Contributors

Louise Zehr
Graduate Student
Georgia Southern University, GA

Donna Hanson
Partner Teacher
Bradwell Institute Hinesville, GA

Intended Audience

<table>
<thead>
<tr>
<th>Age Range</th>
<th>Activity Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>K-4</td>
<td>Requires special equipment</td>
</tr>
<tr>
<td>5-8</td>
<td>Uses hands-on manipulatives</td>
</tr>
<tr>
<td>9-12</td>
<td>Requires mathematical skills</td>
</tr>
<tr>
<td>X</td>
<td>Can be performed individually</td>
</tr>
</tbody>
</table>

Activity Characteristics

<table>
<thead>
<tr>
<th>Classroom Setting</th>
<th>Requires special equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uses hands-on manipulatives</td>
<td>Requires mathematical skills</td>
</tr>
<tr>
<td>Requires more than one (45 min class) period</td>
<td>Appropriate for special needs student</td>
</tr>
</tbody>
</table>
Introduction

Description

Students will use the process of translation to identify prizes that are visually unidentifiable.

Abstract

This lesson discusses the process of translation and the use of DNA barcoding. Individually or in groups of two, students will translate mRNA sequences into amino acids to identify specific prizes that are hidden under identical coffee cups. The students’ job is to determine the amino acid sequence and use the amino acid abbreviations to identify the prize. Once correction identification has taken place, students can pick a prize.

Core Themes Addressed

<table>
<thead>
<tr>
<th>Microbial Cell Biology</th>
<th>Microbial Genetics</th>
<th>Microorganisms and Humans</th>
<th>Microorganisms and the Environment</th>
<th>Microbial Evolution and Diversity</th>
<th>Other –Molecular Biology</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

Keywords

Amino acids, codons, and DNA barcoding

Learning Objectives

At completion of this activity, learner will:

1. Translate mRNA codons to amino acids
2. Infer DNA barcoding is used in real world situations

National Science Education Standards Addressed

Standard C: Life Science

- The cell
- Molecular basis of heredity
- Organization in living systems

Standard: Science and Technology

- Understanding about science and technology
Student Prior Knowledge

Students need to have an understanding of the basic structure and function of DNA. Students also need to know the process of DNA transcription.

Teacher Background Information

Suggested prizes’ are used because their names have the letters of the amino acid codon table abbreviations. (E.g. none of the prizes have the letters U, Y, etc. because they are not single abbreviations in the codon table.) Students will need the activity worksheet and a codon table. Cups are used to cover the prizes so that students will not be able to identify what they are and so that they understand the concept of using DNA barcoding to identify species that look similar. Activity can be used as a race; first student to identify what is in each cup can choose the prize that he/she wants and so forth. This activity can also be done with two students per group. The activity worksheet is split into two papers (barcodes 1-6 page 1, barcodes 7-12 page 2) with one codon sheet.

DNA barcoding first came to the attention of the scientific community in 2003 when Paul Herbert’s research group published a paper on the topic. DNA barcoding is a system of species identification and discovery using a short section of DNA from a standardized region of the genome. That DNA sequence can be used to identify different species, in the same way a supermarket scanner uses the familiar black stripes of the UPC barcode to identify your purchases. The gene region that is being used for almost all animal groups, a 648 base-pair region in the mitochondrial cytochrome c oxidase 1 gene (“CO1”), is proving highly effective in identifying birds, butterflies, fish, flies, and many other animal groups. The advantage of using COI is that it is short enough to be sequenced quickly and cheaply yet long enough to identify variations among species.

Class Time

This activity requires a minimum of one, 45-minute class period.

1. Introductory PowerPoint-15 minutes
2. Explain Lab/Put Students in Groups-5 minutes
3. Lab Activity (including prize collecting)-20 minutes
4. Wrap-Up/Review-5 minutes
Teacher Preparation Time

This lesson will require approximately 5 minutes of preparation time.

1. Label cups 1-12. Fit a sample of each prize underneath assigned cup.

Materials (2 students/Group)

1. One activity worksheet (2 pages with 1-6 on first page, 7-12 on second page).
2. One codon sheet.
4. Twelve cups labeled 1-12.

Methods

1. Split students into groups.
2. Pass out activity worksheet and codon sheet.
3. Tell students when they can start.
4. When students finish allow them to quietly pick their prize.

Tips/Suggestions

1. This activity can be used as an individual lab or can be combined with the entire module.
2. The suggested prizes can be exchanged for different ones but it allows for less confusion among students to use prizes whose letters are used as single abbreviations on the codon chart.

Answers to Student Activity Worksheets

1. PENS
2. TIC TACS
3. SKITTLES
4. ERASER
5. RAISINS
6. LIFE SAVERS
7. PENCILS
8. SMARTIES
9. PRINGLES
10. CRACKERS
11. REESES
12. STICKERS
Student Activity Worksheet Links

Print a PDF of the activity

- Link to Activity Worksheet

- Link to Codon Table
Introduction

DNA barcoding first came to the attention of the scientific community in 2003 when Paul Herbert’s research group published a paper on the topic. DNA barcoding is a system of species identification and discovery using a short section of DNA from a standardized region of the genome. That DNA sequence can be used to identify different species, in the same way a supermarket scanner uses the familiar black stripes of the UPC barcode to identify your purchases. The gene region that is being used for almost all animal groups, a 648 base-pair region in the mitochondrial cytochrome c oxidase 1 gene (“CO1”), is proving highly effective in identifying birds, butterflies, fish, flies, and many other animal groups. The advantage of using COI is that it is short enough to be sequenced quickly and cheaply yet long enough to identify variations among species.

Student Background Knowledge

Students need to have a basic understanding of the basic structure and function of DNA. Students also need to know the process of DNA transcription.

Vocabulary

DNA: Deoxyribonucleic acid is a molecule that encodes the genetic instructions used in the development and functioning of all known living organisms and many viruses.

DNA Barcode: taxonomic method that uses a short genetic marker in an organism’s DNA to identify it as belonging to a particular species.

Materials Checklist

| One activity worksheet (2 pages with 1-6 on first page, 7-12 on second page). |
| One codon sheet. |

Procedure

1. You and your partner use the codon table to translate the mRNA sequences to the correlating amino acid abbreviation.
2. Once you have identified all the “cups” present your worksheet to your teacher in order to collect your prize.
DNA Barcoding

Student Worksheet

1. _______
   
   CCG GAA AAC UCA

2. _______
   
   ACG AUA UGC ACC GCC UGU UCA

3. _______
   
   UCU AAG AUU ACU ACG CUC GAA UCG

4. _______
   
   GAG AGA GCC UCC GAA AGA AGU

5. _______
   
   AGA GCU AUC UCU AUA AAU UCC

6. _______
   
   UUA AUC UUU GAG UCC GCC GUA GAA AGG UCG
7. CCU GAA AAC UGC AUU CUC

8. AGU AUG GCG CGA ACC AUC GAA UCA

9. CCG AGG AUA AAC GGACUA GAG UCA

10. UGC AGG GCA UGU AAA GAA AGG UCC

11. AGG GAA GAG UCA GAA UCC

12. UCC ACA AUC UGC AAA GAG AGA UCA