Abstract a Biological Strategy

Once you've identified a few biological strategies that meet your function(s) there's an important transition you need to make in order to apply them to a design: translating the biological strategies into design strategies. To do so you need to abstract the core working mechanism(s) of the biological strategy and describe them in non-biological terms. Use the example below to practice this process.

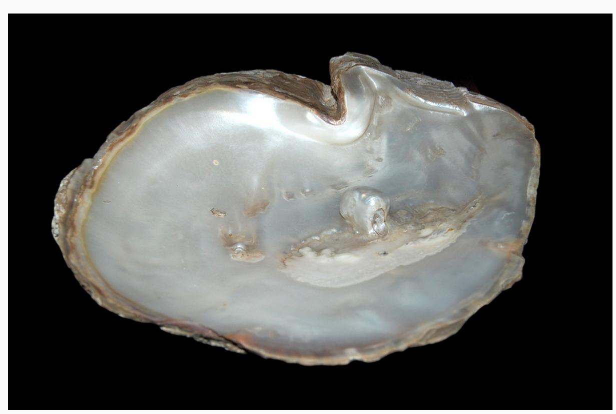
In the biological strategy summary below, highlight or underline the key words and phrases that address the function(s) and mechanism(s) of the strategy.

Nacre Resists Cracking: Black-lipped Pearl Shell

Nacre (also known as mother of pearl) is the shiny biological material that lines the inner surface of many mollusc shells. It consists of approximately 95% inorganic minerals (calcium carbonate) and 5% organic material (a mix of proteins and polysaccharides, including chitin). Inorganic minerals make materials hard and stiff, which is important for supportive or protective structures like shells; however, they also typically make materials brittle and relatively easy to fracture (man-made glass is an example of a brittle material).

Nacre's specific composition and construction make it tough and resistant to catastrophic failure that can result from spreading cracks. Here, higher toughness means that a greater amount of energy is needed to fracture or break the material. Hard microscale mineral layers in nacre are "glued" together by relatively soft nanoscale organic layers. The arrangement is much like staggered layers of bricks that are held together by mortar in a brick wall. When a crack starts in the nacre (say from a predatory attack), it quickly encounters the organic layers that are easy to stretch compared to the mineral layers. The cause behind the organic material's stretchiness can vary among nacres from different species; one mechanism involves wavy or folded fibers that straighten out before experiencing any significant tension.

The overall effect is that the stretchy organic layers provide avenues for deflecting cracks and absorbing and dissipating energy. Cracks can be controlled and stopped before spreading through the whole shell and causing serious damage. Counterintuitively, built-in areas of weakness on the microscale make the whole material tougher on the macroscale.



Strategy excerpt from AskNature. Image CC-BY, the paleobear via Flickr

Make a drawing of the biological strategy based on what you learned from the AskNature excerpt. Drawing is a great way to make sure you understand how the strategy functions in the living system.

Use the words and phrases you underlined to write a design strategy that describes the key mechanisms and functions of the strategy without relying on biological terms.

Draw the design strategy. Hint: Think like an engineer. Imagine the strategy as a mechanical system or process diagram in order to draw it without depicting biological parts.