PreMiEr Precision Microbiome Engineering

NSF Engineering Research Center

This lesson plan was created by a teacher participating in the Research Experiences for Teachers program from the Precision Microbiome Engineering Research Center. Are you interested in spending part of your summer in a lab getting paid to do microbiome research and create lesson plans?

Learn more here: https://premier-microbiome.org/for-teachers-ret/

Lesson plan written by Charlie Hiatt

AG Tier 3 (Grade 3)

Unit Title: Let's Build Up Some STEAM

Lesson Title: A "Berry" Cool Extraction

Purpose/Central Focus of Lesson:
Students will learn that DNA contains the instructions needed for an organism to develop, survive and reproduce. They will also learn how to extract DNA

Student Learning Targets:
3.L.2.1 Students know the names and functions of major plant parts (roots, leaves, stems, flowers). Students know that plants have special parts that perform special functions in order for the plant to survive. 3.L.2.2 Students know that how well plants grow and survive is determined by a combination of environmental conditions. For example, drought conditions will tend to diminish plant health and growth. 3.L.2.3 Students know the distinct stages of the life cycle of seed plants (seed, germination, seedling, adult).

Standard Alignment:
3.L.2 Understand how plants survive in their environments. 3.L.2.1 Remember the function of the following plant structures as it relates to the survival of plants in their environments: • Roots – absorb nutrients • Stems – provide support • Leaves – synthesize food

• Flowers – attract pollinators and produce seeds for reproduction.
3.L.2.2 Explain how environmental conditions determine how well plants survive and grow.
3.L.2.3 Summarize the distinct stages of the life cycle of seed plants.

Prior Academic Learning and Prerequisite Skills:

Some knowledge of photosynthesis
Knowledge that plants have different parts.

Culturally Inclusive Instruction:

Plants are a necessary part of life for all cultures. Plants are an important part of the global food chain. Further, they are essential for the air cycle. Plants emit oxygen which is what humans breathe. Humans in turn, breathe out carbon dioxide, which is what plants take in. DNA is essential to all living organisms. Knowledge of DNA is important for modern cultures to aid in the fight against diseases that may attack plants and cause extinction. Lastly, scientists use DNA to genetically modify food. These modifications have pros and cons that are still being studied. Knowing how to remediate disruptions to ecosystems and the food supply is crucial for all cultural prosperity.

Instructional Materials:

• 2 Strawberries per student or team (frozen then thawed)
• 1 tsp Table Salt
• 2 tsp Dish detergent
• 1/2 cup water
• pinch of meat tenderizer (optional)
• 1/2 cup Ice-Cold Rubbing Alcohol
• 1 re-sealable plastic bag
• 1 Wooden Toothpick
• 2 Cups or beakers
• 1 Coffee filter

Procedures:

Motivation/Hook: Show students a model or picture of the double helix DNA. Refer to DNA Images document in the resources folder.

Explain to students that scientist extract DNA to identify organisms, to study the genetic causes of disease, development of medical treatments, create genetically modified organisms, and other purposes.

Activation of Prior Knowledge: Ask students what they know about genetics and have a class discussion. Probe students on traits or characteristics they may share will relatives or friends.

Examples: eye color, hair color, height, etc. All these physical properties are a result of shared DNA, that ultimately expressed among genes through a process called transcription.

Make the connection that all living things have DNA. Students may want to give examples. Plant cells contain DNA in their nucleus. Probe student knowledge of plants and their parts.

Do they have plants at home? Do they have a yard? Allow for discussion.

Alternatively, the teacher could ask students to write what they know about plants.

Have students explore the resources from Discovery Education below.
Exploring Plants

Delivery of Lesson Content:

Assess student knowledge with the vocabulary pre-test document located in the resources folder.

Use teacher observation to determine knowledge level and adjust pedagogy as needed.

Review pre-test and introduce unfamiliar vocabulary. Use visuals when appropriate. Refer to the strawberry diagram for a visual of plant parts.

Explain to students that it is possible to extract DNA with everyday objects. See below.
DNA Extraction Process

Guided or Individual Practice: Review with students the procedure for DNA extraction. A teacher demonstration may be appropriate. Hand out the Strawberry Extraction Instructions document from the resource folder and review the steps with students. Distribute the materials to students or lab partners. Allow students to conduct the extraction.

Suggested vocabulary activities:

1. Make flash cards and quiz each other. This could be done with index cards or virtually. See below for a virtual flash card creator.
    a. https://www.cram.com/
2. I have, who has……
3. Create your own crossword puzzle:
   crossword puzzle
4. Write a sentence using the word
5. Charades or Pictionary
6. Include review words from previous lesson into the current lesson.
7. Have students come up with their own vocabulary activity!

"PLUS" Extensions: Have a debate on the topic of genetically modified organisms (GMOs). Refer to the document in the resource folder on how GMOs are made.
Closure: Have students write a paragraph or two about the experience. Some suggested prompts: What challenges did you face? Where you able to overcome them? If so, how? What did you learn from this lesson? Would you have done anything differently? If you worked with a partner, was it a good partnership? Why, how so?

Assessments:
Vocabulary test

Supplemental Lesson Plan Elements

Differentiation:
English Language Learners: Provide instructions in the student's native language.
Exceptional Children: Provide one on one instruction as needed.
Highly Gifted: Research more about the transcription process and RNA's role.
Underperforming Students: Probe students regarding their interests and tailor instruction.

