

# Extracting DNA in Your Kitchen

## Teacher Section

**Overview** DNA is the genetic material that has all the information about a cell. If the cell has a nucleus, the DNA is located in the nucleus. If not, it is found in the cytoplasm. DNA is a long molecule formed by two strands of genes. DNA carries two copies—two “alleles”—of each gene. Those alleles can either be similar to each other (homozygous), or dissimilar (heterozygous). We’re going to learn how to extract DNA from any fruit or vegetable you have lying around the fridge.

**Suggested Time** 30-45 minutes

**Objectives :** Students will extract DNA from vegetable or fruit matter, identify DNA, and examine the DNA under the microscope. Many characteristics of an organism are inherited from the parents. Some characteristics are caused by, or influenced by, the environment. DNA is the genetic material of living organisms, and is located in the chromosomes of each cell. Living organisms have many different kinds of molecules including small ones such as water and salt, and very large ones such as carbohydrates, fats, proteins and DNA.

### Materials (per lab group)

- pumpkin OR apple OR squash OR bananas OR carrots OR anything else you might have in the fridge
- dishwashing detergent
- 91% isopropyl alcohol
- coffee filter and a funnel (or use paper towels folded into quarters)
- water
- blender
- clear glass cup

### Lab Preparation

1. Helpful hints for the teacher:
  - Make sure students don’t over blend the fruit or veggie, or they will destroy the DNA strands.
  - If paper towels are too large for the funnel, you may want to cut them to fit ahead of time. If not, students can cut them during the experiment.
2. Print out copies of the student worksheets.
3. Read over the Background Lesson Reading before teaching this class.
4. Watch the video for this experiment to prepare for teaching this class.

### Background Lesson Reading

**DNA** (short for deoxyribonucleic acid), the double-helix shaped molecule found in all cells, answered the question of what these “inheritance factors” were. DNA is often thought of as the cell’s “recipe book.” DNA holds the instructions for building proteins the same way recipe books hold the instructions for making dishes.

Veggies and fruits are made of water, cellulose, sugars, proteins, salts, and DNA. To get at the DNA, you first need to get inside the cells and separate it out from the other parts. The blender breaks up the fibers that hold the cells together.

The salt and detergent are added next so they can break down the cell walls. Cell walls of plants are made of cellulose. Inside that cellulose is another cell wall (cell membrane). This membrane has an outer layer of sugar and an inner layer of fat.

The detergent is a special molecule that has an attraction to water and fats (which is why it works to get your dishes clean). The end of the molecule that is attracted to fat attaches to the fat part of the cell membrane. When you stir up the mixture, it breaks up the membrane (since the other end likes water). It wedges itself inside and opens the cell up... which causes the DNA to flow out.

Since DNA dissolves in water, it stays in the vegetable juice. When alcohol is added, the DNA “comes out” of solution as the ghostly white strands seen at the bottom of the alcohol layer.

## Lesson



1. Hold up a carrot and ask students: “What is this made of?”
2. As students give answers, or if they get stuck, direct them by asking, “Do you think there is water in here? Fat?” etc until you name the “ingredients” of a carrot: water, cellulose, sugars, proteins, salts, and DNA.
3. Explain that fruit and vegetables are made of water, cellulose, sugars, proteins, salts, and DNA. Today we are going to take a closer look at these elements of a carrot, especially DNA.
4. Ask your students: What can we do in order to see what something is made of? (examine it closely, take it apart)
5. Explain in this activity, we are going to take the carrot apart, by separating the parts listed. Then we are going to examine the DNA strands under a microscope.
6. Explain that DNA is a long molecule, which spirals like a staircase.
7. DNA carries the “recipes” of a cell. These “recipes” are for making a protein. These recipes, in scientific terms, are called genes. So, DNA carries genes. The genes are how traits are copied from one generation to the next.
8. To take the carrot apart, we are first going to break the fibers. We will do this with the blender.
9. Then, to further break down the carrot, we will use detergent to pull open the cells, so the DNA can flow out of the cell. Detergent has a special molecule to break open the cells. On one end, this molecule pulls on (or is attracted to fat), and on the other end, it is attracted to water. By pulling the cell membrane apart in this way, detergent molecules can get inside, and “hold the door open,” so the DNA strands can flow out.
10. DNA dissolves in water (here, the carrot juice). Finally, the alcohol pulls the DNA out of the juice, so we can see it under the microscope.

