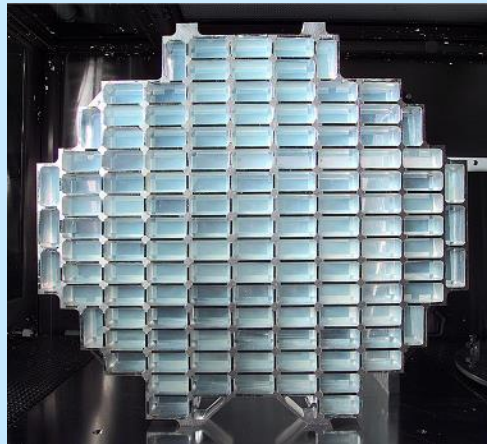


**Welcome to the wonderful
world of wonder materials:**

Aerogel



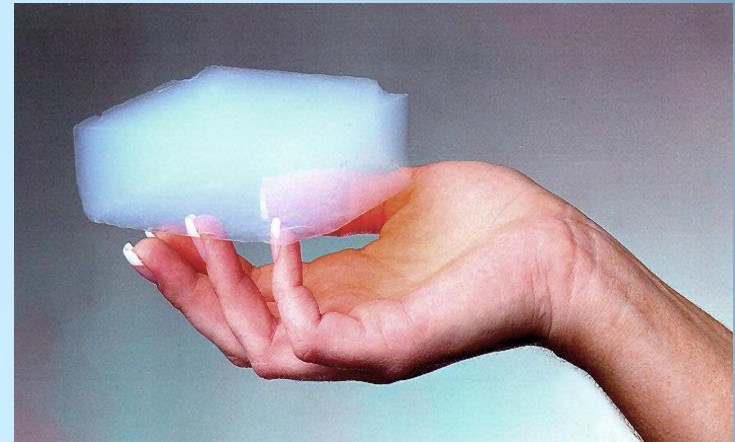
The lightest solid known to humans!

What is an aerogel?

aerogel: air solid

“aero” = air

“gel” = part solid and part liquid



Aerogels are created by removing moisture from a gel while maintaining the gel structure.

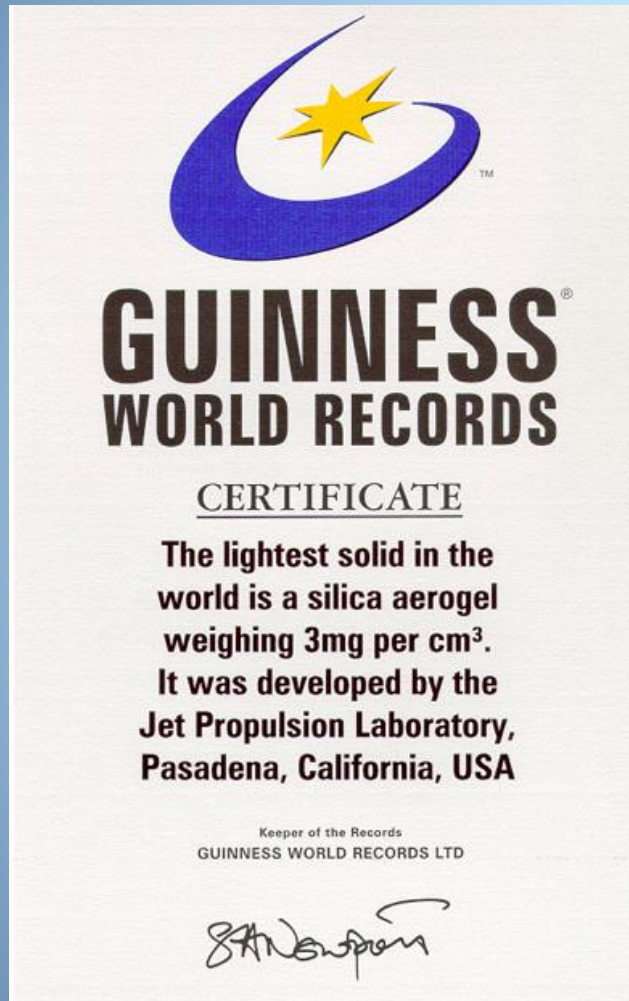
Though ghostly in appearance, aerogel is very solid and feels like hard Styrofoam to the touch.

