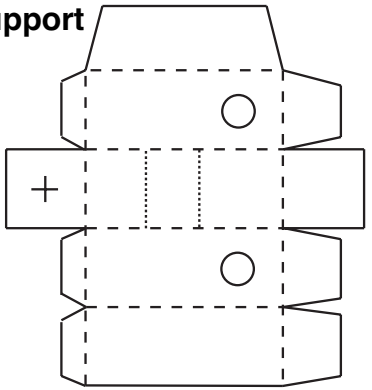
CRANKS

TEMPLATE

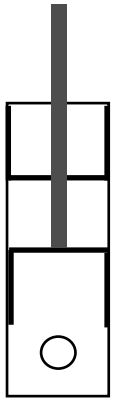
This net template can be assembled using the same instructions as the earlier example on pages 23 & 24. The crank assembly instructions are on page 35.



Bottom Panel

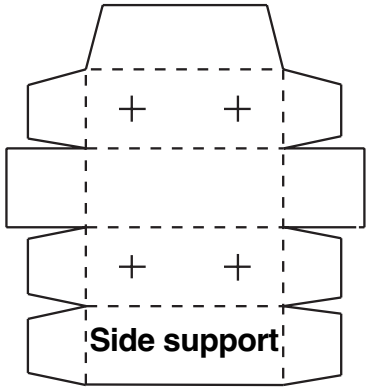
Top Panel

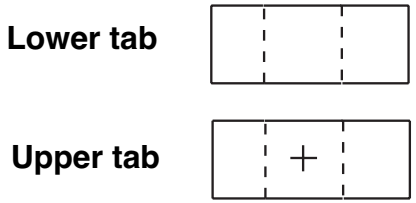
The two tabs are folded into a U shape. Note the upper tab lines up with the top of the support. The con-rod goes through it and rests on the lower tab.

