

# Sports drink bottle – Teachers' notes

## Pro/ENGINEER - Wildfire 3.0

Schools and Schools Advanced Edition

This unit of work is based on unit 7C from the QCA scheme of work for design & technology. It shows how CAD/CAM and Pro/ENGINEER in particular can support work in product design and graphics.

Students are taught how to create the body and cap of this bottle, assemble the parts and then produce an engineering drawing.



### Aim:

Within the context of a sports drink bottle for an athlete, this material teaches you how to use **Pro/ENGINEER** to create and assemble components and produce an engineering drawing. The finished model can be manufactured using CNC or RP equipment.

Wherever possible students should have the opportunity to make and test their designs.

### Learning objectives

By the end of the computer modelling sessions pupils should:

Be aware:

- Of the concepts of 3D parametric solid modelling using Pro/ENGINEER
- Of the engineering drawing capabilities of Pro/ENGINEER
- Be aware of product prototyping techniques

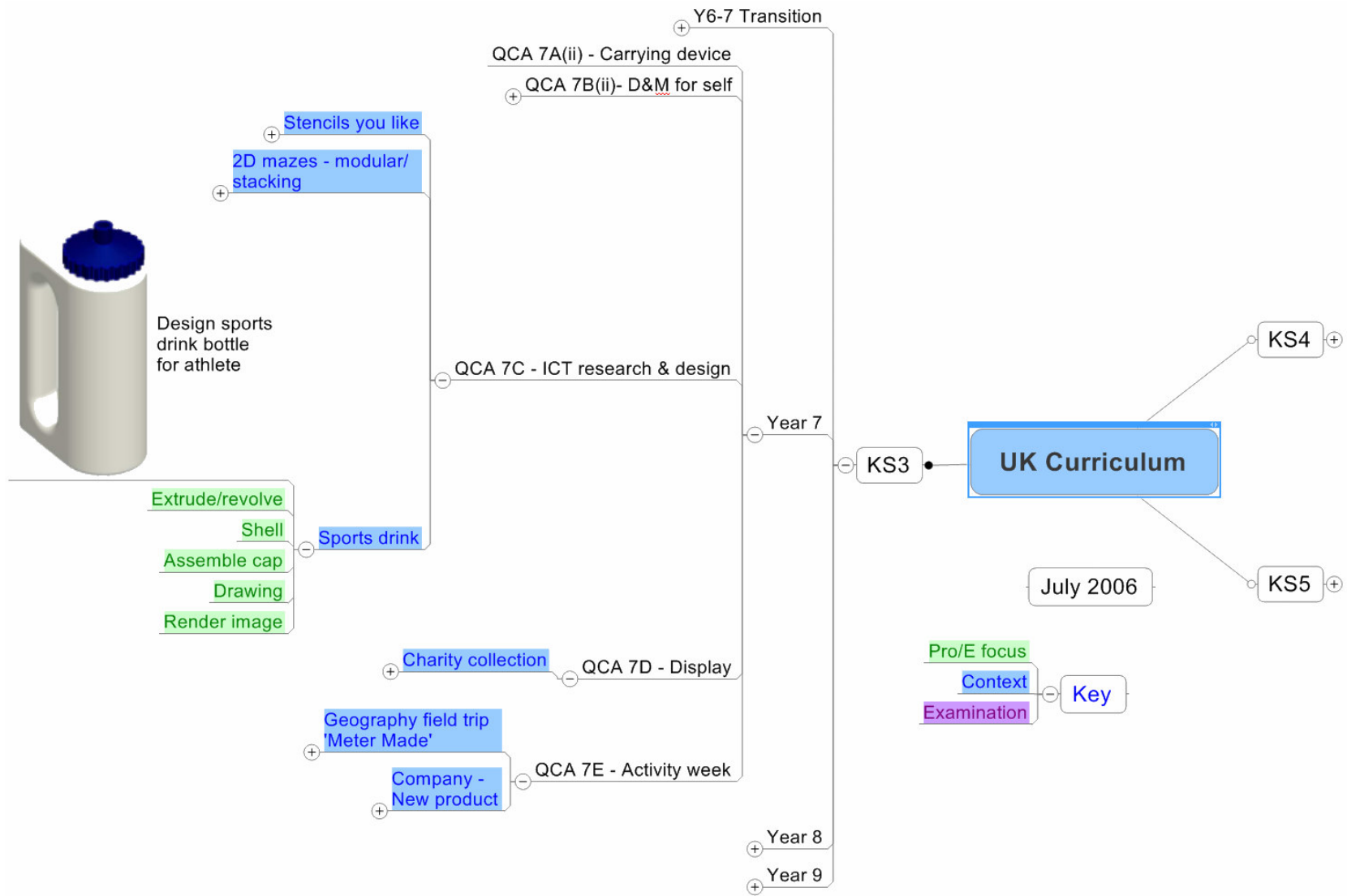
Understand:

