Strawberry DNA Extraction

Below is an overview of the activity Strawberry DNA Extraction (Science & Health Education Partnership, University of California – San Francisco) to incorporate information learned from Dr. Kerkhof's presentation and subsequent discussion.

Lesson Overview

Students extract DNA from strawberries to learn about the methods used in microbial biology.

Lesson Rationale

Students will observe first hand that DNA is in the food that they eat. Students will learn the simple method of DNA extraction and will be able to explain the rationale of each step. Students will be able to explain why DNA extraction is important to scientists.

Key Concept

Because microbes are too small to see with our naked eyes and there are millions of them within a small beaker of ocean water, scientists use molecular techniques to quantify the microbial community. One common technique is extracting DNA from samples of the microbes present.

Strawberry DNA extraction

Lesson Overview

Grade level(s):
Grade 5 – 10

Time needed:
One class period (40-60 minutes)

Summary:
Students will extract DNA from strawberries. All living organisms contain DNA: from bacteria to plants, animals, and humans. DNA is stored in the cell's nucleus and can be extracted using a few simple steps.

Prerequisites for students:
Students should know about the basic function of DNA and its location.

Learning goals/objectives for students:
Students will observe first hand that DNA is in the food that they eat. Students will learn the simple method of DNA extraction and will be able to explain the rationale of each step. Students will be able to explain why DNA extraction is important to scientists.

Vocabulary words:
DNA, nucleus, extraction, Lysis, ethanol, spooling,

What you need:

- SEP's DNA extraction kit K136 or K179
- OR create your own kit:
    - Capped tube with 12ml of Lysis Buffer (90ml water, 10ml Dawn dish soap, 2g of table salt)
    - Capped tube with 12ml of 99% Isoproponol (rubbing alcohol)
    - See-through plastic drink cup
    - Zip-lock bag
    - Plastic coffee stirrer
    - Flat wood sticks
    - Coffee filter

- Rubber band
- Small Eppendorff tube

Content background for instructor:
All living organisms contain DNA. Some fruits are especially suited for DNA extractions due to their multiple sets of chromosomes. Strawberries are octoploid, which means they have 8 copies of each chromosome (human body cells are diploid; they contain two copies of each chromosomes). DNA extraction is a fairly simple procedure that requires a few steps:

1. The lysis buffer (detergent) breaks open the cells by destroying the fatty membranes that enclose the cells as well as the nuclei membranes within the cells. DNA is released into the solution. Detergent and the salt also helps strip away proteins that are associated with the DNA molecules.
2. DNA is NOT soluble in alcohol, whereas other cell parts are. By adding alcohol, DNA precipitates out of the solution and collects at the interface of the alcohol and soap layer. The colder the alcohol, the less soluble the DNA will be in it.

Getting ready:

1. Get the DNA extraction kit at the Daly Ralston Resource Center.
2. OR prepare the lysis buffer and fill class set of labeled tubes with 12ml of the solution and seal. Also, fill class set of labeled tubes with 12ml of Isopropanol and seal.
3. Prepare a tray with materials for each pair/table or set-up another procedure to hand-out material to students.

Lesson Implementation / Outline

Introduction:
Activity to activate knowledge about where DNA can be found: Bring in a variety of different objects (living and non-living) and ask students whether each object contains DNA. Students can respond using white boards, doing a shout-out, filling out a worksheet etc. Have students give reasons for their choices. At the end of this activity, students should understand that all living organisms contain DNA. OR Activity to make students realize the size of DNA. Read out True or False questions addressing scale/size of DNA. Students (as a think-pair-share) decide on the answer and respond (white boards, shout out, worksheet). For ideas refer to the "Fun Facts" that are attached to this lesson plan.

Activity:
Students can either perform the extraction individually/with their partner following their worksheet or teacher can model the extractions while the whole class follows along step by step. Directions for the extraction (also see attached worksheet):

1. Put coffee filter over top of plastic cup and secure with a rubber band.
2. Put a single strawberry win a ziplock bad and close the bag. Remove as much air as you can.
3. Smash up the strawberry with your hand and fingers for 2 minutes. Be careful not to break your bag. The best way to mix it is to massage the mixture at the bottom of the bag.
4. Add 12ml of Lysis Buffer to the bag and zip it closed. Mash again for 1 minute.

5. Tilt the bag so that the mush collects in one bottom corner of the bag, and open the bag. Carefully pour the mush into the coffee filter. Let the liquid drip through into the cup. You can gently stir with the flat wooden stick.
6. After most of the reddish liquid has dripped int the cup, carefully remove the filter paper with the strawberry mush and throw it in the trash. Tilt the cup a little and gently pour the 10ml of Isopropanol in the cup - letting it slowly pour down the side of the cup. DO NOT MIX!
7. Observe and wait a little. You'll see the DNA start to collect as a goopy glob, and you can "spool it out" on the tip of the wooden stick.
8. Transfer the spooled DNA into an Eppendorff tub with some isopropanol. You can take the DNA home with you, but keep it tightly closed to avoid evaporation of the alcohol. The DNA is stable in this form for many years.

Checking for student understanding:
Ask questions that make students think about the rational of steps of the extraction process: Why are we using the lysis buffer, which contains detergent and salt? What does it do to the cell? Ask questions to check if students understand the size of DNA molecules. Make sure they understand that they would NOT be able to see one individual strand of DNA. The white strands that are becoming visible contain many DNA strands clumped together.

Wrap-up / Closure:
Close by re-doing the intro-activity to see what students learned.

Extensions and Reflections

Extensions and connections:
There is a great number of other fruits that can be used for DNA extractions. Links to instructions are below. Have students observe chromosomes under the microscope to reinforce the idea of the scale of DNA molecules.

Reflections:
The alcohol needs to be VERY cold. Store in refrigerator before class.

Weblinks and References

Weblinks:
How to extract DNA from anything [1]
Instructions for cheek cell DNA extraction [2]

Attachment	Size
How does extraction process work.doc [3]	194.5 KB
picture spooled DNA.doc [4]	293.5 KB
Genetics Fun Facts.doc [5]	33.5 KB
Students directions DNA extraction .doc [6]	46 KB

Standards - Grade 7
Genetics:
2. A typical cell of any organism contains genetic instructions that specify its traits. Those traits may be modified by environmental influences. As a basis for understanding this concept:
e. Students know DNA (deoxyribonucleic acid) is the genetic material of living organisms and is located in the chromosomes of each cell.

Standards - Grades 9-12 Biology
Cell Biology:
a. Students know cells are enclosed within semipermeable membranes that regulate their interaction with their surroundings.
Genetics:
a. Students know the general structures and functions of DNA, RNA, and protein.