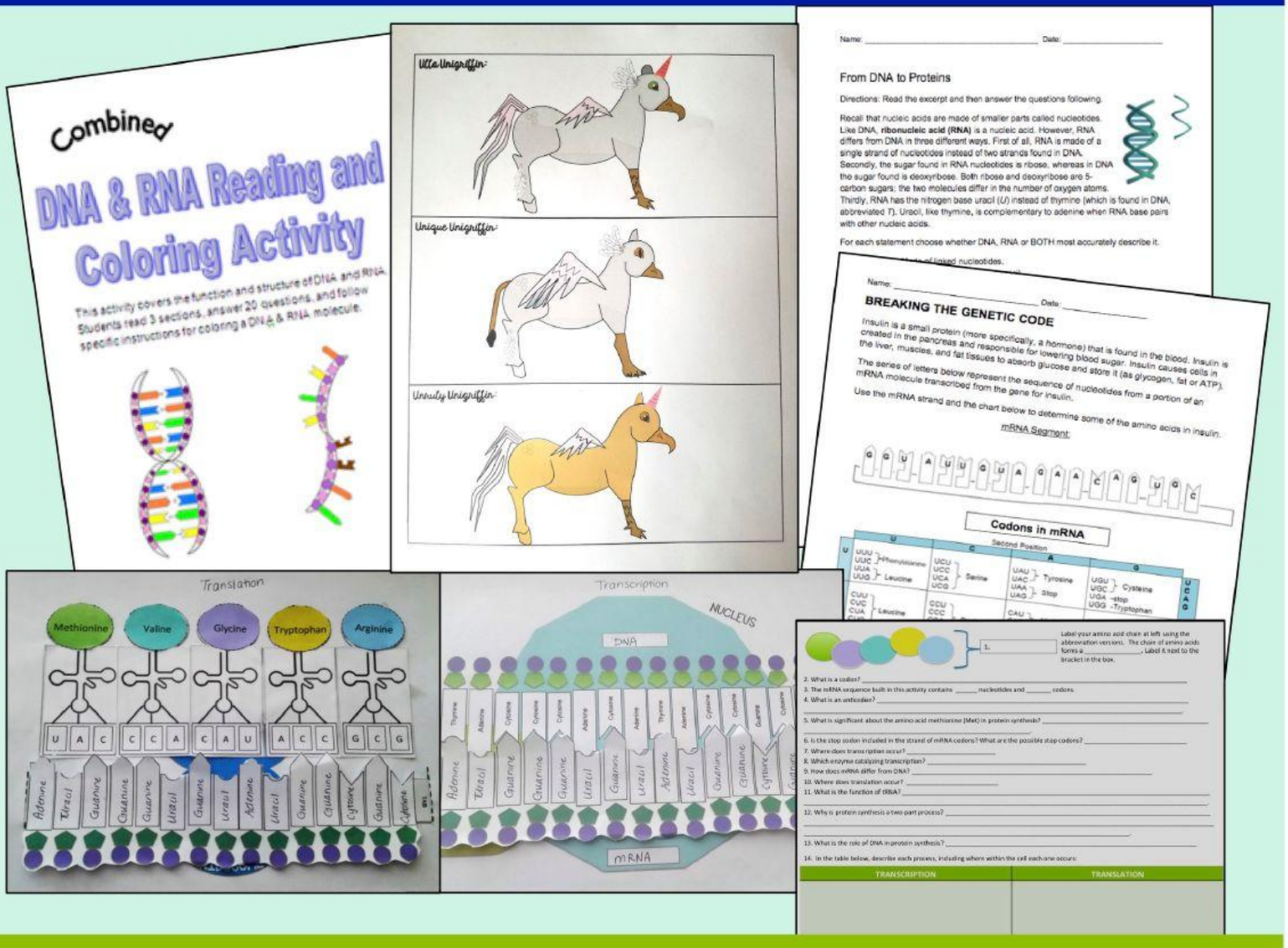
protein synthesis activity bundle



ACTIVITY PACKAGE CONTAINING 1 COLORING ACTIVITY, 1 PAPER LAB, 3 WORKSHEETS, AND 1 CUT AND PASTE THAT CAN BE USED FOR ISN.

