*Lecture by:*

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# MICROARRAY

genetic expression analysis

# INTRODUCTION

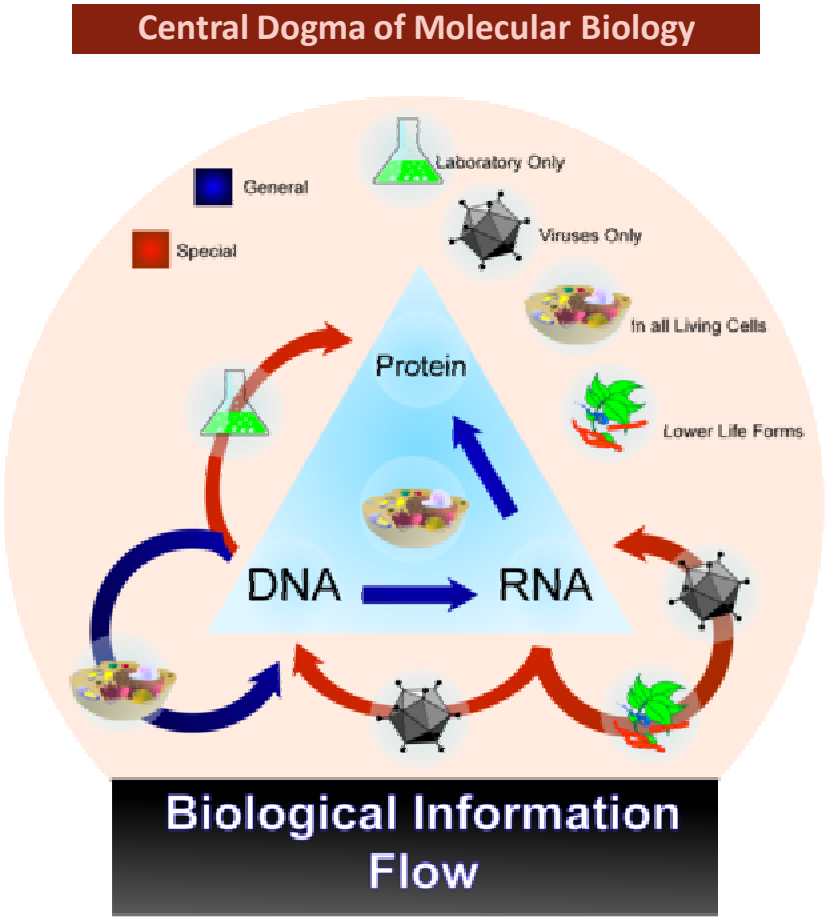
This section will discuss the foundations of Microarray technology

# Gene Expression

With only a few exceptions, **every cell** of the body contains a **full set of chromosomes** and **identical genes**.

**Gene expression** is a highly complex and tightly regulated process that allows a cell to **respond** dynamically both to environmental stimuli and to its own changing needs.

This mechanism acts as both an "**on/off**" **switch** to control which genes are expressed in a cell as well as a "**volume control**" that increases or decreases the level of expression of particular genes as necessary.



