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A child's view of foam

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Abstract

"Are you a grown-up?" I looked up, or more precisely down, into the eyes of a child. He had good reason to ask this since I was playing with bubbles at an exhibition for very young scientists. What attracts them? What does not? Physicists have been arguing over whether or not to consider it a duty to encourage children to enter physics. I would like to describe the actual experience of standing among the young and curious.

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Above The bubble-maker in action: Marc in het Panhuis

A Child's View of Foam

"Are you a grown-up?" I looked up, or more precisely down, into the eyes of a child. He had good reason to ask this since I was playing with bubbles at an exhibition for very young scientists. What attracts them? What does not? Physicists have been arguing over whether or not to consider it a duty to encourage children to enter physics. I would like to describe the actual experience of standing among the young and curious, *writes Marc in het Panhuis.*

The event was the Esat-Digifone Young Scientist Exhibition in Dublin, where secondary school children present their research projects. It is open to the general public and is covered by Irish television and major newspapers.

At our stand we were displaying various ways of studying foams, such as wire frames and cylindrical structures. To physicists (who, at least according to age, are grown-ups) these display interesting foam phenomena. But not to children. They do not see that wire frames can be used to verify the equilibrium rules laid down by the Belgian scientist Joseph Plateau over 100 years ago. Children do not want to hear about symmetric angles between touching films. Instead, they ask if it is possible to blow a square bubble using a cubic frame. The fact that Plateau was blind while working with these elegant frames appeals to their imagination and you can see them wondering how this could be possible.

The typical foam, in our kitchen sinks and our bath tubs, is disordered. However, making an ordered foam is simple and straightforward. All you need is a cylindrical glass tube and a nozzle connected to an air pump. Place the cylindrical glass tube about 5 to 10 centimetres under water and then blow air bubbles into it through the submerged nozzle. With variation of the gas flow rate one can make a large range of ordered structures. My friend and colleague Stefan Hutzler uses them to study foam drainage, twists, and transition patterns between different structures.

I used this tube arrangement to explain to the interested young listeners that a Plateau border is a channel formed where three films meet. Adding liquid shows that a Plateau border can also transport liquid. But children find it hard to get interested in these beautiful experiments – the Plateau borders in the tubes are too small for a child's eye, although adding liquid at the top does thicken the network of Plateau borders, enhancing their visibility.

If you want to attract large crowds of children to a stand, follow these two rules. First, give them hands-on experience by letting them play around with your experiments. Second, the bigger the objects used in the experiments the better. In accordance with this second rule we used a giant bubble maker in addition to the smaller frames and glass tubes. Children, parents and people from other stands were fascinated by this. It consists of a bottle of soap solution which hangs upside down. The top of the bottle, being upside down, is now at the bottom, and from a hole in the top two strands of monofilament are attached to a weight (for the filaments I used simple fishing line bought in a fishing-tackle shop.) Soap solution runs down the wires.

Pulling the wires apart slowly creates a single soap film. I could make a film with a length and breadth of 1.5 to 2 metres. The originators of this trick in the US, who developed it to study flow patterns around objects, have made one of 13.5 metres.

To challenge the young I showed two simple experiments, and then invited them to try it themselves. In experiment one, I pulled the wires apart as far as possible. By gently rocking the film I created an oscillation. As the film moved away towards those standing close-by, I gently blew on the film. The effect is amazing: the film can stretch up to 3.5 metres. Sometimes a bubble would release itself from the film and float in the air for a minute before hitting the ground. In experiment two, I pulled the wires one metre or so apart and made a circular movement with both hands. By closing the wires again, this creates a bubble of roughly one metre in diameter. I challenged the children: the champion bubble maker won a chocolate bar, which happens to be an excellent example of a solid foam.

Am I a grown-up? When standing among 30 children with the strands of the giant bubble maker in my hands, ready to produce the biggest bubble they have ever seen, I think not.

Further reading

S. Hildebrandt and **A. Tromba** *The Parsimonious Universe: shape and form in the natural world* (Springer, New York, 1996)

J.A.F. Plateau *Statique Expérimentale et Théorique des Liquides Soumis aux Seules Forces Moléculaires* (Gautier-Villars, Paris, 1873)

For giant bubble makers see www.pitt.edu/~maarten/work/soapflow/soapflow.html