DNA ANALYSIS

FORENSIC DNA ANALYSIS

The Applied Science of Human Identification

WHAT IS DNA?

DNA stands for Deoxyribonucleic Acid. It is . . .

- The blueprint of life
- Our genetic identity

There are two types of DNA – mitochondrial DNA and nuclear DNA. Both are used in forensic science, but this lesson will focus on nuclear DNA as it is more discriminating and can be used to identify an individual.

Figure 1: Nuclear DNA

DOUBLE HELIX

A = purple

C = red

T = blue

G = green

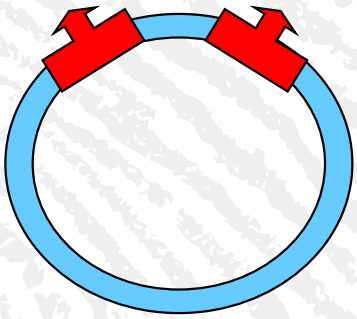


Figure 2: Mitochondrial DNA

NUCLEAR DNA INFORMATION:

- Nuclear DNA is found in the nucleus of a cell
- Nucleotide bases (A, C, T, G) form a ***double helix***
- The total amount of DNA in a cell is a genome

THE HUMAN GENOME

- ***The human genome*** is made up of 23 pairs of chromosomes
- Each parent passes down one copy of each chromosome
- Gender is determined by the sex chromosomes X and Y; XX is female, XY is male

98% of everyone's DNA is the same. Forensic scientists are interested in the 2% of DNA that is different between individuals because it allows them to make identifications.

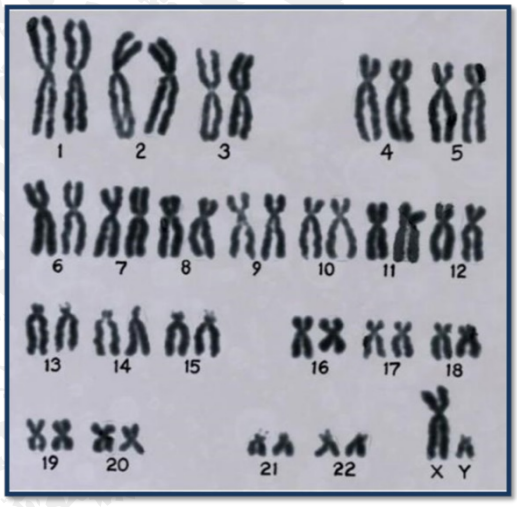


Figure 3: The Human Genome

WHY IS DNA TESTING VALUABLE IN FORENSIC SCIENCE?

- DNA can be retrieved from biological evidence at a crime scene (hair, saliva, blood, etc.)
- Your DNA is the same regardless of the body fluid or tissue from which it is obtained. This means DNA obtained from a blood stain on an item of evidence can be compared to DNA from a buccal swab of a suspect. Remember a buccal swab collects skin cells from the inside of someone's cheek.
- Nuclear DNA is unique to an individual. No two people have the same nuclear DNA – unless they have an identical twin. This means ***nuclear DNA can be used to identify an individual in an investigation (victim or suspect).***

SO HOW IS DNA ANALYSIS DONE IN A LAB?

STEP 1: DNA EXTRACTION

- Chemically removes DNA from cells and purifies the DNA. This makes sure that only DNA is present and no other contaminates or cell components remain.

STEP 2: DNA QUANTIFICATION

- Determines DNA quantity and quality. Assists the analyst in determining if there is enough DNA to proceed with analysis.

STEP 3: DNA AMPLIFICATION

- Creates millions of copies of the DNA through a process called polymerase chain reaction (PCR). PCR allows us to specifically select and copy the parts of the DNA we are interested in analyzing as a forensic scientist (the parts that are different between people).