One of the **highest surface area** solids



Aerogel Properties

Lightest solid in the world



**Has a density lower
than any other
known solid**

Aerogel Properties

Hydrophobicity



Aerogel Properties

Transparency



Aerogel is sometimes called “**solid smoke**” or “**frozen smoke**”

Aerogel Properties

Translucency

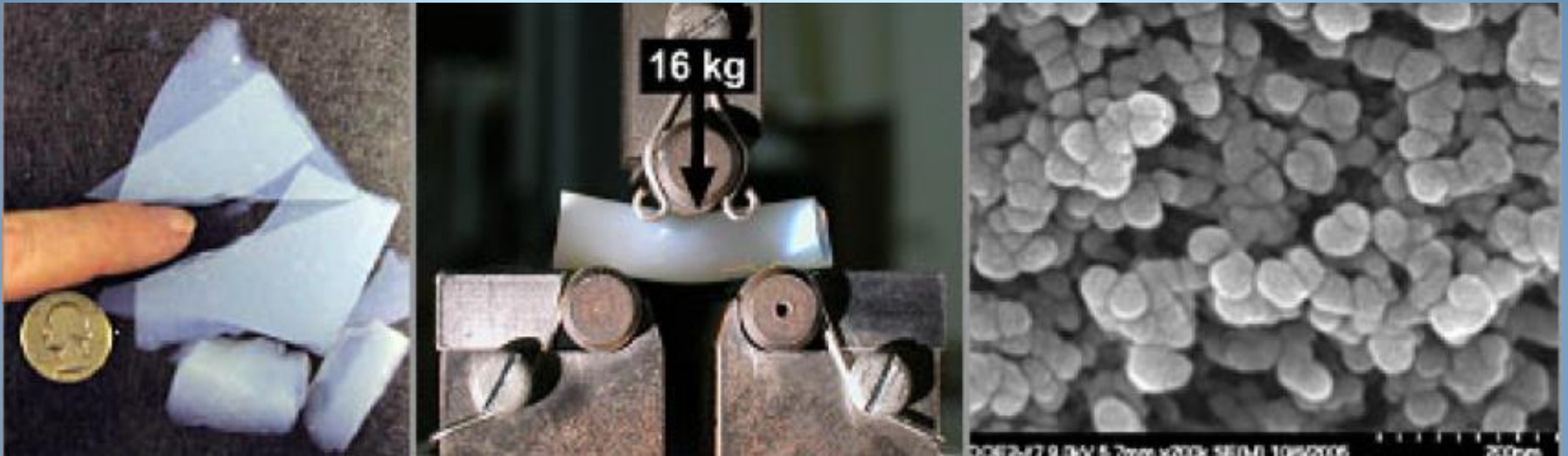


NASA developed ways to create aerogels that are polymer-reinforced.

These aerogels are stronger and can be translucent

Aerogel Properties

Composite Aerogels



Plain slide aerogels (left) are so fragile that they break by a light finger press, whereas a cross-linked aerogel supports a load (middle). The mesoporous structure is maintained after cross-linking (right).

Composite Aerogels



Aerogel Properties

Lowest thermal conductivity



← Crayons on aerogel over a hot flame. The crayons are protected from the flame (no melting!)