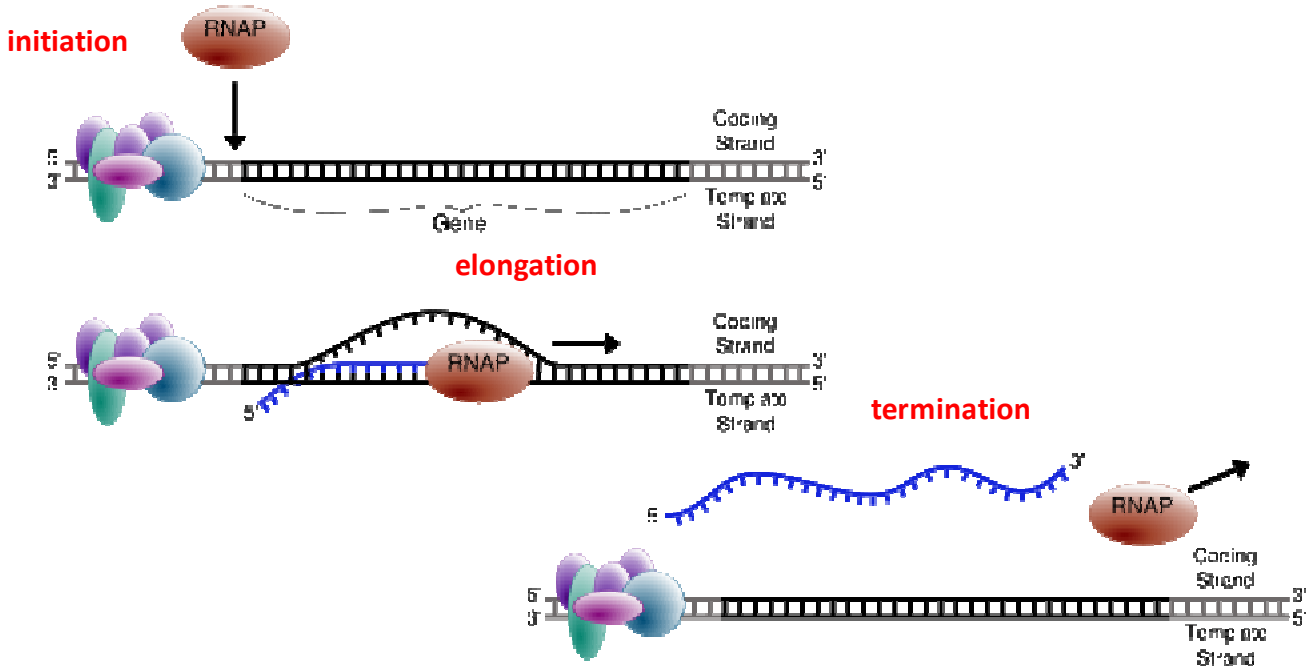

*http://en.wikipedia.org/wiki/Image:CDMB2.png*

# Important Terms

- **Transcription**
- Messenger RNA
- Polyadenylation
- Reverse Transcription
- Complementary DNA
- Oligonucleotide synthesis
- Nucleic acid hybridization
- Fluorescence & Fluophore
- DNA Labeling

## Transcription

is the process by which the information contained in a section of DNA is **transferred** to a newly assembled piece of messenger RNA (mRNA).




*http://en.wikipedia.org/wiki/Image:Simple_transcription_initiation1.svg*

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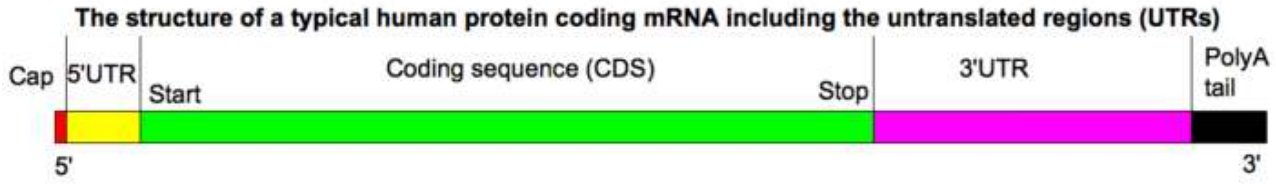
## Messenger ribonucleic acid (mRNA)

is a molecule of RNA encoding a chemical "**blueprint**" for a protein product.

mRNA is **transcribed** from a DNA template, and **carries** coding information to the sites of protein synthesis: **the ribosomes**




