOING EXTRAORDINARY THINGS

Accelerate brings students face-to-face with people working at the forefront of science, engineering, research and industry - giving them the chance to discover where their subjects can take them and to ask questions of people who have actually been there.

This year, students heard from Dr Vincent Smith, a CERN physicist who shared stories from a career in particle physics - including working alongside thousands of scientists on the discovery of the Higgs boson.

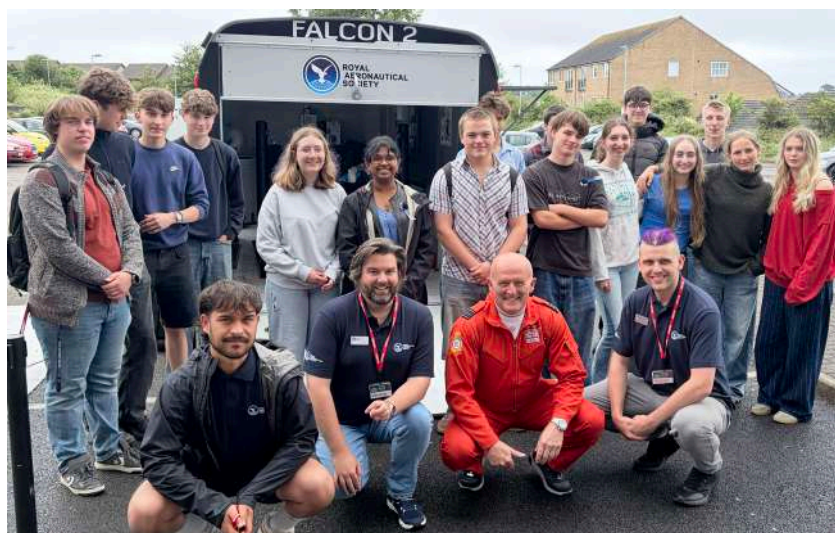
Other sessions ranged from mathematical chaos and traffic modelling to chemical engineering, nuclear decommissioning, environmental science, medicines, sustainability, marine biology and Arctic expeditions.

Students also heard first-hand about careers in the growing space industry, while Project Altitude, delivered with the Royal Aeronautical Society, brought aerospace to life through engineering challenges, a flight simulator and an incredibly popular session with former Red Arrows engineer Ross Priday.

Beyond the visiting programme, our Astro Pi students also earned the opportunity to join a live Q&A with an ESA astronaut as part of their successful mission.

Guest Speakers 2025-2026

Dr Vincent Smith - CERN & Particle Physics
Dr Daniel Moore - Marine Biology & Arctic Expeditions
Tom Knowles - Nuclear Engineering & Decommissioning
Mike Waters - Nuclear Environmental Management
Dr David Hassell - Chemical Engineering
Dr Isabel Hamshaw - Molecules to Medicines
Garry Packer - Chaos & Mathematical Modelling
Amy Payne - Sustainability & Environmental Science
Mark Loveday - Space Industry & Mission Control
Mike Grocott - IRIS & Independent Research
Jake Chatfield - University & Sixth Form
Luca Parmitano - European Space Agency Astronaut
Ross Priday - Red Arrows & Aeronautical Engineering



Project Altitude: Royal Aeronautical Society & Ross Priday (Red Arrows)

Maths & Computing Competitions

UKMT Senior Maths Challenge: **10 Gold, 31 Silver, 26 Bronze**

UKMT Maths Olympiad for Girls: **2 Merits**

UKMT Maths Challenge for Girls: **3 Distinctions, 13 Merits**

UKMT Kangaroo Challenge: **3 Bronze**

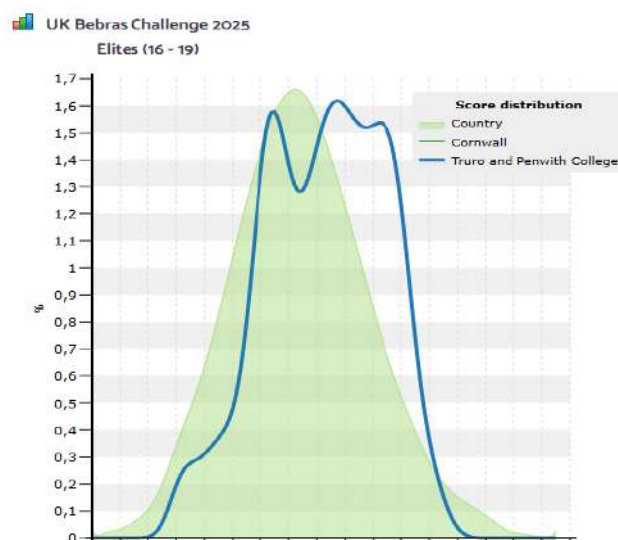
UKMT Maths Olympiad: **1 Merit**

Bebras Programming Challenge: **5 Gold, 4 Distinction, 9 Merit**

Raspberry Pi Programming Challenge: **6 Distinctions**

Melika Jalili-Mehrabani came joint **86th out of 4293** students nationally in the hardest category

Lola Hill came joint **1st out of 10820** students nationally in her category.



Our students averaged 82.3% compared to the national average of 74.2% in the Bebras programming challenge.

2026 Accelerate Destinations

University of Oxford - Engineering · Biology

University of Warwick - Economics · Mathematics · Discrete Mathematics

University of Southampton - Geology · Electronic Engineering · Mechanical Engineering / Sustainable Energy Systems

University of Bristol - Physics · Geography with Study Abroad

Durham University - Geology

University of Bath - Pharmacy

University of Exeter - Robotics & Artificial Intelligence

Cardiff University - Chemistry

Swansea University - Computer Science & Cyber Security

University of Brighton - Aerospace Engineering

University of Plymouth - Biomedical Science

University of Sussex - Mathematics with Foundation Year

Bath Spa University - Psychology, Education & SEN

The Future of Accelerate We're just getting started...

Last year, we wrote about our ambition to make Accelerate bigger: more projects, more research, more opportunities and more ways for students to take their interests beyond the classroom.

This year, much of that ambition became reality.

Accelerate students designed satellites and launched rockets. They engineered racing cars, investigated water pollution, modelled DNA nanostructures and searched for evidence of the Higgs boson. Their code ran aboard the International Space Station. They visited CERN, Oxford, Cambridge and national research facilities, worked alongside scientists and engineers, and presented their own research on a national stage.

Along the way came national finals, engineering awards, Industrial Cadets awards and recognition for outstanding student research. While it's fantastic to see the trophies and certificates - and Accelerate students have collected plenty of them - what matters even more is seeing our students given the freedom to try something difficult, discover what they're capable of, meet people doing extraordinary things and begin to see themselves as the scientists, engineers, researchers and innovators of the future.

Accelerate will keep growing, with new projects, new partnerships and new opportunities for Cornish students to go further.

"The aim has always been simple: find curious students, give them opportunities, and see what they can do." - Alex Wyld, Accelerate Programme Coordinator

So, what will you do next?

Thank you to our partners and sponsors for helping us create extraordinary opportunities for students across Cornwall.

To enquire about sponsoring future Accelerate student-led research or projects please email:
alexwyld@truro-penwith.ac.uk



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