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**Biomimicry in materials science**

Biomimicry is the process of being inspired by nature to help solve human design problems. It can really be helpful in terms of interior architecture [1]. As a matter of fact, it can inspired new innovation but also help to build a more sustainable environment, with a study on natural materials and a use of their properties and structures to create new materials. For example, the lotus leaf was an interesting inspiration to provide superhydrophobic surfaces. Thanks to this mimicry, in can reduce drastically the process of deterioration in infrastructures by avoiding moisture [2]. They created a paint that reproduce the self-cleaning effect of the lotus by having small bumps similar to the ones on the leaf preventing the drop to spread [3].

Biomimicry can also help with environmental issues. In fact, butterfly wings helped scientists to figure out a way for solar panels to be more efficient. By copying the structure of the wings (nanoholes in disorder) in order to create solar cells, that way the panels can absorb more energy [4]. Researchers also found that they could mimic the texture and appearance of shark skin with the use of micro-CT imaging of the skin of a shortfin mako [5] in a silicone structure nontoxic for the environment [6], in order to increase efficiency and reduce drag in water-based applications like boats and submarines for example.

Creating materials that change color like chameleons is also part of the biomimicry. By making a photonic crystal “smart skin” able to respond to sunlight and thermal stimuli [7] in order to change color depending on its environment, researchers were able to get close to the same result as the chameleon [8]. They also tried to find some materials that could re-create the process of self-shaping [9] found in nature mainly in plants: carnivorous plants [10] in response to their environment without using electrical power help [11].

Because of all these types of evolution possible using biomimicry and trying to reproduce how nature works, this field is in constant evolution. Even more now that the environment is endangered [12].

**References**

[1] El-Zeiny, R. M. A. (2012). Biomimicry as a Problem Solving Methodology in Interior Architecture. Procedia - Social and Behavioral Sciences, 50, 502-512. <https://doi.org/10.1016/j.sbspro.2012.08.054>

[2] Share An Online Entry « Lotus-Leaf-Inspired Biomimetic Coatings » . (s. d.). <https://encyclopedia.pub/entry/23625>

[3] Karabetça, A. R. (2015, 23 mars). AIOC’15 Nature Inspired Architectural Designs : Using Biomimicry as a Design Strategy. ResearchGate. https://www.researchgate.net/publication/279748948\_AIOC%2715\_Nature\_Inspired\_ Architectural\_Designs\_Using\_Biomimicry\_as\_a\_Design\_Strategy

[4] Chen, A. (2017, 19 octobre). Butterfly wings inspire a better way to absorb light in solar panels. The Verge. https://www.theverge.com/2017/10/19/16503258/butterfly-wings-engineering-solar-cell-energy-biomimicry

[5] Wen, L., Weaver, J. C., & Lauder, G. V. (2014). Biomimetic shark skin : design, fabrication and hydrodynamic function. The Journal of Experimental Biology, 217(10), 1656-1666. <https://doi.org/10.1242/jeb.097097>

[6] O. (2017, 3 septembre). From Shark skin, boats, olympic swimmers and airplanes. One Ocean Zanzibar. <https://zanzibaroneocean.com/2017/09/03/shark-skin-science/>

[7] Photonic crystal “smart skin” changes color, not size. (s. d.). Cambridge Core. https://www.cambridge.org/core/journals/mrs-bulletin/news/photonic-crystal-smartskin-changes-color-not-size

[8] Clark-Emory, C. (2019, 11 septembre). Color-changing & # 8216 ; smart skin& # 8217 ; steals tricks from chameleons. Futurity. https://www.futurity.org/smart-skin-colorchanging-2157072/

[9] Oliver, K. E., Seddon, A. M., & Trask, R. S. (2016). Morphing in nature and beyond : a review of natural and synthetic shape-changing materials and mechanisms. Journal of Materials Science, 51(24), 10663-10689. <https://doi.org/10.1007/s10853-016-0295-8>

[10] La Porta, C. A. M., Fumagalli, M. R., Bonfanti, S., Milan, S., Ferrario, C., Rayneau Kirkhope, D., Beretta, M., Hanifpour, M., Fascio, U., Ascagni, M., De Paola, L., Budrikis, Z., Schiavoni, M., Falletta, E., Caselli, A., Chepizhko, O., Tuissi, A., Vailati, A., & Zapperi, S. (2019). Metamaterial architecture from a self-shaping carnivorous plant. Proceedings of the National Academy of Sciences of the United States of America, 116(38), 18777-18782. https://doi.org/10.1073/pnas.1904984116

[11] Zhang, Y., & Ferrand, H. L. (2022). Bioinspired Self-Shaping Clay Composites for Sustainable Development. Biomimetics, 7(1), 13. https://doi.org/10.3390/biomimetics7010013

[12] Wommer, K., & Wanieck, K. (2022). Biomimetic Research for Applications Addressing Technical Environmental Protection. Biomimetics, 7(4), 182. https://doi.org/10.3390/biomimetics7040182