







# DESIGN & TECHNOLOGY KS2

# Sample pages

A TEACHER'S HANDBOOK FOR THE NATIONAL CURRICULUM  
G W Asquith & B P Smith

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### 3. COMMUNICATING IDEAS PART 1



Communicating ideas, making annotated drawings, using different views and showing specific features 3-4



As part of designing **communication** is a most important activity as we always need to share ideas and explain our thoughts to others. "On the back of an envelope" has long been an expression in common use.

Drawing, although the most common form of communicating a design is not the only form. Oral communication is useful and to be encouraged from young children. Children may need to and find it useful to model an idea as they find it difficult to draw a 3D object and their idea may need further explanation.

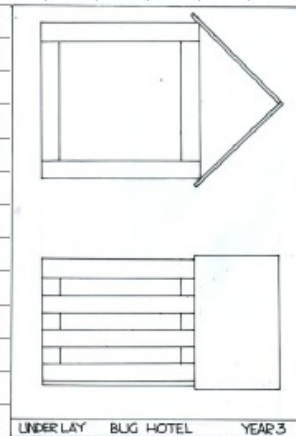
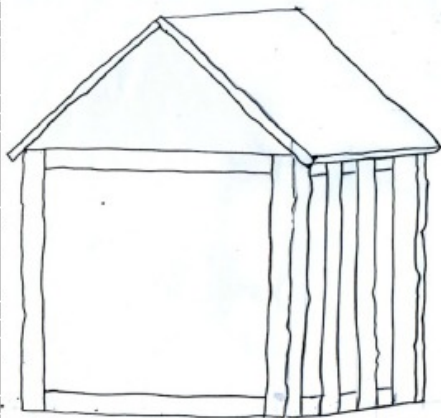


It is expected that drawing will start with using 2D sketches which are drawings which show no depth to an

When children draw in 2D it may be necessary to find out what the side of the object looks like.

During the latter part of the lower Key Stage 2 children should be introduced to drawing in 3D, this may start by adding depth to a 2D drawing.

Typical underlay used for the project



### 10. JOIN AND COMBINE MATERIALS + COMPONENTS



Assemble their components 3  
Join and combine materials and components in a permanent and temporary way. 4-6



There are two types of joining and combining of all materials.

- Temporary, being able to be taken apart.
- Permanent, fixed for good, designed not to be taken apart.

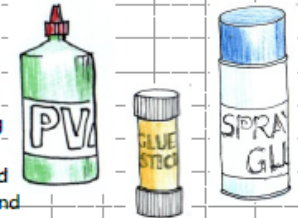
Both these types of fixings are used in Design and Technology.

	Temporary	Permanent
Paper and Board	Paper clips and fasteners	Glue and staples
Wood	Screws, Nuts and bolts	Glue, nails, panel pins
Fabric	Tacking stitches of thread	Sewn with thread
Plastics	Bolts and nuts	Adhesives, Blind/pop rivets (some plastics can't be glued)
Metals	Bolts and nuts	Blind rivets, soldering (welding and brazing are commercial)

#### Glue

Four types of glue are required in Design and Technology.

- Glue sticks for paper and light card
- Aerosol spray glue for non wrinkle gluing. This needs to be undertaken only by staff in a well ventilated space.
- P.V.A. (Poly vinyl acetate). This is generally a white glue which dries clear and is water based and washable whilst wet. Clothing must be protected from P.V.A. It sets by absorption and evaporation. The more glue used the more has to evaporate and the longer it takes to dry. It can be used on all wood and card and applied with a spreader. A tip to remember is when spread the surface should look wet not white, this will give the best results and drying time.
- Glue gun for gluing card and wood, the glue is hot and takes time to cool. The nozzle of the glue gun remains hot for some time. Cool melt guns are available, which aren't as hot.



#### Screws

- They are used for joining two pieces of wood and work best if the top piece of wood is drilled a clearance size of 0.5 mm larger than the shank of the screw.
- The head of screws can differ, the most common is a countersunk one (csk) and a countersink drill bit can be used to produce a flush finish of the screw head.
- Two main types of drive slots are available, the most useful for school work are the star shaped pozidrive ones slotted are also available but for the less dextrous slippage is a problem.
- Four things define a screw. Length, diameter or shank, head shape and pozidrive or slotted.



