LESSON PLAN & TEACHER'S GUIDE

DNA, Crime, and Law Enforcement

Aim

How will advances in DNA technology impact individuals, law enforcement and society?

Time

This lesson can be adjusted to fill 1 or 2 days.

Guiding questions

- How is scientific progress affecting how DNA is used to solve crimes in the United States?
- What are the benefits and dilemmas of collecting DNA from people when they are arrested, but before they have been charged with a crime?
- As a society, how should we balance privacy rights with the rights of crime victims?
- How can DNA evidence be used to free innocent people?
- How are different communities (within and outside your own) affected by the policies and procedures around DNA collection and law enforcement?

Learning objectives

By the end of this lesson, students will be able to:

- Discuss why the number of people in DNA databases is on the rise.
- Discuss the ethical issues surrounding the use of familial searching to solve crimes.
- Analyze some of the controversies in using DNA to solve crimes.

- Debate the issues around privacy, laws, freedom and public safety as they relate to DNA technology and crime.
- Recognize some of the unintended consequences of how and why DNA is collected and used by law enforcement.

Materials

Projector or Smartboard, laptop, handouts.

Standards alignment

Common Core Standards

CCSS.ELA-LITERACY.RH.9-10.6. Compare the point of view of two or more authors for how they treat the same or similar topics, including which details they include and emphasize in their respective accounts.

CCSS.ELA-LITERACY.RH.11-12.3. Evaluate various explanations for actions or events and determine which explanation best accords with textual evidence, acknowledging where the text leaves matters uncertain.

CCSS.ELA-LITERACY.RH.11-12.6. Evaluate authors' differing points of view on the same historical event or issue by assessing the authors' claims, reasoning, and evidence.

CCSS.ELA-LITERACY.RH.11-12.7. Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., visually, quantitatively, as well as in words) in order to address a question or solve a problem.

Next Generation Science Standards

This pgEd lesson integrates some of the NGSS practices and cross cutting concepts associated with the following disciplinary core ideas. The relevant portion of each disciplinary core idea is written out below.

HS-LS3: Inheritance and Variation of Traits

HS-LS3-1:

- Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.

HS-LS3-3:

- Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.

HS. Engineering Design

HS-ETS1-3:

- Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.

Background information

Note: This lesson contains descriptions of acts of physical and sexual violence and murder that may be distressing for some students and teachers. Teachers may want to inform students of this ahead of time and make accommodations, such as allowing students to step out, if needed. Teachers should use their discretion in which case studies, or parts of them, to use in their classrooms.

This lesson examines some of the recent legal and scientific developments in DNA collection and analysis. Students are asked to explore issues related to public safety, privacy rights, race and the role of government in regulating the collection and storage of DNA. Through the reading, slides, and classroom discussion of the scenarios, students are asked to tackle complex issues that may have wide-reaching consequences on the personal and societal levels.

The collection and analysis of DNA is an important tool in law enforcement. The FBI states that, as of 2019, over 450,000 cases have used DNA evidence to aid in criminal investigations. Additionally, The Innocence Project reports over 350 people, several of whom were on death row, have been exonerated as a result of DNA evidence. In 2019, over 16 million people in the United States have their DNA profile in government created and supervised databases, whether it be as someone convicted of a crime, or as someone who has been arrested. Some expect this number will continue to climb as a result of the 2013 Supreme Court decision in *Maryland v. King*, in which the Court ruled to allow law enforcement to collect DNA from people who are arrested, but not charged or convicted of a crime.

This lesson covers five main topics related to DNA and the criminal justice system: (i) privacy rights; (ii) how DNA is collected and used in the US legal system; (iii) unintended outcomes related to increased use of DNA analysis; (iv) the limitations and worries related to DNA and crime and; (v) bias within the criminal justice system.

DNA collection for crime-solving purposes can intersect with the Genetic Information Non-discrimination Act (GINA). This is a chance to inform students that there are federal protections in place, because of GINA, that forbid certain uses of genetic information in the context of health insurance and employment. Employers cannot ask for employee's DNA, even when the employer believes that person is guilty of a crime. This is what happened in *Lowe & Reynolds v. Atlas Logistics Group Retail Services*, which is the subject of the Do Now activity. Employees, accused of a crime and then asked for their DNA by their boss, were awarded $2.25 million in damages as a result of the trial.

DNA databases

DNA is collected and used in the US legal system in what are known as forensic databases, typically overseen by local, state and federal authorities. The information collected captures segments of a person's DNA that are both highly unique and not tied to known physical traits. These DNA profiles can be used to match the DNA from a crime scene to people who may be guilty of committing the crime. Apart from using DNA databases to identify suspects, they can also be used to identify victims and missing persons, or to provide evidence to support exonerations. Criminal DNA databases are growing in terms of the number of people whose DNA is collected. The way in which they are used is also changing. How DNA databases are created and used will be discussed, as well as how and why their composition and regulation have changed over time.

