

Title: Isolation of DNA from Onion with Excel Spreadsheet of Transcription and Translation

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Subject Area(s): Anatomy and Physiology

Grade(s): 10-12

Description of Lesson: This lab is designed to show how DNA can be extracted from onion cells. It includes a test for the presence of DNA. After the activity, students will use an interactive website to help with learning the processes of transcription and translation. Students will create an excel spreadsheet with formulas to simulate the creation of a protein from DNA.

Length of Lesson: 87 minutes (1 block period)

Student Objectives: Students will describe the structure of DNA, extract DNA from onions, explain the differences between DNA and RNA, and explain how DNA codes for proteins.

Materials (per group): Several pieces of fresh onion, goggles, 100 ml beaker, 2 test tubes, glass rod with rough edges on one end, ice cold 95% ethanol, liquid detergent, non-iodized salt (**sodium chloride**), **fresh pineapple or papaya juice, phenol red indicator**

Procedure:

1. Place a piece of onion in the 100 ml beaker with 10 ml of liquid detergent/salt solution (10 g salt, 90 mL water, and 10 mL liquid detergent). Macerate the onion with the glass rod.
2. Decant the liquid from the mixture into a clean test tube. Add 3 to 4 mL of papaya or pineapple juice. Swirl test tube to mix.
3. Carefully pour 10 ml of ice cold ethanol down the side of the test tube to form a layer on top of the onion mixture. Let stand 3 minutes.
4. Using a twirling motion of the glass rod, slowly move the rough end of a glass rod through the interface of the two layers to collect the DNA and place in a clean test tube with a 4% salt solution.
5. Add 5 drops of phenol red indicator to the DNA solution. The resulting dark pink color should be due to the presence of DNA.

Scientific Explanation: The detergent salt solution breaks down the lipid walls of the cells to release the contents of the cell. The salt shields the negative ends of the phosphates of the cell membrane. The enzymes in the fruit juice will denature proteins that may contaminate the DNA. When the phenol red indicator is added to an acid solution, it produces a pink/red color (DNA is an acid). This confirms the presence of DNA.

Assessment: Students will make predictions and observations about the nature of the DNA they are to isolate. They will measure it and describe it. Students will answer questions about the procedure as to why the onions are macerated (it breaks down the cell wall), why the detergent is added (it breaks down cell membranes composed of lipids), why the cold bath is used (it helps form a precipitate). Students will turn in an excel spreadsheet they created with formulas built in to transcribe a strand of DNA into RNA and transcribe it into a protein. They can use the following website to do an interactive program to help them learn the process http://nobelprize.org/educational_games/medicine/

DNA-Double Helix Game
The Genetic Code game

Missouri and Kansas Standards Addressed:

STANDARD 1, Benchmark 1: The student will demonstrate the abilities necessary to do scientific inquiry.

STANDARD 3, Benchmark 1: The student will demonstrate an understanding of the structure and function of the cell.

STANDARD 3, Benchmark 2: The student will demonstrate an understanding of chromosomes, genes, and the molecular basis of heredity.

STANDARD 3, Benchmark 5: The student will develop an understanding of matter, energy, and organization in living systems

Missouri Science Standards (GLE's):

Strand 7.1

Concept B: Scientific inquiry relies upon gathering evidence from qualitative and quantitative observations

Science understanding is developed through the use of science process skills, scientific knowledge, scientific investigation, reasoning, and critical

Strand 3.3

There is a genetic basis for the transfer of biological characteristics from one generation to the next through reproductive processes

Concept B. all living organisms have genetic material (DNA) that carries hereditary information