Roamer Design Manual

Index

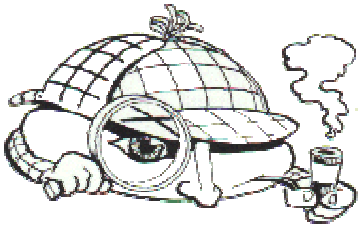
Introduction

Roamer as a Design Medium

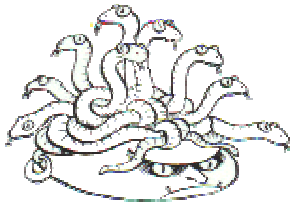
The Roamer was developed to provide a creative medium for children to explore design. Its shape allows the creation of a host of robot characters. These can be a mix of reality and fantasy, of technology and imagination. Developing Roamer characters can be a rewarding educational activity in which the child encounters all elements of the design process: Design Brief, Design, Manufacture and Testing.

Characterisation can also be a catalyst for activities like creative writing, programming, art, crafts and mathematics.

CLEOPATRA
(History)



SHERLOCK HOLMES
(Fiction/Literature)



MEDUSA
(Mythology)

AMERICAN FOOTBALLER
(Sportsworld)

Characters can be based on real and imaginary people and things: Romeo and Juliet, Kermit the Frog, Madonna, Thomas the Tank Engine, Long John Silver, Cinderella...

Robots fascinate children, they love playing and working with them. Their designs can be simple characters made with the Roamer Face Shapes or sophisticated robots using the Roamer control features. By providing a design challenge that can grow with the child's age and ability, Roamer furnishes a link that can be maintained throughout the school years.

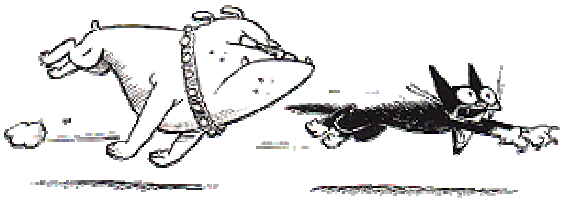
Creating a Roamer character is like creating a mechanical sculpture: "Cycling to Work" by John White. (See photo on right)

Unfortunately much technology reinforces unhealthy gender and racial stereotypes. Roamer was purposely developed to combat this problem by appealing to girls or boys of various cultural backgrounds.

Creating a Roamer character is not an exercise in copying images. It's about depicting the essence of the subject. The Roamer mouse is a robot living in its own world. Mice in Roamerworld do not need to look like 'real mice'. Creation of Roamer characters involves the development of appearance, environment and behaviour.

The fantasy element in characterisation helps to nurture a free-thinking approach to design. And by using the Design Process the student also develops the practical disciplines of the professional designer.

The Roamer fits in well with work across the curriculum and encourages children to appreciate design in the world about them. Design and education prosper in creative environments. The Roamer has a unique place in both.



Cartoonists use artistic licence but still depict the essence in their drawings. This approach is the key to Roamer design work.

The Valiant Roamer Design Handbook

The Handbook is for teachers of children of all ages and abilities. It will be of special interest to Art, Craft, and Design and Technology teachers. The one thing these subjects have in common is 'Design'. The Handbook does not attempt to explain the various sciences and technologies appropriate to design work. The reader should consult other books for this information. The Handbook does not provide instructions for predetermined designs. The children's task is to conceive, develop, make and test their designs. The Handbook does provide a source of ideas, techniques and ways of doing this. This information is not exhaustive but should inspire teacher and pupil to develop projects in their own way.

The teacher needs to be selective and use the Handbook as a resource, tailoring the ideas to suit specific needs.

The Handbook is divided into 5 sections:

Section 1: Introduction

Section 2: Design
This section explains the Design Process and how its principles and techniques apply to the Roamer.

Section 3: Ideas
This section illustrates numerous design ideas.

Section 4: Design and Control
This section demonstrates how control technology can be applied to Roamer design work.

Section 5: Projects

Terminology

Should you use words with which the child is already familiar or specific terminology used within commercial design2 What is certain is that language should not be a barrier to learning the concepts, nor to the child's practical design work. Yet learning the 'jargon' of design is part of learning the subject. In practice children have little difficulty in adopting professional terminology. Their response is similar to approaching computers through leaming and using 'computerese'. Consequently this Handbook uses commercial design language. Alas, for this there is no standard; for example, the terms 'design brief','specification','terms of reference' and 'design requirement' all mean the same thing.

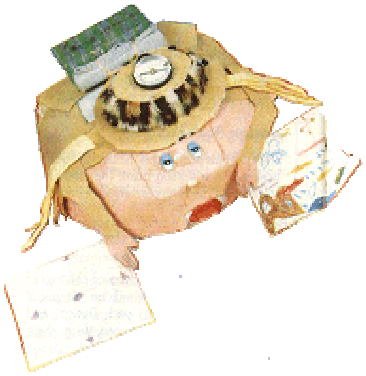
In the end, only the teacher can be the judge of the needs and abilities of his or her pupils. Therefore, whatever terminology is most appropriate should be adopted.

Design in the Classroom

Design is a natural human activiiy stimulated by a need. Commercially-motivated design takes place in a commercial situation. Design in the classroom is often treated as a simulation of 'real world' design. However, Roamer characterisation is real design work. It is motivated by educational needs and takes place in a classroom.

The motivation for the Roamer design activity arises naturally in a creative classroom. The school design environment includes the curriculum, the children's skills and needs, the teacher, the availability of time, materials and financial resources. The children's designs will reflect this. The Roamer is a powerful addition to the classroom design environment.

This number ladder activity was made more enjoyable when the children made the Roamer into a postman. They wrote letters and programmed the postman to deliver them to the houses.



Pupils reinforced their understanding of the principles of the compass, studied in the science class, by designing ond programming an explorer robot.

These young children established a friendship with the Roamer by making a character using the Face Shapes

Making a Roamer dog, linked project work to arts and crafts. Programming the robot to behave like a dog, used mathematics and information technology.

Technology Problem:

Design and build a robot capable of locating a 5cm cube, picking it up and moving it to a predetermined position.
Use the Valiant Roamer as the basis of the design. Include all sketches and construction drawings in your presentation.

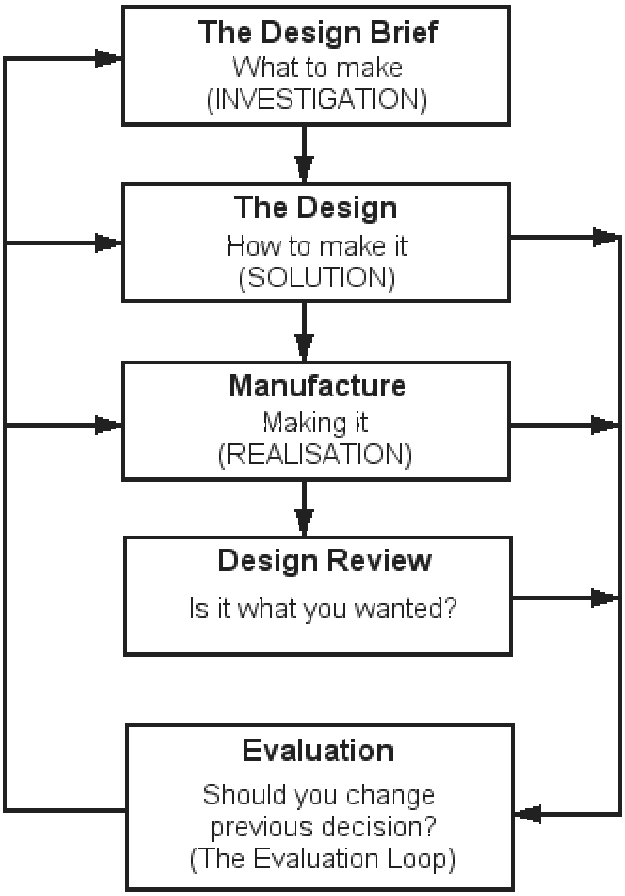
The teacher used the Roamer's design capability to set this problem for a group of fifteen year old students.

Designs will refelect the classroom technological environment.
This can vary between the junior craft room and an engineering workshop.

Design

The Design Process

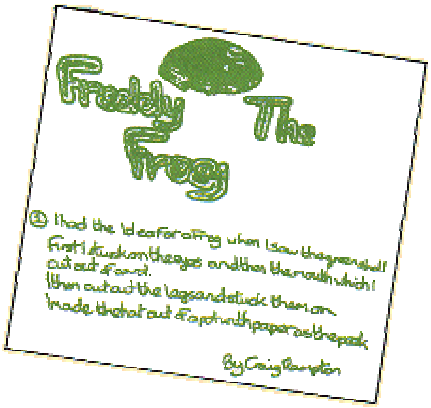
Solving problems is at the heart of design work. The Design Process is a problem-solving strategy. It is inherent in all design. Using the Design Process structures a child's work without stifling creativity.



Interactive and Planned Design

There are two design extremes: Interactive and Planned. Most design is a mixture of the two.

Interactive Designing appears to be spontaneous and unstructured. In fact it is a process of passing through the Evaluation Loop many times. Interactive designs tend to be piecemeal. One stage usually helps to inspire the next.



Interactive Design: *After listening to the story "Scrap Yard Monster" these children decided to make a Roamer Alien (Design Brief. They decided to use deodorant can tops as eyes, a pair of goggles as space mask and Blu-Tack to fix these to the Roamer (Design). They fixed these in place (Manufacture). They decided their Alien needed a mouth (Evaluation). Returning to the junk box they found half a clothes peg which they thought would make a good mouth (Design). This process of Design, Manufacture and Evaluation continued until they were happy with the result (Design Review).*

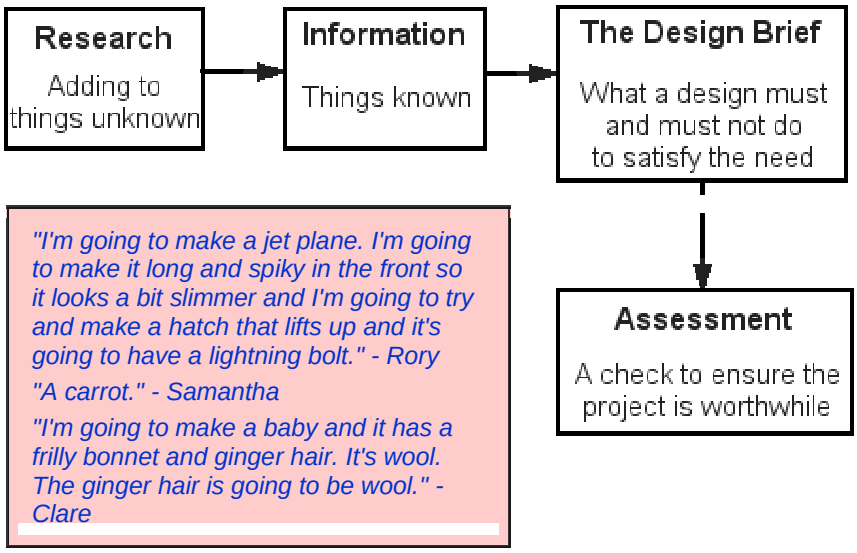
Planned Designs involve deciding all the details at each stage of the Design Process before moving to the next. The only journeys through the Evaluation Loop are to make minor modifications.

Planned Design: *Thirteen-year-olds Sarah and Donna decided with friends Lisa and Vicky which features their Roamer "Hostess" should have (Design Brief. They planned what each port should look like, what materials they were to be made from, how they were to be made and how they were to be fixed to the Roamer (Design). They mode the "Hostess" (Manufacture) then evaluated the result against the original plan (Design Review).*

The Design Brief

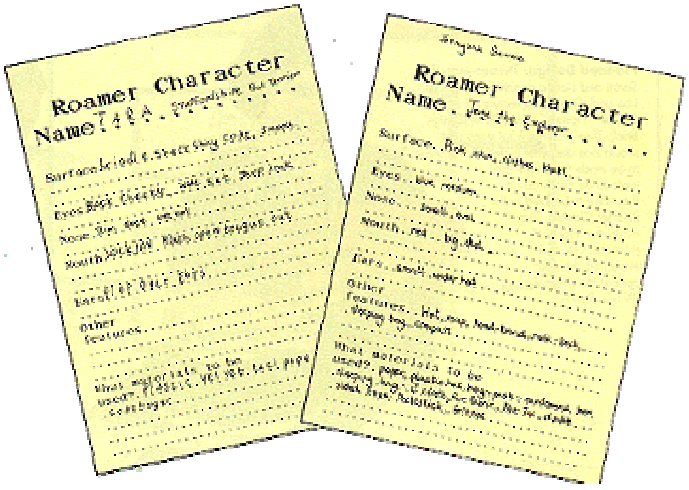
All designs start with the identification of a 'need'. A Design Brief, that is, a statement clarifying what a design must and must not do in order to satisfy the need, is then developed.

The Brief should define the problem and not anticipate a solution. It states the design objectives against which **Evaluation** and **Design Review** can be performed.

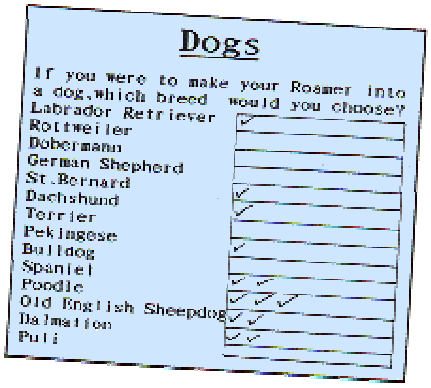


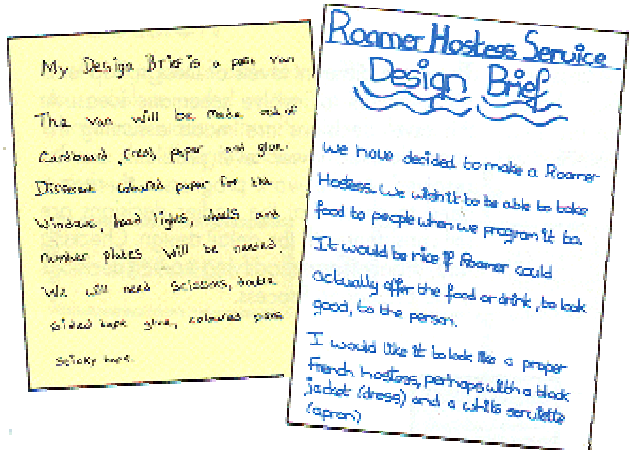
Transcript of verbal Design Briefs from a group of children from Southmead Junior School, Wimbledon.

The Brief may be suggested by the child or the teacher and can be a simple statement like "Make a monster". It may include design constraints such as "Make a monster using the Face Shapes". Such oral briefs can be quite detailed:



Teacher-designed Help Sheets can be used to provide hints for the young designer





Written Design Briefs help the children to clarify their ideas and will be useful at other stages of the Design Process.

More sophisticated Briefs can include the use of the Roamer Control features and make statements on ideas about style.

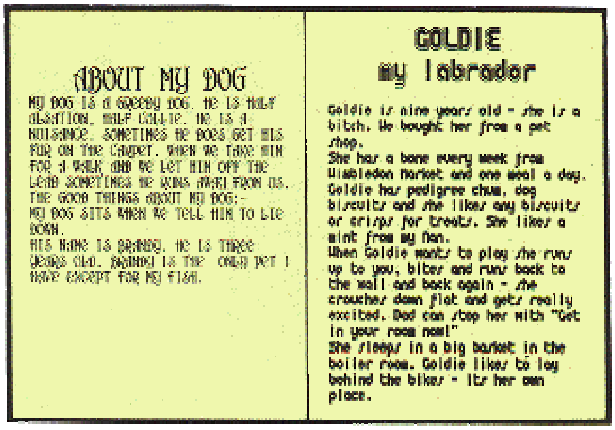
Assessment

Before committing itself to the expense of the Design stage, a commercial organisation would judge a project's viability. This assessment would include technical, market and financial feasibility studies.

In the classroom the assessment is based on educational value and practicality. Is the project possible with the available time and resources? Is it a sufficient test of the child's ability? Does it meet the curriculum needs? Is there a safety problem?

Information and Research

Commercial organisations constantly increase their existing knowledge through research. It is from known-information that a 'need' is identified. However, the need may not be understood sufficiently to permit an adequate Design Brief to be written, or an Assessment to be made. Further research may be required. Since education is about 'knowledge-gathering', identifying 'design- needs' helps to foster a dynamic learning environment.



ABOUT MY DOG

MY DOG IS A GOOEY DOG. HE IS HALF ALSATION, HALF COLLIE. HE IS A NUISANCE. SOMETIMES HE DOES GET HIS FOO ON THE CARPET. WHEN WE TAKE HIM FOO A WALK AND WE LET HIM OFF THE LEAD SOMETIMES HE RUNS AWAY FROM US. THE GOOD THINGS ABOUT MY DOG:-
MY DOG SITS WHEN WE TELL HIM TO LIE DOWN.
HIS NAME IS BARNEY. HE IS THREE YEARS OLD. BARNEY IS THE ONLY PET I HAVE EXCEPT FOR MY FISH.

GOLDIE
my labrador

Goldie is nine years old - she is a bitch. We bought her from a pet shop.
She has a bone every week from Wimbledon market and one meal a day.
Goldie has pedigree chum, dog biscuits and she likes any biscuits or crisps for treats. She likes a mint from my Mum.
When Goldie wants to play she runs up to you, bites and runs back to the wall and back again - she crouches down flat and gets really excited. Dad can stop her with "Get in your room now!"
She sleeps in a big basket in the boiler room. Goldie likes to lay behind the bikes - its her own place.

One group of 8-year-olds surveyed their friends to decide what type of dog they should make. Developing a Design Brief using 'Market Research' is important in commercial design.

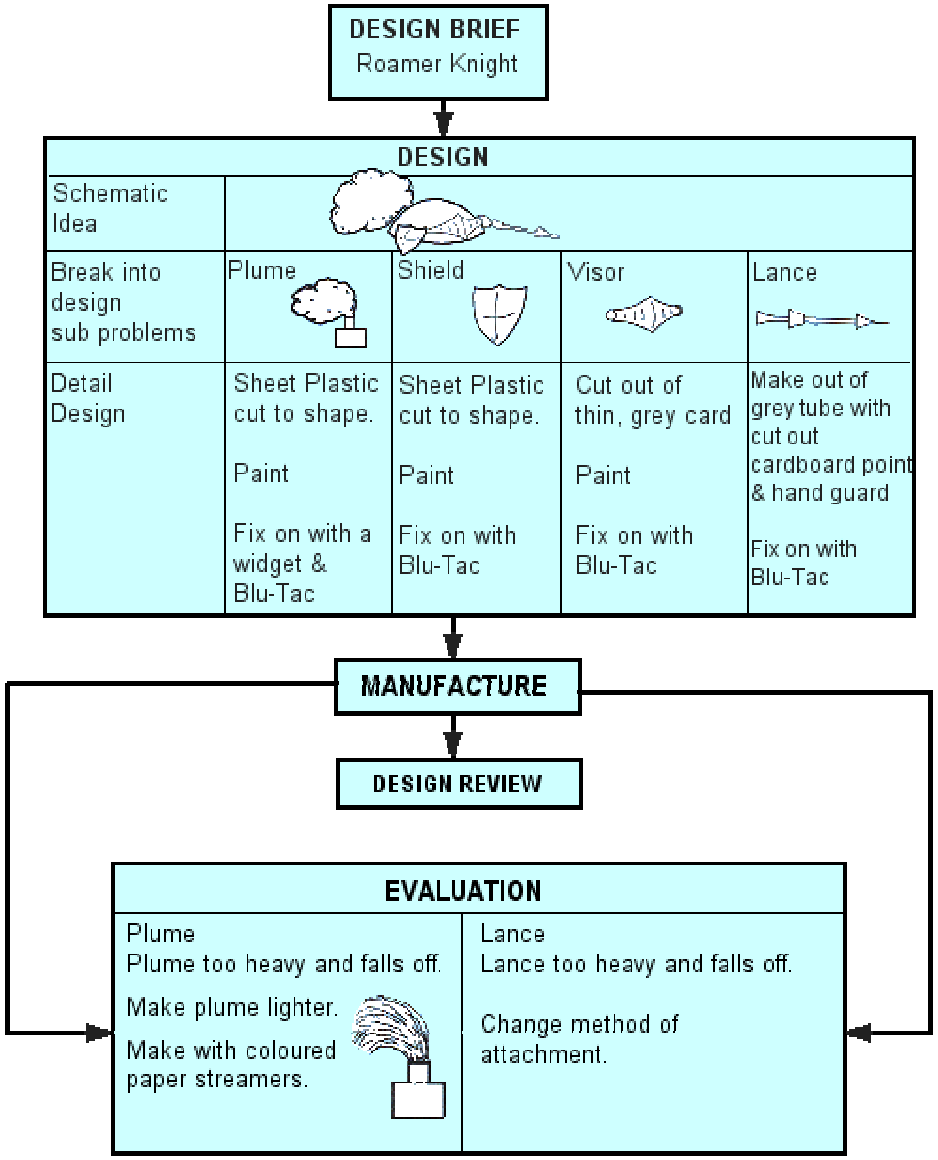
Designers create the Brief from existing knowledge and research. Southmead School's dog project provided the basis of the Brief, which included statements on environment and behaviour.

Evaluation

Evaluation is not the same as the **Assessment** or the **Design Review** phases. Evaluation is an ongoing review of previous decisions and includes the possibility of change or modification.

Design starts with the completely unknown. Yet to design the simplest product involves gathering a mass of detailed information, based on which the designer will make many decisions.

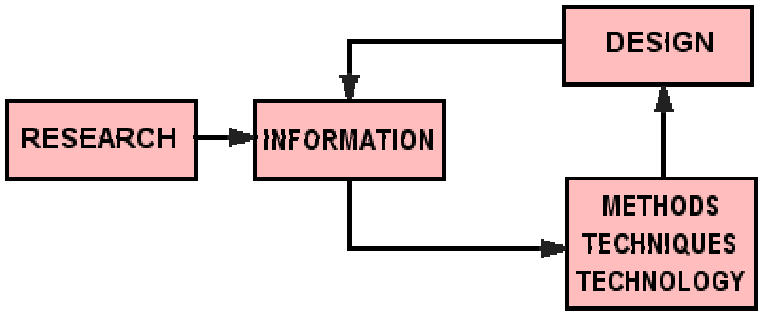
There are different levels of Design. Top level design tends to involve schematic ideas. At this level decisions are made assuming the more detailed lower level problems can be resolved. As the work progresses there is a need to check that the earlier decisions are still consistent with the detail design. Checking and, if necessary, modifying earlier decisions is the Evaluation Process.



The original design idea for the plume and lance failed in manufacture. These ideas were evaluated, changes were made and successfully implemented. Evaluation also takes place befween the schematic ond detail design phases.

The Design

The Design phase aims to create a solution to the problem posed in the Design Brief. The phase concludes with sufficient information to enable the 'design solution' to be manufactured.



Methods, Techniques and Technology

The designers creative flair is at the heart of good design. It is essential that this is harnessed to practical knowledge and experience of design methods, techniques and technology. While these factors have principles common to all design disciplines, each factor varies in its details.

For example, all designers select materials but the range of choice and the importance of the decision are specific to their design discipline.

Crane designers choose materials to industry standards. Consequently, material choice is a routine matter. To the fashion designer, on the other hand, material selection is a fundamental creative decision.

Good designers know how to apply common principles yet have a thorough knowledge of the specifics of their design field. Their ability to assess what factors need to be considered is an imporfant skill (**See here** for factors relevant to Roamer design).

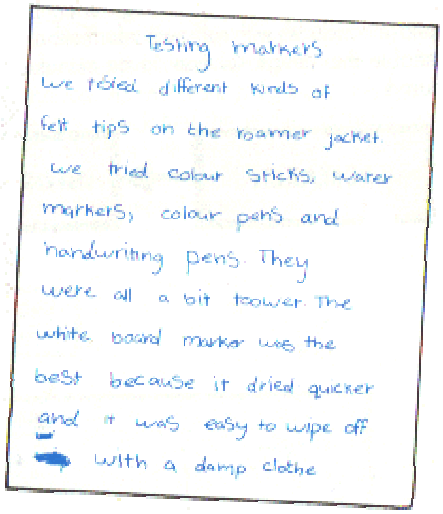
This 'Design' sub-section presents some of the methods, techniques and technologies relevant to Roamer, with examples of classroom work. It shows how these principles compare with commercial design applications. The section ends with illustrated ideas.

Information and Research

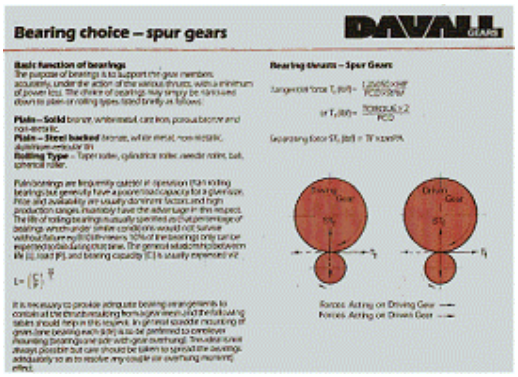
Designs are created from information. The designer will already know the information or can obtain it from various sources. Investigative ability is an essential skill of the designer.

When developing the Design Brief Information and Research generally relates to clarifying the problem. During the Design phase Information and Research relates to the solution.

Reference books on a wide range of subjects are important sources of information.


Testing markers

We tried different kinds of felt tips on the roamer jacket. We tried colour sticks, water markers, colour pens and handwriting pens. They were all a bit trouver. The white board marker was the best because it dried quicker and it was easy to wipe off with a damp clothe



Manufacturers and suppliers of materials and goods often supply useful information in their catalogues.

Experimentation and research are important methods of establishing information.

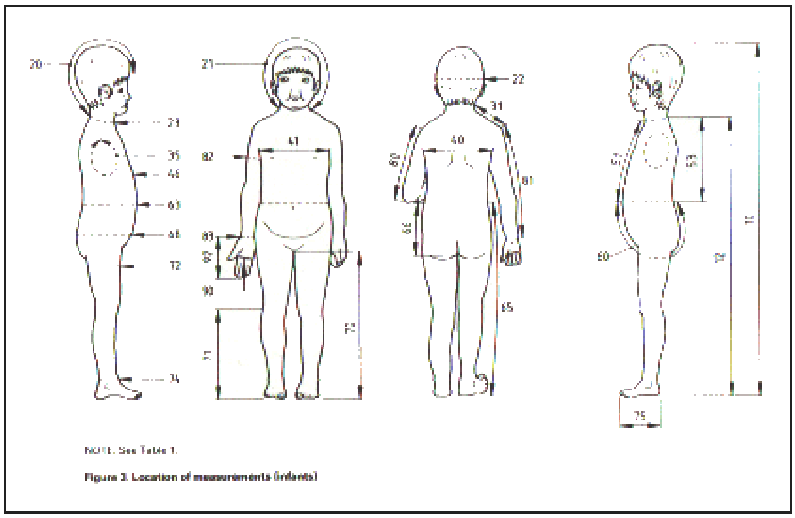


Figure 3. Location of measurements (infants)

National and International Standards supply essential information. This type of data is vital to clothes designers and others creating products for infants.

Table 6. Boys, 110 cm to 164 cm height, 50th centile girth, 75th centile height

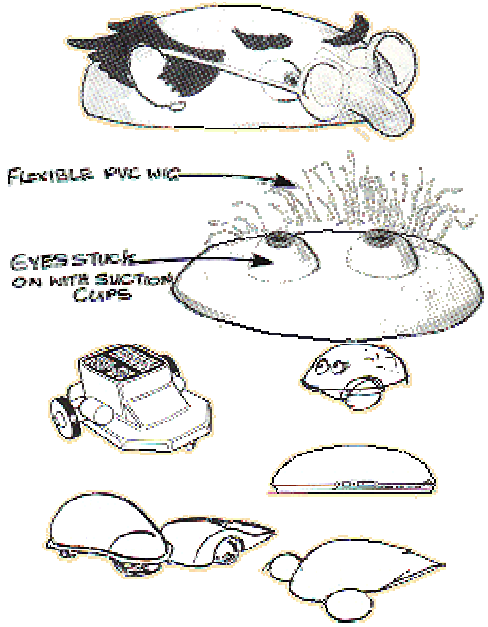
Dimension	10 Height									
	110	116	122	128	134	140	146	152	158	164
12 Cervicale – Foot	91.5	97.0	102.5	108.0	113.5	119.0	124.5	130.0	135.5	141.0
22 Head Girth	52.0	53.0	53.5	53.5	54.0	54.0	54.5	55.0	55.5	56.0
23 Neck girth (at larynx)	29.0	29.5	30.0	30.5	31.5	32.5	33.5	34.5	35.5	37.0
35 Arm Scye Girth	26.5	27.5	28.5	29.5	31.0	32.5	34.0	35.5	37.5	39.5
40 Axillary Width (back)	28.0	29.0	30.0	31.0	32.0	33.0	34.0	35.0	36.0	37.0
46 Chest Girth	58.5	60.0	62.0	64.0	66.5	69.0	73.5	78.5	83.5	86.0
53 Back Neck-Waist	27.0	28.0	29.0	30.0	31.0	32.5	33.5	34.5	36.5	39.0
61 Waist to Crotch	18.5	19.5	20.0	21.0	22.0	23.0	24.5	25.0	26.5	27.0
63 Waist Girth	54.5	55.5	56.5	58.0	60.0	62.0	64.5	67.0	69.5	72.0
65 Waist Height	68.0	70.0	74.0	78.5	83.0	87.5	92.0	96.5	101.0	104.5
68 Hip Girth	58.5	61.0	63.5	66.5	69.5	72.5	76.0	79.5	82.0	85.5
70 Inside Leg	48.5	52.0	56.5	59.0	62.5	66.0	69.5	73.0	76.0	79.0
71 Knee Height	29.0	31.0	33.0	35.0	37.0	39.0	41.0	43.0	45.0	47.0
72 Thigh Girth	32.5	34.0	35.5	37.0	39.0	41.0	43.0	45.0	46.0	47.0
80 Elbow Length	23.0	24.0	25.5	26.5	28.0	29.5	31.0	32.5	34.0	35.5
81 Arm Length	36.5	38.5	41.0	43.0	45.5	48.0	50.5	53.0	55.5	58.0
82 Maximum Upper Arm Girth	17.0	17.5	18.0	18.5	19.5	20.5	21.5	22.5	23.5	24.5
83 Wrist Girth	12.5	12.5	13.0	13.0	13.5	14.0	14.5	15.0	15.5	16.0

NOTE. All dimensions are in centimetres.

