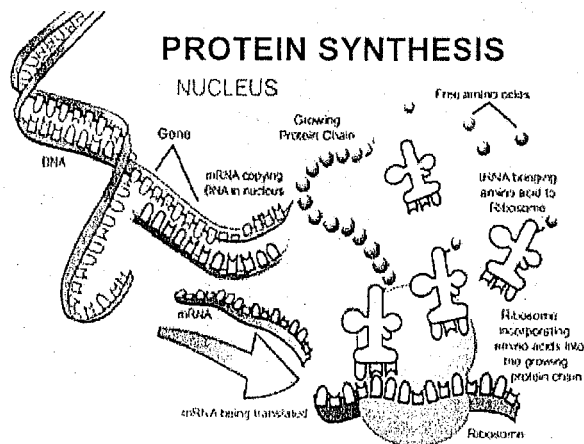
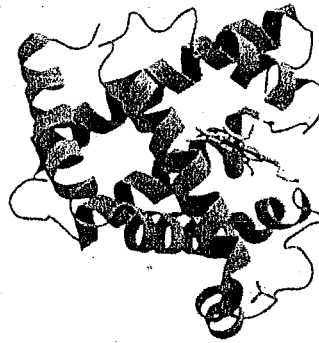
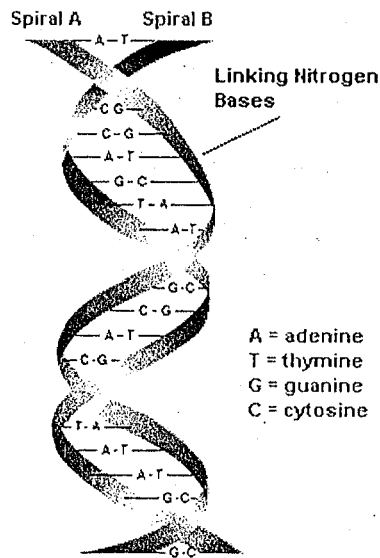


# Unit 8

## DNA Structure & Protein Synthesis





DNA Notes

DNA Notes

# DNA Notes

DNA Notes

## DNA Vocab

Adenine

anti-codon

Codon

complimentary

Cytosine

DNA

double helix

Francis Crick

Gene

Guanine

James Watson

m RNA

mutation

nucleotide

polypeptide

r RNA

replication fork

ribosome

Rosalind Franklin

t RNA

Thymine

transcription

translation

Uracil

By the end of this DNA unit, you should be able to...

## **DNA**

- identify the contributions of the key scientists involved with determining the structure of DNA
- draw the structure of the DNA molecule
- create a strand of complimentary DNA
- describe the steps involved in DNA replication
- give an example of how the environment influences the traits of an organism

## **Protein Synthesis**

- describe translation and transcription
- given a base sequence of DNA, create a mRNA sequence
- determine an amino acid sequence from a piece of mRNA by using the codon chart
- explain how mutations can lead to misshapen proteins, causing genetic disorders
- describe several human genetic disorders

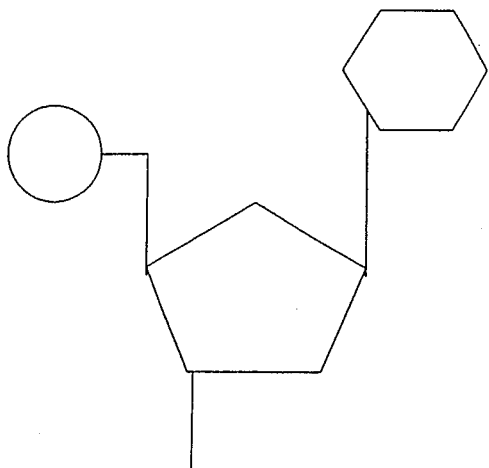
## DNA Structure NOTES

Visit <http://science.howstuffworks.com/environmental/life/cellular-microscopic/dna1.htm> & fill in these notes

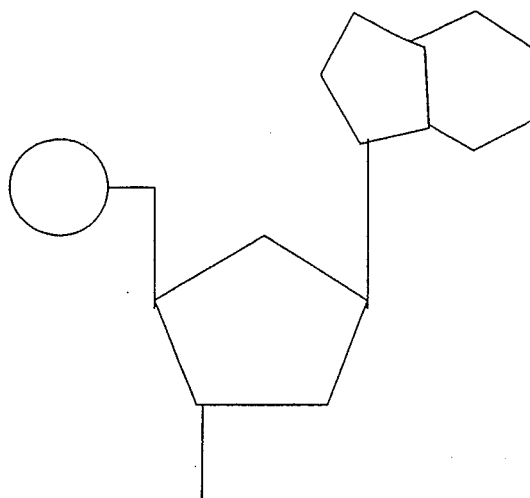
- \* DNA is one of the \_\_\_\_\_, information containing molecules
- \* DNA is found in the \_\_\_\_\_ of every human cell.
- \* The information in DNA guides the cell in making new \_\_\_\_\_, that determine our traits
- \* DNA gets passed (\_\_\_\_\_) from one generation to the next
- \* DNA in a cell is really just a pattern made up of \_\_\_\_\_ different parts called \_\_\_\_\_  
Imagine a set of blocks that has only four shapes, or an alphabet that has only four letters.
- \* Each \_\_\_\_\_ consists of ...

