

ORCHID CELLMARK

A Leader in Identity DNA Testing Services

An Introduction to Y-STR Testing

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Orchid Cellmark

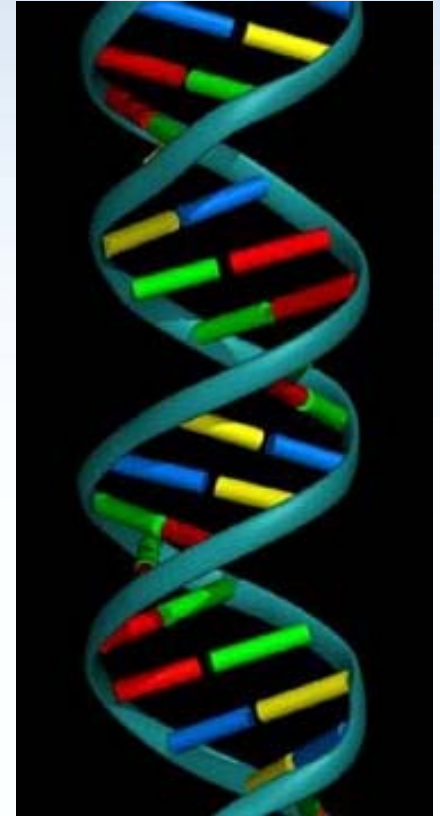
Forensics Supervisor and Technical Leader

Y-STR and Mitochondrial DNA Analysis

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What is DNA?

- ◆ DNA = deoxyribonucleic acid
- ◆ DNA is the instruction manual for your body – it makes us who we are
- ◆ Inherit $\frac{1}{2}$ of DNA from your dad and $\frac{1}{2}$ of DNA from your mom
- ◆ Everyone has a unique DNA profile, with the exception of identical twins!



DNA is found throughout your entire body

- ◆ Blood
- ◆ Semen
- ◆ Saliva
- ◆ Urine
- ◆ Hair
- ◆ Teeth
- ◆ Bone
- ◆ Tissue
- ◆ Skin



What Can be Tested?

- 
- ◆ Essentially any item of evidence with biological material can be tested for DNA
 - ❖ Sexual assault swabs
 - ❖ Fingernails
 - ❖ Clothing
 - ❖ Hairs
 - ❖ Items that have been touched or handled (ex: weapons such as guns, knives, etc.)
 - ❖ Ligatures used for strangulation
 - ❖ Stains collected from an object or surface
 - ❖ ... the list goes on and on

3 Primary Types of DNA Testing

◆ STRs:

- ❖ Widespread acceptance in the forensic community
- ❖ Used in labs across the US and internationally
- ❖ Virginia Department of Forensic Sciences

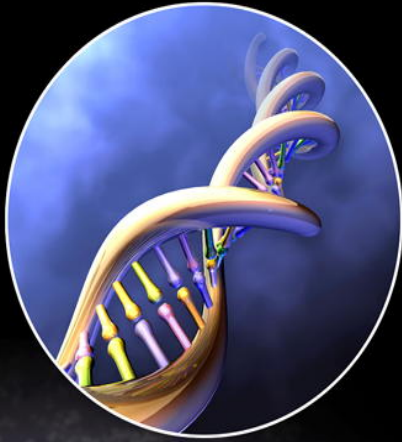
◆ Mitochondrial DNA:

- ❖ Specialized DNA test: widespread acceptance in the forensic community
- ❖ Used in labs in the US and internationally
- ❖ Virginia Department of Forensic Sciences

