1. 2005

ANNUAL REPORT SUMMARY FOR TESTING IN 2006
Prepared by the Relationship Testing Standards and Accreditation Program Units

PREFACE

The 2006 Annual Report includes respondents from accredited laboratories in the United States, Canada and Europe. Many of the laboratories report testing a broad range of cases, including relationship tests for routine paternity testing, immigration, as well as prenatal and postmortem evaluations. Almost all of the laboratories responding to the survey performed immigration testing and reconstruction (family study) cases. Two of the reporting laboratories indicated that they sent their cases to other laboratories for testing and, as such, the data presented here are from the remaining laboratories that performed the testing.

In this report, AABB provides some commentary for laymen on common misconceptions in paternity testing. Some of the commentary is from the previous year's report, as the commentary remains relevant to issues raised this year.

On January 1, 2008, the 8th edition of *Standards for Relationship Testing Laboratories* went into effect. The Relationship Testing Standards Program Unit would also like to remind readers that the *Guidance for Standards for Relationship Testing Laboratories,* published in 2008, discusses the *Standards* in detail and provides suggestions on how to comply with the standards and contains explanations of the requirements, the various types of calculations used, and addresses other issues in relationship testing.

ANNUAL VOLUME OF TESTING

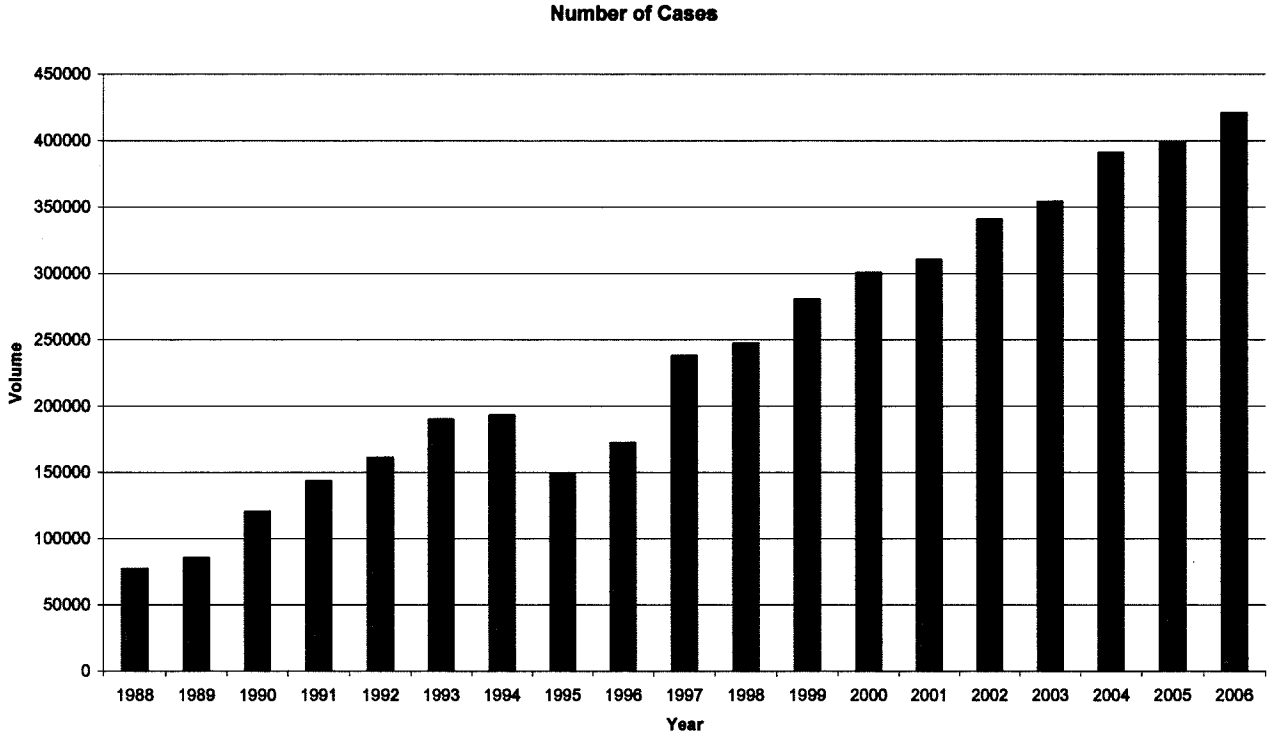
The volume reported for cases tested in 2006 was 420,740. Note that, for some laboratories, only the total number of cases reported is available. The statistics in this report therefore are based on a smaller number of laboratories, as indicated above. The total volume of cases represents an increase of 21,860 cases (or 5.48% increase) from the 2005 volume. A summary of the totals of all years since 1988 is shown in Table 1 and Figure 1.

Table 1. The Number of Relationship Cases Reported for 1988-2006.

Year	No. of Cases	Year	No. of Cases
1988	77000	1998	247317
1989	85231	1999	280510
1990	120436	2000	300626

1991	143459	2001	310490
1992	161000	2002	340798
1993	189904	2003	354011
1994	193000	2004	390928
1995	149100	2005	398880
1996	172316	2006	420740
1997	237981		

Figure 1. Graph of the Case Volume for 1988-2006.



In this report, laboratories were asked if they were testing cases where the chain of custody did not meet the requirements of the *Standards for Relationship Testing*. These so-called "non-legal" tests are generally collected by the individuals being tested, and are not "witnessed by a competent person with no interest in the test outcome" (as required by standard 5.2.2 in the *Standards for Relationship Testing Laboratories,* 8th edition.)

The *Standards* does not prohibit accredited laboratories from performing these types of tests, but because "non-legal" tests do not meet the requirements of *Standards,* laboratories cannot claim or advertise that their "non-legal" testing is encompassed by their AABB accreditation – regardless of whether the testing of the samples conforms to *Standards*. Particularly in relationship testing, the quality of the results depends on the testing just as much as it does on the integrity of the sample collection process. Of the laboratories reporting, over half (53%) reported that they performed "non-legal" testing. Those laboratories reported 19,582 non-legal cases or 5.55% of the total cases reported. Some

laboratories did not track the number of non-legal cases they evaluated, but it seems appropriate to estimate that no more than 10% of all cases were of a "non-legal" type.

Note that during 2007, the Department of Homeland Security, United States Citizenship and Immigration Service (USCIS) met with the committee to discuss this and other issues. Because the sample collection in "non-legal" tests is not controlled, there is the potential for fraud. Accordingly, "non-legal" testing is not acceptable for immigration purposes.

LABORATORIES BY SIZE

Table 2 indicates the size of the various responding laboratories by volume of cases reported. Note that this breakdown reflects individual laboratories, but that a single corporation may own several laboratories. There appears to be a decrease in the number of laboratories reporting 1-500 cases per year.

Table 2. Laboratories by the Volume of Cases Reported.

Case Volumes	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
1-500	40	26	25	20	19	19	13	17	14	18	16	16	8
501-1,000	6	4	8	7	6	5	6	6	2	3	2	4	3
1,001-5,000	7	9	6	10	11	9	11	11	13	11	7	8	8
5,001-10,000	6	4	3	5	0	3	3	5	1	3	7	7	5
10,001-50,000	1	2	3	5	5	7	8	6	7	7	6	5	5
50,001 – 100,000	2	1	1	1	2	1	1	1	0	0	1	1	0
>100,000	0	0	0	0	0	0	0	0	1	1	1	1	1
Total Laboratories	62	46	46	48	43	44	42	46	38	43	40	42	30

EXCLUSION RATE

In 2006, two laboratories did not track the number of exclusions. For the laboratories tracking exclusions, there were 347,719 cases completed, and 89,890 of those (25.85%) were reported as exclusions. The average exclusion rate for the laboratories reporting exclusions is 23.13% with a standard deviation of 5.64. The median exclusion rate is 25.06% with a range of 10.99% to 31.83%. The explanation for the range of exclusion rates is complex but appears to be related to the laboratory's volume and client base. Anecdotal explanations for the various exclusion rates include differences with the type of case (private verses public contracts), and the geographic source of the case (rural versus

metropolitan areas). For the non-legal testing laboratories, there were 4,579 exclusions from laboratories reporting exclusion data (total of 15,082 cases) or an exclusion rate of 30.36%, a higher percentage than the 26% seen for legal testing. The range for non-legal laboratories is 10.99 to 35.04%.

MISCONCEPTIONS IN PATERNITY TESTING – EXCLUSION RATE

AABB has seen the exclusion rate misused by several organizations trying to claim that 30% of men are misled into believing they are biological fathers of children. This claim is incorrect. The exclusion rate includes a number of factors. One is that a case may include several men as alleged fathers because the mother was sexually active with these individuals. These are not men who were misled into believing they were fathers and then later discover they are not. The testing merely determines which man is the likely biological father while excluding the others. Another factor is that the unexcluded alleged father, as part of his defense, may allege that the mother had multiple sexual partners during the time of conception. These other men are subsequently tested. Sometimes testing of a man is required because of a legal presumption. This is when the mother properly names the correct biological father but because the child is the product of a marriage (for example, the mother was married to someone other than the biological father at the time of conception) there is a legal presumption that the husband is the father. The husband is then tested to rebut the legal presumption even though no one believes he is the biological father of the child. There is no evidence that a large number of the men excluded in the testing were misled into believing they are the biological father of a given child.

COMBINED PATERNITY INDEX

The laboratories were asked to indicate what combined paternity index (CPI) they considered acceptable for cases with a standard trio (mother, child, father), single parent cases (mother, or father, not tested cases), and reconstruction cases (disputed parent is missing and other relatives are used to evaluate parentage). Some laboratories reported using different CPIs for different classes of clients (private verses public contracts, or for different technologies). For these laboratories, the higher CPI was used for this report.

The results for the laboratories that responded are shown in Table 3. The most common minimum CPI for a standard trio is 100, with 55% of laboratories using this value, with a range of 100 to 100,000. For cases where the mother is not tested, the most common minimum CPI is 100 with 62% of laboratories using this value, with a range of 100 to 10,000. For the family study or reconstruction cases, 58% indicated that they report "whatever was obtained" and 81% considered a combined paternity index of 101 or less reportable. For sibling studies about 90% of the laboratories considered a combined paternity index of 101 or less reportable.

A common issue is the significance of the paternity index and the reliability of the AABB standard requiring a CPI of 100 to 1. At least one laboratory has claimed that AABB is only concerned about how the testing is performed, but not the meaning of the test. In fact, the Relationship Testing Standards Program Unit is concerned about the meaning of the tests and thus chose a CPU of 100 to 1. First and foremost, this level was chosen because it provides reasonable evidence of paternity in a standard case where a trio is tested. Generally, when a laboratory tests a case, if the disputed person is not excluded and does not reach the laboratory's minimum value, additional testing is performed to evaluate this person. This additional testing may result in non-exclusion, exclusion, or inconclusive reports.

Another issue arises with regard to performing other relationship analyses, such as reconstruction cases, trios with genetic anomalies, and samples from exhumations, coroners, and other postmortem testing. Importantly, note that a CPI of less than 100 is not an indicator of no relationship, unless the CPI is 0 (or much less than 1), and may still in fact be a strong indicator of a relationship. Practical difficulties exist with the ability to obtain results from degraded samples, which are typically used in postmortem testing, and in the mathematical analysis of the relationships in reconstruction cases. Understanding this is particularly important for legislators who establish presumption levels based on paternity calculations, and contract administrators, since testing is often performed in conditions that are not ideal. Another important concept is that a laboratory's minimum combined paternity index, which may reflect scientific reality, is not necessarily the laboratory's testing goal or median combined paternity index.

Table 3. The Number of Laboratories Using Various Minimum Combined Likelihood Ratios for Standard Trios, One Parent (Mother, or father, Not Tested (MNT)) and Reconstruction Cases (Note: not all laboratories indicated a CPI for each type of case).

CPI	Trio	One Parent	Family Study (Reconstruction)	Full Sib	Half Sib
Whatever Is Obtained	0	0	15	12	12
10	0	0	0	3	1
25	0	0	0	0	1
100	16	18	5	2	1
101	0	0	1	0	0
150	1	1	0	0	0
200	2	2	2	1	1
400	0	0	0	0	0
500	2	1	0	0	0
1000	3	3	2	1	0

1001	1	1	0	0	0
2500	2	1	1	0	0
10000	1	2	0	0	0
100000	1	0	0	0	0
Sum	29	29	26	19	16

TESTING WITHOUT THE MOTHER

There is still a strong concern about the apparent increase in the number of clients submitting disputed paternity cases without the mother. Testing without the mother presents a number of problems. First, the paternity index, on average, is cut in half. This also greatly reduces the ability to detect a falsely accused man, and in some cases, such as incest, can easily produce false inclusions. When an apparent inconsistency (mutation) is present, it may not be possible to render an opinion of paternity without obtaining a sample from the mother. Obtaining a sample from the mother is also an important quality control step, because results that exclude the mother may indicate a problem with the testing. The testing of the mother may also allow for the detection of fraud, such as welfare fraud on the part of the mother or cases where the alleged father brings a child he knows is his, but who is not the child of the mother. Thus, the testing of the mother, even if maternity is not disputed, is important in evaluating the questioned relationship, because it improves the chance of obtaining clear results and is a quality control check for both the scientific and legal community. Testing without the mother should only be done when the mother's location is unknown or she is deceased. Every effort should be made to test the mother.

TECHNOLOGY USE

In 2006, the survey showed a continued trend toward the increased use of polymerase chain reaction (PCR) technology (STR analysis) with a decrease in the use of restriction fragment length polymorphism (RFLP) methods. PCR technology was used in 98.53% of reported cases and RFLP was used in 1.12% of reported cases. This is also the first year that no cases were evaluated using serological HLA testing.

