

# CHILDREN, MIRRORS & REFLECTION

Jos Elstgeest

## Introduction

Mirrors are fascinating things to play with as well as to work with, for they hold an element of magic. Magic and science seem to be at odds, but not necessarily to children. An exploration in to the reversed double world behind the looking glass may well retain something of the thrill of the fairy tale and so provide a strong motivation to pursue some real science. The fairy-tale mirror does not exist in the real world. Every child knows that. But the mirror does and so does a child's wonder about its workings. It doubles whatever is in front of it; it shows you your own face; it makes letters look funny and, at first, illegible; left right seem confused; it bounces sunlight into a bright spot on the wall; and in combination with another mirror it seems to keep on reflecting reflections infinitely.

Mirrors are universally and cheap to purchase; children can easily be introduced to borrow a mirror from home. Any piece of glass, especially when blackened on one side, makes a workable, though not ideal mirror. Any shiny smooth surface can serve as a mirror. In fact, the shape and form of some ordinary shiny things, such as teapots, wheel hubs, reflectors, Christmas decorations or spoons add to the challenge, for they make things look different.

The activities in this chapter need little introduction to the children: just provide them with mirrors, and slowly structure and order their investigation. It is a unit of learning which entirely depends the children handling mirrors and other things they need. By direct experience and experimentation children will extract information from the mirrors.

It does not take long for children to start exploring when mirrors are placed in their hands. A certain amount of free exploration as 'a getting to know you' exercise is essential. It focuses the children's mind on an area of science, it generates initial questions, it opens a perspective to 'what you could like to know' and .... they do it anyway. However, free all over the place messing about is still somewhat removed from the scientific enquiry, which the children have to learn. The teacher is the one who should bring order and system in children's explorations and turn them into genuine investigation. Having noticed the children's interest and the direction in which it seems to go, the teacher intervenes. Sometimes the work is stopped altogether and the class discusses possible lines of investigation, which have opened up. Sometimes the children are involved enough to be given individually or in small working groups a challenge in the form of a problem or a new piece of equipment. Questions and tasks may be given by word of mouth or by an appropriate worksheet.

In all cases, the work of the children is given more structure, direction and system; it is ready to become more scientific.

This chapter presents a number of ideas for children to investigate various properties of mirrors and how they interact with light. A number of pages could be copied as they are, and given to the children as worksheets. They suggest some problem and indicate how with the help of one or more mirrors solutions can be sought. Many of the ideas and tips given on other pages can be transferred to homemade work sheets.

Any unit for children is a teacher's resource. Many ideas and suggestions are given but they still need the creative teacher to turn them into children's activities or investigations at the right time. Even readymade worksheets still need the judgment of the teacher as to where and when they should be employed and whether they should or should not be adjusted or extended. Worksheets are there to facilitate the work of the teacher; they are aids, tools for the teacher who retains responsibility to ensure effective learning through the activities. The 'figure card' and 'sample cards' describe and need to be made by the teacher, after which they can be given to the children to solve the problems they pose. Making sets of these cards is of course, a very good teacher training activity. The technical problems of making sets of these cards is slight. Those who cannot draw can use very simple figures make a stencil or use small stickers. They are so many ways to make this easy that it should no body off. Apart from the work of composing pictures-to-be-matched, one is compelled to think. Perhaps, there should be 'easy' as well as 'tough' sets; what makes a scale of difficult from simple to hard? Would you include a few cards with an impossible problem? It would not be bad for the children to realize that in the world of mirrors there are things that just do not work. Mirrors with all their magic obey strict physical laws. A few impossible figure or sample cards may start a lively discussion as well as provide an opportunity to review and summarize the children's findings and ideas so far.

