Noble Academy

Scientist Guide

DNA Bracelet Workshop

Introduction

Deoxyribonucleic acid (DNA) is a molecule that encodes genetic instructions. These instructions guide the development and functioning of all known living organisms. Similar to the way a builder uses a blueprint to construct a house, cells use DNA to construct an organism. DNA is therefore often considered the "blueprint for life."

The DNA instructions are divided into segments called *genes*. All organisms have *genes* that determine various biological traits, some of which are immediately visible, such as eye color or hair color, and some of which are not, such as blood type or musical talent. Each *gene* provides the information for making a *protein*, which carries out a specific function in the cell.

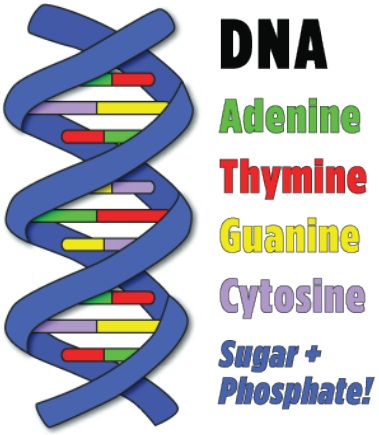

Figure 1.

A molecule of DNA is composed of two backbones and four types of chemical bases. The backbone is formed by a chain of sugars and phosphates. Attached to each sugar molecule is one of the bases. The four types of bases are: adenine, thymine, cytosine and guanine. They are usually represented by their first letters: A, T, C and G, respectively.

The bases form pairs in a very specific way: A always pairs with T, and C always pairs with G. The specific matching of the base pairs, A with T and C with G, provides a way for exact copies of DNA to be made.

A DNA molecule is often compared to a ladder, with the two backbones forming the sides of the ladder and the base pairs forming the steps or rungs (Figure 1). However, instead of a straight ladder, DNA looks like a twisted ladder, known as a double helix ("double" for the two backbones). The DNA sequence is the consecutive order of bases on one side, or strand, of the twisted ladder. The other strand has a complementary sequence determined by the base pairing rules mentioned above.

If you look at a segment of DNA, you can read out the letters in a row from left to right:

ATGCGTGGTCAGTCGATATATGGCCCC

These letters represent one side, or strand, of the twisted ladder (strand 1). Because we now know the base pairing rules, we can determine the sequence of the second strand (strand 2).

ATGCGTGGTCAGTCGATATATGGCCCC (strand 1, one side of the twisted ladder)
TACGCACCAGTCAGCTATATACCGGGG (strand 2, the other side of the ladder)

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This lesson was modified from http://www.agintheclassroom.org/teacherresources/Lesson%20Booklets/bracelet.pdf.

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Activity Overview

In this activity, you will use colored beads (which represent the bases in DNA) and pipe cleaners (which represent the sugar and phosphate backbone of DNA) to construct a DNA bracelet that contains a segment of DNA from the organism of your choice (see "Sequences" below).

Materials

- Pipe cleaner (two pieces approximately 8 inches in length).
- Colored beads (green, red, yellow and blue).

Safety Precautions

- The ends of the wire pipe cleaner may be sharp; please use caution when working with the pipe cleaner.
- Please do not eat or drink in the lab.

Procedure

- To construct your DNA bracelet, choose one of the sequences below.

- Begin by threading the bead that represents the first letter of the sequence you chose onto a pipe cleaner. Determine which color bead represents which letter (Figure 2). For example, the grizzly bear sequence begins with A so a green bead would be threaded onto the pipe cleaner to represent A.

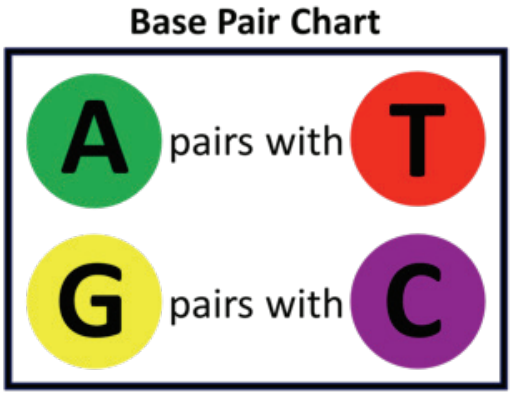

Figure 2.

- On the second pipe cleaner, thread the bead that represents the letter that pairs with A; in this case, since A pairs with T, a red bead would be threaded on the second pipe cleaner to represent T (Figure 2).

- Repeat these steps by following the sequence you chose.

- Once all the beads have been placed on the pipe cleaners, twist them to form a double helix.

- Fit the DNA comfortably on your wrist and twist the ends together to secure the bracelet on your wrist.

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Sequences

Monarch Butterfly
GAGGCTACCAAGTTTCCGAT

Human
TGACCCCAATACGCAAAATT

Grizzly Bear
ATGACCAACATCCGAAAAAA

African Elephant
ATCACCGACATTCGAAAATC

Try-on-your-own Activities

- Using the sequences below, look at your friend's bracelet and try to figure out what sequence they chose.
- Try constructing a DNA bracelet using DNA sequences for some of the organisms shown below.