Table 4 provides a breakdown of the technology used to resolve the reported paternity cases. The three laboratories using HLA molecular methods were asked to identify the source of the frequencies. Laboratories using HLA molecular for Class I HLA methods reported using serologic tables for calculating paternity indices.

Table 4. The Technology Used in Cases Reported in 2006

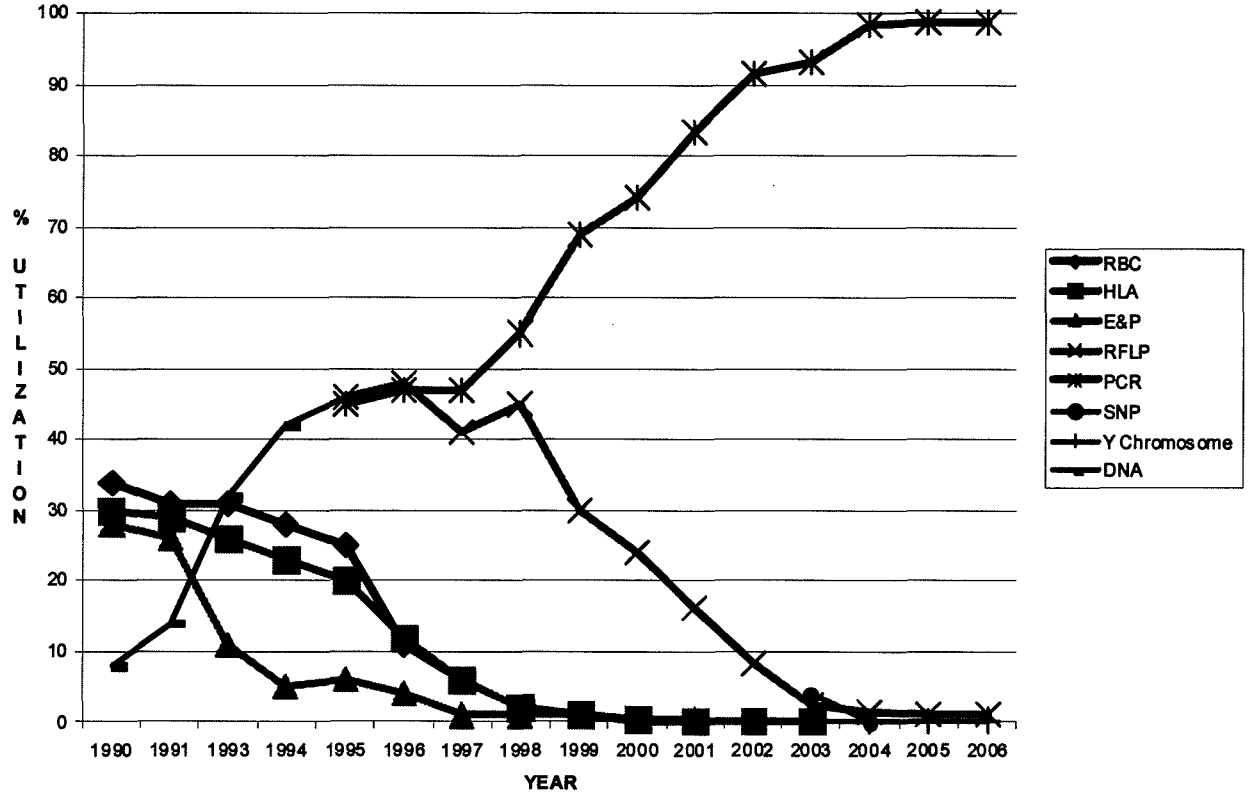
Technology	Number of Cases	Utilization (%)
STR	**344616**	**98.53**

RFLP	**3906**	**1.12**
HLA Class II Molecular	**35**	**0.01**
Y Chromosome	**1079**	**0.31**
HLA Class 1 Molecular	**139**	**0.04**
SNP	**0**	**0**
HLA Serology	**0**	**0**
Red Cell Antigens	**0**	**0**
Red Cell Enzymes/	**0**	**0**
Serum Proteins		
Allotyping	**0**	**0**

*Note that some cases used more than one technology. Not all laboratories responded to this question.

Figure 2 shows the use of various technologies since 1990. As indicated above, the most commonly used technologies in 1990 (red cell antigens, HLA, and red cell enzymes and serum proteins) now account for less than 1% of all casework. The change in DNA technologies from RFLP to PCR technology is also obvious. Prior to 1995, the survey only asked about the use of DNA testing but not about which DNA technology was used (PCR verses RFLP). Note that in some instances, multiple technologies were used in the same case.

Figure 2. The Use of Various Technologies Since 1990.



SAMPLE SOURCE

Laboratories reported approximately 812,177 samples used for the casework in 2006. Not all laboratories reported the samples they used. Of these samples, buccal swabs accounted for 98.05% of the samples. Whole blood samples accounted for .64%. The use of blood spot cards decreased to 1.16% of samples. Various other samples were also reported (See Table 5).

Table 5. Sample Source in 2006

Sample	Number	Percent of Total
Buccal Swabs	812,177	98.0501
Blood	5,278	0.6372
Blood Spot Cards	9,641	1.1639
Amniotic Fluid	693	0.0837

Misc. Tissues	184	0.0222
Paraffin Blocks	10	0.0012
Hair	93	0.0112
CVS	225	0.0272
Products of Conception	15	0.0018
Bone	13	0.0016
Total	828,329	100

AMELOGENIN

The amelogenin locus is now used in a number of laboratories to test for the gender of the sample. A number of males lacking the Y or X amelogenin allele have been observed. Laboratories were asked to measure the apparent X males observed in their laboratory. Like other DNA loci, amelogenin is subject to mutations. Therefore, occasionally normal males have a female amelogenin phenotype or a Y phenotype. The X male phenotype was most commonly seen in the Hispanic populations, in about 1/1392 men. The Y male phenotype was most commonly seen in the Black population in about 1/1688 Black males.

Table 6. A Summary of Data on Apparent X and Y Males Seen with ABI Primers

	Black	**White**	**Hispanic**
Number X Males Observed	**6**	**12**	**16**
%	**0.0099**	**0.0254**	**0.0718**
Number Y Males Observed	**36**	**6**	**4**
%	**0.0592**	**0.0127**	**0.0180**

MUTATION REPORTS

One area of concern is the number of inconsistencies necessary to render an opinion of non-paternity. The laboratories were asked if they had seen any case where, in the opinion of the expert, the inconsistencies were double or triple "mutations" and not sufficient to render an opinion of non-paternity. Twelve laboratories stated they had reported cases with double or triple mutations. Eleven laboratories did not observe any mutations. The

laboratories reported 47 cases with double mutations and no cases with triple mutations as inclusions. Most laboratories report these "double mutation" cases with the inconsistencies noted and statistically considered. This illustrates the importance of accurate assessments of potential mutations and null alleles.

MUTATION CALCULATION AND FREQUENCIES

Single inconsistencies are routinely seen in the testing of paternity cases. If a laboratory comes to the conclusion that the inconsistency is a mutation, then the mutation result must be incorporated into the reported results. Laboratories were asked how they calculated the paternity index (PI) for these loci. The laboratories all appear to be using one of several calculation methods. Some laboratories are using the mutation rate as the PI, while others, most commonly, used the mutation rate divided by the average probability of exclusion. Some laboratories used the mutation rate as a transmission frequency and some of the laboratories used Brenner's method in looking at the repeat length difference between STR alleles.

A summary of the mutation frequencies for each STR locus is provided in Appendix 1. Note that these frequencies incorporate the indeterminate findings. The calculations are summarized at the bottom of the table for each paternal allele as shown in Appendix 2. The frequencies for changes from one allele to another are presented in Appendix 2 Appendix 3.

A continuing objective of this year's report is to begin to collect data on STR loci to provide laboratories with frequencies to use in the mutation calculation. The guidance document for the 7th and 8th edition of standards contains a discussion of two methods that might be useful. One limitation of this data set is if the laboratory did not see any mutations, the laboratory did not provide data on the maternal and paternal meiosis. Many laboratories did not provide any data so the data presented is from a few laboratories.

If one wished to determine the specific mutation frequency at locus D3S1358 for the apparent paternal mutation event of the alleged father's allele 16 changing to an allele 17 in the child. Using the attached table specific calculations could be made. Suppose that are 16 instances where, simply, 16 changed to 17 out of 79247 meiosis reported or a frequency of 0.000202. However there are several other opportunities for this change. If there were five instances where the alleged father's 16 could have changed to either a 15 or 17 (child is a clone of the mother or mother was not tested). To incorporate this data one approach is to calculate the relative chance that the change was 16 to 17 rather than 16 to 15. Note the clear changes and calculate the relative chance of each change. Multiply the relative chance time the number of changes where the allele is 16 to 15 or 17, which is 5 in this data set, to obtain the relative portion attributable to a 16 to 17 change.

Table 6. Relative Chance of allele 16 changing to 15 or 17.

Change	Observed	Relative Chance	Portion of 5
16 to 17	16	16/31 = 0.516	5 * 0.516 = 2.58
16 to 15	15	15/31 = 0.484	5 * 0.484 = 2.42
Total	31	1	5

From this data, add 2.56 to the 16 observed potential changes from 16 to 17 to get the total of 18.56. Similarly, there were seven observations where the alleged father has alleles 16 and 18 either of which could mutate to a 17.

Table 7. Relative Chance of allele 16 or 18 changing 17.

Change	Observed	Relative Chance	Portion of 7
16 to 17	16	16/26 = 0.615	7 * 0.615 = 4.305
18 to 17	10	10/26 = 0.385	7 * 0.385 = 2.695
Total	26	1	5

From this data, add 4.305 to the 18.56 potential changes (paragraph above) from 16 to 17 to get the total of 22.865.

Hypothetically, there were instances where the father's alleles 16 and 19 could have change to a 17 or 18. To incorporate this data a similar approach is used.

Table 8. Relative Chance of allele 16 or 19 changing to 17 or 18.

Change	Observed	Relative Chance	Portion of 1
16 to 17	16	16/21 = 0.762	1 * 0.762 = 0.762
16 to 18	0	0/21 = 0	1*0 = 0
19 to 17	0	0/21 = 0	1*0 = 0
19 to 18	5	5/21 = 0.238	1* 0.238 = 0.238
Total	31	1	1

From this data, add 0.762 to the 22.865 above yielding 23.627.

Lastly, data from those cases where the mutation is either maternal or paternal may be incorporated (indeterminate). Hypothetically there were 7 instances where the mutation to a 17 could have been from a paternal 16. The approach to incorporate these data is similar to the above. First look to the data to determine the frequency of the changes.

Table 9. Relative Chance of allele 16 changing to 17.

Change	Observed	Relative Chance	Portion of 7

16 to 17 Maternal	1 / 67521 = 1.481e-5	1.481e-5/ 2.167e-4 = 0.0683	7 * 0.0683 = 0.478
16 to 17 Paternal	16 / 79247 = 2.019e-4	2.019e-4/ 2.167e-4 = 0.9317	7 * 0.9317 = 6.522
Total	2.167e-4	1	7

Finally add 6.522 to the 23.627 yielding 30.149. Thus for this hypothetical population the frequency of paternal mutation from a 16 to a 17 is 30.149/ 79247 = 0.00038 as compared to the 0.000202 without incorporating all possible mutation events. The committee invites comments on alternative methods of determining the mutation frequencies.

Appendix 1. Summary of Apparent Mutations at various Loci analyzed by PCR in 2006.

	Caucasian		Black		Hispanic	
	Paternal	Maternal	Paternal	Maternal	Paternal	Maternal
D8S1179	0.0024079	0.0002582	0.0027566	0.0004389	0.0021734	0.0005536
D21S11	0.0018992	0.0015278	0.0020646	0.0016688	0.0016599	0.0021119
D7S820	0.0019085	0.0001861	0.0014712	0.0002058	0.0017771	0.0001206
CSF1PO	0.0022249	0.0003272	0.0025281	0.0003962	0.0022446	0.0006719
D3S1358	0.0023268	0.0002622	0.0022779	0.0002555	0.0019073	0.0001514
THO1	0.0000676	0.0000785	0.0000818	0.0001146	<0.0000570	0.0000445
D13S317	0.0021998	0.0001748	0.0023244	0.0007426	0.0016911	0.0003627
D16S539	0.0021727	0.0003588	0.0019858	0.0005468	0.0012631	0.0003971
D2S1338	0.0022049	0.0003617	0.0015539	0.0004469	0.0014671	0.0012259
D19S453	0.0017659	0.0004243	0.0020252	0.0007177	0.0011208	<0.0002909
VWA	0.0044028	0.0004994	0.0036031	0.0006894	0.0026509	0.0003165
TPOX	0.0001878	0.0000702	0.0001548	0.0001012	0.0001143	<0.0000539
D18S51	0.0023140	0.0007041	0.0044855	0.0008289	0.0019579	0.0008343
D5S818	0.0021447	0.0003833	0.0023605	0.0003969	0.0019594	0.0002712
FGA	0.0038970	0.0007061	0.0039352	0.0008705	0.0041331	0.0008344

