Contents

The Magic Manual

Section 2

Transformations

A guide for fabricators and users to stations from the Magic Mathworks Travelling Circus

2. TRANSFORMATIONS

The chosen geometric transformations appear in increasing order of generality:

stations	transformation type	invariant
2.1-2	**isometric**	**shape & size**
2.1	***opposite* (reflection)**	
2.2	***direct* (translation)**	
2.3	**dilative**	**shape**
2.4-5	**affine**	**parallels**
2.6	**projective**	**straightness of lines, cross-ratios**
2.7	**(cylindrical) anamorphic**	**straightness of radial lines, radial distance ratios**
2.8	**topological**	**the order of points on a line**
2.9	includes **2.1-2,** but also another ***direct* isometry (rotation)**; **2.3**; **2.6**.	

2.1.1-5

p The objects chosen have no line/plane of symmetry and are thus **chiral**.

2.1.1-2

c Chiral forms (**enantiomorphs**) can be mapped into each other by reflection.

2.1.1 MIRA

p One positions the second object so that its reflection coincides with the first.

2.1.2 LEFT & RIGHT

p By building them, one discovers how the features of enantiomorphs correspond..

2.1.3.1-2 SEE BOTH SIDES, MIRROR WORLD

c Only objects with a line/plane of symmetry are **a**chiral.

p One must seek out the feature unchanged by reversal.

2.1.4 MIRROR TURNS

c Sense of rotation is reversed on reflection.

p One is led to that observation.

2.1.5.1-2 MIRROR KNOTS A & B

c There are 2 forms of the overhand knot.

p The topological transformation involved - transferring the knot from oneself to the rope - comes as a pleasant surprise to those unfamiliar with the trick.

2.2.1 PROFILE GAUGE

p A practical application of the properties of translation.

2.2.2 LATERAL THINKING

p Another.

2.3.1-4

c To produce a **similar** shape one must scale each feature uniformly.

2.3.1 SQUARING UP & DOWN

p The artist applies that rule in using this traditional technique.

2.3.2 THE O.H.P. AS ENLARGER

p An opportunity for the experimenters to feel themselves a part of the cone of projection.

2.3.3 THE RUBBER BAND ENLARGER

p Although the title tells the experimenters what to expect, they're still pleasantly surprised by the result.

2.3.4 CUBING UP & DOWN

p **2.3.1** extended to 3 dimensions: the painter becomes a sculptor.

2.4 SHADOW-MAKING

c Projection from an infinitely distant point maps parallels into parallels. (The sun is sufficiently distant for no divergence to be measurable.)

p The above property remains implicit in what is presented as a test of physical skill. (A helper can of course guide the experimenter to tease out the geometry.)

2.5 SHEARS

c This interactive models a particular affine transformation, where there is a displacement parallel to a given line and proportional to the distance from it, the **shear**.

p An exercise in visualisation.

2.6 PERSPECTIVE DRAWING

c Some properties of linear perspective.

p The centre of projection is the artist's eye. S/he predicts how specific 2-D and 3-D shapes will be transformed when drawn on a 'Leonardo' screen.

2.7.1-2 ANAMORPHS 1 & 2

c The transformation which results from reflection in a cylindrical mirror perpendicular to the object plane ...

p ... is made the subject of an exercise in reading grid coordinates.

2.7.1 presents a specimen anamorph.
2.7.2 allows the experimenters to make their own.

2.8.1-2

c The Jordan Curve Theorem.

2.8.1 CROSSING COUNTS 1

p By manipulating the rope one finds that shapes and sizes are irrelevant to the numbers the trials throw up.

2.8.2 CROSSING COUNTS 2

p One can most easily resolve the question posed here by applying what one has learned in **2.8.1**.

2.9 SLIDE SHOW TRICKS

c Special cases of the general projective transformation (as listed above).

p The experimenter must recognise - operationally - which transformation/s is/are required.

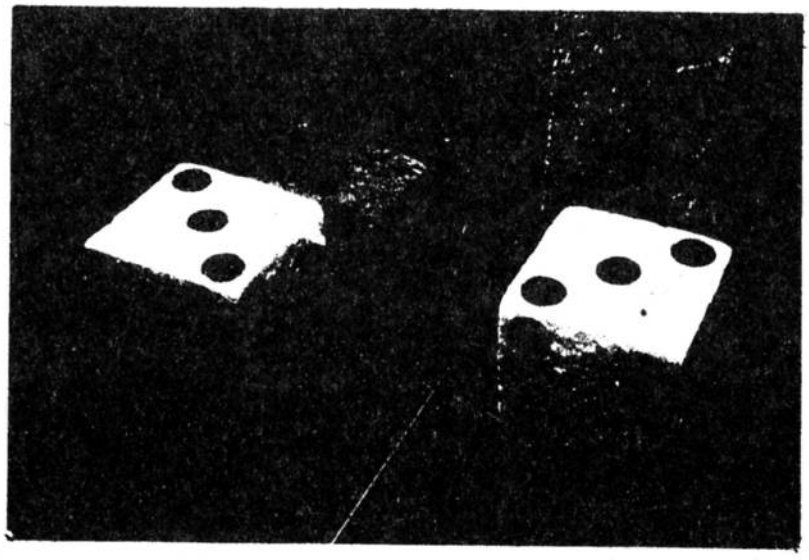
SECTION		AGE RANGE					
TRANSFORMATIONS		Appropriate point of entry - not necessarily to the task set by the caption - and levels on which extension activities generated (some to be pursued off-site)					
STATION							
NUMBER	NAME	4	7	10	13	16	19+
2.1.1	MIRA	*	*	*	*		*
2.1.2	LEFT & RIGHT			*	*		
2.1.3.1	SEE BOTH SIDES		*	*			
2.1.3.2	MIRROR WORLD		*	*			
2.1.4	MIRROR TURNS		*	*			
2.1.5.1	MIRROR KNOTS A		*	*			
2.1.5.2	MIRROR KNOTS B		*	*	*		
2.2.1	PROFILE GAUGE				*	*	
2.2.2	LATERAL THINKING				*	*	
2.3.1	SQUARING UP & DOWN		*	*	*		
2.3.2	THE O.H.P. AS ENLARGER		*	*	*		
2.3.3	THE RUBBER BAND ENLARGER			*	*		
2.3.4	CUBING UP & DOWN			*	*	*	
2.4	SHADOW-MAKING			*	*		
2.5	SHEARS			*	*		
2.6	PERSPECTIVE DRAWING			*	*	*	*
2.7.1	ANAMORPHS 1		*				
2.7.2	ANAMORPHS 2			*	*		*
2.8.1	CROSSING COUNTS 1			*	*		
2.8.2	CROSSING COUNTS 2			*	*		
2.9	SLIDE SHOW TRICKS		*	*	*		*

	INSTRUCTION NEEDED				SUPERVISION NEEDED			SERVICING NEEDED		
→	Needs no explan-ation or caption	Caption enough for most people	Needs aural prompt	Visitors must be talked through stages	None	Benefits from a helper's input	Session must be directed	None	A little	Much
2.1.1		*			*				*	
2.1.2		*			*			*		
2.1.3.1		*				*		*		
2.1.3.2		*				*		*		
2.1.4		*			*			*		
2.1.5.1		*			*			*		
2.1.5.2		*			*			*		
2.2.1			*			*			*	
2.2.2			*			*		*		
2.3.1		*			*				*	
2.3.2			*			*			*	
2.3.3			*			*			*	
2.3.4		*			*			*		
2.4			*		*				*	
2.5			*		*			*		
2.6			*			*			*	
2.7.1			*			*		*		
2.7.2			*			*			*	
2.8.1			*			*			*	
2.8.2			*			*			*	
2.9			*				*		*	

	NUMBER	TITLE
GROUP	2	TRANSFORMATIONS
STATION	2.1 .1	MIRA
TOPIC		Reflection

MIRA

▶ The MIRA is both a WINDOW and a MIRROR.



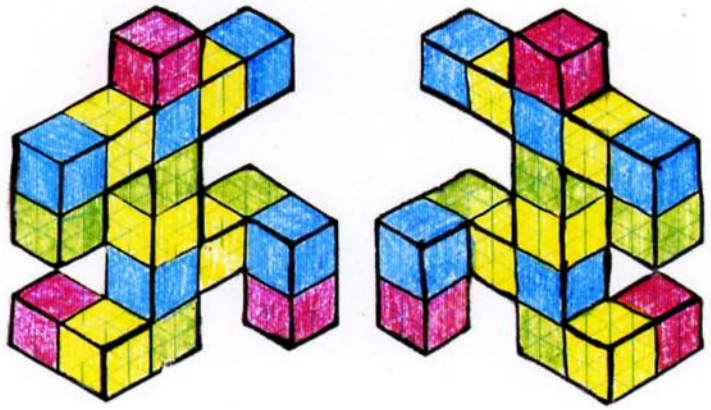
- Investigate!
- Match:

  your own hands,
  the shoes,
  the dice,
  the gears,
  the tetrahedra,
  the molecule models,
  the knots.

	NUMBER	TITLE
GROUP	2	TRANSFORMATIONS
STATION	2.1.2	LEFT & RIGHT
TOPIC		As 2.1.1

LEFT AND RIGHT

- **Build your own objects:**



- **Build a complicated one for your partner to match.**

- **Then use the see-through mirror to check one against the other.**


LEFT & RIGHT
LEFT & RIGHT
f
e
g
h

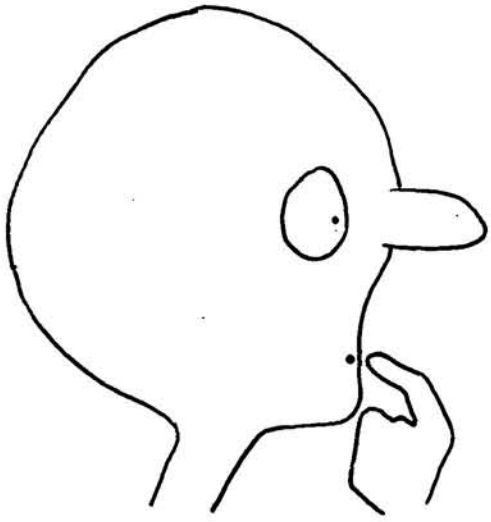

a
b
c
LEFT & RIGHT

PICTURE KEY	DESCRIPTION	TRADE NAME	U.K. SOURCE
a	Glodex sheet, 600 mm (deep) x 450 mm (high), supported in:		local
b	grooved block		local
c	matt black mounting board, 850 mm (wide) x 600 mm (deep)		local
d	trainers		local
e	dice, 50 mm, bought as blanks; spots added to give left- and right-handed forms	Hope catalogue: P4709/001	Hope Education Ltd Orb Mill Huddersfield Road Waterhead Oldham Lancashire OL4 2ST T +44 1616 336611 F +44 1616 333431
f	gears, to one of which an arrow has been added to indicate sense of rotation	NES Arnold catalogue: NB 4660/8	NES Arnold Ltd (address above)
g	tetrahedra, faces coloured to give left- and right-handed forms: Polydron triangles, permanently joined	Equilateral triangle root 2; Polydron catalogue: 10.0303	Polydron International Ltd Kemble Cirencester Gloucestershire GL7 6BA T +44 1285 770055 F +44 1285 770171
h	molecular models: the 2 enantiomers of bromochloroethane	Molymod (student organic set); Griffin catalogue: MTJ-500-M	Griffin Education Bishop Meadow Road Loughborough LE11 ORG T +44 1509 233344 F +44 1509 231893
i	left- and right-handed overhand knots, tied in short lengths of thick rope whose free ends are then bound with tape		local
j	cubes, 2 cm	Multilink: NES Arnold catalogue: SY 007/9	NES Arnold Ltd (address above)

	NUMBER	TITLE
GROUP	2	TRANSFORMATIONS
STATION	2.1.3.1	SEE BOTH SIDES
TOPIC		As 2.1.1

SEE BOTH SIDES

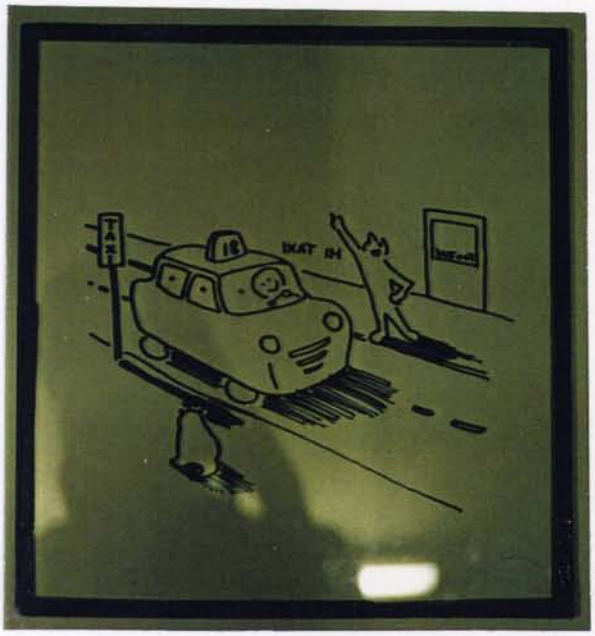
- Look from inside at the picture on the window.



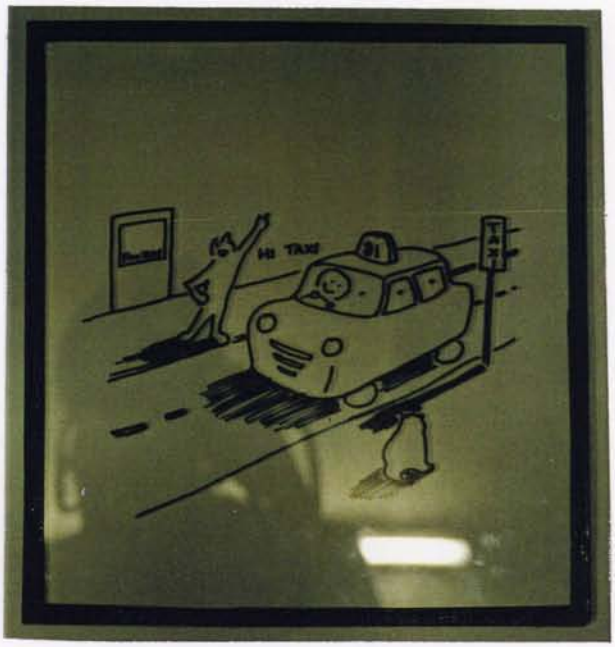
SEE BOTH SIDES

- Look from outside at the picture on the window.

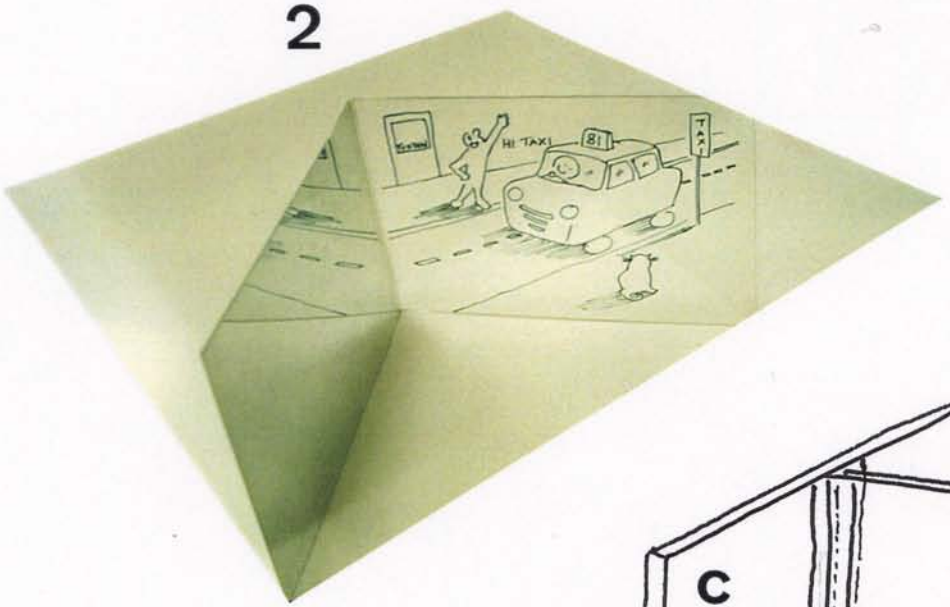
1a

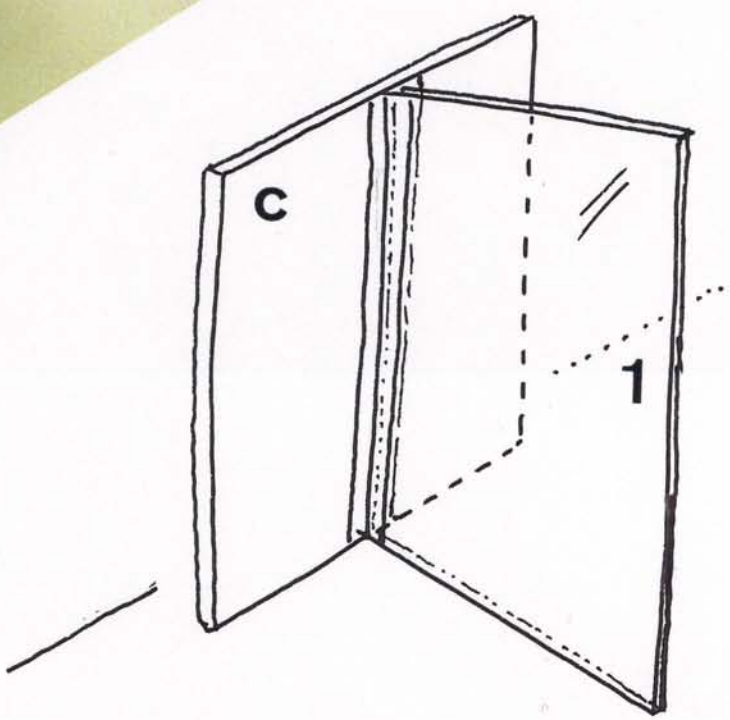


1b



2





PICTURE KEY	DESCRIPTION	TRADE NAME	U.K. SOURCE
1a, 1b	'window' seen from the 2 sides: Glodex sheet 250 mm (deep) x 300 mm (high), with drawing, taped with 30 mm Transpaseal strip both sides to:		
c	2.1.3.1 caption board, as shown		
2	As an extension activity - no caption supplied - a 'window' 300 mm (wide) x 210 mm (high) can be taped to an unbreakable mirror as shown to invite comparison with **2.2**	Economatics catalogue: 08803 (formerly Osmiroid catalogue: 8803)	Economatics Ltd (address above)

	NUMBER	TITLE
GROUP	2	TRANSFORMATIONS
STATION	2.1.3.2	MIRROR WORLD
TOPIC		As 2.1.1

MIRROR WORLD

DIE SPIEGELWELT

- Put the picture on the projector.