- \* \_\_\_\_\_
- \* \_\_\_\_\_
- \* \_\_\_\_\_

**LABEL** these nucleotides!!!



OR

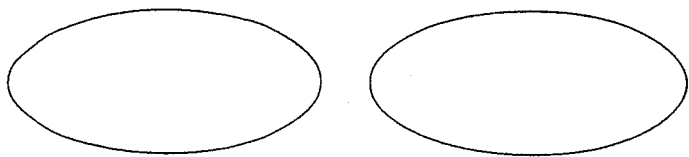


BASES

are either

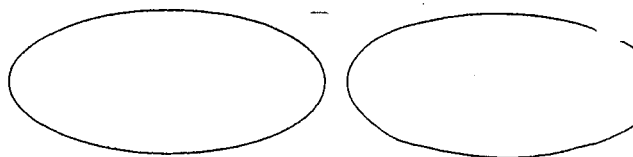
SINGLE ring

Pyrimidines



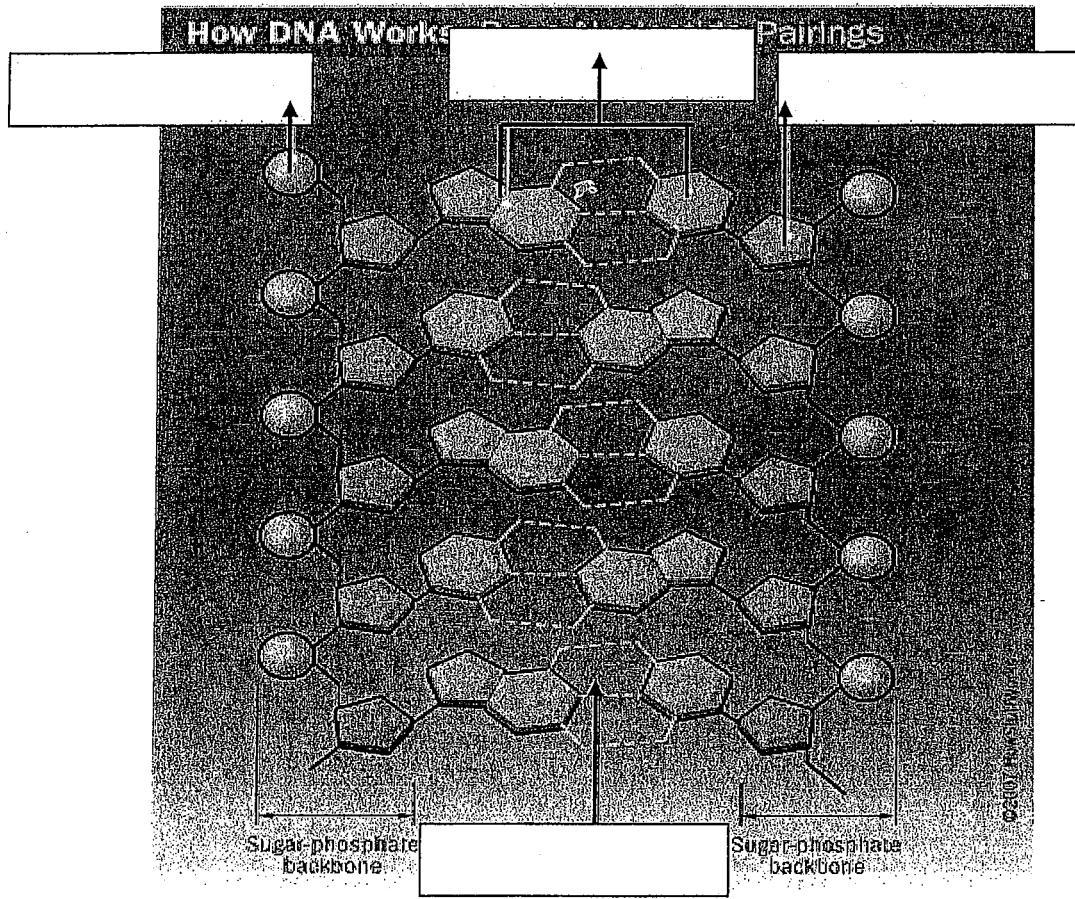
DOUBLE ring

Purines





LABEL this DNA molecule...



- \* \_\_\_\_\_ discovered that DNA had two sides, or strands,
- \* These strands were twisted together like a twisted ladder, or \_\_\_\_\_
- \* The sugars & phosphate make up the \_\_\_\_\_ of the DNA molecule
- \* The nitrogenous bases point \_\_\_\_\_ on the ladder
- \* Each base pair is formed from two \_\_\_\_\_ nucleotides as follows
  - \_\_\_\_\_ with \_\_\_\_\_ (“always together”)
  - \_\_\_\_\_ with \_\_\_\_\_ (“good company”)

These bases are attracted to each and held together by a force called \_\_\_\_\_

A hydrogen “bond” is a \_\_\_\_\_ chemical ATTRACTION.

A hydrogen bond is NOT A BOND!!! (no electrons are shared or transferred!)

