

FORENSIC DNA

DESCRIPTION OF SESSION

This session provides participants with a basic understanding of genetics and how forensic DNA is used in criminal investigations.

CATEGORIES

- Exploring: Law Enforcement
- U.S. Department of Education: Law, Public Safety, Corrections & Security
- U.S. Department of Education: Government & Public Administration

OBJECTIVES

By the end of this session, participants will be able to:

- Describe the molecular basis of inheritance.
- Identify where DNA is located within the cell.
- Discuss the helical nature of DNA.
- List the four nitrogenous bases that make up DNA and describe the concept of base pairing.
- Distinguish between a gene and a chromosome.
- Demonstrate how DNA evidence is collected and how DNA standards are taken from suspects.
- Perform DNA extraction from cheek cells.
- Identify the percentage of DNA that is useful for forensic science purposes.
- Discuss how the sample size requirements have changed since the invention of forensic DNA analysis.
- Describe how restriction enzymes act like molecular scissors.
- Explain what electrophoresis is and how it's used to separate DNA fragments.
- Interpret the results of gel electrophoresis.
- Compare and contrast CODIS and NDIS.

SUPPLIES

- (1) computer with internet access
- For each participant:
 - (1) pair of nitrile or latex gloves (check for allergies before using latex gloves)
 - (1) bottle of stage blood or reddish-brown liquid with the consistency of blood
 - (1) object that the stage blood can be spread on (countertop, pencil, etc.)
 - (2) cotton swabs
 - (1) eye dropper bottle containing water
 - (1) bottle of drinking water (500 ml)
 - (1) bottle of clear dish soap
 - (1) bottle of blue food coloring
 - (1) small container of table salt (1 tablespoon)
 - (1) bottle of 70% isopropyl alcohol (100 ml)
 - (2) clear drinking cups (large enough to hold the 500 ml of water)
 - (1) tablespoon

PREPARATION

See Activity 5 for suggestions of speakers who could attend the meeting or places where participants could visit, and make arrangements as needed.

WEBSITES

- “Basic Genetics” (Genetics Science Learning Center): <http://learn.genetics.utah.edu/content/basics/>—Provides an overview of the basics of genetics.
- “A Simplified Guide to DNA Evidence” (National Forensic Science Technology Center): www.forensicsciencesimplified.org/dna/how.html—A good overview of forensic DNA analysis.
- “Frequently Asked Questions on CODIS and NDIS” (FBI): www.fbi.gov/services/laboratory/biometric-analysis/codis/codis-and-ndis-fact-sheet—A fact sheet about DNA databases maintained by the FBI.
- Innocence Project: www.innocenceproject.org/—This website contains a wealth of information about people who have been exonerated by forensic DNA after being wrongfully convicted of crimes.

VIDEOS

Reminder: Any time you use an outside source, be sure you follow the content owner’s or website’s permission requirements and guidelines.

These videos were chosen because they illustrate important aspects of the forensic science discipline being studied in this session. **Note:** Some of the content in the case studies is geared toward a mature audience. Advisors should review these videos before showing them to ensure that they are age appropriate for the post.

- “Genetics 101” (23andMe): www.youtube.com/watch?v=ubq4eu_TDFc—Five-part series that does a very good job of explaining the fundamentals of DNA and inheritance.
- “Basics of DNA for the Crime Scene” (SirchieGlobal): www.youtube.com/watch?v=YEK EZ9WxUrK—Details how to properly collect forensic DNA evidence.
- “DNA Analysis” (National Forensic Science Technology Center): www.youtube.com/watch?v=JUoBTk1NDZ8—Explains how forensic DNA is analyzed.
- *Medical Detectives: The Footpath Murders* (Forensic Spider): www.youtube.com/watch?v=vjpr_Fx3_X8—Case study No. 1.
- *Forensic Files: The South Side Strangler* (Hese maka): www.youtube.com/watch?v=llgI6jiTIBU—Case study No. 2.
- “Bloodsworth” (Gregory Bayne): www.youtube.com/watch?v=qjAOw-n3CxQ—Presents the story of Kirk Bloodsworth, the first death row inmate exonerated by forensic DNA.
- “Jason Young Trial: DNA Evidence” (Wrongful Convictions): www.youtube.com/watch?v=ICia7WfUYgs—A DNA examiner testifies in a murder trial.

ADVISOR NOTE: Make sure you add time in your activities for viewing and discussing videos with the Explorers. These videos are currently not built into the session plan so you will need to choose those that best complement your activities and plans for this topic.

ADVISOR NOTE: Text in italics should be read aloud to participants. As you engage your post in activities each week, please include comments, discussions, and feedback to the group relating to **Character, Leadership, and Ethics**. These are important attributes that make a difference in the success of youth in the workplace and in life.

