Nasco Education

LESSON PLAN

Science

Developed with Dave Menshew, Forensic Biotech Program, Enochs High School, Modesto, CA

Volume 1 | Gr. 3-12

Strawberry DNA extraction activity

Standards Alignment

This will vary by state, but will always fall in the cell biology and life sciences, as well as investigation and experimentation sections. Also supports elements of language arts, math, and social studies (depending on grade).

Materials list

- Strawberry DNA Extraction Kit (**SB50009**)
- 15 ml plastic tube
- 50 ml plastic tubes
- Test tube rack
- Plastic funnel
- Gauze/cheesecloth
- Zip-close plastic bags
- Strawberries/bananas/kiwi fruit (fresh or frozen, fruit not included)
- Stirring rod (or coffee stirrers)
- 91% isopropyl (rubbing) alcohol
- 25 ml plastic graduated cylinder
- 2 ml dropper/transfer pipette
- Extraction buffer**
- Liquid dish washing soap
- Salt

**Extraction buffer is simply a mix of 100 ml of Dawn® dish soap, 900 ml of water, and 1-2 grams of table salt. Mix but avoid bubbles. Try not to make more than a week before the activity, and keep refrigerated. It has some shelf life, but will degrade over time.

Purpose

To demonstrate that the substance containing the instructions to make and sustain a living thing is present and can be isolated from its cells. That substance, sometimes called the "code of life" is also known as DNA (deoxyribonucleic acid). In human cells, there are about 6 feet of DNA in each of your 70 to 100 trillion cells.

Hypothesis

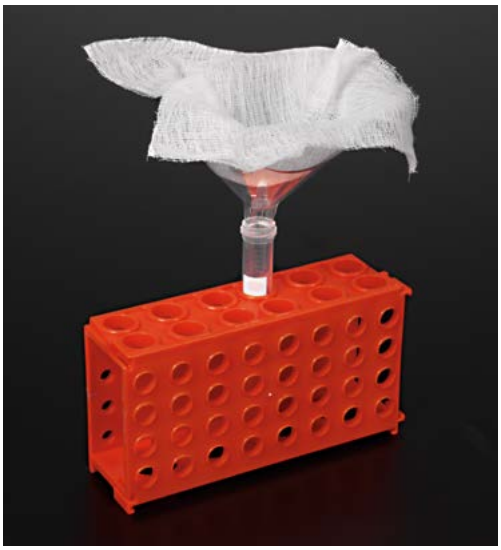
If given the proper materials, students of almost any grade level can isolate the code of life, DNA, from cells.

Discussion

As any good crime scene investigator knows, the first step to DNA analysis is having the ability to retrieve and isolate DNA. In this activity, students perform the same type of lab work as is done in high schools, universities, crime labs, and industry — isolation of DNA for further use and study. This activity is used by the National Ag Science Center Mobile Lab, Modesto, California.

Safety

Goggles are recommended, but gloves are not necessary. No open flames or ignition sources are to be in the room during the activity. Long hair is to be tied back.



Activity

1. The day before you plan to do the experiment, purchase fruit of your choice. Strawberries work best for several reasons. One is that they are almost always available (you can even use frozen, if fresh are not available). Also, most varieties of the strawberry have multiple copies of each chromosome, resulting in a lot of DNA to be harvested. The day before, you will want to pre-chill the alcohol by placing it in a freezer (it will not freeze). For best results, keep the alcohol in the 50 ml tubes and on ice during the experiment, until used.
2. Give each team of 2 students a 15 ml tube, a funnel (which should fit inside of the top of the tube), gauze to cover the top of the funnel, and a plastic zip-close bag with ½ to one whole strawberry, depending on size. Add approximately 15 ml of extraction buffer to the bag, and have the students seal tightly, getting most of the air out of the bag.
3. IMPORTANT: Demonstrate to the students how to "grind" the strawberry/extraction buffer mixture. This will allow you to make a cross-curricular connection to social science and also help prevent the inevitable pounding and slapping of the bag by some students. The point of grinding the mix is to release the cell's contents. Here, we are releasing the DNA from the cell's nucleus.
4. After a couple of minutes of grinding, each pair of students should have a mix of liquid and berries. They are to pour this through the gauze that is on top of the funnel. The point here is to capture approximately 10 ml of just the reddish liquid containing the DNA. To minimize spills, have the student pour slowly. Once this is done, the bags containing the strawberries and buffer can be thrown away. (It is OK to compost the berries and wash the liquid down the drain, but the bags can go in the garbage.)