  Lege das Bild auf dem Projector.

- What's happening?

  Was passiert?

- Turn it over.

  Dreh es um.

- What's happening now?

  Was passiert jetzt?

- Draw your own Mirror World on the blank perspex sheet.

  Zeichne deine eigene Spiegelwelt auf der leeren Plexiglasscheibe.

PICTURE KEY	DESCRIPTION	TRADE NAME	U.K. SOURCE
	As **2.1.3.1: 1a, 1b**		

	NUMBER	TITLE
GROUP	2	TRANSFORMATIONS
STATION	2.1.4	MIRROR TURNS
TOPIC		As 2.1.1

MIRROR TURNS


Look up at
its reflection when
you spin this clockwise.

PICTURE KEY	DESCRIPTION	TRADE NAME	U.K. SOURCE
a	old record player, turntable marked as caption		
b	matt black paper, attached to lid top with Transpaseal		local

	NUMBER	TITLE
GROUP	2	TRANSFORMATIONS
STATION	2.1.5.1	MIRROR KNOTS A
TOPIC		As 2.1.1

MIRROR KNOTS

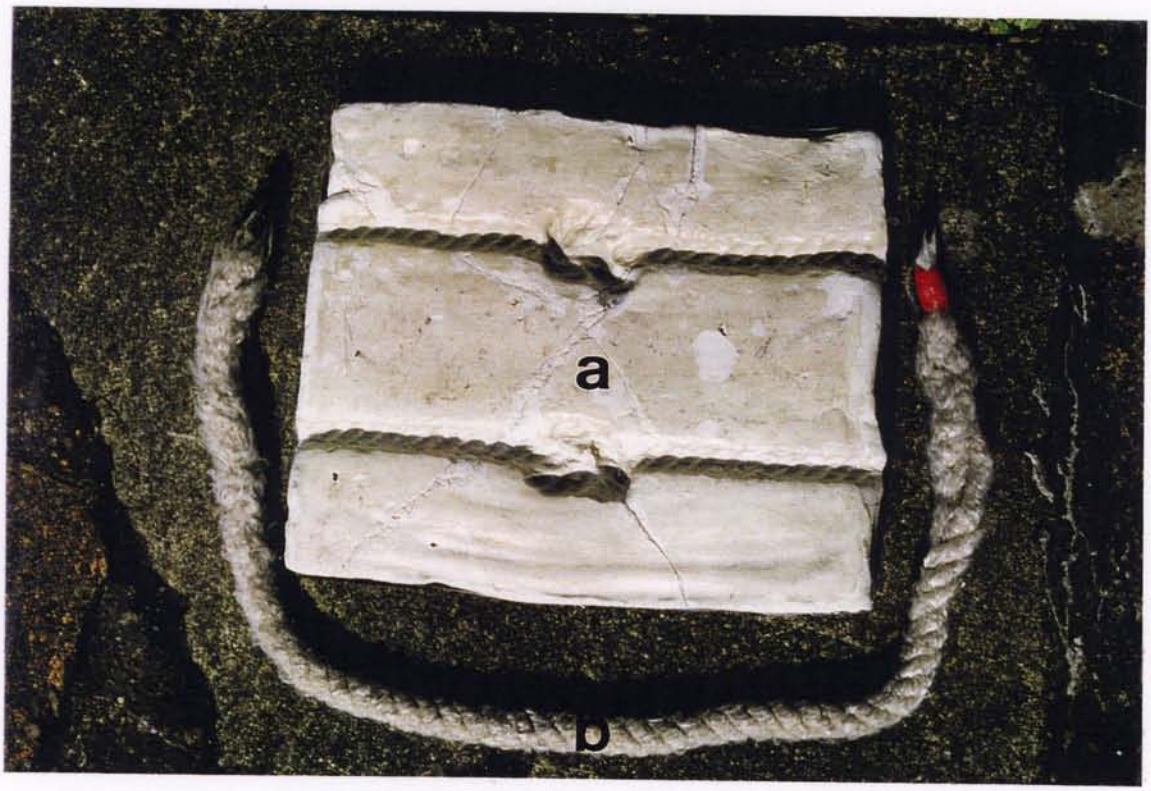
- Fold your arms this way:

- Ask your partner to feed you the rope, one end to each hand.
- Unfold your arms and pull tight.

- Fold your arms this way:

- Ask your partner to feed you the rope, one end to each hand.
- Unfold your arms and pull tight.

■ Which mould does the knot fit ?


a
b

PICTURE KEY	DESCRIPTION	TRADE NAME	U.K. SOURCE
a	clay block, 300 mm (wide) x 200 mm (deep) x 25 mm (thick), built up on rigid baseboard retained in finished model;	Newclay: NES Arnold catalogue: F 523/6	NES Arnold Ltd/ local (address above)
b	thick rope, 750 mm long; ends taped to prevent unravelling		local
	rope tied in respective knots and pushed into soft clay in the 2 positions shown;		
	clay case-hardened;	hardener NES Arnold catalogue: F 524/9	NES Arnold Ltd/ local (address above)
	model varnished;	satin matt varnish NES Arnold catalogue: F 525/5	v.s./ local
	clay block then taped to baseboard		

	NUMBER	TITLE
GROUP	2	TRANSFORMATIONS
STATION	2.1.5.2	MIRROR KNOTS B
TOPIC		As 2.1.1

MIRROR KNOTS

▲ There are 2 lengths of blue rope,

... one for YOU to tie a LEFT-handed knot in,

- Fold <u>your</u> arms this way:

- Pick up your rope by gripping an end in each hand.
- Unfold your arms.
- Pull tight.

... one for YOUR PARTNER to tie a RIGHT-handed knot in.

- Fold <u>your</u> arms this way:

- Pick up your rope by gripping an end in each hand.
- Unfold your arms.
- Pull tight.

- Match the two knots in the MIRA.

PICTURE KEY	DESCRIPTION	TRADE NAME	U.K. SOURCE
	Apparatus as **2.1.5.1 a**, used with station **2.1.1**		

	NUMBER	TITLE
GROUP	2	TRANSFORMATIONS
STATION	2.2.1	PROFILE GAUGE
TOPIC		Translation

THE PROFILE GAUGE

How to cut a tile to fit round a doorpost

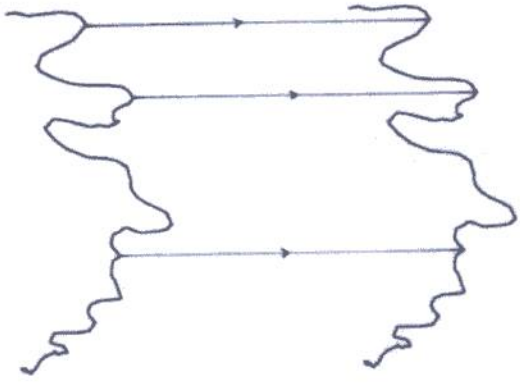
First, the impossible way!

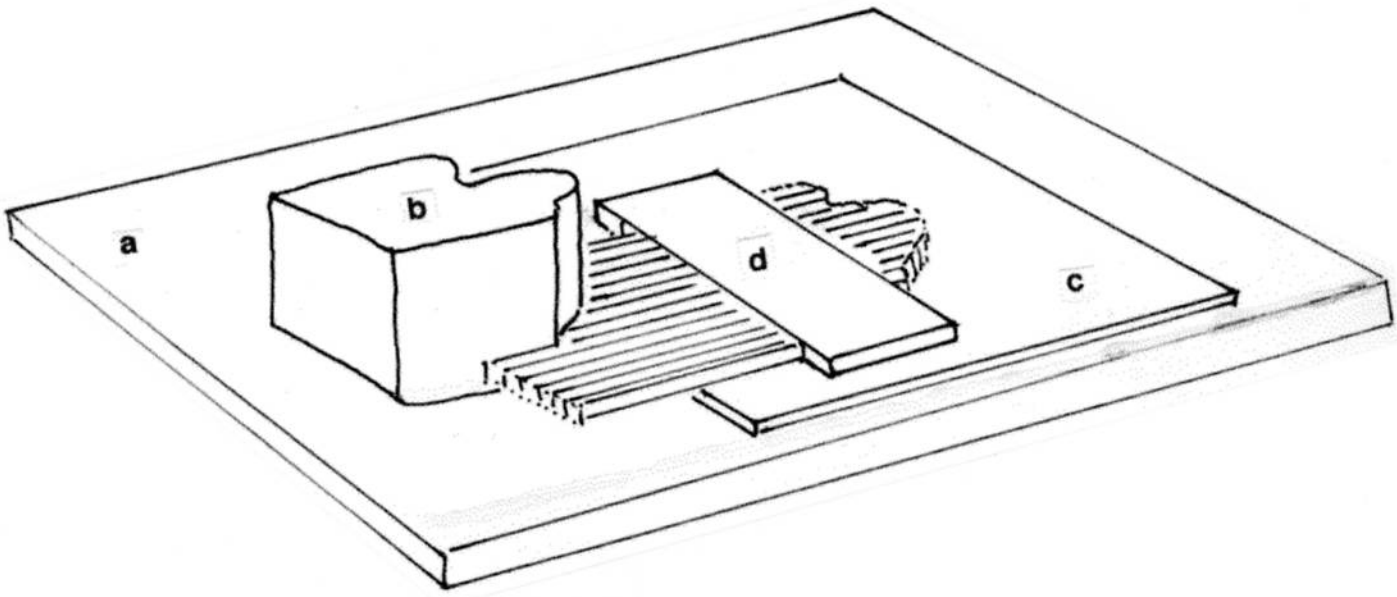
- **Slide the tile under the doorpost and draw round it.**

Now, the possible way:

- **Push the PROFILE GAUGE against the doorpost.**
- **Slide the tile under that and draw round it.**

▶ **This transformation is called a TRANSLATION. Every point moves the same distance in the same direction.**




a
b
d
c

PICTURE KEY	DESCRIPTION	TRADE NAME	U.K. SOURCE
a	'floor': white-faced MDF, 300 mm x 200 mm x 12.5 mm		local
b	'doorpost': any block with a suitably indented face, secured to baseboard with 2 removable pegs		local
c	'tile': 3 mm Glodex, 150 mm square		local
d	profile gauge, of size sufficient to span doorpost		local

