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BIOMATERIALS

Biopolymer Gives Strength To Bones

Gluelike material absorbs energy in stressed bone, resisting fracture

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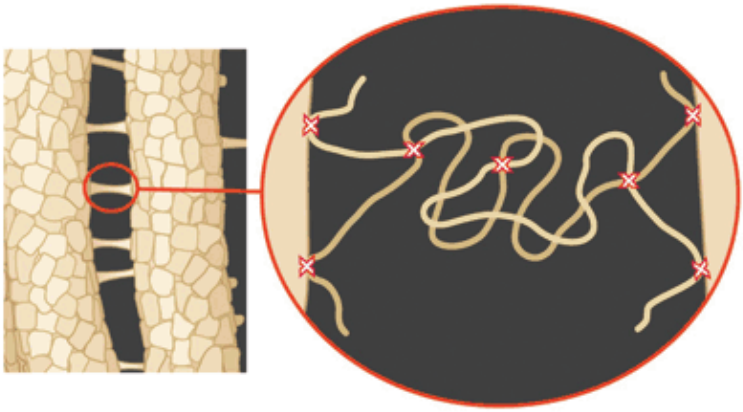

STRETCHED When under stress, bone's biopolymeric glue stretches by breaking sacrificial bonds (red Xs). The process absorbs energy and prevents the bone from breaking.

HANSMA LAB, UCSB

The secret to healthy, fracture-resistant bones may lie within tiny bits of a shock- absorbing biopolymeric "glue" recently discovered by scientists at the University of California, Santa Barbara (*Nat. Mater.,* published online July 17, dx.doi.org/10.1038/nmat1428). The finding could lead to therapies for healing and preventing bone fractures.

"Before this research, it was well-known that the mechanical properties of bone depended on mineral particles and on collagen fibrils," explains physics professor Paul K. Hansma, who conducted the research with graduate student Georg E. Fantner, postdoc Tue Hassenkam, biology professor Daniel E. Morse, and chemistry professor Galen D. Stucky. "The picture of bone was that it consisted of these collagen fibrils coated with tiny mineral crystals only a few atoms thick. What we found is that there is a glue in bone that holds these mineralized collagen fibrils together."

When bone is put under stress, weak bonds in this biopolymer glue break, and the material stretches out. The stretching absorbs energy and lessens the overall impact on the bone. Once the stress is removed, the weak bonds re-form, restoring the bone's strength and resilience. The mechanism is similar to what happens when you step on a freshly chewed wad of gum, Fantner says. Lift up your foot, and gummy threads try to hold your shoe to the ground. Put your foot down again, and those threads will re-form into a mass.

"The next big step is to find out what the glue is exactly," Fantner says. The researchers suspect that it may be made of proteins or glycoproteins, held together by weak calcium-mediated bonds. Knowing precisely how the glue works could eventually help scientists devise ways to improve its function, either with diet or with drugs, Fantner adds. The researchers also note that the properties of synthetic nanoscale composites could be improved by mimicking the nanoscale structure of

bone.

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