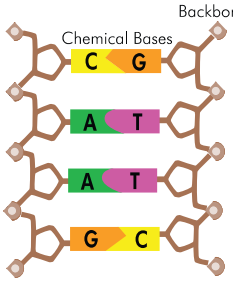
Name: _____ Date: _____

PART I: Have Your DNA and Eat It Too!

___
30

Background:



When isolated from a cell and stretched out, DNA looks like a twisted ladder. This shape is called a double helix. The sides of the DNA ladder are called the backbone and the steps (also called rungs) of the ladder are pairs of small chemicals called bases. There are four types of chemical bases in DNA: Adenine (A), Cytosine (C), Guanine (G), and Thymine (T). They form pairs in very specific ways: Adenine (A) always pairs with Thymine (T) and Cytosine (C) always pairs with Guanine (G).

Task: Using the materials below, you will construct an edible DNA model.

Materials for Each Student:

- 12 Toothpicks
- 2 Twizzlers
- 9 Green Marshmallows
- 9 Pink Marshmallows
- 5 Orange Marshmallows
- 5 Yellow Marshmallows

STEP 1:

A) Write the complimentary strand for both DNA sequences below:

Sequence 1: T A C G T A T G A A A C

Complimentary Strand: _____ _____

STOP! Get a check from your teacher

Sequence 2: T G G T T T A G A A T T

Complimentary Strand: _____

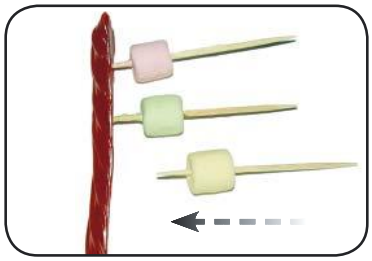
B) Choose EITHER sequence 1 or sequence 2. Draw a CIRCLE around sequence and complementary strand you choose. This will be the DNA molecule you will be modeling.

STEP 2:

A) The twizzlers will form the backbone of the DNA molecule and the marshmallows will be the nitrogenous bases.

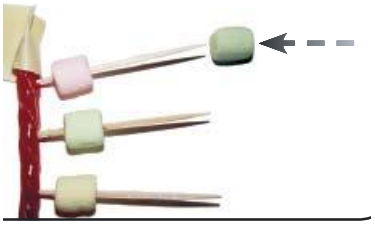
B) Assemble one strand (twizzler) of your DNA molecule.

a. Refer to the table to the right to choose the correct color marshmallow to represent the chemical bases in your sequence.



b. Place a marshmallow on the end of a toothpick so that the point of the toothpick goes all the way through. Stick the toothpick into the twizzler as pictured on the right. Do this for each base of your DNA strand.

C) When you have completed one DNA strand add the complimentary base pairs to the other end of each toothpick. **REMEMBER:** A always pairs with T and G always pairs with C!



D) Complete your DNA model by attaching the other DNA backbone (twizzler) so your model looks like a ladder

E) CAREFULLY twist your DNA model so it looks like a double helix

STOP! Get a check from your teacher

Conclusions Questions:

1. What does the shape of DNA resemble? _____

2. What is the shape of DNA called? _____

3. What are the sides of the DNA molecule called? _____

   What was used in this lab to act as the sides of DNA? _____

   There are 2 things that the sides of the DNA molecules consist of. What are they? _____ &

   _____

4. What acted as the DNA base pairs in this lab _____

5. Name the 4 bases of a DNA molecule:

6. Which DNA bases pair with each other?

7. How many of each base were in your molecule: A _____ T_____ G_____ C_____

8. What makes your DNA different from someone else's?

9. Given the following strand of DNA, write its complimentary base sequence below:

   a) DNA Sequence: A G C G C T A T C G C T A A T A G C A T

   Complimentary Strand: _____

   Without counting, how many thymines are there? _____ EXPLAIN below how you came up with this number

   b) What do you notice about the number of bases in the DNA sequence and the complimentary strand?

   c) How many total Adenines (A's) are there in the DNA sequence? (count both strands) _____ __

10. What does DNA stand for? _____

11. Where is DNA found in the cell? _____

12. What are the building blocks of DNA called? _____

Name the 3 parts that make up the building blocks of DNA: _____, _____ & _____

PART II: Reading DNA (EXTENSION)

STOP! Get a check from your teacher

The four chemical bases in DNA (A, C, G, and T) create a code. Cells "read" this DNA code to make proteins, the building blocks of all organisms. This is done in two steps:

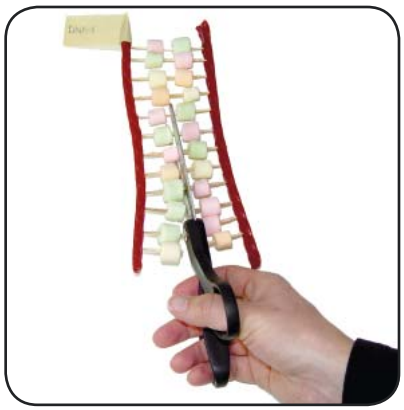
. Copying the directions – **Transcription**
. Reading the copy to string together the small molecules (amino acids) that make up a protein – **Translation.**

1. Making a Copy of DNA – Transcription

Cells read DNA in small portions **(genes)** to create a protein. To do this, the cell must first make a copy of the gene's code to send to the protein-building machinery. This process is called ***transcription.*** Using the following materials, follow the steps below to see how this is done.

