Transfer of Information from DNA

SBI4UP

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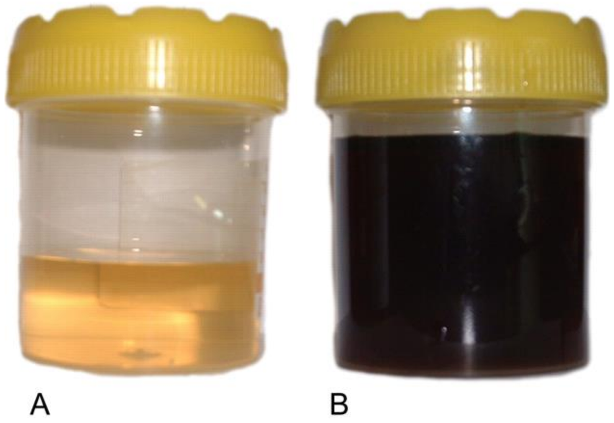
Link Between Genes and Protein

In 1909, Garrod suggested that phenotypes are expressed due to the presence of certain enzymes. He assumed that individuals had particular disorders due to their inability to produce a certain type of enzyme.

Garrold assumed that the production of enzyme was related to the genes in the DNA.

Alkaptonuria is a hereditary condition whereby the urine is black. Individuals with this disorder do not have the enzyme to break apart alkapton.



Link Between Genes and Protein

Beadle and Edward Tatum explored Garrold's idea and studied the bread mold 'Neurospora Crassa'.

Minimal Medium: Culture that contains sugar and inorganic salts.

- ✓ Wild Types N. crassa survive in this medium because they have the enzymes necessary to produce other molecules needed in their diet.

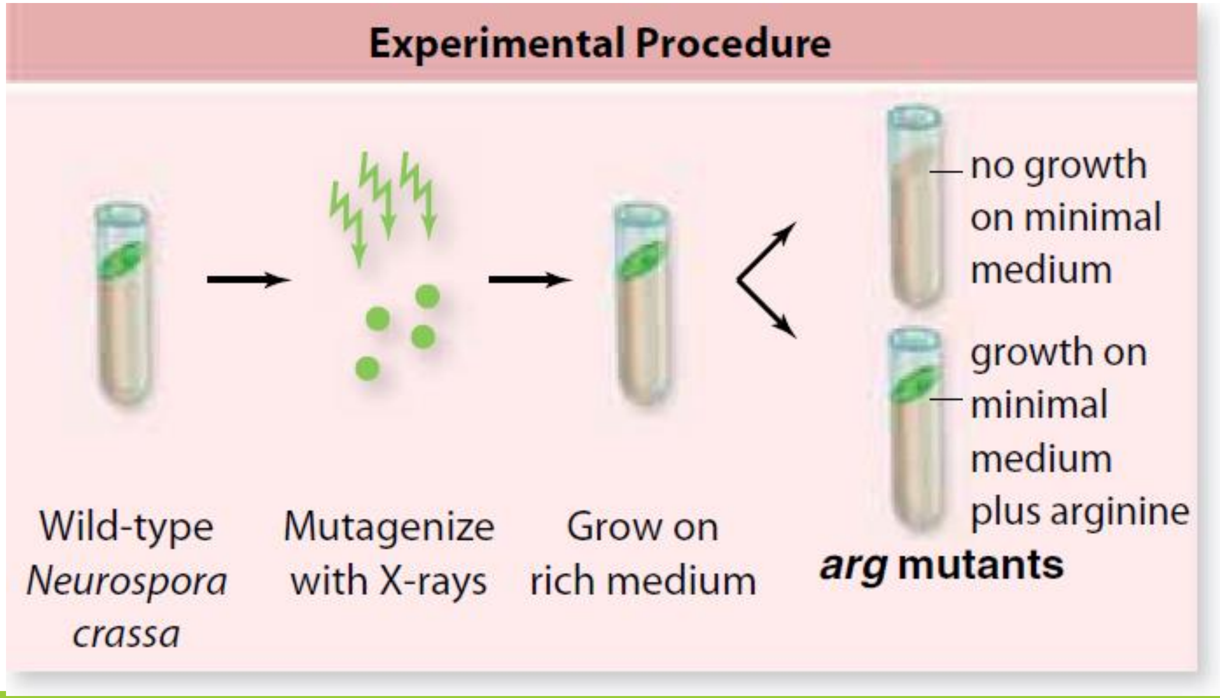
Complete Medium: the medium is supplemented with all 20 amino acids and other important nutrients.