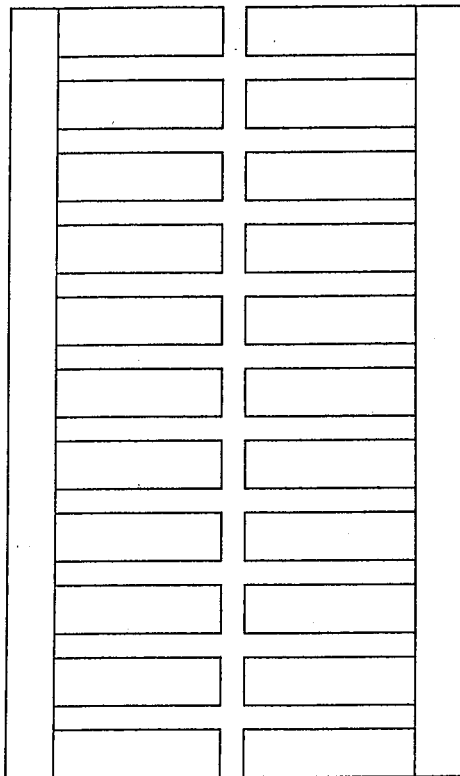
atch this cool animation...

[http://www.sumanasinc.com/webcontent/animations/content/DNA\\_structure.html](http://www.sumanasinc.com/webcontent/animations/content/DNA_structure.html)

CLICK: DNA Workshop Activity, then CLICK: DNA Replication

\* Look in the lower right hand side of the screen. Where are you? I am in the \_\_\_\_\_

\* LABEL and COLOR the DNA molecule you see...



Let's review:

Look at the DNA molecule to the left...

Cytosine ALWAYS pairs with \_\_\_\_\_

Adenine ALWAYS pairs with \_\_\_\_\_

STEPS to copy DNA

1) DNA must be \_\_\_\_\_ to be copied to be replicated. Click on the button to do this.

2) The DNA now resembles a \_\_\_\_\_.

3) \_\_\_\_\_ (special proteins) help unzip the DNA and keep it "open".

CLICK "OK". Make the new copy of DNA.

4) Describe what you did to make the new DNA strands? \_\_\_\_\_

5) In a real nucleus, \_\_\_\_\_ (special proteins) would be responsible for doing this.

6) Each human chromosome contains \_\_\_\_\_ of bases. All \_\_\_\_\_ chromosomes contain a total of \_\_\_\_\_ nucleotides.

CLICK "OK", then LABEL & COLOR your new DNA strands on the page that follows.

Two identical DNA molecule templates side-by-side. Each template consists of a large vertical rectangle divided into two columns by a central vertical line. Each column contains 10 horizontal rectangular boxes, one in each row, representing the base pairs of a DNA double helix. The boxes are currently empty for labeling and coloring.

Look at these DNA molecules. What do you notice about these two DNA molecules?

These two DNA molecules are \_\_\_\_\_ to each other.

\* Look in the lower right hand side of the screen. Where are you?

I am STILL in the \_\_\_\_\_

## GENES

Genes control the synthesis of ALL proteins. Proteins are used by your body in many ways:

- 1.
- 2.
- 3.
- 4.
- 5.

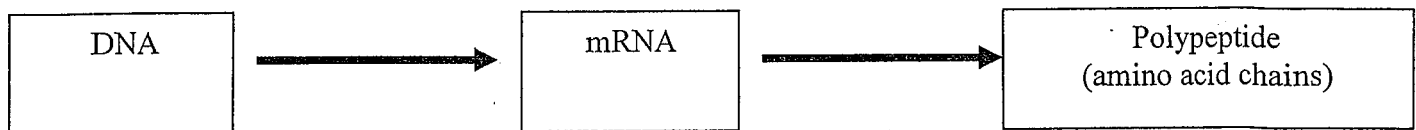
**Gene Chromosome Theory** states that \_\_\_\_\_ contain hereditary information and that

These are located on \_\_\_\_\_ in a definite order.

**One Gene-One Polypeptide Hypothesis** states that \_\_\_\_\_ gene contains the genetic information

To make \_\_\_\_\_ polypeptide chain. Proteins are made from one or more of these polypeptide chains

How do your cells make polypeptides from the information on your DNA?????



ALL the cells in your body contain \_\_\_\_\_ to same \_\_\_\_\_ code.

If this is true, then why are there so many different types of cells that perform very different tasks within your body??

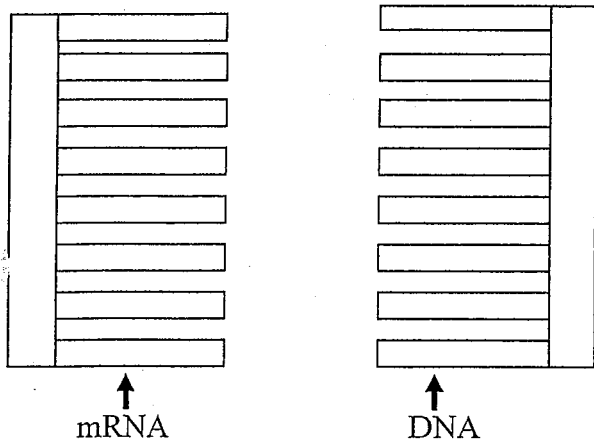
## Protein Synthesis NOTES

REVIEW: Where are proteins made? In the \_\_\_\_\_ of a cell.

