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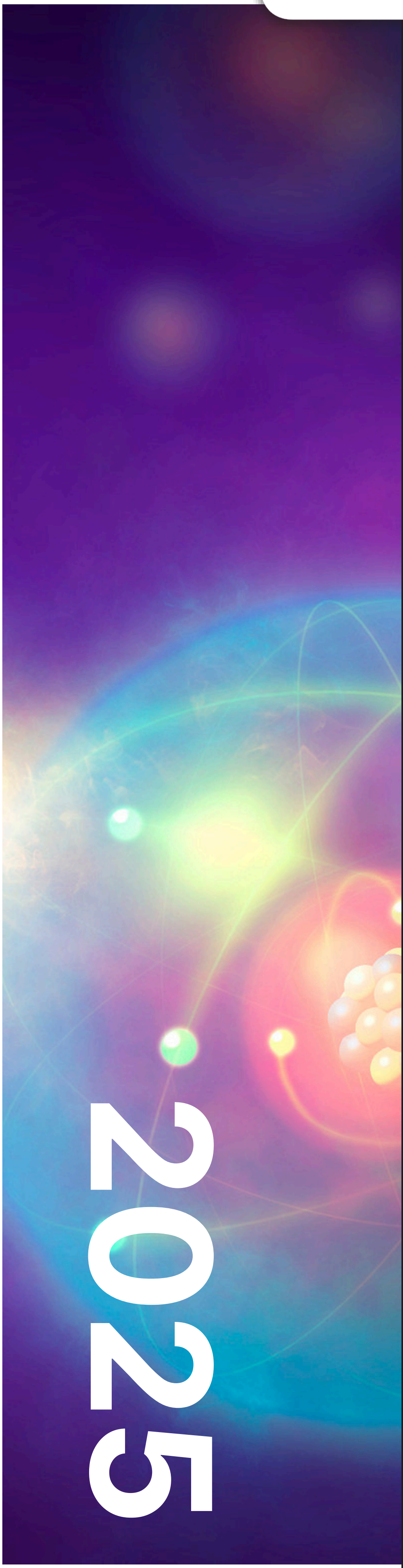
INYUVESI YAKWAZULU-NATALI

COLLEGE OF AGRICULTURE, ENGINEERING AND SCIENCE



STEC@UKZN

Physics RESEARCH CAMP

In partnership with :

Friedrich-Alexander Universitat Erlangen-Nurnberg

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stec@ukzn.ac.za.
www.stec@ukzn.ac.za

Special Thanks

To our partners,

Your contribution made it possible for 13 high-school learners to experience authentic, mentored research—designing experiments, collecting and analysing data, and presenting their findings with confidence. This practical backing translated directly into better learning: stronger experimental designs, higher-quality data, and richer conversations about physics and future STEM pathways. We were especially encouraged by the growth in learners' skills and confidence over the week and by their intention to pursue maths, physics, and engineering at higher levels. Your sponsorship therefore supports more than a single event—it strengthens the skills pipeline in our region and widens access

FAU Friedrich-Alexander-Universität Erlangen-Nürnberg

Eskom EXPO FOR YOUNG SCIENTISTS — DISCOVER YOUR FUTURE

Group Photo on the last day of the camp (18 July 2025) of mentors and participants after receiving certificates of participation.

Executive Summary

This report documents the planning, delivery, and outcomes of the 5-day UKZN Physics Research Camp held from 14–18 July 2025. Nine (9) high-school learners participated in mentored, inquiry-based projects aligned to real-world physics themes (energy, environment, motion, measurement). The camp aimed to strengthen research skills, scientific thinking, and interest in STEM pathways, while showcasing UKZN's facilities and academic support initiatives (e.g., STEC).

Highlights

- Learners completed 8 mini-investigations and improved their conceptual understanding of several physics phenomena.
- Mentorship by UKZN staff/postgraduates using non-formal education methods (hands-on, collaborative, reflective).
- Safety, ethics, and scientific communication were explicitly taught.
- Learners developed several skills or competencies such as: Communication, Critical Thinking, Scientific Inquiry, Presentation Skills

Image of the mentors and participants in the laboratory.
The Physics first year laboratory on the Westville campus was used as the primary venue for the physics Camp.

