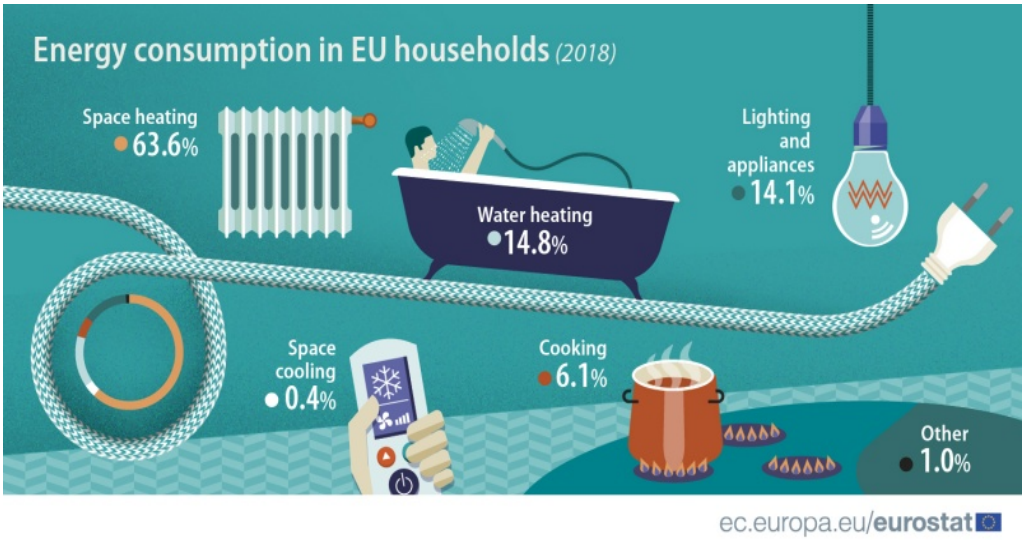
NanoScience – NanoTechnology / NST

ID Student: Activity 1

NST & housing

Modern housing residence has extended energy demands. In 2018, households represented 26% of total energy consumption in the EU.



Reused from Eurostat (2018)

Follow this link from Eurostat's research on Energy consumption in households
https://ec.europa.eu/eurostat/statistics-explained/index.php?title=File:Share_of_final_energy_consumption_in_the_residential_sector_by_type_of_end-use,_2019_(%25)_T3.png

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1) Based on the table form a short commentary on your country's energy consumption in the residential sector. For which purpose do households consume the greater share of energy? Why do you think that your country has these energy needs compared to others?

Challenge: Build an energy-efficient housing model!

2) How could we decrease energy consumption for space heating/cooling?

3) Could NST help us have a more efficient space temperature tuning?

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Watch the following video 1_ supplementary material_worksheet a1_thermochromic.avi:
https://www.youtube.com/watch?v=umSqzjY80dM&feature=youtu.be&ab_channel=IdentitiesProject

SGT

Global Resource (2020)

4) Compare the temperature between the two housing models (based on the graph) and the colour of the glass before and after the exposure to direct sunlight. What do you observe?

5) How would you interpret that phenomenon?

6) Based on the models/information below (a, b, c & d) can you explain how thermochromic glass works?

