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DNA Extraction

You can see and touch DNA!

These simple steps will isolate DNA from any living thing *(we'll use kiwi fruit)*

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Materials Needed

- Kiwi
- Table salt
- Bottled water
- Liquid detergent (dishwashing best)
- Spoon
- Clear cup
- Cheesecloth or coffee filter
- Cold isopropanol (rubbing alcohol)

Optional materials:

- Elastic band or tape
- Glass stir stick
- Ice to cool isopropanol (can put in freezer)

Image source:
Delaware Biotechnology Institute

DNA: Deoxyribonucleic Acid

DNA is found in all living things, including the fruit we eat. We'll use the kiwi fruit in our description but you can use other living things. Kiwi fruit work well because they have lots of cells AND they have lots of chromosomes (DNA within each cell) so we should see lots of DNA at the end of our protocol.

Note: You can technically use this protocol for isolating DNA from human cells but you need lots of tissue – and we don't recommend taking chunks of friends or family.

Prep Work

- Make the salt solution:
  - Mix 1 tsp of table salt in 100 mL of water. Stir to dissolve
- Make the soap solution:
  - Mix 3 mL (3/4 tsp) of liquid soap with 27 mL (2 tbsp) water. Mix gently, trying to avoid bubbles!

Do I have to use kiwi fruit?

No! You can use other fruits: bananas and strawberries work well. Blueberries aren't the best source – can you think of an explanation?

Start the experiment on the next page…

Steps 1 to 3

DNA is inside the nucleus within the cell. We need to break apart the fruit into cells and then break open the cells to get at the DNA

Step 1:

Scoop out the kiwi flesh into a Ziploc bag and mash for 2 minutes.

Mashing helps to break apart the cells and loosen the tough cell wall

Step 2

Add 10 mL of salt solution and grind for at least 5 minutes.

TIP! Use your weight and strength to really mash it up!

The salt solution will help precipitate proteins and carbohydrates away from the DNA

Prep your equipment

We now need to set up a filter. You can use either a coffee filter or 3 layers of cheesecloth.

Place your chosen filter on top of a clear cup. It should cover the entire top!

Attach with an elastic band (above) or tape the filter around the cup.

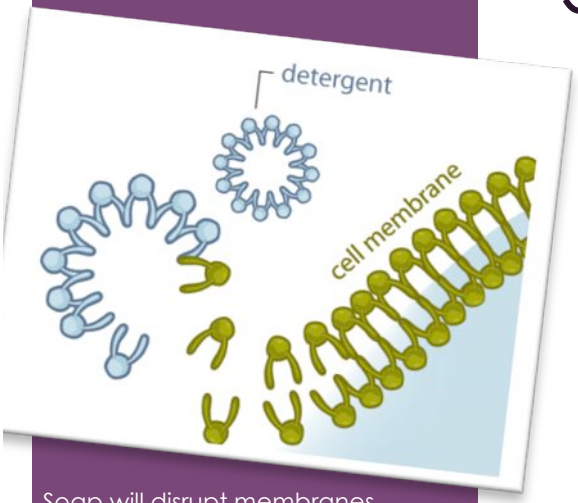
FUN FACT! The DNA in one human cell is about 1.8 metres! Think about it…our chromosomes lined end to end is almost 6 feet long inside cells that we can't see with the naked eye.

Step 3

Pour the kiwi mash through the filter. Let the solution drip into the cup.

TIP! You can get extra juice by squeezing the kiwi through the cloth. *(Ever think you would 'milk' kiwi?)*

Steps 4 to 6



Soap will disrupt membranes
Image source:
Utah Genetic Science Learning Centre

Step 4

Add 3 mL of the soap solution to the filtered liquid.

Swirl gently to mix. Do not shake or stir to vigorously, you want to avoid creating many bubbles.

Soap creates holes in the cell and nuclear membranes

DNA will flow out of the broken cells

Step 5

Gently Pour 2 volumes (about 25 mL) of cold isopropanol down the side of the glass.

TIP! Keep the isopropanol cold. The cold slows down proteins (enzymes) that like to chew up DNA so there is more DNA to precipitate out.

TIP! Pour the isopropanol down the length of a spoon into the kiwi juice. Or, tilt he glass and pour it down the edge. This way it will form a layer on top of the kiwi juice.