ACTIVITIES

Introduction

Say to Explorers: *Forensic DNA is without a doubt one of the most important discoveries in the history of forensic science. Since the dawn of human identification, as it pertains to the investigation of crime, one of the most sought after abilities was to be able to associate biological evidence, such as blood, semen, saliva, etc., with the individuals who deposited it. This ability remained elusive until 1984 when a scientist named Alec Jeffreys from the University of Leicester in England discovered that a small portion of human DNA was highly variable from person to person and could be used to identify an individual with a high degree of statistical probability. He developed a technique that allows DNA from crime scene evidence and DNA from a suspect to be separated, visualized, and compared. In its infancy, forensic DNA analysis required a fresh sample of biological evidence at least the size of a quarter in order to extract a profile. Since its discovery more than 30 years ago, the science of forensic DNA has experienced significant advancements and now even a small, badly degraded DNA sample consisting of a few cells invisible to the naked eye can yield a full DNA profile. In its short tenure as a criminal investigative tool, forensic DNA has enjoyed a great deal of success in identifying criminals and crime victims. It has also become an indispensable tool in the identification of people killed in mass disasters and war. Finally, DNA has played a vital role in exonerating people who have been wrongfully convicted of crimes they didn't commit. A group named the Innocence Project has used DNA to get several hundred people released from jail.*

To provide more background to the Explorers, you may wish to share some of the materials listed under “Websites” and “Videos.”

Activity 1

Collecting DNA Evidence

Show Explorers the following video: “How to Properly Swab DNA Evidence at a Crime Scene” (National Forensic Academy)—www.youtube.com/watch?v=2HPeZWGtjD0.

Then have each Explorer follow this procedure:

- Put on a pair of protective gloves.
- Place a couple of drops of blood or a reddish-brown liquid or substance that has a consistency similar to blood onto a surface such as a countertop or onto an object such as a pencil and allow it to dry.

- Moisten a cotton swab with a drop or two of water and rub it on the edge of the stain until a visible transfer has taken place; do not consume the entire evidence sample.
- Take a second swab and swab the inside of the cheek of another Explorer; this is called a buccal swab and this is what is used to compare the DNA from a suspect to the DNA extracted from an evidence stain (blood, semen, saliva, etc.).
- Dispose of the swabs and clean the bloodstain from the surface or object that it was deposited on.

Activity 2

Extracting DNA From Cheek Cells

Show Explorers the following video: “How to Extract Your Own DNA” (PBS/NOVA)—

www.youtube.com/watch?v=DaaRrR-ZHP4. Then have Explorers complete all of the steps as directed in the video.

Activity 3

Creating a DNA Fingerprint

Go to the following website: “Create a DNA Fingerprint” (NOVA)—

www.pbs.org/wgbh/nova/education/body/create-dna-fingerprint.html and click on the LAUNCH INTERACTIVE button.

Have Explorers take turns going through the steps to complete the Create a DNA Fingerprint activity.

Activity 4

Case Studies

Show the *Medical Detectives* and/or the *Forensic Files* episodes listed under “Videos” to the Explorers and discuss how DNA evidence helped in the investigation.

Activity 5

Speaker or Visit

If possible, make arrangements for one of the following activities in order to provide Explorers with a real-world look at the profession of forensic science.

- Arrange for a visit to a local, county, or state crime laboratory with an emphasis on the forensic DNA section.
- Research cases in the media and on the internet that involve DNA evidence.
- Attend a trial where DNA evidence is being presented.

ADVISOR NOTE

Some sample questions are below. They are designed to help the participants apply what they have learned to their own interests. You are welcome to use these questions or develop your own questions that relate to your post or specific focus area.

REFLECTION

- *What is DNA and how is it passed from one generation to the next?*
- *Explain the concept of base pairing as it pertains to DNA.*
- *List at least three sources of DNA that can be useful in a criminal investigation.*
- *Describe the steps used in forensic DNA analysis.*
- *Should everybody who is arrested be required to give a DNA sample along with their fingerprints? Why or why not?*
- *Do you think that DNA information stored in government database such as CODIS and NDIS could be misused? If so, how?*

ADVISOR AND OFFICER REVIEW

After the meeting, address the following:

- Identify what was successful about the meeting.
- Identify what needed improvement.
- Schedule an officer and Advisor planning meeting to prepare for the next post meeting or activity.

All content is copyright Christopher Bily, Next Generation Forensic Science Initiative, West Virginia University. Used with permission.

Links to other websites are provided for your convenience and information only. When you click on a link to another website, you will be leaving this website. The fact that we provide links to other websites does not mean that we endorse, authorize, or sponsor the linked website, or that we are affiliated with that website's owners or sponsors. Unless otherwise indicated, the linked sites are not under our control and we are not responsible for and assume no liability for the content or presentation of any linked site or any link contained in a linked site, or any changes or updates to such sites. Your use of a linked site and its content is at your sole risk and may be subject to restrictions and/or limitations. Always take care to abide by the linked site's terms of use, including any permission requirements/guidelines.