Differentiated (Tiered) Task
DNA Extraction

Subject Area: Biology

Grade Level: 9th – 10th

Standards (Content and Characteristics):

SB1. Students will analyze the nature of the relationship between structures and functions in living cells.
   a. Explain the role of cell organelles for both prokaryotic and eukaryotic cell, including the cell membrane, in maintaining homeostasis and cell reproduction.
   b. Explain how enzymes function as catalysts.

SB3. Students will derive the relationship between single-celled and multi-celled organisms and the increasing complexity of systems.
   b. Compare how structures and function vary between the six kingdoms (Archaebacteria, Eubacteria, protists, fungi, plants, and animals).

SCSh1. Students will evaluate the importance of curiosity, honesty, openness, and skepticism in science.
   a. Exhibit the above traits in their own scientific activities.
   b. Recognize that different explanations often can be given for the same evidence.
   c. Explain that further understanding of scientific problems relies on the design and execution of new experiments which may reinforce or weaken opposing explanations.

SCSh2. Students will use standard safety practices for all classroom laboratory and field investigations.
   a. Follow correct procedures for use of scientific apparatus.
   b. Demonstrate appropriate technique in all laboratory situations.
   c. Follow correct protocol for identifying and reporting safety problems and violations.

SCSh3. Students will identify and investigate problems scientifically.
   a. Suggest reasonable hypotheses for identified problems.
   b. Develop procedures for solving scientific problems.
   c. Collect, organize and record appropriate data.

SCSh4. Students will use tools and instruments for observing, measuring, and manipulating scientific equipment and materials.
   a. Develop and use systematic procedures for recording and organizing information.
SCSh6. Students will communicate scientific investigations and information clearly.
a. Write clear, coherent laboratory reports related to scientific investigations.
b. Write clear, coherent accounts of current scientific issues, including possible
   alternative interpretations of data.
d. Participate in group discussions of scientific investigation and current scientific issues.

SCSh9. Students will enhance reading in all curriculum areas by:
a. Reading in all curriculum areas
b. Building vocabulary knowledge
d. Establishing context

Enduring Understanding:
- DNA is an important basis of life.
- DNA offers important information about life that can provide technological
  advances in forensics, medicine, and agriculture.

Essential Question(s):
- What impact will advances in DNA biotechnology have on your life?
- How would DNA extraction differ depending on the typical cell structure for a
  specified kingdom?

Opening:
Discuss the following points:
- All living organisms contain DNA
- Genome
- The six kingdoms
- Cell membranes may differ in different organisms
- DNA is located in the nucleus of the cell
- “DNA or No DNA” multimedia presentation
- Basic extraction protocol (see Background/Teacher Notes section below)

Vocabulary: DNA, genome, extraction, and lysis

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<tr>
<th>Performance Task Description</th>
<th>Basic</th>
<th>Intermediate</th>
<th>Advanced</th>
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<td>Investigate the most efficient way to extract DNA from a member of the plant kingdom.</td>
<td>Investigate the most efficient way to extract DNA from a part of the animal kingdom.</td>
<td>Investigate the most efficient way to extract DNA from parts of the animal and fungi kingdoms.</td>
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<td>Duration</td>
<td>Three fifty-minute class sessions (Session 1: Introduce lesson and complete experiment, Session 2: Conduct research and start laboratory report, and Session 3: Complete laboratory report)</td>
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### Background/Teacher Notes

The long, thick fibers of DNA store information that gives the blueprint for life. DNA is present in every cell of living organisms. This procedure uses household equipment and store supplies to extract DNA from fruit or vegetables in sufficient quantity to be seen and spooled. The process of extracting DNA from a cell is the first step for many laboratory procedures in biotechnology. The scientist must be able to separate DNA from the unwanted substances of the cell gently enough so that the DNA does not denature (break up). You will prepare a solution of fruit or vegetable treated with salt, distilled water, and shampoo (detergent). The salt allows the DNA to precipitate out of a cold alcohol solution. The detergent breaks down the cell membrane by dissolving the lipids (fatty molecules) and proteins of the cell and disrupting the bonds that hold the cell membrane together. The detergent then forms complexes with these lipids and proteins, allowing them to be filtered out of solution while leaving the cells’ DNA in the filtrate.

