Introducing Biomimetics through the Study of Wetting and Roughness of Biomimetic Surfaces: A Design of a Didactic Intervention

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Introduction

Biomimetics is a new field of multidisciplinary science. Recently there has been increasing interest in the introduction of this field in education. We present a didactic intervation that introduces the biomimetic concepts of wetting and roughness.

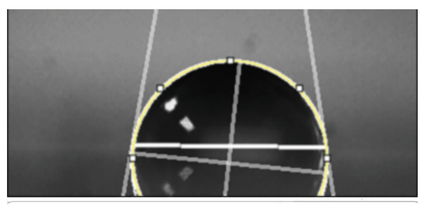
Didactic Transformation

The model of educational reconstruction (MER) was used to convert the scientific content about concepts of biomimetics (wetting and roughness) to a content suitable to engage students in a science club for grades K10-12.

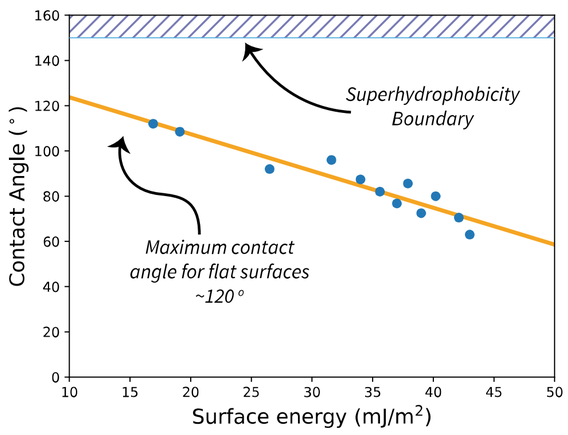
Unit	Main Goal	Procedure
Wetting	*Explain the shape of a droplet as a result of **cohesion and adhesion** forces* *Identify and measure the **contact angle** of a droplet* *Analyse the relationship between **surface energy and contact angle***	*Connection of different representations* *Calculation of contact angle* *Graph Construction*
Roughness	*Recognise the **hierarchical structure** on nature as a key component of superhydrophobicity*	*Image observation and analysis*

Wetting

The students learn how to measure the contact angle and construct a graph, measuring the contact angle (independant variable) through flat surfaces with different surface energy given from tables (independent variable)



With ImageJ the contact angle can be calculated through the spherical approximation

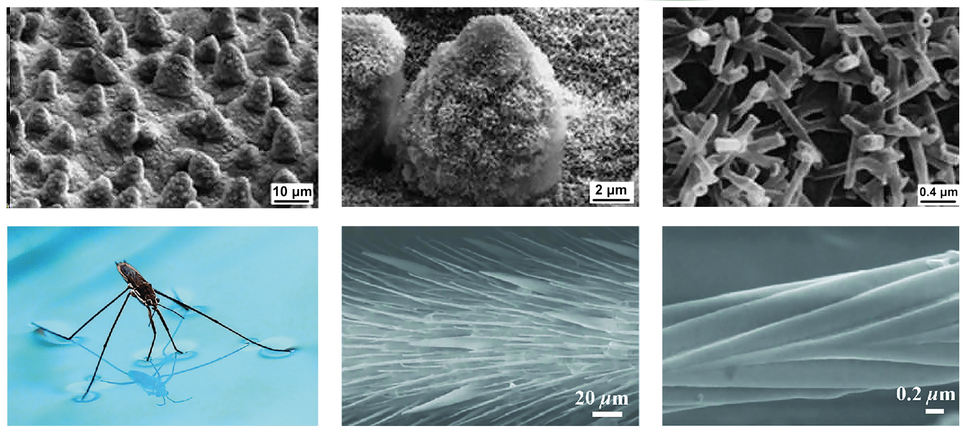


Decreasing the surface energy, water contact angle increases, but even for low surface energy solids it never gets close to superhydrophobic behavior (150°)

Despite the limit however some plants like the lotus leaf exhibit superhydrophobicity

Roughness

After an introduction to the electron microscope (EM) and its capabilities students are given images to study the surface of the lotus leaf to find the reason for its hyperphobicity. From the observation a hierarchical structure is recognized. Subsequent observations from other animals reveal the same characteristic.



The observation of the lotus leaf with an electron microscope (images above) reveal the hierarchical structure. The same can be observed with EM images from the water strider's legs (images below)

Conclusion

Through the sequence described above the students recognize a fundamental idea of biomimetics, that observation of nature can compliment the science knowledge and can reveal new ideas. Furthermore students study and understand the science behind the daily phenomena of wetting and roughness.

RESEARCH COMMITTEE
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