Before watching TV became the main leisure activity of most Western households in the 1950s and '60s, many books were published that contained a comprehensive variety of activities for the enterprising family to do in the home; anything from building your own billiards table or shortwave radio receiver, to learning esoteric card games or staging an amateur dramatics production. If the illustrations were to be believed, all you needed to succeed were a neatly knotted tie or a pearl necklace and a cheery smile.

These books often contained many wonderful puzzles, models, games and tricks, all made by folding and cutting paper. Some of these paper ideas have survived into modern times, but many – sadly – have been forgotten.

This book brings together classics from that bygone time, with little-known cut-and-fold classics from the worlds of puzzling, magic, topology, origami and graphic design, all chosen for their special ability to amaze and amuse. A few designs were adapted or created especially for the book.

The addition of texts, photographs and illustrations transforms these superb paper constructions into ideal promotional giveaways. They provide a great way to describe a new product or service, market yourself, promote a sale or simply say 'Happy New Year' to present and future clients and customers. Some constructions in the book need no additional surface graphics to carry your message, but can be played with or have some useful function. Whatever your needs, there is certain to be something in this book that you can use to promote you or yours.

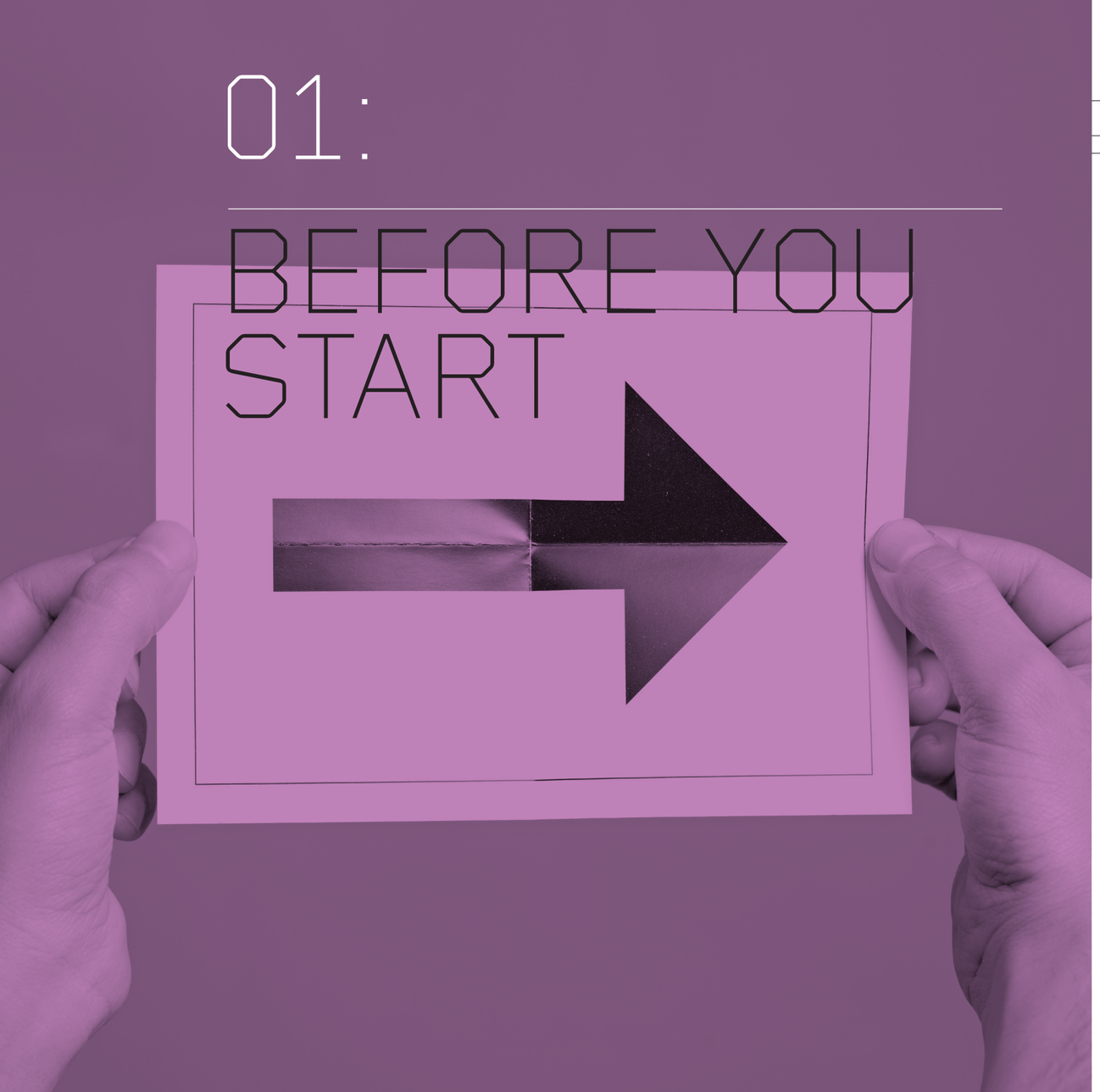
Everything can be mass-produced using conventional die-cutting and printing technologies, or can be made in small numbers in the studio or at home, using graphic design software and a printer. Many of them will fold flat for easy mailing and transform into three-dimensions when opened.

Today we are bombarded with visual information and it can be difficult to make our message stand out. By using these smart, witty and above all memorable cut-and-fold paper constructions, you give yourself a better chance to be heard and for your message to be remembered.