There is no definite sequence in activities provided here. The teacher should use her or his own judgment on what to start with and how and with what to continue. The teacher can add activities and inevitably the questions of the children will lead to think not included here. It will be helpful to have other sources and books at hand and use them as the occasion arises. Periscopes, lateral inversion and angles of incidence among others, have been left out because they can be found in every school textbook. It sounds rather ambitious to expect primary school children to understand the physics of light and reflection yet by way of encounter and interaction with mirrors it is entirely possible. Of course, reflection means little or nothing to children unless it is there, present in the mirror they hold in their hand, changing when they change the position of that mirror or multiplying when they move another mirror nearby. Accumulated experiences, encouraged or suggested by the teacher, ordered and

reflected upon in discussion, formulated in words by recording, and given specific meaning as verification of some hypothesis may order themselves into patterns of understanding; and ideas of a higher level of abstraction may evolve in the minds of the children. They may find that searching behind the looking glass may not be magic in order to be satisfying and rewarding.

These worksheets are about doing with mirrors; about getting children to interact with mirrors. You will not find “lesson about mirrors in them” You will not even find very useful information about mirrors. What you will find are a few starters to get children to investigate and solve problems with the help of mirrors.

Once the children are off on their investigations, be prepared for all sorts of questions. Don't let this alarm you, for either: (a) the mirror will provide the answer (and it is good to learn how to ask the mirror); or (b) you know the answer, which makes it ease... or (c) there are books available which provide an answer; or (d) the answer is simply not known, by you nor by anybody else. Well, let it be so.

Mankind is still learning, and we are not omniscient. That, too, is a very good lesson for our children. Periscopes, lateral inversion, angles of incidence and like bits of language and technology have been left out, you can find these in every school textbook. So use these terms where appropriate and called for by the interest and questions of the children.

# Mirrors and Reflections



What shines  
and mirrors all  
around?

This is a good starting question.  
Many surfaces shine and reflect light,  
some more, some less than mirrors. All  
help to understand how light is reflected.

Write down five objects,  
seen from where you sit,  
and place them, in order  
of "reflectivity".



"Reflectivity?.."



Could you make a list  
of mirror words?

Look for things, which show or  
do what these words describe.

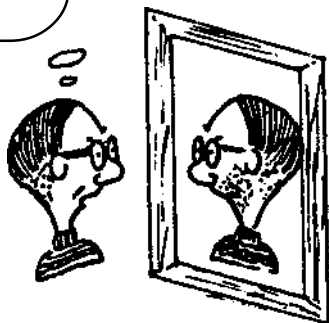


- Mirror
- Shine
- Reflect
- Radiate
- Bounce
- Glisten
- Gleam
- Glint
- Polish
- Sparkle
- Image

Examine these objects and try to  
find words which further explain  
their reflective qualities, such as

- Smooth
- Polished
- Waxed
- Varnished
- Glassy
- Level
- Flat
- Unruffled
- Bald

Clean Shave?



This helps children to develop  
an eye for (relevant) physical  
properties of things.

Besides... it helps them to discuss  
sensibly about their observations.

Sit around with your children and discuss all together your experiences and observations; raise questions, suggest possible answers, propose experiments and agree on what to do, on who does what, on how to go about it and how it all should be recorded and communicated.



How do things become like mirrors?



Boy! Glass mirrors perfectly! Just look at it from an angle.

Ripples in the water make it a funny mirror. You get a ripple face in it.



Spoons and teapots and water kettles are fine mirrors, like my specs!

And my eyes!



Kitchen foil reflects, but it does not mirror.

So do my shoes, provided I have polished them!



Little shiny round things like button make things look ever so tiny.



An aquarium is a fine mirror. Look at the surface from below. Everything swims upside down?



# Mirrors?



What makes a mirror a mirror?

Why don't you ask the mirror itself?

Oh, but then we need lots of mirrors to do things with!



Ask the mirror what?



That is the way to ask the mirror, so see to it that there are sufficient mirrors available:

- a) Bring some yourself
- b) Ask the children to borrow all sorts of mirrors from home. Small ones, big ones; mirrors which enlarge or diminish; rear view mirrors; spoons, coffeepot lids, buttons, Christmas decorations, copperplate, buckles, bumpers, as long as it mirrors.
- c) Let the children work in groups so they can work with each others mirrors, and share ideas and experiences.

