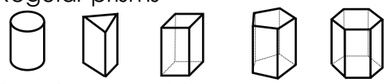
NUMERACY IN
DESIGN
JAMBLED&T

Shapes:
Regular shapes

Regular prisms



Regular pyramids

When designing new products or drawing existing products, try to imagine it as a series of linked shapes. Sketch the shapes lightly in pencil before going over chosen lines a little darker to form your image.

NUMERACY IN
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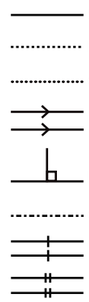
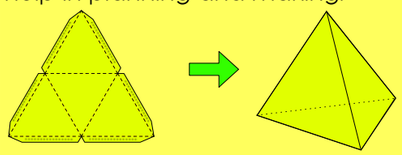
Lines:



When creating a net for a model, these line styles can be applied to help in planning and making.



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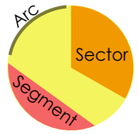
Measuring Circles:

Parts of a circle:



Area of a circle:

$$\pi r^2$$

Key facts…
- Diameter, Ø = 2r
- Circumference, C = 2πr
- Pi or π is the ratio of a circle's circumference to its diameter
- $\frac{\text{Circumference}}{\text{Diameter}} = \pi = 3.14159$
- *Food for thought…* **3.14=Pi.E**

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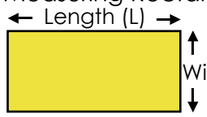
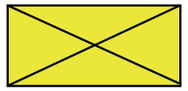
Measuring Rectangles & Squares:





Centre point is found By linking the corners

Area = (L)x(W)

It is important to work out the area of materials needed for our products. This way we can maximise the use of materials and work out how much we need to spend. It will also help us to figure out if existing off-cuts of materials can be used.

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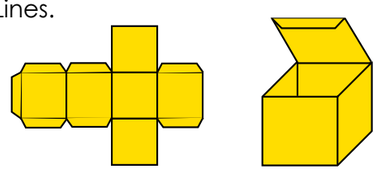
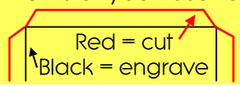
Nets:
Imagine your 3D design as a piece of packaging that has been taken apart and laid out flat. Use the correct line styles for fold and glue Lines.



When using CAD/CAM to design your net, you will need to make sure that the lines are colour coded to match the 'engrave' and 'cut' requirements of your laser cutter.
Eg.



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Scale:
A real object, with accurate sizes that has been reduced or enlarged in size by a certain amount. If an model or drawing is 1/10th of its Intended size as an outcome, it is written as 1:10.

Drawing 1:4 Product

Area = L(10) x W(10)
= 100mm

Area = L(20) x W(20)
= 400mm

= 100:400
= 1:4

NUMERACY IN
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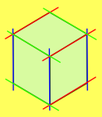
Drawing Formats:
Oblique (45˚) Front face drawing with 45 degree line depth.

Isometric (30˚) 3D drawing, 30 degree lines for depth.

When drawing 3D shapes or products, the most important thing to remember is to use parallel lines in the right place.
Here you can see them split into red, blue and green.



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CAD: 2D Design V2

- 10mm line lock.
- 10mm line lock.
- Radial Lock - Rotate design at set angle.
- Drawing tools to given radius or no. of sides.
- Dimensions - measures between selected areas.
- Contour - create internal or external Perimeter of a shape.
- Transform - Replace or repeat design.

2D Design V2 is a CAD (Computer Aided Design) program that allows you to design ready for CAM (Computer Aided Manufacture). It is really useful to get to know the layout and the tools if you want to get the best and most accurate design work!

NUMERACY IN
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CAD:
3D Design, typical tools:

- Dimensions - *adds and allows you to change line, radius & diameter measurements.*
- Extrude - *To force, press or push out a shape.*
- Chamfer - *Bring an edge down at a chosen angle.*
- *Round - Change an edge to a Chosen radius.*

Using accurate measurements when designing in a 3D CAD program will allow you to grasp the size all of the parts need to be in relation to each other. It will also allow you to calculate area and volume of a product.