Paul Jackson

01:

BEFORE YOU START



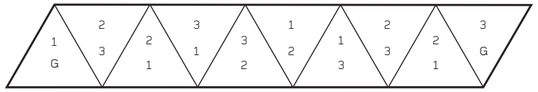
1.1 How to Use the Book

Almost everything in the book is interactive. That is: almost everything will open, close, collapse, turn inside out, change shape or need assembling. These interactions and movements are very difficult to show on the printed page, so if something takes your fancy, but you are uncertain from the drawings and photos how it will move or perform, you are strongly recommended to make it and then to play with it. Don't dismiss something too hastily because you didn't understand every subtlety and nuance from the static, two-dimensional instructions on the page. Trust that the designs have been chosen for their elegance and ingenuity (they have, they have!) and enjoy discovering them as much when they are in your hands, as when they were on the page. Many of the designs are a total delight – mini masterpieces of paper engineering – but they need to be *made* to be enjoyed.

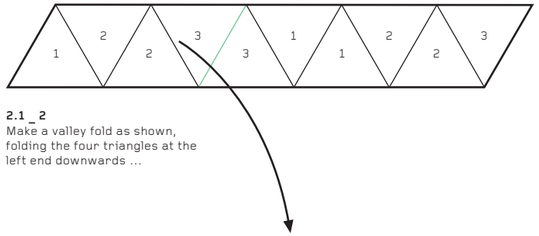
Due to lack of space, some of the more esoteric manipulations buried deep within some of the designs are not explained. So, when you have made something, experiment with it by folding it this way and that, by doing the opposite (however you interpret that) to what you are instructed, add extra material here and there and generally play with it as though you have never seen it before and don't know what it is supposed to do. Your experiments will be well rewarded.

2.1 Tri-hexaflexagon

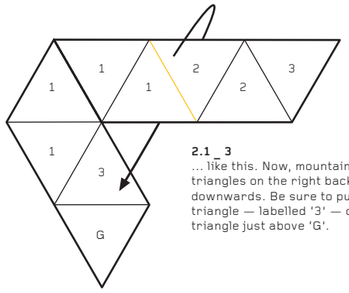
This is the classic, original flexagon, created in 1939 by Arthur Stone, a British-born graduate student of mathematics at Harvard University. Although simple to construct, the permutations of its flexing patterns are fascinating and complex. If you are new to flexagons, start here.



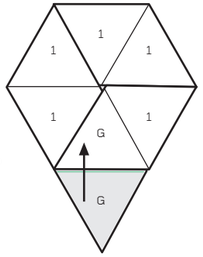
2.1 _ 1
Make a paper strip of ten equilateral triangles (all the angles are 60 degrees). The side length of each triangle should be 4–5cm. Each triangle shows two numbers. Write the top number on the front of the triangle in which it is written and the bottom number on the reverse side of the same triangle. 'G' means 'Glue'.



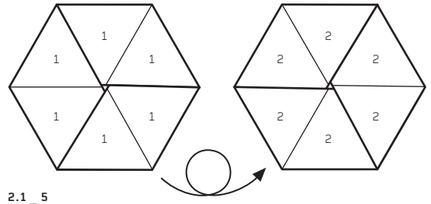
2.1 _ 2
Make a valley fold as shown, folding the four triangles at the left end downwards …



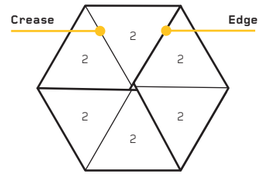
2.1 _ 3
… like this. Now, mountain fold the three triangles on the right backwards and downwards. Be sure to put the end triangle — labelled '3' — on top of the '3' triangle just above 'G'.



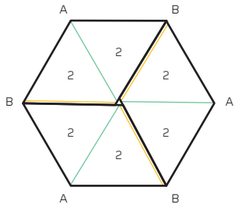
2.1 _ 4
Note how no '3' triangles are visible and the paper strip is loosely locked together. Glue the lower 'G' triangle and fold it onto the upper 'G', sticking them together. This will lock the paper into an endless hexagonal strip (the strip is called a Möbius strip).



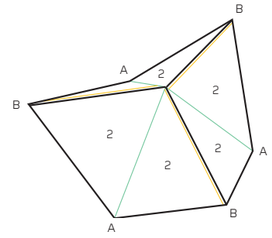
2.1 _ 5
The front face has six number 1s. The back face has six number 2s. If you have another configuration of numbers, check that you have numbered and folded the strip correctly.



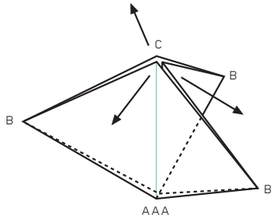
2.1 _ 6
On the 2s side, notice how the six lines that radiate from the centre like the spokes of a bicycle wheel are alternately an edge, then a crease, then an edge, then a crease, then an edge, then a crease, then an edge, then a crease, then an edge, then finally a crease. Every other edge is a crease and every other edge is a fold.



