WORKSHOP OVERVIEW

Summary — This four-day hands-on STEM workshop will introduce students to the engineering journey behind a miniature vehicle and gliders, from understanding the forces that influence its movement to digitally designing, aerodynamically improving, and physically assembling a model car. Through guided activities, demonstrations, and engineering software, students will explore how scientific concepts are applied to real-world automotive and aerospace design.

INTENDED AUDIENCE & PURPOSE

Intended audience

- Students aged 11–16 years with curiosity in STEM, design, and problem-solving (no prior CAD experience required).
- Suitable for mixed-ability groups; activities are scaffolded from beginner to confident learner.

Purpose

- Build foundational understanding of the forces and design decisions that shape vehicle performance and stability.
- Introduce how engineers move from an idea to a digital model, then validate and improve it using simulation.
- Connect classroom science to real engineering workflows in automotive and aerospace contexts.
- Inspire future pathways in engineering, design, and advanced manufacturing through an engaging build experience.

FOUR-DAY PROGRAMME

Day 1 — Forces in Action

Students compare how Forces move cars on the ground and gliders through the air, building a clear picture of how engineers control motion, efficiency, and performance.

Key concepts introduced

- **Thrust** — the push/pull that drives a vehicle forward.
- **Drag** — air resistance that slows motion and reduces efficiency.
- **Lift** — upward force created by airflow; beneficial for gliders and critical to manage for vehicles.
- **Downforce** — a controlled "push down" that can improve grip and stability at speed.
- **Weight** — the force due to gravity, influencing traction, acceleration, and handling.
- **Stability** — how balanced and controllable the vehicle remains during motion.

Interactive demonstrations help students see these forces in action and understand how engineers balance them to achieve safe, stable, and high-performing designs.

Day 2 — Designing with CAD

Students are introduced to Computer-Aided Design (CAD) and learn how engineers transform an idea into a digital three-dimensional model.

Guided practical activity

- Use basic CAD tools to create a simple miniature car body.
- Learn how **shape**, **dimensions**, and **symmetry** affect both appearance and function.
- Work within clear **design constraints** (e.g., size limits, wheel/axle placement considerations, and simple geometric rules).

Day 3 — Exploring Aerodynamics

Students run a guided aerodynamic simulation on the basic car shape developed during the workshop and observe how air travels around the vehicle.

Simulation focus

- Identify areas of **high drag** and understand what design features cause turbulence or resistance.
- Explore how small shape changes can improve airflow and reduce drag.
- Develop the basic model into a more **streamlined** design based on simulation observations.

Day 4 — Assembling the Car

On the final day, students assemble a physical miniature car using pre-manufactured CNC bodies and 3D-printed components prepared for the workshop.

Hands-on build steps

- Identify components and understand each part's purpose in the overall system.
- Install wheels and axles and discuss alignment, rolling resistance, and fit.
- Connect how the vehicle's systems work together (structure, rolling system, and stability considerations).
- Complete final assembly with a focus on careful build quality and engineering thinking.

LEARNING OUTCOMES

By the end of the workshop, students will have gained introductory exposure to the following areas:

- [ ] Engineering Forces (thrust, drag, lift, downforce, weight, stability)
- [ ] Automotive and Aerospace Principles (how performance and efficiency are shaped by design choices)
- [ ] 3D CAD Design (creating a simple digital vehicle body with basic tools and constraints)
- [ ] Aerodynamic Simulation (observing airflow, identifying drag areas, and iterating on design)
- [ ] CNC Manufacturing (understanding how digital designs can become physical parts)
- [ ] 3D Printing (how additive manufacturing supports prototyping and component creation)
- [ ] Mechanical Assembly (wheels, axles, fit, alignment, and system thinking)

CLOSING STATEMENT / WORKSHOP IMPACT

This workshop enables students to experience how an engineering product progresses from scientific understanding and digital design to simulation, manufacturing, and final assembly. By building confidence with real engineering tools and workflows, students leave with a clearer view of how STEM concepts translate into practical, creative, and impactful careers.