Aerogels resist temperature change

Aerogel Properties

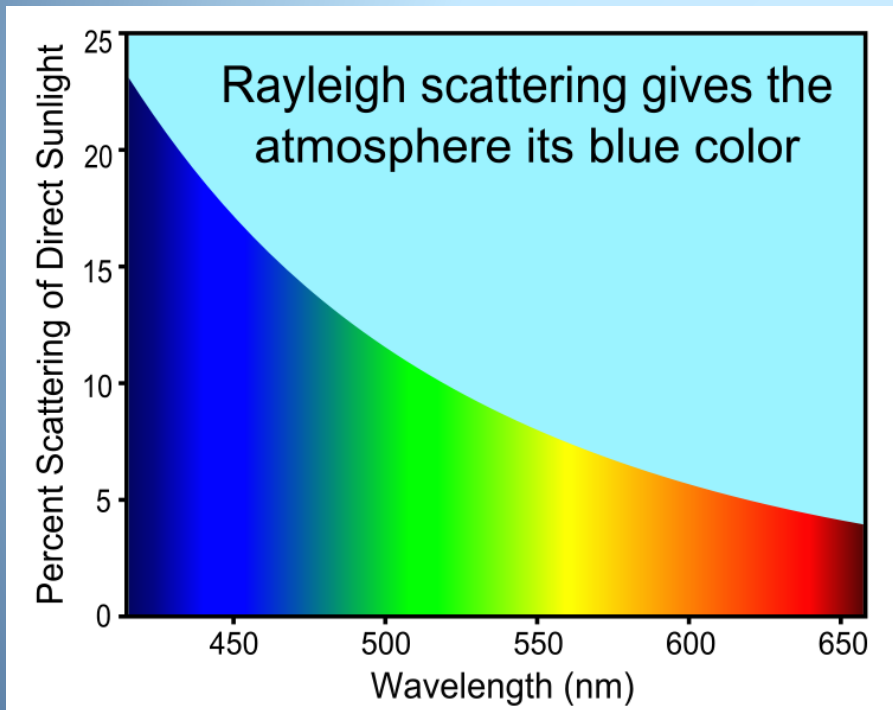
Composite Aerogels

Though aerogels are often made of silicon dioxide, SiO_2 , many **hybrid** aerogels have been created.



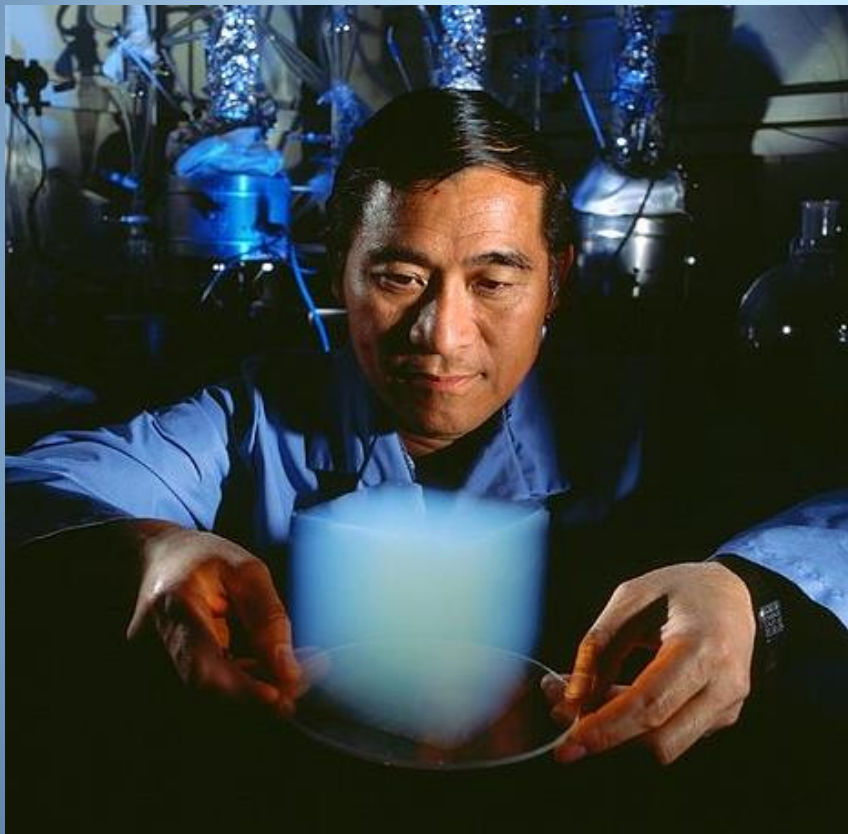
These pieces of silica aerogel have been coated with silicon nanoparticles using chemical vapor methods. The composites emit red light when excited with ultraviolet light.

Why are some aerogels blue?



Rayleigh scattering is the elastic scattering of light by particles much smaller than the wavelength of light.

Why are some aerogels blue?



The sky, glaciers and some aerogels have tiny particles or bubbles that scatter light.

