DNA, RNA and protein formation
DNA and inherited information

Norman Cohen:
If you're going to build anything complicated you need some sort of plan, a blueprint, a set of instructions. Now that's just as true of living cells as anything else, but they contain the instructions within themselves, they're inherited, they're copied and passed on from generation of cell to generation of cell. Now what we're going to do is look at what the instructions are and how they work. But before we do that, just stop for a moment and think what sorts of characteristics any set of inherited instructions is likely to have. I think there are probably three. First of all, the instructions have to be stable, they have to last long enough to be copied and passed on to the next generation of cells. And there's the second point. They need to be capable of being copied, and copied accurately. And finally, and most obviously, as instructions they need to contain information. Well that's all very well when it's really just sort of speculation theory – what about the reality? The reality is a molecule called DNA. Now you might think that the structure of a molecule that contains the instructions for making a complete cell must itself be very complicated but, in fact, the basic structure of DNA is remarkably simple.

Commentary:
Here's the schematic model of DNA. Unwind the double helix and it consists of two long strands that form a ladder-like structure. The strands of DNA are strings of chemically repeating units which act as basic building blocks. Each unit contains a sugar, deoxyribose, a phosphate group and a base, together these form a nucleotide. There are actually four types of base: adenine, thymine, cytosine and guanine. Within a strand of DNA the bases can come in any order and just how important this sequence is will become clear later. What's more, in double-stranded DNA, the bases match up in a particular fashion. Adenine always pairs up with thymine, and guanine with cytosine. This precise base pairing means that the base sequence in one strand is complementary to the sequence in the other. The base pairs are held together by relatively weak hydrogen bonds, but when summed up over the whole DNA double helix, these hydrogen bonds impart great stability.

Norman Cohen:
Let's have a look at base pairing in a bit more detail. Here's another model of DNA. It's a different type of model and it's of a very short section of DNA. These are the two strands of the double helix and connecting them, like steps, are those pairs. We've arranged it with both types of base pair represented. A, T, and on the other side, G, C, and during the base pairs these are the hydrogen bonds. Now hydrogen bonds are relatively weak bonds, but summed up over the whole DNA molecule which, in reality, would be a very long molecule, the double helix is stable. In some ways, DNA is a bit like a zip fastener. Individual links are weak but overall the thing's quite stable. But if it's stability you're after, why have something that can quite simply fall apart? Well, the answer's also quite simple. There are occasions when the two strands of a DNA double helix do have to separate. For instance, remember that before cells divide they have to copy their DNA in a process called replication.