Design & Development of teaching materials for Introducing Wetting Models into Science Club

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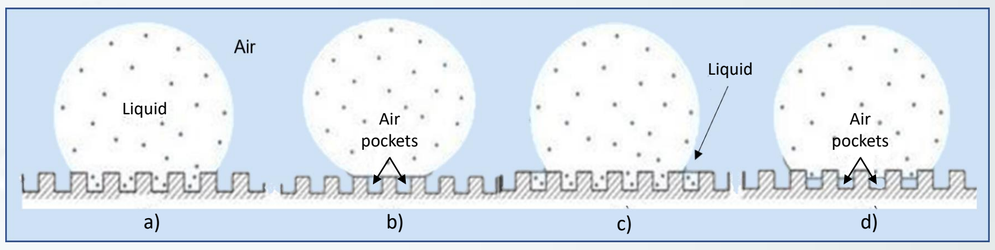
Introduction

Wetting is an important part of Biomimetics which has offered a plethora of technological achievements and products with various applications in macro & micro scale.

Objective

In this study, a proposal to introduce Wetting Models in the context of a Science Club, addressed to high school students is presented. The Educational Model, MER (Duit et al., 2012) was employed in order to develop a specific plan to presenting the topic in a beneficial manner.

Scientific Content

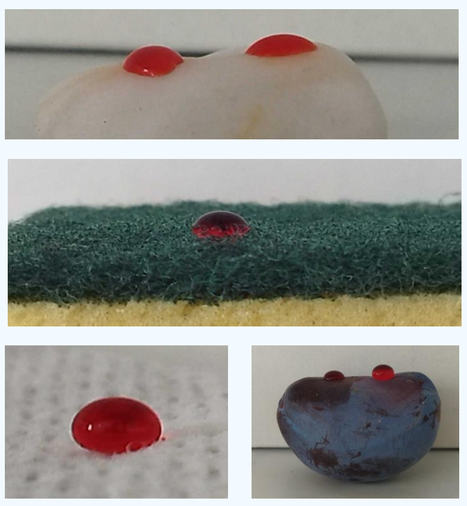


Representation of wetting models. a) Wenzel interface, b) Cassie-Baxter interface, c) Cassie - impregnated interface and d) mixed / impregnated interface (Bushan, 2016).

Teaching Activities

Introduction of Wetting

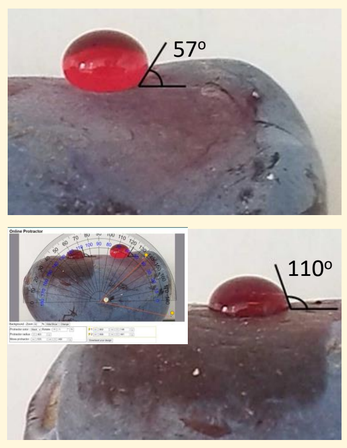
Activity of wetting everyday materials with & without the use of waterproofing products, observation of the water droplet's shape by the naked eye. Discussion.



Learning Objectives

- ✓ To understand the concept of wetting
- ✓ To understand that the droplet's shape indicates the wettability of the surface

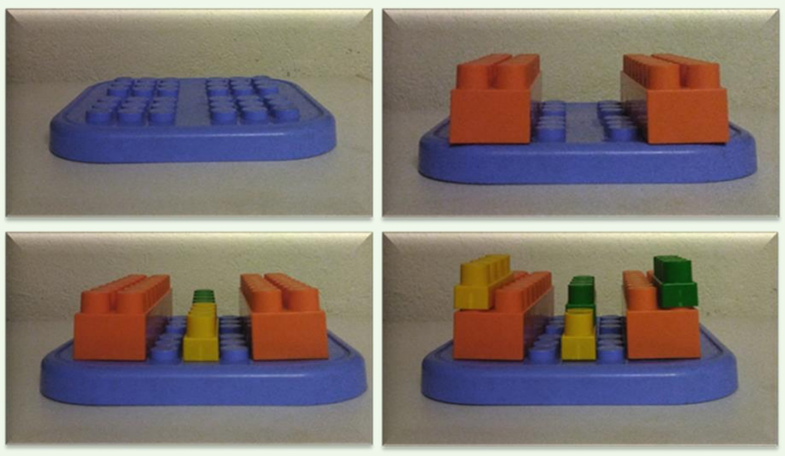
Contact Angle



Measurements can be taken using magnifying glass and USB microscope. Classification of the previous activity's materials regarding the contact angle value. Students can be asked to measure the contact angles and identify the type of wetting based on the value of contact angle.

Learning Objectives

- ✓ Understanding the concept of contact angle and how surfaces are characterized by it's value
- ✓ Comprehension of wetting regimes

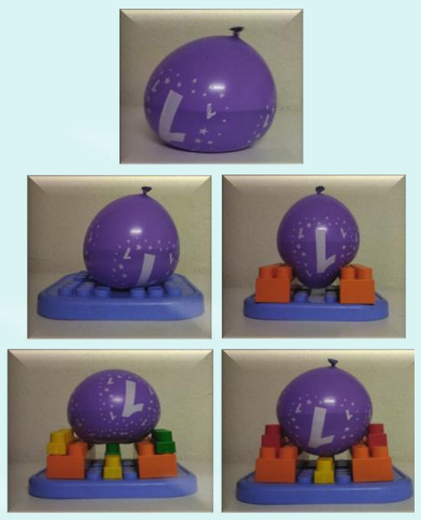


Surface Roughness

Usage of a USB microscope to observe students' choices of seemingly smooth surfaces. Introduction to the concept of roughness and the criteria by which a surface is classified as rough or smooth. Discussion to follow explaining the fact that no surface is smooth to the micro-nano scale. SEM images of micro and nano bumps to be presented, and the relative size of micro and nano scale to be visualized by presenting images-diagrams. Students to be given materials (balloons and lego blocks) to construct their own roughness models.

Learning Objectives

- ✓ To understand the order of micro & nano magnitude
- ✓ To understand the correlation between wetting and hierarchical roughness
- ✓ To understand the dependency of characteristic properties on surface's geometrical features and sample size



Wetting Models

Introduction to the concept of models and their importance to science. Introduction of the four wetting models (Wenzel, Cassie-Baxter, Cassie & mixed). Construction of wetting models with the materials given (balloons and lego blocks). Measurement of the contact angle and observation of adhesion on students' models.

Learning Objectives

- ✓ Understanding the importance of models and their use in science
- ✓ To distinguish the four wetting models and to identify differences between them
- ✓ To be able to distinguish when each model is detected (homogeneous – uneven wetting, rough – smooth surface)

Rose Petal effect

Lotus effect

Application of Knowledge

Students to be asked to pour a water droplet on two different surfaces of leaves (or other surface) resembling the ones of lotus and rose petal, and to take pictures with USB microscope from the side. Then to observe the droplet's contact angle and adhesion and to identify each wetting model.

Learning Objectives

- ✓ Ability to qualitatively describe the wetting phenomenon
- ✓ Recognize the Cassie – Baxter and Wenzel model on each surface respectively

Conclusions

- Elementarization of scientific content using the MER
- Development of five modules concerning wetting, surface roughness, contact angle, wetting models, and application of knowledge
- Consideration of learning environment characteristics in the design of the activities
- Proposal for implementation in non formal education setting

References

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❑ Duit, R., Gropengießer, H., Kattmann, U., Komorek, M., & Parchmann, I. (2012). The model of educational reconstruction – a framework for improving teaching and learning Science1. Science Education Research and Practice in Europe, 13-37.

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