Monarch Butterfly
GAGGCTACCAAGTTTCCGAT

Human
TGACCCCAATACGCAAAATT

Grizzly Bear
ATGACCAACATCCGAAAAAA

African Elephant
ATCACCGACATTCGAAAATC

Brown Trout
TACATCAGCACTAACTCAAGG

Malayan Spitting Cobra
AACCGACCGCTGCAACAACTG

Carnivorous Plant
GTAGCCACAGACTCAGTCATC

Sunflower
TGAGATGCTAGAAGGTGCAA

Sweet Orange
TGCTACAGTTGCTGTTGTTGG

Madagascar Hissing Cockroach
GATTCGCCGCTATCAGAAGAG

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Student Worksheet

DNA Bracelet Workshop

Name _____

1. The three letter abbreviation for deoxyribonucleic acid is?

2. DNA is often considered the "_____ for life."

3. Segments of DNA that determine an organism's biological traits are called?

4. A molecule of DNA is composed of how many backbones?
   - ☐ 1
   - ☐ 2
   - ☐ 3
   - ☐ 4

5. DNA looks like a twisted ladder which is called a _____ ?
   - ☐ Helical wheel
   - ☐ Double triangle
   - ☐ Helices
   - ☐ Double helix

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Teacher Resource

DNA Bracelet Workshop

Name _____

1. What does DNA stand for?

2. Why is DNA often referred to as the “blueprint for life”?

3. In an organism, what do genes determine?

4. How many backbones does a molecule of DNA have?

5. DNA looks like a twisted ladder which is called?

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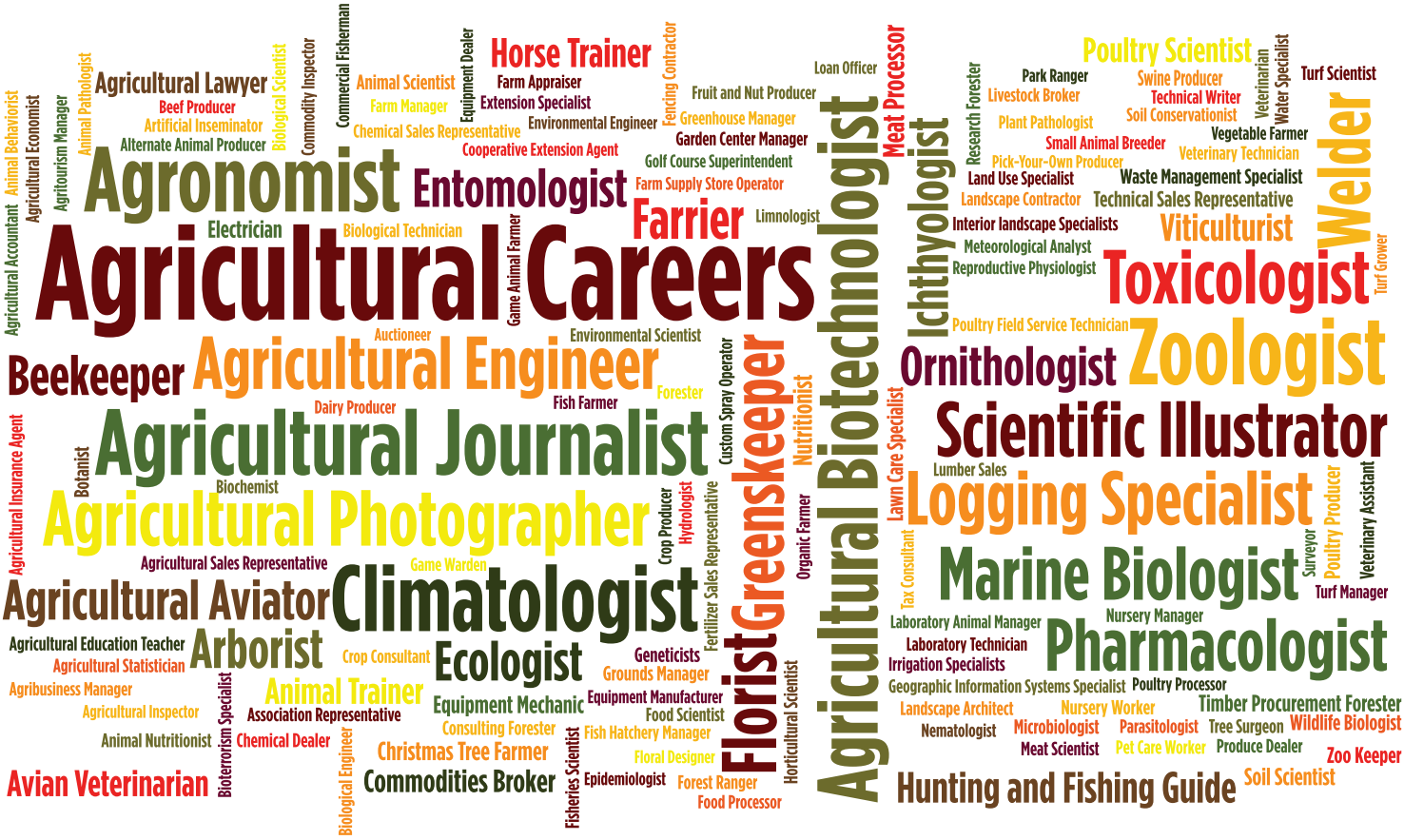
Careers in Agriculture



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