

# What is gene expression?

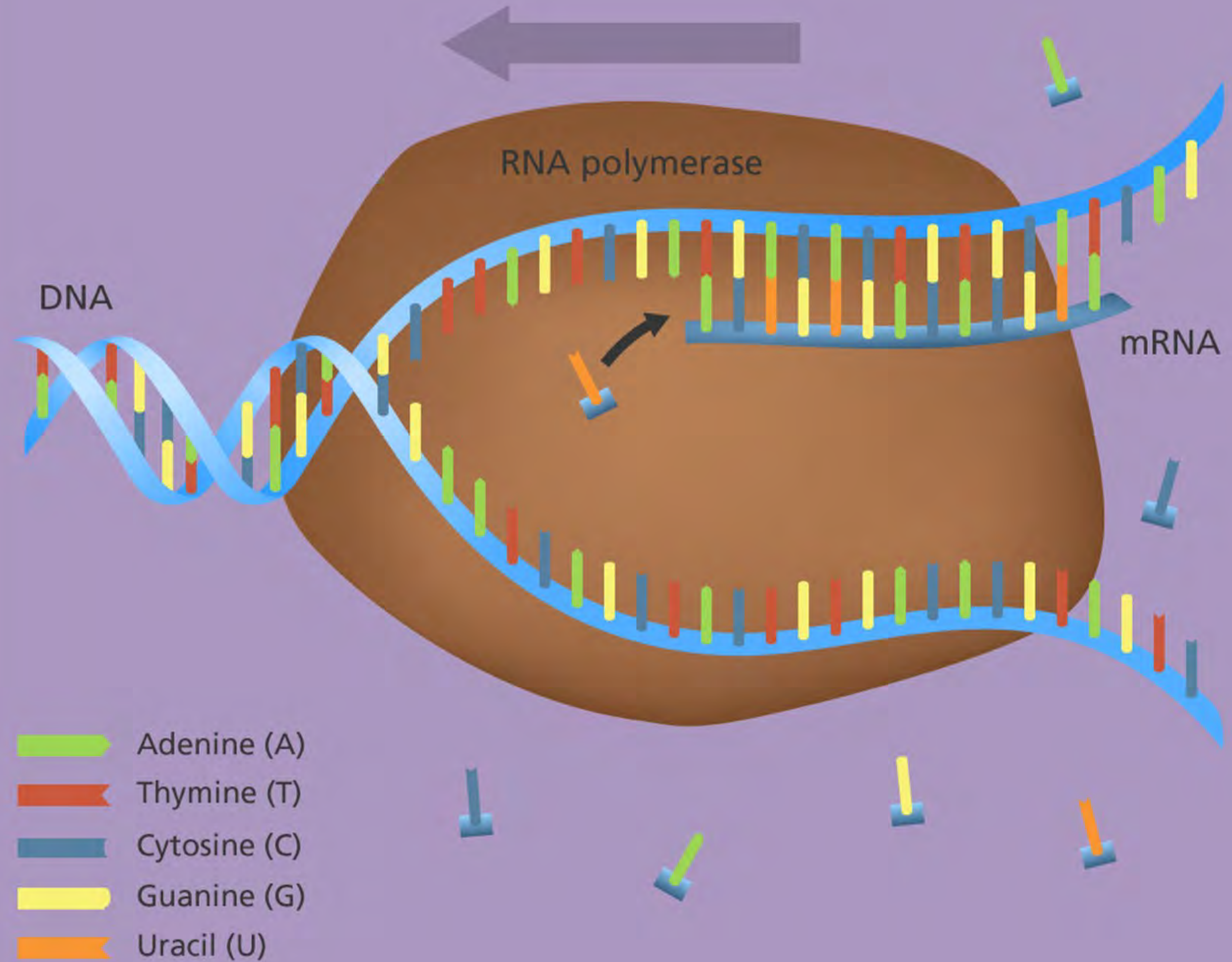
- Gene expression is the process by which the instructions in our DNA are converted into a functional product, such as a protein.
- When the information stored in our DNA is converted into instructions for making proteins or other molecules, it is called gene expression.
- Gene expression is a tightly regulated process that allows a cell to respond to its changing environment.
- It acts as both an on/off switch to control when proteins are made and also a volume control that increases or decreases the amount of proteins made.
- There are two key steps involved in making a protein, transcription and translation.