Blue scatters the most, so they all look **blue**.

Great insulators



← Used as jacket insulation for wear in extremely harsh conditions

Provides thermal & acoustic insulation

↙ The NASA-developed aerogel material was incorporated into this jacket, which was tested during an Antarctic expedition

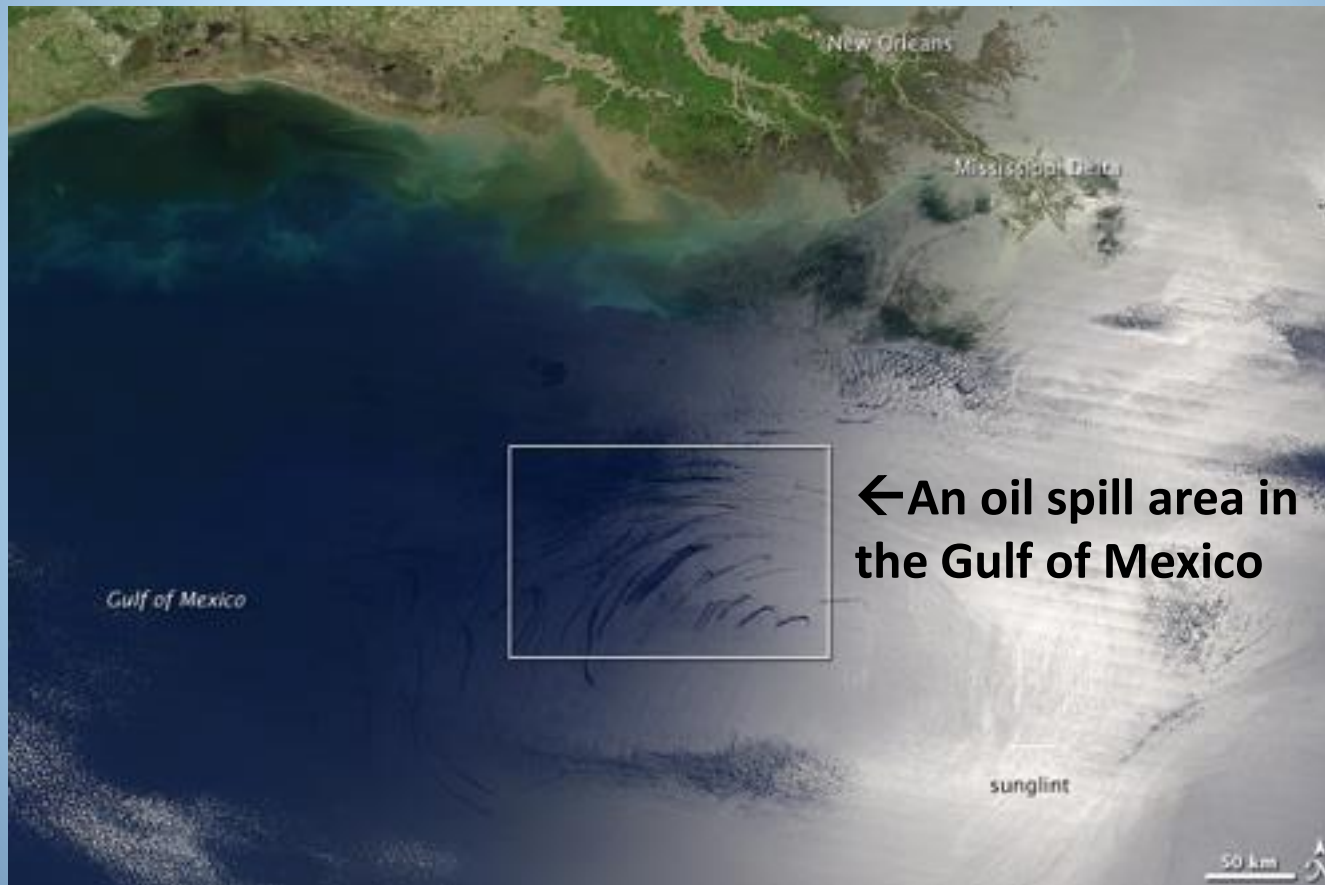
Aerogel material also used to insulate shuttles and aircraft