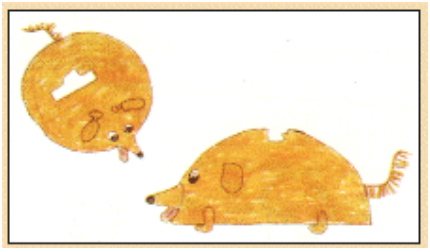
Extracts from BS 7231: Part 2 : 1990 are reproduced with the permission of BSI. Complete copies can be obtained by post from BSI Sales, Linford Wood, Milton Keynes. MK14 6LE.

Sketching

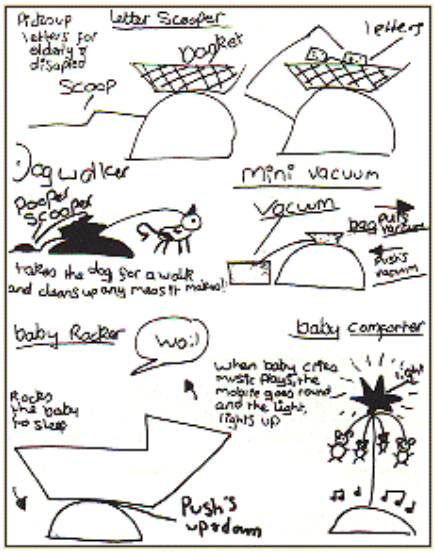
Designers "think" through their pencil. Sketching helps designers to clarify and communicate their ideas. Even young children should be encouraged to sketchtheir basic Roamer design.



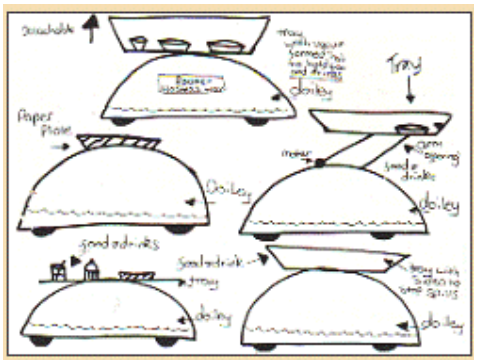
Concept sketches used by Valiant to develop the basic Roamer shape.



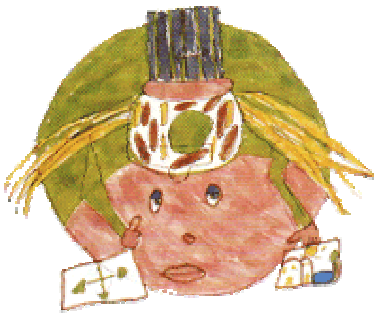
Southmead Dog project sketches were developed into Roamer design ideas: Southmead School



Ideas for designs by children of King Richard School, Portsmouth.



Sketches by Sarah of King Richard SCool show how the "Hostess" design idea developed.

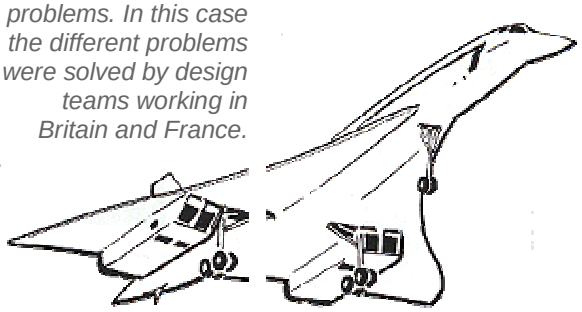


Design sketches of the explorer robot.

Design Sub-Problems

Because "Human knowledge doubles every six years", fact-cramming can not be the only teaching objective. Education needs to develop problem solving and thinking skills. One reason design is such a good educational medium is that it's about problem solving. Teachers familiar with Logo may have met the "Top Down" problem solving strategy, which involves taking complex problems and breaking them down into smaller, more manageable ones. This technique is very familiar to designers.

Complex designs, like Concorde, are broken down into many smaller design problems. In this case the different problems were solved by design teams working in Britain and France.

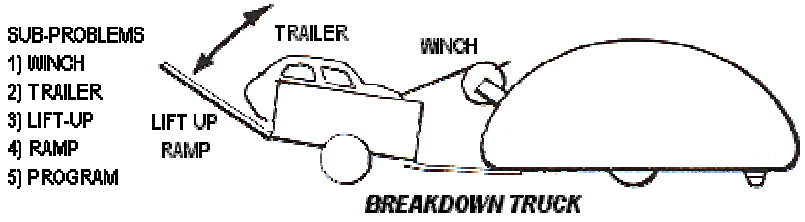


Complex projects, worked on by teams of designers, are deliberately broken down into sub-problems. However, even designs worked on by one designer will be consciously or subconsciously sub-divided.

Design Teams - Group Working

Most designs are created by teams combining ideas, expertise and experience. The advantage of group work is already familiar to teachers. Roamer design work is on excellent opportunity for using this method.

Resolving a design into a series of sub-problems provides a natural basis for organising group projects within a classroom.



Complex designs are split up into small design problems. The function of each sub problem needs to be defined.

Stimulation of Ideas

There are many techniques a designer may use to stimulate ideas or themes that provide a basis for a design.

Current Developments

Designers keep up to date with developments and innovations by reading technical literature and attending conferences and exhibitions.

Children should be encouraged to discuss their designs. Roamer design projects will appear regularly in the Valiant "GO" Magazine.

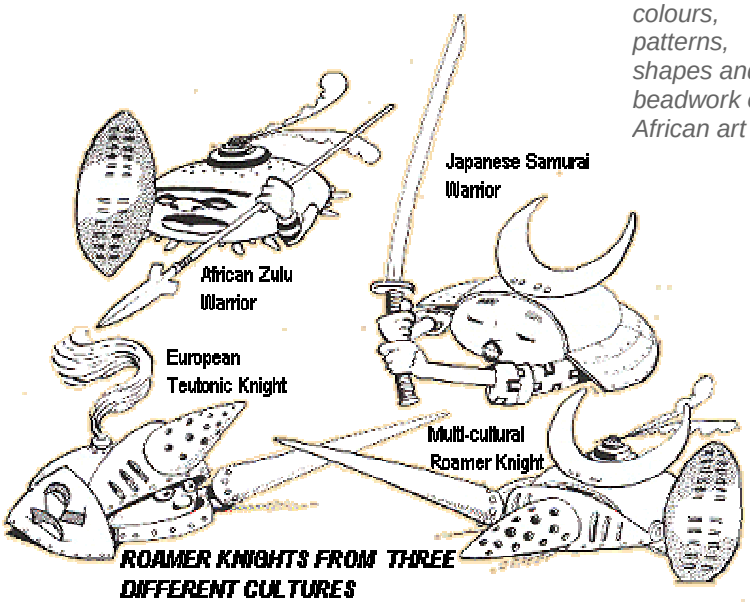
Interactive Design

Sometimes professional designers use the **interactive approach** to solve design problems. Picking up objects and playing with them can lead to interesting ideas.

Different Cultures

Design has developed differently in various cultures. Looking at other cultures can provide dynamic ideas.

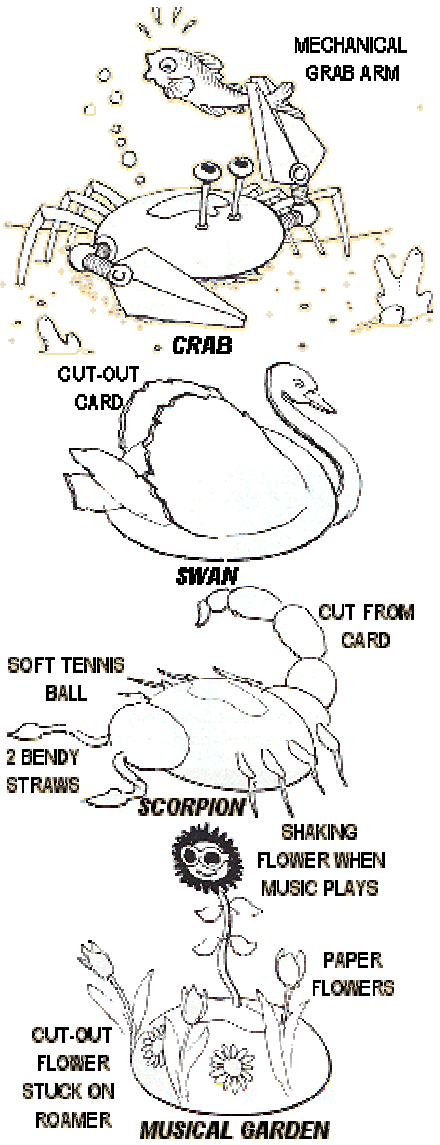
When cultures meet dramatic and exciting designs result. Clare Underwood's designs for perfume bottles were influenced by the bright colours, patterns, shapes and beadwork of African art

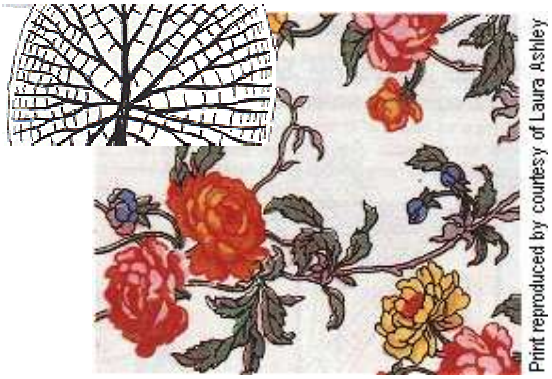


ROAMER KNIGHTS FROM THREE DIFFERENT CULTURES

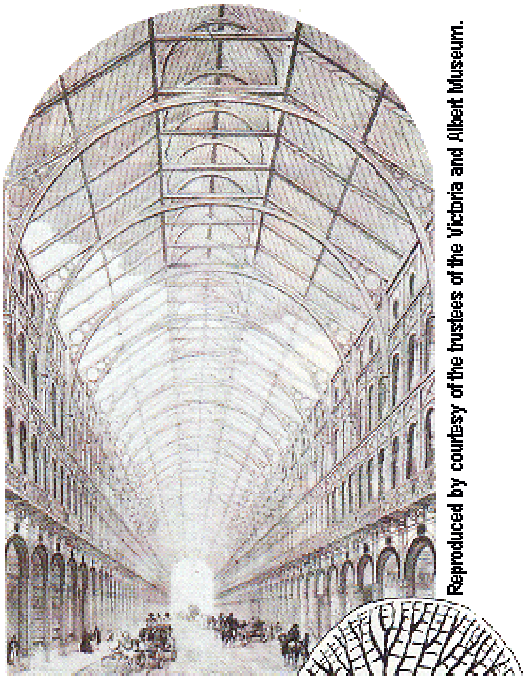
Nature

Nature inspires many design ideas. Roamer characters based on animals, plants, etc; provide a new perspective on nature study, particularly when the child comes to program the **Roamer's behaviour**.





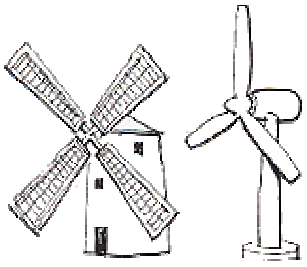
Laura Ashley designs are distinctive for their use of floral patterns.



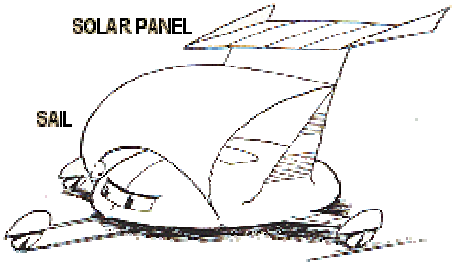
Nature stimulates more than decorative designs. London's Crystal Palace was a revolutionary design. Built in 1851, its key structural elements were inspired by a giant water lily leaf.

Historical Designs

Historical designs can be used with new technologies and materials. Visits to museums and books on design history are good sources of ideas.



Used as a major source of power in Europe since around 1150AD, the windmill became obsolete with the invention of the steam engine. The idea has now been revitalised in the form of wind-powered electricity generators.



This futuristic land vehicle uses a sail as well as solar panels to power it.

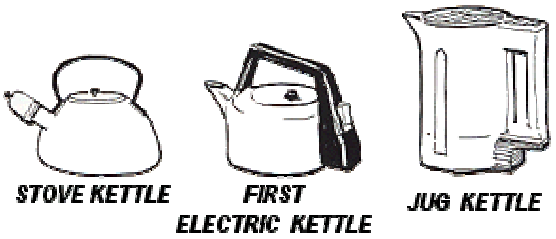
Some large modern ships have started using Hi-Tech sails to supplement their oil-fird boilers.

Sharon Wilson created this furniture design from the shape of Liquorice Allsorts sweets.

The design used to develop the "Flexator" pneumatic arm for disabled people by Jim Hennequin of Inventaid was also used on the automated figures at the "Spitting Image" museum Rubber Works.

Fresh Approach

Sometimes designers become trapped looking at things in a particular way. They need to constantly question the basis of designs and consciously search for new perspectives to enable them to find exciting new solutions.



The round shape of the stove kettle was stable when seated on a cooker and provided a large area for conducting heat. The first electric kettles copied this design. The jug kettle was a fresh approach. It allowed water to be boiled for a single sup. The side handle was physically easier to use and prevented the user from being scalded when pouring out the water.

A TYPICAL ROAMER DESIGN

THINK BEFORE YOU GO ON TO THE NEXT SECTION!

IN WHAT WAYS COULD YOU DRAMATICALLY CHANGE ROAMER DESIGNS?

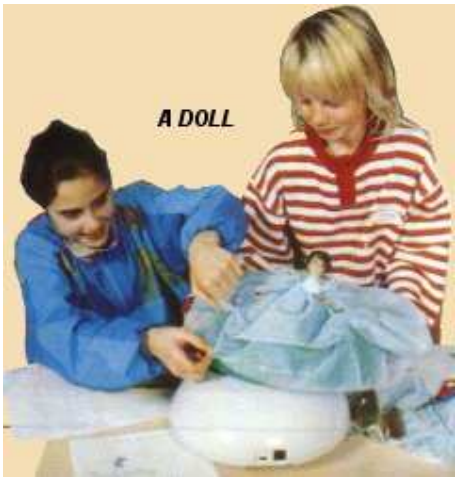
How can you get out of a rut in Roamer Design?

Change the basic shape.

Give the Roamer a trailer

Change the basic colour.

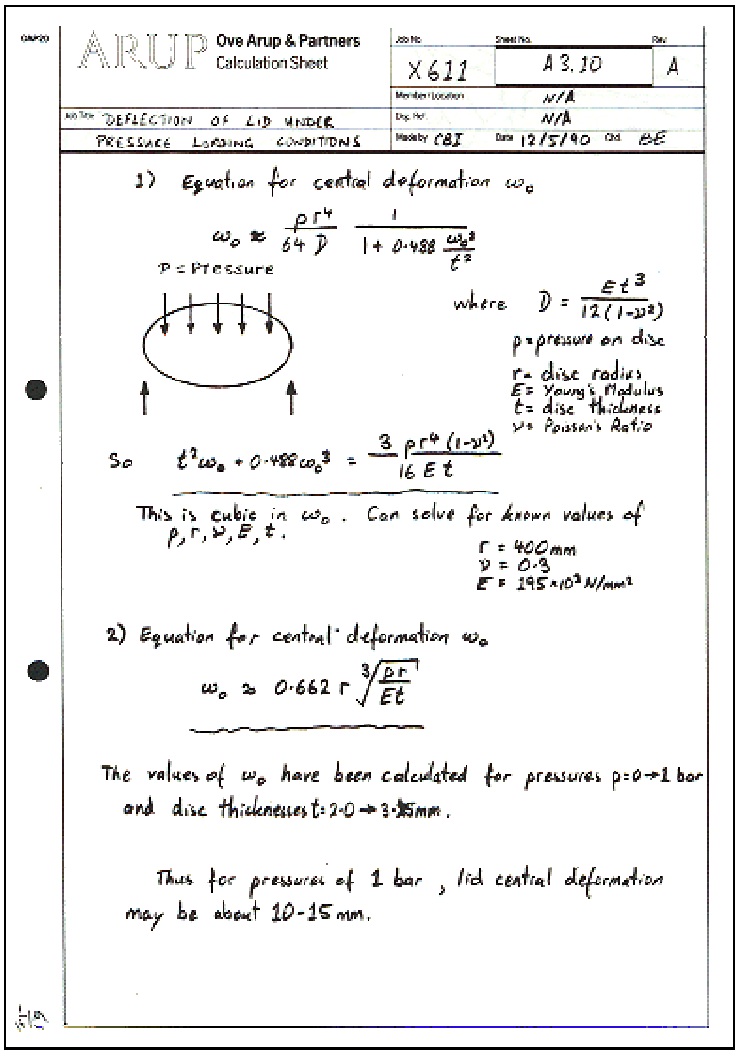
Make the Roamer into a body, not a head.



Design Calculations

Most designers work intuitively. Yet design, particularly engineering design, can involve mathematical, scientific or technological calculations. Good professional designers can support their intuitive flair with calculation and vice versa.

Design calculation may provide useful educational opportunities for older pupils. By providing a practical problem solving context, Roamer design can make mathematics meaningful. The simplest calculations illustrate how vital mathematicsis in modern technology and how essential the skill is to some types of designer.



ARUP Ove Arup & Partners
Calculation Sheet

Job No. X611 | Sheet No. A 3.10 | Rev. A
Member Location N/A
Drg. Ref. N/A
Subject DEFLECTION OF LID UNDER PRESSAGE LOADING CONDITIONS
Made by CBI | Date 12/5/90 | Chd. BE

1) Equation for central deformation w_o

$$w_o \approx \frac{p r^4}{64 D} \cdot \frac{1}{1 + 0.488 \frac{w_o^2}{t^2}}$$

P = Pressure

where $D = \frac{E t^3}{12(1-\nu^2)}$

p = pressure on disc
r = disc radius
E = Young's Modulus
t = disc thickness
ν = Poisson's Ratio

So $t^2 w_o + 0.488 w_o^3 = \frac{3 p r^4 (1-\nu^2)}{16 E t}$

This is cubic in w_o. Can solve for known values of p, r, ν, E, t.

r = 400mm
ν = 0.3
E = 195×10³ N/mm²

2) Equation for central deformation w_o

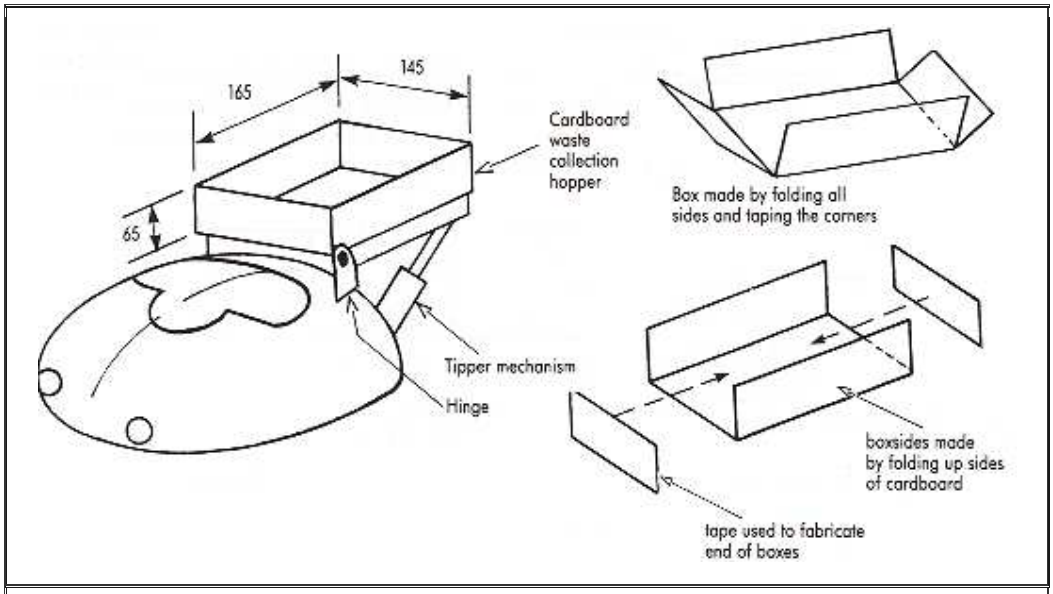
$$w_o \approx 0.662\, r \sqrt[3]{\frac{pr}{Et}}$$

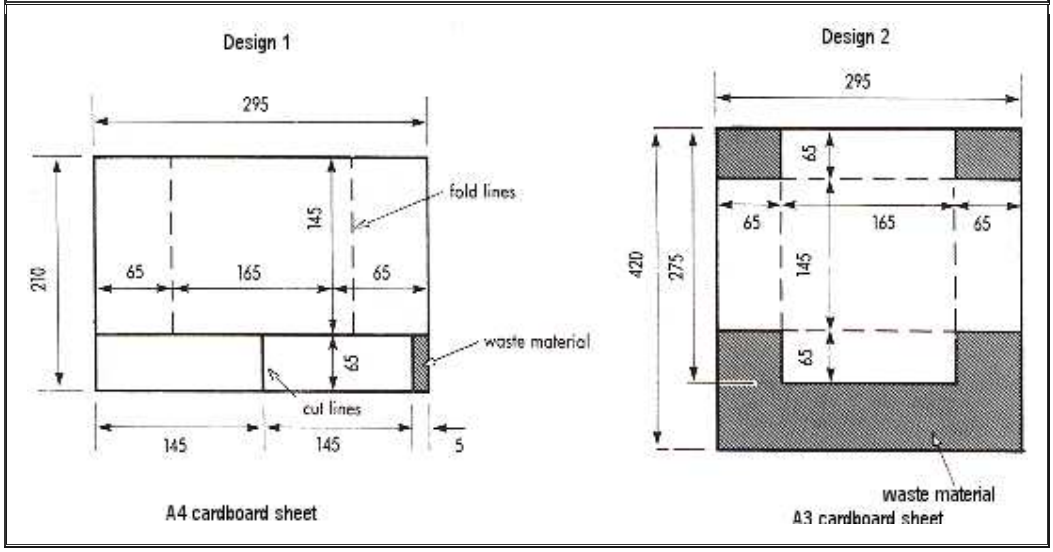
The values of w_o have been calculated for pressures p=0→1 bar and disc thicknesses t: 2·0 → 3·5mm.

Thus for pressures of 1 bar, lid central deformation may be about 10-15 mm.

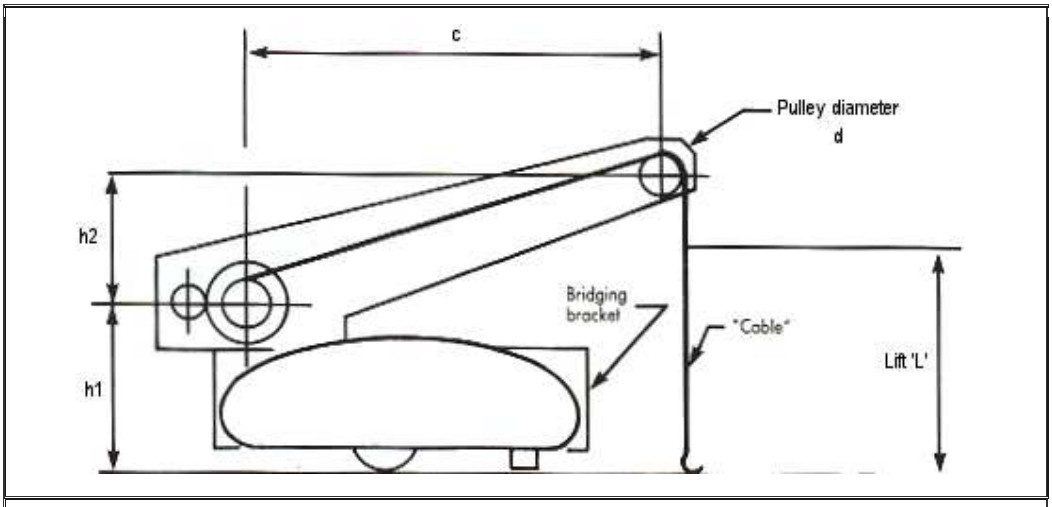
Structural engineering designers are frequently involved in stress and strain calculations. However, they do develop an intuition which enables them to predict answers to very complex problems. Sometimes they estimate the size of a structural member and check its suitability by calculations. Other times they check their calculations by intuition.

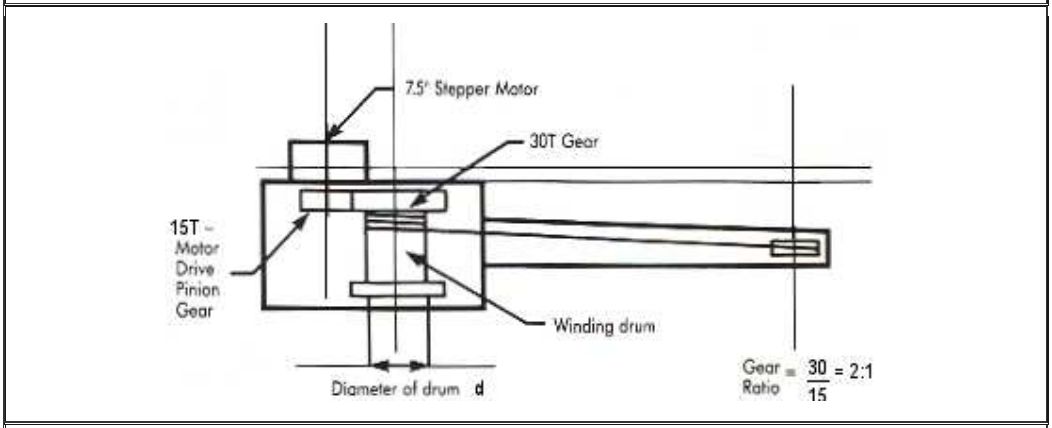
Calculate the minimum sheet size from which the cardboard hopper can be made.
Calculations involving minimising material wastage are very common, even in non-technical design fields





Roamer Crane: What length of "cable" is required?
How many 7.5o steps does the stepper motor need to take to lift a load through a height L?
These questions can be resolved by trial and error; alternatively they can be solved by calculation.