Appendix 2. Paternal & Maternal Mutation Data

CSF Paternal Mutations

Paternal Mutation – Allele:		Caucasian		Black		Hispanic		American Indian	Asian (Oriental)
From	To	Number	Frequency	Number	Frequency	Number	Frequency		
7	8								
7	9			1	0.0000229				
8	9								
9	8	1	0.0000279						
9	10			2	0.0000458				
10	8								
10	9	1	0.0000279	2	0.0000458	1	0.0000588		
10	11	1	0.0000279	6	0.0001373	4	0.0002354		
11	9					1	0.0000588		
11	10	5	0.0001396	6	0.0001373				1
11	12	4	0.0001117	3	0.0000687	2	0.0001177		2
11	15								
11	10 or 12			2	0.0000458	1	0.0000588		
12	10			1	0.0000229				
12	11	1	0.0000279	10	0.0002289	3	0.0001765		
12	13	11	0.0003072	18	0.0004120	6	0.0003531		1
12	11 or 13	2	0.0000558		0.0000000				
13	12	6	0.0001675	15	0.0003434	1	0.0000588		
13	14	4	0.0001117	6	0.0001373	1	0.0000588		
13	12 or 14	1	0.0000279						
14	13	5	0.0001396	2	0.0000458	2	0.0001177		1
14	15	1	0.0000279						
15	14	3	0.0000838			2	0.0001177		
10 or 11	9 or 12								

10 or 12	11	4	0.0001117	1	0.0000229	2	0.0001177		
10 or 12	11 or 13	1	0.0000279						
10 or 12	9 or 11			1	0.0000229				
10 or 13	11 or 12	1	0.0000279	1	0.0000229				
10 or 13	9 or 12			1	0.0000229				
11 or 12	10 or 13	1	0.0000279						
11 or 13	12	4	0.0001117	4	0.0000916				
11 or 13	10 or 12	1	0.0000279						
12 or 14	13	2	0.0000558	2	0.0000458				
9 or 11	10								
	Sum	60	0.0016754	84	0.0019228	26	0.0015300		5
Total Paternal Meiosis by Race		35,812		43,686		16,993			229
Paternal Frequency		0.0016754		0.0019228		0.0015300			0.0218341
Maternal Frequency		0.0002464		0.0003013		0.0004580			
Sum		0.0019218		0.0022241		0.0019881			
Relative Frequency Paternal		0.8717879		0.8645264		0.7696148			
Relative Frequency Maternal		0.1282121		0.1354736		0.2303852			
Indeterminate		0.0006303		0.0007001		0.0009284			
Frequency Paternal Indeterminate		0.0005495		0.0006053		0.0007145			
Frequency Maternal Indeterminate		0.0000808		0.0000948		0.0002139			
Total Paternal Mutation Frequency		0.0022249		0.0025281		0.0022446			
Total Maternal Mutation Frequency		0.0003272		0.0003962		0.0006719			

CSF Maternal Mutations

Maternal Mutation – Allele:		Caucasian		Black		Hispanic		American Indian	Asian (Oriental)
From	To	Number	Frequency	Number	Frequency	Number	Frequency		
7	8								
8	9			1	0.0000215				
9	10								
10	8								
10	8			1	0.0000215				
10	9	1	0.0000224	1	0.0000215				
10	11								1
11	10	1	0.0000224	1	0.0000215				
11	12	1	v	2	0.0000430				
11	15								
11	10 or 12								
12	11	2	0.0000448	1	0.0000215				1
12	13	3	0.0000672	3	0.0000646	2	0.0001018		
12	14					1	0.0000509		
12	11 or 13	1	0.0000224						
13	12			1	0.0000215	1	0.0000509		
13	14	1	0.0000224			1	0.0000509		
14	13					1	0.0000509		
14	15								1
15	16	1	0.0000224						
10 or 11	9 or 12								
10 or 12	11					1	0.0000509		
10 or 12	11 or 13					1	0.0000509		
10 or 12	9 or 11								
10 or 12	9 or 13					1	0.0000509		

11 or 12	10 or 13			1	0.0000215				
11 or 13	12			2	0.0000430				
11 or 13	10 or 12								
12 or 14	13								
9 or 11	10								
	sum	11	0.0002464	14	0.0003013	9	0.0004580		3
Total Maternal Meiosis by Race		44,642		46,464		19,650			498
	Freq	0.0002464		0.0003013		0.0004580			0.0060241

D2S1338 Paternal Mutations

Paternal Mutation – Allele:		Caucasian		Black		Hispanic		American Indian	Asian (Oriental)
From	To	Number	Frequency	Number	Frequency	Number	Frequency		
16	17			2	0.0000914				
17	16			1	0.0000457				
17	18	4	0.0002125						
17	20			1	0.0000457				
18	17			1	0.0000457				
18	19			1	0.0000457				
18	17 or 19								
19	17	1	0.0000531						
19	18	2	0.0001062						
19	20			2	0.0000914	1	0.0002934		
20	19								
20	21	1	0.0000531	1	0.0000457	1	0.0002934		1
21	20			1	0.0000457				
21	22	1	0.0000531	3	0.0001371	1	0.0002934		

22	21	2	0.0001062	1	0.0000457				
22	23	2	0.0001062	3	0.0001371				1
23	22	2	0.0001062	2	0.0000914	1	0.0002934		1
23	24	4	0.0002125						
23	25								
24	23	3	0.0001593						
24	25	2	0.0001062						
24	26			1	0.0000457				
25	24	5	0.0002656	5	0.0002285				1
25	26	2	0.0001062	2	0.0000914	1	0.0002934		
26	25	2	0.0001062	5	0.0002285				
26	27	3	0.0001593						1
27	26			2	0.0000914				
20 or 24	19 or 23								
21 or 23	22								
23 or 25	24								
23 or 25	24								
	Sum	36	0.0019121	34	0.0015539	5	0.0014671	0	5
Total Paternal Meiosis by Race		18827		21881		3408			229
Paternal Frequency		0.0019121		0.0015539		0.0014671			0.0218341
Maternal Frequency		0.0003137		0.0004469		0.0012259			
Sum		0.0022258		0.0020008		0.0026930			
Relative Frequency Paternal		0.8590726		0.7766339		0.5447958			
Relative Frequency Maternal		0.1409274		0.2233661		0.4552042			
Indeterminate		0.0003408		0.0000000		0.0000000			
Frequency Paternal Indeterminate		0.0002928		0.0000000		0.0000000			

Frequency Maternal Indeterminate	0.0000480		0.0000000		0.0000000			
Total Paternal Mutation Frequency	0.0022049		0.0015539		0.0014671			
Total Maternal Mutation Frequency	0.0003617		0.0004469		0.0012259			

D2S1338 Maternal Mutations

Maternal Mutation – Allele:		Caucasian		Black		Hispanic		American Indian	Asian (Oriental)
From	To	Number	Frequency	Number	Frequency	Number	Frequency		
17	16					1	0.0003065		
17	18	1	0.0000627			1	0.0003065		
18	19	1	0.0000627	1	0.0000559				
18	22			1	0.0000559				
18	17 or 19								
19	18								
19	20			1	0.0000559				
20	19								
20	21								
21	20								
21	22			1	0.0000559	1	0.0003065		
22	21	1	0.0000627	1	0.0000559				
22	23			1	0.0000559				
23	22								
23	24								
23	25								
24	23	1	0.0000627	2	0.0001117				
24	25	1	0.0000627						
25	24								

25	26					1	0.0003065		
26	25								
27	26								
20 or 24	19 or 23								
21 or 23	22								
23 or 25	24								
23 or 25	24								
	Sum	5	0.0003137	8	0.0004469	4	0.0012259		
Total Maternal Meiosis by Race		15940		17901		3263			
	Frequency	0.00031368		0.0004469		0.00122587			

D3S1358 Paternal Mutations

Paternal Mutation – Allele:		Caucasian		Black		Hispanic		American Indian	Asian (Oriental)
From	To	Number	Frequency	Number	Frequency	Number	Frequency		
11	12	1	0.0000187						
14	15	3	0.0000561	3	0.0000440				
15	12								
15	13					1	0.0000425		
15	14	2	0.0000374	6	0.0000880	1	0.0000425		
15	16	6	0.0001122	7	0.0001027	3	0.0001275		
15	14 or 16								
15.2	16.2			1	0.0000147				
16	15	5	0.0000935	7	0.0001027	3	0.0001275		
16	17	9	0.0001683	11	0.0001613	2	0.0000850		1
16	15 or 17			1	0.0000147				
17	15								

17	16	11	0.0002057	20	0.0002934	1	0.0000425		
17	18	9	0.0001683	18	0.0002640	7	0.0002976		1
17	19			2	0.0000293				
17	16 or 18								
18	17	13	0.0002431	8	0.0001173	4	0.0001701		2
18	19	10	0.0001870	8	0.0001173	3	0.0001275		1
18	16 or 17								
19	18	11	0.0002057	2	0.0000293				
19	20								
20	19	2	0.0000374	2	0.0000293				
20	21								
22	23					1	0.0000425		
23	22	1	0.0000187						
14 or 16	15	1	0.0000187	1	0.0000147				
14 or 17	15 or 16			3	0.0000440				
15 or 16	14 or 17			1	0.0000147				
15 or 17	16	1	0.0000187	5	0.0000733	1	0.0000425		
15 or 17	14 or 16								
15 or 17	16 or 18	1	0.0000187						
15 or 18	16 or 17			1	0.0000147	1	0.0000425		
15 or 19	14 or 18			1	0.0000147				
15 or 19	16 or 18	1	0.0000187						
16 or 17	15 or 18	1	0.0000187						
16 or 18	17	4	0.0000748	5	0.0000733	2	0.0000850		
16 or 19	15 or 18					1	0.0000425		
16 or 19	17 or 18								
17 or 18	16								
17 or 19	18								
	Sum	92	0.0017201	113	0.0016575	31	0.0013180		5

Total Paternal Meiosis by Race	53,486		68,176		23,521			229
Paternal Frequency	0.0017201		0.0016575		0.0013180			0.0218341
Maternal Frequency	0.0001938		0.0001859		0.0001046			
Sum	0.0019139		0.0018434		0.0014226			
Relative Frequency Paternal	0.8987395		0.8991524		0.9264712			
Relative Frequency Maternal	0.1012605		0.1008476		0.0735288			
Indeterminate	0.0006751		0.0006900		0.0006361			
Frequency Paternal Indeterminate	0.0006067		0.0006204		0.0005893			
Frequency Maternal Indeterminate	0.0000684		0.0000696		0.0000468			
Total Paternal Mutation Frequency	0.0023268		0.0022779		0.0019073			
Total Maternal Mutation Frequency	0.0002622		0.0002555		0.0001514			

D3S1358 Maternal Mutations

Maternal Mutation – Allele:		Caucasian		Black		Hispanic		American Indian	Asian (Oriental)
From	To	Number	Frequency	Number	Frequency	Number	Frequency		
12	14	1	0.0000194						
14	15								
15	12								
15	14								
15	16								

15	14 or 16								
16	14			1	0.0000169				
16	15	1	0.0000194	2	0.0000338	1	0.0000523		
16	17			1	0.0000169	1	0.0000523		
16	15 or 17								
17	15								
17	16	2	0.0000388	2	0.0000338				
17	18	2	0.0000388						
17	19								
17	16 or 18								
18	17	2	0.0000388						
18	19								
18	16 or 17								
19	18	1	0.0000194						
19	20								
20	19								
20	21								
14 or 16	15								
14 or 17	15 or 16								
15 or 17	16			1	0.0000169				
15 or 17	14 or 16								
15 or 19	16 or 18								
16 or 17	15 or 18								
16 or 18	17	1	0.0000194	2	0.0000338				
16 or 18	15 or 17			1	0.0000169				
16 or 19	17 or 18								
17 or 18	16			1	0.0000169				
17 or 19	18								
	Sum	10	0.0001938	11	0.0001859	2	0.0001046		

Total Maternal Meiosis by Race Trios Only		51,611		59,157		19,126			
	Frequency	0.0001938		0.0001859		0.0001046			

D5S818 Paternal Mutations

Paternal Mutation – Allele:		Caucasian		Black		Hispanic		American Indian	Asian (Oriental)
From	To	Number	Frequency	Number	Frequency	Number	Frequency		
9	10								
10	11	2	0.0000516	1	0.0000208				
11	10	1	0.0000258	3	0.0000623				
11	12	5	0.0001291	7	0.0001455	3	0.0001682		1
11	13	5	0.0001291						
11	9					1	0.0000561		
12	10								
12	11	1	0.0000258	6	0.0001247	1	0.0000561		
12	13	12	0.0003098	17	0.0003533	1	0.0000561		
12	10 or 11								
12	11 or 13								
13	12	8	0.0002065	6	0.0001247	1	0.0000561		
13	14	7	0.0001807	19	0.0003949	7	0.0003925		1
13	12 or 14			1	0.0000208				
14	13	11	0.0002840	11	0.0002286	3	0.0001682		
14	15			2	0.0000416				
15	14								
17	18								
10 or 12	11					1	0.0000561		
10 or 13	11 or 12			1	0.0000208				

10 or 14	9 or 13								
11 or 12	13 or 14								
11 or 13	12	2	0.0000516	9	0.0001870				
11 or 13	12 or 14			1	0.0000208				
11 or 14	12 or 15			1	0.0000208				
11 or 14	12 or 13					1	0.0000561		
12 or 14	13	2	0.0000516	3	0.0000623	1	0.0000561		1
12 or 14	11 or 13	1	0.0000258						
9 or 11	10								
	Sum	57	0.0014715	88	0.0018288	20	0.0011213	0	3
Total Paternal Meiosis by Race		38,736		48,119		17,836			581
Paternal Frequency		0.0014715		0.0018288		0.0011213			0.0051635
Maternal Frequency		0.0002630		0.0003075		0.0001552			
Sum		0.0017345		0.0021363		0.0012765			
Relative Frequency Paternal		0.8483712		0.8560507		0.8784097			
Relative Frequency Maternal		0.1516288		0.1439493		0.1215903			
Indeterminate		0.0007935		0.0006211		0.0009541			
Frequency Paternal Indeterminate		0.0006732		0.0005317		0.0008381			
Frequency Maternal Indeterminate		0.0001203		0.0000894		0.0001160			
Total Paternal Mutation Frequency		0.0021447		0.0023605		0.0019594			
Total Maternal Mutation Frequency		0.0003833		0.0003969		0.0002712			