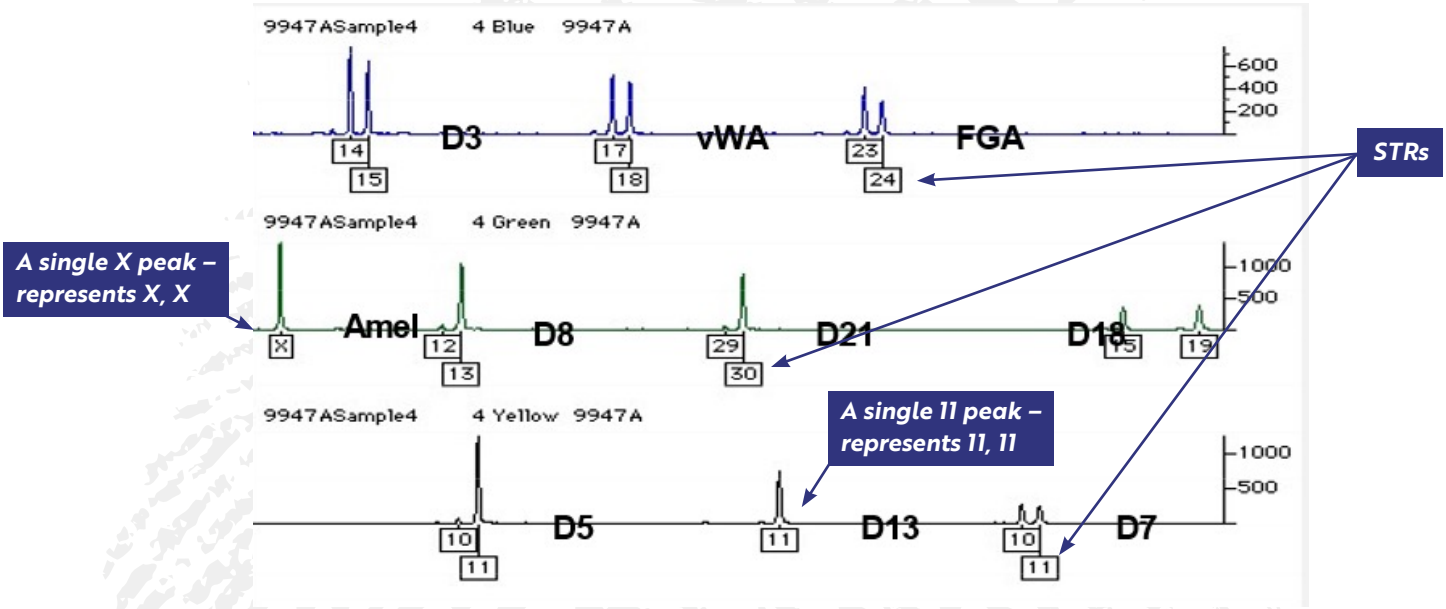
STEP 4: GENETIC ANALYZER

- PCR amplified DNA is separated out on a genetic analyzer, producing a DNA profile called an electropherogram. ***This profile is a small, but discriminating part of the genome.***