CABLE LENGTH

Allow 3 dead turns on winding drum

L1 = Cable Length of dead turns - $3\pi d$

L2 = Cable length from Pulley to ground = h1 + h2

L3 = Cable length from Drum to Pulley = $\sqrt{C^2 + h_2^2}$

L4 = Approximate length of cable around pulley = $\frac{\pi D}{4}$

Total length of cable = L1 + L2 + L3 + L4

NO OF STEPS REQUIRED TO RAISE LOAD THROUGH DISTANCE 'L'

No of turns required By winding drum = $\frac{L}{\pi d}$

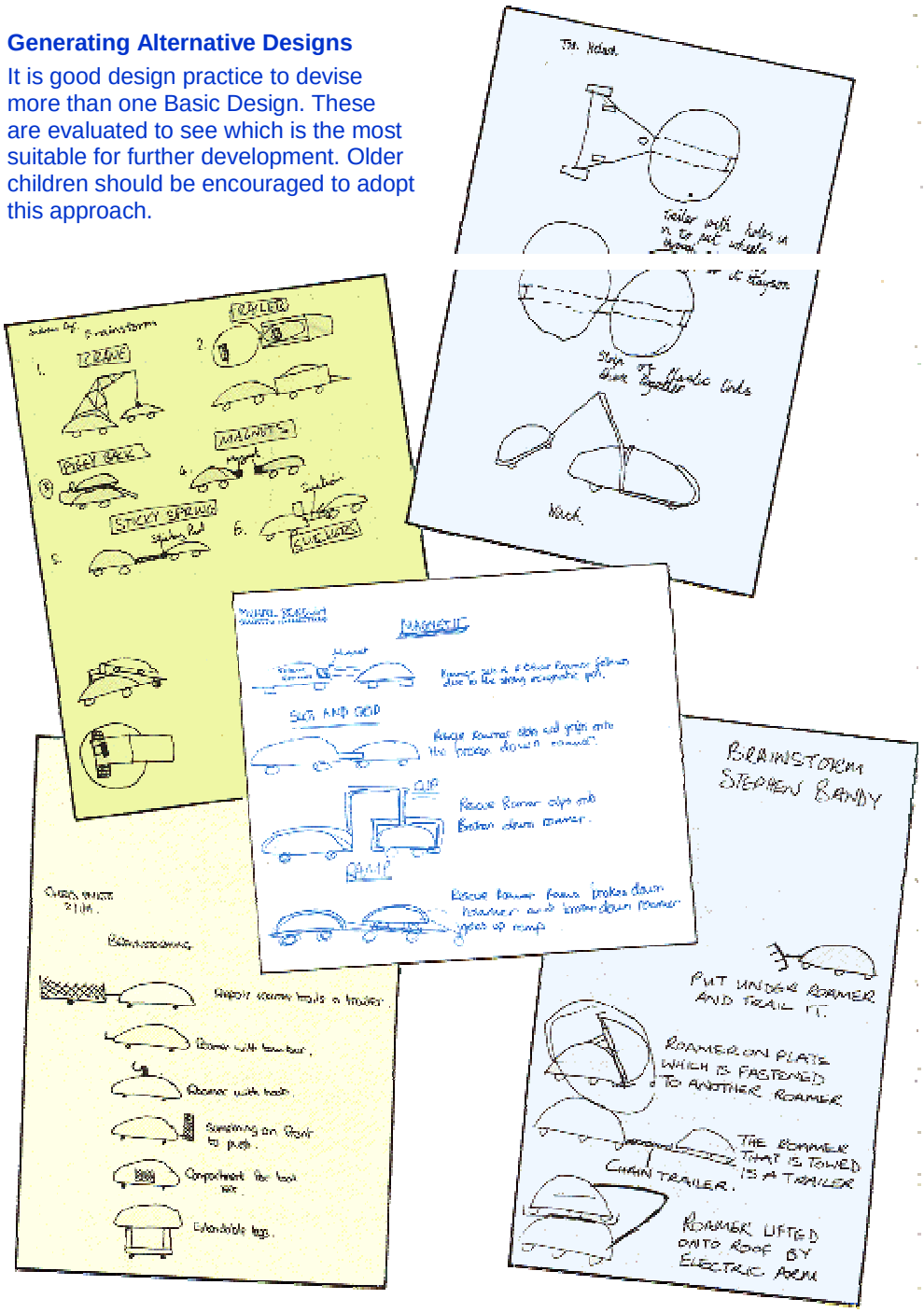
No of turns required By stepper motor = Gear Ratio $\times \frac{L}{\pi d}$

No of 7.5^0 steps required = Gear Ratio $\times \frac{L}{\pi d} \times \frac{360}{7.5}$

= Gear Ratio $\times \frac{48L}{\pi d}$

Generating Alternative Designs

It is good design practice to devise more than one Basic Design. These are evaluated to see which is the most suitable for further development. Older children should be encouraged to adopt this approach.



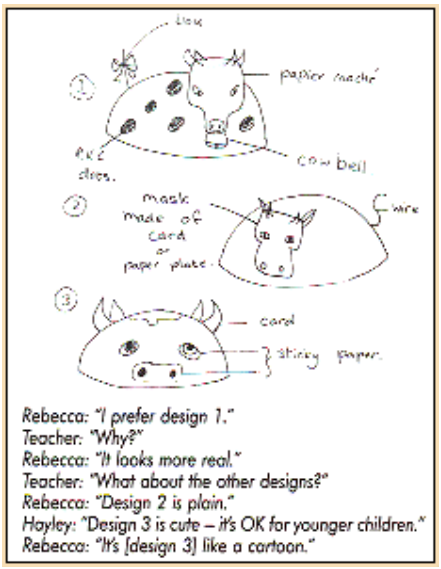
Appraising Basic Designs

Proposed designs should be judged on their ability to fulfil the Design Brief. During evaluation the designer will consider factors not stated explicitly in the brief. For example, a designer would automatically appraise a design on its manufacturing simplicity even if this was not stated specifically in the design brief. (Also see Design Factors).

Appraisal should be tried even by inexperienced pupils. It helps to clarify what they are expecting and make comparisons with the final design.

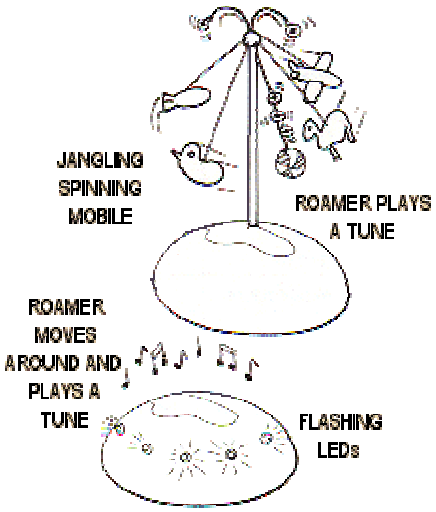
Teacher-designed Appraisal Sheets can prove useful for younger children.

Teacher: "Do you think your design will be easier to make than the others?"
Clare: "Yes."
Teacher: "Why?"
Clare: "Cos it uses lots of stickers and widgets. They're easy to put on."
Teacher: "What about the paper?"
Clare: "I want to paint it red. You can paint paper easy."



Rebecca: "I prefer design 1."
Teacher: "Why?"
Rebecca: "It looks more real."
Teacher: "What about the other designs?"
Rebecca: "Design 2 is plain."
Hayley: "Design 3 is cute – it's OK for younger children."
Rebecca: "It's [design 3] like a cartoon."

Transcript of appraisal discussions of a group of junior school children looking at different design ideas for a cow.

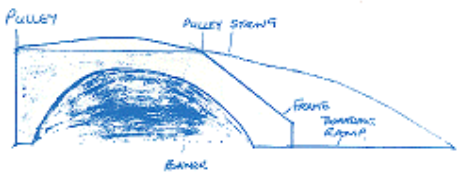


Written design briefs are useful check lists for design appraisal.

This transcript illustrates how teacher-led discussions can be very beneficial in helping pupils to clarify their expectations.

A Formal method for Appraising a design

Older children may try a formal evaluation method. The options for a Roamer Rescuer were evaluated using this approach.



Roamer Rescuer: Pick-Up Ramp Design

Appraisal criteria were considered to be:

Roamer Rescuer: Pick-Up Ramp Design				
Criteria	Weighting	Score	Weighted Score	Comments
Locate Breakdown	2	1	2	Could be difficult to get boarding ramp in right place.
Pick-up breakdown	3	2	6	Simple mechanism
Drag breakdown	3	2	6	Keeping breakdown on ramp may be a problem
Programming	2	2	4	Involves Control programming
Speed of recovery	1	2	2	Locating breakdown could be slow.
Manufacture	2	3	6	Simple to make
Cost	1	3	3	Simple design = low cost
		Total	29	

The design criteria are classified as to their importance:

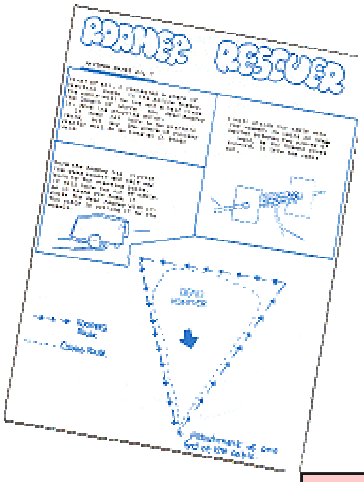
0 - Unimportant
1 - Useful feature - Achieve if possible.
2 - Important feature.
3 - Essential feature.

How well the design complied with each criterion is scored:

0 - Does not satisfy the criterion.
1 - Moderately satisfies the criterion.
2 - Satisfies the criteria very well.
3 - Completely satisfies the criterion.

The viability of the design is calculated. The design with the highest total is selected. Any design rating 0 for any of the essential factors is automatically precluded.

Evaluation of Roamer Rescuer: Drag Line Design				
Criteria	Weighting	Score	Weighted Score	Comments
Locate Breakdown	2	3	6	No precise movement required
Pick-up breakdown	3	3	9	Simple mechanism
Drag breakdown	3	3	9	Experiments show this method ofdragging works well.



Programming	2	3	6	No complex programming
Speed of recovery	1	3	3	Will be as fast as possible if route around Roamer is kept to a minimum.
Manufacture	2	3	6	Simple to make
Cost	1	3	3	Simple design = cheap cost
		Total	42	

Drag Line Design

Formal appraisal of Roamer Rescue designs by pupils from King Edward VI School serves to illustrate a number of key points.

- The Drag Line Design is an excellent example of an'out-of-the-rut' design solution.
- Its simplicity makes it an easy winner.
- If the criterion "Move the Roamer to any location" is considered essential then this design could score 0 and would be rejected.

Careful choice of ihe appraisal criteria is essential.

This technique can be hard for the inexperienced pupil. But the process of formal appraisal provides an excellent record of the pupils thinking and can be used to assess which design assumptions worked and which didn't.

Techniques for Roamer

Roamer Jackets

Jackets and Hats are practical classroom design aids developed specifically for the Roamer.

A Jacket is a plastic cover which fits over the Roamer. A character can be built onto the Jacket while the Roamer is used elsewhere.

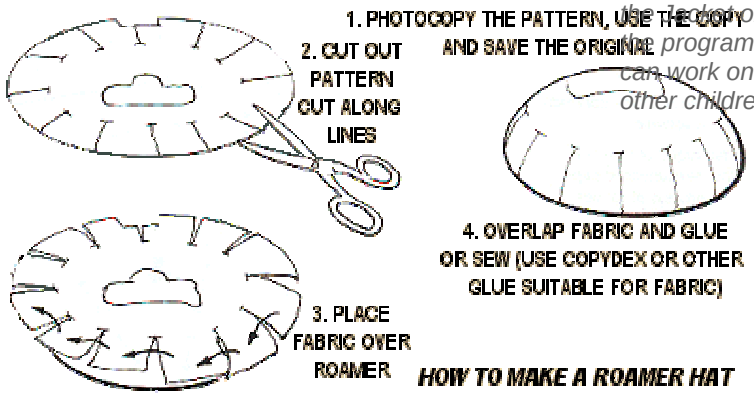
Jackets were designed as a semi-replaceable item. They are relatively inexpensive so they can be subjected to techniques which would normally damage the Roamer. For example, they can be painted and repainted or decorated with fibre-tipped pens. Glue can be used to attach things to them and holes can be drilled in them. None of these techniques should be used on the basic Roamer. With Jackets, designs can be made permanent.

One Jacket is included in this Design Pack. Others are sold in 4 and 12 packs and are available in 4 different colours: red, green, yellow and grey.

Time can be spent on making Jacket characters. These can be saved from one lesson to another. At the start of the next lesson put the Jacket on the Roamer and start the programming activity. Children can work on jacket designs while other children use the Roamer.

Roamer Hats

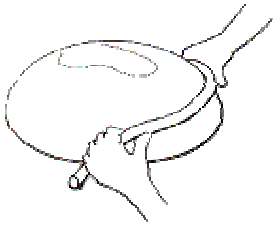
Like the Jacket, the Roamer Hat is a cover. It can be made from paper or fabric. A Roamer Hat pattern is included in this package.

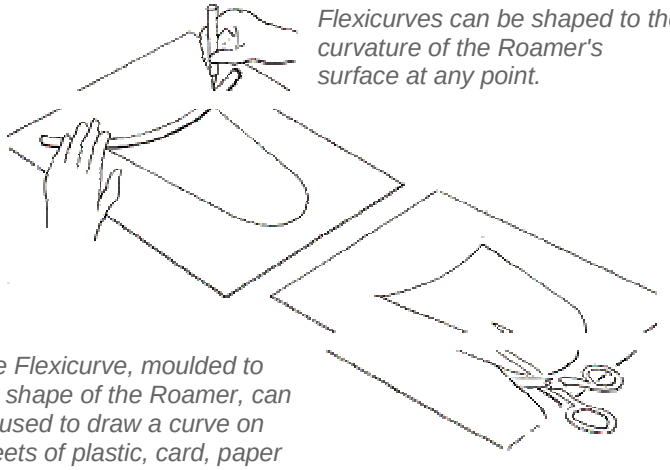


Cutting Shapes to Fit Roamer's Surface Using Flexicurves

Many Roamer designs use materials like cardboard or plastic sheets to fit the Roamer's surface. The Roamer shell is an ellipsoid of major axis 30cm and minor axis 17.5cm. The dimensions for the outside of a Jacket are: major axis 30.4cm and minor axis 17.9cm. This information should be useful for setting up CAD (Computer Aided Design) systems or for creating a series of Roamer templates.

Flexicurves can be purchased from drawing office or graphic supplies or any good stationers.





Flexicurves can be shaped to the curvature of the Roamer's surface at any point.

The Flexicurve, moulded to the shape of the Roamer, can be used to draw a curve on sheets of plastic, card, paper etc.

Cut out the curve and fit to the Roamer's surface

Design Factors

It was discussed how design involves numerous considerations. Different disciplines consider the same factors yet their importance and the methods, techniques and technologies involved may vary considerably.

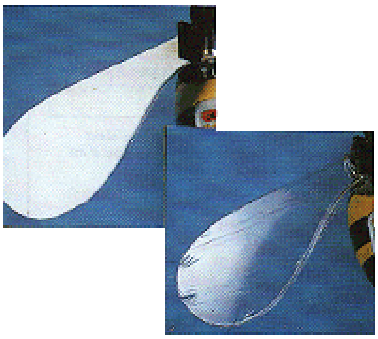
Designing a Roamer character generally involves the following factors:

- Materials
- Style
- Function
- Manufacture
- Fastening
- Finishing
- Robot Behaviour
- Environment

Many of these factors are interrelated and need to be considered simultaneously. Consideration is a deliberate and conscious process. The factors above form the basis of a useful check list to ensure that all aspects of the design have been covered.

Materials

Some of the more common aspects a designer considers when selecting a material:



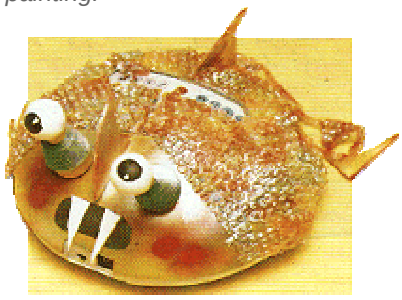
Style: *The Roamer Bumble Bee wings made with cardboard are easier to make but less insect-like than those made using cling-film.*

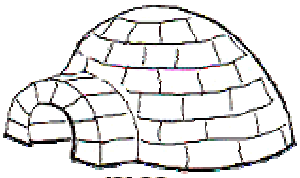
Manufacture: *The children decided to use a Jacket and marker pens to create the brindle coat because they felt it would be too difficult to make from fabric.*

Strength: *The Robotic Battering Ram uses balsa wood because of its strength, rigidity and light weight.*

Shape and Size: *Ten year old Emma developed her Roamer Doll design around the shape and size of the available dress material.*

Finish: *The bubble wrap material provided the monster with a scaly skin effect and a surface suitable for painting.*





Availability: *House designers around the world use the locally available materials. Very often children use what's immediately available.*

Selecting Materials

A dramatic social change occurred when 'technologists' learned how to use bronze instead of stone for tools and weapons. Phrases like the Stone, Bronze, Iron, Atomic and Silicon Ages testify to the importance of materials in design and the impact of design on society.

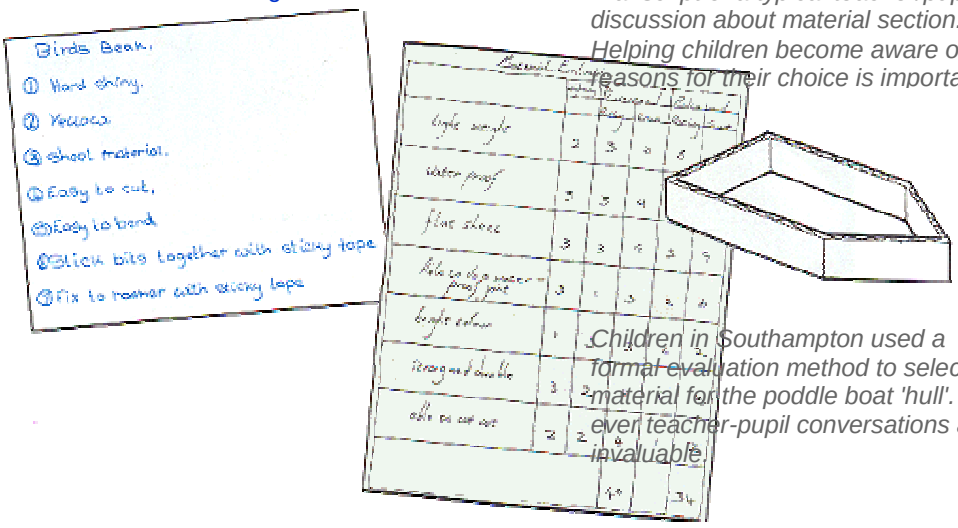
Usually young children choose the material immediately available or sometimes the teacher may specify the material as part of the Design Brief. Wherever possible, children should be encouraged to make a conscious material selection.

It is important to know the properties of materials. Science projects and design experience will develop this knowledge. Try making the same design in different materials.

Some of the more common aspects a designer considers when selecting a material:

Teacher: "What materials are you going to use to make the explorer?"
Gemma: "Paper."
Teacher: "Do you think cloth would be better?"
Gemma: "I think it's better wifh paper."
Teacher: "Why?"
Gemma: "'Cos you can stick things on good. If you make a mistake you can take it off the paper and move it as you like."

Transcript of a typical teacher/pupil discussion about material section. Helping children become aware of the reasons for their choice is important.



Children in Southampton used a formal evaluation method to select the material for the poddle boat 'hull'. As ever teacher-pupil conversations are invaluable.

Composing a list of required praperties is a useful technique for material selection.

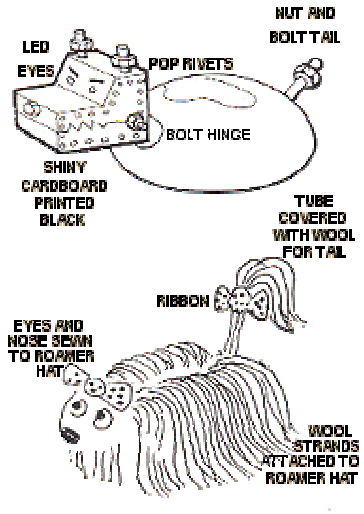
COLLECTING MATERIALS FOR ROAMER DESIGN

Most models can be made using classroom 'junk' and art and craft materials.
Other sources of materials can be found in toy and model shops, haberdashers, jumble or rummage sales etc.

Style

Style is the way a design looks. It involves shape, colour, dimension and proportion.

Style reflects the designer's character, experience, and abilities. Style can be developed by studying design books, fashion, available products in stores and by visiting art galleries and museums.

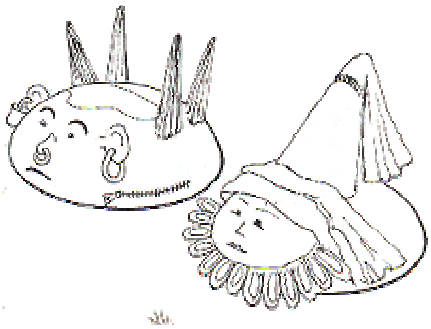


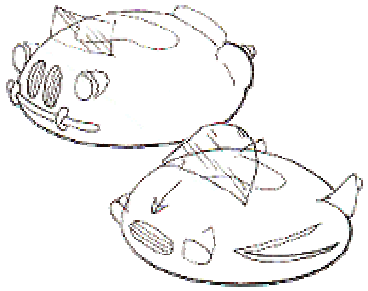
Style is a fundamental aspect of characterisation: The mechanical style makes the Guard Dog look fierce and the fabric materials give the film stars pooch a frivolous look.

Famous American archited Frank Lloyd Wright designed the Prairie House, with their emphasis on horizontal lines and use of intemal spaces, they echoed the sweeping plains of the midwest which he loved.

Photograph from the British Architectural Library, R.I.B.A., London.

Studying a designers work reveals their stylistic development. Changes in style are often a reflection of events in the designer's everday life.





Style involves attention to detail; small changes in detail can have

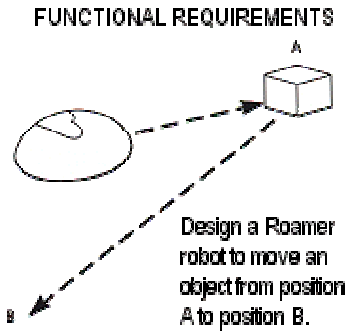
a dramatic affect.

The three pig designs (see below) illustrate how materials and manufacturing method can affect the design style.

Function

The functional requirements are stated in the design brief. However, the brief may not describe all the requirements and often details will not be known. These will be clarified as the work progresses.

Throughout the design process the designers should constantly evaluate how well the design satisfies the requirements. This often leads to 'fine tuning' of the design and sometimes minor changes to the design brief.



Teacher: "You said you wanted to make a guard dog?"
Steven: "Yes."
Teacher: "What are guard dogs like?""
Steven: 'They're fierce and growl and bark a lot. They're Alsatians, mine's going to be an Alsatian."
Teacher: "Anything else?"
Steven: "They chase people and bite them. Not their friends. They don't bite their friends."

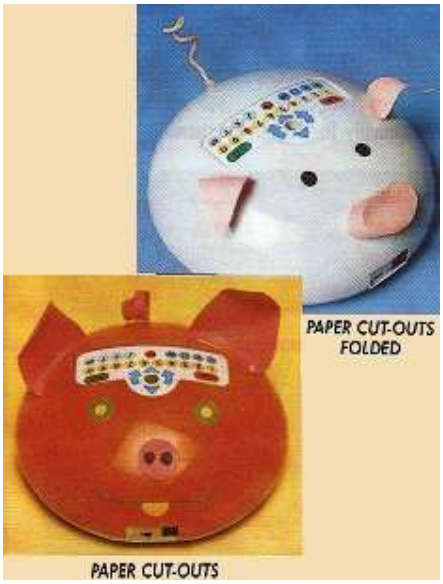
Design briefs consisting of simple statements need to be developed. This normally involves clarifying functional aspects of the design.

The designer needs to prioritise functional requirements. In this problem the main function is to move the object. Stylistic appearance is sacrificed to achieving that function as efficiently as possible.

Manufacture

At some stage the designer will consciously decide how the design can be made. The options available to children will vary from school to school. Children should be encouraged to make reasoned decisions.

(Note: This Handbook does not attempt to discuss manufacturing techniques. The reader should refer to craft and technology books for such information).

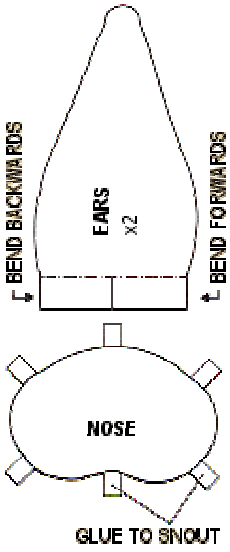


These three little pigs are all made out of paper but their appearance varies considerably. Style can

depend on the method of manufacture.

Listing the Manufacturing Process

It is good practice for the designer to list the manufacturing details. This helps to highlight potential manufacturing difficulties and can lead to design improvements.



- Draw out the shapes.
- Cut out the ears.
- Bend over the fixing flaps.
- Fold ears to give the 'droopy effect'.
- Use adhesive tape to fix ears to Roamer
- Cut out snout
- Bend snout into shape.
- Apply glue to snout joining flap.
- Join snout together.
- Cut out snout end.
- Bend over fixing flaps.
- Apply glue to flaps.
- Fix the end to the snout
- Fix snout to Roamer with adhesive tape.
- Fix black counters (eyes) to Roamer with Blu-Tack
- Cut out tail.
- Wrap tail around a pencil to make it curly.
- Mount tail onto Roamer with adhesive tape

List of processes for making the cut out and fold Roamer Pig.

The more sophisticated manufacturing capability of secondary school pupils adds significantly to design possibilities.

Thirteen-year-old pupils making an electronic circuit to operate a police car siren operated via the Roamer Control features.

Sometimes designers have to consider the size of the machinery available to

make the design. Pupils at King Edward VI school used the school's vacuum-forming machine to create their own jacket designs. The size of the machine necessitated making the jackets in two parts and joining them together.

Selecting a Manufacturing Method

Sometimes the designer may need to choose between altemative manufacturing methods. A review of the advantages and disadvantages of each should be made. Adaptation of the **formal evaluation technique** may be useful. This kind of analysis highlights specialist skills and tooling requirements.

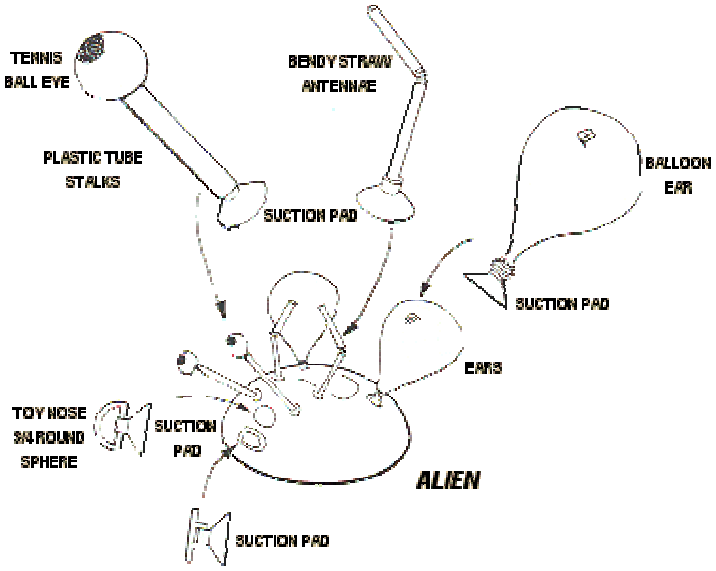
Without a saw, the wood design could not be made. Availability of tools affects the design decisions of even the largest commercial organisation.

	PVC Plastic	Paper	Fabric	Wood
Marking out the shapes	Use special pen	Use pencil	Use tailor's chalk	Use pencil
Cutting out the shapes	Needs scissors	Needs scissors	Needs scissors	Needs saw
Fixing the shapes together	Not applicable	Use paper adhesive	Sew together	Tack pins Needs hammer
Assembling flowers onto the Roamer	Just put into position	Use Blu-Tack	Sew onto Roamer Hat	Use Blu-Tack

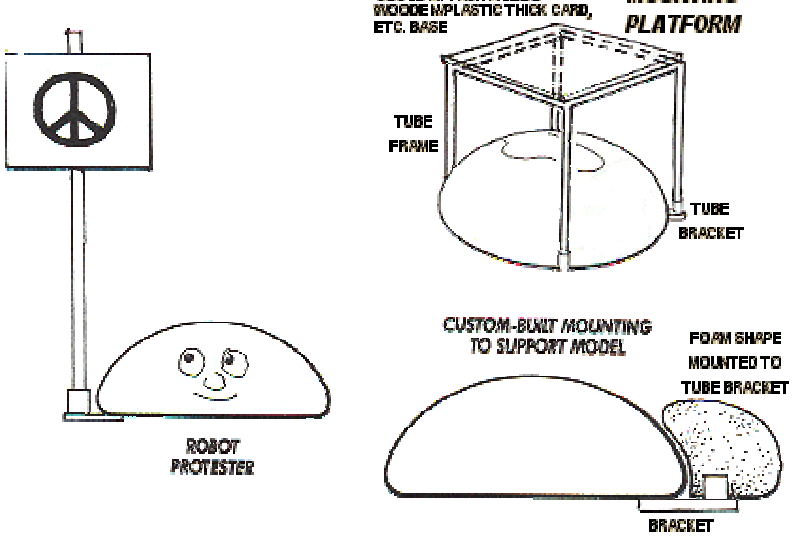
Fastening

Most fastening techniques used with the Roamer need to be quick, simple and temporary. The following section illustrates several of these and include a few of a more permanent nature.