NUMERACY IN
DESIGN
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'Maths behind the design':

Alexander McQueen
S/S 10' Dress

Can you combine inspiration found in research to come up with a design for a product? Try the 'Maths behind the design' to demonstrate in a simple way how patterns are combined to form a solution.

NUMERACY IN JAMBLED&T

MANUFACTURE

CAM (**C**omputer **A**ided **M**anufacture):
Laser Cutting

- % Power cut/engrave
- % Speed cut/engrave

- Height of bed.
- Depth of material
- Depth of engraving

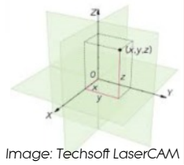


Image: Techsoft LaserCAM

Check the recommended speed and power for cutting, light and deep engravings.
Make sure the laser has been on for the required start up time before running the print.

NUMERACY IN JAMBLED&T

MANUFACTURE

CAM (**C**omputer **A**ided **M**anufacture):
3D Printing

- Slice height in mm
- % Density of solid fill
- Angle of tolerance
- Available print area
- Estimated print time
- % of build
- Filament usage in metres

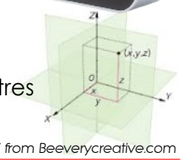


Image: 'Beethefirst' from Beeverycreative.com

Export your 3D designs to '.stl' (Stereo lithography) files.
BRIM - creates a skirt around design.
RAFT - creates a base beneath design.
SUPPORTS - temporary supports under lipped platforms.

NUMERACY IN JAMBLED&T

MANUFACTURE

CNC (**C**omputer **N**umerical **C**ontrol):
Vinyl Cutting

- Force of cut
- Speed of cut
- No. of passes
- Application tape for accuracy
- CNC Output

Image: 'Graphtec Silhouette SD'

Vinyl cut designs are a quick way to make your work look professional.
Try cutting your design twice and offsetting one colour from another?
Use the leftover outline of your design as a stencil?

NUMERACY IN JAMBLED&T

MANUFACTURE

Manufacturing plan:
Make sure instructions for making a product are in the correct order to follow…

Stage	Tools/ Machines	Quality Checks	H&S
1:			
2:			
3:			

In industry, the designer does not always make the end product. It Is very important that calculations are correct to avoid costly mistakes!

NUMERACY IN JAMBLED&T

MANUFACTURE

Mathematical Literacy:

Length, Width, Depth
Square, Right Angle, Degrees
Jig, Measure
Density, Tolerance, Force
2D, 3D
Rotation

Use the correct terminology in lessons and when writing up your practical work. Do you know the meanings of the above mathematical literacy?
Could you add any more?

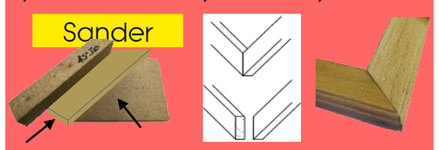
NUMERACY IN JAMBLED&T

MANUFACTURE

Angles:

Jigs: We can make a jig to help control the location or motion or a material or tool. These are really useful for accuracy and when making more than one product.

Eg.
1) 2) 3)



NUMERACY IN JAMBLED&T

MANUFACTURE

Cutting List:

Part	Material	L (mm)	W (mm)	D (mm)	Number

Find out what materials you have to choose from in school. Check whether they are in sheet or plank form. Find out the different thickness Include a labelled image of your work. Measurements in millimetres.

NUMERACY IN JAMBLED&T

MANUFACTURE

Measuring:
Tape Measure
1m=100cm=1000mm

Marking Gauge
Scribes a parallel cutting line

Plastic Ruler
10cm=100mm

Steel Rule
1cm=10mm

Make sure that you start at zero.
Measure in mm for better accuracy.
Add suggested sizes to initial designs and actual sizes to developments & final ideas.
Double check all measurements!
Use a sharp pencil.

NUMERACY IN JAMBLED&T

EVALUATION

Scales of Production:

One Off (1)- A prototype product, a one off solution to a problem.

Batch (10s to 1000s)- Small quantities or identical.

Mass (10,000s to millions)- Large quantity, normally in a line of small stages.

Continuous

Usually simple to make, 24 hours a day, all year round.