- ✓ Mutatn N.crassa can survive in this growth medium. They do not need to rely on enzymes to supplement their diet.

Beadly and Tatum's Experiment

1. Beadle and Tatum created mutants of N. crassa with X-rays. There mutants were now deficient in producing essential nutrients.

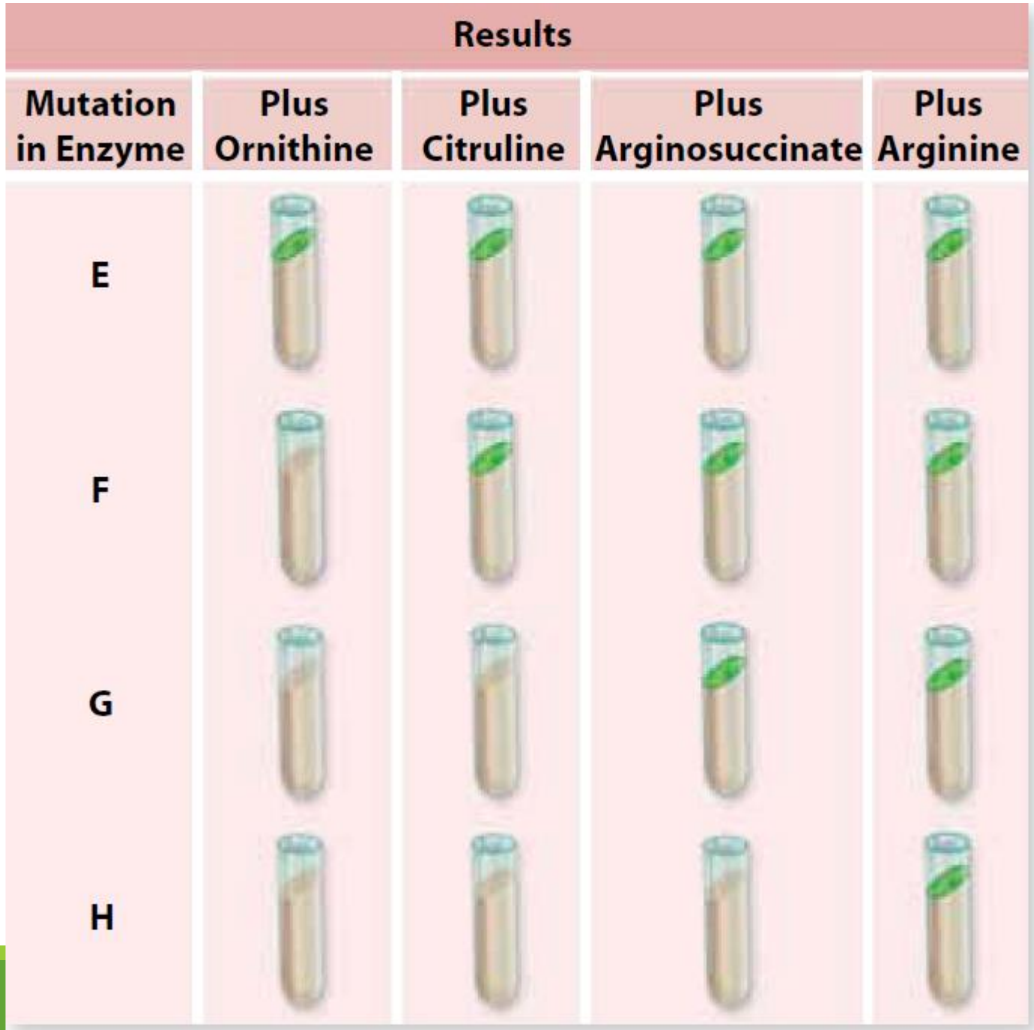
2. All of the mutants that were growing in the complete medium were transferred over to the minimal medium.