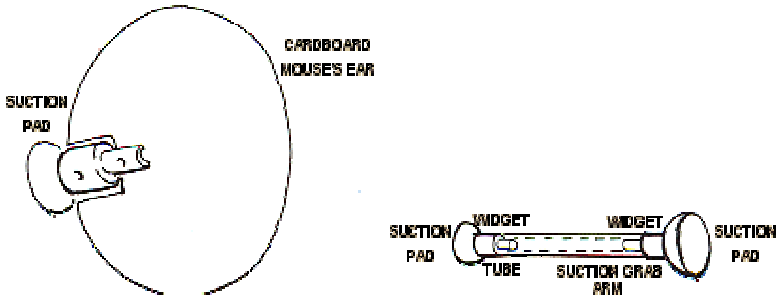
The Suction Pad

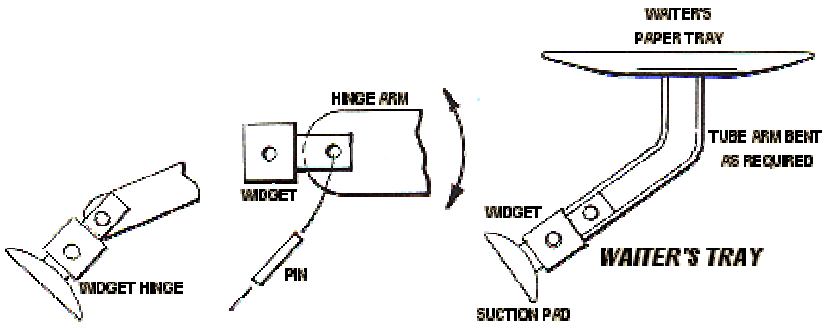


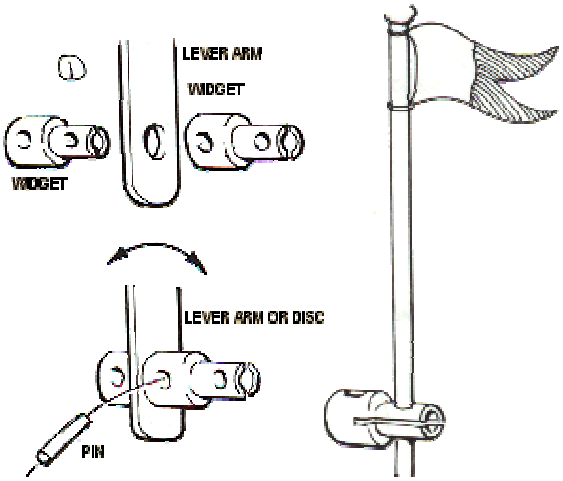
Tube Brackets

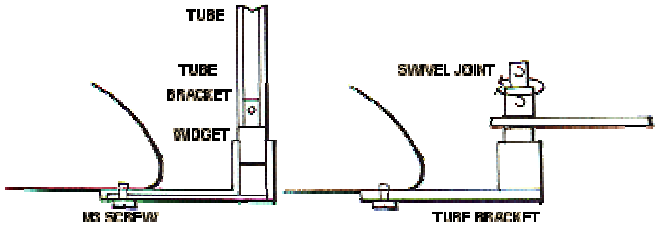


The Widget

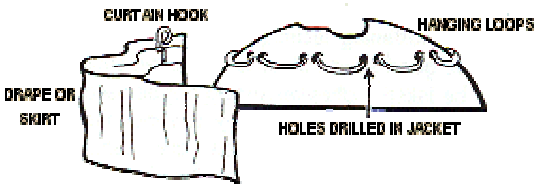


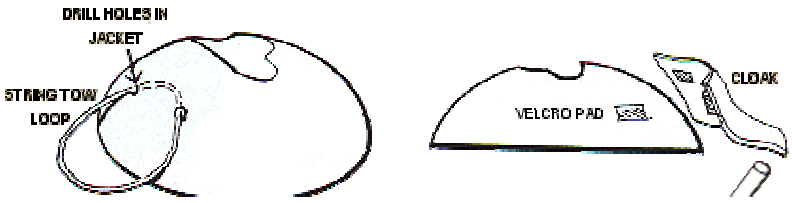


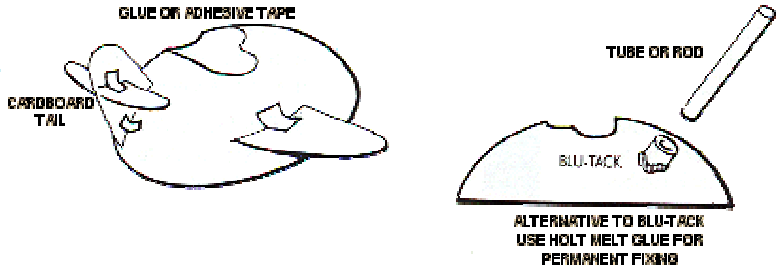




Fixing to Jackets

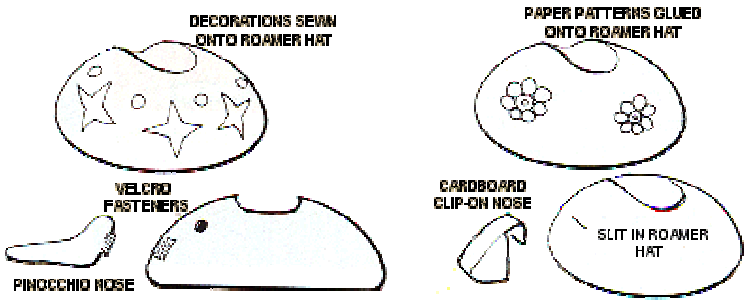


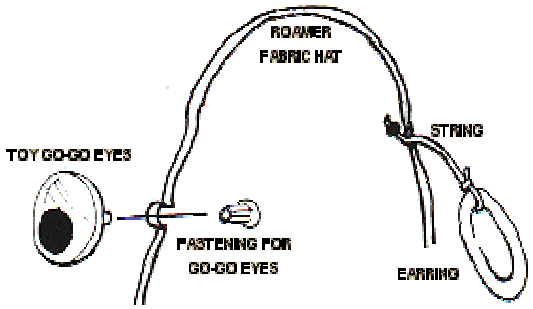




Fixing to a Roamer Hat

Using the fabric Roamer Hat provides an opportunity to use all the conventional techniques for fastening and joining fabric such as seaming, hemming etc.





Adhesives

Adhesives can prove to be a simple and effective fastening technique. They can also provide good structural joints. However, care must be taken. Adhesives should not be used directly on the Roamer - they can mar the plastic. The Roamer Jackets are semi-disposable and, in most cases, the damage can be tolerated. In fact, if the aim is to make a permanent Roamer character on a Jacket, use of adhesives has much to offer.

WARNING

Adhesives can be dangerous and should only be used under a teacher's supervision. It is the teacher's responsibility to ensure safe use of adhesives and the notes on this page are intended for general guidance only. The teacher should read and follow the adhesive manufacturer's instructions carefully.

Local Education Authority regulations may preclude the use of certain adhesives in schools. It is the teacher's responsibility to become aware of and comply with these instructions.

SUPER GLUE: Available from DIY stores. They are very quick to harden. New gel versions are easier to use than earlier liquid types.
Materials: Metal to metal and other materials like plastic. Plastic to plastic, fabric to fabric and plastics. Can be used to stick rubber to rubber.

PASTES AND GUMS: These include the traditional glues used in the classroom for paper and craft materials. They are available in dispensers like Pritt Stick, Glue Pens etc. Some need to be mixed with water.
Materials: Paper to paper or card. Card to card. Can be used with varying success in sticking card/paper to materials like wood, cloth, cork, etc.

SPRAY MOUNT: These products are used by professional graphic designers to 'paste' photographs and drawings on paper backgrounds. These products should be used with particular caution and under close supervision by the teacher.
Materials: Same as paste and gums.

CONTACT ADHESIVES: These adhesives are normally used for sticking sheets of material or flat surfaces together. They are particularly useful for bonding together different materials. Sometimes called 'Impact Adhesives', proprietary brands include EVO-STIK.
Materials: A wide range of dissimilar materials, e.g: Leather to leather, wood to wood or leather, plastics to each other and to leather, cloth, wood, cardboard or paper. Cardboard to cardboard.

CEMENTS: This range of adhesives includes the various types of Tensol. They are solvent based and joints are made by chemical action cementing the two plastics together. They work on thermoplastics but not all thermoplastics.
Materials: Example materials include perspex to perspex (i.e. acrylic to acrylic), PVC to PVC and polystyrene to polystyrene.

WOOD GLUES: These include a range of traditional animal-based glues like scotch glue. Although this glue makes very strong joints, it is messy and using it is time consuming. PVA (Polyvinyl Acetate) glue is also useful for wood. There is a range of balsa wood cements commercially available from craft and model-making shops.

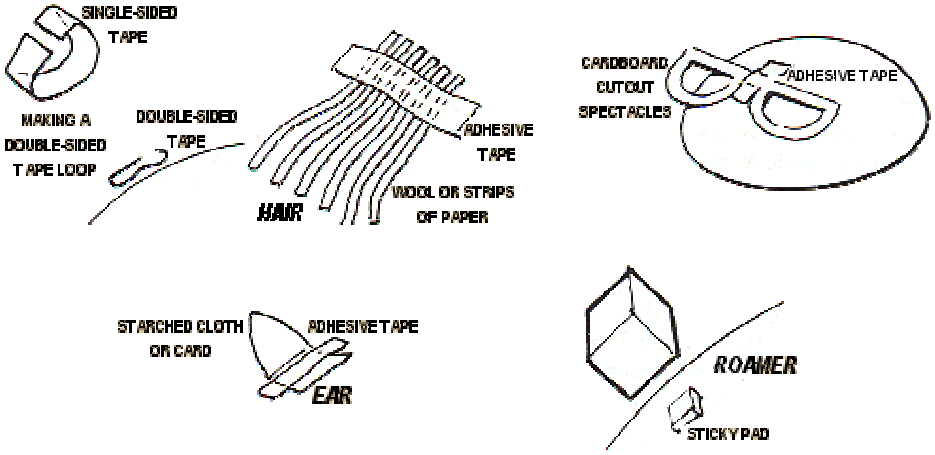
EPOXY RESIN: This adhesive is available from most DIY stores and hardware stores. It comes in two parts: the adhesive and a catalyst (hardener).
Materials: It can stick almost anything to anything. Wood to wood, metal to metal and

plastic to plastic. The glue can also be used to stick dissimilar materials together like wood to metal etc.

HOT MELTS: This type of glue requires a special application gun. This is relatively inexpensive and available from hardware, DIY stores and other stores. Hot melts are easy to use and have proved very effective in making strong joints to Roamer Jackets.
Materials: A whole range of dissimilar materials including metals, wood, some plastics, cardboard, paper, leather, textiles, ceramics, etc.

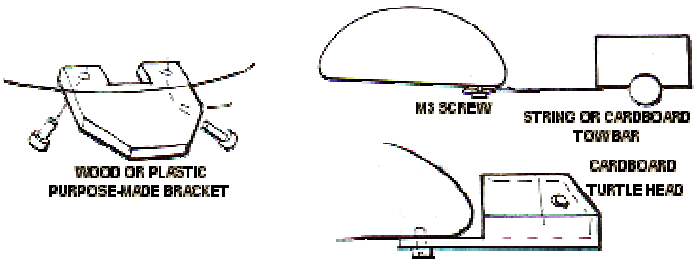
Sticky Tape and Pads

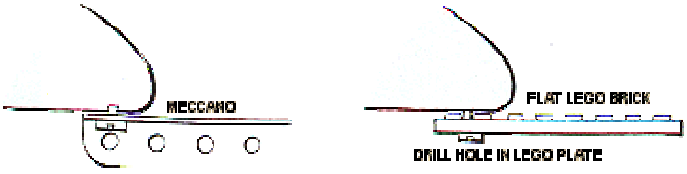
Adhesive tape and sticky pads are available from stationers, under a variety of trade names. If the adhesive is too strong it may leave marks on the Roamer surface. You could use the inside of the battery cover to check this first.



M3 Screws

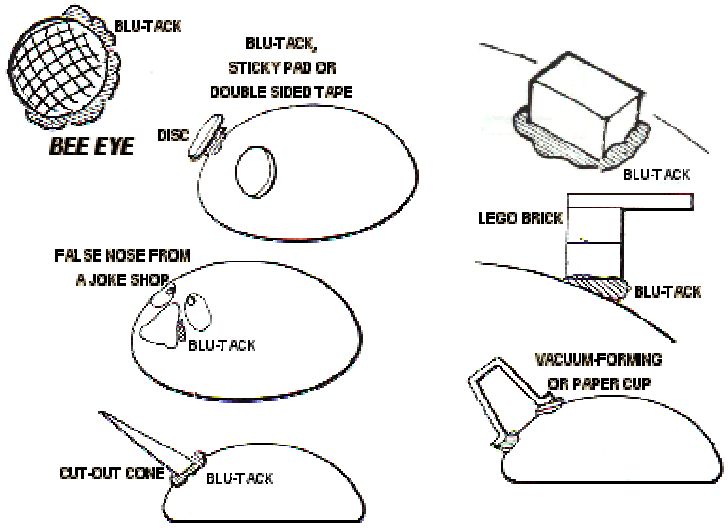
Fitted to the ubderside of Roamer are 8 brass bushes suitable for use with the M3 x 12mm long screws.





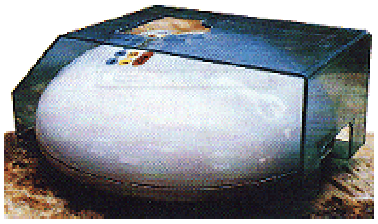
Blu-Tack

Blu-Tack is simple and quick to use, effective and can be used without affecting the Roamer surface.

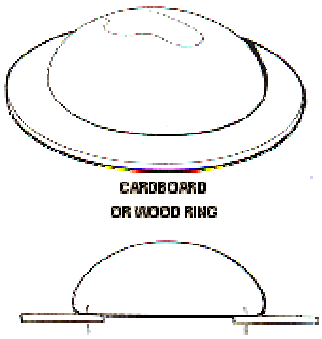


Purpose-made Brackets

A wide variety of brackets can be designed and built to fit onto the Roamer. The M3 screw holes, the Jackets or the Tube, or Mounting Brackets available from Valiant can be used to support them.

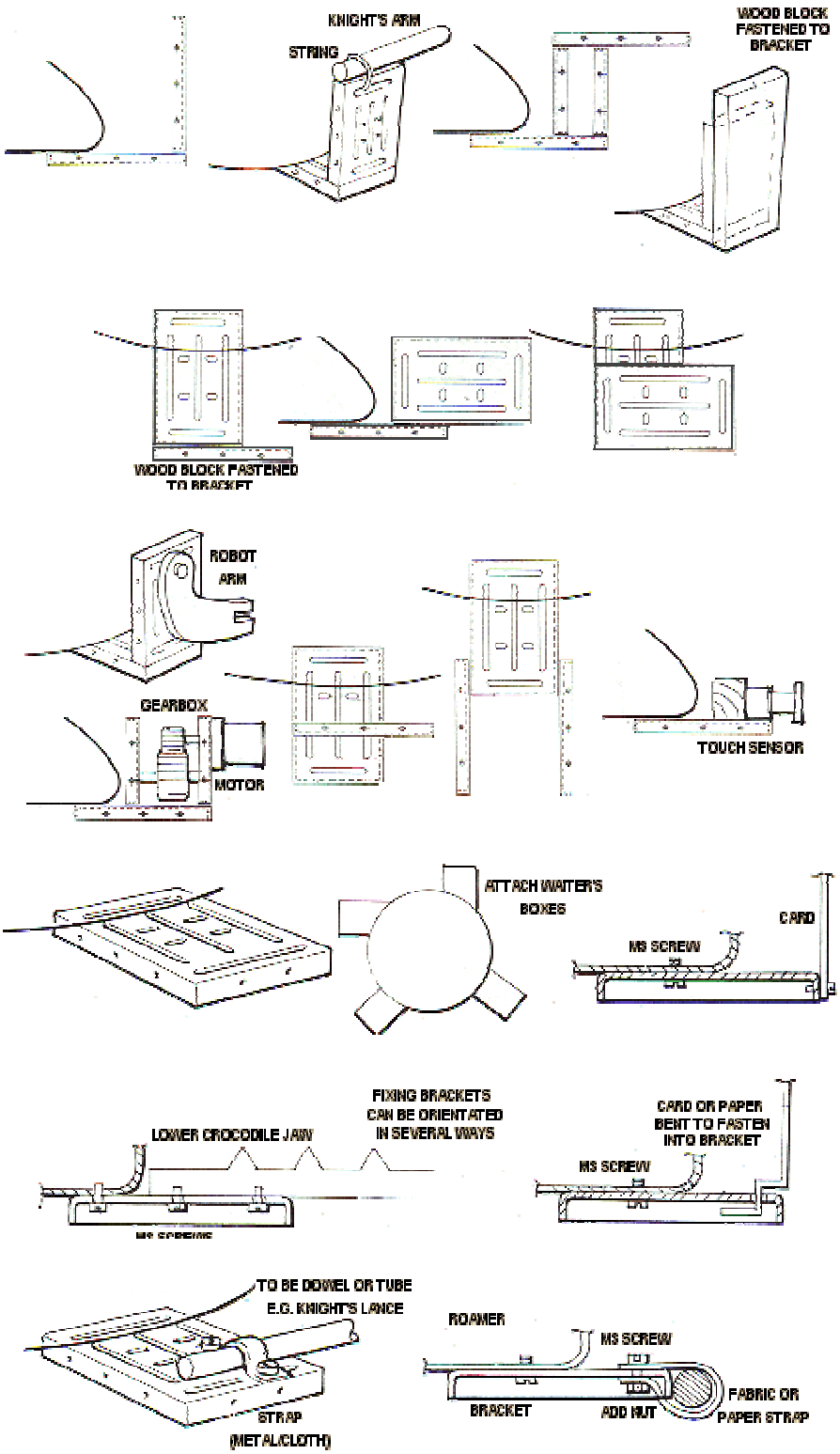


Acrylic(perspex) bracket forming a mounting bridge.



Mounting Brackets

Fix to Roamer with M3 screws.



Finishing

Finishing is used to improve the appearance of, or to protect a product.

Paint and marker pens can be applied to cladding materials (see below), and Roamer Jackets and Hats. Jackets can be painted and over-painted.

Glitter or sequins can be used on Jackets or Hats using body spray or graphics spray mount.

Using Theatrical Make-up can have dramatic results.

WARNING

Spray mount, paint, marker pens and adhesives can all mar the Roamer plastic.

They can be used on the semi-disposable Jacket providing the damage can be tolerated.

Robot Behaviour

Isaac Asimov's wonderful science fiction stories portrayed robots as mechanoids, each behaving in a different manner. His robots are designed for particular jobs and working environments. The robots of Roamerworld can also be programmed to suit their environment and their function.

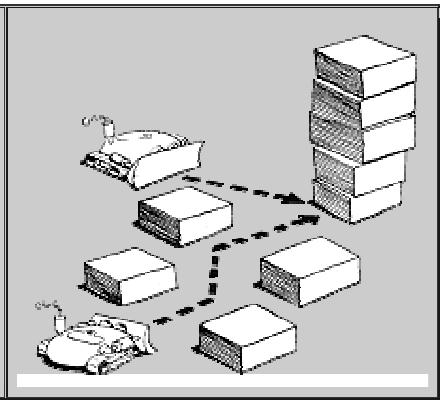
Demolition Roamer

Build a tower from empty boxes or polystyrene blocks.

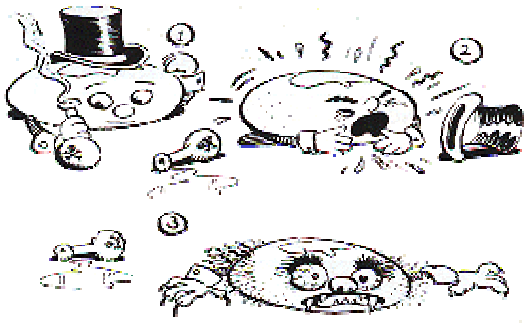
Position the Roamer at any starting point.

Instruct the Roamer to knock down the tower using moves and turns.

Obstacles may be placed in the path which the Roamer must avoid during demolition.



Activities like Demolition Roamer (Roamer Activity Book) suggest character designs. Programming the Roamer as part of the sctivity provides the robot with it's behaviour.

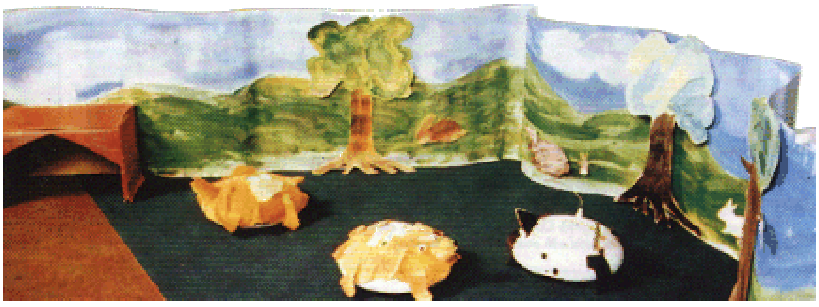


Suggested Activity: Use two Jackets. Design one as Dr. Jekyll, and the other as Mr. Hyde and program the Roamer to change behaviour as the character changes.

REMEMBER: Roamer design is not about copying an image. In Roamerworld it is possible to bend or break the 'rules' to create a totally new rule book. This principle can also be applied to the robot's behaviour.

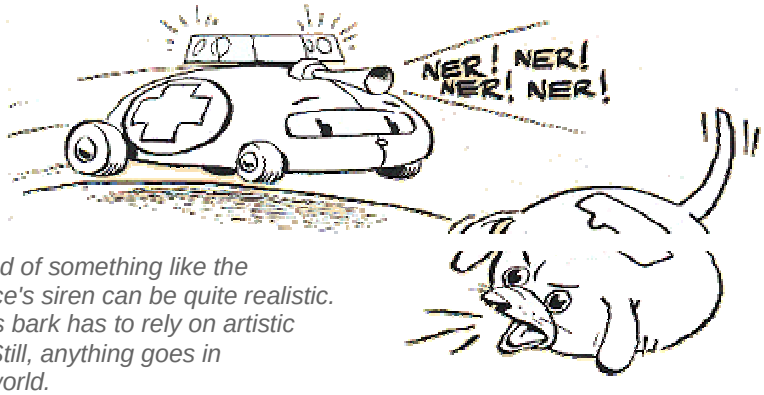
Literature supplied with the Roamer and the various Accessory Packs present numerous examples of how Roamer behaviour can be integrated into classroom activities and character designs.

As part of their dog project Southmead's pupils realised that dogs move around marking out their territory. They programmed their dog to mimic this behaviour.



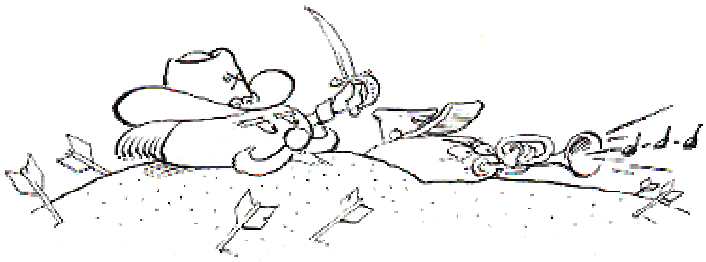
Behaviour and Roamer's Sound Facility

Roamer can be programmed to play notes over 3 chromatic scales. There is a choice of 8 different durations and 5 tempos for each sound. This allows children to give 'voice' to their characters.



The sound of something like the ambulance's siren can be quite realistic. The dog's bark has to rely on artistic licence. Still, anything goes in Roamerworld.

This robot interpreter can be programmed to 'speak' in many different languages. Morse code is one. Others can be devised by the students. Note: the 'language' spoken by R2D2 of Star Wars fame.

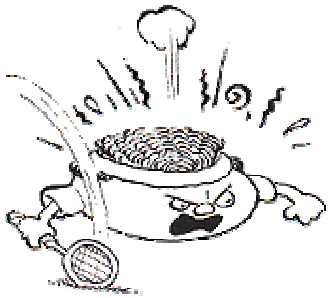


During battles, generals used the bugler to pass orders to the troops.

Behaviour and Roamer's Output and Stepper Motor Features

Behaviour patterns can be devised for robots using stepper motors. See **Biceps the strong man** and **Chuckles the Clown**.

Roamer cars switch on their headlights when it becomes dark. They behave very politely, using their flashing light indicator when they change direction and a brake



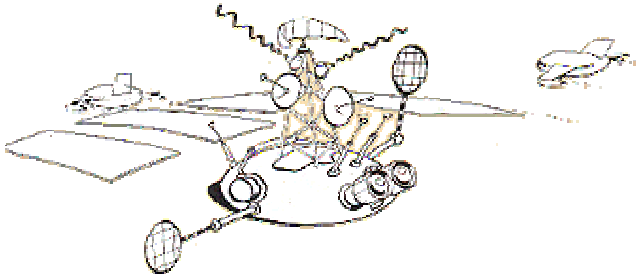
John MacRoamer can be programmed to swing his tennis racket run around the

light when they are going to stop.

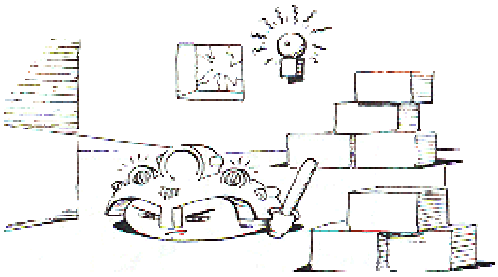
court and make disapproving noises.

Roamer's Behaviour when Sensors are used

Roamers sensor capability allows the robots to interact with their environment. This provides Roamer with a variety of interesting behaviour patterns. Some of them are relatively simple: for example, the Roamer car can be programmed to turn its headlights on if it becomes dark. Others, like the examples illustrated below, can be quite complex.



The air traffic controller can tell the pilot of this Roamer aeroplane which of the runways to land on. One light flash will make it land on runway 1, two flashes on runway 2, and so on.



The Roamer security guard patrols the factory grounds. When it hears a sound it raises an alarm, switches on its search light and starts to scan for intruders.

There are many other examples of 'behaviour' and Roamer control features in the Design and Control Section. The reader should also refer to the Roamer Control Box User Guide supplied with the Roamer Control Box and the Activity Books supplied with the Light, Sensor and Motor packs.

Debugging

Debugging Roamer programs is an essential part of the process of developing characters. Roamer procedures are very useful in debugging complex behaviour programs (See the Valiant Roamer User Guide).

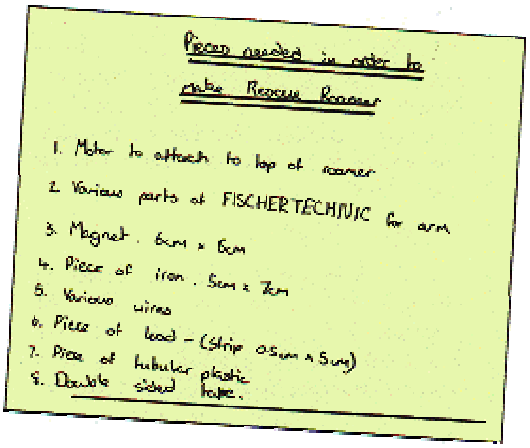
Computer Support

The Roamer/Control Console Computer Interface allows the user to DISPLAY programs on the computer, PRINT and SAVE them on disk. Viewing can help with complex programs and printing provides hard copy for project reports. Once the Roamer is switched off, the program is lost. SAVE allows the pupil to develop complex programs over several lessons, store them on the computer and download at the start of the next session.
The user can create a library of behaviour programs for one or more robot designs. Using the Interface's MERGE feature will join selected programs together they can be downloaded into Roamer.

Using the Valiant Computer Interface to support Roamer design projects.

Environment

Roamers often require an environment to be created as part of an activity or project (see **Dog Project**). Establishing the environment is a design project in its own right.



A parts list is another way that designers communicate information about the design to the manufacturer.

Bamford County Primary School in Ipswich used Roamer in a Road Safely Project for young pupils. Older students contributed by designing the realistic model village.

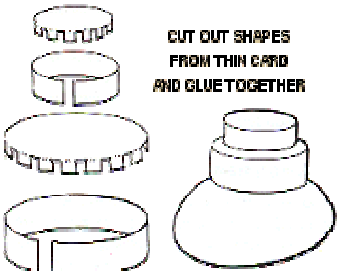
Environments can be created using classroom furniture etc. Even these situations involve the design process.

Manufacturing Information

The Design Stage is completed when the designer can provide enough information to enable a product to be manufactured. In a commercial environment this information may be in a variety of forms. Engineering drawings, numerical control tapes for machine tools, models, moulding tools and a 'sketch on the back of an envelope' are a few of the methods used.

Children using the interactive design approach tend to be stimulated by the items within their immediate environment. Their manufacturing information consists of a mental image.

Sketches are often used to provide manufacturing information.