# Transcription

- Transcription is when the DNA in a gene is copied to produce an RNA transcript called messenger RNA (mRNA).
- This is carried out by an enzyme called RNA polymerase which uses available bases from the nucleus of the cell to form the mRNA.
- RNA is a chemical similar in structure and properties to DNA, but it only has a single strand of bases and instead of the base thymine (T), RNA has a base called uracil (U).

# Transcription

Image credit:  
Genome Research Limited





# Translation

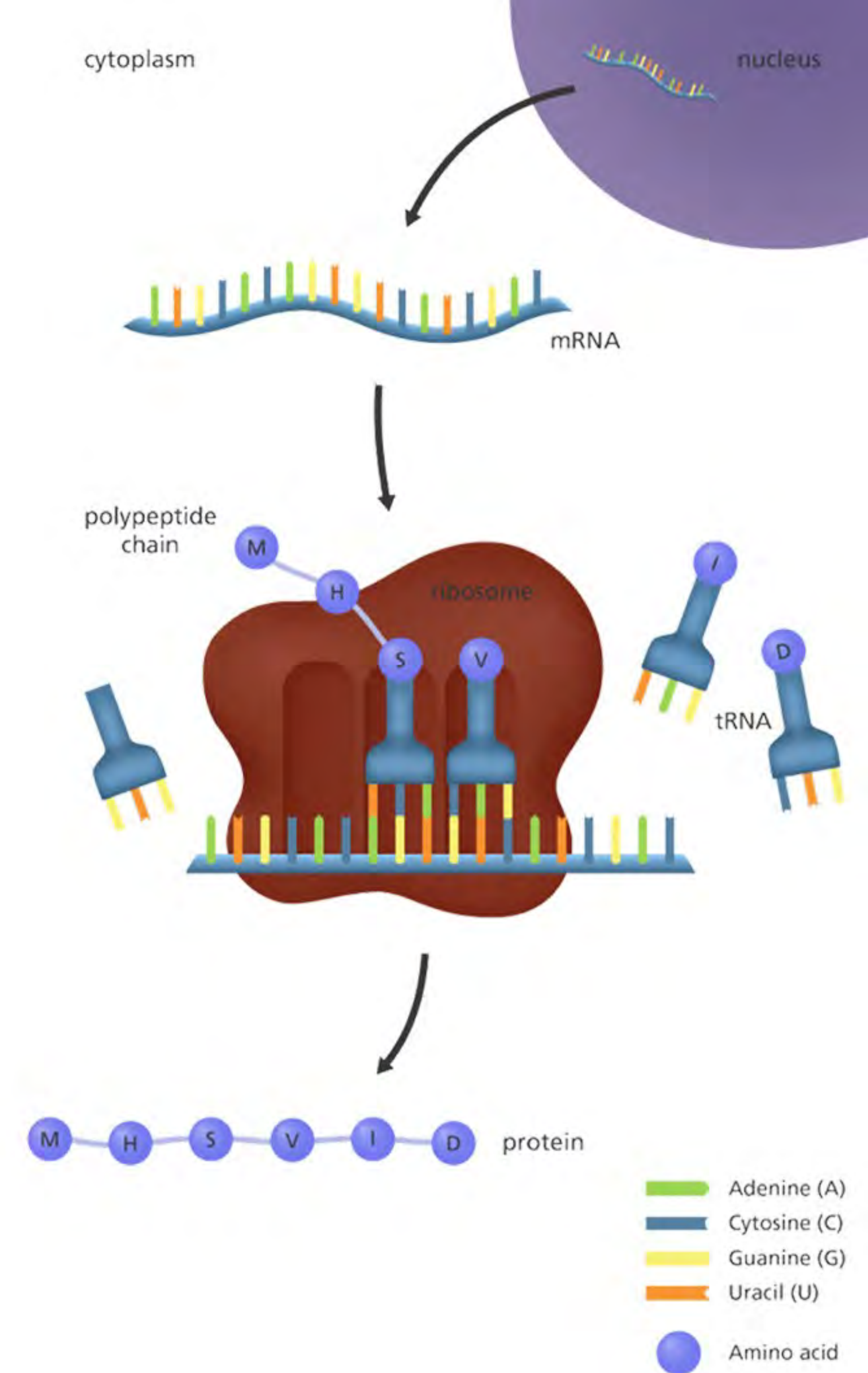
- Translation occurs after the messenger RNA (mRNA) has carried the transcribed 'message' from the DNA to protein-making factories in the cell, called ribosomes.
- The message carried by the mRNA is read by a carrier molecule called transfer RNA (tRNA).
- The mRNA is read three letters (a codon) at a time.
- Each codon specifies a particular amino acid. For example, the three bases 'GGU' code for an amino acid called glycine.
- As there are only 20 amino acids but 64 potential combinations of codon, more than one codon can code for the same amino acid. For example, the codons 'GGU' and 'GGC' both code for glycine.