visit <http://www.wisc-online.com/objects/ViewObject.aspx?ID=AP1302>

CLICK: "Next" when your are ready; fill in below as you go along. CLICK: "View Again" as needed

- \* A cell will be sent a \_\_\_\_\_ to tell it in needs to make a certain amount of \_\_\_\_\_
- \* A portion of the DNA molecule \_\_\_\_\_ exposing a \_\_\_\_\_ responsible for making that protein.
- \* Nucleotides, with the help of \_\_\_\_\_ (special proteins) move along one strand of the gene to form a \_\_\_\_\_ molecule. C & G still pair up, but now A pairs with a new base, \_\_\_\_\_ (uracil).
- \* LABEL DNA strand with its COMPLIMENTARY mRNA molecule you see...



Let's review:

Look at the mRNA molecule...

Cytosine ALWAYS pairs with \_\_\_\_\_

Adenine NOW pairs with \_\_\_\_\_

- \* The newly made \_\_\_\_\_ must leave the nucleus through little holes called \_\_\_\_\_.
- I think the mRNA is going to the \_\_\_\_\_ because that is where the proteins are made!!
- \* Once at a \_\_\_\_\_, the mRNA is "read" \_\_\_\_\_ letters at a time, called a \_\_\_\_\_.
- \* A \_\_\_\_\_ RNA (or tRNA) can recognize the three base sequence (codon) because it is complimentary to the mRNA. Each tRNA can "carry", or transfer, an \_\_\_\_\_.
- \* The tRNA transfers an \_\_\_\_\_ to the ribosome.
- \* A \_\_\_\_\_ bond is formed between two amino acids, using \_\_\_\_\_.
- \* More amino acids are brought and connected to each other, forming a \_\_\_\_\_ chain.
- Once finished, the polypeptide chain (protein) must \_\_\_\_\_ into its correct \_\_\_\_\_ in order to work.

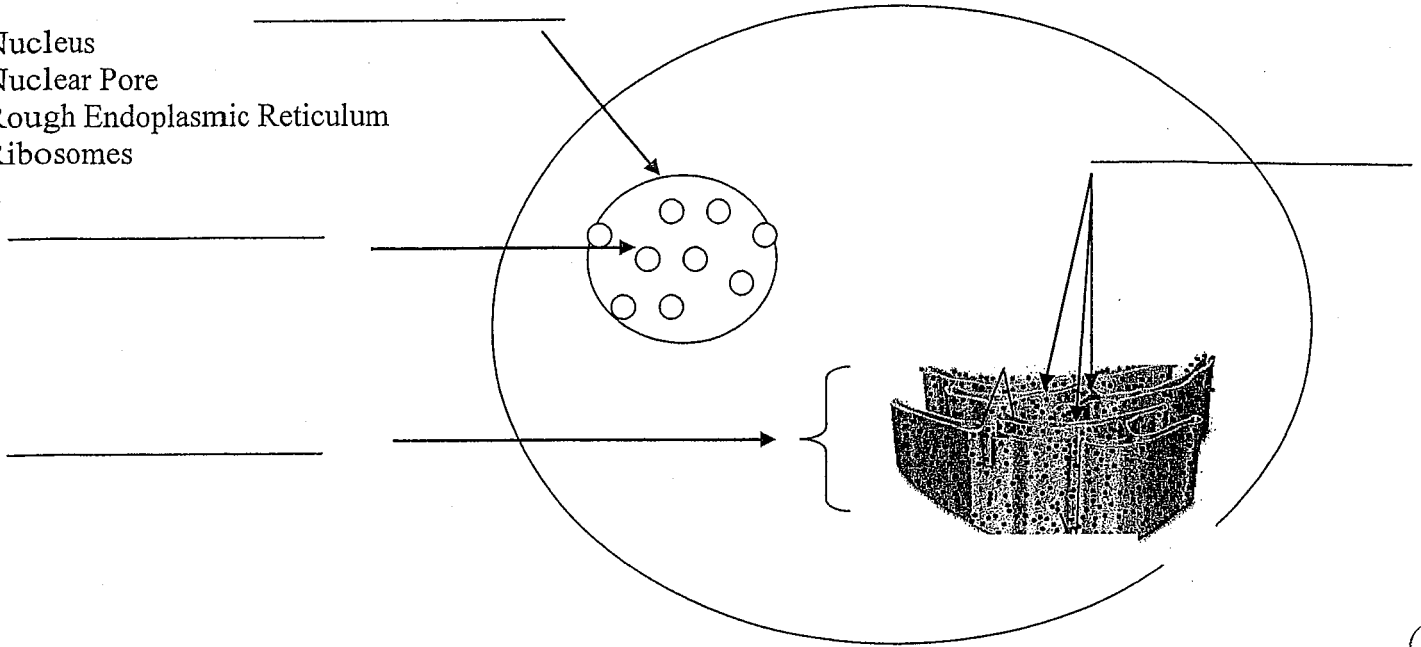
What do you know about a protein and its shape????



