Engineering, Design & Technology

Engineering, Design & Technology enables students to think, create and problem solve through the lens of an engineer. Knowledge is acquired through engagement with ambitious questions about how engineered systems work, using hands on experiments, material testing and digital simulations to investigate real world challenges. This process encourages curiosity, teamwork and evidence based reasoning as students refine ideas through practical testing and reflection. The experience enables students to gain understanding of engineering as a tool for creativity, innovation and purposeful engagement with the world of design and technology.

Course structure

Learning is structured around a six-phase Challenge that mirrors authentic engineering practice. This incorporates exploration of how physical forces behave as well as modelling and prototyping of solutions, and testing, evaluating and defending final designs. Students will explore how bridges support load, how rockets achieve stable flight and how design decisions influence strength, efficiency and performance. Throughout the programme, tutors guide learners in a structured cycle of inquiry, experimentation and iteration.

Skills gained

Engineering, Design & Technology enables students to demonstrate significant growth in their technical understanding, design capability and engineering mindset. They will be able to explain how forces and materials interact, interpret performance data, and articulate clear, evidence based reasoning behind their design decisions. Prototypes, whether structural or aerodynamic, will become increasingly sophisticated as students apply an iterative design process to refine strength, stability, and efficiency.

- Students strengthen their ability to **communicate** engineering concepts through precise vocabulary, structured explanations and well supported arguments.
- **Presentation skills** and **confidence** grow, with final competitions and engineering defences providing a platform to showcase understanding of design trade offs and performance outcomes.
- The programme cultivates **resilience, teamwork, creativity,** and **analytical thinking** – transferable skills that prepare learners for future studies in physics, engineering, design, and technology.
- Students leave with a deeper appreciation of how real engineers **investigate problems, test solutions,** and **use innovation** to shape the world around them.

Key learning objectives

- Deepen understanding of engineering by working through rich, practical tasks that combine scientific principles, design thinking, and technical communication.
- Explore how materials respond under different loads based on investigation of forces such as tension, compression, thrust, drag and gravity.
- Develop the analytical skills needed to interpret data, predict behaviour and make informed design choices, learning through experiments, simulations and prototype development.
- Consider how design changes affect performance, stability, and efficiency through the use of digital modelling tools and hands-on construction techniques.
- Learn how to present ideas visually, through sketches, diagrams and annotated plans, and verbally, through pitches and engineering defences.
- Negotiate design trade-offs, justify decisions and respond constructively to peer feedback as part of collaborative project work.
- Identify weaknesses, propose improvements and take increasing ownership of the engineering process.

Example challenge

The question: How can engineers design a bridge using limited materials that is strong, efficient, and safe? This is a load-tested bridge competition, with teams presenting and defending their design decisions using engineering language and evidence from experiments.