Aerogel Applications



Chemical adsorber

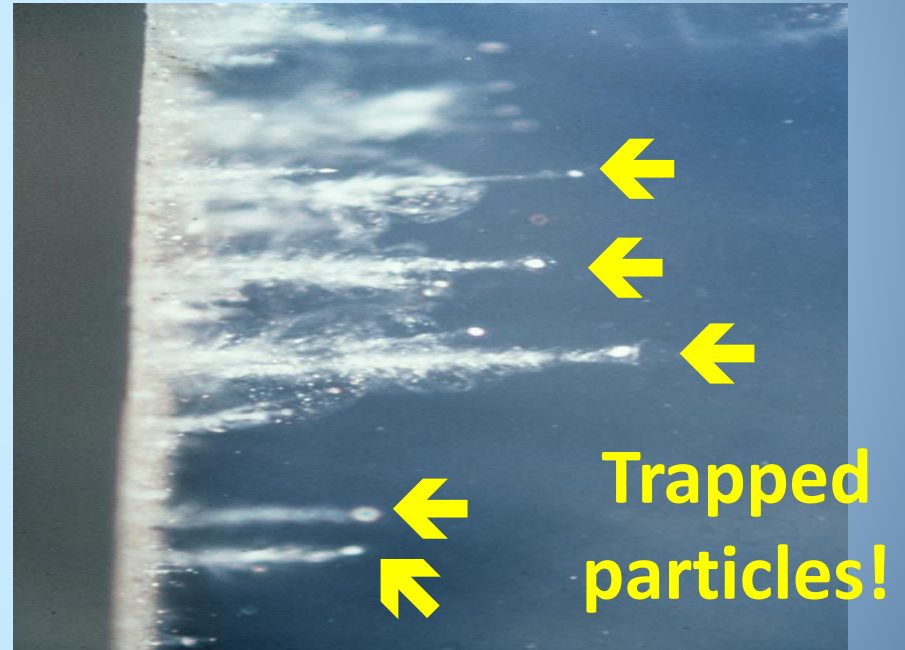
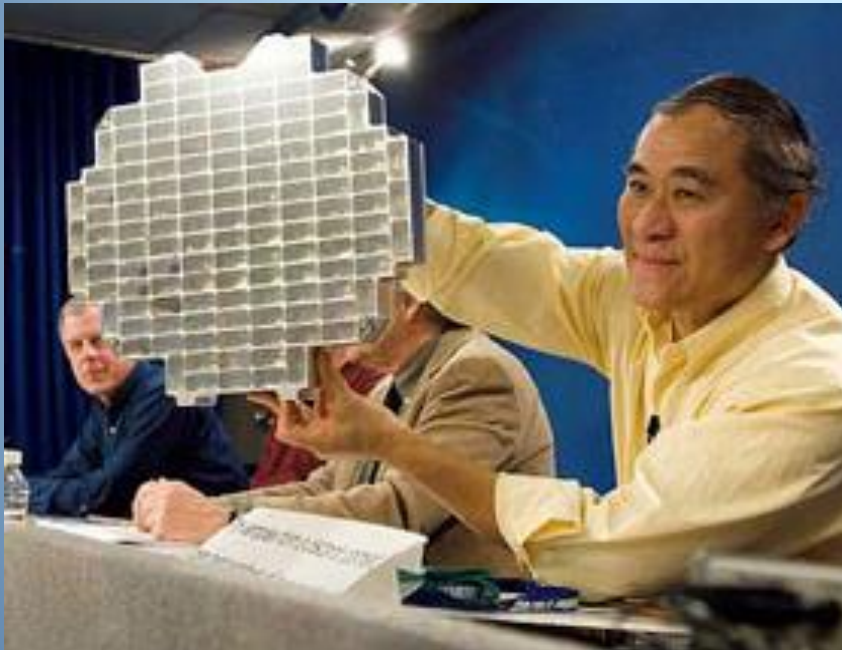
For cleaning up oil and chemical spills



Aerogel Applications

Stardust collector

NASA used aerogels in a device that collects dust samples (including ancient stardust and comet particles) in space



Aerogel Applications