Now, go back to the beginning and view the entire animation again. Then answer these questions...

Label...

- \* Nucleus
- \* Nuclear Pore
- \* Rough Endoplasmic Reticulum
- \* Ribosomes



- 1) Which molecule ALWAYS lives in the nucleus? \_\_\_\_\_
- 2) This molecule contains "recipes" to make thousands of different \_\_\_\_\_.
- 3) Which molecule is made in the nucleus that travels to the ribosome? \_\_\_\_\_
- 3) A three base sequence on a messenger RNA is called a \_\_\_\_\_.
- 4) \_\_\_\_ RNA brings \_\_\_\_\_ to the ribosome.
- 5) A peptide bond is a \_\_\_\_\_ that links two \_\_\_\_\_ together.
- 6) Linking many \_\_\_\_\_ together makes a protein, or polypeptide.
- 7) Once made, a protein must fold into its correct \_\_\_\_\_ in order to work.
- 8) List some examples of proteins: \_\_\_\_\_  
(review)



## Why do Fireflies Glow??



Go to the following website, read and play the animations to answer the questions below.

<http://learn.genetics.utah.edu/content/begin/dna/firefly/>

- 1) Which enzyme do the cells in a firefly's tail produce? \_\_\_\_\_

**View** the animation when you are ready, then **click** "More".

- 2) Which enzyme finds the gene to make the above enzyme? \_\_\_\_\_

- 3) The gene that codes for the enzyme that produces the light is called the \_\_\_\_\_ gene.

- 4) The gene specifies a particular sequence of \_\_\_\_\_ that make the enzyme, which is a protein.

**View** the animation when you are ready, then **click** on "More".

- 5) RNA polymerase copies the gene into a \_\_\_\_\_ molecule.

This process is known as \_\_\_\_\_.

**View** the animation when you are ready, then **click** on "More".

- 7) When the above process is done, the \_\_\_\_\_ moves to the \_\_\_\_\_.

Why?? (Use brain) \_\_\_\_\_

**View** the animation when you are ready, then **click** on "More".

- 8) What is the cell's protein making "machine"? \_\_\_\_\_

**View** the animation when you are ready, then **click** on "More".

- 9) The \_\_\_\_\_ makes a chain of \_\_\_\_\_, which will become the enzyme needed to make the light.

- 10) The process of making an amino acid sequence from an mRNA molecule is called \_\_\_\_\_.

**View** the animation when you are ready, then **click** on "More".

- 11) What must the enzyme do before it can work properly? \_\_\_\_\_

**View** the animation when you are ready, then **click** on "More".

12) What chemical do the luciferase enzymes bind to? \_\_\_\_\_

**View** the animation when you are ready, then **click** on "More".

13) What slightly different chemical is made when the process in #12 above happens? \_\_\_\_\_

**View** the animation when you are ready, then **click** on "More".

14) What happens to this chemical to produce the light we see? \_\_\_\_\_  
\_\_\_\_\_

15) If you were a firefly, what 2 purposes does the light you make have (how do you use it)?

a) \_\_\_\_\_ b) \_\_\_\_\_

**View** the animation when you are ready. **Click** on "Start Over" and watch the entire animation again.

Using **bullets**, summarize in your own words how a gene is used by a cell to make a functional protein (such as an enzyme). Be sure to include and **UNDERLINE** the following words: (words can be used more than once)

DNA      gene      mRNA      translation      transcription      ribosome      cytoplasm  
amino acid sequence      protein      folding      RNA polymerase      nucleus      codon

A U G G G U C G U A A U G G U U U G U U U C U U U A A

AMINO ACID CODON CHART

SECOND BASE																	
FIRST BASE	U				C				A				G				THIRD BASE
	U	UUU	}	PHE	UCU	}	SER	UAU	}	TYR	UGU	}	CYS	U C A G			
		UUC			UCC			UAC			UGC						
		UUA	}	LEU	UCA		}	STOP	UAA	}	UGA	}	STOP				
		UUG			UCG				UAG		UGG		TRP				
	C	CUU	}	LEU	CCU	}	PRO	CAU	}	HIS	CGU	}	ARG	U C A G			
		CUC			CCC			CAC			CGC						
		CUA			CCA			CAA	CGA	}	GLN						
		CUG			CCG			CAG	CGG								
	A	AUU	}	ILE	ACU	}	THR	AAU	}	ASN	AGU	}	SER	U C A G			
		AUC			ACC			AAC			AGC						
		AUA	}	MET or START	ACA		}	LYS	AAA	}	AGA	}	ARG				
		AUG			ACG				AAG		AGG						
	G	GUU	}	VAL	GCU	}	ALA	GAU	}	ASP	GGU	}	GLY	U C A G			
		GUC			GCC			GAC			GGC						
		GUA			GCA		GAA	GGA	}	GLU							
GUG		GCG			GAG		GGG										

## Traits influenced by the environment

An individual's phenotype often depends on conditions in the environment. In plants, hydrangea (*heye DRAYN juh*) flowers of the same genetic variety range in color from blue to pink, depending on the acidity of the soil. As seen in **Figure 8-17**, hydrangea plants in acidic soil bloom blue flowers, while those in neutral to basic soil will bloom pink flowers.

