DNA Extraction

Summary

Students extract DNA from wheat germ. This is a quick and low cost experiment for extracting very observable quantities of DNA. Students can each take a small amount of DNA home. Students also make a model of DNA out of licorice and marshmallows.

Time Frame

1 class periods of 60 minutes each

Group Size

Small Groups

Materials

To build the model of DNA use the "Have Your DNA and Eat it Too" lab from the learn.genetics.utah.edu website. Instructions and materials needed are found on the website. The link is: http://teach.genetics.utah.edu/content/begin/dna/eat_DNA.html

- Student Questions sheet

Raw wheat germ, can be purchased from Whole Foods store. One package is enough for one class of 30 students.
measuring spoons
50 ml plastic beakers, plastic cups or other small jars, one for each student
Dawn dish detergent
test tubes, one for each student
25 or 50 ml graduated cylinders
ethanol, works better than store bought isopropyl alcohol. About 500 ml is needed for one class.
paper clips extended out with a hook
goggles optional
small microtubes or other small container for kids to take their DNA home

Background for Teachers

Traits are observable characteristics that are passed down from parent to child. For example; hair color, eye color and height are traits. These traits are passed down from parent to offspring through a chemical called deoxyribonucleic acid or DNA. Our individual combinations of traits makes us all unique.
DNA is found in the nucleus of every cell of our body and every cell of any living thing. We have a lot of DNA. The basic structure of DNA is the same in every living organism it just differs in the order of its code.
DNA provides the instruction or blueprint for building and operating all living things. The DNA instructions are divided into segments called genes. Each gene provides the information for making a protein that carries out a specific function in the cell. These genes are found in chromosomes inside the cell's nucleus. Chromosomes are what get copied and passed on from generation to generation.
The DNA molecule consists of two strands that form a double helix, a spiraling shape much like a twisted ladder. The DNA molecule has a sugar part, a phosphate part and four different chemical bases - adenine (A), thymine (T), cytosine (C) and guanine (G). The backbone is formed by a chain of alternating phosphates and sugars. The sugar molecule in the backbone provides an attachment site for one of the chemical bases. The four chemical bases are the DNA's alphabet for forming codes that instruct a cell to make different proteins. The differences in these combinations result in the

differences among all living organisms. In this DNA alphabet two bases link together at a time. Adenine always combines with thymine and cytosine always combines with guanine.

Intended Learning Outcomes

3a. Know and explain science information specified for the grade level.
4b. Describe or explain observations carefully and report with pictures, sentences, and models.

Instructional Procedures

Pre-lab discussion:
Discuss with students what traits are and give some examples. Explain that DNA is the chemical that passes traits from parents to offspring. Inform the students that we have 6 feet of DNA in every human cell and over 100 trillion cells in our bodies. Show students a diagram of DNA and explain the chemistry of the nitrogen bases and their bonding. If you make a model of the DNA from licorice and marshmallows you can show them what they will be making.
Instructional procedure: The DNA extraction and the DNA model building can be done simultaneously. Start the extraction first and then when the mixture needs to sit the students can begin working on the model.

Place 1 g or 1 teaspoon of raw wheat germ in a 50 ml beaker. The wheat germ is from the wheat seed and is our source of DNA in this experiment.
Add 20 ml of hot (50-60 C) tap water and swirl the beaker with its contents off and on for 3 minutes. The warm water softens the fats in the membrane which surrounds the cell and the nucleus. The heat also inactivates an enzyme called DNase that would break the DNA into tiny pieces and we wouldn't be able to see it.
Add 1ml or a scant 1/4 teaspoon of liquid detergent and mix gently every minute for 5 minutes. Try not to create foam. The detergent pulls apart the fats from the protein in the membrane and releases the DNA. Do not stir this mixture!
Let the mixture settle for at least 5 minutes.
Carefully pour off the top layer of liquid into a test tube until it is 1/2 full. Leave as much of the wheat germ residue in the beaker as possible. The DNA is in the liquid mixture but can't be seen at this time.
If you have goggles or safety glasses students can put them on for the alcohol step. Tilt the test tube at an angle. SLOWLY pour an equal amount of alcohol down the side so that it forms a layer on top of the water/wheatgerm/detergent solution. Do not mix the two layers together. Alcohol causes DNA to precipitate out of the water solution at the water-alcohol interface (the boundary between the water and the alcohol). It can now be seen and is separated from all of the other components of the cell that are left in the water solution.
To see the DNA more clearly take a paper clip hook and dip it into the water mixture and pull it up through the alcohol interface. Do not stir the mixture with the paper clip. This allows more of the DNA to come into contact with the alcohol. The white, slimy material is DNA.
Use the paper clip hook to transfer some of the DNA to a small microtube for students to take home.

Bibliography

Rio Tinto Hands-on Science Curriculum Team
Ms. Rae Louie -- Administrator, Principal Beacon Heights Elementary
Emily Mortensen -- Grant writer, teacher outreach, 2nd grade teacher at Beacon Heights Elementary
Ruth Li -- Curriculum design, K-6 Science Educator at Indian Hills Elementary
Deirdre Straight -- Curriculum development, K-6 Science Educator at Beacon Heights Elementary

Tim Rausch -- Website development, Library Media at Beacon Heights Elementary

Authors

Utah LessonPlans