- The principles of 3D parametric solid modelling including part creation, assembly and drawing using Pro/ENGINEER
- How 3D solid modelling software be used to refine designs including parts and assemblies.
- Understand the role of prototype models in product development

Be able to:

- Create 3D solid model components from internal sketches using extrusions and revolves
- Assemble components using assembly constraints
- Create an engineering drawing using Pro/ENGINEER
- Create a proof of concept model and e-folio presentation.

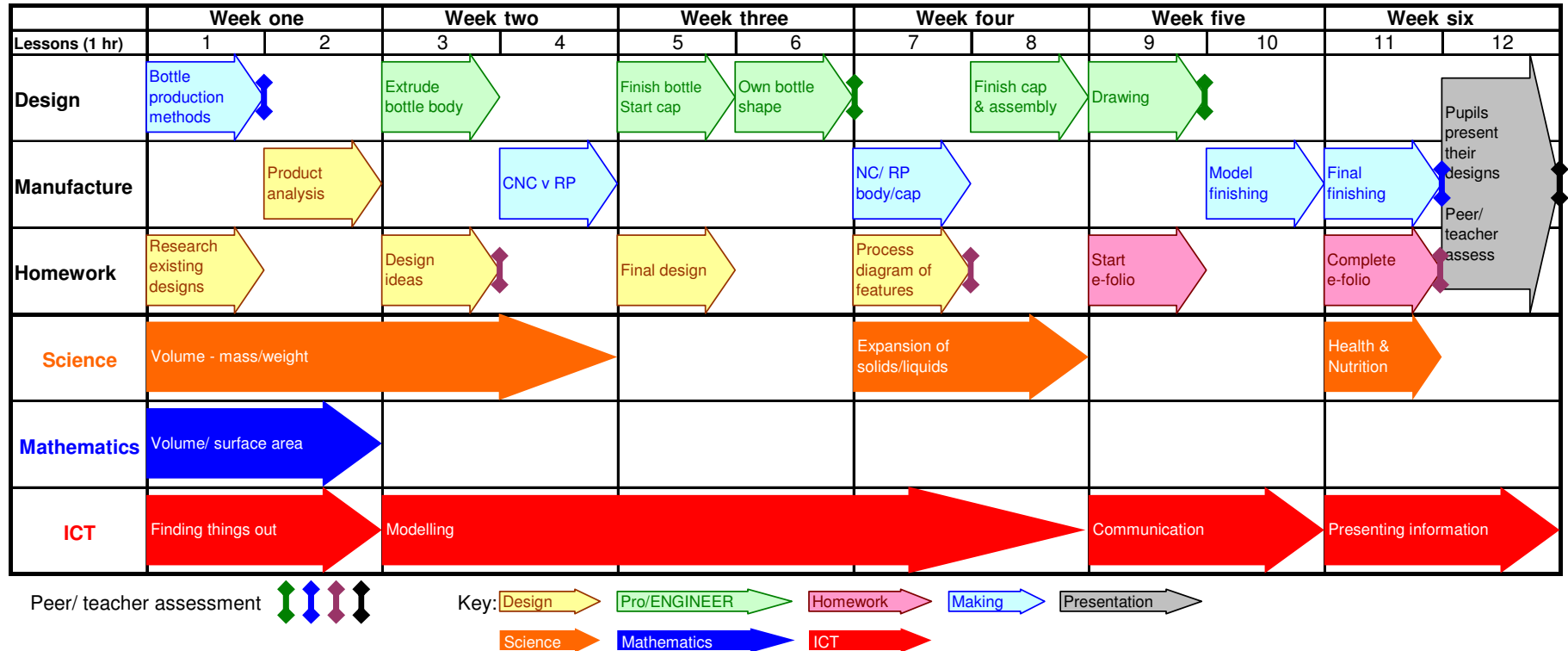
### Where it fits into the 'scheme' of things...