**TEACHER NOTE:** The lab instructions are for the basic group only. Differentiate the amount of information given to the intermediate and advanced groups concerning general DNA extraction. The students will receive a better cheek tissue sample if they have not eaten before they try to retrieve the sample. Please review the following website for information about extracting DNA from bone:


### Materials Needed

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<td>Gram balance, 10 ml pipette, 25 ml test tube, 250 ml beaker, 25 ml graduated cylinder, clear shampoo/soap, small plastic re-sealable bag, distilled water, table salt (non-ionized), member of plant kingdom (ex. Strawberry), member of fungi kingdom (ex. Mushroom), member of animal kingdom (ex. Liver pieces), small bathroom cups, 1% vinegar solution, mortar, pestle, bone sample (ex. Chicken leg or thigh bone), 91% isopropyl rubbing alcohol or absolute Ethanol, paper clip, pineapple juice, meat tenderizer, blender, # 2 coffee filter or cheesecloth, funnel, stopwatch, and lab notebook</td>
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### Safety Precautions

Wash your hands before and after the activity. Do not put chemicals in your mouth. Wear goggles and lab aprons or coats. Follow proper protocol when collecting DNA from live organisms. Follow standard laboratory safety procedures.
## Detailed Description

### Teacher Role?
Review cell structure and DNA. Place students in groups of three (basic, intermediate, advanced). Distribute lab materials to students. Review safety procedures and lab procedures with the students. Lead students through the activity.

### Student Role?
Listen to the teacher and follow the lab instructions to extract DNA from a member of the plant kingdom. Record all data in your lab notebook. Research the characteristics of the plant kingdom – include these in your lab report. Complete the follow up questions. Write a lab report in collaboration with the other two members of your team.

## Technology Application
- Internet research, laboratory pipetting techniques, and measurement skills

## Career Connections
- Research Associate, Laboratory technician, and Genetic Counselor

## Accommodations (ELL, SWD, and Gifted)
- **ELL**: Provide detailed written instructions and labeled pictures of materials and equipment.
- **SWD**: Multimedia presentation, provide time to respond, and extended time on task.
- **Gifted**: Teacher assumes the role of the facilitator. Students are allowed to design their own experiment.
Scenario

You have just been hired by Strawberry Forensics - a biotechnology laboratory. The company is trying to obtain the funding for a new project they are working on in conjunction with the Federal Bureau of Investigation (FBI). The FBI would like help extracting DNA from different samples. Your company’s CEO, Dr. Life, has advised the FBI that Strawberry Forensics can extract DNA from anything! Part of your job requirements is to work with a team of two other scientists to determine the best way to extract DNA from plants, animal, fungi, and even bone and then write the procedure for the extraction. Each person on your team decides to work on a specific kingdom and then compare notes before you submit the report. You set to work mixing extraction buffers and trying out different experimental procedures.
Lab Instructions

Problem: How is DNA extracted from organisms?

Materials: Gram balance, 10 ml pipette, 25 ml test tube, 250 ml beaker, 25 ml graduated cylinder, clear shampoo/soap, small plastic re-sealable bag, distilled water, table salt (non-ionized), fruit (ex. Strawberry), 91% isopropyl rubbing alcohol or absolute Ethanol, paper clip, #2 coffee filter or cheesecloth, funnel, stop watch, and lab notebook

Procedures:

1. Mix 4 grams of salt, 225 ml of distilled water, and 25 ml of clear shampoo to make the extraction buffer.

2. Pull the stem and leaves off of a strawberry. Place one strawberry or fruit piece in a re-sealable bag. Smash up the fruit using your fist or fingers. Work the strawberry into a liquid for two minutes.

3. Add 10 ml of DNA extraction buffer to the bagged strawberry. Push out the air and reseal the bag. Mash the mixture for one minute.

4. Place the filter into the funnel. Place the funnel into a 25 ml test tube. Cut the corner off the plastic bag and squeeze the contents in the funnel and allow it to filter. Allow a few minutes for the filtration process to complete.

5. Throw the pulp and the filter away.

6. Draw five ml of alcohol into a pipette. Slowly drip the alcohol into the test tube. (The amount of alcohol should match the amount of filtrate in the tube.) DO NOT MIX. Wait for a few minutes. The strings of DNA will float to the top.

7. Open the paper clip to extend the length. Dip the clip into the tube, right where the ethanol and extract layers are in contact with each other. Twirl the clip into this layer, the DNA will form fibers. Pull out the fibers.
Lab Follow-Up

Discuss and Answer:

1. Where in the cell is DNA located?

2. What components make up the membrane that surrounds the cell?

3. What will happen to the cell without a cell membrane? How do you know?

4. What other parts of the cell have membranes made up of lipids?

5. Is DNA located in the same location for eukaryotes and prokaryotes? Explain.

6. What part of the experiment can be left out if you were trying to extract DNA from bacteria? Why?

7. Why is DNA important to biological systems?

8. Explain the role of the enzymes in the DNA extraction.