SCIENCE AT HOME

DNA EXTRACTION

GRADE: **11**

SBI3U, SBI3C
SUBJECT: Biology
STRAND: Genetics
TOPIC: DNA extraction from cells
EXPECTATIONS: A1.1, D1.1, D2.1, D3.2, D3.3
VIDEO: youtu.be/BEUjyDvBnRA

INTRODUCTION:

DNA is found in nearly every cell in your body and it contains the blueprint for creating you. Using a few simple tools and ingredients from around your home, you are now going to extract some DNA from another organism...

ACTIVITY: Extract DNA from food in your kitchen

TIME: 10 minutes

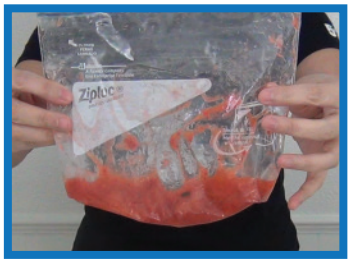
SAFETY: Don't eat any part of your experiment after you begin!

WHAT YOU NEED:

- Measuring cup
- Measuring spoons
- Sealable plastic bag
- Fruit source of DNA (anything that's easy to squish, like strawberries or bananas)
- ¼ cup water
- 1 tsp liquid dish soap
- 1 tsp salt
- Coffee filter (or cheese cloth)
- Funnel (or something to hold the coffee filter)
- Clear, narrow glass jar (a spice jar, a baby food jar or a small drinking glass)
- Isopropyl alcohol, rubbing alcohol or any liquid containing at least 40% alcohol (enough to fill your jar about ¼ full)
- Toothpick or skewer
- Kitchen scale (optional)

WHAT YOU DO:

- Put the alcohol in the freezer to chill for at least 30 minutes.
- Put the fruit into the plastic bag, then mash it up with your hands for about two minutes.



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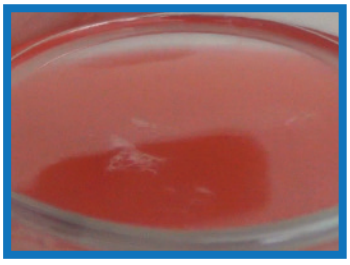
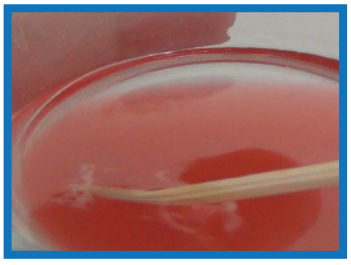
WHAT YOU DO (continued):

- Mix the water, dish soap and salt. Add 3 tbsp of this solution to your food mash, and mix it together in the bag for one minute.

- Put the filter into the funnel and the funnel into the jar. Pour the mixture from the bag into the filter, and let it drip into the jar until it's ¼ full.

- Now get your chilled alcohol. Tilt the jar and pour the alcohol slowly down the side, until you have roughly equal volumes of alcohol and fruit mixture in the jar. Try to keep the layers from mixing.





- Set the jar on a flat surface and don't move it. Look closely at what is happening at the interface where the two liquids meet.
- Look carefully and you should see white strands of DNA start to emerge. Dip your skewer into the DNA — it should stick to the skewer as you turn it — and gently reel it out.

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WHAT YOU DO (continued):

- If you have a scale, measure the mass of DNA you extracted. (The easiest way to do that is to weigh the skewer both with and without DNA on it.)

WHY THIS MATTERS:

DNA extraction is the first step in a lot of work in genetics, including genetic testing and genetic engineering. Scientists break open the cells and nuclear membranes of living things, or the capsules of viruses, and then separate and purify the DNA (or viral RNA) found inside.

Scientists can then "sequence" the DNA to work out the underlying code. There are many reasons a scientist might want to know the sequence of a genome: to learn about the evolution of a species, to know more about an organism's phenotype or to identify genetic mutations that cause disease. This process is being used in the fight against COVID-19, for instance. Extraction, purification and sequencing of the RNA in SARS-CoV-2 — the virus that causes COVID-19 — has revealed that it likely evolved in bats before infecting humans. Understanding where the virus came from might help us fight its spread.

Many medical treatments use DNA extraction as a starting point, too. One treatment for diabetes, for instance, involves genetically modifying bacteria to produce insulin. (People with diabetes either don't produce enough insulin or can't respond properly to it, and some need to inject it.) Scientists made a copy of the human insulin gene, inserted it into a piece of bacterial DNA called a "plasmid," then placed that back into the bacterium, a process known as "transformation." Then they used the bacterium as a factory to mass-produce insulin — which people with diabetes can take to stay healthy.

It all starts with a simple DNA extraction, like the one you can do in your kitchen.

TAKING IT FURTHER: Tinker

Now try experimenting on your own. See which variables you can change to extract more DNA from the same amount of starting material. (You will need to find a way to measure how much material you start with and how much DNA you collect.) Remember, a good experiment only changes one variable at a time. Keep track of what you change and how that affects the amount of DNA you get.

Challenge your friends! See who can develop the best protocol!

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HINTS:

Think about your "reagents" — the chemicals you are using to do the extraction. What does each of them do? Do you think adding more or less of anything would make a difference? Is there anything else you could do or add to improve the protocol?

Some plants are "polyploid" — meaning they have more than two sets of chromosomes in each of their cells. Some can have up to 10 copies of each chromosome in each cell. That's a lot of DNA! Look up the "ploidy" — number of sets of chromosomes — that different plants have. Can you use this information to maximize your DNA yield?

Could you use vegetables, grains or legumes? Does the concentration, temperature or type of alcohol affect how much DNA you get?

MORE ONLINE:

Make origami DNA:
https://www.yourgenome.org/activities/origami-dna

Find out how insulin is made in bacteria:
https://www.nlm.nih.gov/exhibition/fromdnatobeer/exhibition-interactive/recombinant-DNA/recombinant-dna-technology-alternative.html

Learn about observable human phenotypes:
https://learn.genetics.utah.edu/content/basics/observable/

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