### QCA 7E – ICT research & design – Sports drink bottle

Within the context of research and design using ITC, students use Pro |ENGINEER to create the body and cap for a sports drinks bottle and assemble them. The expectation is that schools have some form of computer controlled machining facility so that handling prototypes can be realised. At the end of the module students are expected to deliver a short electronic presentation of their work.

#### Gantt chart overview



## Homework tasks

The following are suggested homework tasks to support the taught sessions in this module of work.

- Session 1 – Students research existing bottle designs for sports drinks and record these by drawing annotated pictorial sketches of at least three.
- Session 3 – Students generate design ideas based on their understanding of the extrude and revolve features in Pro/ENGINEER
- Session 5 – Students use their understanding of Pro/ENGINEER, existing bottle designs and bottle manufacturing processes to design their own sports drink bottle that can be manufactured in school.
- Session 7 – Students complete a 'Modelling steps' form explaining the sequence of feature creation for their own design of sports drink bottle.
- Session 9 – Students begin collating all their information into an e-presentation.
- Session 11 - Students complete their e-presentation for delivery in the final session.

**Note:** The session plans that follow outline all sessions but detail **only the Pro/ENGINEER teaching and learning** in the Design strand of the GANTT chart above.

## Introduction

The Sports Drink bottle tutorial introduces Students to the skills and techniques needed to develop design ideas within Pro/ENGINEER Wildfire 3.0.

During these tutorials users will learn how to create parts and assemblies within Pro/ENGINEER Wildfire 3.0, and explore the D&T activities that are involved in the product design process

This tutorial and teacher resource has been produced by PTC® and in support of the PTC Design & Technology in Schools programme.

## Pre-requisites

Pro|ENGINEER Wildfire 3.0 Schools Edition

or

Pro|ENGINEER Wildfire 3.0 Schools Advanced Edition

or

Pro|ENGINEER Wildfire 3.0 University Plus Edition

or

Pro|ENGINEER Wildfire 3.0 Student Edition

This tutorial contains screen and menu images taken from the Schools Edition so users of other Pro|ENGINEER Editions may notice some slight differences.

This tutorial has also been based on the use of Pro|ENGINEER start parts & templates supplied as part of the PTC D&T programme. While this tutorial can be used with other Pro|ENGINEER start parts there may be changes required in terms of view orientation, datum plane and coordinate system references etc.

This tutorial requires no previous modelling experience in Pro|ENGINEER, however the user should be able to navigate the Pro|ENGINEER Wildfire user Interface.

Pro|ENGINEER Wildfire requires the use of a 3 button mouse. If possible a mouse with a combined middle wheel & button can improve user interaction with Pro|ENGINEER Wildfire.

## Abbreviations and terminology used within this tutorial

Left-click	Press and release the left-hand mouse button
Left-click-drag	Press and hold-down the left-hand mouse button and move the mouse
Right-click	Press and release the right-hand mouse button
Middle-click	Press and release the middle mouse button
Middle-drag	Press and hold-down the middle mouse button and move the mouse

The aim of the tutorial is to introduce students to the basic solid-modelling process and techniques used within Pro|ENGINEER Wildfire 3.0.

## Installation and setup

These Installation notes have been compiled based on a directory structure used as part of the PTC D&T programme, the UK CAD in Schools initiative and the deployment of Pro|ENGINEER. Users not part of this programme can still use this tutorial but may need to adapt either their Pro|ENGINEER configuration files or the directory structure used in the tutorial.

Please ensure you have the required materials (LDPE..mat or LDPE.mtl) in the material library folder within pro\_standards.

The students will need to create a directory under their 'My documents' or network folder called "bottle".

