Year 3 Planning
DESIGN AND TECHNOLOGY
Structures – Shell structures using computer-aided design
Apply understanding of computing to program, monitor and control products

Prior Learning:
- Experience of using different joining, cutting and finishing techniques with paper and card.
- A basic understanding of 2-D and 3-D shapes in mathematics and the physical properties and everyday uses of materials in science.
- Familiarity with general purpose software that can be used to draw accurate shapes, such as Microsoft Word, or simple computer-aided design (CAD), such as 2D Primary or Techsoft.

Lesson 1 - TECHNICAL KNOWLEDGE/MAKE SKILL KNOWLEDGE RECORDED IN KEY SKILLS BOOKS	Lesson 2 – EVALUATING COMPLETE PAGES 2-4 FROM ACCOMPANYING BOOKLET	Lesson 3 - DESIGNING COMPLETE PAGE 5 FROM ACCOMPANYING BOOKLET
WALT: Develop and use knowledge of how to construct strong, stiff shell structures.	**WALT: Investigate and evaluate a range of existing products**	**WALT: Generate a realistic design criteria collaboratively**

WALT: Develop and use knowledge of how to construct strong, stiff shell structures.

Key vocabulary:
shell structure, three-dimensional (3-D) shape, net, cube, cuboid, prism, vertex, edge, face, length, width, breadth, capacity, marking out, scoring, shaping, tabs, adhesives, joining, assemble, accuracy, material, stiff, strong, reduce, reuse, recycle, corrugating, ribbing, laminating, font, lettering, text, graphics, decision, evaluating, design brief design criteria, innovative, prototype

SHELL STRUCTURES
Show children a collection of different shell structures including boxes of various shapes. In groups, ask children to take a small package apart identifying and discussing parts of a net **including the tabs** e.g. *How are different faces of the package arranged? How are the tabs used to join the 'free' edges of the net?*

CONSTRUCTING NETS (FTs)
Begin by asking children to use kit parts (CLIXI) with flat faces to construct nets. Discuss the 2-D shapes which form the faces of 3-D shapes. [LINKS TO MATHS CURRICULUM]

WALT: Investigate and evaluate a range of existing products

INVESTIGATIVE AND EVALUATIVE ACTIVITIES (IEAS)
Have a collection of boxes of various shapes on the tables. If you have the opportunity, visit a local shop or supermarket to investigate different types of packaging.

EVALUATING SHELL STRUCTURES
Ask children to investigate the collection of different shell structures including packaging. Use questions to develop children's understanding e.g. *What is the purpose of the shell structure – protecting, containing, presenting? What material is it made from? How has it been constructed? Are the materials recyclable or reusable? How has it been stiffened i.e. folded, corrugated, ribbed, laminated? What size/shape/colour is it? What*

WALT: Generate a realistic design criteria collaboratively

CARRY OUT RESEARCH
Get children to gather information about needs and wants of a particular audience by completing a survey, interview or questionnaire in order to develop a design specification for their product.
- Purpose of the product
- Intended Users
- Popular themes
- Context of product

Children must carefully consider the purpose and intended user for their product.
LINKED TO 3RD HOUR ACTIVITY

CREATING A DESIGN BRIEF
Discuss with the children the purpose of shell structure products. Discuss the uses and purposes of their shell structure e.g. *What does the product need to do? Who is it aimed at? How will the purpose and user affect your design decisions?* Agree on design criteria that can be used to guide the development and evaluation of children's products *e.g. How will we know that we have designed and made successful products?*
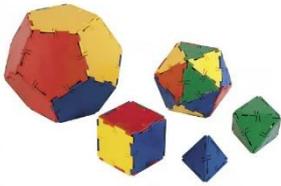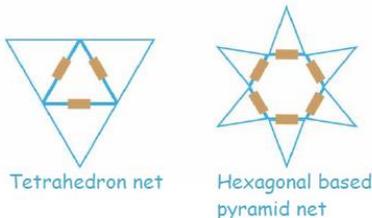
Next, ask children to practise making nets using standard sized card squares, rectangles, equilateral triangles, isosceles triangles and hexagons. Get children to join the flat faces with masking tape to create 3-D shapes. Experiment with assembling the nets in numerous ways.
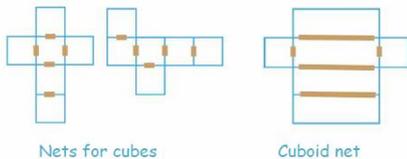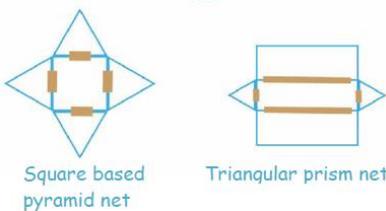

