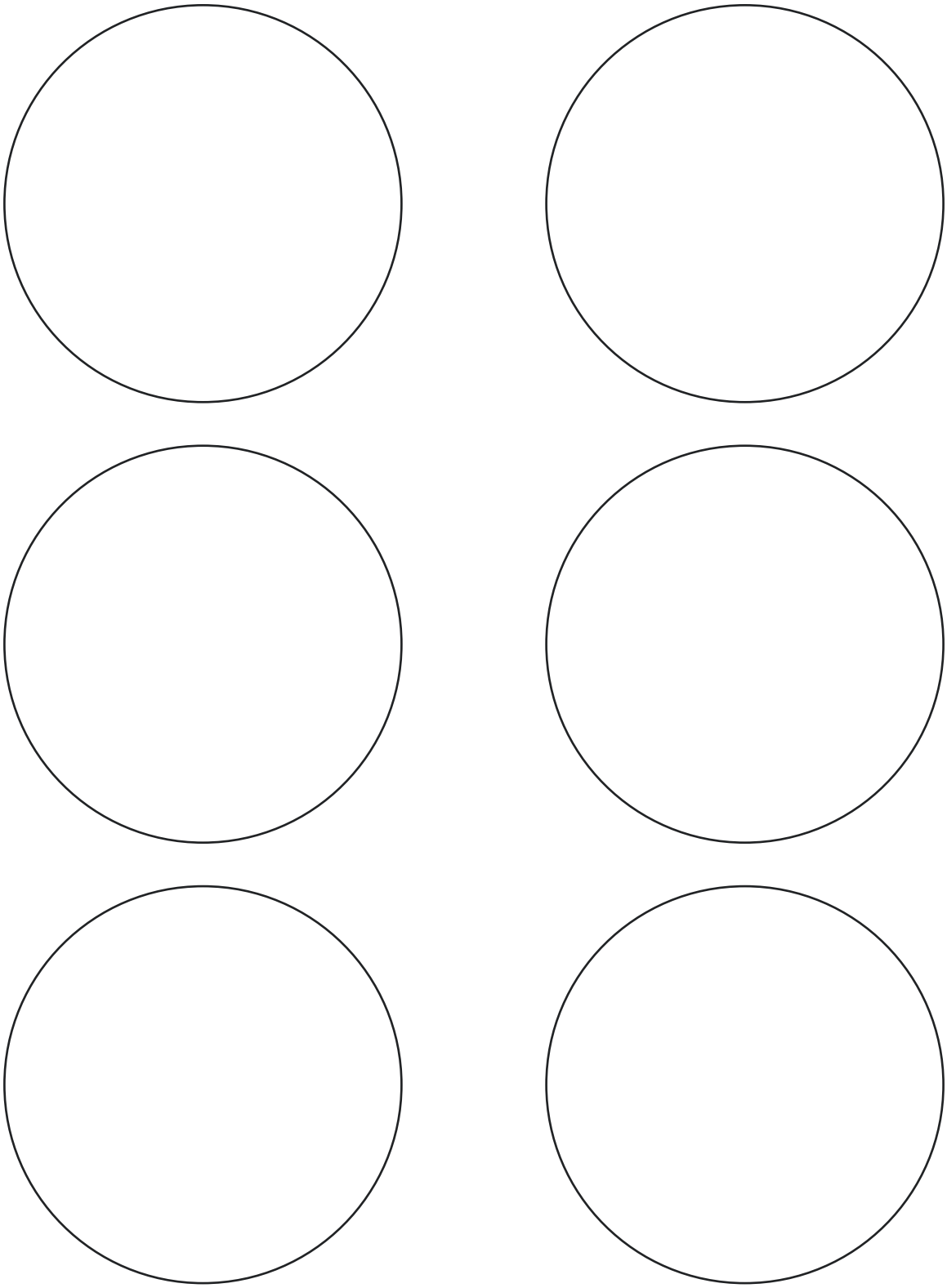
Teacher References: Reading DNA



Name _____ Date _____

Reading DNA

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:

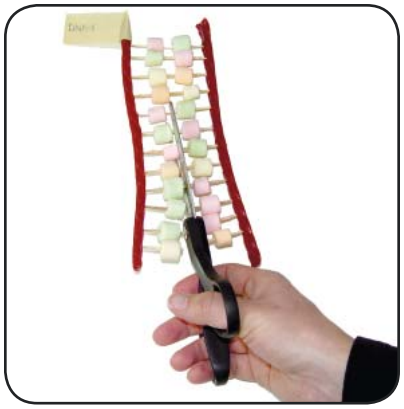
1. Copying the directions – **Transcription**
2. Reading the copy to string together the small molecules (amino acids) that make up a protein – **Translation**.

