EPIGENETICS
DNA's Mastercode

DNA is subject to an overriding mastercode in the form of hydrogen-loaded carbon 'tags' that are attached at various points along the side rails of the double helix. These carbon tags (CH**3**) determine whether or not particular genes or groups of genes are available for transcription. Their pattern of attachment is known as methylation and it represents DNA's overriding mastercode.

A genome's pattern of methylation ensures that each cell expresses only those proteins that are appropriate to it at the time of transcription. Altered methylation alters gene expression by changing the way DNA folds. In general, genes in tightly compressed DNA are not readily expressed, while DNA that is more loosely packed is more accessible to the machinery involved in transcribing it into messenger RNA (mRNA), and thereby into protein. Appropriate DNA methylation is therefore essential for the appropriate development and functioning of an organism.

Bees perfectly illustrate this. The only genetic difference between the large fecund queen bee and her army of small, sterile, female workers is the pattern of methyl tags on their otherwise identical DNA, and this difference is solely determined by the kind of food that is fed to them when they are larvae. Larvae that are chosen as future queens are fed a specialised diet of 'royal jelly'; workers get little of it.

Some viruses, bacteria and chemical pollutants are similarly able to disturb a genome's basic sequence of methyl tags. Even the body's own immune system, its hormonal response to stress, and the processes of aging can alter the methylation pattern of DNA and directly interfere with the structure and behaviour of an organism—sometimes in a heritable fashion.

Our species offers no exception to this rule. So although our genes determine our fundamental structure and behaviour, our overriding epigenetic code orchestrates all the finer details of our mental and physical existence.

Altered patterns of methylation can compromise human immune systems, producing a wide range of ailments such as diabetes, some cancers, arthritis, asthma, and some allergies that degrade the fitness of the population as a whole. Traumatic stress in childhood, or a lack of appropriate parental nurturing during our developmental years has also been shown to slightly alter our methylation patterns. Such changes can significantly alter our perceptions of the world around us, and can thereby remould our adult behaviour to some degree. Meanwhile, methylation is the essential factor that shapes our memory (short-term and long-term), and this too, can modify our behaviour.