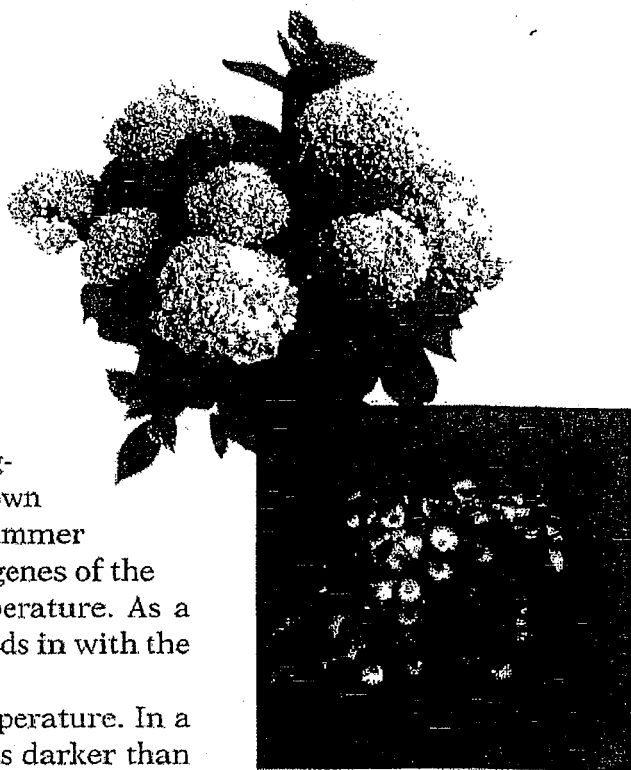
The color of the arctic fox is affected by temperature. During the warm temperatures of summer, the fox produces enzymes that make pigments. These pigments darken the fox's coat to a reddish brown, as shown in **Figure 8-18**, enabling the fox to blend in with the summer landscape. During the winter, the pigment-producing genes of the arctic fox do not function because of the cold temperature. As a result, the coat of the fox is white, and the animal blends in with the snowy background.

Fur color in Siamese cats is also influenced by temperature. In a Siamese cat, the fur on its ears, nose, paws, and tail is darker than on the rest of its body. The Siamese cat has a genotype that results in dark fur at locations on its body that are cooler than the normal body temperature. Thus, the darkened parts have a lower body temperature than the light parts.

In humans many traits, such as height, are influenced by the environment. For example, height is influenced by nutrition, an internal environmental condition. Exposure to the sun, an external environmental condition, alters the color of the skin. Many aspects of human personality, such as aggressive behavior, are strongly influenced by the environment, although genes appear to play an even more important role. Because identical twins have identical genes, they are often used to study environmental influences. Since identical twins are genetically identical, any differences between them are attributed to environmental influences.

**Figure 8-18** Environmental influences on fur color

Can the same fox look so different? Many arctic mammals, such as the arctic fox, develop white fur during the winter and dark fur during the summer.



**Figure 8-17**  
**Environmental influences on flower color.** Hydrangea with the same genotype for flower color express different phenotypes depending on the acidity of the soil.

Answer these questions after reading pg 16 in your packet (or pg 177 in your textbook)

\_\_\_\_\_ is a factor that influences the color of hydrangea plants.

2) Complete the chart...

<u>pH</u>	<u>Flower Color</u>

3) In the summertime, an artic fox makes \_\_\_\_\_ that produce \_\_\_\_\_, which make the foxes fur a \_\_\_\_\_ color.

4) a) During the winter, what happens to the chemicals that an artic fox makes during the warmer winter months?

b) How does this affect the fox's fur color during the winter?

c) How is this advantageous for the artic fox?

5) Explain how identical twins, with exactly the same DNA, can be different heights?

6) True or False

a) Genes alone determine the phenotype (physical appearance) of an organism. **T or F**

b) Environmental factors work along with genes to determine the phenotype of an organism. **T or F**

c) Science is amazing!! (Hint: don't pick false!) **T or F**

## Mutations Notes

### Background

1. In what form is information encoded in your DNA?
2. What is the information in your DNA translated into?

Define:

*Mutation-*

*Mutagen-*

*i.e.*

### Types of Point Mutations

1. SEETHEBIGMADDOGRUNFORTHEFATREDCAT

A "normal" gene

2. SEETHEBIGMADDOGRUNFORTHEFARREDCAR
3. SEETHEBIGMADDOGRUNFORTHE DATRADCAT

*SUBSTITUTION-*

4. SEETHEBIGMMADDOGRUNFORTHEFATREDCAT

*INSERTION-*

5. SEETHEBIGMADDOGRNFORTHEFATREDCAT

*DELETION-*

READING FRAME SHIFT-

Why are some mutations BAD??

Why are some mutations GOOD??

Mutation Practice...

- 1) Determine how the mutations below will affect the amino acid sequence.

