SCIENCE NORTH SCIENCE NORD
SUDBURY, ONTARIO, CANADA

Extracting DNA from Peas — Grade 8 – Cells

Lesson Plan

Assessment	Quest., observation, worksheet
Cross-curricular	

Big Ideas
- Cells are the basis of life.

Learning Goals
- Learn the basic procedure involved in extracting DNA from the cell's nucleus.
- Assess why DNA extraction could be important to human health or the environment.

Specific Expectations:
1.1 assess the role of selected technologies in enhancing our understanding of cells and cellular processes
1.2 assess the potential that our understanding of cells and cell processes has for both beneficial and harmful effects on human health and the environment, taking different perspectives into account
2.1 follow established safety procedures for handling apparatus and materials
2.6 use a variety of forms to communicate with different audiences and for a variety of purposes
3.1 demonstrate an understanding of the postulates of the cell theory
3.2 identify structures and organelles in cells, including the nucleus, cell membrane, cell wall, chloroplasts, vacuole, mitochondria, and cytoplasm, and explain the basic functions of each

Description:
In this lesson students will learn the basic procedure involved in extracting DNA from the cell's nucleus. They will assess why DNA extraction could be important to human health or the environment.

Materials/Resources:
Conclusions and Analysis worksheet

For each group: heavy duty zippered plastic bag, ¼ cup of frozen peas (thawed), spoon, 10 mL not concentrated dish soap, 90 mL distilled water, 3g table salt, coffee filter or cheesecloth

Also for each group: funnel, 50 mL test tube, ice water, stirring stick, 10 mL ethanol

Optional: warm water bath, meat tenderizer or pineapple juice

Safety Notes: wear safety goggles and glove

Introduction

Start by telling the students that we are going to follow the basic process scientists would use to extract DNA from a cell's nucleus. We are going to be using items we would likely have in our homes.

Go over the three parts of the cell theory (The cell is the basic unit of life. All cells come from pre-existing cells. All living things are made up of one or more cells). Ask them what do they think DNA will look like. (You might have to review DNA a little. Deoxyribonucleic acid. Contains the genetic information of an organism. Provides instructions for making proteins.) Ask students where do they think DNA is found (cell nucleus). Is it always found in the nucleus? (Unicellular organisms do not have nuclei.)

Note: this lab can be done using fruit such as strawberries, bananas or kiwis (kiwis have protease in them which cuts the DNA away from the proteins it is wrapped around), but the white strands are usually pectin instead of DNA.

Action

Prepare the DNA extraction buffer: dissolve the salt in 90 mL of distilled water. Add 10mL of dish soap and mix gently. Make sure there are no bubbles. The buffer may be shared with two or three groups.

Make sure the ethanol is ice-cold. Store it in an ice-water bath until ready for use.

Place the thawed peas in a zippered plastic bag, and mash the peas with the back of a spoon to make them pulpy. Be careful to not break the bag. Add about 15mL of DNA extraction buffer to the peas. It should not be too dilute, but liquid. Knead the buffer with the peas for about 1 minute. Let the mixture sit for 15 minutes. You can also rest the mixture in a warm (600C) water bath for 15 minutes.

If you heated the mixture, cool the mixture by putting it in an ice-water bath for 5 minutes.

Place the cheesecloth or coffee filter into the funnel. Use this to filter your pea mixture into a test tube. You can choose to add a pinch of meat tenderizer or a few drops of pineapple juice (contains protease) to the solute in the test tube. Stir very gently, so as not to break up the DNA. Note: the protease will degrade some of the proteins in the preparation.

Slowly pour the cold ethanol down the side of the test tube so it floats on top of the solute. Leave the tube, undisturbed, for a few minutes. Observe what happens. Note: nucleic acids (DNA and RNA) are insoluble in cold ethanol and will precipitate into the ethanol layer.

Dip the stirring stick into the tube where the pea extract and ethanol layers come into contact with each other. Collect the white strands, and make some observations.

Adapted from:
http://www.shsu.edu/~agr_www/documents/DNALAB.pdf

http://www.ncbe.reading.ac.uk/DNA50/peadna.html
http://www.nuffieldfoundation.org/practical-biology/extracting-dna-living-things
http://learn.genetics.utah.edu/content/labs/extraction/howto/

Consolidation/Extension

Make connections between the steps in the procedure and the reasons for these steps. Have the students fill out the Conclusions and Analysis worksheet (See Link) on DNA extraction. This could be used as a formative or summative assessment.

Go to Learn Genetics from the University of Utah for Frequently Asked Questions and talking points to discuss with your students.
http://learn.genetics.utah.edu/content/labs/extraction/howto/faq/

You can connect this lesson with the lesson on microscopes. The DNA is too small to be seen with a light microscope. Scientists have images of DNA using an electron microscope.
https://www.newscientist.com/article/dn22545-dna-imaged-with-electron-microscope-for-the-first-time/