Uses of DNA as a forensic tool

Four case studies are used to illustrate the ways in which DNA databases can be used to: (i) identify suspects; (ii) identify victims and missing persons; (iii) provide evidence to support exonerations. Within each case is a chance to explore the challenge of establishing ethical and legal frameworks in a timely manner to guide the use of newly developed technologies.

The first case tells the story of a serial killer known as the "Grim Sleeper", who was arrested and convicted based, in part, on a technique known as familial searching. Familial searching uses DNA databases and specialized computer software to identify people whose DNA is similar, but not an exact match, to DNA found at a crime scene. As we share part of our DNA with our biological relatives, the assumption is that the similarity in DNA occurs because the identified person is a family member of the actual suspect. This practice is controversial because of privacy concerns, which are discussed in detail in slide 13. Beyond the use of government-run, DNA databases (which were developed in the early 1990s) a new approach to crime solving emerged in 2018: Police seeking suspects or their biological relatives in a non-profit, open access database for genealogy hobbyists. The latter method was applied to identify the "Golden State Killer", who killed 10 women in California and terrorized communities for many years. The third case study is an example of the use of DNA as a tool to identify victims and missing persons. Grandmothers known as the "Abuelas de Plaza de Mayo", protested the kidnapping and murder of their children by the dictatorship during Argentina's "Dirty War" (1976-1983). They sought out geneticists, and together, developed DNA tools to locate and reunite with those children and grandchildren. The final case tells the story of Darryl Hunt, who was exonerated after serving 19 years in jail for a crime he did not commit, thanks to his and his allies' tireless advocacy combined with the use of familial searching.

Limitations

The limitations of the use of DNA in forensic investigations are discussed in the final part of the lesson plan. Rapid growth of DNA databases alongside evolving of genetic technologies bring new challenges to the forefront. A key question that is woven through this lesson is how we as a society can use genetics to keep people safe, solve crimes and, at the same time, develop policies that ensure fairness and provide appropriate safeguards and privacy protections. A useful message to share with students is that many experts do not agree on how DNA should be used to prevent and solve crime. The questions tackled in this lesson are currently being discussed at local, state and federal levels, and are the subject of legal debates, pending legislation, and court cases.

Note: We have included a number of news articles and videos throughout this lesson plan. However, as technology evolves at a rapid pace, we recommend visiting http://pged.org/genetics-and-crime/ for regular updates related to this lesson.

Outline of resources and activities in this lesson

1. Part 1 – Student reading and "Do Now" exercise (page 6)
2. Part 2 – Slideshow (slide notes on pages 7-14)
3. Part 3 – Classroom activity (page 15, discussion scenarios on pages 17-20)
4. Part 4 – Assessments & handouts (page 16)
5. Short quiz (answer key on page 16, handout on page 22)
6. List of additional resources (page 23)

Activities

Do Now exercise (5-7 minutes), slideshow (20-25 minutes), scenarios (20 minutes).

DNA, Crime, and Law Enforcement

Part 1: OVERVIEW FOR STUDENTS

Reading for students:

These two articles, together, present a variety of views on the issues related to the use of DNA as a forensic tool to solve crime, with an emphasis on familial searching. The articles highlight the discussions and disagreements within the law and civil rights communities over how to most effectively and fairly use DNA in law enforcement. These articles are used in a homework assignment to follow the lesson, but you instead may choose to have students read it in advance of the lesson.

"Is Your DNA in a Police Database?" by Jill Lawless, November 2015, *NBC News.*

"The Controversial DNA Search That Helped Nab the "Grim Sleeper" is Winning Over Skeptics" by Marisa Gerber, October 2016, *LA Times.*

Do Now exercise (5-7 minutes):

Have students read the following scenario and answer the accompanying question, individually or in pairs, and then share their answers in a brief classroom discussion. This scenario is on slide 2 in the slideshow, with further information about this case on slide 3.

You are a business owner. In the past two weeks, your manager has found a pile of human feces in the warehouse on more than one occasion. The manager thinks some unhappy workers may be the 'devious defecators' and proposes using a DNA test to find the culprit.

As the business owner, do you go forward with DNA testing your employees to identify the "devious defecators"?

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Part 2: SLIDESHOW (20-25 minutes)

The slideshow is located on the pgEd website along with this lesson, and accompanying explanatory notes for the slideshow are provided below.

