



About Science Prof Online PowerPoint Resources

- Science Prof Online (SPO) is a free science education website that provides fully-developed Virtual Science Classrooms, science-related PowerPoints, articles and images. The site is designed to be a helpful resource for students, educators, and anyone interested in learning about science.
- The SPO Virtual Classrooms offer many educational resources, including practice test questions, review questions, lecture PowerPoints, video tutorials, sample assignments and course syllabi. New materials are continually being developed, so check back frequently, or follow us on Facebook (Science Prof Online) or Twitter (ScienceProfSPO) for updates.
- Many SPO PowerPoints are available in a variety of formats, such as fully editable PowerPoint files, as well as uneditable versions in smaller file sizes, such as PowerPoint Shows and Portable Document Format (.pdf), for ease of printing.
- Images used on this resource, and on the SPO website are, wherever possible, credited and linked to their source. Any words underlined and appearing in blue are links that can be clicked on for more information. PowerPoints must be viewed in *slide show mode* to use the hyperlinks directly.
- Several helpful links to fun and interactive learning tools are included throughout the PPT and on the Smart Links slide, near the end of each presentation. You must be in *slide show mode* to utilize hyperlinks and animations.
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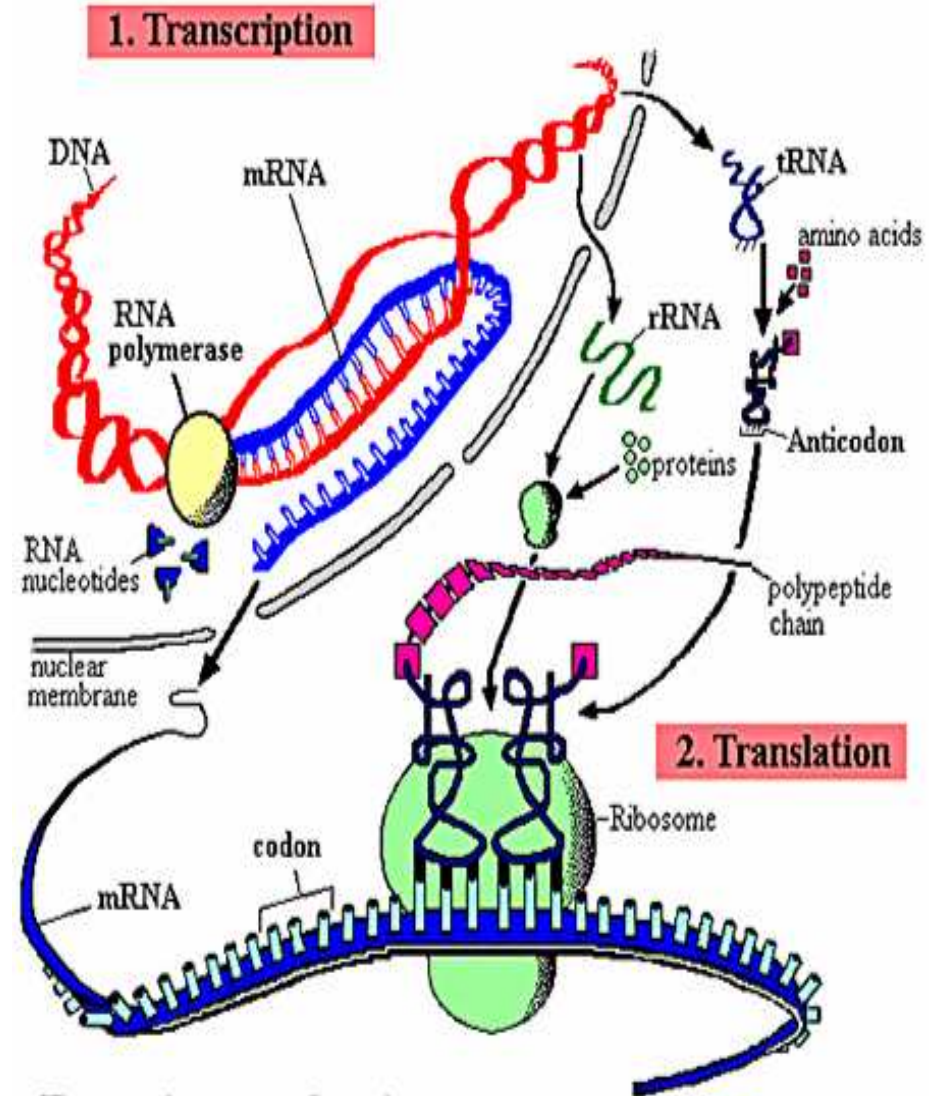
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Gene Expression

Transcription

&

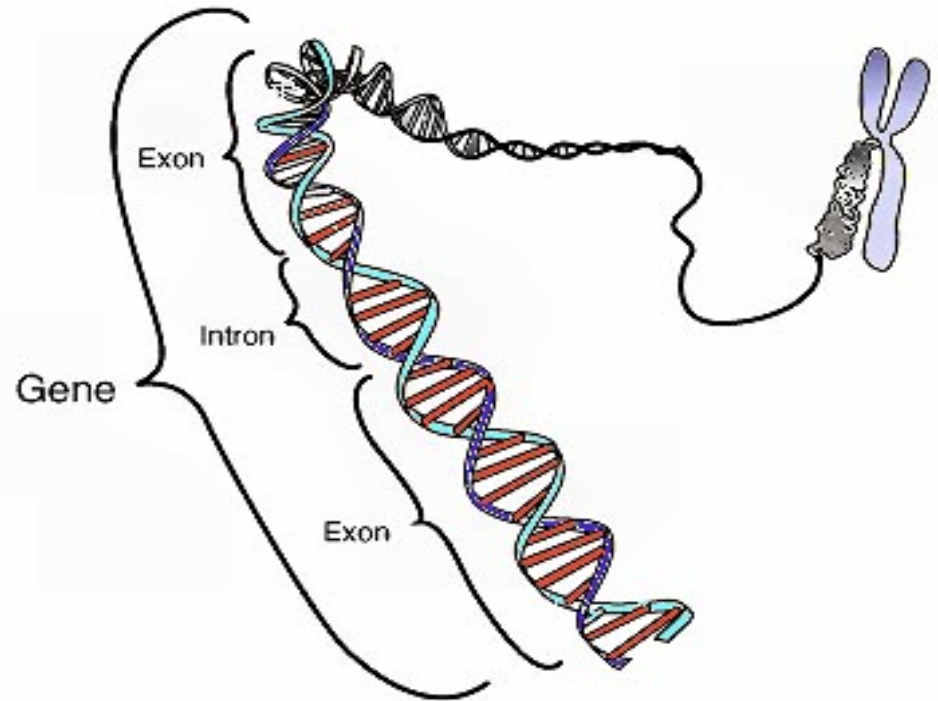
Translation (Making Proteins)