Questioning, doing, trying, figuring out and renewed questioning will follow naturally.

What follows consists of tips, ideas, suggestions, and gentle nudges...

- Some pages may be photocopied as worksheets for the children.

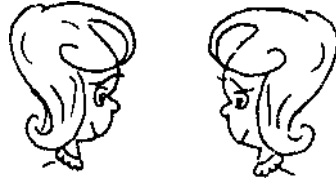
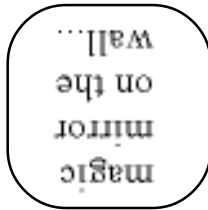
Remember: these are only starters!

Add and change whatever you want:

You and your children are the boss!

# Children can do a lot with mirrors

Just give them mirrors and watch....



Who me?

With the mirrors  
you can look  
behind your ears.



In the mirror...

You can look at yourself (or others)

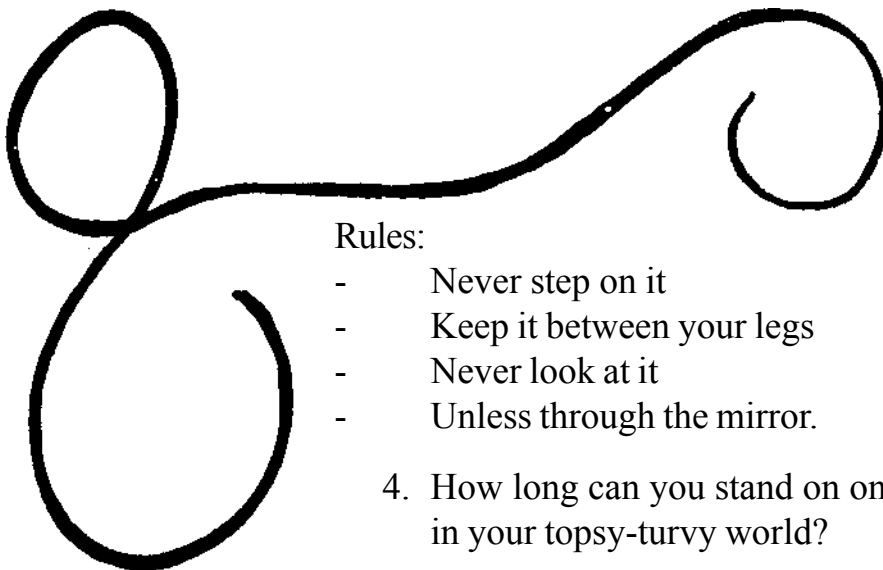
You can look round a corner.

You can look in your mouth.

If you hold a mirror above your eyes or your head:

1. Everything looks upside down.
2. And in this upside down world
  - You can walk and jump;
  - Shake your hands,
  - Walk through a line of chairs or stools,
  - Place something in a matchbox and put it on the table.
3. You can try and follow a snaky line on the ground.

Draw the line or use a rope or a garden hose.



Rules:

- Never step on it
- Keep it between your legs
- Never look at it
- Unless through the mirror.



4. How long can you stand on one leg in your topsy-turvy world?



Try and walk through the school building (and out of it by the front door) holding a mirror under your chin: look in to the mirror held steady, and facing upwards.



Can you make a full face out of a half?

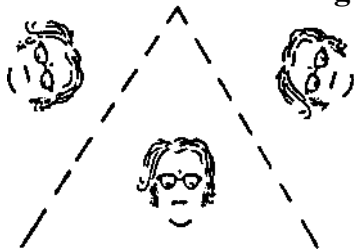
Had to  
to two east  
face out of  
a full one?



With two mirrors you can.....  
Well,



What can you do with two mirrors held at an angle?



Try this:

Place something small between two mirrors held upright at an angle.

Count the images and measure the angle.

Change the angle and count the images again.

