Low-Cost Experiments in STEM Education

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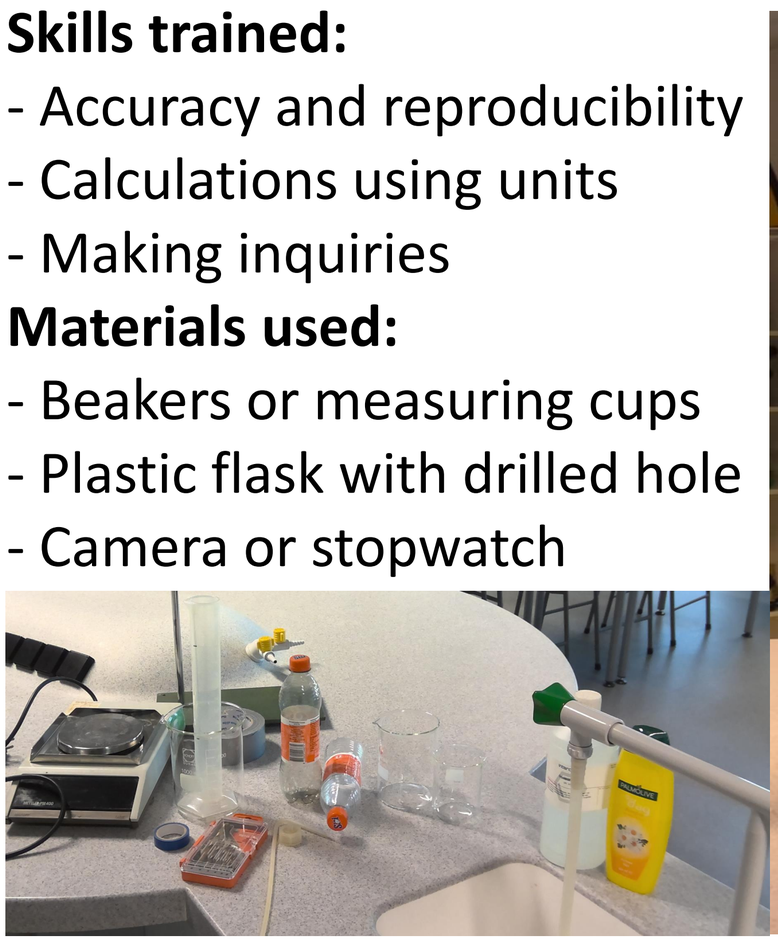
Flow, soft matter and the Kaye effect

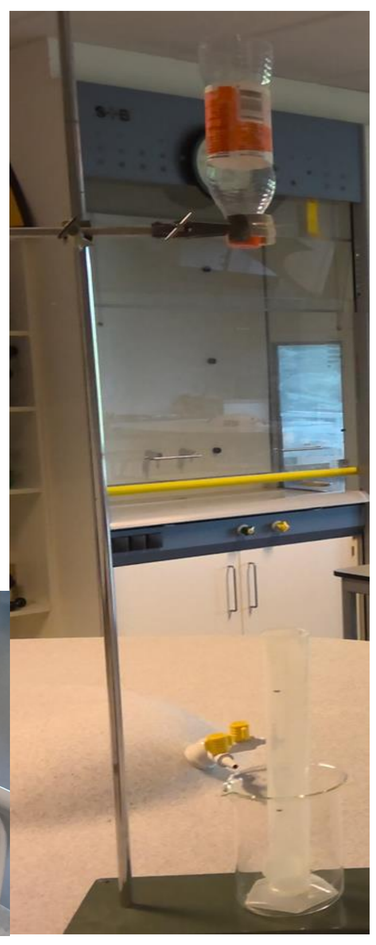
Introduction:
Solutions and emulsions are topics typically learned by pupils. However, some important aspects of these fluids are rarely shown. Even though scholars know how flow differs for water, soft ice, ketchup, shampoo, etc.
Why not explain the basic scientific aspects of flow?
It is motivating since it involves well known materials and practical work.