## 12. MODELLING IDEAS



National Curriculum

Communicate design proposals by modelling ideas. 3  
Communicate ideas. 4-5  
Make working models. 6



Modelling is a most useful design tool and in KS2 it should be used throughout. The modelling of ideas is a very different activity to model making in that the model in Design and Technology is not the end product but is an aid to understand how a product might look (aesthetic qualities), might work and move (technical qualities). From the model a product should be developed.

- In year 3 to show what a 3D product is to be like and could be of card.
- In year 3 Lego could be the modelling material to explore linkages, gears etc.
- In year 4 to show what the structure designed will be like and show how the structure will be stiffened could be in a variety of materials.
- In year 5 modelling can be linked to the use of ICT to explain to a third party the design.
- In year 6 children should draw on their previous experience to model and evaluate the value of their idea prior to manufacture.

Many different materials should be available to aid modelling. The list below could form a useful starter:

- Card
- Paper drinking straws both large and small
- Rubber bands
- Paper clips
- Lolly sticks large and small
- Card wheels various sizes
- Cotton reels
- Aluminium foil
- String, thick and thin.
- Masking tape
- Thin florists wire (safety spectacles must be worn)
- Lego sets



Tools and equipment that should be available:

- Scissors
- Craft knife (5-6)
- Cutting mat
- Paper punch



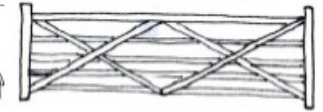
### 3S's

It is useful to think that you are designing:  
**S**omething for... The product  
**S**omeone for... The end user  
**S**ome purpose The product function

## 14. STRUCTURES

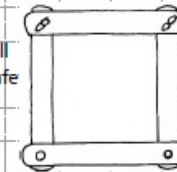
### Triangulation

Triangles are the strongest frame shape and architects and designers more often than not build triangular shapes into their structures; roof trusses, dock side cranes; pylons; skyscrapers and even farm gates and step ladders and bicycle frames.

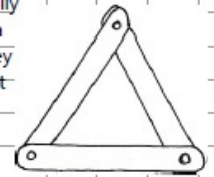


### Lolly stick rectangle and triangle

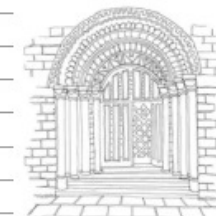
Children should create the square of lolly sticks hinged with paper fasteners. They will then see the structure is unsafe as it will flex side to side creating a parallelogram.



If the children remove one lolly stick and reconnect to form a triangle they will discover they now have a strong shape that will not flex.

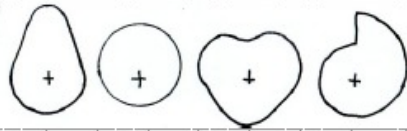


Curved shapes have been used in architecture for a long time. They are strong shapes and have been used in old buildings such as cathedrals and bridges. Curved shapes are also used in modern architecture. The Taj Mahal is a famous example of a curved structure. The igloo and the dome of St. Peter's Basilica are other examples of curved shapes. The arch has also been used since early times in various structures.

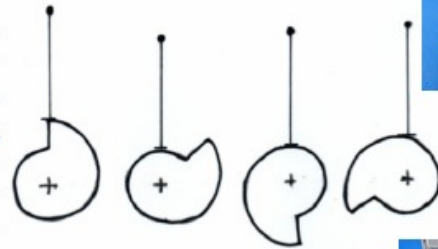


## 15. MECHANICAL SYSTEMS

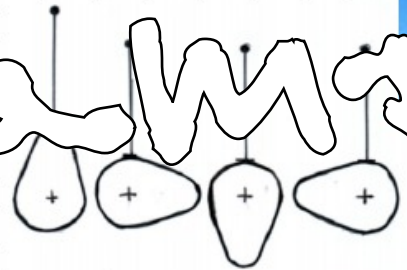
**Cams** are a mechanism that can be used to change one type of movement to another. Cams can be of an infinite number of different shapes all of which rotate and can be manufactured to produce a particular movement. The most common types are the pear, the snail and the eccentric shaped cams.