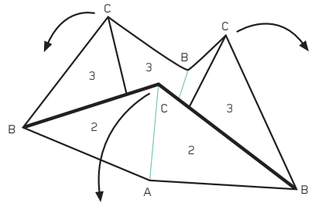
2.1 _ 7
Along every crease (A), make a valley fold. Along every edge (B), make a mountain fold. The hexagon will become three dimensional …



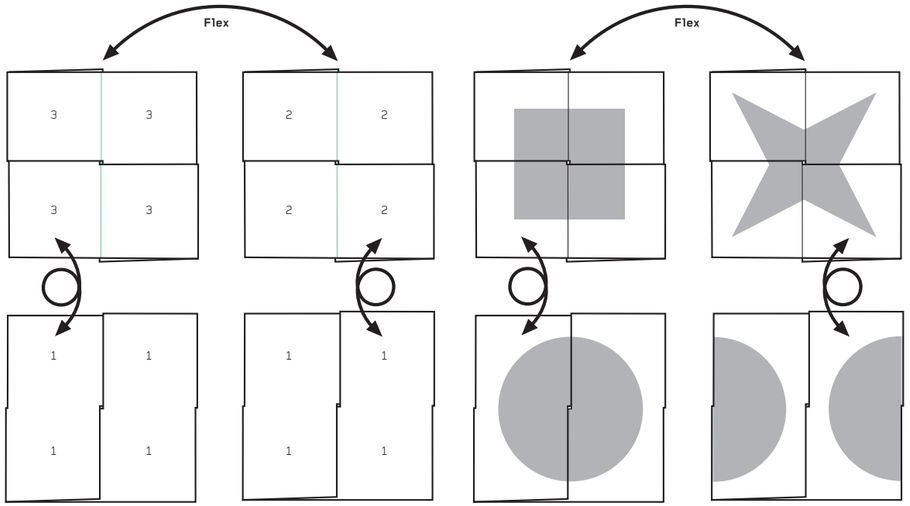
2.1 _ 8
… like this. Note how the A corners are dipping down and the B corners are rising up.



2.1 _ 9
Eventually, the three A corners will meet at the bottom and the three B corners will be at the ends of three flat fins. A new corner (C) has been created at the top. Open out the three parts of corner C …

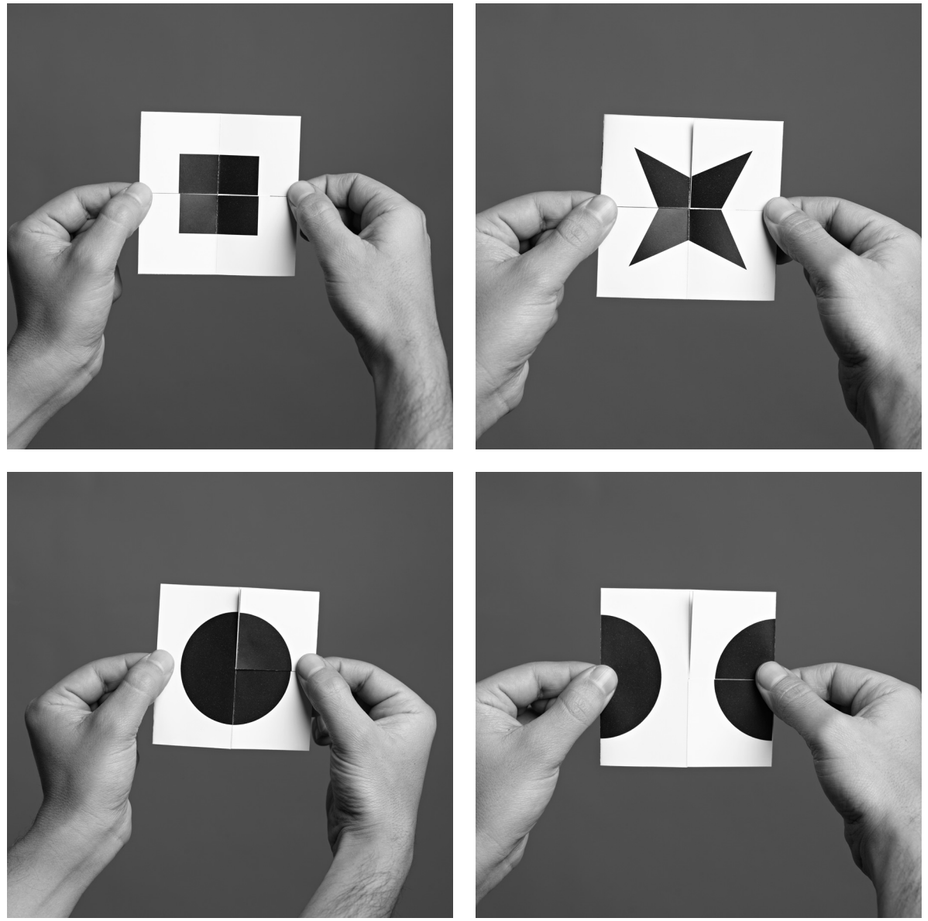


2.1 _ 10
… like this. C will split into three parts. Flatten the hexagon further by separating the C corners more and more.



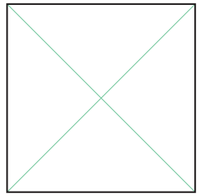
2.2 _ 7
By flexing in the way described above, it is possible to flex between the 3 and 2 faces. If the flexagon is turned over, the 1 face is always in view, whichever number (3 or 2) is on the other side.

2.2 _ 8
If surface graphics are substituted for the numbers 3 and 2, then a square will always be a square and a star will always be a star. However, the circle (on the side with the 1s) will either be an intact circle or two disconnected semicircles, depending on what image is on the other side of the flexagon at the time.