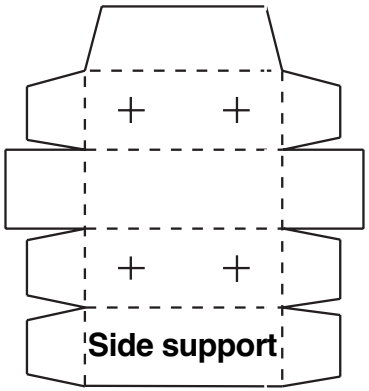


Side Panel

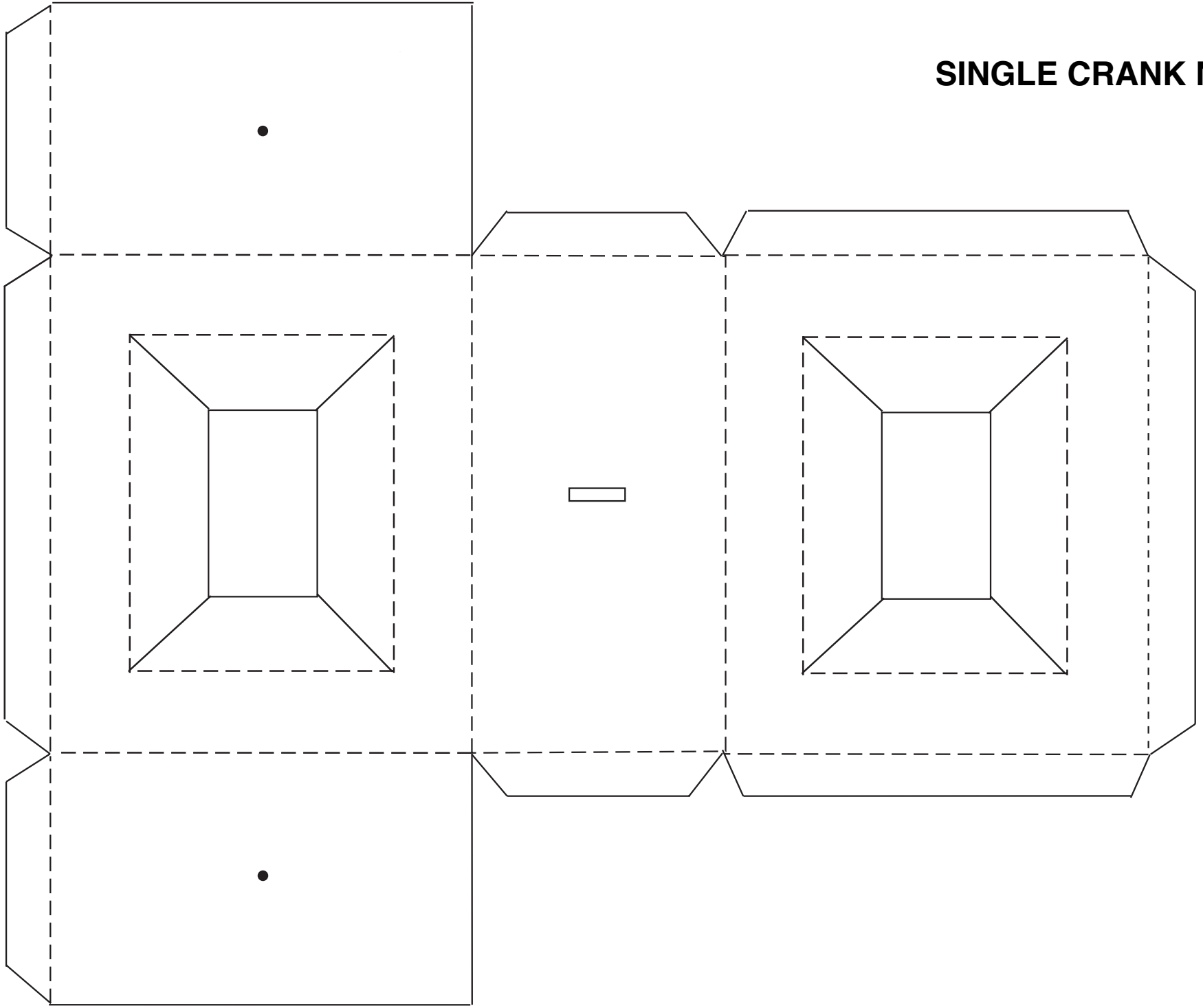
Side Panel



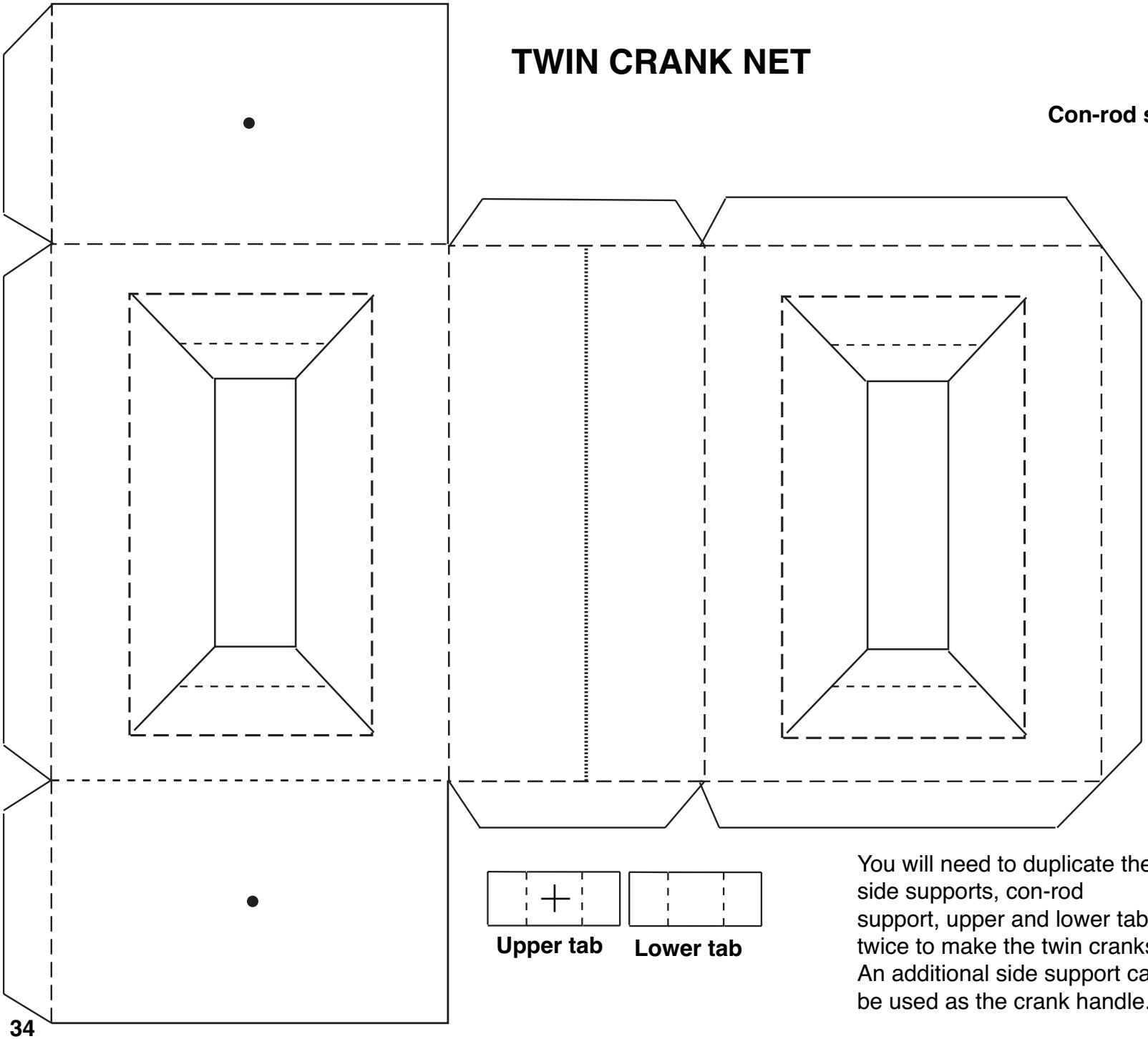




SINGLE CRANK NET

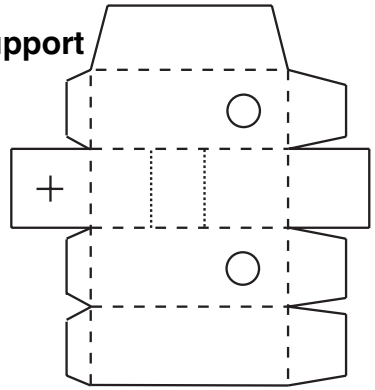


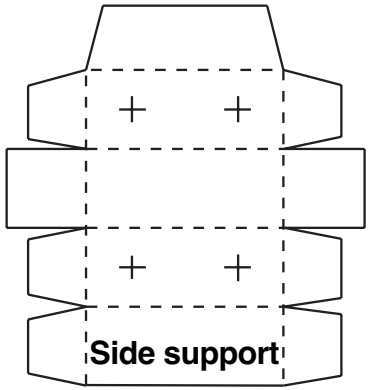
TWIN CRANK NET



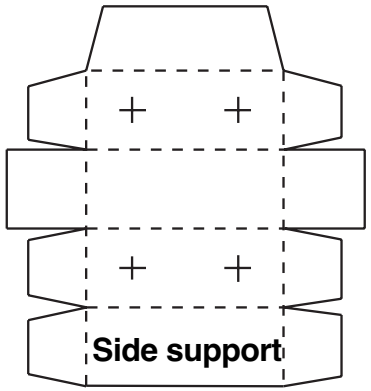
Upper tab Lower tab

Con-rod support





Side support



Side support

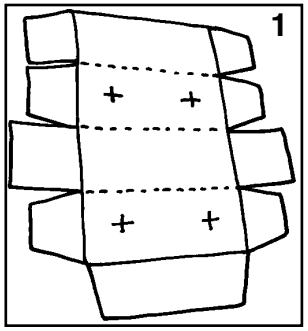
You will need to duplicate the side supports, con-rod support, upper and lower tabs twice to make the twin cranks. An additional side support can be used as the crank handle.

CRANKS

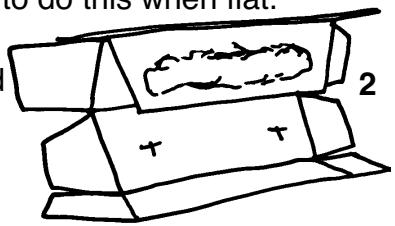
INSTRUCTIONS

This template makes up a twin cam set-up illustrated on page 31. The actual crank is fairly simple to make and all shafts are wooden barbecue sticks about 3mm thick.