SCAFFOLDED TRANSCRIPTION AND TRANSLATION PRACTCE

Name: _____ Date: _____ Per: ____

Practice Problems: Decoding the Genetic Code

Directions: Create the complementary mRNA strand using the given DNA strand. Then, using the charts below, decode the mRNA into the correct amino acids. Use your amino acid sequence to figure out which protein the DNA codes for.

AMINO ACID CHART

First position (5'end)	Second Position U	Second Position C	Second Position A	Second Position G	
U	UUU, UUC: Phenylalanine; UUA, UUG: Leucine	UCU, UCC, UCA, UCG: Serine	UAU, UAC: Tyrosine; UAA, UAG: Stop	UGU, UGC: Cysteine; UGA: -stop; UGG: -Tryptophan	U C A G
C	CUU, CUC, CUA, CUG: Leucine	CCU, CCC, CCA, CCG: Proline	CAU, CAC: Histidine; CAA, CAG: Glutamine	CGU, CGC, CGA, CGG: Arginine	U C A G
A	AUU, AUC, AUA: Isoleucine; AUG: Methionine	ACU, ACC, ACA, ACG: Threonine	AAU, AAC: Asparagine; AAA, AAG: Lysine	AGU, AGC: Serine; AGA, AGG: Arginine	U C A G
G	GUU, GUC, GUA, GUG: Valine	GCU, GCC, GCA, GCG: Alanine	GAU, GAC: Asparagine; GAA, GAG: Glutamic Acid	GGU, GGC, GGA, GGG: Glycine	U C A G

strand: TAT GGT GAT GTG TAG

rand: _____

quence: _____

otein does the DNA strand code for? _____

strand: AAC GGT CCA TGG CAG

rand: _____

quence: _____

otein does the DNA strand code for? _____

strand: GCG GTG AAG TTG CGC

rand: _____

quence: _____

otein does the DNA strand code for? _____

strand: GCC GTT AAT TTC CGA

rand: _____

_____

_____

ode for? _____

Name: _____ Date: _____

BREAKING THE GENETIC CODE

Insulin is a small protein (more specifically, a hormone) that is found in the blood. Insulin is created in the pancreas and responsible for lowering blood sugar. Insulin causes cells in the liver, muscles, and fat tissues to absorb glucose and store it (as glycogen, fat or ATP).

The series of letters below represent the sequence of nucleotides from a portion of an mRNA molecule transcribed from the gene for insulin.

Use the mRNA strand and the chart below to determine some of the amino acids in insulin.

mRNA Segment:



Codons in mRNA

First position (5'end)	Second Position U	Second Position C	Second Position A	Second Position G	
U	UUU, UUC: Phenylalanine; UUA, UUG: Leucine	UCU, UCC, UCA, UCG: Serine	UAU, UAC: Tyrosine; UAA, UAG: Stop	UGU, UGC: Cysteine; UGA: -stop; UGG: -Tryptophan	U C A G
C	CUU, CUC, CUA, CUG: Leucine	CCU, CCC, CCA, CCG: Proline	CAU, CAC: Histidine; CAA, CAG: Glutamine	CGU, CGC, CGA, CGG: Arginine	U C A G
A	AUU, AUC, AUA: Isoleucine; AUG: Methionine	ACU, ACC, ACA, ACG: Threonine	AAU, AAC: Asparagine; AAA, AAG: Lysine	AGU, AGC: Serine; AGA, AGG: Arginine	U C A G
G	GUU, GUC, GUA, GUG: Valine	GCU, GCC, GCA, GCG: Alanine	GAU, GAC: Asparagine; GAA, GAG: Glutamic Acid	GGU, GGC, GGA, GGG: Glycine	U C A G

Analysis

1. Translate the mRNA segment into an amino acid sequence:

_____

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Analysis

1. Translate the mRNA segment into an amino acid sequence:

_____

2. Determine the 6 tRNA anticodons that will bind to the mRNA molecule:

_____

3. Before translation occurs, transcription must occur. Recall that transcription is the formation of an mRNA molecule from a DNA template strand. Determine the sequence of nucleotide bases of the DNA strand that the mRNA molecule was transcribed.

_____

4. Suppose that there was a point mutation in the DNA segment described above. What would happen if the third nucleotide were changed from an *A* to a *C*. Do you think this mutation would have any negative effects on the insulin protein?

