Codon Bingo

Introduction

Codon Bingo is a stimulating game that involves deciphering the genetic code. The game is designed to give students practice with transcription and translation of codons while at the same time generating full class participation. As students play the game, they develop increased proficiency while unraveling the genetic code found in the base pairs. After playing Codon Bingo, the students will find it easier to transcribe the DNA base pair messages into mRNA codons and to translate the mRNA codons into an amino acid sequence.

Concepts

- Amino acids
- DNA
- Nucleotide (base) pairing rules
- RNA
- Transcription
- Translation

Background

The DNA that makes up the human genome can be subdivided into genes. Each gene encodes for a protein (or part of a protein) that performs a specific function in a cell. The two-step process of transcription and translation is responsible for transforming the DNA instructions into a functional protein. During *transcription* the DNA code is copied into a strand of messenger RNA (mRNA). The nucleotide pairing rules for transcribing DNA to RNA are slightly different than the base pairing rules for replicating a strand of DNA. In DNA, the purine adenine (A) always pairs with the pyrimidine thymine (T), and the pyrimidine cytosine (C) always pairs with the purine guanine (G). In RNA, the pyrimidine cytosine (C) still pairs with the purine guanine (G), but the purine adenine (A) pairs with the pyrimidine uracil (U). The strand of mRNA travels out to the cytoplasm of the cell. In the cytoplasm a ribosome binds to the mRNA strand at a specific point called a start codon. The ribosome reads three mRNA nucleotides at a time—these base triplets are called *codons*.

A single mRNA nucleotide sequence—adenine-uracil-guanine (AUG)—acts as the starting point for the translation of any mRNA into a chain of amino acids. There are three different codons that are read as "stop" by the ribosome, causing the ribosome to detach from the mRNA strand. The remaining 61 of the 64 possible nucleotide combinations codons correspond to one of the twenty amino acids used to form an amino acid chain that will become a protein. Each mRNA codon is matched to an anticodon on a transfer RNA (tRNA) molecule. The tRNA molecule has two key areas that are important for translation. The first area is the anticodon. The *anticodon* is a triplet base nucleotide sequence that mirrors and is complementary to the 64 codon sequences found in mRNA. The second area on tRNA has a specific amino acid bonded to it. The codons are a universal code, meaning that each mRNA codon codes for the same amino acid in all living things from bacteria to humans. It is the specific sequence of amino acids that varies in different proteins. Changes in the amino acid sequence cause the amino acid string to bend and fold in unique ways, creating unique proteins for each organism.

Materials

- Amino Acid Decoding Chart
- Bingo card, blank
- Bingo chips, 25 per student
- Index cards, 64
- Small cups to hold the bingo chips

Procedure

1. Using index cards, create the bingo "draw cards" by writing the name of an amino acid, an mRNA codon for that amino acid (or stop), and the DNA code that corresponds to the mRNA codon. Create one card for each of the 64 RNA codons.
2. Create bingo cards using a word processing program. Bingo cards have five columns and five rows, creating twenty-five empty boxes. If desired, a free-space may be added to the center box of each bingo card.
3. Have the students randomly write the name of all 20 amino acids plus stop on the bingo card. Five amino acids must be used twice to fill the bingo card. *Note:* Students should not use methionine or tryptophan more than once as they only have one RNA code.

Publication No. 10882
100917

4. Give an Amino Acid Decoding Chart and a small cup containing 25 bingo chips to each student.
5. Shuffle the bingo draw cards and begin the first game.
6. Draw one bingo draw card. Call out the mRNA codon. Students must use the Amino Acid Decoding Chart to translate the mRNA codon into the amino acid. If the student's bingo card has the amino acid, a bingo chip should be placed on that box.
7. Lay the bingo draw card to one side. It will be used to check the winner's bingo card. Give the students enough time—especially in the beginning of the game—before drawing the next game piece.
8. Continue to call out mRNA codons until a student says "Bingo!" Check the winner's bingo card against the bingo draw cards. If the student has made a mistake continue to call out new mRNA codons; otherwise, have the students clear the bingo cards and start a new game.
9. Advanced variation—rather than call out mRNA codons, call out the DNA bases. Students must first transcribe the DNA to mRNA, and then translate the mRNA code to the amino acid.

NGSS Alignment

This laboratory activity relates to the following Next Generation Science Standards (2013):

Disciplinary Core Ideas: Middle School
- MS-LS1 From Molecules to Organisms: Structures and Processes
  - LS1.A: Structure and Function
- MS-LS3 Heredity: Inheritance and Variation of Traits
  - LS3.A: Inheritance of Traits
  - LS3.B: Variation of Traits

Disciplinary Core Ideas: High School
- HS-LS1 From Molecules to Organisms: Structures and Processes
  - LS1.A: Structure and Function
- HS-LS3 Heredity: Inheritance and Variation of Traits
  - LS3.A: Inheritance of Traits

Science and Engineering Practices
- Developing and using models
- Analyzing and interpreting data
- Constructing explanations and designing solutions

Crosscutting Concepts
- Patterns
- Cause and effect
- Structure and function

Tips

- Most student textbooks contain an amino acid decoding chart or table. Three versions are typically found in textbooks—two versions are tables, whereas the third version is circular with the amino acids appearing as "spokes on a wheel." Allow students to use the type of chart they are likely to use during a test.
- Bingo may be called when any five spaces across are filled, either horizontally, vertically or diagonally. Four corners, post age stamp, or blackout are less traditional bingo choices. Play the game with as many or as few bingo variations as you desire.

Acknowledgment

Special thanks to Cynthia Mannix for bringing this activity to our attention.

A *Codon Bingo Kit* is available from Flinn Scientific, Inc.

Catalog No.	Description
FB1112	Codon Bingo Kit

Consult your *Flinn Scientific Catalog/Reference Manual* for current prices.

Amino Acid Decoding Chart

mRNA