

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

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Lesson Plan Date Implemented:

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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!)

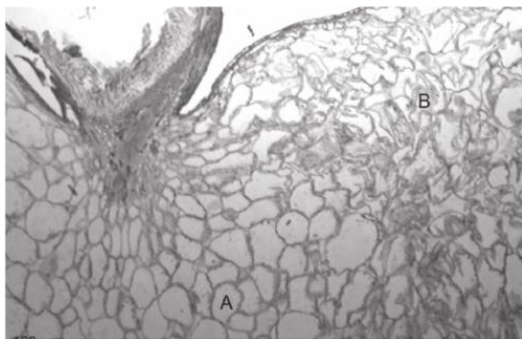
Preparation of Materials/Timeline:

- 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

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.