## Contributors

Dat Hoang and Derek Tucker  
Graduate Student  
Georgia Southern University, GA

Michelle Griffin and Lynne Burkhalter  
Partner Teacher  
Claxton High School, GA

## Intended Audience

<table>
<thead>
<tr>
<th>Level</th>
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<tbody>
<tr>
<td>K-4</td>
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<tr>
<td>5-8</td>
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<tr>
<td>9-12</td>
<td>X</td>
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## Activity Characteristics

<p>| | |</p>
<table>
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<tbody>
<tr>
<td>Classroom Setting</td>
<td>X</td>
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<tr>
<td>Requires special equipment</td>
<td>X</td>
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<tr>
<td>Uses hands-on manipulatives</td>
<td>X</td>
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<tr>
<td>Requires mathematical skills</td>
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<tr>
<td>Can be performed individually</td>
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<tr>
<td>Requires group work</td>
<td>X</td>
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<tr>
<td>Requires more than one (45 min class) period</td>
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<tr>
<td>Appropriate for special needs student</td>
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Introduction

Description

Students get a hands-on opportunity to isolate DNA from split peas using household items.

Abstract

Students extract DNA from split peas using various household reagents. The split peas cells are separated with a blender and detergent is added to lyse the cell and nuclear membranes to release the DNA molecules. A small amount of salt and meat tenderizer is then added to the pea cells/detergent solution. To precipitate the DNA out of the solution, cold ethanol or isopropyl alcohol is added.

Core Themes Addressed

| Microbial Cell Biology |  
| Microbial Genetics |  
| Microorganisms and Humans |  
| Microorganisms and the Environment |  
| Microbial Evolution and Diversity |  
| Other -DNA | X |

Keywords

DNA Isolation, DNA extraction

Learning Objectives

At completion of this activity, learner will

1. Understand the reasoning behind the various steps required to isolate DNA from a cell.
2. Extract and visualize DNA from a split pea.

National Science Education Standards Addressed

Standard A: Science as Inquiry

- Abilities necessary to do scientific inquiry

Standard C: Life Science

- Molecular basis of heredity
Student Prior Knowledge

Students need a basic understanding of what DNA is and where it is located in the cell.

Teacher Background Information

DNA molecules are located within the nucleus of every split pea cell. To isolate DNA, the pea cells are separated using a blender and detergent and salt is added to the pea cell solution. The detergent will disrupt the cell and nuclear membrane and release the DNA molecules. The Na$^+$ ions from the salt will bind to the phosphate groups, which will confer a neutral charge to DNA molecules thus making it easier for them to come together. In the final step, cold alcohol is added, which precipitates DNA out of the solution since DNA is poorly soluble in alcohol.

Class Time

This activity will require a minimum of one 45 minute class period

1. Introduction (5 minutes)
2. Steps 1-5 as a class (20 minutes)
3. Steps 6-8 (10 minutes)
4. Explanation of steps (10 minutes)

Teacher Preparation Time

This lesson will require approximately 10 minutes of preparation time.

1. Setup blender and other materials (5 minutes)
2. Make copies of handouts (5 minutes)

Safety Precautions

The blender can be very dangerous closely watch students while they are working the blender. Lab coats/aprons can be worn to protect clothing from the pea solution.
Materials and Equipment (Per class/ or student)

1. 1 Blender (per class)
2. 1 Strainer (per class)
3. ½ cup split peas (per class)
4. 1/8 teaspoon salt (per class)
5. 1 cup cold water (per class)
6. 30 ml of liquid detergent (per class)
7. 1 test tube (per student)
8. Pinch of meat tenderizer (per student)
9. 10 ml of ethanol or isopropanol (per student)

Methods

Steps 1 - 5 complete as a class.

1. Put in a blender:
   1/2 cup of split peas (100 ml)
   1/8 teaspoon table salt (less than 1 ml)
   1 cup cold water (200 ml)

2. Blend on high for 15 seconds. The blender separates the pea cells from each other, so you now have a really thin pea-cell soup.

3. Pour your thin pea-cell soup through a strainer into another container

4. Add about 2 tablespoons (30ml) of liquid detergent and swirl to mix.
5. Let the mixture sit for 5-10 minutes.
6. Pour the mixture into test tubes, each about 1/3 full.
7. Add a pinch of enzymes (meat tenderizer) to each test tube and stir gently.
8. Tilt your test tube and **slowly** pour 70% isopropyl alcohol into the tube down the side so that it forms a layer on top of the pea mixture.