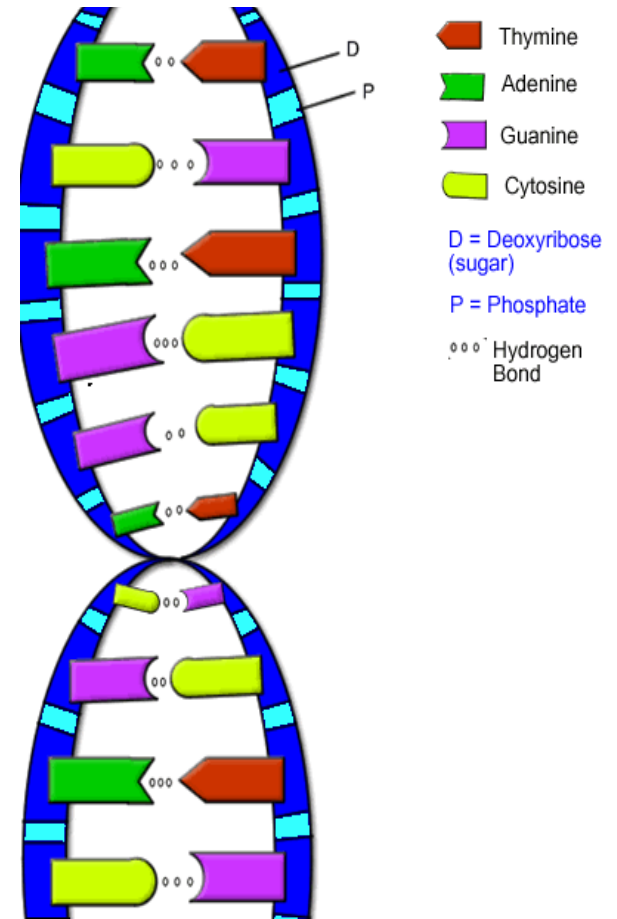
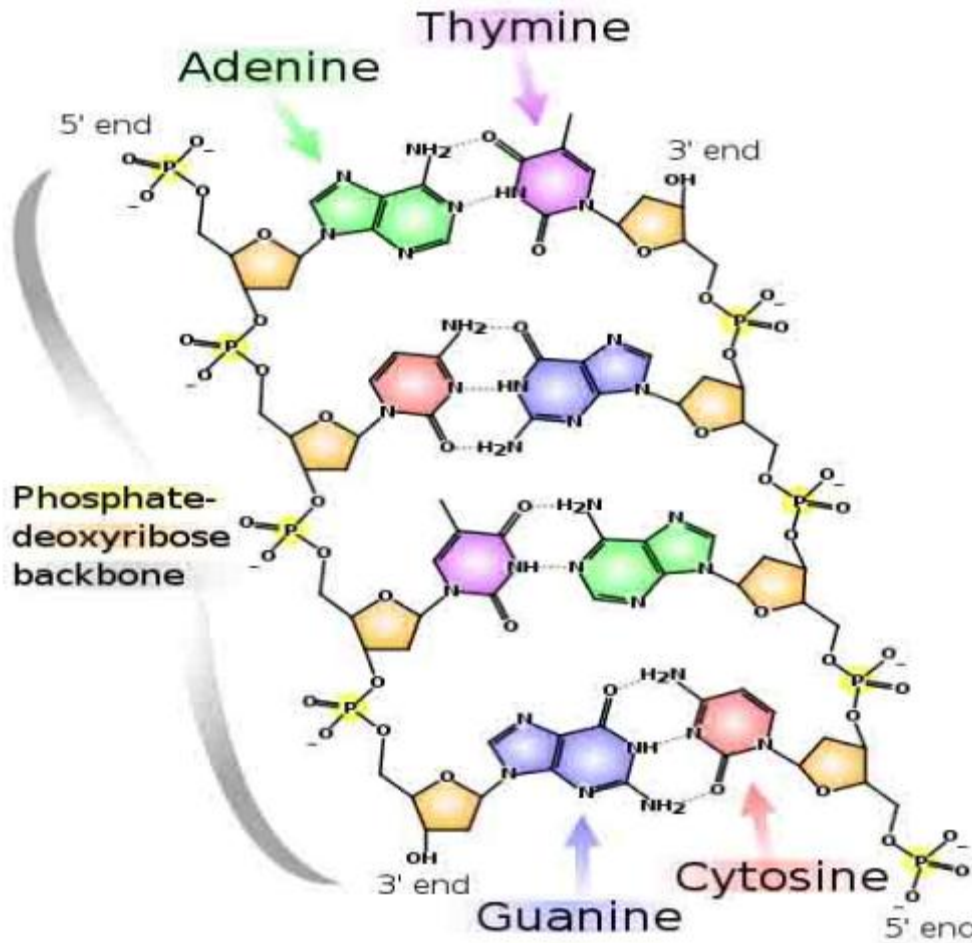
Protein synthesis

Chromosomes & Genes

- **Genome** - Complete complement of an organism's DNA.
- Cellular **DNA** is organized in **chromosomes**.
- **Genes** have specific places on chromosomes.



Nucleic Acid: DNA Structure

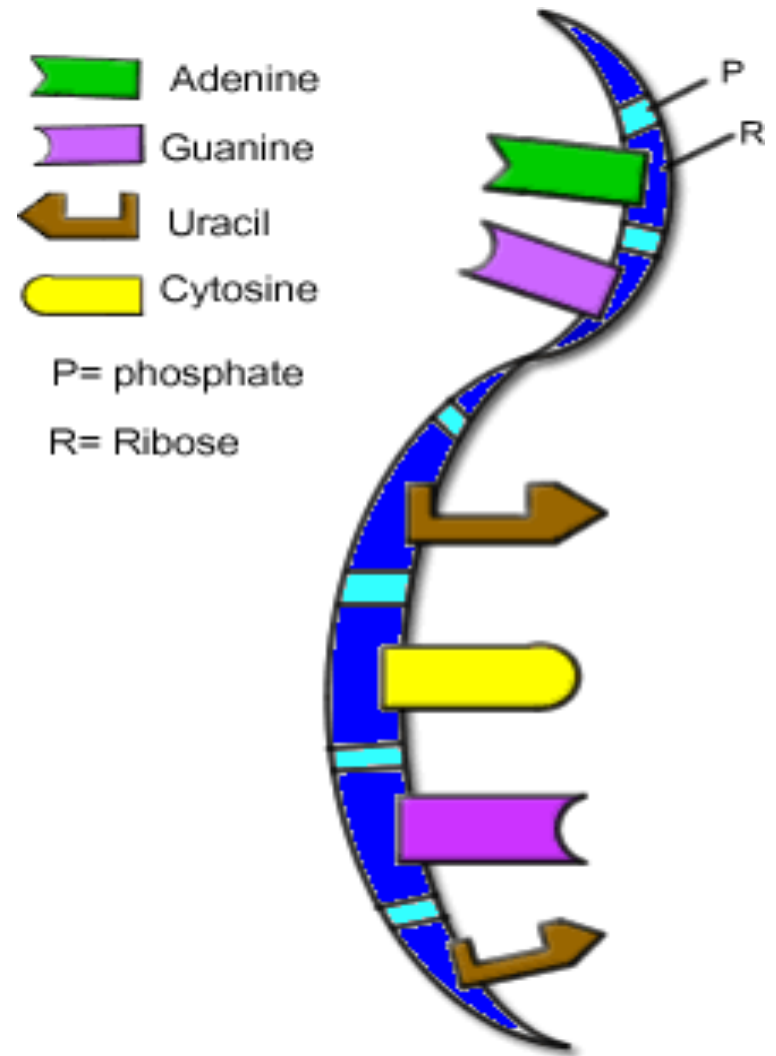


Nucleic Acids: RNA Structure

RNA is typically a single-stranded molecule.

