Sources of Pigmentless Colour in Nature – Seashells, Butterflies and Beetles

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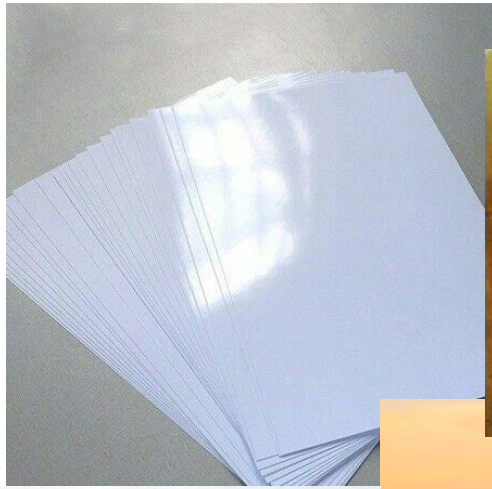
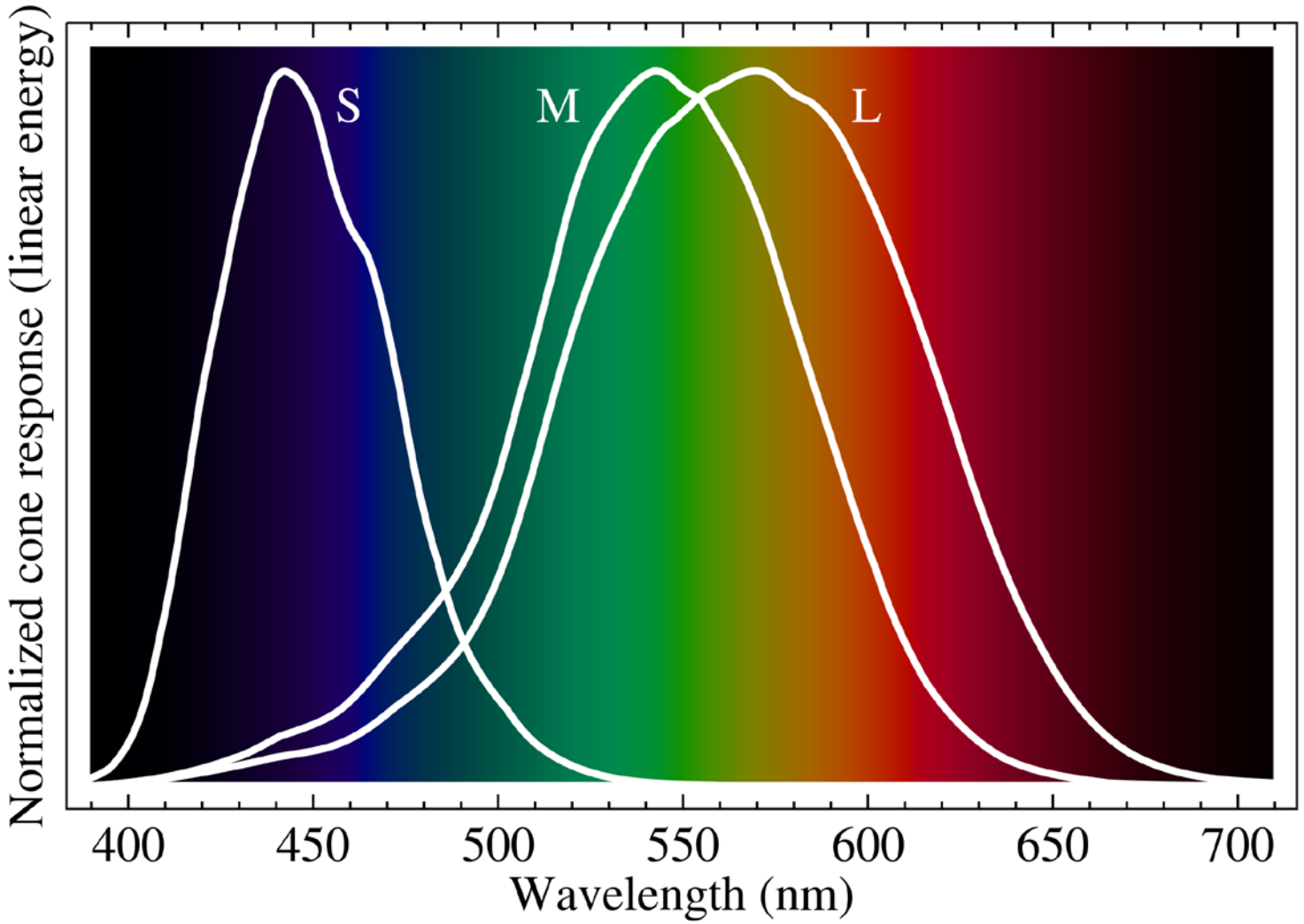
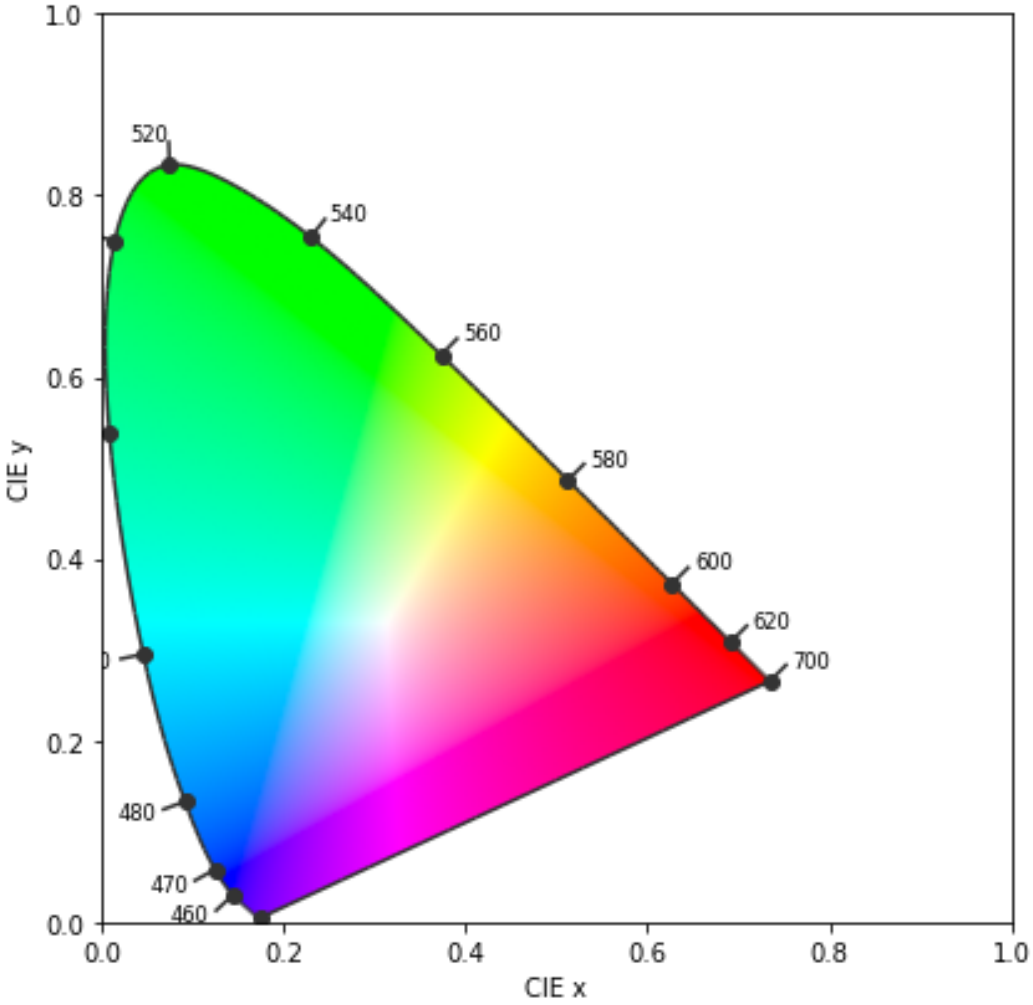
What does this look like? And why?