	NUMBER	TITLE
GROUP	2	TRANSFORMATIONS
STATION	2.2.2	LATERAL THINKING
TOPIC		As 2.2.1

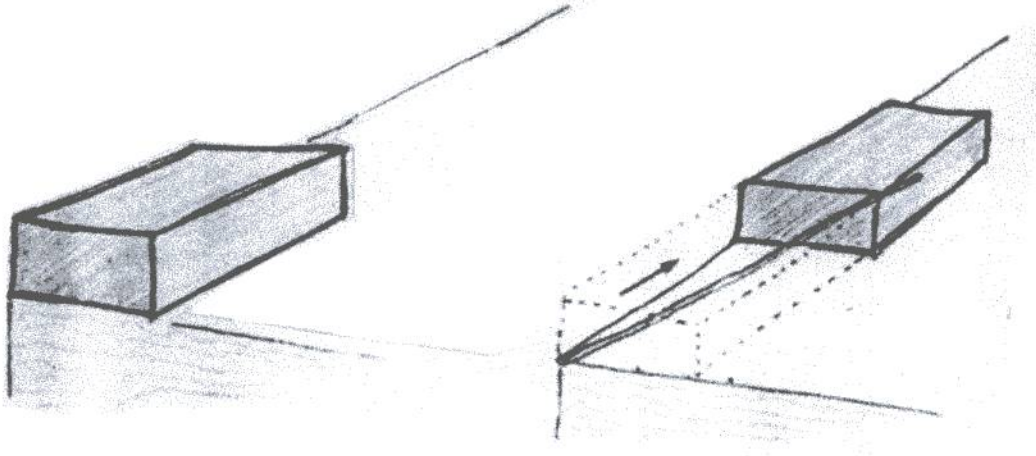
LATERAL THINKING

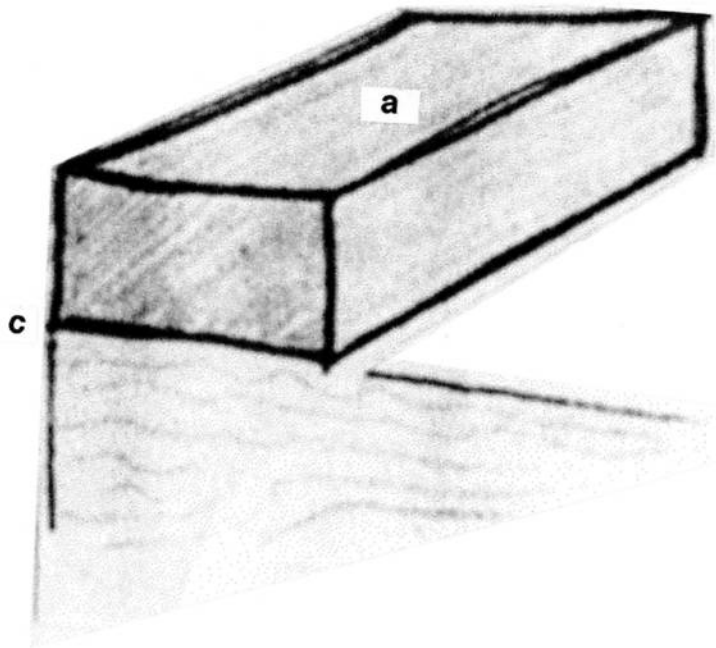
■ **Will the stick fit in the box?**

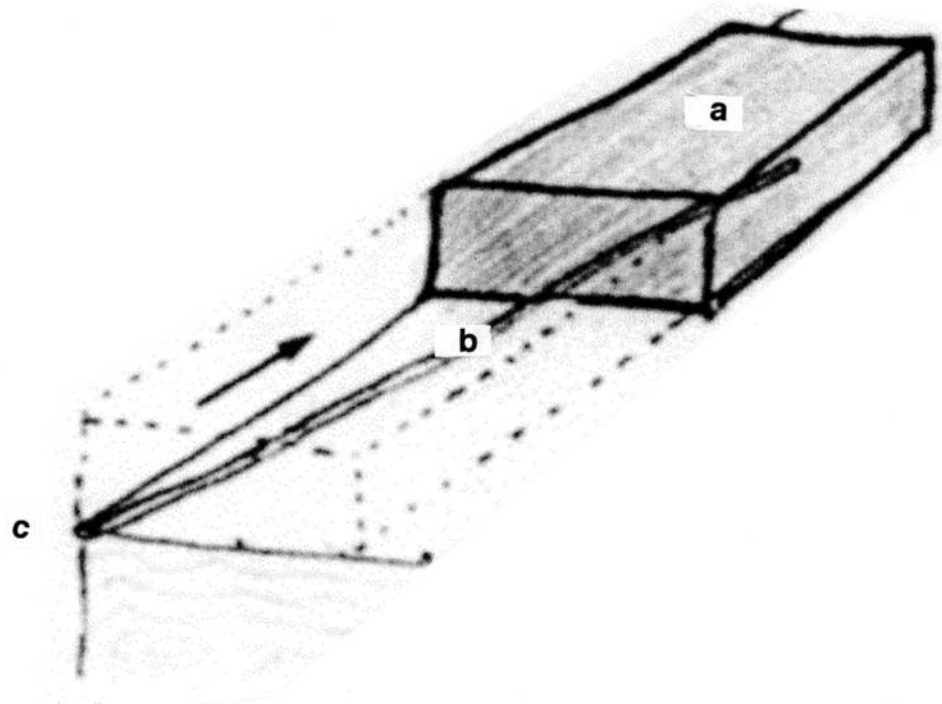
- No measuring or calculating needed -

● **Turn over for the trick.**

	NUMBER	TITLE
GROUP		
STATION		(Above continued)
TOPIC		




a
c

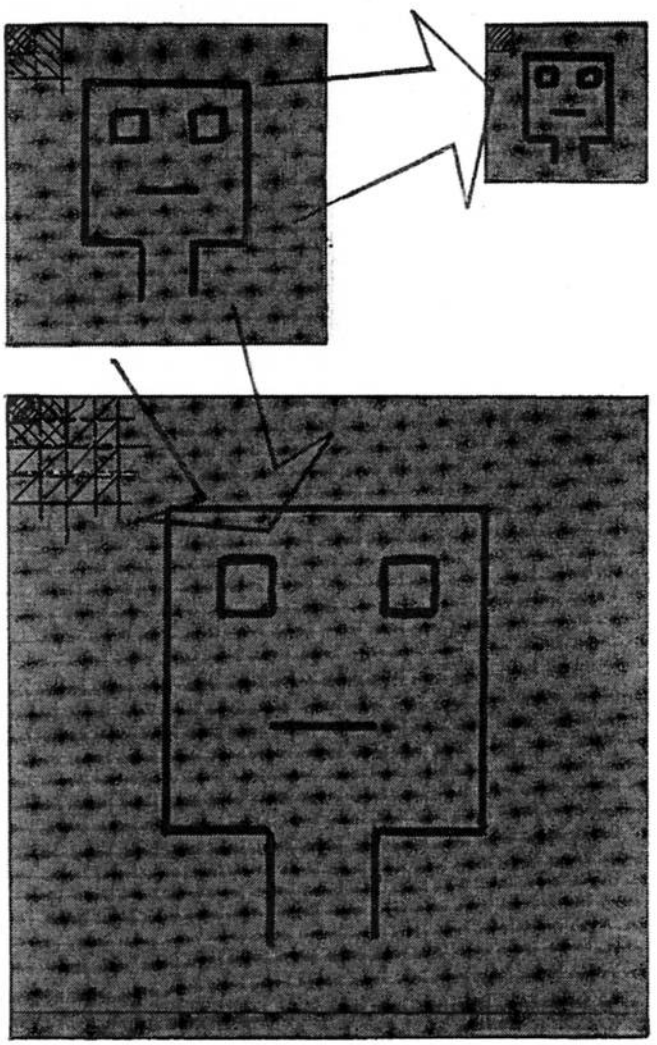

a
b
c

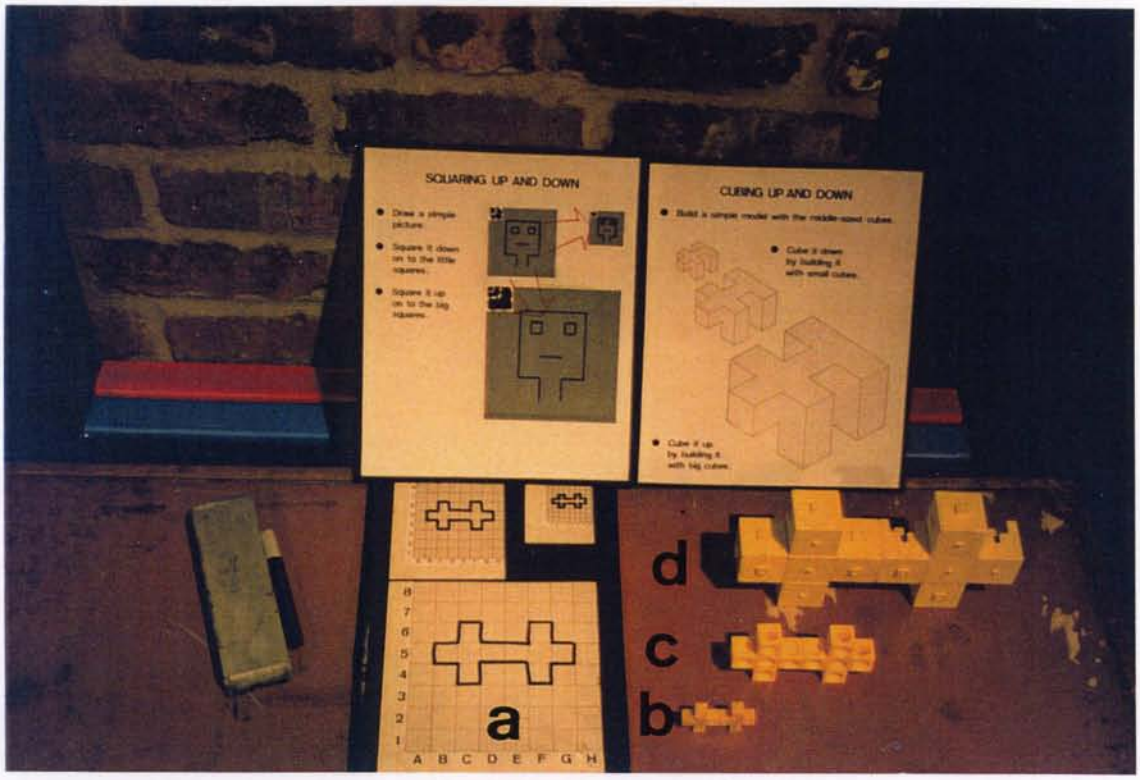
PICTURE KEY	DESCRIPTION	TRADE NAME	U.K. SOURCE
a	Box: Corriflute, 300 mm x 200 mm x 100 mm		NES Arnold Ltd (address above)
b	Stick: 6 mm wood dowel. It should be not more than 15 mm longer than the space diagonal of the box, in the above case therefore 390 mm.		local
c	If the table has a clean, right-angled corner, (as in the case shown), nothing more is needed; if it hasn't, the apparatus should be placed on a rectangular board at least 2 x the box's length and wide enough to allow the box's width to pass easily in front of the caption on its stand.		local

	NUMBER	TITLE
GROUP	2	TRANSFORMATIONS
STATION	2.3.1	SQUARING UP AND DOWN
TOPIC		Enlargement (in 2-D)

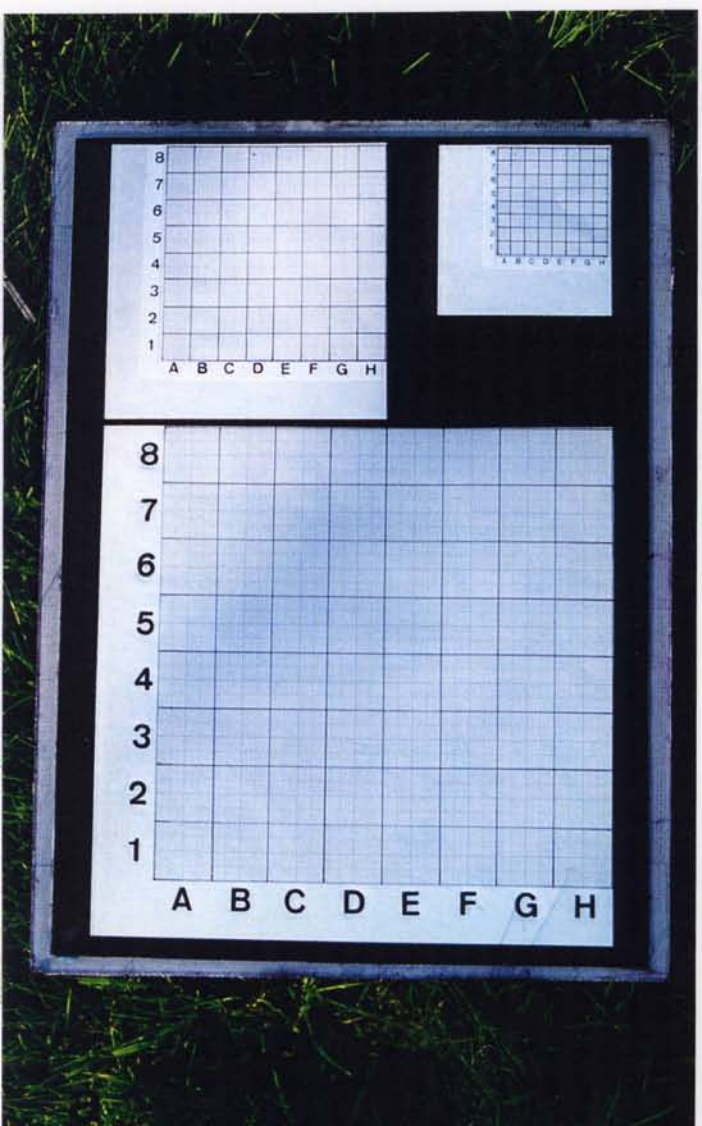
SQUARING UP AND DOWN

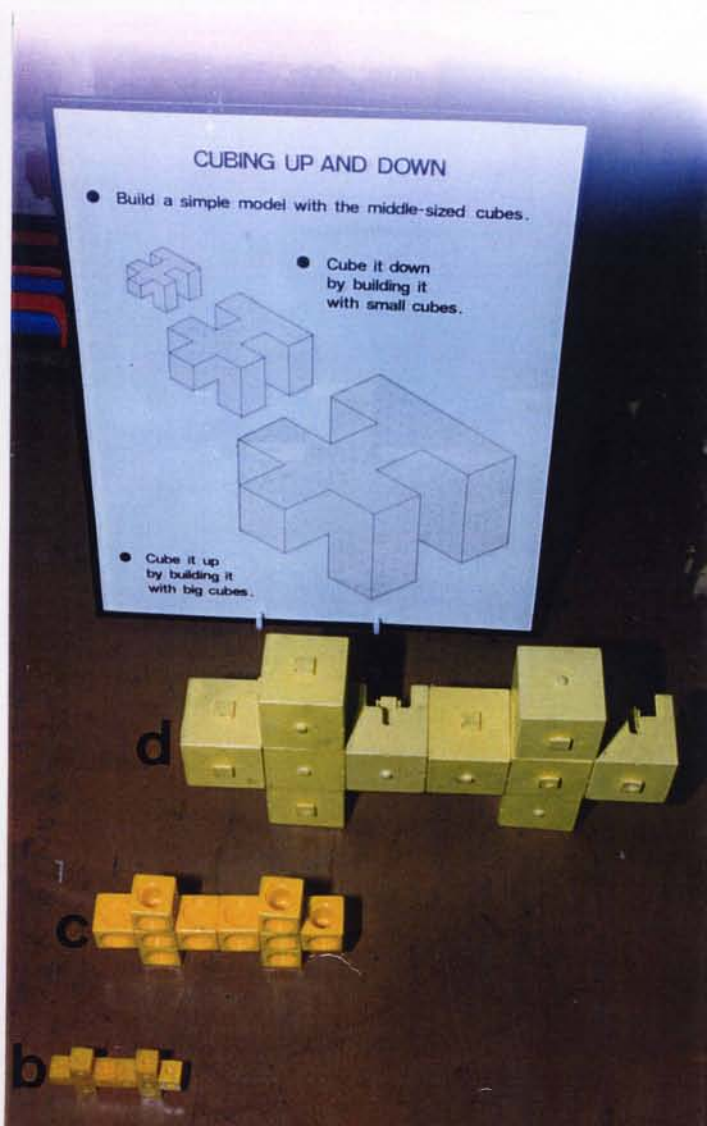
- Draw a simple picture.
- Square it down on to the little squares.
- Square it up on to the big squares.




SQUARING UP AND DOWN
CUBING UP AND DOWN
a
d
c
b

a


8
7
6
5
4
3
2
1
A B C D E F G H


CUBING UP AND DOWN
Build a simple model with the middle-sized cubes.
Cube it down by building it with small cubes.
Cube it up by building it with big cubes.
d
c
b

PICTURE KEY	DESCRIPTION	TRADE NAME	U.K. SOURCE
a	grids shown stuck to caption board as described; Glodex sheet of same dimensions taped over top		
b	cubes, 1 cm [b, c, d refer on to 2.3.4]	Centicube	v.s.
c	cubes, 2 cm	Multilink	v.s.
d	cubes, 4 cm	Modulix NES Arnold catalogue: KJ 685	NES Arnold Ltd (address above)

	NUMBER	TITLE
GROUP	2	TRANSFORMATIONS
STATION	2.3.2	THE O.H.P. AS ENLARGER
TOPIC		As 2.3.1

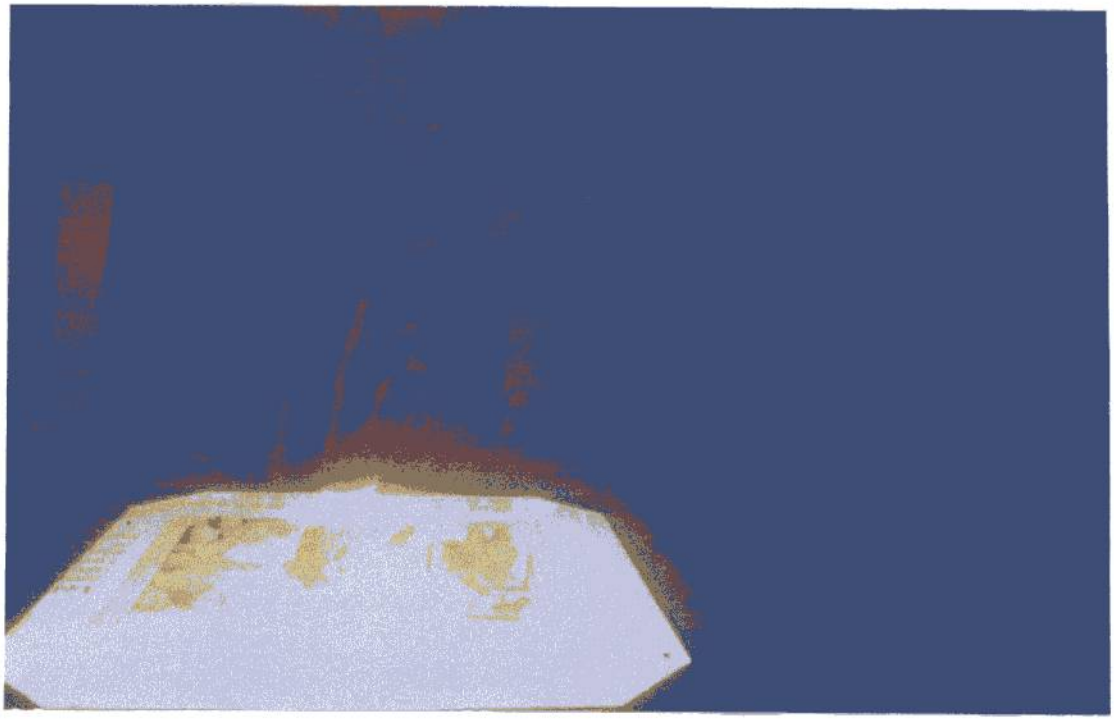
ENLARGEMENT

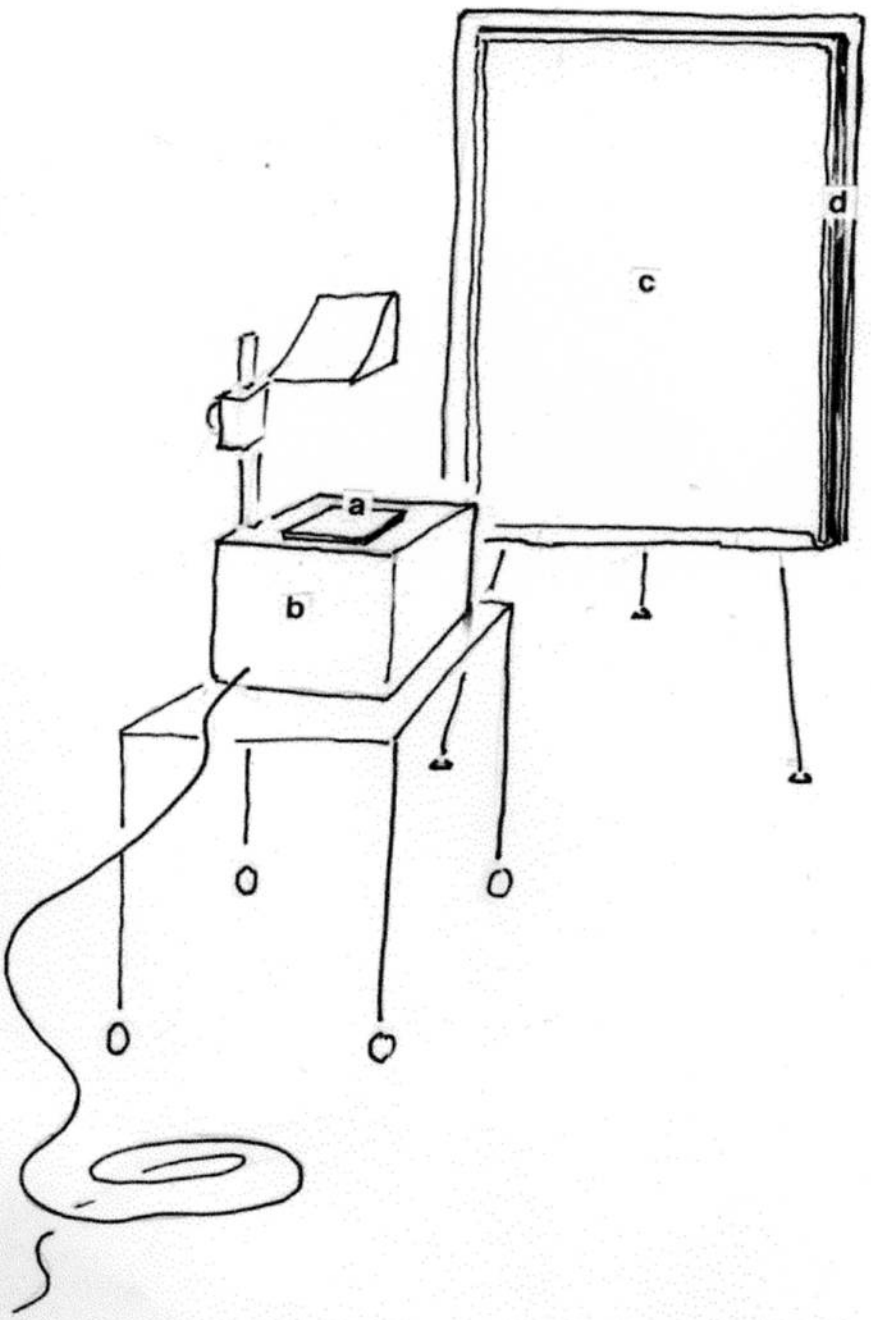
▶ **Here is a technique for enlarging a drawing.** ➔