## Pro|ENGINEER functionality addressed in this tutorial.

- Sketching
  - 2D geometry creation & modification
    - Circles, Lines, Centrelines, Trimming.
    - References
  - Geometric & dimensional constraints
    - Weak, Strong & Locked dimensions
    - Linear and angular dimensional constraints
    - Equal radius and tangent geometric constraints
- Modelling
  - Revolve
  - Shell
  - Extrude
  - Patterning
  - Parametric modifications
- Assemblies
  - Assembly constraints
- Drawings
  - Dimensioning

## ICT areas addressed in this tutorial

- Modelling
- Communication

## Module objectives

By the end of this module students should:

Be aware:

- Of the concepts of 3D parametric solid modelling using Pro/ENGINEER
- Of the engineering drawing capabilities of Pro/ENGINEER
- Be aware of product prototyping techniques

Understand:

- The principles of 3D parametric solid modelling including part creation, assembly and drawing using Pro/ENGINEER
- How 3D solid modelling software be used to refine designs including parts and assemblies.
- Understand the role of prototype models in product development



Be able to:

- Create 3D solid model components from internal sketches using extrusions and revolves
- Assemble components using assembly constraints
- Create an engineering drawing using Pro/ENGINEER
- Create a proof of concept model and e-folio presentation.

## D&T subject areas addressed in this tutorial

- Developing, planning and communicating ideas
- Working with tools, equipment, materials and components to produce quality products
- Evaluating processes and products
- Knowledge and understanding of materials and components

## Prior knowledge, understanding and skills

<b>Teaching</b> 	<b>Learning</b> 
<p>The teacher should be confident using Pro/ENGINEER to create simple extruded/revolved components from internal sketches, pattern features and create assemblies.</p> <p>In order to support students when they have problems the teacher should also be comfortable interrogating the model browser and editing profile sketches.</p> <p>Everyone leading or supporting this project should work through the tutorial.</p> <p>Use should be made of a student CAD/CAM mentor if one is available.</p>	<p>Students should:</p> <p>Understand design briefs, the need for: detailed design specification, planning and rigorous evaluation.</p> <p>Have experience of foam modelling.</p> <p>Be aware of design for self (y7).</p> <p>Have a basic knowledge of materials and making skills of cutting, joining and finishing.</p> <p>Be able to organise own work area and work safely.</p>

## Useful resources for this activity include:

UK government curriculum	<a href="http://www.standards.dfes.gov.uk/keystage3/respub/design/foreword/">http://www.standards.dfes.gov.uk/keystage3/respub/design/foreword/</a>
Designing posters	<a href="http://www.designandmakingcentre.co.uk/curriculum/designing.asp?cat=designing+pack">http://www.designandmakingcentre.co.uk/curriculum/designing.asp?cat=designing+pack</a>
Coke bottle articles	<a href="http://www.onevision.co.uk/default.asp?id=1061">http://www.onevision.co.uk/default.asp?id=1061</a> <a href="http://www.theavanti.com/LoewyCoke.html">http://www.theavanti.com/LoewyCoke.html</a> <a href="http://en.wikipedia.org/wiki/Coca-Cola">http://en.wikipedia.org/wiki/Coca-Cola</a>
Directory of design consultants	<a href="http://www.designdirectory.co.uk/ind.htm">http://www.designdirectory.co.uk/ind.htm</a>
Centre for Sustainable Design	<a href="http://www.cfsd.org.uk/journal/">http://www.cfsd.org.uk/journal/</a>
AME Design Consultants	<a href="http://www.ame-design.co.uk/?gclid=CJzCgfzQllgCFSbAJAoda3npOw">http://www.ame-design.co.uk/?gclid=CJzCgfzQllgCFSbAJAoda3npOw</a>
Hyphen product design	<a href="http://www.hyphendesign.com/?referrer=google_ad">http://www.hyphendesign.com/?referrer=google_ad</a>
Technology Student	<a href="http://www.technologystudent.com/equip1/blowm1.htm">http://www.technologystudent.com/equip1/blowm1.htm</a>
Injection moulding company Protomold	<a href="http://www.protomold.com/Default.aspx?Redirect=true">http://www.protomold.com/Default.aspx?Redirect=true</a>

## Session one (of twelve x 1 hour)

### Focus: Bottle production methods

#### Aim:

Students will learn about the different bottle production methods concentrating on thermo plastic polymer materials and blow moulding. They will need to combine this understanding with early capability with Pro/ENGINEER when designing and detailing their own bottle design later in the module.