**Example:**

mRNA sequence: UGU-CCG      cysteine-proline

mutation sequence: UGC-CGC      cysteine-arginine

a. mRNA sequence: GAA-CGU

mutation sequence: GAU-CGU

b. mRNA sequence: AUC-UGC

mutation sequence: AUC-UGG

c. mRNA sequence: UGU-CCU-CCU

mutation sequence: UGU-UUC-CCU

d. mRNA sequence: GGG-UUA-ACC

mutation sequence: GGU-UAA

- 2) What is the most likely effect of a mutation on the SHAPE of a protein?
- 3) If a protein has a change in its shape due to a mutation, is it likely to function? YES / NO  
Explain
- 4) Why might a change in the shape of an essential protein be a BAD thing for an organism?
- 5) Why might a change in a shape of a protein be a GOOD thing for an organism?

**Human Genetic Disorders** CAUSED by \_\_\_\_\_ leading to \_\_\_\_\_

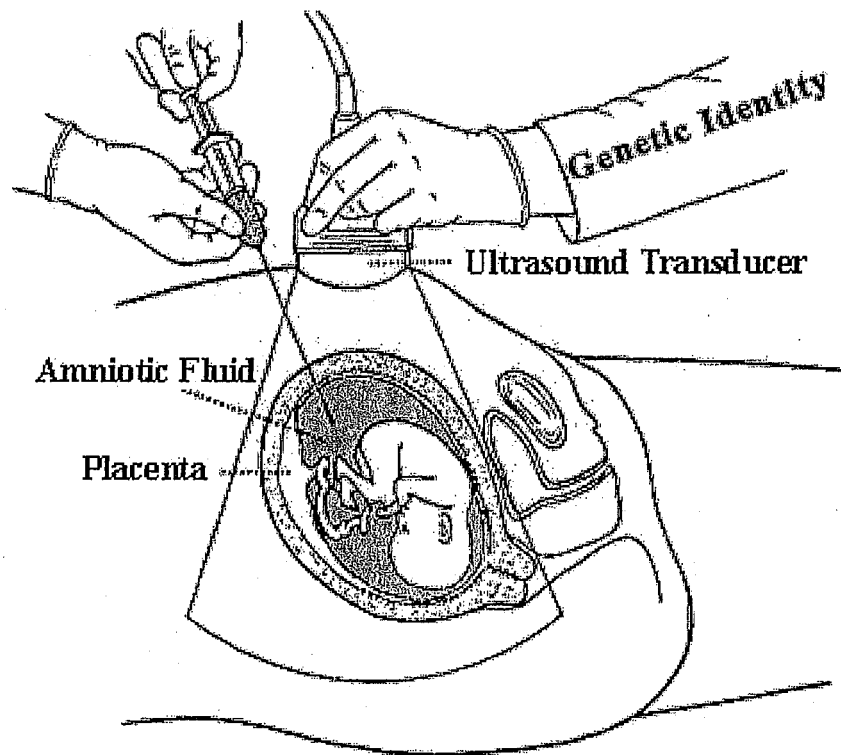
Disease	Mutation	Autosomal or Sex Linked?	Dominant Or Recessive?	How is body system(s) effected?	Shorter or Normal Life?
Huntington's Disease	Chromosome # _____				
Familial hyper- cholesterolemia	Chromosome # _____				
PKU	Chromosome # _____				
Sickle Cell Anemia	Chromosome # _____				
Cystic Fibrosis	Chromosome # _____				
Hemophilia	Chromosome # _____				
Duchenne Muscular Dystrophy	Chromosome # _____				

Teacher Check \_\_\_\_\_

## Detection:

In children & adults: \_\_\_\_\_ testing can be done to detect gene \_\_\_\_\_

In fetuses: Amniocentesis:



Here is a summary of the important facts and information related to amniocentesis:

- Amniocentesis is a relatively painless procedure that is performed in a doctor's office or hospital.
- A small amount of the amniotic fluid bathing a fetus is removed during amniocentesis to identify potential birth defects and many other problems.
- The procedure involves inserting a needle through the abdomen skin into the uterus to remove a sample of amniotic fluid. Ultrasound is used to determine the position of the fetus so that the needle can avoid the placenta and fetus.
- Amniocentesis is used to diagnose chromosome abnormalities, neural tube defects such as spina bifida, and many specific genetic and other abnormalities that may concern a family, usually because of a family history.
- Amniocentesis will diagnose the sex of the baby.
- Genetic amniocentesis increases the risk of miscarriage by less than 1% over the baseline risk for miscarriage.
- Doctors and genetic counselors typically recommend genetic amniocentesis when the statistical risk of an abnormal pregnancy exceeds the risk of miscarriage from the procedure.
- Many other studies of the fetus can be done with amniotic fluid obtained by amniocentesis in the second half of pregnancy. These include fetal infection, fetal lung maturity, and fetal anemia.

Provided by [YourMedicalSource.com](http://YourMedicalSource.com)

Last Reviewed: 2002 by William N. Spellacy, M.D.

## 9-2: The Structure of DNA

1) Who were James Watson and Francis Crick? \_\_\_\_\_

2) Identify the two pieces of information that enabled Watson and Crick to discover the double helical structure of DNA.

#1: \_\_\_\_\_

#2: \_\_\_\_\_

3) The two strands of a DNA molecule are said to be COMPLIMENTARY. Explain what this means.