Slide 2

The scenario for this "Do Now" activity will help students begin to consider the topics covered in the lesson. This "Do Now" exercise is based on the "devious defecator" case, which is outlined in slide 3. Detailed notes on the "Do Now" are on page 6.

Slide 3

A recent court case highlighted how the Genetic Information Non-discrimination Act (GINA) protects employees from genetic testing in the work environment. Someone had been repeatedly defecating in a grocery warehouse in Atlanta. The manager suspected it was Dennis Reynolds and Jack Lowe, two Black men, who worked for the company. As the employer, the manager asked that they submit a DNA sample to test if they were in fact the "devious defecators", a nickname coined in the media to describe this case. Reynolds and Lowe, afraid of losing their jobs, agreed to a DNA test. The results indicated that they were not the perpetrators. However, it was illegal for the manager to ask for a DNA sample, because the Genetic Information Non-Discrimination Act (GINA) forbids employers from asking for DNA from their employees. The men sued their employer and won $2.25 million dollars in damages to be shared between them. This was the first case that went to trial under GINA (other cases were previously settled without a trial). It shows how the law protects employees from employers seeking genetic information to make a decision to fire employees. For more information on this case please see "'Devious Defecator' Case Tests Genetics Law" by Gina Kolata, May 2015, *The New York Times*.

Slide 4

GINA is a federal law that prohibits employers and health insurance providers from discriminating on the basis of genetic information. Signed into law in 2008, GINA has two main provisions. First, it forbids employers to use genetic information to make hiring, firing and promotion decisions. Second, GINA forbids group and individual health insurers from using genetic information to adjust premiums, add or drop people from policies, or deny coverage. GINA has limits - it only covers people who work at an organization with more than 15 employees. Furthermore, GINA does

not apply to people in the U.S military or veterans, and also does not apply to those who get health care from the Indian Health Services - as they receive protections from other federal agencies. Lastly, GINA does not apply to disability, long term care or life insurance. For more information on GINA, please check out our lesson plan "Genetics, jobs, and your rights".

Slide 5

This presentation consists of 3 parts: 'DNA databases', 'uses of DNA as a forensic tool', and 'limitations'. The first part of this lesson explores the DNA databases that are used to aid criminal investigation, how these databases of genetic information are created, and how their composition has changed over time. In the second part of the lesson plan, the focus shifts to the ways in which DNA can be used as a forensic tool to: (i) identify suspects; (ii) identify victims and missing persons; and (iii) provide evidence to support exonerations. The third and final part of the presentation acts to ensure students grasp that, although DNA is a powerful tool in forensic investigations, there are a number of limitations and controversies surrounding its use, from both technical and societal perspectives.

Slide 6

Criminal DNA databases are generally broken into two parts: DNA from offenders and DNA collected at crime scenes. A forensic database stores DNA profiles from samples collected at crime scenes, and an offender database stores DNA profiles from people who have been arrested, charged or convicted of a crime. The two databases are compared to one another in an effort to match offender DNA with DNA collected from crime scenes. The *Nature Education* article "Forensics, DNA Fingerprinting, and CODIS" provides a scientific overview of how DNA profiles are generated.

Slide 7

U.S. criminal DNA databases are overseen by various branches of government. In the United States, each state maintains its own database and may share information with the Federal Bureau of Investigation's (FBI's) database, known as the Combined DNA Index System (CODIS). There are also international law enforcement databases, such as Interpol. Updated federal statistics as well as breakdowns by state are available on the FBI's CODIS statistics website. According to this website, "as of April 2019, CODIS has produced over 464,308 hits assisting in more than 453,512 investigations." CODIS now includes profiles of "arrestees," meaning, people who have been arrested but not necessarily charged or convicted. As of 2018,

31 states and Puerto Rico have statutes allowing for DNA collection from certain arrestees (see Slide 10 and 11 for further details).

Slide 8

What types of crimes require a person to provide a DNA sample? In the US, states regulate the types of offenses that require offenders to provide a DNA sample, which is then added to a criminal DNA database. The statistics on the slide are taken from the National Conference of State Legislatures. A felony is considered the most serious category of crime and includes violent crimes, many sex offenses and many drug-related crimes. A misdemeanor, such as trespassing, is a criminal offense that is less serious than a felony and often punished by a fine or short jail term.

Slide 9

Misdemeanor offenses that require offenders to provide a DNA sample in some states can occur for graffiti painting and being part of a protest. Law enforcement agencies argue that collecting DNA samples from people who commit misdemeanors helps catch people who may have already committed more serious crimes, or who may in the future. Privacy advocates, such as the New York Civil Liberties Union, argue that the scope of DNA collection is too broad, will have negligible effects on public safety, and increases the risk of wrongful prosecutions and convictions.