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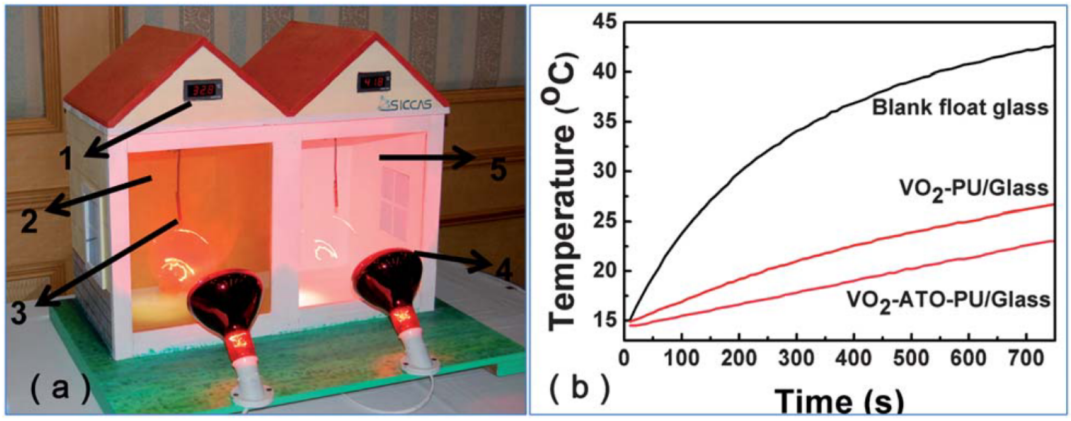
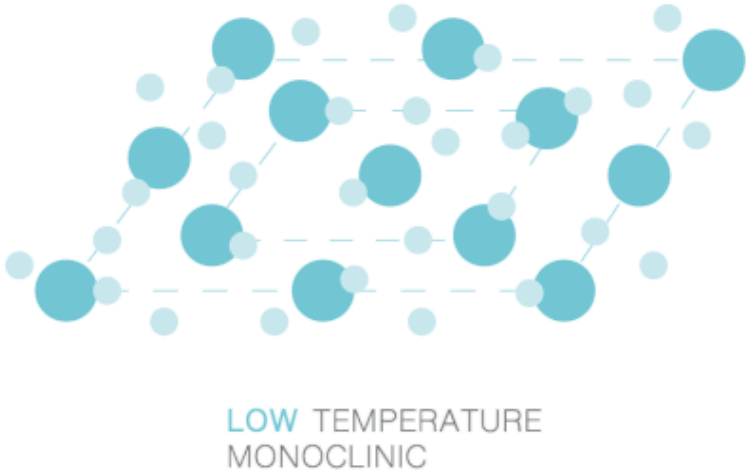
a.



Reused from Gao et al., 2012

b.



Reused from Sunovate (2020)

c.

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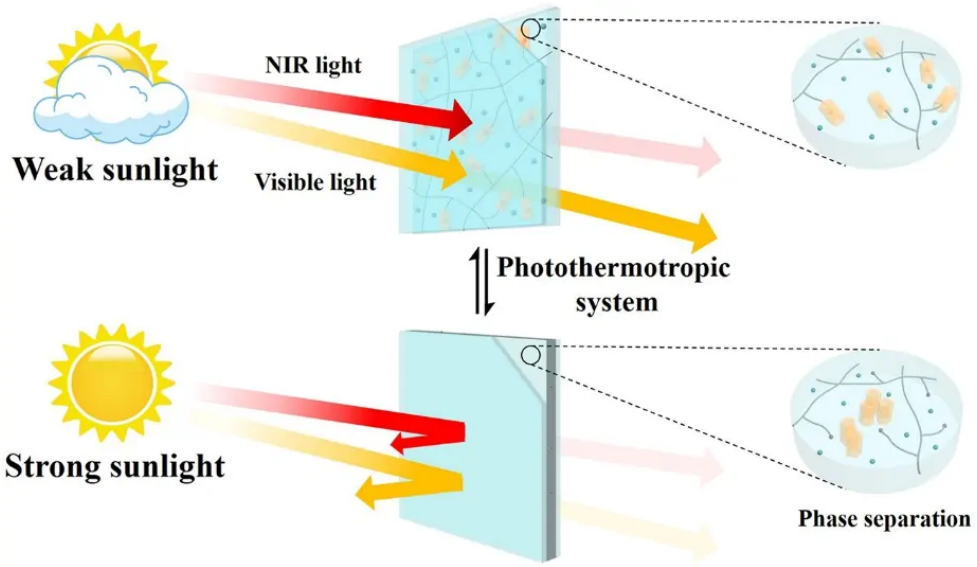
The material is a nanometer sized thermochromic pigment based on VO2. The material autonomously changes its crystal structure at a temperature of 68°C. The change in crystal structure coincides with a change in electrical and optical properties. By adding a suitable dopant, we can lower this switching temperature to around 25°C, which is desired for the application. (Gao et al. 2012)

d.



Reused from Xu et al. (2018)

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Challenge: Build an non-moistured housing model!

Popov (n.d.)

1) What is the problem in this top floor apartment? How may this damage deteriorate the life of the inhabitants?

2) What NST solutions could contribute to addressing this problem?

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Watch this video 2_supplementary material_worksheet a1_Lotus effect.avi:
https://www.youtube.com/watch?v=STDiKqIqAfA&ab_channel=IdentitiesProject

Eye-Spy Focus (2013)

3) Could the lotus leaf properties help address the building humidity/mould problem? In what way?