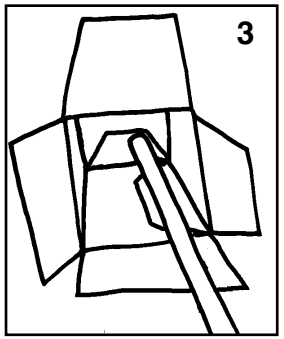
This mechanism relies on a good, strong bond, made using UHU or similar adhesive. Always allow all parts at least 12 hours to dry before putting any strain on them.

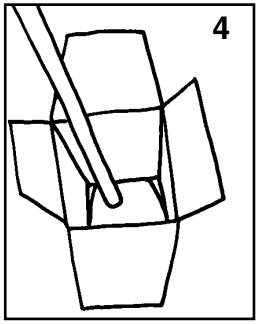


(1)Cut out the two crank supports, make sure you cut through the 4 crosses. This is where the crack shafts will be going. It is much easier to do this when flat.

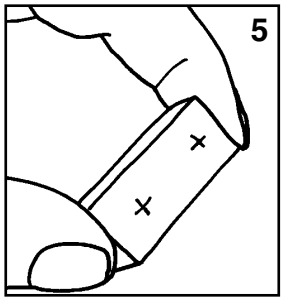


(2)Glue the end tab to make up a rectangular shape.

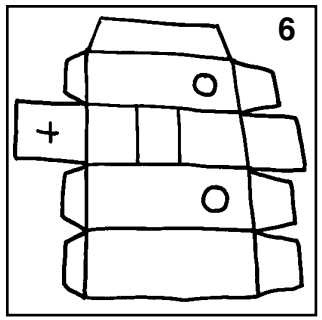




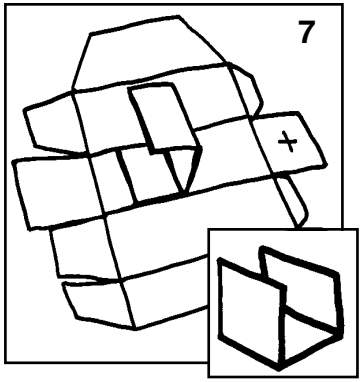
(3)-(4) Use a barbecue stick to put pressure on the tab and press it flat. This will help it to glue faster and stronger. Fold the tabs at one end, glue and use the stick to apply pressure.



