Differentiated (Tiered) Task
No Electronics At School!  Who Broke The Rule?
Gel Electrophoresis

Subject Area: Biology
Grade Level(s): 9-10

Standards (Content and Characteristics):

Co-Requisite - Content
SB2. Students will analyze how biological traits are passed on to successive generations.
   b. Explain the role of DNA in storing and transmitting cellular information.
   f. Examine the use of DNA technology in forensics, medicine, and agriculture.

Co-Requisite - Characteristics of Science
Habits of Mind
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.
   e. Develop reasonable conclusions based on data collected.

Enduring Understanding:
- DNA is an important basis of life.
- Excepting identical twins/clones, each organism’s DNA is unique.
- DNA offers important information about life that can provide technological advances in forensics, medicine and agriculture.
- The development and use of technologies may lead to social, moral, ethical, and legal issues.

Essential Question(s):
- How does genetic material differ from one organism to another?
- How can the differences in each organism’s genetic material be used to isolate/identify specific organisms?
- What are some uses of DNA fingerprinting?
Opening:
Review the following: DNA, DNA model, RNA, nucleotides, storage of cell information and transmission of the information in the cell. Elicit from students the concept that, excepting identical twins, everyone’s DNA is unique.

<table>
<thead>
<tr>
<th>Performance Task Description</th>
<th>Basic</th>
<th>Intermediate</th>
<th>Advanced</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Students will work with a partner to perform a lab simulation to identify the owner of a lost electronic device left in a classroom and subsequently claimed by four different students. Students will model the processes of electrophoresis and DNA fingerprinting. Students will brainstorm and discuss other uses of this technology.</td>
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<tr>
<td>Duration</td>
<td>Approximately two (2) fifty minute class periods.</td>
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<tr>
<td>Background/Teacher Notes</td>
<td>Gel electrophoresis is an easy way to separate DNA fragments by their respective sizes and visualize them. It is a common diagnostic procedure used in molecular biological labs.</td>
<td>Every organism's DNA is composed of strings of four different nucleotides: G (Guanine), C (Cytosine), A (Adenine), and T (Thymine). These strings of nucleotides are connected to one another by nucleotide pairing (G-C and A-T) to form the two-stranded DNA molecule that makes up the chromosome. For the most part, the order - or sequence - of these base pairs is very similar from one individual to another. However, there are regions of DNA that are highly variable in length and/or sequence and therefore are different from individual to individual (except in identical twins whose DNA is identical). These variable regions of DNA are typically used in DNA fingerprinting.</td>
<td>A DNA fingerprint is made by taking a sample of DNA - which can be taken from nuclear or mitochondrial DNA found in almost every living cell - making copies of the extracted DNA, and isolating certain known base pair sequences. Since the fragment lengths starting with these known sequences differ in every person, they can be used to help determine identity. A DNA fingerprint looks at only a small number of base pair sequences contained in a person's total DNA. Nevertheless, the differences between the DNA in different people are such that even this small number of sequences can eliminate a large majority of other people in determining an individual’s identity. In DNA fingerprinting, the DNA is isolated, cut using restriction enzymes and sorted by size using gel electrophoresis. DNA is placed in a gel and an electrical charge is applied to the gel. The negative charge is at the top and the positive charge is at the bottom. Because DNA has a slightly negative charge, the pieces of DNA will be attracted to the bottom. The smaller pieces move more quickly towards the bottom than the larger pieces. The DNA can then be analyzed.</td>
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</tbody>
</table>
The rate at which the DNA will move toward the positive pole is slowed by making the DNA move through an agarose gel. The gel is a buffer solution (which maintains the proper pH and salt concentration) with 0.75% to 2.0% agarose added. The agarose forms a porous lattice in the buffer solution and the DNA must slip through the holes in the lattice in order to move toward the positive pole. This slows the molecule down. Larger molecules will be slowed down more than smaller molecules, since the smaller molecules can fit through the holes easier. As a result, a mixture of large and small fragments of DNA that has been run through an agarose gel will be separated by size.

(To perform an actual Gel Electrophoresis or a Virtual Electrophoresis see resources below.)