Purine Bases (double ring)
Adenine & Guanine

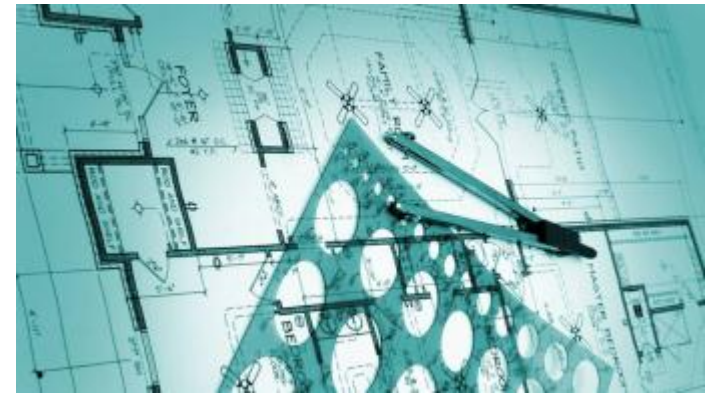
Pyrimidine Bases (single ring)
Cytosine & _____



Types of RNA

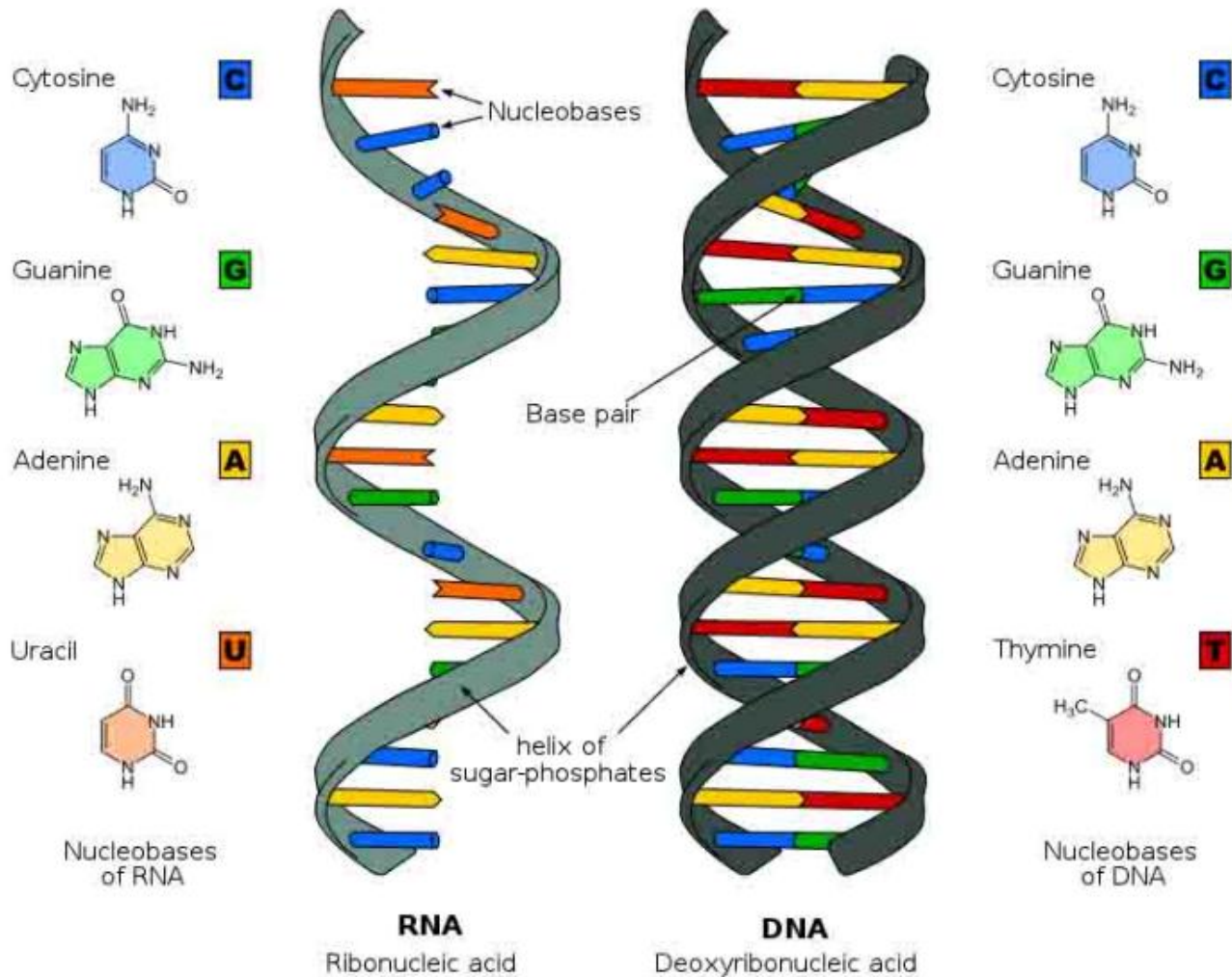
Genetic information copied from DNA is transferred to 3 types of RNA:

- **messenger** (mRNA) is like a Copy of information in DNA that is brought to the ribosome where the information is translated into a protein.
- **ribosomal** (rRNA) is like a The protein factories of the cells.
- **transfer** (tRNA) are like a Brings the amino acid to the ribosome.



Images: Blueprint, clipart; [Factory](#), Andreas Praefcke; [Truck](#), PRA; [Ribosome translating protein](#), Xvazquez.

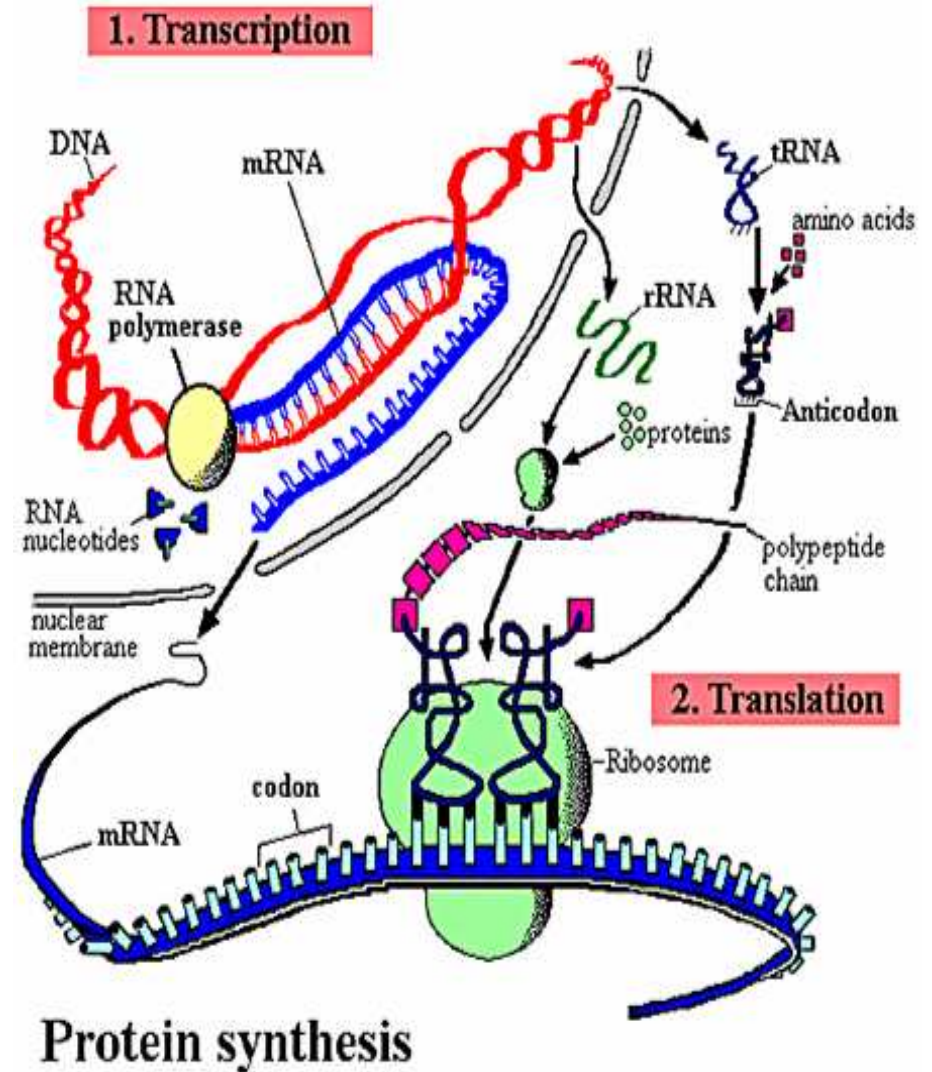
Nucleic Acid Structure



See SPO Class Notes article on [Nucleotides & Nucleic Acids](#).