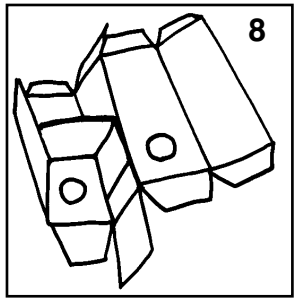
(5) You now need to glue the tabs at the other end. The trick is to fold them “outward” in the opposite direction. Then push them back and apply the glue. The tabs will now be trying to spring back and will push against your fingers as they dry. Repeat this for the other crank support.



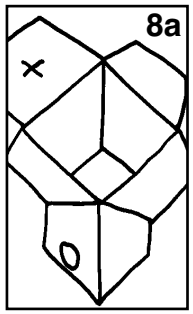
(6) Cut out the crank slider. Remember to cut the crosses and the circles.

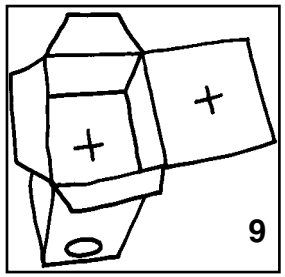


(7) There are 2 lines marked on the inside. Glue the first stop tab (this is the one without a cross) to the lower line nearest the two holes.

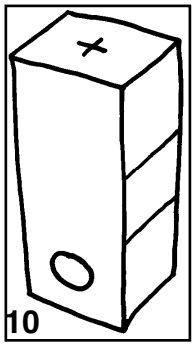


(8) Now fold over the sides and glue the other side of the tab. You will have to fold the lower end tabs as per step (3)-(4). Keep the top end open.

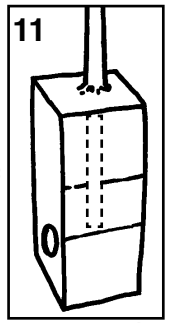




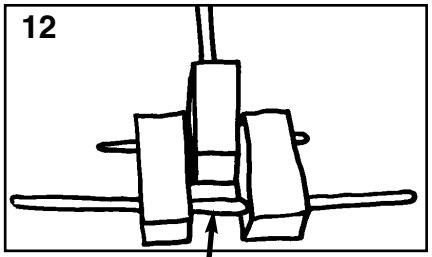
(9) The box now needs to have the second inner tab fitted. This one has a cross on it, which will need cutting. You need to glue the 2 sides and align them with the mark in the box.



(10) Bend the tabs outwards like in step (5) to complete the crank, which should now look like this.



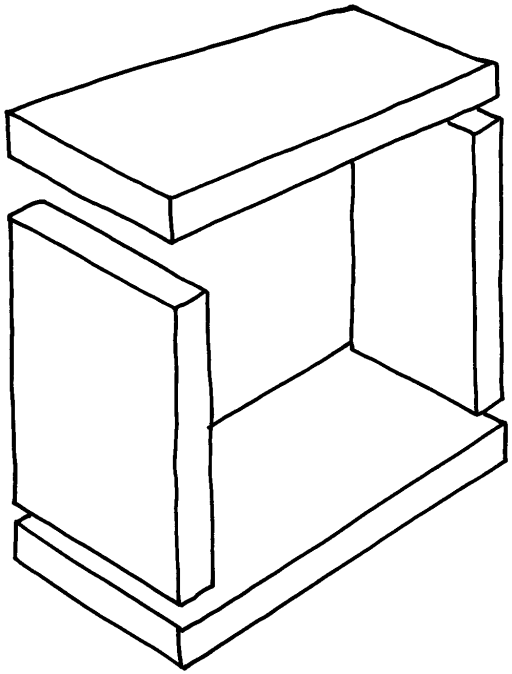
(11) You now need to apply glue to the lower part of a length of barbecue stick. Push it through the top and inner tab stopping at the lower tab. A bit of glue around the top will give extra strength.



(12) Finally join up all the pieces. Make the crank in one piece and let it dry. You can then cut out the extra drive shaft when the glue is dry. This part is covered more thoroughly on page 75.

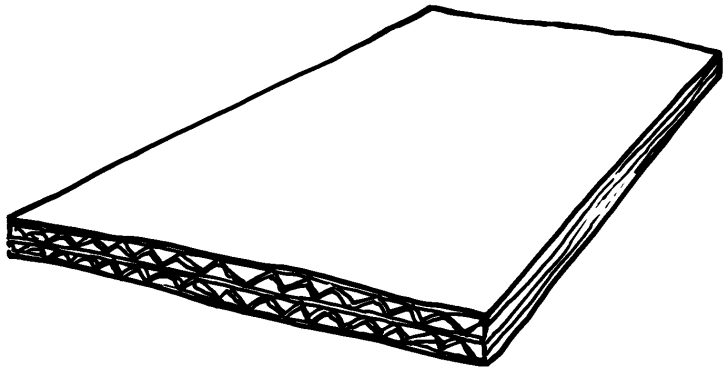
CONSTRUCTION TECHNIQUES

An open sided box is an ideal housing for automata mechanisms and is simple to make. You will need to work out the length and depth needed, then construct it from card. Alternatively, you could make use of existing things such as cereal boxes. Recycling offers the opportunity to be very creative with household rubbish. You can make art and help save the environment at the same time.