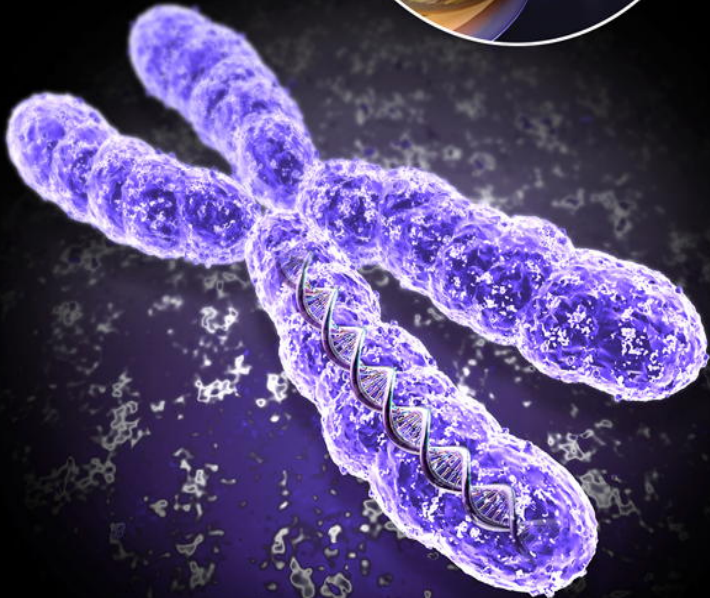
◆ Y-STRs:

- ❖ Specialized DNA test: widespread acceptance in the forensic community
- ❖ Used in labs across the US and internationally
- ❖ Currently not used by the Virginia Department of Forensic Sciences

What is STR Testing?

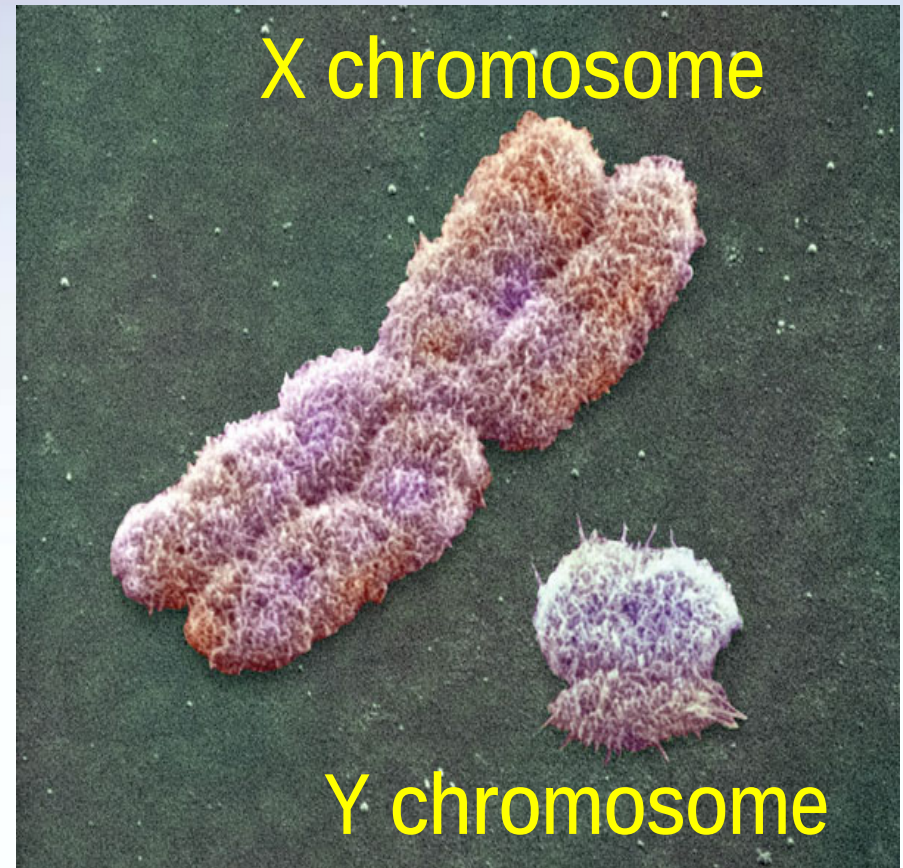


- ◆ Type of testing performed in crime labs
- ◆ Examines female and male DNA
- ◆ Look at 13 different areas of the DNA (on multiple chromosomes) to develop an STR profile
- ◆ Can pinpoint 1 person in the world (except identical twins)