Accommodations:
Extended Time: as needed
Read Aloud: computer generated read aloud
Language Demands & Support: Computer language assistance
Other: as needed

Extension:
Plant strawberries in a campus garden.

Technology:
Computer and projector

Strawberry DNA Vocabulary

1. DNA - Deoxyribonucleic acid, it carries the code a genetic material. It is a blueprint for the creation of cells.

2. Photosynthesis - the process by which green plants and some other organisms use sunlight to synthesize foods from carbon dioxide and water.

3. Roots – absorb nutrients from soil or water.

4. Stems – provide support for the plant.

5. Leaves – makes food from sunlight.

6. Flowers – attract pollinators and produce seeds for reproduction.

7. Extraction - the action of taking out something, especially using effort or force.

8. Isolate - to separate something or someone from other things or people with which they are joined are mixed.

9. Insertion – the action of putting something in.

Strawberry DNA Vocabulary Pre-Test

Directions: Write what you know regarding these terms.

1. DNA –

2. Photosynthesis –

3. Roots –

4. Stems –

5. Leaves –

6. Flowers –

7. Extraction –

8. Isolate –

9. Insertion –

Strawberry DNA Vocabulary Test

Directions: Match the terms with the correct definition below. Put the letter of the definition by the term.

10. DNA –

11. Photosynthesis –

12. Roots –

13. Stems –

14. Leaves –

15. Flowers –

16. Extraction –

17. Isolate –

18. Insertion –

a) the process by which green plants and some other organisms use sunlight to synthesize foods from carbon dioxide and water.

b) absorb nutrients from soil or water.

c) makes food from sunlight.

d) provide support for the plant.

e) Deoxyribonucleic acid, it carries the code a genetic material. It is a blueprint for the creation of cells.

f) the action of putting something in.

g) to separate something or someone from other things or people with which they are joined are mixed.

h) attract pollinators and produce seeds for reproduction.

i) the action of taking out something, especially using effort or force.

How to Extract DNA from a Strawberry

Cells are the basic unit of life and make up all plants, animals and bacteria. Deoxyribonucleic acid, or DNA, is the molecule that controls everything that happens in the cell. DNA contains instructions that direct the activities of cells and, ultimately, the body. This activity will demonstrate how DNA can be isolated from a strawberry using common household materials.

https://www.youtube.com/watch?v=hOpu4iNSBh4

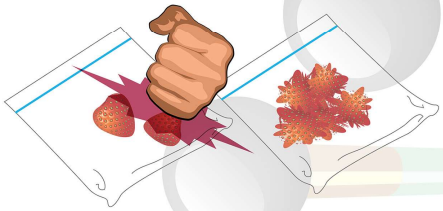
What you will need:

1	2	2 tsp	1/2 cup	2	1	1	1/2 cup	1
re-sealable plastic bag	Strawberries (fresh or frozen)	Dish detergent	Water	Plastic cups	Coffee filter	Scientist	COLD Rubbing Alcohol	Coffee Stirrer

1

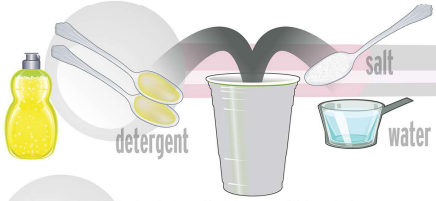
Pull off any green leaves on the strawberry that have not been removed yet.

2



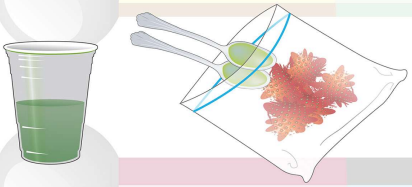
Put the strawberries into the plastic bag, seal it and gently smash it for about two minutes. Completely crush the strawberries. This starts to break open the cells and release the DNA.

3



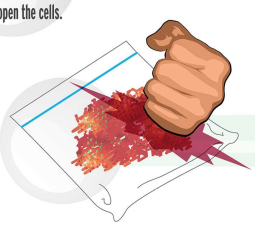
In a plastic cup, make your DNA extraction liquid: mix together 2 teaspoons of detergent, 1 teaspoon of salt and 1/2 cup of water.

4



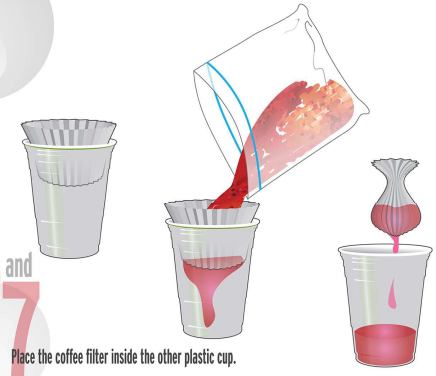
Add 2 teaspoons of the DNA extraction liquid into the bag with the strawberries. This will further break open the cells.

5



Reseal the bag and gently smash for another minute (avoid making too many soap bubbles).

6 and 7



Place the coffee filter inside the other plastic cup.

Open the bag and 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.

8

Next, pour down the side of the cup an equal amount of cold rubbing alcohol 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.

9

Within a few seconds, watch for the development of a white cloudy substance (DNA) in the top layer above the strawberry extract layer.

10

Tilt the cup and pick up the DNA using a plastic coffee stirrer or wooden stick.

NIH National Human Genome Research Institute
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