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Watch this video 3_ supplementary material_worksheet a1_hydrophobicity.avi
https://www.youtube.com/watch?v=t-hqv5xjb38&ab_channel=IdentitiesProject

UltraTech International, Inc. (2012)

4) Compare the two surfaces. What do you observe?

5) How would you interpret that phenomenon?

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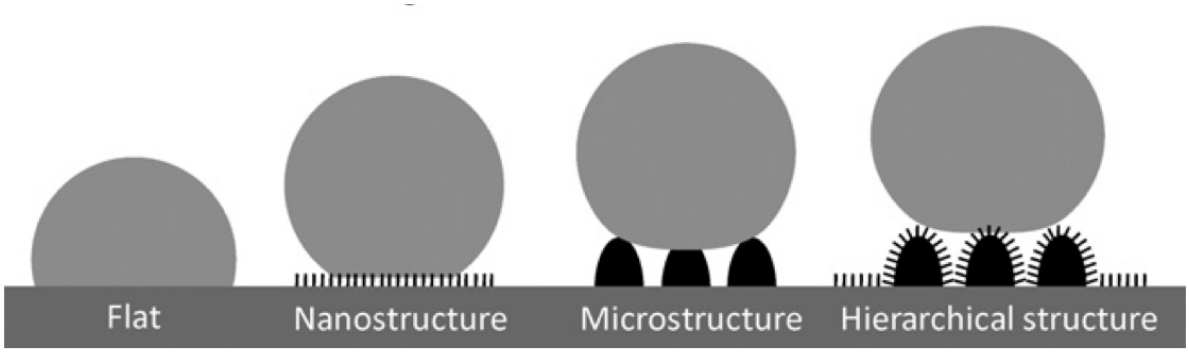
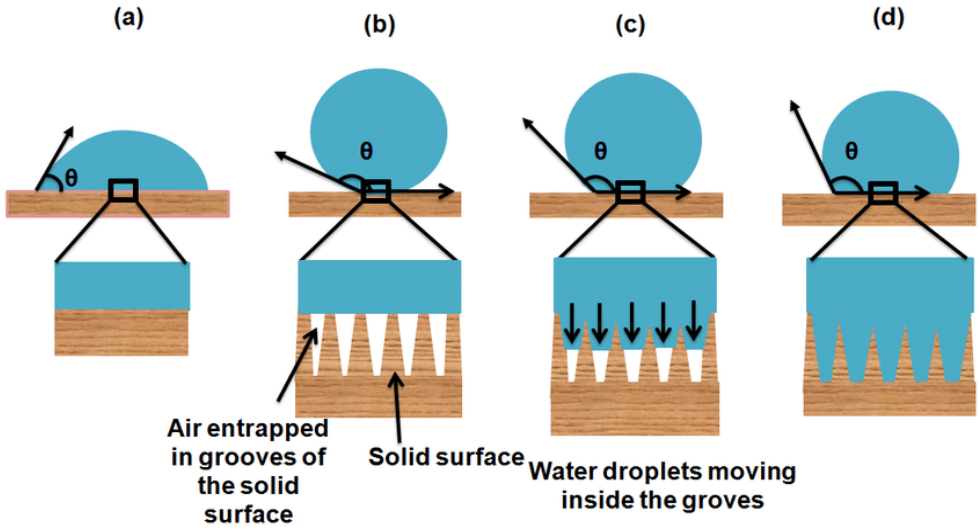
6) Based on the models below (a, b & c) can you explain the superhydrophobic properties of materials?

a.



Reused from Frigione & Lettieri (2018)

b.



