Environmental Science Institute
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DNA Extraction

Adapted by Duc Tran, Environmental Science Institute, February 2011
Source: "DNA Extraction with Kitchen Chemistry" by Donna M. Bronson and John B. Drake
http://mypages.iit.edu/~smile/mp0498.htm

Grade Level: 6 – 7; may be adjusted for high school
Time: 1 class period
Sample TEKS:
§112.18. Science, Grade 6: 1A, 1B, 2A, 2B, 3A, 4A, 4B, 12A, 12B, 12D
§112.19. Science, Grade 7: 1A, 1B, 2A, 2B, 3A, 4A, 4B, 12C, 12D, 14A, 14C

Overview: In this activity, students will perform a process known as DNA extraction. They will extract DNA from dry split peas.

Objectives:
The students will be able to:
- Demonstrate safe practices during laboratory investigations.
- Investigate the structure of DNA.

Background:
Deoxyribonucleic acid, better known as DNA, is a nucleic acid present in the cells of all living organisms. It is often referred to as the "building blocks of life," since DNA encodes the genetic material which determines what an organism will develop into. DNA is the genetic blueprints passed from parents to offspring.

DNA is composed of chains of nucleotides built on a sugar and phosphate backbone, which wrapped around each other to form a double helix. The backbone supports 4 bases: guanine, cytosine, adenine, and thymine. Guanine and cytosine are complementary, always appearing opposite each other on the helix, as are adenine and thymine. This is critical in the reproduction of DNA, as it allows a strand to divide and copy itself, since it only needs half of the material in the helix to duplicate successfully.

Nucleic acid is capable of self replication and it also contains set of base pairs which come together to create the genetic code, determining things like eye color, height, body structure and many more. The vast majority of DNA in most organisms is non-coding, meaning that it does not appear to have any known function.

Meat tenderizer powder contains enzymes known as proteases (or proteolytic enzymes) that break down peptide bonds between amino acids found in proteins. DNA is surrounded by different type of proteins so by breaking the bonds that hold those proteins together, DNA will become more accessible.

Source:
- http://www.wisegeek.com/what-is-dna.htm
- http://www.wisegeek.com/how-do-meat-tenderizers-work.htm

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Materials (per group):

- ¼ cup dry split peas
- ¼ tsp. of salt
- 1 cup of water
- Blender (optional)
- Dish detergent
- Toothpicks
- Meat tenderizer powder
- 3 Small glass containers
- 1/3 cup of alcohol
- Strainer
- Goggles
- Latex gloves
- Aprons

Activity: The lab should be carried out in groups of 2 students. Since it is a short lab and does not require a lot of time, the groups should be small to ensure that each student has the chance to be part of the lab activity.

Part A

1. Stir mixture of water, peas and salt until salt is dissolved in a glass container.
2. Leave the peas in water until softened (overnight recommended).
3. Put the mixture of peas and salt water in the blender and chop for just a couple seconds. You may use a fork to squash the peas. The mixture should be lumpy, containing small pieces of peas. Too much blending will break up the DNA, making it too hard to see.
4. In a new container, gently mix the peas and water from the blender with a few drops of soap.

Part B

1. Put the pea mixture in the strainer.
2. Filter about 1/3 cup of the liquid into a small glass container.
3. Wet the end of a toothpick and dip it into the meat tenderizer powder.
4. Put the end of the toothpick with the enzymes in the cell mixture and gently stir.

Part C

1. Slowly pour in an equal amount of alcohol.
2. The alcohol will form a layer on top of the cell debris.
3. Watch carefully as the DNA precipitates through the alcohol. The DNA is clear. Small bubbles will attach to the strands as they migrate up through the alcohol. Use the toothpick to gently stir the alcohol layer. Notice how those strands move like snot. The snotty substance is the DNA.

Sampled Evaluation Questions:

1. What part of the cells would be most affected by soap?
2. What type of enzymes is in meat tenderizer that breaks down meat? How do these enzymes function? [Proteolytic enzymes or proteases are in meat tenderizer. These enzymes break the peptide bonds between amino acids found in proteins.]
3. Why does only the DNA, and not other components of the cell, rise to the top after the addition of alcohol?