- A surprisingly complex question!
- Materials have roughly four visual qualities:
  - **Colour**
  - Texture
  - Gloss
  - Translucency
- These can vary as well, depending on:
  - Lighting
  - Viewing angle
  - Distance
  - Observer
- Can be informed by:
  - **Size**
  - **Structure**
  - Chemical composition



Colour & The Observer





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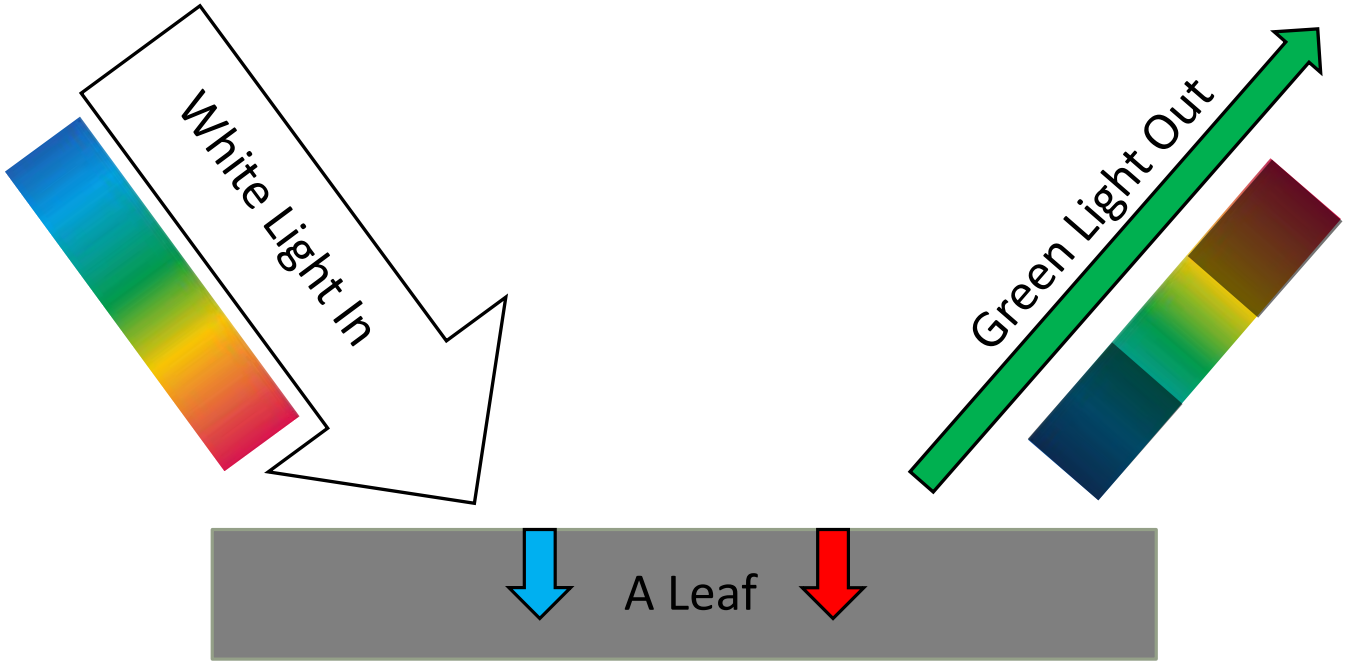
Let’s Simplify - A Leaf

•So why is a leaf green? Mostly chlorophyll!



Two ‘Types’ of Green?

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Not Just Green!

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Iridescent

[74, 129, 44]

Green

[180, 147, 0]