Beadly and Tatum's Experiment

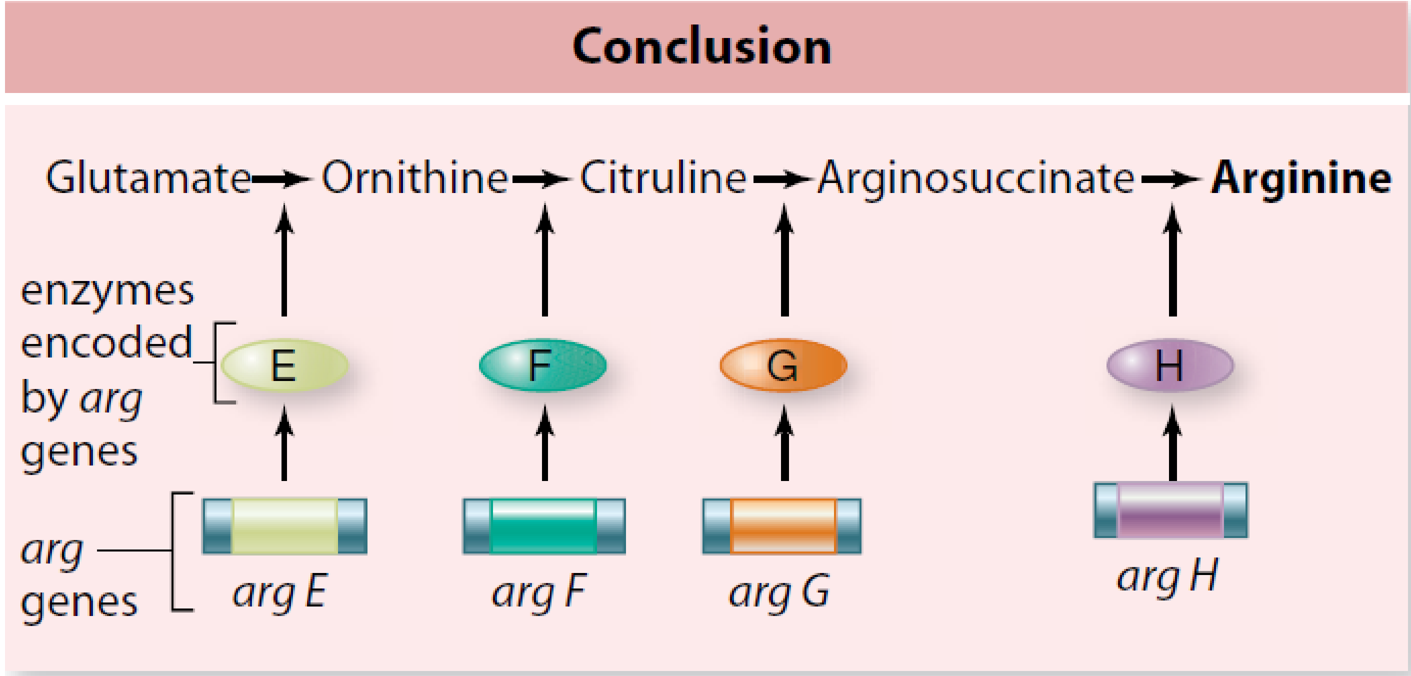
Beadle and Tatum wanted to determine if there was a one-to-one relationship between genes and proteins. Thus they studied the biochemical pathway of N.crassa more closely.

The scientists hypothesized that if the correct gene was mutated there would be no growth unless arginine was present in the medium.



One-Gene/One-Polypeptide Hypothesis

Beadle and Tatum concluded that one gene codes for one enzyme. This relationship was updated to the one-gene/one-polypeptide hypothesis since not all proteins are enzymes.