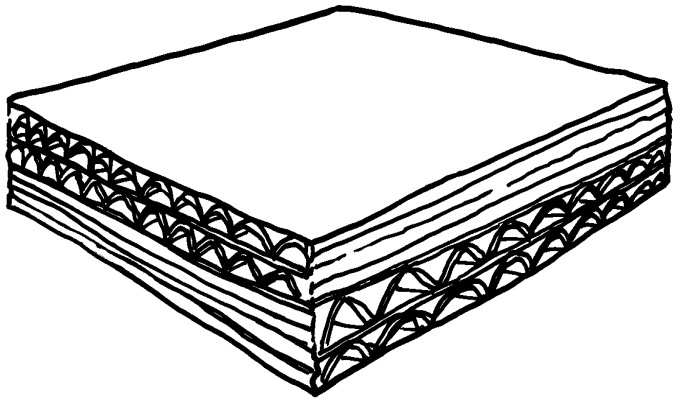


A simple four sided box makes an ideal housing for automaton mechanisms. You can make them from a range of materials such as cardboard or wood.

Corrugated card is an excellent material to work with. It is readily available and has a good residual strength. It is also easy to make holes in and bonds well when glued. Fruit boxes, computer boxes, in fact, anything designed to carry a heavy weight is usually made from thick, strong cardboard and is the best type to use as it is constructed with several layers or laminates. You can make super strong card by gluing two or more thinner pieces of corrugated card together. Placing them at 90^0 will add more strength. Put a weight evenly spaced on top while the glue dries. You can then cut it to the required size. This should be done by an adult using a steel rule and sharp knife. Children can then make and glue it together. Always make your drive shaft holes prior to gluing the box. It is a lot easier done flat, also they line up better if done simultaneously.

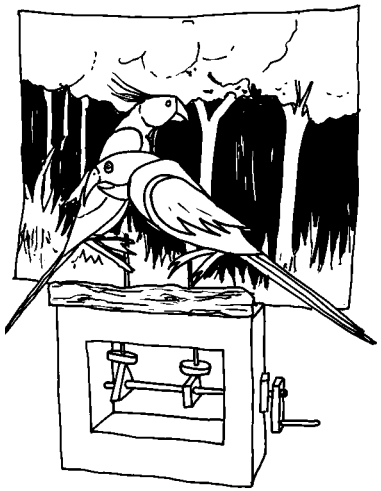


Good quality, strong corrugated card is made up from several layers or laminates.



You can make your own strong card by laminating two or more thinner pieces at 90^0 to each other. This makes a cheap and effective base to make automata housing and parts from.

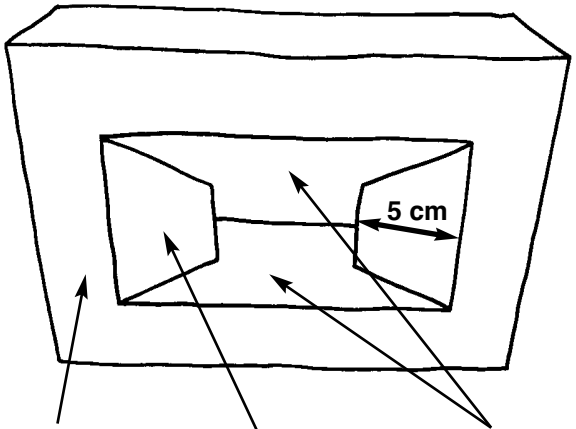
Cereal boxes make good housings. If cut correctly there will be little waste and they can be structurally strengthened. It also promotes recycling and they are free!



The housing and backdrop for this automaton was a cereal box.

CONSTRUCTION TECHNIQUES

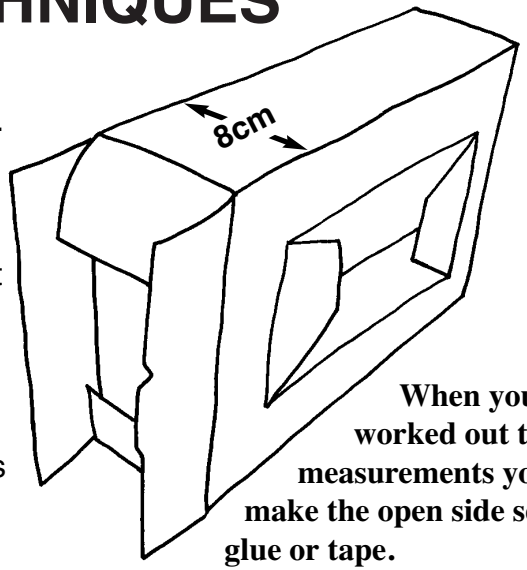
To make the housing you first need to measure your cereal box and work out a few dimensions. In this example the box has been turned on it's side. The inner shape and flap folds have been drawn on both sides. The basic side shapes were achieved by eye, look for a proportion that gives a good working size yet keeps the box strong. The inner side flaps were drawn with extra length for gluing. The depth of the box was 8cm so the flaps were drawn to 5cm each. This gives an overlap to glue. The same applies for the top and bottom flaps. You will notice the side flaps are much bigger. This is because the drive shaft will be running through them so they need to be strong.