_____

_____

_____.

5. Suppose there was yet another point mutation in the DNA strand- except this was in a different location. What would happen if the 8th nucleotide base was

Name: _____ Date: _____

From DNA to Proteins

Directions: Read the excerpt and then answer the questions following.



Recall that nucleic acids are made of smaller parts called nucleotides. Like DNA, **ribonucleic acid (RNA)** is a nucleic acid. However, RNA differs from DNA in three different ways. First of all, RNA is made of a single strand of nucleotides instead of two strands found in DNA. Secondly, the sugar found in RNA nucleotides is ribose, whereas in DNA the sugar found is deoxyribose. Both ribose and deoxyribose are 5-carbon sugars; the two molecules differ in the number of oxygen atoms. Thirdly, RNA has the nitrogen base uracil (*U*) instead of thymine (which is found in DNA, abbreviated *T*). Uracil, like thymine, is complementary to adenine when RNA base pairs with other nucleic acids.

For each statement choose whether DNA, RNA or BOTH most accurately describe it.

1. _____ Made of linked nucleotides.
2. _____ Contains the nitrogen base uracil
3. _____ Consists of a single strand of nucleotides
4. _____ Contains a 5-carbon sugar
5. _____ Contains ribose
6. _____ Is a nucleic acid
7. _____ Consists of a double strand of nucleotides
8. _____ Contains a base that pairs with adenine
9. _____ Contains deoxyribose



Fill in the blanks with the word that best completes the analogy.

10. DNA is to *T* as RNA is to _____
11. DNA is to deoxyribose as RNA is to _____.

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T GGT GAT GTG TAG

_____

_____

DNA strand code for? _____

C GGT CCA TGG CAG

_____

_____

DNA strand code for? _____

G GTG AAG TTG CGC

_____

_____

DNA strand code for? _____

C GTT AAT TTC CGA

_____

_____

DNA strand code for? _____

PROTEIN SYNTHESIS PAPER LAB & DNA VS. RNA READING + COLORING

Name: _____ Date: _____

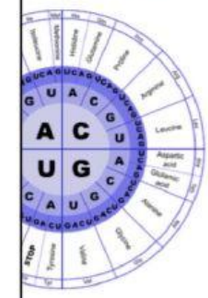
How DNA Determines Traits

A distant alien planet similar to earth has been discovered. The most popular species on the planet are called "unigriffins"- which are some hybrid of birds, lions, and unicorns. Scientists have recently obtained DNA samples and have mapped out 10 genes so far.

Your job as science students is to analyze the DNA sequences of the unigriffin samples to determine which features each sample codes for. Determine which traits each type of unigriffin has by decoding the DNA. There are a total of 10 genes, which could be two possible versions.

Gene	Amino Acid Sequence	Description
Gene 1- ear shape	val - ser - leu	Rounded ears like a lion
	val - ser - lys	Pointed ears like a horse
Gene 2- wings	tyr - pro - glu - glu - lys	Long wings
	val - pro - thre - glu - lys	Short wings
Gene 3- front legs	leu - leu - leu - pro	Scaled front legs with claws (bird-like)
	leu - leu - ser - ala	Furry front legs with claws (lion-like)
Gene 4- beak	ala - val - val	Short pointy beak
	val - ala - ala	Long curved beak
Gene 5- body color	his - iso	tan
	his - his	gray
Gene 6- eye color	ser - pro - val	Green eyes
	val - phe - tyr	Brown eyes
Gene 7- eye pupil	asp - iso - leu - leu - pro - thre	Vertical pupils like a bird
	asp - iso - pro - pro - pro - thre	Round pupils like a mammal
Gene 8- unicorn horn	val - asp - asp - ala	Unicorn horn present
	asp - asp - asp - ala	Unicorn horn not present
Gene 9- feathers on body	phe - ser - gly	Feathers present around head and hind legs
	phe - phe - gly	Feathers not present on body
Gene 10- tail	arg - tyr - cys - lys	Horse like tail (short tail bone; long hair)
	arg - arg - asp - thre	Lion tail (long tail bone; short hair)

Before you can decode the DNA samples you must FIRST transcribe the DNA to its complimentary mRNA strand. Using the mRNA codons, you can configure the amino acids to determine the traits.
AUG is a start codon, and it signals the beginning of each gene. UAA is a stop codon and signals the end of a gene. Though these start and stop codes would typically be seen at the start and end of *each and every gene*, to save [illegible] translated for us.
[illegible] back and translate the amino acids, and lastly determine traits.



