

DNA Bracelet Activity / DNA extraction

SUBJECT: Biology/ Genetics

CONCEPTS: DNA, relatedness, genetics

LEARNING OBJECTIVES

- All living things have DNA.
- DNA is a special code in your body that contains all the information about your body – the color of your hair and eyes for examples. Your DNA is stored in your cells.
- Each person's DNA is unique. Your DNA makes you unique and different from everyone else.

PART 1: DNA bracelet

MATERIALS

- String or pipe cleaners
- Beads (At least as many beads per color as number of students, 20 students 20 red, blue, green... etc beads)
- Bowls (to keep the beads in)
- "Station" mats

BACKGROUND INFORMATION

- DNA is a special type of molecule that holds your body's genetic information. This means it is like a "recipe book" on how to make you!
- Each person's DNA is unique; it is different from everyone else's. Some types of twins (identical twins) share the same DNA.
- Your DNA helps your body make you, you. It controls things like hair color, eye color, whether you are right or left handed, and all kinds of other traits.
- One piece of evidence that suggests that all living things are related evolutionarily is the fact that they all have DNA.

ACTIVITY

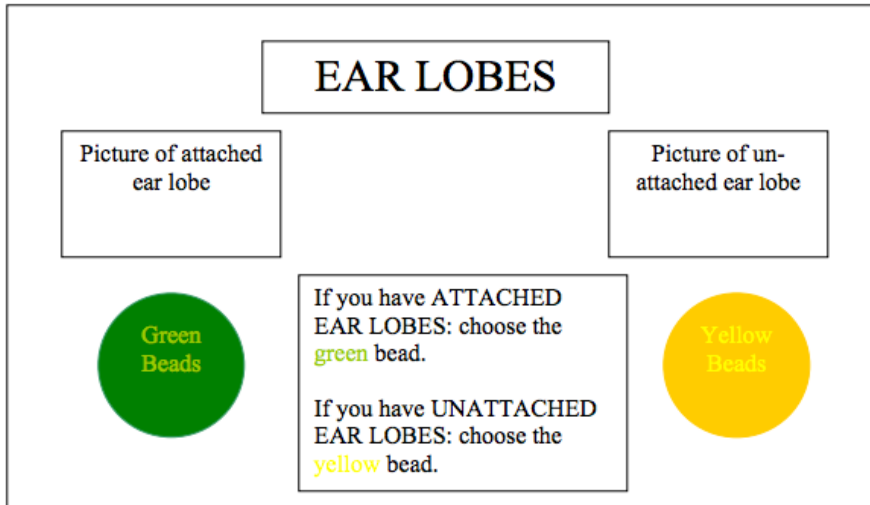
1. Inform students that they will be learning about a special molecule called DNA. Tell students that DNA is special because it is what makes everyone different and unique!
 - Let your student know that:
 - o Everyone and every living thing has DNA
 - o Each person's DNA is unique; it is different from everyone else's. Some types of twins (identical twins) share the same DNA.
 - o DNA is like a recipe book that tells your body how to make you, you!
2. Next, tell students that DNA controls traits (special characteristics) like hair color, eye color, or handedness.
 - Tell the children to look around and notice the differences between themselves and their classmates. The differences are due, in part, to DNA. Now pass out the pipe cleaners to the students.

3. Instruct the students to visit each of the 8 stations. Each station has a different “gene”. Tell the students to identify which “version” or “allele” of the gene they have (i.e. right or left handed, dimples or no dimples, etc.)
 - Then have the students pick the bead which represents the trait they have (i.e. green bead for attached ear lobes, yellow bead for un- attached earlobes.)
 - Make sure the students put their beads on in the correct station order.
4. Once the students have visited all of the stations, have them return to their seats and look at their completed bracelets.
 - Have them observe the similarities and differences between their bracelet and their classmates’.
5. Inform students that people who are related share more DNA than people who are not related. That’s because DNA is passed down from your parents.
 - If you have twins or siblings in your class, this is a good time to compare their bracelets. (Their bracelets should be more similar to each other than to other students’.)
6. Ask students to give examples of what they have learned and how it relates to their bracelet.
 - Ex: “Does your bracelet match anyone else’s exactly?”
 - “What are some differences you see between your bracelet and your friends’ bracelets?”
 - Ask the students to figure out what fraction or percentage of their bracelet is the same as their neighbor’s.
7. Review the important information that was given at the beginning of the activity.
 - All living things have DNA.
 - DNA is a special molecule in your body that contains all the information about your body – the color of your hair and eyes for examples.
 - Each person’s DNA is unique. Your DNA makes you unique and different from everyone else.