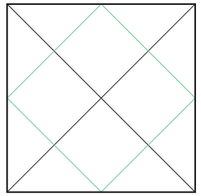


2.3 Windmill Base Manipulations

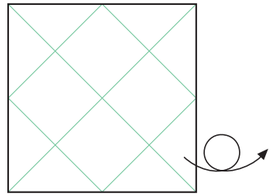
This is one of the few flexagons that is an example of pure origami. It is simply a folded square. Origami aficionados will immediately recognize it not as a model, but as the traditional Windmill Base, one of several bases traditionally used as the starting point for many models.



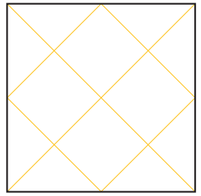
2.3 _ 1
Begin with a square of paper, 10–15cm on each side. Fold and unfold both diagonals.



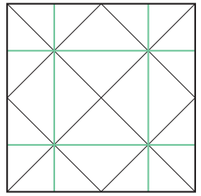
2.3 _ 2
Fold each corner to the centre point. Unfold.



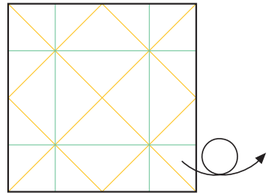
2.3 _ 3
Turn the paper over.



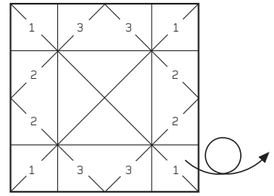
2.3 _ 4
Seen from this side, the existing folds are all mountains.



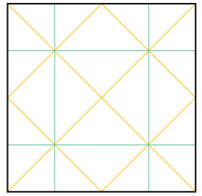
2.3 _ 5
Fold each edge to the centre point. Unfold each one before folding the next.



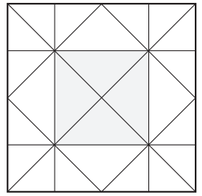
2.3 _ 6
This is the completed crease pattern. Turn over again.



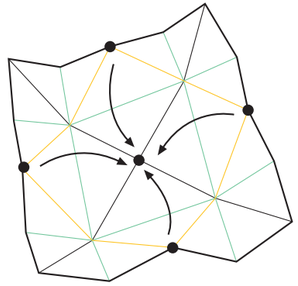
2.3 _ 7
Write numbers where shown. Turn over again.



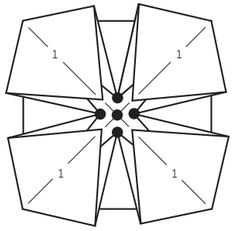
2.3 _ 8
Check the pattern of mountains and valleys.



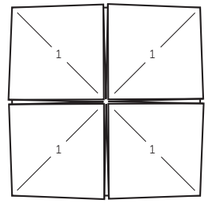
2.3 _ 9
Glue the centre square.



2.3 _ 10
Begin to collapse the creases, folding the four outer dots towards the central dot …



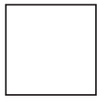
2.3 _ 11
… like this. Eventually, all five dots will merge together and the paper will be glued flat, though with loose triangles on the top side.



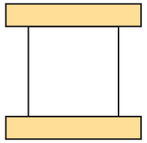
2.3 _ 12
This is the completed flexagon, ready to be flexed. Check that the eight triangles are loose enough to fold to and fro.

3.4 Jigsaw Cubes

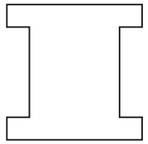
The principles of the cubes shown previously in the chapter can be altered slightly so that the tabs are not folded, but instead project outside the cube. The example shown here is of the six-piece version but it can also be applied to the three-piece and two-piece cubes. The units are not folded.



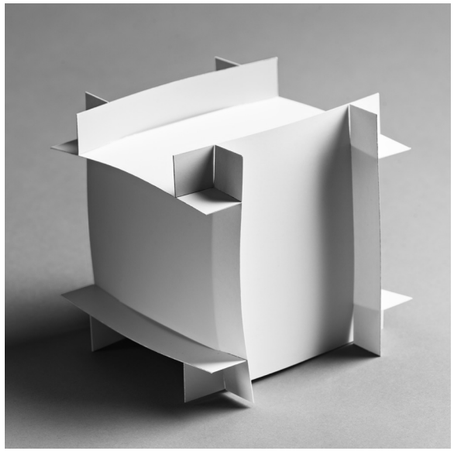
3.4 _ 1
Using 200–250gsm card, draw a square.

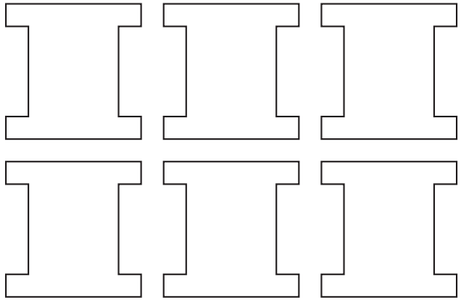


3.4 _ 2
Add two tabs to the square. Note how they project a little way over the sides of the square. This projection is crucial to the locking of the pieces.

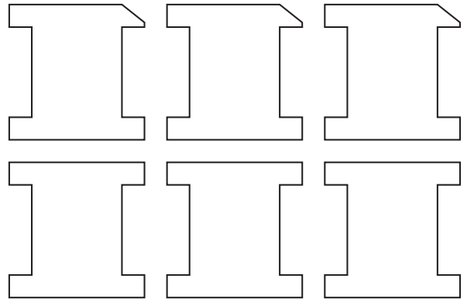


3.4 _ 3
This is the final unit. Note the absence of any folds.