- **Draw your own picture on a clear sheet.**
- **Put it on the projector.**
- **Move the trolley till your enlargement is the size you want.**
- **Draw it.**

■ **What happens if you set the trolley at an angle to the screen?**

	NUMBER	TITLE
GROUP		
STATION		(Above continued)
TOPIC		




a
b
c
d

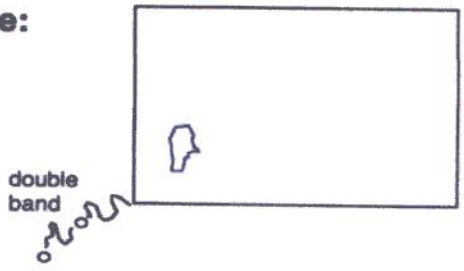
PICTURE KEY	DESCRIPTION	TRADE NAME	U.K. SOURCE
a	3 mm Glodex, 150 mm square		local
b	OHP + trolley, sufficient free cable to allow trolley to be moved in and out to give a range of magnifications from, say, x3 to x6		(see, e.g., **2.9 b** & **c**)
c	whiteboard, 850 mm x 600 mm, 3 mm Glodex sheet inset and taped in place round edge		local - e.g. IKEA, Partners
d	easel, heavy-duty - e.g. the sort used to support A1 flipcharts		Selectasize (address above)

	NUMBER	TITLE
GROUP	2	TRANSFORMATIONS
STATION	2.3.3	THE RUBBER BAND ENLARGER
TOPIC		As 2.3.1

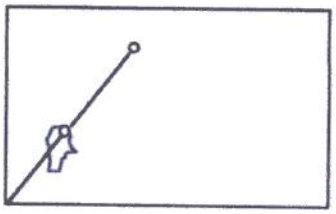
THE RUBBER BAND ENLARGER

● Four steps:

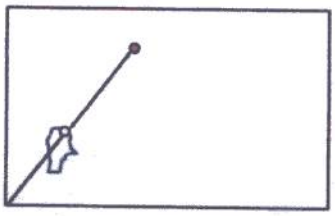
1. Draw a small picture:



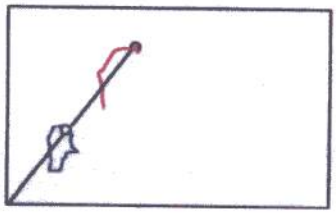
2. Stretch the double band till the first ring lies over your picture:

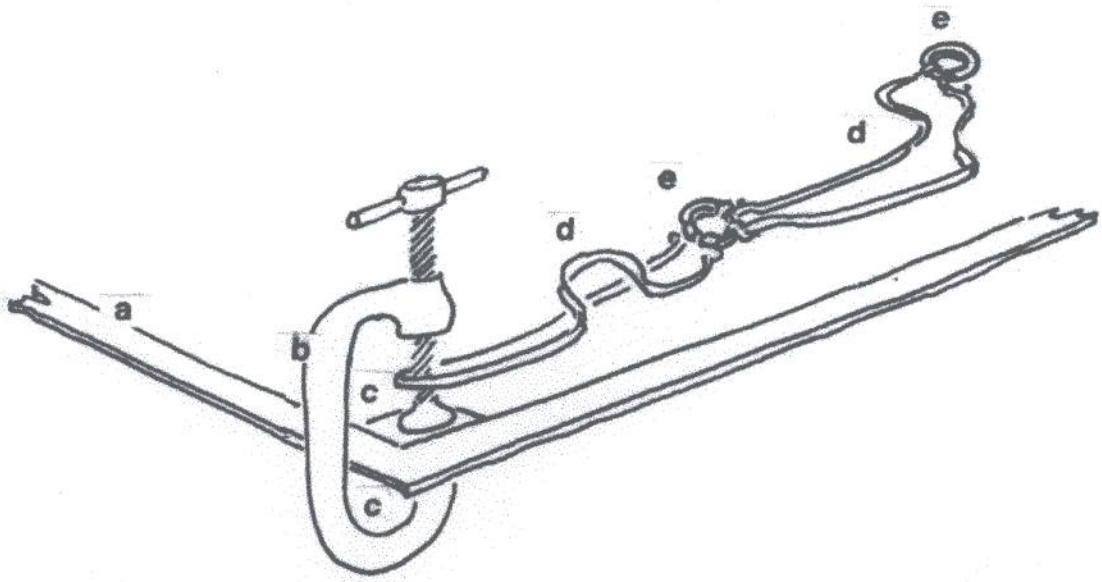


3. Put a pen in the second ring:



4. Follow your picture with the first ring, letting the pen draw its own:



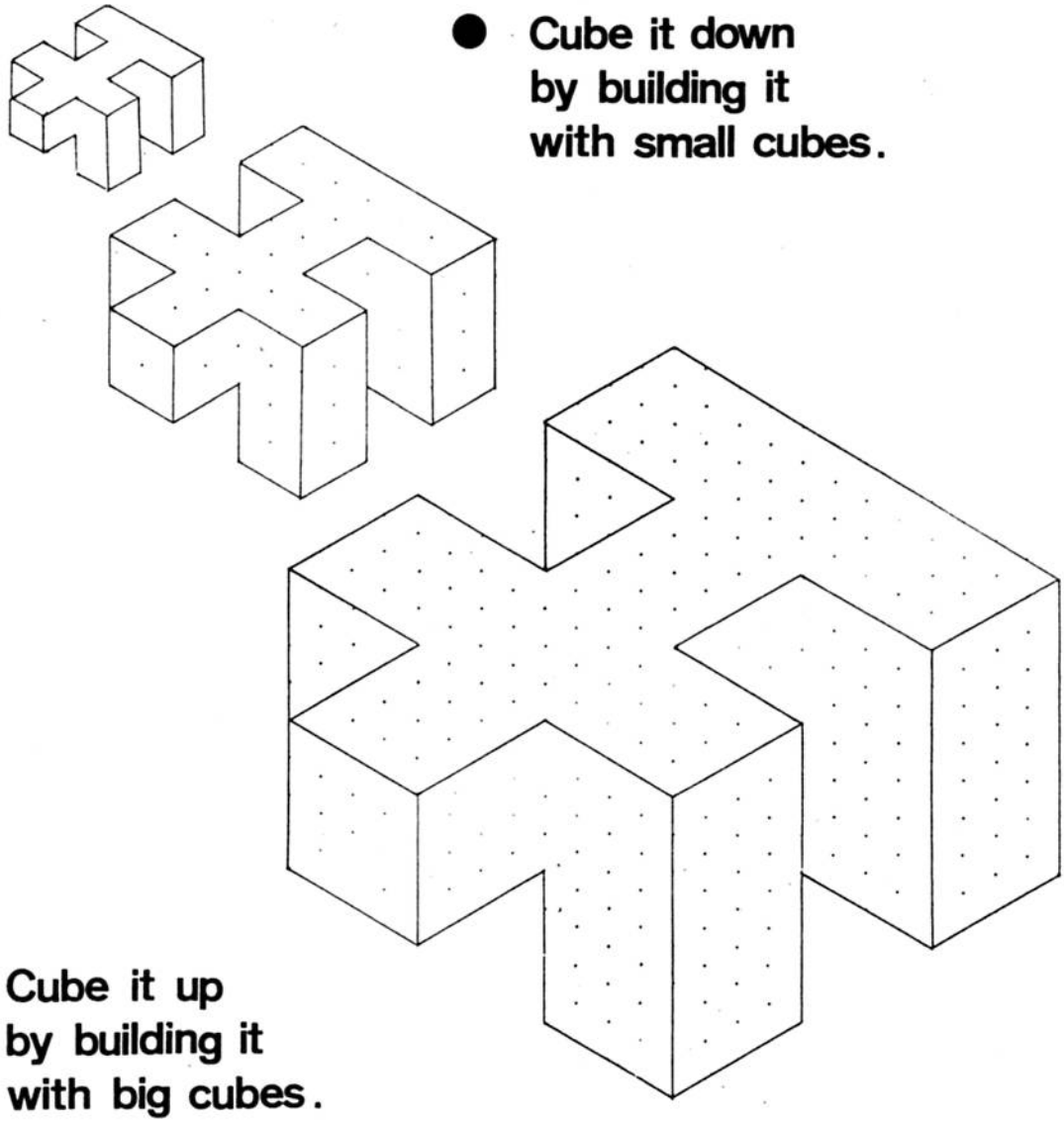

a
b
c
c
d
d
e
e

PICTURE KEY	DESCRIPTION	TRADE NAME	U.K. SOURCE
a	As **2.3.2 c** The board overlaps the corner of the supporting table to accommodate the G-cramp.		(q.v.)
b	G-cramp, of size to allow jaws to open to 20 mm		local
c	tiles top and bottom to distribute stress, e.g. 3 mm PVC, 25 mm square		local
d	rubber band, broad, of about 150 mm unstretched length		local
e	washer, internal diameter slightly greater than that of final collar of dri-wipe pen in use (see **Part 1: General Notes: The Caption Boards: pens**)		local

	NUMBER	TITLE
GROUP	2	TRANSFORMATIONS
STATION	2.3.4	CUBING UP AND DOWN
TOPIC		Enlargement (in 3-D)

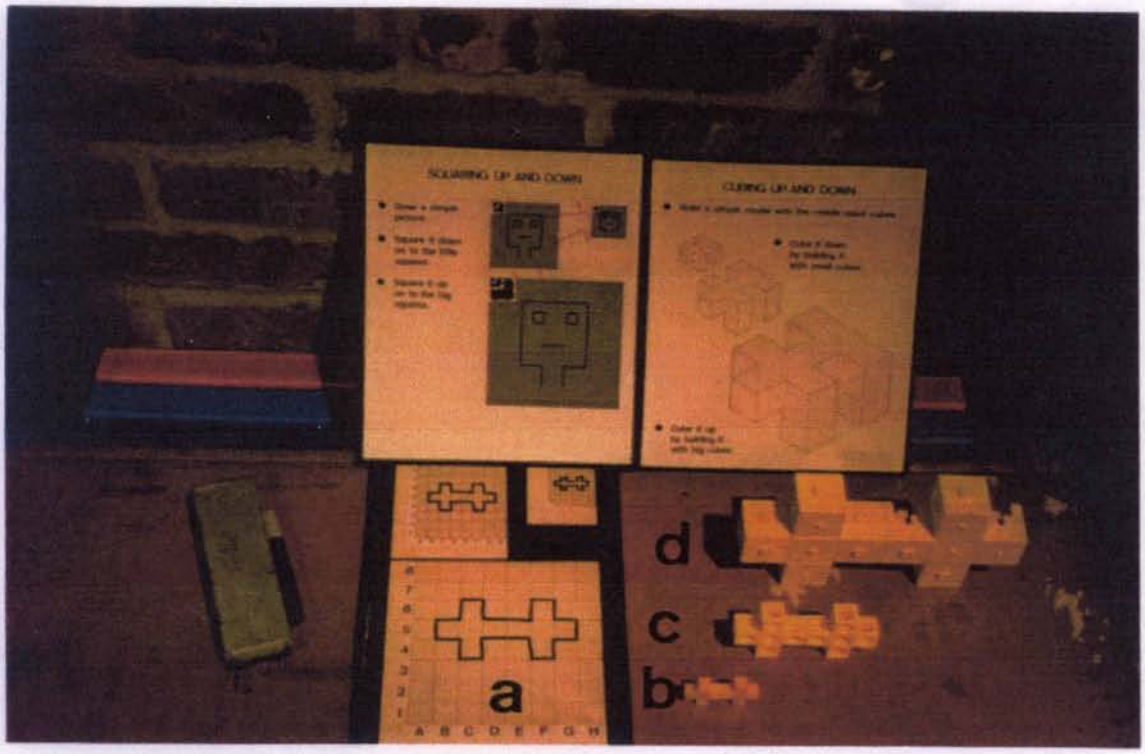
CUBING UP AND DOWN

- **Build a simple model with the middle-sized cubes.**

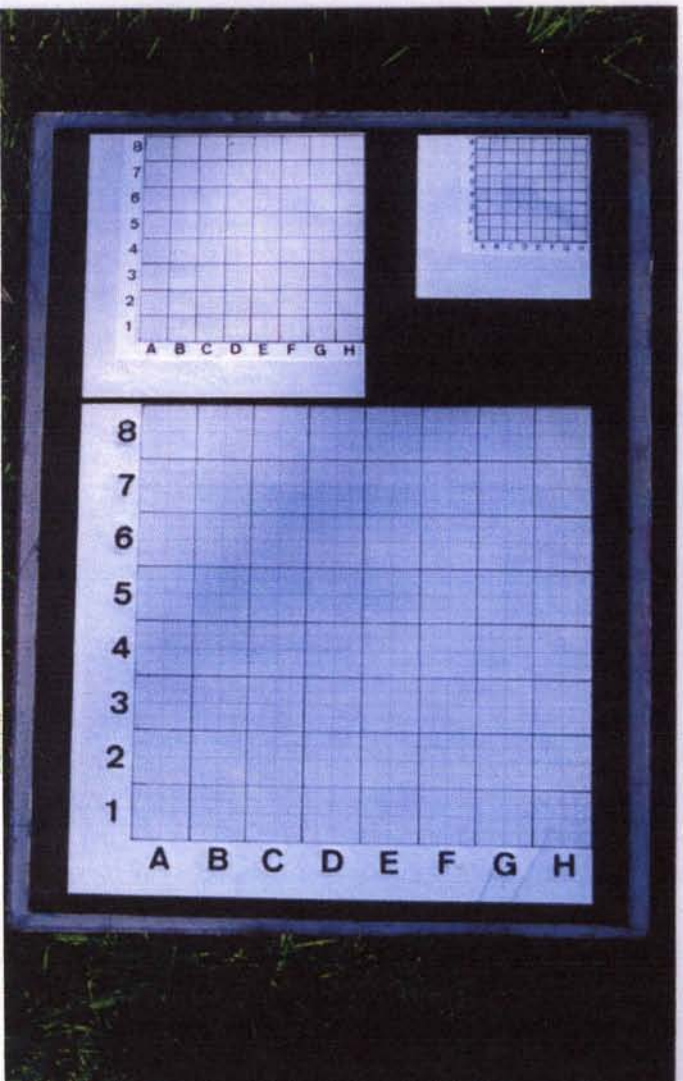


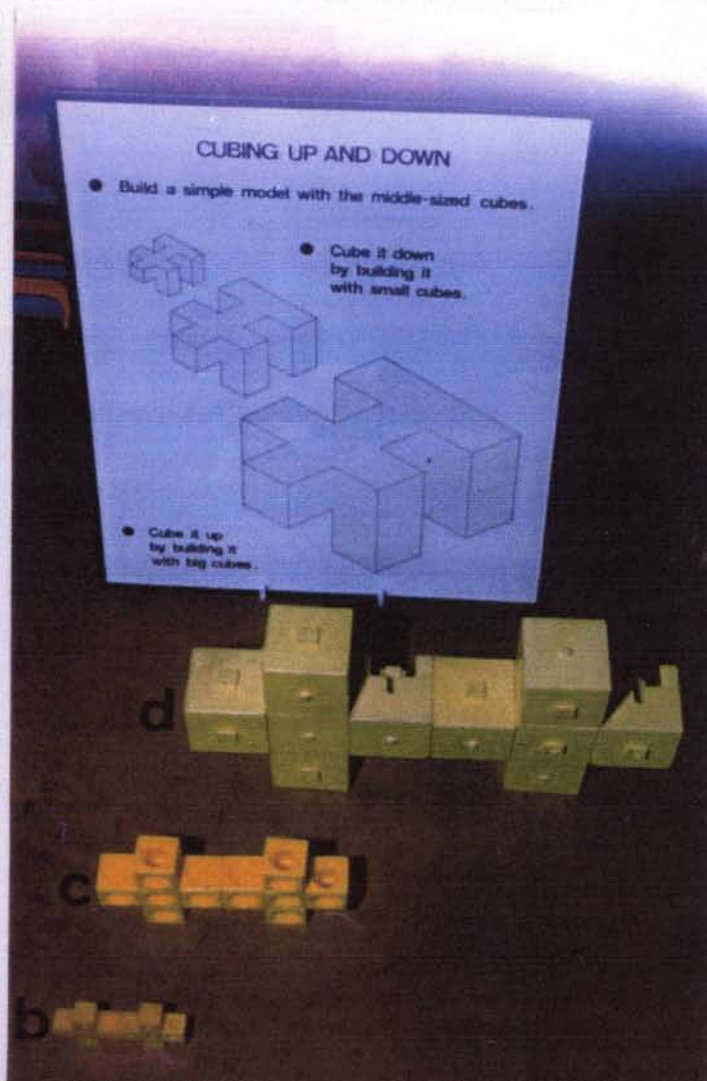
- **Cube it down by building it with small cubes.**