Slide 10

In a 5-4 vote on the *Maryland v. King* case, the Supreme Court expanded the rights of law enforcement to collect DNA from people who were arrested. In 2009, Alonzo King was arrested for assault, and his DNA was collected in the course of the arrest. Maryland authorities used his DNA sample from the arrest to search a forensic DNA database. They found a match linking King to an unsolved rape from 2003, and he was charged and sentenced to life in prison for this crime. The Supreme Court ultimately decided it is constitutional to take DNA samples from arrestees for the purpose of linking a suspect to other possible crimes. In its majority opinion, the Court argued that a DNA profile is fundamentally the same as a fingerprint, used to confirm identity, and that people who are arrested should expect diminished privacy protections. The Court was sharply divided, and the dissenting justices argued that DNA collection from arrestees is a violation of the 4th amendment, which forbids unreasonable search and seizure.

Slide 11

DNA collection from arrestees has expanded since the Supreme Court decision in 2013. Since the Maryland v. King case, U.S. state laws vary regarding the collection of DNA samples from arrestees to be added to an offender database. State laws can mandate DNA collection from those arrested or charged, but not convicted, for certain crimes. The map on this slide illustrates, as of 2019, states with DNA arrestee laws (shaded in blue), while those in white represent states with no DNA arrestee laws. This slide illustrates that the laws on DNA collection (if arrested) vary from state to state. For further information: National Conference of State Legislatures: DNA Arrestee Laws 2018 Update.

Slide 12

Since CODIS was established in 1994 it has continued to expand. This slide highlights how quickly the CODIS databases are growing. Between 2000 and 2019, over 13 million offender profiles were added to the offender DNA database. Evidence suggests that the databases grew more quickly as a result of the Maryland v. King Supreme Court decision, which allows DNA collection from arrestees. For updated CODIS statistics, please refer to https://www.fbi.gov/services/laboratory/biometric-analysis/codis/ndis-statistics.

Slide 13

Familial searching allows law enforcement to connect people in ways the original system did not anticipate. The second part of this presentation focuses on the uses of DNA as a forensic tool to: (i) identify suspects; (ii) identify victims and missing persons; and (iii) provide evidence to support exonerations. Before diving into the four case studies that illustrate these uses, the concept of 'familial searching' is explained.

A technique to search DNA databases, one that was not originally intended, is called 'familial searching'. The original intent of CODIS was to find "perfect" matches - linking a possible criminal to a crime scene with the DNA matched on every single marker that was examined. Familial searching uses specialized software to intentionally search DNA databases to identify people whose DNA is similar, but not a perfect match, to DNA found at a crime scene. As we share part of our DNA with our biological relatives, the assumption is that the similarity in DNA occurs because the identified person is a family member of the actual suspect. This means that criminals who have never been arrested or convicted - and whose DNA has thus not been entered in an offender DNA database - can still be identified through a family member whose DNA is present in such a database. In the United States, as of 2019, crime labs in 11 states are conducting familial searching. On the other hand, Maryland and Washington DC have formally

prohibited this method of identifying suspects. The use of familial searching is evolving, and a matter of debate within law enforcement, privacy, civil rights and legislative communities. For more information, please see: "Familial DNA searching- an emerging forensic investigative tool." by Sara Debus-Sherrill and Michael B. Field, January 2019, *Science & Justice*.

Slide 14

Familial searching has been used to identify suspects. In the period of 1985-1988, there was a string of unsolved murders of black women in Los Angeles. Many of the victims were killed with the same gun, so police suspected it was a serial killer. In 2007, a murder took place that investigators were able to link to the 1980s murders through DNA evidence. The serial killer was given the nickname "The Grim Sleeper", because police thought he had taken a break (or "slept") for a long period of time between the killings. However, they now believe he probably never "slept." When law enforcement compared the likely killer's DNA against an offender DNA database, they did not find a perfect match. However, using familial searching, they did identify someone whose DNA was very similar: Christopher Franklin. Christopher Franklin was too young to be the murderer, but his father, Lonnie Franklin, was of an age where it was possible that he was the killer. Police obtained a DNA sample from Lonnie Franklin by following him to a restaurant and, with an officer posing as an employee, collected tableware and pizza crust with his DNA on it. Lonnie Franklin's DNA was a perfect match with the DNA found at the crime scenes, and he was arrested. He was convicted in 2016 of the murders of ten women and girls, but police think he may have murdered more than 25 people. He was sentenced to death and is in jail in California as of June 2019.