<table>
<thead>
<tr>
<th>Materials Needed</th>
<th>Chart paper; scissors; tape; ruler/meter stick.</th>
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<tbody>
<tr>
<td>Safety Precautions</td>
<td>Reinforce scissor safety. Follow other standard laboratory safety procedures.</td>
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</table>

**Detailed Description**

<table>
<thead>
<tr>
<th>Teacher’s Role?</th>
<th>Teacher</th>
<th>Students</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Teacher</strong></td>
<td>Review the structure and function of DNA as needed. Distribute materials to pairs of students.</td>
<td>Working with a partner, students will follow the teacher’s verbal instructions and the written procedures to complete the activity.</td>
</tr>
<tr>
<td><strong>NOTE:</strong> Make enough copies of each of the five (5) DNA Results sheets (Student Pages 2a-e) so that each pair of students will receive a strip. There are 7 strips on each sheet. Each of the DNA Results sheets should be copied on a different color of paper to make them distinctive.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Go over the scenario and ensure that students understand the task. Guide students through the lab activity.</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Teacher</strong></td>
<td>Review the structure and function of DNA as needed. Distribute materials to pairs of students.</td>
<td>Working with a partner, students will follow the written procedure to complete the activity. Students will then share their results with other groups and make comparisons.</td>
</tr>
<tr>
<td><strong>NOTE:</strong> Make enough copies of each of the five (5) DNA Results sheets (Student Pages 2a-e) so that each pair of students will receive a strip. There are 7 strips on each sheet. Each of the DNA Results sheets should be copied on a different color of paper to make them distinctive.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Go over the scenario and ensure that students understand the task. Monitor and assist students as needed in completing the lab activity.</td>
<td>Facilitate a class discussion of the lab’s experimental design, and other uses of DNA fingerprinting.</td>
<td></td>
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</tbody>
</table>
Students will then share their results with other groups and make comparisons.

Students will research the contributions made by Sir Alec John Jeffreys to DNA fingerprinting and report their findings.

Students will identify/brainstorm other uses of DNA fingerprinting.

Students will complete the virtual lab on gel electrophoresis.

Students will take the lead in a class discussion involving all groups critiquing the activity and identifying other uses of DNA fingerprinting. Possible questions to be addressed:
1. How do we “see” DNA?
2. How does this activity compare to the actual procedure for DNA fingerprinting?
3. What possible legal and/or health issues may arise when using DNA to solve “Who Done Its?” in schools?
4. What health concerns may arise in using DNA to solve problems?

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<tr>
<th>Technology Application</th>
<th>Gel Electrophoresis</th>
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<td>Career Connections</td>
<td>DNA fingerprinting, involving gel electrophoresis, has become a widely used procedure, with applications in areas such as genetic testing, paternity determinations, and forensic science. Related careers include forensic scientist, geneticist, pathologist, and laboratory technician (specialized).</td>
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<tr>
<td>Accommodations</td>
<td>ELL: Pair with language proficient peer. Multi-media presentation to guide students in completing the activity.</td>
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<td></td>
<td>SWD: Pair with stronger student as a peer tutor. Extended time on task. Multi-media presentation to guide students in completing the activity.</td>
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<td></td>
<td>Gifted: Students will further explore the process of gel electrophoresis by completing the virtual lab at: <a href="http://learn.genetics.utah.edu/units/biotech/gel/">http://learn.genetics.utah.edu/units/biotech/gel/</a></td>
</tr>
<tr>
<td>Resources</td>
<td>[<a href="http://www.biologycorner.com/worksheets/who_ate_the_cheese.html">http://www.biologycorner.com/worksheets/who_ate_the_cheese.html</a>][5] (Virtual lab)</td>
</tr>
<tr>
<td></td>
<td><a href="http://www.worldofteaching.com/biologypowerpoints.html">http://www.worldofteaching.com/biologypowerpoints.html</a> (Gel electrophoresis power point)</td>
</tr>
<tr>
<td></td>
<td><a href="http://www.vivo.colostate.edu/hbooks/genetics/biotech/gels/agardna.html">http://www.vivo.colostate.edu/hbooks/genetics/biotech/gels/agardna.html</a> (Agarose Gel electrophoresis)</td>
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<td></td>
<td><a href="http://biotechbiology.arizona.edu/labs/labs.html">http://biotechbiology.arizona.edu/labs/labs.html</a> (Products of DNA Protein Electrophoresis - Fingerprinting, Tools for examining DNA)</td>
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<td></td>
<td>Multimedia presentations</td>
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Adapted from: [http://www.biologycorner.com/worksheets/who_ate_the_cheese.html](http://www.biologycorner.com/worksheets/who_ate_the_cheese.html)
**Student Page**

**Lab:** No Electronics At School! Who Broke The Rule?

Gel Electrophoresis

**Scenario**

Ms. Middleton, a science teacher at a midsize school in Midville, Georgia returned to work after an absence of two days during which she had attended a professional conference. While straightening up her classroom at the end of her first day back, she found that an electronic device with earphones had been left behind a stack of books on one of the work benches. Her forehead puckered in displeasure, since it was obvious that during her absence the school rule prohibiting the use of unauthorized electronic devices in the classroom had been violated.

