Design & Technology
Year 9 Curriculum

ASPIRE – ENDEAVOUR - SUCCEED

Purpose

Design and technology is an inspiring, rigorous and practical subject. Using creativity and imagination, pupils design and make products that solve real and relevant problems within a variety of contexts, considering their own and others' needs, wants and values. They acquire a broad range of subject knowledge and draw on disciplines such as mathematics, science, engineering, computing and art. Pupils learn how to take risks, becoming resourceful, innovative, enterprising and capable citizens. Through the evaluation of past and present design and technology, they develop a critical understanding of its impact on daily life and the wider world. High-quality design and technology education makes an essential contribution to the creativity, culture, wealth and well-being of the nation.

Aims

The national curriculum for design and technology aims to ensure that all pupils:

- develop the creative, technical and practical expertise needed to perform everyday tasks confidently and to participate successfully in an increasingly technological world
- build and apply a repertoire of knowledge, understanding and skills in order to design and make high-quality prototypes and products for a wide range of users
- critique, evaluate and test their ideas and products and the work of others.

Threshold concepts

The Iterative Design Process

- Analyse - Research purposefully: Using a range of sources showing selectivity and analytical skill.
- Design - Visual Communication: Demonstrate innovation and creativity in response to a client's need/problem, using a range of 2D and 3D techniques.
- Make - Safe Working Practice: Select and use tools and equipment safely and accurately in order to manufacture a high quality prototype that demonstrates a range of skills.
- Evaluate - Critical Reflection: Demonstrate the ability to reflect critically throughout the design process showing an understanding for modification and improvement.
- Technical Knowledge - Yr 7 and 8 D&T content.
- Impact on Society: Understand developments in Design and Technology, their ecological and social footprint with an awareness of the impact on society.
- ACCEESSFMM

These threshold concepts appear repeatedly throughout the curriculum.

Sequence of learning – students are on a rotation.

All students study the iterative design process as part of all units of work. Specific aspects of the design progress are used as a foci in each unit of work. Students must understand that this underpins the design and make process in industry, in all material areas. Students study different topics within Year 9 in different sequences due to resources and rooming.

Polymers – CAD/CAM pen pot and 3D printed Architecture keyring.

Students have been introduced to acrylic and forms of plastics in Yr 8. As their knowledge on polymers/plastics is developed further, students begin to look at the sustainability of new plastics and their impact on society and the environment. They will be introduced to designing for a client and their needs, looking at products they own and the specific dimensions and tolerances allowed to ensure the product is accurate and usable. Students use 2D design for the second time in KS3 to embed key concepts and learn new features – like the filet tool. An orthographic image of the pen pot will be introduced here. Recall from the Yr 7 Blockhead unit of work.

Students explore the advantages and disadvantages of CAD/CAM for both the manufacturer and the user and will be introduced to a 3D CAD program to design a small architectural item. This architectural theme runs through the solar lamp as well as some aspects of the drawing perspectives to link smaller unit together. An oblique and isometric drawing will be completed as part of the 3D printing project.

Energy - Lamp

Students begin with an introduction of why energy is important in the industries related to Design and Technology and how it is used. This moves through into the use of fossil fuels, their origins, extraction, conversion to energy for use in industry and domestically. Students then explore the advantages and disadvantages of these processes and their use. The same is then completed for renewable energy. This leads to looking into products that use renewable energy. Students then learn about nuclear energy and compare and contrast the arguments for the use and against. With this unit of work we look at how energy is then stored and can be used in products. I.e. Solar garden lamp – linked to energy study and moving towards energy storage and integration into products.

Minimisation is covered, looking at the improvements in battery technology and consumer demand to minimise everyday items like mobile phones. Portable storage energy systems allow students to learn about a variety of storage solutions that enable products to use energy. Alkaline, rechargeable and built-in batteries.

Students will design and manufacture a lamp project, using the iterative design process. This will be based on battery and solar technology, which reinforces the knowledge from the energy unit of work, including the use of vinyl plastic and a cityscape design. Students will look at systems and processes (input – process – output) and the use of electronic components and microcontrollers to power systems and products. A one-point perspective city scape will be complete as part of the drawing unit here.

