

Green Genes: a DNA Curriculum

Massachusetts 4-H Program

Activity #3: SWISH AND SPIT: Isolate Your Own DNA

Time: 45-60 minutes

Introduction to Group:

Ask the students to review what they have learned from the last two activities. Mention that the next step is looking at their own DNA. Even though the DNA structure is hard to see with the naked eye, because the human genome (DNA sequence) is so long and there is an abundance of DNA in our cells, we can extract it and it is visible to the naked eye. You can ask the group why and when DNA is extracted in real life.

Goals:

- Conduct a scientific experiment.
- Compare the process they used to extract their DNA with what professionals do.

Group Size: 2 youth per group

Supplies:

- (2) teaspoons of 0.9% salt solution (2 teaspoons of table salt mixed in one quart or liter of water) *Gatoraid can be substituted.*
- 1:4 dilution (25% strength) of the dishwashing detergent (Dawn, Woolite, Palmolive) *1 part soap and 3 parts water*
- (1-2) tubes containing cold alcohol (ethanol or isopropanol/rubbing alcohol). Chill in freezer until ready to use.
- (2) self-laminating squares, 2-1/2" x 2-1/2" - optional
- (1) 1"-square piece stiff black paper or cardboard - optional
- Glass rods, plastic sticks, coffee stirrers, toothpicks or similar "tools" to spool DNA
- (1) 90ml **new** plastic cups for swishing and spitting – *3or 5oz bathroom cups work well*
- (2) 15ml screw-cap plastic test tubes -*cups can be used with 15ml marked on side*
- (1) 50ml screw-cap plastic test tube- *a clear film canister can be substituted*
- (1) glass stirring rod or wood coffee stirrer

Preparations:

Make up and label all solutions and supplies. Put alcohol/ethanol in tubes and place in freezer or cooler with dry/ regular ice. (Depending on the group, your time, and facility, you can have the youth measure the alcohol and place in freezer.)

Have several **extra** tubes of alcohol on hand

***Make sure all solutions and test tubes are labeled correctly. Caution: Rubbing alcohol is poisonous.**



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Teaching Tips:

- This is a wonderful hands-on activity that lets people isolate their own DNA and see it with their very own eyes. The process itself is absolutely safe, painless and inexpensive. We found the original protocol in the Teacher's Guide pages on the NOVA "Cracking the Code" Web site, and modified the DNA isolation procedure to better accommodate our needs. For example, we found that we can replace the ethanol, which is difficult for most people to obtain, with rubbing alcohol available at the grocery store. This "user friendly" lab activity has been used to successfully isolate DNA from people of all ages, from children to grandparents and retired folk, and they do all the work!
- The only downside is the relatively small yield of DNA obtained from the cheek cells harvested inside the mouth. This makes handling the DNA very tricky, especially at the point where the students try to transfer the DNA to a lamination card. Higher yields of DNA can be isolated from other sources (such as vegetables) but we find that most people prefer to isolate the DNA from their own cells.
- If you prefer you can have students first extract the DNA from fruit such as bananas, strawberries or kiwi. To prepare the plant DNA you will need to puree the fruit by mashing it with a fork and your salt solution to aid the process. Add about 2 tablespoons to soap solution and mix gently then filter using a coffee filter. Filtration will take a while, but once filtered add alcohol to about 10-15ml of the filtered fruit solution. Wait and then try to extract using the same instruction as for Swish & Spit.
- You can also increase the strength of the soap solution or use full strength if experiencing low yields.
- Activity should not be done after youth have eaten abrasive foods like chips, granola bars, or pretzels. (They will generally have a lower yield of cheek cells.)

Directions:

- People will work in pairs today.
- Each pair will process only one DNA sample at a time.
- Everyone will isolate their own DNA by the end of class.
- Be sure to follow the instructions carefully.
- If you make a mistake, it's not a problem. Just ask for help right away!

Each person should have:

- (1) plastic cup with 10ml salt solution (0.9%)
- (1) large tube with 5ml detergent (soap) solution (25%)

Wait! Everyone should start at the same time!

1. Pour everything in the plastic cup marked "salt" into your mouth. Swirl the salt solution around inside your mouth for 30 seconds.
2. Spit the salt solution back into the plastic cup marked "salt."
3. Carefully pour the contents of the plastic cup (your salty saliva) into the large screw cap test tube marked "soap."
4. Close the tube with the screw cap so that it does not leak. Gently tilt the soap tube end-to-end for 3 minutes. *Do not shake the soap tube. (This is an opportunity to ask them questions or review while you are waiting.)*



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5. Open the soap tube and hold it at a slight angle. Carefully pour the cold ethanol (ETOH) or rubbing alcohol from one small screw cap tube down the inside wall of the soap tube. The cold ethanol (ETOH) or rubbing alcohol should make a layer on top of the soap tube.
6. Set the ETOH/soap tube into a rack on the bench for 1 (one) minute.
7. Carefully place a glass rod or wood stirrer into the top (ETOH) layer but not into the soap layer. Slowly stir in one direction. Do not mix the soap with the top layer! You want to wind long DNA strands around the stick. (You probably can't see the DNA yet.)
8. Slowly twist the rod/stirrer in the top layer for several minutes going in one direction. You should see the strands of DNA wrapping around the rod. Remove the glass rod from the ETOH/soap tube and place it into the second small screw cap tube of ethanol (ETOH) or rubbing alcohol. (*Optional – place DNA directly on a small black piece of cardstock or posterboard. Clear scotch tape or packing tape can be used to secure DNA sample after drying.*)

Debriefing/Reflecting:

- What is the purpose of the salt solution?
- Why did you need to use detergent?
- Why do we use cheek cells?
- What did you observe happening in the test tube?
- Why do you *not* shake up the contents in Step 4?
- What happens when you stir the mixture with a glass rod? Why?
- Why is the DNA visible?

Apply:

- Where else can you get DNA?
- How is DNA used in forensics and anthropology?

Go further:

- Check the library or the Web for a copy of NOVA's "Cracking the Code of Life," originally aired on April 17, 2001.
- Try this activity at home.
- Try to extract DNA from vegetables and fruits; try bananas, onions, or strawberries.
- Talk to a law enforcement officer about DNA evidence.
- Look at the paper or the MyDNA website for information or articles on DNA tests, evidence, etc.
- Explore topics on the human genome:
 - Biotechnology: DNA and genes in action.
 - Criminal justice and DNA.
 - DNA fingerprinting: identification in forensics.
 - DNA laws and public policy: DNA databases for non-violent crimes.
 - Genome treasure hunt: Iceland's DNA database story.



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- Identification: victims of 9/11 - Most (2/3) were never recovered.
- The Human Genome Project: Who did it and why? The race.
- Law and justice: DNA from the OJ trial goes to the Smithsonian...why?
- Public opinion and the role of the popular press: who to believe?
- The Innocence Project: DNA testing exonerates over 100 convicts.

Reference:

Modified from NOVA Online by M. Fitzgerald-Hayes and Frieda Riechsman: NOVA Cracking the Code of Life (Printable Activity) www.pbs.org/wgbh/nova/teachers/activities/2809_genome.html)

Article: The Amateur Scientist: Spooling the Stuff of Life by Shawn Carlson (*Scientific American*, Sept. 1988, pg 96-97)



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