*http://en.wikipedia.org/wiki/Image:MRNA_structure.png*

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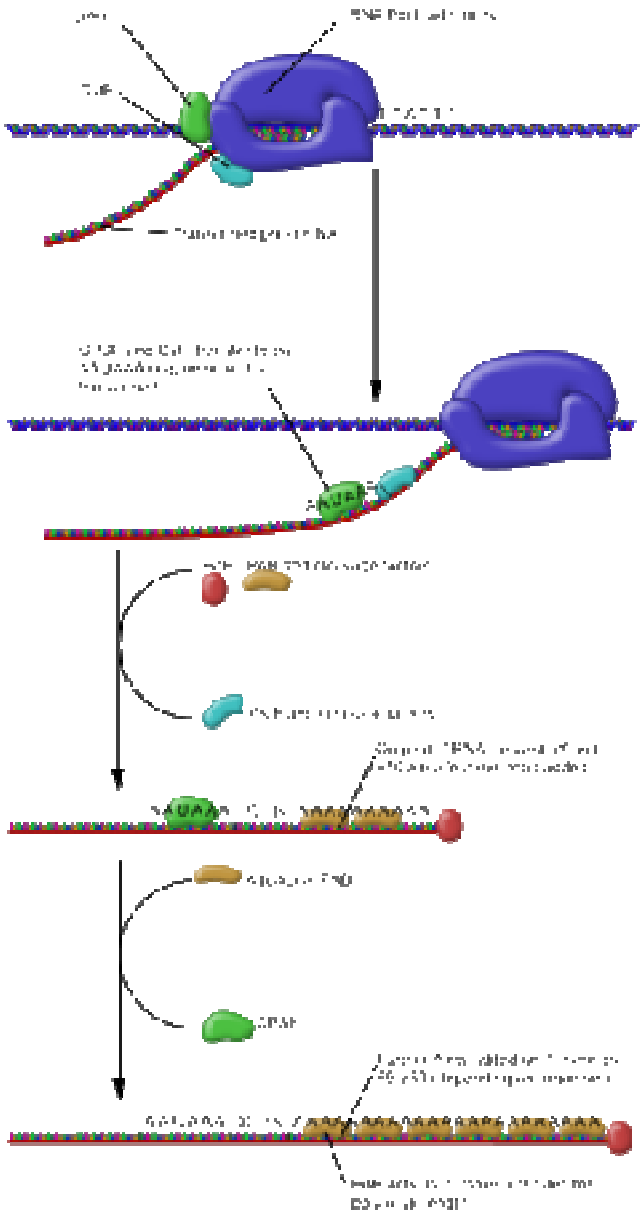
## Polyadenylation

Polyadenylation is the covalent linkage of a polyadenylyl moiety to a messenger RNA molecule at 3’ end (**3' poly(A) tail**).

**protecting** mRNA from degradation by exonucleases.

Important for transcription termination, export of the mRNA from the nucleus, and translation.

Occurs during and immediately after transcription of DNA into RNA.



*http://en.wikipedia.org/wiki/Image:Polyadenylation.png*

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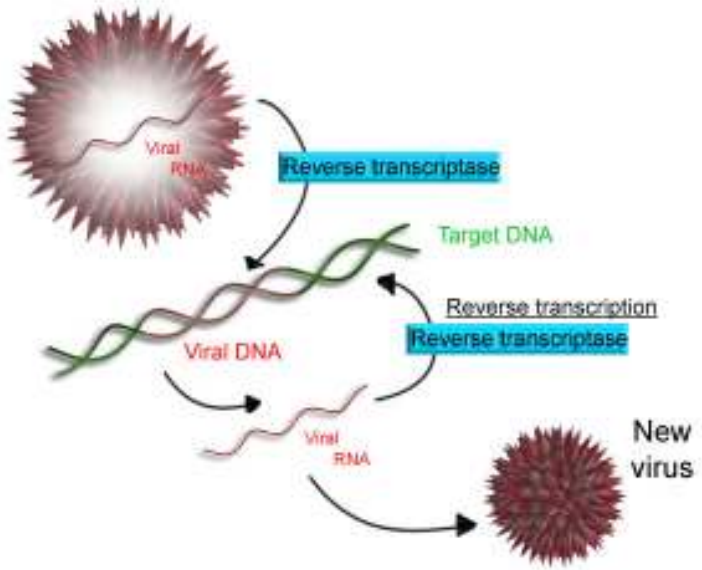
## Reverse Transcription

is the transfer of information from **RNA to DNA** (the reverse of normal transcription).

This is known to occur in the case of **retroviruses**, such as HIV, and, in higher eukaryotes, in the case of retrotransposons.

It is **not**, however, the **general case** in most living organisms.




