GeneChip Microrrays

Appendix B -

DNA Basics: DNA Structure, Transcription, and Translation

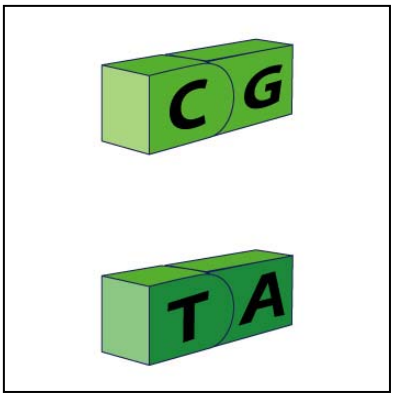
The Double Helix

To understand the significance of what GeneChip expression analysis microarrays do, you need to understand the basics of DNA. DNA is a long chain of molecules shaped like a **double helix**, or a very long spiral staircase. DNA is the genetic blue print, or script, providing instructions for all cellular processes.

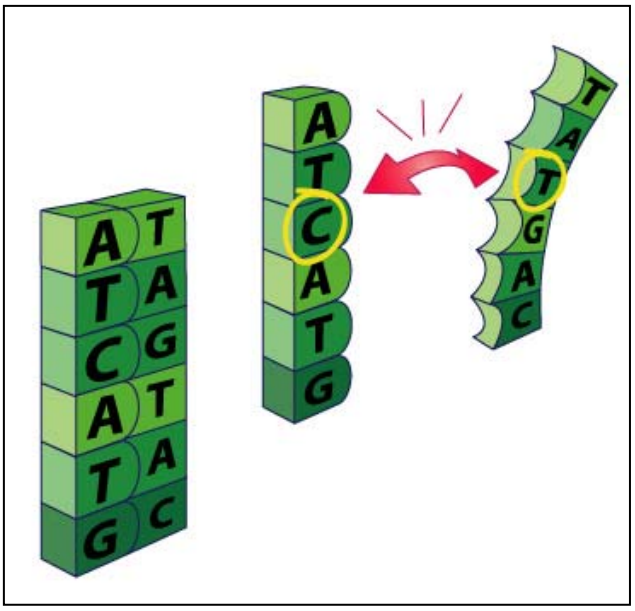
Whereas DNA is the script for making ribonucleic acid (RNA) and **proteins**, RNA directs the production of all proteins including **enzymes** and the structural proteins that make up our ears, liver, heart, hair and skin.

C pairs with G and T pairs with A

There are only four molecules in the DNA chain: adenine (A), guanine (G), thymine (T) and cytosine (C). These As, Cs, Ts and Gs are also called "bases." These four molecules partner: ***C*** partners with ***G*** and ***T*** partners with ***A***. Pairing is a natural state for DNA and if you pulled the double helix apart, it would inevitably move back together, like two long chains of magnets that are attracted to each other.



A good match sticks, a bad match doesn't
However, if two bases aren't complementary, they won't fit together. Instead, they'll repel each other, just like the identical poles of two magnets will repel each other. An A won't pair with a C, and a T won't pair with a G. So if there's even a single base that's not complementary to its partner, it could keep a single strand from sticking to another single strand.

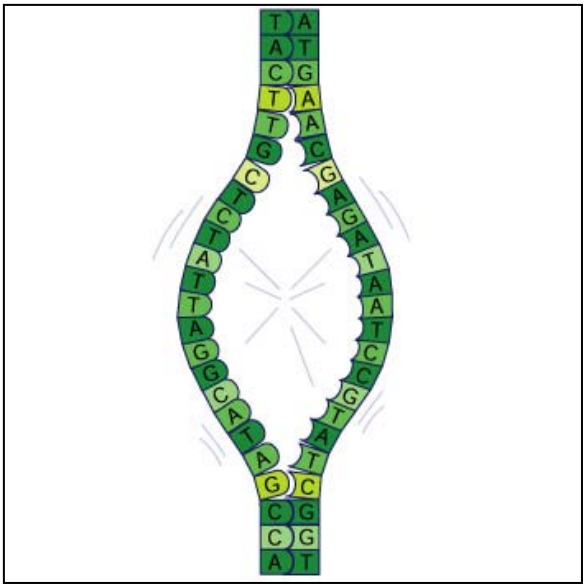


What's a gene and what does it do?
A gene is a section of DNA that functions as a unit. It can be a sequence of the molecules A, T, C and G, which are the script for producing a specific protein, say hair protein.