Nucleic Acid Function

Transcription & Translation



Transcription

Process by which a DNA sequence is copied to produce a complementary mRNA strand.

In other words, it is the transfer of genetic information from DNA into RNA.

Like replication, but making RNA.

Beginning of the process that ultimately leads to the translation of the genetic code (via mRNA) into a protein.



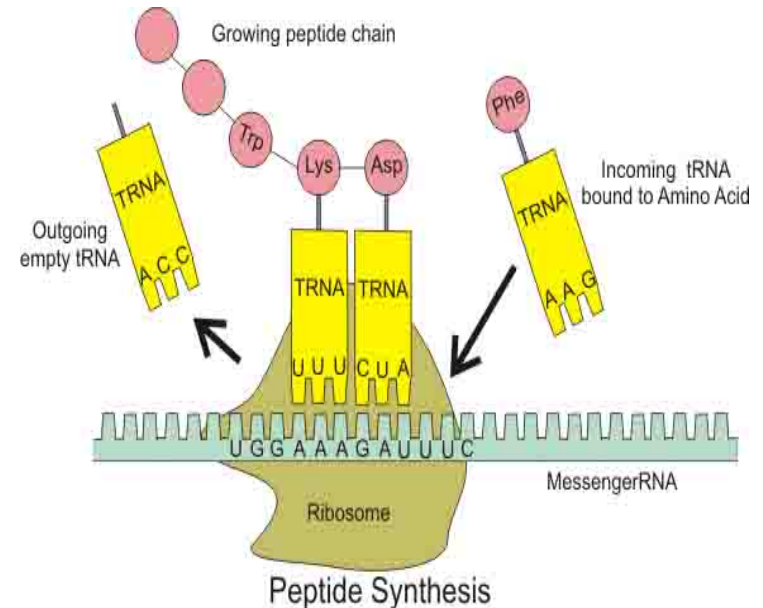
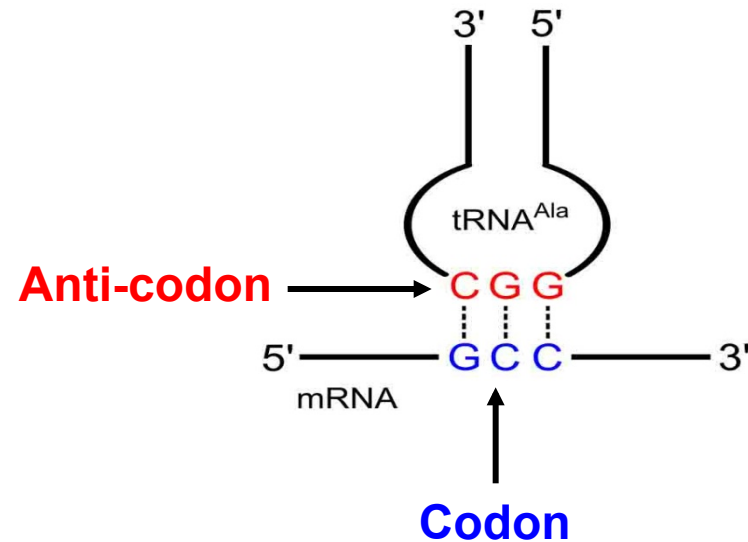
REVIEW

Transcription Animations

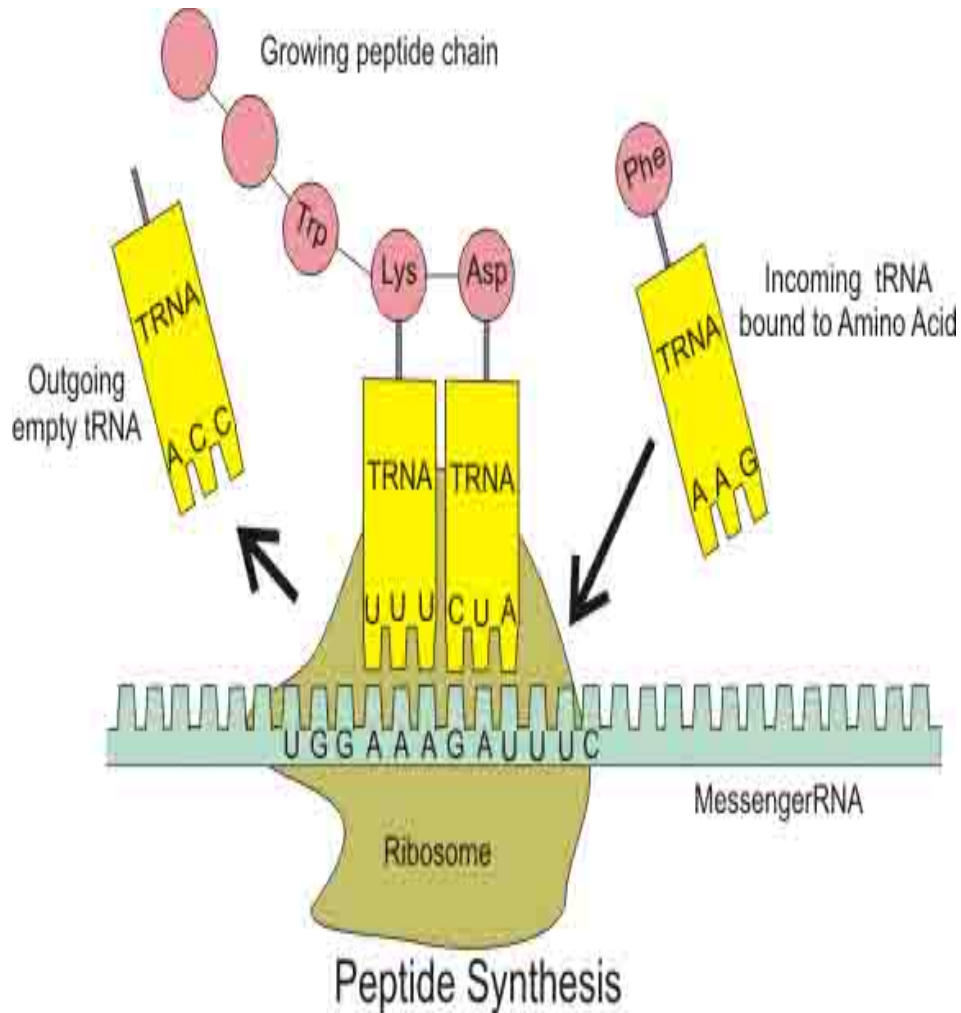
1. mRNA Synthesis from McGraw-Hill
2. Transcription from WH Freeman

Translation

- Ribosomes (which contain rRNA) make proteins from the messages encoded in mRNA.
- The genetic instructions for a polypeptide chain are 'written' in the DNA as a series of 3-nucleotide 'words.'
- _____ on mRNA
- _____ on tRNA
- 'U' (uracil) replaces 'T' in RNA
- This is the **genetic code**.
- **Q:** Where does translation occur in prokaryotes?
- **Q:** Eukaryotes?