References

This activity was modified from Utah Genetics: [http://gslc.genetics.utah.edu](http://gslc.genetics.utah.edu)
Answers to Student Handouts

1. Why do we start by grinding up the peas in a blender?
   We grind up the peas in a blender to separate the cells and release the DNA.

2. In what part of the cell is the DNA located?
   DNA is located in the nucleus.

3. What is the purpose of the liquid detergent?
   The liquid detergent causes cell lysis.

4. What is the purpose of the enzymes (meat tenderizer)?
   The enzyme unravels the DNA from the proteins.

5. Why do we add the alcohol?
   Alcohol is added to precipitate DNA out of solution.
Introduction

DNA is found in most living things, this activity will allow you to complete a DNA extraction using everyday household items.

Student Background Knowledge

The extraction of DNA is important in many science fields today. Biologists use DNA to infer relatedness among species to better understand how new species have evolved. Immunologists may study an animal’s DNA to check for the presence or absence of a harmful disease. Crime scene investigators can use DNA left behind at the scene to determine the guilt or innocence of a suspect.

Vocabulary

**DNA**: deoxyribonucleic acid, molecule that stores genetic information in all organisms.

**Cell**: the functional unit of all known living organisms.

**Cell Membrane**: double layer of phospholipids that forms a boundary between the cell and the surrounding environment and controls the passage of materials into and out of the cell.

**Nucleus**: Organelle composed of a double membrane that acts as a storehouse for most of a cell’s DNA

**Lipid**: nonpolar molecule composed of carbon, hydrogen, and oxygen; includes fats and oils.

**Protein**: polymer composed of amino acids linked by peptide bonds; folds into a particular structure depending on bonds between amino acids.

**Enzyme**: protein that catalyzes chemical reactions for organisms.

Safety Considerations

The blender can be very dangerous only operate with the top on and the teacher’s permission.
Materials Checklist

<table>
<thead>
<tr>
<th>Item</th>
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<tbody>
<tr>
<td>½ cup Split peas</td>
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<tr>
<td>1/8 tsp salt</td>
</tr>
<tr>
<td>Blender</td>
</tr>
<tr>
<td>Strainer</td>
</tr>
<tr>
<td>30 mL Liquid laundry detergent</td>
</tr>
<tr>
<td>A pinch of meat tenderizer</td>
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<tr>
<td>70% isopropyl</td>
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</table>

Procedure (Steps 1 - 5 will be completed as a class)

1. Put in a blender:
   - 1/2 cup of split peas (100 ml)
   - 1/8 teaspoon table salt (less than 1 ml)
   - 1 cup cold water (200 ml)
2. Blend on high for 15 seconds. The blender separates the pea cells from each other, so you now have a really thin pea-cell soup.
3. Pour your thin pea-cell soup through a strainer into another container.
4. Add about 2 tablespoons (30ml) of liquid detergent and swirl to mix. The detergent removes cell membrane lipids to expose the DNA.
5. Let the mixture sit for 5-10 minutes.
6. Pour the mixture into test tubes, each about 1/3 full.
7. Add a pinch of enzymes (meat tenderizer) to each test tube and stir gently. Be careful! If you stir too hard, you’ll break up the DNA, making it harder to see. The enzymes help remove proteins from the DNA.
8. Tilt your test tube and slowly pour 70% isopropyl alcohol into the tube down the side so that it forms a layer on top of the pea mixture. You do NOT want the two liquids to mix. Pour until you have about the SAME amount of alcohol in the tube as pea mixture. Alcohol is less dense than water, so it floats on top. Look for clumps of white stringy stuff where the water and alcohol layers meet. DNA is a long, stringy molecule. The salt that you added in step one helps it stick together. So what you see are clumps of tangled DNA molecules! DNA normally stays dissolved in water, but when salty DNA comes in contact with alcohol it becomes undissolved. This is called precipitation. The physical force of the DNA clumping together as it precipitates pulls more strands along with it as it rises into the alcohol.
Student Worksheet

Split Pea DNA Isolation

Name: ___________________________ Block: __________

1. Why do we start by grinding up the peas in a blender?

2. In what part of the cell is the DNA located?

3. What is the purpose of the liquid detergent?

4. What is the purpose of the enzymes (meat tenderizer)?

5. Why do we add the alcohol?