Our Team

Our mentorship team was intentionally interdisciplinary and multi-level, blending science communication specialists with mentors from physics, applied mathematics/data analysis, chemistry/chemical engineering, environmental science (GIS/remote sensing), geology, electrical engineering, and mechanical/mechatronics engineering. This mix meant learners received bench-side support that was both rigorous and practical: PhD and master's mentors safeguarded scientific method, safety, and feasibility; honours and 2nd-year near-peer mentors made the lab approachable, reinforcing core concepts just covered in their own studies.

The variance in specialisation ensured every team could access the right expertise at the right time, while the variance in seniority modelled authentic research collaboration and widened the range of relatable role models for learners.

Verlan Moodley

Physics: Molecular Optics

Bolelang Tsolo

Environmental Science

Steve Camp

Applied math & physics(Undergrad)

Thembelihle Gumede

Applied Chemistry & chemical engineering

Mohammed Khan

Electrical Engineering

Sinothando Mndali

Environmental & Engineering geology

Simphiwe Mkhasibe

Applied mathematics

Whitney Mtolo

Mechatronics

Dr Tanja Reinhardt
Science Centre Coordinator/ Curator

Lexia Naidoo
Physics and Physics Education

Background & Objectives

The Physics Research Camp is a outreach and STEM-development initiative which provides authentic research experiences. Learners design and conduct small-scale investigations, thereby developing scientific habits of mind and exposure to university research culture.

Rationale

- Bridge the gap between school science and authentic inquiry.
- Improve readiness for university STEM programmes.
- Support the national skills pipeline in physics, engineering, and data science.

Objectives

1. Develop learner competence in the research cycle: question → plan → measure → analyse → communicate.
2. Build confidence, curiosity, and persistence in problem-solving.
3. Strengthen awareness of physics careers and UKZN pathways (access/support programmes).
4. Foster mentoring relationships between learners and UKZN students/staff.
5. Produce tangible outputs (lab notebooks, datasets, posters) suitable for school science fairs.

Program design

The camp followed an inquiry-based, learner-centred model with mini-inputs and lots of hands-on time. We used non-formal education strategies (collaboration, reflection journals, rapid prototyping) and explicit teaching of science communication.

Daily Sequence (Simplified)

- Mini-input (skills/methods) → Team planning → Lab/field work → Data capture → Reflection → Share-outs.

The camp opened on Monday at STEC with registrations, a warm welcome, and short learner project pitches to surface interests and match mentors. After a focused lab-safety briefing, teams began setting up their investigations before returning to hands-on work in the afternoon—energised by a mid-day science show that helped frame the spirit of inquiry for the week. From Tuesday to Thursday the programme shifted into the Physics First-Year Laboratory (H-Building), where long morning and afternoon bench sessions—punctuated by brief tea breaks and a shared lunch—gave learners uninterrupted time to plan, trial, and iterate on methods with mentors circulating for just-in-time support.

This steady rhythm allowed groups to move from initial feasibility checks to more systematic data collection and refinement, with growing attention to how they would communicate results. On Friday, teams consolidated their findings and prepared for the showcase, then toured selected research labs while the teaching space was cleaned and reset. The week concluded with learner presentations, acknowledgements, and certificate hand-overs—closing a programme that blended safety, structure, and sustained mentorship with plenty of space for curiosity, problem-solving, and scientific communication.

Learner Profiles

Learner name:
Khethelo Ntshangase

High School:
Adams College

Grade: 11

Project Title: Measuring the efficacy of Zeolite as a CO_2 Scrubber.

Summary:

"My project was to see if I would be able to filter out carbon dioxide from burning organic waste like paper using a natural filter, zeolite. I created a prototype using a cardboard can. I created two holes to attach tubes which would allow carbon dioxide censors to measure the amount of Carbon dioxide remaining. The results were promising as I made a last minute discovery that the CO_2 sensors were sensing the CO_2 in the Zeolite. I realized that even though my results were incorrect, this is part of the scientific process."

Project Title: Investigating the absorption of light by solar panels, when different materials are used.

