

Code Cracking

Protein Synthesis: Teacher Answer Key

In this activity, you will translate segments of DNA into their respective amino acid sequences and record the one letter amino acid symbol that corresponds to the correct translation of each codon. If you have accurately translated each DNA segment, the resulting amino acid sequence will spell out a word or phrase. A codon wheel is included to assist you in translation.

1. Locate the codon wheel below. You will need to use this to translate the RNA sequence.
2. Start by transcribing the DNA sequence into mRNA. Remember that DNA bases pair together in specific ways: C with G, and A with T. Your RNA sequence will pair U with A instead of T.
3. Record your RNA sequence.
4. Remember that the cell reads the DNA code in groups of three bases. Each triplet of bases, also called a codon, specifies which amino acid will be added next during protein synthesis. (Putting dashes or lines between each triplet, or circling each group of 3 bases can make translation easier.)
5. Using the codon wheel, find the first base letter of the codon at the center of the wheel, the second base letter in the next circle out and finally the last base in the third circle.
6. Record the amino acid indicated outside the colored wheel. Find and record its one letter symbol from the symbol table.
7. If you have accurately synthesized your protein, the amino acid symbols should spell out a word or phrase in English.

Example:

DNA sequence: **C C A C T C T T A C T T**
mRNA sequence: **G G U-G A G-A A U- G A A**
Amino acid: **GLY-GLU-ASN-GLU**
Letter symbol: **GENE**

Now you try it!

DNA Decoding (Protein Synthesis) Practice Sheet

1. DNA: C T T C C A C C T
mRNA: GAA GGU GGA
AA: Glu Gly Gly
Symbol: EGG

2. DNA: G T G C T T T T A
mRNA: CAC GAA AAU
AA: His Glu Asn
Symbol: HEN

3. DNA: G G T C G T A C C
mRNA: CCA GCA UGG
AA: Pro Ala Trp
Symbol: PAW

4. DNA: T C G T T C T A A
mRNA: AGC AAG AUU
AA: Ser Lys Iso
Symbol: SKI

Try a longer sentence

5. Following the same procedure, decode the message your teacher gives you below.
(Note: the stop codons are used as spaces)

Students will decode one message using the paper strips given to them by their teacher. Codes (to be cut into strips) are provided on the next page. Answers for each decoded message are also provided.

Now create your own message!

6. Create your own message. (Letters not available: B J O U X Z)

Check that students accurately create a decoded message.

Decoded Message (English word or words):

AMINO ACID SEQUENCE (three-letter abbreviations are okay):

mRNA:

DNA:

SAY IT WITH DNA MESSAGES

*Cut each DNA message into a strip and give one message to each student.
Thirty messages are provided. Note that some messages are longer and may
take longer to decode.*

1. CCT CTT TGC ACT CGG ATC GTA CGC TAT TCT ATG ATT ACA CGG TTG
CGA TCC ATA
2. AGA TAC TAG GAC CTT ACT CGA TTG CTG ATT GCG CGA CTA TAA
CGG TGC CTC ACT CGG ATT AAC TAG TGC TGA AAT CTT ATT ACG
GTA CTT CTC GCC ATC
3. TCC CTT GGG GAA TAT ACA CGC TGG CTT ACT CGA ATT TGA CTC CGT
ACG GTA CTC GCC ATC
4. AGA ACA TAA CTC TTA ACA CTC TAA AGA CCA GCA CTC CGA TGA
5. TAA ACT CGG TAC ATT CTA GCT TAG CAC TAA TTA CCC ATC
6. TAC CGT TTC CTT ATT GAT CGC GCC CCA CTC ATT CTT CGG TCT AGG
ATC
7. CTA GCC CTC CGT TAC TAG TTA CCT ACT TAT TCA ATT TTG TAA ACG
CTC ATC CGA ACC CGC TTT TAA TTG CCC ACT TAG TCG ATT ACC CGT
TTA TGT TAA TTA CCT ATC
8. ACC GTG ATA ACT CGT GCT CTT ATT ACC CTC ACT AAT CTC CGG TCC
TTA TAT TTG CCT ATT TGC GTA TAG TCG ATC
9. TAC CGA TTT CTT ACT AGT GGC TCC TAT TTA CCT ATA ATT ACAGTG
TAA ACG TTC CTC TTA TCA ATC
10. CTA TTA CGA ACT TAG AGC ATT GAA TAG AAA CTT ATC