Material properties, Mechanisms and Cams

Students spend a short amount of time (3-4 lessons) learning about forces, linkages, cams and levers. They are directly related to products students are familiar with. Mathematical calculations are used here, when looking into the structures and properties of the materials used in these products to ensure they work efficiently.

Subject Knowledge	Procedural knowledge
Design is a process that is cyclical/iterative	

Careers/Employment in the industry are explicitly linked to all or some aspects of the design process. Different careers focus on key areas of the design process and require different skill sets. Term 1: Costume Designers - Film Term 2: Food Nutritionist Term 3: Electrician	Identify attributes and characteristics of different job roles. Explain how the design process is linked to the DP.
The order of the design process	Apply aspects of the design process to complete projects.
What the acronym ACCEESSFMM stands for. A – Aesthetics - The appearance of a product C – Cost - The money paid to cover materials, equipment, labour, buildings and services so a product can be manufactured C – Customer - A single person or a target market group that a product or service is aimed at. E – Environment - The positive or negative impact a product may have on the environment. Including the materials and energy used for manufacturing. E – Ergonomics - the process of designing or arranging workplaces, products and systems so that they fit the people who use them. Body measurement data is used. (Anthropometrics) S – Safety - How safe a product is to manufacture and use S – Size - The physical dimension and measurement of a product and how appropriate it is for the user. F – Function - What a product does and how it works M – Manufacture - Techniques and processes used to manufacture/make a product. M – Materials - A resource used to manufacture a product.	Apply the terminology in several aspects of the design process.
Energy • Resources are classified as finite and non-finite in the context of energy. • These may be referred to as renewable sources and non-renewable sources of energy. • How electricity is generated. • The use of Fossil fuels in the UK • How the use of turbines and generators are used. • The advantages and disadvantages of renewable energy • The advantages and disadvantages of non renewable energy • How nuclear power is obtained • Pros/cons of Nuclear power • Examples of nuclear disasters and aftereffects.	Define non renewable energy sources and give examples Define renewable energy sources and give examples. Describe how electricity is generated using turbines and generators and nuclear power. Analyse the reasons people may opposed to the use of renewable energy. Identify reasons why people are for/against the use of nuclear power.

Energy Storage: • How energy generated from renewable and non-renewable resources can be stored. • What battery storage is. • Wireless products contain batteries and stored energy. • Advantages of products with stored energy. • The use of batteries to drive electronic circuits. • The negative environmental impact of alkaline batteries • Minimisation of batteries and its impact on product design. Practical Lamp Project: • The use of CAD/CAM to design. • What the vinyl cutter is used for • How to set work out to minimise waste when using CAD/CAM (tessellation) • Electronic circuits require soldering to allow current to flow. • Components of the solar kits – names and functions. Microcontrollers, collar panels, LED. • Use of electronics for working systems.	Identify products that use alkaline batteries and describe their environmental impact. Apply elements of the Design Process and ACCEESSFMM to design and manufacture a solar lamp. Use 2D Design to create a city scape Describe the use and set up of the vinyl cutter and materials used. Solder components into a PCB. Connect an appropriate battery source. Draw a one point perspective city scape to represent their design.
Pen Pots *(recap in italics)* • *Plastics/Polymers mainly derive from crude oil.* • *Crude oil is extracted and refined from underground.* • *The refining process, with different chemicals and processes allows the oil to be converted into different usable products.* • *Plastic is classified as a finitie material/resource. It will eventually run out.* • *Plastics are classified into two main groups – thermo plastics and thermosetting plastics.* • *Examples of each plastic classification and their uses.* • *Thermoplastics can be reshaped when heated. They are easy to recycle and are manufactured into the majority of plastic products we use.* • *Thermosetting plastics cannot be reshaped when heated. Once moulded/cured into shape they cannot be recycled.* • Sustainable and biodegradable versions of plastic are continually being developed and are already available in common products we use and see. • Bioplastic examples • The impact of mobile technology on society – particularly teenagers. • CAD = Computer Aided Design - example in school is 2D Design and Fusion 360. • Advantages of CAD/CAM for design/make products. • CAM = Computer Aided Manufacture , examples in school include the laser cutter and 3D printer.	*Recall the two main categories of plastics.* *Define the categories* *List example plastics.* Understand developments in design and technology, its impact on individuals, society and the <u>environment,</u> and the responsibilities of designers, engineers and technologists. Analyse a product that has been improved/developed to meet the needs of the consumer (bioplastic trainers/ food packaging)

