P I P \* P N Q P S P C A L P I S A P V L L P A V L P H R Q P V D T K I R G Q A D

Whole set of tracks (DNA + 6-frames) continues on the left below

 R S H S P I S R P H A P Y Q Y Q R R S F F P R Y F R T V S R S I P R S A A K P T

 D P I A Q S A V P M R L T N I S A G P S S R G T S A P S A G R Y Q D P R P S R P

32041 CCGATCCCATAGCCCAATCAGCCGTCCCCATGCGCCTTACCAATATCAGCGCCGGTCCTTCTTCCCGCGGTACTTCCGCACCGTCAGCCGGTCGATACCAAGATCCGCGGCCAAGCCGAC

 ....:....|....:....|....:....|....:....|....:....|....:....|....:....|....:....|....:....|....:....|....:....|....:....|

 GGCTAGGGTATCGGGTTAGTCGGCAGGGGTACGCGGAATGGTTATAGTCGCGGCCAGGAAGAAGGGCGCCATGAAGGCGTGGCAGTCGGCCAGCTATGGTTCTAGGCGCCGGTTCGGCTG

 G I G Y G L \* G D G H A K G I D A G T R R G A T S G C R \* G T S V L I R P W A S

 R D W L G I L R G W A G \* W Y \* R R D K K G R Y K R V T L R D I G L D A A L G V

 A S G M A W D A T G M R R V L I L A P G E E R P V E A G D A P R Y W S G R G L R

 L S R T V A S R Q D H E R T S R R G G C L M L L T R H S Q L F A G A A N R V L I

Set con-tinues on the right above

 S V A P S L A A R T T S V R A A A V A A S C F \* R A T A S S S P A R R I A S S S

 Q S H R R \* P P G P R A Y E P P R W L P H A S D A P Q P A L R R R G E S R P H R

32161 CTCAGTCGCACCGTCGCTAGCCGCCAGGACCACGAGCGTACGAGCCGCCGCGGTGGCTGCCTCATGCTTCTGACGCGCCACAGCCAGCTCTTCGCCGGCGCGGCGAATCGCGTCCTCATC

 ....:....|....:....|....:....|....:....|....:....|....:....|....:....|....:....|....:....|....:....|....:....|....:....|

 GAGTCAGCGTGGCAGCGATCGGCGGTCCTGGTGCTCGCATGCTCGGCGGCGCCACCGACGGAGTACGAAGACTGCGCGGTGTCGGTCGAGAAGCGGCCGCGCCGCTTAGCGCAGGAGTAG

 R L R V T A L R W S W S R V L R R P P Q R M S R V R W L W S K A P A A F R T R M

 E T A G D S A A L V V L T R A A A T A A E H K Q R A V A L E E G A R R I A D E D

 G \* D C R R \* G G P G R A Y S G G R H S G \* A E S A G C G A R R R R P S D R G \*

 A D E L A G R R V E Y G L Q L V R L V R A G I Q L R Q C R N S V L V A L H P L T

 P M R \* R A A E S R M A F S S C A \* C G P A Y S S V N A A T V S S \* R C T R S P

 R \* S S G P P S R G W P S A R A P S A G R H T A P S M P Q Q C P R S A A P A H P

32281 GCCGATGAGCTAGCGGGCCGCCGAGTCGAGGATGGCCTTCAGCTCGTGCGCCTAGTGCGGGCCGGCATACAGCTCCGTCAATGCCGCAACAGTGTCCTCGTAGCGCTGCACCCGCTCACC

 ....:....|....:....|....:....|....:....|....:....|....:....|....:....|....:....|....:....|....:....|....:....|....:....|

 CGGCTACTCGATCGCCCGGCGGCTCAGCTCGTACCGGAAGTCGAGCACGCGGATCACGCCCGGCCGTATGTCGAGGCAGTTACGGCGTTGTCACAGGAGCATCGCGACGTGGGCGAGTGG

 A S S S A P R R T S C R R \* S T R R T R A P M C S R \* H R L L T R T A S C G S V

 G I L \* R A A S Y L M A K L E H A \* H P G A Y L E T L A A V T D E Y R Q V R E G

 R R H S L P G G L R A H G E A R A G L A P R C V A G D I G C C H G R L A A G A \*

 R D R P V A A V E P H P L A S H H V C P L A G R R Q D S G L S A A G G R T \* A G

 G I V R S R P S S R T R L P R T M S V L S L V G D R I A A \* A P P A A E P E P A

 G S S G R G R R A A P A C L A P C L S S R W S E T G \* R P E R R R R P N L S R P

32401 CGGGATCGTCCGGTCGCGGCCGTCGAGCCGCACCCGCTTGCCTCGCACCATGTCTGTCCTCTCGCTGGTCGGAGACAGGATAGCGGCCTGAGCGCCGCCGGCGGCCGAACCTGAGCCGGC

 ....:....|....:....|....:....|....:....|....:....|....:....|....:....|....:....|....:....|....:....|....:....|....:....|

 GCCCTAGCAGGCCAGCGCCGGCAGCTCGGCGTGGGCGAACGGAGCGTGGTACAGACAGGAGAGCGACCAGCCTCTGTCCTATCGCCGGACTCGCGGCGGCCGCCGGCTTGGACTCGGCCG

 R S R G T A A T S G C G S A E C W T Q G R A P R L C S L P R L A A P P R V Q A P

 P I T R D R G D L R V R K G R V M D T R E S T P S L I A A Q A G G A A S G S G A

 G P D D P R P R R A A G A Q R A G H R D E R Q D S V P Y R G S R R R R G F R L R

Try your hand at finding ORFs in DNA sequence. First, find some ORFs that begin with a methionine (M), encoded by ATG.

* Circle a methionine (M), then draw a line along the amino acid sequence.
* Continue the line in the same reading frame until you reach a stop codon (see examples above).
* Can you find ORFs in the forward direction and other ORFs in the reverse direction?

Translation can also start with GTG or TTG in bacterial/phage genomes. Although an initiator tRNA with f-Met will bind to these codons when they are used to start translation, the codons are shown here specifying valine (V for GTG) and leucine (L for TTG).

* Circle a valine (V) that is encoded by GTG in the DNA, then draw a line for the ORF.
* Challenge: Circle a leucine (L) that is encoded by TTG in the DNA, then draw a line for the ORF.