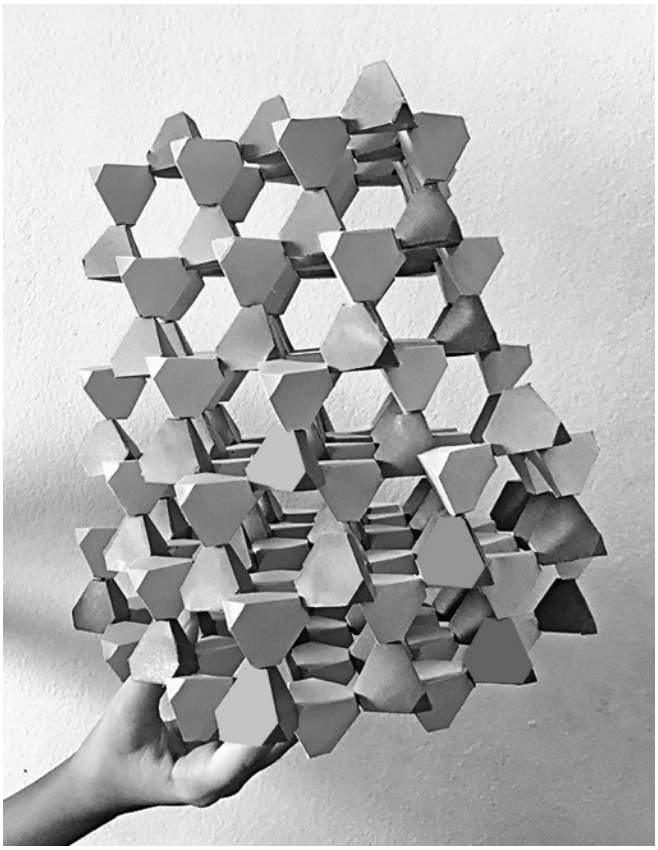
Diamond

Shannon and Ian Jacobs

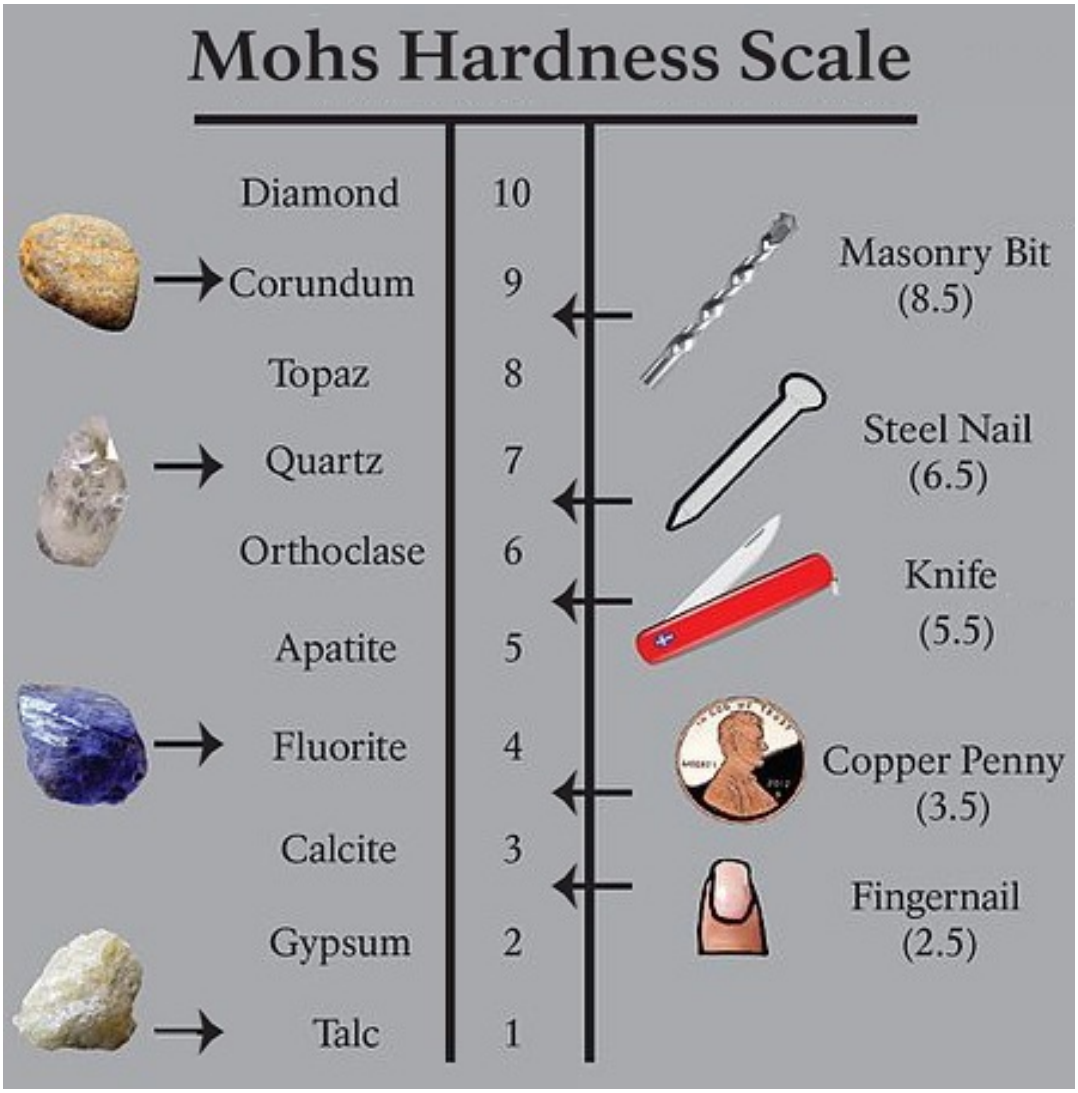
Diamonds might be nice but make sure you never have a house fire. Diamonds are pure carbon: they burn like coal and they shatter like coal if you hit them with a hammer.