## Experiment

1. Review the instructions on their worksheets and then break the students into their lab groups.
2. Hand each group their materials and give them time to perform their experiment and write down their observations.
3. First, grab your fruit or vegetable and stick it in your blender with enough water to cover. Add a tablespoon of salt and blend until it looks well-mixed and like applesauce. Don’t over-blend, or you’ll also shred the DNA strands!
4. Pour this into a bowl and mix in the detergent. Don’t add this in your mixer and blend or you’ll get a foamy surprise that’s a big mess. You’ll find that the dishwashing detergent and the salt help the process of breaking down the cell walls and dissolving the cell membranes so you can get at the DNA.

5. Place a coffee filter cone into a funnel (or use a paper towel folded into quarters) and place this over a cup. Filter the mixture into the cup. When you're done, simply throw away the coffee filter. Note: Keep the contents in the cup!  
Step 4: *Be careful with this step!* You'll very gently (no splashing!) pour a very small amount of alcohol into the cup (like a tablespoon) so that the alcohol forms a layer above the puree.
6. Observe! Grab your compound microscope and take a sample from the top. You'll want a piece from the ghostly layer between the puree and the alcohol – this is your DNA.

### Exercises

- What are fruits and veggies made of? (water, cellulose, sugars, proteins, salts, and DNA.)
- What does DNA stand for? (deoxyribonucleic acid)
- What is DNA? (DNA is often thought of as the cell's "recipe book." DNA holds the instructions for building proteins the same way recipe books hold the instructions for making dishes.)
- What is a gene? (Genes are individual codes for making proteins that are passed on from generation to generation.)
- Describe the structure of DNA. (It is a double-helix shaped molecule found in all cells. It is in the form of a long double strand, like a spiral staircase.)

**Closure** Before moving on, ask your students if they have any recommendations or unanswered questions that they can work out on their own. Brainstorming extension ideas is a great way to add more science studies to your class time.

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## Student Worksheet

Name \_\_\_\_\_

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**What to Learn** We’re going to learn how to extract DNA from any fruit or vegetable you have lying around the fridge. DNA is the genetic material of living organisms, and is located in the chromosomes of each cell. Living organisms have many different kinds of molecules including small ones such as water and salt, and very large ones such as carbohydrates, fats, proteins and DNA.

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Step 4: *Be careful with this step!* You’ll very gently (no splashing!) pour a very small amount of alcohol into the cup (like a tablespoon) so that the alcohol forms a layer above the puree.
4. Observe! Grab your compound microscope and take a sample from the top. You’ll want a piece from the ghostly layer between the puree and the alcohol – this is your DNA.

**Extracting DNA in Your Kitchen Data Table**

<b>Fruit or Veggie</b>	<b>Draw a Picture of the DNA Under the Microscope</b>

## Reading

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## Exercises

1. What are fruits and veggies made of?
2. What does DNA stand for?
3. What is DNA?
4. What is a gene?
5. Describe the structure of DNA.

**Answers to Exercises: Extracting DNA in Your Kitchen**

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2. What does DNA stand for? (deoxyribonucleic acid)
3. What is DNA? (DNA is often thought of as the cell's "recipe book." DNA holds the instructions for building proteins the same way recipe books hold the instructions for making dishes.)
4. What is a gene? (Genes are individual codes for making proteins that are passed on from generation to generation.)
5. Describe the structure of DNA. (It is a double-helix shaped molecule found in all cells. It is in the form of a long double strand, like a spiral staircase.)