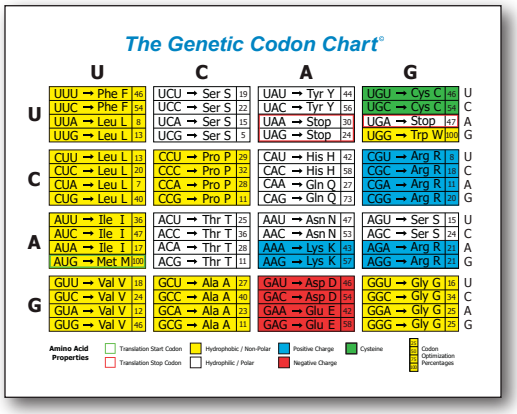
Stop! Decode, Discuss

A Codon Chart Pause Point for Central Dogma Labs



Connect the big picture of the central dogma **to the codon-by-codon decisions** made during translation!

The Flow of Genetic Information Kit© already guides students through replication, transcription, and translation, including decoding mRNA into protein on the ribosome placemat. This insert **adds a focused pause point** where students use the Genetic Codon Chart (Circle or Table) to strengthen their **understanding of how the sequence of mRNA nucleotides determines the sequence of amino acids in proteins.**

Best for College & Advanced High School Courses

This extension works well in introductory college biology, non-major biology, and advanced high school courses covering transcription, translation, mutations, or protein synthesis. It can be used as a:

- enhancement to the translation portion of the Flow of Genetic Information Kit©
- short lab-bench reference for students who need more practice reading codons
- digital follow-up using the interactive protein visualization tool for students who finish early or want to explore structure further
- post-activity or learning check for understanding.

Included with This Resource Guide

This resource includes:

- **Instructor Guide** (this document) — learning goals, suggested instructor moves, and discussion prompts for using the Codon Charts with the Flow of Genetic Information Kit©
- **Student Activity Sheets** — ready-to-print translation and mutation activities using sequences from beta-globin and the Flow of Genetic Information Kit©
- **Answer Key** — instructor reference for the student activity
- **Interactive 3D Visualization** — free digital tool for students to explore protein structure at https://ar.3dmoleculardesigns.com/codon-chart-extension/.

Learning Goals

After using the codon chart with FGIK, students will be able to:

- Read an mRNA sequence in the correct direction and group nucleotides into codons.
- Use a codon chart to identify the amino acid specified by each codon.
- Identify the chemical property of each amino acid using

The 3DMD Genetic Codon Circle & Chart use color to represent amino acid side-chain properties:

Yellow = Hydrophobic

White = Polar

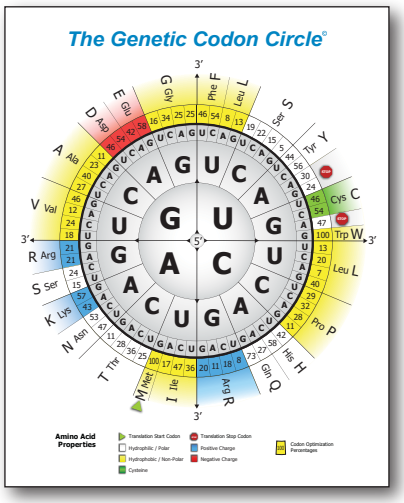
Red = Acidic (Negative)

Blue = Basic (Positive)

Green = Cysteine

This color scheme lets students do more than translate a sequence — they can immediately read the chemical character of each amino acid and begin reasoning about protein behavior.

the color coding on the Circle Chart and connect it to how that amino acid might behave in a folded protein.
- Distinguish start and stop codons during translation.
- Explain how a change in one nucleotide can change a codon and potentially alter a protein.
- Recognize that multiple codons can specify the same amino acid because the genetic code is degenerate.

