

Viral Mutations Curriculum Activity

A curriculum activity to complement “Emerging Infections: How Epidemics Arise” by Donald E. Ganem on the December 1999 HHMI Holiday Lecture “2000 and Beyond: Confronting the Microbe Menace”

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OBJECTIVE

- to understand how DNA and RNA supply information for changes within a cell, and those processes

PROCESS

- review and discussion of contained material, written assignments, and HHMI video on viral epidemics

APPLICATION

- research on viruses within the U.S., where they originated, symptoms, if the virus mutated or had an environmental change.

DAY ONE: review and discuss DNA, RNA, and the processes they are involved in. Material to be covered includes:

DNA: (deoxyribonucleic acid)

Double stranded polymer of nucleotides, each containing a phosphate group, a nitrogenous base (adenine, thymine, guanine, cytosine), and the sugar deoxyribose.

RNA: (ribonucleic acid)

Single strand nucleic acid whose nucleotide contains the sugar ribose, and the base uracil instead of thymine.

Genetic Code:

correspondence between particular DNA nucleotide base triplets and specific amino acids.

-remember proteins are synthesized from amino acids

-amino acids are represented by a sequence of three nucleotides

-refer to handout 1

Codon:

A set of three nucleotides of mRNA molecule corresponding to a particular amino acid.

mRNA: (messenger RNA)

- carries information in a gene's nucleotide sequence from the nucleus to the cytoplasm.
- enzymes unwind and pull apart double stranded DNA.
 - RNA polymerase moves along the strand putting together a molecule of mRNA.
- This process is known as TRANSCRIPTION.

Example: (parent DNA) A T G C G T A A C A

(daughter RNA) *U A C G C A U U G U*

- this process continues until it hits a "terminal signal" or "stop codon"
- mRNA then can move out of the nucleus and enter the cytoplasm to work with the ribosomes. This acts as a "template" for---

Translation:

the assembly of an amino acid chain according to that code from mRNA to synthesize proteins

tRNA: (transfer RNA)

an RNA molecule that carries an amino acid to its correct position on an mRNA strand

anticodon:

three nucleotides that are complimentary to mRNA.

- in translation, a ribosome bonds to mRNA
- tRNA with an anticodon holds an amino acid to the mRNA
- the second tRNA comes, combines, forms a peptide bond between the amino acids (which are attached to the tRNA)
- the first tRNA releases and goes back to the cytoplasm, process repeated

Replication:

Reproduction of an exact copy of a DNA molecule.

- the double strand of DNA unwinds and pulls apart
- new DNA nucleotides form complimentary pairs with the exposed bases
- enzymes knit back together, so each DNA molecule has one strand of the old and one of the new. (necessary for mitosis)

ASSIGNMENT for Day One

Refer to handout 2.

DAY TWO: view HHMI DVD, Lecture #4, Emerging Infections: How Epidemics Arise

ASSIGNMENT for Day Two

Refer to handout 3.

HANDOUT 1

	DNA sequence	RNA sequence
<i>AMINO ACIDS</i>		
Alanine	CGT	GCA
Arginine	GCA	CGU
Asparagine	TTA	AAU
Aspartic acid	CTA	GAU
Cysteine	ACA	UGU
Glutamic Acid	GTT	CAA
Glycine	CCG	GGC
Histidine	GTA	CAU
Isoleucine	TAG	AUC
Leucine	GAA	AAA
Lysine	TTT	AAA
Methionine	TAC	AUG
Phenylalanine	AAA	UUU
Proline	GGA	CCU
Serine	AGG	UCC
Threonine	TGC	ACG
Tryptophan	ACC	UGG
Tyrosine	ATA	UAU
Valine	CAA	GUU

INSTRUCTIONS

Start protein synthesis	TAC	AUG
Stop protein synthesis	ATT	UAA

Handout 2

INSTRUCTIONS: Label the parent strand, the daughter strand, and match with the appropriate base.

TRANSCRIPTION

T A C C A G T A A G T C T A

TRANSLATION

C A U G G A C U U A U C G U

REPLICATION

G A A G C T C A T T G C G C

1. What is a mutation? Give an example of a mutation.

2. What is a mutagen? Give an example of a mutagen.

Handout 3

QUESTION FROM THE HHMI VIDEO

1. What are the two ways new diseases can arise from a virus? 2 pts.
2. DNA and RNA are involved with a genetic change in a virus. Which one has fewer mutations and why? 3 pts.
3. What is the difference between antigenic drift and antigenic shift? 2 pts
4. What environmental change brought about the Hantavirus in the U.S., and list the chain of events that lead to the epidemic. 4pts
5. Explain why the smallpox virus was so terrible and deadly for the Native Americans, and not as big a problem for the Europeans. 5 pts

6. What are the three key roles of humans allowing the global spread of viruses? 3 pts.

RESEARCH

Research a virus that is or has been in the United States. Tell of its origin, some of the symptoms of the virus, if it has mutated over time or stayed relatively that same, if environmental conditions effect it and its spread, and how it is spread. 15 pts