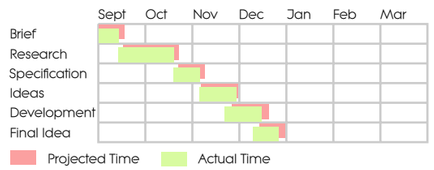
If you were to change your design to suit one of the forms of production above, what changes would you need to make? Would packaging need to be modified?

NUMERACY IN JAMBLED&T

EVALUATION

Gantt Charts:

At the beginning of a project, you Will have compared the tasks to the time you had available.



Effective time management is essential in a project. It is worth reflecting on your estimated times when evaluating. This way you can improve upon your future planning and management.

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EVALUATION

Measurement testing:

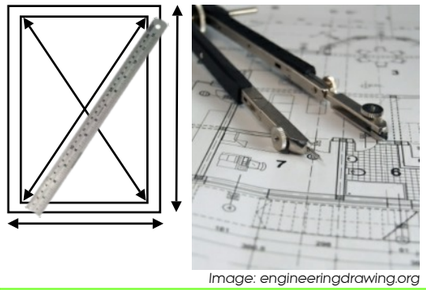


Image: engineeringdrawing.org

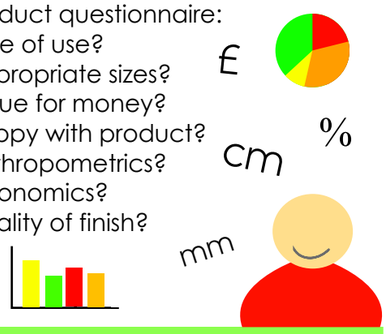
It is important to double check our measurements throughout the design & make process. When the product is finished we should make final checks as to whether the sizes make the product fit for it's purpose, ergonomics and anthropometrics.

NUMERACY IN JAMBLED&T

EVALUATION

Product questionnaire:

Ease of use?
Appropriate sizes?
Value for money?
Happy with product?
Anthropometrics?
Ergonomics?
Quality of finish?



As we manufacture our products, we find that many changes take place. It is important to analyse data gathered from users of the product in order to figure how successful it is and if any further changes are necessary.

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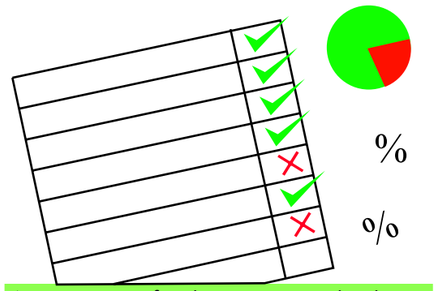
EVALUATION

Design & product specification:



As we manufacture our products, we find that many changes take place. It is important to analyse data gathered from users of the product in order to figure how successful it is and if any further changes are necessary.

NUMERACY IN JAMBLED&T

EVALUATION

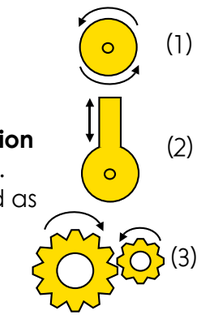
Mathematical Literacy:
One-off, Batch, Mass, Continuous, Gantt, Chart, Actual, Projected, Time, One, Ten, Hundred, Thousand, Million, Quantity, Stages, Measurements, Millimetre, Centimetre, Anthropometrics, Ergonomics.

Use the correct terminology in lessons and when writing up your evaluation. Do you know the meanings of the above mathematical literacy?
Could you add any more?

NUMERACY IN JAMBLED&T

KNOWLEDGE

Mechanisms:
Cranks and cams convert **rotary Motion** (1) to **reciprocating motion** (2) and vice versa. **Gears** (3) are used as Force multipliers And reducers.



Always consider force and motion within your design to enable working mechanisms. Test these to make sure they work in unison to gain the required outcome.

NUMERACY IN JAMBLED&T

KNOWLEDGE

Anthropometrical Data:
In order to make a design suitable to a specific user, a target market or as inclusive as possible, it is important to look average human Sizes.

Use a tape measure to work out the average measurements of your target market. This will enable you to design specifically for them. Data can be found on the Internet but why not measure yourself or a peer to make it primary research!