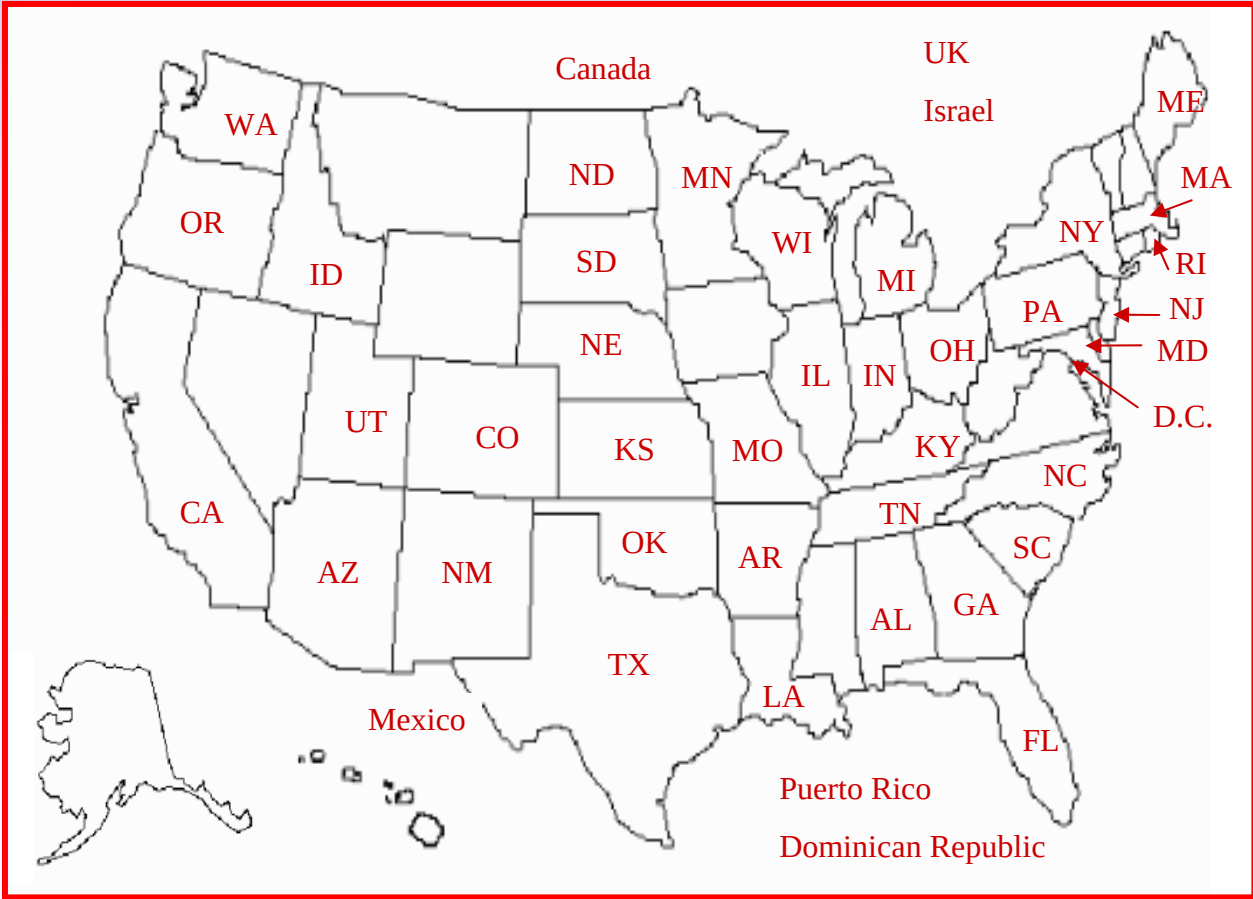
What is Y-STR Testing?