# Translation

- Each amino acid is attached specifically to its own tRNA molecule.
- When the mRNA sequence is read, each tRNA molecule delivers its amino acid to the ribosome and binds temporarily to the corresponding codon on the mRNA molecule.
- Once the tRNA is bound, it releases its amino acid and the adjacent amino acids all join together into a long chain called a polypeptide.
- This process continues until a protein is formed.
- Proteins carry out most of the active functions of a cell.

# Translation

Image credit:  
Genome Research Limited

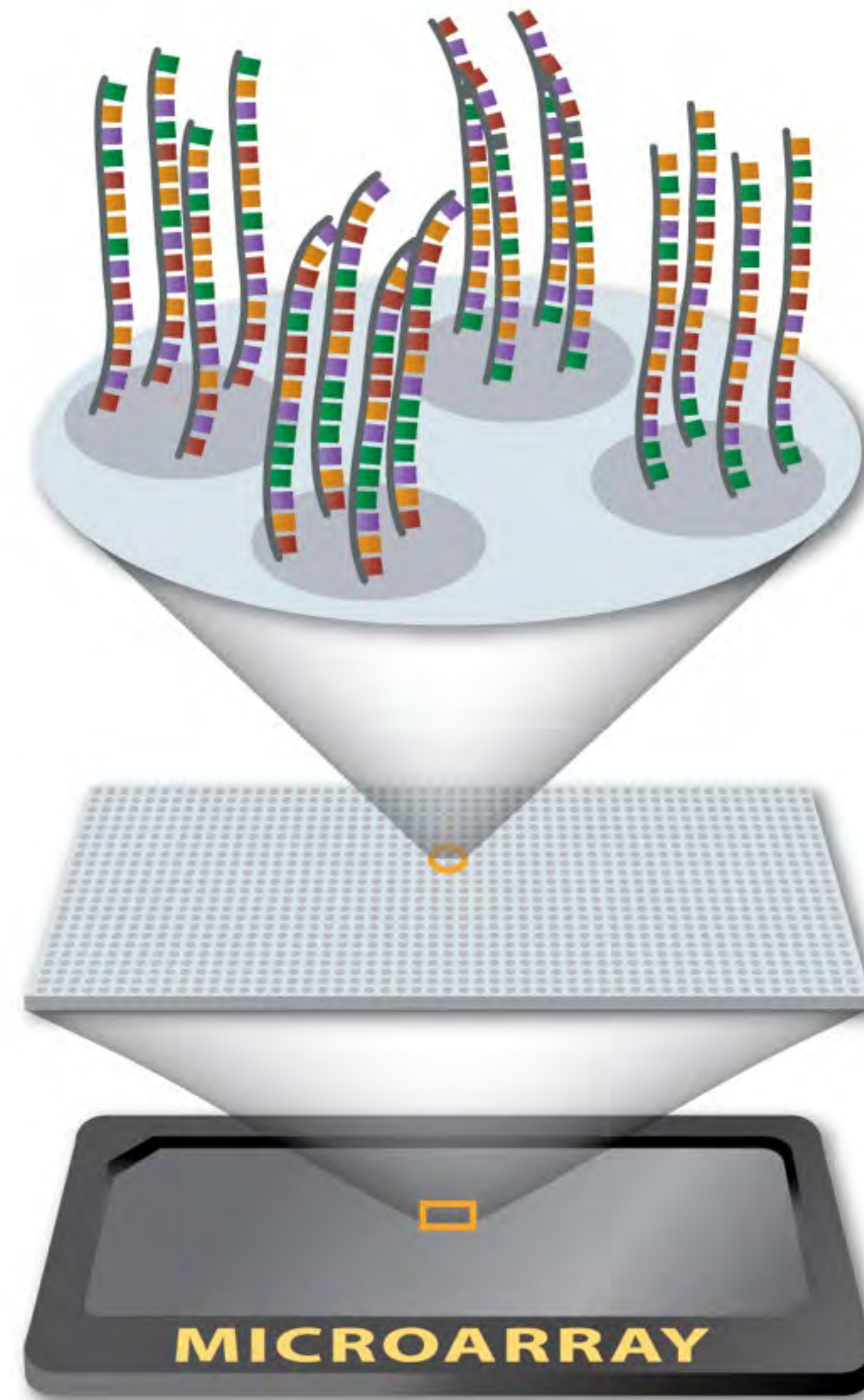


# Gene Expression Analysis using DNA microarrays

- The human genome contains approximately 21,000 genes. At any given moment, each of our cells has some combination of these genes turned on, and others are turned off. How do scientists figure out which are on and which are off?
