DNA Extraction: Tomato

Learning Outcomes

Students will use basic chemical techniques to isolate DNA from a tomato. Further, students should relate the molecule of DNA as common to all plants and animals as the chemical that holds genetic information.

QCC Standards

Grade 7:

Science Process Skills Standards 1 & 2
5: Identifies the role elements, atoms, and molecules play in cell development and functions.
10: Describes the structure of a chromosome, DNA replication, and how genes interact to determine the traits of an organism.
12: Describes various advances within the fields of agriculture, animal husbandry and medicine due to Applied Genetics (STS).

Applied Biology & Chemistry 2:

Science Process Skills Standards 1 & 3
4.2 Constructs a model of DNA.
4.4 Explains how DNA is able to control the activities of the cell.
10.2 Describes the basic processes used in genetic engineering.
11.1 Identifies the ways genetic engineering can benefit mankind.
11.2 Evaluates the ethical issues surrounding the use of genetic engineering.

Biology:

Science Process Skill Standard 1
8.1 Describes the double-helix model.
10.1 Defines important genetic terms.

National Standards

Cells store and use information to guide their functions. The genetic information stored in DNA is used to direct the synthesis of the thousands of proteins that each cell requires.

In all organisms, the instructions for specifying the characteristics of the organism are carried in DNA, a large polymer formed from subunits of four kinds (A, G, C, and T). The chemical and structural properties of DNA explain how the genetic information that underlies heredity is both encoded in genes (as a string of molecular "letters") and replicated (by a templating mechanism). Each DNA molecule in a cell forms a single chromosome.
Science often advances with the introduction of new technologies. Solving technological problems often results in new scientific knowledge. New technologies often extend the current levels of scientific understanding and introduce new areas of research.

Background & Definitions

DNA was first identified in 1868 by Friedrich Miescher and has not always been recognized as the molecule of heredity. Its role was not determined until the mid 20th century. Francis Crick, James Watson, and Maurice Wilkins received the Nobel Prize in 1962 for determining the molecular structure of DNA in 1953. Historical developments in our understanding of DNA can be found at http://esg-www.mit.edu:8001/esgbio/dogma/dogmadir.html.

Materials & Equipment

Tomato	Dishwashing detergent
Tablespoon	Beakers/Test Tube/Glass container
Water (distilled/bottled)	Paper Clip
Sodium chloride	Mortar/ pestle
Tissue paper	Knife/Scalpel
Cold Ethanol (95%)	Sodium citrate

Web Resources

http://www.ornl.gov/hgmis/project/hgp.html History of Human Genome Project
http://www.biotech.ca/EN/what_history.html
http://www.dnafiles.org/home.html

Safety

Safety goggles and gloves should be worn when handling chemicals and glass.

Duration

30 minutes

Procedure

This activity can be performed by groups of students or as a demonstration, depending upon the class constraints.

1. Prior to the activity, mix 8.8g of sodium chloride and 44g of sodium citrate in 1L water. This mixture will be used in the lab to extract the DNA from the tomato.
2. Cut a small portion of the tomato (one-quarter) into very small pieces.
3. Using a mortar/pestle (or something that can accomplish the same thing), combine the tomato, two tablespoons of the solution from part 1, and _ teaspoon of dishwashing detergent. Grind for one minute.
4. Pour and strain the tomato mixture through 2 sheets of tissue paper into a small beaker or other container.
5. Pour _ tablespoon of the strained mixture into another glass container or test tube.
6. Add _ tablespoon of water.
7. Slowly add 4 tablespoons of cold ethanol – this should remain on top of the water.
8. The DNA will form at the surface where the water and alcohol touch. Use a paperclip to remove the DNA from the mixture.

Extension

Use the web sites provided to share with students the history behind doing the lab activity/demonstration. This activity can serve as a springboard into further discussion of genetic engineering. After all, the first step in doing so is isolating DNA.

Reinforce the concept of density after adding the alcohol to the water. With a lower density, the alcohol "floats" on top of the water. If you are doing this as a demonstration, ask the students to predict what will happen given the density of the two liquids.

Time permitting, be prepared for students to ask to view the DNA under the microscope. This might be a good activity to get the students interested in using the microscope at the beginning of the course.

Activity adapted from Petra M. Frey, www.ucbiotech.org

Student Page

Overview

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Procedure

1. (An extraction solution will be prepared for you before class).
2. Cut a small portion of the tomato (one-quarter) into very small pieces.
3. Using a mortar/pestle (or something that can accomplish the same thing), combine the tomato, two tablespoons of the solution from step 1, and _ teaspoon of dishwashing detergent. Grind for one minute.
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Questions

1. What does the DNA look like?
2. Where would you likely find DNA in a living organism?
3. What do you think was the specific purpose of adding each of the following: (a) lysis solution, (b) tissue paper, (c) alcohol, (d) dishwashing detergent?
4. Why might it be important to be able to isolate DNA in a lab?