Slide 15

Suspects are being identified not just through criminal databases - but also genealogy databases designed for researchers and hobbyists. After failing to find a match in the government-created databases, investigators in "The Golden State Killer" case uploaded what they believed to be the notorious rapist and murderer's DNA to an open-source genealogy database, called GEDmatch. GEDmatch is a privately-created database that welcomes people to upload their DNA analysis from private companies like 23andMe or Ancestry.com, in the hopes of building a large community for people seeking familial connections. Law enforcement found a genetic connection in the database – a distant cousin of the suspected killer. Using genealogical research to construct a family tree, investigators narrowed down the possible suspects and, with additional DNA testing, an arrest was made. Joseph James DeAngelo is under arrest for the crimes and is awaiting trial as of June 2019.

This case is an example of how quickly a new technique can take hold. Though GEDmatch was not developed to be a legal tool, in the months after the arrest of the suspected "Golden State Killer", law enforcement agencies used the database to make arrests in several other "cold cases." Some people have reacted positively to this news by saying that any and all methods are justified in the pursuit of solving crimes. Others have voiced concern regarding the fact that if even one biological relative uploads their DNA to a genealogy database like GEDmatch, then some of their shared DNA is also part of a system that is now being used for law enforcement reasons. Additionally, decisions about law enforcement access to the GEDmatch database is largely in the hands of two private citizens who founded the organization.

In May 2019, GEDmatch changed its terms of service so that DNA profiles are now by default opted out of use for law enforcement investigations. Users are able to opt-in if they wish to do so. As of June 2019, only 5% of the 1 million members of GEDmatch have opted-in.

Slide 16

Grandmothers in Argentina pioneered one of the applications of DNA in forensic investigations - using it as a tool to reunite separated biological relatives. During Argentina's "Dirty War" (1976-1983), Argentina's military dictatorship declared a war against those suspected of being left wing "communist opponents". War tactics included killings, torture, abduction or the "disappearing" of children. Top officers gave the "disappeared" children away to military couples and pregnant people were major targets. Identities of children were erased. As a result, the "Abuelas de Plaza de Mayo" (Grandmothers of the Plaza de Mayo), organized in response to their grandchildren's disappearance. Weekly demonstrations in front of the presidential palace gained international attention, including from geneticists.

In 1984, Dr. Mary-Clair King, a geneticist from the University of Berkeley teamed up with Dr. Ana Maria DiLonardo, a geneticist from Buenos Aires, Argentina. They developed a test that could identify a genetic link between the grandmothers and their grandchildren using mitochondrial DNA. Mitochondrial DNA is a part of our DNA that is generally passed down to offspring via the egg and not via the sperm. Thus, this type of DNA provides a genetic link from the grandchildren, via their biological mothers, to the Grandmothers, who were trying to find them.

For more information please see: "40 years later, the mothers of Argentina's 'disappeared' refuse to be silent" by Uki Goñi, April 2017, *The Guardian*.

Slide 17

DNA can be used to exonerate people wrongly incarcerated, such as Darryl Hunt. Darryl Hunt was freed after serving 19 years in prison for a crime he did not commit. In 1984, he was sentenced to life in prison for the murder of journalist Deborah Sykes. In 1994, a DNA test showed that Darryl's DNA did not match the DNA found at the crime scene, but nonetheless his appeal was rejected. He was exonerated in 2003 after further DNA testing proved that he was not the perpetrator.

DNA evidence collected at the crime scene was compared to a DNA offender database. They didn't find a perfect match - but did find someone whose DNA was quite similar. With that information, investigators were able to narrow their search to the brothers of that person and, through their investigation, police identified Willard Brown as a suspect. Investigators were able to show that DNA from a cigarette discarded by Willard Brown matched the DNA found at the crime scene of Deborah Sykes' murder. Following Brown's confession, Darryl Hunt was exonerated. Hunt became an activist and educator, and was awarded $1.6 million dollars in damages from the city of Winston-Salem, North Carolina. Sadly, Hunt took his own life in March 2016.

Slide 18

DNA is a powerful forensic tool, but it has its limitations. Forensic technologies are increasingly sophisticated, but crime scene conditions can make collecting and interpreting DNA complicated. People 'shed' different amounts of DNA, and secondary and tertiary transfer of DNA can be sources of contamination. Investigators who rely on DNA evidence often face many technical challenges (see slide for details). Some of these challenges are described in detail in "How Forensic DNA Evidence Can Lead to Wrongful Convictions" by Naomi Elster, December 2017, *JSTOR Daily*. Taking these factors into account, it is important for students to realize that the mere presence of someone's DNA at a crime scene is not necessarily sufficient for conviction. German investigators spent years on the hunt for a female serial killer, as they repeatedly found her DNA at multiple crime scenes. In truth, a female factory worker accidentally and repeatedly contaminated forensic laboratory materials with her own DNA. ("Germany's Phantom Serial Killer: A DNA Blunder," May 2009, *Time*).