G CTT CTT TTT | GAG AAT TCA CGC |

| CAA AAA ATG | TTA TAG AAT GAC GGG T

AGA CCT | GCA GCC TTG TGT |

TGA CTT TTC | GAA GAG GAG GGG |

GA CTT TTT | AAT AAT GAC GGG |

AGA GGG CAT | TTG TAA GGA GGG GGG TGT |

CAT AAA ATA | TTG TAA GGA G

AAA CCA | GCT ATG ACA TTT |

A CCC | GCC ATA ACA TTT |

Name: _____ Date: _____

Deoxyribonucleic Acid

As we have learned, the nucleus of the cell is analogous to the control center of the cell because it is responsible for most of the cell's functions. The nucleus is a small, spherical, membrane-bound organelle found in all eukaryotic cells. It contains chromosomes, which are thread-like structures comprised of a mixture of proteins and genes. A gene is a segment of D.N.A. that codes for a specific trait.

D.N.A. (deoxyribonucleic acid). D.N.A is the chemical that controls your cells because it is responsible for the production of proteins. Your entire body is made out of proteins. What the proteins are like depends on the sequence of D.N.A. So in other words, your hair, your skin, your nails, even your muscles and blood type all depend on your D.N.A. sequence, which is found in the nucleus of your cells (it is also found in the mitochondria, but it is only the D.N.A in the nucleus that controls the cell).

D.N.A is a nucleic acid composed of smaller units called nucleotides. A nucleotide is a monomer consisting of one sugar attached to a phosphate group and a nitrogen base. In D.N.A, the sugar found in the nucleotides is called deoxyribose (hence the "D" in D.N.A.). Deoxyribose is a sugar containing 5 carbon atoms.

In 1953, James Watson and Frances Crick (with the help of Rosalind Franklin) determined that the shape of D.N.A was a double helix. Meaning there are two strands of DNA (double) that are twisted in a circular pattern (helix). Imagine a twisted ladder. The sides of the ladder are made up of linked sugar and phosphate molecules, which is known as the "sugar-phosphate backbone" of D.N.A. **Color all the deoxyribose molecules purple (dark purple, medium purple will do)** ⬠ **Color all the phosphates pink** ◯

The rungs (steps) of the ladder are the nitrogen bases. The nitrogen bases follow specific "base-pairing rules", which means that adenine will only pair with thymine, and vice versa, and that guanine will only pair with cytosine, and vice versa. The nitrogen bases bond using hydrogen bonds, which are the weakest type of chemical bond; it is necessary that the bonds break apart during DNA replication. During replication DNA unzips itself, breaking the hydrogen bonds in the process. DNA replication occurs right before cell division so that new cells have a copy of DNA, too. Adenine and thymine share two hydrogen bonds, whereas cytosine and guanine share three hydrogen bonds.

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In addition, guanine and adenine are bigger than thymine and cytosine. They are classified as purines (double ring structure); thymine and cytosine are classified as pyrimidines (single ring structure).

color guanine green

color cytosine yellow

[illegible] hymine blue

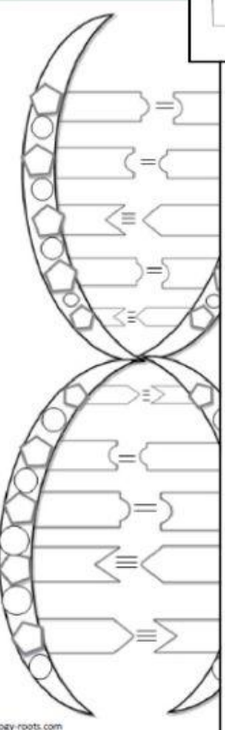
[illegible] and composition differ in
[illegible] important? We know that
[illegible] ains a sequence that is
[illegible] uences, which code for many
[illegible] in your skin, hair and nails.
[illegible] uld have such as color and
[illegible] s regard, DNA is just like a