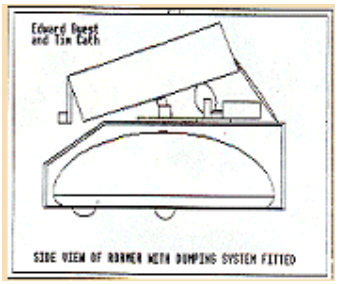


Fairy Cakes

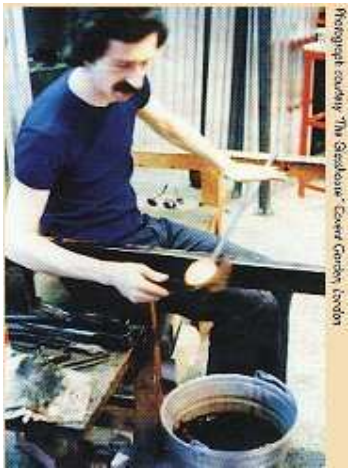
Ingredients
50g sugar
50g margarine
2 eggs
150g s.r. flour

Method
1. Cream sugar and margarine together
2. Gradually beat in egg
3. Stir in flour
4. Place mixture in cake cases and cook at 180℃ for 15-20 minutes

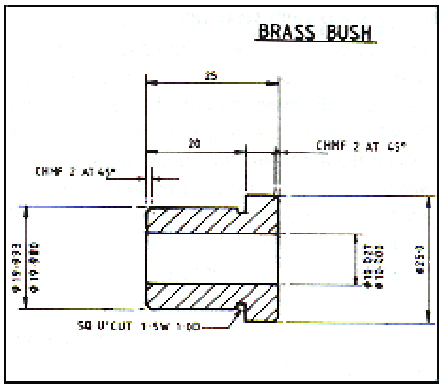
Manufacturing information comes in many forms depending on the industry. A recipe provides the chef with manufacturing information.



This drawing using CAD was done by pupils of King Edward VI School in Southampton.



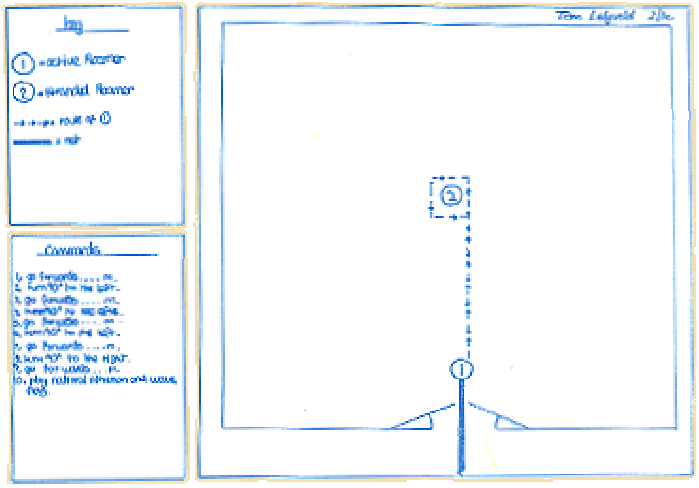
Manufacturing from photographs is one method used by young children. Craftspeople like the glassblower shown in this photograph sometimes use this method.



Some older children produce detailed manufacturing drawings.

Programming

Recording the 'behaviour program' is the software equivalent of manufacturing information.



MANUFACTURING

In many commercial design situations the designer may have little to do with the manufacturing process. However, practical experience of manufacturing processes is an essential skill. Even though the technologies children use for creating Roamer designs are vastly different from commercial technologies, children can develop confidence and a practical intuition in making their own robot creations. But above all a tremendous satisfaction can be attained from making designs they have created.

This manual does not intend to present information on the actual manufacturing processes. For these, consult various Craft and Technology books.

DESIGN REVIEW

The Design Review is the final phase of the design process. It is not the same as Evaluation. Evaluation is the ongoing review of previous decisions. The Design Review is checking whether the finished product meets the requirements of the Design Brief. The Review phase also allows the designer the opportunity to assess how ideas worked.

In practice the Design Review can take the form of teacher/pupil or pupil/pupil discussions and can be presented in informal or formal reports.

Even if it is not intended to modify the design, the Review should always endeavour to suggest improvements and identify the design's strengths and weaknesses. It is through reflection that the most is learnt from each design experience.

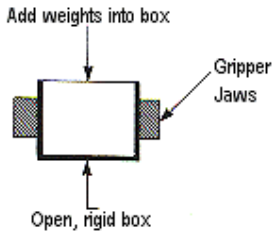
In addition to these ideas the Roamer Activity Book and most of the Activity Books for the Accessories contain ideas and themes suitable for Roamer design projects.

Sometimes designs need very exhaustive testing, even to the extent that specialist test equipment needs to be designed for that purpose. Expensive equipment will be subjected to "Commissioning" tests. The buyer will create check lists against which the product is reviewed. Devising specific "Design Review" procedures can be an effective activity across a range of age groups.

DESIGN REVIEW - BICEPS			
FEATURE	**GOOD**	**ACCEPTABLE**	**NEEDS IMPROVEMENT**
LIFTING MECHANISM		✓	
LOAD LIFT CAPABILITY			✓
EASE OF MANUFACTURE		✓	
STYLE	✓		
FACE	✓		
EASE OF PROGRAMMING	✓		

A simple Check list is one possible approach. These will include aspects of the Design Brief, factors considered by the designer and areas about which the designer is uncertain.

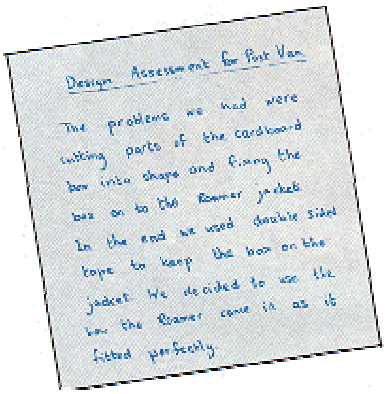
Test for Roamer
with Gripper Arm



1. Place weight in box
2. Grip
3. Lift gripper arm
4. Hold for 5 seconds
5. Lower Gripper Arm
6. Release grip

Repeat process for increasing weight.

Testing may involve devising test and test equipment. Equipment to test the grip capability of a Roamer grab arm provides a good science project.


Design Assessment for Post Van

The problems we had were cutting parts of the cardboard box into shape and fixing the box on to the Roamer jacket. In the end we used double sided tape to keep the box on the jacket. We decided to use the box the Roamer came in as it fitted perfectly.

Written test reports can be made even by very young children.

Teacher: "You said you used a different technique to cut out the main shape of the material which would be easier."
Paul: "Yes. I would cut out squares and put it on it then when you get to the edges you would cut around it so it fits properly."
Teacher: "Would that be easier for you to do?"
Paul: "Yeah."
Teacher: "Would it have been just as good?"
Paul: "It wouldn't have turned out as good."
Teacher "Are you happy wifh the way its turned out?"
Paul: "Yes very happy - I wouldn't change anything."

Transcript of discussion between teacher and pupil on the success of the ***dog design***


SMAUG THE DRAGON

DOES THE DRAGON LOOK FIERCE? _____

WHAT DO YOU LIKE MOST ABOUT IT? _____

WHAT MAKES IT LOOK LIKE SMAUG? _____

_____

_____

COMMENTS _____

_____

_____

_____

Questionnaire for testing reaction to designs of Smaug the Dragon from the Hobbit

Ideas

Materials & Techniques

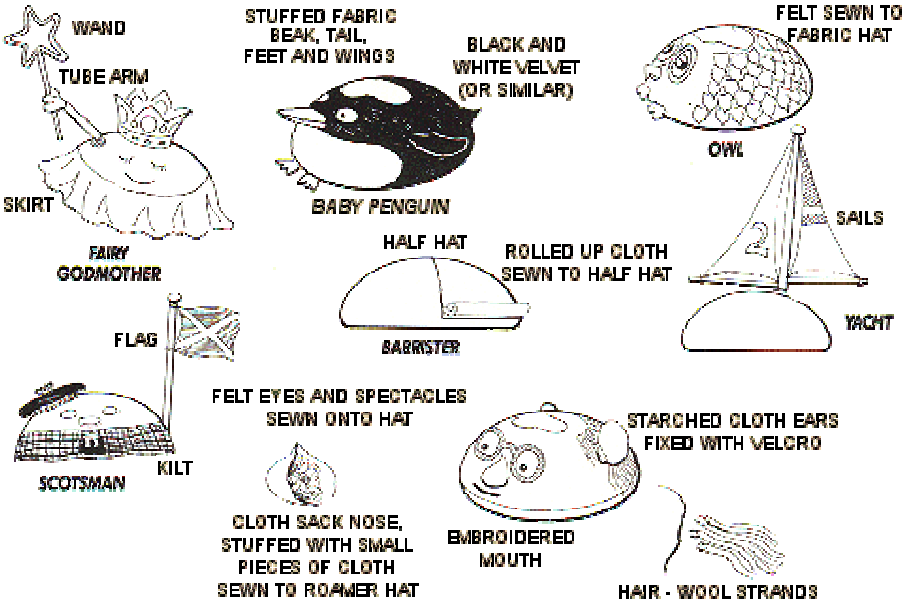
This section illustrates some of the wide ranging ideas for Roamer character designs. The various Roamer Activity Books contain other suggestions as well as indicating how programming and other educational exercises can be developed around a character. Other ideas will be inspired by exploring the many art, craft and technology books.

The Witch was made by draping black muslin over the Roamer and rolled up paper arms.

Artificial animal fur can be obtained from haberdashers or from suppliers to the toy industry.

Using Fabrics

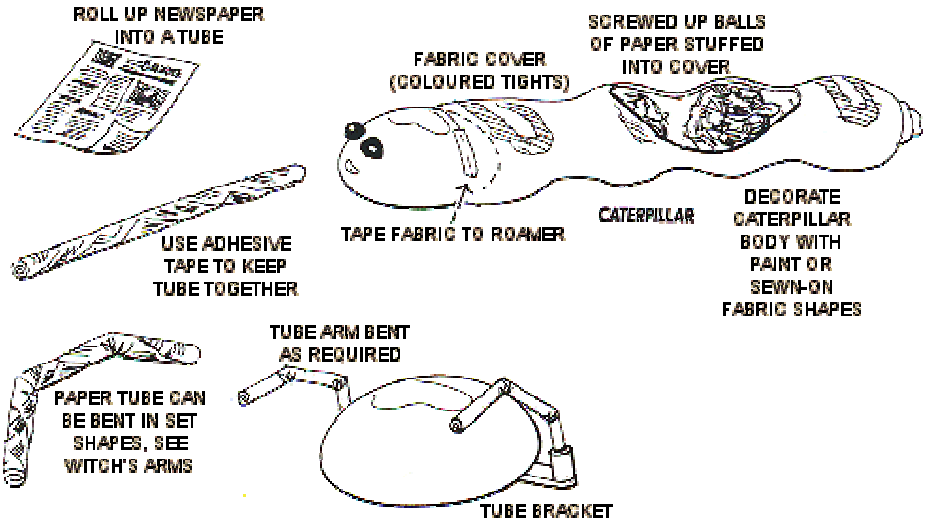
There is a huge variety of materials available with different textures and patterns. One good source of material is old clothes, which can be readily used in Roamer design. All the traditional manufacturing techniques of cutting and sewing can be used.

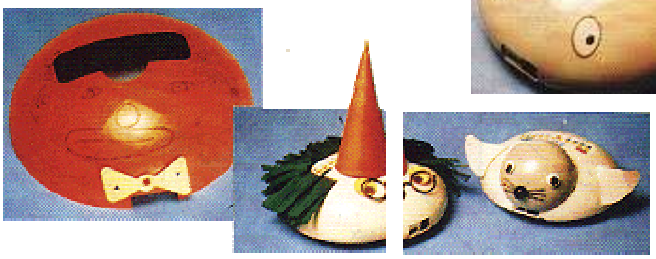


Using Paper and Card

Paper and card are easily decorated using paint, crayons, fibre-tipped pens etc.

Covers like this post van are simple to make. Note: when covering the keyboard, start the program with a W10 instruction. This allows time to put the cover on before the 'real' program starts.

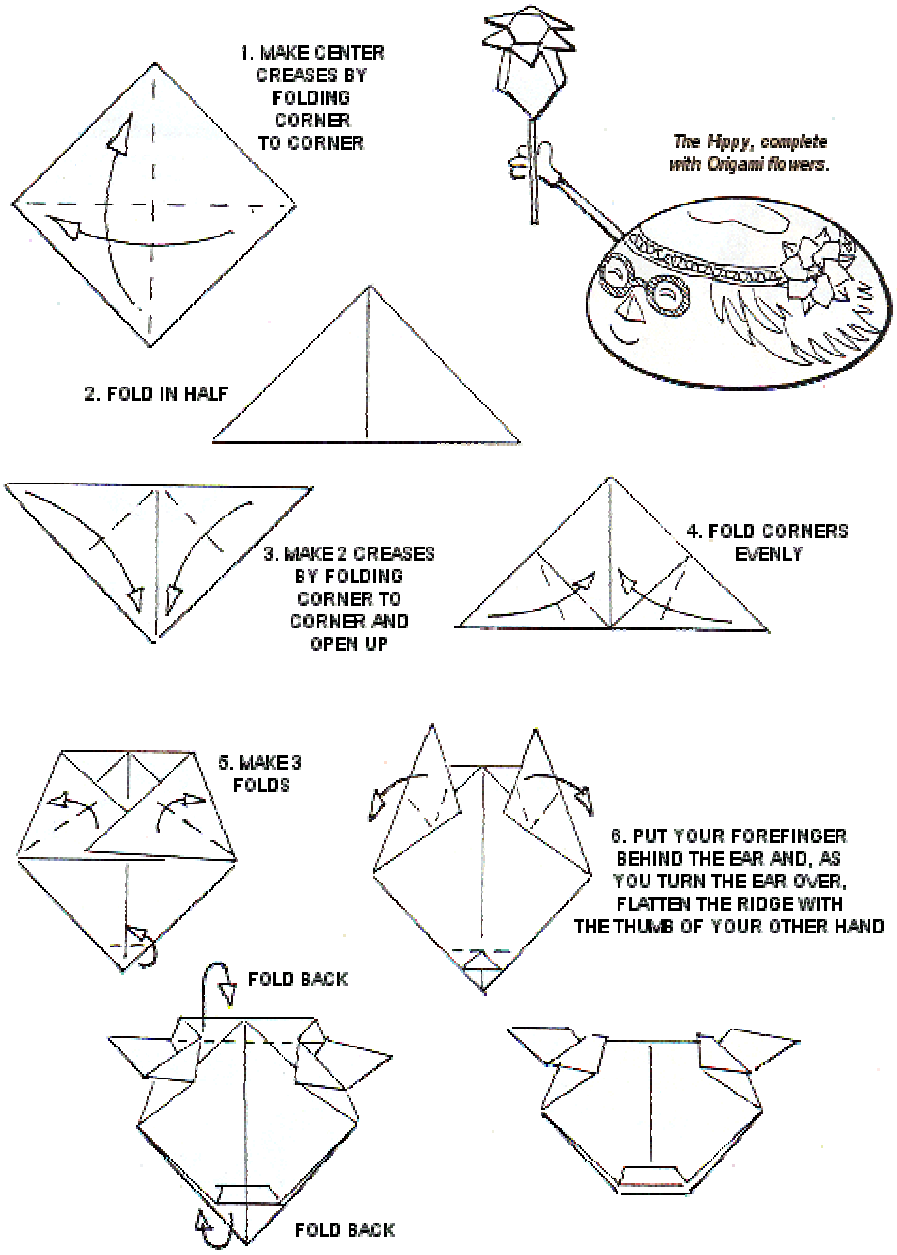




Using Paper and Origami

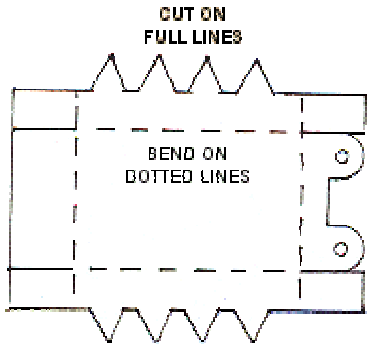
Masks and decorations are two ways in which Origami can be used. The reader should consult the many Origami books for ideas and to gain a thorough understanding of its techniques.

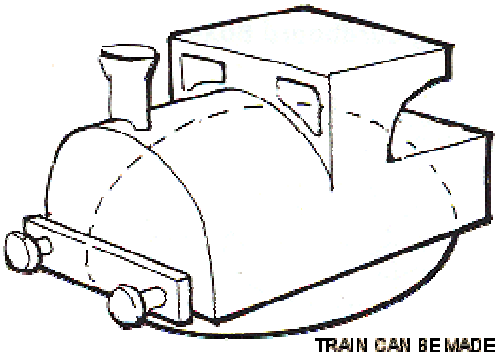
How to make an **Origami Pig**.

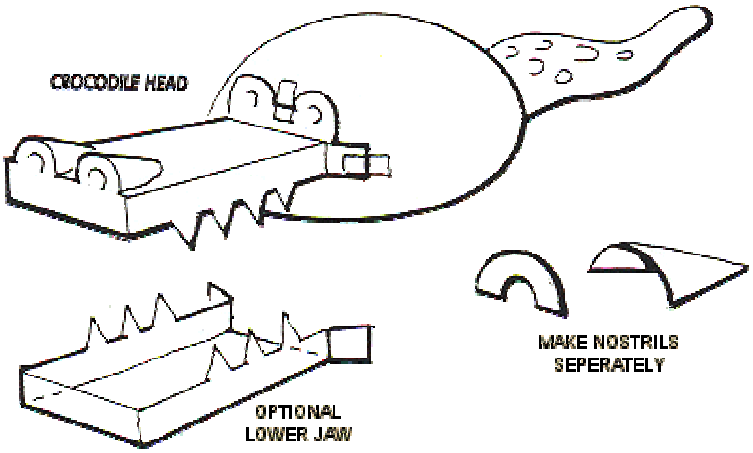


Using Paper, Card and Cut-Out Patterns

The teacher can provide patterns, like the Pig Pattern, to introduce younger children to this techniques. Older children should be asked to design thier own patterns.





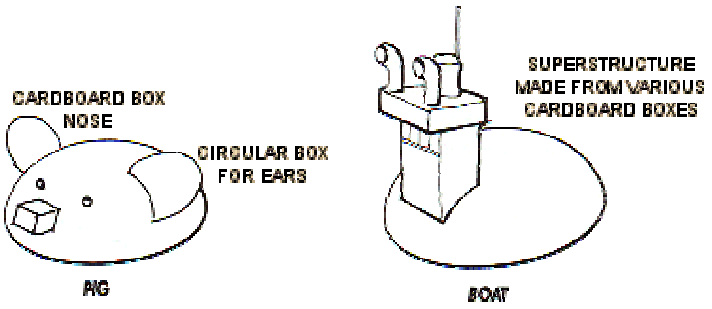


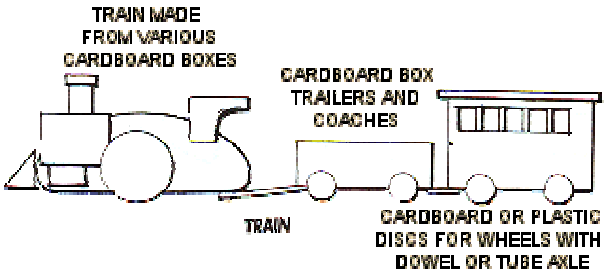
Using Papier-Mache

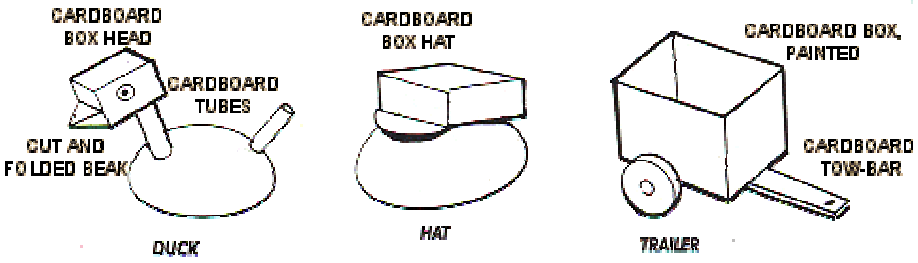
Papier-mache can be used effectively to produce novel shapes and ideas. Wire frames can be made to cover the Roamer. They can then be removed and the papier-mache formed over them. Alternatively, the papier-mache can be built directly onto a Jacket.

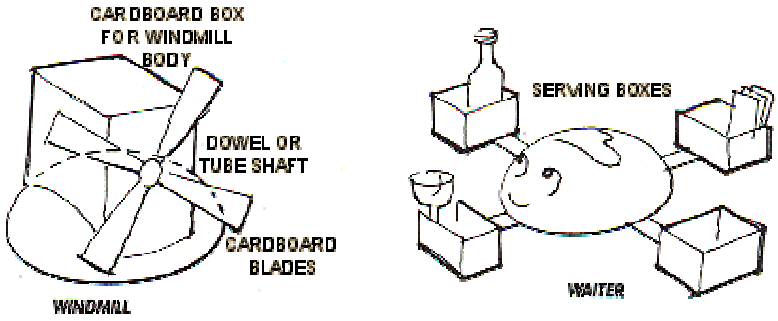
Treebeard from Tolkien's "Lord of the Rings".

Using Cardboard Boxes

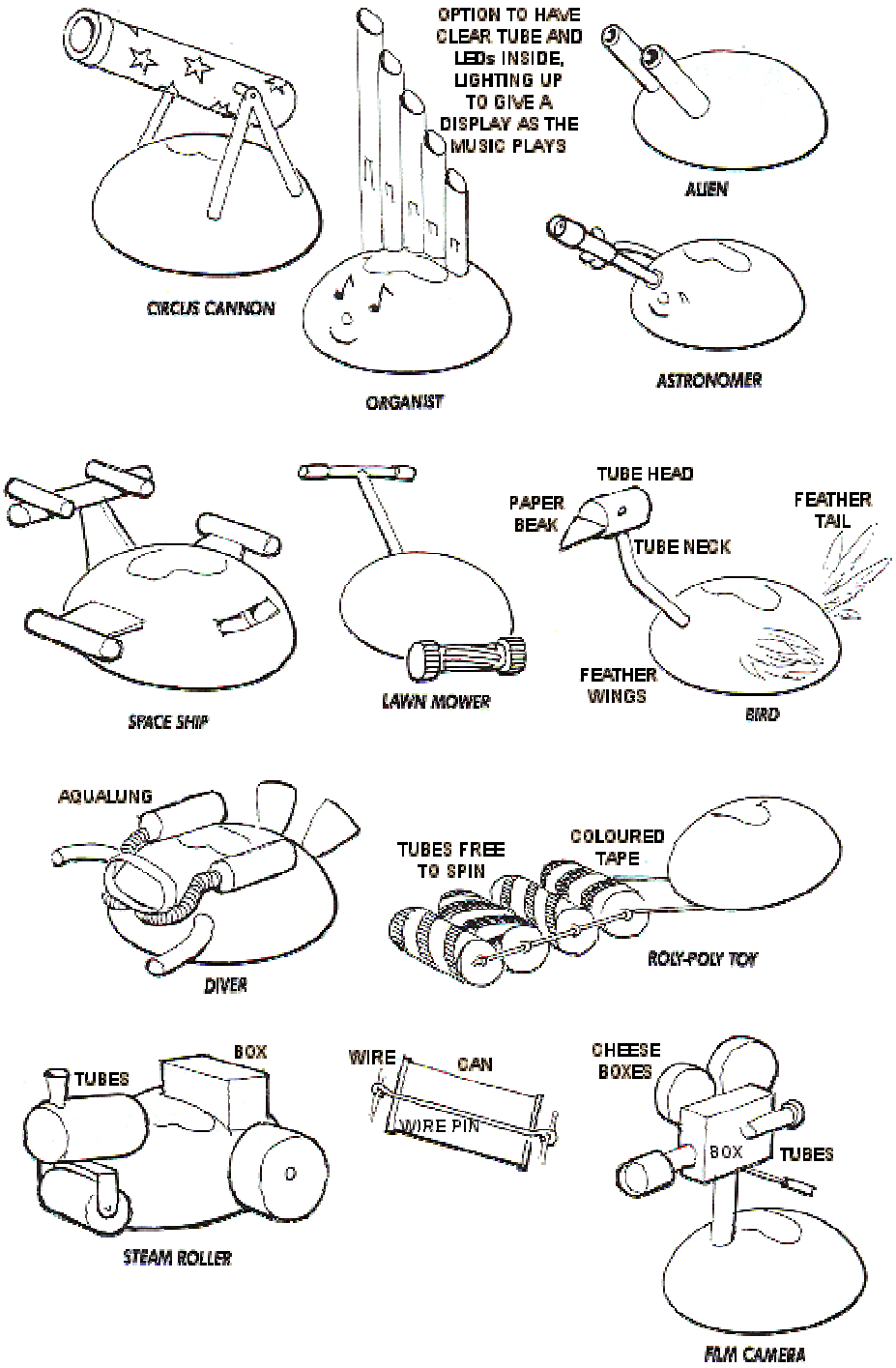




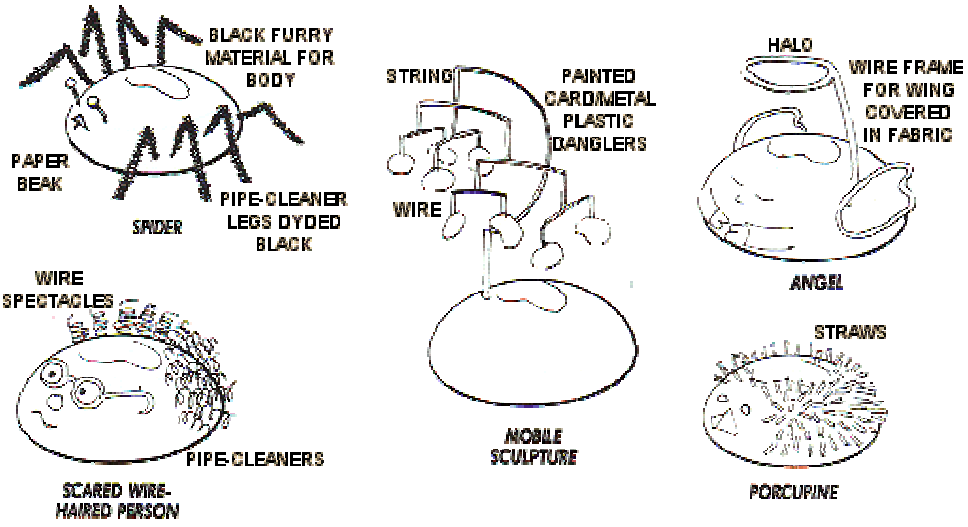




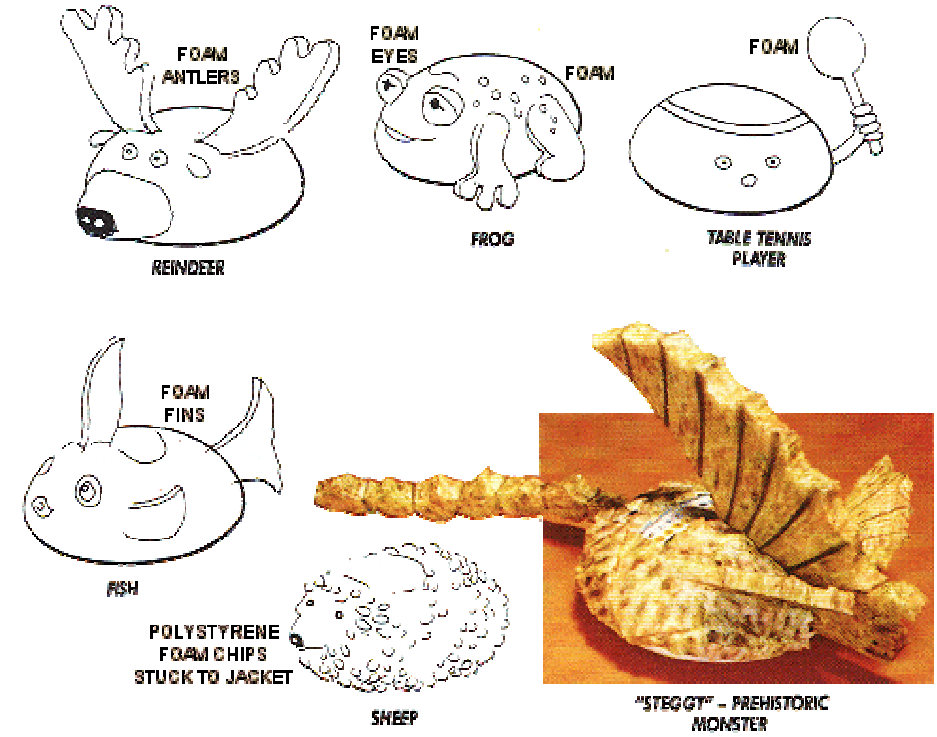
Using Tubes


OPTION TO HAVE CLEAR TUBE AND LEDs INSIDE, LIGHTING UP TO GIVE A DISPLAY AS THE MUSIC PLAYS
CIRCUS CANNON
ORGANIST
ALIEN
ASTRONOMER
SPACE SHIP
LAWN MOWER
TUBE HEAD
PAPER BEAK
TUBE NECK
FEATHER TAIL
FEATHER WINGS
BIRD
AQUALUNG
DIVER
TUBES FREE TO SPIN
COLOURED TAPE
ROLY-POLY TOY
TUBES
BOX
STEAM ROLLER
WIRE
CAN
WIRE PIN
CHEESE BOXES
BOX
TUBES
FILM CAMERA

