This course so far…

- HIV: strings, understanding a virus
- Personal Genomics: SNPs, associations

Genetic data for

- Exonerating wrongfully convicted
- Exposing flaws in the justice system

The genetics of innocence

The Innocence Project

- Fast facts: http://www.innocenceproject.org/dna-exonerations-in-the-united-states/
- Video: http://www.innocenceproject.org/about/

Science is fairly straightforward, legal process is not

- Example case: http://www.innocenceproject.org/cases/marvin-anderson/
- Challenges of getting post-conviction DNA testing
  - state law does not allow
  - cost of test not covered by state
  - evidence is not preserved

Sexual Assault Survivor's Bill

"Victims have the right:

- Not to be charged for a sexual assault evidence collection kit.
- To be informed of testing results.
- To be notified in writing 60 days beforehand if the kit is going to be destroyed, and to request that the kit be preserved.
- To have the kit preserved for the entire applicable statute of limitations."

Above taken from: http://www.vox.com/identities/2016/10/7/13200350/sexual-assault-survivors-bill-of-rights-obama-shaheen

Full text of Bill at: https://www.congress.gov/bill/114th-congress/senate-bill/2566/text

The science behind DNA fingerprinting

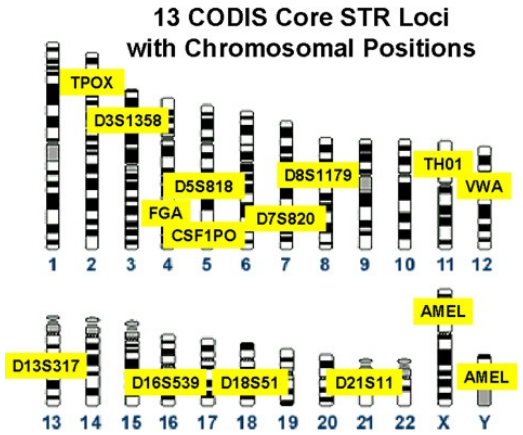
'DNA fingerprint' - Alec Jeffreys

Rough idea

...CTG**AATGAATGAATGAATGAATGAATGAATGAATGAATGAATG**TTTG...

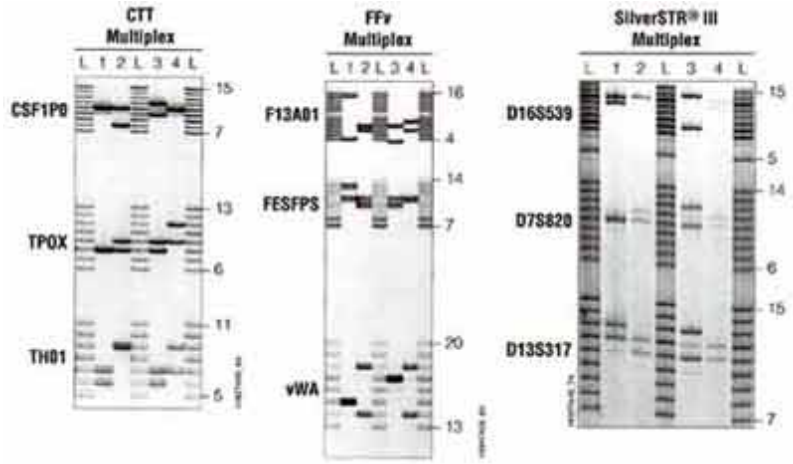
- repeated short DNA motifs are found in non-coding regions of the genome:
  - easy to measure
  - different between individuals (except monozygotic twins)
- number of times a STR is repeated is called the 'allele' (11 for AATG above)

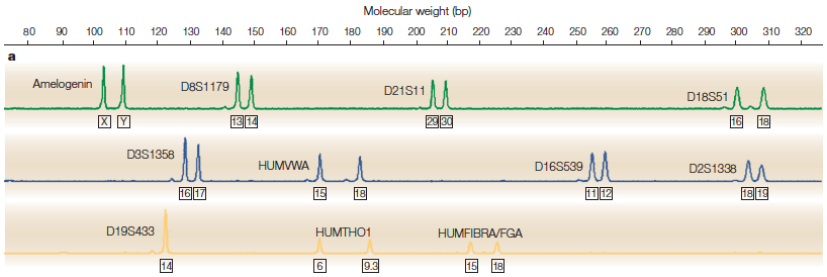
(from http://www.nature.com/scitable/topicpage/forensics-dna-fingerprinting-and-codis-736)



Create your own DNA fingerprint

- http://ca.pbslearningmedia.org/resource/tdc02.sci.life.gen.creatednafingerprint/create-a-dna-fingerprint/





STR Locus	Evidence Sample	Suspect A
D3S1358	15, 17	17, 17
vWA	15, 16	18, 19
FGA	23, 27	21, 23
D8S1179	12, 13	14, 15
D21S11	28, 30	27, 30.2
D18S51	12, 18	14, 18
D5S818	13, 13	9, 12
D13S317	12, 12	12, 12
D7S820	10, 11	9, 10
CSF1PO	8, 11	11, 12
TPOX	7, 8	8, 8
THO1	9.3, 9.3	6, 9.3
D16S539	9, 13	11, 12

Excluding a suspect can sometimes be challenging

- *If* data quality is high, a mismatch in *any* of the loci proves innocence
- But, if biological sample is degraded, contains mixture of individuals, improperly analyzed, exclusion can be harder to prove: http://www.theatlantic.com/magazine/archive/2016/06/a-reasonable-doubt/480747/

STR Locus	Evidence Sample	Suspect A	Suspect B
D3S1358	15, 17	17, 17	15, 17
vWA	15, 16	18, 19	15, 16
FGA	23, 27	21, 23	23, 27
D8S1179	12, 13	14, 15	12, 13
D21S11	28, 30	27, 30.2	28, 30
D18S51	12, 18	14, 18	12, 18
D5S818	13, 13	9, 12	13, 13
D13S317	12, 12	12, 12	12, 12
D7S820	10, 11	9, 10	10, 11
CSF1PO	8, 11	11, 12	8, 11
TPOX	7, 8	8, 8	7, 8
THO1	9.3, 9.3	6, 9.3	9.3, 9.3
D16S539	9, 13	11, 12	9, 13

Final thoughts

- Human genome: 3 billion base pairs, >99% similarity between two humans, yet less than 10000 nucleotides is enough to uniquely identify us (10^{-5} of the genome)
- Next time: making the case for guilt using DNA fingerprinting and probability — watch the TED talk posted on the calendar!