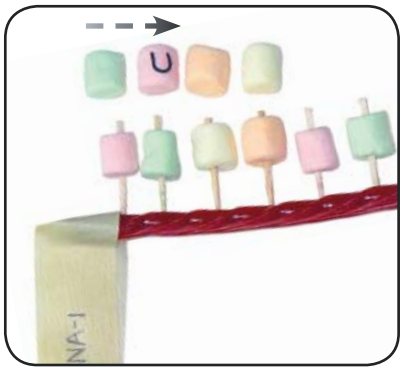
You will need:

Your licorice and marshmallow model of DNA
9 green marshmallows
9 yellow marshmallows
9 orange marshmallows
9 pink marshmallows labeled "U"
6 toothpicks broken or cut in half (12 half-toothpicks total)
1 piece black licorice



Step 1: Unzip your DNA. Cells copy only one side of the DNA ladder. In order to make this copy, the chemical bases forming the rungs of the DNA ladder must be separated.

- Cut or break in the middle the toothpicks in your model to separate the chemical bases and unzip the DNA ladder.
- Set the unlabeled backbone (with chemical bases attached) aside.



Step 2: Begin to form your mRNA strand. The exposed chemical bases of the unzipped DNA are used to make the copy. ***This copy is called messenger RNA (mRNA).*** The mRNA molecule is also made of a backbone and the same chemical bases as DNA. There is one exception however – instead of Thymine (T), mRNA uses Uracil (U). The chemical bases in mRNA form pairs in the same way as DNA:

Adenine (A) binds with Uracil (U)

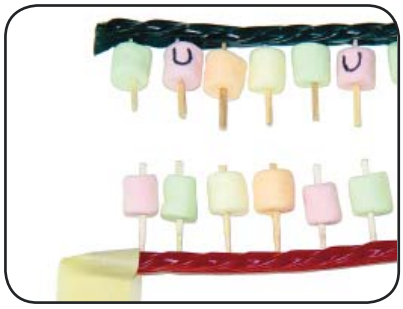
Guanine (G) binds with Cytosine (C).

Adenine (A) = Green

Uracil (U) = Pink

Cytosine (C) = Yellow

Guanine (G) = Orange



- Place your backbone labeled "DNA-1" or "DNA-2" (depending on which you used to make your model) in front of you.
- Follow the rules of base pairing to make your mRNA copy of the DNA code by lining up colored marshmallows with their appropriate match.

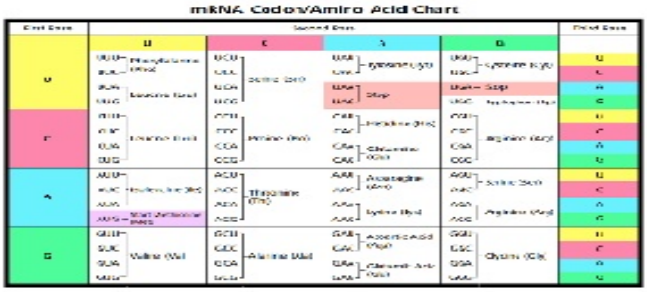
Step 3: The chemical bases of mRNA are also attached to a backbone as in DNA.

- Attach the new chemical bases to a piece of black licorice backbone using toothpicks cut or broken in half. This forms a new mRNA copy of your DNA strand.
- Label this new strand mRNA-1 or mRNA-2 *(the same number as your DNA strand)* on the left end of the backbone.

STOP! Get a check from your teacher

2. Reading a Copy of the DNA Instructions to Assemble a Protein – Translation

The mRNA copy of DNA is essentially a recipe for assembling a protein. Proteins are built from small molecules called amino acids. When the mRNA copy is sent to the protein-building machinery it is read and the appropriate amino acids are assembled. This process is called ***translation.*** Using the following list of materials, follow the steps below to see how this is done.