NUMERACY IN JAMBLED&T

KNOWLEDGE

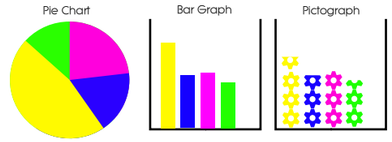
Ergonomics:
Measurements and positioning of products and their components in order to optimise interaction with a human. Effective ergonomic design allows for well placed components and features without over complicating.

Create space, CAD and card models in order to allow high quality testing strategies for the user. Check your measurements of parts to enable the user an uncomplicated experience. Remember…
good design is smarter, not harder.

NUMERACY IN JAMBLED&T

KNOWLEDGE

Data Collection:
Start with a client interview or questionnaire to gain opinions. Now analyse data.

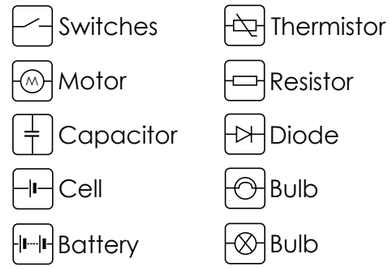


In D&T we are usually designing for others. It is vital to find out what our target market wants out of the product. Analyse these answers and show we have considered them in our designs. Use annotations to link designs to your customer.

NUMERACY IN JAMBLED&T

KNOWLEDGE

Electronic symbols:



Ohms Law:
Calculates Voltage, Current or Resistance in a circuit.

V = I x R

Voltage (V) = Volts
Current (I) = Amps
Resistance (R) = Ohms

Now try the resistor calculator!

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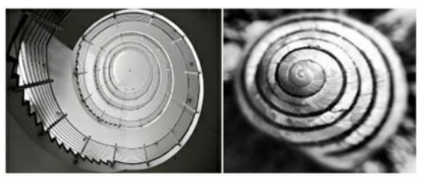
KNOWLEDGE

Biomimicry:
The design and production of materials, structures, and systems that are modelled on biological entities and processes



Nature not only inspires ideas and designs but solves many problems that designers face too! Think about how biomimicry and the Mathematics of nature could improve your design and make it more sustainable.

NUMERACY IN JAMBLED&T

KNOWLEDGE

Mathematical Literacy:
Averages

Mode - The most common value of the data.
Median - The middle value when data is put in order.
Mean - Add all of the values together & divide by the total number of pieces of data.

Data:	1, 7, 5, 8, 4, 7, 6, 5, 5, 2
Mode	1, 7, **5**, 8, 4, 7, 6, **5**, **5**, 2 = **5**
Median	1, 2, 4, 5, **5**, 5, 6, 7, 7, 8 = **5**
Mean	1+7+5+8+4+7+6+5+5+2 = **50**

NUMERACY IN JAMBLED&T

KNOWLEDGE

Mathematical Literacy:
Brackets - Symbols used in pairs to group calculations together.
Indices - Concept for expressing very large numbers.
Division - Separating into a number of parts.
Multiplication - Adding an integer to itself a specified number of times.
Addition - The total of 2 or more Numbers.
Subtract - Taking a number or amount away from another.

Symbols:

B = ( ) I = 2^5 D = ÷

M = × A = + S = —

NUMERACY IN JAMBLED&T

KNOWLEDGE

Mathematical Literacy:
Brackets, Indices, Division, Multiplication, Addition, Subtraction, Percentages, Symbols, Input, Output, Mode, Median, Mean, Models, Structure, Systems, Process, Flow, Data, Data Analysis, Fractions, Anthropometrics, Ergonomics, Units of measurement - Metres (m) Centimetres (cm) & Millimetres (mm)

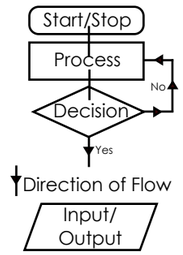
Use the correct terminology in lessons and when writing up all aspects of your work. Do you know the meanings of the above mathematical literacy?
Could you add any more?

NUMERACY IN JAMBLED&T

KNOWLEDGE

Flow Diagrams:

Key:



Flow Diagrams will help you to order a series of instructions and decisions in a task. These decisions are often your QA's (Quality Assurances).