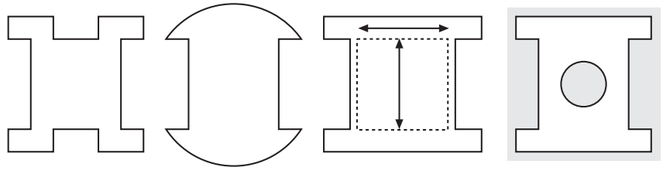


3.4 _ 4
Make six identical units. Assemble them using the locking pattern of the six-piece Jackson Cube (see page 36).

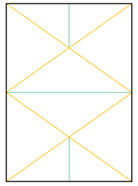


3.4 _ 5
Three of the corners may also be shaved off, so that when placed together at one corner of the cube, the cube can stand on a stable triangular foot.

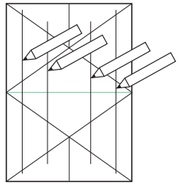
3.4 _ 6
The external tabs can take on all manner of exotic shapes, to create cubes of great originality and beauty. The tabs can also be made huge, so that the cube is only a small part of a large structure. It is even possible to make figurative sculptures, such as a plant in a pot or a steam train. Your imagination can really run riot here!



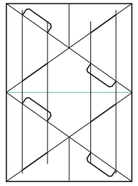
Structure Three: Whole Pyramid



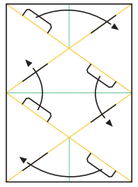
3.6 _ 24
Using 200gsm A4 card, create four mountain folds and three valley folds, as shown.



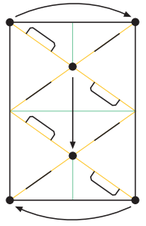
3.6 _ 25
Draw four lines, more or less as shown. Their exact placement is unimportant, but it is crucial that the left and right pairs of lines are placed symmetrically on the card.



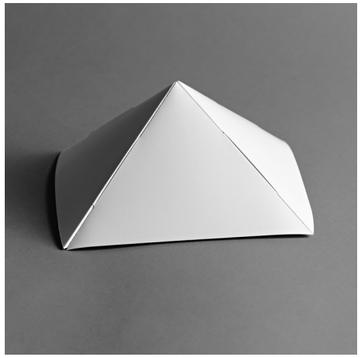
3.6 _ 26
Create four tabs and four slits, as shown, each of which begins and ends exactly on the drawn lines.



3.6 _ 27
Engage the four pairs of tabs and slits. This will lock the final whole pyramid into shape.

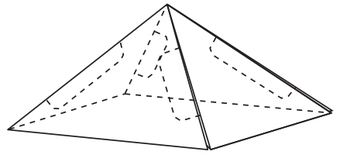


3.6 _ 28
While engaging the pairs of tabs and slits, it is helpful to remember to bring together these three pairs of dots.

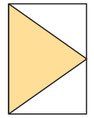


3. MODULAR SOLIDS
3.6 A4 Pyramids

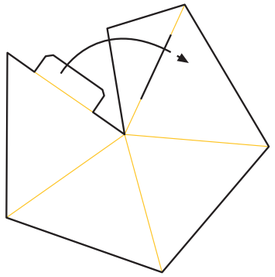
Structure Three: Whole Pyramid



3.6 _ 29
Here is the final whole pyramid. It may take a little time to engage all the tabs into all the slits, but when complete, the whole pyramid will be very strong and clean.

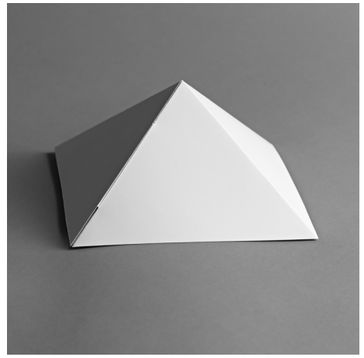


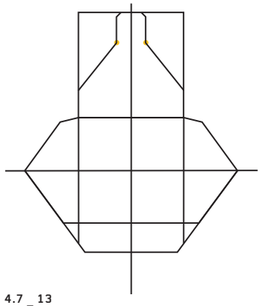
3.6 _ 30
There is a second way to create the whole pyramid. Note the triangle that makes the four triangular faces of the pyramid.



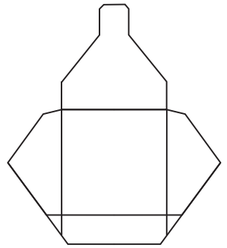
3.6 _ 31
Put four of these triangles together, so that they meet at a common point (if it looks like they create four sides of a pentagon, the geometry is not quite accurate). Add a tab at the left, a slit at the top right and also an extra small triangle. Make mountain folds, then engage the tab into the slit. The whole pyramid will form.

The advantage of this method of making a whole pyramid over the first method is that the pyramid will collapse flat for mailing and can be easily erected into three-dimensions. The disadvantage is that it is an engineered structure, not made from a simple sheet of A4 card.

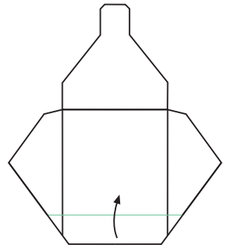




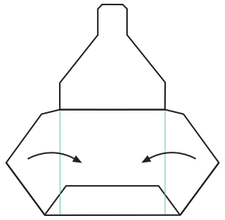
4.7 _ 13
Use the two new dots as a guide to draw the 'roof with a chimney' shape shown here.



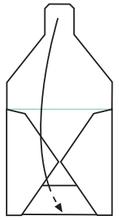
4.7 _ 14
Erase the lines of the upper square. This is the final shape of the envelope. Cut it out from the card.



