Introduction: Key Purpose of Project

During key stage 3 pupils use a wide range of materials to design and make products. In this project pupils will move away from the use of materials and use 3D modelling software to create their designs. They will develop their understanding of designing and modelling by improving their ICT skills. They will use computers as an integral part of designing. The main aim of this project is to develop pupils understanding of designing in a virtual reality.

Students will learn to Creo software to model a range of different products. These exercises will provide students with the procedure for constructing the various parts of the design then assembling them into the final unit. The procedures for executing the design of each part will be presented separately. Each step is numbered and they should be done in the order presented. After all parts are completed, students will proceed to the assembly. Each section is appropriately named and furnishes applied in appropriate places. Engineering drawings will be provided to help students produce each product. They will contain different views and measurements to help students.

Once students have completed the Creo exercises their main assignment will be to recreate an object of their choice in Creo. They must produce an accurate 3D model, engineering drawings and an explanation of how they created the design. The project allows pupils to understand basic principles of. The project builds upon ICT skills previously learnt. Pupils will also be introduced to other areas of design including:

Aims of the project:

- To enable pupils to develop their ICT skills.
- To develop knowledge and understanding of 3D environments.
- Select and use a range of tools and processes within the software.
- Understand how to use a range of tools, simple ‘quick keys’, and different drawings.
- Accurately measure and draw a range of products from real life in Creo.
- Effectively join a range parts together in an assembly.
- To evaluate work throughout the manufacturing process.
- To develop knowledge/ skills to enable achievement of a high quality finish in practical work.

Knowledge and understanding that will be needed or acquired:

- Understanding the procedure for constructing the various parts of the design then assembling them into the final unit.
- Following instructions and step by step guides.
- Recreate an object of their choice in Creo.
- Produce accurate 3D model, engineering drawings and an explanation of how they created the design.
- Use of a range of Creo tools (Sketching, Extrusion, Revolve, Rounds, Chamfer, Assembly).
- Students will consider materials, colours, lighting, scenes and image layout.
- Pupils will understand the concept of parts, sub-assemblies and assemblies.
- Students will be able to create engineering drawings and export images.

Pupils will be assessed on:

- Images of 3D exercise models.
- Accurate 3D models, engineering drawings and an explanation of how they created the design.
- Production of effectiveness of outcome (level of accuracy and finish)

Key Terms:

CAD/CAD, CNC, Mood Board, Image Collection, Evaluation, Extrusion, Revolve, Rounds and Chamfers, Assemblies, Colours and Engineering Drawings, Vice, Material, Chuck, Light, Lathe Bed, Cutting Tool, Guard, Motor, Part, Solid and Sketch.

Areas to be covered within the Project:

During the project students will focus on CAD/CAD Theory, CNC Theory, Mood Board and Image Collection, Evaluation and Explanation of Outcome. Students will be given explanations of Creo Overview, Extrusion, Revolve, Rounds and Chamfers, Assemblies, Colours and Engineering Drawings.

