

END RESULTS: WHAT HAPPENS NEXT?

Mirror matters—the answer

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Mirror matters—the answer

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Abstract

Some simple experiments looking at the images produced in plane mirrors.

1. Mirror image

We asked how a circle drawn around an image in a mirror would vary as the observer moved towards the mirror [1].

The line encircling the face drawn on the mirror surface will be the same size wherever the observer stands.

The image seen in the mirror is the same size as the ‘head’ object...and the mirror is half way between the object and image (figure 1). Thus, the circle drawn will have a diameter half that of the head. The same argument applies when the observer moves closer to the mirror (figure 2).

2. More mirror writing

When viewed in a mirror the symmetry (or otherwise) of the letters and position of the mirror plays an important part in how the image is perceived.

The solution to the problem set in the [1] is shown below (figures 3 and 4)

The key here is the symmetry of the letters. The first letters have vertical symmetry (WHAT A) through the centre line of the letters, whilst the others have horizontal symmetry (COOKIE). So, whilst all the letters are inverted front to back (referred to in many textbooks erroneously as ‘laterally inverted’), one set of letters in each case appears to remain unaltered. See [2] for a more detailed discussion. Vertical symmetry appears to leave the letters unchanged with a vertically held mirror, whereas for horizontally symmetrical letters the mirror must be held horizontally for the letters to appear unchanged.

This is clearly illustrated in figure 5 where the letters are coloured; whilst the shape of the letters can remain unaltered, the relative positions of the colours are changed right to left and left to right.

Of course, any language should be able to find words that illustrate this effect, for example in Hungarian: (figure 6) ‘TUTYIMUTYI BOCI’ translates as doddering calf.

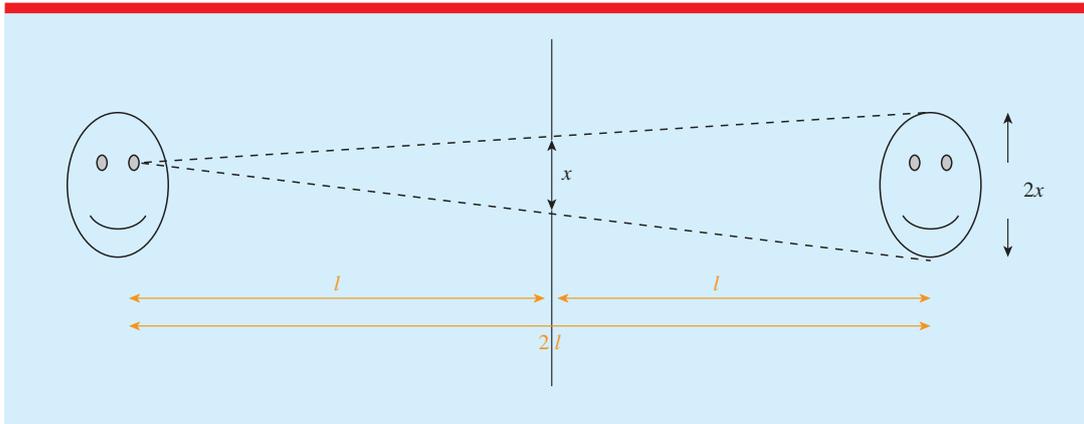


Figure 1. Image of head ($2x$) with mirror circle shown (x).

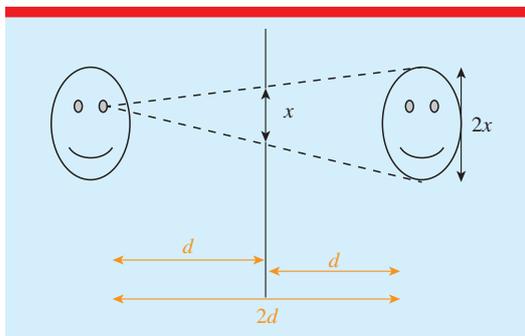


Figure 2. Image of head ($2x$) with mirror circle shown (x). The mirror circle will always be half the size of the object and image.

