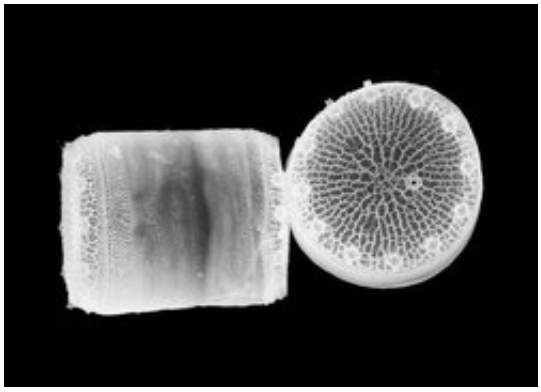
Tiny diatoms boast enormous strength

8 February 2016, by Lori Dajose



Diatoms are single-celled algae organisms, around 30 to 100 millionths of a meter in diameter, that are ubiquitous throughout the oceans. These creatures are encased within a hard shell shaped like a wide, flattened cylinder—like a tambourine—that is made of silica. Researchers in the lab of Julia Greer, professor of materials science and mechanics in Caltech's Division of Engineering and Applied Science, have recently found that these shells have the highest specific strength—the strength at which a structure breaks with respect to its density—of any known biological material, including bone, antlers, and teeth.

The findings have been published in the February 9 issue of *Proceedings of the National Academy of Science*.

The shell, or frustule, of a diatom is porous, perforated by a honeycomb-like pattern of holes. There are several theories about the function of these intricate shell designs, including that they evolved to control fluid flow, for example, or to help the organisms acquire nutrients. Greer and her group propose that the holes also act as stress concentrators—"flaws" in the material that can suppress the propagation of cracks, which would lead to failure of the entire organism.

"Silica is a strong but brittle material. For example, when you drop a piece of glass, it shatters," says Greer. "But architecting this material into the complex design of these diatom shells actually creates a structure that is resilient against damage. The presence of the holes delocalizes the concentrations of stress on the structure."

The group plans to use design principles from diatoms to create resilient, bioinspired artificial structures.

More information: Microstructure provides insights into evolutionary design and resilience of Coscinodiscus sp. frustule, *PNAS*, www.pnas.org/cgi/doi/10.1073/pnas.1519790113

Provided by California Institute of Technology