Tubes: the question

David Featonby[1] **and Paul Nugent**[2]

[1] Science on Stage Europe, Wylam, United Kingdom
[2] Science on Stage Europe, Dublin, Ireland

E-mail: da.featonby@googlemail.com

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Abstract

Estimating different lengths, shades and shapes can be difficult when their background is changed or when you attempt to compare volumes in different shaped containers, or straight lines and curves, This is a simple example of the latter with a mathematical twist, a question of judgement rather than illusion. I have also included what may be called confusing optical illusions examples which mislead the observer due to background as illustrations.
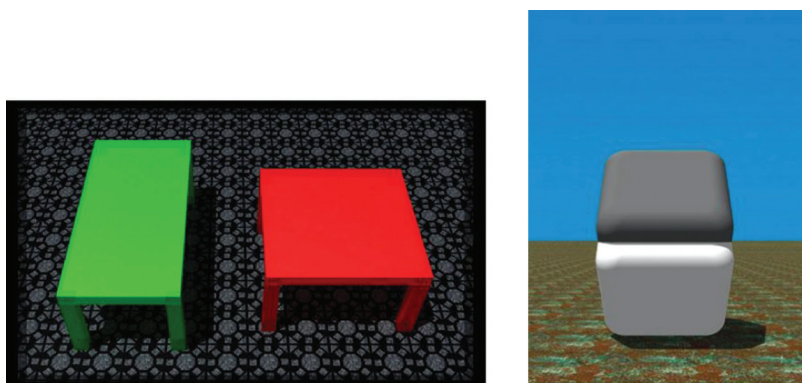
Figure 1. Two popular examples of 'eye deceit' The two tables tops (known as Shepard Tables) have the same dimensions (albeit rotated by 90 degrees) and the upper and lower slabs are the same shade of grey.

There are many examples of our eyes being deceived by the 'background' or the perspective of an object. Examples are the two identical table tops, perspective deception (figure 1) or colour/shade illustrations (figure 1) when background plays a big part in what is perceived. Another example of this difficulty is in my WHN article on conical beakers [1], comparing volumes in different cross sectional areas. The problem set in this article is a practical illustration, where a straight length is compared with a circumference.

Today's problem is to compare the vertical height and the top circumference of various cylindrical beakers, that is, to compare a straight line distance with a circular circumference. Comparing the tubes in figure 2, how does the vertical height compare with the circumference of the rim. So we ask in which of the cylindrical tubes/glasses, etc, is the vertical height greater than the circumference.

It is simpler to ask, which is larger, the circumference of this tube or its height (figure 3)?

Figure 2. Tubes to compare the vertical height with their circumference.

Figure 3. Which is greater, the circumference or height?

References

[1] Featonby D 2012 *Phys. Educ.* **47** 502

David Featonby retired from school physics teaching at a Newcastle comprehensive school in 2003, where he worked as head of physics, head of science, head of sixth form and assistant head (though not all at the same time). Most recently he has been an active member of the Science on Stage Europe executive board, helping to arrange its biannual festival and supporting on going cooperation between teachers. He continues to participate in many conferences across Europe with a variety of workshops, including 'What happens next?' based on this column.

Paul Nugent has been involved in physics education for over 20 years. In Ireland, he supports other science teachers through his work with the Institute of Physics in Ireland (IOPI) and the National Professional Development Service for Teachers (PDST). He is the Irish National Representative for GIREP-International Research Group on Physics Teaching. Paul is a founding member and leader of the science outreach group, Physics Busking (http://www.physicsbusking.ie).

He is co-chair of the Irish Science on Stage NSC and a member of the Executive Board of Science of Stage Europe. He has delivered many workshops in Ireland, UK and in Europe.