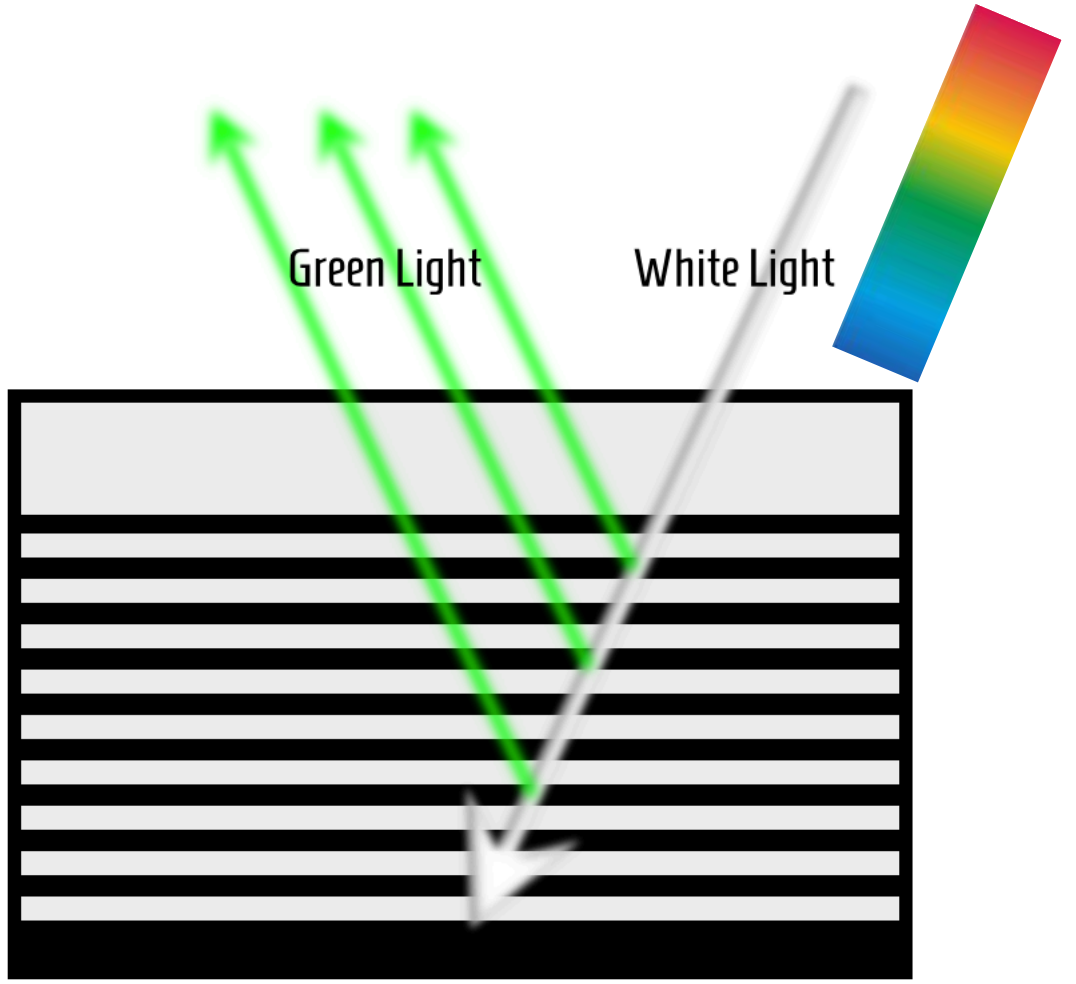
Yellow

[168, 97, 0]