- ◆ Methods used are very similar to those used in STR testing
- ◆ However, Y-STRs only examine **MALE DNA**
- ◆ Ignores female DNA
- ◆ Look at 17 areas of the Y chromosome to develop a Y-STR profile



Y-STR Testing at Orchid Cellmark

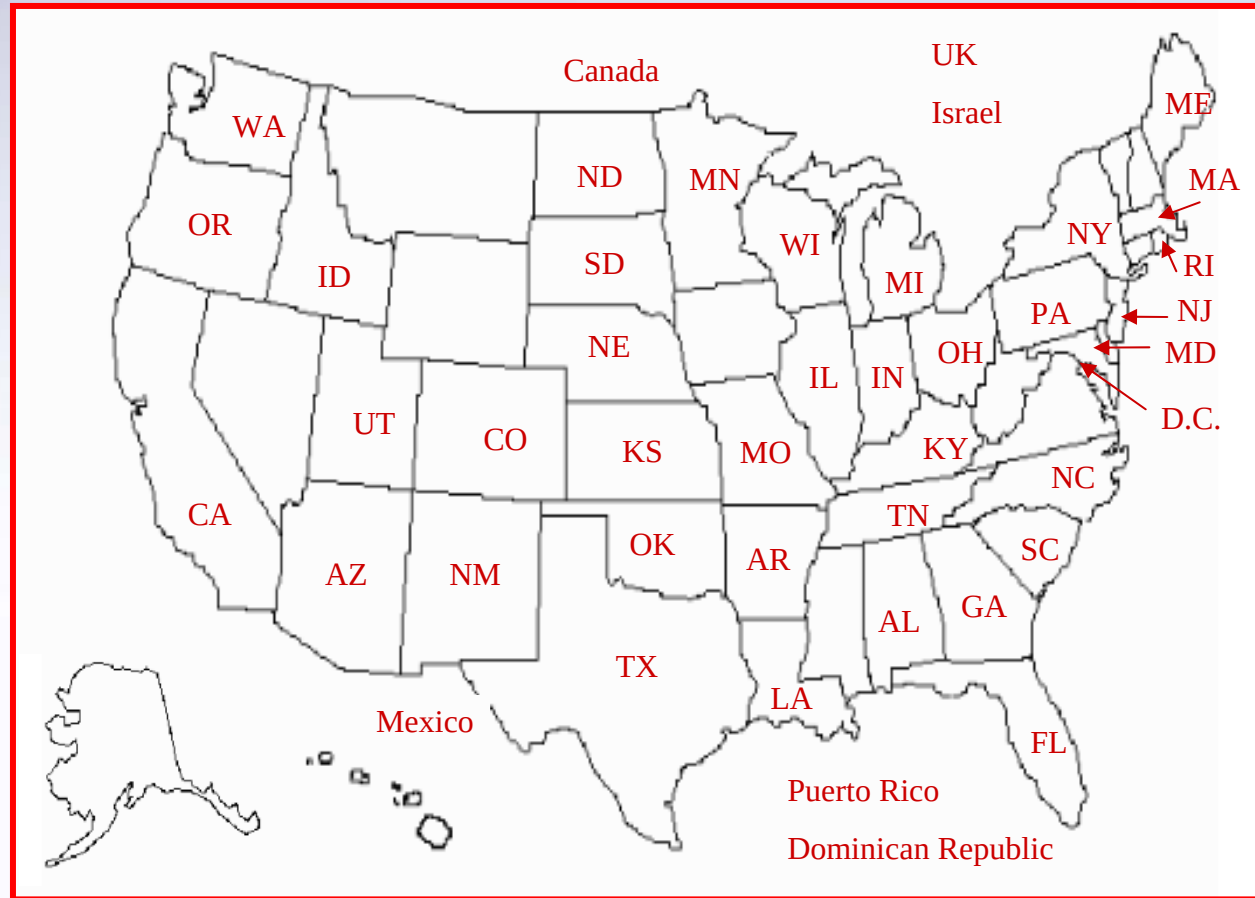
- ◆ Began Y-STR testing in 2002
- ◆ Y-STR testing in >500 cases, US and abroad



A map of the United States and surrounding regions, including Canada, Mexico, Puerto Rico, and the Dominican Republic. The map is outlined in red. Various states and regions are labeled with red text. In the Northeast, red arrows point to specific locations: MA, RI, NJ, MD, and D.C. The labels include: Canada, UK, Israel, ME, MA, RI, NJ, MD, D.C., NY, PA, OH, MI, WI, MN, ND, SD, NE, KS, MO, IL, IN, KY, TN, NC, SC, GA, AL, FL, TX, OK, NM, AZ, UT, CO, CA, WA, OR, ID, and Mexico. Puerto Rico and Dominican Republic are labeled at the bottom right.

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- ◆ Began Y-STR testing in 2002
- ◆ Y-STR testing in >500 cases, US and abroad



Y-STR Testing at Orchid Cellmark

- ◆ Y-STR testimony provided >20 times
 - ❖ Texas, Oklahoma, Michigan, Massachusetts, Colorado, Ohio, Kentucky, California, Florida, New Mexico, Indiana
 - ❖ ~ 5 admissibility hearings: all successful
- ◆ Use commercially available Y-STR kits → more standardization between laboratories

Advantages and Limitations of Y-STR Testing

- ◆ Y-STR testing **cannot uniquely identify** an individual
 - ❖ Men get their Y chromosome directly from their fathers
 - ❖ All men from the same lineage will have the same Y-STR profile
- ◆ Statistics: less discriminating than conventional STRs
 - ❖ Perhaps 1 in ~3500 (this will soon be 1 in ~14,000)
 - ❖ Powerful in their ability to exclude a suspect
 - ❖ Cannot search for a Y-STR profile in CODIS, the convicted offender database
- ◆ Male specific DNA test!

When should Y-STR testing be used?

- ◆ Majority of cases:
 - ❖ Y-STRs are used after more conventional DNA testing (STR) is attempted or if screening indicates little male DNA is present
- ◆ Minority of cases:
 - ❖ Y-STR testing may be the 1st type of testing used
- ◆ Substantially larger amount of female than male DNA (high ratio of female:male)
- ◆ Very small amounts of male DNA

Y-STR Testing May be Useful in Sexual Assault Cases

- ◆ Large amounts of female DNA and small amounts of male DNA (ex: sexual assault swabs)
 - ❖ Sometimes the male DNA hides behind the female's profile
 - ❖ Male DNA is completely obscured or difficult to interpret
- ◆ No or few sperm cells
 - ❖ Includes seminal fluid from vasectomized males
 - ❖ Male DNA can be detected from epithelial cells in ejaculate, even if sperm are not present
- ◆ Male saliva collected from female's body
 - ❖ Example: only oral contact is reported by the victim

Y-STR Testing May be Useful in Homicide Cases

- ◆ Mixture of male and female blood
 - ❖ Example: suspect allegedly cuts himself while stabbing a female victim
- ◆ Fingernail clippings from a female victim
 - ❖ Often a large amount of female DNA
- ◆ Ligatures used for strangulation – contact DNA from male
- ◆ In most of these examples, the amount of female DNA may overwhelm the male DNA.
- ◆ In most of these examples, STRs are attempted 1st
 - ❖ Y-STRs are often used as a second step in the DNA testing process

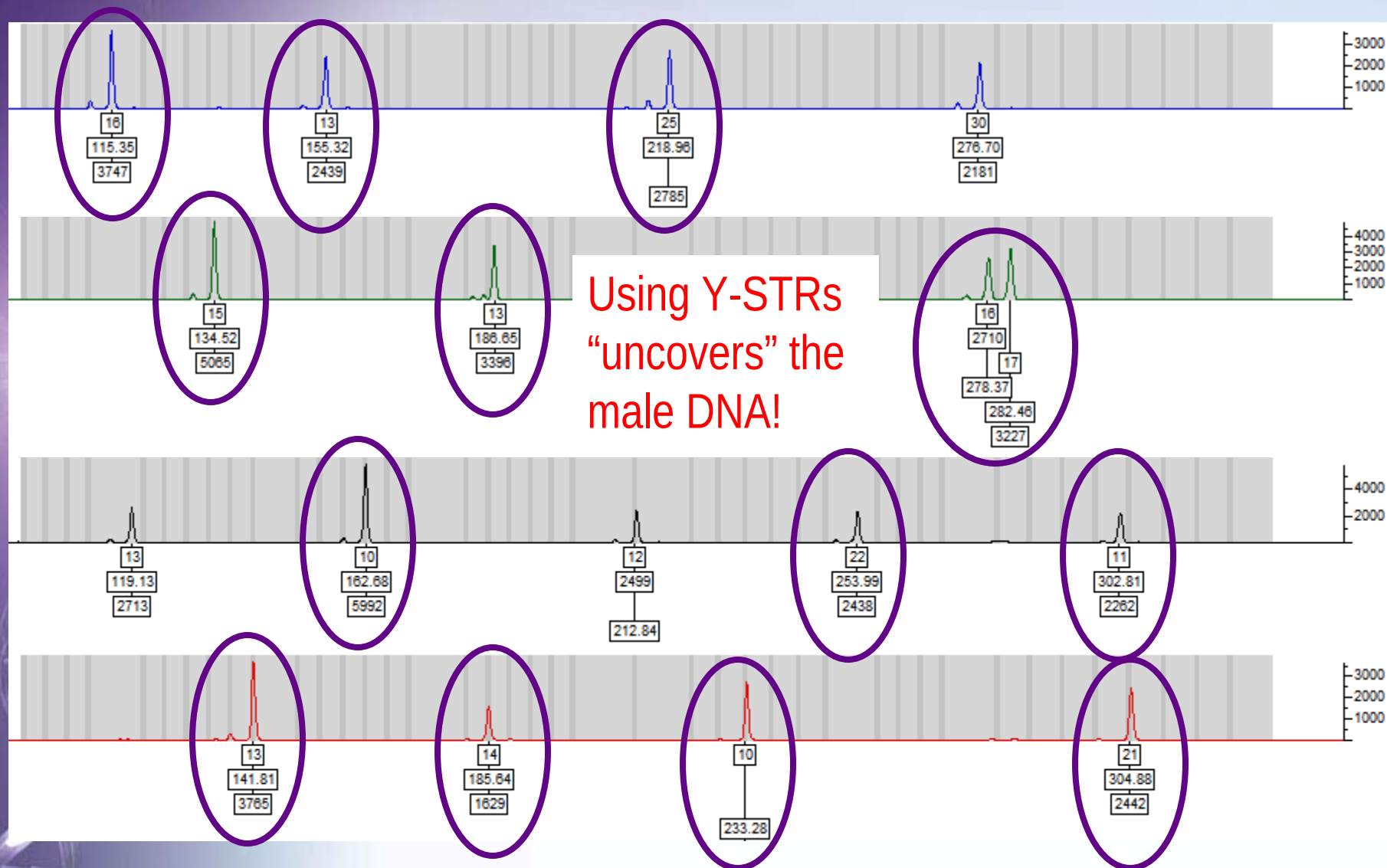
Y-STR Testing at Orchid Cellmark

- ◆ Of the total casework: only ~5-10% is Y-STR testing
- ◆ Of the Y-STR casework: only 10-15% is at the request of the defense (including post-conviction)
- ◆ What does this mean?
 - ❖ For every 100 DNA cases, ≤ 1 case is post-conviction Y-STR testing

Case Example #1: Panty cutting

- ◆ Previous STR testing performed at state crime lab
- ◆ Only detected female DNA from the panty cutting
 - ❖ Classic Y-STR case: female DNA obscures the DNA profile from the male contributor (ratio of female:male is too high!)

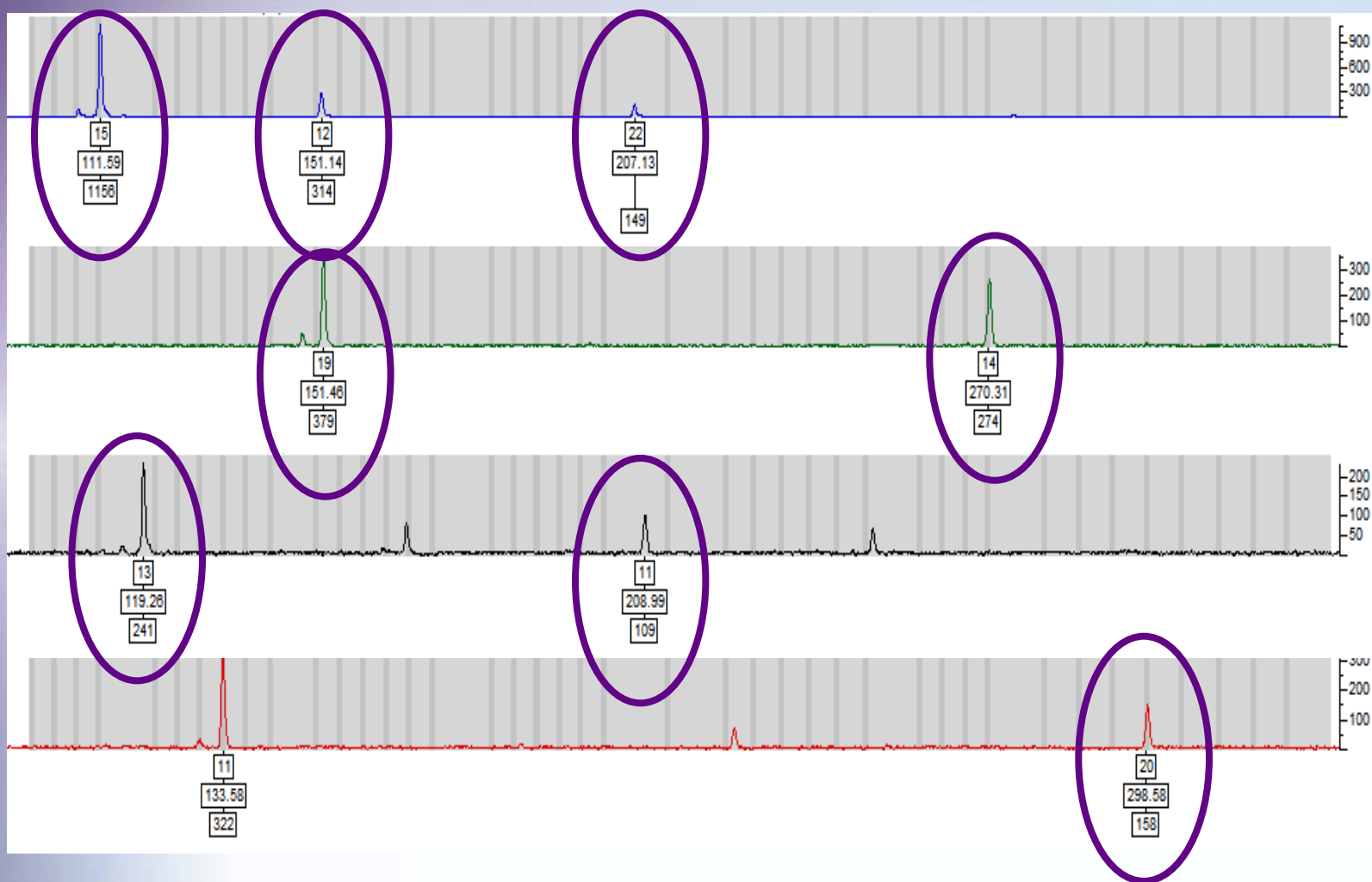
Case Example #1: Panty cutting



Case Example #2: Vaginal smear sample

- ◆ Limited male DNA present on a challenging sample
- ◆ Possible degradation of DNA

Case Example #2: Vaginal smear sample



These are only 2 examples of exonerations based on Y-STRs – there have been multiple others!

Things to Keep in Mind...

- ◆ If you can get STR DNA testing results, do it!
 - ❖ STRs are highly discriminating and detect both female and male DNA!
 - ❖ STR results are uploadable into the CODIS database, Y-STRs aren't!
 - ❖ Y-testing should typically be reserved for cases when STR testing fails or is inconclusive
- ◆ Y-STR testing cannot uniquely identify an individual
 - ❖ All men from the same male lineage have the same Y-profile
- ◆ Y-STR testing can provide extremely valuable genetic information when other testing has failed, is inconclusive, or not appropriate based on the case/sample type

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