Note what you get at

180° : .....images

90° : .....images

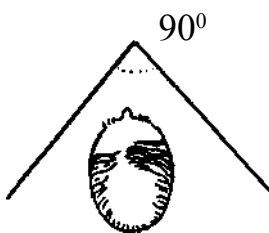
60° : .....images

45° : .....images

30° : .....images

Make this into a simple graph – x axis (angle); y axis (number of images)

Can you now figure out a formula, which gives you the number of images for any angle?



Look at yourself in this 90° combination...

Then wink at yourself.

Can you explain this?



# Write your name in mirror script

(that is: so that you can read it in the mirror.)

in block letters

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IN CAPITALS

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I know a trick  
Turn this page  
over and hold it  
up against the light.



You are allowed to use tricks, but do try it without tricks first.

You may write “mirror words”

On paper

On the floor, the ground,

On the blackboard.

Which letters of the alphabet do not change in the mirror?

--	--	--	--	--	--	--	--	--	--	--	--

Can you write whole words,  
which do not change in the mirror?

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.....Or a sentence...

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# Mirror scrabble

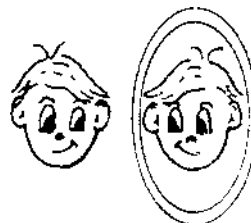


U  
P  
S  
I  
D  
E  
D  
O  
W  
N



A mirror reverts things.

That is why  
mirror letters  
look so funny.



Laterally

# B C D E H I K O X

Hold the mirror on this line to reflect the letters above.

A M

T W

I O

V X

H

Hold the mirror along this line to reflect the letters on the left.

Can you make a whole word which looks the same in the mirror?  
Or a sentence?

With the letters on the left you may make vertical words.

And... you would make palindromes

Any idea what a  
palindrome is?



Oh no!

# DICK BOXED BEDE

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**M**  
**A**  
**M**  
**A**  
**I**  
**A**  
**M**

Copy this sheet for the children.

Glue the letters on thin cardboard, and cut them out.

Now you can make mirror scrabble words

Could you invent a mirror-scrabble-game?

Make up your own rules.

<b>B</b>	<b>B</b>	<b>B</b>	<b>B</b>	<b>C</b>	<b>C</b>	<b>C</b>	<b>C</b>
<b>D</b>	<b>D</b>	<b>D</b>	<b>D</b>	<b>E</b>	<b>E</b>	<b>E</b>	<b>E</b>
<b>H</b>	<b>H</b>	<b>H</b>	<b>H</b>	<b>I</b>	<b>I</b>	<b>I</b>	<b>I</b>
<b>K</b>	<b>K</b>	<b>K</b>	<b>K</b>	<b>O</b>	<b>O</b>	<b>O</b>	<b>O</b>
<b>A</b>	<b>A</b>	<b>A</b>	<b>A</b>	<b>M</b>	<b>M</b>	<b>M</b>	<b>M</b>
<b>T</b>	<b>T</b>	<b>T</b>	<b>T</b>	<b>U</b>	<b>U</b>	<b>U</b>	<b>U</b>
<b>V</b>	<b>V</b>	<b>V</b>	<b>V</b>	<b>W</b>	<b>W</b>	<b>W</b>	<b>W</b>
<b>X</b>	<b>X</b>	<b>X</b>	<b>Y</b>	<b>Y</b>	<b>Y</b>	<b>'</b>	<b>'</b>



How many mice can you make with?

- One mirror?
- Two mirrors?
- Three mirrors?
- More mirrors?



What difference(s) do you see when you “multiply” the first or the second mouse?

Draw or describe:

- The position of the mirrors.
- How the mice are sitting.



What more can you do and find out with mice and mirrors?

And what do you get when:

- You mirror tiny mice?
- Or a picture of yourself?
- Or a pencil?
- Or ...?
- Or... you can take anything.



## **MOUSE**

Even with the word “mouse” you can make something nice using two (or more) mirrors.

Try it and draw the result.

# DRAW

What you can make out of each of these figures and a mirror.