Another limitation of DNA as a crime solving tool is related to the available DNA at a crime scene. It may be limited in amount, of poor quality, and a mixture of many individuals' genetic material; all of which can result in an incomplete DNA sample of the perpetrator. With an incomplete DNA sample from which to generate a profile, there is an increased risk of identifying the wrong person as a suspect. In 2013, the National Institute of Standards and Technology (NITS) performed a study to see how well different forensics labs across the US could identify suspects, working from samples with a varied degree of complexity. The results showed that for a simple sample with

DNA from only 2-3 people, the participating labs identified suspects correctly or chose to label them "inconclusive". However, for more complex samples, with DNA from multiple people at varied ratios, the participating laboratories did not give consistent results. In one example in this study, 69% of the forensic labs came to an incorrect identification. This highlights the limits of forensic technologies and the risks of incorrectly identifying someone as a suspect in an investigation. For more on this study see "NIST interlaboratory studies involving DNA mixtures (MIX05 and MIX13): Variation observed and lessons learned."

Slide 19

Advances in forensic DNA technologies might disproportionately affect certain populations. The growth in DNA collection has led to worries that existing racial biases in the American criminal justice system will be reinforced and amplified. US government data from the FBI (see 2016 data here) and the Bureau of Justice Statistics (see most recent data here and here), have shown that communities of color are disproportionately affected by the criminal justice system. This is particularly the case for Black, Hispanic and Native Americans. As can be seen on the graph on this slide, these communities are arrested, charged, and incarcerated at higher percentages than their representation in the US population. These racial differences translate into over-representation of DNA from Black, Hispanic and Native American people being collected in criminal databases.

Please note that these identity categories are created by the U.S census. Many people do not see their identity fully recognized within these categories. Some may not include the vast majority or racial and ethnic categorization that exist outside of these boxes.

With regards to familial searching (see slide 13), there is concern that a similarity in DNA profile can occur not just between biological relatives, but also between unrelated individuals. The latter would result in people being incorrectly and unfairly drawn into criminal investigations. The probability for DNA profiles of unrelated individuals to show high similarity increases as the number of people in the offender index grows and will disproportionately affect those populations that are over-represented in the DNA databases. For more information: "Potential for Incorrect Relationship Identification in New Forensic Familial Searching Techniques," February 2012, *Science Daily*.

Part 3: CLASSROOM ACTIVITY (20 minutes)

A key question that is raised throughout this lesson is: How can we as a society use genetics to identify suspects, exonerate people, and find missing persons, and at the same time develop policies that ensure fairness and provide appropriate safeguards and privacy protections?

The scenarios provided on pages 17-20 encourage students to critically think about this question from a variety of perspectives. Please remind students that many experts, including lawyers, privacy and civil rights scholars, and law enforcement, do not agree on when and how DNA should be used in law enforcement investigations and that the questions posed here are part of an ongoing debate.

For this activity, divide students into groups. Depending on class size, you can put students into 3 groups, or say, 6 groups, with two groups each working on the same scenario. Handouts for students are on pages 17-20 of this lesson plan. Group sizes can be flexible based on your class size and need. Within each group, have students read the assigned scenario and consider the accompanying questions. Then, have each group present their scenario to the rest of the class and close with a group discussion.

Part 4: ASSESSMENTS & HANDOUTS

Homework assignment:

Have students read the April 2008 *Washington Post* article "From DNA of Family, a Tool to Make Arrests," and answer the following questions using the information from the slideshow and/or ideas from the class discussion. A handout for students may be found on page 21.

1. What are the benefits of law enforcement using the DNA of a suspect's relative to try to catch the suspect? What might be concerning about this approach? Explain.

2. It has been estimated that African Americans comprise approximately 40% of the CODIS database, despite comprising about 13% of the United States population. By extension, then, relatives of African-Americans are also more likely to be identified in familial searches of an offender database. What do you think about this discrepancy? Should something be changed to bring this more in line with the racial makeup of the United States population? How important are race and privacy considerations when developing these policies?

"DNA, Crime, and Law Enforcement" quiz answer key

(see page 22 for quiz)

1. To identify suspect, to identify victims and missing persons, and to provide evidence to support exonerations.
2. Mitochondrial DNA. It is passed down to offspring generally only through the egg and not the sperm. Thus, it links the grandchildren, through their biological mothers, to the Grandmothers.
3. D
4. F
5. T
6. T
7. F

DNA, Crime, and Law Enforcement

STUDENT HANDOUT

Name_____ Date_____

Scenario A: Mitochondrial DNA and the Grandmothers of Plaza de Mayo

How can mitochondrial DNA be used to solve crimes, and should there be a limit to the role courts have in enforcing DNA testing on an unknown relative?