Orange

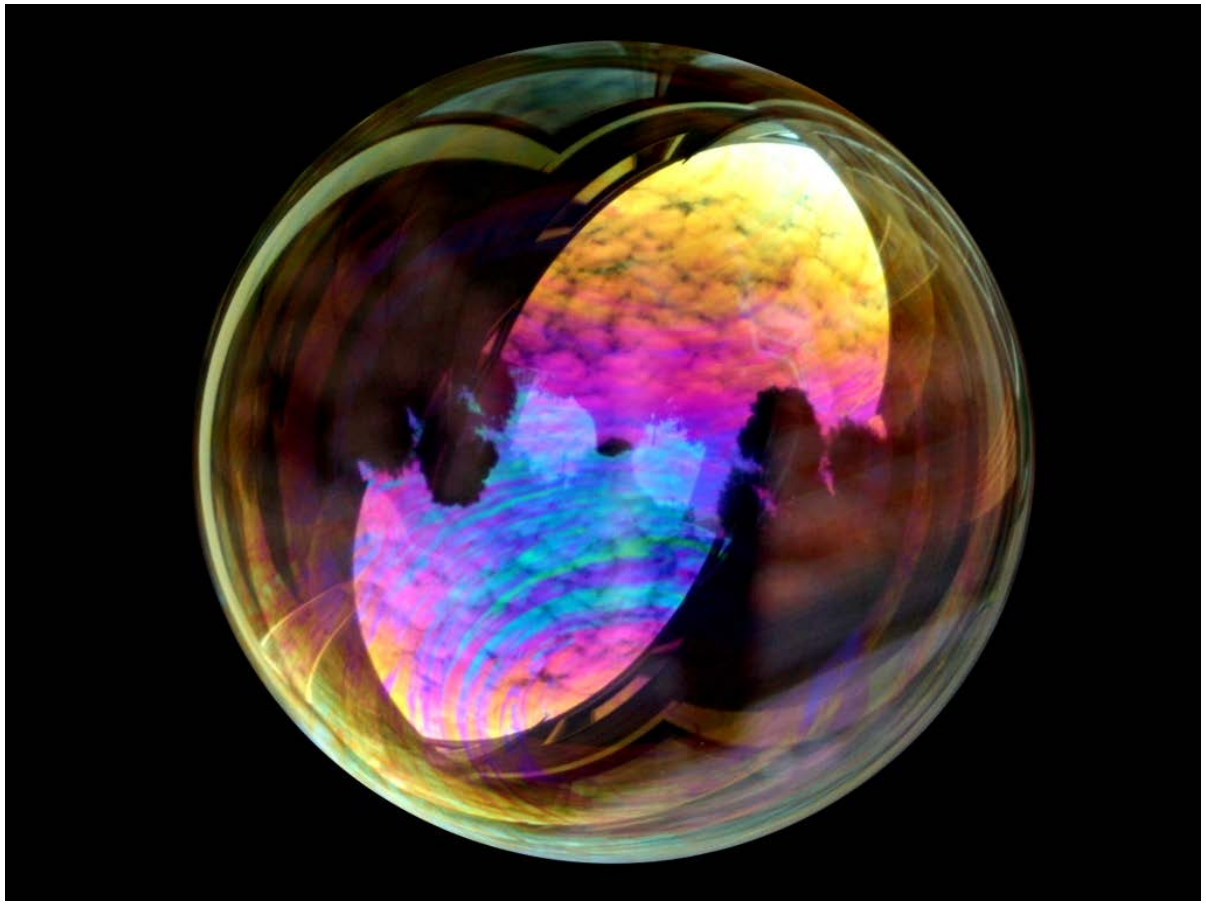
Multilayer Reflector

- Within the cuticle of the beetle exists alternating layers of material.
- White light enters, moves through the material and is ‘selectively reflected’.
- No pigment in these layers!
- The colours reflected depend on the optical properties of the material and the thickness of the layers.



Might sound strange…

- Thin film interference – no pigment, still vivid colours!