Acknowledgment of the range of skills of year 9 will be needed in order to keep the attention of the whole class. Allowing freedom within the project to personalize the work may help to do this. Also challenging the whole class and allowing for differentiation within the class. Pupils will also be introduced to peer assessment and evaluation of their ideas and of others.
<table>
<thead>
<tr>
<th>Outline of Key Developments</th>
<th>Key Activities to Fulfil Developments</th>
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<tbody>
<tr>
<td>Developing, planning and communicating ideas</td>
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<tr>
<td>- Generate, develop, model and communicate ideas in a range of ways, using appropriate strategies.</td>
<td>- Introduce the project and allow pupils to explore the use and possible products (Mood Board).</td>
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<td>- Respond creatively to briefs, developing their own proposals and producing specifications for products.</td>
<td>- Pupils will be required to develop and communicate a range of 3D models using appropriate strategies.</td>
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<td>- Use their understanding of others’ designing to inform their own.</td>
<td>- Pupils will be required to develop a range of 3D models. Students will practice their sketching techniques within the software.</td>
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<td>- Analysing existing products and solutions to inform designing and making.</td>
<td>- Develop a final design idea. Improving and adapting the idea.</td>
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<td>- Undertake focused tasks that develop knowledge, skills and understanding in relation to design and make assignments.</td>
<td>- Understanding the procedure for constructing the various parts of the design then assembling them into the final unit.</td>
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<tr>
<td><strong>Tools, equipment, materials and components (including CAD/CAM)</strong></td>
<td>- Recreate an object of their choice in Creo.</td>
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<td>- Applying knowledge of materials and production processes to design products and produce practical solutions that are relevant and fit for purpose.</td>
<td>- Produce accurate 3D model, engineering drawings and an explanation of how they created the design.</td>
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<td>- Have a broad range of techniques, including handcraft skills and CAD/CAM, and use them to ensure consistency and precision when making single and multiple products.</td>
<td><strong>Tools, equipment, materials and components</strong></td>
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<tr>
<td>- Evaluate which hand and machine tools, equipment and computer-aided design/manufacture (CAD/CAM) facilities are the most appropriate to use.</td>
<td>- Demonstrations on the use of the software (Extrusion, Revolve, Rounds and Chamfers, Assemblies, Colours and Engineering Drawings).</td>
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<td><strong>Understanding Materials and components</strong></td>
<td>- To develop knowledge and skills to enable the achievement of a high quality ICT work.</td>
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<td>- Apply their knowledge and understanding of a range of materials, ingredients and technologies to design and make their products</td>
<td>- Development of techniques and accuracy.</td>
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<td>- Know how to use materials, smart materials, technology and aesthetic qualities to design and make products of worth.</td>
<td>- Explanation of tools and processes used.</td>
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<td>- Exploring and experimenting with ideas, materials, technologies and techniques.</td>
<td>- Produce a high quality and accurate model.</td>
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<tr>
<td>- How to use materials, smart materials, technology and aesthetic qualities to design and make products of worth.</td>
<td>- Use of a range of Creo tools (Sketching, Extrusion, Revolve, Rounds, Chamfer, Assembly).</td>
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<td><strong>Planning</strong></td>
<td><strong>Understanding Materials and components</strong></td>
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<tr>
<td>- Plan and organise activities and then shape, form, mix, assemble and finish materials, components or ingredients.</td>
<td>- Focus on Extrusions, Revolves, Rounds and Chamfers, Assemblies, Colours and Engineering Drawings.</td>
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<tr>
<td>- Solve technical problems.</td>
<td>- Students will consider materials, colours, lighting, scenes and image layout.</td>
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<td>- How to prepare and assemble components to achieve functional results.</td>
<td>- Pupils will understand the concept of parts, sub-assemblies and assemblies.</td>
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<td><strong>Evaluation</strong></td>
<td><strong>Planning</strong></td>
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<td>- Reflect critically when evaluating and modifying their ideas and proposals to improve products throughout their development and manufacture.</td>
<td>- Procedure plan / sequence of manufacture produced.</td>
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<td>- Aesthetic, technical, constructional and relevant wider issues that may influence designing, selection of materials, making and product development.</td>
<td>- Following instructions and step by step guides.</td>
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<td><strong>Communication</strong></td>
<td><strong>Evaluation</strong></td>
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<tr>
<td>- Use ICT as appropriate for image capture and generation; data acquisition, capture and handling; controlling; and product realisation.</td>
<td>- Evaluations of pupils own work and the work of others.</td>
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<td>- Test, modify and evaluate that the quality of their product is suitable for intended users and devise modifications where necessary for improvements.</td>
<td>- Able to represent designs in the form of accurate and recognised drawing forms (quality of drawings).</td>
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<td>- Present information in a form that suits its purpose, using appropriate media.</td>
<td>- Students will be able to create engineering drawings and export images.</td>
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<td>- Develop research techniques and the selection of relevant information.</td>
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## Methods of Assessment (How and When)

Assessment is an essential part of teaching and learning in all subjects. It can take many forms and be used for a range of purposes. Use of Assessment of learning (summative assessment) to judge students’ performance against national standards (level descriptions), at the end of a unit of work. Assessment for learning (formative assessment) involves using assessment in the classroom to raise students’ achievement. It is based on the idea that students will improve most if they understand the aim of their learning, where they are in relation to this aim and how they can achieve the aim.