Translation

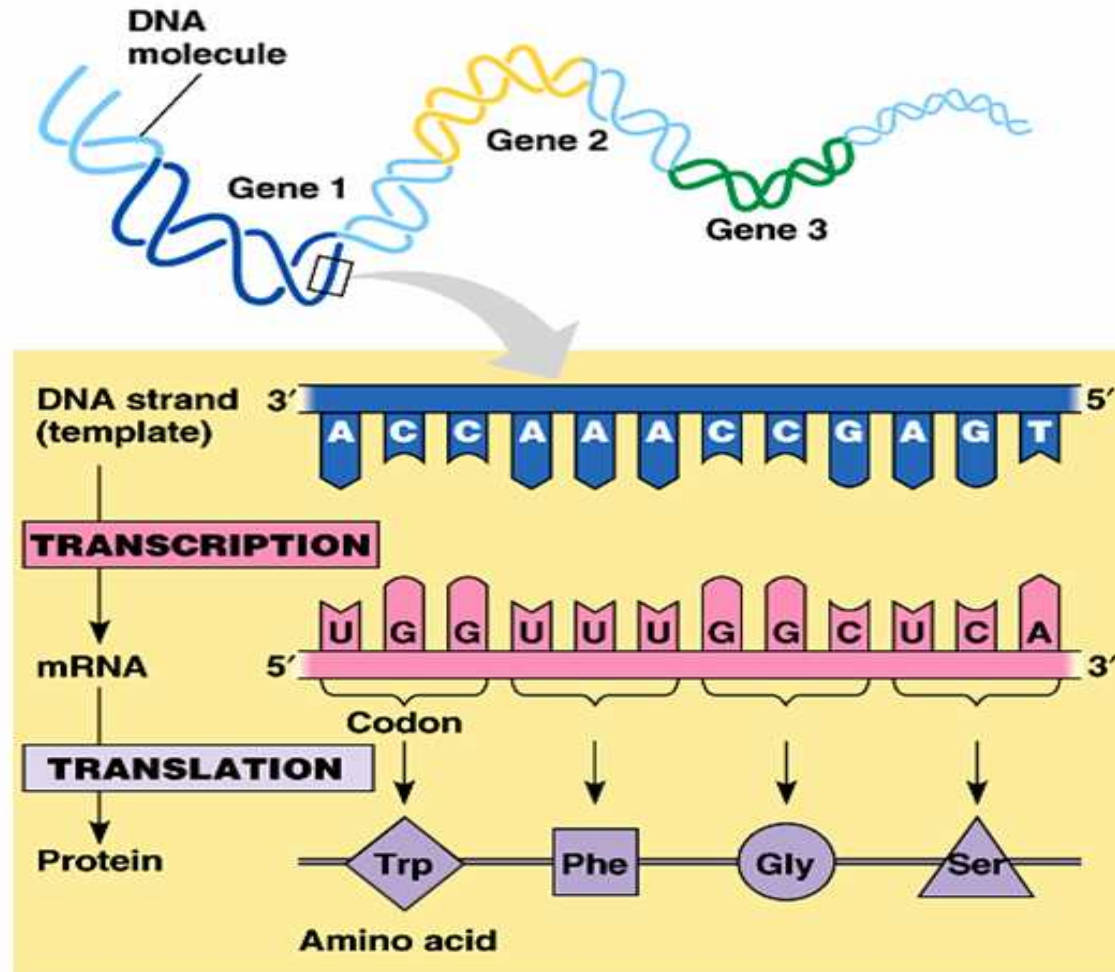


REVIEW

Translation Animations

1. [How Translation Works](#)
from McGraw-Hill
2. [Ribosome Building a Protein](#)
from Wikipedia

Transcription & Translation Overview



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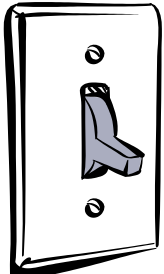
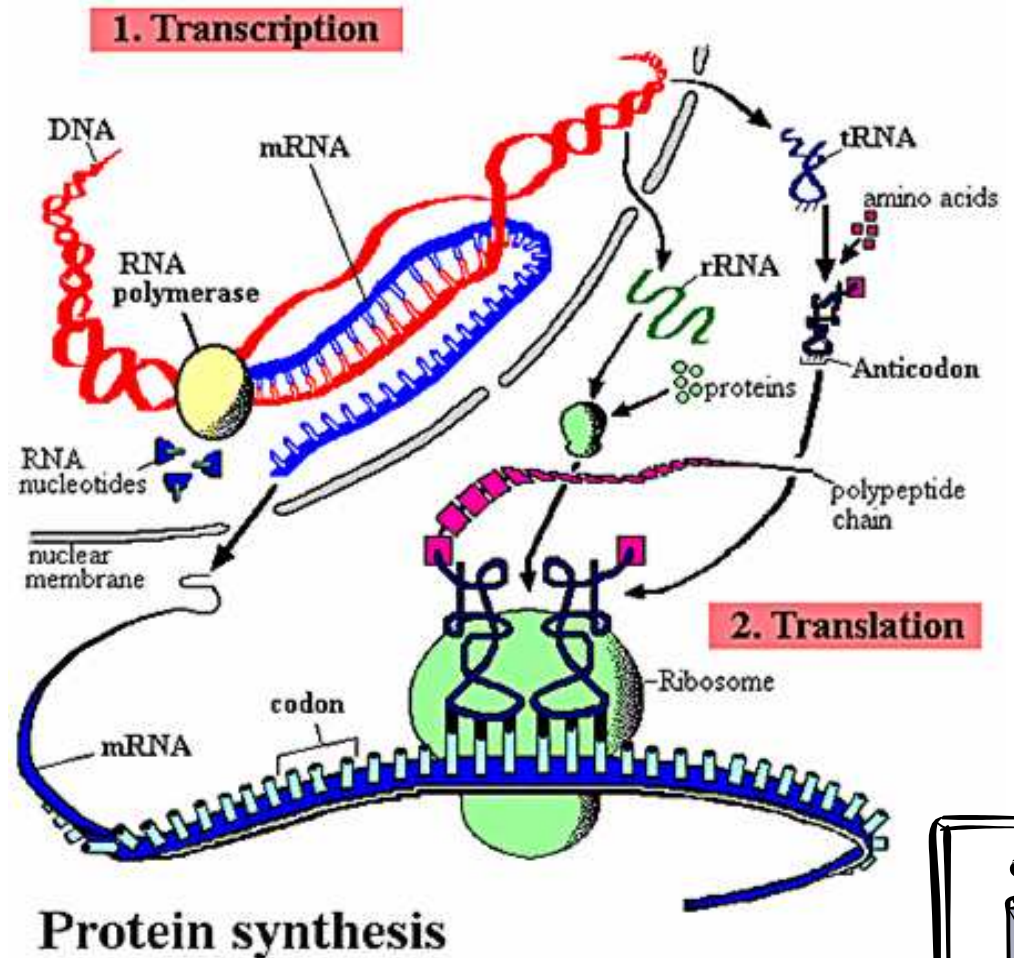
REVIEW

Interactive animation that allows you to transcribe and translate a gene!

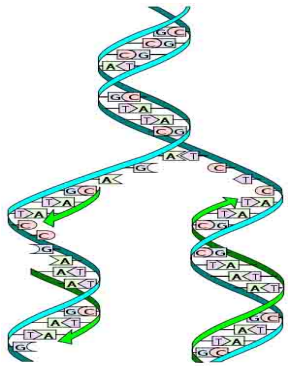
See SPO Class Notes article on [DNA Function: Transcription & Translation](#).

