NOVA PBS

MAKING STUFF WITH DAVID POGUE

Tips for Helping a General Audience Understand Stronger Materials

The goal of the "Making Stuff" outreach campaign is to help people appreciate and gain a better understanding of the material world. As you (or your invited speaker) prepare your 10- to 12-minute presentation, consider organizing your remarks so that the audience will leave understanding the **Big Ideas**. Use the **Conversation-Starter Questions** as a way to kick off a general discussion.

Big Idea #1: There are different kinds of strength in materials.

The word strong actually refers to a range of properties, each defined by the ability to stand up to a different type of force. Strength is a measure of how well a material can resist a force (or load) before failing. The load is distributed over an area and is more accurately defined as stress (force per unit area). There are different kinds of stresses, including tension (pulling), compression (squeezing), impact (a sharp blow), torsion (twisting), and shearing (surfaces sliding past one another).

A material may be strong in one property but not another; for example, chalk has little tensile strength or toughness but has high compressive strength. Materials scientists test the strength of materials by stressing them to their breaking point, called failure, at which point the material ruptures and cannot rebound to its original condition or shape.

conversation-starter question: WHAT DOES IT MEAN TO BE STRONG?

Big Idea #2: The strength of a material is determined by its atomic structure.

The atomic structure of a material determines its properties, including strength. For example, in a metal like iron, the atoms are packed together in a crystalline structure but can slide past each other when pushed or pulled. However, steel is composed of iron and carbon; the carbon atoms fit between the iron atoms, making a more rigid crystalline structure, which gives steel its tensile strength. The higher the carbon content of steel, the greater the tensile strength (but the lower the ductility).

A polymer such as Kevlar® has long chains of rigid rings that run parallel to the fibers and are bonded to each other by strong hydrogen bonds. Like rungs of a ladder, the hydrogen bonds lock the rigid rings into a tight formation to give Kevlar® superior tensile strength.

conversation-starter question: WHY ARE SOME MATERIALS STRONGER THAN OTHERS?