PHASE	ACTIVITY	SKILLS DEVELOPMENT
PHASE 1 **Foundation and Orientation**	Students explore images and videos of successful and failed bridges, discuss possible causes of failure, learn key force concepts (tension, compression, load), label diagrams, and observe live demonstrations showing bending and force behaviour. They begin asking engineering questions and identifying structural risks.	**Scientific and Engineering:** • Identifying different bridge types, recognising loads and basic forces, observing bending in a demonstration, and explaining why real bridges failed using emerging force concepts. **Practical Investigation and Problem Solving:** • Examining how a simple beam bends, making predictions about failures, testing ideas against evidence, and asking questions about what makes structures stable. **Engineering Design and Technical Communication:** • Labelling diagrams with tension and compression, using introductory engineering vocabulary, and explaining observations verbally and in writing. **Collaboration & Reflective Working:** • Discussing causes of failure in pairs/groups, sharing ideas, listening to others' interpretations, and reflecting on misconceptions revealed through video analysis.
PHASE 2 **Exploration and Practice**	Students conduct hands on experiments with simple beams and trusses using straws, string, and paper. They test where structures bend and fail, identify tension and compression members, add force arrows to diagrams, and analyse how loads travel through structures. They link findings to why triangles provide stability.	**Scientific and Engineering:** • Learning how tension, compression and load paths work by experimenting with simple beams and trusses and understand why triangles add structural strength. **Practical Investigation & Problem Solving:** • Building test structures from straws/paper, adding increasing loads, identifying weak points, and adjusting structural shapes based on performance. **Engineering Design and Technical Communication:** • Annotating diagrams with force arrows, identifying members in tension/compression, and communicating analysis through sketches and explanations. **Collaboration and Reflective Working:** • Constructing models together, comparing findings, discussing structural weaknesses, and reflecting on which shapes performed best and why.
PHASE 3 **Application and Collaboration**	Students test different materials (paper, card, wood, plastic, string) for strength, stiffness, elasticity, and brittleness using weights and measurement tools. They record results, compare performance, interpret data, and justify which materials would be most suitable for a bridge based on experimental evidence.	**Scientific and Engineering:** • Investigating material properties such as stiffness, elasticity, density, and brittleness, and linking material behaviour to appropriate engineering use. **Practical Investigation and Problem Solving:** • Conducting tension, compression and bending tests, recording measurements, analysing performance patterns, and evaluating material trade-offs. **Engineering Design and Technical Communication:** • Recording test data, producing comparison tables, using correct terminology, and justifying material choices with evidence in their written selection report. **Collaboration & Reflective Working:** • Rotating through testing stations, combining and comparing results, discussing preferred materials, and reflecting on unexpected test outcomes.

PHASE	ACTIVITY	SKILLS DEVELOPMENT
PHASE 4 **Independence and Mastery**	Given a design brief and constraints, students sketch multiple bridge concepts, compare bridge types, and select the most suitable approach. They build and test prototype sections (e.g., a single truss) to refine their engineering choices. They then pitch their final design, explaining material choices, force paths, and predicted weaknesses.	Scientific and Engineering: • Applying knowledge of forces and materials to select an appropriate bridge type, predict force paths, and identifying potential failure points in their design. Practical Investigation and Problem Solving: • Building and testing prototype sections, identifying weaknesses, adjusting shapes to improve performance, and making informed choices within resource constraints. Engineering Design and Technical Communication: • Creating annotated design sketches, drafting multiple concepts, using technical diagrams to communicate force pathways, and delivering a design pitch. Collaboration & Reflective Working: • Sharing design roles, debating features of alternative concepts, giving constructive critique, and reflecting on prototype results before finalising a design.
PHASE 5 **Consolidation and Presentation**	Students construct their full bridge, applying their designs while adapting to challenges that arise. They complete interim load tests, identify weak points, reinforce or redesign sections, review each other's structures, and document their decisions and modifications in engineering logs.	Scientific and Engineering: • Applying structural principles while building, identifying areas that need reinforcement, interpreting interim test results, and understanding why certain elements fail. Practical Investigation and Problem Solving: • Constructing the full bridge, troubleshooting issues during assembly, carrying out mid-build load tests, and implementing targeted improvements to strengthen the structure. Engineering Design and Technical Communication: • Documenting decisions in engineering logs, sketching modifications, recording problems and solutions, and explaining the reasoning behind design changes. Collaboration & Reflective Working: • Coordinating tasks during construction, conducting peer reviews of other teams' bridges, providing feedback on stability and efficiency, and reflecting before final testing.
PHASE 6 **Evaluation and Reflection**	Students conduct formal load testing on completed bridges, recording performance and failure points. Each team presents an engineering defence, explaining their design choices, force management strategies, and material selection. Finally, they reflect on what worked, what failed, and how they would improve their design with more time or different resources.	Scientific and Engineering: • Observing how the bridge behaves under increasing load, explaining deformation and failure using engineering concepts, and connecting performance to design choices. Practical Investigation and Problem Solving: • Conducting controlled load testing, recording results, analysing efficiency, interpreting failure modes, and proposing evidence-based improvements. Engineering Design and Technical Communication: • Delivering an engineering defence, using technical vocabulary, diagrams, and evidence, and writing final reflections evaluating performance and design decisions. Collaboration & Reflective Working: • Presenting as a team, supporting one another during testing and Q&A, reflecting honestly on the group process, and celebrating both successes and learning points.