ACTIVITY 7-1

Ch. Obj. 7.2, 7.5, and 7.6

DNA FINGERPRINTING SIMULATION USING DYES

The apparatus

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Objectives:

By the end of this activity, you will be able to:

1. Describe the charge on a DNA molecule.
2. Explain the process of electrophoresis.
3. Describe how DNA fragments can be visualized.
4. Compare two DNA fingerprints to determine if they match.

Introduction:

When an egg is fertilized by a sperm, half of the DNA is from the mother and the other half is from the father. To verify paternity, DNA fingerprints of the child, the mother, and the alleged father are compared. Paternity is established if half of the child's DNA bands match those of the alleged father.

Probability Calculation:

By using four different probes for four different genes, it is possible to calculate the probability that a DNA fingerprint belongs to a specific person. For example, suppose that:

1 in 100 people have a gene for trait A
2 in 50 people have a gene for trait B
1 in 10 people have a gene for trait C
3 in 20 people have a gene for trait D

MATHEMATICS

To calculate the probability that one person possesses all four of these traits, you need to multiply the individual probabilities:

$(1/100) \times (2/50) \times (1/10) \times (3/20) = 6/1{,}000{,}000$

To improve the accuracy of matching bands in a child's DNA fingerprint to a parent's bands, additional probes can be used.

Scenario:

In this activity you will use dyes to perform a simulated DNA fingerprint. The purpose of this activity is to determine the paternity of a child.

A couple had been trying to conceive a child for three years. No cause for their infertility was identified after they underwent many tests. The couple continued to try to conceive a child without success. The doctor at the fertility clinic suggested using a sperm donor and artificial insemination. One month after the artificial insemination, the couple learned of the pregnancy. Eight months later, when the baby was born, the baby bore a strong resemblance to the husband. The couple wanted to know if the husband and not the sperm donor could be the biological father. They contacted the fertility clinic, and were told that a lab technician had not kept good records. Semen from two sperm donors had been used on the day of the artificial insemination. The baby could be either the husband's biological child or it could be the child of one of the two sperm donors.

The parents were anxious to know if the husband was the biological father. The doctor suggested doing a DNA fingerprint. DNA was extracted from blood samples collected from the mother, the baby, and the husband. DNA was extracted from semen specimens of the two sperm donors. The DNA samples were treated with restriction enzymes.

Your task is to load the digested DNA into the wells and produce a DNA fingerprint. Analyze the gel to determine whose sperm fertilized the mother's egg. Who is the biological father of this baby?

Time Required to Complete Activity: 40 to 90 minutes

Materials:

(student groups of five)
simulated DNA labeled #2-6
1 DNA sample
1 package of colored pencils or markers
1 gel box
prepared 0.8 M agarose gel
1 set of five prepared unknown samples of simulated DNA labeled 1 to 5
1 DNA standard sample (pre-cut DNA with loading dye already added)
6 10-microliter micropipettes (Wards' 15-3000) with plungers
300 mL TBE buffer 5%
DNA stain
power supply
plastic ruler

Safety Precautions:

Make sure all gels are loaded and connected before turning on the power supply for gel boxes.
Properly dispose of all used pipettes.

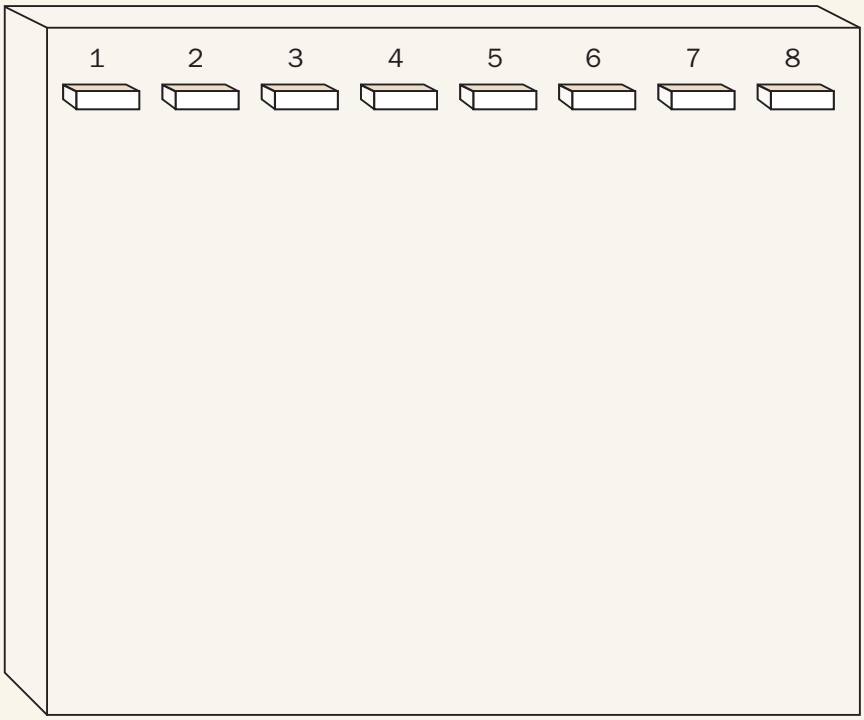
Procedure:

Omit steps 1 to 4 if the gel has been prepared by your instructor.