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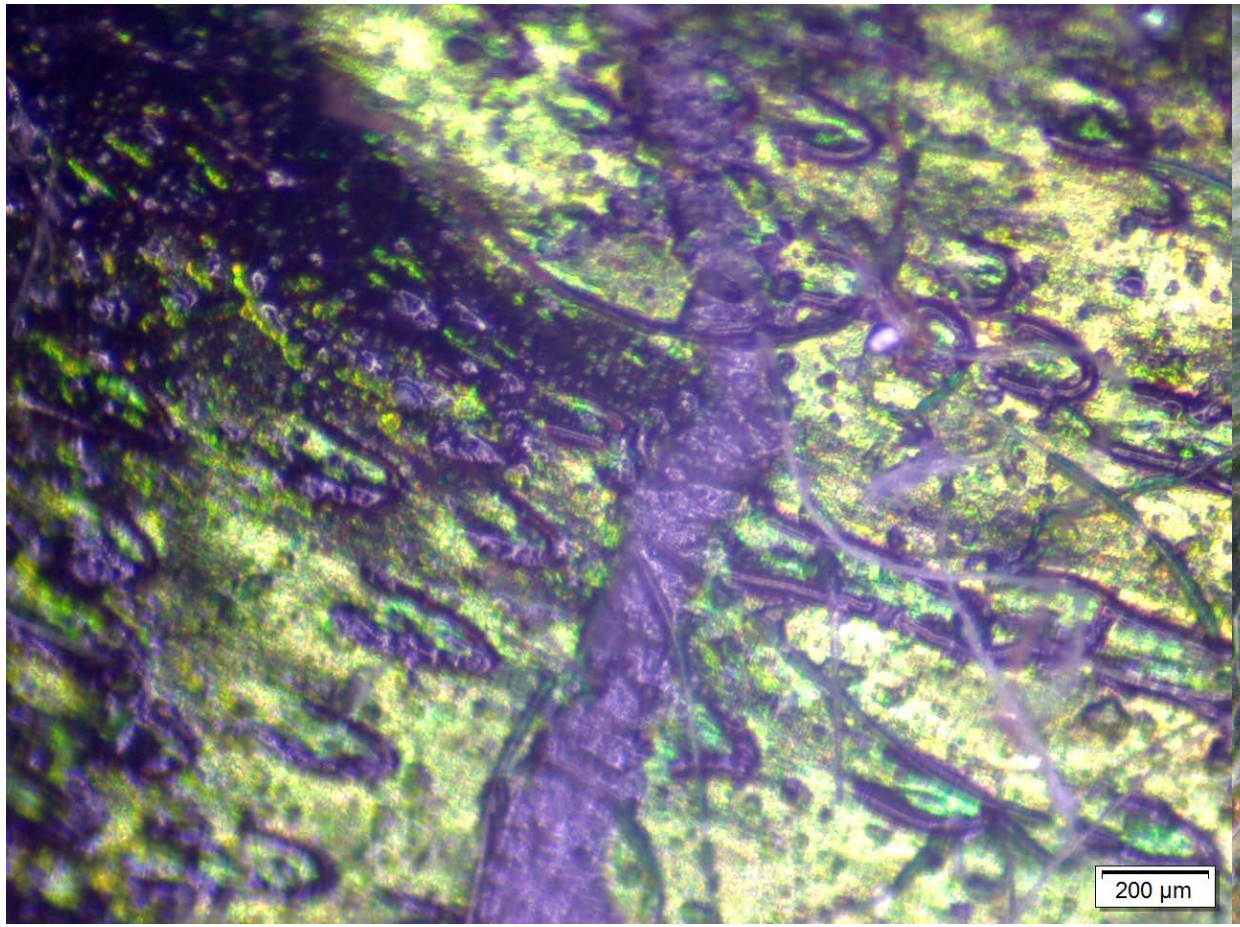
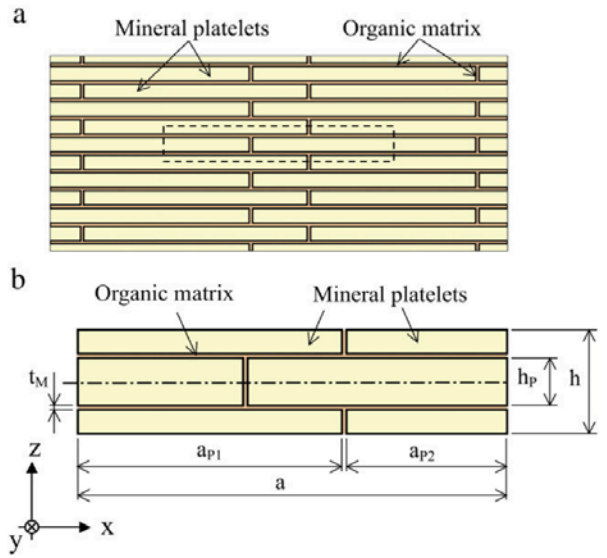
Rose Chafer (*Cetonia aurata*)

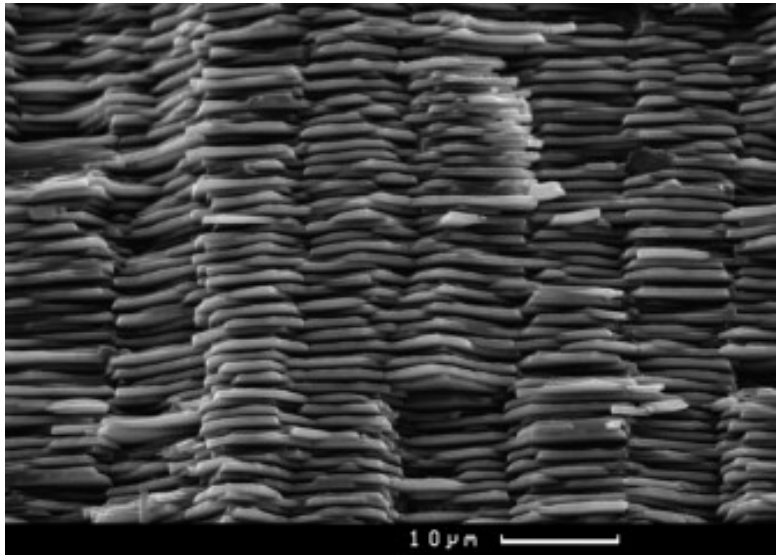


Specimen provided by Niamh Fahy.