Learning and undertaking activities in design and technology contribute to achievement of the curriculum aims for all young people to become:

- Successful learners who enjoy learning, make progress and achieve.
- Confident individuals who are able to live safe, healthy and fulfilling lives.
- Responsible citizens who make a positive contribution to society.

### Key characteristics of assessment for learning are:

- Using effective questioning techniques.
- Using marking and feedback strategies.
- Sharing learning goals.
- Peer and self assessment.
- Consistent Question and Answer sessions within lessons.
  - Formal questioning is used throughout the lesson which is addressed to the whole class, small groups or an individual.
  - Informal questioning takes place during pupil activities. This can be used to confirm pupils are kept on task, understand the work they are doing and motivate pupils in a positive direction.
- Praise and encouragement in the classroom. Pupils are monitored throughout the lesson and motivated through praise and encouragement. Providing students with both positive and constructive comments during assessment. Students will be given an area to improve on for each project.
- Pupils evaluate their own work during the course and assess their level of achievement towards the end of the project. Peer assessment involves students assessing the performance of other students.

### Key characteristics of assessment of learning are:

- To judge students' performance against national standards.
- Measuring what has been learned in formal assessment.
- Emphasis is more on helping pupils learn.
- Regular homework once a week.
- National Curriculum level at the end of the topic. Pupils will be given a grade based on the national curriculum levels at the end of the topic. These will be from level 4 to level 8.
- Pupil monitoring during lesson. Assessing the students as you are walking around will provide more of an insight to how different students work. Students who seem to be working hard and show enthusiasm and effort could influence their mark. It will allow the students to ask for help or assistance if they see a teacher’s presence. Guidance can be given and encouragement can be shown through positive comments.

### Good assessment:

- Helps develop successful learners.
- Recognises strengths and areas for development and clearly identifies ways for learners to progress.
- Is based around pupils’ needs and leads to improved attainment and progress.
- Encourages pupils to take a central role in their own assessment.
- Is essential in creating personalised learning.
- Helps teachers to be flexible enough to recognise learning as it happens.
- Results in decisions and actions from both day-to-day interactions with pupils and through taking a periodic overview of progress.

### Assessment needs to:

- Value and include a wide range of attitudes, dispositions and skills, as well as achievement in subjects.
- Draw on a broad range of evidence, including beyond the school.
- Involve those that know the learner best – including parents, peers and members of the wider community.
Performance Criteria (National Curriculum Level Related)

**Level 4**
Pupils generate ideas by collecting and using information. They take users’ views about aesthetic and technical issues into account as they respond to briefs. They communicate alternative ideas using words, labelled sketches and models, showing that they are aware of constraints. They apply their knowledge and understanding of materials, ingredients and components, and work with them with some accuracy, paying attention to quality of finish and to function. They use some ideas from others’ designing to inform their own work. They produce step-by-step plans and then select and work with a range of tools and equipment. They identify what is working well and what could be improved to overcome technical problems. They reflect on their designs as they develop, recognising the significance of knowledge and previous experience.

**Level 5**
Pupils develop ideas by drawing on and using various sources of information. They clarify their ideas through discussion, drawing and modelling, showing understanding of aesthetic and economic dimensions. They respond to briefs showing understanding of how culture and society are reflected in familiar products when developing and communicating their own ideas. They show that they are aware of constraints as they apply knowledge and understanding of materials, ingredients and techniques. They use understanding of others’ designing as they develop their work. They work from their own detailed plans, modifying them where appropriate. They work with a range of tools, materials, ingredients, equipment, components and processes with some precision. They check their work as it develops, solve technical problems and show some evidence of creativity as they modify their approach in the light of progress. They test and evaluate their products, showing that they understand the situations in which the products will function.

**Level 6**
Pupils draw on and use a range of sources of information, and show that they understand the form and function of familiar products as they develop and model ideas. They respond creatively to briefs, exploring and testing their design thinking. They develop detailed criteria for their products and use these to explore proposals. They apply their knowledge and understanding by responding to several aspects of the problem. They recognise the significance of others’ designing and modify their approaches accordingly. They produce plans that outline alternative methods of making progress. They work with a range of tools, materials, ingredients, equipment, components and processes, showing that they understand their characteristics. They check their work as it develops and solve technical problems by modifying their approach in the light of progress. They evaluate how effectively they have used information sources, using the results of their research to inform their judgements when developing products. They evaluate their products as they are being used, and identify ways of improving them.

