

## DNA Fingerprinting!

Watch the YouTube video from Bozeman Biology on DNA Fingerprinting:

<https://www.youtube.com/watch?v=DbR9xMXuK7c>

You may also want to read the background story on the first criminal case to be solved using DNA evidence. It's a bit disturbing because it was a homicide case. Not required:

<https://www.theguardian.com/uk-news/2016/jun/07/killer-dna-evidence-genetic-profiling-criminal-investigation>

Now, try to figure out the DNA Fingerprinting activity worksheet. The restriction enzymes cut the DNA samples based on a specific set of letters.

## Blood Type

Read about blood type at NobelPrize.org and play the blood type game:

<https://www.nobelprize.org/educational/medicine/bloodtypinggame/>

1. List ALL the possible genotypes for each of the 4 blood types:

Type O \_\_\_\_\_ Type A \_\_\_\_\_ Type B \_\_\_\_\_ Type AB \_\_\_\_\_

1. A man with AB blood is married to a woman with AB blood. What blood types will their children be and in what proportion? SHOW WORK!

2. A woman with type A blood is claiming that a man with type AB blood is the father of her child, who is also type AB. Could this man be the father? Show the possible crosses; remember the woman can have AO or AA genotypes. SHOW WORK!

3. A man with type AB blood is married to a woman with type O blood. They have two natural children, and one adopted child. The children's blood types are: A, B, and O. Which child was adopted?

## DNA Fingerprinting Activity

**Introduction:** DNA fingerprinting relies on the fact that the DNA code is universal for all living things and that there are differences between individuals within that code. Because human DNA is very similar to every other human's DNA, DNA fingerprinting primarily focuses on the areas of the genetic code that vary greatly amongst individuals. These non-coding regions of DNA, called introns, have the most variable coding sequences within members of a species because they do not code for proteins.

Scientists use restriction enzymes to cut intron segments of DNA. They "run" the fragments of DNA in a gel electrophoresis, and then use the banding patterns (created by the fragments) between individuals to determine identity. Uses for DNA fingerprinting include: crime scene investigation, missing person identification, paternity testing, diagnosing genetic disorders, species identification and many others.

**Instructions:**

- Using the restriction enzymes Bam HI, Hin dIII and Eco RI, identify and label the sites where each would cut the DNA sequence provided.
- Record the number of cuts, the number of fragments and the length of each fragment created by each of the three enzymes. **NOTE:** To count fragment lengths, only count the number of bases on the **longest side** of the DNA strand.
- Using the data collected, draw the banding patterns that would result if these fragments were run on an electrophoresis gel.

**Data Table:**

Restriction Enzyme	# of cuts	# of fragments	Length of DNA fragments
<i>Bam HI</i>			
<i>Hin dIII</i>			
<i>Eco RI</i>			

**Restriction Enzyme and where the cut:**

<u>Bam HI</u>	<u>Hin dIII</u>	<u>Eco RI</u>
CG	CG	TA
CG	TA	TA
TA	TA	CG
AT	AT	GC
GC	AT	AT
GC	GC	AT

**DNA Sample:**

1	2	3	4	5	6
T A	G C	T A	T A	G C	T A
G C	A T	T A	T A	T A	T A
G C	G C	C G	C G	A T	C G
G C	A T	G C	G C	T A	G C
C G	T A	A T	T A	T A	A T
C G	T A	A T	C G	C G	A T
T A	C G	G C	C G	G C	C G
A T	T A	G C	T A	A T	G C
G C	T A	T A	T A	A T	G C
G C	A T	A T	A T	C G	G C
C G	A T	C G	A T	T A	G C
A T	G C	A T	G C	C G	C G
C G	T A	C G	C G	C G	C G
A T	C G	C G	T A	T A	C G
T A	A T	T A	T A	T A	T A
T A	A T	A T	T A	A T	A T
C G	G C	G C	T A	A T	G C
G C	C G	G C	A T	G C	G C
A T	A T	C G	A T	A T	A T
A T	G C	T A	A T	A T	C G
G C	G C	C G	T A	T A	C G

**Results:**

Draw the fragments created by each restriction enzyme in the diagram below:

		Bam HI	Hind III	Eco RI
		Start	Start	Start
Fragment Length (number of base pairs)	100			
	75			
	50			
	25			
	0			

**Analysis Questions:**

- 1.. What is the relationship between the DNA fragment length and the distance it traveled in the Gel?
2. What characteristic about the DNA molecule fragments allows them to separate when an electrical current is applied to gel in the electrophoresis box?
3. What is the advantage of using multiple restriction enzymes to cut the DNA during DNA fingerprinting?

**Crime Scene Analysis:**

Case #1: A stolen car was found on the side of the road with an empty bottle of Sprite. Detectives were able to collect enough DNA from the saliva left on the top of the bottle to create a DNA fingerprint. Below are the DNA fingerprints from the crime scene and two suspects who were seen near the abandoned car.

Crime Scene DNA Sample		
	Bam HI	Hind III
100	████████	
75	████████	
50		████████
25		████████
0		

Sally "Sticky" Finger		
	Bam HI	Hind III
100		████████
75	████████	
50		
25	████████	
0		████████

Bubba "Ballistic" Ray		
	Bam HI	Hind III
100	████████	
75	████████	
50		████████
25		████████
0		

**Analysis Questions:**

1. Who stole the car?
2. How do you know?

Case #2: A mother files a lawsuit for child support against a man she claims is the father of her child. The man claims that he has no children and does not even know the woman and so shouldn't have to pay child support. Below are the DNA fingerprints of the child, the mother and the man. Remember, children receive half of their DNA from their mother and the other half from their father.

Child's DNA		
	Bam HI	Hind III
100	████████	
75		████████
50	████████	
25		████████
0		

Mother's DNA		
	Bam HI	Hind III
100	████████	
75		████████
50	████████	
25		████████
0		

The Man's DNA		
	Bam HI	Hind III
100		
75	████████	
50		████████ ████████
25	████████	
0		

**Analysis Questions:**

1. Could the man be the father of this child?
2. How do you know?

Name: \_\_\_\_\_ Date: \_\_\_\_\_ Period: \_\_\_\_\_

# Blood Type Review Worksheet

Use your notes if needed to help answer the following questions.

- 1) Circle the **antigens** that would exist on red blood cells if a person was type AB- blood.

A antigen      B antigen      Rh antigen

- 2) Circle the **antibodies** that would exist in blood plasma if a person was type AB- blood.

A antibody      B antibody      Rh antibody

- 3) Which blood type would only have Rh and A **antigens** on the surface of red blood cells?

A+    A-    B+    B-    AB+    AB-    O+    O-

- 4) Which blood type would have no Rh **antigens**, but only have B **antigens** on the surface of red blood cells?

A+    A-    B+    B-    AB+    AB-    O+    O-

- 5) Which blood type would only have Rh and B **antibodies** flowing through blood plasma?

A+    A-    B+    B-    AB+    AB-    O+    O-

- 6) Maxwell has lost a lot of blood and needs a transfusion. Doctors at the hospital have identified that he has A- blood type, which means he also has B and Rh antibodies in his plasma. Circle blood types he can safely receive?

A+    A-    B+    B-    AB+    AB-    O+    O-

- 7) A person who has B+ blood has the B and Rh antigen on their red blood cells. Circle the blood types that should not receive B+ blood in a transfusion.

A+    A-    B+    B-    AB+    AB-    O+    O-

Jason is rushed to the hospital after losing blood from a work related accident. Because he was wearing a medical bracelet, the hospital staff knows that he has AB- blood type. Answer the following questions.

8) Circle the antigens found on his blood cells.

A    B    Rh

9) Circle the antibodies that can be found in his plasma.

A    B    Rh

10) Circle the types of blood that Jason can receive in a blood transfusion.

A+    A-    B+    B-    AB+    AB-    O+    O-

Maria (type B+) and Jacob (type B-) are sister and brother.

11)    Circle the antigens found on Maria's blood cells.    A    B    Rh

12)    Circle the antigens found on Jacob's blood cells.    A    B    Rh

13)    Circle the antibodies found inside Maria's plasma.    A    B    Rh

14)    Circle the antibodies found inside Jacob's plasma.    A    B    Rh

15)    Can Jacob receive Maria's blood in the event of an emergency? Explain.

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16)    Can Maria receive Jacob's blood in the event of an emergency? Explain.

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