Reused from Akhmad & Kan (2016)

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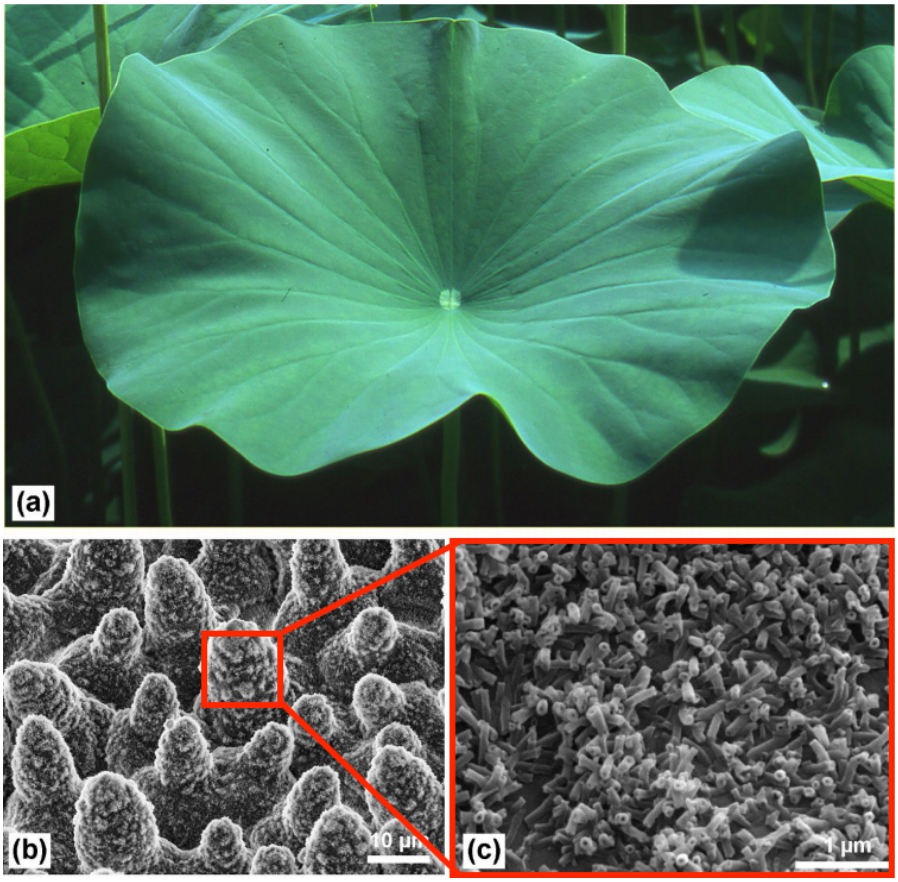
c.



Reused from Ensikat et al. (2011)

6) Have you experienced surfaces with similar properties in other applications? Name some of them.

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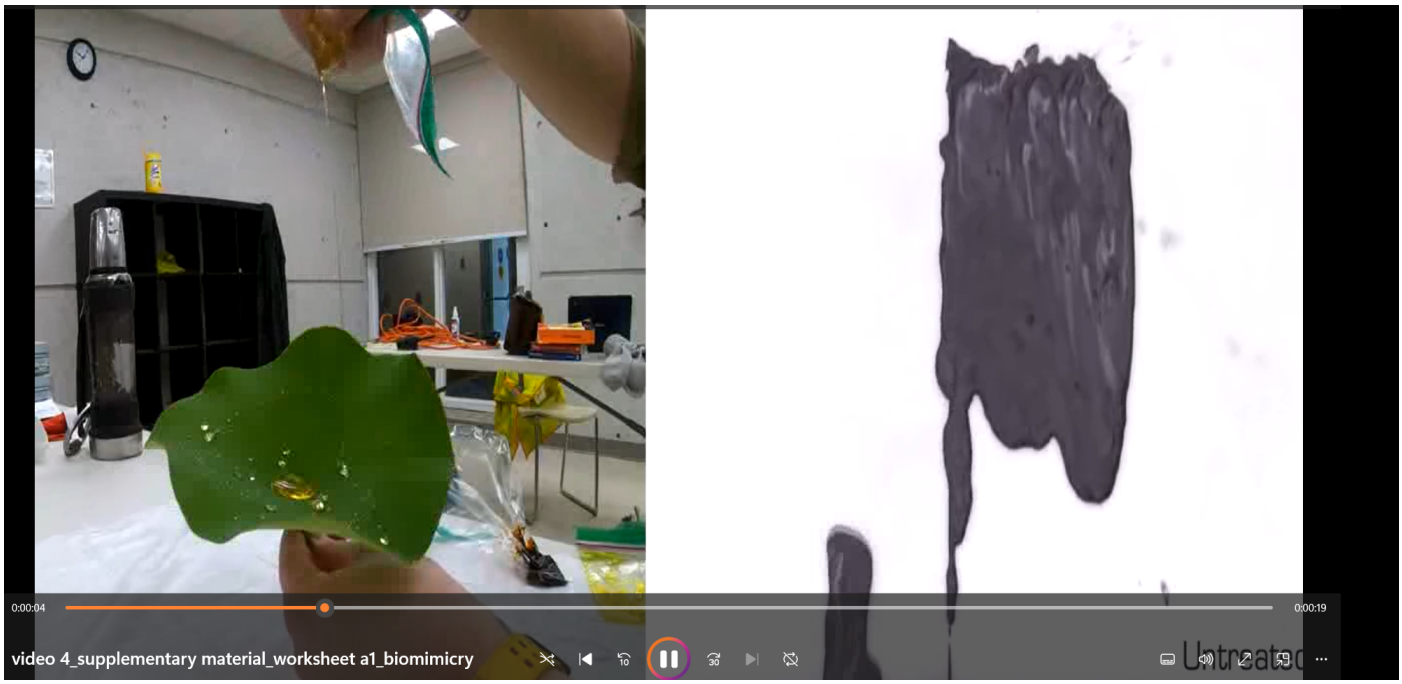
Watch this video 4_supplementary material_worksheet a1_biomimicry.avi:
https://www.youtube.com/watch?v=oh2-BAGFhAc&ab_channel=IdentitiesProject



