**THE GENETIC CODE**

* Set of rules by which information encoded within genetic material is translated into proteins by living cells.
* nitrogen bases (A, T, G, C) are characters (like numbers/letters) in the DNA code.
	+ combine to form THREE letter words (codons). GGC, TAC, CAA, etc.
* Each **three letter code (codon)**, makes an **amino acid** which are building blocks for **proteins**.

**Genetic Code is:**

* 1. **Redundant**- More than one codon can code for the same amino acid
	2. **Continuous** - It reads as a series of codons without spaces, punctuation or overlap
	3. **Universal** – All organisms build proteins with the genetic code.
* **each** codon encodes for **one** of the 20 amino acids used in the synthesis of proteins (3 exceptions).
* 64 codons of nucleotides. How can 4 bases code for 64 codons?



From DNA to Genes

* **Gene** - a short section of DNA that codes for an amino acid sequence (building block for proteins).
* **Genome** - All of an organisms genes (its entire DNA).
* The reason we are all different is because we have different amino acid sequences 🡪 different alleles (in genes) 🡪different characteristics/proteins

From Genes to Proteins:



**GENE EXPRESSION**

* synthesis of a protein based on the DNA sequence of a gene.
* **transcription** and **translation**.

**RNA**

* DNA does not leave the nucleus. RNA carries the message to the ribosomes in the cytoplasm.
* uses Uracil in place of Thymine
* single stranded

**TRANSCRIPTION** – portion of DNA is **transcribed** by single-stranded mRNA (3 phases):

* **Initiation:**
* Only one strand of DNA is transcribed (antisense or template strand)
* Sense strand or coding strand – not transcribed
* **RNA polymerase** binds to **promoter region** on DNA strand
* DNA unwinds

TATA box- Proteins called transcription factors can bind to the TATA box and recruit RNA polymerase

* **Elongation**: **RNA polymerase** adds complementary nucleotides onto growing mRNA strand.
* **Termination:** **stop codon** (termination sequence) on DNA causes RNA polymerase to detach.
	+ **RNA processing**
	+ mRNA strand moves out of nucleus to ribosomes in the cytoplasm, where sequence of bases will be translated into a sequence of amino acids.

Introns -non coding sections of mRNA, get removed by ribozyme

Exons

<https://www.youtube.com/watch?v=-K8Y0ATkkAI>

<http://highered.mheducation.com/sites/9834092339/student_view0/chapter15/stages_of_transcription.html> McGraw Hill

<http://highered.mheducation.com/sites/9834092339/student_view0/chapter15/mrna_synthesis__transcription_.html> McGraw Hill

**TRANSLATION -** RNA takes the message out of the nucleus to the ribosomes where the message is **translated** into protein. (3 phases)

1. **Initiation:** ribosome docks onto the mRNA near the **start codon** (AUG).

 **Transfer RNA** bring amino acids to the ribosome, beginning with methionine

1. **Elongation:** ribosome shifts to the next codon on the mRNA. Each successive tRNA leaves behind an amino acid that links in sequence via peptide bonds. The polypeptide elongates as the process of tRNA docking and amino acid attachment is repeated.

polyribsomes – multiple ribosome along a strand of mRNA

1. **Termination -** ribosome reaches a stop codon on mRNA, signaling the end of the message. Ribosome detaches from the mRNA and peptide is released.



Three types of RNA:

**mRNA** (**messenger RNA**) - temporary copies of the information found in DNA;

**rRNA** (**ribosomal RNA**) - structural components of ribosomes;

**tRNA** (**transfer RNA**) - ferry amino acids to the ribosome

* + single strand doubled back on itself to create anticodon loop
	+ attachment requires ATP



<https://www.youtube.com/watch?v=5bLEDd-PSTQ>

<https://www.youtube.com/watch?v=ODd_sKbE8dQ> Crash course

<http://highered.mheducation.com/sites/9834092339/student_view0/chapter15/how_translation_works.html> McGraw Hill

<http://highered.mheducation.com/sites/9834092339/student_view0/chapter15/protein_synthesis.html> McGraw Hill

**Control of Gene Expression**

**Gene Regulation**: the control and change to gene expression in response to different conditions in the cell or environment.

Constitutive genes are expressed all the time, at varying rates, while other genes may be turned on or “off”.

**In prokaryotes, genes expression regulated at level of transcription**

Operon Model:

Operon is a cluster of genes with related functions along with DNA sequences that regulate transcription

operon includes a promoter (sequence of DNA where RNA polyermerase first attaches to whena gene is to be transcribed) and an

operator sequence of DNA to which a repressor may find to prevent transcription

Structural Genes- coding genes for enzymes of metabolic pathways.

A Regulator Gene –regulates activity of structural genes. codes for a repressor that can bind to operator to switch off the operon.

**Control of Gene Expression in Eukaryotes: Four Levels of Control**

Most mechanisms that control gene expression do so by **controlling transcription** (synthesis of mRNA).

1. **Transcriptional Control** – in nucleus
	1. Organisation of chromatin
	2. transcription factors (DNA binding proteins)
		1. require activation to bind
		2. activated when phosphorylated by kinase
		3. phosphatase remove P

kinases and phosphatases are signalling proteins that regulate growth, if mutated 🡪cancer

1. **Posttranscriptional Control** – in nucleus
	1. mRNA processing and rate
2. **Translational Control** – cytoplasm, after mRNA leaves nucleus, before protein made
	1. Proficiency of mRNA, life expectancy, ability to bind to ribosomes
3. **Posttranslational Control** – in cytoplasm, after protein synthesis
	1. Protein must be functional to be active

<https://highered.mheducation.com/sites/9834092339/student_view0/chapter16/control_of_gene_expression_in_eukaryotes.html>