Transcription + Translation = Gene Expression

- Section of DNA (a gene) being transcribed & translated to produce a protein.
- Genes can be turned on and off.
- **DISCUSSION:** How do the Radiolab "Inheritance" Podcast segments on rat **maternal behavior** (time 16:00 - 25:00) and **starving boys from Overkalix, Sweden** (time 28:30 - 40:00) relate to gene expression?



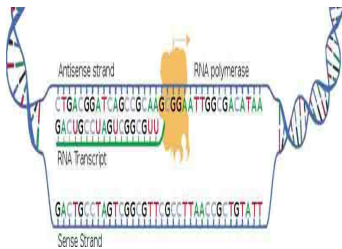
Replication, Transcription, Translation



MAKING DNA

Making a copy of the genetic material = **Replication**
When you think "replication" think "duplication"

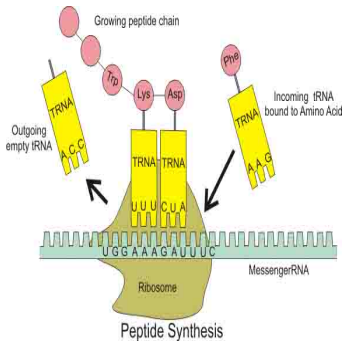
Q: Where does replication occur in prokaryotes? Eukaryotes?



MAKING RNA

Transferring genetic code (DNA) to RNA = **Transcription**
Think of a medical transcriptionist copying the physicians words into another format.

Q: Where does transcription occur in prokaryotes? Eukaryotes?



MAKING PROTEINS

Making proteins = **Translation**

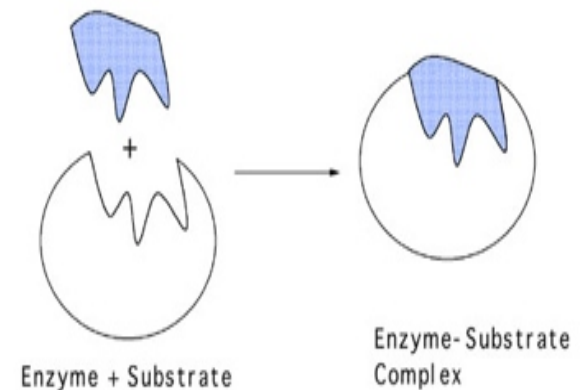
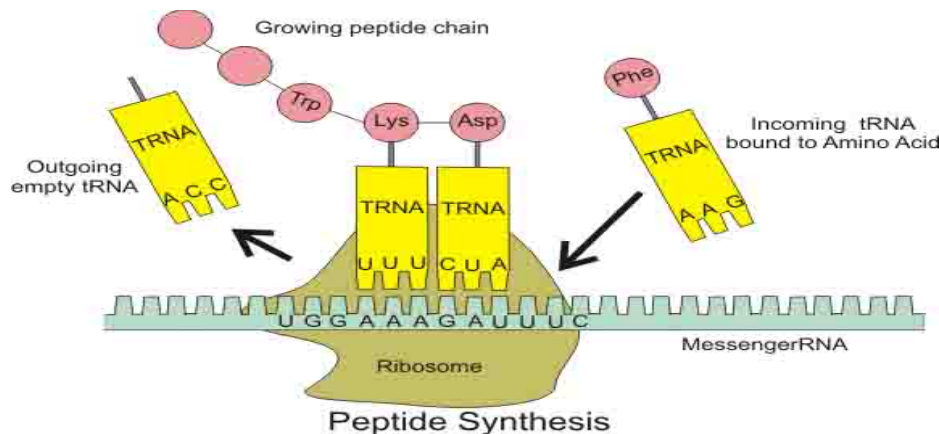
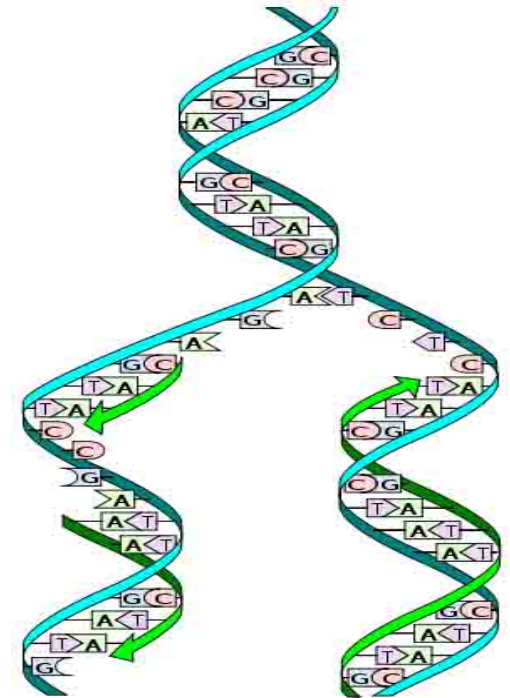
Think of how translation relates to languages.

The translation of DNA translates DNA information into proteins.

Q: Where does translation occur in prokaryotes? Eukaryotes?

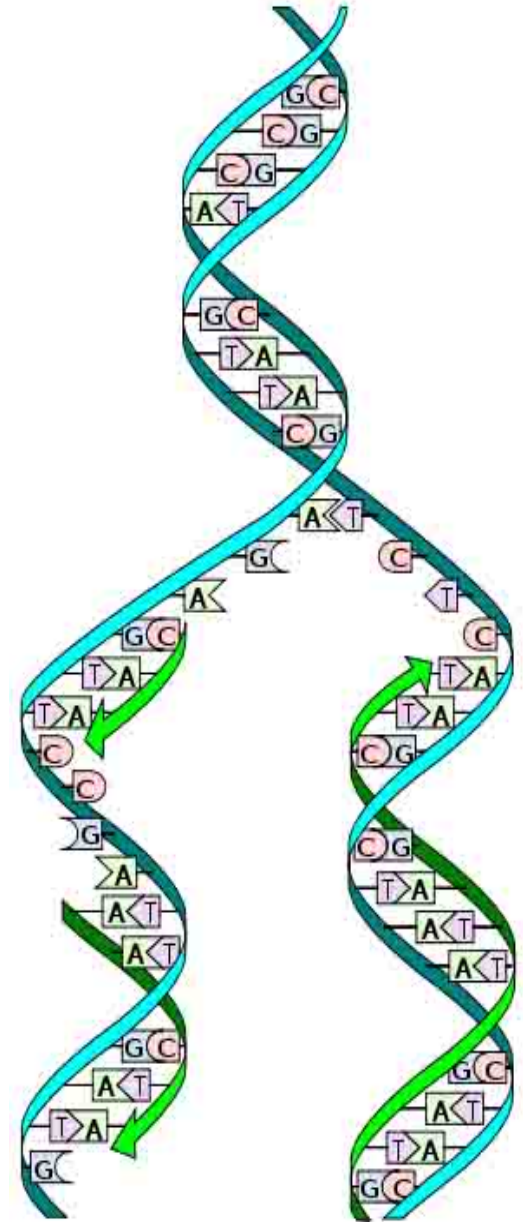
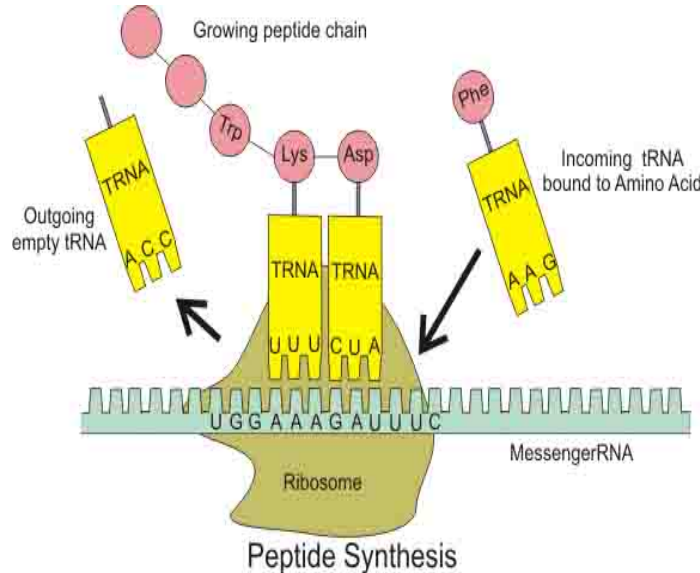
Let's put it all together!