*http://en.wikipedia.org/wiki/Image:RetroTranscription.jpg*

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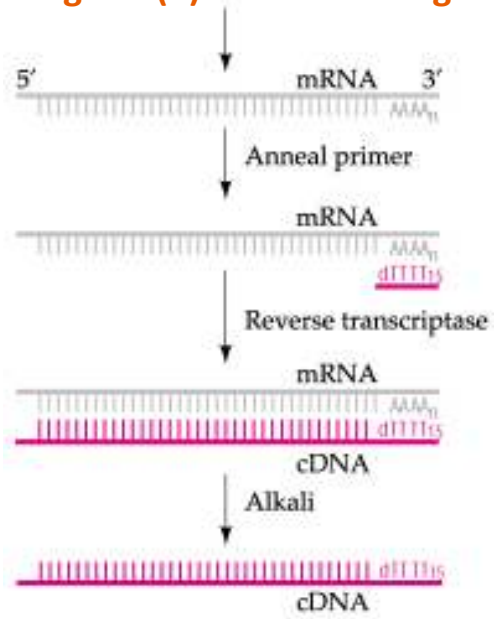
## Complementary DNA (cDNA)

is DNA **synthesized from a mature mRNA** template in a reaction catalyzed by the enzyme **reverse transcriptase**.

This enzyme operates on a single strand of mRNA, generating its complementary DNA based on the pairing of RNA base pairs (A, U, G and C) to their DNA complements (T, A, C and G respectively).

We can use **oligo dT(n)** or **random oligo** as primer.




*http://8e.devbio.com/images/ch04/0405fig2.jpg*

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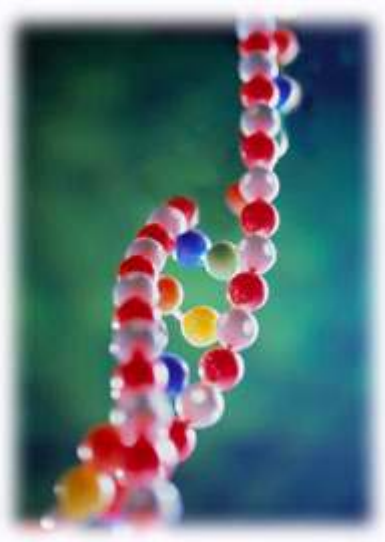
## Oligonucleotide synthesis

is the non-biological, **chemical synthesis** of defined short sequences of nucleic acids

Automated synthesizers allow the synthesis of oligonucleotides (typically single stranded) up to **160 to 200 bases**

Commonly used as **primers**, **probes** and **restriction sites**



*http://www.ctaalliance.org/MCBI/images/oligo.jpg*

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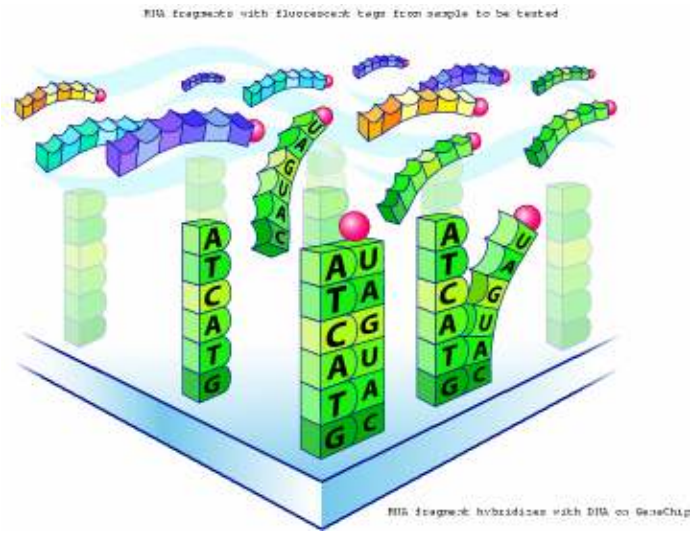
## Nucleic acid hybridization

**Hybridization** is the process of combining complementary, single-stranded nucleic acids into a single molecule.

Nucleotides will bind to their complement under normal conditions, so two perfectly complementary strands will bind to each other readily.