During Argentina's "Dirty War" (1976-1983), Argentina's military dictatorship declared war against those suspected of being "communist opponents" of the country's leaders. The war tactics used included torture, abduction and murder of adults and children. It is estimated that 10,000-30,000 citizens were taken by the Argentinian government and labeled as "disappeared" or "desaparecidos", including an unknown number of children. Many pregnant women placed in detention camps by the dictatorship had their babies taken after birth and in many cases given or sold to couples with close ties to the military. The women were usually murdered, and the identities of children were erased.

Locating the children and connecting them to the biological families from whom they were taken, is the mission of the "Abuelas de Plaza de Mayo" (Grandmothers of the Plaza de Mayo), a group of mothers of the murdered women. Weekly demonstrations in front of the presidential palace gained international attention, including from US and Argentinian geneticists.

In 1984, Dr. Mary-Clair King, a geneticist from the University of Berkeley teamed up with Dr. Ana Maria DiLonardo, a geneticist from Buenos Aires, Argentina. They developed a test that could identify a genetic link between the grandmothers and their grandchildren using mitochondrial DNA. Mitochondrial DNA is a part of our DNA that is generally passed down to offspring via the egg and not via the sperm. Thus, this type of DNA provides a genetic link from the grandchildren, via their biological mothers, to the Grandmothers, who were trying to find them.

In 1989, the Grandmothers were able to push the Argentinian government to set up a National Genetic Data Bank. This bank collects and stores the DNA of the relatives of missing children, so that genetic identification can be done in the future even after the grandmothers have passed away.

Discussion questions:

1. How was mitochondrial DNA used to reunite families?

2. In 2010, Argentinian courts ordered that the DNA of two adopted children of a wealthy businessman be tested, against their will, to determine if they are children who were kidnapped during the Dirty War. Do you think the court order was right or wrong? Do the children have a right to not know who are their biological parents? Explain.

Name_____ Date_____

Scenario B: The Grim Sleeper

Should law enforcement use a technique called 'familial searching' to solve violent crimes?

There was a string of unsolved murders of black women in the 1980s in Los Angeles, CA. Many of the victims were killed with the same gun, so police suspected it was a serial killer. There were at least eight people killed between 1985-1988, but then there seemed to be a pause in the murders. The community was frightening, and frustrated, as many felt the cases did not get a fair amount of attention because the victims were mostly young black women, and some were prostitutes.

In 2007, a murder took place that investigators believed was linked to the 1985-1988 murders. DNA from the unknown perpetrator found on the victim, Janecia Peters, connected Peters to the women who had been killed in the 1980s. The murderer was given the nickname "The Grim Sleeper" because police thought he had taken a break (or "slept") for a long period between the killings. However, they now believe he probably never "slept."

When law enforcement ran the murderer's DNA against an offender DNA database, they did not find a perfect match. However, using familial searching, they did identify someone whose DNA was very similar: Christopher Franklin. Christopher Franklin was too young to be the murderer, but his father, Lonnie Franklin, was of an age where it was possible that he might be the killer.

Police obtained a DNA sample from Lonnie Franklin by following him to a restaurant and, with an officer posing as an employee, collected tableware and pizza crust with his DNA on it. Lonnie Franklin's DNA was a perfect match with the DNA found at the crime scenes, and he was arrested. He was convicted in 2016 of the murders of ten women and girls, but police think he may have murdered more than 25 people. He was sentenced to death and is in jail in California as of June 2019.

Discussion questions:

1. How was Lonnie Franklin caught? Explain.

2. Is it acceptable to look for suspects by comparing DNA from a crime scene to relatives of people whose DNA is in a criminal database? Is this an invasion of privacy or a good crime-fighting technique? Explain your answer.

Name_____ Date_____

Scenario C: Ancestry testing used to identify a murder suspect

Should databases designed for family history hobbyists be used to solve crimes?

Your favorite hobby is researching your family history. You have spent countless years finding all the information you could, visiting the towns where your grandparents lived, combing through church records to gather information about births, weddings and funerals.

Genetic genealogy is the use of DNA, combined with traditional research, to construct family trees and find relatives. Online genetic testing has opened up a whole new area of your hobby in recent years. You had your DNA tested by a private company and wanted to use that information to expand your family tree. You decided to upload your DNA information to GEDmatch, which is a non-profit database run by private citizens and is open to anyone who wants to join.

