Good afternoon! Here are the assignments for Week 2. Please let me know what help or clarification you need. These assignments build on Week 1's assignments and will wrap up our Genetics section. As last week's assignments I will be taking these for a grade. You can turn these in as you finish them via email. Hope everyone is staying well!

To explain a little bit of each paper read below. Everything got scanned 1 sided so there are actually five assignments for the week. Let me know what other clarification I can provide!

1. The paper labeled "Extension" in the top left is an explanation of how to turn the mRNA message into the amino acids that bond together with peptide bonds to form a protein.
2. Breaking the Code is further practice/application of the "Extension" paper. Use the codon chart from the "Extension" to help you find the polypeptide (protein). Be sure to use the mRNA strand from transcription to find the proper amino acid (DO NOT use the tRNA strand...it's a common mistake)
3. The paper labeled "Determining the Traits of a Mystery Organism...." is a way to show you how transcription/translation are connected to genes and phenotypes. Below is how to complete Gene A to help you with the other traits. DNA: ACC GGT TAT mRNA: UGG CCA AUA
tRNA: ACC GGU UAU Amino Acid sequence (use the chart at the top of the previous page and the mRNA sequence): UGG-Tryptophan, CCA-Proline, AUA-Isoleucine Trait (use the chart at bottom of previous page to look for the sequence of amino acids you just found): Walks upright on two legs
So you know when you draw to the best of your ability your creature it's going to walk upright.
4. The paper labeled "Protein Synthesis Simulation" lets you "act" out being a protein. When it says start at the nucleus, pick a spot to write the opposite strand of DNA from this sequence:
A T G C C C C C G G C A G C C G C G T A G
Use the new strand of DNA you just wrote (replicated) to find the mRNA strand.
When it says go to one of the ribosomes, ignore step 3 on your paper it's not necessary, just move to another spot in your house (taking your paper with you) and divide your strand of letters into sets of three (A U G and then so on). Use the "tRNA card with words" sheet to help you find the "amino acids".
As the directions say you should end up with an actual sentence that makes sense at the end of the activity. Write this sentence down and do the conclusion questions.
5. The "Summary Questions" are self-explanatory for the most part and are like a quiz review. Let me know if you need help with 8, 10, 11 or 12 especially. Those are the trickiest.
Finally it's not written on a paper but get outside and enjoy the warm weather and sunshine when it's available. Biology is all around you! :).

email: heather.desguin@crooksville.k12.oh.us
Google Classroom: Students signed in the first weeks of school, but email me if need the code to join
Remind: remind.com/join/mrsdesg or text @mrsdesg to the number 81010

Extension: **Genes and traits**	Get the Gizmo ready: • You will not need to use the Gizmo for this activity.	

Introduction: Inside a ribosome, amino acids are linked together to form a protein molecule. As the chain of amino acids grows, it folds and coils to form a three-dimensional shape. The complex shape that results determines the properties of the protein. Proteins have a wide variety of structures and perform many essential functions in living things.

A sequence of DNA that codes for a specific protein is called a **gene**. By coding for proteins, genes determine an organism's inherited traits.

Question: How do genes code for specific proteins and traits?

1. Translate: Each codon codes for one of 20 amino acids. This code is universal among all living things. For example, the mRNA codon GGU codes for the amino acid glycine in every living thing, from a bacteria to an elephant.

   Examine the codon chart below. The amino acid coded for by a specific mRNA codon can be determined by finding the first base of the codon along the left side of the table, the second base along the top of the table, and the third base along the right side of the table.

Second base

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

What amino acids do the following codons code for?

AUG: _____ CUG: _____ ACC: _____ UAG: _____

(Extension continued on next page)

Extension (continued from previous page)

2. Apply: Suppose you wanted a protein that consists of the amino acid sequence methionine, asparagine, valine, and histidine. Give an mRNA sequence that would code for this protein.

   ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___

3. Summarize: How do genes determine the traits of an organism? Explain in detail.

   _____

   _____

   _____

   _____

   _____

4. Extend your thinking: Sometimes errors occur during transcription or translation. Examine the codon chart on the previous page. Notice that each amino acid is coded for by several different codons. For example, alanine is coded for by GCU, GCC, GCA, and GCG.

   How might this offset transcription or translation errors? _____

   _____

   _____

BREAKING THE CODE

REPLICATION

For each of the three DNA sequences below, write the sequence of the complementary strand of DNA that results after replication.

DNA molecule #1: TACCGGATGCCAGATCAAATC

Complementary DNA #1_____

DNA molecule #2: TACGGGGGCGTAACCACAACT

Complementary DNA #2_____

DNA molecule #3: TACCTGTTAAGCTACAAAATT

Complementary DNA #3_____

TRANSCRIPTION

For each of the same DNA sequences below, write the sequence of messenger RNA codons that is synthesized during transcription. Be sure to separate the codons into ***triplets***.

DNA molecule #1: TACCGGATGCCAGATCAAATC

mRNA #1 _____

DNA molecule #2: TACGGGGGCGTAACCACAACT

mRNA #2_____

DNA molecule #3: TACCTGTTAAGCTACAAAATT

mRNA #3_____

TRANSLATION

For each of the mRNA codon sequences you have written, determine the sequence of tRNA anticodons that match it.

Anticodons for mRNA #1: _____

Anticodons for mRNA #2: _____

Anticodons for mRNA #3: _____

Using the chart below, write the amino acid sequence coded for by each mRNA. (Note: The code is based on mRNA codons, not tRNA anticodons.)

Polypeptide #1: _____

Polypeptide #2: _____

Polypeptide #3: _____

The Genetic Code

(Based on Messenger RNA Codons)

First Base	Second Base: U	Second Base: C	Second Base: A	Second Base: G	Third Base
U	Phenylalanine	Serine	Tyrosine	Cysteine	U
	Phenylalanine	Serine	Tyrosine	Cysteine	C
	Leucine	Serine	Stop	Stop	A
	Leucine	Serine	Stop	Tryptophan	G
C	Leucine	Proline	Histidine	Arginine	U
	Leucine	Proline	Histidine	Arginine	C
	Leucine	Proline	Glutamine	Arginine	A
	Leucine	Proline	Glutamine	Arginine	G
A	Isoleucine	Threonine	Asparagine	Serine	U
	Isoleucine	Threonine	Asparagine	Serine	C
	Isoleucine	Threonine	Lysine	Arginine	A
	start Methionine	Threonine	Lysine	Arginine	G
G	Valine	Alanine	Aspartic acid	Glycine	U
	Valine	Alanine	Aspartic acid	Glycine	C
	Valine	Alanine	Glutamic acid	Glycine	A
	Valine	Alanine	Glutamic acid	Glycine	G

Determining the Traits of a "Mystery Organism" Through Protein Synthesis

Introduction:

Genes determine what characteristics an organism will have. Genes are segments of DNA molecules that are the instructions for building the proteins of the cell. The sequence of nucleotides in DNA determines the sequence of amino acids in the proteins. In a process called transcription, which takes place in the nucleus of the cell, messenger RNA (mRNA) is transcribed from DNA and carries the instructions for how to make certain proteins. These instructions must be taken to the ribosomes where proteins are made. mRNA carries the instructions from the nucleus to the ribosomes. Once at the ribosome, transfer RNA (tRNA) reads the message, gathers the necessary amino acids, and brings them to the ribosome. The amino acids are lined up, and connected together by peptide bonds to form a protein. This process is known as translation.

In this lab, you will be creating a "mystery organism." You must determine which proteins must be made to produce your mystery organism. You will be simulating the process of protein synthesis to determine the traits this organism will inherit. Your mystery organism belongs to the Animal Kingdom. It is made up of 6 different genes (A, B, C, D, E, and F). Each of these genes is responsible for a certain trait.

