## Crack the Code (COVID-19 edition)

Overview:
In addition to being able to replicate itself, double stranded DNA can also be transcribed into a single strand of RNA. That RNA, in turn, can then be translated into amino acid sequences in order to build protein molecules. These proteins serve to provide structure, function, and regulation for all of the body's cells and tissues.
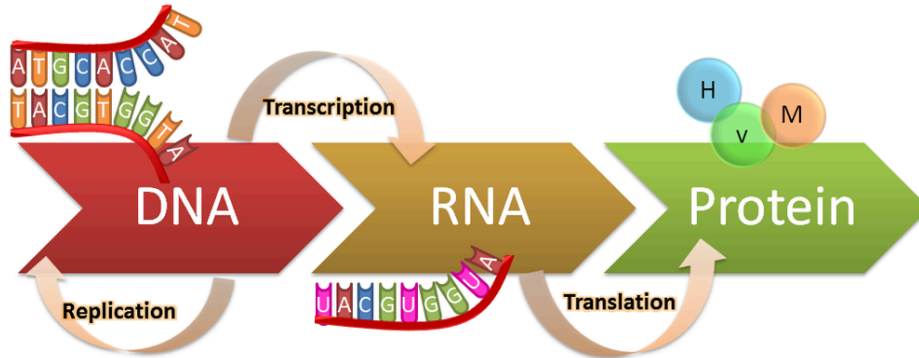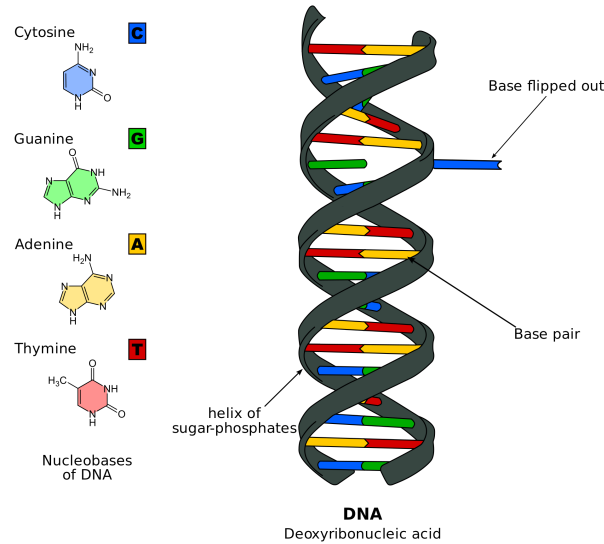

This activity will show you how to decipher a genetic code, revealing a secret message about coronavirus.
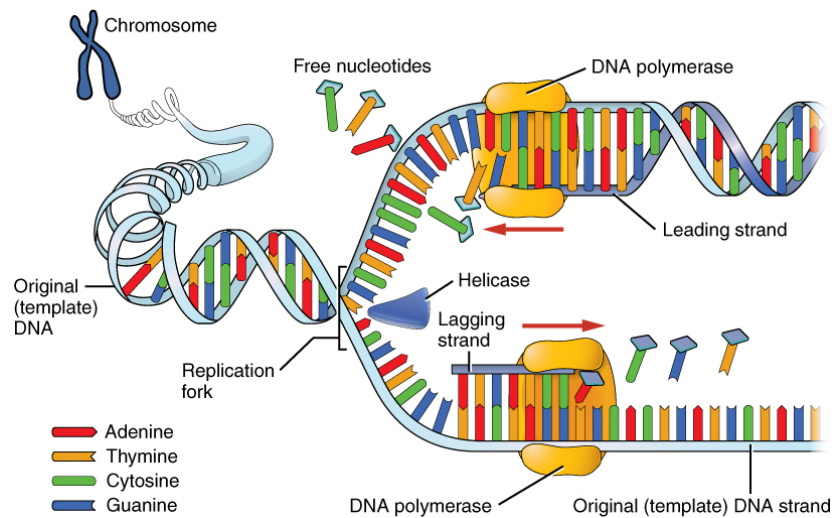
Learning Objectives:
- Recognize that ribosomes read RNA in groups of three letters called codons
- Understand that the instructions for building proteins are stored in DNA and that proteins are made up of amino acids
- Use a codon wheel to read and decipher an RNA message

Background Information:
The DNA double helix consists of four primary base pairs: Adenine (A), Thymine (T), Cytosine (C), and Guanine (G). Notice from the color of the base pairs in the image that A and T always pair together, as do C and G.