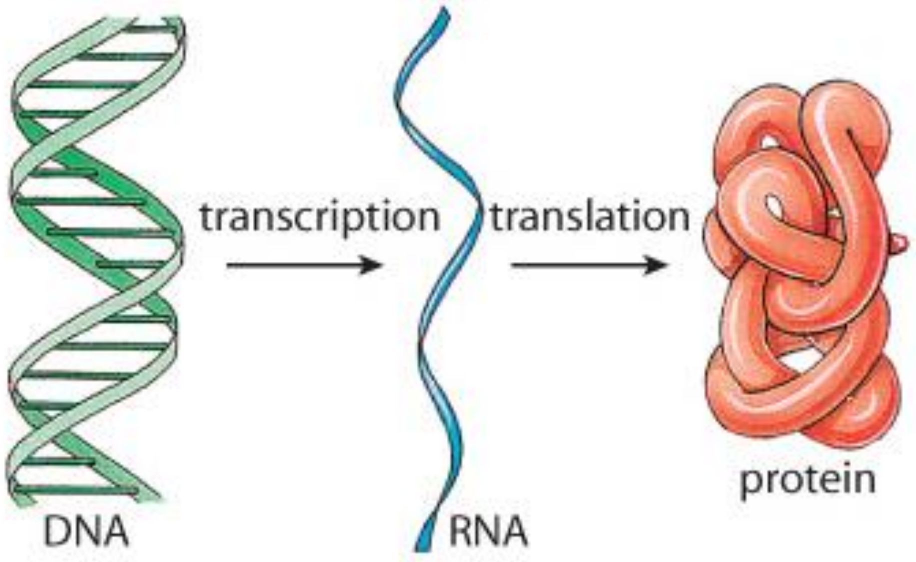


Messenger between DNA and Proteins

Scientists had discovered that genes were located one the chromosome within the DNA, wherea the proteins were synthesized in the cytoplasm.

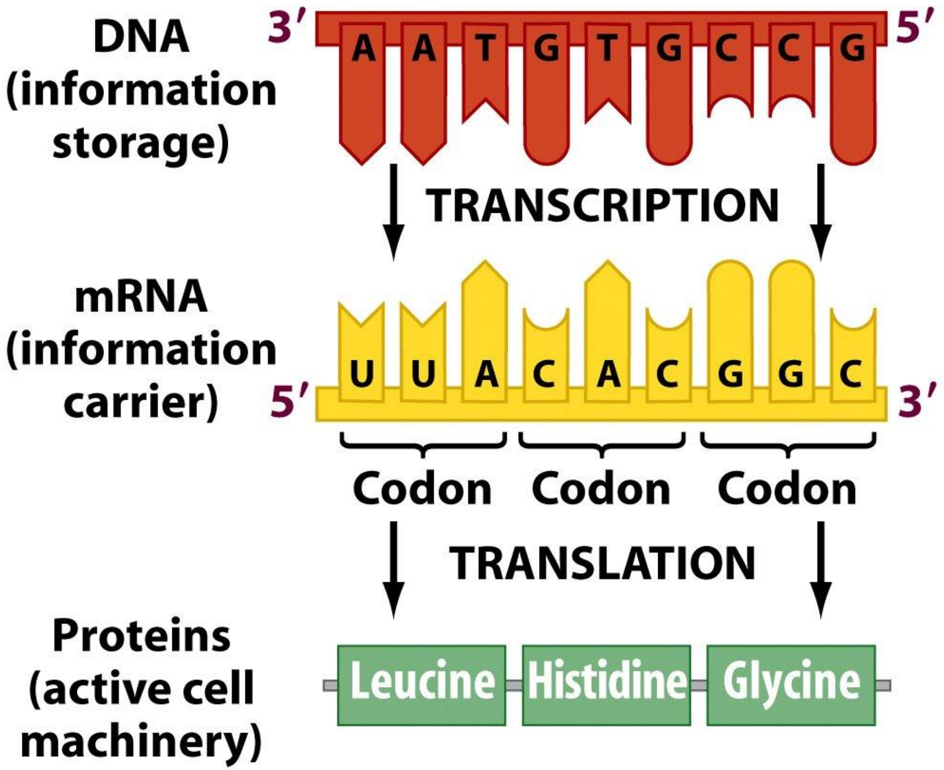
Scientists also found that RNA (another form of nucleic acid) could be found in both the nucleus and the cytoplasm. The amount of RNA that they found in the cytoplasm often correlated with the amount of protein in the cytoplasm.

Thus scientists concluded that RNA could be synthesized in the nucleus and transported to the cytoplasm to synthesize protein.