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

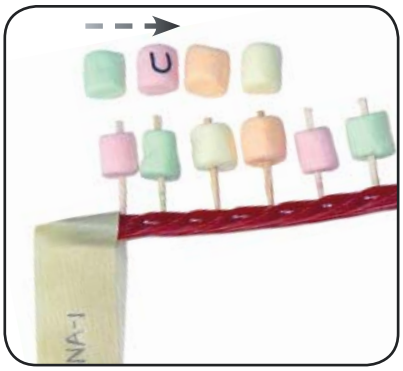


Step 1: Unzip your DNA. Cells copy only one side of the DNA ladder. In order to make this copy, the chemical bases forming the rungs of the DNA ladder must be separated.

- 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.

Name _____ Date _____

Reading DNA continued...



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).

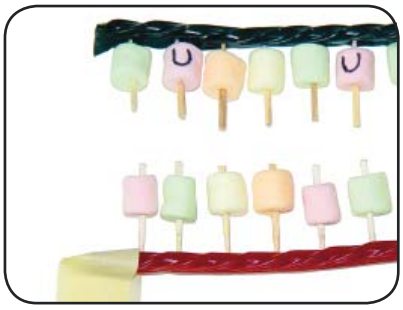
Adenine (A) = Green

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.

Reading DNA continued...

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:

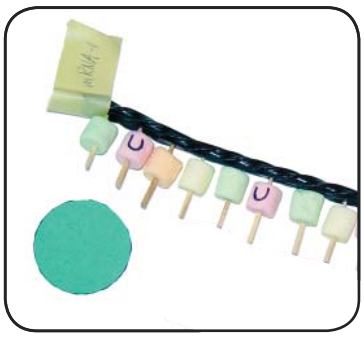
Your new mRNA strand
Two of each colored circle cut-out
Tape

AMINO ACID KEY

Code	AAA	ACC	ACU	AUG	CAU	UAA	UCU	UUG
Amino Acid	dark yellow	pink	pink	green (start)	purple	red (stop)	light yellow	blue

Step 1: Begin to create your protein. mRNA is read in groups of three chemical bases. 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 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 first 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.
- Place the colored circle cut-out representing that amino acid on the table directly below the three chemical bases.

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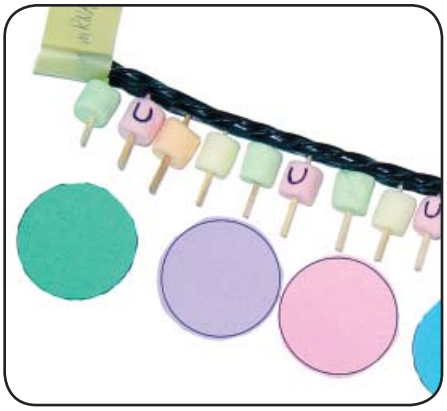
Reading DNA continued...



Step 2: Continue to create the protein.

- Repeat Step 1 for each group (or code) 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!

Extension: Find the name of each amino acid coded for above. An amino acid table is available on the next page.

For example:

AAA codes for the amino acid called _____.

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Reading DNA continued...

THE GENETIC CODE:

First base in mRNA triplet	Second base in mRNA triplet	Choices for third base in mRNA triplet	Amino Acid Encoded
A	A	A	Lysine
		G	
		C	Asparagine
		U	
	G	A	Arginine
		G	
		C	Serine
		U	
	C	A	Threonine
		C	
		G	
		U	
	U	A	Isoleucine
		G	Methionine
		C	Isoleucine
		U	
G	A	A	Glutamic acid
		G	
		C	Aspartic acid
		U	
	G	A	Glycine
		G	
		C	
		U	
	C	A	Alanine
		G	
		C	
		U	
	U	A	Valine
		G	
		C	
		U	
C	A	A	Glutamine
		G	
		C	Histidine
		U	
	G	A	Arginine
		G	
		C	
		U	
	C	A	Proline
		G	
		C	
		U	
	U	A	Leucine
		G	
		C	
		U	
U	A	A	Stop
		G	
		C	Tyrosine
		U	
	G	A	Stop
		G	Tryptophan
		C	Cysteine
		U	
	C	A	Serine
		G	
		C	
		U	
	U	A	Leucine
		G	
		C	Phenylalanine
		U	