Lesson Plan: **Genetic Wonders - Extracting DNA from Strawberries**

Lesson Plan Date Created: June 2024

Lesson Plan Date Last Edited: June 2024

Lesson Plan Date Implemented:

Lesson Plan Created by: Danielle Condry, PhD (adapted from online resources)

**Target Audience/Grade Level:** Middle School (Grades 6-8) – can be shifted to K-5 or 9-12 – see notes at the end.

**Topic:** Genetic Wonders - Extracting DNA from Strawberries

**Unit:** Introduction to Genetics

**Step 1: Objectives** (What do I want my audience/students to be able to do after this lesson?):

Students will …

- Explain the basic concept of DNA and its role in genetics.

- Learn the process of extracting DNA from strawberries.

- Visualize and describe the physical appearance of DNA.

- Connect the experiment to a real-world application in biotechnology.

**Step 2: Assessment Plan** (How will I know my audience/students accomplished the objectives?):

Direct Assessment:

- Students will complete a lab report detailing the steps of the DNA extraction process and their observations.

- A quiz on the basic concepts of DNA and genetics covered in the lesson.

Indirect Assessment:

- Classroom discussion and Q&A session to gauge understanding and engagement.

- Observation of student participation during the experiment.

**Step 3: Activities** (How I will help my audience/students achieve the objectives?):

Materials:

* - A resealable plastic bag
* 2 strawberries (fresh or frozen, but remove the green leaves)
* 1 teaspoon (5 mL) dish detergent
* 1/2 teaspoon (7 grams) salt
* 1/4 cup (60 mL) water
* Measuring spoons and cups and/or Scale/weigh paper
* 2 plastic cups
* 1 coffee filter
* 1/4 cup (60 mL) cold 91% Isopropyl alcohol
* 1 coffee stirrer
* Safety Goggles (recommended)
* 1 scientist (you!)

Preparation of Materials/Timeline:

- Gather all materials and ensure the rubbing alcohol is chilled (store in a freezer).

- Prepare ahead a solution of dish soap, salt, and water (for each group of students).

- Set up workstations with the necessary materials for each group.

Activity Steps:

1. Introduction to DNA (10 minutes):

 - Brief lecture on DNA, its structure, and its importance in genetics.

 - Show a video or presentation explaining DNA extraction and its applications.



Strawberry cells under microscope

2. Lab Procedure (30 minutes):

**Step 1:**Place 1 strawberry in a plastic bag. Close the bag.

**Step 2:**SMASH the strawberry for ~2 minutes until nice and smashed! This is to loosen up all the strawberry cells.

**Step 3:**Make DNA extraction solution by adding the following to the first plastic cup:

* 1 teaspoon dish detergent (5 mL)
* 1/2 teaspoon salt (7 grams)
* 1/4 cup water (60 mL)

Gently mix the extraction solution (until salt is dissolved)

**Step 4:**Pour the DNA extraction solution into the bag of smashed strawberries. You are breaking open the cells! The detergent breaks open the cells and the salt stabilizes the DNA.

**Step 5:**Reseal the bag and \*gently\* massage and mix the mixture for a minute. Try to avoid making too many soap bubbles!

**Step 6:**Place the coffee filter over the opening of the second plastic cup. (tape each side for easier pouring)

**Step 7:** Open the plastic bag, and pour the liquid onto the coffee filter. Then wait for the liquid to drip through the coffee filter into a second plastic cup (highly recommend a clear cup to see the layers), leaving the strawberry \*schmutz\* on the coffee filter. You have removed the “cellular debris” and let the DNA go through the filter.

**Step 8:**You’re almost there! Pour an equal amount (1/4 cup or 60 mL) of cold rubbing alcohol into the liquid in the second plastic cup.

**Step 9:**Gently move the cup around in circles and watch the whitish \*snot-like\* material form in the upper layer of liquid — that is the strawberry DNA! You are “precipitating” the DNA out of the solution!

**Step 10:**Use the coffee stirrer to pick up strawberry DNA out of the liquid.

3. Observation and Discussion (15 minutes):

 - Students observe and describe the DNA.

 - Discuss what they see and the significance of the experiment.

4. Wrap-up and Assessment (15 minutes):

 - Students complete their lab reports.

 - Conduct a brief quiz on the concepts covered.

 - Open floor for questions and reflections.

**References:**

<https://www.genome.gov/about-genomics/teaching-tools/strawberry-dna-extraction>

Got this from another teacher? Check out our other resources at: <https://www.ndsu.edu/agriculture/academics/academic-units/microbiological-sciences/k-12-teaching-resources>

 **Making the Lesson Plan Culturally Relevant**

1. Incorporate Diverse Examples:

 - Include examples of genetic research and applications from different cultures around the world. Highlight contributions from scientists of diverse backgrounds.

 - Discuss traditional agricultural practices and how understanding plant genetics can help preserve and improve indigenous crops. Check out Maize and Nitrogen Fixation!

2. Relate to Students’ Lives:

 - Connect the lesson to the students’ own experiences and backgrounds. Ask students to bring in fruits or plants that are significant in their culture for a similar DNA extraction activity.

 - Encourage students to share stories or traditions related to plants and agriculture from their cultural backgrounds.

3. Highlight Global Impact:

 - Discuss how biotechnology and genetics can address global challenges such as food security, disease prevention, and environmental conservation.

 - Present case studies of how different countries use genetic technology to improve crop yields, combat diseases, or preserve biodiversity.

4. Invite Guest Speakers:

 - If possible, invite a guest speaker from a diverse background working in the field of genetics or biotechnology to talk about their work and its impact on the community and the world.

