Computer Interpretation of Quantitative DNA Evidence

Commonwealth of Pennsylvania v. Allen Wade
May, 2016
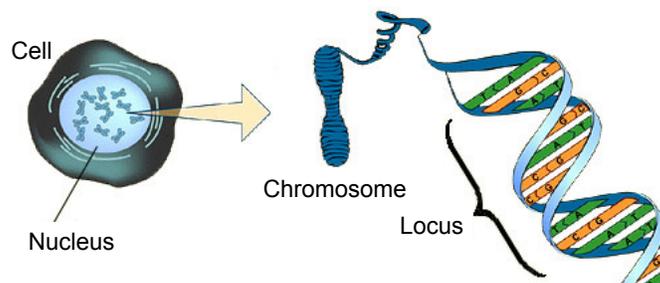**Pittsburgh, PA**

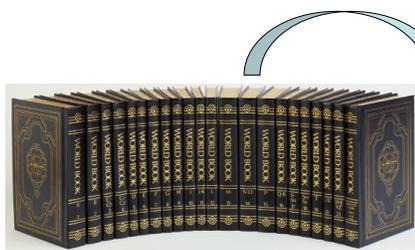**Mark W Perlin, PhD, MD, PhD**
Cybergenetics, Pittsburgh, PA

Cybergenetics

DNA biology

Short tandem repeat

DNA locus paragraph

Take me out to the ball game
take me out with the crowd
buy me some peanuts and Cracker Jack
I don't care if I never get back
let me
root root root root root root root root root root
for the home team,
if they don't win, it's a shame
for it's one, two, three strikes, you're out
at the old ball game

"root" repeated 10 times, so
allele length is 10 repeats

23 volumes in cell's
DNA encyclopedia

DNA genotype

Chromosome
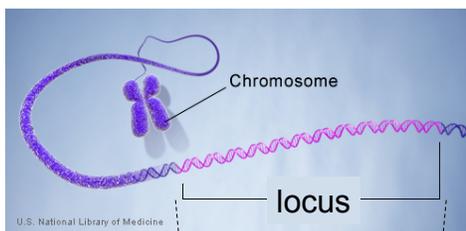
locus

mother
allele

1 2 3 4 5 6 7 8 9 10

ACGT repeated word

father
allele

1 2 3 4 5 6 7 8 9 10 11 12

A genetic locus has
two DNA sentences,
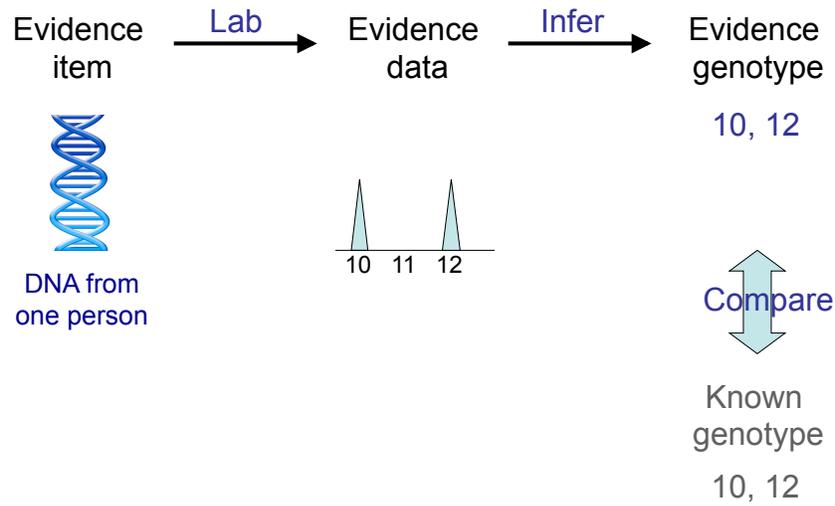one from each parent.

An allele is the number
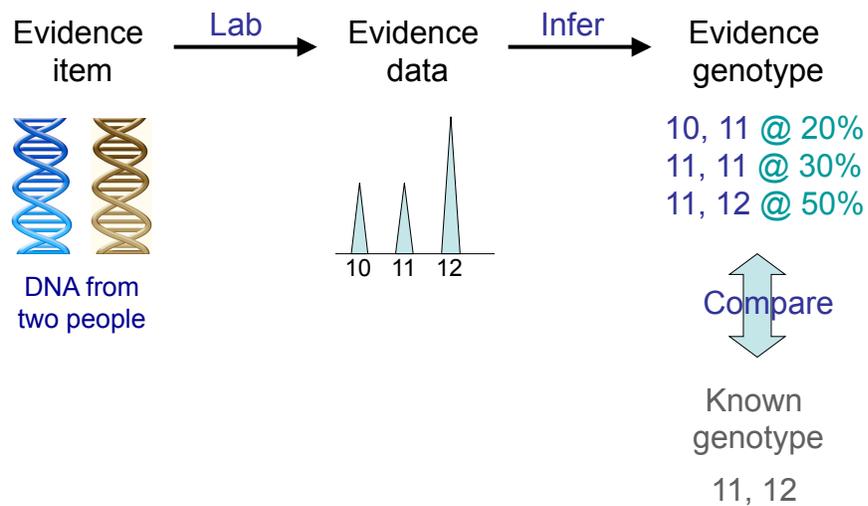of repeated words.

A genotype at a locus
is a pair of alleles.

10, 12

Many alleles allow for
many many allele pairs.
A person's genotype
is relatively unique.

DNA evidence interpretation

Evidence item → Lab → Evidence data → Infer → Evidence genotype

10, 12

DNA from one person

10 11 12

Compare

Known genotype

10, 12

DNA mixture interpretation

Evidence item → Lab → Evidence data → Infer → Evidence genotype

10, 11 @ 20%
11, 11 @ 30%
11, 12 @ 50%

DNA from two people

10 11 12

Compare

Known genotype

11, 12

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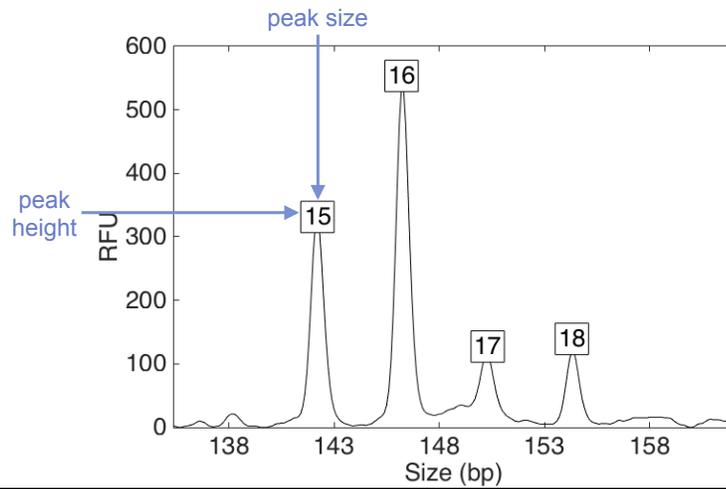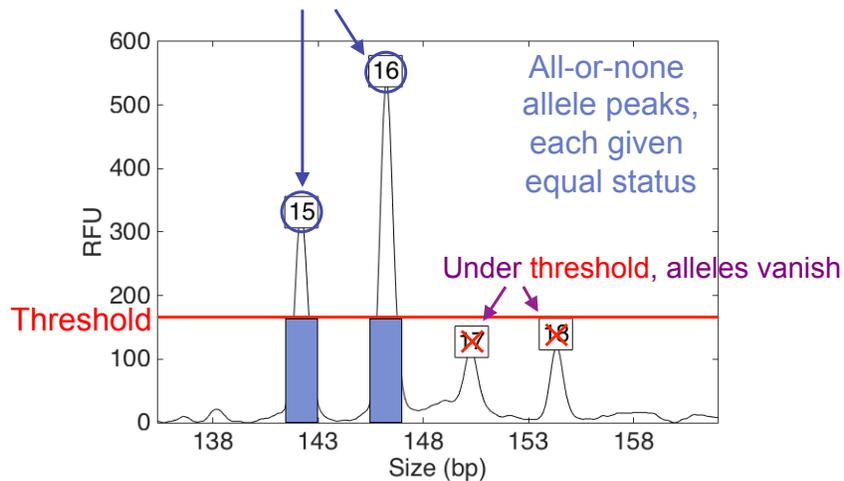
Computers can use all the data

Quantitative peak heights at locus vWA

People may use less of the data
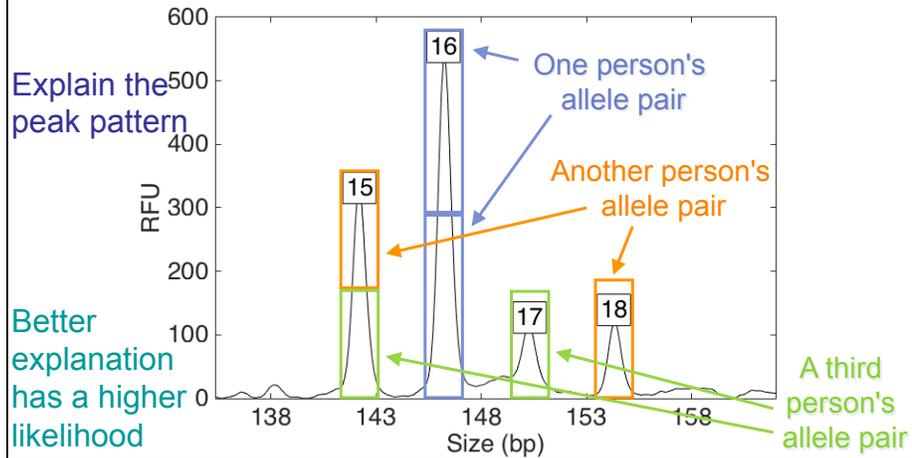
Over threshold, peaks are labeled as allele events

How the computer thinks

Consider every possible genotype solution

Explain the peak pattern

Better explanation has a higher likelihood

One person's allele pair

Another person's allele pair

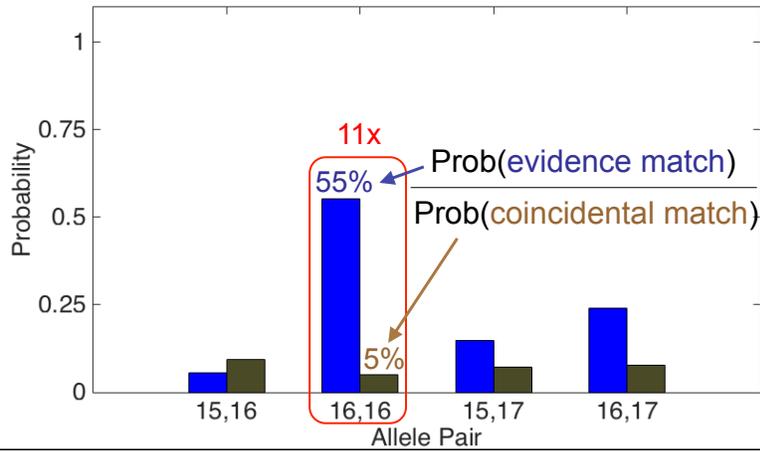A third person's allele pair

Evidence genotype

Objective genotype determined solely from the DNA data.
Never sees a comparison reference.
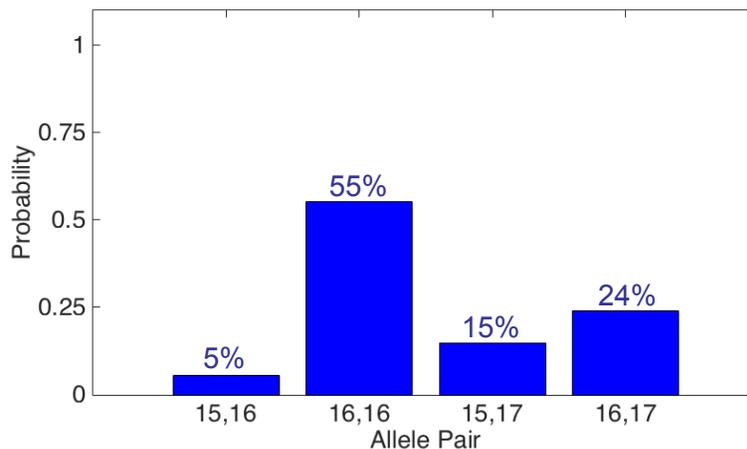
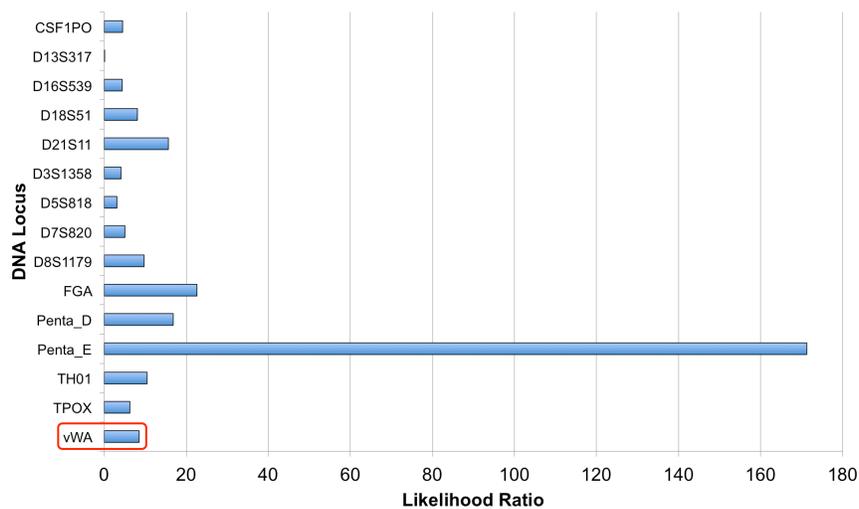# DNA match information

How much more does the suspect match the evidence
than a random person?

Match information at 15 loci

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Is the suspect in the evidence?

A match between the <u>right fingernails</u>
and <u>Allen Wade </u>is:

6.06 trillion times more probable than
a coincidental match to an unrelated Black person

32.5 trillion times more probable than
a coincidental match to an unrelated Caucasian person

8 trillion times more probable than
a coincidental match to an unrelated Hispanic person

Is the victim in the evidence?

A match between the <u>right fingernails</u>
and <u>Susan Wolfe </u>is:

57.2 million times more probable than
a coincidental match to an unrelated Black person

47.1 million times more probable than
a coincidental match to an unrelated Caucasian person

21.8 million times more probable than
a coincidental match to an unrelated Hispanic person

Match statistics
Burglary

Item	Description	19A Susan Wolfe	30A Sarah Wolfe	49A Allen Wade
1A	Hat			65.3 thousand

Match statistics
House

Item	Description	19A Susan Wolfe	30A Sarah Wolfe	49A Allen Wade
15A	Plastic cup	20.5 thousand		
17A	Right fingernails	21.8 million		6.06 trillion
18A	Left fingernails	139 thousand		
30A	Grocery bag	5.5 quintillion		

Match statistics
Car

Item	Description	19A Susan Wolfe	30A Sarah Wolfe	49A Allen Wade
20J	Gear shift		9.37 million	
25C	Driver's seatback lever		385 billion	

Match statistics
Whitfield Street

Item	Description	19A Susan Wolfe	30A Sarah Wolfe	49A Allen Wade
36A1	Sweatpants waistband			13.7 quintillion
36A2	Sweatpants blood stain			22.4 quintillion
37A	Black knit hat			25.7 thousand
38A	Hanes sock		300	2.96 quintillion
39A	Hanes sock			5.7 quintillion

Match specificity

Non-contributor distribution for the
Hanes sock genotype (Item 38A)

Match statistic
for Sarah Wolfe
(Item 30A)

1 in
trillion

1 in
million

1   million