Cytosine **C**

Guanine **G**

Adenine **A**

Thymine **T**

Nucleobases
of DNA

Base flipped out

Base pair

helix of
sugar-phosphates

DNA
Deoxyribonucleic acid

When DNA replicates, the helix is unwound by a helicase enzyme and each half of the original strand has new base pairs added by DNA polymerase enzymes to create two exact copies of the original.

Chromosome

Free nucleotides

DNA polymerase

Leading strand

Original
(template)
DNA

Helicase

Lagging
strand

Replication
fork

Adenine
Thymine
Cytosine
Guanine

DNA polymerase

Original (template) DNA strand

When DNA is transcribed, the helix is opened and a single strand of corresponding RNA is formed with the assistance of an RNA polymerase enzyme. One important difference to notice is that there is a slight change to the bases in this process. In RNA, Thymine is replaced by Uracil, so the RNA letters are now A, U, C, and G.
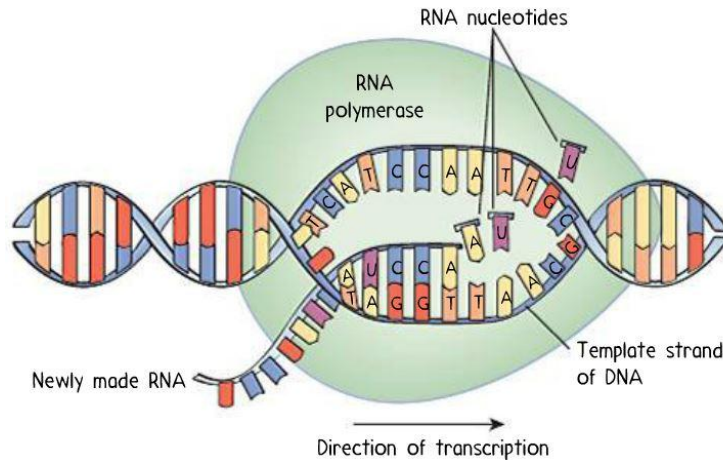
The single strand of RNA is now ready to be translated into a protein. Here is where it really gets interesting. In the previous steps, each base was always matched with a known pair, either A and T/U or C and G. During translation, the bases are now read in sets of three, each triplet is called a codon. Every three letter codon combination codes for a different amino acid. These are simple organic compounds that, when strung together, will form complex protein molecules. This process is facilitated by a biological deciphering machine called a ribosome.
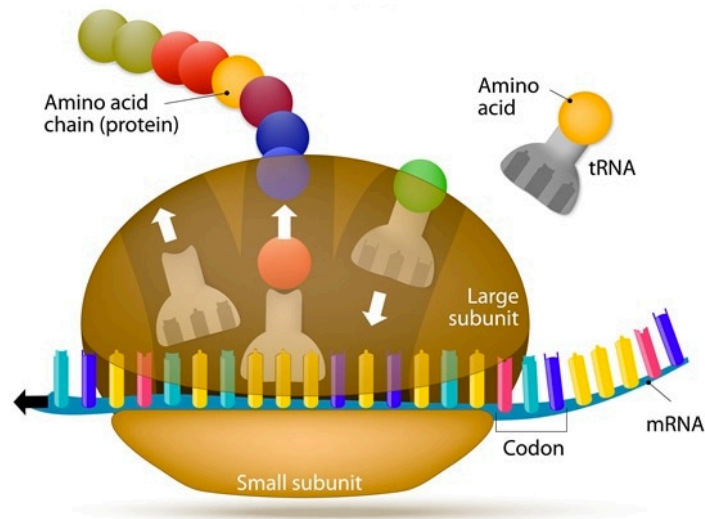

Activity Directions:
In this activity, you will be the ribosome, a code breaker whose goal is to decipher this secret code:

AAA GAA GAG CCU UAG UGC GCC CUC AUG UGA AAG GAG GAA CCA UAA GAC AUC AGU ACC GCU AAC UGC GAA UGA AAA GAA GAG CCG UAG UGG GCG AGC CAU AUC AAC GGU UGA CAC GCC AAU GAU AGC UAA

The answer will offer helpful advice to avoid the coronavirus.