#### Learning objectives:

By the end of this session students should:

Be aware:

- of the production methods used to create plastic bottles.

Understand:

- the limitations blow moulding techniques impose on bottle design.

Be able to:

- suggest bottle shapes that might be manufactured

The main part of the session teaches students about plastic bottle production methods including the materials used. Focus on the manufacturing process/materials and the limitations these impose on the shape.

The teacher should introduce the module including the challenge making links to health and well-being. Make explicit the connections with sport and food technology who may be designing the drink to go in the bottle making sure it is healthy, nutritious and provides an energy boost.

**Homework:** Students are asked to research existing bottle designs for sports drinks and draw annotated pictorial sketches of at least three. They should bring examples in for next session.

## Session two (of twelve x 1 hour)

### Focus: Product analysis

#### Aim:

Develop a clear understanding of existing sports drink bottles how they function, their shape, method of manufacture and the information displayed on the outside.

#### Learning objectives:

By the end of the session students should:

Be aware:

- of the different shapes of bottle and how this can be linked to a specific company.

Understand:

- how the shape of plastic bottles is limited by the blow moulding manufacturing process.

Be able to:

- suggest shapes that might appeal to the user and can be manufactured.

This session engages the students in product analysis techniques to help students gain a clear understanding of the range of sports drinks bottles, their materials, design, closure, holding, etc.

Useful resources to help with teaching and learning aspects of design can be found at:

<http://www.standards.dfes.gov.uk/keystage3/respub/design/foreword/>

Designing posters

<http://www.designandmakingcentre.co.uk/curriculum/designing.asp?cat=designing+pack>

## Session three -



#### Aim:

In this session students will learn about the Pro/ENGINEER graphical user interface (GUI) and be taught how to create the body of a sports drink bottle.

#### Learning objectives:

By the end of this session students should:

- Be aware of the part creation techniques using Pro | ENGINEER.
- Understand the principles of sketch based features and direct features.
- Be able to create valid sketch geometry.
- Be able to create solid shapes using extrude and revolve features.
- Be able to shell the shape to create a hollow part.

Session details	Teaching 	Learning 
Prior to session	Homework – Collect responses from week one task – <b>Product analysis – existing sports drink bottles.</b> Provided 2/3 web sites and suggested library books. Handling collection of sports drink bottles. Teacher’s PC with a range of CAD models of different bottle designs pre-loaded	<b>Awareness</b> about the range of existing bottle products
On arrival	Register – <b>instruct</b> students to log-on and start Pro/E. Eyes and ears front.	Students <b>log-on</b> to network and start <b>Pro/E</b>
Starter – 5 min	Reminder of challenge and introduce task. Show examples of bottle designs in Pro/ENGINEER. Include some classic designs including the coke bottle ‘shape’. Challenge students to identify the brand from the shape	Students listen to introduction and watch Pro/ENGINEER bottle examples gaining an initial insight into the GUI From <b>existing knowledge and understanding</b> , students are challenged to identify brands from the bottle shapes.
Demo’ - 10 mins	Straight into swift whole class <b>demonstration</b> using digital projector – Set working directory, start extrusion feature, sketch base profile and complete initial extrusion. Teacher <b>models</b> techniques and procedures to externalise the concepts for students. If possible move students away from PCs or lock using network management software.	Students <b>watch</b> teacher demonstration of frame assembly. They should not be allowed to follow on their PC.
Indiv’ -15 mins	Teacher <b>monitors</b> individual work and supports individuals with the help of student CAD/CAM <b>mentor</b> if available Instruct students to save work	Students start extrusion feature, <b>sketch base profile complete extrusion</b> following step-by-step guide. Students <b>save</b> work.
Demo’ - 10 mins	<b>Recap</b> key principles using <b>Q+A</b> – GUI, screen navigation, sketch, feature. Demonstrate revolve feature and adding neck extrusion and rounds.	Students expected to <b>recount</b> principles and processes. Students <b>watch</b> teacher demonstration of revolve feature, neck and rounds. They should not be allowed to follow on their PC.
Indiv’ - 15 mins	Support as before <b>Instruct</b> students to save work and log-off	Students add handle revolve, extruded neck and rounds following step-by-step guide. Students save and log-off
5 mins - Plenary	<b>Recap</b> key objectives for the session using Q+A. <b>Explain</b> next CAD session will finish bottle and start cap.	Students able to recall key principles and techniques using correct technical vocabulary.