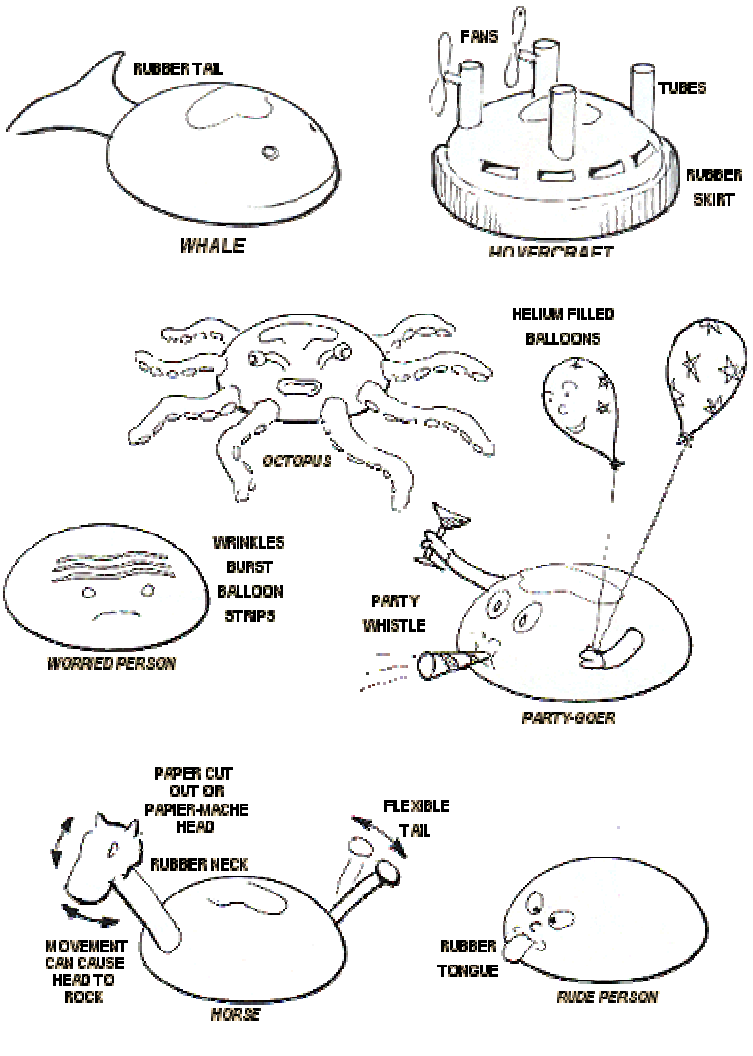
Using Wires, Straws and Rods



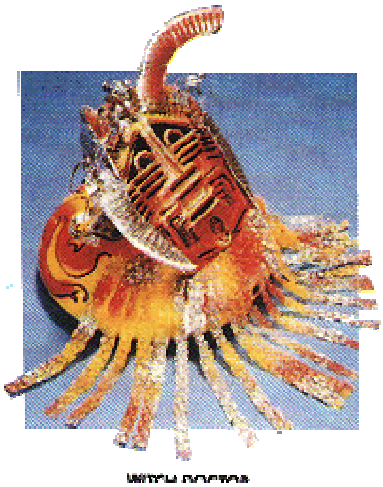
Using Foam

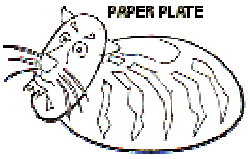


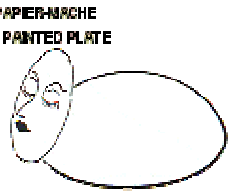
Using Rubber

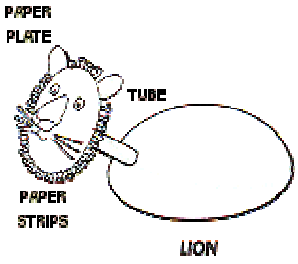


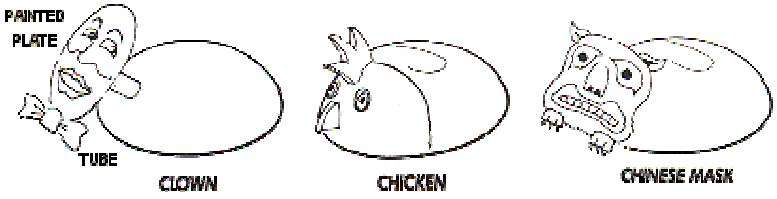
Using Masks



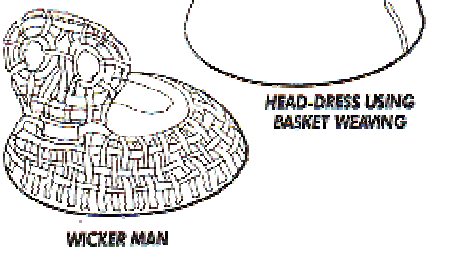


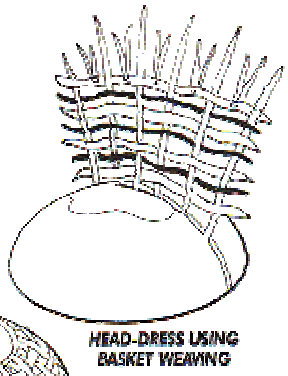






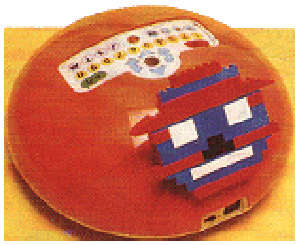
Using Weaving

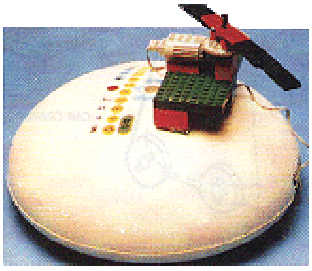




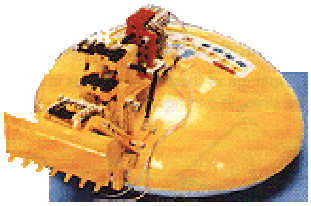
Using Construction Kits

Construction kits like Lego and Meccano are suitable for use with the Roamer. Many ideas that come with these production packs can be used with the Roamer. Construction kits are particularly useful with Roamer Control features.





Lego can be used to make simple designs like the Cat. The Helicopter indicates a simple use of Roamer's COntrol features. The Digger provides a challenge to older children.



A Meccano crane.

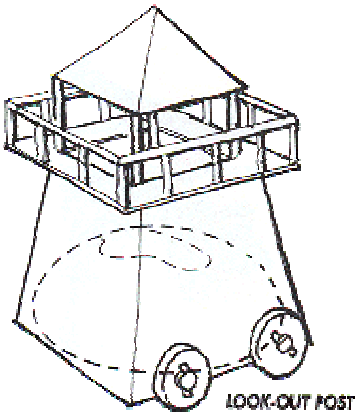
A Paddle Ship made from Teko and driven like a treadmill by Roamer.

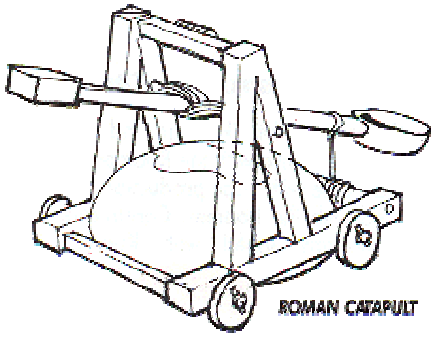
WARNING!

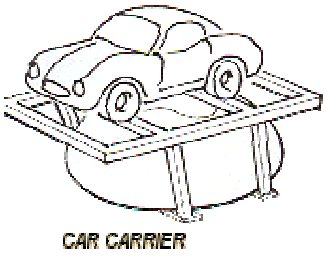
Roamers don't like water. Damage caused by water is not covered by Valiant's warrantv.

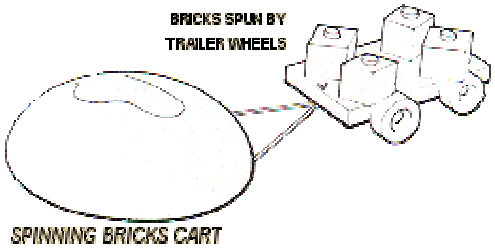
Using Wood or Plastic Sheet

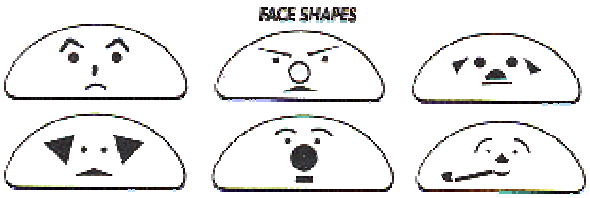
The advantage of these materials lies in their relative strength and rigidity.

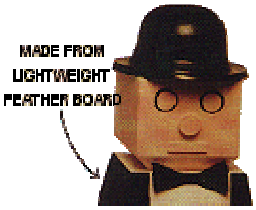






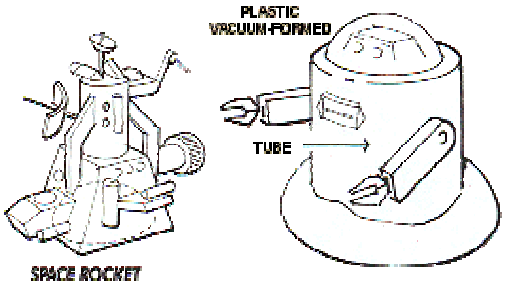


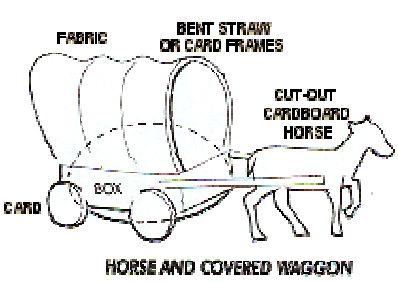


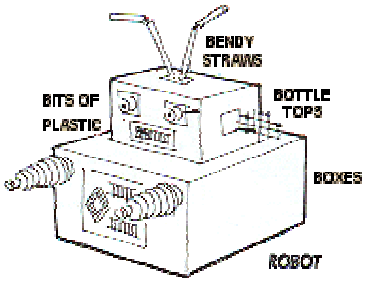


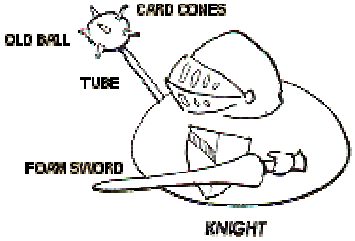
Using Junk Materials

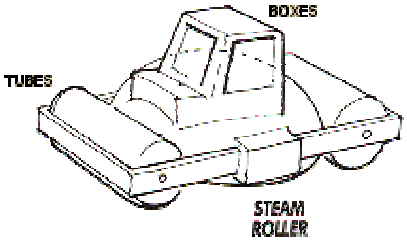
In practice, most designs are a mixture of materials, techniques and ideas. Often Roamer designs are created from what is immediately available in the classroom 'junk' box (see **material availability**). With absorption in Roamer design work some children start to think of how the materials, shapes and forms available in their everyday environment can be used to create characters.


PLASTIC
VACUUM-FORMED
TUBE
SPACE ROCKET


FABRIC
BENT STRAW
OR CARD FRAMES
CUT-OUT
CARDBOARD
HORSE
BOX
CARD
HORSE AND COVERED WAGGON

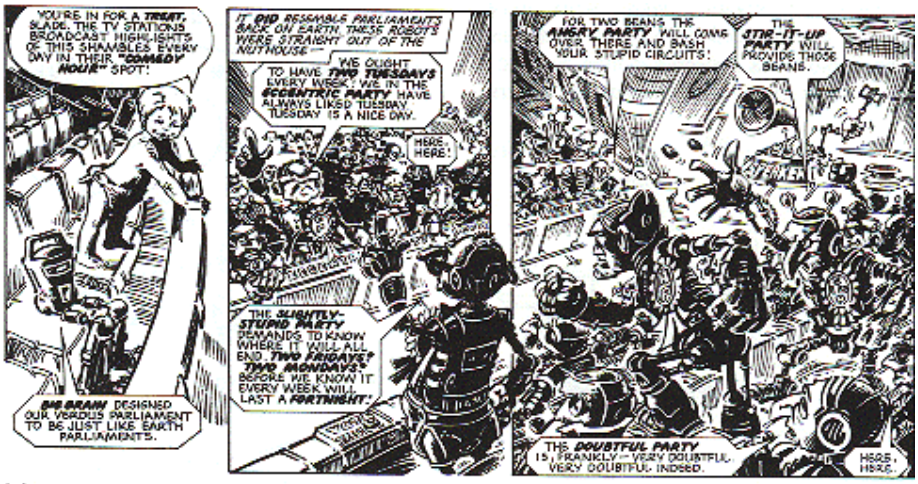

BENDY
STRAWS
BITS OF
PLASTIC
BOTTLE
TOPS
BOXES
ROBOT


CARD CONES
OLD BALL
TUBE
FOAM SWORD
KNIGHT


BOXES
TUBES
STEAM
ROLLER

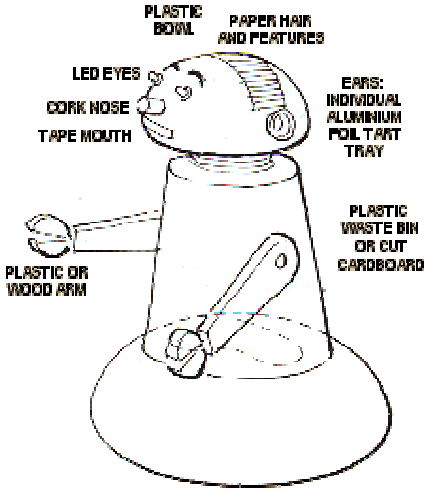
Character Features

Creating Roamer characters involves using their functional parts to create humanoid or other animal-like features. The following pages illustrate ideas for some of the more common attributes.



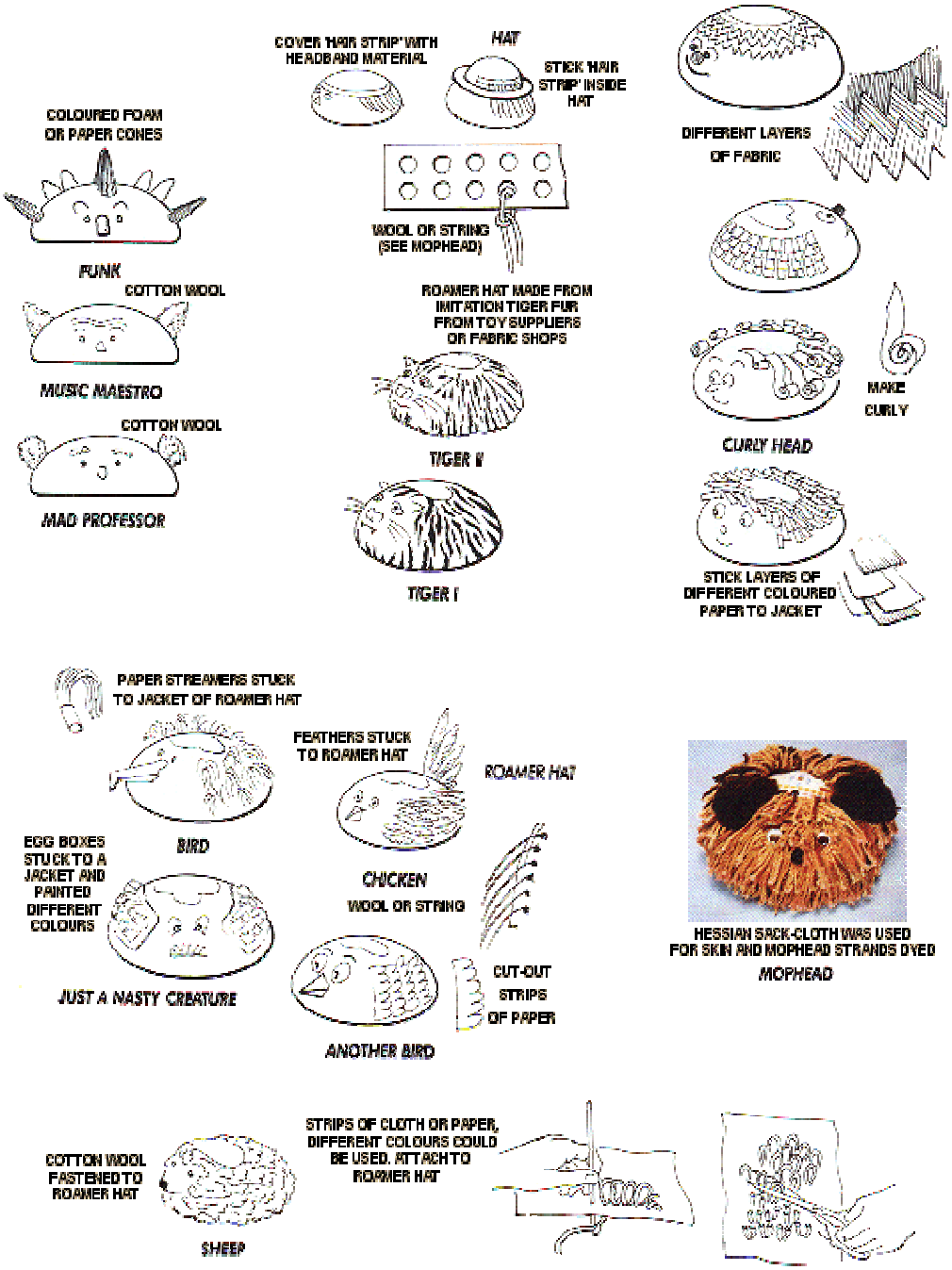
Robo-Hunter, © Fleetway Publications. Used with permission.

This satirical excerpt from the comic "2000 AD" shows how the droide encountered by Sam Slade in the Robo-Hunter stories represent the popular humanoid conseption of droids.

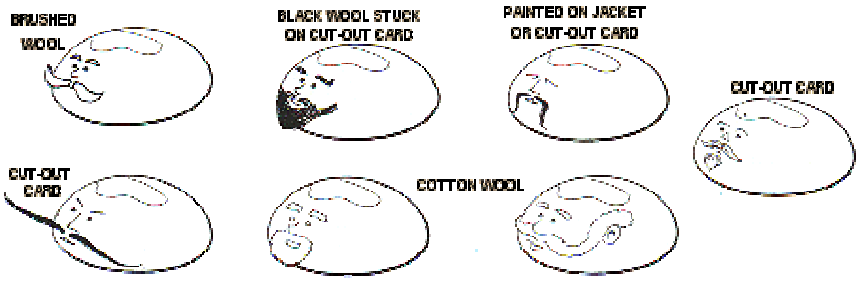


This robot is designed to have a humanoid appearance

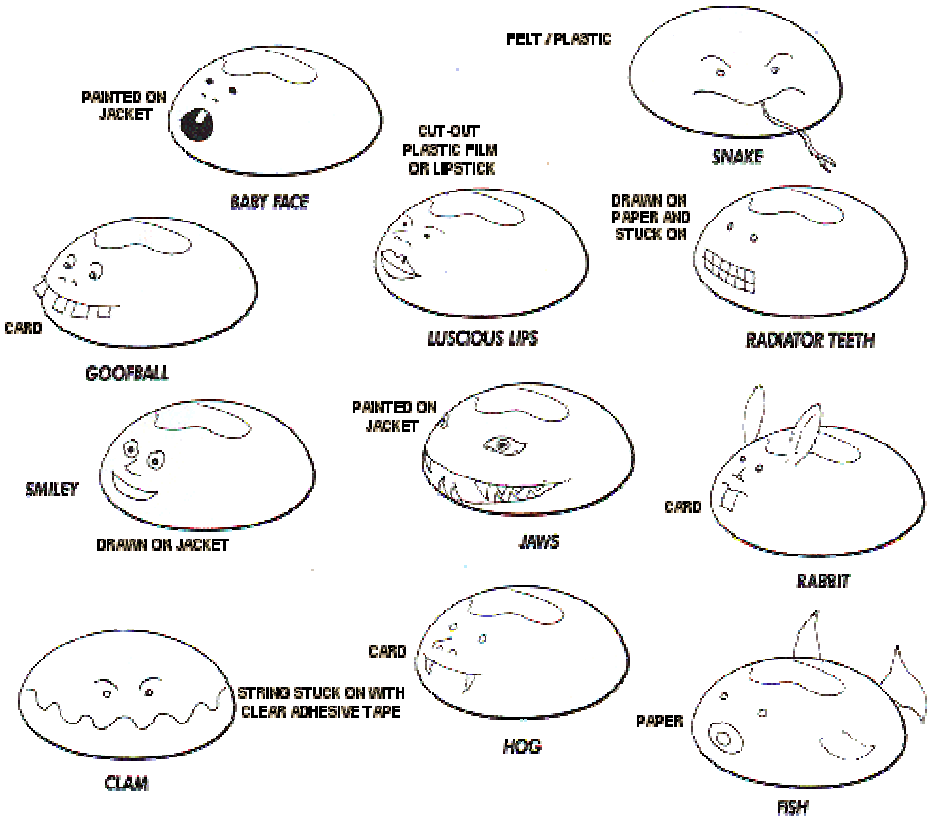
Hair and Fur


COLOURED FOAM OR PAPER CONES
PUNK
COTTON WOOL
MUSIC MAESTRO
COTTON WOOL
MAD PROFESSOR
COVER HAIR STRIP WITH HEADBAND MATERIAL
HAT
STICK HAIR STRIP INSIDE HAT
WOOL OR STRING (SEE MOPHEAD)
ROAMER HAT MADE FROM IMITATION TIGER FUR FROM TOY SUPPLIERS OR FABRIC SHOPS
TIGER II
TIGER I
DIFFERENT LAYERS OF FABRIC
MAKE CURLY
CURLY HEAD
STICK LAYERS OF DIFFERENT COLOURED PAPER TO JACKET
PAPER STREAMERS STUCK TO JACKET OF ROAMER HAT
BIRD
FEATHERS STUCK TO ROAMER HAT
ROAMER HAT
EGG BOXES STUCK TO A JACKET AND PAINTED DIFFERENT COLOURS
JUST A NASTY CREATURE
CHICKEN
WOOL OR STRING
CUT-OUT STRIPS OF PAPER
ANOTHER BIRD
HESSIAN SACK-CLOTH WAS USED FOR SKIN AND MOPHEAD STRANDS DYED
MOPHEAD
COTTON WOOL FASTENED TO ROAMER HAT
SHEEP
STRIPS OF CLOTH OR PAPER, DIFFERENT COLOURS COULD BE USED. ATTACH TO ROAMER HAT

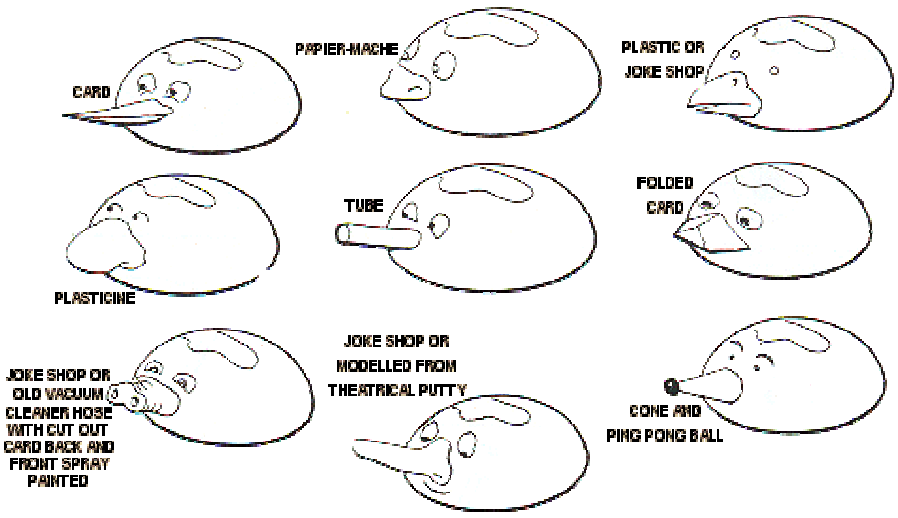
Moustaches, Beards and Whiskers

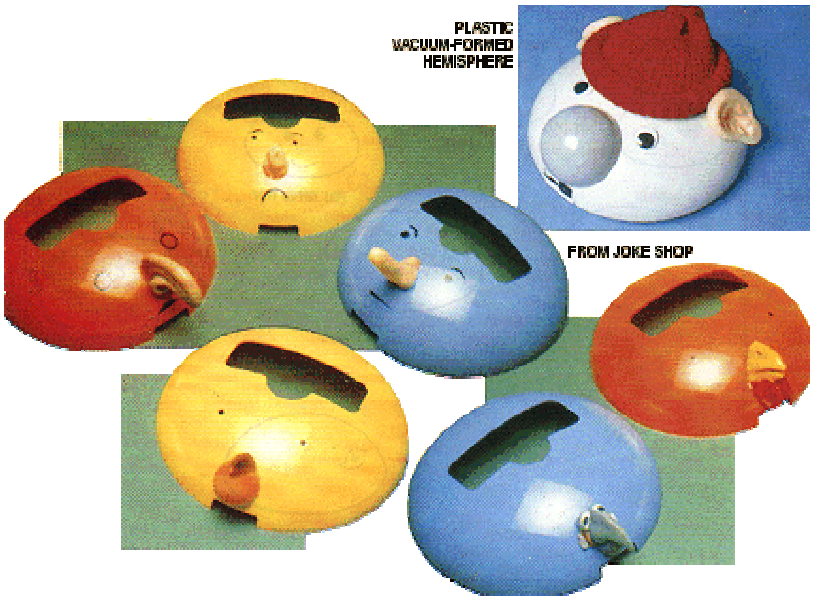


Mouths, Teeth and Fangs



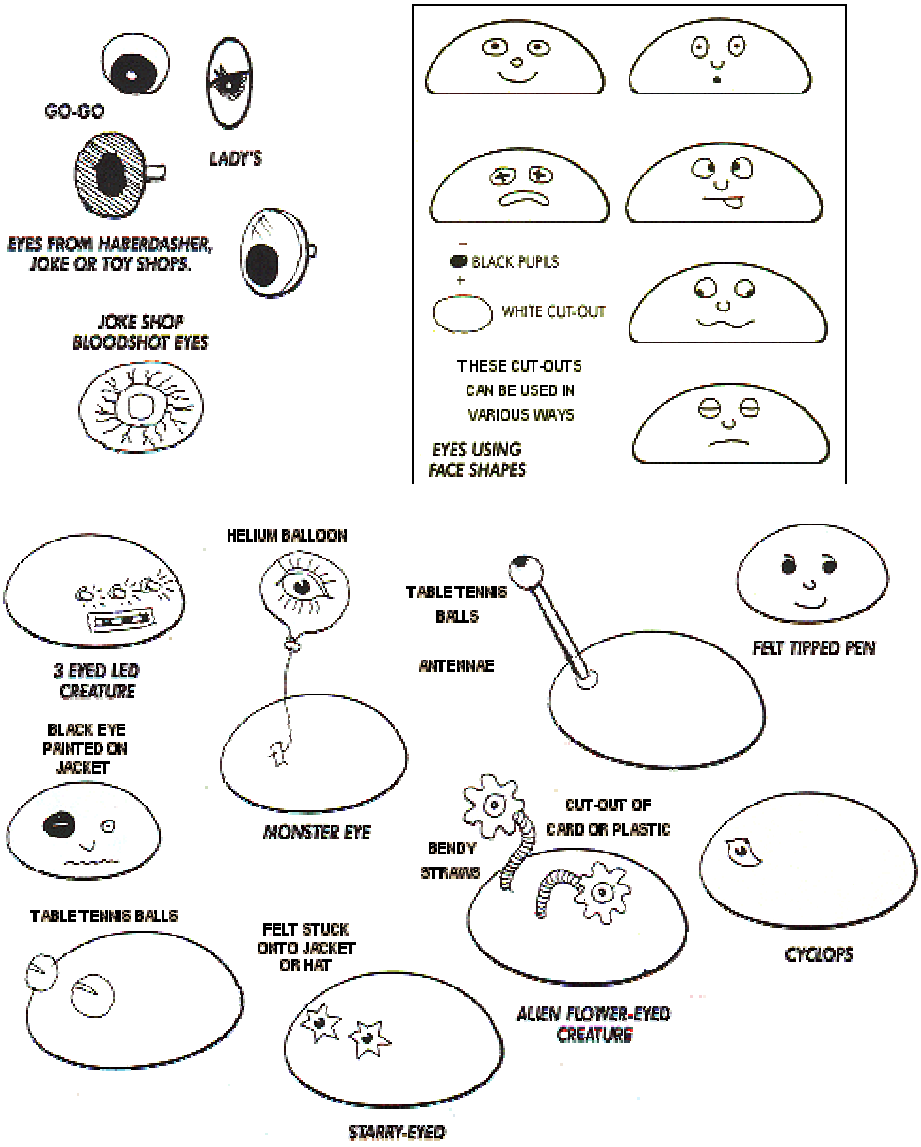
Noses


CARD
PAPIER-MACHE
PLASTIC OR
JOKE SHOP
PLASTICINE
TUBE
FOLDED
CARD
JOKE SHOP OR
OLD VACUUM
CLEANER HOSE
WITH CUT OUT
CARD BACK AND
FRONT SPRAY
PAINTED
JOKE SHOP OR
MODELLED FROM
THEATRICAL PUTTY
CONE AND
PING PONG BALL

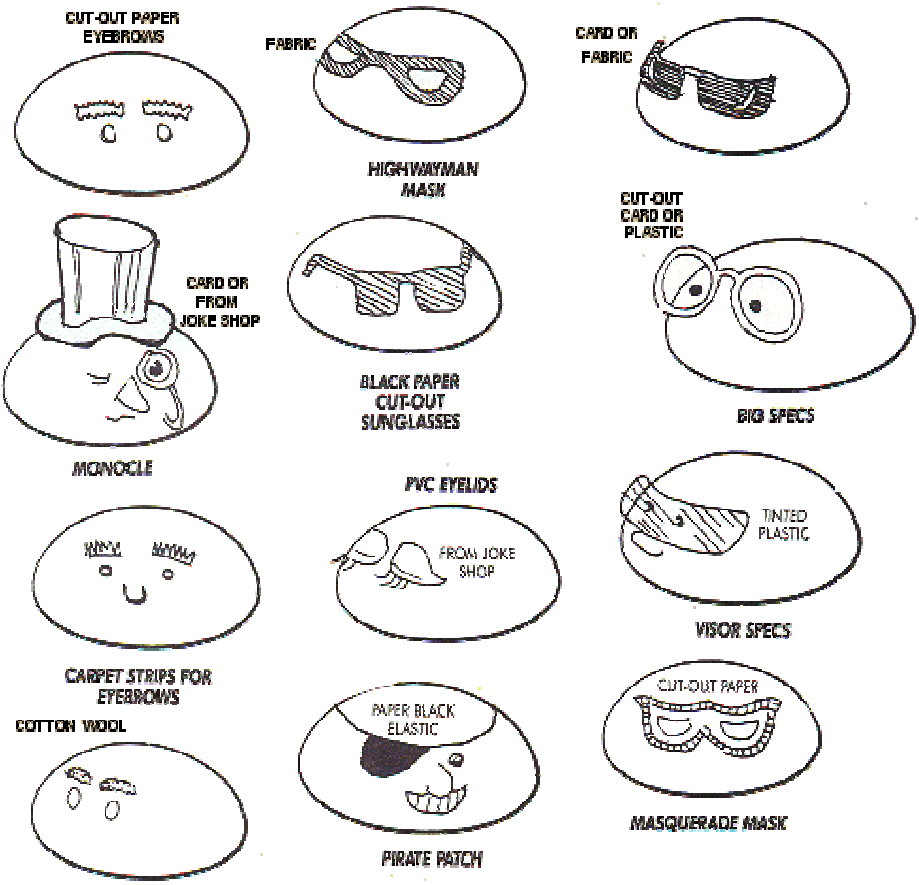

PLASTIC
VACUUM-FORMED
HEMISPHERE
FROM JOKE SHOP

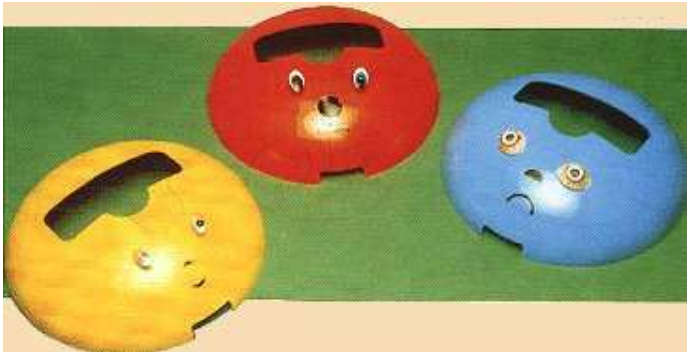
Eyes

Eyes are said to be the windows of the soul. Simple changes affect radically a character's appearance.