Bobs Yeruncle (2020) & UltraTech International, Inc. (2012)

7) Are the above surfaces artificial or natural? Do the superhydrophobic properties apply to both?

8) What other applicability would such a surface have?

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Reflection

9) How has NST improved housing design? What are the benefits from such an approach?

10) Compare your initial views on NST with the latter ones. What shifts, if any, do you recognize on using NST in housing?

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References

Ahmad, I. & Kan, C. (2016) A Review on Development and Applications of Bio-Inspired Superhydrophobic Textiles. *Materials*, 9(11): 892.

Bobs Yeruncle (2020, July 17.). Stress testing a lotus leaf! Honey, marmite, olive oil, rubbing alcohol. [Video] YouTube. https://www.youtube.com/watch?v=UMIIXXxEqt0

Ensikat, H., J., Ditsche-Kuru, P., Neinhuis, C. & Barthlott, W. (2011), Superhydrophobicity in perfection: the outstanding properties of the lotus leaf. *Beilstein Journal of Nanotechnology*, 2, 152-161.

Eurostat (2018). Energy consumption in EU households. https://ec.europa.eu/eurostat/web/products-eurostat-news/-/ddn-20180322-1

Eye-Spy Focus (2013, July 8). *NanoTech: Lotus 'Self-Cleaning, Waterproof' Advanced to Ion-Mask* [Video]. YouTube. https://www.youtube.com/watch?v=EeJz7iPPy1Y

Frigione, M., & Lettieri, M. (2018). Novel attribute of organic–inorganic hybrid coatings for protection and preservation of materials (stone and wood) belonging to cultural heritage. *Coatings*, *8*(9), 319.

Gao, Y., Luo, H., Zhang, Z., Kang, L., Chen, Z., Du, J., Kanehira, M. & Cao C. (2012) Nanoceramic VO2 thermochromic smart glass: A review on progress in solution processing. *Nano Energy*, 1(2), 221-246.

Popov, A. (n.d.). *Shocked Woman Looking At Mold On Wall*. Adobe Stock. https://stock.adobe.com/it/images/shocked-woman-looking-at-mold-on-wall/237788180

SGT Global Resource (2020, June 13). *Tintuitive self tinting windows.* [Video] YouTube. https://www.youtube.com/watch?v=AuRfdnqXWWc

Sunovate (2020). Functional materials. https://www.project-sunovate.com/products/thermochromic-smart-window/

UltraTech International, Inc. (2012, November 13). *The Official Ultra-Ever Dry Video - Superhydrophobic coating-Repels almost any liquid*. [Video] YouTube. https://www.youtube.com/watch?v=IPM8OR6W6WE

Xu, Z., Wang, S., Hu, X. Y., Jiang, J., Sun, X., & Wang, L. (2018). Sunlight-Induced Photo-Thermochromic Supramolecular Nanocomposite Hydrogel Film for Energy-Saving Smart Window. *Solar Rrl*, *2*(11), 1800204.

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