

# F1 in Primary Schools Project: Use of Prodesktop to make a CO<sub>2</sub> powered race car

## Focus – CAD / CAM Technology

### About this Unit

In this unit, children develop their understanding of how products can be designed and manufactured using CAD-CAM equipment, and in particular a CO<sub>2</sub> powered race car. They develop their designing skills by looking at streamlined objects, those occurring naturally and man made. Children will also look at examples of completed Jaguar Project cars. From these, children will produce elevation and plan view sketches of their intended designs. They develop skills in the use of Prodesktop which enables them to produce a 3Dimensional drawing of their sketches.

The designs produced in Prodesktop are tested using Virtual Wind Tunnel (VWT) software and from the information gathered, children can revisit and improve their designs.

Completed designs are then produced on a computerised milling machine using a balsa wood block. The children will develop their vehicle with wheels and appropriate finishing techniques to produce a quality streamlined car.

The completed cars will then be put forward to compete against other cars on a flat, straight race track and are powered by small CO<sub>2</sub> cartridges.

### PRIOR LEARNING

It is helpful if the children have:

- produced labelled drawings
- used tools safely and accurately
- fixed wheels and axles to a chassis

This unit builds on Units 2A 'Vehicles', 5C 'Moving Toys'

### VOCABULARY

In this unit, children will use words and phrases relating to:

- designing e.g. design proposal, criteria, labelled drawing, plan view, side elevation, isometric, modification,
- making e.g. planning, Computer Aided Design (CAD), Computer Aided manufacturing (CAM), assembling, components, finishing technique
- knowledge and understanding e.g. wheel, axle, chassis, speed, wind resistance, propulsion, CO<sub>2</sub>

### RESOURCES

- history of CAD / CAM PowerPoint presentation
- examples of completed jaguar project cars
- reference books
- Prodesktop 3D drawing software
- Prodesktop 3D training materials
- Design templates
- a copy of balsa wood block .des file.
- actual balsa wood block
- hand drill and drill bits
- bench hooks
- g-clamps
- materials for finishing, e.g. coloured PVA based paints, coloured pens/pencils, various grades of glass paper
- access to CAM equipment
- wheels and axles
- access to Virtual Wind Tunnel
- access to wind tunnel
- Video Conferencing facility

### EXPECTATIONS

at the end of this unit

*most children will:*

have gained an understanding of how CAD / CAM equipment can be used to design and manufacture a product (F1 in Primary Schools car); have understood how streamlining can aide a vehicle to increase its speed; have looked at VWT information and understood how it can be used to improve a design; have designed and made a working race vehicle accurately and to a high standard.

*some children will not have made so much progress and will:*

have a limited understanding of how CAD / CAM equipment can be used to design and manufacture a product; will have done some research on streamlining and looked at VWT information; will have required a lot of support to design and complete their race vehicles.

*some children will have progressed further and will:*

have gained a good understanding of how CAD / CAM equipment can be used to design and manufacture a variety of products; have understood how streamlining can aide a vehicle in going faster and used it to good effect in their vehicle design, have also used information gathered in VWT testing to improve their vehicle; have produced a quality product; have identified the extent to which particular features of their vehicle work and what could be done to improve them

LEARNING OBJECTIVES CHILDREN SHOULD LEARN	TEACHING ACTIVITIES	LEARNING OUTCOMES CHILDREN
<b>INVESTIGATE, DISASSEMBLY AND EVALUATIVE ACTIVITIES (IDEA's)</b>		
<ul style="list-style-type: none"> <li>What is the F1 in Primary Schools Project</li> <li>What does a finished car look like</li> <li>What is streamlining and of what significance is its use in car design</li> <li>What makes a real car move</li> </ul>	<ul style="list-style-type: none"> <li>§ Watch videos located on the F1 in Primary Schools Project CD-Rom to give children an idea of what the project is all about.</li> <li>§ Let children handle F1 in Primary Schools Comp cars in various stages of completion to see close up what they are going to make.</li> <li>§ Use books and the Internet to find pictures of fast cars and fast trucks and analyse why they are fast. Also, look at fast, sleek animals and investigate why they are fast – dolphins, sharks, fish, birds...</li> <li>¶ If possible, allow children to look around a real car and discuss what the various components of a car do</li> </ul>	<ul style="list-style-type: none"> <li>detail what the F1 in Primary Schools Project involves</li> <li>describe how streamlining assists in the movement of a vehicle through space and show examples</li> <li>identify component parts and their functions</li> </ul>
<b>FOCUSSED PRACTICAL TASKS (FPT's)</b>		
<ul style="list-style-type: none"> <li>What is meant by CAD/CAM and what is its importance in industry</li> <li>What is Prodesktp and what can it do</li> <li>To understand Prodesktp's place in the design and manufacturing process</li> <li>To use Prodesktp to produce 3D shapes</li> </ul>	<ul style="list-style-type: none"> <li>§ Overview of CAD/CAM in industry – Watch 'History of Cad/Cam' PowerPoint presentation</li> <li>§ Provide children with an overview of Prodesktp as Computer Aided Design (CAD) software</li> <li>§ Discuss with children what happens after something is designed in Prodesktp. <i>It is the CAD part of CAD/CAM, The design now needs to be manufactured using a computerised milling machine. The object then needs to be finished – smoothed, painted...</i></li> <li>§ Give children a set of progressive, sequential, teacher led activities that will build up their skills in the use of Prodesktp</li> </ul>	<ul style="list-style-type: none"> <li>§ know what CAD/CAM stands for</li> <li>§ describe the stages in the development of a product using CAD/CAM</li> <li>§ follow a set of instructions that show the development of an object in Prodesktp</li> <li>§ know how to produce simple designs in Prodesktp that meet design criteria</li> </ul>
<b>DESIGN AND MAKE ASSIGNMENT (DMA)</b>		
<p>Children to be placed in teams of six, two of whom will design the CO<sub>2</sub> powered car using Prodesktp, two children to produce PowerPoint presentation of design process; the other two children will design and apply the skin of the car, take photos and digital video. Any spare time will be used to produce promotional material.</p>		
<ul style="list-style-type: none"> <li>To generate model ideas through discussion and drawing</li> <li>To plan the main stages of making</li> <li>To design using Prodesktp utilising competition criteria</li> <li>To evaluate their designs and make alterations to their designs based on VWT results</li> <li>To remote manufacture using CAM technology</li> <li>To apply skins to cars and assemble them</li> <li>To evaluate their work according to their original sketches, against competition criteria and the results of the competition, and to suggest improvements</li> </ul>	<ul style="list-style-type: none"> <li>§ Look at previously constructed examples of Jaguar Project race cars and discuss the competition design requirements prior to children producing side elevation and plan view sketches of their intended designs using design templates. <i>What does the vehicle need to do? What will it look like?</i></li> <li>§ Ask children to identify the main stages in the manufacture of their design</li> <li>§ In pairs, children develop their design using Prodesktp based on preloaded 'balsawood black.des file'</li> <li>§ The children's designs are put through a VWT program that analyses the wind flow / drag over the vehicle. The results are discussed with CAD/CAM technician and alterations are then made to design or design is started again. If possible, Video Conferencing is to be used by designers to talk to CAD/CAM technicians. Files can be sent back and forth using e-mail or other similar technology that allows file sharing between sites.</li> <li>§ The children's designs are then sent for manufacture using CAM technology.</li> <li>§ When the balsawood cars are returned to the design teams, they are then painted, decals applied and wheels attached</li> </ul>	<ul style="list-style-type: none"> <li>apply what they have learnt through IDEAs/FPTs in their designing and making</li> <li>work together to discuss and evaluate their ideas</li> <li>use drawing as a way of modelling ideas</li> <li>identify the main stages of making</li> <li>work together to make a quality product</li> <li>evaluate their vehicle according to the design criteria and suggest improvements</li> </ul>
	<ul style="list-style-type: none"> <li>§ Essential activities</li> <li>¶ Optional activities</li> </ul>	