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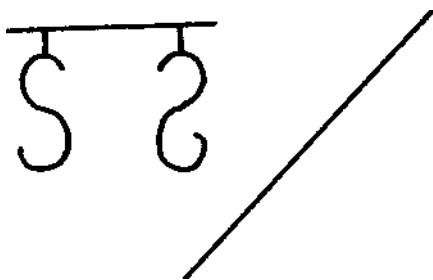
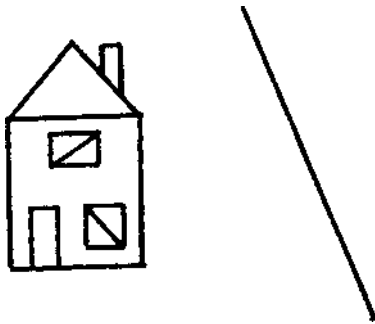
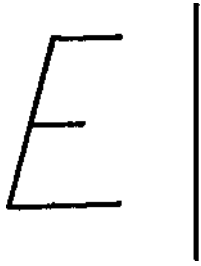
**L**

**S**

# DRAW

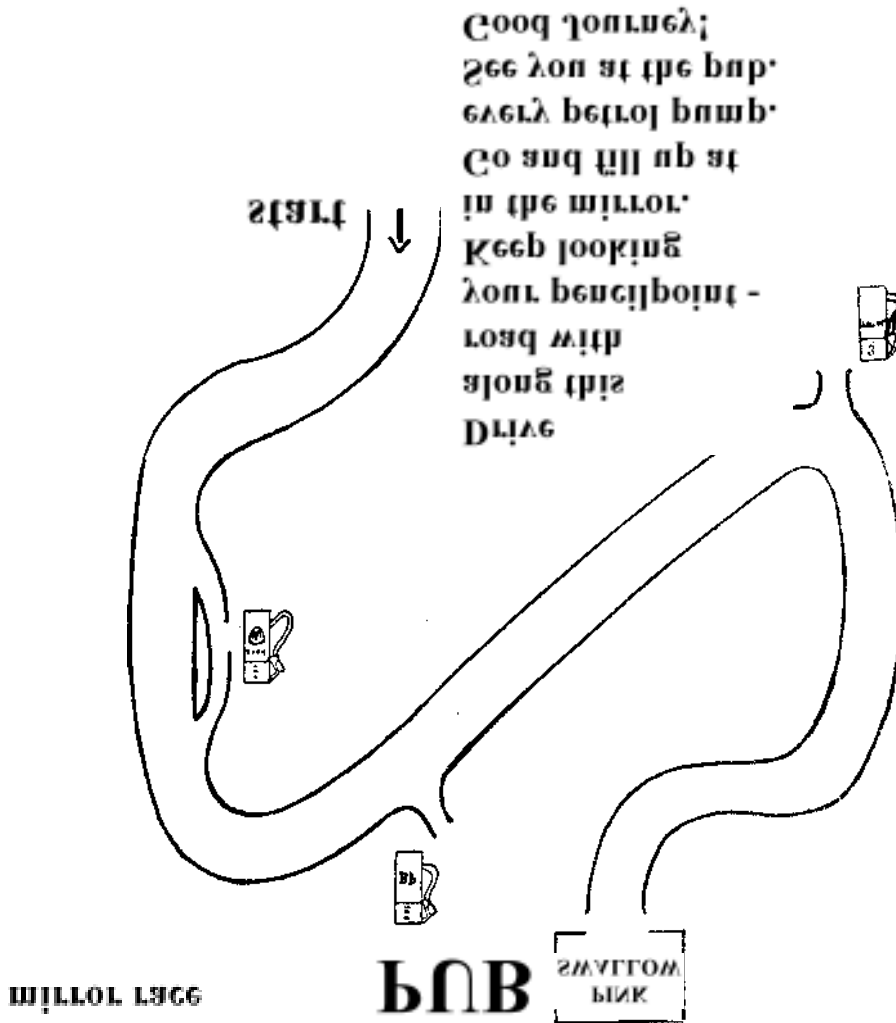
The figures (left) as you will see them when you place a mirror on the line.