Nets for cubes   Cuboid net

Tetrahedron net   Hexagonal based pyramid net

Square based pyramid net   Triangular prism net

STIFFENING AND STRENGTHENING SHEET MATERIALS

Ask children *'How can we improve the strength of our shell structures?'* Demonstrate how to use different ways of stiffening and strenthening their shell structures e.g. folding and shaping, corrugating, ribbing, laminating. Give children card, paper and straws to provide opportunities for them to practise these skills and to carry out tests

information does it show and why? How attractive is the design?

Discuss the environmental issues relating to the wastage of materials when packaging items including the three R's - reducing, recycling and reusing.

INVESTIGATE DESIGN FEATURES

Evaluate existing products to determine which designs children think are the most effective. Provide opportunities for the children to judge the suitability of the shell structures for their intended users and purposes. Discuss graphics including colours/impact of style/logo/size of font e.g. *What do you prefer and why? What style of graphics and lettering might we want to include in our product to meet users' preferences and its intended purpose? Which packaging might be the best for…?*

In groups, get children to put together an image board of packaging so children can see the range of fonts and consistency with a brand. [see page 4] Then get them to draw an existing product, annotating it to show material, the different faces of the package, and the type of shell structure etc. Alternatively, children could take photographs of the product and annotate (see page 2).

EDWARD DE BONO THINKING HATS

Next, ask children to record answers to these questions against **Edward De Bono Thinking Hats**. Explain what each hat represents [page 3]

In groups, ask children to generate a range of ideas on what they could design, make and evaluate, encouraging realistic responses. [talk-less teaching strategy], e.g. *gift boxes/containers, lunchboxes, packaging, money boxes, desk tidy, mystery boxes.* (see page 5 of booklet for a detailed list)..

THE DESIGN BRIEF

Now model how to develop an authentic and meaningful design brief with the children based on their research - this should consist of no more than seven criteria their product must meet e.g. the product was be weather proof.

Show children examples of design briefs for products and explain that the design brief must concentrate on design outcomes (like size, function) not specific product details (like colour). The design brief will allow children to focus on the problem they are solving and what they are trying to achieve from the product.

Agree on a design criteria that can be used to guide the development and evaluation of the children's products, including safety features.
Develop a project title from the results:
Design, make and evaluate a _____ (product) for _____ (user) for _____ (purpose).

to find out where their structures might need to be strengthened or stiffened. Ask children to record the 3 methods in their key skills books:
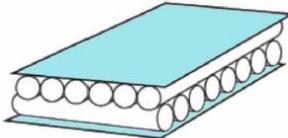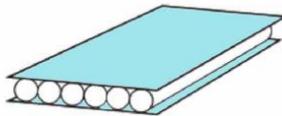
1. Laminating – glue together several layers of card.
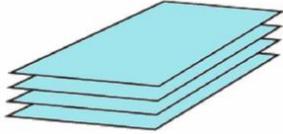
2. Corrugating – zig-zag a piece of paper or card and glue in between two layers of card.
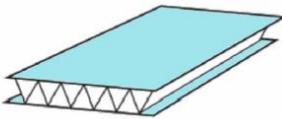
3. Ribbing – glue layers of straws between layers of card.

Ask children to use standard shapes as templates to create their own nets and apply the stiffening techniques to their own structures rather than using rectangles.

Attach their example stiffening and strengthening techniques to PAGE 1 of the accompanying booklet.

- WHITE: Facts
- RED: Feelings
- BLACK: Problems
- GREEN: Creativity
- YELLOW: Benefits
- BLUE: Process

Display technical vocabulary to encourage the children to use it when discussing, designing and making their product.

Lesson 4 - DESIGNING

WALT: Communicate ideas using annotated sketches and CAD

LAPTOPS OR COMPUTERS RUNNING THE CRUBLE SOFTWARE WILL BE REQUIRED

In this lesson, model how to communicate ideas through detailed, annotated sketches.