Purpose:

1. To see how the genes on a chromosome determine the characteristics of an organism.
2. To simulate transcription and translation from a DNA template.

Materials: Colored Pencils and Paper

Safety Precautions: None

Procedure:

1. Look at the boxes in the data table. You have been given the DNA sequence of 6 different genes that compose a mystery organism. From the DNA sequence given, determine the mRNA codons, the tRNA anticodons, the amino acid sequence, and the trait (protein) made by linking those amino acids.

2. To determine what traits your mystery animal has, fill in the boxes in the data table.

3. To determine the amino acid sequence, refer to the list below. This list contains all codons and their amino acid sequence.

   There are 20 different amino acids. A combination of many different amino acids composes different types of proteins. One amino acid is called for by one codon. A codon is a sequence of three nitrogen bases. There are 64 possible combinations of bases (codons), but only 20 amino acids. Several codons may be used to call for the same amino acid.

Amino Acid	Codons for this Amino Acids
Alanine	GCA, GCC, GCG, GCU
Arginine	AGA, AGG, CGA, CGC, CGG, CGU
Asparagine	AAC, AAU
Aspartic Acid	GAC, GAU
Cysteine	UGC, UGU
Glutamic Acid	GAA, GAG
Glutamine	CAA, CAG
Glycine	GGA, GGC, GGG, GGU
Histidine	CAC, CAU
Isoleucine	AUA, AUC, AUU
Leucine	UUA, UUG, CUA, CUC, CUG, CUU
Lysine	AAA, AAG
Methionine - Start	AUG
Phenylalanine	UUC, UUU
Proline	CCA, CCC, CCG, CCU
Serine	AGC, AGU, UCA, UCC, UCG, UCU
Threonine	ACA, ACC, ACG, ACU
Tryptophan	UGG
Tyrosine	UAC, UAU
Valine	GUA, GUC, GUG, GUU
Stop Codons	UAA, UAG, UGA

4. To determine what traits are present in your mystery organism, refer to the table below. Use the amino acid sequences from your data table to determine what characteristic is being called for.

AMINO ACID SEQUENCE	TRAIT
Alanine – Histidine – Lysine	Walks on four legs
Proline – Serine – Phenylalanine – Glycine	Freckles
Tryptophan – Proline – Isoleucine	Walks upright on two legs
Serine – Tryptophan – Lysine	Small purple ears
Cysteine – Alanine	Blue hair, very hairy
Arginine – Histidine – Threonine	Yellow eyes
Histidine – Valine	Very little red hair
Alanine – Glycine – Proline – Serine	No Freckles
Serine – Lysine	Short orange nose
Lysine – Leucine	Long red nose
Tyrosine – Isoleucine – Aspartic Acid	Blue eyes
Proline – Alanine – Alanine	Green elephant ears

Data Table:

GENE A	GENE B	GENE C
DNA: ACC GGT TAT	DNA: ACG CGA	DNA: TTT AAC
mRNA:	mRNA:	mRNA:
tRNA:	tRNA:	tRNA:
Amino Acid Sequence:	Amino Acid Sequence:	Amino Acid Sequence:
Trait:	Trait:	Trait:

GENE D	GENE E	GENE F
DNA: GGA CGC CGA	DNA: GGG AGG AAA CCC	DNA: GCT GTG TGC
mRNA:	mRNA:	mRNA:
tRNA:	tRNA:	tRNA:
Amino Acid Sequence:	Amino Acid Sequence:	Amino Acid Sequence:
Trait:	Trait:	Trait:

OBSERVATION QUESTIONS:

1. Distinguish between transcription and translation.
2. Where does transcription take place? Where does translation take place?
3. How does the ribosome know which proteins to make and how to make them?
4. List the steps in protein synthesis.
5. What is the importance of the "start" and "stop" codons?
6. List 5 different kinds of proteins that might be made by the ribosomes.
7. Distinguish between a codon and an anticodon.
8. Random mutations may occur that cause a change in the order of nitrogen bases in a codon. One type of mutation involves the substitution of one of the nitrogen bases in a codon. Explain the effect of a substitution of one of the bases in a codon.
9. What would be the effect of an addition or a deletion of one of the bases in a codon?
10. Using colored pencils, draw your mystery organism.