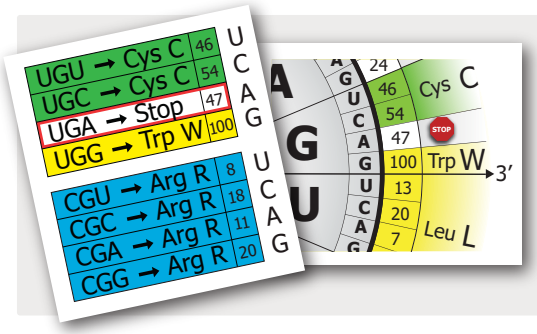


When To Pause in FGIK

Add the codon chart at the point where students **begin translation on the ribosome placemat and start decoding mRNA into protein.** Rather than relying only on the foam pieces for reference, **ask students** to use the standalone Circle or Table Codon Chart to **locate each codon, name the amino acid, and check whether they have started at the correct AUG codon.**

Suggested Instructor Moves

1. Ask students to **flag the first AUG codon** in their mRNA before they begin translation.
2. Have students **translate 3–5 codons** one at a time, **saying aloud: "codon, amino acid, next codon."**
3. After students translate another 3–5 codons, ask them to **call out the color of each amino acid** and sort their sequence mentally into **"hydrophobic core"** vs. **"surface-exposed"** candidates. This takes 60 seconds and plants the protein-structure seed early.
4. Pause after a few amino acids and **ask students how they know where translation will stop.**
5. If groups finish early, ask them to compare two codons for the same amino acid and discuss why more than one codon can map to the same product.



For an introductory college extension, invite students to notice that the Genetic Codon Circle & Chart include human codon preference values and ask which synonymous codon appears more common in humans.

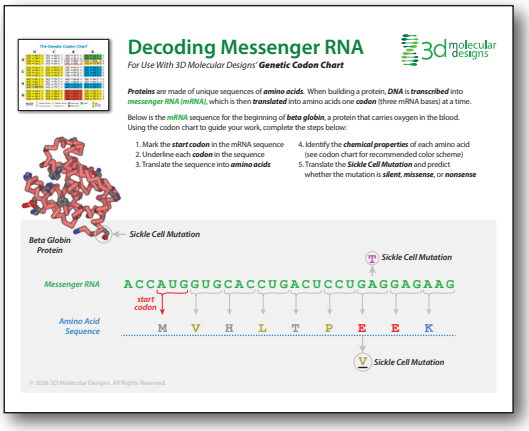
Quick Discussion Prompts

- Why is it important to identify the reading frame before translating?
- What happens if a one-nucleotide insertion or deletion mutation is incorporated before the codons are grouped?
- Why do different codons sometimes lead to the same amino acid?
- How could a mutation change the protein without changing the amino acid sequence?
- If you see a stretch of yellow amino acids in your translated sequence, where might that segment end up in a folded protein — and why?
- Why might a mutation that changes a blue (basic) codon to a red (acidic) one have a bigger functional impact than a change between two yellow (hydrophobic) codons?

Optional 10-Minute Extension

Give students a short mRNA sequence (example sequences from both the beta globin protein and 3D Molecular Designs' Flow of Genetic Information Kit© can be found on the following pages) and ask them to:

1. Mark the ***start codon*** in the mRNA sequence
2. Underline each ***codon*** in the sequence
3. Translate the sequence into ***amino acids***
4. Identify the ***chemical properties*** of each amino acid
5. Change one ***nucleotide*** in a single codon and predict whether the mutation is silent, missense, or nonsense.



Optional digital extension: Visualize your translated protein sequence in 3D using the interactive molecular modeling tool at https://ar.3dmoleculardesigns.com/codon-chart-extension/. Identify where hydrophobic (yellow) and charged (red/blue) amino acids are located in the folded structure and compare that to your predictions from Step 4.

This extension keeps the focus on translation and mutation without requiring any additional model components. Student activity sheets for this extension — including an answer key — are included on the following pages.

Why This Adds Value

The Flow of Genetic Information Kit© helps students model the central dogma as a physical process, while **the codon charts slow students down at the translation step** so they can interpret sequence information deliberately. Used together, they reinforce that protein synthesis is not just a memorized pathway but a sequence-based decoding process with clear molecular rules. The **accompanying student activity sheets and interactive 3D visualization tool** extend this further, giving students both a hands-on translation practice experience and a digital tool to see how the amino acid sequence they decoded folds into a functional protein structure.