11. CTC CAC GTG AGA ATT CAC CGA GCA TCA TAG TGG
ATG ATT AGA ACC TAT TAC TAC TAT TTG CCT ATC

12. ACC GTG ATA ACT CGA GCA CTC ATT GGC AAC CGC TTA TGT AGC
ATT CCT TCT CTC CTT TTG ATC

13. ACG GCT CTC CGT TGT CTC ACT CGA TTG ATT CTC ATG CTT ATC

14. CTG CTT AGT TAT CCA TTG ACT CGA ATT GTG CGC TTG CTG ATC

15. ACA GCC CTT CGC TGC CTC ACT CGA ATT AAA TAT TTG CCA CTC
GCT ATC

16. AAA TAT TTA CTA ACT TGG GTA CTT ATT AGC CTC ACG GCG CTT TGT
ATT TAC CTC AGA AGC CGA CCA CTC ATC

17. CTT CGA TGA ATT CCA GCC CTC CTT TTG ATC CTT CCA CCT AGC
ATC CGA TTG CTA ACT GTA CGC ATC

18. AGT TAC TAA GAA CTT ACT TAG TGT TCA ATC GTA CTT CGA GAG TGG
GTA ATG

19. ACC CGA TGG CTC TCT ATC TAT AGC ATT ACA AAC CTC CGA GCG

20. ACG CTT GAA AAT AGG ACT CGA TCT CTC ATC CCG TCC CTG
CGC TGC ATT TGT GTA TAG TTA CCC AGG

21. GAA CTC CGA TCT TTG TAT CCG ACT CTA TTA CGG ATC TAA AGC ATT
CCT TCC CTT CGT TGT

22. TAC ATA ACT TAC TAG TTA CTA ATC TAT AGA ATT TAC CGA CCC TTG
TAT AAA TAG ACG CTT TTA TGC ATC

23. TAA ACT GTG CGA CAC CTC ATT CGT ATC CTA GCG CTT CGT TAC ATC

24. AGA CGG CAA CTC ATT TGG GTG CTT ACT TGT TCT CTT CTC AGT
ATC

25. CCG GCA CTC CTT CTA ATT GCT CTT TAG CCA TTA AGT ACT TAA
TTG ATC ACC CGA AAT GAG ATT AGG TGT TCC CTC CTT TGC ATC

26. GAT TAA AAA CTC ACT TAG AGC ATT AGT GGG CTT ACA TAA CGG GAA
ATC

27. ACC GTA ATG ATT TAG AGG ATC CTG TTA CGA ACT TTG CTC ACA
CTT AGC AGT CGG TCC ATA ATC

28. GTA CGA GGA GGA ATG ATC CAA CGA AAC CTC TTA TGA TAA TTA
CTC AGG ATC CTA CGA ATA ATC

29. AAT CTC CGA GCT TTG TAG TTA CCC ATT TAG AGT ATC TAG TTG
TGT CTC GCT CTC AGG TGC TAT TTG CCT ACT

30. CGA ACT AGA TAA CCC TTA TAG AAA TAT ACA CGC TTG TGA AAC
ATA ATC CGG CTG CAA CGT TTA ACA CTC CTA ATT AGG ACA TAA CTC
TTG ACA CTT ACT TAG AGA ACT CTC CGC TCA TAG GAG ATA ATT TAC
TAA AGA TGA CGG TTT CTT TTG ACT CGA AGC ATT TAC CGC CCC TAG
ATC

Credit: These sentences are from the activity Say It with DNA: Protein Synthesis Tutorial, developed by Larry Flammer, 2004, Evolution & the Nature of Science Institute. <http://www.indiana.edu/~ensiweb/connections/genetics/dna.les.html>

SAY IT WITH DNA MESSAGES (Answer Sheet)

1. CCT CTT TGC ACT CGG ATC GTA CGC TAT TCT ATG ATT ACA CGG TTG
CGA TCC ATA

Get a hairy canary

2. AGA TAC TAG GAC CTT ACT CGA TTG CTG ATT GCG CGA CTA TAA
CGG TGC CTC ACT CGG ATT AAC TAG TGC TGA AAT CTT ATT ACG
GTA CTT CTC GCC ATC

Smile and radiate a little cheer

3. TCC CTT GGG GAA TAT ACA CGC TGG CTT ACT CGA ATT TGA CTC CGT
ACG GTA CTC GCC ATC

Replicate a teacher

4. AGA ACA TAA CTC TTA ACA CTC TAA AGA CCA GCA CTC CGA TGA

Science is great

5. TAA ACT CGG TAC ATT CTA GCT TAG CAC TAA TTA CCC ATC

I am driving

6. TAC CGT TTC CTT ATT GAT CGC GCC CCA CTC ATT CTT CGG TCT AGG
ATC

Make large ears

7. CTA GCC CTC CGT TAC TAG TTA CCT ACT TAT TCA ATT TTG TAA ACG
CTC ATC CGA ACC CGC TTT TAA TTG CCC ACT TAG TCG ATT ACC CGT
TTA TGT TAA TTA CCT ATC

Dreaming is nice. Awaking is wanting.

