

Know the DNA of your onions!

Clientele: 13 years and up

Type of resource: Experiment to do in class.

Objectives

The students will extract deoxyribonucleic acid (DNA) from tissues of a living organism (the onion) using grocery products.

Description of the activity

DNA is the genetic material of all living organisms. Within this master molecule, all the information necessary to create and direct the chemical machinery of life is found. Before being able to study DNA in the context of a university research laboratory, of medical analyses or of criminal investigations, scientists must be able to extract it from the tissue in which it is contained.

Preparatory questions

One week before the activity, either during class or by having your students complete some research, you may go over the following points regarding DNA:

- The location of DNA: where is the DNA located in a tissue and in a eukaryotic cell?
- The composition of DNA: of what is DNA composed?
- The composition of the eukaryotic cell membrane: what is the composition of a cell membrane?
- The protocol for the extraction of DNA: a scientist wishes to extract DNA from a mouse in order to clone it. What steps must he or she follow in order to obtain pure DNA (without proteins, fats and sugars) from the mouse?

Material

- an onion;
- 100 mL of a solution of meat tenderizer (0.05 g / mL water) and dishwashing liquid (0.01 mL / mL water);
- 50 mL 95 % ethanol kept in the freezer or on ice;
- Ice bath;
- cheesecloth;
- glass stirring rod;
- five (5) test tubes;
- 250, 500 and 1000 mL beakers;
- blender;
- scale;
- water bath at 60° C;
- stopwatch.

Steps of the experiment

Working in teams of four (4), the students must extract DNA from an onion. This activity takes fifty (50) minutes and only requires kitchen products and laboratory glassware.

The experiment

1. Chop the onion.
2. Pour the meat tenderizer solution (100 ml) into a 250 mL beaker and heat it to 60°C in a water bath.

3. Add 50 g of chopped onion to the meat tenderizer solution. Stir and let sit for 15 min. at 60°C.
4. Remove the beaker from the water bath and immediately place it on ice for five minutes.
5. Pour the mixture into a blender.
 - a) Blend at low speed for 45 seconds and stop.
 - b) Blend at high speed for 30 seconds and stop.
6. Pour the mixture onto a piece of cheesecloth folded in four and draped over a 500 ml beaker that is already on ice.
7. Gently squeeze off filtrate.
8. Pour about 5 ml of the filtrate into each of the individual test tubes that are already on ice. Place the test-tubes in such a way that they rest at an angle.
9. Pour approximately 10 ml of ice cold 95% ethanol down the wall of the test-tube.

Synthesis questions

- What do you see?
When you see the stringy substance bubbling out of solution (that is the DNA), gently twirl the glass rod in the test-tube to pick up the DNA. It can now be used for analysis or gene manipulation.
- Why was it necessary to chop the onion and mix it with a solution of meat tenderizer?
Answer: Chopping the onion allows its tissues to be broken up so that the meat tenderizer solution can take effect and attack the cell walls and membranes.
- To extract DNA, the nucleus must come out of the cell. Salts and the dishwashing liquid in the meat tenderizer solution degrade the onion's cell membranes, the nuclear membrane and the proteins that would otherwise remain linked to the DNA. What happens to the soap during the extraction of DNA from the onion?
Answer: The cell membrane is composed of proteins and lipids. In the presence of soap, the lipids and proteins are become imprisoned in the soap bubbles and the cell membrane is broken.
- Why does the filtered mixture have to be placed on ice for the remaining steps of DNA extraction?
Answer: Keeping the filtered mixture at the lowest possible temperature, slows the action of the enzymes that are naturally present in the onion cells. In fact, there are nucleases inside cells that could attack and degrade DNA.
- Why use 95% ethanol?
Answer: When the DNA is liberated from the nucleus and the cell, alcohol must be added to recover it. 95% alcohol is less dense than water and so floats on the surface. The lipids and proteins will fall to the bottom of the test tube while the DNA, which is less dense than the proteins and lipids, will rise into the alcohol layer.

***Know the DNA of your onions!* and education programs**

Quebec

Quebec education program
Target clientele: secondary

Training areas

Science and technology

General training areas	Cross-curricular competencies	Disciplinary competencies	Universe
Environment and consumption	Using the information, solving problems.	Using scientific and technological knowledge	Living universe: DNA

Ontario

Ontario's curriculum, from grade 1 to grade 8 – Science and technology, revised edition, 2007

Grade 8

The cell

Main ideas

The cell is the basic unit of life.

Grade 9

Handling of tools and equipment
Health and safety regulations