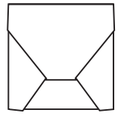
4.7 _ 15
The envelope can now be closed. Fold up the bottom edge.



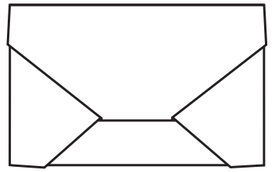
4.7 _ 16
Then, fold in the left and right corners.

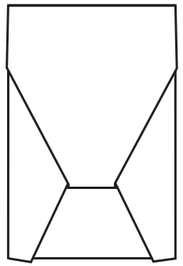


4.7 _ 17
Finally, fold down the top flap, tucking it into the pocket near the bottom edge. The envelope will lock shut.



4.7 _ 18
This is the completed engineered envelope.

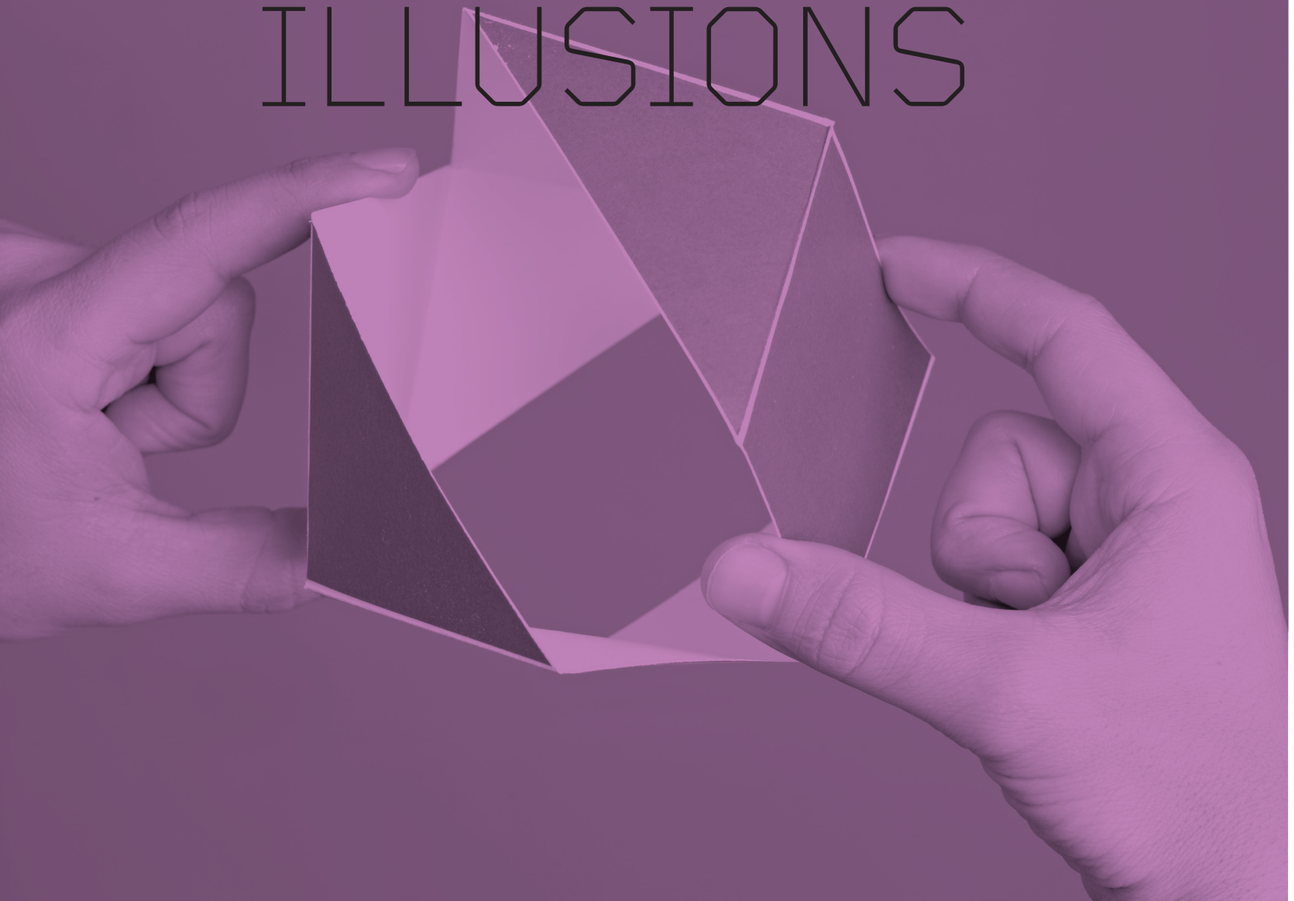




4.7 _ 19
Rectangular envelopes can be made as easily as the square envelope explained here. Simply follow the same method of construction, but instead of starting in step 1 with a square, start with a rectangle of your chosen size and shape.

05:

PUZZLES AND ILLUSIONS



Introduction

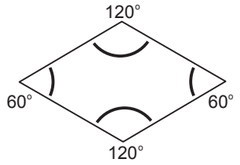
We all love a good puzzle or illusion. They make us pause and think, ask us to question what we consider possible and give us a few moments of personal contemplation.

As a type of promotional device, they have a great advantage because they invite prolonged interaction. They invite people to play with them, to question and to problem-solve … and by doing so, encourage a greater involvement with what is presented on the object (a message, information, etc.). In turn, this makes what is presented more memorable, which of course, is the point of it all.