**Level 7**
Pupils use a wide range of appropriate sources of information when developing and modelling ideas. They investigate form, function and production processes as they respond creatively to briefs. They apply their knowledge and understanding, recognising the different needs of a range of users, and search for trends and patterns in existing solutions as they develop fully realistic products. They use their understanding of others’ designing to inform their own as they communicate creative ideas. They produce plans that predict the time needed to carry out the main stages of making products. They work with a range of tools, materials, ingredients, equipment, components and processes, taking full account of their characteristics. They adapt their methods of manufacture to changing circumstances as they solve technical problems, providing a sound explanation for any change from the design proposal. They select appropriate techniques to evaluate how their products would perform when used and modify their products in the light of this evaluation to improve their performance.

**Level 8**
Pupils use a range of strategies to fully develop and model appropriate ideas, responding to information they have identified. They identify conflicting demands on a product and respond creatively to briefs, suggesting ways forward and explaining how their ideas address these demands. When applying knowledge they make decisions on materials, ingredients and techniques based on their understanding of physical properties and working characteristics. They use their understanding of others’ designing by reinterpreting and applying learning in new contexts. They organise their work so that they can carry out processes accurately and consistently, and use tools, equipment, materials, ingredients and components with precision. They use accurate testing to inform their judgements when solving technical problems. They identify a broad range of criteria for evaluating their products, clearly relating their findings to environmental, ethical, and social and cultural dimensions.