5. Multilingual Resources:

 - Provide resources and materials in multiple languages to accommodate students who are English language learners.

 - Include videos, articles, and books that discuss genetics and biotechnology in various languages and from different cultural perspectives.

6. Inclusive Discussion:

 - Foster an inclusive classroom environment where students feel comfortable sharing their thoughts and experiences related to the lesson.

 - Be mindful of cultural sensitivities and ensure that all students’ perspectives are respected and valued during discussions.

7. Cultural Significance of Strawberries:

 - Explore the cultural significance of strawberries in different cultures. For example, discuss how strawberries are used in traditional dishes, ceremonies, or folk medicine in various cultures.

**Adjustments for Different Grade Levels**

**Shifting the Lesson Plan for Grades K-5:**

Simplification:

- Focus on basic concepts of DNA without delving into complex genetic information.

- Use simpler vocabulary and provide more visual aids, such as pictures and videos that explain DNA and its importance in a more elementary way.

- Recommended Book to talk about what a cell is and what DNA is: <https://a.co/d/bxM1npe> Genetics for Smart Kids

Hands-On Activity:

- Guide students step-by-step with more direct instruction and supervision during the experiment.

- Allow more time for each step and ensure safety precautions are thoroughly explained and followed.

Assessment:

- Replace the lab report with a simple worksheet where students can draw what they observed and answer basic questions about the process.

- Use a verbal quiz or a matching game to assess their understanding of the key concepts.

Activities Adjustments:

- Introduction to DNA (10 minutes):

 - Use a story or animation to introduce DNA. Example: <https://www.youtube.com/watch?v=6368Y-OfU9U>

- Lab Procedure (30 minutes):

 - Conduct the experiment as a class with teacher guidance, rather than in small groups.

- Observation and Discussion (15 minutes):

 - Focus on describing what they see with more group discussion and sharing.

- Wrap-up and Assessment (15 minutes):

 - Use simple worksheets and verbal questions for assessment.

**Shifting the Lesson Plan for Grades 9-12:**

In-depth Content:

- Include more detailed information about the structure and function of DNA, genetic inheritance, and the significance of biotechnology.

- Discuss more advanced applications of DNA extraction, such as genetic engineering and forensics. Perhaps even talk about the ethics of biotechnology!

Complex Experiment:

- Introduce additional steps or techniques in the DNA extraction process that require more precision and understanding.

- Discuss the science behind each step in greater detail.

Assessment:

- Require a more detailed lab report that includes hypotheses, detailed observations, and conclusions based on the experiment.

- Include more challenging quiz questions that test deeper understanding and application of genetic concepts.

Activities Adjustments:

- Introduction to DNA (15 minutes):

 - Provide a detailed lecture on DNA structure, function, and genetic technologies.

- Lab Procedure (40 minutes):

 - Allow students to work more independently or in smaller groups with less direct supervision.

 - Introduce variations or extensions to the basic experiment.

- Observation and Discussion (20 minutes):

 - Encourage students to compare their results and discuss potential errors or improvements to the procedure.

- Wrap-up and Assessment (15 minutes):

 - Use a more comprehensive quiz and require a detailed lab report. Include critical thinking questions and real-world application scenarios.

 Worksheet for Grades K-5

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Activity: Extracting DNA from Strawberries

1. Draw a Picture

 Draw what you saw after extracting DNA from the strawberry.

2. Questions

 - What is DNA?

 - a) A type of food

 - b) The building block of all living things

 - c) A kind of toy

 - What did you use to mash the strawberry?

 - a) Spoon

 - b) Ziplock bag

 - c) Fork

 - What did you see when you added the rubbing alcohol?

 - a) Bubbles

 - b) White, stringy stuff

 - c) Nothing happened

3. True or False

 - DNA is inside every living thing. (True / False)

 - We used soap to help break down the strawberry cells. (True / False)

 - The rubbing alcohol makes the DNA visible. (True / False)

**Worksheet for Grades 6-8**

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Activity: Extracting DNA from Strawberries

1. Lab Observations

 - Describe the appearance of the DNA you extracted:

 - Why do we use dish soap in the DNA extraction process?

 - What role does the salt play in the extraction process?

 - Explain why the rubbing alcohol needs to be chilled.

2. Multiple Choice Questions

 - DNA is important because:

 - a) It makes our food taste better.

 - b) It contains the genetic instructions for living organisms.

 - c) It helps us sleep at night.

 - During the experiment, the strawberry's cells are broken down by:

 - a) Sugar

 - b) Water

 - c) Dish soap

 - The white, stringy substance you see is:

 - a) Sugar

 - b) DNA

 - c) Protein

3. Short Answer

 - How can extracting DNA from strawberries help scientists?

 **Worksheet for Grades 9-12**

Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Activity: Extracting DNA from Strawberries

1. Lab Observations

 - Write a detailed description of the DNA you extracted, including its appearance and texture.

 - Discuss the purpose of each component used in the experiment (dish soap, salt, and rubbing alcohol).

 - Dish Soap:

 - Salt:

 - Rubbing Alcohol:

2. Analysis Questions

 - Explain the principle behind the DNA extraction process. Why do each of the steps work to isolate DNA?

 - What are some potential sources of error in this experiment? How could they affect your results?

 - Compare the DNA extraction from strawberries to the process used for human DNA. What are the similarities and differences?

3. Application Questions

 - How can DNA extraction techniques be applied in real-world scenarios (e.g., forensics, medicine, agriculture)?

 - Research and describe a recent advancement in biotechnology that involves DNA extraction.

4. Critical Thinking

 - If you were to design an improved method for DNA extraction, what changes or additions would you propose? Justify your choices.