## Homework

Students generate design ideas based on their understanding of the extrude and revolve features in Pro/ENGINEER.

## Session four

### Focus: Comparison of CNC and RP

#### Aim:

In this session students will be introduced to computer controlled manufacturing processes including high speed machining and rapid prototyping. Ideally by visiting a modern high-tech company or through video/web based resources.

#### Learning objectives:

By the end of this session students should:

- Be aware how 3D computer models can be manufactured by adding or subtracting material.
- Be aware of applications for CNC and RP and the role they can play in shortening the time from design to manufacture
- Understand the way CNC machining works and the limitations the process has on the shapes that can be made.
- Understand the different rapid prototyping methods.
- Be able to suggest shapes that can be made using CNC/RP technologies.

This session aims to give students a good understanding of modern Computer Aided Manufacture and is best done by visiting a commercial site to see both CNC machining and rapid prototyping. Bureaus are increasingly common often located at technology parks linked to universities and colleges.

A PowerPoint presentation is available that explains the difference between CNC and RP.

In addition, there are lots of useful resources on the web including:

#### Useful resources for this activity include:

- |                           |                                                                                                     |
|---------------------------|-----------------------------------------------------------------------------------------------------|
| Rapid Prototype Home page | <a href="http://www.cc.utah.edu/~asn8200/rapid.html">http://www.cc.utah.edu/~asn8200/rapid.html</a> |
| MCP Technologies          | <a href="http://www.mcp-group.com/rpt/">http://www.mcp-group.com/rpt/</a>                           |
| Boxford                   | <a href="http://www.boxford.co.uk/boxford/">http://www.boxford.co.uk/boxford/</a>                   |
| e-machine shop            | <a href="http://www.emachineshop.com/">http://www.emachineshop.com/</a>                             |

## Session five

#### Aim:

In this session students build on the experience of revolving the handle void and are taught how to revolve the cap with patterned ridges around the edge and a 'snap fit' lip inside.

**Learning objectives:**

By the end of this session students should:

- Be aware solids can be created using the revolve feature and features can be patterned
- Understand the concepts underlying solid creation using sketch based features.
- Understand that solids can be modified using direct features.
- Be able to create solids using revolve features
- Be able to modify solids using direct features

Session details	Teaching 	Learning 
Prior to session	Homework – Collect responses from week three task – <b>Design ideas</b> . Teacher’s PC with completed bottle cap open on screen.	Prior experience creating the bottle body in the previous CAD session
On arrival	Register – <b>instruct</b> students to log-on and start Pro/E. Eyes and ears front.	Students <b>log-on</b> to network and start <b>Pro/E</b>
Starter – 5 min	Brief Q+A recap on key concepts and techniques from previous session. Introduce aims and objectives for this session	Students recall from previous session.
Demo’ - 10 mins	Straight into swift whole class <b>demonstration</b> using digital projector – Set working directory. <b>Recap</b> key principles using <b>Q+A</b> – GUI, screen navigation. Demonstrate shell feature and revolved snap fit lip.	Students expected to <b>recount</b> principles and processes. Students <b>watch</b> teacher demonstration of shell, neck and lip. They should not be allowed to follow on their PC during the demonstration.
Indiv’ - 15 mins	Support as before <b>Instruct</b> students to save work and log-off	Students <b>add rounds and shell</b> following step-by-step guide. Students save and log-off
Demo’ - 10 mins	Save and close bottle Start new part start revolve, sketch cap profile, complete revolve, repeat for internal lip Teacher <b>models</b> techniques and procedures to externalise the concepts for students. If possible move students away from PCs or lock using network management software.	Students <b>watch</b> teacher demonstration of cap creation. They should not be allowed to follow on their PC.
Indiv’ -15 mins	Teacher <b>monitors</b> individual work and supports individuals with the help of student CAD/CAM <b>mentor</b> if available Instruct students to save work	Students start revolve feature, <b>sketch cap profile and complete revolve. Internal lip is then created using a revolve as reinforcement.</b> Both by following step-by-step guide.