D5S818 Maternal Mutations

Maternal Mutation – Allele:		Caucasian		Black		Hispanic		American Indian	Asian (Oriental)
From	To	Number	Frequency	Number	Frequency	Number	Frequency		
9	10								
10	11								
11	10	2	0.0000405						
11	12	1	0.0000202	2	0.0000410				
11	13								
11	13					1	0.0000517		
12	10								
12	11	3	0.0000607	1	0.0000205				
12	13			4	0.0000820	1	0.0000517		
12	10 or 11								
12	11 or 13								
13	12	1	0.0000202	1	0.0000205				
13	14	2	0.0000405	3	0.0000615				1
13	12 or 14			1	0.0000205				
14	13			1	0.0000205				
14	15	1	0.0000202	1	0.0000205				
15	14	2	0.0000405						
17	18								
10 or 12	11								
10 or 14	9 or 13								
11 or 12	13 or 14								
11 or 13	12	1	0.0000202	1	0.0000205	1	0.0000517		
12 or 14	13								
12 or 14	11 or 13								
9 or 11	10								

	Sum	13	0.0002630	15	0.0003075	3	0.0001552	0	1
Total Maternal Meiosis by Race		49,428		48,777		19,328			234
	Frequency	0.0002630		0.0003075		0.0001552			0.0042735

D7S820 Paternal Mutations

Paternal Mutation – Allele:		Caucasian		Black		Hispanic		American Indian	Asian (Oriental)
From	To	Number	Frequency	Number	Frequency	Number	Frequency	Number	Number
7	6								
7	8			1	0.0000212				
8	7			1	0.0000212				
8	9			2	0.0000423				
9	8			3	0.0000635	1	0.0000515		
9	10	2	0.0000527	1	0.0000212	1	0.0000515		
10	9								
10	11	4	0.0001054	5	0.0001058	2	0.0001030		1
11	10	1	0.0000263	2	0.0000423	2	0.0001030		1
11	12	7	0.0001844	8	0.0001693	1	0.0000515		
11	12 or 13								
12	11	9	0.0002371	3	0.0000635	2	0.0001030		
12	11.3			1	0.0000212				
12	13	2	0.0000527	7	0.0001482	6	0.0003089		
12	11 or 13					1	0.0000515		
13	12	10	0.0002635	6	0.0001270	6	0.0003089		1
13	14	5	0.0001317	1	0.0000212				
14	13	5	0.0001317	6	0.0001270	3	0.0001545	1	
14	15								

15	14			1	0.0000212				
10 or 12	11			1	0.0000212	2	0.0001030		
10 or 12	11 or 13	1	0.0000263						
10 or 12	9 or 11								
10 or 12	9 or 13								
10 or 13	11 or 12								
10 or 13	11 or 12			1	0.0000212				
11 or 13	12	4	0.0001054			1	0.0000515		
11 or 13	10 or 12			1	0.0000212	1	0.0000515		
11 or 14	10 or 15	1	0.0000263						
12 or 14	13								
8 or 10	9			2	0.0000423				
8 or 11	9 or 10			1	0.0000212				
8 or 11	9 or 12	1	0.0000263						
8 or 12	9 or 11			1	0.0000212				
9 or 11	10	2	0.0000527	2	0.0000423	2	0.0001030		
9 or 12	10 or 11								
9 or 12	10 or 13	1	0.0000263						
9 or 13	10 or 12								
	Sum	55	0.0014490	57	0.0012065	31	0.0015961	1	3
Total Paternal Meiosis by Race		37,957		47,244		19,422		352	229
Paternal Frequency		0.0014490		0.0012065		0.0015961		0.0028409	0.0131004
Maternal Frequency		0.0001413		0.0001688		0.0001083			
Sum		0.0015903		0.0013753		0.0017044			
Relative Frequency Paternal		0.9111493		0.8772634		0.9364596			
Relative Frequency Maternal		0.0888507		0.1227366		0.0635404			

Indeterminate	0.0005043		0.0003017		0.0001932			
Frequency Paternal Indeterminate	0.0004595		0.0002647		0.0001809			
Frequency Maternal Indeterminate	0.0000448		0.0000370		0.0000123			
Total Paternal Mutation Frequency	0.0019085		0.0014712		0.0017771			
Total Maternal Mutation Frequency	0.0001861		0.0002058		0.0001206			

D7S820 Maternal Mutations

Maternal Mutation – Allele:		Caucasian		Black		Hispanic		American Indian	Asian (Oriental)
From	To	Number	Frequency	Number	Frequency	Number	Frequency		
7	6								
8	7								
8	9								
9	8								
9	10								
10	9	1	0.0000202	1	0.0000211				
10	11	1	0.0000202	1	0.0000211				
10.1	9.1			1	0.0000211				
11	10			1	0.0000211				
11	12			1	0.0000211				1
11	12 or 13								
12	11								
12	13	1	0.0000202						
13	12								

13	14	1	0.0000202						
14	13	1	0.0000202						
14	15	1	0.0000202						
10 or 12	11								
10 or 12	9 or 11								
10 or 12	9 or 13								
10 or 13	11 or 12								
11 or 13	12			1	0.0000211	1	0.0000541		
12 or 14	13								
8 or 11	9 or 10			1	0.0000211				
9 or 10	8 or 11			1	0.0000211				
9 or 11	10								
9 or 11	8 or 10					1	0.0000541		
9 or 12	10 or 11								
9 or 13	10 or 12								
9 or 13	8 or 12	1	0.0000202						
	Sum	7	0.0001413	8	0.0001688	2	0.0001083	0	1
Total Maternal Meiosis by Race		49,530		47,391		18,469			264
	Frequency	0.0001413		0.0001688		0.0001083			0.0037879

D8S1179 Paternal Mutations

Paternal Mutation – Allele:		Caucasian		Black		Hispanic		American Indian	Asian (Oriental)
From	To	Number	Frequency	Number	Frequency	Number	Frequency		
9	10								
10	11	2	0.0000370	2	0.0000291	1	0.0000411		1
11	7								

11	9					1	0.0000411		
11	10			1	0.0000145				
11	12	4	0.0000740	4	0.0000581				
12	11	1	0.0000185			1	0.0000411		
12	13	12	0.0002221	3	0.0000436	2	0.0000823		
12	11 or 13			1	0.0000145				
13	12	8	0.0001481	7	0.0001018	1	0.0000411		1
13	14	7	0.0001296	8	0.0001163	2	0.0000823		2
13	15								
13	12 or 14	3	0.0000555						
14	11			1	0.0000145				
14	13	15	0.0002776	11	0.0001599	4	0.0001646		1
14	15	12	0.0002221	20	0.0002907	4	0.0001646	1	
14	13 or 15					1	0.0000411		
15	14	11	0.0002036	21	0.0003053	2	0.0000823		1
15	16	6	0.0001111	25	0.0003634	4	0.0001646		
15	14 or 16					1	0.0000411		
16	15	11	0.0002036	10	0.0001454	5	0.0002057		
16	17	1	0.0000185	6	0.0000872	1	0.0000411		
16	18								
16	15 or 17								
17	16	5	0.0000925	5	0.0000727	1	0.0000411		
17	18	2	0.0000370						
18	16			1	0.0000145				
18	17	1	0.0000185	2	0.0000291	1	0.0000411		
18	19					1	0.0000411		
19	20			1	0.0000145				
10 or 12	11								
10 or 13	11 or 14								
11 or 13	12								
11 or 13	10 or 12								

11 or 13	12 or 14			1	0.0000145				
12 or 13	11 or 14								
12 or 14	13	1	0.0000185	6	0.0000872	1	0.0000411		
12 or 14	11 or 13								
12 or 14	13 or 15			1	0.0000145				
12 or 15	13 or 14								
12 or 18	13 or 17					1	0.0000411		
13 or 14	15								
13 or 14	12 or 15			2	0.0000291				
13 or 15	14	4	0.0000740	7	0.0001018	2	0.0000823		
13 or 15	12 or 14								
13 or 15	14 or 16			1	0.0000145				
13 or 16	12 or 17								
13 or 16	14 or 15								
14 or 16	15			3	0.0000436	1	0.0000411		
14 or 16	13 or 15								
15 or 16	14 or 17			1	0.0000145				
15 or 17	16			2	0.0000291				
15 or 18	14 or 17								
	Sum	106	0.0019619	153	0.0022240	38	0.0015633	1	6
Total Paternal Meiosis by Race		54,028		68,796		24,308			229
Paternal Frequency		0.0019619		0.0022240		0.0015633			0.02620087
Maternal Frequency		0.0002104		0.0003541		0.0003982			
Sum		0.0021723		0.0025781		0.0019615			
Relative Frequency Paternal		0.9031462		0.8626490		0.7969891			

Relative Frequency Maternal	0.0968538		0.1373510		0.2030109			
Indeterminate	0.0004938		0.0006174		0.0007656			
Frequency Paternal Indeterminate	0.0004460		0.0005326		0.0006102			
Frequency Maternal Indeterminate	0.0000478		0.0000848		0.0001554			
Total Paternal Mutation Frequency	0.0024079		0.0027566		0.0021734			
Total Maternal Mutation Frequency	0.0002582		0.0004389		0.0005536			

D8S1179 Maternal Mutations

Maternal Mutation – Allele:		Caucasian		Black		Hispanic		American Indian	Asian (Oriental)
From	To	Number	Frequency	Number	Frequency	Number	Frequency		
9	10								
10	11	2	0.0000301			1	0.0000498		
11	7								
11	10	1	0.0000150						
11	12	1	0.0000150	1	0.0000169				
12	11			1	0.0000169				
12	13	1	0.0000150	2	0.0000337	2	0.0000996		
12	11 or 13								
13	12			1	0.0000169	1	0.0000498		
13	14	1	0.0000150	2	0.0000337	3	0.0001493		
13	15								
13	12 or 14								

14	13	3	0.0000451	4	0.0000675	1	0.0000498		
14	15	1	0.0000150	2	0.0000337				
14	13 or 15								
15	14	2	0.0000301	2	0.0000337				
15	16			2	0.0000337				
16	15			3	0.0000506				
16	17								
16	18								
16	15 or 17								
17	16								
17	18								
18	17			1	0.0000169				
10 or 12	11								
10 or 13	11 or 14								
11 or 13	12								
11 or 13	10 or 12								
12 or 13	11 or 14								
12 or 14	13								
12 or 14	11 or 13								
12 or 15	13 or 14								
13 or 14	15								
13 or 14	12 or 15								
13 or 15	14	1	0.0000150						
13 or 15	12 or 14								
13 or 15	14 or 16								
13 or 16	12 or 17								
13 or 16	14 or 15								
13 or 16	14 or 15	1	0.0000150						
14 or 16	15								
14 or 16	13 or 15								
15 or 17	16								

15 or 18	14 or 17								
	Sum	14	0.0002104	21	0.0003541	8	0.0003982		
Total Maternal Meiosis by Race		66,529	66,529	59,299		20,090			
	Frequency	0.0002104		0.0003541		0.0003982			

D13S317 Paternal Mutations

Paternal Mutation – Allele:		Caucasian		Black		Hispanic		American Indian	Asian (Oriental)
From	To	Number	Frequency	Number	Frequency	Number	Frequency		
8	9	1	0.0000245						
9	10			1	0.0000209				
10	8								1
10	9			1	0.0000209	1	0.0000507		
10	11			1	0.0000209				
10	15								
11	9								
11	10	3	0.0000736	2	0.0000418	1	0.0000507		
11	12	6	0.0001472	9	0.0001883	3	0.0001520		
11	15								
11	10 or 12	1	0.0000245						
12	9								
12	11	6	0.0001472	9	0.0001883				
12	13	8	0.0001963	14	0.0002929	4	0.0002027		2
12	11or 13	1	0.0000245	4	0.0000837				
13	12	3	0.0000736	6	0.0001255	1	0.0000507		1
13	14	8	0.0001963	6	0.0001255	6	0.0003040		

13	12 or 14			2	0.0000418				
14	13	10	0.0002453	7	0.0001464	3	0.0001520		
14	15	2	0.0000491	2	0.0000418	2	0.0001013		
15	14	3	0.0000736	4	0.0000837	1	0.0000507		
16	15			1	0.0000209	1	0.0000507		
16	17			1	0.0000209				
10 or 12	11								
10 or 13	11 or 12								
11 or 12	10 or 13								
11 or 13	12	5	0.0001227	7	0.0001464	1	0.0000507		
11 or 13	12 or 14			2	0.0000418				
11 or 14	12 or 13			1	0.0000209	1	0.0000507		
11 or 15	13			1	0.0000209				
12 or 13	11 or 14								
12 or 14	13			4	0.0000837				
12 or 14	11 or 13	1	0.0000245						
12 or 14	11 or 15								
12 or 15	13 or 14	1	0.0000245						
13 or 14	12 or 15			1	0.0000209				
13 or 15	14	3	0.0000736	1	0.0000209				
16 or 18	15 or 17	1	0.0000245						
8 or 12	11 or 9								
8 or 12	9 or 13								
	Sum	63	0.0015455	87	0.0018200	25	0.0012667	0	4
Total Paternal Meiosis by Race		40,763		47,801		19,736			229
Paternal Frequency		0.0015455		0.0018200		0.0012667			0.0174672
Maternal Frequency		0.0001228		0.0005815		0.0002717			
Sum		0.0016683		0.0024015		0.0015384			