8. ACC GTG ATA ACT CGT GCT CTT ATT ACC CTC ACT AAT CTC CGG TCC
TTA TAT TTG CCT ATT TGC GTA TAG TCG ATC

Why are we learning this

9. TAC CGA TTT CTT ACT AGT GGC TCC TAT TTA CCT ATA ATT ACA GTG
TAA ACG TTC CTC TTA TCA

Make a springy chicken

10. CTA TTA CGA ACT TAG AGC ATT GAA TAG AAA CTT ATC

DNA is life

11. CTC CAC GTG AGA ATT CAC CGA GCA TCA TAG TGG
ATG ATT AGA ACC TAT TAC TAC TAT TTG CCT ATC

EVHS Varsity swimming

12. ACC GTG ATA ACT CGA GCA CTC ATT GGC AAC CGC TTA TGT AGC
ATT CCT TCT CTC CTT TTG ATC

Why are plants green

13. ACG GCT CTC CGT TGT CTC ACT CGA TTG ATT CTC ATG CTT ATC

Create an eye

14. CTG CTT AGT TAT CCA TTG ACT CGA ATT GTG CGC TTG CTG ATC

Design a hand

15. ACA GCC CTT CGC TGC CTC ACT CGA ATT AAA TAT TTG CCA CTC
GCT ATC

Create a finger

16. AAA TAT TTA CTA ACT TGG GTA CTT ATT AGC CTC ACG GCG CTT TGT
ATT TAC CTC AGA AGC CGA CCA CTC ATC

Find the secret message

17. CTT CGA TGA ATT CCA GCC CTC CTT TTG ATC CTT CCA CCT AGC
ATC CGA TTG CTA ACT GTA CGC ATC

Eat green eggs and ham

18. AGT TAC TAA GAA CTT ACT TAG TGT TCA ATC GTA CTT CGA GAG TGG
GTA ATG

Smile it's healthy

19. ACC CGA TGG CTC TCT ATC TAT AGC ATT ACA AAC CTC CGA GCG

Water is clear

20. ACG CTT GAA AAT AGG ACT CGA TCT CTC ATC CCG TCC CTG
CGC TGC ATT TGT GTA TAG TTA CCC AGG

Cells are great things

21. GAA CTC CGA TCT TTG TAT CCG ACT CTA TTA CGG ATC TAA AGC ATT
CCT TCC CTT CGT TGT

Learning DNA is great

22. TAC ATA ACT TAC TAG TTA CTA ATC TAT AGA ATT TAC CGA CCC
TTG TAT AAA TAG ACG CTT TTA TGC ATC

My mind is magnificent

23. TAA ACT GTG CGA CAC CTC ATT CGT ATC CTA GCG CTT CGT TAC ATC

I have a dream

24. AGA CGG CAA CTC ATT TGG GTG CTT ACT TGT TCT CTT CTC AGT
ATC

Save the trees

25. CCG GCA CTC CTT CTA ATT GCT CTT TAG CCA TTA AGT ACT TAA
TTG ATC ACC CGA AAT GAG ATT AGG TGT TCC CTC CTT TGC ATC

Greed reigns in Wall Street

26. GAT TAA AAA CTC ACT TAG AGC ATT AGT GGG CTT ACA TAA CGG GAA
ATC

Life is special

27. ACC GTA ATG ATT TAG AGG ATC CTG TTA CGA ACT TTG CTC ACA
CTT AGC AGT CGG TCC ATA ATC

Why is DNA necessary

28. GTA CGA GGA GGA ATG ATC CAA CGA AAC CTC TTA TGA TAA TTA
CTC AGG ATC CTA CGA ATA ATC

Happy Valentines Day

29. AAT CTC CGA GCT TTG TAG TTA CCC ATT TAG AGT ATC TAG TTG
TGT CTC GCT CTC AGG TGC TAT TTG CCT ACT

Learning is interesting

30. CGA ACT AGA TAA CCC TTA TAG AAA TAT ACA CGC TTG TGA AAC
ATA ATC CGG CTG CAA CGT TTA ACA CTC CTA ATT AGG ACA TAA CTC
TTG ACA CTT ACT TAG AGA ACT CTC CGC TCA TAG GAG ATA ATT TAC
TAA AGA TGA CGG TTT CTT TTG ACT CGA AGC ATT TAC CGC CCC TAG
ATC

A significantly advanced science is easily mistaken as magic