Only after drawing can you check with your mirror and see how “correct” you are.



**TAKE** A sizable mirror and hold it firmly above your eyes, or high in front, so that you, looking in the mirror, look down upon this paper.

Then following the instructions underneath.

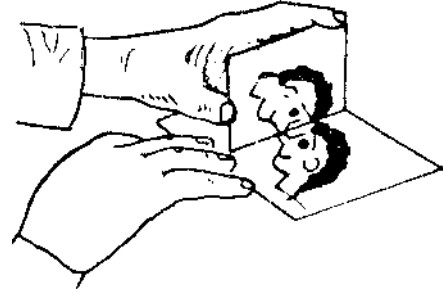


Did we go in, or  
did we 'just' come  
out of that pub?

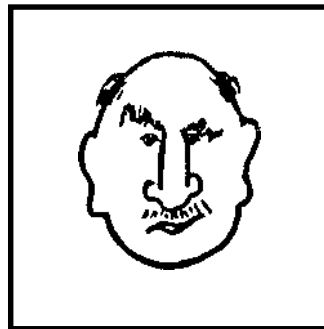
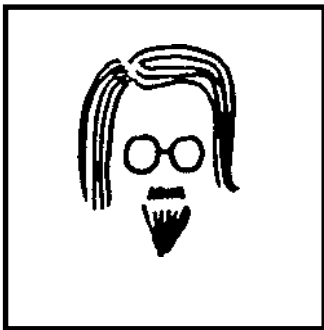
# MIRROR-WORK & PROBLEM CARDS

With any picture and any mirror you can make many pictures.

1. Paste, faces, houses, trees, landscapes on thin cardboard and see what it becomes when you slide a mirror across it in any direction.....

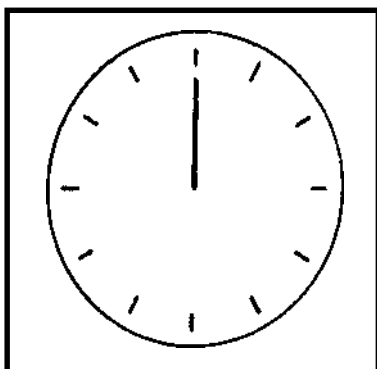


...just for the fun...



...or to challenge one another.

2. A real problem card



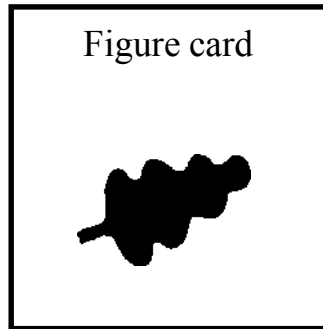
Use a mirror and this clock to make:

- a) Breakfast time.
- b) School time.
- c) Dinner time.
- d) Bed time.
- e) Free time.
- f) No time, or any time.