Relative Frequency Paternal	0.9263930		0.7578643		0.8233903			
Relative Frequency Maternal	0.0736070		0.2421357		0.1766097			
Indeterminate	0.0007063		0.0006655		0.0005154			
Frequency Paternal Indeterminate	0.0006543		0.0005044		0.0004244			
Frequency Maternal Indeterminate	0.0000520		0.0001611		0.0000910			
Total Paternal Mutation Frequency	0.0021998		0.0023244		0.0016911			
Total Maternal Mutation Frequency	0.0001748		0.0007426		0.0003627			

D13S317 Maternal Mutations

Maternal Mutation – Allele:		Caucasian		Black		Hispanic		American Indian	Asian (Oriental)
From	To	Number	Frequency	Number	Frequency	Number	Frequency		
8	9								
9	10								
10	9								
10	11								
10	15								
11	9								
11	10			1	0.0000208				
11	12	2	0.0000409	6	0.0001246				
11	15								
12	9								
12	11			1	0.0000208	1	0.0000543		1
12	13	1	0.0000205	7	0.0001454	1	0.0000543		

12	11or 13			1	0.0000208				
13	12			4	0.0000831				
13	14			3	0.0000623	1	0.0000543		
13	12 or 14								
14	13	1	0.0000205			1	0.0000543		
14	15	1	0.0000205	1	0.0000208				
14	16			1	0.0000208				
15	14			1	0.0000208	1	0.0000543		
10 or 12	11								
10 or 13	11 or 12								
11 or 12	10 or 13								
11 or 13	12								
11 or 13	12 or 14								
11 or 14	12 or 13								
12 or 13	11 or 14								
12 or 14	13	1	0.0000205	1	0.0000208				
12 or 14	11 or 13								
12 or 14	11 or 15								
8 or 12	11 or 9								
8 or 12	9 or 13								
9 or 12	10 or 11			1	0.0000208				
	Sum	6	0.0001228	28	0.0005815	5	0.0002717	0	1
Total Maternal Meiosis by Race Trios Only		48,852		48,154		18,406			234
	Frequency	0.0001228		0.0005815		0.0002717			0.0042735

D16S539 Paternal Mutations

Paternal Mutation – Allele:	Caucasian	Black	Hispanic	American Indian	Asian (Oriental)

From	To	Number	Frequency	Number	Frequency	Number	Frequency		
8	9	1	0.0000237						
9	8	1	0.0000237						
9	10	2	0.0000473	2	0.0000367				
9	11			1	0.0000184				
10	11			5	0.0000918	1	0.0000510		
10	9 or 11								
11	9	1	0.0000237						
11	10	2	0.0000473	1	0.0000184	1	0.0000510		
11	12	6	0.0001420	17	0.0003120	1	0.0000510		1
11	13			1	0.0000184				
11	14					1	0.0000510		
11	10 or 12	1	0.0000237						
12	10	1	0.0000237						
12	11	13	0.0003076	8	0.0001468	2	0.0001019		1
12	13	10	0.0002366	12	0.0002202	3	0.0001529		1
12	11 or 13	2	0.0000473						
13	9								
13	11								
13	12	7	0.0001656	8	0.0001468	1	0.0000510		
13	14	12	0.0002839	13	0.0002386	2	0.0001019		1
13	12 or 14					1	0.0000510		
14	13	7	0.0001656	9	0.0001652	2	0.0001019		
14	15	3	0.0000710	3	0.0000551				
15	14			1	0.0000184	1	0.0000510		
15	16					1	0.0000510		
10 or 12	11	1	0.0000237	2	0.0000367				
10 or 12	11 or 13								
10 or 12	9 or 13								
11 or 13	12	3	0.0000710	3	0.0000551	1	0.0000510		

11 or 13	12 or 14			1	0.0000184				
11 or 14	10 or 13								
11 or 14	12 or 13			1	0.0000184				
11 or 15	12 or 14								
12 or 14	13	3	0.0000710	1	0.0000184	2	0.0001019		
12 or 15	13 or 14								
13 or 15	14								
9 or 11	10	1	0.0000237						
9 or 12	10 or 11								
9 or 13	10 or 12								
	Sum	77	0.0018219	89	0.0016332	20	0.0010193	0	4
Total Paternal Meiosis by Race		42,264		54,494		19,622			229
Paternal Frequency		0.0018219		0.0016332		0.0010193			0.0174672
Maternal Frequency		0.0003009		0.0004497		0.0003204			
Sum		0.0021228		0.0020829		0.0013397			
Relative Frequency Paternal		0.8582520		0.7840919		0.7608132			
Relative Frequency Maternal		0.1417480		0.2159081		0.2391868			
Indeterminate		0.0004088		0.0004497		0.0003204			
Frequency Paternal Indeterminate		0.0003509		0.0003526		0.0002438			
Frequency Maternal Indeterminate		0.0000579		0.0000971		0.0000766			
Total Paternal Mutation Frequency		0.0021727		0.0019858		0.0012631			
Total Maternal Mutation Frequency		0.0003588		0.0005468		0.0003971			

D16S539 Maternal Mutations

Maternal Mutation – Allele:		Caucasian		Black		Hispanic		American Indian	Asian (Oriental)
From	To	Number	Frequency	Number	Frequency	Number	Frequency		
8	9								
9	10	1	0.0000158						
10	9			1	0.0000150				
10	11			1	0.0000150				1
10	9 or 11								
11	9			1	0.0000150				
11	10					1	0.0000458		
11	12								
12	11	3	0.0000475	5	0.0000750	1	0.0000458		
12	13								
12	11 or 13	1	0.0000158						
13	9								
13	11								
13	12	2	0.0000317	10	0.0001499				
13	14	1	0.0000158	2	0.0000300				
13	12 or 14	1	0.0000158						
14	13	4	0.0000634	5	0.0000750	1	0.0000458		1
14	15			1	0.0000150	1	0.0000458		
15	14	2	0.0000317	1	0.0000150	2	0.0000916		
15	16								
10 or 12	11			1	0.0000150				
10 or 12	11 or 13								
10 or 12	9 or 13								
10 or 13	11 or 12	1	0.0000158						
11 or 13	12	1	0.0000158	1	0.0000150	1	0.0000458		
11 or 14	10 or 13								

11 or 15	12 or 14								
12 or 14	13	2	0.0000317	1	0.0000150				
12 or 15	13 or 14								
13 or 15	14								
9 or 12	10 or 11								
9 or 13	10 or 12								
	sum	19	0.0003009	30	0.0004497	7	0.0003204	0	2
Total Maternal Meiosis by Race		63,137		66,708		21,845			234
	Frequency	0.0003009		0.0004497		0.0003204			0.0085470

D19S453 Paternal Mutations

Paternal Mutation – Allele:		Caucasian		Black		Hispanic		American Indian	Asian (Oriental)
From	To	Number	Frequency	Number	Frequency	Number	Frequency		
12	10								
12	11	2	0.0001028						
12	13			1	0.0000433				
12	14	1	0.0000514						
12.2	13.2								
13	14	1	0.0000514	3	0.0001298	1	0.0002802		
13	12	4	0.0002057	1	0.0000433				
13	15			1	0.0000433				
13.2	11.2								
13.2	12.2			1	0.0000433				
14	13	1	0.0000514	3	0.0001298	1	0.0002802		
14	15	3	0.0001543	3	0.0001298				1
14	13 or 15								

14	14.2			1	0.0000433				
14.2	13.2	1	0.0000514	1	0.0000433				
15	14	2	0.0001028	2	0.0000865				
15	16	2	0.0001028	3	0.0001298	1	0.0002802		
15.2	16.2			1	0.0000433	1	0.0002802		
15.2	14.2	4	0.0002057	1	0.0000433				
16	15	3	0.0001543	1	0.0000433				
16	17	2	0.0001028						
16.2	15.2	1	0.0000514	1	0.0000433				
16.2	17.2	1	0.0000514						
17	16								
17	18								
17.2	16.2	1	0.0000514						
13 or 15	14								
14 or 16	15								
	Sum	29	0.0014912	24	0.0010381	4	0.0011208	0	1
Total Paternal Meiosis by Race		19448		23119		3569			229
Paternal Frequency		0.0014912		0.0010381		0.0011208			0.0043668
Maternal Frequency		0.0003583		0.0003679		0.0000000			
Sum		0.0018495		0.0014060		0.0011208			
Relative Frequency Paternal		0.8062673		0.7383370		1.0000000			
Relative Frequency Maternal		0.1937327		0.2616630		0.0000000			
Indeterminate		0.0003408		0.0013369		0.0000000			
Frequency Paternal Indeterminate		0.0002748		0.0009871		0.0000000			
Frequency Maternal Indeterminate		0.0000660		0.0003498		0.0000000			

Total Paternal Mutation Frequency	0.0017659		0.0020252		0.0011208			
Total Maternal Mutation Frequency	0.0004243		0.0007177		<0.0002909			

D19S453 Maternal Mutations

Maternal Mutation – Allele:		Caucasian		Black		Hispanic		American Indian	Asian (Oriental)
From	To	Number	Frequency	Number	Frequency	Number	Frequency		
12	10								
12.2	13.2								
13	12	3	0.0001535						
13	14								
13.2	11.2								
14	13			2	0.0001051				
14	15								
14	13 or 15								
14.2	13.2								
14.2	15.2			1	0.0000526				
15	11			1	0.0000526				
15	14	2	0.0001024	2	0.0001051				
15	16								
15.2	14.2			1	0.0000526				
15.2	16.2								
16	15	2	0.0001024						
16	17								
16.2	15.2								
16.2	17.2								
17	16								
17	18								

13 or 15	14								
14 or 16	15								
	Sum	7	0.0003583	7	0.0003679	0	0		
Total Maternal Meiosis by Race		19539		19027		3438	0.00029087		
	Frequency	0.0003583		0.0003679		0.0000000			

D21S51 Paternal Mutations

Paternal Mutation – Allele:		Caucasian		Black		Hispanic		American Indian	Asian (Oriental)
From	To	Number	Frequency	Number	Frequency	Number	Frequency		
23	29								
26	27								
27	28			2	0.0000292	1	0.0000427		
28	26								
28	27	1	0.0000187	2	0.0000292				
28	27.2								
28	29	4	0.0000747	8	0.0001168	3	0.0001280		
28	30	1	0.0000187	1	0.0000146				
28	27 or 29								
29	28	2	0.0000374	4	0.0000584	1	0.0000427		
29	30	6	0.0001121	12	0.0001752				1
29	30.2			1	0.0000146				
29	33								
29	28 or 30								
30	28								
30	29	6	0.0001121	7	0.0001022	2	0.0000854		

30	29.2	1	0.0000187						
30	30.2	1	0.0000187						
30	31	16	0.0002990	16	0.0002336	5	0.0002134		
30	32								
30	32.2	1	0.0000187						
30	29 or 31								
30.2	31.2	3	0.0000561	1	0.0000146				
31	30	6	0.0001121	2	0.0000292				1
31	31.2								
31	32	4	0.0000747	7	0.0001022	2	0.0000854		2
31.2	30.2			2	0.0000292				
31.2	31	1	0.0000187						
31.2	32.2	6	0.0001121	3	0.0000438	1	0.0000427		
32	31	4	0.0000747						
32	33	2	0.0000374	3	0.0000438				
32.2	30					1	0.0000427		
32.2	31.2			2	0.0000292	4	0.0001707		
32.2	33.2	8	0.0001495	7	0.0001022	3	0.0001280		
32.2	31.2 or 33.2								
33	32	1	0.0000187						
33	34	1	0.0000187						
33.2	31.2	1	0.0000187						
33.2	32.2	3	0.0000561	4	0.0000584	1	0.0000427		
33.2	34.2	3	0.0000561	7	0.0001022	2	0.0000854		
33.2	32.2 or 34.2					1	0.0000427		
34	33			2	0.0000292				
34	35			2	0.0000292				
34.2	33.2			1	0.0000146				
34.2	35.2	1	0.0000187	1	0.0000146				

35	34			2	0.0000292				
35	36			5	0.0000730				
35.2	34.2								
36	35			2	0.0000292				
36	37			3	0.0000438				
36.2	35.2								
37	36			1	0.0000146				
37	38			1	0.0000146				
16 or 19	14 or 20								
27 or 29	28			1	0.0000146				
27 or 29	28 or 30								
27 or 30	28 or 29					1	0.0000427		
27 or 32	28 or 31								
28 or 29	29 or 30								
28 or 30	29			2	0.0000292	1	0.0000427		
28 or 30	27 or 29								
28 or 30	27 or 31								
28 or 30	29 or 31					1	0.0000427		
28 or 31	29 or 30								
28 or 31.2	29 or 32.2	1	0.0000187						
28 or 32.2	29 or 31.2								
29 or 30	28 or 31			1	0.0000146				
29 or 31	30	1	0.0000187	2	0.0000292				
29 or 31	28 or 30								
29 or 32	30 or 31								
29 or 32.2	28 or 31.2					1	0.0000427		
30 or 31	29 or 32	1	0.0000187						
30 or 31.2	31								

