Monster Synthesis Activity

Purpose:

- To examine how an organism's DNA determines their phenotypes.

Problem:

- How can traits on a particular chromosome be determined?
- How can these traits determine the characteristics of an organism?

Background Information:

Your unique body characteristics (traits), such as hair color or blood type, are determined by the proteins your body produces. Proteins are the building block of life - in fact, about 45% of the human body is made of protein. These organic macromolecules perform a wide range of functions including body repair, regulation, and protection. Proteins are created by bonding groups of amino acids that are coded for by the nucleotide base sequences (A, T, G, and C) in your DNA.

Genes are the units that determine inherited characteristics, such as hair color and blood type. Genes are lengths of DNA molecules that determine the structure of polypeptides (the building blocks of proteins) that our cells make. The sequence of nucleotides in DNA determines the sequence of amino acids in polypeptides, and thus the structure of proteins.

In a process called **_transcription_**, which takes place in the nucleus of the cell, messenger RNA (mRNA) reads and copies the DNA's nucleotide sequences in the form of a complementary RNA molecule. Then the mRNA carries this information in the form of a code to the ribosomes, where protein synthesis takes place. The code, in DNA or mRNA, specifies the order in which the amino acids are joined together to form a polypeptide. The code words in mRNA, however, are not directly recognized by the corresponding amino acids. Another type of RNA called transfer RNA (tRNA) is needed to bring the mRNA and amino acids together. As the code carried by mRNA is "read" on a ribosome, the proper tRNAs arrive in turn and give up the amino acids they carry to the growing polypeptide chain. The process by which the information from DNA is transferred into the language of proteins is known as **_translation_**.

In this investigation, you will simulate the mechanism of protein synthesis and thereby determine the traits inherited by fictitious organisms called CHNOPS. CHNOPS, whose cells contain only two chromosomes made up of 12 genes, are

Instructions:

1. Pick out a DNA strand for each category.
   a. Write down the DNA strand and allele number on your "Monster Synthesis Data Sheet"
   b. Transcribe each DNA strand into mRNA.
   c. Translate the mRNA strand into an amino acid sequence using the genetic codon chart.
   d. Write down the physical appearance (phenotype) based on the amino acid sequence you have decoded.

2. Draw a picture of your Monster on a separate sheet of blank paper based on the traits that you have decoded.

Monster DNA Sequences

1. Pick a DNA Strand for **BODY COLOR**.
   Allele 1: TAC ATA CGC GGG ATT
   Allele 2: TAC ATA CGC GTA ATT
   Allele 3: TAC GGG CCC AAA ATT
   Allele 4: TAC GGC CCT TTT ATT

2. Pick a DNA Strand for **EYE COLOR**.
   Allele 1: TAC ATA CGC GGG ATT
   Allele 2: TAC ATA CGC GTA ATT
   Allele 3: TAC GGG CCC AAA ATT
   Allele 4: TAC GGC CCT TTT ATT

3. Pick a DNA Strand for **HAND SIZE**.
   Allele 5: TAC AAA TTT CCC ATC
   Allele 6: TAC CAA CAT CAG ATC
   Allele 7: TAC GTA GTG GCT ATC

4. Pick a DNA Strand for **FEET SIZE**.
   Allele 5: TAC AAA TTT CCC ATC
   Allele 6: TAC CAA CAT CAG ATC
   Allele 7: TAC GTA GTG GCT ATC

5. Pick a DNA Strand for **NUMBER of FEET.**
   Allele 8: TAC TAT CCG ATA ATC
   Allele 9: TAC TAT CCG TAT ATC
   Allele 10: TAC TAT CCG TGA ATC
   Allele 11: TAC TAT CCG AGG ATC
   Allele 12: TAC TAT CCG GGG ATC
   Allele 13: TAC TAT CCG GCA ATC

6. Pick a DNA Strand for **NUMBER of HANDS.**
   Allele 8: TAC TAT CCG ATA ATC
   Allele 9: TAC TAT CCG TAT ATC
   Allele 10: TAC TAT CCG TGA ATC
   Allele 11: TAC TAT CCG AGG ATC
   Allele 12: TAC TAT CCG GGG ATC
   Allele 13: TAC TAT CCG GCA ATC

7. Pick a DNA Strand for **NUMBER OF EYES.**
   Allele 8: TAC TAT GGA TAA ATC
   Allele 9: TAC TAT CCG TAT ATC
   Allele 10: TAC TAT CCG TGA ATC
   Allele 11: TAC TAT CCG AGG ATC
   Allele 12: TAC TAT CCG GGG ATC
   Allele 13: TAC TAT CCG GCA ATC

8. Pick a DNA Strand for **FUR TYPE.**
   Allele 14: TAC ACA ACG ACC ATT
   Allele 15: TAC ACA ACG CTT ATT

9. Pick a DNA Strand for **GENDER**.
   Allele 16: TAC AAA TTT TTT ATC
   Allele 17: TAC AAA TTT GCA ATC

10. Pick a DNA Strand for **HORNS**.
    Allele 18: TAC CTT GTA GTA ATT
    Allele 19: TAC CTT GTA TCA ATT

11. Pick a DNA Strand for **TYPE of WINGS.**
    Allele 22: TAC CAA CGA GAA ATT
    Allele 23: TAC CAT CGA GTC ATT

12. Pick a DNA Strand for **TEETH**.
    Allele 24: TAC ATA CGC CTC ATT
    Allele 25: TAC TTA CGC GGA ATT
    Allele 26: TAC GGG TTA AAA ATT

