INTRODUCTION:

Genes are the units that determine inherited characteristics, such as hair color and blood type. Genes are segments of DNA that code for proteins. The sequence of bases in DNA is the code that determines the sequence of amino acids, and thus the structure and function of proteins.

Protein synthesis starts in the **nucleus**. Here, the cell constructs a strand of mRNA from the DNA code of a particular gene. The mRNA message leaves the nucleus and goes to the **ribosome**, which will read the message to construct a *particular sequence of amino acids*.

The mRNA message is read by the ribosome one **codon** (group of 3) at a time. Each codon codes for one of the 20 **amino acids**. Amino acids are joined by **peptide bonds**, and the process is complete when a *chain of amino acids* is released by the ribosome. The release happens when the ribosome reads a codon that signals a **STOP**.

Proteins gain their functional shapes by *bending*, *folding*, and *twisting* in a particular manner. The pattern of bending and folding depends *on the chemical properties of each amino acid.* It is the sequence of amino acids that determines how the protein will fold. Folding into the correct **shape** is essential for the **job** of the protein. Proteins are sensitive to changes in **pH** and **temperature**, which can disrupt the weak bonds that hold the protein into its shape, causing it to **denature** (unfold, untwist, and lose its shape) and become a *nonfunctional* amino acid chain.

1. What does each gene in your DNA code for?
2. Where does protein synthesis begin, and what takes place?
3. Where are proteins constructed in the cell?
4. What is a codon, and what does each codon code for?
5. What type of bond joins amino acids together?
6. When does the ribosome complete the chain of amino acids?
7. How do amino acid chains become functional proteins?
8. What would happen if there was a mistake in the amino acid sequence?...
9. What are some factors that can cause a protein to denature?

BUILD-A-SAM:

In this activity, you will simulate the mechanism of protein synthesis and thereby determine the traits inherited by a fictitious organism called **SAM**. SAM cells contain only one chromosome. This chromosome is made up of 8 genes (gene A, B, C, D, E, F, G, H and I). Each gene codes for a particular protein and thereby trait.

PROBLEM: * How can traits on a particular chromosome be determined?

* How can these traits determine the characteristics of an organism

PROCEDURE:

Gene A has been completed as an example. Notice the sequence of bases in the DNA. On the line provided *above*, write the *complementary sequence* of **DNA** bases (**REPLICATION**). On the line provided *below*, write the sequence of bases of **mRNA** that would be made for protein synthesis. Then, on the next line, write the sequence of **amino acids** that are coded for by the ***mRNA codons.*** Use the *amino acid sequence chart* to determine the **trait** of your SAM. Draw a picture of your SAM using the traits coded for by its DNA. "Make" 2 additional genes that code for a trait of your choice to make your SAM unique.

BUILD-A-SAM

Gene A- *EXAMPLE*

DNA TGG - CCA - ATA
DNA ACC - GGT - TAT

(codons)
mRNA UGG – CCA - AUA

Amino Acid Sequence TRP -PRO - MET

Trait: HAIRLESS

Gene B

DNA TCG - GCT
DNA AGC - CGA

mRNA UCG GCU

Amino Acid Sequence ser ala

Trait plump

Gene C

DNA AAA - TTG
DNA TTT - AAC

mRNA AAA UUG

Amino Acid Sequence lys leu

Trait 4 legs

Gene D

DNA CCT - GCG - AGT
DNA GGA - . CGC - TCA

mRNA CCU GCG AGU

Amino Acid Sequence pro ala ser

Trait one tooth

Gene E

DNA CCC - TCC - TTT - AGC
DNA GGG - AGG - . AAA - TCG

mRNA CCC UCC UUU AGC

Amino Acid Sequence pro ser phe ser

Trait small ears

Gene F

DNA TAC - TAC - AGT
DNA ATG -. ATG - TCA

mRNA UAC UAC AGU

Amino Acid Sequence tyr tyr ser

Trait cute face

Amino Acid Sequence	Trait
TRP-PRO-MET	Hairless
TRP-PRO-VAL	Hairy
SER-ALA	Plump
SER-VAL	Skinny
LYS-LEU	Four-legged
LYS-VAL	Two-legged
PRO-ALA-ALA	Two teeth
PRO-ALA-SER	One tooth
PRO-SER-PHE-GLY	Big ears
PRO-SER-PHE-SER	Small ears
TYR-TYR-ASP	Grumpy face
TYR-TYR-SER	Cute face

Universal Genetic Code Chart
Messenger RNA Codons and the Amino Acids for Which They Code

FIRST BASE	SECOND BASE U	SECOND BASE C	SECOND BASE A	SECOND BASE G	THIRD BASE
U	UUU, UUC: PHE; UUA, UUG: LEU	UCU, UCC, UCA, UCG: SER	UAU, UAC: TYR; UAA, UAG: STOP	UGU, UGC: CYS; UGA: STOP; UGG: TRP	U C A G
C	CUU, CUC, CUA, CUG: LEU	CCU, CCC, CCA, CCG: PRO	CAU, CAC: HIS; CAA, CAG: GLN	CGU, CGC, CGA, CGG: ARG	U C A G
A	AUU, AUC, AUA: ILE; AUG: MET or START	ACU, ACC, ACA, ACG: THR	AAU, AAC: ASN; AAA, AAG: LYS	AGU, AGC: SER; AGA, AGG: ARG	U C A G
G	GUU, GUC, GUA, GUG: VAL	GCU, GCC, GCA, GCG: ALA	GAU, GAC: ASP; GAA, GAG: GLU	GGU, GGC, GGA, GGG: GLY	U C A G

Drawing: Draw and NAME your SAM

NAME of SAM:

CLYDE

Create ***two additional traits*** to make your SAM unique. Create a **DNA sequence of 9 bases** and transcribe this into **mRNA codons**. Include the resulting amino acid sequence. **Then DRAW those 2 new traits on your SAM.**

GENE H

DNA GAC TTA CCG

mRNA _____

Amino Acid Sequence: _____

Trait: freckles

GENE I

DNA ATC AGG CGG

mRNA UAG

Amino Acid Sequence: _____

Trait: Green color