30 or 32	31	1	0.0000187						
30 or 32.2	31 or 33.2			1	0.0000146				
31.2 or 32	31								
31.2 or 33.2	32.2								
	Sum	87	0.0016256	118	0.0017232	31	0.0013230	0	4
Total Paternal Meiosis by Race		53,520		68,479		23,432			229
Paternal Frequency		0.0016256		0.0017232		0.0013230			0.0174672
Maternal Frequency		0.0013077		0.0013928		0.0016832			
Sum		0.0029333		0.0031160		0.0030062			
Relative Frequency Paternal		0.5541821		0.5530104		0.4400862			
Relative Frequency Maternal		0.4458179		0.4469896		0.5599138			
Indeterminate		0.0004938		0.0006174		0.0007656			
Frequency Paternal Indeterminate		0.0002737		0.0003414		0.0003369			
Frequency Maternal Indeterminate		0.0002201		0.0002760		0.0004287			
Total Paternal Mutation Frequency		0.0018992		0.0020646		0.0016599			
Total Maternal Mutation Frequency		0.0015278		0.0016688		0.0021119			

D21S51 Maternal Mutations

Maternal Mutation – Allele:		Caucasian		Black		Hispanic		American Indian	Asian (Oriental)
From	To	Number	Frequency	Number	Frequency	Number	Frequency		
23	29								
26	27								
27	28								
28	26								
28	27	1	0.0000147						
28	27.2								
28	29	1	0.0000147	5	0.0000718				
28	30								
28	27 or 29								
29	27	1	0.0000147						
29	28	4	0.0000588	2	0.0000287	4	0.0001772	1	
29	30	2	0.0000294	1	0.0000144	2	0.0000886		
29	31.2	1	0.0000147						
29	33								
29	28 or 30								
30	28								
30	29	12	0.0001763	14	0.0002010	2	0.0000886		
30	31	1	0.0000147	1	0.0000144	2	0.0000886		
30	32								
30	29 or 31								
30.2	31.2								
31	30	18	0.0002645	17	0.0002441	5	0.0002215		
31	31.2								
31	32	2	0.0000294	4	0.0000574				
31	30 or 32			1	0.0000144				

31.2	30.2	1	0.0000147	1	0.0000144				
31.2	31	1	0.0000147						
31.2	32.2	1	0.0000147	1	0.0000144				
32	31	3	0.0000441	8	0.0001149	3	0.0001329		
32	33								
32.2	31.2	3	0.0000441	4	0.0000574	2	0.0000886		
32.2	33.2	3	0.0000441	3	0.0000431	1	0.0000443		
32.2	31.2 or 33.2					1	0.0000443		
33	32	2	0.0000294	1	0.0000144				
33	34	2	0.0000294		0.0000000				
33.2	32.2	8	0.0001175	10	0.0001436	8	0.0003544		
33.2	34.2	1	0.0000147	1	0.0000144	1	0.0000443		
33.2	32.2 or 34.2								
34	33								
34	35			1	0.0000144				
34.2	33.2	6	0.0000882	5	0.0000718	4	0.0001772		
34.2	35.2								
35	34			1	0.0000144				
35	36								
35.2	34.2								
36	35								
36	37			2	0.0000287				
36.2	35.2								
37	36			2	0.0000287	1	0.0000443		
16 or 19	14 or 20								
26 or 32.2	27 or 33.2	1	0.0000147						
27 or 29	28								
27 or 29	28 or 30								

27 or 32	28 or 31								
27 or 34.2	28 or 33.2			1	0.0000144				
28 or 29	29 or 30								
28 or 30	29	2	0.0000294	2	0.0000287				
28 or 30	27 or 29								
28 or 30	27 or 31			1	0.0000144				
28 or 30	29 or 31	1	0.0000147						
28 or 31	29 or 30								
28 or 32.2	29 or 31.2								
29 or 30	28 or 31								
29 or 31	30	5	0.0000735	7	0.0001005	1	0.0000443	1	
29 or 31	28 or 30	1	0.0000147						
29 or 32	30 or 31								
29 or 32.2	28 or 33.2	1	0.0000147						
30 or 31.2	31								
30 or 32	31	2	0.0000294						
30 or 32.2	31 or 33.2								
30 or 33	31 or 32	1	0.0000147						
31.2 or 32	31								
31.2 or 33.2	32.2	1	0.0000147	1	0.0000144	1	0.0000443		
	Sum	89	0.0013077	97	0.0013928	38	0.0016832	2	
Total Maternal Meiosis by Race		68,057		69,644		22,576			
	Frequency	0.0013077		0.0013928		0.0016832			

FGA Paternal Mutations

Paternal Mutation – Allele:		Caucasian		Black		Hispanic		American Indian	Asian (Oriental)
From	To	Number	Frequency	Number	Frequency	Number	Frequency		
17.2	18.2								
18	19								
18.2	19.2			1	0.0000148				
19	17	1	0.0000188						
19	18	3	0.0000565			1	0.0000426		
19	20	4	0.0000753	2	0.0000297	1	0.0000426		
19	21	1	0.0000188						
19.2	20.2								
20	18	1	0.0000188						
20	19	4	0.0000753	2	0.0000297				
20	21	6	0.0001129	5	0.0000742	4	0.0001703		
20	22			1	0.0000148				
20	19 or 21								
20.2	21.2			1	0.0000148				
21	18								
21	19	1	0.0000188	1	0.0000148				
21	20	2	0.0000376	5	0.0000742				
21	20.2			1	0.0000148				
21	22	7	0.0001318	16	0.0002374	4	0.0001703		1
21.2	21								
21.2	22.2								1
22	20	1	0.0000188	1	0.0000148				
22	21	2	0.0000376	11	0.0001632	1	0.0000426	1	
22	23	10	0.0001882	12	0.0001780	6	0.0002555		1
22	24			1	0.0000148				

22	21 or 23			1	0.0000148				
22.2	21.2								
22.2	22								
22.2	23.2	1	0.0000188	1	0.0000148				
23	21	1	0.0000188						
23	22	11	0.0002071	6	0.0000890	1	0.0000426		2
23	24	10	0.0001882	18	0.0002670	3	0.0001277		2
23	22 or 24	1	0.0000188						
23.2	22.2			1	0.0000148				
23.2	24.2	1	0.0000188	1	0.0000148				
24	19			1	0.0000148				
24	22	1	0.0000188	1	0.0000148				
24	23	4	0.0000753	15	0.0002225	6	0.0002555	1	
24	25	20	0.0003765	27	0.0004005	2	0.0000852	1	
24	26	1	0.0000188						
24	27								
24	23 or 25					1	0.0000426		
24	25 or 26								
24.2	23.2	1	0.0000188						
24.3	25.3								
25	24	16	0.0003012	17	0.0002522	2	0.0000852		2
25	26	17	0.0003200	18	0.0002670	5	0.0002129		1
25	27								
25	24 or 26	1	0.0000188						
25.2	24.2								1
26	23								
26	25	11	0.0002071	18	0.0002670	15	0.0006387		
26	27	8	0.0001506	7	0.0001038	8	0.0003406	1	1
26	25 or 27								
27	24			1	0.0000148				
27	25	1	0.0000188						

27	26	6	0.0001129	8	0.0001187	5	0.0002129		
27	28	1	0.0000188	2	0.0000297	4	0.0001703		
28	26					1	0.0000426		
28	27	1	0.0000188	4	0.0000593	1	0.0000426		1
28	29			3	0.0000445				
29	28	1	0.0000188						
29	30			1	0.0000148				
30	29			2	0.0000297				
30.2	31.2								
33.2	34.2								
43.2	42.2			1	0.0000148				
43.2	44.2			1	0.0000148				
45.2	46.2								
46.2	45.2			1	0.0000148				
19 or 21	20								
19 or 23	20 or 24					1	0.0000426		
19 or 24	21 or 25								
19 or 25	20 or 24	1	0.0000188						
20 or 22	21	5	0.0000941						
20 or 22	21 or 23					1	0.0000426		
20 or 24	19 or 25								
20 or 24	21 or 23					1	0.0000426		
21 or 23	22			1	0.0000148	1	0.0000426		
21 or 23	22 or 24								
21 or 25	20 or 26			1	0.0000148				
21 or 25	22 or 24	1	0.0000188						
21 or 26	20 or 25					1	0.0000426		
22 or 24	23	3	0.0000565	4	0.0000593				
22 or 24	21 or 23			1	0.0000148				
22 or 24	21 or 25			1	0.0000148				
22 or 24	22 or 25								

22 or 24	23 or 25	1	0.0000188						
22 or 25	23 or 24					1	0.0000426		
22 or 26	21 or 25								
22 or 26	23 or 25	1	0.0000188						
22 or 29	23 or 28								
23 or 24	22 or 25								
23 or 25	24	2	0.0000376	1	0.0000148	2	0.0000852		
23 or 25	22 or 24								
23 or 25	24 or 26	1	0.0000188						
23 or 26	22 or 25								
23 or 26	24 or 25			1	0.0000148				
24 or 26	25	3	0.0000565	1	0.0000148	3	0.0001277		
24 or 26	23 or 25								
24 or 26	25 or 27					1	0.0000426		
25 or 27	26			1	0.0000148				
25 or 28	24 or 27			1	0.0000148				
26 or 28	27								
	Sum	176	0.0033132	229	0.0033972	83	0.0035340	4	13
Total Paternal Meiosis by Race		53,121		67,408		23,486		352	523
Paternal Frequency		0.0033132		0.0033972		0.0035340		0.0113636	0.0248566
Maternal Frequency		0.0006003		0.0007515		0.0007135			
Sum		0.0039135		0.0041487		0.0042475			
Relative Frequency Paternal		0.8466075		0.8188586		0.8320279			
Relative Frequency Maternal		0.1533925		0.1811414		0.1679721			
Indeterminate		0.0006896		0.0006570		0.0007200			
Frequency Paternal Indeterminate		0.0005838		0.0005380		0.0005991			

Frequency Maternal Indeterminate	0.0001058		0.0001190		0.0001209			
Total Paternal Mutation Frequency	0.0038970		0.0039352		0.0041331			
Total Maternal Mutation Frequency	0.0007061		0.0008705		0.0008344			

FGA Maternal Mutations

Maternal Mutation – Allele:		Caucasian		Black		Hispanic		American Indian	Asian (Oriental)
From	To	Number	Frequency	Number	Frequency	Number	Frequency		
17.2	18.2								
18	19								
18	24			1	0.0000150				
18.2	19.2			1	0.0000150				
19	20			1	0.0000150	1	0.0000446		
19.2	20.2								
20	19	2	0.0000308						
20	21	1	0.0000154						
20	19 or 21								
21	18								
21	19			1	0.0000150				
21	20	1	0.0000154						
21	22	2	0.0000308	1	0.0000150				
21.2	21								
21.2	22.2	1	0.0000154						
22	20								
22	21	2	0.0000308	2	0.0000301	2	0.0000892		
22	23	3	0.0000462	3	0.0000451	2	0.0000892		

22	24			1	0.0000150				
22	29			1	0.0000150				
22	21 or 23								
22.2	21.2	1	0.0000154						
22.2	22								
22.2	23.2								
23	21			1	0.0000150				
23	22	3	0.0000462	7	0.0001052	1	0.0000446		
23	24	2	0.0000308	5	0.0000752				
23.2	24.2								
24	19			1	0.0000150				
24	22			1	0.0000150	1	0.0000446		
24	23	5	0.0000770	7	0.0001052	1	0.0000446		
24	25	2	0.0000308	2	0.0000301				
24	27								
24	23 or 25								
24	25 or 26								
24.3	25.3								
25	24	4	0.0000616	2	0.0000301	2	0.0000892		
25	26	2	0.0000308	4	0.0000601				
25	27								
25	24 or 26								
26	23								
26	25	2	0.0000308	3	0.0000451				
26	27					1	0.0000446		
26	25 or 27								
27	26	1	0.0000154	2	0.0000301	1	0.0000446		
27	28	1	0.0000154						
28	27					1	0.0000446		
28	29								
29	28								

30	29								
30.2	31.2								
33.2	34.2								
45.2	46.2								
19 or 21	20								
19 or 24	21 or 25								
19 or 25	20 or 24								
20 or 22	21	1	0.0000154						
20 or 24	19 or 25								
20 or 24	21 or 23					1	0.0000446		
21 or 23	22								
21 or 23	22 or 24								
21 or 24	20 or 25			1	0.0000150				
21 or 25	22 or 24								
21 or 26	22 or 25					1	0.0000446		
22 or 24	23	1	0.0000154						
22 or 24	21 or 25								
22 or 24	22 or 25								
22 or 24	23 or 25								
22 or 26	21 or 25								
22 or 26	23 or 25					1	0.0000446		
22 or 29	23 or 28								
23 or 24	22 or 25								
23 or 25	24	1	0.0000154	1	0.0000150				
23 or 25	22 or 24								
23 or 25	22 or 26			1	0.0000150				
23 or 25	24 or 26								
23 or 26	22 or 25								
24 or 26	25	1	0.0000154						
24 or 26	23 or 25								
25 or 27	26								

26 or 28	27								
	Sum	39	0.0006003	50	0.0007515	16	0.0007135		
Total Maternal Meiosis by Race		64,971		66,533		22,426			
	Frequency	0.0006003		0.0007515		0.0007135			

THO Paternal Mutations

Paternal Mutation – Allele:		Caucasian		Black		Hispanic		American Indian	Asian (Oriental)
From	To	Number	Frequency	Number	Frequency	Number	Frequency		
6	7								
7	6								
7	8								
8	7			1	0.0000153				
8	9			1	0.0000153				
8	9.3								
9	8	1	0.0000225	1	0.0000153				
9	10	1	0.0000225						
9.3	7			1	0.0000153				
10	8								
10	11	1	0.0000225						
6 or 8	7 or 9								
8 or 10	9								
	Sum	3	0.0000676	4	0.0000612	0			
Total Paternal Meiosis by Race		44,348		65,369		17,554			
Paternal Frequency		0.0000676		0.0000612		0.0000000			