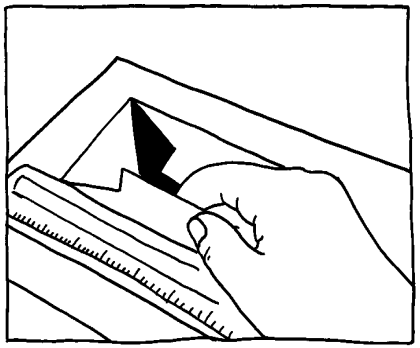
Side shape is equidistant all round.

The side flaps are measured so that they will overlap when folded, an extra 1cm was added.

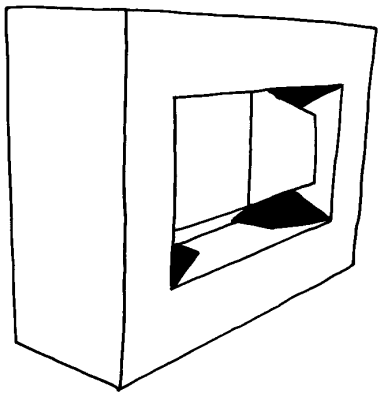
The top and bottom flaps should also overlap.



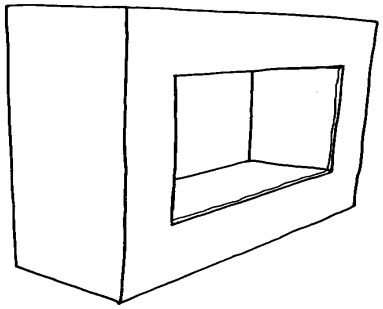
When you have worked out the measurements you need to make the open side secure using glue or tape.



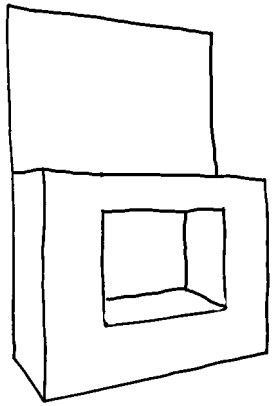
Next cut out the flaps. They can be folded in more easily if they are first folded outwards. Using a ruler helps fold them in a straight line.



The final box should be quite strong when the flaps are glued or taped into position.



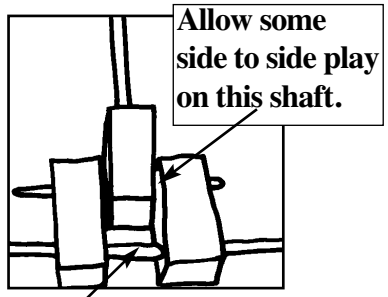
Extra card panels can be stuck on top of the flaps to give even greater support and strength.



By cutting and folding the box on it's base you can use the complete back panel to create a back-drop for the automaton. The front panel is used to create the top.

CRANK SHAFTS

It is advisable to make crank shafts in one long length. When the glue is completely dry, saw off the unwanted parts with a fine junior hacksaw blade. This helps keep everything in position. Extra glue can be added to give more strength on the cut parts. Twin cranks can only successfully be made this way.



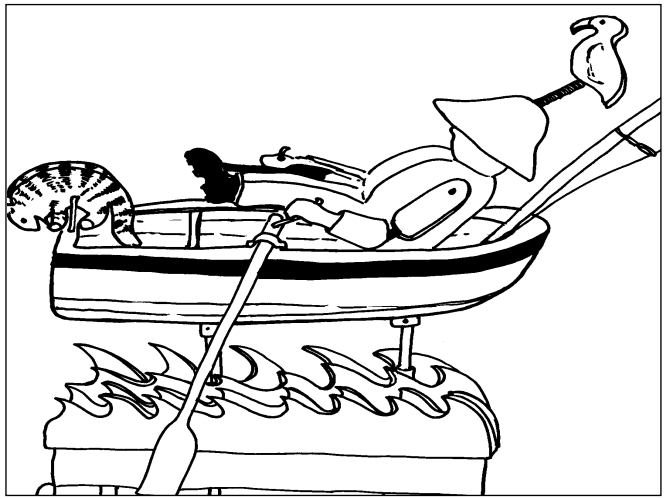
This part will need to be removed when the glue is dry. A blob of glue can be added to the ends for extra strength. Allow a little play at the crank follower end so that it can clear the lower supports.

CONSTRUCTION TECHNIQUES

CAMS, GEARS and FIGURES

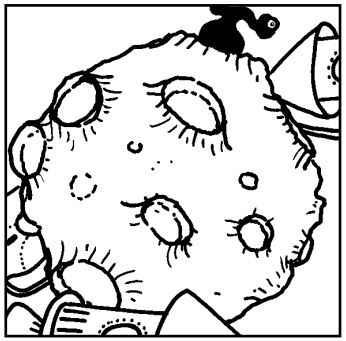
Probably the best materials to use are the pre-cut card circles that are available in a range of sizes, usually with a 5mm centre hole. They can be cut to shape and even sanded. They are very stiff and strong and are highly recommended for use in the D&T classroom.