Snail cam rotates only in one direction, in this case clockwise, it has a gradual rise and a sudden fall.

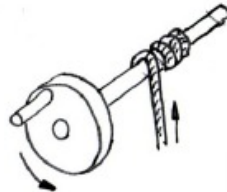
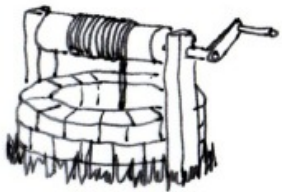


This is an automatic data made in card.



Pear cam rotates in either direction. It has a gradual fall and an uneven dwell at the top and bottom of the rotation.

**Crank:** A crank is a rotary mechanism and is often seen as a winder, as in a well. The distance of the offset of the handle to the shaft gives more force (longer lever) to turn the shaft. Another use can be seen in a child's pedal car.

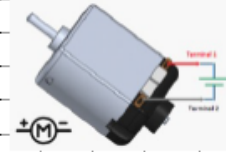


The cranks to the right have different offset distances, the lower one will be easier to turn due to the larger offset.

## 17 - USING ELECTRICAL SYSTEMS

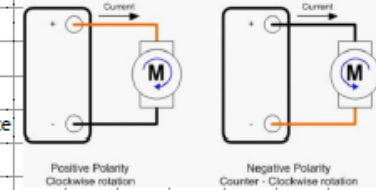
### Circuits using motors

The most common simple motor is the DC motor, applying a voltage to it will cause it to rotate, converting electrical energy into rotational motion (kinetic energy - energy of motion).

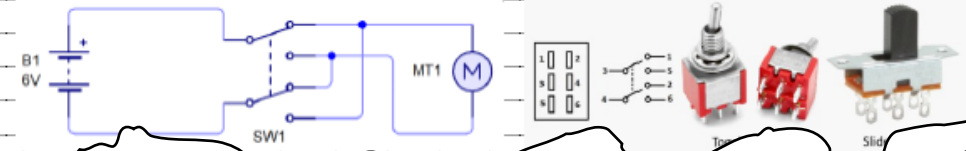


### Simple direction control

The direction of rotation is controlled by the direction of current flow through the motor, reversing the current flow will make the motor rotate in the opposite direction:



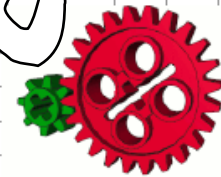
This type of control can be achieved quite easily using a DPDT switch (Double Pole Double Throw) toggle or slide type:



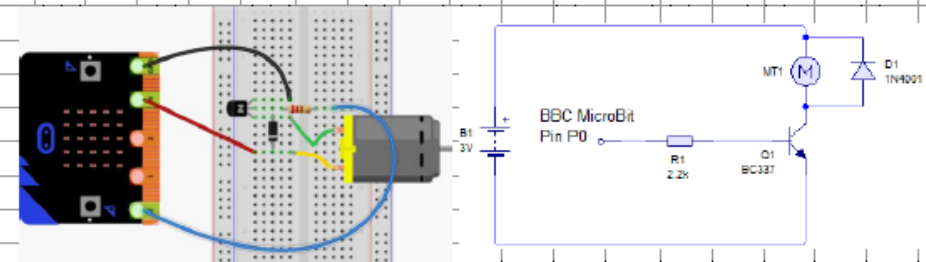
### Controlling a motor

All the motors you will use will have a high speed quoted in RPM (Revolutions per minute), but they have a low torque (Turning force). To reduce the speed of a motor you can use the following methods:

- Using gears to reduce the speed, this has the consequence of increasing the torque as a result, this can easily be investigated with either Lego or gear kits. This process is known as gearing down:
- Using an electronic circuit using a transistor or programmable devices (microcontroller eg BBC MicroBit).



GEARING DOWN



## 18. USING ELECTRONIC SYSTEMS

To do this we would use Ohm's Law  $V=I \times R$ , for example, using a typical red LED and a 20mA operating current, we have the following:

Using Ohm's law to find the required series resistor, the first step is to find the voltage across the resistor, this is given by the supply voltage minus the forward voltage required by the LED in this case 7V.