[illegible] s and it has to be cracked...
[illegible] uld be through the tiny holes
[illegible] e messenger RNA (mRNA)
[illegible] osed of a single strand of
[illegible] essentially half the size of
[illegible] d enzyme, it reads the DNA's
[illegible] mplementary nucleotides.
[illegible] DNA and RNA. RNA does
[illegible] base called uracil. Uracil

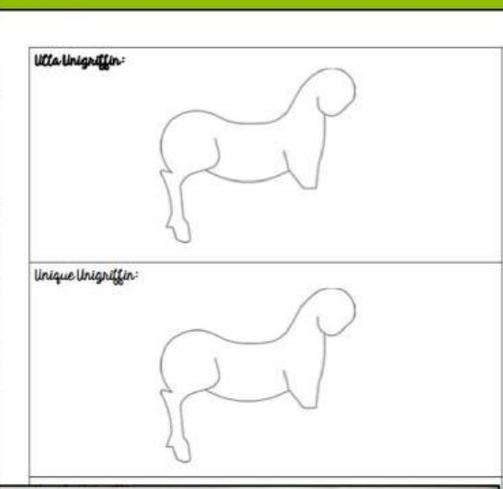
[illegible] deliver the DNA's "code" to
[illegible] ell (outside the nucleus). This
[illegible] s are where all those

