

LESSON 3

The deep-down meaning of hotness.

Q1. You blow air into a balloon, forcing the rubber to stretch and the balloon to expand. But the air (a gas) is mainly empty space, so how does it pressurise the balloon? *[Through the continuous bombardment by zillions of molecules. This is what keeps balloons fat.]*

The endless movement of atoms and molecules is what we all know as hotness (temperature). That discovery solved a mystery which puzzled people for thousands of years. Hot air looks just the same as cold air. This is because we cannot see the atoms and molecules, so we cannot see that **they are moving faster in the hot air.**

Now you know the secret of hotness, and it is only because you are learning about atoms and molecules. Hotness means faster-moving atoms and molecules. It is a huge advance in human understanding – part of the knowledge that has got man to the moon!

Make the rope circle again, and help your pupil repeat the helium balloon acting of Lesson 1. Point out that molecules are not living things like birds, so the He molecules cannot change direction except when they bounce off the rubber or other He molecules. Now imagine the helium in the balloon is heated. The hotter it is, the faster the molecules are moving, so to imitate nature properly you will both have to move faster and faster.

Q2. Will heating alter the force of collisions between the He molecules and the rubber? *[It makes the collisions harder.]*

Q3. Will heating alter the number (frequency) of these collisions? *[It makes the collisions more frequent, because the molecules are moving faster.]*

If you are wondering how such heating would affect the size of the balloon you are thinking like a scientist.

Q4. Is an He particle an atom or a molecule? *[It's an atom, but it's stable and moves about on its own, so we can also call it a molecule.]*

Notes for Parents

Thinking about the importance of science helps to keep a science teacher's spirits up, so if getting man to the moon doesn't impress you, let's look at forensics (which brings murderers to book and clears innocents of blame), or modern communications and transport (that keep families in touch), or anaesthetics (that reduce suffering), or life expectancy, which continually increases, making a mockery of those extremists who dwell darkly on pollution and "chemicals". It is science that has provided the leisure time in which to grumble about science!

A hot cooking pot seems the same as a cold one until you go to pick it up! The pot's atoms are not free to move through space like the atoms in helium gas, but they are vibrating more vigorously in the hot pot than those in the cold pot. This example could have been used in the explanation of temperature, but it is not put in the lesson because we don't deal with solids until lesson 11.

Q2 and Q3 are fair, but don't expect your pupil to go further and deduce that heating the gas in a rubber balloon would make it expand. Science teachers know that such thinking takes time to develop. It is very encouraging to ask answerable questions, so ask plenty of questions that are similar to ones you have asked before. Don't ask too many your pupil won't get right.