This voltage value is now divided by the current required in this case 20mA (0.02A). If volts and mA are used the resistance value is given in K ohms, if volts and A are used then the value will be given in ohms - this can be confusing and it is important to be consistent, and know how to change K ohms into ohms.

In most cases a series resistor value between 270 ohms to 390 ohms is all that is required, no calculation required.

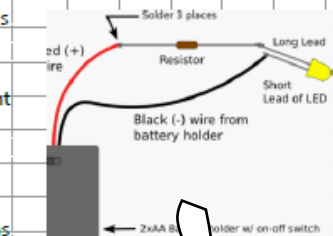
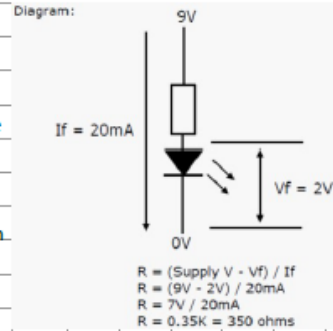
Here's a typical setup for an LED circuit, which involves a small amount of soldering, a simple skill that is easily learnt.

LED are also useful when using programmable devices (eg BBC MicroBit) to indicate information, whether something is on/off or to light up some part of a product, where using a bulb is more difficult as they are more current than the MicroBit can supply.

There is another type of LED called Neopixels or Sparkies - different makers call them by different names.

They contain a small controller chip along with a red, green and blue LED, NO calculation is needed due to the controller. They can display thousands of different colours.

Neopixels can be connected together in a line, circles and matrices, to control them you will need to use a MicroBit, Crumble, Raspberry Pi Pico or similar microcontroller



3S's

It is useful to think that you are designing:

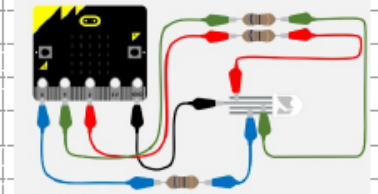
Something for...	The product
Someone for...	The end user
Some purpose	The product function

## 19. APPLY KNOWLEDGE OF PROGRAMMING IN PRODUCTS

### What is a programmable system?

A programmable system is an electronic system that has at its heart a microcontroller, which is then attached to a number of inputs and outputs. The functionality of the system is determined by the program code stored in the microcontroller.

The stored program will have been created on a computer or laptop and then downloaded (transferred) into the microcontroller usually via a USB cable. The microcontroller can be programmed more than 100,000 times before it fails. This allows the user to iteratively develop their program code solution, making corrections and additions as they develop the final working version.



Because most of the functionality is provided by the program code ie software, the electronics on the outside is generally very simple, making the development of products using this technology much simpler and cheaper than traditional electronics. It allows children to create quite complex, creative and innovative products as a result.

### Why are they important?

Simply because they are the core component in any product that contains electronics, whether that be a simple toaster to a modern car, microcontroller are everywhere and there are 10,000s of job opportunities in this field of design and manufacturing. This because they are so cheap and infinitely flexible, only limited by the designers imagination, they have made the impossible possible. We can use this technology to develop 21st century designers and makers.

### What is a simple board for KS2?

The key programmable systems are:

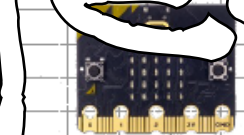
**BBC MicroBit** - MicroBit is a SBC (Single board computer) has a number of inputs/outputs, a built-in LED matrix for display and a range of sensor: accelerometer, compass and bluetooth connectivity. Well supported with teaching materials and add-on devices and components.

**Crumble** - a another SBC that has a number of inputs and outputs along with a dual motor controller, which makes it good for robotics. It also can control specialist RGB (red, green, blue) LEDs singly, in a matrix or strips, with a vast colour palette.

**Pixie [Picaxe or Genie]** - a main board that can use either a Picaxe or Genie microcontroller, which can be plugged into a wide range of add-on boards or connected to ones built on breadboard for example.

**Vex Go and Vex IQ** - are robotics system with a wide range of Lego like parts that allows a wide range of robotic solutions to be designed and programmed.