Messenger between DNA and Proteins

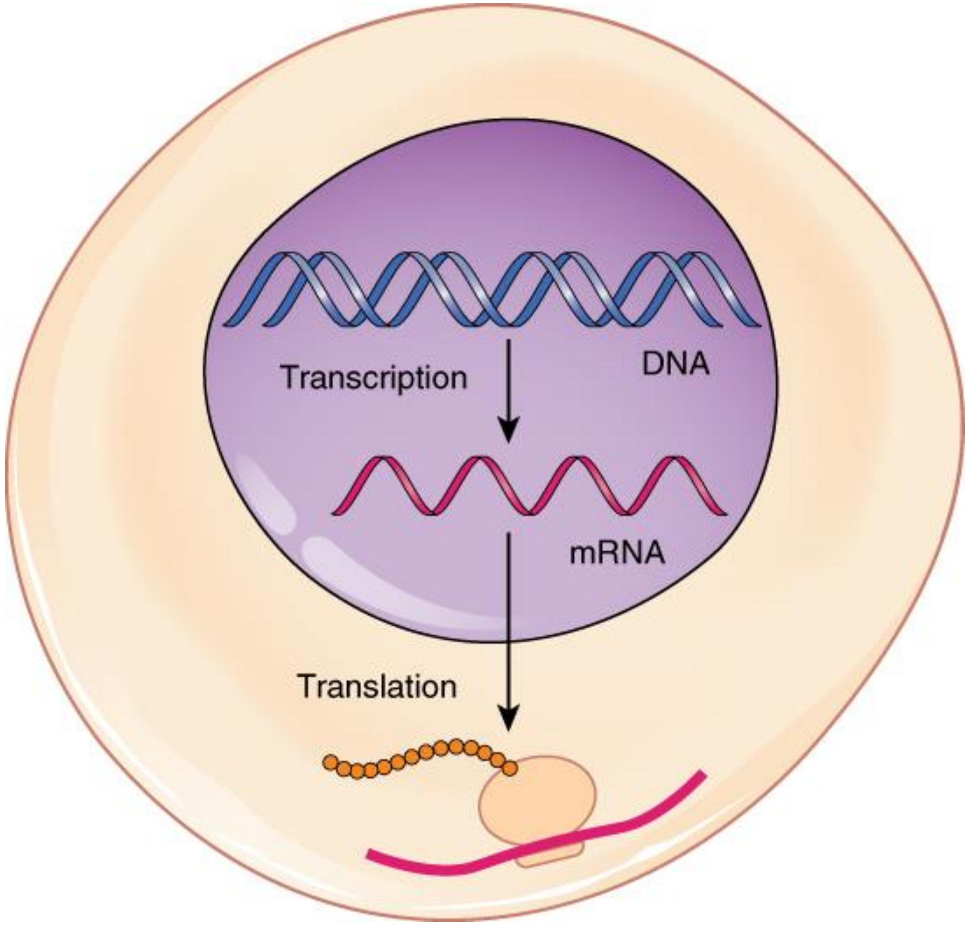
In 1961, Jacob and Jacques Monod, through their experiment postulated that there was a ***messenger RNA (mRNA)*** that was synthesized by the genetic code in the DNA.



Messenger between DNA and Proteins

- *mRNA is synthesized in the nucleus and later transported into the cytoplasm.*

- *In the cytoplasm mRNA is converted into a polypeptide (i.e protein)*



The Genetic Code

Genetic Code: is a set of rules for determining how genetic information in the form of a nucleotide sequence is converted to an amino acid sequence of a protein.