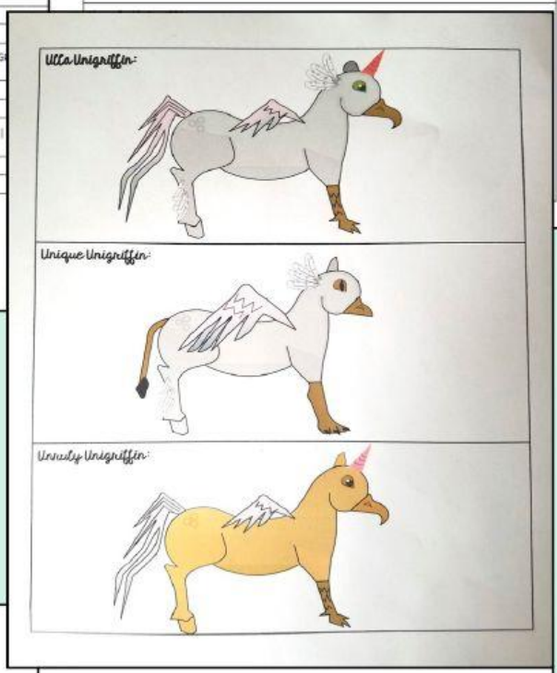
[illegible] PT

[illegible] BROWN

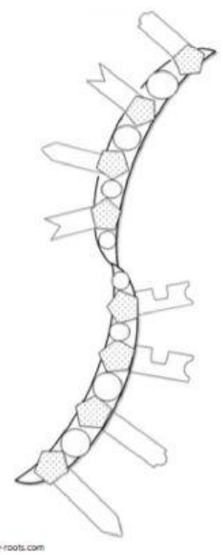


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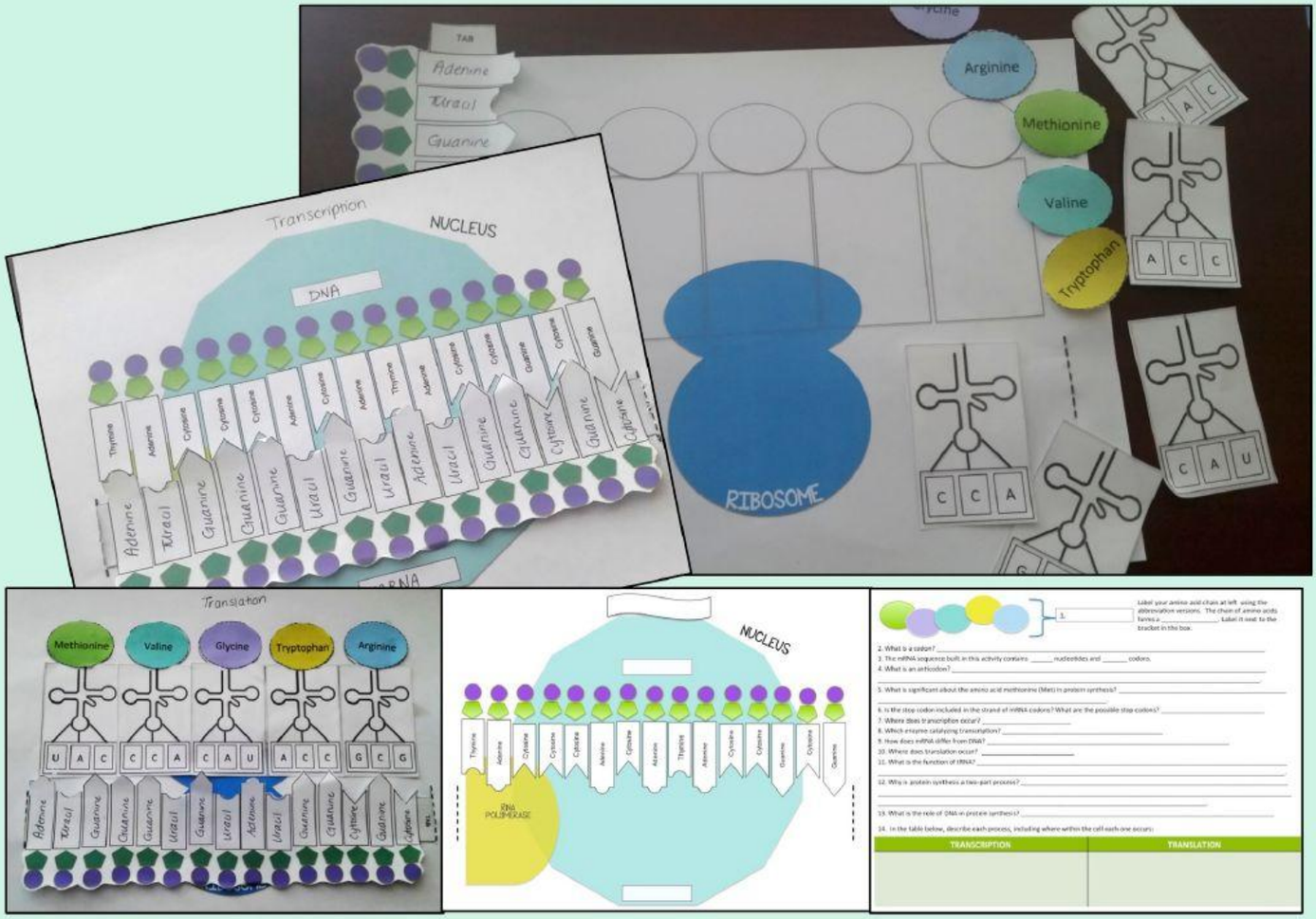


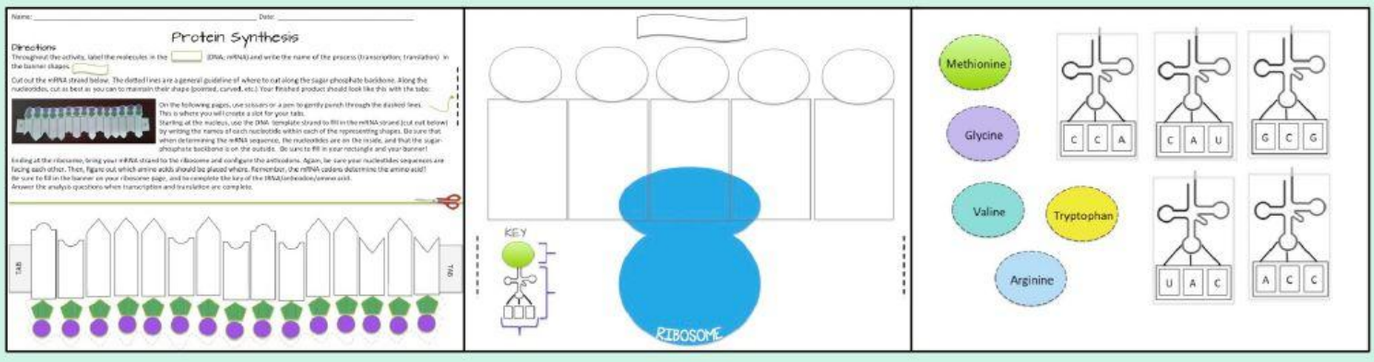
RNA



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PROTEIN SYNTHESIS CUT AND PASTE MODEL





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