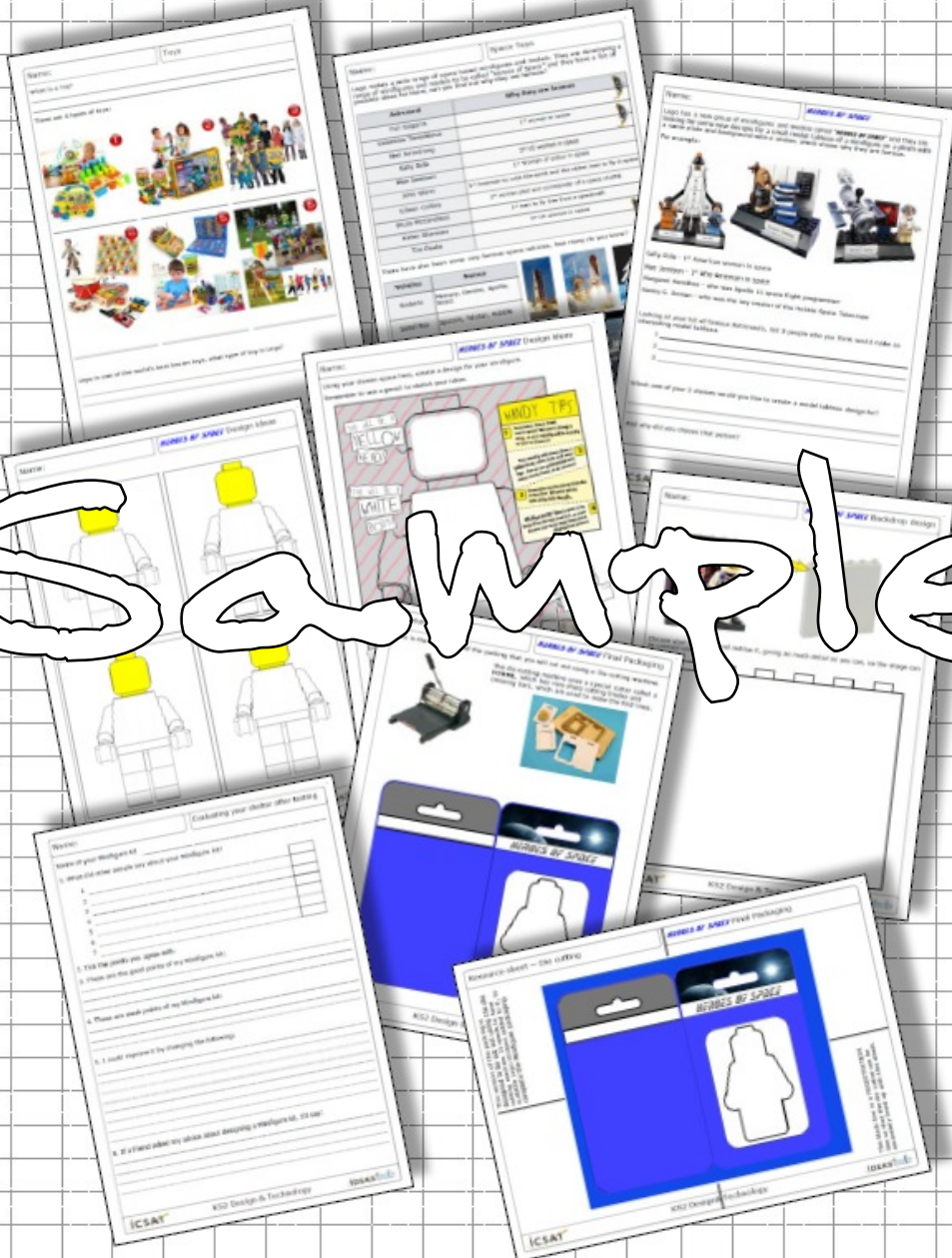
**Lego Spike** - is a robotics system with a wide range parts that allows a wide range of robotic solutions to be designed and programmed.