When Ms. Middleton questioned her students the next day about the equipment, no one admitted ownership. However, by lunchtime she had received e-mail messages from two students, and was visited by another at the end of the day, each stating that the electronic device was their property. A fourth student stopped by her class before homeroom the next day and claimed to be the owner. Presented with this dilemma of ownership, as well as the infraction of school rules, Ms. Middleton came up with a novel way to resolve the issue. Her classes were just beginning their study of genetics, and Ms. Middleton proposed that they conduct a DNA test to identify which of the four students might be the owner of the electronic device.

With the permission of their parents, and the school’s principal, Ms. Middleton collected DNA samples from the cheek lining of each of the four students. These samples were to be compared to cell samples collected from the earphones attached to the electronic device. The DNA was extracted from the collected samples. Because the samples were so small, the DNA was amplified using the **polymerase chain reaction**. The DNA from the four students was isolated and compared to the DNA from the headphone using DNA **restriction enzymes** and **gel electrophoresis**.

The DNA Results, showing the sequence of base pairs for each of the samples, are on the next pages.
Student Page

DNA Results

Earphone Sample

```
Earphone DNA  Earphone DNA  Earphone DNA  Earphone DNA  Earphone DNA  Earphone DNA
GTCGACCGGTGACCGTGCTACAGTGCTATCCGGATAGCTAATAGCTCCGGTG
CAGCTGGCCACTGGCACGCATGTACCGATAGGCTATCGATTATCGAGGCCAC

Earphone DNA  Earphone DNA  Earphone DNA  Earphone DNA  Earphone DNA  Earphone DNA
GTCGACCGGTGACCGTGCTACAGTGCTATCCGGATAGCTAATAGCTCCGGTG
CAGCTGGCCACTGGCACGCATGTACCGATAGGCTATCGATTATCGAGGCCAC

Earphone DNA  Earphone DNA  Earphone DNA  Earphone DNA  Earphone DNA  Earphone DNA
GTCGACCGGTGACCGTGCTACAGTGCTATCCGGATAGCTAATAGCTCCGGTG
CAGCTGGCCACTGGCACGCATGTACCGATAGGCTATCGATTATCGAGGCCAC

Earphone DNA  Earphone DNA  Earphone DNA  Earphone DNA  Earphone DNA  Earphone DNA
GTCGACCGGTGACCGTGCTACAGTGCTATCCGGATAGCTAATAGCTCCGGTG
CAGCTGGCCACTGGCACGCATGTACCGATAGGCTATCGATTATCGAGGCCAC

Earphone DNA  Earphone DNA  Earphone DNA  Earphone DNA  Earphone DNA  Earphone DNA
GTCGACCGGTGACCGTGCTACAGTGCTATCCGGATAGCTAATAGCTCCGGTG
CAGCTGGCCACTGGCACGCATGTACCGATAGGCTATCGATTATCGAGGCCAC

Earphone DNA  Earphone DNA  Earphone DNA  Earphone DNA  Earphone DNA  Earphone DNA
GTCGACCGGTGACCGTGCTACAGTGCTATCCGGATAGCTAATAGCTCCGGTG
CAGCTGGCCACTGGCACGCATGTACCGATAGGCTATCGATTATCGAGGCCAC
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Georgia Department of Education
Kathy Cox, State Superintendent of Schools
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DNA Results
Student 1 Sample

Student 1 DNA  Student 1 DNA  Student 1 DNA  Student 1 DNA  Student 1 DNA  Student 1 DNA  Student 1 DNA  Student 1 DNA
GTCCGCCGGAACCGTACCGGTAGTATCCAGGCCGTAGAGATAGCGTAAGGCGGTG
CAGGCGGCTGCGCATGCGCCATCTAGGTGCGGCCATCTCTCATCGCATTCCGAC

Student 1 DNA  Student 1 DNA  Student 1 DNA  Student 1 DNA  Student 1 DNA  Student 1 DNA  Student 1 DNA  Student 1 DNA
GTCCGCCGGAACCGTACCGGTAGTATCCAGGCCGTAGAGATAGCGTAAGGCGGTG
CAGGCGGCTGCGCATGCGCCATCTAGGTGCGGCCATCTCTCATCGCATTCCGAC

Student 1 DNA  Student 1 DNA  Student 1 DNA  Student 1 DNA  Student 1 DNA  Student 1 DNA  Student 1 DNA  Student 1 DNA
GTCCGCCGGAACCGTACCGGTAGTATCCAGGCCGTAGAGATAGCGTAAGGCGGTG
CAGGCGGCTGCGCATGCGCCATCTAGGTGCGGCCATCTCTCATCGCATTCCGAC

Student 1 DNA  Student 1 DNA  Student 1 DNA  Student 1 DNA  Student 1 DNA  Student 1 DNA  Student 1 DNA  Student 1 DNA
GTCCGCCGGAACCGTACCGGTAGTATCCAGGCCGTAGAGATAGCGTAAGGCGGTG
CAGGCGGCTGCGCATGCGCCATCTAGGTGCGGCCATCTCTCATCGCATTCCGAC

Student 1 DNA  Student 1 DNA  Student 1 DNA  Student 1 DNA  Student 1 DNA  Student 1 DNA  Student 1 DNA  Student 1 DNA
GTCCGCCGGAACCGTACCGGTAGTATCCAGGCCGTAGAGATAGCGTAAGGCGGTG
CAGGCGGCTGCGCATGCGCCATCTAGGTGCGGCCATCTCTCATCGCATTCCGAC

Student 1 DNA  Student 1 DNA  Student 1 DNA  Student 1 DNA  Student 1 DNA  Student 1 DNA  Student 1 DNA  Student 1 DNA
GTCCGCCGGAACCGTACCGGTAGTATCCAGGCCGTAGAGATAGCGTAAGGCGGTG
CAGGCGGCTGCGCATGCGCCATCTAGGTGCGGCCATCTCTCATCGCATTCCGAC

Student 1 DNA  Student 1 DNA  Student 1 DNA  Student 1 DNA  Student 1 DNA  Student 1 DNA  Student 1 DNA  Student 1 DNA
GTCCGCCGGAACCGTACCGGTAGTATCCAGGCCGTAGAGATAGCGTAAGGCGGTG
CAGGCGGCTGCGCATGCGCCATCTAGGTGCGGCCATCTCTCATCGCATTCCGAC
**Student Page 2c**

**DNA Results**

**Student 2 Sample**

