Discovering New Classical Shapes in Molecular Micro-Compartments

Vernizzi, G., Sknepnek, R. & Olvera de la Cruz, M. (2011)
"Platonic and Archimedean geometries in multi-component elastic membranes"
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Nature optimizes structure to maximize function. Such is the case of cell organelles known as carboxysomes, which are compartments made of many shell-proteins that carry the structure of special faceted shapes optimized for trapping components that facilitate the process of converting carbon-dioxide into sugar as an energy source. Most homogeneous shells, such as viruses and fullerenes, buckle into a 20-sided structure called *icosahedron*. With the potential to design micro-reactors that mimic the functions of cell compartments, researches at Northwestern developed a new model for the spontaneous faceting of shells made up of more than one structural component, into new shapes taking the forms of various irregular and regular polyhedra including *classical Platonic and Archimedean geometries* discovered in Greek antiquity.

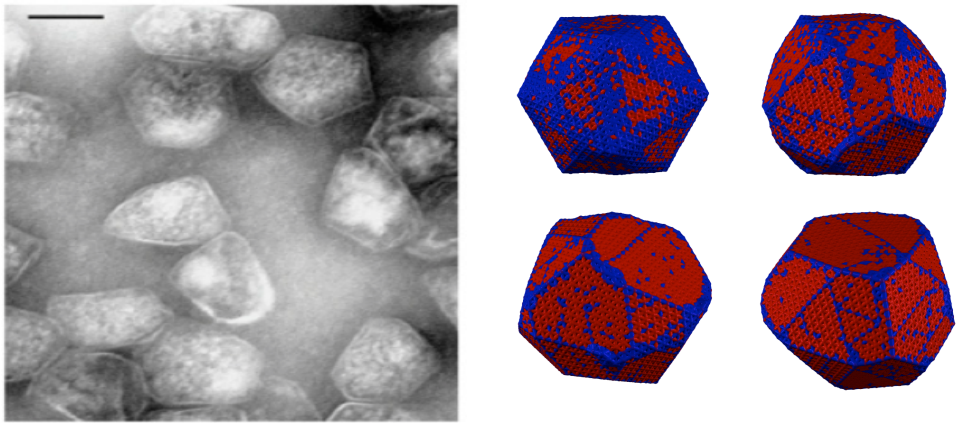

Figure: Cellular shells (Left) resembling inhomogeneous co-assembled polyhedra shells (Right).

The research team uses physics, mathematics and computers to explain the formation of a rich variety of classical shapes, such as the *dodecahedra* (12 sides), *octahedral* (8 sides), and *tetrahedral (4 sides)*, as well as their truncated forms, *Johnson solids* and *exotic hosohedra*, by shells made up of components that have different rigidities and mechanical properties. Armed with this new model, engineers could now potentially design shells that have intelligence and perform tasks within severe specificity requirements.

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- http://www.pnas.org/content/108/11/4265.full.pdf+html
- http://www.sciencecodex.com/researchers_discover_new_shapes_of_microcompartments