James Bond Cellular Spy (Protein Synthesis)

Time: 50 minutes
Grade level: 7-12
Adapted From: National Association of Biology Teacher's presentation (1999)

Objectives:

- The students will more fully understand the process of transcription and translation by becoming part of the cell.
- The students will be able to translate an amino acid sequence to create a protein.
- The students will understand why decoding an amino acid sequence is so important in real life situations.
- They will be able to identify what a mutation is and why it happens.

Idaho Achievement Standards

651.01a Know that cells have particular structures that underlie their functions.
651.01c Know that cells store and use information in the form of DNA to guide their functions.
651.01d Know that cell functions are regulated by expressed genes that provide code for the synthesis of proteins.
651.02a Know that the instructions for specifying the characteristics of the organism are carried in DNA.
651.02b Know that genetic material is both encoded in genes and replicated.

Introduction:

Each student will participate in transcription and translation. Bring each student into the nucleus (front of the class). Give each a piece of paper they will hang around their necks that have one of the letters A C T G on them. They have now become nucleotides. The students will then create a DNA double helix strand matching up the letters by holding hands across from each other. One strand will then pull away from the other strand of DNA. Half of the students can then flip their cards over and become RNA (Uracil replaces Thymine). Then have the mRNA leave the nucleus and bind with the two subunits of a ribosome (two other students). The remaining students become tRNA and find the amino acids that match up with the three person codon. As the process of mRNA binding to a ribosome is repeated, a protein gets generated.

Lab Activity:

Begin this activity by addressing the students as cellular spies and tell them their mission is to secretly crack a DNA code. Each pair will approach "Master H"(teacher) to receive their specific mission. These groups will be given their own assignment that must be

decoded secretly and in complete silence (decoding chart attached). Once the code has been cracked and the sequence solved the group will move around the room (cytoplasm) finding beads that match certain amino acids. They will connect these beads until they have created their full protein (bead color chart attached). Once this mission has been completed they must return the decoded sequence to "Master H" to see if they have been successful in their mission. If so they will be rewarded. (reward may vary) If their mission was not completed successfully it is up to them to find the missing link. Have fun and keep it secret.

Note to teacher: You can use an audiotape from "Mission Impossible" and revise it or add to it as necessary to set the stage for this lab activity. If you surprise students by entering the room in a white lab coat and giving a serious "talk" on their mission, making use of the audiotape (which burns up when the mission has been completed), you should be able to do an effective job of engaging your students prior to the activity.

Discussion:

Once the intro and lab activity have been completed have the class discuss what they learned from this activity. What part was most complicated? What would have happened if they decoded something wrong? Why is it so important to code things accurately? How do mutations occur? (point mutations such as insertions and deletions occur in the shift in the reading frame of nucleotide sequences during translation). What would happen if tRNA was unable to find the correct amino acid? How would that affect the human body?

Evaluation (take home):
Once the class seems to understand transcription and translation and the importance of accuracy give the students the opportunity to create their own mutation (deletion and addition) then have them present to the class the affects that their mutation had on the human body.

Amino Acid/Popple bead color key:

Arginine (Arg)..... White
Cysteine (Cys)..... Black
Lysine (Lys)..... Red
Proline (Pro)..... Green
Tyrosine (Tyr)..... Yellow
Methionine (Met)..... Blue
Valine (Val)..... Purple
Phenylalanine (Phe).....Orange

First Position	Second Position				Third Position
	U	**C**	**A**	**G**	
U	phe phe leu leu	ser ser ser ser	tyr tyr end end	cys cys end trp	U C A G
C	leu leu leu leu	pro pro pro pro	his his gin gin	arg arg arg arg	U C A G
A	ile ile ile met	thr thr thr thr	asn asn lys lys	ser ser arg arg	U C A G
G	val val val val	ala ala ala ala	asp asp glu glu	gly gly gly gly	U C A G

JAMES BOND CELLULAR SPY ACTIVITY

YOUR NAME_____

PARTNER'S NAME_____

Please answer the following questions for your first mission!

1. When mRNA takes the genetic information copied from DNA out of the nucleus and into the cytoplasm of the cell it is called _____.

2. _____ converts the nucleotide sequence of the mRNA into a specific sequence of amino acids to produce a specific protein.

3. Which of these nucleotide base pairs are correct?
    a. Adenine-Guanine
    b. Thymine-Cytosine
    c. Thymine-Adenine
    d. Guanine - Cytosine
    e. Both c and d

4. The start codon _____ codes for the amino acid_____.

5. Decode the following amino acid sequences.

    a. TACGCGCATTTCGCCATGAAGACATTTATTCTGCTTCTC

    b. TACGGATCTTTCAAAGGTCATTTTATTATC

    c. TACTTCGGTATAGGGACAGCTCATATAAAGATCATTGGTGGA

    d. TACTTTGCGATGATAACACAACACAAGACTATC

First Position	Second Position				Third Position
	U	**C**	**A**	**G**	
U	phe phe leu leu	ser ser ser ser	tyr tyr end end	cys cys end trp	U C A G
C	leu leu leu leu	pro pro pro pro	his his gin gin	arg arg arg arg	U C A G
A	ile ile ile met	thr thr thr thr	asn asn lys lys	ser ser arg arg	U C A G
G	val val val val	ala ala ala ala	asp asp glu glu	gly gly gly gly	U C A G

Master of Secret Agents Decoding Key

1. TACATAGGCGGAACGAAGTCTATATACTTTCAGATTATC
2. TACCAAGGCACGTCTTTCATAACAGGGACTATC
3. TACAAACATGCATCCATGTTCACAATGTTTATTATC
4. TACGCAGCTTCCACAACTATTGGTACATTTATAACTATG
5. TACATGCACCAAAAGACGTTCGCGTCTGGAATAGGGATCACT
6. TACATGATTACTTTCTCTGCAATATCCACGACATTCACGGGGATT

Take Home Assessment

Name _____ **Date:_____**

Directions: Create two of your own nucleotide sequences one with a mutation and one that is normal (without mutation) then explain what type of mutation you created and how it changes your sequence.