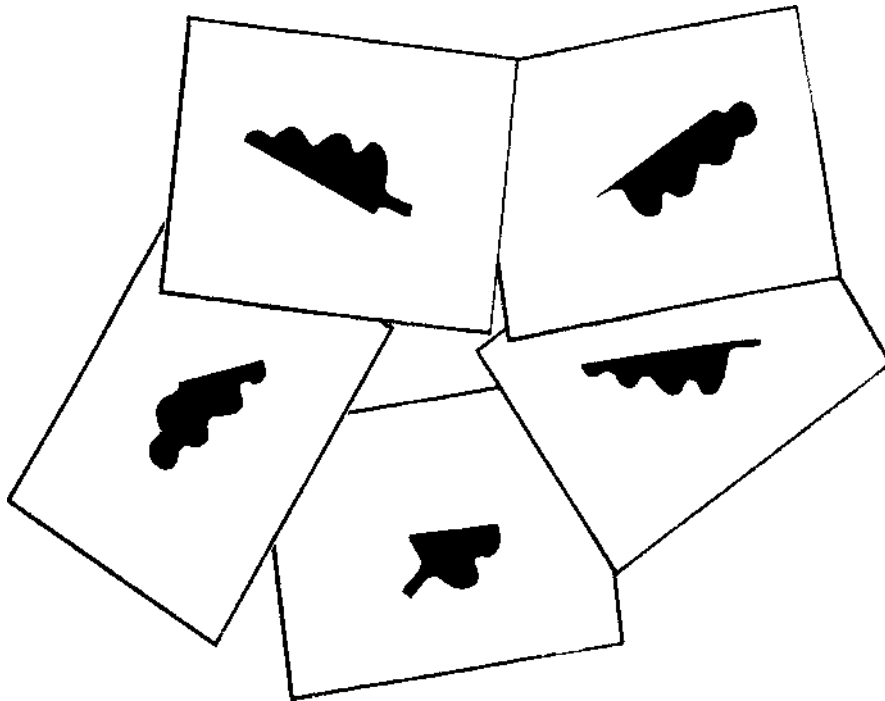


### 3. Figure Cards

You need one “figure card”:



And a set of problem cards.



The problem is:

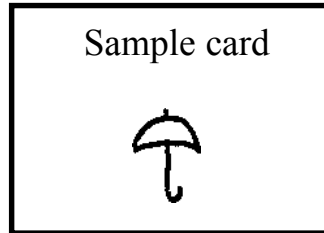
With which of these cards and a mirror –  
can you reproduce the figure on the figure card?

### 3. Sample Card Problems

This is another set of problem cards whereby a mirror is used with the “sample card” only.

The problem is: try and copy the configurations found on the other cards.

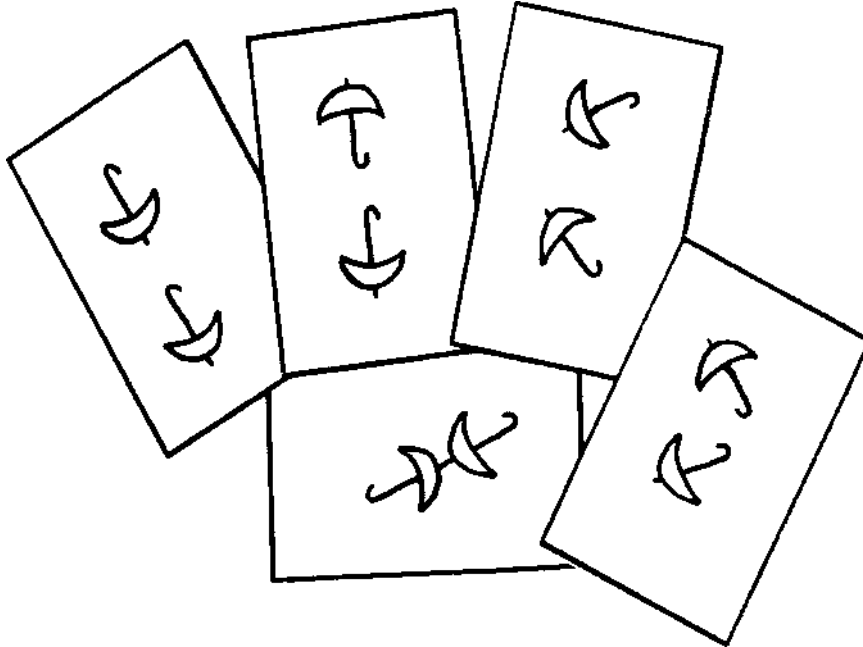
(Can you, or can you not?)



N.B.

These are only a few examples

You can make many more.



Make various such sets.