Step 6

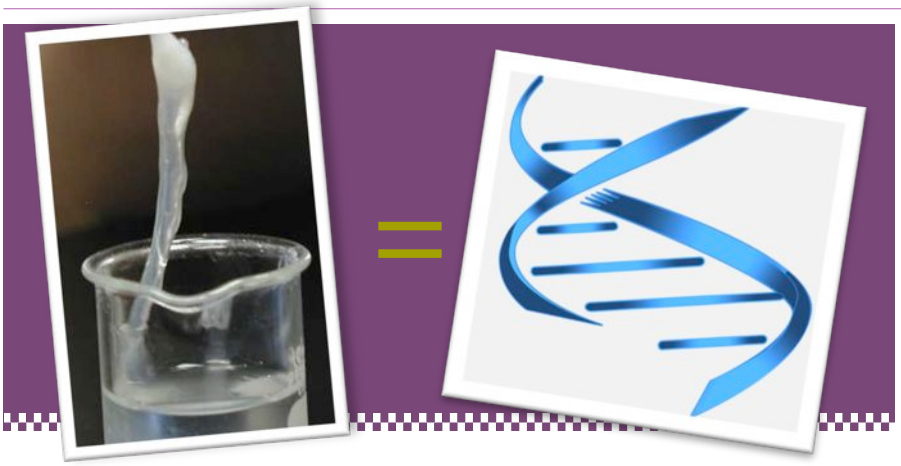
Let the isopropanol-kiwi layers sit. The DNA will precipitate from the juice into the alcohol.

TIP! Use a wooden stir stick or glass rod to spool some DNA out of the cup!

DNA is not soluble in alcohol so it will precipitate out, away from the soap and salt solution

Congratulations!

You have isolated DNA!



FAQs

DNA extraction

These are some of the questions that we've answered after doing DNA extractions with various audiences.

Why don't I see the classic double helix?
We need a special microscope to see the double helix because our DNA is so thin. You have isolated LOTS of DNA (from millions and millions of cells) so it has clumped together. It's like we are looking at a snowball – the fancy structure of a snowflake is within that ball of snowflakes but we only see the clump of snow.

How do we know this is DNA?
There are other cellular materials stuck to the DNA, such as some proteins. To isolate pure DNA we would have to do another experimental step, to remove everything else (remove all proteins, lipids, membranes). In a lab we could also do more testing using specific stains and sophisticated techniques to confirm this is DNA.

Could we use this DNA for experiments about kiwi fruit?
Technically, yes. This is the same protocol (recipe) used in many labs but labs use more sophisticated materials and equipment. Therefore our DNA may have extra things that could interfere with next steps of analysis.

Could we clone a new kiwi fruit with this DNA?
Hmmm, not really. Cloning of living organisms requires a single, complete genome (a genome is all of the DNA from one nucleus from one cell). The DNA we've extracted from kiwi is from millions of cells: so we have millions of genomes. It would be really difficult to isolate a single genome from our extracted DNA. . For more information on all the steps involved in cloning check out: http://j.mp/hextYI

Isn't this also RNA?
Yes, this is a protocol for isolating nucleic acids. To get pure DNA, we would have to do further purification steps.

How long will my DNA sample last?
The DNA you extracted from kiwi could last for years when stored in alcohol. Shaking the container can break the DNA into smaller pieces, making it harder to see. However, this extraction isn't as sophisticated as those done in professional labs so we may have extra things (e.g. enzymes) that can chew up our DNA and the sample can disappear over time.

If you have more questions, please email anderson@genegeek.ca

Why do some things give more DNA?
The biggest factor is the ratio of DNA to cell volume, and how many cells you have to take DNA from. DNA is found in the nucleus of a cell (plant and animal cells anyway, bacteria do not have nuclei). If your sample has many cells, you will have many nuclei, and therefore lots of DNA. Also, if the genome is large there will be more DNA in each nucleus. The human genome consists of 46 chromosomes (23 from mom, 23 from dad) but the kiwi genome contains 174 chromosomes! That's a lot of DNA in one nucleus. Blueberries have very few cells, compared to kiwi, so you will get less DNA if you tried to extract it from blueberries. Lots of cells and a large genome are a good combination for DNA extraction.

The 2003 two pound coin commemorated the 50 year anniversary of discovering the structure of DNA