1. The order of nucleotide bases in the DNA, in three base groupings (codons), is the genetic code; the "blueprints" of an organism.
2. Mutations result when there is a mistake copying the DNA (replication).
3. DNA is instructions for building proteins (from amino acids).
4. Mutations in the DNA code can result in the wrong amino acid being added to a protein.
5. A different amino acid can change the shape of that protein, and if a protein's shape is changed, it can't do its job.



Hereditary Diseases are due to DNA mutations

All inherited diseases arise from a mistake in the genetic code passed down from a person's parents, which leads to a defective protein.



Genetic Disease: **Cystic Fibrosis** (CF)

Cystic fibrosis (CF) is the most common, fatal genetic disease in the US.

Causes the body to produce thick mucus that clogs the lungs, leads to infection, and blocks the pancreas from delivering digestive enzymes to the intestine.

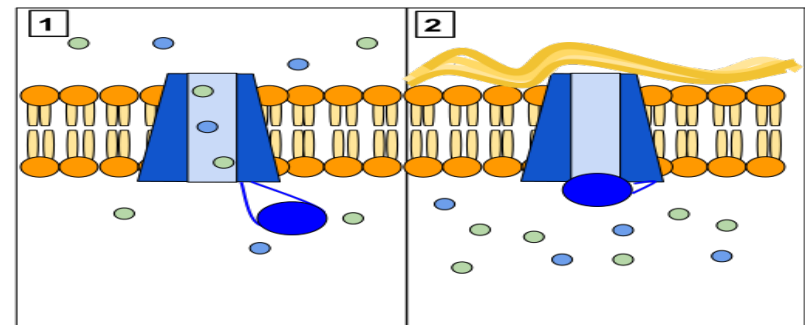
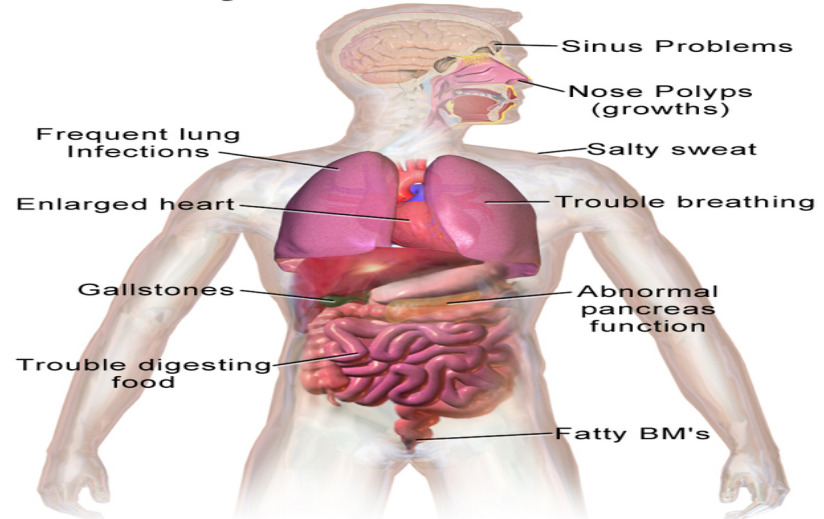
Results from mutations in a single gene: Cystic Fibrosis Transmembrane Regulator (CFTR) gene.

In normal cells, the CFTR channel protein allows cells to release chloride and other ions.

In people with CF, this protein is defective and the cells are not able to release the chloride, resulting in an improper salt balance in the cells and thick, sticky mucus.

Medical research is focusing on ways to cure CF by correcting the defective gene, or correcting the defective protein.

Health Problems with Cystic Fibrosis



CFTR channel protein controls flow of H₂O and Cl⁻ inside the lungs. When this protein is working correctly (Panel 1) ions can flow in and out of the cells. But, when the CFTR protein is blocked (Panel 2) these ions cannot flow out of the cell due.

Genetic Disease: **Sickle Cell Disease**

Most common inherited blood disorder in the United States.

In the US, sickle cell disease is most prevalent among African Americans.

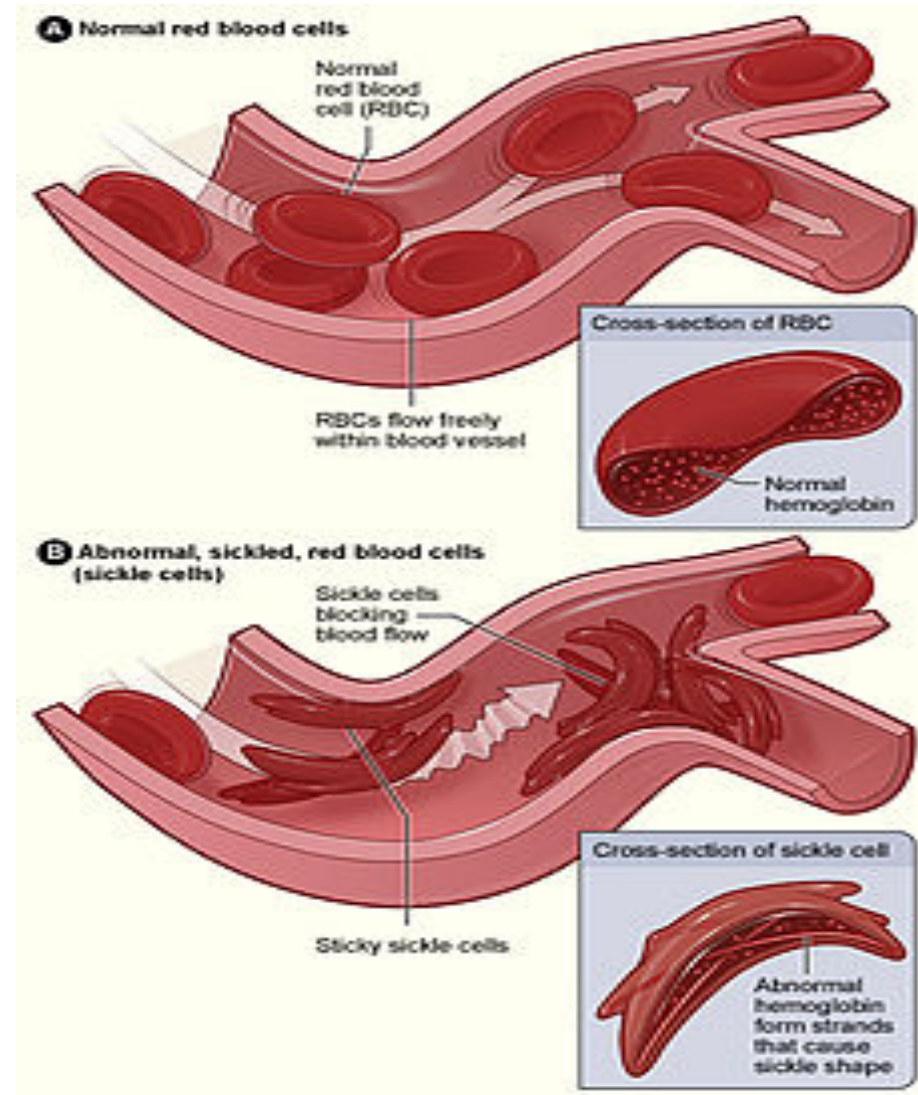
Caused by a mutation in the hemoglobin-Beta gene found on chromosome 11.