**Southern and Northern blotting** are the exist two kind of nucleic acid hybridization



*http://cswww.essex.ac.uk/staff/W.Langdon/genechip/hybridization_of_taggeed_probes.gif*

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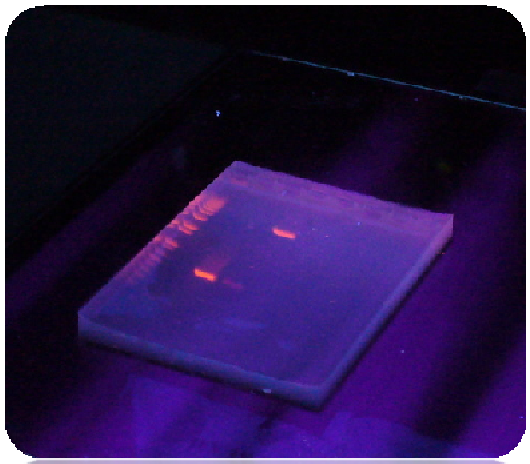
## Fluorescence

is a **luminescence** that is mostly found as an **optical phenomenon** in cold bodies, in which the molecular absorption of a photon triggers the emission of another photon with a longer wavelength.

## Fluorophore

is a component of a molecule which causes a molecule to be **fluorescent**.

It is a functional group in a molecule which will **absorb energy** of a specific wavelength and **re-emit** energy at a different (but equally specific) wavelength.



http://en.wikipedia.org/wiki/Image:AgarosegelUV.jpg

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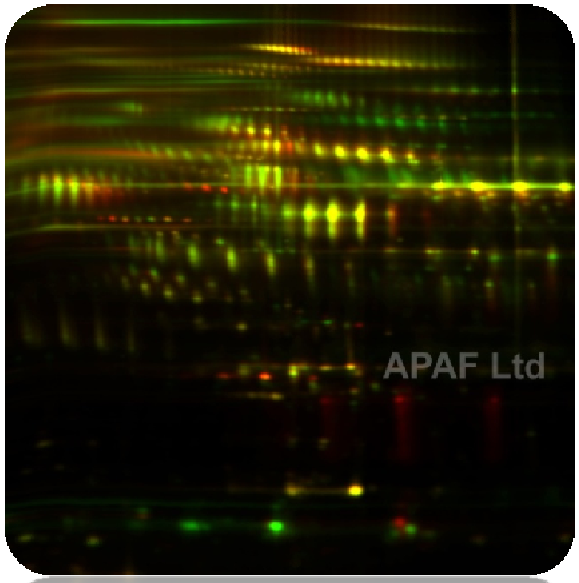
## DNA Labeling

is an addition of a chemical into DNA strand to make them **visualizable**. A label can be a radioactive compound or a **fluorophore**.

The most famous fluorophore family used in Microarray experiment is **Cyanine (Cy)**,there are two mostly used of Cy compounds, **Cy3** and **Cy5**.

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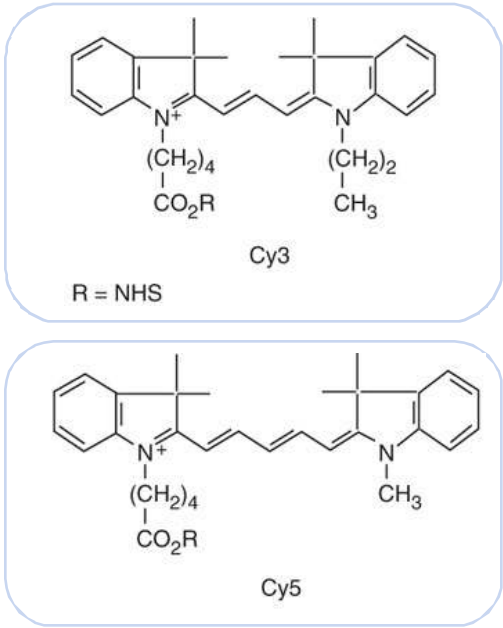


http://www.nature.com/nprot/journal/v1/n3/images/nprot.2006.234-F2.jpg