Amino Acid Sequences and the Traits They Code For

Tyr – Ala – Pro = Green and Yellow
Iso – Gly – Thr = One
Asp – Ala – Pro = Straight
Val – Val – Val = Really big
Val – Ala – Leu = Insect like
Pro – Gly – Phe = Pink and Purple
Pro – Asp – Phe = Missing Teeth
Cys – Cys – Glu = Rough and Curly
Phe – Lys – Lys = Male (Bowtie)
Iso – Gly – Pro = Eight
Tyr – Ala – Glu = Crooked
Pro – Gly – Lys – Black and Red
Iso – Gly – Iso = Four
Tyr – Ala – His = Orange and Blue
Phe – Lys – Arg = Female (Bow)
Phe – Ser – Phe = Hat
Phe – Lys – Gly = Small
His – His – Arg = Medium
Glu – His – His = One
Iso – Gly – Ser = Two
Iso – Gly – Tyr = One
Val – Ala – Glu = Bird like
Iso – Gly – Arg = Five
Glu – His – Ser = Two
Cys – Cys – Try = Smooth and Straight

Second Base

First Base		U	C	A	G	Third Base
		U	C	A	G	
U		Phe	Ser	Tyr	Cys	U
		Phe	Ser	Tyr	Cys	C
		Leu	Ser	Stop	Stop	A
		Leu	Ser	Stop	Try	G
C		Leu	Pro	His	Arg	U
		Leu	Pro	His	Arg	C
		Leu	Pro	Glu	Arg	A
		Leu	Pro	Glu	Arg	G
A		Iso	Thr	Asp	Ser	U
		Iso	Thr	Asp	Ser	C
		Iso	Thr	Lys	Arg	A
		Met	Thr	Lys	Arg	G
G		Val	Ala	Asp	Gly	U
		Val	Ala	Asp	Gly	C
		Val	Ala	Glu	Gly	A
		Val	Ala	Glu	Gly	G

Monster Synthesis Data Sheet

1. Gene for Body Color (allele # ____)

   DNA: _____
   mRNA: _____
   Amino Acid: _____
   Physical Appearance/Protein: _____

2. Gene for Eye Color (allele # ____)

   DNA: _____
   mRNA: _____
   Amino Acid: _____
   Physical Appearance/Protein: _____

3. Gene for Hand Size (allele # ____)

   DNA: _____
   mRNA: _____
   Amino Acid: _____
   Physical Appearance/Protein: _____

4. Gene for Feet Size (allele # ____)

   DNA: _____
   mRNA: _____
   Amino Acid: _____
   Physical Appearance/Protein: _____

5. Gene for Number of Feet (allele # ____)

   DNA: _____
   mRNA: _____
   Amino Acid: _____
   Physical Appearance/Protein: _____

6. Gene for Number of Hands (allele # ____)

   DNA: _____
   mRNA: _____
   Amino Acid: _____
   Physical Appearance/Protein: _____

7. Gene for Number of Eyes (allele # ____)

   DNA: _____
   mRNA: _____
   Amino Acid: _____
   Physical Appearance/Protein: _____

8. Gene for Fur Type (allele # ____)

   DNA: _____
   mRNA: _____
   Amino Acid: _____
   Physical Appearance/Protein: _____

9. Gene for Gender (allele # ____)

   DNA: _____
   mRNA: _____
   Amino Acid: _____
   Physical Appearance/Protein: _____

10. Gene for Horns (allele # ____)

    DNA: _____
    mRNA: _____
    Amino Acid: _____
    Physical Appearance/Protein: _____

11. Gene for Wings (allele # ____)

    DNA: _____
    mRNA: _____
    Amino Acid: _____
    Physical Appearance/Protein: _____

12. Gene for Teeth (allele # ____)

    DNA: _____
    mRNA: _____
    Amino Acid: _____
    Physical Appearance/Protein: _____

Draw and Name your CHNOPS based off your Data Sheet

Name of CHNOPS:

1. Distinguish between transcription and translation.

2. What is the specific site for transcription? _____
3. What is the specific site for translation? _____
4. Supposed you knew the makeup of specific proteins in a cell? Explain how you determine the particular DNA code that coded for them.

5. How could one change in a DNA nucleotide alter the formation of the translated protein? (Example: normal and sickle cell hemoglobin)

6. How can traits on a particular chromosome be determined?

7. How can these traits determine the characteristics of an organism?

8. What would happen if a base is out of order?

9. How is the shape of a protein determined? Why is the shape of the protein important? What happens if the shape of the protein changes? Explain all three questions in detail.

10. What is the importance of DNA and RNA in protein synthesis?

11. Why is protein synthesis important?