Name (s):

Protein Synthesis Simulation

1. Start at the "nucleus". Pick up a DNA strand and write the number of the DNA strand here:

2. Staying in the "nucleus", transcribe the DNA into mRNA. Write the mRNA sequence here:

3. Go to one of the "ribosomes" and write the tRNA sequence that corresponds to your mRNA here:

4. Split the tRNA sequence into anti-codons (groups of 3 letters)

5. Look around the room for the tRNA cards that match your anti-codons. Write down the words in order.

If you complete this correctly, you should have a sentence. If it does not make sense, you have made a mistake and need to go back and start over. Check your answer with the teacher when you are done and then answer the questions on the back of this sheet.

If you have time, you may complete another DNA sequence for bonus points.

Questions:

1. Why did you have to stay in the "nucleus" to write down the mRNA?

2. Which part of this activity represents transcription?

3. Which part of this activity represents translation?

4. What happens in the ribosomes during protein synthesis?

5. What does the final sentence represent in terms of protein synthesis?

6. What does each word represent in terms of protein synthesis?

7. All DNA sequences started with ATG and ended with TAG? Why?

8. How does this activity differ to doing protein synthesis problems using the genetic code?

tRNA card with Words (that **go on the back):**

UAG = Stop (period)
AUG = Initiator (Start)
AAA = ***Your***
AAC = mother
ACG = funny
ACA = breath
AGU = Beatles
AUC = band
CAC = rubber
CCA = when
CUC = love
GAA = all
GAU = and
GCG = fun
GGC = to
GUA = a
GUU = nothing
UAU= this
UCG = be
UGC = you
UUA= DNA
UUU= life

CCG = is
CCU = subject
CGA = *drink*
AAG = ***wears***
ACC = have
AGA = the
AGC = best
AUU= an
CAG = breaks.
CCC = Biology
CUG = roll
GAC = demented
GCA = so
GCU = education
GGG = future
GUC = dress
UAA = we
UCA = together
UCU = informed
UGG = read
UUC = code

CGC = water
CGG = every
CGU = day
AAU = dresses
ACU = ***dog***
AGG = are
AUA = rock
CAA = *old*
CAU = pulled
CUA = I
CUU = music
GAG = puppies
GCC = much
GGA = *door*
GGU = father
GUG = brother
UAC = in
UCC = **must**
UGA = around
UGU = little
UUG = for

SUMMARY QUESTIONS:

1. Compare the phosphates, sugars and bases of DNA and RNA.

2. Compare the general appearance of the DNA molecule with the mRNA molecule.

3. What is produced in transcription?

4. What is produced in translation?

5. If a DNA triplet code is TAC, what is the complementary code of mRNA?

6. If mRNA codons are AUG, GGU, CAG, what three codons of tRNA will attach?

7. In an analogy between a factory and a cell: If DNA is the superintendent and mRNA is the order to the assembly line (ribosomes), what might be the role of tRNA?

8. What is the source of free amino acids in the cytoplasm?

9. If the DNA analysis of a gene shows 20% adenine bases, what would be the percentage of thymine? _____

cytosine? _____ guanine? _____ and uracil? _____

10. List by order of size the following: gene, cell, chromosome, atom, nucleus, base subunit, nucleotides.

*OPTIONAL

11. What are two general uses of protein in an organism?

12. What might be the result of a mutation of DNA in which a triplet code such as CAC now says CTC?