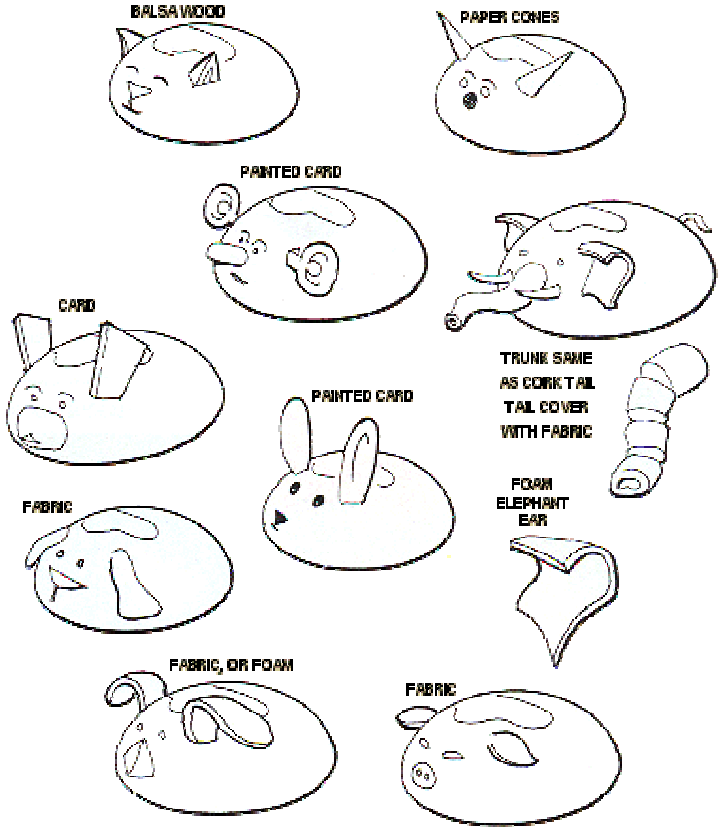


Eye Adornments

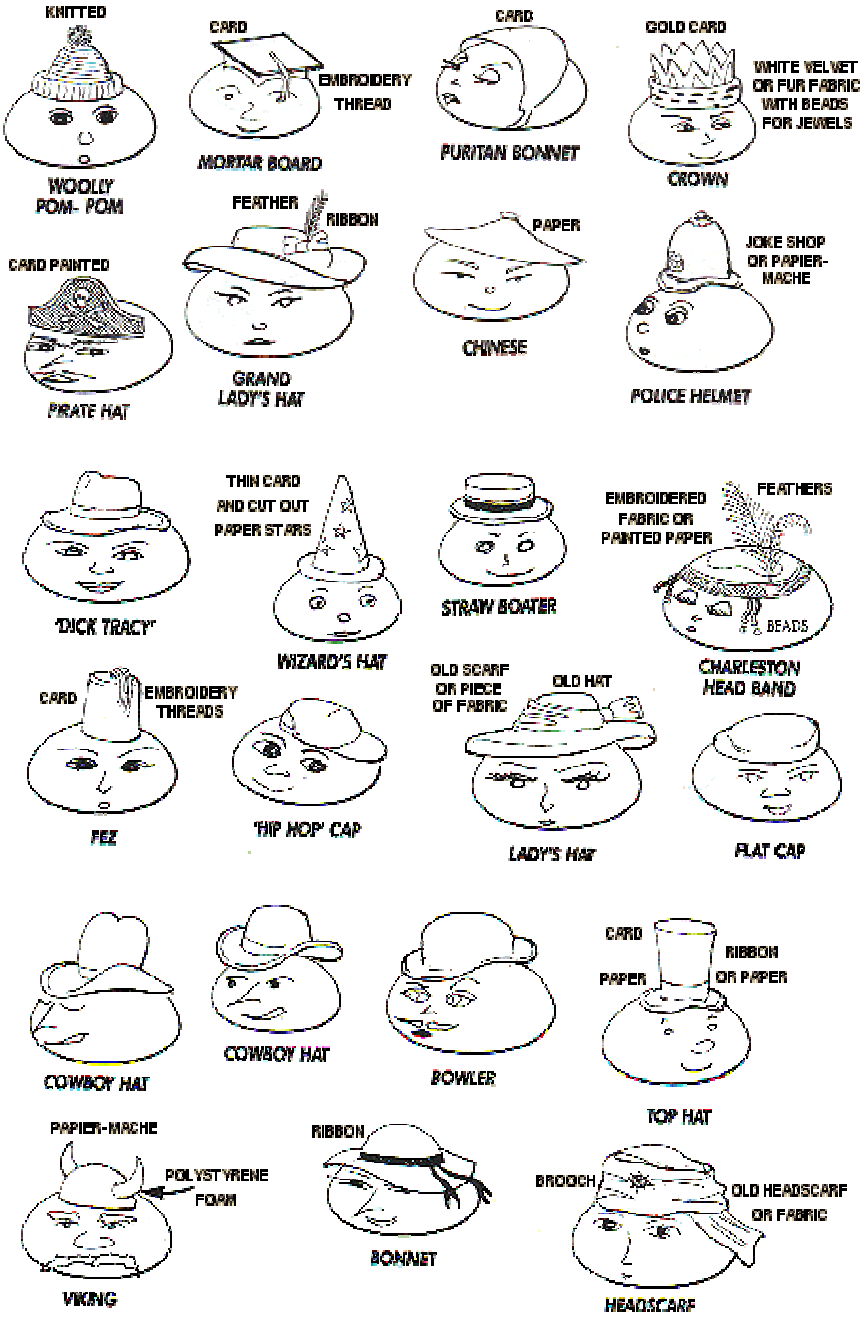




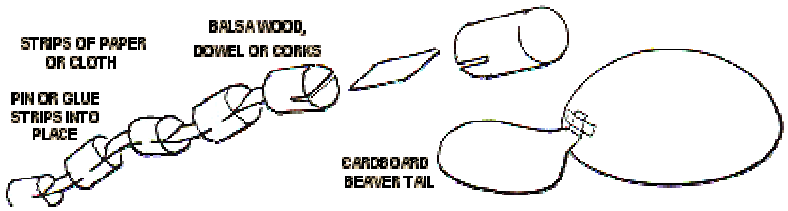
Ears


BALSA WOOD
PAPER CONES
PAINTED CARD
CARD
TRUNK SAME
AS CORK TAIL
TAIL COVER
WITH FABRIC
PAINTED CARD
FOAM
ELEPHANT
EAR
FABRIC
FABRIC, OR FOAM
FABRIC

Hats

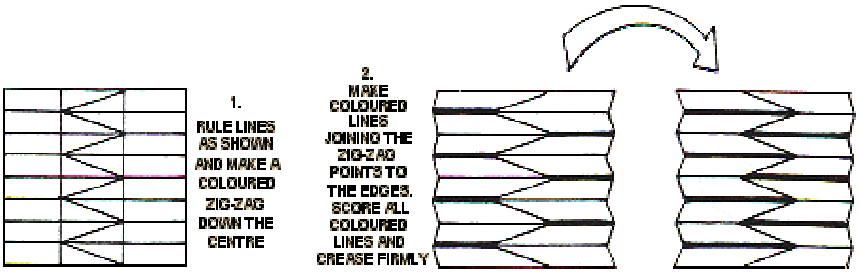

KNITTED
WOOLLY POM- POM
CARD
EMBROIDERY THREAD
MORTAR BOARD
CARD
PURITAN BONNET
GOLD CARD
WHITE VELVET OR FUR FABRIC WITH BEADS FOR JEWELS
CROWN
CARD PAINTED
PIRATE HAT
FEATHER
RIBBON
GRAND LADY'S HAT
PAPER
CHINESE
JOKE SHOP OR PAPIER-MACHE
POLICE HELMET
"DICK TRACY"
THIN CARD AND CUT OUT PAPER STARS
WIZARD'S HAT
STRAW BOATER
EMBROIDERED FABRIC OR PAINTED PAPER
FEATHERS
BEADS
CHARLESTON HEAD BAND
CARD
EMBROIDERY THREADS
FEZ
'HIP HOP' CAP
OLD SCARF OR PIECE OF FABRIC
OLD HAT
LADY'S HAT
FLAT CAP
COWBOY HAT
COWBOY HAT
BOWLER
CARD
PAPER
RIBBON OR PAPER
TOP HAT
PAPIER-MACHE
POLYSTYRENE FOAM
VIKING
RIBBON
BONNET
BROOCH
OLD HEADSCARF OR FABRIC
HEADSCARF

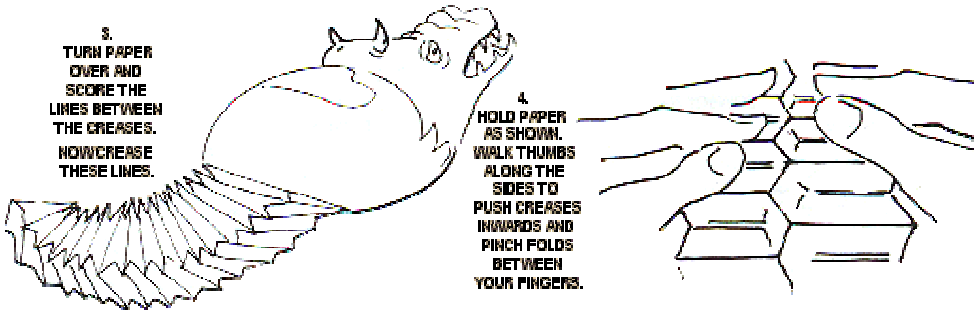
Tails


STRIPS OF PAPER OR CLOTH
BALSA WOOD, DOWEL OR CORKS
PIN OR GLUE STRIPS INTO PLACE
CARDBOARD BEAVER TAIL


FOAM / TABLE TENNIS BALL
LEATHER OR CLOTH STRAP
WOOL POM POM
RIGID ROD OR TUBE

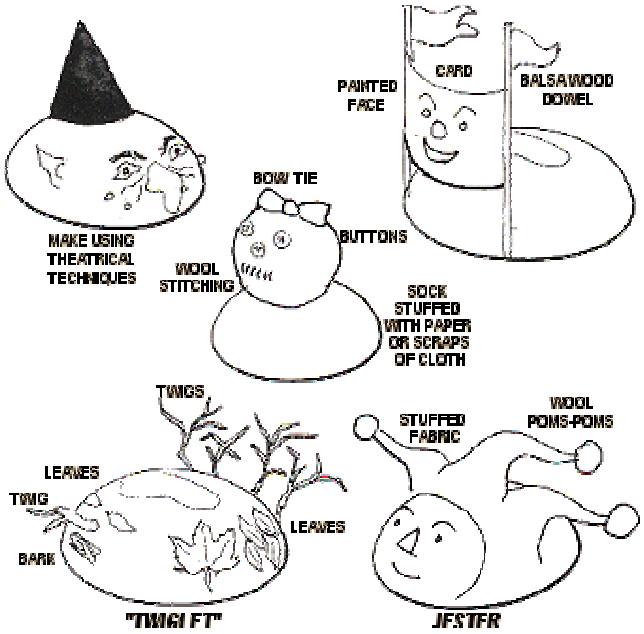

FABRIC SOCK TAIL
FILL WITH PAPER OR CLOTH / WOOL OFF-CUTS
FEATHERS
WEIGHT FASTENED TO TUBE. TAIL WILL WAG WITH MOVEMENT OF ROAMER
RUBBER TUBE
BRACKET


1. RULE LINES AS SHOWN AND MAKE A COLOURED ZIG-ZAG DOWN THE CENTRE
2. MAKE COLOURED LINES JOINING THE ZIG-ZAG POINTS TO THE EDGES. SCORE ALL COLOURED LINES AND CREASE FIRMLY


3. TURN PAPER OVER AND SCORE THE LINES BETWEEN THE CREASES. NOW CREASE THESE LINES.
4. HOLD PAPER AS SHOWN. WALK THUMBS ALONG THE SIDES TO PUSH CREASES INWARDS AND PINCH FOLDS BETWEEN YOUR FINGERS.

Miscellaneous

DESIGNS USING FACES FROM MAGAZINES

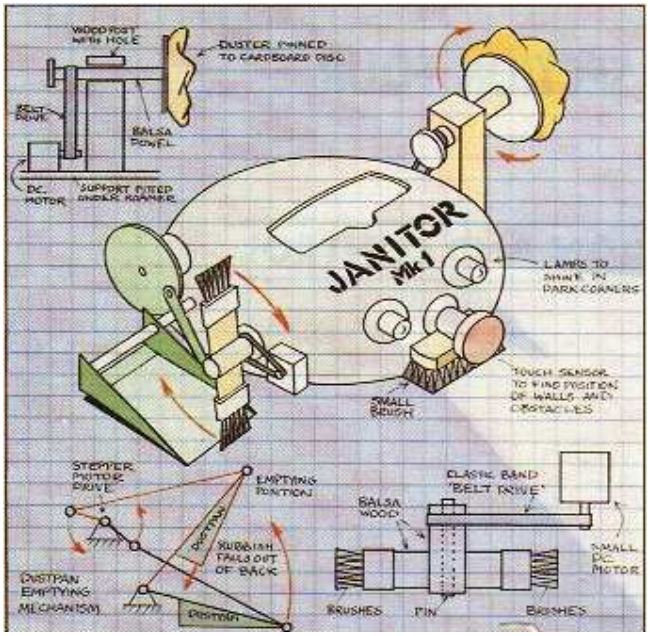


Control and Roamer Design

Control Technology provides many educational opportunities. It offers a subject to study and a general approach to education. With Roamer, Control Technology becomes a natural extension of design work.

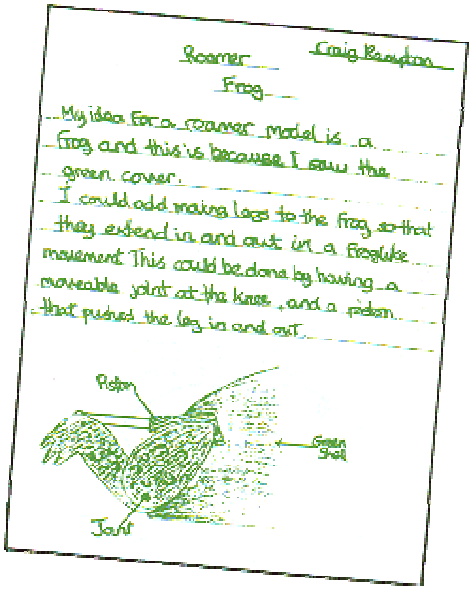
When a child's design ambition extends beyond appearance, Roamer's Control Features offer new levels of design possibilities: the design of a dog's tail that wags, a helicopter's rotor that turns, a car whose headlights turn on when it becomes dark... with Roamer, all these are achievable.

One of the most demanding areas of design is the creation of special effects for movies. Because the context is so unusual, designers cannot rely on 'textbook solutions' nor on precedents. They have to rely instead on their own creative flair and knowledge of technology and design. It is the same with Roamer design work when using Control features. 'Hard-edged' technical problems are often heavily disguised by the 'novelty' and the softness of their appearance. In fact it is in this context that Roamer design work becomes such an excellent design education tool.



Behind the fun image of characters like the Janitor lie challenging problems of technology and design.

Applications can be very basic, like this aeroplane which uses a DC motor to turn each propeller.



Craig Rampton from Portsmouth decided that he wanted to make a frog with legs that would move. The ability to perceive the problem leads naturally to the exploration of Control Technology.

Roamer's Control Features

Roamer's Control Features consist of:

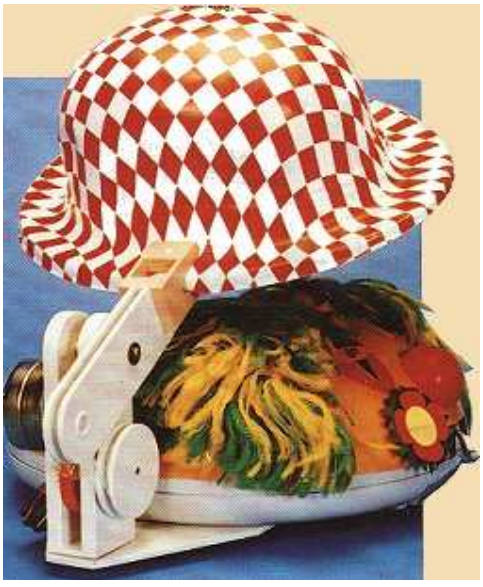
- Four Outputs capable of operating motors, LEDs, lamps ... anything requiring a DC current.
- One Input Line capable of being operated by touch sensors, limit switches, push-buttons, light sensors. sound sensors etc.
- The Roamer also provides a sensor power supply for light sensors etc.

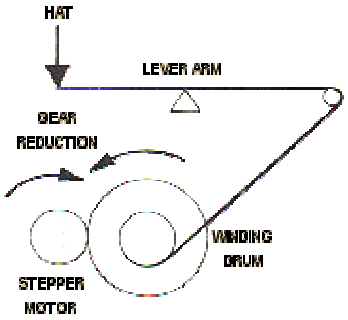
This manual does not attempt to explain the science nor the technology of Control. It does present a way in which Control can be approached through solving practical design problems.

Valiant Roamer Control Packs

Roamer Control Accessories include several packs useful for design activities:

- Light Pack
- Sensor Pack
- Motor Pack

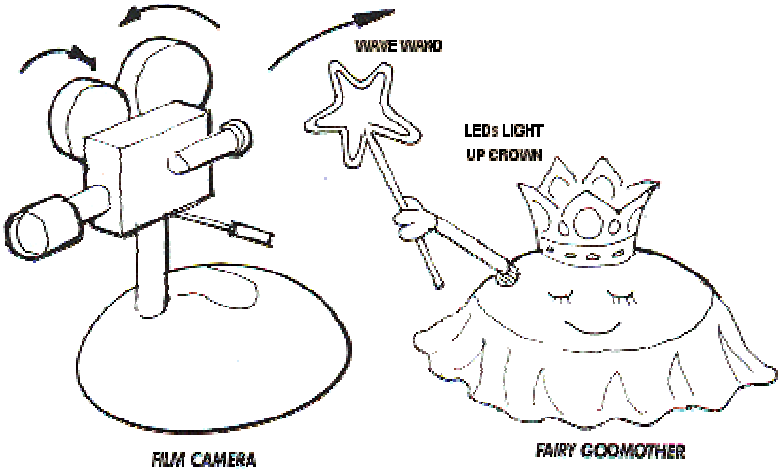


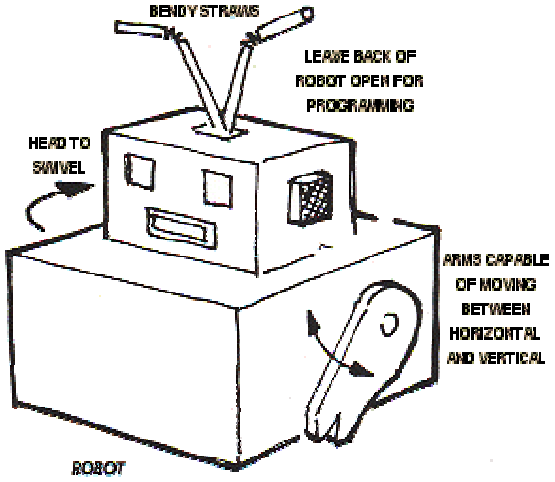


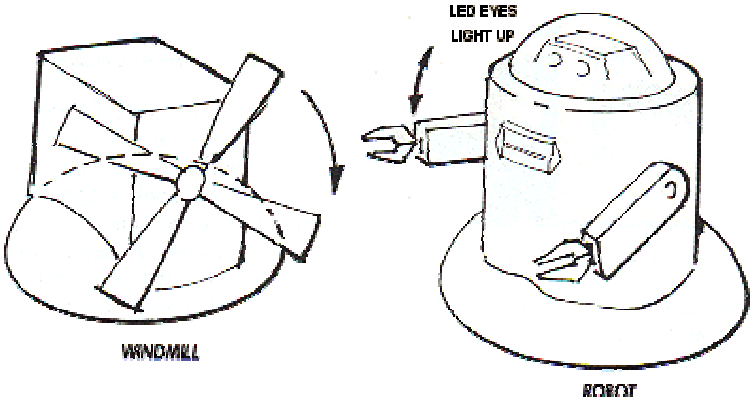
Chuckles the Clown's hat-lifting mechanism is a combination of a simple gearbox, a crane hoist and a lever arm.

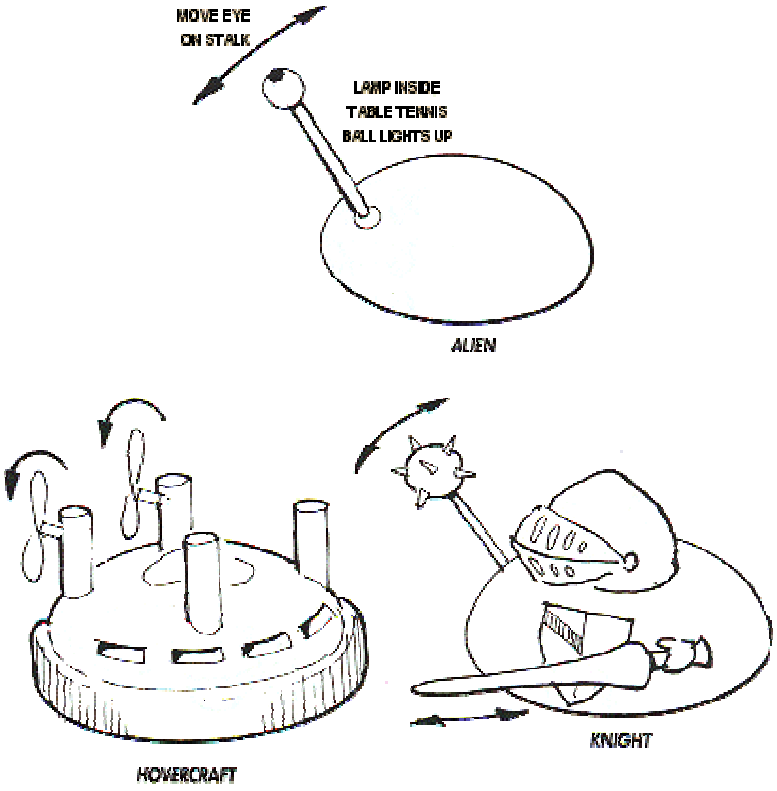
Animation of Visual Designs

Most Roamer characters can be developed from 'visual-only' to 'animated-design' using the Roamer Control features.



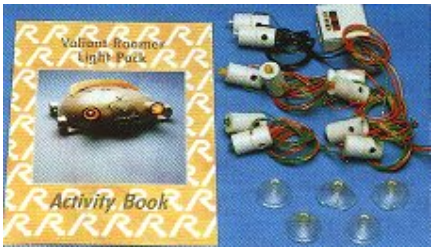






Design Ideas Using Lights

Valiant Roamer Light Pack



The Valiant Light Pack Contains:

- Two Lamps
- Two Red LEDs
- Two Yellow LEDs
- Two Green LEDs
- Two Amber LEDs
- One Flasher Unit
- Five Suction Pads
- One Activity Book

LEDs used with Roamer need to be fitted with series resistors to limit the current. All LEDs in the Roamer Light Pack are fitted with these resistors.

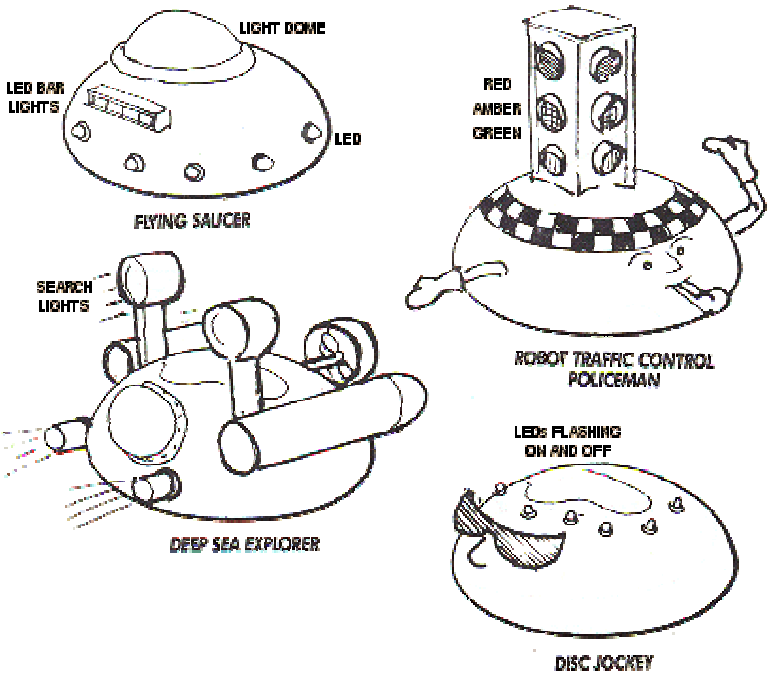
Roamer Lamps and LEDs are fitted into plastic housings that enable them to be attached quickly to the Roamer using the suction pads.