```
GTCTACGTAATCGTAGGATCCGGACTAGCTGTCGCCGGAGTCTCTCTAGATGTG
CAGATGCATTAGCATCGGATGGCCTGATCGACACGGCCTCAAGAGATCTACAC
```

```
GTCTACGTAATCGTAGGATCCGGACTAGCTGTCGCCGGAGTCTCTCTAGATGTG
CAGATGCATTAGCATCGGATGGCCTGATCGACACGGCCTCAAGAGATCTACAC
```

```
GTCTACGTAATCGTAGGATCCGGACTAGCTGTCGCCGGAGTCTCTCTAGATGTG
CAGATGCATTAGCATCGGATGGCCTGATCGACACGGCCTCAAGAGATCTACAC
```

```
GTCTACGTAATCGTAGGATCCGGACTAGCTGTCGCCGGAGTCTCTCTAGATGTG
CAGATGCATTAGCATCGGATGGCCTGATCGACACGGCCTCAAGAGATCTACAC
```

```
GTCTACGTAATCGTAGGATCCGGACTAGCTGTCGCCGGAGTCTCTCTAGATGTG
CAGATGCATTAGCATCGGATGGCCTGATCGACACGGCCTCAAGAGATCTACAC
```

```
GTCTACGTAATCGTAGGATCCGGACTAGCTGTCGCCGGAGTCTCTCTAGATGTG
CAGATGCATTAGCATCGGATGGCCTGATCGACACGGCCTCAAGAGATCTACAC
```

```
GTCTACGTAATCGTAGGATCCGGACTAGCTGTCGCCGGAGTCTCTCTAGATGTG
CAGATGCATTAGCATCGGATGGCCTGATCGACACGGCCTCAAGAGATCTACAC
```

```
GTCTACGTAATCGTAGGATCCGGACTAGCTGTCGCCGGAGTCTCTCTAGATGTG
CAGATGCATTAGCATCGGATGGCCTGATCGACACGGCCTCAAGAGATCTACAC
```

```
GTCTACGTAATCGTAGGATCCGGACTAGCTGTCGCCGGAGTCTCTCTAGATGTG
CAGATGCATTAGCATCGGATGGCCTGATCGACACGGCCTCAAGAGATCTACAC
```

```
GTCTACGTAATCGTAGGATCCGGACTAGCTGTCGCCGGAGTCTCTCTAGATGTG
CAGATGCATTAGCATCGGATGGCCTGATCGACACGGCCTCAAGAGATCTACAC
```

```
GTCTACGTAATCGTAGGATCCGGACTAGCTGTCGCCGGAGTCTCTCTAGATGTG
CAGATGCATTAGCATCGGATGGCCTGATCGACACGGCCTCAAGAGATCTACAC
```
DNA Results
Student 3 Sample

Student 3 DNA  Student 3 DNA  Student 3 DNA  Student 3 DNA  Student 3 DNA  Student 3 DNA
GTCGACCGGTGACCGTGCACAGTCTATCCGGATAGCTAATAGCTCCGGTG
CAGCTGGCCACTGGCACGCATGTCAACGATAGGCTATCGATTATCGAGGCCAC

Student 3 DNA  Student 3 DNA  Student 3 DNA  Student 3 DNA  Student 3 DNA  Student 3 DNA
GTCGACCGGTGACCGTGCACAGTCTATCCGGATAGCTAATAGCTCCGGTG
CAGCTGGCCACTGGCACGCATGTCAACGATAGGCTATCGATTATCGAGGCCAC

Student 3 DNA  Student 3 DNA  Student 3 DNA  Student 3 DNA  Student 3 DNA  Student 3 DNA
GTCGACCGGTGACCGTGCACAGTCTATCCGGATAGCTAATAGCTCCGGTG
CAGCTGGCCACTGGCACGCATGTCAACGATAGGCTATCGATTATCGAGGCCAC

Student 3 DNA  Student 3 DNA  Student 3 DNA  Student 3 DNA  Student 3 DNA  Student 3 DNA
GTCGACCGGTGACCGTGCACAGTCTATCCGGATAGCTAATAGCTCCGGTG
CAGCTGGCCACTGGCACGCATGTCAACGATAGGCTATCGATTATCGAGGCCAC

Student 3 DNA  Student 3 DNA  Student 3 DNA  Student 3 DNA  Student 3 DNA  Student 3 DNA
GTCGACCGGTGACCGTGCACAGTCTATCCGGATAGCTAATAGCTCCGGTG
CAGCTGGCCACTGGCACGCATGTCAACGATAGGCTATCGATTATCGAGGCCAC