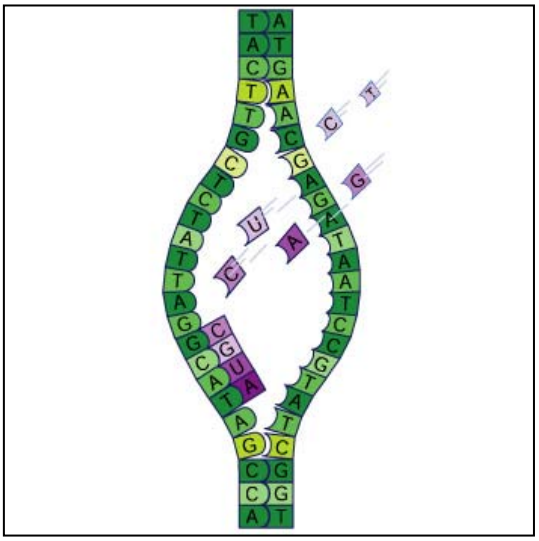
In brief, this is what happens to turn a DNA blueprint for hair into an actual piece of hair:

- An RNA copy of the DNA blueprint is made
- The RNA copy is used as a template to create a hair protein
- Many of these proteins join together to make actual hair.

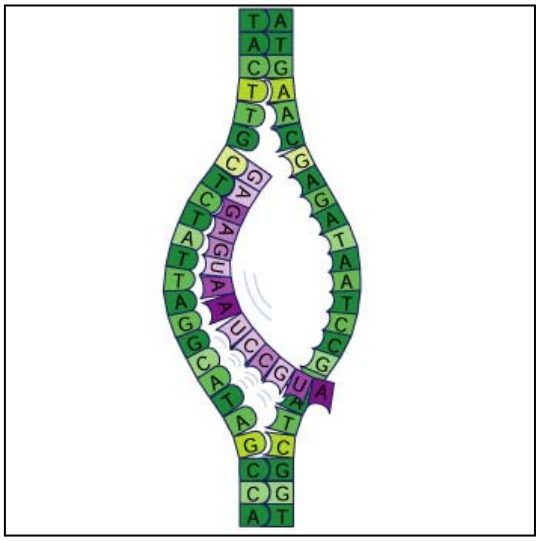
Unzipping the DNA
In order to make hair protein the gene first makes an RNA molecule. It does this with the help of special proteins that temporarily separate or unwind and unzip the DNA strands so that the bases that make up the hair gene are exposed.



Transcription - Making the RNA copy of DNA
RNA molecules are very similar to DNA and are attracted to the unzipped DNA. The RNA molecules partner with the single stranded DNA molecules to form a mirror image copy of the DNA. RNA differs slightly from DNA: in place of every molecule of T (thymine) you have a molecule of U (uracil). So, every A in the DNA binds to a U in the newly formed mRNA



The addition of nucleotides



The final mRNA is built

The New RNA Copy of the Gene
The new chain of RNA then breaks off and the DNA double helix zips back up. The new RNA goes on to direct the production of the hair protein. This process is called "**transcription**" because the four-letter DNA code is actually transcribed into the RNA.

Making Protein from RNA
The RNA copy of the gene now serves as a template for making proteins, much in the same way DNA was a template for making RNA. This process is called "**translation**" because the RNA molecules are translated into proteins, composed of 20 different **amino acids**, such as Methionine (Met), Proline (Pro), Asparagine (Asn), Arginine (Arg) and Threonine (Thr). The final protein can now break away and go do its' job in the cell.