- **Cube it up by building it with big cubes.**


SQUARING UP AND DOWN
CUBING UP AND DOWN
a
d
c
b

a


8
7
6
5
4
3
2
1
A B C D E F G H

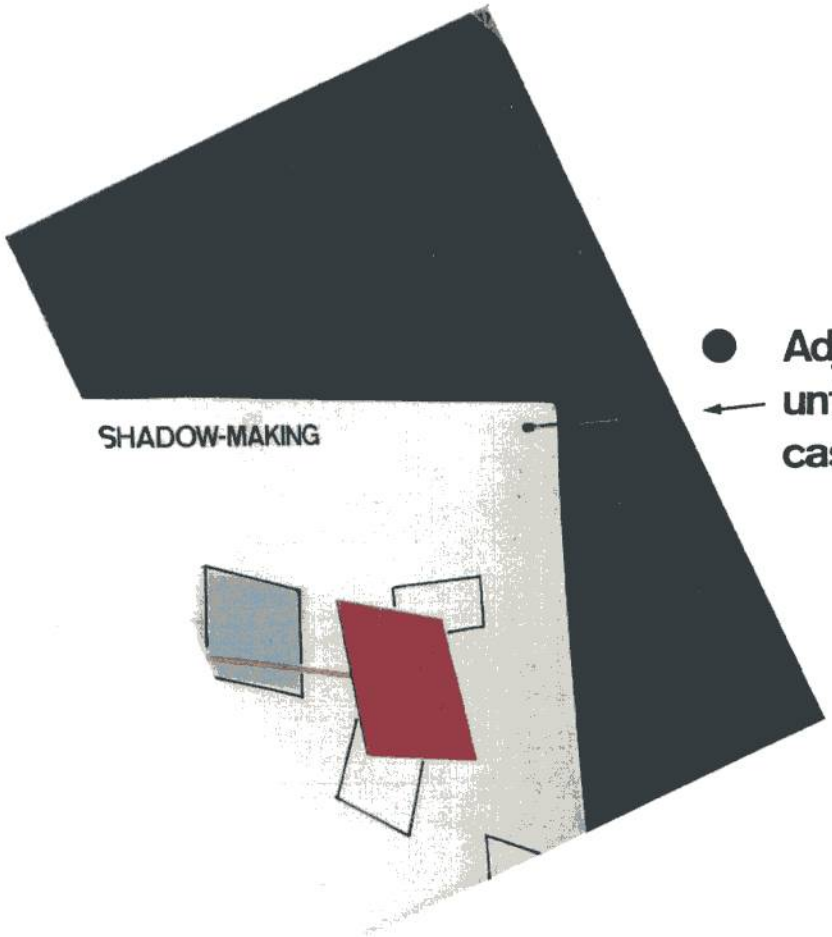

CUBING UP AND DOWN
Build a simple model with the middle-sized cubes.
Cube it down by building it with small cubes.
Cube it up by building it with big cubes.
d
c
b

PICTURE KEY	DESCRIPTION	TRADE NAME	U.K. SOURCE
a	grids shown stuck to caption board as described; Glodex sheet of same dimensions taped over top		
b	cubes, 1 cm [a refers back to 2.3.1]	Centicube	v.s.
c	cubes, 2 cm	Multilink	v.s.
d	cubes, 4 cm	Modulix NES Arnold catalogue: KJ 685	NES Arnold Ltd (address above)

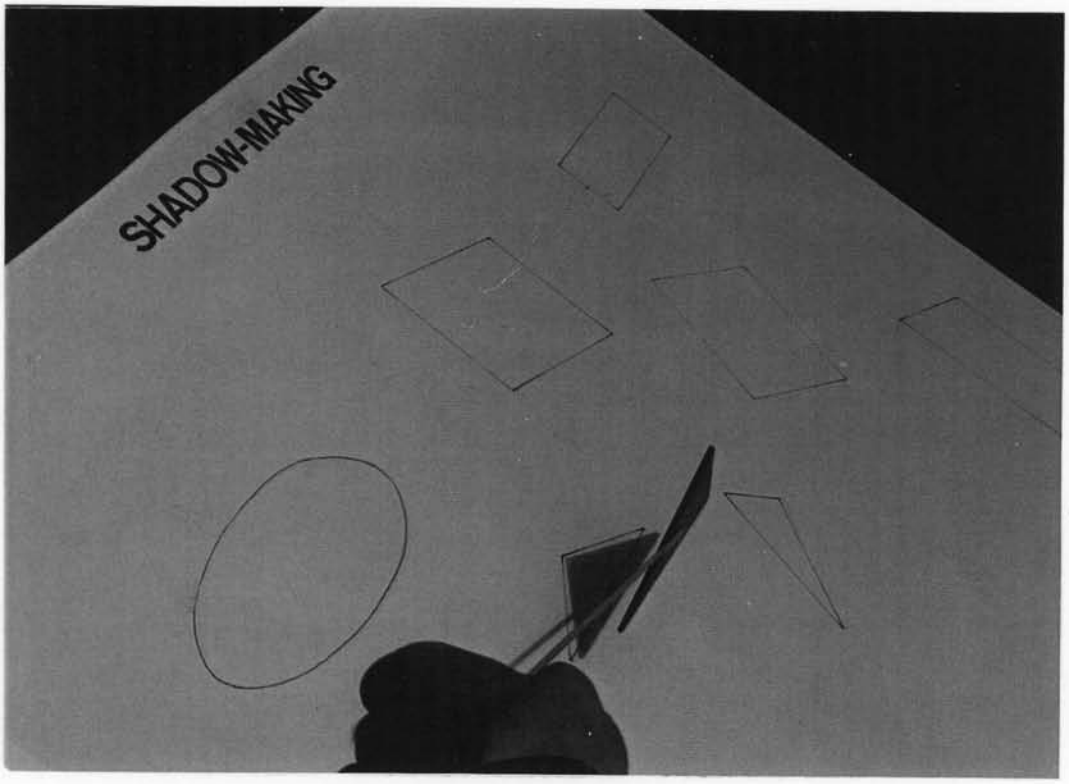
	NUMBER	TITLE
GROUP	2	TRANSFORMATIONS
STATION	2.4	SHADOW-MAKING
TOPIC		Parallel-preserving transformations

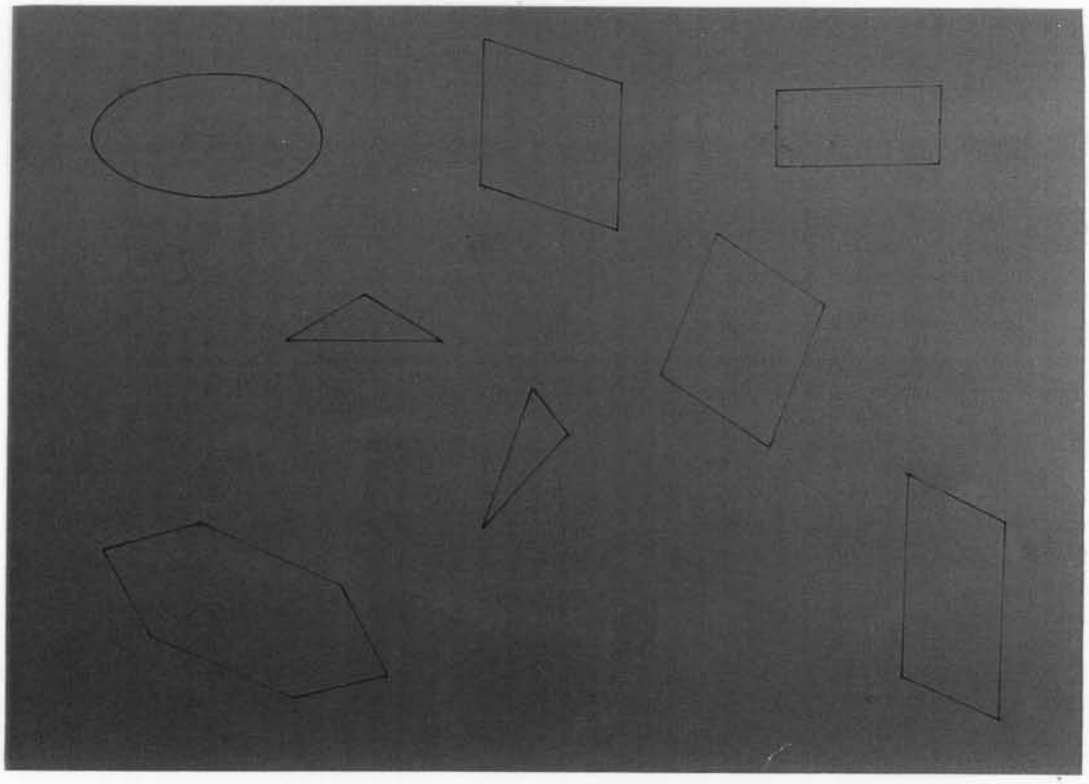
SHADOW-MAKING

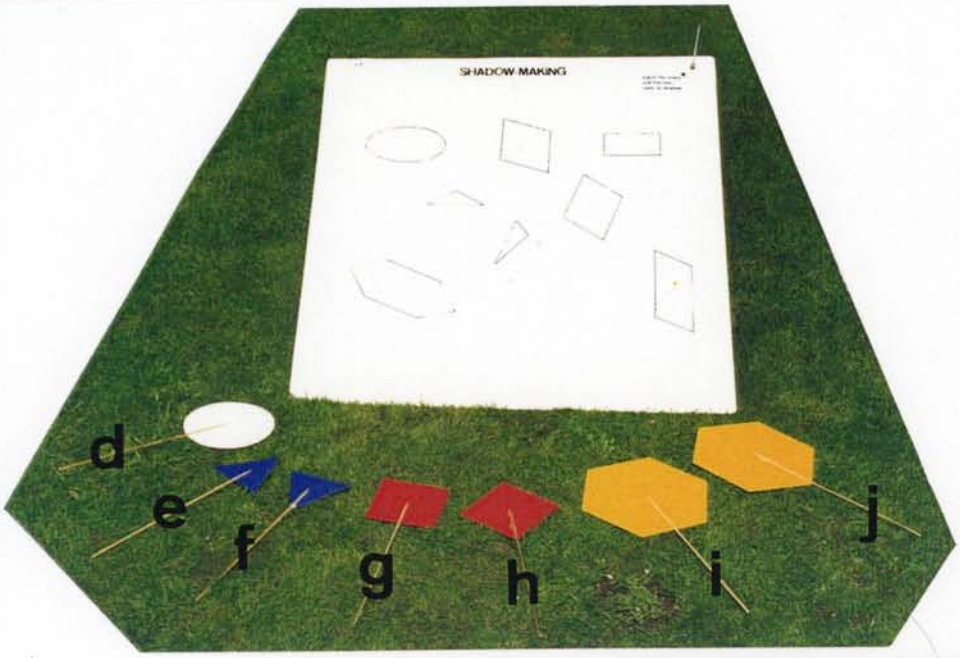
- Choose the correct shapes.
- Try to hold them in such positions that their shadows fit the outlines:

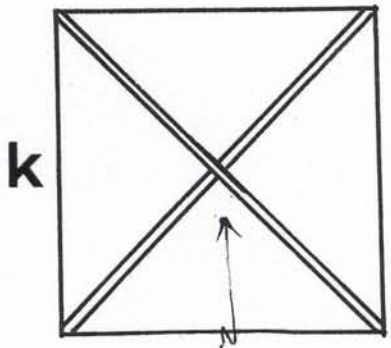


- Adjust the board ← until this rod casts no shadow.

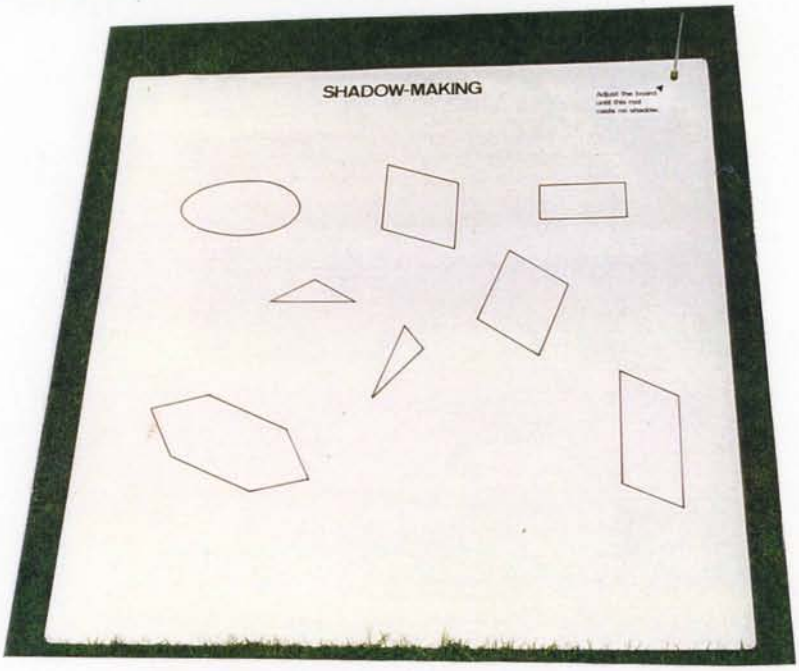

SHADOW-MAKING

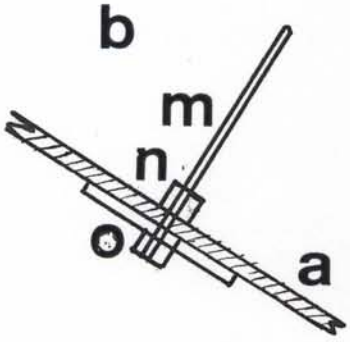


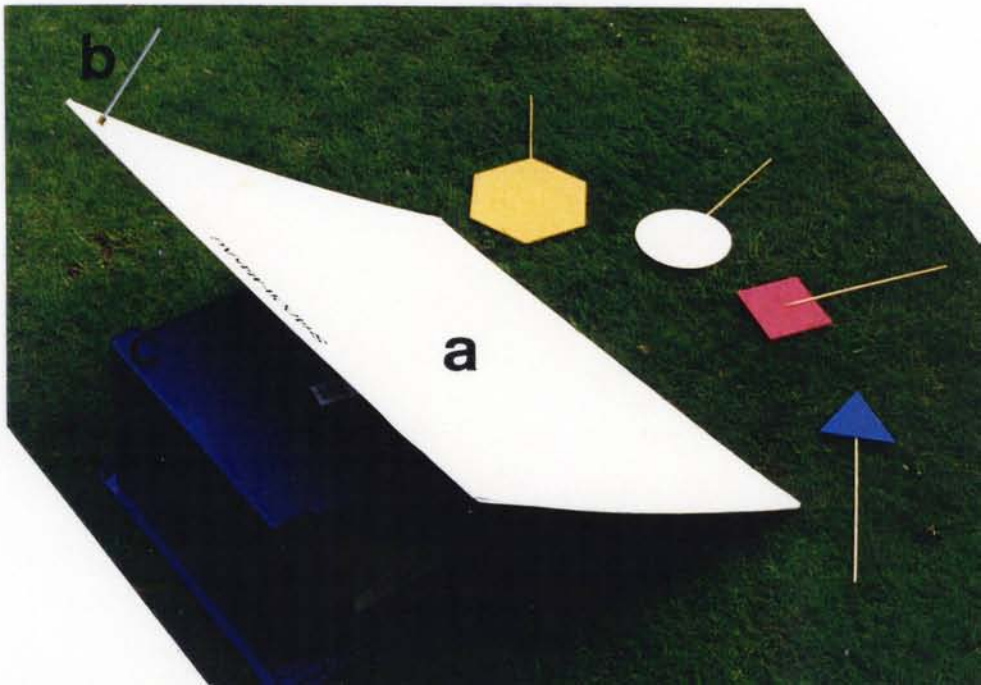

SHADOW MAKING
d
e
f
g
h
i
j


k


l


SHADOW-MAKING


b
m
n
o
a

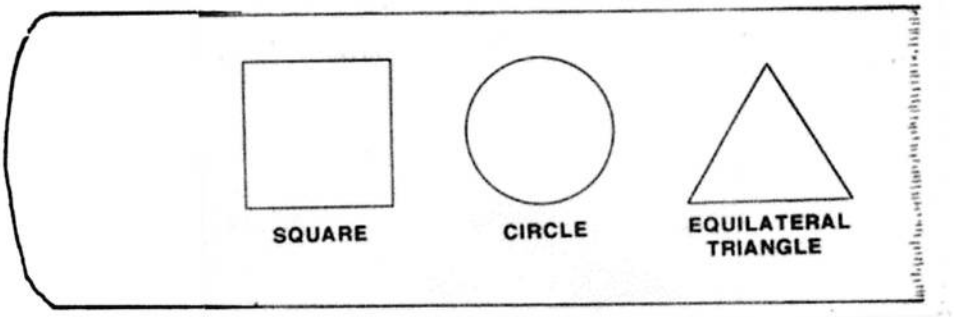

b
a

PICTURE KEY	DESCRIPTION	TRADE NAME	U.K. SOURCE
a	white-faced hardboard, 750 mm x 750 mm,		local
k	braced across the back by 2 12 mm x 6 mm wood laths		
l	crossing in butt joint		
	The board must be light enough for the students to move but not so light that it blows over easily.		
b	gnomon, removed for transport; when located, it should be perpendicular to the board within 1°.	Meccano; part nos. as follows:	Everything Meccano 4 Greys Road Henley-on-Thames Oxon RG9 1RY
m	rod, 100 mm long	15A	T +44 1491 572436 F +44 1491 571175
n	collar + grub screw	59	
o	bush wheel + grub screw	24	
c	support - here Addis Module 2000 unit 4		v.s.
d - j	shapes as laminae in 3 mm PVC, stuck to wands circular in section except where bevelled to accommodate laminae	Amari Foam 3 mm	Amari Plastics Shenstone Trading Estate Bromsgrove Road Halesowen West Midlands B63 3XB T +44 1215 509971 F +44 1215 503476
d	disk, 100 mm diameter		
e, g, i	regular polygons, 60 mm edge, mounted with wands as **edge** bisectors		
f, h, j	same, wands as **angle** bisectors		
e, f	triangle		
g, h	square		
i, j	hexagon		
	The outlines are best made by reversing the experiment, i.e. casting shadows with the shapes held obliquely and drawing round them.		