If using MDF make sure that you wear a mask as it produces a very fine dust when sanded or cut.



More complicated figures can be made from modelling clay then painted with neat PVA glue, finally a topcoat of paint mixed with PVA will give a good finish. The PVA makes the figures very strong and sets the shape. This technique allows quite complicated figures to be modelled and is strong enough to make moving, jointed figures like the one above.

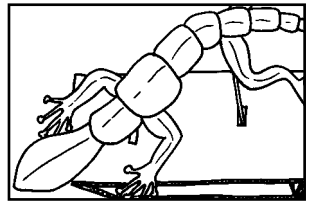
Paper mache is another good modelling material as it produces a lightweight, strong finish. It can be a little more difficult to make realistic figures with but is excellent for simple shapes. The planet for the space ride was made with papier mache.



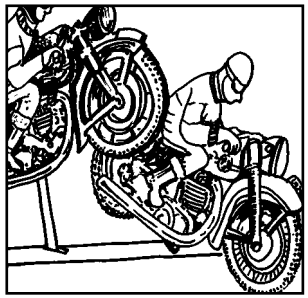
Paper pulp is another cheap and effective material. Paper is put in a blender with a quantity of water, then pulped down. When reasonably fine yet still sightly lumpy it can be strained and then used to model with, squeezing the desired character into shape. It is a bit messy and takes a few days to dry out but the results are great. A little PVA glue can be added to the pulp mix to help it to bond. Various parts can be made and then glued together. Again, it works best with simple shapes, although you can achieve a surprising amount of detail. The leopard in the"Jungle Jimmy" automaton was made entirely from paper pulp.

Origami offers another solution for making things, from animals to people. It takes a bit of practice to achieve good results.

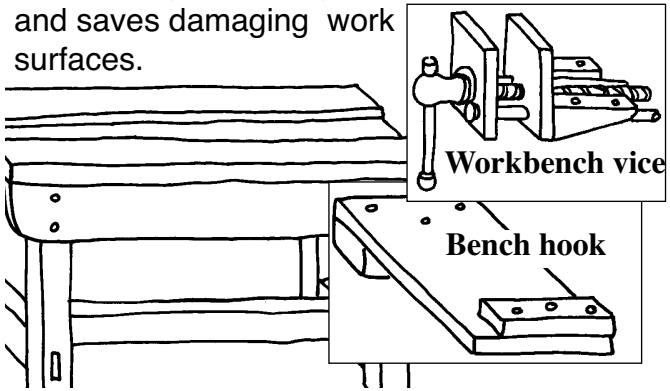
Coloured card is another good material to work with as it is both flexible and strong. Many of the automata creatures in this book were made with card. "Larry the lizard' is a good example of card being used to construct a creature.



Photocopying pictures and drawings, then colouring them in or taking prints from a computer are all good ways of achieving the desired end result. These images can be stuck to stiff card to give them strength.



If you are cutting wood then make sure that you always cut away from yourself and hold the work squarely in a vice or bench hook. Card and paper are best cut on a "cutting mat". This is made of semi hard plastic that heals up after cutting. It prolongs the life of the blade and saves damaging work surfaces.



CONSTRUCTION TECHNIQUES

GLUING

There are a number of different glues available that work well for various requirements.

Wood to wood, cardboard or paper

Wood glue is a great all round adhesive. It dries clear and sets fairly quickly. Paper and card are wood in origin, so it works well with them. There are many different brands on the market . They all seem to do a good job and are readily accessible from most hardware stores and schools suppliers. If you can find it, professional wood working glue (which is often yellow, and sometimes referred to as aliphatic resin) gives excellent results. There is a range from America which is non-toxic and safe for classroom work.

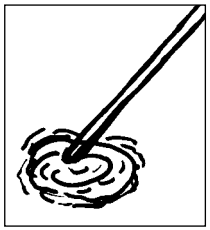
Wood or metal

A two-part epoxy resin is very useful as it dries in about 10 minutes and sets clear. You mix two equal parts thoroughly. When first mixed, the glue is fairly runny. As it begins to set, it gradually becomes stiffer until it eventually starts hardening, When stiff, you can place it on the objects that need bonding. Be watchful, as the glue turns very quickly from stiff to set. Give yourself enough time to work, and only mix up as much glue as you need at a time.

Warning: Two-part epoxy resin glues contain harmful chemicals. They should be used with care, and if you get any on your skin, wash immediately with soap and water. Do not allow children to use it.

Two-part epoxy resin glue is incredibly strong, dries quickly and sticks most things. It works very well on metal and wood, and is an invaluable aid to the automata maker.

It should only ever be used by an adult. It is the perfect glue for sticking things that require a lot of strength.



