

# INNOCENT OR GUILTY? DNA DETERMINATION

Berkeley Engineers and Mentors  
October 2, 2008

Objective: Review DNA concepts and explore its relevance in forensic science

Lesson Plan:

- Introduce the crime
- Load dyes and start the agarose gel electrophoresis
- Discussion: DNA Basics, DNA Testing Concepts
- Game: Who is the killer?
- Analyze the gel and confirm the killer's identity

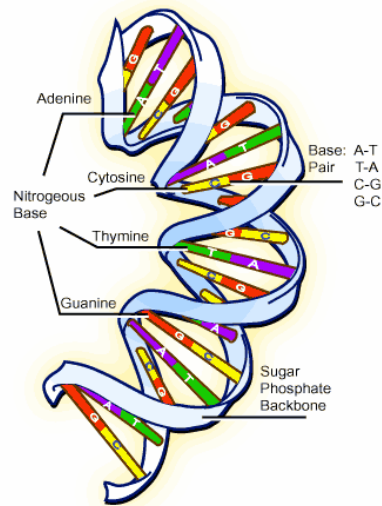
POLICE REPORT:

A STAFF MEMBER OF THE SCHOOL WAS MURDERED ON THE NIGHT OF WEDNESDAY, OCT. 1 AT AROUND 7PM. POLICE HAVE CONFIRMED THAT THE STAFF MEMBER WAS CONDUCTING INTERVIEWS WITH THE BEAM MENTORS AT THE TIME, AND THAT ONLY THE STAFF MEMBER AND THE BEAM MEMBERS WERE ON SCHOOL GROUNDS.

Who is guilty?

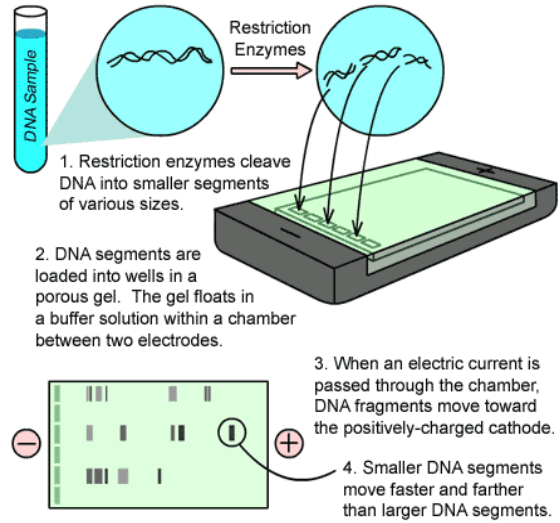
## CONCEPT: DNA Basics

- Deoxyribonucleic acid (DNA) is the "blueprint" of life
- Contains genetic information that guides the development and functioning of all living organisms
- Consists of 2 strands of nucleotides that hydrogen bond to each other, forming a double helix
- Everyone's DNA sequence is unique (except for identical twins)
- Among humans, 99.9% DNA is identical- the 0.1% accounts for all our differences!
- Human genome- about 3 billion base pairs
  - Fills 200 1000-page phonebooks
  - Takes 3 gigabytes of storage space



**CONCEPT: DNA Testing**

- KEY: Utilizes DNA variations to distinguish one person from another.
- DNA is cut with **restriction enzymes** (“molecular scissors” that cut at a specific sequence)
- Each unique DNA sequence will cut differently, leading to a unique set of smaller DNA fragments.
- Electrophoresis: DNA, negatively charged, move toward positive-charged cathode
- Smaller fragments move faster through “pores” in agarose gel than larger fragments
- Result- “DNA fingerprint”



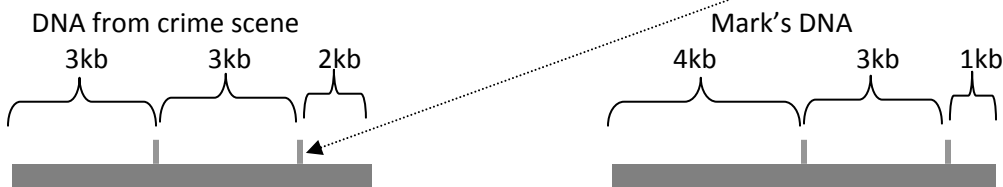
**CASE STUDY: Cat Saddened by its new Coat**

Mark is a suspect in a recent crime- his normally purple cat was painted orange. Notorious for pranks, Mark is a prime suspect. To aid in the investigation, authorities obtained a sample of Mark’s DNA and submitted it along with crime-scene DNA to a forensics lab.

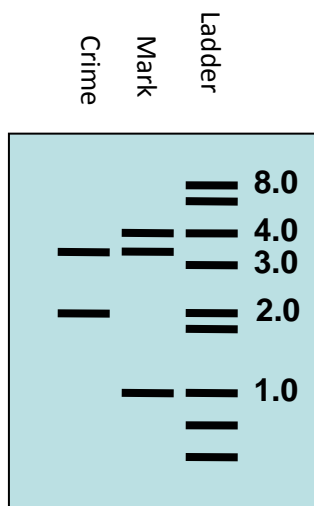


The lab incubates both DNA samples with HaeIII

- pronounced “Hay three”: restriction enzyme that cuts at “GGCC”



Can Mark be ruled out as a suspect?



Picture of an actual DNA gel (colors inverted)



### Model: DNA "Dyes"

As suggested in the police report, all BEAM mentors are suspects in the staff member's murder. You, the investigators, have obtained "DNA" from all BEAM mentors and the crime scene and will soon determine the killer. In the mean time, use clues from the crime scene to narrow down the possibilities.

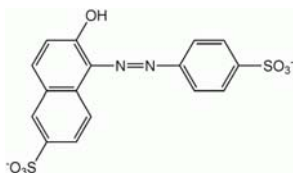
GAME: Clues

Who do we think the killer is?

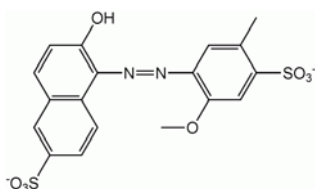
Now let's analyze the DNA samples. Rather than running actual DNA (lack of time and reagents), we are using food dye. Each mentor's "DNA" has a different combination of food dye (red, yellow, blue). These colors represent different sized fragments that result from restriction digests (when DNA is cut with the restriction enzymes). Like these fragments, each colored dye is negatively charged and has a different molecular weight. Thus, they will migrate at different rates.

	Chemical Formula	MW (g/mol)	In what order will they migrate? Fastest to slowest
Sunset Yellow FCF	$C_{16}H_{10}Na_2O_7S_2N_2$	452.37	
Allura Red AC	$C_{18}H_{14}N_2Na_2O_8S_2$	496.42	
Brilliant Blue FCF	$C_{37}H_{34}N_2Na_2O_9S_3$	854.04	

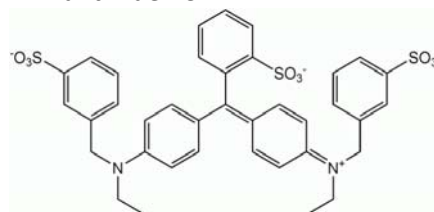
Sunset Yellow FCF



Allura Red AC



Brilliant Blue FCF



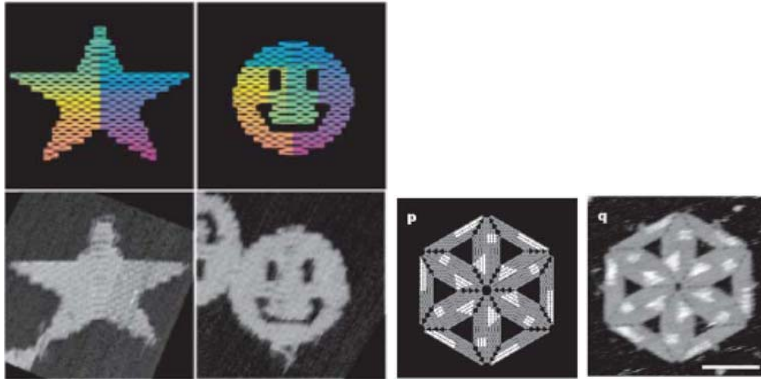
	DNA "Colors "
Killer	
Andy	
Joyce	
Ben	
James	
Joanna	

Who is the killer?

Other applications:

Paternity Testing

DNA ORIGAMI



Links to explore:

For further questions on topics related to this activity, contact:

Links: <http://www.scientific.org/tutorials/articles/riley/riley.html> “DNA Testing: An Introduction For Non-Scientists An Illustrated Explanation”

Vimalier at

Michael at MikeLin@berkeley.edu

[http://en.wikipedia.org/wiki/Image:Brilliant\\_Blue\\_FCF.png](http://en.wikipedia.org/wiki/Image:Brilliant_Blue_FCF.png)

[upload.wikimedia.org/.../8/89/Allura\\_Red\\_AC.png](http://upload.wikimedia.org/.../8/89/Allura_Red_AC.png)

[http://en.wikipedia.org/wiki/Image:FD%26C\\_Yellow\\_6.svg](http://en.wikipedia.org/wiki/Image:FD%26C_Yellow_6.svg)

[http://www.vivo.colostate.edu/hbooks/genetics/medgen/dnatesting/dnatest\\_apps.html](http://www.vivo.colostate.edu/hbooks/genetics/medgen/dnatesting/dnatest_apps.html)

DNA PIC: <http://www.scq.ubc.ca/wp-content/dna.gif>

<http://images.google.com/imgres?imgurl=http://www.pasteur.ac.ir/researchDepartment/molecularImmunology/images/DNA%2520Gel.jpg&imgrefurl=http://portal.chaminade-stl.com/LinkClick.aspx%3Flink%3DPhysical%2520Evidence.ppt%26tabid%3D5418%26mid%3D9619&h=496&w=862&sz=437&hl=en&start=1&um=1&usq=6Jsf6fsUjJdoqqW7PFmjU2uHg=&tbnid=Pq2neANWrgs1iM:&tbnh=83&tbnw=145&prev=/images%3Fq%3Ddna%2B%2Bgel%2Bcrime%26um%3D1%26hl%3Den%26client%3Dfirefox-a%26rls%3Dorg.mozilla:en-US:official%26sa%3DG>

<http://pantheaunique.files.wordpress.com/2007/10/cute-cat2.jpg>