You will need:

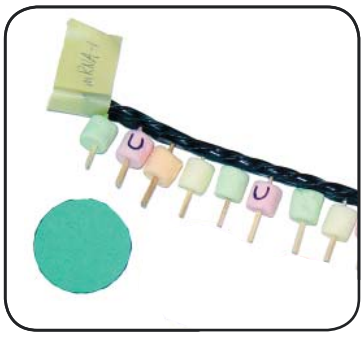
Your new mRNA strand
Your new mRNA strand
Two of each colored circle cut-out
Tape

mRNA Codon/Amino Acid Chart

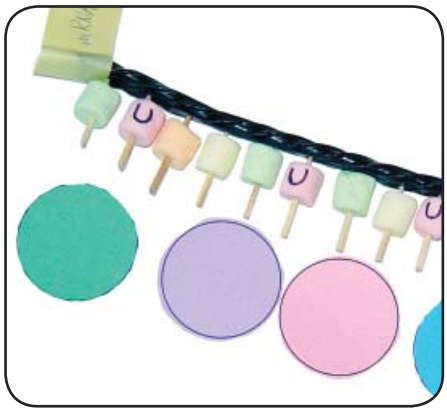
First Base	Second Base				Third Base
	U	C	A	G	
U	UUU, UUC – Phenylalanine (Phe) UUA, UUG – Leucine (Leu)	UCU, UCC, UCA, UCG – Serine (Ser)	UAU, UAC – Tyrosine (Tyr) UAA, UAG – Stop	UGU, UGC – Cysteine (Cys) UGA – Stop UGG – Tryptophan (Trp)	U C A G
C	CUU, CUC, CUA, CUG – Leucine (Leu)	CCU, CCC, CCA, CCG – Proline (Pro)	CAU, CAC – Histidine (His) CAA, CAG – Glutamine (Glu)	CGU, CGC, CGA, CGG – Arginine (Arg)	U C A G
A	AUU, AUC, AUA – Isoleucine (Ile) AUG – Start Methionine (Met)	ACU, ACC, ACA, ACG – Threonine (Thr)	AAU, AAC – Asparagine (Asn) AAA, AAG – Lysine (Lys)	AGU, AGC – Serine (Ser) AGA, AGG – Arginine (Arg)	U C A G
G	GUU, GUC, GUA, GUG – Valine (Val)	GCU, GCC, GCA, GCG – Alanine (Ala)	GAU, GAC – Aspartic Acid (Asp) GAA, GAG – Glutamic Acid (Glu)	GGU, GGC, GGA, GGG – Glycine (Gly)	U C A G

Step 1: Begin to create your protein. mRNA is read in groups of three chemical bases, called a ***codon***. Each group of three tells the cell which amino acid to assemble. In other words, each group of three is a "code" for a particular amino acid.

- Find a partner another group who has a ***different*** mRNA sequence (mRNA-1 or mRNA-2) than you do.



- Place both strands of mRNA end-to-end on the table in front of you, with the mRNA-1 strand on the left.
- Look at the fi rst 3 chemical bases on the left end of your mRNA strand.
- Use the Amino Acid Key above to determine which amino acid these 3 chemical bases code for.
- Cut out a circle from the last page, write the ***3 letter code name for the Amino Acid*** on the circle
    - *Example if your amino acid is Glycine, write "Gly"*
- Place this under the 3 chemical bases on your mRNA strand.



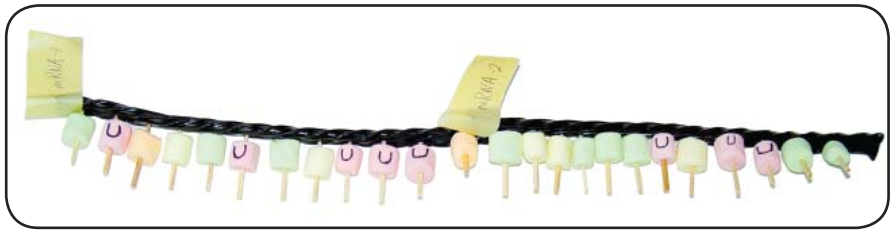
Step 2: Continue to create the protein.

- Repeat Step 1 for each group (or codon) of three chemical bases on the mRNA strand.
- When you have all of the appropriate amino acids lined up, *tape them together*. Now you have a protein!

Conclusion Questions:

1. Write the base sequence code to you mRNA-1 and mRNA-2 strand below:

a) mRNA Sequence:



b) draw a box around each group of 3 chemical bases which code for a protein *(show this above)*

c) Write the corresponding amino acid sequence below:

2. Cells read DNA in small portions (genes) to create a protein. To do this, the cell must first make a copy of the gene's code to send to the protein-building machinery. This process is called _____

3. a) When DNA "unzip's" to make the copy, this new copy is called: _____

b) The new copied strand is made of the same sugar phosphate backbone and the same chemical bases as DNA, but there is one exception, instead of Thymine (T), mRNA uses _____

4. Name the 4 chemical bases in mRNA and state which pair together:

5. The mRNA copy of DNA is essentially a recipe for assembling a protein. Proteins are built from small molecules called amino acids. When the mRNA copy is sent to the protein-building machinery it is read and the appropriate amino acids are assembled. This process is called _____