

HS Lesson 8:

Understanding DNA Fingerprinting

(Post-Exhibit Visit)

Objective:

Students will be able to explain how the process of DNA fingerprinting works and several uses of the technology.

Curriculum Connection:

This lesson is best taught after an overview of genetic technologies. Students should have prior knowledge of DNA structure, replication, and base pairing. This lesson gives students a more detailed idea of how DNA fingerprinting works and how it can be useful. There is a large amount of “junk DNA” – DNA that does not code for protein – in the human genome. Junk DNA is made up of repeated sequences that are called repeats. Although individuals may have identical genes, there may be different numbers of repeats between these genes. For example, one person may have 7 repeats while another has 12. The more repeats, the longer the junk DNA between genes. One method of DNA fingerprinting — which produces a Southern Blot — begins by taking a DNA sample from something such as skin, saliva, blood, or hair. The DNA is cut into pieces using restriction enzymes. The resulting collection of DNA pieces will consist of some pieces of junk DNA and some genes. The sample DNA pieces are placed into a clear gelatin, where an electric current pushes the DNA pieces through the gel. Short pieces move farther than long ones, so a piece of DNA that had 7 repeats would move faster than a piece of DNA with 12 repeats. Since DNA has no color more steps must be completed so scientists can “see” particular DNA pieces. The sequences are denatured so only a single strand remains. They are transferred onto a nylon sheet where the strands are permanently fixed. A radioactive probe with a known sequence is then added. After a radioactive probe of single stranded DNA has been allowed to bond by basepairing with the denatured DNA on the paper, an X-ray reveals only the areas where the radioactive probe sits. These are the only things that will show up on the film. This allows researchers to identify, in a particular person’s DNA, the occurrence and frequency of the particular genetic pattern contained in the probe. For more information see additional resources.

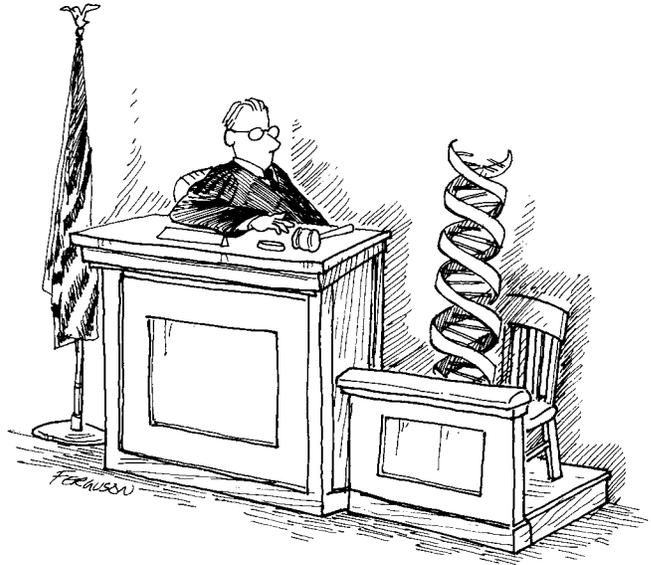


Exhibit Link:

This activity builds on *DNA Detective* of the exhibit that explains DNA fingerprinting and allows students to match the DNA sample from a crime scene to a sample from the person convicted of the crime.

Class Time Required:

90 minutes

Materials Needed:

For each student:

- Handout
- Highlighter or Light Colored Marker
- Tape
- Scissors

Focus Activity:

Write the following information about DNA fingerprinting on the board:

DNA fingerprinting is a technology that looks for similarities in specific sections of DNA samples. Since each person's DNA is unique but every cell in that individual contains the same DNA, this technique can be used to identify an individual from such samples as skin, saliva, blood, or hair, which contain DNA.

Put the students in pairs, and have them make a list of five scenarios where DNA fingerprinting would be a useful technology.

Lesson Steps:

1. Discuss the students' answers, and clarify any misconceptions.
2. Read the students the following story:
Within a span of three months, Haywood and Clark counties suffered eight bank robberies. The banks were mostly small and rural, with minimal security. The robber wore a ski mask, carried a large gun, and got in and out within minutes. However, the robber got more bold in his last robbery. He chose a larger bank with new surveillance cameras and a security guard. The robber still escaped, but not before he was chased by the guard. When the guard caught the robber, the robber shot and killed him, but not before the guard managed to pull off the robber's ski mask, revealing his face to the surveillance cameras. Meanwhile, a woman leaving a hair salon across the street witnessed it all.
Police Chief Harry Gilford felt pressure from the state to make a quick arrest. Using the pictures from the tape, he brought in two possible suspects, both with prior arrests. The woman identified Suspect 1, who could not account for his whereabouts at the time of the robbery. Within weeks, Gerald Walker was convicted and sentenced to life in prison, despite his plea of innocence. Chief Gilford was pleased to close the case, but he couldn't help wondering if they really got the right man.
Four years later, a new governor was elected. With advancements in genetic technologies, he soon signed a law that allows prisoners on death row or life sentences to demand a retrial that would use DNA testing on the evidence. Gerald Walker hired a lawyer and pressed for a new case. Using hair samples from the ski mask recovered by the security guard, the crime lab did a Southern Blot test. During the investigation, hair samples were also taken from both suspects. Use the suspects' hair samples to determine if the right man was convicted.
3. Explain to students how a Southern Blot test works (see curriculum connection). Also, There is a great animation of a Southern Blot at <http://www.dnalc.org/shockwave/southan.html>
4. Distribute the handout, and tell students that it shows the results of the Southern Blot test done on the hair sample found in the ski mask recovered from the robbery. Have students cut out the DNA fragments for Gerald Walker and for Suspect 2 and tape them in the correct places on the blot. If the direction of electricity is going up, students should understand that the shortest pieces would be found toward the top. They should then cut out the probe sequence and try to match the probe sequence with those on each suspect. Have students highlight any probe sequence that finds a perfect match (but not other sequences) For example, the probe sequence of AGGT binds perfectly to any segment containing a TCCA sequence. Any sequence with TCCA should be highlighted. The suspect with the match from the hair sample is most likely the one who committed the robbery. (They should find that it wasn't Gerald Walker!)

Extensions & Modifications:

- Have students write a police report regarding their findings.
- For lower level students, do the ordering of the sequences on the board as a class and simply have them copy the information onto their paper.
- Have more advanced students do research to find out how a Southern Blot works and then do the activity based on this information.

Important terms: Southern Blot, DNA fingerprinting, probe

Writing Prompts/Potential Discussion Questions:

1. DNA fingerprinting is widely used in court cases today. Discuss the pros and cons of relying on such technologies to make convictions.
2. What kinds of future genetic technologies can you imagine that would aid the police in solving crimes?
3. Using such technologies in court cases would be more beneficial if there were a database containing every person's DNA sequence. Discuss the pros and cons of creating such a database.
4. What are some of the advantages of DNA fingerprinting has over traditional fingerprinting?



Additional Resources:

Basics of DNA fingerprinting

<http://protist.biology.washington.edu/fingerprint/dnaintro.html>

Very easy to understand!

Understanding a Southern Blot test

<http://protist.biology.washington.edu/fingerprint/blot.html>

This page from the same site above gives step by step explanations about how a Southern Blot test is done.

National Standards Addressed:

Standard E – Understandings about Science and Technology

- New technologies often extend the current levels of scientific understanding and introduce new areas of research.
- Sometimes scientific advances challenge people's beliefs and practical explanations concerning various aspects of the world. Sometimes scientific advances challenge people's beliefs and practical explanations concerning various aspects of the world.