You were shocked to learn that police have been using this database to search for DNA connections to wanted murderers and rapists. Investigators create a profile, using DNA of a likely perpetrator that was collected at the crime scene, and then upload it to GEDmatch. The hope is to find DNA matches - even to distant relatives. Once they find individuals with similar DNA to a likely perpetrator, police investigators can work with ancestry and genealogy researchers to develop a potential list of suspects.

In your results, you learned you are one of the three people in GEDmatch who share a small segment of DNA with the notorious "Golden State Killer" - you and the killer share a relative four generations in the past. Through this information, law enforcement found and arrested Joseph James DeAngelo, who is presently awaiting trial. You never met him, live over 2000 miles away from where he was arrested, and nobody in your family can recall any connection at all - but you still share some DNA. You are what is called a "genetic informant".

Discussion questions:

1. How do you feel about your unknowing role in the arrest of this serial killer?

2. If GEDmatch gave you a choice to have your DNA searched by police in other investigations, would you allow it or not? Why or why not?

3. Should police be allowed to search DNA databases that were never intended to be part of the criminal justice system? Why or why not?

DNA, Crime, and Law Enforcement

HOMEWORK

Read the article, "From DNA of Family, a Tool to Make Arrests," and answer the following questions using the information from the slideshow and/or ideas from the class discussion. Each answer should be at least one paragraph long.

1. What are the benefits of law enforcement using the DNA of a suspect's relative to try to catch the suspect? What might be concerning about this approach? Explain.

2. It has been estimated that African Americans comprise approximately 40% of the CODIS database, despite comprising about 13% of the United States population. By extension, then, relatives of African-Americans are also more likely to be identified in familial searches of an offender database. What do you think about this discrepancy? Should something be changed to bring this more in line with the racial makeup of the United States population? How important are race and privacy considerations when developing these policies?

DNA, Crime, and Law Enforcement

QUIZ

Name_____ Date_____

1. Short answer: List three ways in which forensic DNA is used to solve crimes?

2. What is the type of DNA that is used by the "Abuelas de Plaza de Mayo" to reunite families in Argentina? Why is it a uniquely helpful tool to connect biological grandmothers, mothers, and children?

3. GEDmatch is a database used by genealogists (people who are interested in learning about their family) to construct family trees and find relatives. Recent use of this database by law enforcement to search for people in an effort to make arrests for long-unsolved crimes has caused controversy because:

A) People who added their DNA to GEDmatch didn't know it would be used by police.
B) People might unknowingly implicate their relatives in a crime.
C) There are not as many rules and guidelines about how to use this database compared to CODIS.
D) All of the above.

4. The only way to have your DNA added to a state or federal criminal database, such as CODIS, is to be convicted of a felony. T/F

5. In addition to being useful to capture and convict criminals, DNA also has been used to free hundreds of people who have been wrongly convicted. T/F

6. If a person's DNA profile is in a criminal database, a law enforcement agency might be able to use that information to identify and possibly arrest another family member who is suspected of a crime. T/F

7. DNA analysis is a foolproof tool to solve crimes and will likely replace traditional police investigations in the near future. T/F

DNA, Crime, and Law Enforcement

ADDITIONAL RESOURCES FOR TEACHERS

For a scientific overview of DNA profiling: "Forensics, DNA Fingerprinting, and CODIS" by Karen Norrgard, 2008, *Nature Education*.

The Innocence Project: http://www.innocenceproject.org/

"Darryl Hunt's fight for freedom" by Farai Chideya, April 2007, *NPR*.

"DNA Sample from Son Led to Arrest of Accused 'Grim Sleeper'" by Kim Zetter, July 2010, *Wired*.

"The Surprisingly Imperfect Science of DNA Testing" by Katie Worth, June 2015, *The Marshall Project*.

"Traces of Crime: How New York's DNA Techniques Became Tainted" by Lauren Kirchner, September 2017, *New York Times*.

"The DNA of a Killer", *48 Hours* on CBS, April 2017.

"Argentina tries to uncover 'dirty war' orphans" by Andres D'Alessandro and Chris Kraul, June 2010, *Los Angeles Times.*

"Disappeared Argentina activists' son finds family after 40 years" June 2019, *BBC.*

"DNA Site That Helps Cold-Case Sleuths Curbs Access for Cops" by Kristen V. Brown, June 2019, *Bloomberg.*

"How Genotype Imputation Is Helping Solve Difficult Genetic Genealogy Cases" by Kevin Lord, June 2019, *Forensic Magazine.*

Podcast that discusses the science and ethics behind the Golden State Killer arrest and the use of genetic genealogy databases: "The Daily: A New Way to Solve a Murder. Part one and Part two". June 6 and 7th, 2019. *New York Times.*