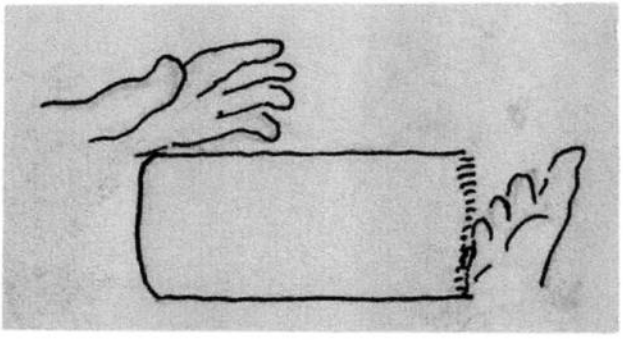
	NUMBER	TITLE
GROUP	2	TRANSFORMATIONS
STATION	2.5	SHEARS
TOPIC		As 2.4 but a special case

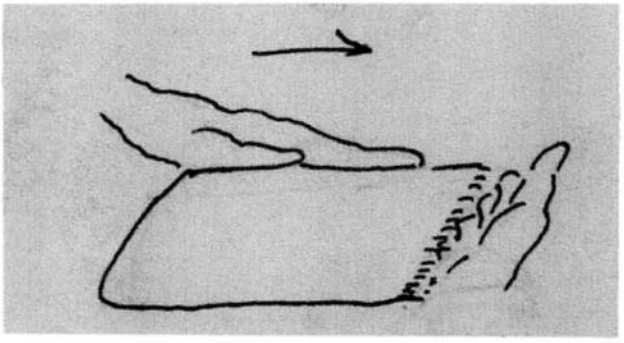
SHEARS

- **Look at the shapes drawn on the end of the catalogue:**

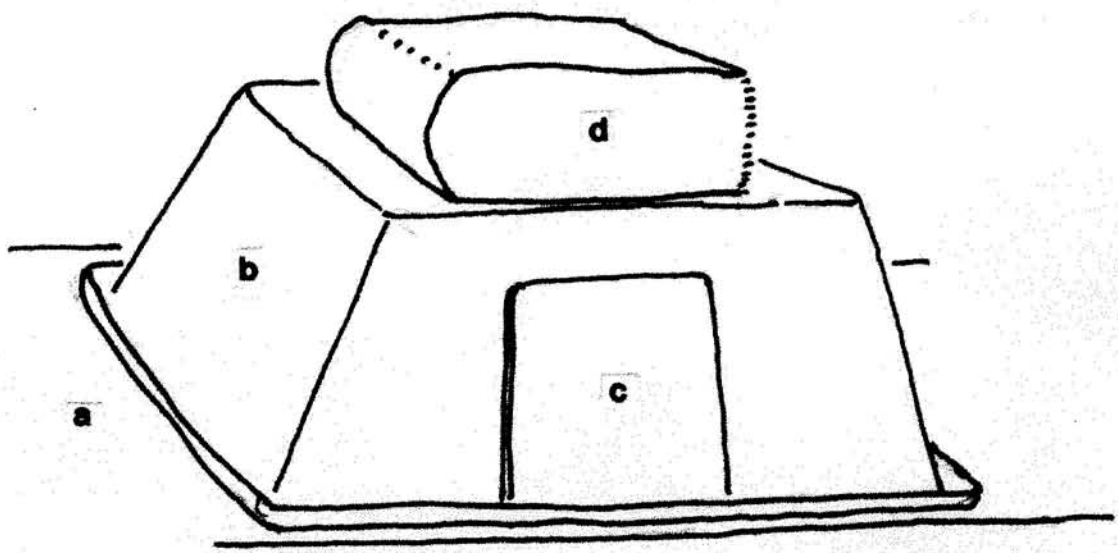


- **Predict what will happen to each shape when you do this:**





- **This transformation is called a SHEAR.**

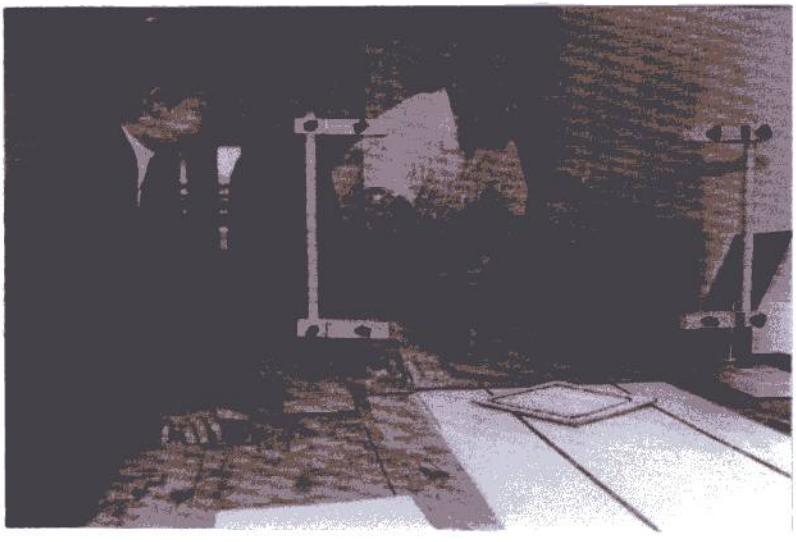

d
b
c
a

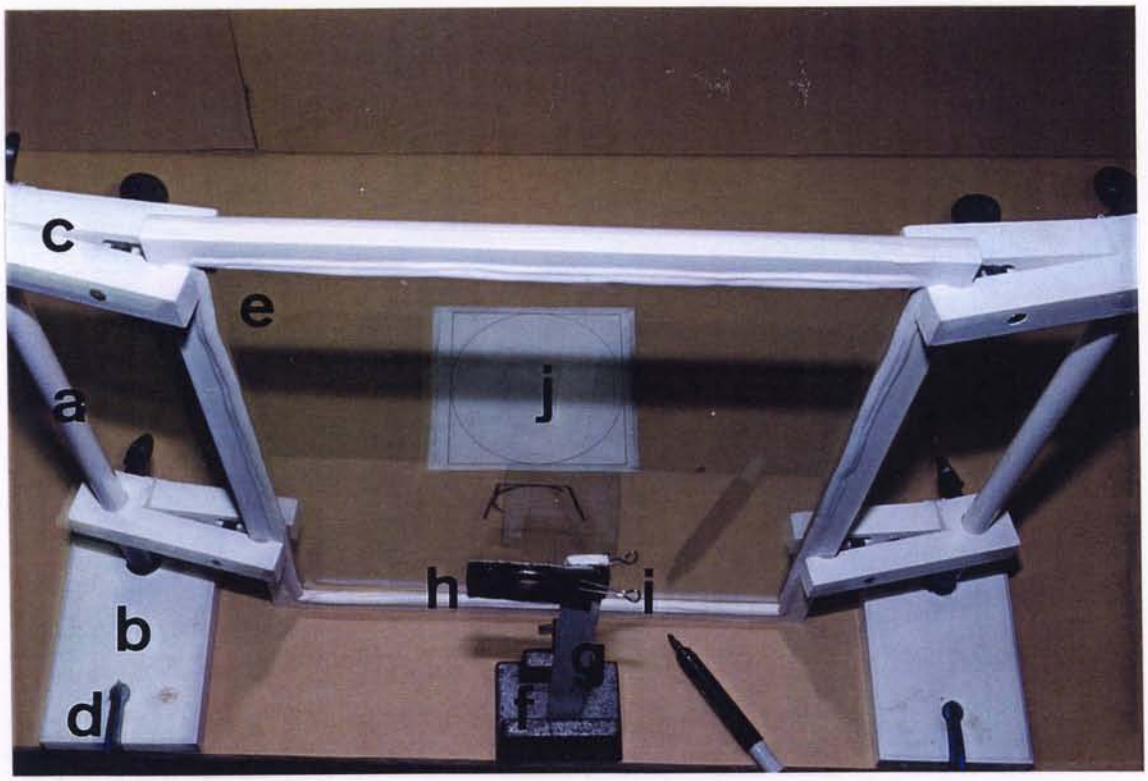
PICTURE KEY	DESCRIPTION	TRADE NAME	U.K. SOURCE
a	table top		
b	Addis Module 2000 system no. 4 (see **Part 1: The Storage System**)		Addis Housewares Ltd (address above)
a, b	The idea is to bring the end of the catalogue to eye level for a standing experimenter.		
c	position of caption		
d	any catalogue sufficiently thick - the thicker the better The apparatus should approximate a stack of loose sheets. The lefthand side of the sheared stack should be flat. To reduce the distorting effect of the binding, the figures should be drawn reasonably far from it.		local

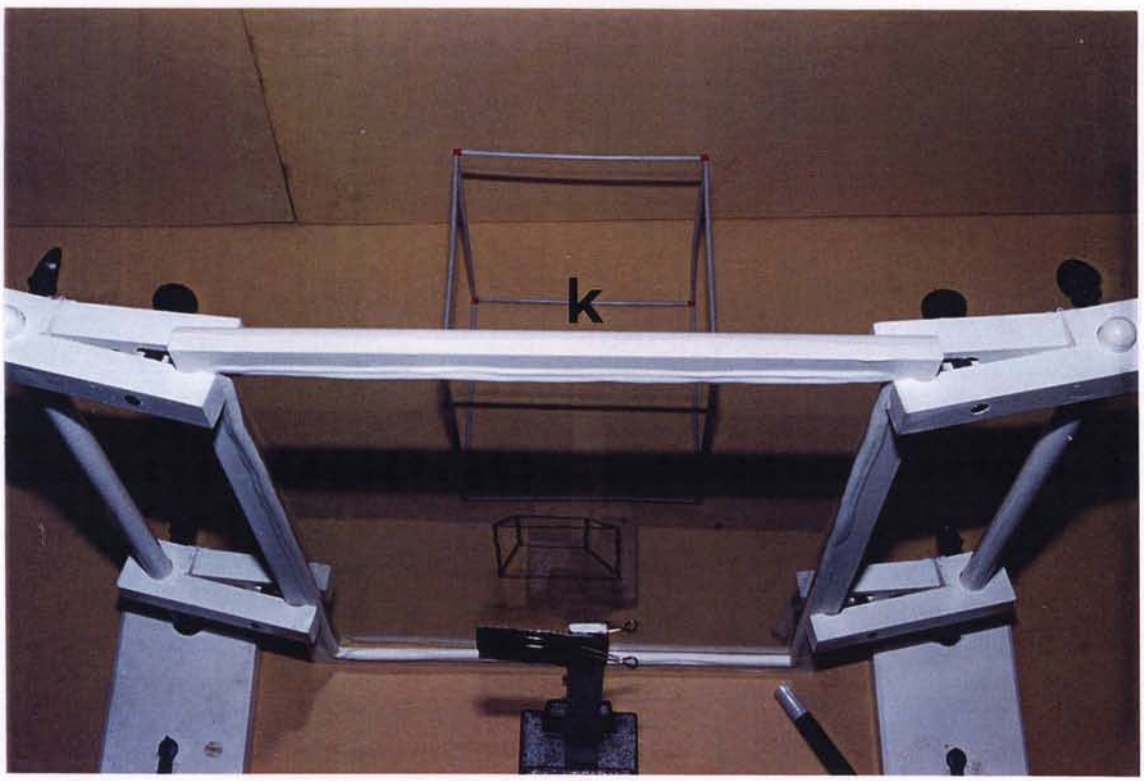
	NUMBER	TITLE
GROUP	2	TRANSFORMATIONS
STATION	2.6	PERSPECTIVE DRAWING
TOPIC		Projective transformations (central)

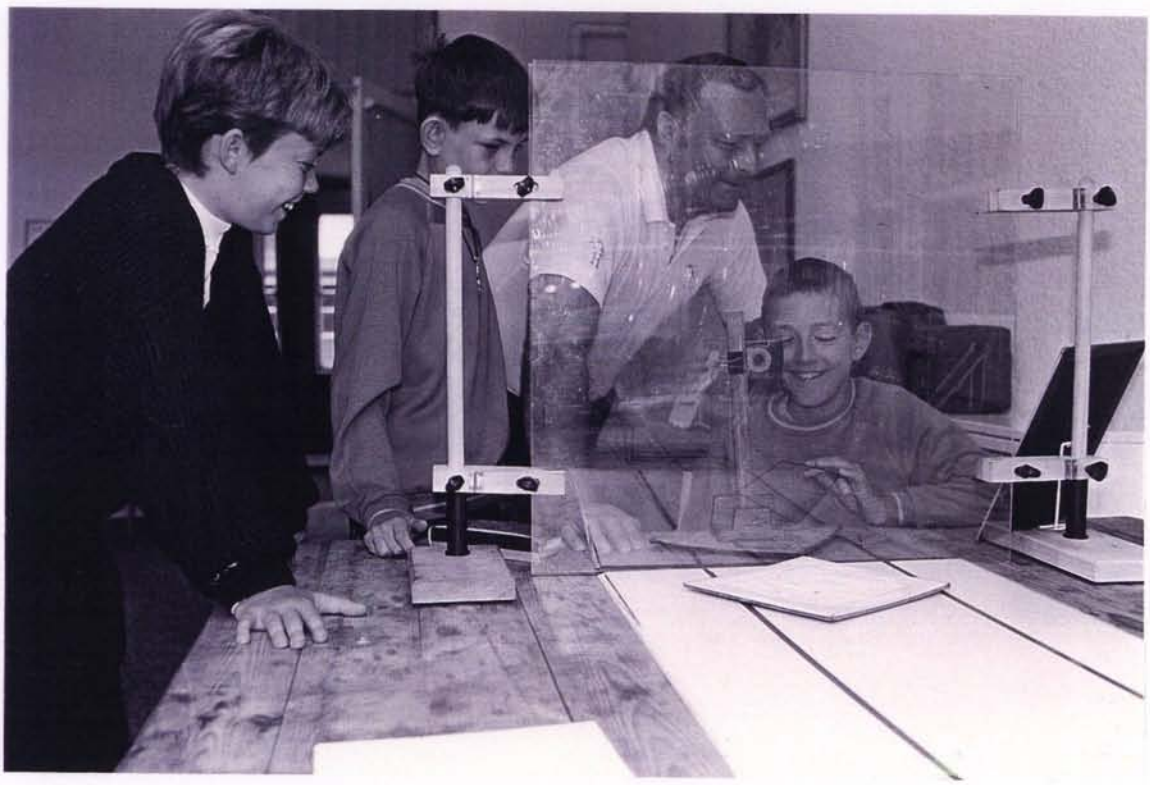
PERSPECTIVE DRAWING

How will your shape turn out when you trace it on the glass?




c
e
a
j
h
i
b
g
f
d

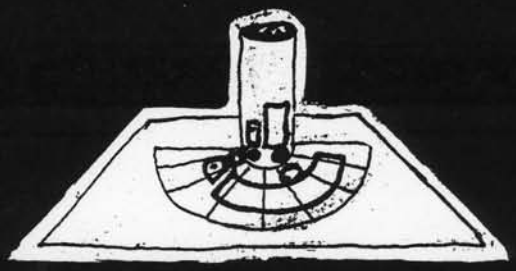

k



PICTURE KEY	DESCRIPTION	TRADE NAME	U.K. SOURCE
a, b	retort stand; **a** unscrews from **b** for transport	STA-200 -010F	Griffin Education (address above)
c	clamp for same	STA 220 -010X	
d	G-cramp		local
e	glass, secured in picture frame by beading over draught-excluding strip; overall dimensions: 450 mm (wide) x 525 mm (high)		local
f	slotted base	STA-395-W	Griffin Education (address above)
g	wood lath, 25 mm (wide) x 6 mm (deep) x 200 mm (high)		local
h	sight: washer with 12 mm hole in black mount, held to **g** by:		local
i	bulldog clip; this allows:		local
	1. the height of **h** to be adjusted.	Orbit: 0114 + Kubic Bubbles: 0030	Cochranes of Oxford Ltd Fairspear House Leafield Widney Oxon OX8 5NY T +44 1993 87641 F +44 1993 87416
	2. **h** to be switched to the right-hand side of **g** for observer wishing to use left eye.		
	Ff. 2-D shapes - drawn on caption boards protected by Glodex as described - suggested:		
	1. circle, 200 mm diameter		
	2. square, 200 mm		
j	**3.** circle in square, same dimensions		
	4. equilateral triangle, 200 mm edge		
	F. 3-D shape - as demountable skeleton solid - suggested:		
k	**1.** cube, 200 mm		
	Ff. 3-D shapes - as perspex solids -	Hope Education catalogue:	Hope Education Ltd (address above)
	2. cylinder, diameter: 205 mm, height: 205 mm	PL 580/ 096	
	3. cone, diameter: 205 mm, height: 205 mm	as above	
	4. pyramid, square-based, diameter: 205 mm, height: 205 mm	as above	

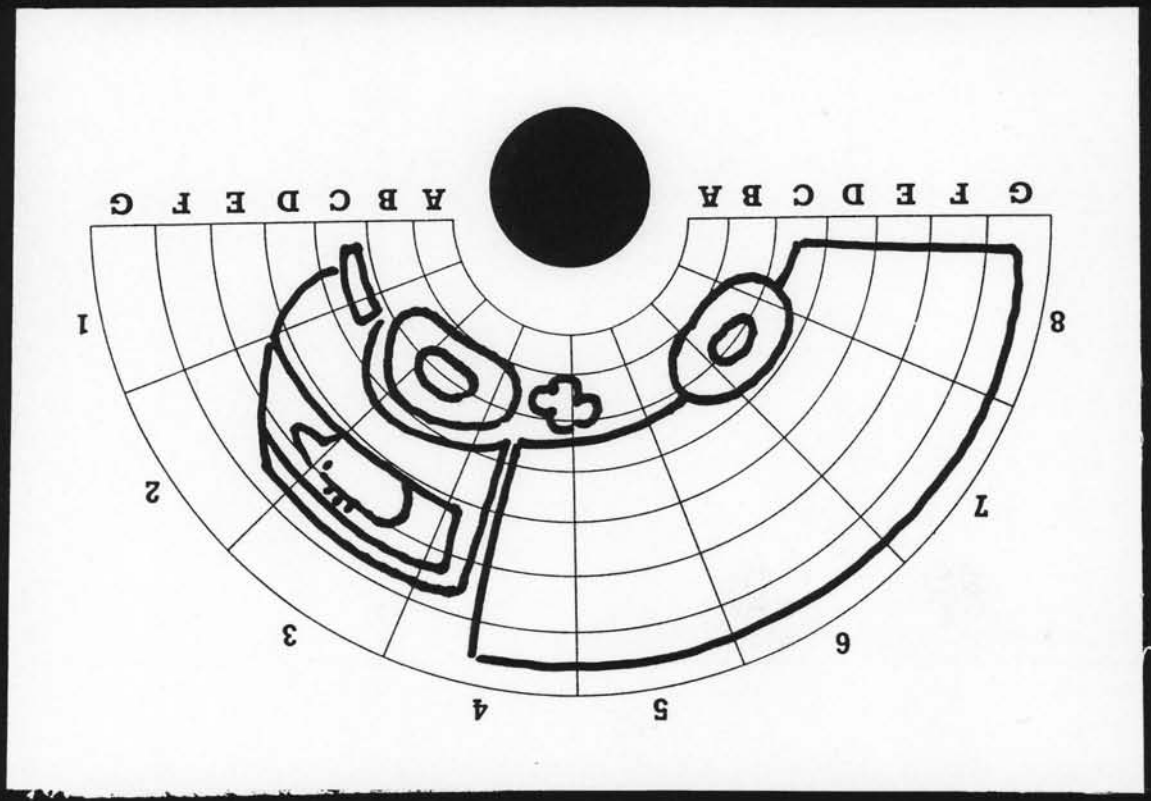
	NUMBER	TITLE
GROUP	2	TRANSFORMATIONS
STATION	2.7.1	ANAMORPHS
TOPIC		Anamorphic transformations

ANAMORPHS



	NUMBER	TITLE
GROUP		
STATION		(Above continued)
TOPIC		

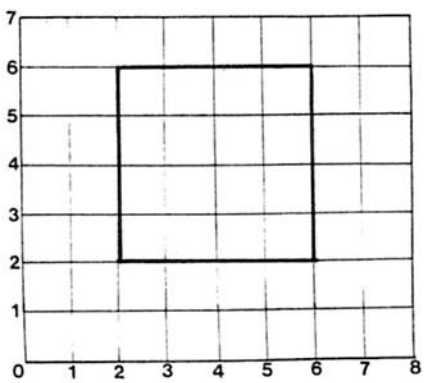
HINGE



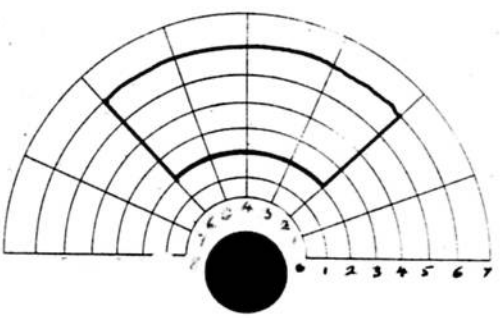
	NUMBER	TITLE
GROUP	2	TRANSFORMATIONS
STATION	2.7.2	ANAMORPHS
TOPIC		As 2.7.1.

ANAMORPHS

- Draw a shape on the square grid.

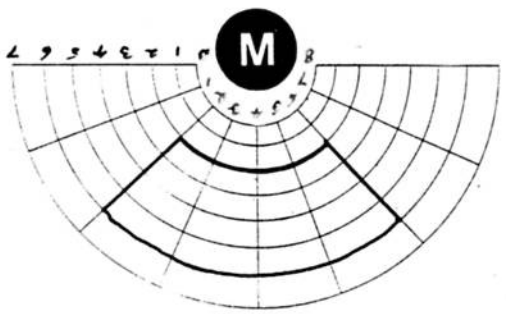


- Copy it on the fan-shaped grid.



shape → → Distort → → 'non-shape' (anamorph)

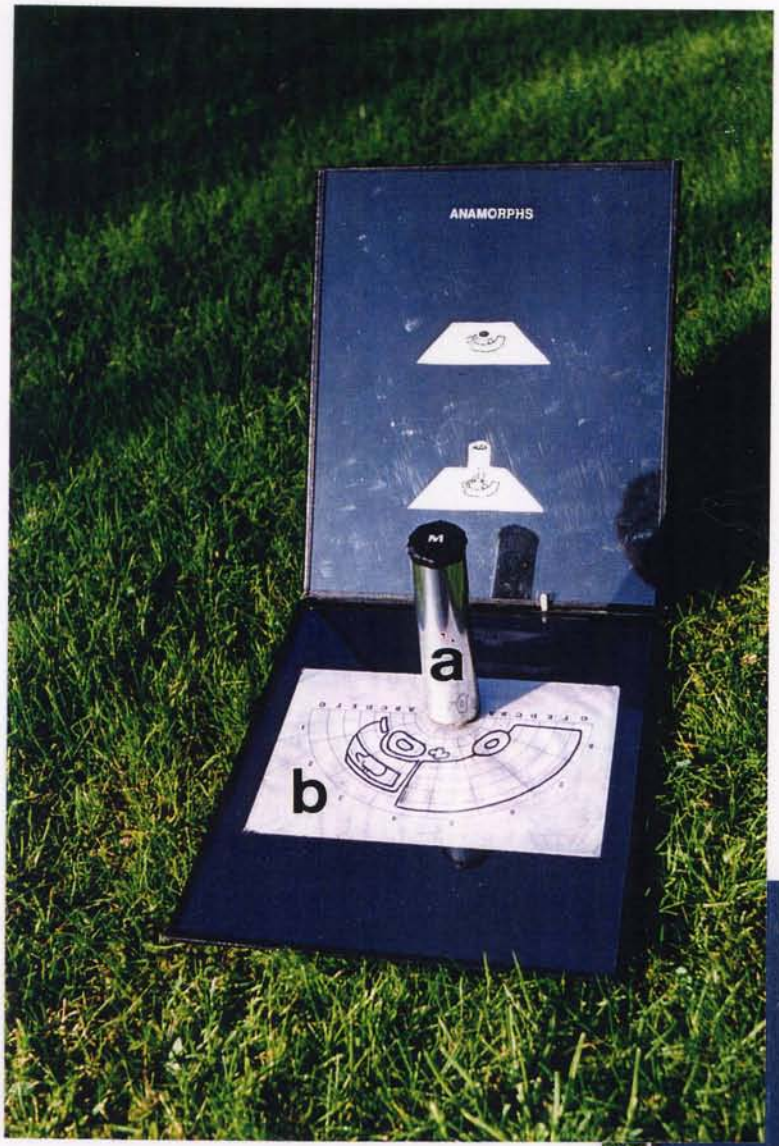
'non-shape' (anamorph) ← ← Correct ← ← shape

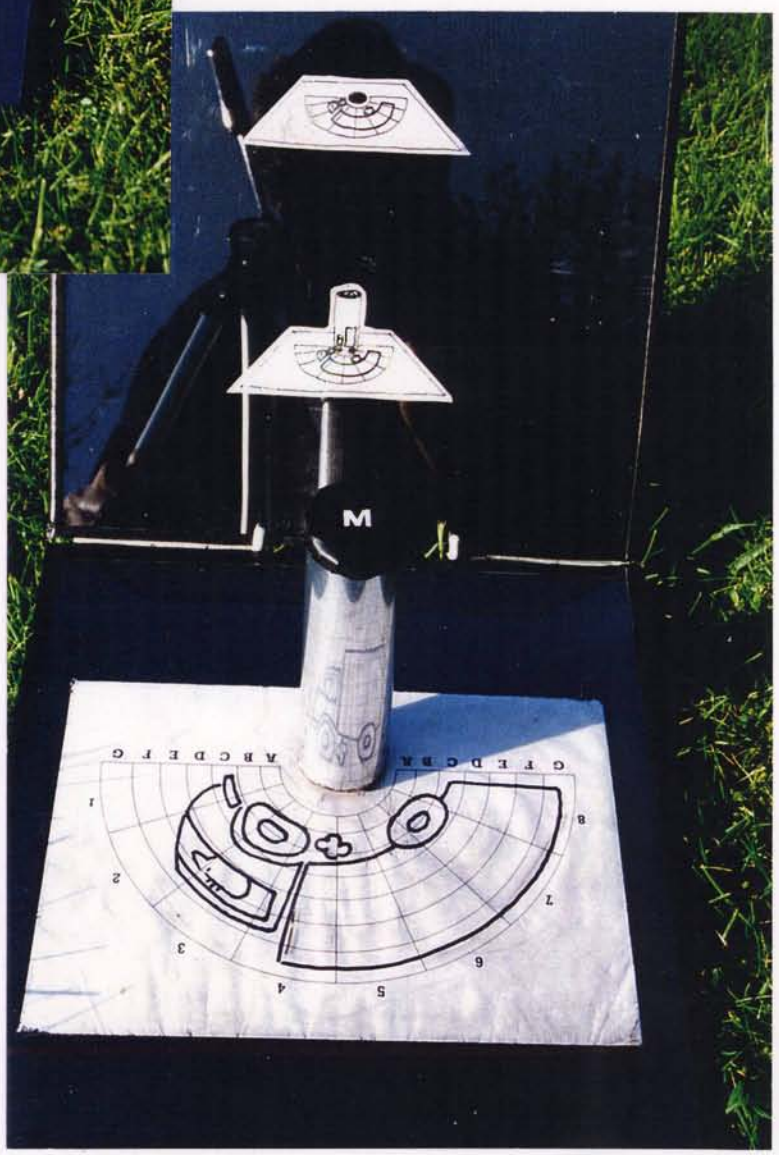


- Turn it round.
- Stand the mirror on the black circle:

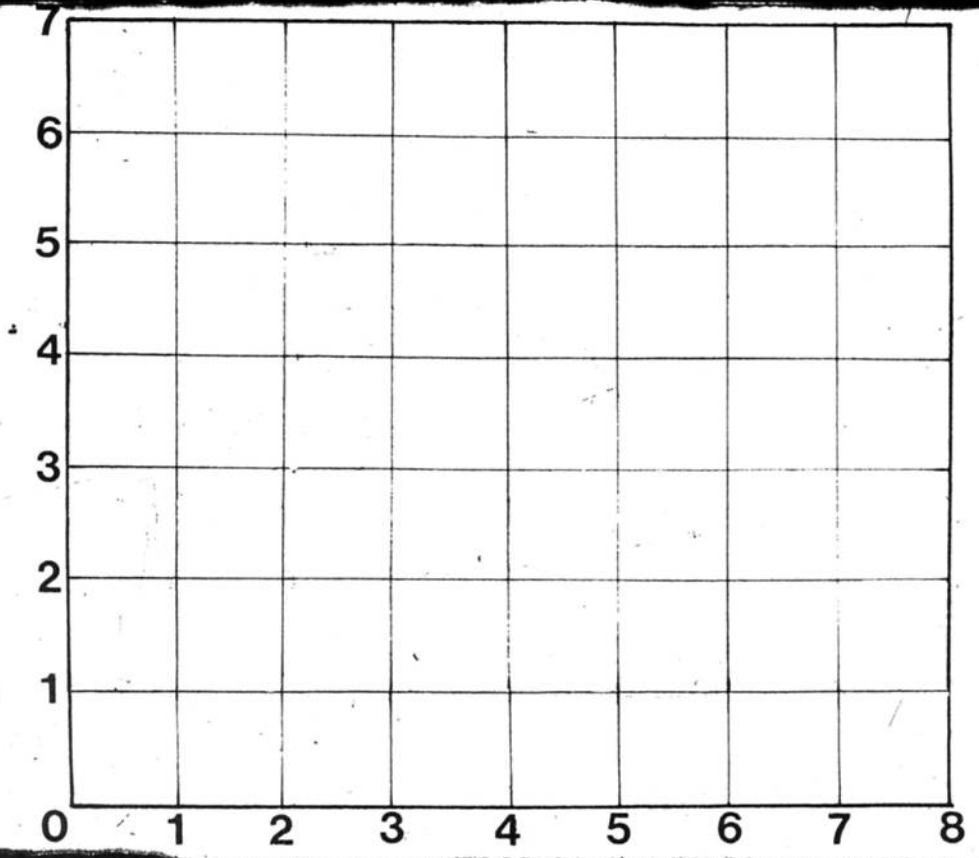
M

- Look in the mirror.
- What do you see?

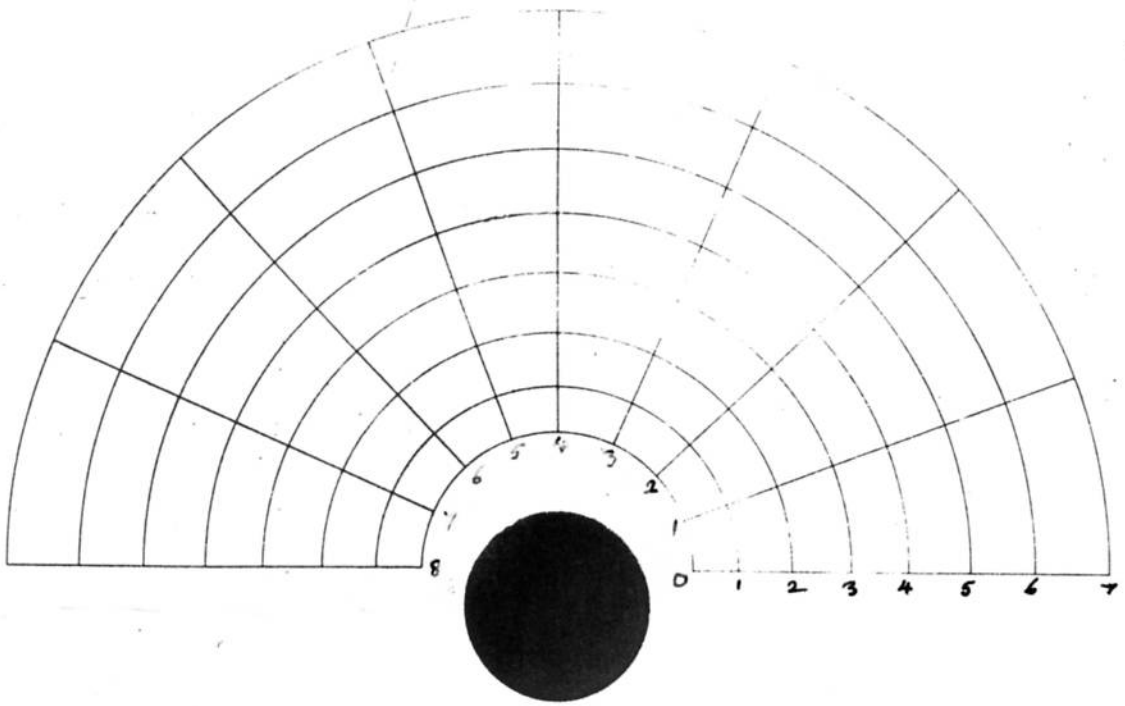

ANAMORPHS
a
b


M
A B C D E F G
G F E D C B A
1
2
3
4
5
6
7
8

c



d

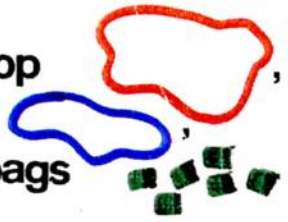


PICTURE KEY	DESCRIPTION	TRADE NAME	U.K. SOURCE
a	flexible mirror, 100 mm (high) x 75 mm (wide), glued, bent around wood dowel, 100 mm (high) x 25 mm (diameter), and taped	Economatics catalogue: 08803 (formerly Osmiroid catalogue: 8803)	Economatics Ltd (address above)
b,c,d	grids shown sandwiched between caption boards and Glodex sheets as described		

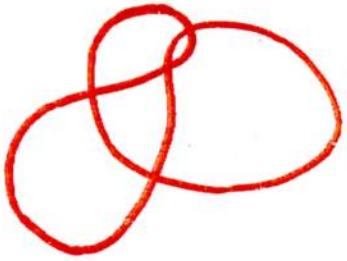
	NUMBER	TITLE
GROUP	2	TRANSFORMATIONS
STATION	2.8.1	CROSSING COUNTS 1
TOPIC		Topologically equivalent cases. The Jordan Curve Theorem

CROSSING COUNTS 1

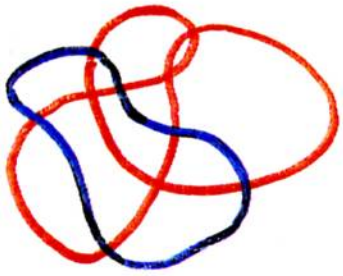
▶ Here is:
an orange loop,
a blue loop,
green bean bags.