The stations can be as follows: (Make sure the beads are put on the bracelet in this order)

1. Hair Color- - - - - blonde, brown, red, black- - - - - 4 colors needed
2. Handedness- - - - - right handed, left handed- - - - - 2 colors needed
3. Hairline- - - - - straight, widow’s peak- - - - - 2 colors needed
4. Tongue Rolling- - - roller, non- roller- - - - - 2 colors needed
5. Eye Color- - - - - blue, brown, green, gray- - - - - 4 colors needed
6. Dimples- - - - - dimples, no dimples- - - - - 2 colors needed
7. Ear Lobes- - - - - attached, unattached- - - - - 2 colors needed
8. Hair Texture- - - - - curly, straight- - - - - 2 colors needed

Example station:



PART 2: DNA Extraction

Now that we've learned what DNA is, let's see what DNA looks like! You can do the strawberry DNA extraction first, and then move onto the cheek cell extraction.

BACKGROUND INFORMATION

- Cells are the basic unit of life and make up all plants, animals, and bacteria.
- DNA (Deoxyribonucleic acid) is stored inside the cell
- DNA is stored in packages, called chromosomes (e.g their whole bracelet would be a "chromosome" with multiple "genes"). Humans have two copies of their 23 chromosomes. Strawberries have eight copies of their 7 chromosomes.
- If you uncoiled the DNA in a cell, it would be about three meters long

Materials (per person)

- 1 ziploc bag
- 1 Strawberry (fresh or frozen)
- 2 teaspoons dish detergent
- 1 teaspoon of salt
- 1/2 cup of water
- 2 plastic cups
- Ice cold 90 percent rubbing alcohol
- 1 wooden popsicle stick or plastic coffee stirrer
- Eppendorf Tube

STRAWBERRY DNA EXTRACTION

1. Pull off any green leaves on the strawberry that have not been removed yet.
2. Put the strawberry into the plastic bag, seal it, and gently smash it for about two minutes. Completely crush the strawberry. This starts to break open the cells and release the DNA.
3. In a plastic cup, make your DNA extraction liquid. Mix together 2 teaspoons of detergent, 1 teaspoon of salt, and $\frac{1}{2}$ cup of water.
4. Add 2 teaspoons of the DNA extraction liquid into the bag with the strawberry. This will further break open the cells.
5. Reseal the bag and **gently** smash for another minute. Avoid making too many soap bubbles.
6. Place the coffee filter inside the other plastic cup. Open the bag and carefully pour the strawberry liquid into the filter. You can twist the filter just above the liquid and gently squeeze the remaining liquid into the cup.
7. Next, pour down the side of the cup an equal amount of cold rubbing alcohols as there is strawberry liquid. **DO NOT MIX OR STIR.** You have just isolated the DNA from the rest of the material contained in the cells of the strawberry.
8. Within a few seconds, watch for the development of a white cloudy substance (DNA) in the top layer above the strawberry extract layer.
9. OPTIONAL: Tilt the cup and pick up the DNA with a wooden stick or plastic coffee stirrer. You can put the DNA into an eppendorf tube filled with rubbing alcohol, if desired.

What's going on here? By adding soap to your cheek cells, it breaks the membranes of the cell open and the contents of the cell, including the DNA, spill out. The salt changes the ionic concentration of the water and makes it easier for the DNA and RNA to separate. DNA will not dissolve in alcohol, so when you add alcohol to the solution the DNA collects where the two layers meet.

CHEEK CELL DNA EXTRACTION

1. Mix a half glass of water (approximately 6 oz.) with 1 tablespoon of table salt. Label the cup 1.
2. Have students swirl the 10ml of salt solution in their mouths for 30 seconds. This will remove dead cells lining the mouth.
3. Have students spit their solution back into their dixie cup and then add the rest of the detergent solution from before.
4. GENTLY mix for 2-3 minutes. IMPORTANT: Don't shake or mix it too vigorously. DNA will break into smaller fragments and will be harder to see later on.
5. After 3 minutes, slightly tilt it and carefully pour the chilled alcohol down the side of the test tube. The alcohol and the detergent should form two distinct layers with alcohol sitting on top.
6. Have students let the tube stand for one minute. Then, have them use the coffee stirrer to slowly move some of the alcohol into the soap layer. DNA will start to precipitate out of the soap solution. Have students twirl the stirrer to spool the DNA strands around it. If the DNA fragments are too short to wind up, students can use the pipette the suck up the fragments.

7. Students can transfer the DNA into a small tube (Eppendorff tubes work well), filled with rubbing alcohol, and take it home. The DNA should be stable in that form for a long time. They can add it to their bracelet or put it on a string to make a necklace.

Follow-up questions:

1. What does DNA stand for?
2. Where in your body can DNA be found?
3. Why do you think it's easier to see the strawberry DNA than the cheek cell DNA?
4. Have students make a Family Tree. You can have them trace their ancestors back to their grandparents or even further