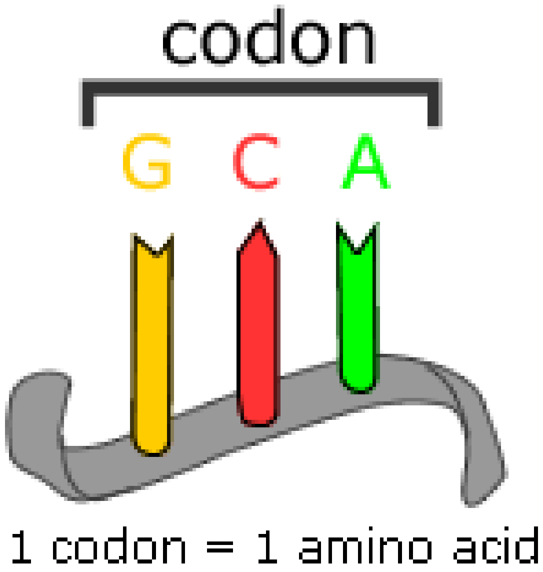
Researchers identified four nucleotides in RNA (A, U, G, and C) and 20 amino acids.

Mathematically, there could not be a one-to-one relationship between nucleotides and amino acids, nor could there be just two nucleotides per amino acids.

How many bases correspond to one amino acid?

The Triplet Hypothesis

The genetic code consists of a combination of three nucleotides, called a codon. Each codon would code for an amino acid.



The codes for protein synthesis are always interpreted through the mRNA strand.

*Remember. . . the **thymine** nitrogenous base is replaced with **uracil** in the mRNA sequence.*

Interpreting Codons

AUG: *initiatory codon and codes for methionine*

UAA, UAG & UGA: *terminator codons*

First Base	Second Base				Third Base
	U	C	A	G	
U	UUU phenylalanine UUC phenylalanine UUA leucine UUG leucine	UCU serine UCC serine UCA serine UCG serine	UAU tyrosine UAC tyrosine UAA stop** UAG stop**	UGU cysteine UGC cysteine UGA stop** UGG tryptophan	U C A G
C	CUU leucine CUC leucine CUA leucine CUG leucine	CCU proline CCC proline CCA proline CCG proline	CAU histidine CAC histidine CAA glutamine CAG glutamine	CGU arginine CGC arginine CGA arginine CGG arginine	U C A G
A	AUU isoleucine AUC isoleucine AUA isoleucine AUG methionine*	ACU threonine ACC threonine ACA threonine ACG threonine	AAU asparagine AAC asparagine AAA lysine AAG lysine	AGU serine AGC serine AGA arginine AGG arginine	U C A G
G	GUU valine GUC valine GUA valine GUG valine	GCU alanine GCC alanine GCA alanine GCG alanine	GAU aspartate GAC aspartate GAA glutamate GAG glutamate	GGU glycine GGC glycine GGA glycine GGG glycine	U C A G

Characteristics of Codons

1. **Genetic code is redundant:** More than one codon can code for a particular amino acid.

First Base	
	U
U	UUU phenylalanine UUC phenylalanine UUA leucine UUG leucine

UUU and UUC both code for the amino acid phenylalanine.

UUA and UUG both code for the amino acid leucine.

2. **Genetic Code is continuous:** the mRNA is read continuously without any spaces or pauses. There is always a start and an end to the translation process.

Characteristics of Codons

3) **Genetic code is universal**: Most organisms build their proteins using the rules of the triplet codon.

First Base	Second Base				Third Base
	U	C	A	G	
U	UUU phenylalanine UUC phenylalanine UUA leucine UUG leucine	UCU serine UCC serine UCA serine UCG serine	UAU tyrosine UAC tyrosine UAA stop** UAG stop**	UGU cysteine UGC cysteine UGA stop** UGG tryptophan	U C A G
C	CUU leucine CUC leucine CUA leucine CUG leucine	CCU proline CCC proline CCA proline CCG proline	CAU histidine CAC histidine CAA glutamine CAG glutamine	CGU arginine CGC arginine CGA arginine CGG arginine	U C A G
A	AUU isoleucine AUC isoleucine AUA isoleucine AUG methionine*	ACU threonine ACC threonine ACA threonine ACG threonine	AAU asparagine AAC asparagine AAA lysine AAG lysine	AGU serine AGC serine AGA arginine AGG arginine	U C A G
G	GUU valine GUC valine GUA valine GUG valine	GCU alanine GCC alanine GCA alanine GCG alanine	GAU aspartate GAC aspartate GAA glutamate GAG glutamate	GGU glycine GGC glycine GGA glycine GGG glycine	U C A G

Homework

Textbook: p.250 # 2,5,8,10,11,12,13 & 14