1. Loosen the cap before heating.
2. Warm the bottle of agarose gel in a hot-water bath or autoclave until the bottle is warm to the touch and the agar is melted. Be sure that all of the agar has melted and that there are no chunks of agar in the heated solution.
3. Insert the comb into the gel box and seal the edges before adding the warmed agar.
4. Fill the gel box with agar so that the teeth of the comb are covered to a depth of at least one-half to two-thirds of the length of the teeth. Gels can be prepared up to several days in advance.
5. Allow the gel box to cool for 15 minutes. The agarose gel will turn from clear to opaque white.
6. Cover the gels with plastic wrap to store.
7. When you are ready to use the gel, uncover and remove the comb by pulling straight up simultaneously from both ends of the comb.
8. Place the gel box containing the gel in the electrophoresis chamber.
9. Place the wells near the negative (black) end of the box.

10. Add TBE buffer. Fill one reservoir, and then fill the second reservoir in the gel box.
11. Add enough TBE buffer to cover the entire top of the gel. The TBE buffer should be at least 2 millimeters above the surface of the gel. Use a clean 10 ml pipette for each of the six DNA samples.
12. Add 10 microliters of the following samples to the wells of your gel. Wells 7 and 8 are left empty.

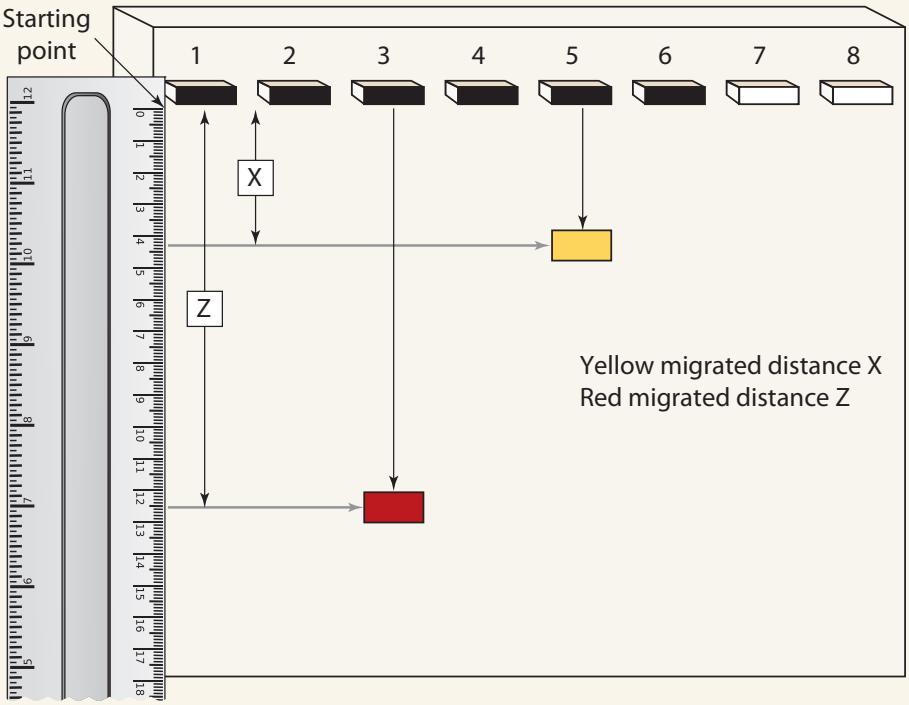
Sample 1	Standard	Well 1
Sample 2	Mother	Well 2
Sample 3	Child	Well 3
Sample 4	Man 1	Well 4
Sample 5	Man 2	Well 5
Sample 6	Husband	Well 6



13. Set the power supply to 110 V DC. The power should remain on for approximately 45 minutes, or until the loading dyes have moved toward the positive end of the gel.
14. After the gel has run, complete the sketch found in question #1 using colored pencils or markers.
15. Measure the distance the bands traveled from the center of the well to the center of the color band. Record the measurement at the bottom of the band on the DNA Fingerprint Data figure.

Analysis:

This is a simplified simulation of how a DNA fingerprint is made using gel electrophoresis. When an actual DNA fingerprint is made, many bands are examined. In this simulation, we are assuming that the gel was washed with only one probe, resulting in just two visible bands under each well. You can verify the parentage of a child by comparing the DNA fingerprints for each of the parents with the child's DNA fingerprint. Recall that one-half of the DNA in the child is donated by



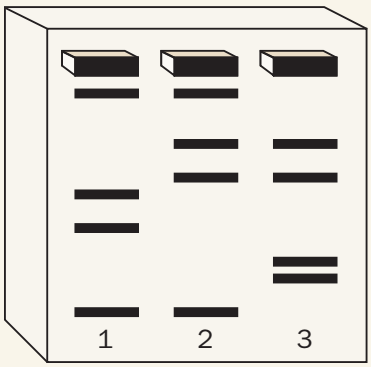
each parent. Your task is to determine who the biological father is. On your DNA fingerprint sketch, be sure to sketch the results of the DNA gel. Be sure to align the DNA in the correct lane. To distinguish the DNA from each individual, use a different colored pencil for each person's DNA.