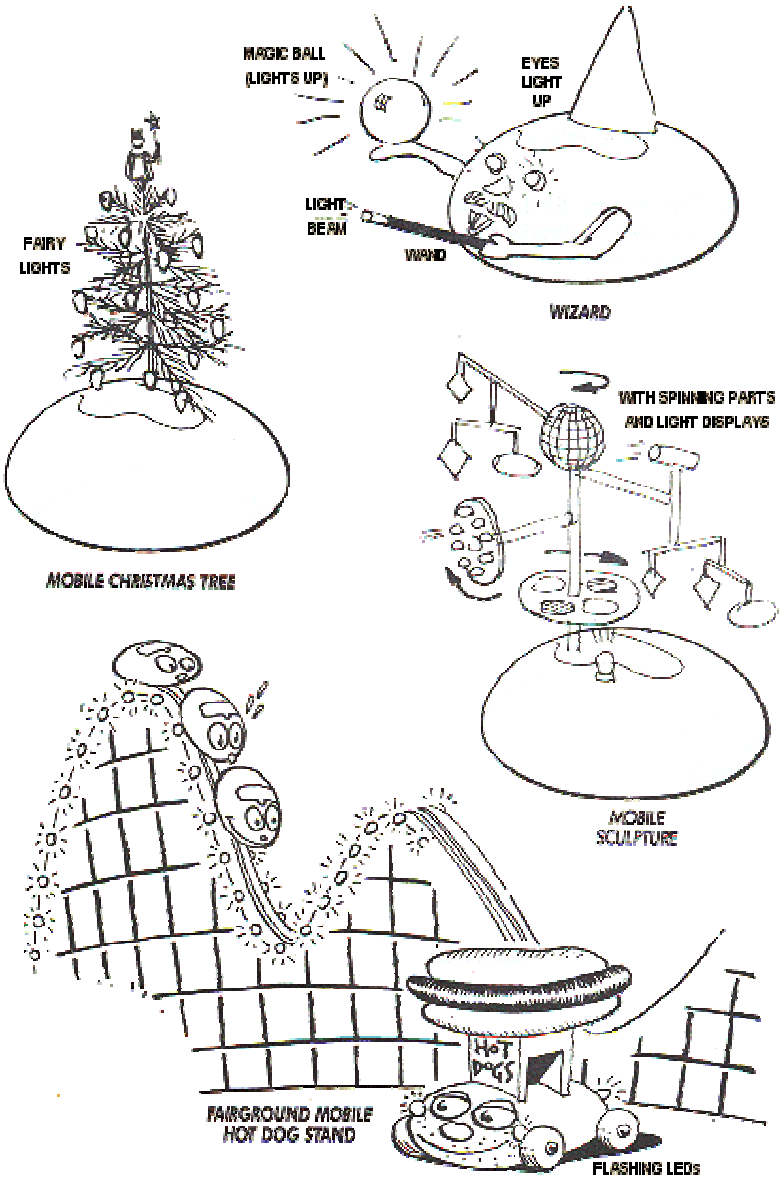
The Activity Book suggests several design activities using Lamps and LEDs. It also contains numerous design ideas.

The items supplied with the Light Pack are fitted with colour-coded wires to simplify connecting to the Roamer Control Box.

The Flasher Unit facilitates the flashing of lights while the Roamer is engaged in some action like playing a tune or moving forward. This is not possible using a REPEAT or WAIT command. The Flasher Unit can flash up to two sets of lights in phase or antiphase.

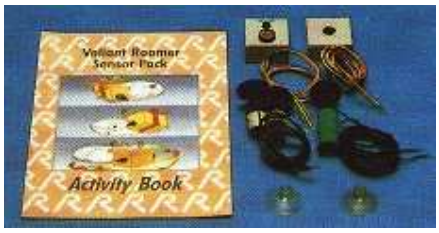
Lights are a simple way to enliven a Roamer character design.


LIGHT DOME
LED BAR LIGHTS
LED
FLYING SAUCER
RED
AMBER
GREEN
ROBOT TRAFFIC CONTROL POLICEMAN
SEARCH LIGHTS
DEEP SEA EXPLORER
LEDs FLASHING ON AND OFF
DISC JOCKEY


MAGIC BALL
(LIGHTS UP)
EYES
LIGHT
UP
LIGHT
BEAM
WAND
WIZARD
FAIRY
LIGHTS
MOBILE CHRISTMAS TREE
WITH SPINNING PARTS
AND LIGHT DISPLAYS
MOBILE
SCULPTURE
HOT
DOGS
FAIRGROUND MOBILE
HOT DOG STAND
FLASHING LEDs

Design Ideas Using Sensors

Valiant Roamer Sensor Pack

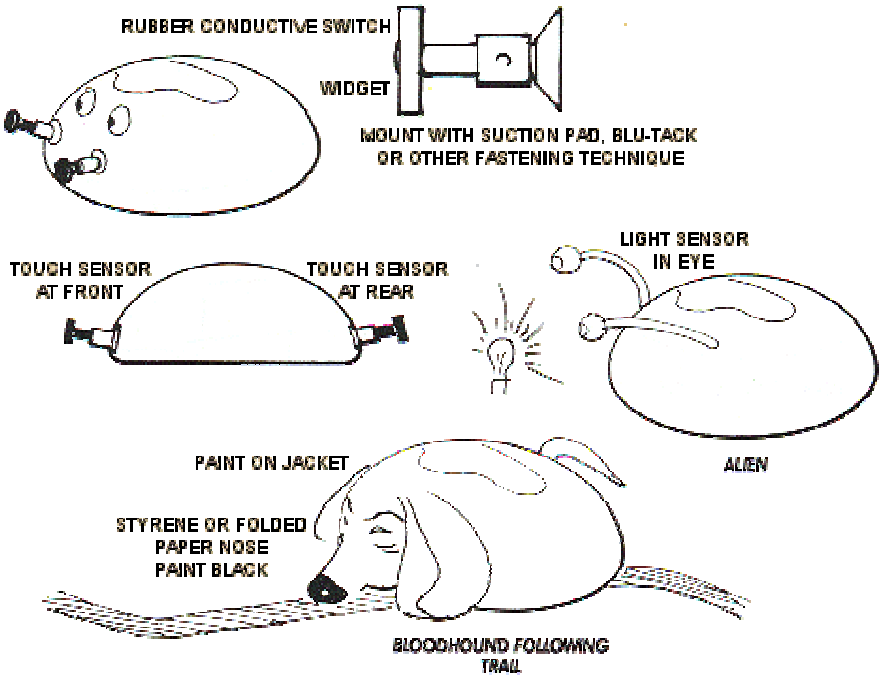


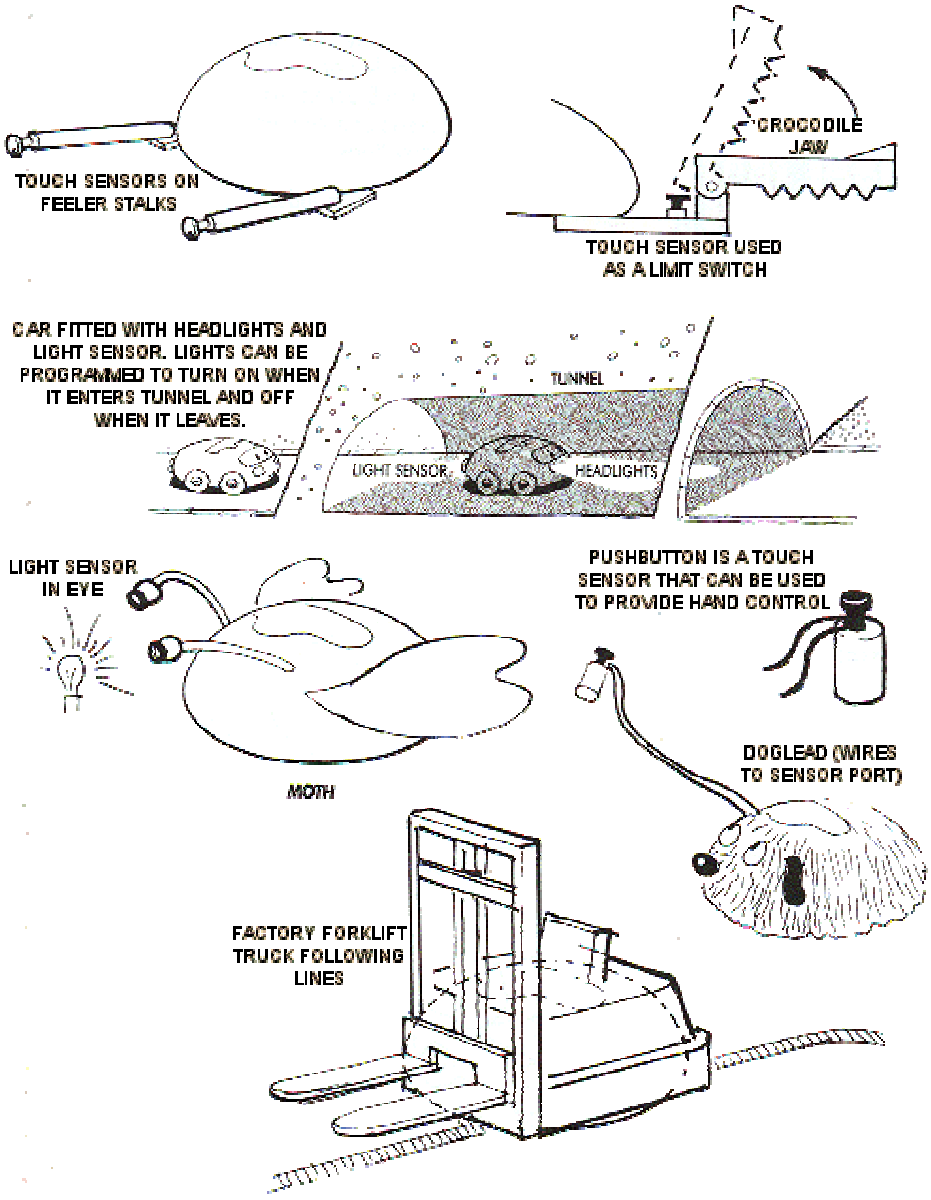
The Valiant Sensor Pack Contains:

- A Light Sensor
- A Sound Sensor
- Two Touch Sensors
- A Pushbutton
- Two Suction Pads
- One Activity Book

Use of sensors in a Roamer design has little effect on the appearance of the robot. It is its behaviour, or interaction with its environment, that is most affected.

The Activity Book includes some activities intended to introduce pupils to the ideas of robotic sensors. It also includes a number of suggestions for using sensors in Roamer designs.


RUBBER CONDUCTIVE SWITCH
WIDGET
MOUNT WITH SUCTION PAD, BLU-TACK
OR OTHER FASTENING TECHNIQUE
TOUCH SENSOR
AT FRONT
TOUCH SENSOR
AT REAR
LIGHT SENSOR
IN EYE
ALIEN
PAINT ON JACKET
STYRENE OR FOLDED
PAPER NOSE
PAINT BLACK
BLOODHOUND FOLLOWING
TRAIL



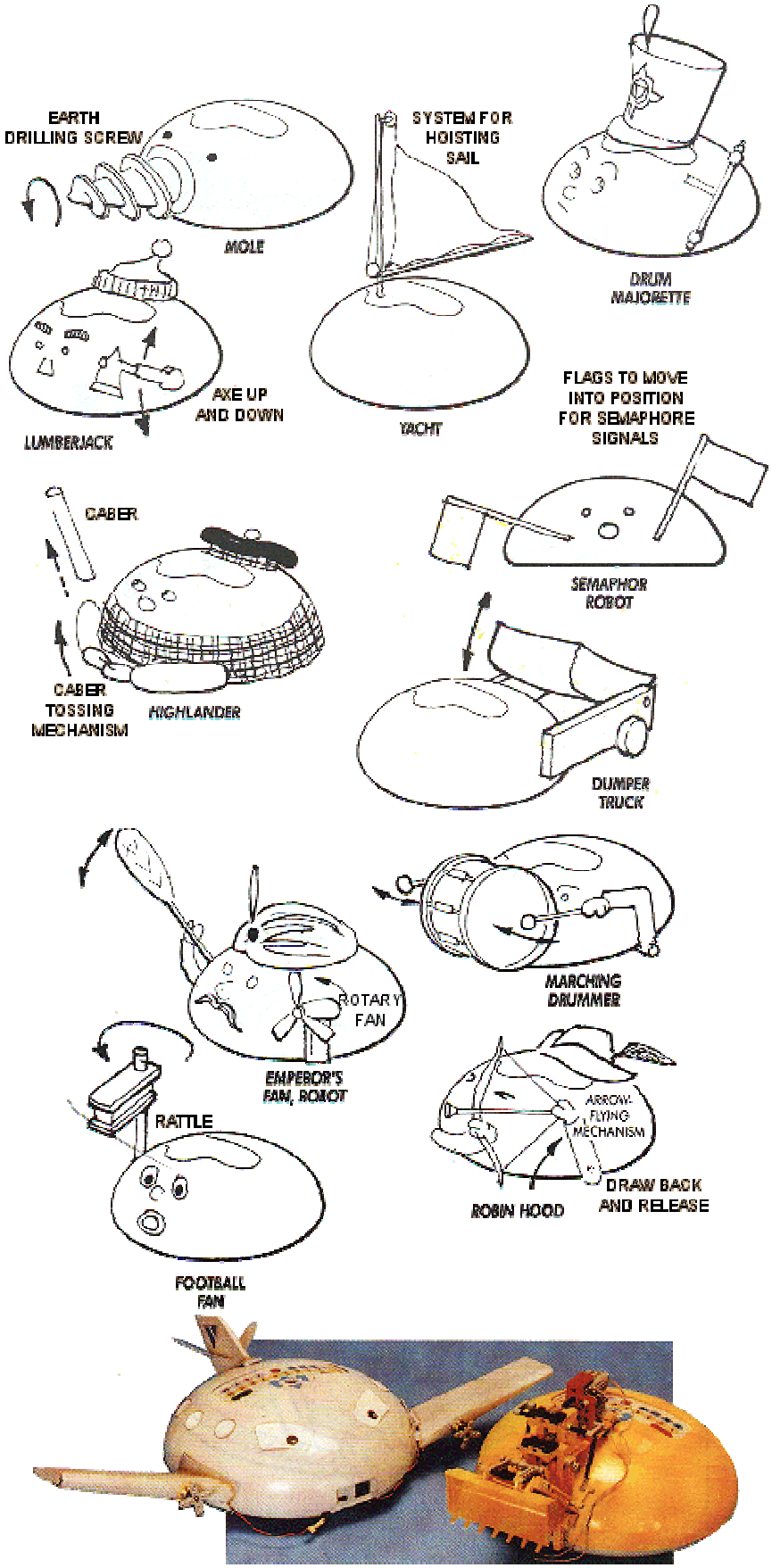
Design Ideas Using Motors

Valiant Roamer Motor Pack

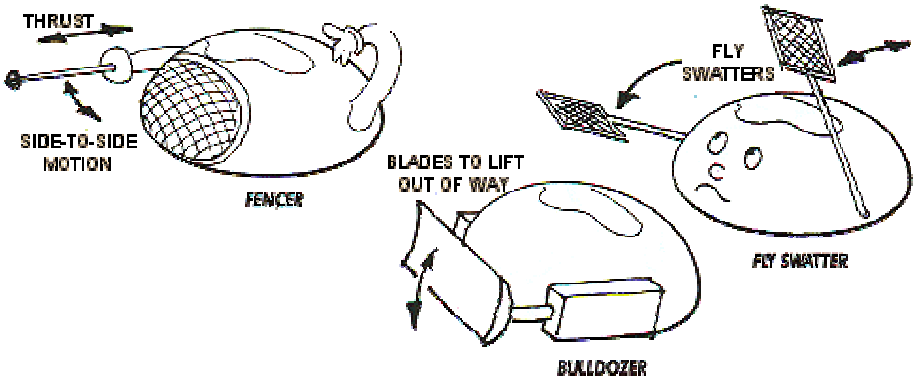
The Valiant Sensor Pack Contains:

- Two High-Quality DC Motors
- One Stepper Motor
- Six Mounting Brackets
- Fixing Screws and Washers
- One Activity Book

The Activity Book includes several activities using both DC and Stepper Motors in Roamer design work.

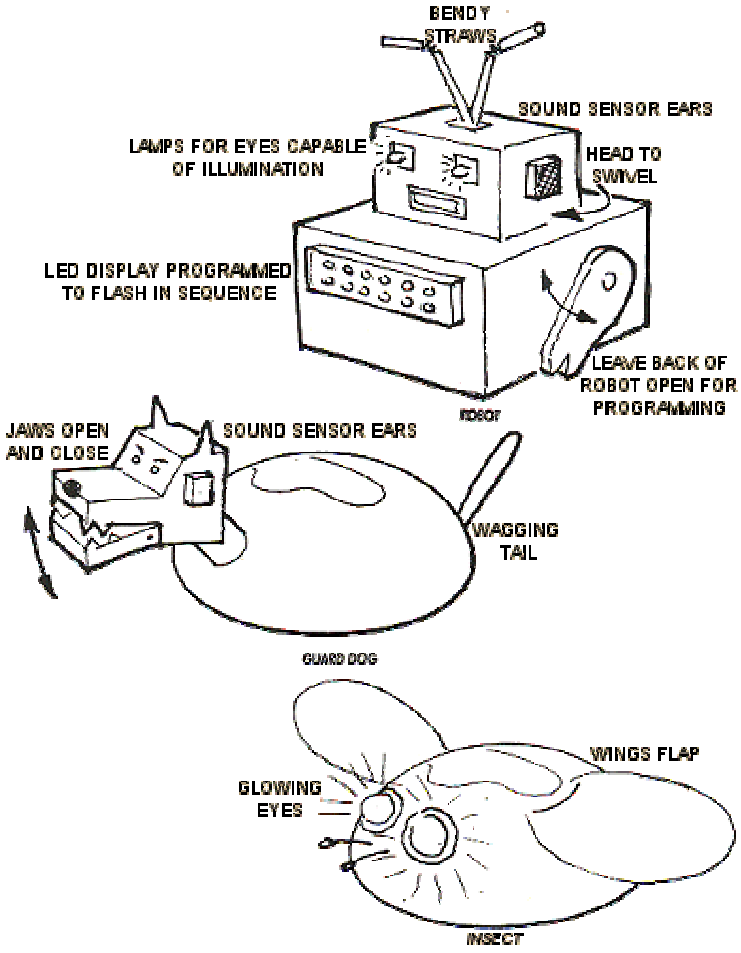

EARTH DRILLING SCREW
MOLE
SYSTEM FOR HOISTING SAIL
DRUM MAJORETTE
AXE UP AND DOWN
LUMBERJACK
YACHT
FLAGS TO MOVE INTO POSITION FOR SEMAPHORE SIGNALS
CABER
SEMAPHOR ROBOT
CABER TOSSING MECHANISM
HIGHLANDER
DUMPER TRUCK
MARCHING DRUMMER
ROTARY FAN
EMPEROR'S FAN, ROBOT
ARROW-FLYING MECHANISM
RATTLE
DRAW BACK AND RELEASE
ROBIN HOOD
FOOTBALL FAN

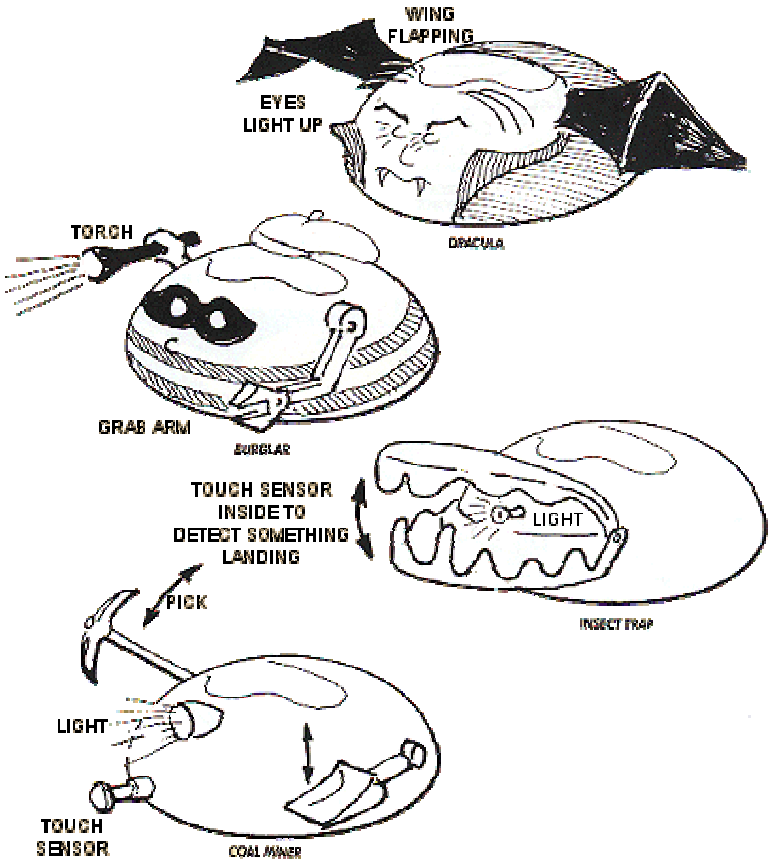
Plane is typical of the animated models made by young children. It uses two DC motors. The lego excavator is a challenge to the abilities of other children.



General Ideas Using Control Technology

Most designs use various combinations of motors, lights and sensors.




WING
FLAPPING
EYES
LIGHT UP
DRACULA
TORCH
GRAB ARM
BURGLAR
TOUCH SENSOR
INSIDE TO
DETECT SOMETHING
LANDING
LIGHT
INSECT TRAP
PICK
LIGHT
TOUCH
SENSOR
COAL MINER

Project Suggestions

This section consists of several suggested design projects. Each has a main theme and a few suggestions on how the idea could be developed. The teacher should adapt these ideas to suit the circumstances.

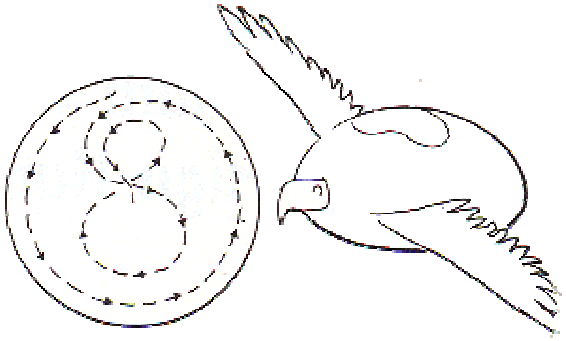
In addition to these ideas the Roamer Activity book and most of the Activity books for the accessories contain ideas and themes suitable for Roamer design projects.

North American Indian Project

Design an Indian and an Indian village.

Program the Roamer to perform the Eagle Dance. What other dances could it perform?

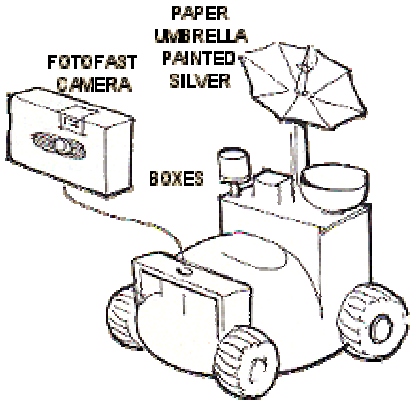
AMERICAN INDIAN DESIGN



EAGLE DANCE COSTUME AND THE STEPS TAKEN BY THE DANCER

Investigate the North American Indian culture. Look at design in their society: houses, tools, clothing, pottery, religious artifacts, weapons, art, musical instruments ... What materials did they use? What inspired their designs? What manufacturing methods did they use?

This type of project can be applied to any culture. It can also have an historical perspective. For example, a Roman project.



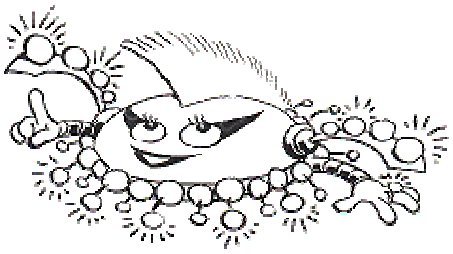
Moon Buggy

Design and build a robot Moon Buggy capable of exploring the surface of new planets. The robot should be able to travel and take photographs of what it sees. Using a disposable camera like Fotofast is one possibility.

The crux of this design is the camera mounting and the mechanism for operating the camera. Another key problem is deciding a strategy for taking photographs of the terrain to ensure maximum information is gathered.

What other features should an explorer robot like a Moon Buggy have?

Alternative character ideas using a camera include paparazzi, newspaper photographers or spies.



Fashion Parade

Design Roamer fashion outfits and organise a fashion show. Modern robotic fashion does not restrict itself to using cloth and some designs even act as extensions to the robot itself.

Program Roamer to 'walk down' a catwalk and move like a fashion model. Select appropriate music for the show.

Roamer Jewellery - Catch That Thief!

Rosie Roamer had just started a new job. Being a forward young Roamer who believed in equal opportunities, she was working on the colonisation project. On her second morning, without thinking, she put on her latest 'Flashing Globe' necklace and matching earrings which had been specially designed for her by her friend Debbie.

Of course, when she arrived at the construction zone and started to change into her weightless overalls, she realised that it was not very suitable for working in and that she would have to take it off.

Unfortunately during the day someone stole it from her space locker. Rosie enlisted the help of Constable Collins to help her get it back. They spotted the thief wearing the jewellery and an exciting chase ensued, which ended with a space jeep crashing.

This project gives plenty of scope both for characterisation and for programming Roamer to act in a variety of different situations and circumstances.

Design a range of jewellery for the Roamer.

Remember the Roamer is a robot - the jewellery could be equally inspired by animal, alien or human. It could even be novel robotic jewellery. Robotic jewellery, for example, could include flashing lights or be made to move!

Explore human jewellery and personal decoration. Look at different cultures and the symbolic meaning behind the designs. Create a mythology behind the central motifs of the Roamer jewellery.

Bus Project

The objective is for the children to design a bus route around an imaginary set of streets and program the Roamer bus to travel the route.

This is an example of a 'system design' problem. Although it is radically different from characterisation, the Design Process still applies. The key to the design is to develop a mathematical model defining the ideal bus route. The Roamer is used to simulate how the bus travels around its route.

The full scope of the project is very sophisticated. However, the teacher can vary the activity to meet the needs of pupils of different age groups and the time available.

1. BASIC PROJECT
    a. The children should place the bus stops where they think they should be.
    b. Make the Roamer into a bus.
    c. Program the bus to travel around the route.
2. INVESTIGATE THE SITE OF BUS STOPS:
    a. Note the positioning of the local bus stops. Are they next to hospitals, schools, factories, etc.
    b. Measure the distance between the local bus stops.
    c. Consider the safety aspects.

    Use the information to position the bus stops.
3. INVESTIGATE MORE ABOUT THE MOVEMENT OF BUSES:
    a. How long do they take to load and unload passengers?
    b. How does this vary with the time of day?
    c. Does it change with location, e.g. bus stop next to old people's home?
    d. What delays will the bus experience because of other traffic, traffic lights, the need to follow the highway code, etc?

    Use the information to program the Roamer bus journey.
4. WORK OUT A BUS TIMETABLE.
    a. Work out a timetable for a single bus route.
    b. Create a large area that requires several bus routes to provide a good service.
    c. Work out the routes and timetables for several buses.

Children of Southmead involved in the simple version of Bus Project.

It may be worthwhile visiting the local bus depot and asking the people there how they design their routes.

Scarecrow

Design a Roamer scarecrow. It need not stand still nor stay quiet. Older children could consider moving arms and flashing lights. How could the birds be repelled?

Rescue Droids

This is an ideal project if there are several Jackets available. The idea can be based on the old television puppet series "Thunderbirds". Each Jacket can be designed as a different type of Rescue Droid with features suitable for an emergency. Other children can write stories and build models of a catastrophe which needs the Rescue Droids to save the day. The "Accident Controller" has to decide which rescue equipment the robot needs and then dispatch it to the scene.

Construction Robots

As for the Rescue Droids, the children can use a set of Jackets to create a range of construction robots. The designs can vary to suit different projects like railway builders, dam builders, power station constructors etc. The idea can be extended to include a set of Demolition Droids or Mining Robots. One idea might situate these robots on another planet, preparing it for Earth colonisation.

Traffic Control Robot

This traffic robot can not only direct traffic with its 'hands' or traffic light system but it can hand out parking tickets, tow away cars, provide street lighting and act as an ambulance in an emergency.

Circus Robots

Design a set of circus robots and program them to perform the greatest show on Earth.

Jungle Droids

Design a set of jungle robots and write stories about their way of life and the adventures they have. Program them to perform the stories.

Character Ideas

Robocop	Detective	Nurse
Chimnet Sweep	Asteroid	Luxury Liner
Rhinoceros	Mouse	Cat
The Mad Hatter	Loch Ness Monster	Film Star
Napoleon	Cowboy	Sumo Wrestler
Roman Centurion	Barber	Ghengis Khan
Greek God/Godess	Ferrari	Dr. Livingstone
Kangaroo	Mobile Home	Viking
Chinese Junk	Gangster	Butler
Town Hall Clock	Gorilla	Joan of Arc
Robot Zoo Animal	Pinball Machine	Guard Dog
Tracker - Hunter	Navigator	Surveyor
Packer	Spy	Hay Bailer
Lancelot	A Queen	A Princess
Mata Hari	Boadicea	Lawrence of Arabia
Cleopatra	A Traffic Warden	Snow White
Girl Guide		