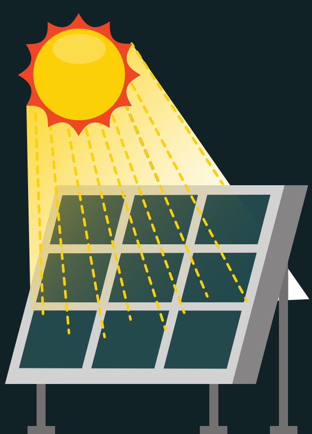
Learner name:
Shriyaan Rampersad

High School:
Amanzimtoti High School

Grade: 11

Summary:

I chose this experiment because I was curious about how solar panels work and how simple, affordable changes could improve their efficiency. With load-shedding being a constant issue in South Africa, I wanted to test real solutions using basic tools. This week, I tested the panel with different coloured light filters, built a foil box to reflect more light, used magnifying lenses to concentrate it, and went out at different times of the day to see how sunlight angle and intensity affect current. I found that red and orange filters gave stronger readings, thin lenses worked better, and light conditions changed a lot throughout the day. I also saw that while temperature can increase current slightly, it drops voltage and lowers efficiency. This project showed me how small changes can make a big difference in solar performance.



Learner name:
Okuhle Mgobhozi

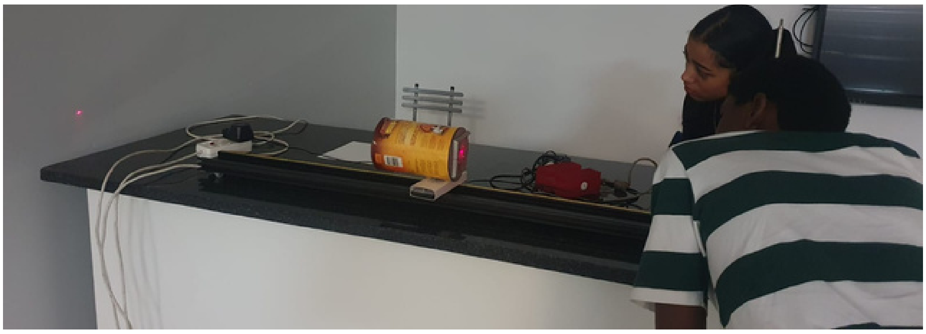
High School:
Amanzimtoti high

Grade: 11

Project Title: Understanding wave-particle duality of Light

Summary:

The purpose of this research project is to demonstrate wave-particle duality, with emphasis on wave nature of light. A laser was directed at the slits with a screen behind them. The slits were alternated from custom made slits to a strand of hair, and the interference patterns were observed on screen. Width of hair was calculated using fringe separation formula. An interference pattern of bright and dark fringes were observed making the constructive and destructive interferences visible.
The results support wave theory of light, highlighting properties such as interference patterns as well as showing that greater distances between slits and screen produce larger patterns as well as smaller widths of slits produce larger patterns. This experiment, even when performed with simpler materials, demonstrate foundational principles of the microscopic world as well as it serves as an entry point of understanding wave-particle duality of light.



Learner name:
Mihle Sihlahla

High School:
Adams college

Grade: 11

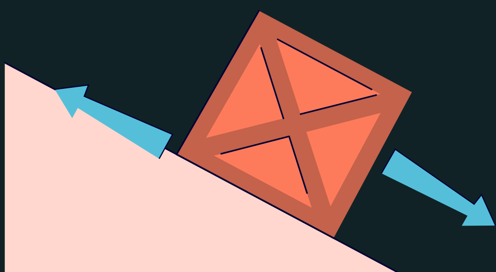
Project Title: Investigating the effects of different surfaces and masses on the frictional force and friction coefficient generated.

Summary:

“My name is Mihle Sihlala, I go to Adams College. I am 16 years old.

Curiosity can take you a long way in life. It all started with a fall, then that fall led to questions — why do I fall easily on tiles than the carpet? This led to a lot of research. What is friction? How do I calculate it? How does it affect us? Why does it affect us the way it does? A lot of questions crossed my mind, questions I never thought I’d get the opportunity to answer myself. STEC filled me with knowledge, adventure, confidence and made me feel recognized.

My project was about investigating how friction affects an object relative to angles, different surfaces and masses. I had a good experience and had a lot of fun making it. I would like to thank STEC and the staff for believing in me, seeing potential in me. This is a rare opportunity and I’m happy I experienced it.”