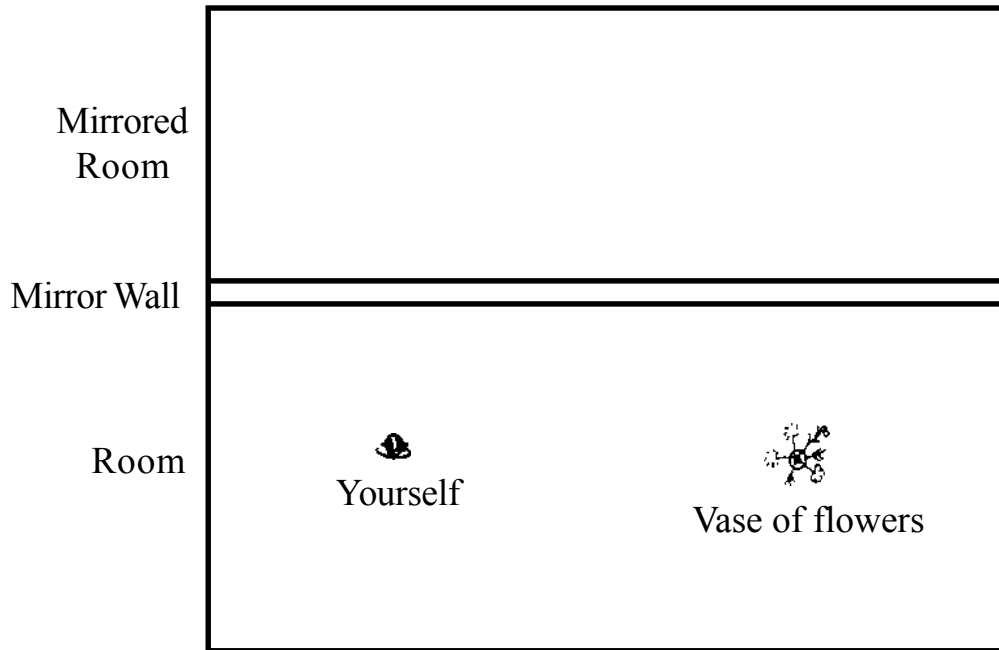
Perhaps a nice project for helpful parents...?



Famous last words?

# The problem of the Mirror Wall

Imagine you are in a room one wall of which is one huge mirror.  
You are in the company of a solitary vase of flowers.



You stand at the spot indicated on this plan  
and you are looking in the mirror at the vase of flowers.

Sketch in pencil the direction in which you are looking.



After drawing your “line  
of vision” by all means,  
do check with a mirror.

....But do not get  
confused.

## The problem of the Rear-view Mirror

Shine or tempest, my car is parked outside. I had not washed it for quite sometime ...too long, and so it happened that my rear view window looked somewhat grimy ...

A naughty, little neighbor boy scribbled on it with a wet finger:



At first I did not notice anything until I boarded my vehicle and looked into my rear-view mirror...

### What exactly did I see?

Fill into this mirror image of my rear window what I actually did see.



Rear-view mirror with mirror image of rear-windows.

Please, how do you explain this?

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# The Flexible Mirror







Flexible sheets of thin shiny metal or plasticized foil make beautiful flexible mirrors, but these are not easy to obtain.

A sheet of acetate – overhead projector transparency – fixed onto a dark black paper makes a very good substitute.

Position yourself facing a source of light (a lamp or a window) and having a darker, shadowy, background, and look at yourself in the flexible mirror.

What do you see, if you flex it...



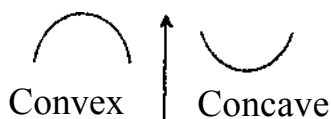
- Like this... 
- Or this.... 
- Or this.... 
- Or this.... 
- Or this.... 
- Or this.... 

Place a newspaper headline in front of your flex-mirror.

What do you see?

And what do you see, if you flex the mirror?

Draw Here



## Talking about your work & experience is very important.

Allow children, as a matter of course, to muse and share ideas and problems.



How come I am upside down in a spoon?



You can shine the sun from your mirror on the wall.



But you are right side up on the back! Much smaller though!

From how far?



In the bumper of my dad's car I am awfully fat and ugly. Yeah!

Oh, ever so far!  
And a square mirror shines around!



You can see the bottom of a fly if you make him walk on a mirror!

You can play "catch" on the wall. You must try and touch my shiny patch!



I can look over the heads of grown ups with my mirror!



I can bounce the sun through your mirror back in my face!

END