- Scientists can answer this question for any cell sample or tissue by gene expression profiling, using a technique called microarray (pronounced MY-crow-ah-ray) analysis.
- Microarray analysis involves breaking open a cell, isolating its genetic contents, identifying all the genes that are turned on in that particular cell, and generating a list of those genes.
- DNA microarray analysis is a technique that scientists use to determine whether genes are on or off.
- Scientists know a gene is on in a cell if its mRNA is present.



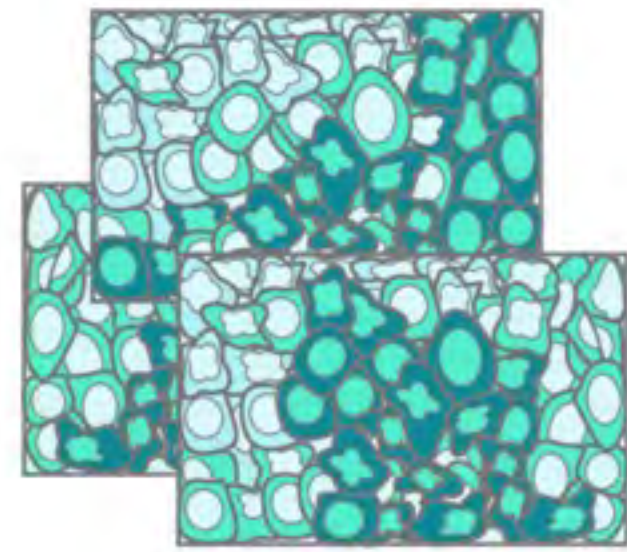
What is  
a DNA microarray?



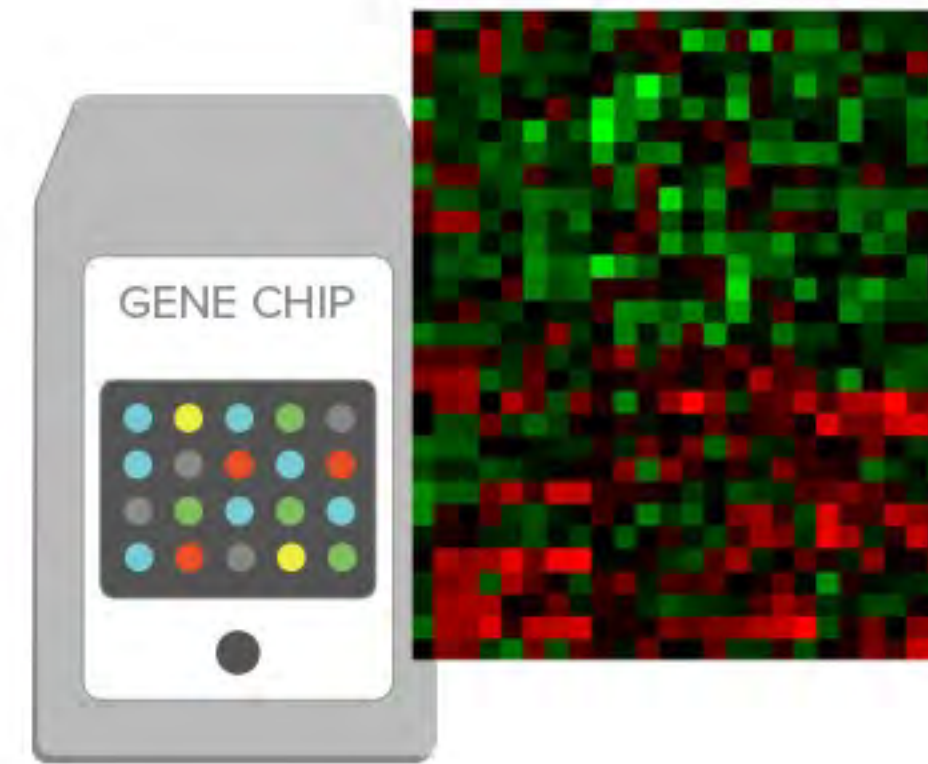
Genetic Science Learning Center, University of Utah