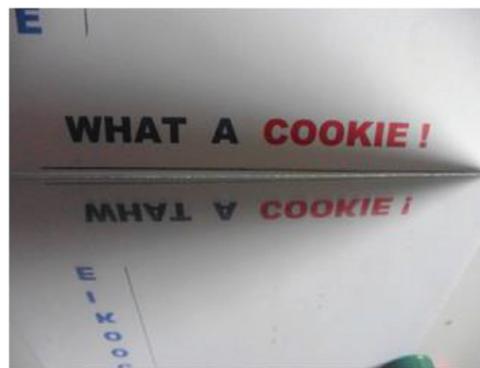


Figure 4. Image of letters when printed horizontally.

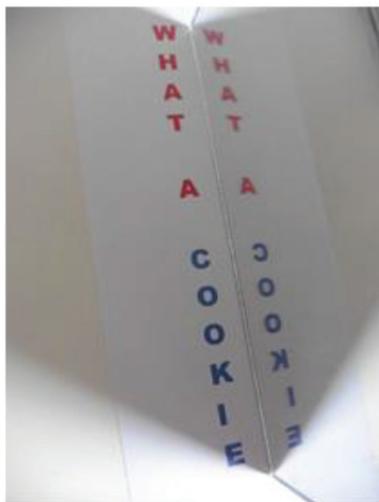


Figure 3. Image of letters when printed vertically.

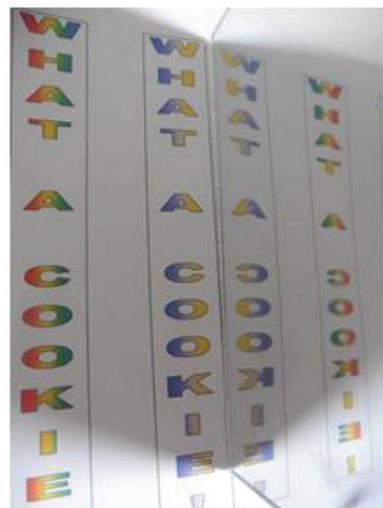


Figure 5. Image of letters with varied colour. Lateral inversion is clear in all of the letters.



Figure 6. Showing words in Hungarian which can be used in this illustration.

Some other Hungarian, German and French words that can be used. The reader can compile their own lists.

Like 'WHAT' (vertical symmetry)	Meaning	Like 'COOKIE' (horizontal symmetry)	
ÜTŐ	Batting	BIO	Organic/bio
VITA	Argument	DOB	Drum
HIT	Faith	EKE	Plough
ÖT	Five	IDE	Here
HAVI	Per a month	BIBI	Scab
HOVA	Where?	IS	Too
AUTÓMATA	Automat	OK	Ok
FUT	To run	BOCI	Calf
FA	Tree	KEDDI	On Tuesday
MAMA	Mother		
MAMUT	Mammoth		
MUTATÓ	Cursor		
MI	We/us		
TUTYIMITYI	Doddering		
TÖMÖTT	Crowded		
MOHÓ	Avid		

German words:

Like 'WHAT'	Meaning	Like 'COOKIE'	
HAI	Shark	DIE	The (female)
HUT	Hat		
MUT	Courage		
KOCH	Chef		
HEXE	Witch		
AUTO	Car		
HOCH	High		
MUTTI	Mummy		

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French words:

Like 'WHAT'	Meaning	Like 'COOKIE'	
MIMI	Kitten	BOBO	Scar
THYM	Thyme		
TOIT	House		
TITI	Guy		
TOUTOU	Puppy		

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References

- [1] Featonby D and Vitkoczi F 2019 *Phys. Educ.* **54** 057002
- [2] www.youtube.com/watch?v=RTe5dMsZTMc



David Featonby is a retired Physics teacher who taught during his career at a large comprehensive school in Newcastle, England. After retirement he worked as a Physics Network Coordinator for the Institute of Physics and now volunteers as a member of the Science on Stage Europe having been elected to the executive board. He travels extensively throughout Europe giving lectures and workshops and has also written several articles for Physics Education on physics applications for school teachers.

Fanni Vitkocsi graduated in 2016 from the Eötvös Loránd University in Hungary. She has been teaching Mathematics and Physics to students between the ages of 12–19 at Trefort Ágoston Practice Grammar School ELTE in Budapest since 2015. She represented Hungary at the Science on Stage in 2017 in Debrecen and in Brussels and presented “What Happens Next?” workshops with David in Europe.