Use the codon wheel below to help you decipher the code.
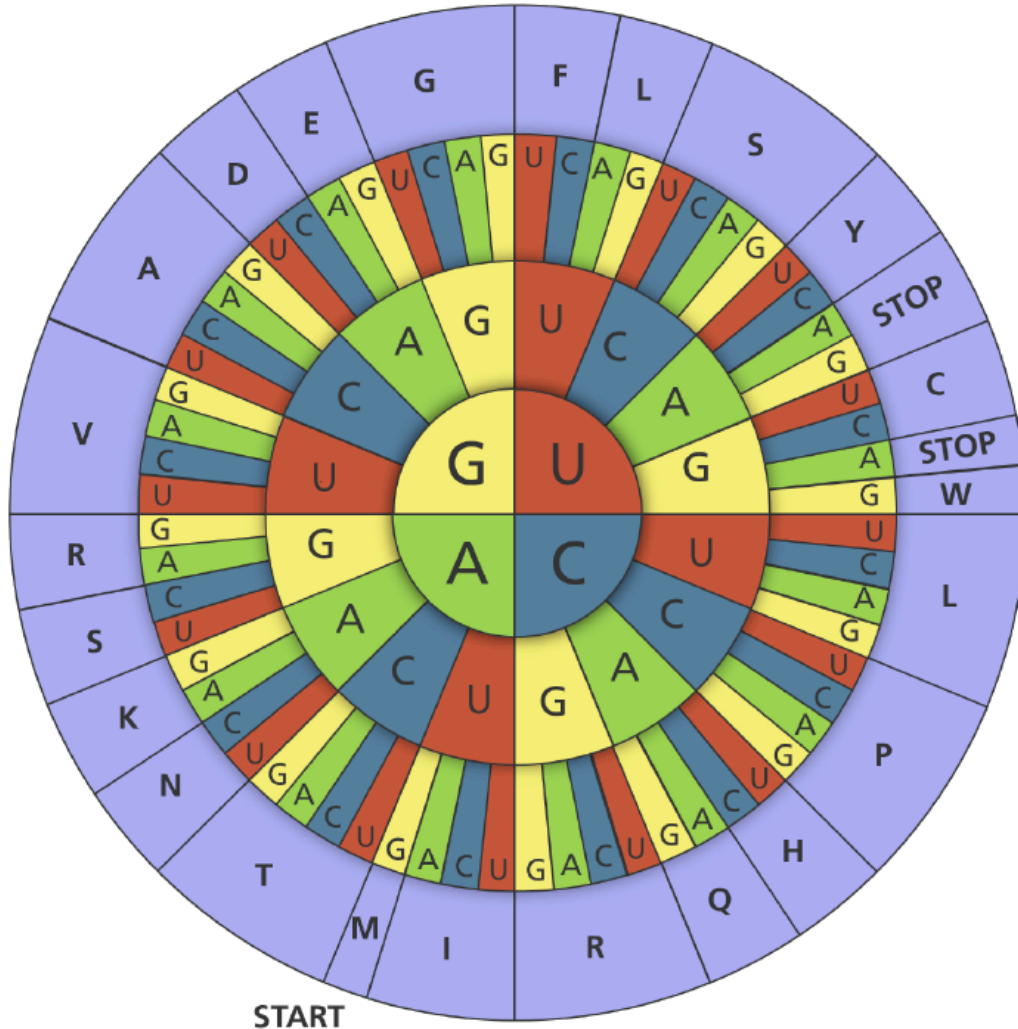
AAA GAA GAG CCU UAG UGC GCC CUC AUG UGA AAG GAG GAA CCA UAA GAC AUC AGU ACC
GCU AAC UGC GAA UGA AAA GAA GAG CCG UAG UGG GCG AGC CAU AUC AAC GGU UGA CAC
GCC AAU GAU AGC UAA

How to Use the Codon Wheel:
Start at the center of the wheel and move outward. For example:

The codon "UGC" = Cysteine (C)
So the following three sets: UGC GCC ACA = the word "CAT"
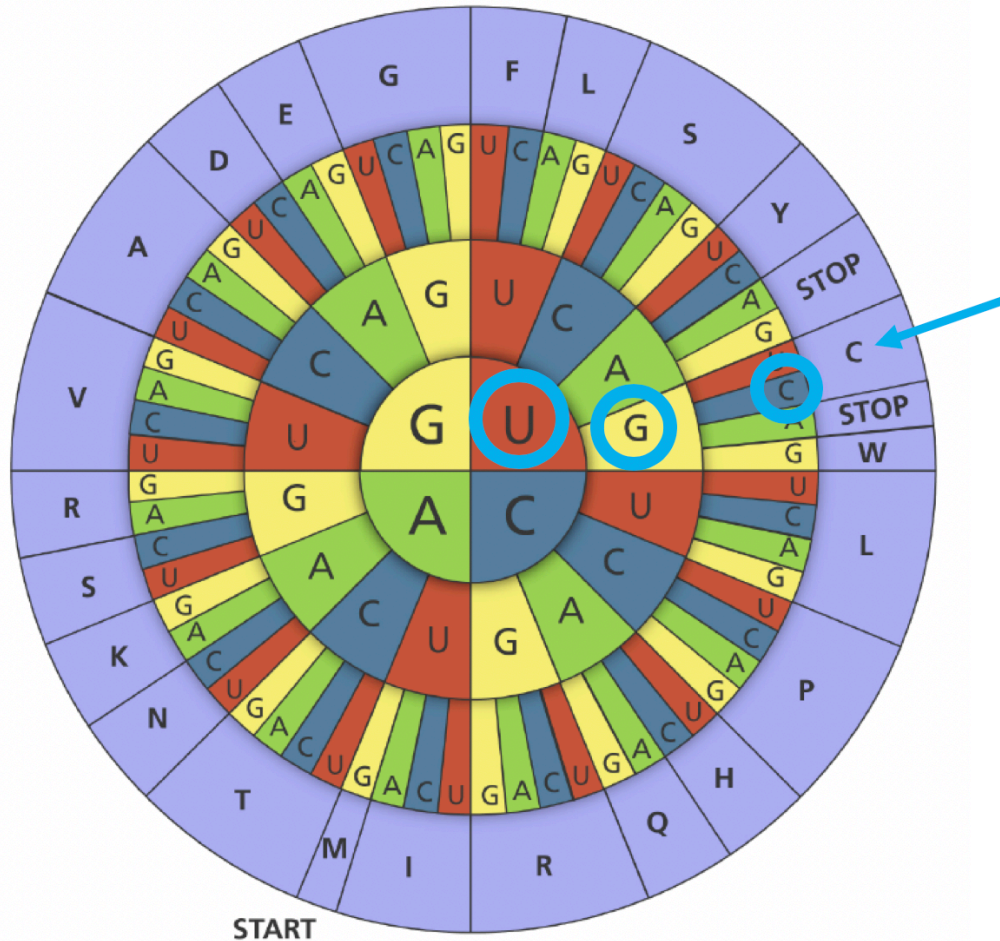
Amino acid code

A - Alanine	**G** - Glycine	**M** - Methionine	**S** - Serine
C - Cysteine	**H** - Histidine	**N** - Asparagine	**T** - Threonine
D - Aspartic acid	**I** - Isoleucine	**P** - Proline	**V** - Valine
E - Glutamic acid	**K** - Lysine	**Q** - Glutamine	**W** - Tryptophan
F - Phenylalanine	**L** - Leucine	**R** - Arginine	**Y** - Tyrosine

If you get to a codon that = STOP (such as UAA), that will be a space between two different words.

Answer Key:

AAA GAA GAG CCU UAG UGC GCC CUC AUG UGA AAG GAG GAA CCA UAA GAC AUC AGU ACC GCU AAC UGC GAA UGA AAA GAA GAG CCG UAG UGG GCG AGC CAU AUC AAC GGU UGA CAC GCC AAU GAU AGC UAA

The secret code reveals the following coronavirus advice:

KEEP CALM, KEEP DISTANCE, KEEP WASHING HANDS