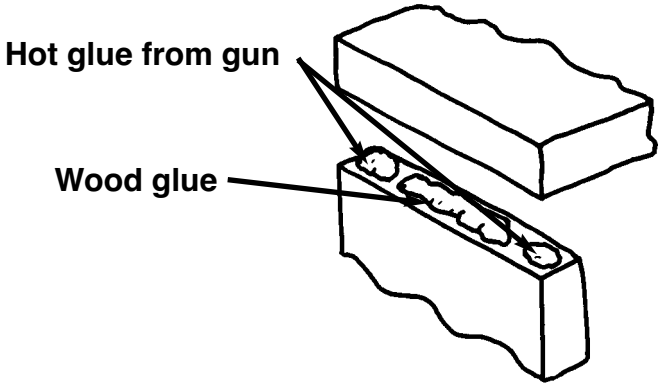
The secret to using epoxy glues, is to mix both parts thoroughly and in even amounts. (Always follow the manufacturer's guidelines).

Glue guns

Glue guns are very useful. They use sticks of ordinary or wood working glue. Be warned the glue is very hot when it comes out and burns, if touched. This also applies to the cool melt guns which supposedly run at a lower temperature. However, it does cool quickly. It will bond most materials together, although it does not form such a strong bond as wood glue or epoxy resin.

You do not have much control over the spread of glue, so a trigger type of gun is recommended. This enables you to control the flow of glue and can be operated with one hand. A glue gun will work on metal, wood, card and paper.

A handy tip for using glue (to make a base for example) is to put a few spots of glue down with the glue gun and then use traditional wood glue or PVA. The hot glue will dry in about a minute and hold the work whilst the glue sets in about 15 - 20 minutes. This will avoid you having to clamp the work.

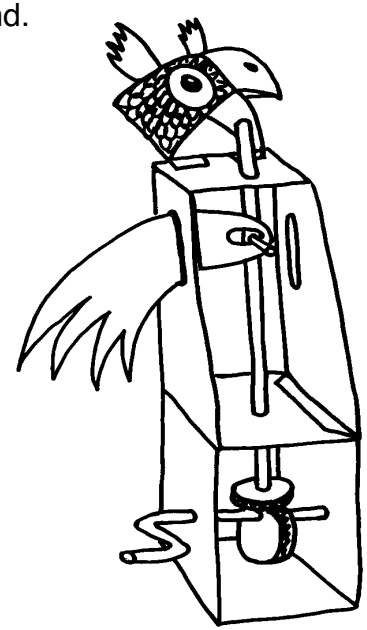


A cool-melt glue gun with trigger.

CONSTRUCTION TECHNIQUES

Paper and card glues

Wood glue is excellent for bonding paper and card but may not suitable for children to use (check the label for a safety warning). PVA glue is a good alternative. It takes a little longer to dry, but is relatively harmless and safe for young people to work with under supervision. All-purpose adhesive is excellent in it's solvent base form. It dries very quickly and makes a strong bond, but this is not suitable for children. However there are solvent-free, all purpose glues available that children can use. They dry fast and produce a strong bond.



If you are working with card or paper then there are several glues you can use that are safe and solvent-free. You could also use sticky tape.

Keeping the cost down is always a problem. PVA glue is used because it is relatively cheap and will wash out of clothes. It is also non-toxic (I wouldn't want to put that claim to the test). All these factors make it an obvious choice but there are a few drawbacks. It is water based so often cockles paper and thin card. It takes quite a long time to dry and finally it is not very strong. Whilst it will suffice for about 80% of gluing jobs, you should consider using specialist, stronger glues for work that need more strength or a quicker drying time. Some of these, like solvent free UHU, can be used safely by children. This type of glue has a very fast setting time or "grab time". For example, if the class were making the cat from the net on page 19. They could cut out and glue most parts within a two hour session. Because UHU holds within 15 to 30 seconds (full setting is about one hour) the parts can be assembled fairly rapidly. PVA just can't match this as its grab or sticking time is about 3 minutes. Setting time is about 3 hours. Whilst this is fine for many applications it does slow things down. There are also some wood glues that dry very fast, with a strong bond and are certified non-toxic. It's worth exploring some alternatives that will help save time in the classroom or to salvage work where parts needs extra strength. Finally, glue sticks like prit-stick are very useful they produce a good strong bond on paper and card, instantly.

Painting and Finishes

The final finish of any automaton can have a tremendous affect on how it looks. Working with coloured card is an alternative to painting. It comes in various weights and colours and can give a very uniform, professional look.

Painting poses a few problems, water based paints will swell paper or card fibres. This can cause moving parts to stick and not move properly. Too thick an application can also stop parts from moving freely. Acrylic paints give the best overall finish and flatness of colour but are expensive. You can add PVA glue to poster paints. This will help them flow a little better as well as leaving the dried paint with a gloss finish. An alternative is to use felt tipped pens, again these are water based and although fine for small areas are not practical on larger areas.

Another alternative is to produce work on the computer and get a colour print. This can then be stuck down with a glue stick, like prit-stick, which will not cockle the paper and gives a very strong bond.

Children enjoy painting and colouring. It is an important area of the project and should be considered as part of the design process.This could be used as a classroom activity, investigating paint finishes by producing test strips.