## APPENDIX 5 PROJECT SNAPSHOTS

### Yr2 / 3 Heroes of Space Project

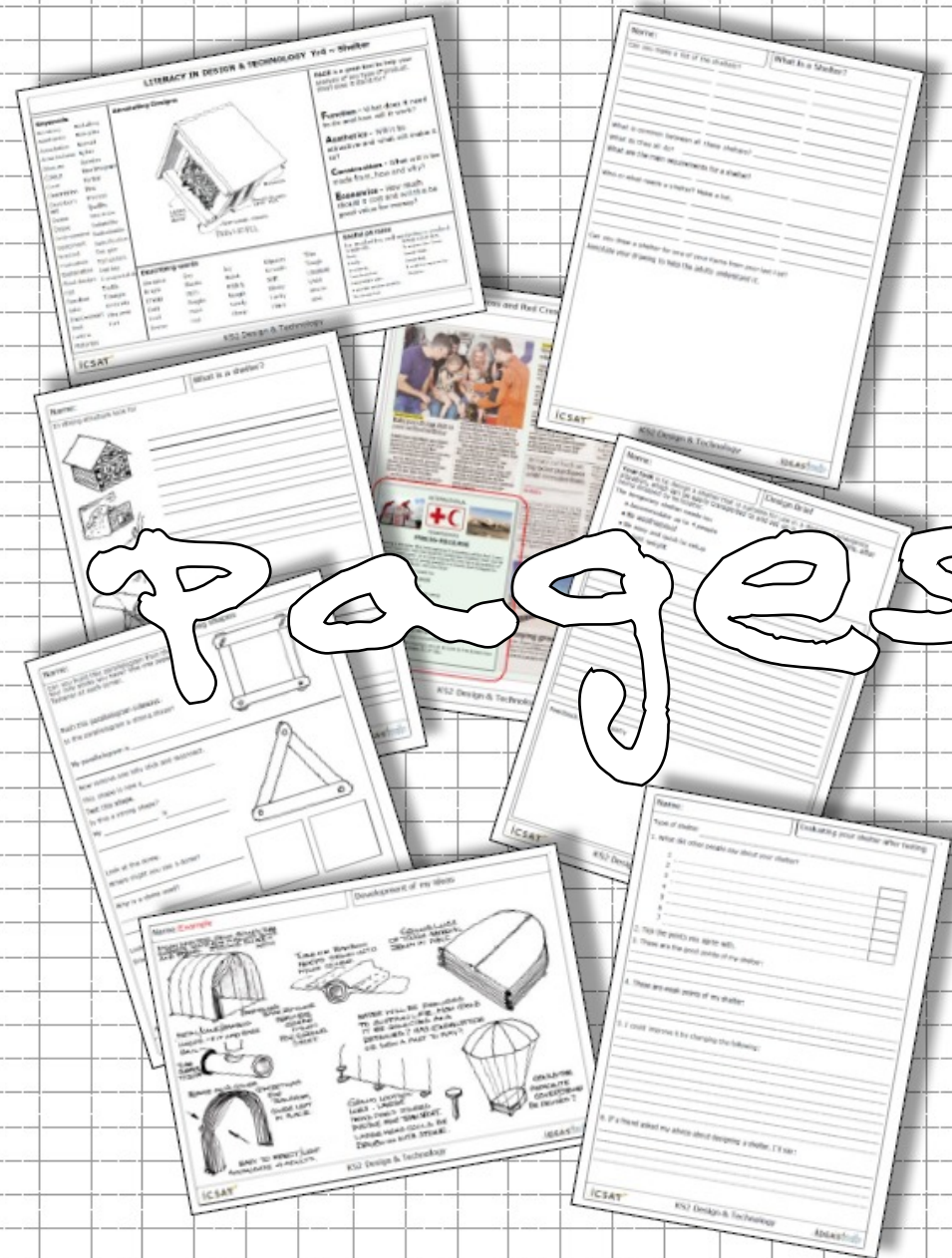
A full teaching pack supported with materials pack.



## APPENDIX 5 PROJECT SNAPSHOTS

### Yr4 Shelters Project

A full teaching pack supported with materials pack.



Sample pages

APPENDIX 6 GALLERY

Year 4 Shelters



Ideas collection - starting point



Sample pages

# A TEACHER'S HANDBOOK TO MATCH THE NATIONAL CURRICULUM

This iCSAT handbook explains all the subject content for Design & Technology at KS2

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