Hemoglobin transports oxygen from the lungs to other parts of the body.

Red blood cells with normal hemoglobin (hemoglobin-A) are smooth and round and easily flow through blood vessels.

People with this disease have abnormal hemoglobin molecules that stick to one another and cause red blood cells to become sickle shaped and pile up, rather than flow, causing blockages and damaging vital organs and tissue.

People who only carry the sickle cell trait typically don't get the disease, but can pass the defective gene on to their children.



What is Epigenetics?

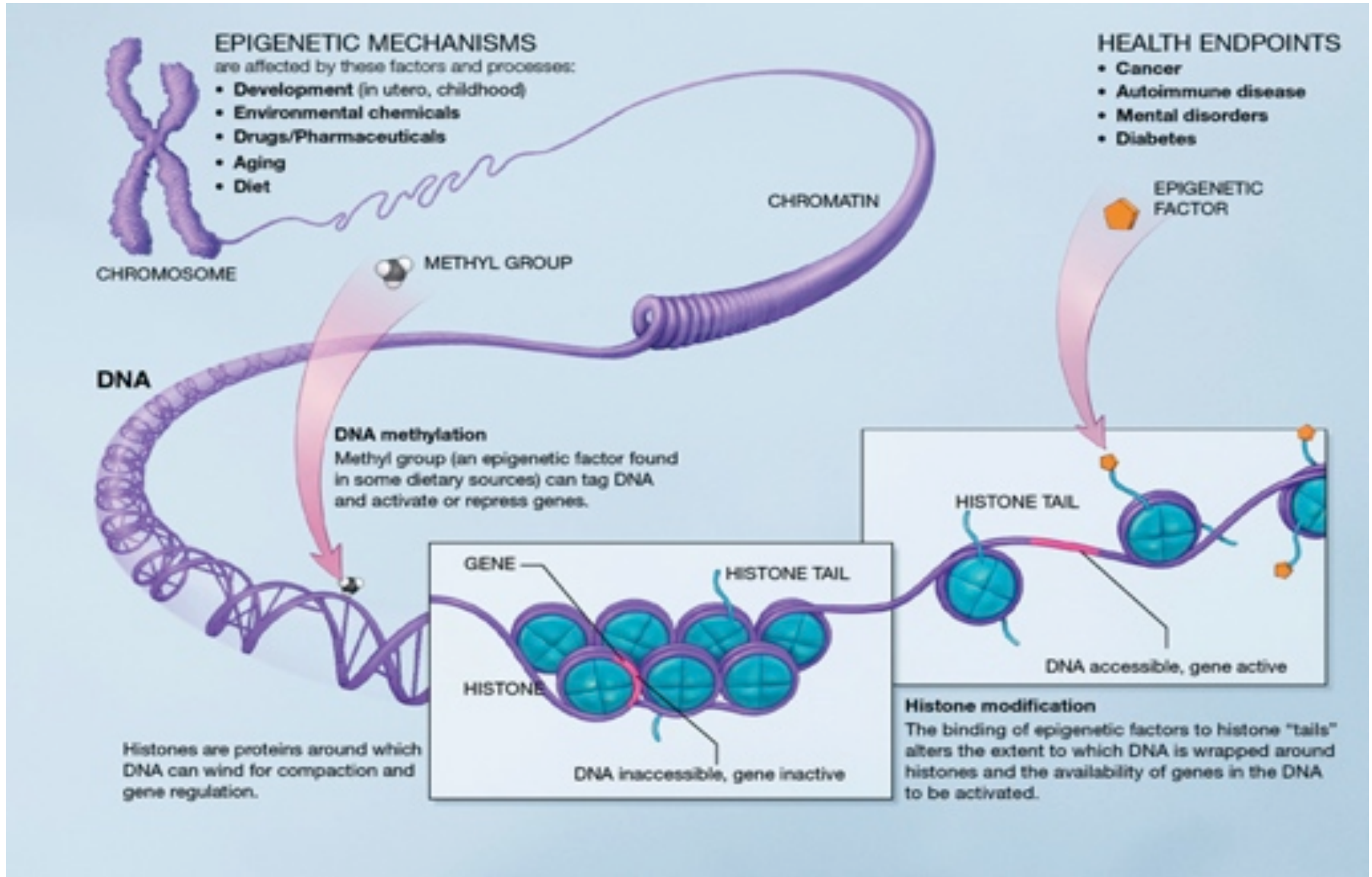
Heritable changes in gene expression that do not involve changes to the DNA sequence

A change in phenotype without a change in genotype.

Epigenetic change can be influenced by several factors including age, environment, lifestyle, and disease.



What is Epigenetics?



Confused?

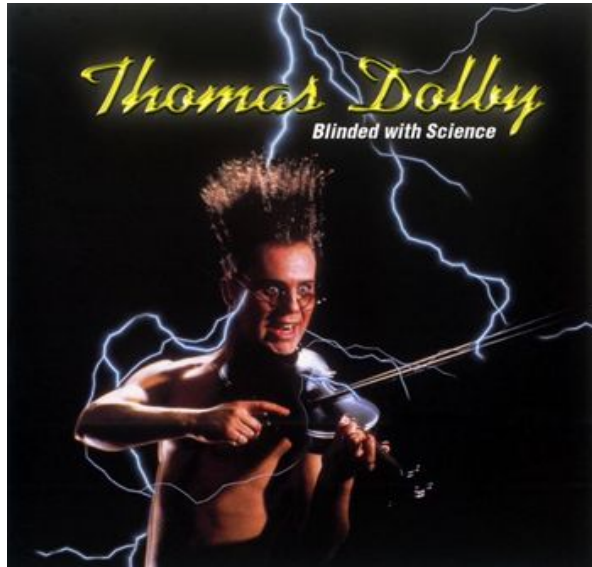
Here are links to fun resources that further explain genetic transcription & translation:

Smart Links



- [Molecular Genetics: Replication](#) Main Page on the Virtual Cell Biology Classroom of [Science Prof Online](#).
- ["That Spells DNA"](#) song by Jonathan Coulton.
- [DNA Structure](#) Cell Biology Animation from John Kyrk.
- [Build a DNA Molecule](#) from University of Utah.
- [DNA Replication](#) animation and review questions.
- [DNA Replication Process](#) animated video by FreeScienceLectures.com.
- [DNA Replication](#) step-through animation by John Kyrk.
- [Transcription & Translation](#) Main Page on the Virtual Cell Biology Classroom of [Science Prof Online](#).
- [DNA Transcription](#) step-through animation by John Kyrk.
- [Transcribe & Translate a Gene](#), from University of Utah.
- [DNA Transcription and Protein Assembly](#) animated movie by RedAndBrownPaperBag.
- [Transcription and Translation](#) animated movie from PBS production "DNA: The Secret of Life."

(You must be in PPT slideshow view to click on links.)



Are you feeling blinded by science?

Do yourself a favor. Use the...

Virtual Cell Biology Classroom (VCBC)!

The VCBC is full of resources to help you succeed,
including:



- practice test questions
- review questions
- study guides and learning objectives
- PowerPoints on other topics

Access the [Virtual Cell Biology Classroom](http://www.ScienceProfOnline.com) (VCBC) on the Science Prof Online website
www.ScienceProfOnline.com