Student 3 DNA  Student 3 DNA  Student 3 DNA  Student 3 DNA  Student 3 DNA  Student 3 DNA
GTCGACCGGTGACCGTGCACAGTCTATCCGGATAGCTAATAGCTCCGGTG
CAGCTGGCCACTGGCACGCATGTCAACGATAGGCTATCGATTATCGAGGCCAC

Student 3 DNA  Student 3 DNA  Student 3 DNA  Student 3 DNA  Student 3 DNA  Student 3 DNA
GTCGACCGGTGACCGTGCACAGTCTATCCGGATAGCTAATAGCTCCGGTG
CAGCTGGCCACTGGCACGCATGTCAACGATAGGCTATCGATTATCGAGGCCAC

Student 3 DNA  Student 3 DNA  Student 3 DNA  Student 3 DNA  Student 3 DNA  Student 3 DNA
GTCGACCGGTGACCGTGCACAGTCTATCCGGATAGCTAATAGCTCCGGTG
CAGCTGGCCACTGGCACGCATGTCAACGATAGGCTATCGATTATCGAGGCCAC

Student 3 DNA  Student 3 DNA  Student 3 DNA  Student 3 DNA  Student 3 DNA  Student 3 DNA
GTCGACCGGTGACCGTGCACAGTCTATCCGGATAGCTAATAGCTCCGGTG
CAGCTGGCCACTGGCACGCATGTCAACGATAGGCTATCGATTATCGAGGCCAC
Student Page 2e

DNA Results
Student 4 Sample

Student 4 DNA  Student 4 DNA  Student 4 DNA  Student 4 DNA  Student 4 DNA  Student 4 DNA
GTCGACATCCGGACTACACATGCTGTATCCGGTGATACCATGCGTCCCGGAGTG
CAGCTGTAGGCCTGTAGTGTAACGACATAAGGCACACTATGGTACGCAGGCCTCAC

Student 4 DNA  Student 4 DNA  Student 4 DNA  Student 4 DNA  Student 4 DNA  Student 4 DNA
GTCGACATCCGGACTACACATGCTGTATCCGGTGATACCATGCGTCCCGGAGTG
CAGCTGTAGGCCTGTAGTGTAACGACATAAGGCACACTATGGTACGCAGGCCTCAC

Student 4 DNA  Student 4 DNA  Student 4 DNA  Student 4 DNA  Student 4 DNA  Student 4 DNA
GTCGACATCCGGACTACACATGCTGTATCCGGTGATACCATGCGTCCCGGAGTG
CAGCTGTAGGCCTGTAGTGTAACGACATAAGGCACACTATGGTACGCAGGCCTCAC

Student 4 DNA  Student 4 DNA  Student 4 DNA  Student 4 DNA  Student 4 DNA  Student 4 DNA
GTCGACATCCGGACTACACATGCTGTATCCGGTGATACCATGCGTCCCGGAGTG
CAGCTGTAGGCCTGTAGTGTAACGACATAAGGCACACTATGGTACGCAGGCCTCAC

Student 4 DNA  Student 4 DNA  Student 4 DNA  Student 4 DNA  Student 4 DNA  Student 4 DNA
GTCGACATCCGGACTACACATGCTGTATCCGGTGATACCATGCGTCCCGGAGTG
CAGCTGTAGGCCTGTAGTGTAACGACATAAGGCACACTATGGTACGCAGGCCTCAC

Student 4 DNA  Student 4 DNA  Student 4 DNA  Student 4 DNA  Student 4 DNA  Student 4 DNA
GTCGACATCCGGACTACACATGCTGTATCCGGTGATACCATGCGTCCCGGAGTG
CAGCTGTAGGCCTGTAGTGTAACGACATAAGGCACACTATGGTACGCAGGCCTCAC

Student 4 DNA  Student 4 DNA  Student 4 DNA  Student 4 DNA  Student 4 DNA  Student 4 DNA
GTCGACATCCGGACTACACATGCTGTATCCGGTGATACCATGCGTCCCGGAGTG
CAGCTGTAGGCCTGTAGTGTAACGACATAAGGCACACTATGGTACGCAGGCCTCAC