Learner name:

Luthando and Lunathi Mzindle

High School:

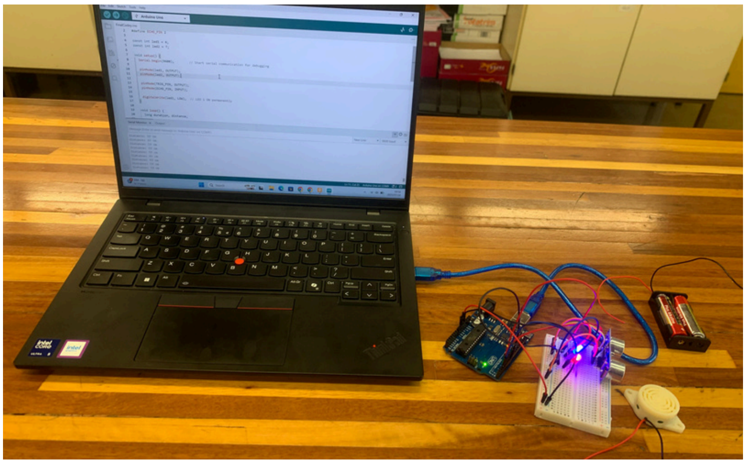
Anton Lembede MST Academy

Grade: 10

Project Title: Ear Alert: Reducing Kidnapping attempts through wearable GPS for children.

Summary:

This project was designed to imitate the functions of the Cartel solution by using Arduino Uno, Ultrasonic sensor HCSrour, LEDs. With the Arduino functioning as the brain of the circuit, the ultrasonic sensor imitated a GPS module as it calculated distance. Two LED lights were used (red and blue). When the object sensed by the ultrasonic sensor is above 15 cm then the blue LED will be on but the red LED will be off to indicate that the law enforcement has received victim's location data, and below 15 cm the red LED and blue LED will be on to show vibration feedback signal has been received. Resistance calculated using band method with 220 Ω ohms. Time response was calculated to determine how fast the alert is sent after detection. For instance, if the ultrasonic sensor detects presence in 1 second, the LED flashes after 1.2 seconds. The response time was 0.2 seconds.



Project Title: Polarized light and optical Phenomena investigation

Summary:

Re-enacting the Quantum eraser with three polarizers, the third being hand held and rotating. This showed how the angle of the intermediate polarizer affects what appears on screen modeling. The phenomenon of superposition and quantum measurement. Observing the effects of different tools, with most of the trials being successful and allowing me to better understand polarization effects.

Learner name:
Dominique Nagan

High School:
Apollo secondary

Grade: 11

Learner name:
Chinazam Ndiomaluke

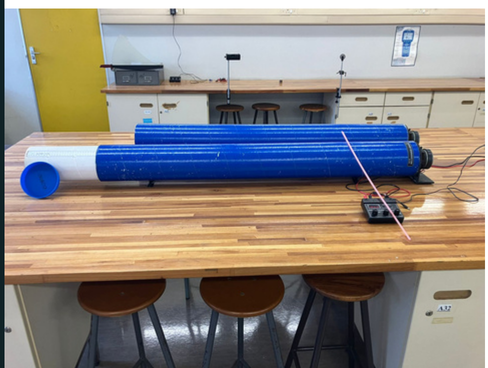
High School:
Brettonwood High

Grade: 11

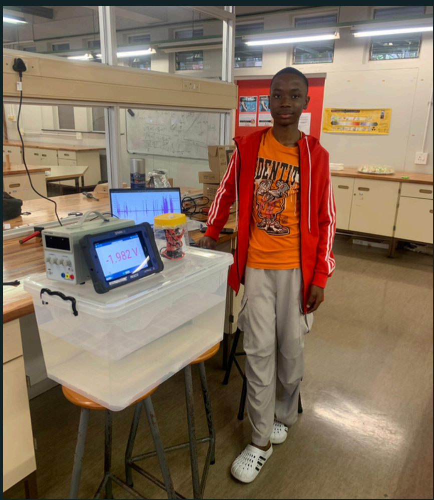
Project Title: Investigating the Physics of Musical Instruments

Summary:

So when I applied to this camp I was very interested in the relationship between sound and musical instruments. I aimed to understand them through three main experiments: standing waves on a string, sound waves in resonance chambers, and combining both experiments to understand musical instruments. I demonstrated this through a vuvuzela made from a straw. Through my project and research I was able to gain better insight into how musical instruments work and why their design is so important.



Project Title: Harnessing Ocean Wave Energy to Generate electricity



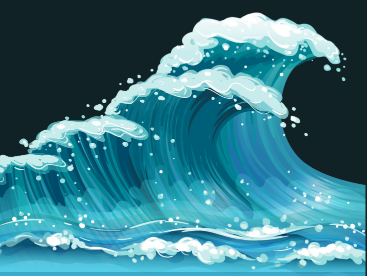
Learner name:
Azi Katleho Gambushe

High School:
Scottburgh High School

Grade: 10

Summary:

This project investigated generating electricity from the up-and-down motion of ocean waves using electromagnetic induction. A small-scale prototype consisting of a floating buoy, magnet, solenoid coil, LED, and waterproof container was built to model how wave motion can produce electricity. The study aimed to understand how oscillating motion creates electrical energy, how much can be produced, and its potential as a renewable source. Various tests were conducted, confirming that moving the magnet through the coil produced a voltage strong enough to power an LED, though insufficient for higher-power devices like motors or fans. Waterproofing was successful, and voltage measurements showed fluctuations corresponding to wave activity, with stronger outputs during more active wave motion. The results demonstrated that wave energy, even at small scale, can be harnessed to generate usable electricity.

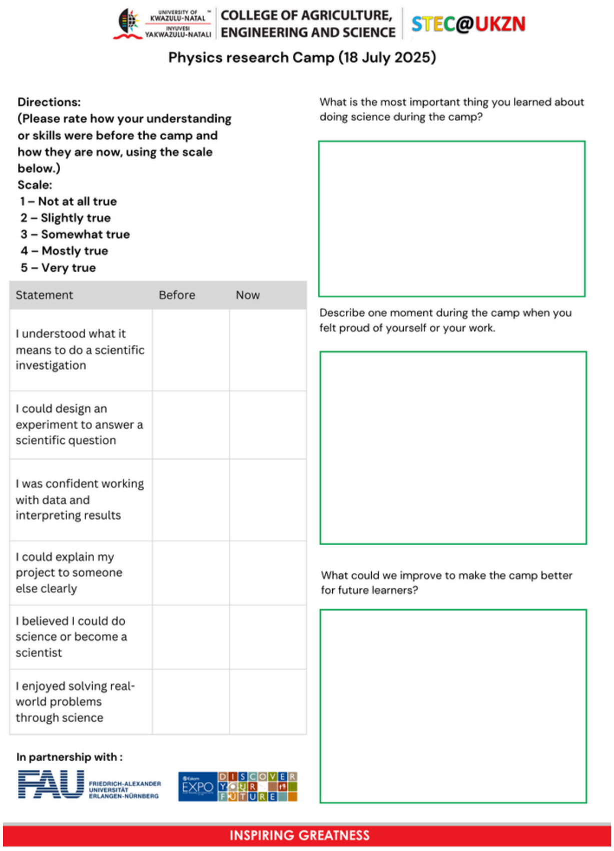


Feedback

To gather feedback and assess the impact of the research camp a survey and a set of interview questions were used.

Survey Analysis

The feedback from each student was recorded and the data compiled. Along side is the Survey template which was used. This was retrospective survey. For the next Camp, both a pre and post surveys will be conducted.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Physics research Camp (18 July 2025)

Directions:
(Please rate how your understanding or skills were before the camp and how they are now, using the scale below.)
Scale:
1 – Not at all true
2 – Slightly true
3 – Somewhat true
4 – Mostly true
5 – Very true

Statement	Before	Now
I understood what it means to do a scientific investigation		
I could design an experiment to answer a scientific question		
I was confident working with data and interpreting results		
I could explain my project to someone else clearly		
I believed I could do science or become a scientist		
I enjoyed solving real-world problems through science		

What is the most important thing you learned about doing science during the camp?

Describe one moment during the camp when you felt proud of yourself or your work.

What could we improve to make the camp better for future learners?