Maternal Frequency	0.0000785		0.0000858		0.0000445			
Sum	0.0001461		0.0001470		0.0000445			
Relative Frequency Paternal	0.4628688		0.4162911		0.0000000			
Relative Frequency Maternal	0.5371312		0.5837089		1.0000000			
Indeterminate	0.0000000		0.0000494		0.0000000			
Frequency Paternal Indeterminate	0.0000000		0.0000206		0.0000000			
Frequency Maternal Indeterminate	0.0000000		0.0000288		0.0000000			
Total Paternal Mutation Frequency	0.0000676		0.0000818		<0.0000570			
Total Maternal Mutation Frequency	0.0000785		0.0001146		0.0000445			

THO Maternal Mutations

Maternal Mutation – Allele:		Caucasian		Black		Hispanic		American Indian	Asian (Oriental)
From	To	Number	Frequency	Number	Frequency	Number	Frequency		
6	7					1	0.0000445		
7	6								
7	8								
8	7	2	0.0000392						
8	9.3								
9	7	1	0.0000196						
9	8			5	0.0000858				
9.3	8	1	0.0000196						
10	8								
6 or 8	7 or 9								

8 or 10	9								
	Sum	4	0.0000785	5	0.0000858	1	0.0000445		
Total Maternal Meiosis by Race		50,961		58,261		22,448			
	Frequency	0.0000785		0.0000858		0.0000445			

TPOX Paternal Mutations

Paternal Mutation – Allele:		Caucasian		Black		Hispanic		American Indian	Asian (Oriental)
From	To	Number	Frequency	Number	Frequency	Number	Frequency		
8	9								
9	10			2	0.0000442				
9	11			1	0.0000221				
10	9								
10	11	1	0.0000271						
11	10	1	0.0000271	2	0.0000442				
11	12	3	0.0000814						
11	16								
12	11	1	0.0000271			1	0.0000572		
12	13								
13	12					1	0.0000572		
10 or 12	11			1	0.0000221				
9 or 10	8 or 11			1	0.0000221				
9 or 11	10								
	Sum	6	0.0001628	7	0.0001548	2	0.0001143		
Total Paternal Meiosis by Race		36,845		45,229		17,496			

Paternal Frequency	0.0001628		0.0001548		0.0001143			
Maternal Frequency	0.0000609		0.0001012		0.0000000			
Sum	0.0002237		0.0002559		0.0001143			
Relative Frequency Paternal	0.7278144		0.6047342		1.0000000			
Relative Frequency Maternal	0.2721856		0.3952658		0.0000000			
Indeterminate	0.0000343		0.0000000		0.0000000			
Frequency Paternal Indeterminate	0.0000250		0.0000000		0.0000000			
Frequency Maternal Indeterminate	0.0000093		0.0000000		0.0000000			
Total Paternal Mutation Frequency	0.0001878		0.0001548		0.0001143			
Total Maternal Mutation Frequency	0.0000702		0.0001012		<0.0000539			

TPOX Maternal Mutations

Maternal Mutation – Allele:		Caucasian		Black		Hispanic		American Indian	Asian (Oriental)
From	To	Number	Frequency	Number	Frequency	Number	Frequency		
8	9	1	0.0000203						
9	10			1	0.0000202				
10	9			1	0.0000202				
11	10	1	0.0000203	1	0.0000202				
11	12	1	0.0000203	1	0.0000202				
11	16								
12	11								
12	13								

13	12								
8 or 10	9			1	0.0000202				
9 or 11	10								
	Sum	3	0.0000609	5	0.0001012	0			
Total Maternal Meiosis by Race		49,229		49,427		18,539			
	Frequency	0.0000609		0.0001012		0.0000000			

VWA Paternal Mutations

Paternal Mutation – Allele:		Caucasian		Black		Hispanic		American Indian	Asian (Oriental)
Paternal Mutation – Allele:		Number	Frequency	Number	Frequency	Number	Frequency		
From	To								
14	11					1	0.0000414		
14	12					1	0.0000414		
14	13								
14	15			3	0.0000437	1	0.0000414		
15	14	2	0.0000375	4	0.0000583	1	0.0000414		
15	16	6	0.0001126	13	0.0001895	1	0.0000414		
15	14 or 16	1	0.0000188						
16	13	1	0.0000188						
16	15	5	0.0000938	12	0.0001749	2	0.0000829		
16	17	9	0.0001689	10	0.0001457	5	0.0002072		1
16	18			2	0.0000291				
16	15 or 17			2	0.0000291				
17	16	18	0.0003379	11	0.0001603	4	0.0001658		
17	18	20	0.0003754	21	0.0003061	6	0.0002486		
17	16 or 18								

18	16	2	0.0000375	1	0.0000146				
18	17	22	0.0004129	19	0.0002769	3	0.0001243		1
18	19	16	0.0003003	18	0.0002623	6	0.0002486		
18	20								
18	21			1	0.0000146				
18	17 or 19	4	0.0000751						
19	18	29	0.0005443	29	0.0004226	4	0.0001658		1
19	20	15	0.0002815	14	0.0002040	6	0.0002486		1
19	18 or 20			1	0.0000146				
20	19	17	0.0003191	17	0.0002478	3	0.0001243		1
20	21	2	0.0000375	1	0.0000146				
21	19			1	0.0000146				
21	20	5	0.0000938	2	0.0000291	1	0.0000414		1
21	22								
22	21	1	0.0000188	2	0.0000291				
23	22			1	0.0000146				
10 or 12	11								
13 or 15	14			1	0.0000146				
14 or 16	15	1	0.0000188						
14 or 16	15 or 17								
14 or 18	16								
14 or 18	15 or 17			1	0.0000146				
15 or 17	16	1	0.0000188	4	0.0000583	1	0.0000414		
15 or 17	14 or 18								
15 or 17	16 or 18								
15 or 18	16 or 17			1	0.0000146	1	0.0000414		
15 or 18	16 or 19					1	0.0000414		
15 or 19	16								
15 or 19	17			1	0.0000146				
15 or 19	14 or 20								
15 or 20	16 or 19					1	0.0000414		

16 or 17	15 or 18								
16 or 18	17	3	0.0000563	4	0.0000583	1	0.0000414		
16 or 18	15 or 17			2	0.0000291				
16 or 18	17 or 19	1	0.0000188						
16 or 19	15 or 18								
16 or 19	17 or 18	1	0.0000188	1	0.0000146				
17 or 18	16 or 19	1	0.0000188						
17 or 19	18	4	0.0000751	4	0.0000583	1	0.0000414		
17 or 19	16 or 18			1	0.0000146				1
17 or 19	18 or 20	1	0.0000188						
17 or 20	16 or 19								
17 or 20	18 or 19								
18 or 20	19	2	0.0000375	3	0.0000437	2	0.0000829		
18 or 20	17 or 19								
18 or 20	19 or 21	1	0.0000188						
19 or 21	20								
	Sum	191	0.0035850	208	0.0030314	53	0.0021963	0	7
Total Paternal Meiosis by Race		53,278		68,616		24,132			523
Paternal Frequency		0.0035850		0.0030314		0.0021963			0.0133843
Maternal Frequency		0.0004066		0.0005800		0.0002622			
Sum		0.0039916		0.0036114		0.0024585			
Relative Frequency Paternal		0.8981353		0.8393870		0.8933355			
Relative Frequency Maternal		0.1018647		0.1606130		0.1066645			
Indeterminate		0.0009106		0.0006811		0.0005090			
Frequency Paternal Indeterminate		0.0008178		0.0005717		0.0004547			

Frequency Maternal Indeterminate	0.0000928		0.0001094		0.0000543			
Total Paternal Mutation Frequency	0.0044028		0.0036031		0.0026509			
Total Maternal Mutation Frequency	0.0004994		0.0006894		0.0003165			

VWA Maternal Mutations

Maternal Mutation – Allele:		Caucasian		Black		Hispanic		American Indian	Asian (Oriental)
From	To	Number	Frequency	Number	Frequency	Number	Frequency		
14	15								
15	14								
15	16	2	0.0000301	3	0.0000435	1	0.0000524		
16	15			3	0.0000435	1	0.0000524		
16	17	4	0.0000602	3	0.0000435	1	0.0000524		
16	18								
16	15 or 17			1	0.0000145				
17	15			1	0.0000145				
17	16								
17	18	3	0.0000452	5	0.0000725	1	0.0000524		
17	16 or 18								
18	17	1	0.0000151	4	0.0000580				
18	19	6	0.0000904	2	0.0000290	1	0.0000524		
18	20	1	0.0000151						
18	17 or 19								
19	18			2	0.0000290				
19	20	3	0.0000452	2	0.0000290				
20	19	1	0.0000151	1	0.0000145				
20	21			4	0.0000580				

21	20	1	0.0000151	1	0.0000145				
21	22								
14 or 16	15			1	0.0000145				
14 or 16	15 or 17								
14 or 18	16								
14 or 18	15 or 17	1	0.0000151						
14 or 20	15 or 19			1	0.0000145				
15 or 17	16								
15 or 17	16 or 18	1	0.0000151						
15 or 18	16								
15 or 18	16 or 17			1	0.0000145				
15 or 18	16 or 19								
16 or 17	15 or 18								
16 or 18	17	2	0.0000301	1	0.0000145				
16 or 18	15 or 17								
16 or 18	15 or 19			1	0.0000145				
16 or 18	17 or 19			1	0.0000145				
16 or 19	15 or 18								
16 or 19	17 or 18								
17 or 19	18			1	0.0000145				
17 or 20	16 or 19								
17 or 20	18 or 19								
17 or 21	16 or 22			1	0.0000145				
18 or 20	19	1	0.0000151						
18 or 20	17 or 19								
19 or 21	20								
	Sum	27	0.0004066	40	0.0005800	5	0.0002622		
Total Maternal Meiosis by Race		66,397		68,961		19,067			
	Frequency	0.0004066		0.0005800		0.0002622			

D16S539 Paternal Mutations

Paternal Mutation – Allele:		Caucasian		Black		Hispanic		American Indian	Asian (Oriental)
From	To	Number	Frequency	Number	Frequency	Number	Frequency		
8	9	1	0.0000237						
9	8	1	0.0000237						
9	10	2	0.0000473	2	0.0000367				
9	11			1	0.0000184				
10	11			5	0.0000918	1	0.0000510		
10	9 or 11								
11	9	1	0.0000237						
11	10	2	0.0000473	1	0.0000184	1	0.0000510		
11	12	6	0.0001420	17	0.0003120	1	0.0000510		1
11	13			1	0.0000184				
11	14					1	0.0000510		
11	10 or 12	1	0.0000237						
12	10	1	0.0000237						
12	11	13	0.0003076	8	0.0001468	2	0.0001019		1
12	13	10	0.0002366	12	0.0002202	3	0.0001529		1
12	11 or 13	2	0.0000473						
13	9								
13	11								
13	12	7	0.0001656	8	0.0001468	1	0.0000510		
13	14	12	0.0002839	13	0.0002386	2	0.0001019		1
13	12 or 14					1	0.0000510		
14	13	7	0.0001656	9	0.0001652	2	0.0001019		
14	15	3	0.0000710	3	0.0000551				
15	14			1	0.0000184	1	0.0000510		
15	16					1	0.0000510		

10 or 12	11	1	0.0000237	2	0.0000367				
10 or 12	11 or 13								
10 or 12	9 or 13								
11 or 13	12	3	0.0000710	3	0.0000551	1	0.0000510		
11 or 13	12 or 14			1	0.0000184				
11 or 14	10 or 13								
11 or 14	12 or 13			1	0.0000184				
11 or 15	12 or 14								
12 or 14	13	3	0.0000710	1	0.0000184	2	0.0001019		
12 or 15	13 or 14								
13 or 15	14								
9 or 11	10	1	0.0000237						
9 or 12	10 or 11								
9 or 13	10 or 12								
	Sum	77	0.0018219	89	0.0016332	20	0.0010193	0	4
Total Paternal Meiosis by Race		42,264		54,494		19,622			229
Paternal Frequency		0.0018219		0.0016332		0.0010193			0.0174672
Maternal Frequency		0.0003009		0.0004497		0.0003204			
Sum		0.0021228		0.0020829		0.0013397			
Relative Frequency Paternal		0.8582520		0.7840919		0.7608132			
Relative Frequency Maternal		0.1417480		0.2159081		0.2391868			
Indeterminate		0.0004088		0.0004497		0.0003204			
Frequency Paternal Indeterminate		0.0003509		0.0003526		0.0002438			
Frequency Maternal Indeterminate		0.0000579		0.0000971		0.0000766			
Total Paternal Mutation Frequency		0.0021727		0.0019858		0.0012631			

Total Maternal Mutation Frequency	0.0003588		0.0005468		0.0003971			

D16S539 Maternal Mutations

Maternal Mutation – Allele:		Caucasian		Black		Hispanic		American Indian	Asian (Oriental)
From	To	Number	Frequency	Number	Frequency	Number	Frequency		
8	9								
9	10	1	0.0000158						
10	9			1	0.0000150				
10	11			1	0.0000150				1
10	9 or 11								
11	9			1	0.0000150				
11	10					1	0.0000458		
11	12								
12	11	3	0.0000475	5	0.0000750	1	0.0000458		
12	13								
12	11 or 13	1	0.0000158						
13	9								
13	11								
13	12	2	0.0000317	10	0.0001499				
13	14	1	0.0000158	2	0.0000300				
13	12 or 14	1	0.0000158						
14	13	4	0.0000634	5	0.0000750	1	0.0000458		1
14	15			1	0.0000150	1	0.0000458		
15	14	2	0.0000317	1	0.0000150	2	0.0000916		
15	16								
10 or 12	11			1	0.0000150				
10 or 12	11 or 13								

10 or 12	9 or 13								
10 or 13	11 or 12	1	0.0000158						
11 or 13	12	1	0.0000158	1	0.0000150	1	0.0000458		
11 or 14	10 or 13								
11 or 15	12 or 14								
12 or 14	13	2	0.0000317	1	0.0000150				
12 or 15	13 or 14								
13 or 15	14								
9 or 12	10 or 11								
9 or 13	10 or 12								
	sum	19	0.0003009	30	0.0004497	7	0.0003204	0	2
Total Maternal Meiosis by Race		63,137		66,708		21,845			234
	Frequency	0.0003009		0.0004497		0.0003204			0.0085470

Appendix 3. Mutations that are Indeterminate as to their parental origin.

