A HOTEL FIRE

INTRODUCTION

Note: This is a fictional story based on a real event. It uses actual STRs and allele data.

On October 31, 2006, a fire roared through the historic Mizpah Hotel in the casino district of Reno, Nevada. The fire claimed 12 lives and gutted much of the building. Valerie Moore, a cook at a nearby casino who lived in the hotel, was convicted of setting the fire after an argument with another tenant. Cooke was sentenced to 12 consecutive life prison terms without parole.

The remains of one of the victims were recovered from a section of the hotel that had completely burned down. The sample was processed to isolate DNA. The DNA was then analyzed to determine the profile of the 13 standard STR loci for identification. The mock sample profile is shown in Figure 1.

Figure 1. DNA profile of a sample from a victim of the Mizpah Hotel fire. The profile uses 13 standard STR loci and the AMEL locus for sex determination.

One of the hotel guests that was not accounted for after the fire was a tourist, John Doe, visiting Reno from New York. Authorities sampled DNA from his toothbrush obtained from his apartment in New York. They used the DNA to generate a DNA profile using the 13 standard STR loci. The data is shown in Figure 2.
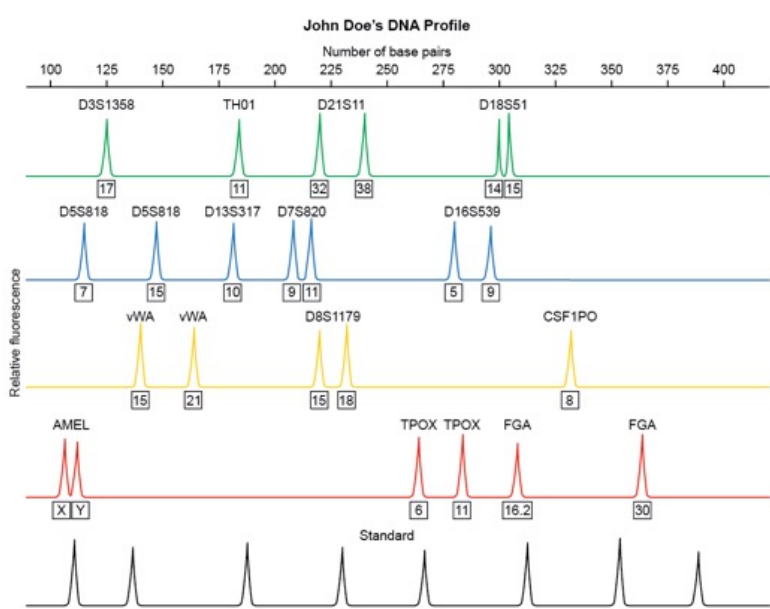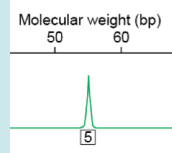

Figure 2. DNA STR profile (13 STR loci and AMEL locus for gender identification) of John Doe.

STR	Genotype	Genotype probability in the U.S. population
CSF1PO	8, 8	4.494×10^{-4}
D8S1179	15, 18	5.472×10^{-4}
FGA	16.2, 30	1.000×10^{-6}
D13S317	10, 10	7.903×10^{-3}
D16S539	5, 9	1.626×10^{-4}
D18S51	14, 15	4.205×10^{-2}
TH01	11, 11	2.500×10^{-7}
D21S11	32, 38	1.400×10^{-5}
TPOX	6, 11	1.564×10^{-2}
VWA	15, 21	3.772×10^{-4}
D3S1358	17, 17	4.170×10^{-2}
D5S818	7, 15	4.028×10^{-5}
D7S820	9, 11	5.727×10^{-2}

Table 1. The table shows the victim's genotype for each of the 13 STR loci and the probability of having that genotype.

Answer the following questions.

1. Multiply the probabilities of each genotype to get the probability of a person in the United States having this exact genetic profile.

2. The population of the United States in 2006 was about 298.4 million (2.98×10^8). Based on this information, explain why the medical examiner was confident in telling the victim's family that the recovered remains were those of their son.

3. If DNA from John Doe's toothbrush had not been available, positive identifications could also have been made by comparing the victim's DNA profile with that of a presumed parent, sibling, and/or other blood relative. Explain why such a comparison could work.

4. Not all STR alleles have a regular, repeating pattern. For example, one of the FGA alleles present in the profile is designated 16.2, which indicates an irregular structure. The structure of FGA is more complex than that of some of the other STRs. Instead of a simple repeat unit, it consists of the following structure: $[TTTC]_3$ TTTT TTCT $[CTTT]_n$ CTCC $[TTCC]_2$, where n is a variable number of repeats. An FGA allele with a whole number designation, such as allele 16, will follow this pattern exactly and only vary in the number of variable repeats. Irregular alleles, such as 16.2, will deviate from this pattern.

Compare the structures of alleles 16 and 16.2 below:
Allele 16: $[TTTC]_3$ TTTT TTCT $[CTTT]_8$ CTCC $[TTCC]_2$
Allele 16.2: $[TTTC]_3$ TTTT TT $[CTTT]_9$ CTCC $[TTCC]_2$

a. What are the differences between the two alleles?

b. How do you think these differences arose?