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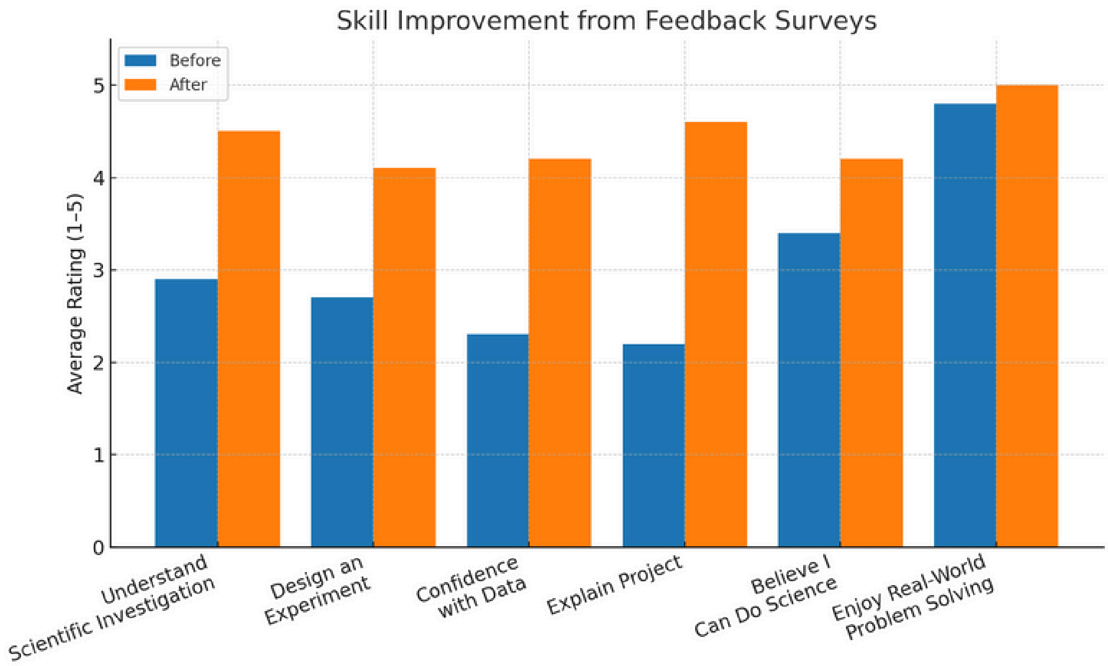
INSPIRING GREATNESS

Skills Improvement

Main takeaway:

- The biggest growth areas were explaining projects (+2.4) and confidence with data (+1.9).
- Learners already enjoyed real-world problem solving before the programme, so gains there were smaller.



Key Lessons Learned (Themes)

Recurring points across surveys:

- Resilience and persistence – "Failure is not the end," "Keep trying until you succeed," "Every attempt teaches something."
- Unexpected discoveries – Science can lead to outcomes you didn't expect; the process is as important as results.
- Real-world connections – Physics and coding link to real-life systems, showing science is everywhere.
- Value of mentorship – Guidance from mentors made troubleshooting and idea refinement possible.
- Collaboration and networking – Interacting with peers with similar goals was motivating and educational.

Proudest Moments

Learners most often mentioned:

- Completing a working prototype or experiment after multiple failures.
- Achieving measurable or visible results (e.g., interference patterns, resonance sounds).
- Being selected to participate or represent their school.
- Presenting their project successfully.

Suggestions for Improvement (Grouped)

Logistics & Duration

- Extend camp to a full week to allow more project time.
- Provide on-site accommodation to save travel time and increase focus.
- Offer a wider variety of food (including dessert).

Preparation & Support

- Inform learners in advance about Eskom Expo and competition requirements.
- Provide pre-camp mentoring or resources to help generate project ideas.

Mentorship & Learning Environment

- Match learners with mentors in their fields of interest.
- Ensure sufficient one-on-one guidance during experiments.

Overall Findings

- High impact: Significant increases in learners' ability to explain projects and handle data indicate that the programme is strengthening communication and analytical skills.
- Strong learner engagement: Enjoyment of real-world problem solving was already high and remained so after the camp.
- Empowerment through process: Learners consistently reported increased resilience and problem-solving persistence as major takeaways.
- Clear logistical opportunities: Extending the programme and improving pre-camp preparation could further boost project quality and learner confidence.

Interview highlights

Many of the participants arrived at the camp with limited or even negative perceptions of science. Okuhle, for instance, admitted he used to think science was boring and that scientists lived isolated lives, always "cooped up in laboratories." He was surprised to find that his tutor could hold a conversation about football. This small moment began to shift his assumptions. Similarly, Azile shared that he once believed scientists always achieved perfection in their work. However, after engaging in hands-on activities, he discovered that failure is not only common but also an essential part of the process. Chinazam echoed this, saying the camp helped her realise that "science is patience, being able to repeat an experiment and not letting failure stop you from trying to reach your results." Lunathi and Luthando supported this view, adding that they were surprised by how often they had to repeat their experiments. This evolving perspective was particularly valuable, as many learners encountered real challenges with their projects. Shriyaan, for instance, noted that environmental and atmospheric conditions, like rising temperatures, affected his results, requiring him to repeat some experiments to ensure accuracy. When asked if they planned to continue working on their projects after the camp, all participants expressed interest in doing so. Some intended to make small adjustments to improve their results, while others, like Khethelo, were inspired to explore new directions based on feedback from their mentors.