Student 4 DNA  Student 4 DNA  Student 4 DNA  Student 4 DNA  Student 4 DNA  Student 4 DNA
GTCGACATCCGGACTACACATGCTGTATCCGGTGATACCATGCGTCCCGGAGTG
CAGCTGTAGGCCTGTAGTGTAACGACATAAGGCACACTATGGTACGCAGGCCTCAC

Student 4 DNA  Student 4 DNA  Student 4 DNA  Student 4 DNA  Student 4 DNA  Student 4 DNA
GTCGACATCCGGACTACACATGCTGTATCCGGTGATACCATGCGTCCCGGAGTG
CAGCTGTAGGCCTGTAGTGTAACGACATAAGGCACACTATGGTACGCAGGCCTCAC
Procedures:

1. Use the chart paper provided by your teacher to make a larger version of the chart shown above. The enlarged chart will simulate a gel electrophoresis chamber. Use a ruler or meter stick to make sure all of the lengths are the same.

2. **Cut out one of the DNA fragment sample strips from each of the 5 DNA Results sheets**, making sure to leave the source of the DNA (Earphone DNA, Student 1 DNA, Student 2 DNA, etc.) attached.

3. Examine each DNA fragment strip closely, looking for the sequence **CCGG**. This is a restriction site, where enzymes will cut the DNA into even smaller fragments. Use a pencil to mark these sites, with a line between the inner C and the inner G (CC | GG). Then use the scissors to cut across the fragments at those sites. Count and label the number of base pairs contained in each of the DNA fragments.
Student Page 4

4. Tape the DNA fragments to the chart that you made, using the number of base pairs in each DNA fragment as a guide in placing the fragments.
   Example: IF a DNA fragment from Student 4 contained 16 base pairs, it would be taped at the place indicated on the above chart.

5. Compare the DNA from the earphone used with the electronic device to the student samples. Circle the student’s DNA that matches the DNA from the earphone.

Analysis: Who Broke The Rule?

1. Who will receive the electronic device, AND get three days of detention for breaking the school rule banning unauthorized electronic devices?

2. For each of the following tasks carried out in the activity, tell what you were simulating that would occur in a real DNA fingerprinting procedure.
   - Using the scissors to cut the DNA into fragments:
     - Taping the DNA fragments onto the chart that you made:

3. For each of the terms below, tell how it relates to DNA fingerprinting.
   - Polymerase chain reaction:
     - Restriction enzymes:
     - Gel Electrophoresis: