University of Maryland

Department of Physics Education and Outreach

Physics at Home Activities

DNA Duo!

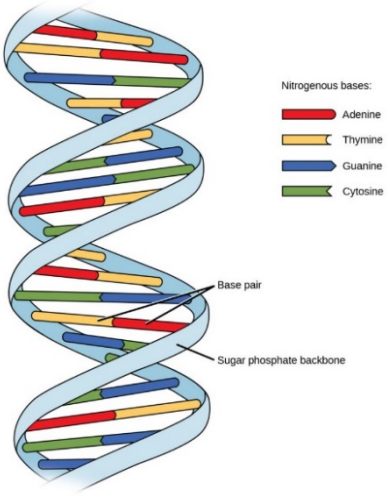
Learning Objective: The following hands-on activity is a highlight from our *Amazing Science Discovery Camp!* The camp features daily science themes including physics, chemistry, engineering, nanotechnology, and biology, the day when this activity is presented. In this activity, you will discover the process of extracting DNA from the cells of a strawberry! Along the way, you will also learn about the structure of DNA and its extremely important function!

Activity #1: Constructing DNA

1. **Materials**
    a. 2 Twizzlers
    b. 40 mini-marshmallows (you can 20 and have a smaller chain)
    c. 4 markers (red, blue, green, yellow)
    d. 10-15 toothpicks

These are materials we use in the summer camp setting. You can also use construction paper to cut out necessary pieces, draw the DNA, or improvise with other materials you find at home!

2. **What is DNA?**
    a. DNA (deoxyribonucleic acid) is the genetic material that stores all the information that makes up all organisms. DNA is in every cell of every living thing and is the backbone for how they function. In humans, DNA controls things like hair and eye color, skin tone, and even whether an individual gets a certain disease, along with thousands of other important tasks.



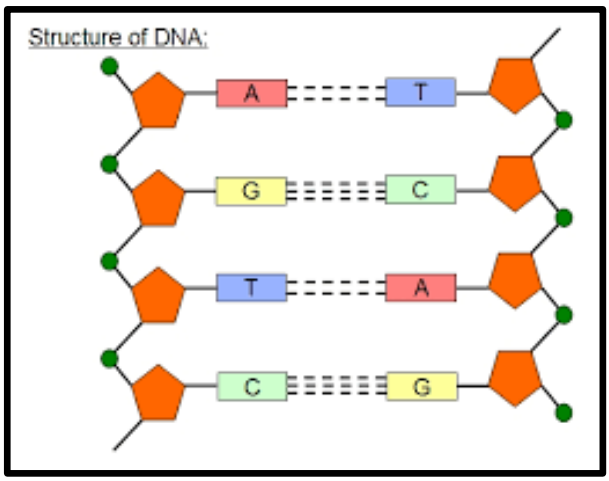
3. **DNA Structure**
    a. DNA is extremely small; one strand of DNA is only about 2 nanometer or 2 billionths of a meter! For size reference, your fingernails

grow 1 nanometer every second, so consider just how small that really is. DNA looks like a twisting spiral staircase and has a double helix shape.

4. DNA Components

a. DNA has a complex sugar-phosphate backbone (dark green + orange) and 4 unique nitrogenous bases. These four bases are adenine (red), thymine (blue), guanine (yellow), and cytosine (green). Adenine always bonds with thymine and cytosine always bonds with guanine. These base pairs combine into DNA fragments which constitute our genome!

Figure 1



5. Instructions

a. Start by separating your marshmallows into 4 equal groups.
b. Using the marker, color each group of 10 marshmallows as follows: red **adenines**, blue **thymines**, yellow **guanines**, and green **cytosines**.
c. Collect your ***complex sugar-phosphate backbone*** (Twizzlers will work perfectly!).
d. Using the toothpicks, start to construct DNA. Use Figure 1 as a reference!
    i. Insert a toothpick into two matching nitrogenous bases (remember, A-T and C-G). Do this for all pairs.
    ii. After all pairs are connected, randomly align your toothpicks like the rungs on a ladder on the table. Now, insert each side of the toothpick into each piece of Twizzler.
e. You now have a model DNA strand!

Activity #2: Extracting DNA from a Strawberry

1. **Materials**
    a. 1 re-sealable plastic sandwich bag
    b. 2 strawberries (fresh work best, but frozen will also work)
    c. 2 tsp dish soap
    d. ½ cup water
    e. 1 tsp salt
    f. 2 plastic cups
    g. 1 paper coffee filter
    h. ½ cup cold water
    i. 1 coffee stir stick (a wood chop stick or wood skewer will also work)

2. Instructions

a. Remove all green parts from the strawberry.
b. Place the strawberries into the bag and seal tightly.
c. Using your hands, crush the strawberries for 1.5-2 minutes. You want to crush thoroughly as this will start the process of breaking the cells and releasing DNA.
d. In one of the plastic cups, make your extraction liquid. Mix the salt, soap, and water.
e. Add 2 teaspoons of the extraction liquid to the plastic bag. Re-seal the bag and use your hands to massage the crushed strawberries and extraction liquid together. Note: do not massage too aggressively to avoid creating bubbles as they will make the next steps harder!
f. Place the coffee filter over the 2nd plastic cup so there is only half an inch hanging over the lip and a deep well inside the cup.
g. Dump the contents of the plastic bag into the well you created with the filter. Be sure to keep the contents in the filter and do not let any spill into the cup. You only want the filtered liquid to remain after the step.
h. Once you have drained as much liquid as you could from the filtered material, discard filter/strawberry/extraction liquid into the trash.
i. Carefully pour the cold rubbing alcohol into the cup with the filtered strawberry liquid. Your goal is to add equal parts rubbing alcohol and strawberry liquid and to not mix the two.
j. Finally, allow the cup to sit for 5 minutes and observe the DNA rise to the top of the rubbing alcohol! You can pick up the DNA using the coffee stir stick, but be sure not to mix the contents of the cup!
    i. *If you have a small container, use the coffee stir stick to remove the DNA and submerge it in alcohol to make a necklace! At camp, we use microcentrifuge tubes (image below).*

Image of strawberry DNA necklace using microcentrifuge tube!