		Students <b>save</b> work.
5 mins - Plenary	<p><b>Recap</b> key objectives for the session using Q+A.</p> <p><b>Explain</b> next CAD session will assemble bottle.</p>	Students able to recall key principles and techniques using correct technical vocabulary.

## Homework

Students use their understanding of Pro/ENGINEER, existing bottle designs and bottle manufacturing processes to design their own sports drink bottle that can be manufactured in school.

## Session six – Own bottle shape

### Aim:

In this session students build on the Pro/ENGINEER skills they have learned to model their own bottle design on computer.

### Learning objectives:

By the end of this session students should:

- Be more aware of the possibilities and limitations of modelling 3D shapes using Pro/ENGINEER.
- Be able to combine 3D sketch based features to create a simple bottle shape of their own design.
- Be able to apply direct features to modify basic shapes.

### Focus:

During this session students use the techniques they have learned in Pro/ENGINEER to model their own design for a sports drink bottle.

Students should have the opportunity to see the designs of other students and share the highs and lows inherent in learning new software.

## Session Seven – NC/RP bottle

### Aim:

Students will use the available CNC machining or rapid prototyping equipment to manufacture the shape of their bottle.

### Learning objectives:

- Be aware of the running costs of operating CNC/RP equipment
- Be aware of downstream production techniques including vacuum forming, casting, moulding, etc.
- Understand the health and safety requirements of operating CNC/RP equipment
- Be able to use CNC/RP equipment under close supervision to create their own bottle design.

**Focus:**

The format for this session depends entirely on the type and quantity of manufacturing equipment the school has and the level of technical support available. An absolute minimum provision would be a small 3D engraver/mill used to produce a design in two halves that are then joined together. Schools should consider downstream manufacturing processes like vacuum forming for prototyping designs.

**Homework**

complete a 'Modelling steps' form explaining the sequence of feature creation for their own design of sports drink bottle.



**Session eight****Focus:**

In this session students are introduced to the assembly tools in Pro/ENGINEER combining the bottle and cap.

**Learning objectives:**

By the end of this session students should:

- be aware how 3D parametric solid modelling software can create multi-part assemblies
- Understand the principles of assembly in Pro/ENGINEER and the tools and procedures to accomplish this.
- Be able to assemble components using insert, mate and align constraints in Pro/ENGINEER.

Session details	Teaching 	Learning 
Prior to session	Homework – Collect responses from week three task – Final design. Start Pro/ENGINEER and load completed assembly.	Completed the previous tasks creating bottle body and cap using Pro/ENGINEER with parts saved in student documents folder.
On arrival	Register – <b>instruct</b> students to log-on and start Pro/E. Eyes and ears front.	Students <b>log-on</b> to network and start <b>Pro/E</b>
Starter – 5 min	Ask individuals to <b>describe</b> something new they learned in the previous CAD sessions. Introduce task and expected outcomes – <b>Assemble the parts created in previous sessions to produce a complete sports drink bottle assembly</b> . Show completed model and demonstrate kinematic rotation is only movement of cap.	Students respond with new learning recalled from previous sessions. Listen to task
Demo' - 10 mins	Straight into swift whole class <b>demonstration</b> using digital projector – Teacher <b>models</b> techniques and procedures to externalise the concepts for students. If possible move students away from PCs or lock using network management software.	They should not be allowed to follow on their PC.  Students <b>watch</b> teacher demonstration of

	<p><b>Recap</b> key principles using <b>Q+A</b> – GUI, screen navigation, sketch, feature.</p> <p>Demonstrate creation of grip extrusion and pattern around cap.</p>	frame assembly.
Indiv' - 15 mins	<p>Support as before</p> <p><b>Instruct</b> students to save cap.</p>	Students <b>add grip and pattern round cap</b> .
Demo' – 10 min	<p>Starting assembly – distinguish between this and part file. Show adding component and fixing in position. Add cap and create assembly constraints.</p> <p>Demo degrees of freedom of movement using kinematics.</p>	<p>Students <b>watch</b> teacher demonstration of bottle assembly. They are expected to recognise the key concepts and understand the sequence of operations as a precursor to following the step-by-step guide.</p> <p>Students should not be allowed to follow on their PC.</p>
Indiv' - 15 min	<p>Teacher <b>monitors</b> individual work and supports individuals with the help of student CAD/CAM <b>mentor</b> if available</p> <p>Instruct students to save work</p>	<p>Students <b>assemble</b> frame following step-by-step guide.</p> <p>Students <b>save</b> work.</p>
Plenary - 5 min		

## Session nine – Engineering drawing



### Aim:

In this session students are taught how to use Pro/ENGINEER to create an engineering drawing for their bottle design.