• Tolerance – the amount of variation that is allowed in a measurement +/- • Pre existing product measurements to design correct parts/holes for project. • How a no/go gauge works • The names of tools on 2D Design. **3D printing – Architecture Keyring.** • The interface and basic tools of Fusion 360. • Why prototypes are used for 3D printing. • Advantages of 3D printing • Disadvantages of 3D printing	How to draw basic shapes in 2D Design. How to draw holes in basic shapes How to change the dimensions of basic chapes How to add a filleted edge to shapes How to set line colours and thickness for Laser printing. How to draw basic shapes in Fusion 360. How to dissect and make holes in basic shapes How to change the dimensions of basic chapes How to add a chamfer to shapes How to render final shapes.
Technical Drawing/ Graphics (Completed in different projects through the rotation) The drawing conventions (rules) for drawing in: • Oblique • Isometric • One point perspective • Two point perspective • Orthographic • Designing – SCAMPER	Draw products in each perspective. • Oblique • Isometric • One point perspective • Two point perspective • Orthographic Design innovative and unique products using SCAMPER as a tool for creativity
Material Properties: Properties of materials can be defined as mechanical or physical. Mechanical properties: The strength of a material is its ability to resist a force applied. This will vary depending on the type of strength a material has. • Tensile strength - resistance to tension caused by pulling. • Compressive strength - resistance to crushing when squeezing. • Shear strength - resistance to two parallel forces acting in opposite directions. • Torsional strength - resistance to twisting. Hardness is the resistance of a material to scratching and wear. Toughness - the ability of a material to not break when sudden force is applied Malleability – The ease with which a shape can be changed without the material breaking. Physical Properties:	Understand how more advanced mechanical systems used in their products enable changes in movement and force

Density – the mass of a material per unit volume. Electrical Conductivity – The ability of electricity to pass through a material. Absorbency – The ability of a material to draw moisture. How these properties relate to timbers/metals and plastics. **Mechanisms** Mechanical devices change the amount or direction of a force in a system. There are 4 types of movement • Linear motion • Rotary motion • Reciprocating motion • Oscillating motion Linkages can be used to change direction of motion, the type of motion or the direction of force. They are constructed by joining together links, rods or levers using pivots. Pivots can be fixed or movable. Linkages include: • Reverse motion • Parallel Motion • Bell crank. Spur gears are a circular gear with teeth that create a gear train when combined with other spur gears. **Cams** Cam and follower mechanisms turn rotary motion in a reciprocating motion. As the cam turns, the follower moves up and down. I.e used in sewing machines to make the needle go up and down. There are different shaped cams for different outputs. Round, egg shaped, eccentric, snail.	Students can identify products that use different types of motion. Mathematical modelling and can calculate scenarios in relation to Levers/linkages/Cams. Students understand Mathematical modelling and can calculate scenarios in relation to Levers/linkages/Cams.

Curriculum links to careers

Unit: All – Lesson completed at beginning of each term/rotation.
Term 1: Costume Designers - Film
Term 2: Food Nutritionist
Term 3: Electrician
Links: How careers across the industry link with the design process. Looking at the daily roles of specific people/careers and how their job is reliant on the iterative design process, an integral part of each project students' study in the rotation of D&T, textiles and food.

Outcome: Students identify links and explain how the employees work individually or as a team to meet the needs of the consumer/target market. Listing skills required for the role.