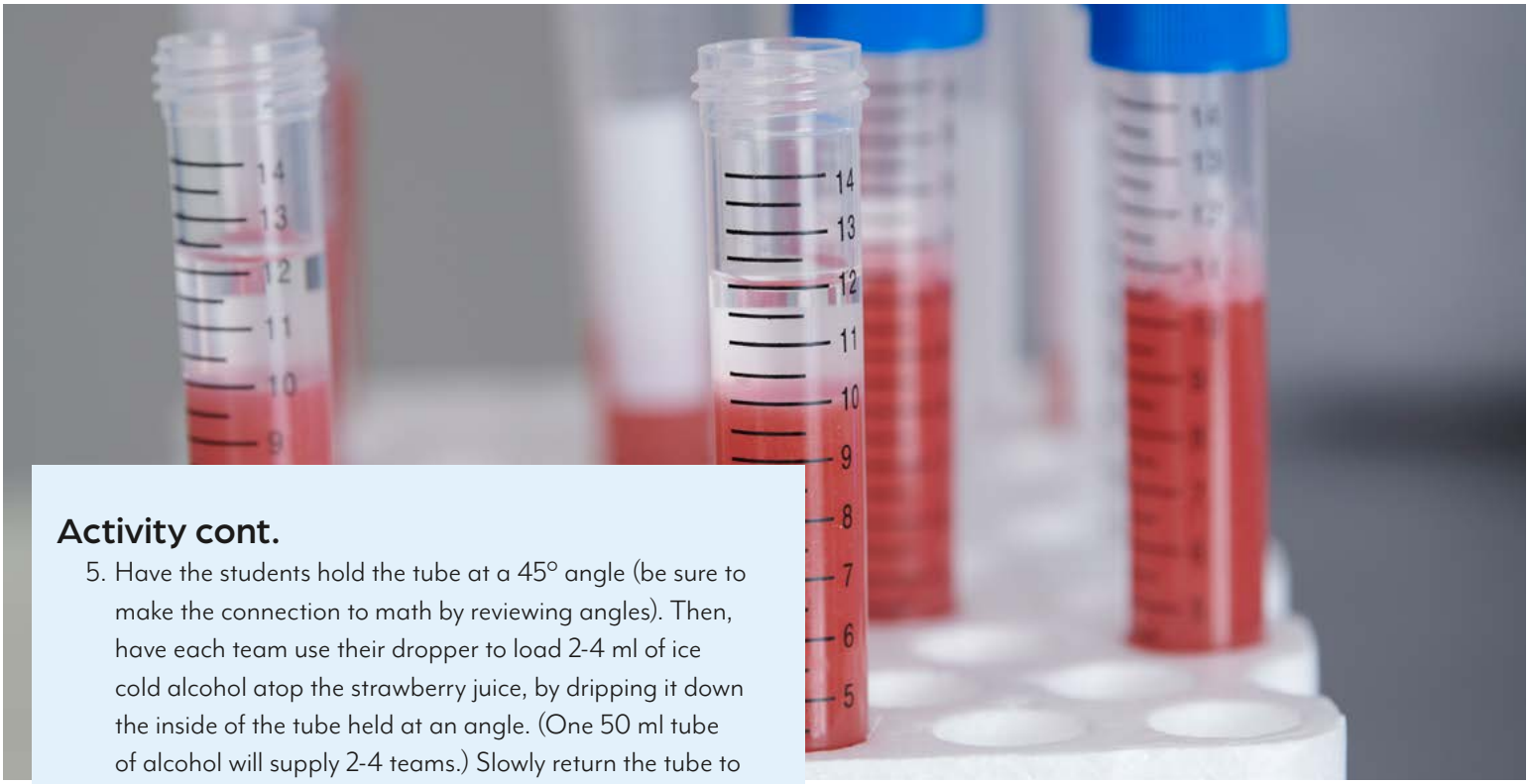
cont. next page

Student Lab Write-Up

To be done in lab books or on a separate piece of paper. Answer in complete sentences and make complete drawings with labels.

1. What is the purpose of the lab activity?
2. What is the hypothesis you are testing?
3. What are your materials?
4. What should you do to be safe in this lab? (List everything you can think of.)
5. Make a detailed drawing of the lab setup. Include all labels and the function of each part.
6. Why did the alcohol sit on top of the buffer and strawberry juice?
7. What formed at the boundary between the alcohol and juice?
8. Why didn't all of the bubbles rise to the top of the tube?
9. What is contained in the DNA you isolated from the cells?
10. Were your results the same as others in the class? Why or why not?

Answers on p. 4



Activity cont.

5. Have the students hold the tube at a 45° angle (be sure to make the connection to math by reviewing angles). Then, have each team use their dropper to load 2-4 ml of ice cold alcohol atop the strawberry juice, by dripping it down the inside of the tube held at an angle. (One 50 ml tube of alcohol will supply 2-4 teams.) Slowly return the tube to its upright position for 2-3 minutes. This would be a good time to have students make a drawing of the setup with all labels. Have the students observe and record, using good language arts skills, what is happening inside of the tube in the upper layer. They should see tiny bubbles forming that don't float to the top. They are being held in place by the strands of DNA.
6. After 2-3 minutes, take your glass stirring rod or coffee stirrer and go down slowly into only the clear alcohol. With a twisting or stirring motion, begin to spool up the DNA. Avoid the red layer below. Do not mix or shake.
7. At this point, you can elect to save the DNA in a 50 ml centrifuge tube.
8. Cleanup: Students can wash the extraction buffer and unsaved DNA down the drain. All tubes and materials will clean up well with soap and water.
9. A follow-up lab activity is available for human DNA extraction using students' cheek cells.

Answers for lab write-up from p. 2

1. What is the purpose of the lab activity?

   See purpose of lab.

2. What is the hypothesis you are testing?

   See hypothesis.

3. What are your components?

   See components list.

4. What should you do to be safe in this lab? (List everything you can think of.)

   Goggles must be worn, but not gloves; there are to be no open flames or ignition source; and hair is to be tied back.

5. Make a detailed drawing of the lab setup. Include all labels and the function of each part.

   Students' drawings will vary, but should be completely labeled and detailed.

6. Why did the alcohol sit on top of the buffer and strawberry juice?

   The alcohol is both less dense and non-polar. It will mix with the juice if stirred.

7. What formed at the boundary between the alcohol and juice?

   The DNA precipitates out of solution at the interface between the juice and the alcohol.

8. Why didn't all of the bubbles rise to the top of the tube?

   They were held in place by the tiny DNA strands.

9. What is contained in the DNA you isolated from the cells?

   All of the instructions for making and keeping alive the organism that the cells came from.

10. Were your results the same as others in the class? Why or why not?

    Answers will vary, but some may have bigger strawberries, some may have spooled differently, and some may have accidentally mixed the two layers.