COMPARISON

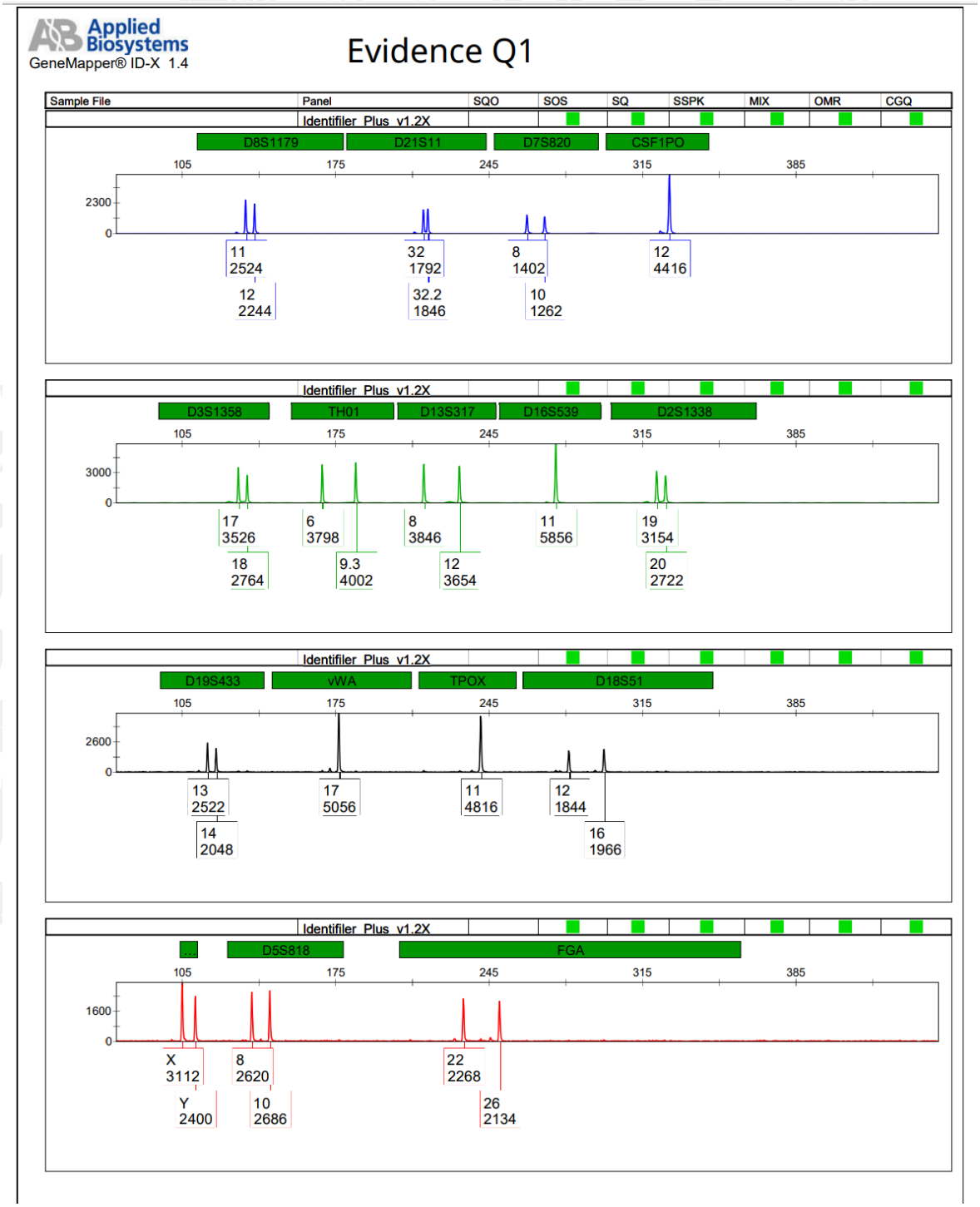
- Inside everyone's genome are sections of DNA called short tandem repeats (STRs). This is the section of DNA that varies between individuals.
- DNA profiles are compared between unknown evidence and known individuals based on the STRs in their electropherograms. STRs are represented by the numbers under the peaks.
- Forensic DNA analysts look at STRs at 21 different locations in the human genome. They can also determine gender by examining the Amelogenin or sex-determining location.
- If the numbers under the peaks and the gender of the individual are the same between an unknown profile from a crime scene sample and a known profile from a suspect, an identification or match is made.
- Once a match is made, a comparison statistic is calculated and the association is reported.