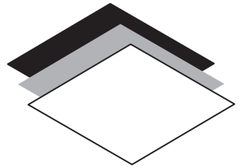
Puzzles and illusions can take many diverse forms. Those presented in the chapter have been chosen for their quality, fun appeal and the ease with which surface graphics can be applied. However, it is recommended that before creating a final design, you test it on as many people as possible to see if they can solve the puzzle or make the illusion. If they can't, you will need to make it easier in some way. If it seems too easy, complicate it slightly. There is little point in making something that is either too difficult or too easy, as it will only make people frustrated or not engage them sufficiently to make it worthwhile. It's a fine balance and it needs to be struck correctly.

5.7 Reversing Cubes

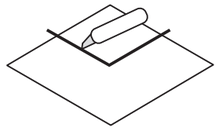
Here is a classic illusion, interpreted in card. Sometimes the cubes appear solid and sometimes we are looking into the corner of a room – yet the design of both is the same! The pieces can be arranged in an infinite number of ways to create some fascinating surfaces.



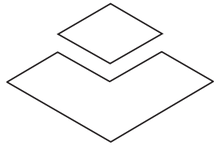
5.7 _ 1
Use pieces of strong card with corners that are exactly 120 and 60 degrees.



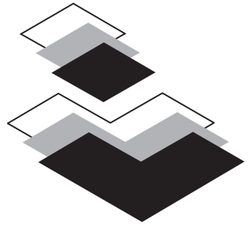
5.7 _ 2
Make the pieces using three different tones or three contrasting colours.



5.7 _ 3
Cut away one quarter of the rhombus, exactly connecting the middle of two sides with the centre point. This must be done with great precision.

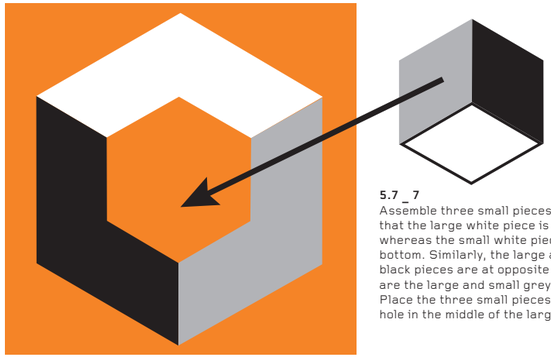


5.7 _ 4
This is the result. Keep both pieces.



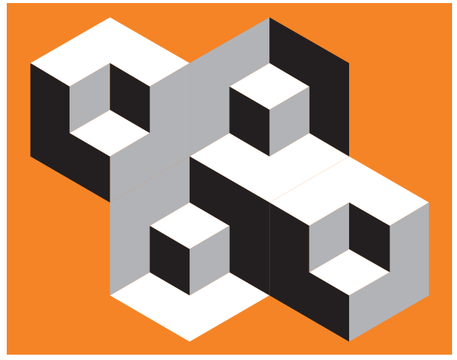
5.7 _ 5
Create as many pieces as are needed, making an equal number in three colours.

5.7 _ 6
On a contrasting ground, assemble one piece of each colour, as shown, leaving a hole in the middle.



5.7 _ 7
Assemble three small pieces. Note that the large white piece is at the top, whereas the small white piece is at the bottom. Similarly, the large and small black pieces are at opposite sides, as are the large and small grey pieces. Place the three small pieces into the hole in the middle of the large pieces.

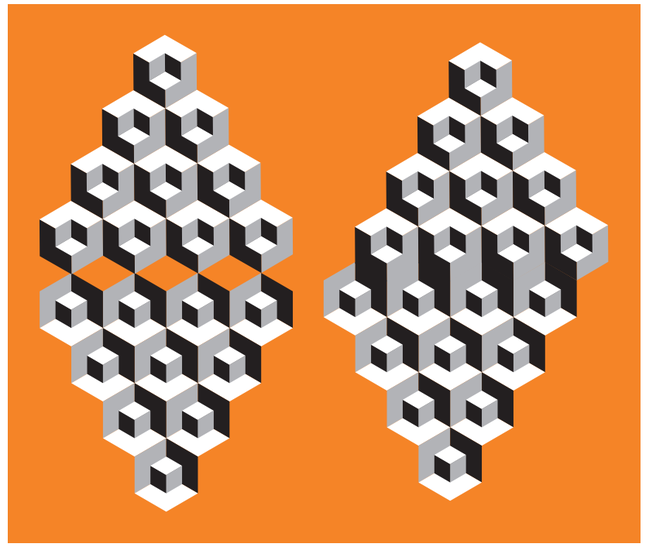
5.7 _ 8
This is the result!
Look at the two examples. Note how the example on the left appears to be a solid cube with a corner missing, whereas the example on the right appears to be the corner of a room with a small cube sitting in the corner. Look again and you will see that the two examples are the same! Each is the other rotated through 180 degrees. Why do they look different? The answer is that light generally comes from above, so we are conditioned to seeing horizontal surfaces looking lighter than vertical surfaces. The example on the right has two white horizontal surfaces, with the larger one at the top, so it appears to be a solid cube. However, when the example is rotated through 180 degrees, the larger illuminated white surface now appears to be the floor of a room. For this effect to work well, the two white pieces need to be positioned as shown, though as we will see, exceptions can be made.