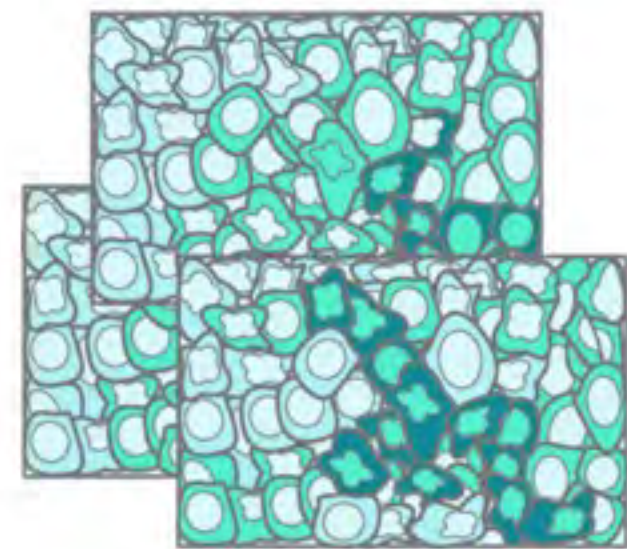
Genome-wide  
profiling:  
Gene expression  
profiles of tumors



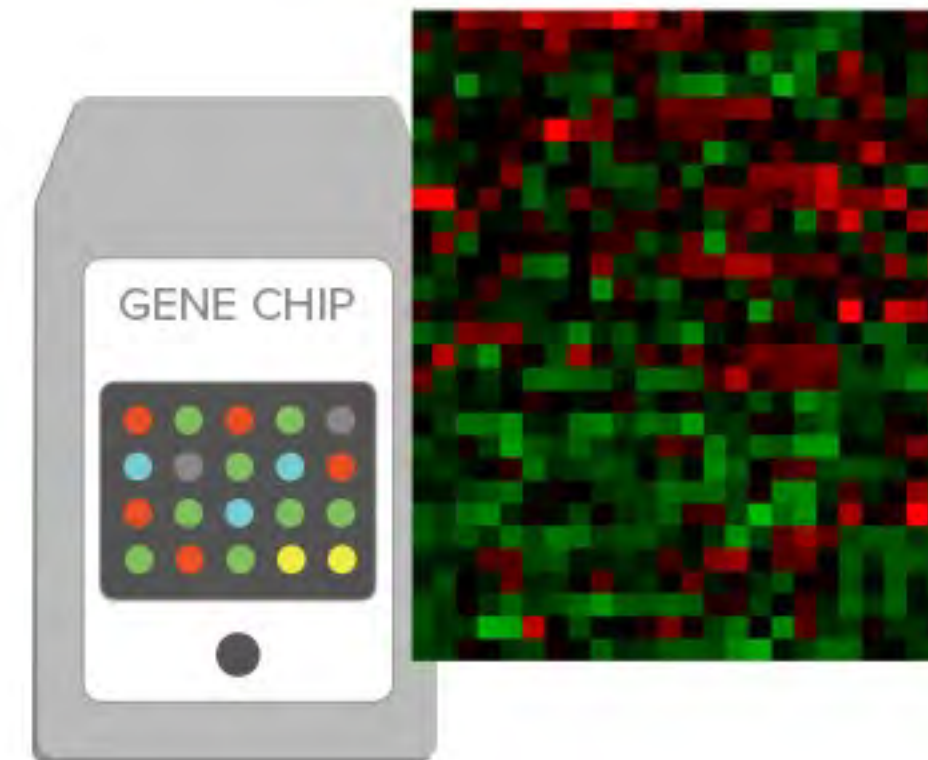
All LN+ breast tissue samples  
(metastatic)



Lymph node positive



All LN- breast tissue samples  
(non-metastatic)



Lymph node negative



What does  
my patient's profile  
say about the  
**diagnosis?**  
**Prognosis?**  
**Treatment?**