4) **DNA Has the Structure of a Winding Staircase**

*In the space provided, write the letter of the description that best matches the term or phrase.*

\_\_\_\_\_ 1. double helix

\_\_\_\_\_ 2. nucleotides

\_\_\_\_\_ 3. deoxyribose

\_\_\_\_\_ 4. DNA

\_\_\_\_\_ 5. hydrogen bond

\_\_\_\_\_ 6. nitrogen base

\_\_\_\_\_ 7. adenine

\_\_\_\_\_ 8. cytosine

a. a five-carbon sugar

b. type of bond that holds the double helix together

c. one of three parts of a nucleotide made of one or two rings of carbon and nitrogen atoms

d. subunits that make up DNA

e. one of two pyrimidines used as a nitrogen base in nucleotides

f. one of two purines used as a nitrogen base in nucleotides

g. abbreviation for deoxyribonucleic acid

h. two strands of nucleotides twisted around each other

## 9-3 The Replication of DNA

1) Summarize the steps of DNA replication below.

Step #1: \_\_\_\_\_

Step #2: \_\_\_\_\_

Step #3: \_\_\_\_\_

2) Which special proteins help throughout the DNA replication process? \_\_\_\_\_

3) What is the effect of many replication forks on the speed of DNA replication? FASTER / SLOWER \_\_\_\_\_

4) A replication fork is \_\_\_\_\_

**10-1 From Genes to Proteins** (text pgs 206 – 209 ONLY)

1) Complete the table by checking the correct column for each statement.

	Statement	DNA	RNA
1.	Contains ribose		
2.	Composed of a double chain of nucleotides		
3.	Contains deoxyribose		
4.	Contains uracil		
5.	Contains thymine		
6.	Composed of a single chain of nucleotides		

- 2)
- |                                 |  |
|---------------------------------|--|
| _____ 1. ribonucleic acid (RNA) | a. the entire process by which proteins are made   |
| _____ 2. uracil                 | b. a molecule made of linked nucleotides   |
| _____ 3. transcription          | c. the process of reading instructions on an RNA molecule to put together the amino acids that make up a protein |
| _____ 4. translation            | d. the process of transferring a gene's instructions for making a protein to an RNA molecule                     |
| _____ 5. gene expression        | e. a nitrogen base used in RNA instead of the base thymine found in DNA  |

3) Define:

- a) mRNA: \_\_\_\_\_
- b) codon: \_\_\_\_\_
- c) transcription: \_\_\_\_\_
- d) translation: \_\_\_\_\_

4) Order the steps in translation from 1 to 8.

- \_\_\_\_\_ The tRNA anticodon recognizes the mRNA codon, and the two molecules join.
- \_\_\_\_\_ At the end of the mRNA strand there is a codon, for which no tRNA molecules have anticodons to match; therefore, translation stops.
- \_\_\_\_\_ An mRNA codon attaches to a ribosome.
- \_\_\_\_\_ Once the first and second amino acids are in place, they bond together; then, the first tRNA is released.
- \_\_\_\_\_ A tRNA molecule approaches, carrying its amino acid.
- \_\_\_\_\_ The second mRNA codon is joined by the proper tRNA molecule with its amino acid.
- \_\_\_\_\_ The process continues as the ribosome moves along the mRNA strand and a polypeptide chain grows.
- \_\_\_\_\_ The polypeptide chain breaks away from its assembly line.

Use the table below to complete items 1-3.

First base	Second base				Third base
	U	C	A	G	
<b>U</b>	UUU ] Phenylalanine	UCU ] Serine	UAU ] Tyrosine	UGU ] Cysteine	<b>U C A G</b>
	UUC ]	UCC ]	UAC ]	UGC ]	
	UUA ] Leucine	UCA ]	UAA ] Stop	UGA ] - Stop	
	UUG ]	UCG ]	UAG ]	UGG ] - Tryptophan	
<b>C</b>	CUU ] Leucine	CCU ] Proline	CAU ] Histidine	CGU ] Arginine	<b>U C A G</b>
	CUC ]	CCC ]	CAC ]	CGC ]	
	CUA ]	CCA ]	CAA ] Glutamine	CGA ]	
	CUG ]	CCG ]	CAG ]	CGG ]	
<b>A</b>	AUU ] Isoleucine	ACU ] Threonine	AAU ] Asparagine	AGU ] Serine	<b>U C A G</b>
	AUC ]	ACC ]	AAC ]	AGC ]	
	AUA ]	ACA ]	AAA ] Lysine	AGA ] Arginine	
	AUG ] - Start	ACG ]	AAG ]	AGG ]	
<b>G</b>	GUU ] Valine	GCU ] Alanine	GAU ] Aspartic acid	GGU ] Glycine	<b>U C A G</b>
	GUC ]	GCC ]	GAC ]	GGC ]	
	GUA ]	GCA ]	GAA ] Glutamic acid	GGA ]	
	GUG ]	GCG ]	GAG ]	GGG ]	

5) Complete the table below by using the codon chart above

DNA	a. _____	b. _____	GAT	c. _____
mRNA codon	d. _____	e. _____	f. _____	UAU
Amino acid	Tryptophan	j. _____	k. _____	l. _____

6) Translate the following mRNA sequence into an amino acid sequence...

A U G A A U U A U U G G C C U U G A

\_\_\_\_\_