MODULE: Matter 1

Activity Sheet 1.12: Making Better Materials

Rubber

Is a wonderful material; its particle structure can change, altering its properties.

Rubber comes from trees. Careful treatment of the trees gives a milky liquid called latex. This is natural rubber.

Rubber has some amazingly useful properties. It is solid, light, waterproof, and can be coloured easily – but most of all it is **elastic**.

Elastic means that if you use a force to change its shape, and then remove the force, the rubber returns to its original shape.

This can happen thousands and thousands of times without the rubber getting tired or breaking.

(The word *plastic* is actually the opposite of *elastic*. When a plastic material gets squashed, it stays that shape; clay is a good example.)





Rubber molecules are very long and thin. They are made from lots of small molecules linked together.

The long molecules in natural rubber are arranged in a solid like this:



When the rubber is stretched, the folded molecules change shape under the influence of the force.



A problem with properties

Natural rubber is nice and stretchy, but it is soft and sticky. It is not very hard-wearing. For many uses, it is just too soft, and it wears out very quickly.

The structure of solid rubber can be changed by adding other materials to it.

The other materials make cross-links between the long molecules, holding them steady, and making the rubber harder and more wear-resistant.



The more cross-links there are between the long, thin molecules, the harder the rubber becomes. It also becomes less elastic and harder to stretch. With a lot of cross-linking, the rubber can end up as a hard, breakable solid.

This property is useful, too. The rubber, with cross-linking material in it, can be moulded when it is soft, then heated to activate the cross-linking process. Complex shapes like musical instruments, which are difficult to make otherwise, can be made in this way.

Your task

Copy the diagram of unstretched rubber. Add notes and extra drawings to show how this can be made harder.

Here are some objects that are usually made from rubber as a raw material:

Rubber band, car tyre, pencil eraser, rubber glove, electrical insulation, shoe sole, saxophone mouthpiece.

Put these into three groups:

- Very little cross-linking, so they stay flexible
- Moderate cross-linking, so they remain flexible but become much tougher
- Lots of cross-linking, until nearly rigid.

Explain your choice of cross-linking for each product.