WORKING DRAWINGS
Ask children to create annotated sketches to develop, model and communicate their ideas for the product they want to make on paper. For support, allow children to use standard shapes as templates.
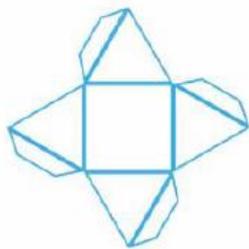
Remind children to ensure that they include sufficient tabs in their drawings for assembling their nets.

The drawings should indicate the design decisions made, including the **materials, dimensions,** and the **appearance and finishing techniques** for the product. Children annotate their working drawing explaining their thought process and techniques.

Children to consider the following questions:
- *What will you need to include in your design?*
- *How can you improve it?*
- *What materials will you use?*

Lesson 5 - TECHNICAL KNOWLEDGE/MAKE

WALT: Use computer-aided design to explore graphic techniques

LAPTOPS OR COMPUTERS RUNNING THE CRUBLE SOFTWARE WILL BE REQUIRED
Explain that today we will be using drawing software to design the net, text and graphics for your product.

FOCUSED TASKS (FTs)
Introduce children to simple drawing software such as Techsoft 2D Primary or Microsoft Word. Ask children to explore the interface and drawing tools to practise drawing and manipulating shapes such as rectangles, squares, ellipses, trapezoids and traingles.
[THIS SKILL COULD BE CONTINUED IN ICT KEY SKILLS]

USING MICROSOFT WORD
Microsoft Word has many features that allow children to draw and manipulate accurate shapes, import or paste in graphics and print the final designs without having to use dedicated CAD software.
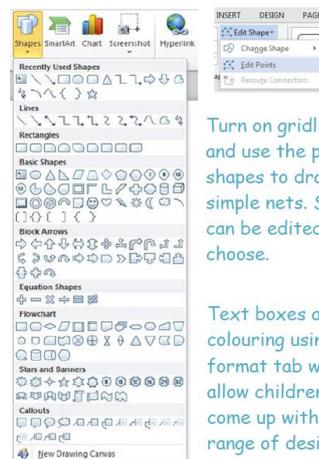
Turn on gridlines and use the pre-set shapes to draw simple nets. Shapes can be edited if you choose.

Text boxes and colouring using the format tab will allow children to come up with a range of designs.

OR..

Lesson 6 – MAKING

WALT: Plan and order the main stages of making

Applying their knowledge, understanding and skills from **Focused Tasks (FTs),** children should make a high quality prototype.

### MAKING A PROTOTYPE NET WITHOUT CAD
Start by demonstrating the skills and techniques of scoring, cutting out and assembling using pre-drawn shapes. Begin by allowing children to print out their computer-aided design (CAD) nets to develop a prototype in order to evaluate and refine their ideas.

In order to understand how it was constructed, ask them to cut out the individual faces of their net and stick them together again.
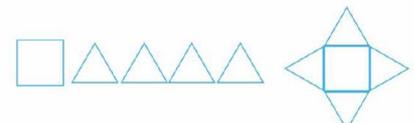
Then add tabs, glue the paper net onto card and cut out. The use of an empty ballpoint pen together with a safety rule is ideal for scoring.
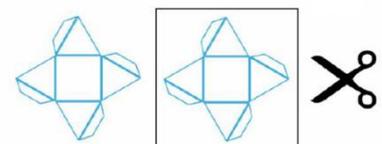
Provide children with copies of 2-D nets for those who struggle. Ask children to consider the use of enlarge and reduce facilities on the photocopier, depending on desired product size, when copying 2-D nets for the children.

- *How will you make sure your product works well and has the right appearance?*
- **How will you strengthen and stiffen your design?**

If children are designing and making packages for a food product, they will need to choose materials appropriate for direct contact with food.

GRAPHIC DESIGN FEATURES
Extend children to develop their computer-aided design (CAD) skills by using such as Techsoft 2D Primary or Microsoft Word to generate and modify appearance and finishing techniques for the product. Children should recognise that designs can be easily modified and repeated on the computer without the need for a physical product.

Using Microsoft Word, let the children explore and be guided to try out different fill and font tools to become familiar with the graphic design aspects of the available software to achieve the desired appearance of their products. At this stage of the design, decisions do not need to be final.