Nacre – Mother of Pearl

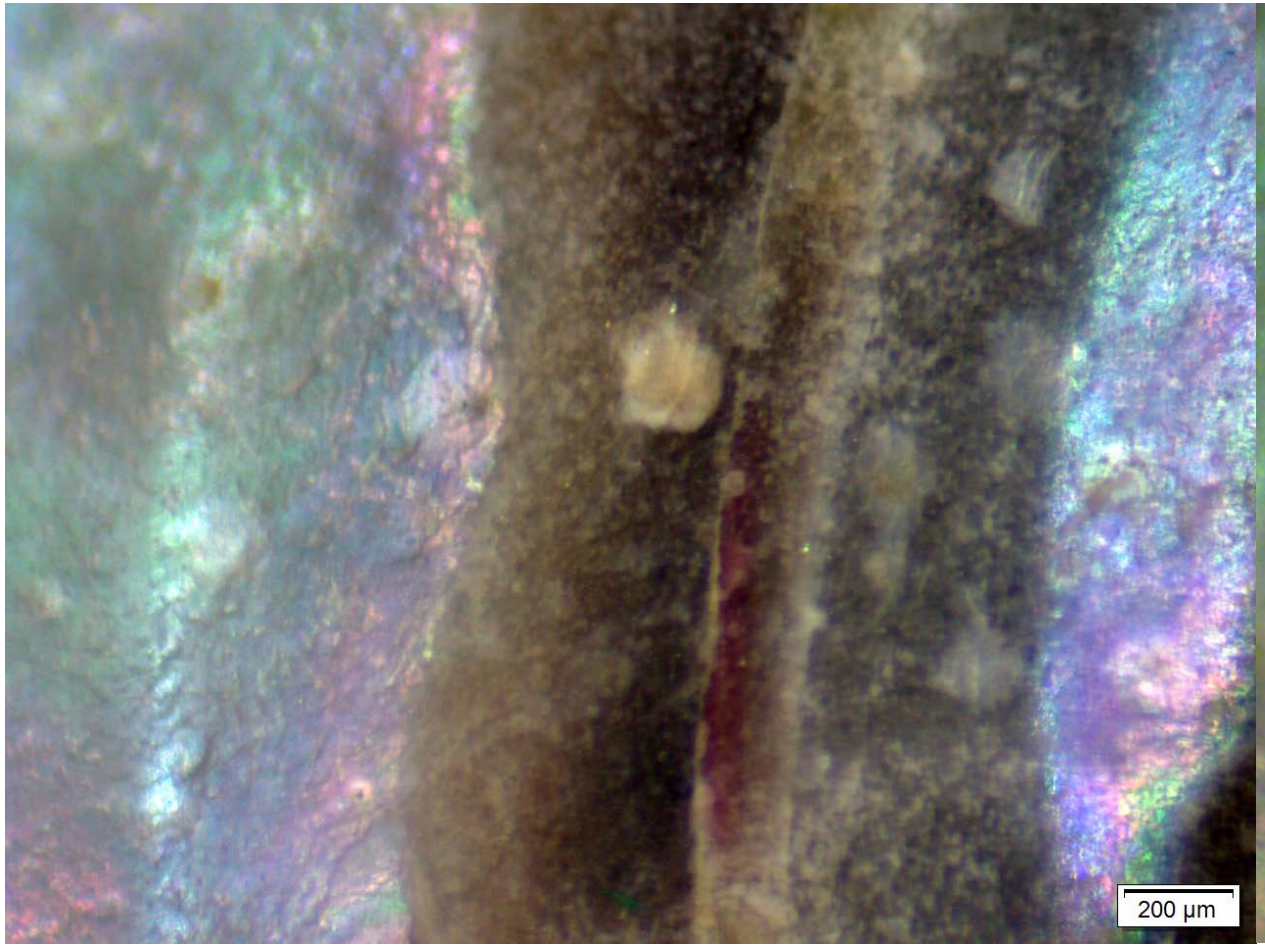
- Organic-inorganic compound produced in some molluscs.
- Platelets bound by long biopolymers – binding materials similar to before, chitin, lustrin etc.
- But usually hidden?