POINTS TO NOTE	
Links to this unit	
Information Communication Technology	This unit links directly with the F1 in Primary Schools Project Unit: Use of Microsoft PowerPoint to make a multimedia presentation for CO <sub>2</sub> powered race car. There are also opportunities to use Microsoft Word, Microsoft Publisher and various picture/drawing software to assist in the design of team logos, team business cards, team uniforms, press releases, posters, team car decals.
Literacy	Instructional Texts
Speaking and Listening	Teaching strategies for talking in groups <i>e.g. a procedure for dealing with different ideas or disagreement at the evaluation stage</i> Teaching strategies for talking to an audience, assessors
Science	Units 1E 'Pushes and Pulls', 2E 'Forces and Movement', 4E 'Friction', 6E 'Balanced and Unbalanced Forces'
Mathematics	Measuring: length - mm, mass - g Shape and Space: 2D, 3D representational drawings of regular and irregular shapes, angles
Content	<ul style="list-style-type: none"> <li>This unit introduces and focuses on the use of CAD / CAM technology to produce a CO<sub>2</sub> powered race car. Children will need to reach a minimal level of skill in using the Prodesktop software in order to complete the Design and Make Assignment (DMA). There are design criteria that children must adhere to, to enable their car to compete in the various stages of the F1 in Primary Schools Project.</li> <li>This unit introduces a new means of propulsion to the children - compressed Carbon Dioxide (CO<sub>2</sub>). The car is designed around the small CO<sub>2</sub> cartridge.</li> <li>It is hoped that there will be a chance to use Video Conferencing to share design files, to discuss designs in progress and to also see a car being milled in the CAM.</li> <li>Some children may need extra support with making the axle parallel</li> </ul>
Class Management	<ul style="list-style-type: none"> <li>F1 in Primary Schools Project Teams are made up of six members. It is envisioned that all children will take part in the IDEAs and FPTs and have input into the DMA, but that only two children from within each team will complete the DMA.</li> <li>Once the car has returned to the school/team as a milled piece of Balsawood, two other team members will finish off the car - sanding, painting, applying logos, adding axles and wheels.</li> <li>Other members of the team will complete a PowerPoint presentation, take still photos and digital video of the design and make process, design team business cards, team logos, team uniforms, press releases...</li> </ul>
Health and Safety	<p>When carrying out a risk assessment for this activity, teachers will need to consider the materials, tools and equipment being used.</p> <p>In addition, the following points should be noted:</p> <ul style="list-style-type: none"> <li>The only time that a hand tool is used is when the car chassis is drilled to allow the attachment of axles and wheels. The use of simple jigs, g-clamps, bench hooks can reduce the health and safety risks with drilling.</li> <li>When the car is raced a small CO<sub>2</sub> cartridge is inserted into the back of the car, this is done by a trained race organiser.</li> </ul>
Out-of-school activities and homework	<p>Children could:</p> <ul style="list-style-type: none"> <li>Collect pictures and models of race cars and other streamlined, aerodynamic items such as dolphins, sharks, and use these to aid discussion during design process</li> <li>Look at books, CDs, DVDs and Internet to extend their knowledge of streamlined and aerodynamic vehicles and animals</li> </ul>

(A.Shields 2006-04-25 Updated)