Children annotate their drawings with chosen fonts and colours they wish to include in their final product.
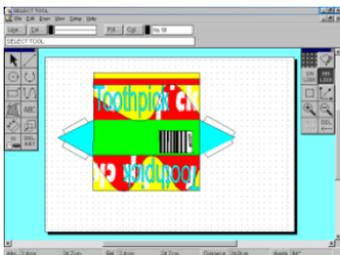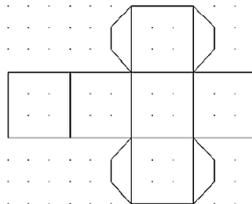

USING TECHSOFT 2D PRIMARY
Explore and use the different drawing tools and zoom, grid and locking tools to help ensure accurate drawings.
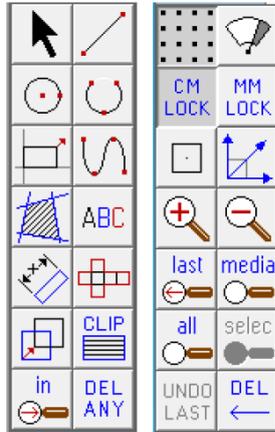
Demonstrate how to draw a simple net. Now ask children to practise drawing a net for their product designed in the previous lesson, ensuring they use the copy and move 'handles'.

Remind children to ensure that they include sufficient tabs in their drawings for assembling their nets.

Using the fill and font tools, get children to add the graphic design aspects to their product. *Perhaps they could include packaging logos and certificate markings etc.*
ATTACH A PRINT OUT TO PAGE 7

Children can be shown how to achieve this.

Children need to consider how they will strengthen and stiffen their shell structure, and finishing techniques ready for manufacture in the application weeks.

Ask children to consider the following questions when making their prototype:
- *What tools and materials will I need?*
- *What constraints am I working to?*
- *What fonts and colours will I use?*
- *Will my product meet the needs, wants and interests of the user group?*
- *How will it address a problem or need?*

Example prototype for a lunchbox

RECORD THE MAKE
Ask children to consider the main stages in making and testing before assembling a high quality product in the application weeks. They must draw on their knowledge, understanding and skills learnt through IEAs and FTs. Children should produce a detailed, step-by-step plan, listing tools and materials. Children can take photographs at each stage of the make [see page 8 of booklet].

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	Note: Instructions and example programs on how to use the TechSoft 2D Primary interface can easily be found on the internet.	**CRITICALLY EVALUATE THE DESIGN** Encourage children not to be afraid to include any failed designs into displays of final products. Include evaluations of why the designs didn't work and how children would make them work. This links to design in the real world and the concept that designs don't always work first time around. Discuss the model below and key terminology [REFER TO PAGE 15 in booklet]. Show children how to evaluate against the six essential characteristics by giving it a score from 0-5, with 0 being the lowest score.
	TIPS ✓ Use the options in Microsoft Word and other software to display rulers and grids that can help with generating nets and other items ✓ Using copy and paste will ensure that objects are of a consistent size.	
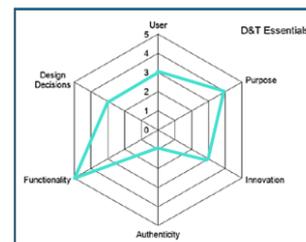
Note:

One Project booklet is required per child for the entire 6-week unit. Preferably A3 size.

During the first 3 weeks of the modelling teaching sequence, children will complete the first half of their booklet outlined in the plans above. When creating the design brief and communication of ideas, children must decide in their groups on a product they would like to manufacture.

Lesson 6 requires children to make a prototype of their chosen design using materials and knowledge gained through the focused tasks (FTs).

Throughout the application weeks, children will work in their groups and complete the second half of their project booklet [pages 10-15]. Outlined below are the tasks children are required to complete.

Application of Skill
TASK SHEET

Structures – Shell structures using computer-aided design
Apply understanding of computing to program, monitor and control products

1. Make a high quality product, applying knowledge, understanding and skills from IEAs and FTs:
    Make a shell structure using computer-aided design (CAD) which must contain a strengthening and stiffening technique. Include a photograph and drawing of the finished product. [page 11-12]
2. Compare the final product to the original design specification. [page 12]
3. Test products with the intended user, where safe and practical [page 13]
4. Critically evaluate the quality of the design, manufacture, functionality and fitness for purpose. [page 14]
5. Consider the views of others to improve your work using Thinking Hats [page 15]
6. **ENGLISH TASK - Produce a leaflet or information text discussing the environmental issues relating to the wastage of materials when packaging items including the three R's - reducing, recycling and reusing.**