**Exceptional Performance**
Pupils seek out information to help their design thinking. They recognise how products contribute to lifestyle and choices of a variety of client groups as they develop and model ideas in an innovative way. Responding creatively to briefs, they are discriminating in their selection and use of information sources to support their work. They interpret and apply knowledge and understanding creatively in new design contexts and communicate ideas in new or unexpected ways. They use understanding of others’ designing in innovative ways. They work with tools, equipment, materials, ingredients and components to a high degree of precision. They make products that are reliable and robust and that fully meet the quality requirements given in the design proposal. They reflect critically and effectively throughout designing and making processes.
<table>
<thead>
<tr>
<th>Week</th>
<th>Topic/area of study</th>
<th>Skills/knowledge acquired (including curriculum links)</th>
<th>NC PoS links</th>
<th>Activities (extension/differentiation)</th>
<th>Resources/risks</th>
</tr>
</thead>
</table>
| 1    | • Introduction to the Project (aims and objectives of the project in relation to the Nation Curriculum Levels).  
• Understanding CAD/ CAM and CNC terms.  
• Researching a range of topics in relation to the project.  
• Introduction to Creo software.  
• Understand the project and how it will evolve over the course.  
• Knowledge and understanding of CAD/CAM and CNC.  
• Developing research skills.  
• Knowledge and understanding of theory work.  
Links to literacy – Knowledge and understanding of technical terms used within design.  
| 2f  3c | • Students will complete the CAD/CAM Theory and CNC Theory sheets within their booklets.  
• Students will gain knowledge and understanding of Creo software and 3D modelling.  
• Students will learn how to load Creo and some of the basic features.  
Quick demonstration on how to create a 3D object.  
• Introduce students to setting up working directories and saving work.  
| • Project Booklets.  
• ICT computer room. |
| 2    | • Introduction to Creo, tools and processes.  
• Demonstration of Sketching Tool and Extrusions.  
• Understanding the procedure for constructing the various parts of the design then assembling them into the final unit.  
• Practice and testing of creating basic models/ parts.  
• Able to generate CAD designs, develop skills and produce a 3D product. Pupils will develop their project proposals and sketching techniques (annotations).  
• Able to use a range of tools, processes and stages to produce an accurate 3D model.  
• Demonstrations on Sketching Tool and Extrusions.  
• Students will gain knowledge and understanding of Creo software and 3D modelling.  
| 1.3b, c 2a 2g 3j 3n | • Students will use Creo to practice the skills of 3D CAD modelling.  
• Students will learn to develop sketching and extrusions.  
• Follow instructions and step by step guides.  
• Students will practice the skills learnt to draw their own mobile phones.  
**Homework**  
Students will complete a Mood Board and Image Collection of possible products that they could create in Creo.  
| • Project Booklets.  
• ICT computer room. |
| 3    | • Continue CAD design work.  
• Pupils to develop their ICT skills.  
• To develop knowledge and understanding of 3D environments.  
• Select and use a range of tools and processes within the software.  
• Understanding of the model tree and keeping it organised.  
• Able to generate CAD designs, develop skills and produce a 3D product. Pupils will develop their project proposals and sketching techniques (annotations).  
• Able to use a range of tools, processes and stages to produce an accurate 3D model.  
• Demonstrations on Revolves.  
• Students will gain knowledge and understanding of Creo software and 3D modelling.  
| 1.3b, c 2a 2g 3j 3n | • Students will use Creo to practice the skills of 3D CAD modelling.  
• Students will learn to develop sketching and revolves.  
• Follow instructions and step by step guides.  
• Students will create a basic cube and strut design that focuses on all the skills learnt.  
• Students will learn to develop rounds and chamfers.  
| • Project Booklets.  
• ICT computer room. |
| 4 | • Continue CAD design work.  
• Understand how to use a range of tools, simple 'quick keys', and different drawings.  
• Demonstrations on the construction of Engineering drawings within Creo. | • Able to generate CAD designs, develop skills and produce a 3D product.  
• Demonstrations on Assembly and Colours.  
• Understanding of dimensioning and 3d angle perspective within Engineering drawings. | 1.3b, c  
2a  
2g  
3j  
3n | • Students will gain knowledge and understanding of Creo software and 3D modelling.  
• Follow instructions and step by step guides.  
• Students will use Creo to practice the skills of 3D CAD modelling. | • Project Booklets.  
• ICT computer room. |
|---|---|---|---|---|---|
| 5 | • Continue CAD design work.  
• Recreate an object of their choice in Creo.  
• Effectively join a range parts together in an assembly.  
• Create a product in a 3D environment that looks as realistic as possible. | • Able to generate CAD designs, develop skills and produce a 3D product.  
• Demonstrations on Sweeps and Shelling.  
• Development of a range of skills and techniques previously learnt. | 1.3b, c  
2a  
2g  
3j  
3n  
4c | • Students will use Creo to practice the skills of 3D CAD modelling.  
• Students will begin to recreate an object of their choice in Creo.  
• Follow instructions and step by step guides.  
• Students will produce a mind map and mood board of images to help with their chosen product. | • Project Booklets.  
• ICT computer room. |
| 6 | • Complete CAD design work.  
• Recreate an object of their choice in Creo.  
• Effectively join a range parts together in an assembly.  
• Create a product in a 3D environment that looks as realistic as possible. | • Able to generate CAD designs, develop skills and produce a 3D product.  
• Demonstrations on Engineering Drawings.  
• Development of a range of skills and techniques previously learnt. | 1.3b, c  
2a  
2g  
3j  
3n | • Students will use Creo to practice the skills of 3D CAD modelling.  
• Students will begin to recreate an object of their choice in Creo.  
• Follow instructions and step by step guides.  
Homework  
Students will complete an Evaluation and Explanation of Outcome. | • Project Booklets.  
• ICT computer room. |
| 7 | • Produce a detailed plan of making. Include stages undertaken.  
• Understanding the procedure for constructing the various parts of the design then assembling them into the final unit.  
• Effectively join a range parts together in an assembly. | • Students will produce the following outputs from Creo:  
• Photo realistic images.  
• Engineering drawings  
• Screen shots of different views.  
• Assembly and part drawings.  
• Produce a detailed sequence of main CAD activities.  
• Completion of all project work.  
• Students will submit all computer files onto the shared area. | 2h  
4f | • Students will use Creo to practice the skills of 3D CAD modelling.  
• Students will begin to recreate an object of their choice in Creo.  
• Students will save all their work in the shared area and print off any explanations and images.  
• Produce accurate 3D model, engineering drawings and an explanation of how they created the design.  
Homework  
Students must Complete Final Task and assignment. | • Project Booklets.  
• ICT computer room. |