A paper model of the diamond structure



The model was made by glueing cyclohexane rings together so that three sets of parallel hexagonal channels are formed through the structure. The glued bonds are strong and the structure is remarkably strong and rigid. Carbon atoms line up to form flat surfaces that are called cleavage planes. If a sharp steel blade is placed against a raw diamond in just the right direction and tapped firmly with a hammer the diamond will split into two flat sided pieces. Get it wrong at it will shatter.

The common unit of hardness is the Moh.



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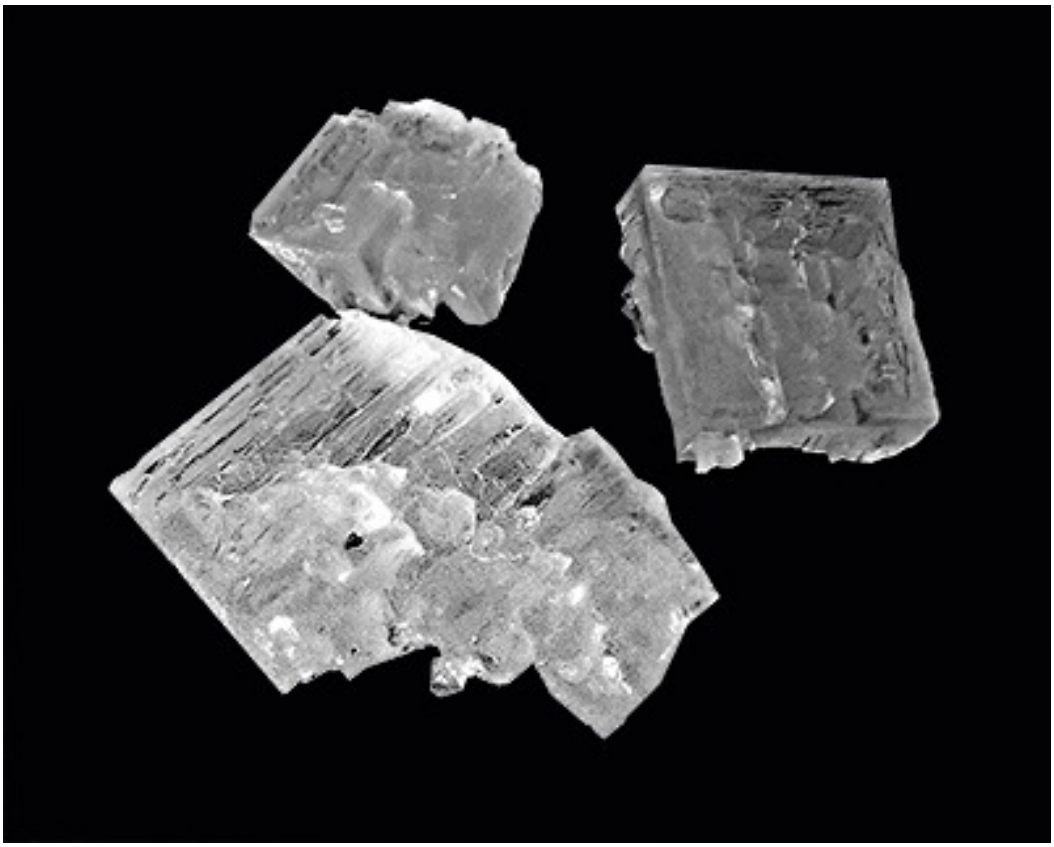
A fingernail will scratch talc and gypsum, a diamond will scratch steel and window glass, but no natural substances will scratch a diamond. Diamonds are polished with diamond dust.

The Chinese have recently (2021) reported making an artificial form of diamond that they call diamond glass. Tiny crystals of diamond are embedded in an irregular lattice of carbon in the structure of a glass. This artificial substance is reported to be harder than diamond and may become commercially important in the near future.

Diamond glass

Why are salt and diamond so different?



The salt we use for cooking looks like this up close.

Salt crystals are transparent and have cleavage planes like diamond, but they are soft and dissolve in water: not at all useful for decorating rings and tiaras.

The bonding in a salt crystal is ionic. The outer isolated electron of each sodium atom is transferred to a chlorine to complete the outer shell of eight.

Both ions, Na^+ and Cl^-, have complete outer shells and are bonded in the crystal structure by the relatively weak attraction between single positive and negative charges.

The reason for the extraordinary hardness of a diamond crystal is the strong covalent bonding of each carbon atom to four nearest neighbours.