To Analyze the Fingerprints:

First examine the bands under lane 3, the child.
Determine which bands of the child came from the mother in lane 2.
Remember that the remaining bands of the child had to come from the biological father.
Examine the DNA from lanes 4, 5, and 6. Which of the men contributed his DNA to the child?

Questions:

1. In your sketch of the DNA fingerprint, use a pink-colored pencil or marker to circle the DNA bands shared by both mother and child. Use a blue-colored pencil or marker to circle the DNA bands shared by both the child and the biological father.
2. Who is the biological father of the child——the husband, Man #1, or Man #2? Support your answer with data from your DNA gel test.
3. A different DNA profile is performed with DNA from a father, a mother, and their child. The results are shown in the DNA fingerprint seen below. Which of the three lanes represents the child's DNA? (Hint: One-half of the child's DNA comes from each parent.) Explain your answer.



ACTIVITY 7-2 *Ch. Obj. 7.1, 7.2, and 7.4*

WHERE'S THE CAT? SIMULATION

Scenario:

A man was assaulted and robbed of his wallet by two men outside a bar. He was unable to describe either of his attackers, but he did manage to scratch the face of one of the assailants. Surveillance video was examined, and two suspects were identified and detained.

DNA samples from the two suspects were compared to the DNA obtained from scrapings collected from the victim's fingernails. Your task is to determine if the DNA collected from the victim matches the DNA from either of the suspects. Will DNA evidence identify either of the two suspects?

Objectives:

By the end of the activity, you will be able to:

1. Describe how restriction enzymes cut DNA.
2. Describe how to prepare and load a gel for gel electrophoresis.
3. Determine if a DNA fingerprint of a suspect matches the DNA fingerprint from the evidence obtained from an assault victim.

Time Required to Complete Activity:

Two 40-minute class periods

Background:

DNA fingerprinting may be performed on DNA extracted from relatively small samples of cells, such as a bloodstain the size of a nickel (about two drops) or a semen stain the size of a dime. When performed under properly controlled conditions and interpreted by an experienced forensic scientist, such DNA fingerprinting can link a suspect to a particular incident with compelling accuracy or completely exonerate a suspect.

Lab Procedure for DNA Fingerprinting

These steps are followed when performing DNA fingerprinting on crime-scene evidence. Isolate the DNA from a tissue sample. (Blood, semen, saliva, skin, and hair follicles are sources of DNA.) It may be necessary to amplify the DNA using a method of copying DNA called PCR (polymerase chain reaction). DNA is treated to separate the double helix into two single strands. Single-stranded DNA is cut with a restriction enzyme to produce specific fragments. Each kind of restriction enzyme recognizes a specific sequence of bases on the DNA and acts as "molecular scissors" to cut the DNA strand within the recognition sequence.

In this activity, you will use the enzyme *Hind III*. This enzyme recognizes the AAGCTT base sequence in DNA. The *Hind III* enzyme cuts the DNA between the two A bases: A/AGCTT. Within the human genome, the AAGCTT base sequence is found in multiple places. *Hind III* cuts the human genome into many pieces—perhaps as many as a million different fragments!

Loading the Gel

Once the digested DNA has been cut into fragments, these fragments are loaded into wells at the negative end of an agarose gel.

Electrophoresis of the DNA Fragments

After the DNA is loaded onto the gel, an electric current is passed through the gel. Because DNA is negatively charged, the fragments of DNA will migrate toward the positive electrode in the gel chamber. DNA ***runs to red***, that is, toward the positive electrode. A control standard ladder of known sizes or known lengths of DNA fragments is run alongside the unknowns to provide size standards for comparison. After electrophoresis is complete, the DNA from the gel is transferred to a membrane in a process known as Southern blotting.

If DNA were stained at this point, there would be so many fragments that the DNA would appear to be a continuous smear. In order to distinguish between the DNA of one individual and that of another, we need to label only the particular fragments of interest. In this case, we will label only those fragments of DNA that contain the sequences.

Radioactive Probe

Complementary sequences of DNA labeled with radioactive isotopes are called probes. These probes recognize and bind to the repeating CATCAT within the DNA sequence.

Note: If the VNTR is CATCATCAT, then the radioactive probe is

GTAGTAGTA

(G pairs with C, A pairs with T)

A solution containing the radioactive probes is allowed to interact with the DNA bands on the Southern blot membrane. Probes that do not attach are washed away, and the radioactivity is visualized by placing X-ray film in contact with the Southern blot membrane. To repeat this process for examination of different VNTRs, the first probe is removed. Then probes for different sequences are added, and the process is repeated.

Materials:

(per group, students will work in groups of five)
1 control standard ladder of DNA (general population) in envelope 1
1 DNA sample from the Victim in envelope 2
1 DNA sample from underneath the victim's fingernails in envelope 3 (crime-scene DNA)
1 DNA sample from Suspect 1 in envelope 4
1 DNA sample from Suspect 2 in envelope 5
1 set of GTA (radioactive) probes cut from red paper in envelope
6 colored pencils or markers
1 sheet construction paper approximately 2 feet by 3 feet
scissors
meter stick
black magic marker
tape
glue stick

Safety Precautions:

No special precautions are needed.

Procedure:

Working in a group of five students, assign a role to each person in your group:
- Standard DNA
- Crime-scene DNA (DNA from underneath the victim's fingernails)
- DNA from the victim
- DNA from suspect 1
- DNA from suspect 2

Obtain your DNA samples from your instructor:
- Standard DNA (envelope 1)
- Crime-scene DNA (DNA from underneath the victim's fingernails) (envelope 2)
- DNA from the victim (envelope 3)
- DNA from suspect 1 (envelope 4)
- DNA from suspect 2 (envelope 5)

Note that in this lab simulation, only a very short sequence of a person's DNA is being used.

If you are working with the Standard DNA sample (envelope 1):
1. Cut out the DNA fragments.
2. You will not need to look for any recognition sites because your section of DNA has already been broken into known sizes (lengths) of DNA (predigested).

If you are working with DNA samples from the crime scene, victim, suspect 1, or suspect 2, then you will need to do the following:
1. Remove the pieces of DNA from your envelope.
2. Attach the strips together using tape so that the asterisks (*) are taped together, making one long piece of DNA.
3. Look at your DNA samples and locate the restriction sites for the *Hind III* enzyme.
4. You will need to find all of the restriction sites on your segment of DNA. Be sure to find the entire sequence: AAGCTT.
5. Using a pencil, draw a line between the first two A/A as shown below.

Identify the sequence A/AGCTT in all of the lengths of DNA. If you did this correctly, you should find eight cuts for each DNA sample.

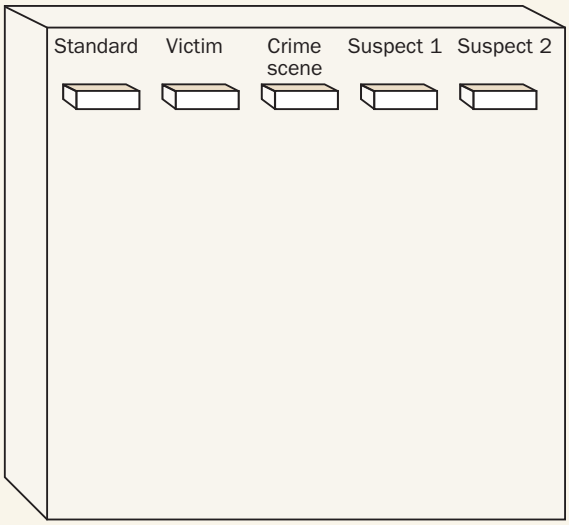
Restriction Enzyme Digest
1. Using scissors, cut the DNA between the A/AGCTT.
2. Count the number of restriction fragments. (You should have a total of nine fragments for each DNA sample.)

Prepare the Gel
1. Have a member of your group prepare the gel.
2. Obtain a 2' x 3' piece of construction paper.
3. Using a ruler and a black magic marker, label wells for each of the DNA samples as noted in the diagram below, with the wells at the top of the paper.

4. Label the positive and negative ends of the gel.

Electrophoresis of the DNA Fragments

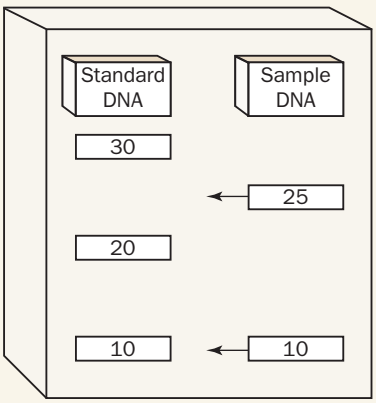
1. Beginning with the standard, simulate running the DNA fragments through the gel by separating each of the fragments of DNA by size.
2. Recall that the largest DNA pieces move more slowly than the smaller DNA pieces. Move the DNA fragments, allowing a small space both at the top and at the bottom of the gel.
3. Simulate running each of the successive DNA fragments through the gel, sorting the DNA fragments according to size.
4. Use the standard DNA fragments as a size reference to determine placement of other DNA fragment samples.



Model for 2' x 3' construction paper

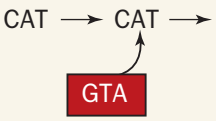
If the DNA fragment contains 10 nitrogen bases and your DNA ladder has a fragment containing 10 nitrogen bases, then these fragments will move through the gel at the same time and should be parallel. If your DNA sample contains 25 nitrogen bases and your DNA ladder has one band at 20 nitrogen bases and another at 30 nitrogen bases, then you know to place your DNA fragment in a location between the 20 and 30 base bands of your DNA ladder.

When you are satisfied that all fragments have correctly moved through the gel, use a glue stick to attach each DNA fragment to the paper gel. If you have two DNA fragments that are the same length but have different bases, place them next to each other on the appropriate line.



Radioactive Probes

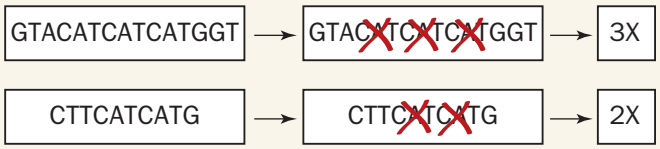
1. Obtain the radioactive probes from your instructor (envelope 6).
2. Cut the probes so that you have fragments of GTA. "Probe" your gel with the radioactive GTA fragments.
3. Anywhere on the gel where a CAT appears, the radioactive GTA fragments will attach to the CAT.
4. Place your GTA probes on top of the CAT in the DNA fragments.



Data Report:

1. Each team will submit a glued paper model of the DNA fingerprint (one per team).
2. Each student will complete Figure 1 like the one at the top of this page. Refer to the large DNA fingerprinting sheet as a reference.
   - When drawing in the bands for the DNA standard ladder, you will need to count the number of bases within the fragment. For example, if the fragment is GAATCGGCCA, that fragment has 10 bases. So you will align this 10-base band next to number 10. If the band is GTCTA, then you will align this 5-base band next to number 5.

- As you draw in the bands for each of the other four samples of DNA, you need to count the number of bases in each fragment and align the DNA fragment on the gel according to size. (Refer to the DNA standard on the left.)
- In Figure 1, use colored pencils or markers to shade in the area where a DNA fragment would be located. Do not copy the GT(s). Indicate the position of the radioactive probes by placing an X within the DNA fragment. Write the number of repeats in front of the X. (Remember you are probing for the VNTR of "CAT" within each of the fragments.)



Analysis:

When you have completed "running your gel" and adding the radioactive probes, try to determine if the crime-scene DNA evidence matches any of the other samples of DNA. If the crime-scene DNA matches any of the other DNA samples, then:

- The band patterns and positions will be the same.
- The radioactive probes will be aligned in the same location.
- The number of VNTRs (repeats of CAT) will be the same within each gene.

Questions:

After completing your DNA gel and Table 1, answer each of the following questions:

1. Which DNA samples match? Explain your answer.
2. Does this evidence provide sufficient information for a conviction? Why or why not?
3. Explain why it was necessary to run a sample of the victim's own DNA.
4. Explain how the DNA fragments are separated within the gel.
5. Complete the table on the next page.

Complete the table below:

Materials Used in DNA Fingerprinting	State the Function
Gel	
Restriction Enzymes	
Electric Current	
VNTR	
Radioactive Probes	

Further Study:

1. How are restriction enzymes named? (e.g., *Hind III*, EcoRI)
2. How is the recognition sequence for EcoR1 determined?
3. Lawyers usually cite statistics when analyzing a DNA fingerprint. In the O.J. Simpson trial, the odds that the crime-scene evidence DNA sample belonged to anyone else were extremely low. This was determined by using several different probes on the DNA fingerprint. Dr. Eric Lander of MIT took issue with the method of analysis. Research how this probability is determined and identify Dr. Lander's concerns.

ACTIVITY 7-3 *Ch. Obj. 7.1 and 7.2*

WARD'S DNA FINGERPRINTING SIMULATION

Scenario:

A man was convicted and sentenced to life in prison for murder. The convicted murderer continues to maintain his innocence. After the sentencing, another man confessed to the crime. The lawyer for the convicted man requested a DNA analysis of evidence found at the crime scene to compare to his client's DNA. The lawyer also requested a DNA comparison with the man who confessed to the murder. In this activity, your task will be to perform the DNA analyses and determine whose DNA matches the DNA found at the crime scene.

Objective:

By the end of this activity, you will be able to:
Determine whose DNA was found at the crime scene after performing Gel Electrophoresis

Introduction:

In this activity, a simulated DNA gel electrophoresis is run, and a suspect's DNA is compared to DNA found at a crime scene. Suspect 1 is the convicted murderer, and Suspect 2 is the person who confessed to the crime.

Time Required to Complete Activity:

40 to 90 minutes depending on preparation of group

Materials:

(class of 24, four students per group running 6 gels)
Ward's Natural Science Kit–DNA Detectives 36W6231 (contains predigested DNA and loading dye)
3 gel boxes (36W5160), so each gel box can run two gels
6 gel casting trays (36W5172)
12 snap-on end dams (36W5173)
6 dual-sided gel combs (36W5171)
2 power supply boxes, which will accommodate three gel boxes (36W5112)
1 package 10 microliter micropipettes (Wards; 15-3000) with plungers
TBE buffer
digital camera (optional)

Safety Precautions:

Make sure all gel boxes are loaded and covered with TBE buffer before connecting them to the power supply.
Wash your hands before and after handling gels.

Procedure:

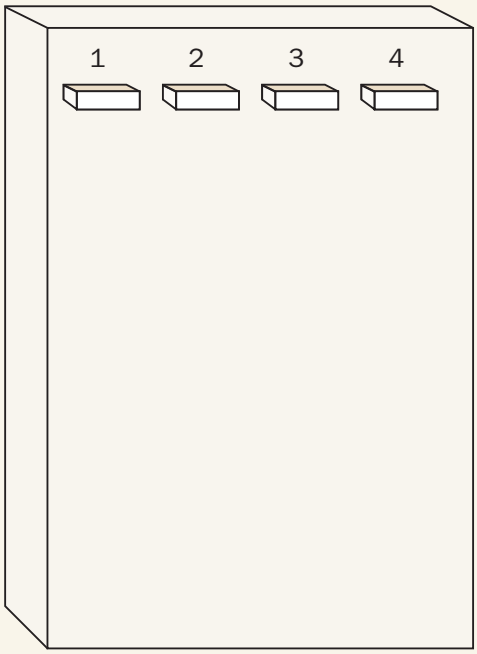
These steps need to be revised and renumbered.

1. Pour a gel. (This step may have already been performed by your teacher.)

2. After the gel has cooled, slowly remove the comb by lifting it straight up.
3. Remove the dams from the end of the gel.
4. Place the gel in the gel box with the wells at the negative end of the box.
5. Cover the gel with TBE buffer. Slowly fill the gel box by adding the buffer to one end of the gel box. Fill the opposite end of the gel box with buffer so that the buffer covers the top of the gel and fills the wells.
6. Using a clean pipette, add 10 microliters of each of the following DNA samples to the wells at the negative end of the gel.

Sample 1	DNA standard marker
Sample 2	Crime-scene DNA
Sample 3	Suspect 1 DNA sample
Sample 4	Suspect 2 DNA sample

7. Turn the power supply boxes to 110 V DC. Run the gels for about 45 minutes or until the blue dye migrates to within about one-half inch from the positive end of the gel.
8. Analyze your DNA gel and determine if the DNA from the crime scene matches the DNA of suspect #1 or of suspect #2.
9. Make a sketch of DNA gel on the diagram below. (If a digital camera is available, take a photograph of the gel.)



Questions:

1. Which suspect's DNA profile matches the crime-scene DNA evidence?
2. Justify your answer, referring to the DNA fingerprint.
3. Explain what other testing could be done using DNA gel electrophoresis to increase the probability that a person's DNA either matches or does not match the evidence DNA.

ACTIVITY 7-4 *Ch. Obj. 7.5 and 7.6*

WHO ARE THE PARENTS?

Scenario:

Three baby boys were born on the same morning in the same hospital. That morning, the hospital had started using new identification bracelets. When the babies were bathed, the identification bracelets slipped off and the nurses thought a mix-up might have occurred. Given the information from the DNA profile in the diagram, determine which baby belongs to each set of parents.

Objective:

By the end of this activity, you will be able to:
Use DNA profiles to match a child to his parents.

Materials:

3 colored pencils or markers (red, green, blue)
ruler

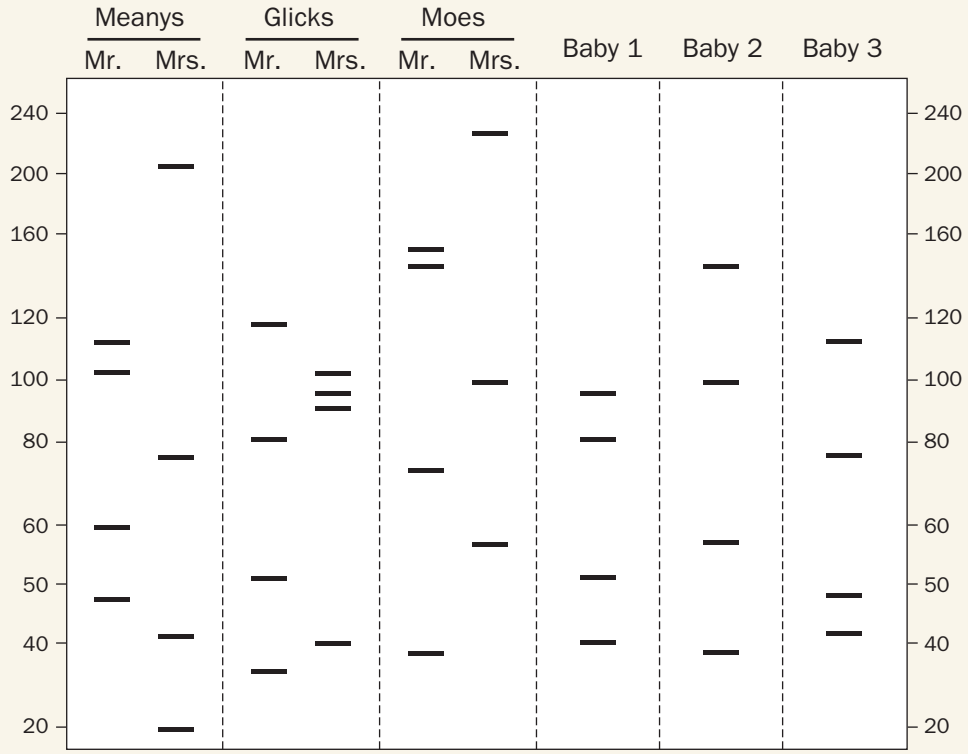
Safety Precautions:

None

Time Required to Complete Activity: 10 minutes

Procedure:

1. Recall that 50 percent of a child's DNA is obtained from each parent.
2. Use a ruler to align the DNA bands of the baby with any DNA bands of the parents. Determine if any of the parents share the same band of DNA with the babies.
3. There is only one correct set of parents matching a baby.
4. Use colored pencils or markers to circle the band patterns shared by baby and parents. Use red for Baby 1 and his parents, blue for Baby 2 and his parents, and green for Baby 3 and his parents.



Questions:

1. Which baby belongs to the Meanys?
2. Which baby belongs to the Glicks?
3. Which baby belongs to the Moes?
4. Is it possible for a child to have a DNA band that is not found in the mother's DNA? Explain your answer.

ACTIVITY 7-5 *Ch. Obj. 7.5 and 7.6*

WHICH MAN IS THE FATHER?

Scenario:

Two men are claiming to be the father of the child of a rich heiress who died suddenly without leaving a will. They are both suing for custody of the child. A DNA sample was collected from a hair found in the hairbrush of the dead heiress. Blood samples were collected from each man and the baby. Which man is the father of the child?

Objective:

By the end of this activity, you will be able to:
Use DNA fingerprinting to identify the father of a child (establish paternity) or to prove that a man is not the father of a child (exclude paternity).

Materials:

two colored pencils or markers (red and blue)
ruler

Safety Precautions:

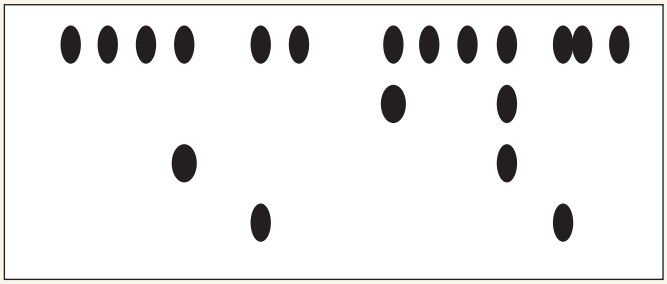
None

Time Required to Complete Activity: 10 minutes

Procedure:

1. Refer to the DNA profiles below Recall that 50 percent of a child's DNA comes from each parent.
2. Use a ruler to help align the positions of DNA band patterns in the diagram of the baby. Determine which DNA bands of the baby were inherited from the mother. Determine if any of the baby's DNA aligns with the DNA band of the two men claiming to be the father.
3. Use colored pencils or markers to circle any band patterns shared by both child and mother. In both profiles, use red for child and mother, and use blue for any band patterns shared by the child and alleged father.
4. Remember: Any band patterns not found in the mother must come from the father.
5. After analyzing the DNA, answer the questions at the end of this activity.

Profile set #1



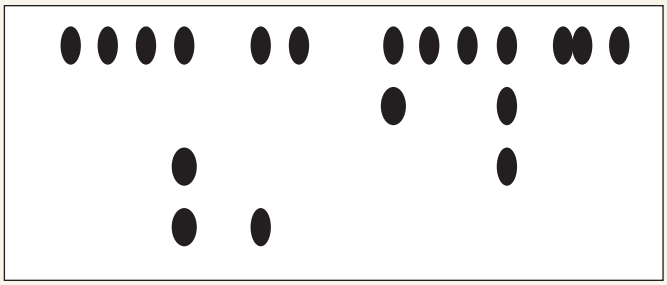
Ladder

Mother

Child

Alleged father #1

Profile set #2



Ladder

Mother

Child

Alleged father #2

Questions:

1. Can either man be excluded as the father? Explain.
2. Which man may be the father of the child? Explain.
3. How many radioactive probes were used in this activity?
4. Is this DNA profile sufficient to establish paternity? Why or why not?

ACTIVITY 7-6 THE BREAK-IN

Ch. Obj. 7.1 and 7.2

Scenario:

One afternoon, a break-in occurred at a high school, and several computers were stolen. At the time of the break-in, the building was empty. A motion detector tripped by movement in one of the hallways alerted police. When the police arrived to investigate, they found that one of the doors leading into the school had been propped open with paper wedged into the doorjamb. The door appeared to be locked, but it could easily be pushed open. Near the door, police found a cold soft drink can. Because of the cool temperature of the drink, police suspected that the can was left by one of the intruders.