Possible research questions with water flow:
- Is the shape of a container affecting the time to be emptied?
- Does the amount of water in the container affect flow rate?
- What is the relationship between opening diameter and average flow rate?

Skills trained:
- Accuracy and reproducibility
- Calculations using units
- Making inquiries

Materials used:
- Beakers or measuring cups
- Plastic flask with drilled hole
- Camera or stopwatch

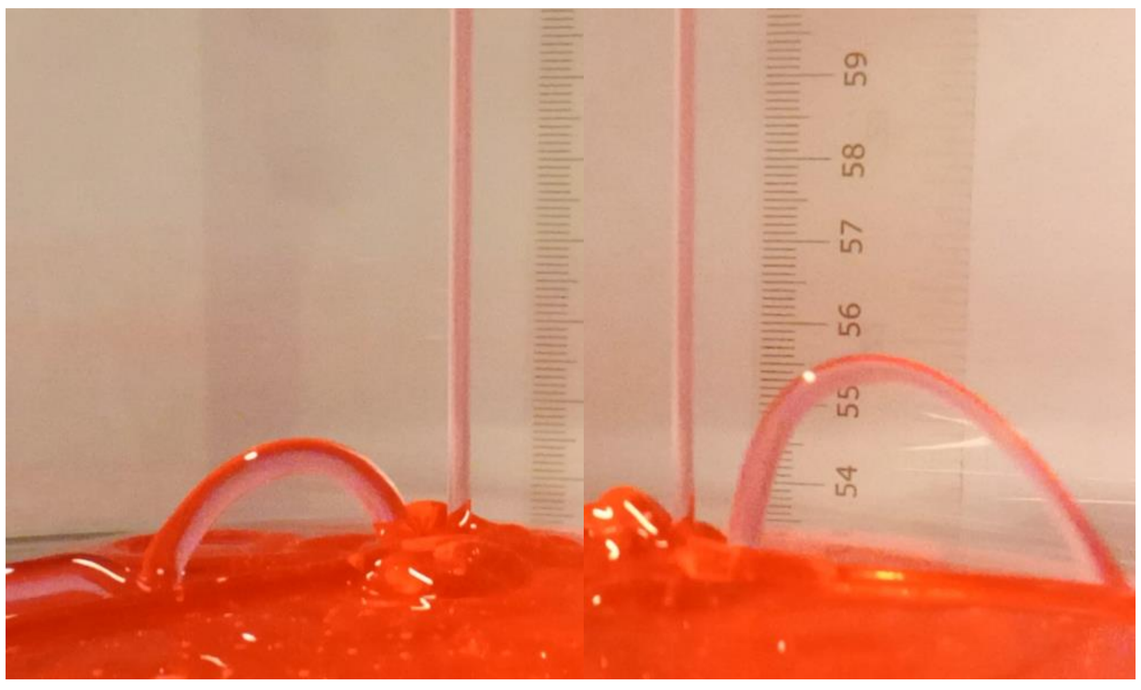




What is soft matter?
Soft matter is easily deformed by thermal fluctuations and mechanical stress.[1]
Examples of soft matter are polymers, foams, gels, colloids, liquid crystals and biomaterials.

Possible experiments with soft materials:
Fill a containers only half with a fluid and turn it over to see viscosity and shear effects. Suitable materials are mayonnaise, ketchup, honey, etc. Continue investigating temperature effects, quantify force with a Newton meter or stir with a milk frother.

What is the Kaye effect?
The Kaye effect results in bouncing liquid when a thin stream is poured on a surface.[2]
It can be observed with shear thinning mixtures. This short-lasting phenomenon is also known as “leaping shampoo” and makes an impressive demonstration.



Conclusion: Do not leave the elephant in the classroom and elaborate on movement of fluids like ketchup and shampoo.

Literature: 1 – soft matter: https://www.utwente.nl/en/max-planck-center/research/SoftMatter/; www.iop.org/explore-physics/big-ideas-physics/soft-matter-physics; www.youtube.com/watch?v=uPqm-CKXM7w
2 – Kaye effect: https://en.wikipedia.org/wiki/Kaye_effect; https://www.youtube.com/watch?v=UBVwo-3K5xU