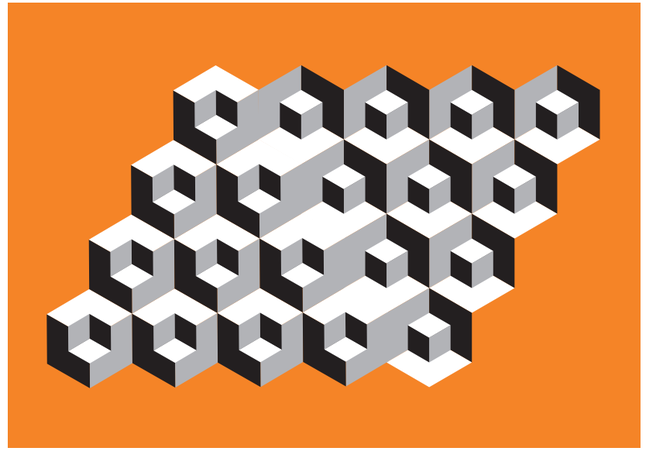
5.7 _ 9
Here are three examples using two, three and four negative and positive forms. The two-piece example pairs together the negative and positive cubes connected by a common grey surface. Rotated through 180 degrees, it will look exactly the same! The three-piece example – unusually – is illuminated from the left side.

The four-piece example uses four identically constructed positive and negative cubes, arranged so that the white, grey and black surfaces continue from one cube to the next. Unlike the two-piece example, when rotated through 180 degrees, it will not look the same.

Try to create your own examples using just a few cubes. There are a great many possibilities!



5.7 _ 10
With more cube units, there are many ways to create repeat surfaces. The two examples illustrated here have ten units on the top half inverted on the bottom half, but whereas the two halves are disconnected in the left-hand example, they are connected in the right-hand example.

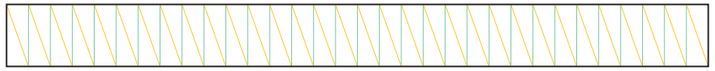


5.7 _ 11
The same pyramid of ten cubes can be inverted and placed to the side. This repetition can be continued indefinitely. What other repetitions can you design? What can you design that is not a repetition? The possibilities are infinite and fun to discover.

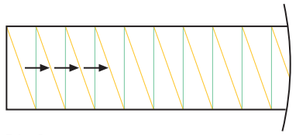
7.1 Spinning Spiral

Few folded structures are as elegant as this spiral. Carefully made and positioned in gently moving air, it will spin vigorously. Its single, one-layer surface means that it is easy and inexpensive to apply effective surface graphics.

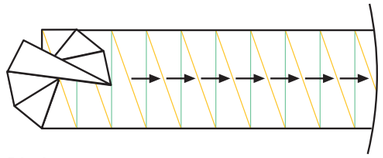
7.1 _ 1
Cut 100gsm paper to a rectangle somewhere between 11 x 1 and 12 x 1. A good depth is about 8cm. Divide it into 32 equal sections with valley folds. These divisions can be measured with a ruler, or if you want to do it purely by folding, refer to the author's previous book *Folding Techniques for Designers*, where a folding method for dividing into 32 is given.



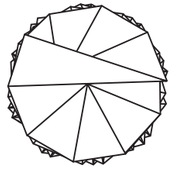
7.1 _ 2
Add mountain folds across the diagonal of each of the 32 panels. Make sure they are folded very accurately.



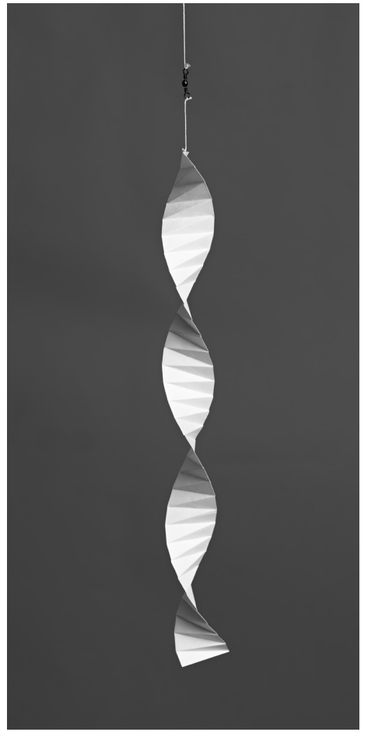
7.1 _ 3
Begin to fold each mountain and each valley in turn, being careful not to omit any of the folds ...

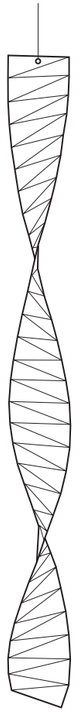


7.1 _ 4
... like this. The strip will begin to create a circle. Continue to make all the folds, right across the strip.



7.1 _ 5
This is the final result. The paper is flat. To make the spiral, separate your first finger and thumb by about 2cm and with your other hand, pull the strip up through the gap between them. This will open the pleats to create a spiralling strip.





7.1 _ 6
The spiral is complete. Note that to spin effectively and also to look its most beautiful, the spiral should twist through no more than three complete rotations from top to bottom. If it is twisting more, pull it again between your first thumb and forefinger, but this time with a smaller gap between them. Make a hole in the middle of one end and hang it from a cotton thread.

A very useful addition is a small fishing swivel, seen in the photograph. Cut the cotton a little above the spiral and then tie the swivel between the loose ends. It will allow the spiral to spin perpetually in one direction, without twisting and breaking the thread. Fishing swivels can be bought where fishing rods are sold. They are very inexpensive and come in packets of a dozen or so.