The can was bagged as evidence, and in the forensics laboratory, a DNA sample was obtained from the lip of the can. The neighborhood was canvassed, and a clerk in a convenience store remembered selling canned soft drinks to two young males just before the break-in occurred. The surveillance video in the convenience store was examined, and the clerk provided the police with the names of all males who were in the store just prior to the break-in. Three suspects were identified from the surveillance video, and blood samples and conventional fingerprints were collected from the suspects.

Introduction:

Using a DNA sample obtained from the soft drink can collected at the crime scene, a PCR was run to amplify the amount of DNA, and then a DNA profile was performed. Cheek swabs were obtained from three suspects, and their DNA was tested. The results are shown below.

Objective:

By the end of this activity, you will be able to:

1. Describe how DNA fingerprinting can be used to identify a suspect.
2. Determine if the suspect's DNA matches the DNA found at the crime scene.

Materials:

colored pencil or marker
ruler

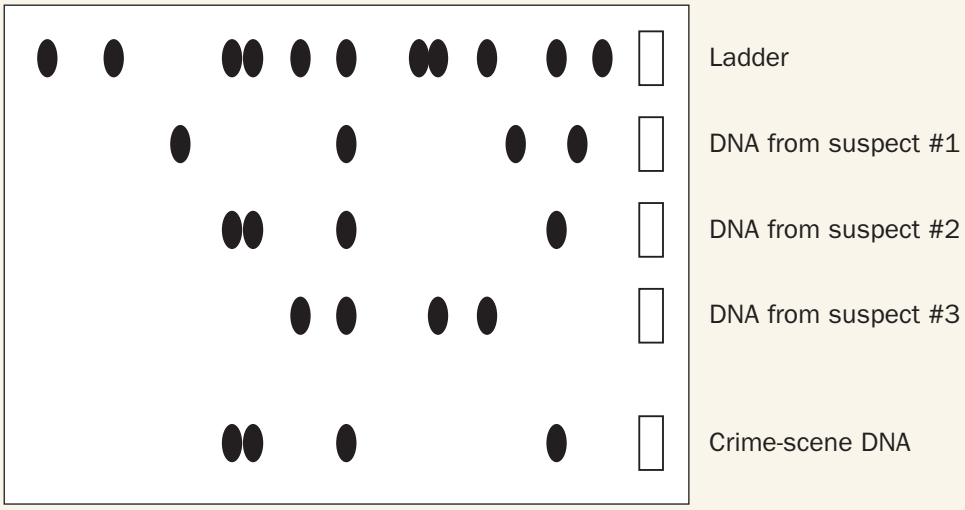
Safety Precautions:

None

Time Required to Complete Activity: 15 minutes

Procedure:

1. Review the steps to the DNA autoradiograph shown in Figure 7-7.
2. A standard DNA ladder of known lengths of DNA has been provided for comparison.
3. Your task is to try to match the crime-scene DNA sample with a DNA samples from three suspects.
4. Use a ruler to check the positions of DNA band patterns in the autoradiograph. DNA from the same source should have band patterns that line up. Do the DNA patterns of any of the suspects' DNA match the DNA pattern of the crime-scene DNA?
5. Use a colored pencil or marker to circle the band patterns shared by the crime-scene DNA and each suspect.



Questions:

1. Does the crime-scene DNA match the DNA from any of the suspects? If so, which one(s)?
2. Is there more than one DNA match? Explain.
3. Is this DNA profile sufficient to convict a suspect? Explain.

ACTIVITY 7-7 *Ch. Obj. 7.5 and 7.6*
INTERNET SEARCH

Background:

The Romanov family ruled Russia for 300 years. In 1918, the last ruling Romanov, Nicholas II, and his family were executed and buried in a mass grave in Siberia. When the grave was exhumed, two of the bodies were missing. In this activity, you will use forensic tools to solve the mystery of the missing Romanovs.

Go to www.dnai.org/d/index.html.
Click on "Applications."
Review Module Two: Recovering the Romanovs and the use of mitochondrial DNA.

Romanov family history:
Delve into the history of the Romanovs, the last imperial family of Tsarist Russia.

The mystery of Anna Anderson:
Meet Anna Anderson, who claimed to be the missing Anastasia Romanov, and compare her features with Anastasia's.

Science solves a mystery:
Find out how DNA science was used to determine whether Anna Anderson was the missing Anastasia Romanov. After reviewing the module, answer the following questions.

Questions:

1. How is it possible that a family with the same genotypes as the Romanovs have no children with hemophilia?
2. How can skeletons be identified?
3. How is mitochondrial DNA different in shape from nuclear DNA ?
4. From which parent is mitochondrial DNA inherited?
5. How was DNA science used to prove the identity of skeletal remains from the Yekaterinburg?
6. What did the comparison of mitochondrial DNA sequences show?
7. Do you think Anna Anderson is Anastasia? Support your answer with the evidence.