ELECTROPHEROGRAM EXAMPLE



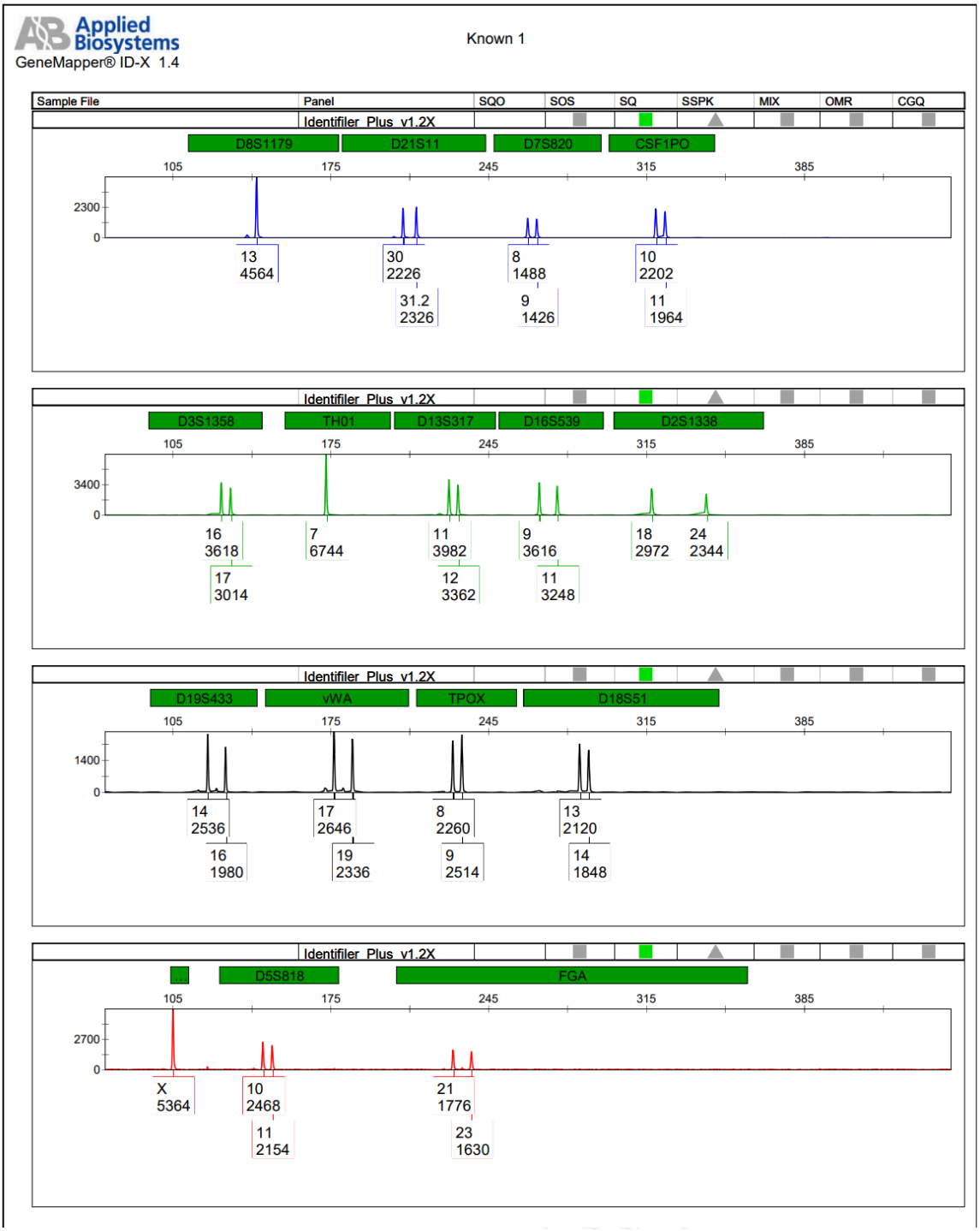
DNA COMPARISON EXERCISE: Compare evidence Q1 to known evidence items K1, K2, and K3 and find the match.

Q1 – EVIDENCE PROFILE



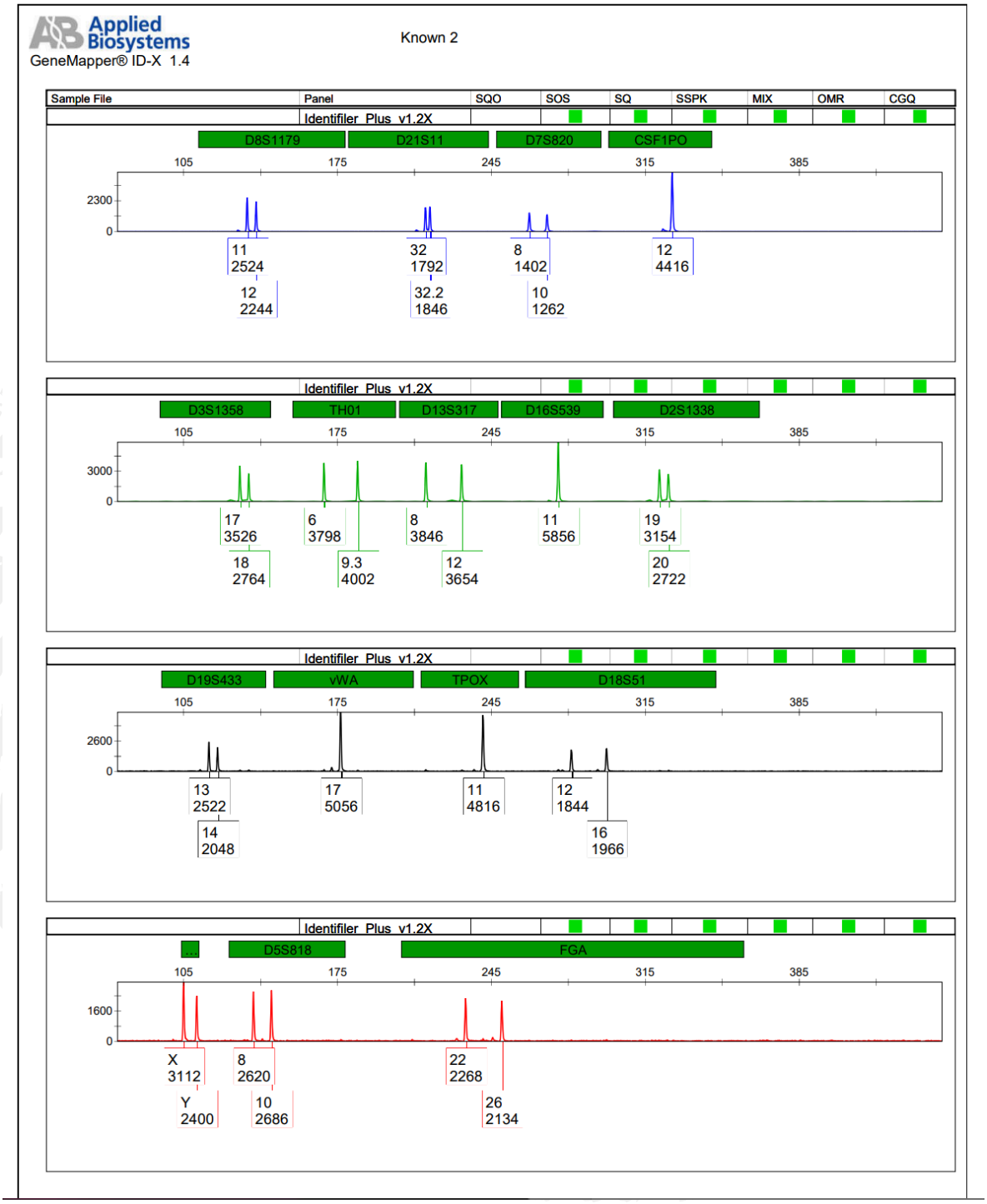
DNA COMPARISON EXERCISE: Compare evidence Q1 to known evidence items K1, K2, and K3 and find the match.

K1 – KNOWN PROFILE



DNA COMPARISON EXERCISE: Compare evidence Q1 to known evidence items K1, K2, and K3 and find the match.

K2 – KNOWN PROFILE



DNA COMPARISON EXERCISE: Compare evidence Q1 to known evidence items K1, K2, and K3 and find the match.

K3 – KNOWN PROFILE

Applied Biosystems
GeneMapper® ID-X 1.4

Known 3