### Learning objectives:

By the end of this session students should:

- Be aware of the international standards for engineering and technical drawings.
- Understand how technical drawings are used for quality control, assembly and operation of products.
- Be able to use Pro/ENGINEER to create an orthographic drawing of their bottle including a pictorial view.

Session details	Teaching 	Learning 
Prior to session	<p>Part and assembly files for the bottle and cap should be available in the student's user area.</p> <p>Start Pro/E with the completed assembly loaded</p>	<p>Completed the preceding part creation and assembly tasks.</p> <p>Able to access the Pro/ENGINEER bottle parts and assembly.</p>
On arrival	<p>Register – <b>instruct</b> students to log-on and start Pro/E. Eyes and ears front.</p>	<p>Students <b>log-on</b> to network and start <b>Pro/E</b></p>
Starter – 5 min	<p>Brief <b>Q/A</b> to check prior knowledge and understanding of engineering/technical drawings. Use examples to explain the</p>	<p>Respond to questions with previous experience/ examples.</p> <p>Listen to explanation – Purpose of</p>

	changing purpose of drawings: blueprints, velum, CAD, quality control, assembly, maintenance, etc.	drawings.
Demo' - 10 min	Straight into swift whole class <b>demonstration</b> using digital projector – Teacher <b>models</b> techniques and procedures to externalise the concepts for students. If possible move students away from PCs or lock using network management software.  <b>Demonstrate</b> Task 18 – Steps 1-22	They should not be allowed to follow on their PC.  Students <b>watch</b> teacher demonstration of frame assembly.
Indiv' – 15 min	Support as before.  <b>Instruct</b> students to save drawing.	Students use <b>Pro   ENGINEER</b> to <b>create</b> new drawing with chosen template, adding three views.  Students save their work
Demo' – 10 min	Demonstrate from Task 18 - Steps 23-41 Instruct students to save their drawing.	Students use <b>Pro   ENGINEER</b> to add centre lines and dimensions to their drawing. Students save their work.
Indiv' - 15 min	Support as before.  <b>Instruct</b> students to save drawing and close <b>Pro   ENGINEER</b> .	Students use <b>Pro   ENGINEER</b> to <b>create</b> centre lines and dimensions to their drawing.  Students save their work and close <b>Pro   ENGINEER</b> .
Plenary - 5 min	All pupils stand. Each pupil asked to describe one of following: history/ modern uses of engineering drawings, principles of creating drawings and specific Pro/E tools and techniques. When entire class seated, dismiss class.	Pupils choose an aspect of this session and describe it. Correct responses allow student to sit  Students leave when everyone has provide a correct answer.

This completes the CAD sessions for this module

## Homework

Students begin collating all their information into an e-presentation.

## Session ten – Finishing bottle prototype

### Aim:

Students will use this session in the workshop to finely finish the surface of their prototype bottle and apply information/ surface designs.

### Learning objectives:

By the end of this session students should:

Be aware of:

- a range of prototype finishing techniques.

Understand:

- the role of handling prototypes in product development.

Be able to:

- produce a well finished bottle prototype as a proof of concept design.

Some students may need time during this session to complete the finishing of their foam CNC models in a workshop.

You must make sure you are very clear about the health & safety implications for working with foam and take all necessary precautions to keep yourself and others safe and healthy.

Many will be putting together their presentations ready to deliver during the next session.

## Homework

Students complete their e-presentation for delivery in the final session.

## Session eleven – Electronic presentations

**Aim:**

**Aim:**

During this session students will have time to deliver their presentations describing their designs to the rest of the group.

### Learning objectives:

By the end of this session students should:

Be aware:

- of presentation techniques.

Understand:

- the importance of message over special effects.

Be able to:

- Deliver presentations to peers.

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