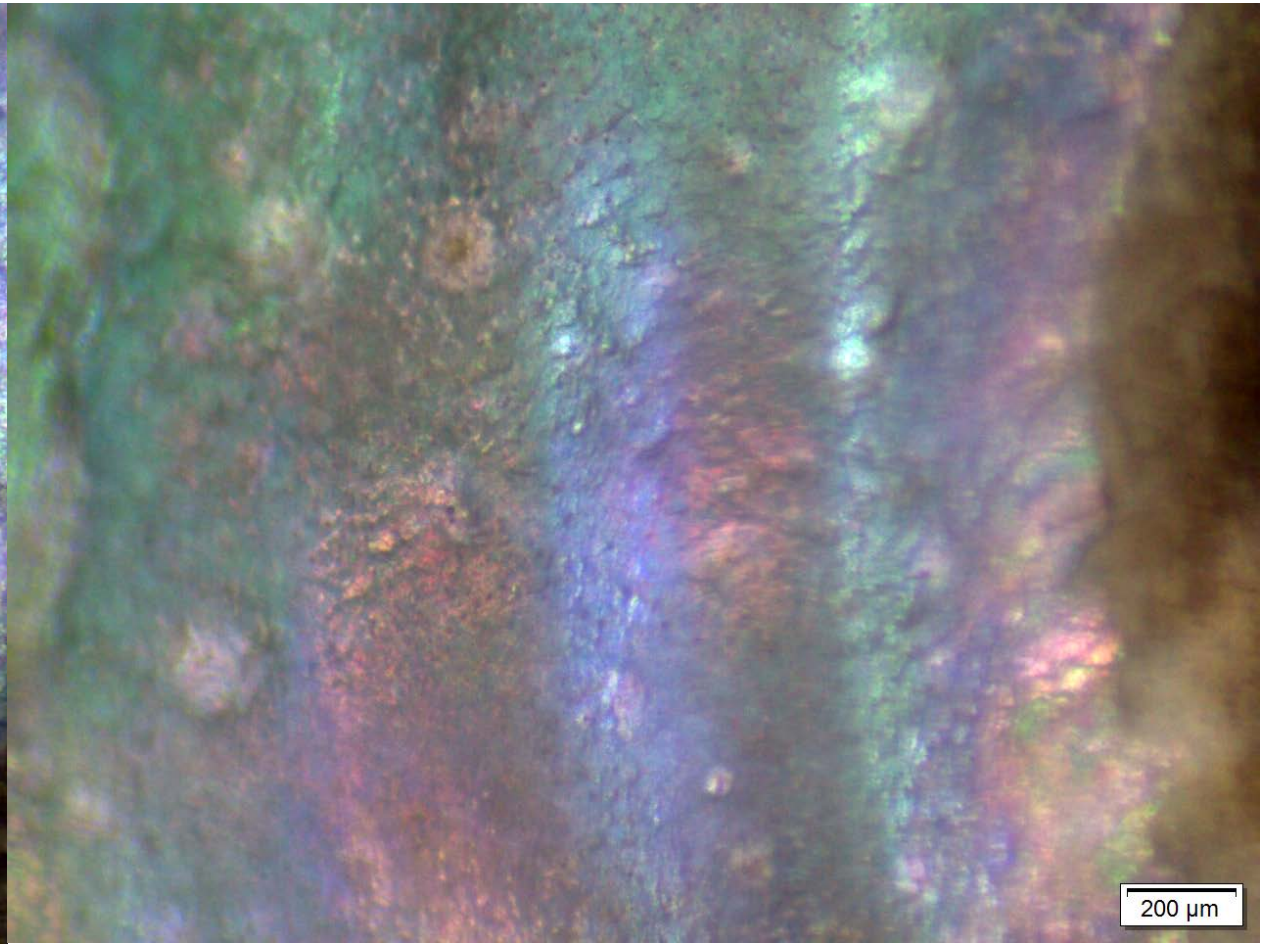




Tushtev, K., Murck, M., & Grathwohl, G. (2008). *Materials Science and Engineering: C*, *28*(7), 1164-1172.

Flat Top Shell (*Gibbula umbilicalis*)





Summary

- Natural colour systems are complex and fascinating from a design perspective.
- Use structure rather than pigment to produce colour.
- How do we use bioinspiration to help with our design?