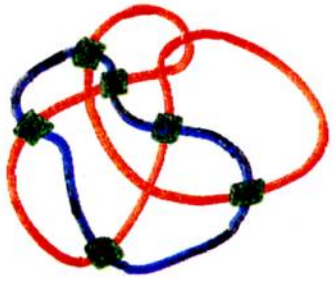
● Throw the orange loop down:



● Throw the blue loop on top of it:



● Put a bean bag wherever blue crosses orange:



● Count the bags.

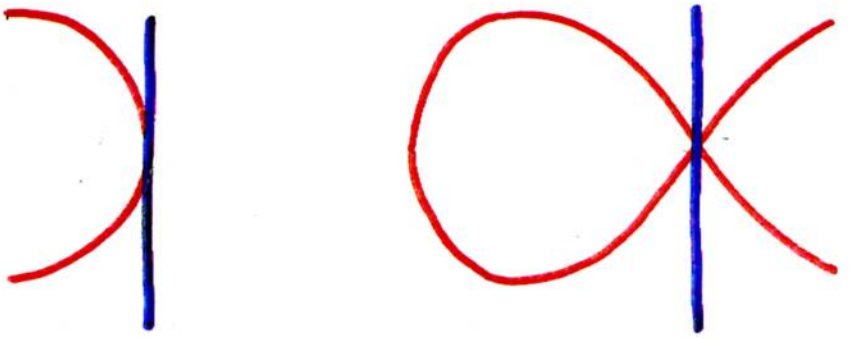
● Record your count by clicking a red cube in the number stick. If your count is odd, the cube won't go in. Study the next board and check your bags.

■ Why must the count be even?

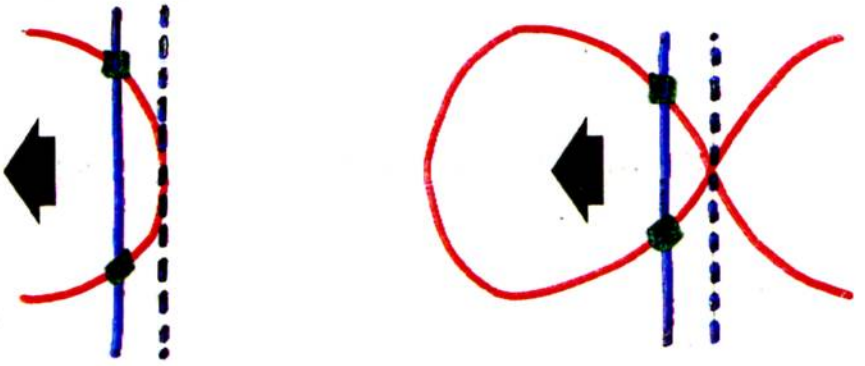
	NUMBER	TITLE
GROUP		
STATION		(Above continued)
TOPIC		

TWO SPECIAL CASES

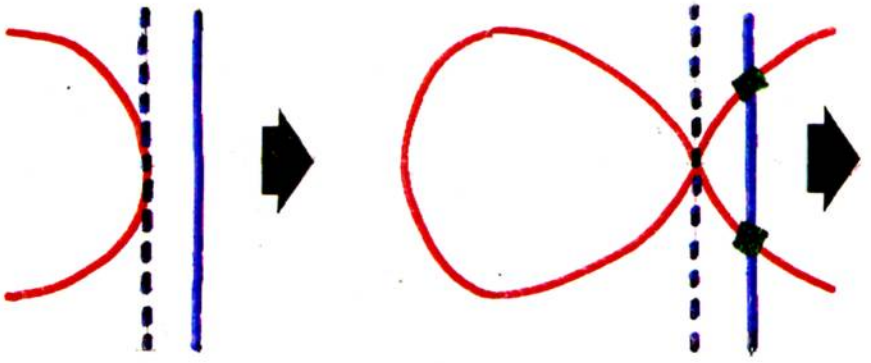
- **If this ... or this ... happens,**



move the blue rope this way ...



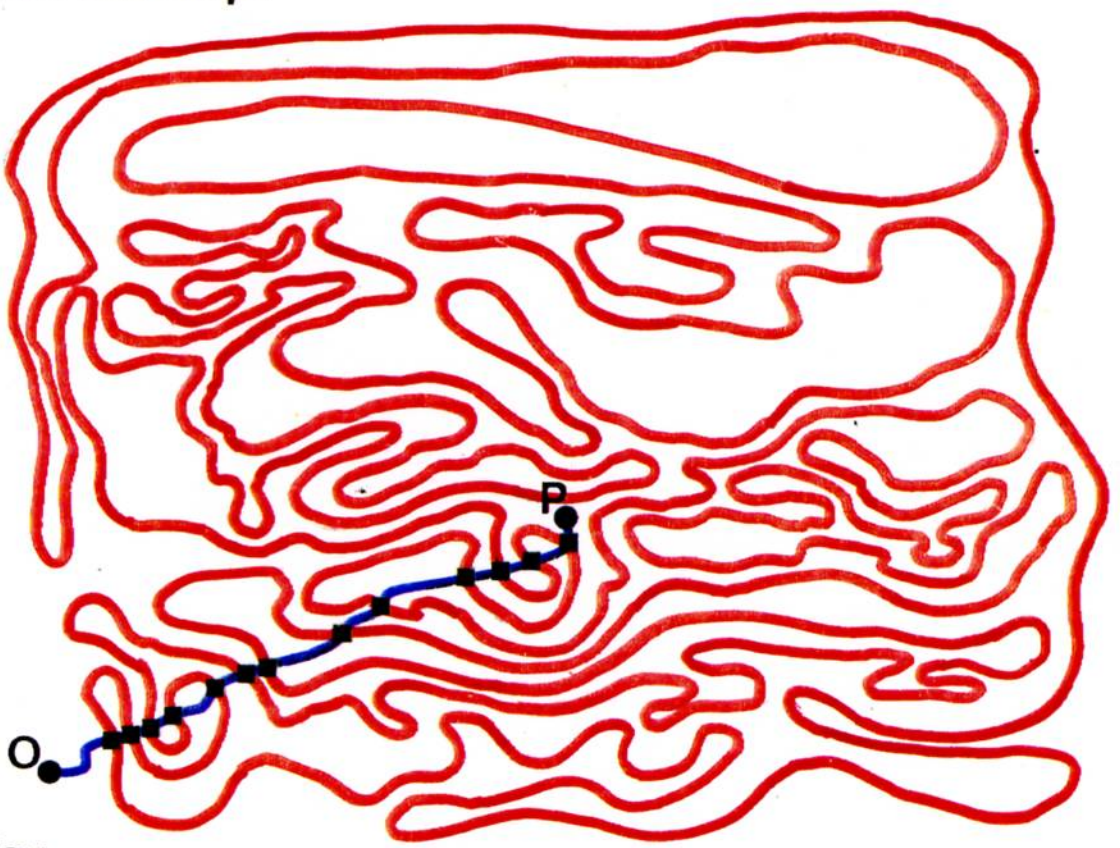
or this way ...



	NUMBER	TITLE
GROUP	2	TRANSFORMATIONS
STATION	2.8.2	CROSSING COUNTS 2
TOPIC		As 2.8.1

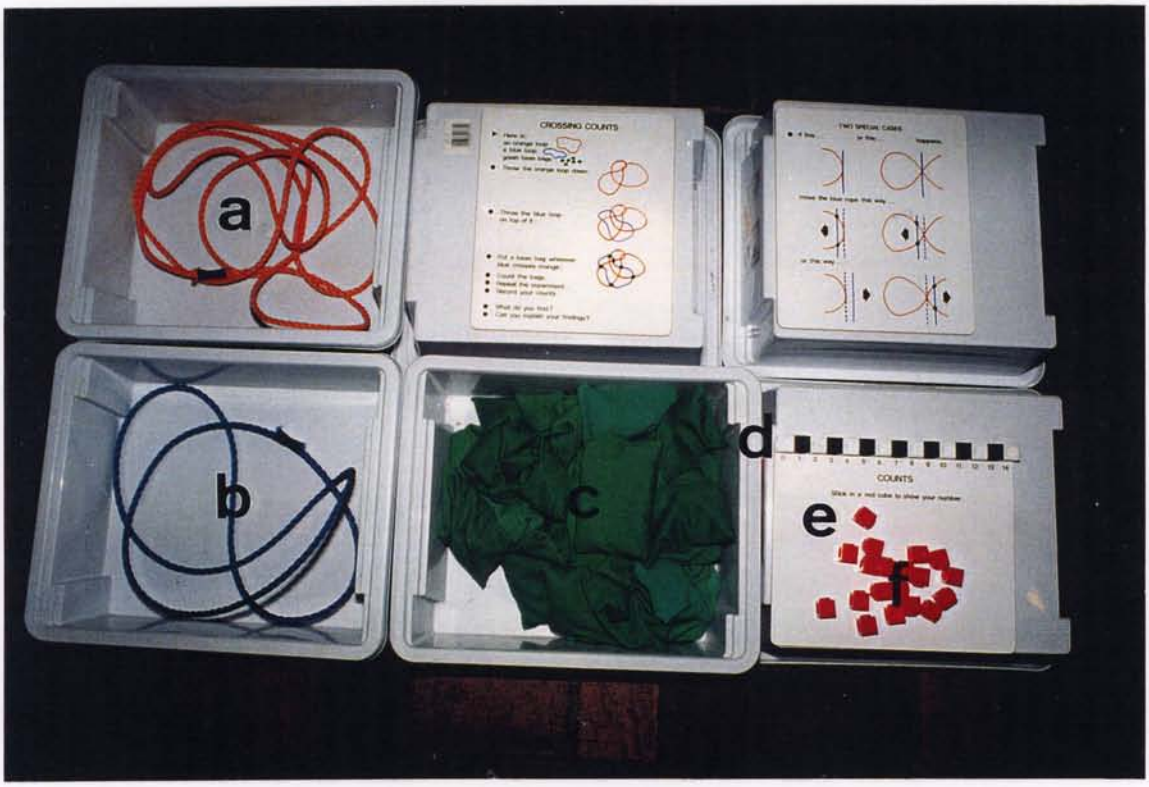
CROSSING COUNTS 2

▶ **Inlandia is surrounded by Outlandia.**
Here is a map:



▶ **Key**

- O● a city in Outlandia
- ~ a road
- ■ a border crossing
- P● a city - but in which country?


a
CROSSING COUNTS
b
c
d
COUNTS
e
f

PICTURE KEY	DESCRIPTION	TRADE NAME	U.K. SOURCE
a, b	ropes, orange and blue respectively, 2 m long, 12 mm diameter, ends taped to form loops		local
c	bean bags, green	NES Arnold catalogue: L 3062/30 **(2 packs needed)**	NES Arnold Ltd (address above)
d, f	Multilink cubes;		v.s.
	black and white glued to form		
d	rod shown;		
	d stuck to		
e	caption board;		
	assembly identical to **d/e**, detachable from same by unpluging cube rod, continues **d** by further 7 black, 7 white cubes; cubes numbered on board as shown from 0 (extreme left) to 28 (extreme right); recesses in black cubes taped over		

	NUMBER	TITLE
GROUP	2	TRANSFORMATIONS
STATION	2.9	SLIDE SHOW TRICKS
TOPIC		A review of Group 2

SLIDE SHOW TRICKS

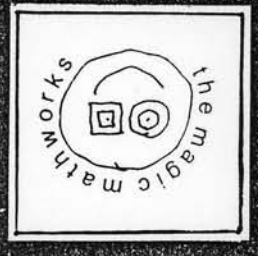
You will find this drawing on a clear plastic sheet on the projector. This sits on a trolley and forms a picture on the screen.

- You may move:
  - the drawing,
  - the trolley,
  - both.

- Make the picture 3 x as big as the drawing.

- Make these pictures:

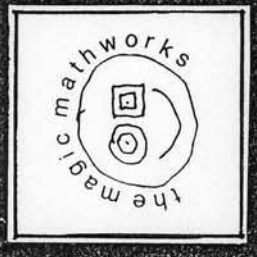
1



3

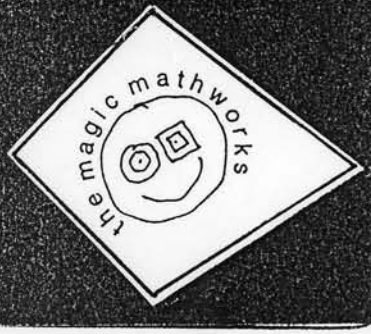
5

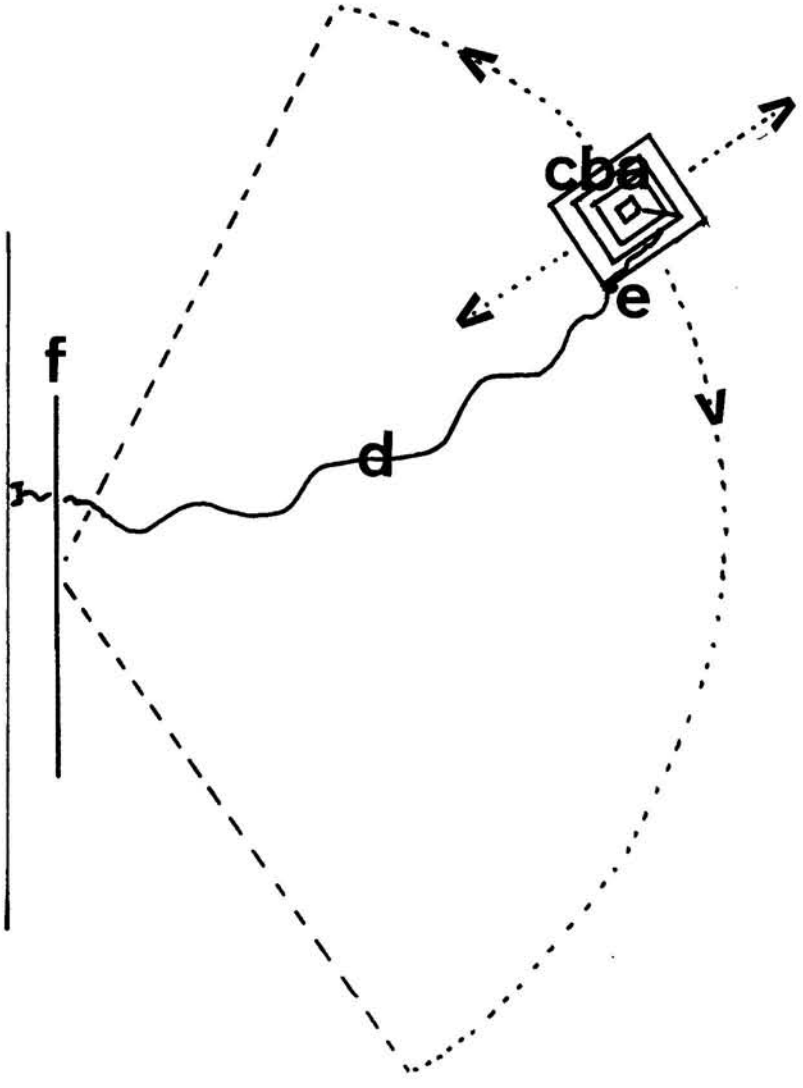
2



4

6




cba
e
f
d
v

PICTURE KEY	DESCRIPTION	TRADE NAME	U.K. SOURCE
a	drawing as caption photocopied on to acetate sheet, A4, - border square has side 200 mm - and sandwiched between Glodex sheets of same size and taped;		local
	used on platen of:		
b	overhead projector, platen A4 square, on:	Elite Vision Selectasize catalogue: 911002	Selectasize (address above)
c	trolley	Brentford trolley Selectasize catalogue: MP 26 AV	
d	cable for projector taped to trolley leg at		
e	e		
f	tripod with projection screen, 1250 mm square	Selectasize catalogue: P5	