CSF1PO Mutations that are Indeterminate as to the Parental Origin

MOTHER'S ALLELES	CHILD'S ALLELES	FATHER'S ALLELES	Caucasian	Black	Hispanic	American Indian	East Asian (Oriental)
11	10, 11	11					
10, 12	10, 11	10	1				
10, 12	10, 11	10, 12	1	1	2		
11, 12	10, 11	11, 12					
11, 12	10, 11	11, 13	1	1			
10, 11	10, 12	10, 11		1			
10, 11	10, 12	10, 13			1		
10, 13	10, 12	10, 11					
11, 12	10, 12	11					
10, 12	10, 13	10, 12					
10, 12	10, 13	10, 12					
10	10, 11	10			1		
10	10, 11	10, 12		1			
11	10, 11	11, 13		1			
11, 12	10, 11	11	1		1		
11, 12	10, 11	9, 11		1			
9, 10	10, 11	10		1			
10, 13	10, 12	10, 13		1			
11, 12	10, 12	11, 12			1		
11	11, 12	10, 11		1			
11	11, 12	11, 13	1				
11	11, 12	7, 11					
12	11, 12	10, 12	1				
10, 11	11, 12	11					
10, 11	11, 12	11, 13		2			1
10, 12	11, 12	10, 12	1	3			

11, 13	11, 12	11, 13					
8, 11	11, 12	11		1			
8, 11	11, 12	9, 11					
9, 11	11, 12	11, 13					
9, 12	11, 12	12, 13	1				
11, 12	11, 13	11, 12	2				
11	11, 12	11					1
12	11, 12	12		2	1		
10, 12	11, 12	12	1				
10, 12	11, 12	12, 13	1				
7, 12	11, 12	12	1	2			
12	12, 13	10, 12	1		1		
12	12, 13	11, 12	1	1			
12	12, 13	8, 12					
13	12, 13	10, 13					
10, 12	12, 13	12					
10, 12	12, 13	10, 12		1			
10, 13	12, 13	10, 13	1				
11, 12	12, 13	12			1		
11, 12	12, 13	10, 13					
11, 12	12, 13	11, 12	1		3		
8, 12	12, 13	12					
8, 12	12, 13	8, 12					
12	12, 13	12		1			
11, 12	12, 13	12, 14		1			
11, 13	12, 13	11, 13			1		
9, 13	12, 13	11, 13	1		1		
10, 13	13, 14	8, 13	2	1			
10, 12	8, 10	10, 12					
10	8, 10	10, 11		1			
8, 10	8, 11	8, 12		1			

10	9, 10	10, 12					
10, 12	9, 12	11, 12					
10, 13	9, 10	10		1			
		Sum	20	27	14	0	2
		Indicate the number of cases.	31729	38566	15079	998	229
		Frequency	0.0006303	0.0007001	0.0009284	0.0000000	0.0087336

D3S1358 Mutations that are Indeterminate as to the Parental Origin

MOTHER'S ALLELES	CHILD'S ALLELES	FATHER'S ALLELES	Caucasian	Black	Hispanic	American Indian	East Asian (Oriental)
15, 17	13, 15	15, 16					
14, 16	14, 15	14, 16					
14, 16	14, 15	14, 18					
15, 17	14, 15	15					
15, 18	14, 15	15, 17					
16	14, 16	15, 16					
14	14, 15	14, 16		1			
15	14, 15	15, 16	1				
14, 19	14, 15	14, 17	1				
14, 16	14, 17	14, 16			1		
15	15, 16	15, 17	1	2			
15	15, 16	15, 18			1		
16	15, 16	13, 16					
16	15, 16	14, 16					
16	15, 16	16, 17		1			
14, 15	15, 16	15					
15, 17	15, 16	15			2		
15, 17	15, 16	15, 17	1		1		
15, 18	15, 16	15					

16, 17	15, 16	16		2			
16, 18	15, 16	16					1
15, 16	15, 17	15, 16					
15, 16	15, 17	15, 18		2			
15, 18	15, 17	15, 16		1			
15, 18	15, 17	15, 18					
16, 17	15, 17	16, 17					
18	15, 18	17, 18					
14, 18	15, 18	14, 18					
15, 16	15, 18	15					
15, 16	15, 19	15					
16	15, 16	16	1	2			
16	15, 16	16, 18	1				
14, 16	15, 16	14, 16			1		
14, 16	15, 16	16, 17		1			
15, 18	15, 16	15, 17	2				
16	16, 17	16, 18		1			
17	16, 17	15, 17		4			
17	16, 17	17, 18	1	1			
14, 16	16, 17	15, 16					
14, 16	16, 17	16, 18		1			
15, 16	16, 17	15, 16			1		
15, 16	16, 17	16, 18					
15, 17	16, 17	17	2	3			
15, 17	16, 17	15, 17					
15, 17	16, 17	17, 18	1				
16, 18	16, 17	16					
16, 19	16, 17	16					
15, 18	16, 18	17, 18					
16, 17	16, 18	16					
17, 18	16, 18	17, 18	1				

16	16, 17	16		2			
16	16, 17	14, 16	1	1			
16, 18	16, 17	15, 16	1				
16, 18	16, 17	16, 18	2				1
17, 18	16, 17	15, 17		1			
16, 17	16, 19	16	1				
17	17, 18	17					
17	17, 18	16, 17					
14, 18	17, 18	15, 18					
15, 17	17, 18	15, 17	1				
16, 17	17, 18	16, 17					
16, 17	17, 18	17, 19					
16, 18	17, 18	16, 18					
15, 17	17, 19	16, 17					
18	17, 18	16, 18		1	1		
14, 18	17, 18	16, 18	1				
15, 18	17, 18	15, 18	1				
15, 18	17, 18	16, 18			1		
16, 17	17, 18	15, 17		1			
16, 18	17, 18	18	1				
18	18, 19	18, 20					
14, 19	18, 19	19					1
16, 18	18, 19	14, 18			1		
		Sum	22	28	10	0	3
		Indicate the number of cases.	32590	40581	15720	1060	229
		Frequency	0.0006751	0.0006900	0.0006361	0.0000000	0.0131004

D5S818 Mutations that are Indeterminate as to the Parental Origin

MOTHER'S ALLELES	CHILD'S ALLELES	FATHER'S ALLELES	Caucasian	Black	Hispanic	American Indian	East Asian (Oriental)
11, 12	10, 11	11	3		2		
11, 12	10, 11	11, 12			1		
10, 11	10, 12	10, 13					
10, 12	10, 13	10, 12					
9, 13	10, 13	11, 13					
11	10, 11	11, 12		1			
11, 12	10, 11	9, 11			1		
11, 12	10, 12	11, 12			1		
12, 13	10, 12	11, 12					
11, 13	10, 13	11, 13		1			
11	11, 12	11	1		1		
12	11, 12	12			1		
12	11, 12	8, 12		1			
10, 12	11, 12	12		1			
11, 13	11, 12	11, 13					
12, 13	11, 12	12		2			
12, 13	11, 12	10, 12					
9, 11	11, 12	11					
11	11, 13	11, 12					
10, 13	11, 13	12, 13					
11, 12	11, 13	11, 12	1	1			
11, 12	11, 13	11, 12					
11, 12	11, 13	11, 14	2	1			
12, 13	11, 13	12, 13					
11	11, 12	11, 13	2				
12	11, 12	10, 12	1				
11, 13	11, 12	11	4				
11, 13	11, 12	9, 11			1		
12, 13	11, 12	12, 13		1			

8, 11	11, 12	10, 11			1		
8, 11	11, 12	11, 13		1			
11, 14	11, 13	11, 12	1				
12	12, 13	11, 12	2	1	1		
12	12, 13	12, 14		4			
12	12, 13	9, 12		1			
13	12, 13	13			1		
11, 12	12, 13	12					
11, 12	12, 13	12					
11, 12	12, 13	12	1		1		
11, 12	12, 13	10, 12					
11, 12	12, 13	11, 12	1	1	1		
11, 12	12, 13	12, 14		2	1		
11, 12	12, 13	7, 12					
11, 12	12, 13	9, 12	1				
11, 13	12, 13	9, 13			1		
7, 13	12, 13	13					
8, 12	12, 13	10, 12		1			
8, 12	12, 13	12, 14					
8, 13	12, 13	13					
11, 12	12, 14	12, 13					
12	12, 13	12	3	2			
12, 14	12, 13	12	1				
11, 13	13, 14	13					
11, 13	13, 14	12, 13	3				
12, 13	13, 14	13					
12, 13	13, 14	11, 13		2			
12, 13	13, 14	11, 13					
12, 13	13, 14	12, 13					
13	13, 14	13		1			
7, 11	7, 12	7, 11					

9, 12	9, 13	9, 12					
		Sum	27	25	15	0	0
		Indicate the number of cases.	34028	40251	15721	1059	
		Frequency	0.0007935	0.0006211	0.0009541		

D7S820 Mutations that are Indeterminate as to the Parental Origin

MOTHER'S ALLELES	CHILD'S ALLELES	FATHER'S ALLELES	Caucasian	Black	Hispanic	American Indian	East Asian (Oriental)
10	10, 11	10					
10	10, 11	10, 12		3			
10	10, 11	8, 10		1			
11	10, 11	11					
10, 12	10, 11	10					
10, 12	10, 11	9, 10					
11, 12	10, 11	11	1				
11, 12	10, 11	11, 12					
8, 11	10, 11	11					
9, 10	10, 11	10		1			
9, 10	10, 11	10, 12	1				
10, 11	10, 12	10, 11					
10, 11	10, 12	10, 13	1				
10, 13	10, 12	10, 11	1				
10, 11	10, 13	10, 12					
9, 10	10, 13	10, 12					
10, 11	11, 12	11					
10, 11	11, 12	10, 11					
10, 12	11, 12	10, 12		1			
10, 12	11, 12	12, 13					
10, 12	11, 12	8, 12					
10, 12	11, 12	9, 12					

11, 13	11, 12	11, 13					
12, 14	11, 12	10, 12					
8, 11	11, 12	11					
8, 12	11, 12	8, 12					
9, 11	11, 12	8, 11		1			
9, 11	11, 12	9, 11					
9, 12	11, 12	12	1				
9, 12	11, 12	8, 12	1				
10, 14	11, 14	10, 14	1				
12	12, 13	10, 12	2		1		
10, 12	12, 13	10, 12					
10, 13	12, 13	10, 13	1				
11, 12	12, 13	9, 12					
8, 12	12, 13	12			1		1
8, 12	12, 13	8, 12	1				
9, 13	12, 13	11, 13		1			
8, 13	13, 14	10, 13	1				
8, 10	7, 8	8		1			
8, 10	8, 11	8, 12	1	1			
8, 11	8, 12	8, 11					
8, 13	8, 12	8, 13					
8, 12	8, 13	8, 12					
8, 11	8, 9	8, 11					
9	9, 10	9	1				
10	9, 10	10, 12					
10, 11	9, 10	10		1			
10, 11	9, 10	8, 10			1		
8, 10	9, 10	8, 10					
8, 9	9, 10	9, 11	1				
9, 10	9, 11	9, 10		1			
9, 10	9, 11	9, 12	1				

9, 11	9, 12	9, 13	1				
		Sum	17	12	3	0	1
		Indicate the number of cases.	33713	39774	15530	1050	229
		Frequency	0.0005043	0.0003017	0.0001932	0.0000000	0.0043668

D8S1179 Mutations that are Indeterminate as to the Parental Origin

MOTHER'S ALLELES	CHILD'S ALLELES	FATHER'S ALLELES	Caucasian	Black	Hispanic	American Indian	East Asian (Oriental)
10, 15	10, 11	10, 13					
10, 15	10, 16	10, 15					
11	11, 12	11, 14					
11, 14	11, 12	11, 15					
10, 13	11, 13	10, 13					
12, 13	11, 12	10, 12			2		
11, 13	11, 14	11, 15		1			
12, 14	11, 14	12, 14			1		
13	12, 13	13					
13	12, 13	11, 13					
13	12, 13	13, 14					
13	12, 13	13, 15					
10, 12	12, 13	12, 14					
11, 13	12, 13	13, 15					
12, 14	12, 13	12					
9, 13	12, 13	13, 14		1			
10, 13	12, 15	13, 15					
12, 14	12, 15	12, 14					
13	12, 13	11, 13			1		
10, 12	12, 13	8, 12	1	1			
12, 13	12, 14	12, 15			1		

12, 15	12, 14	12, 13	1				
13	13, 14	13					
13	13, 14	13, 15		1	1		
14	13, 14	14					
14	13, 14	12, 14	1	1			
14	13, 14	14, 15		1	1		
10, 13	13, 14	13					
10, 14	13, 14	11, 14		1			
11, 13	13, 14	13	1				
11, 13	13, 14	13, 15			2		
11, 14	13, 14	12, 14					
11, 14	13, 14	14, 15					
12, 14	13, 14	12, 14					
13, 15	13, 14	12, 13	1				
13, 15	13, 14	13, 15	2				
14, 16	13, 14	11, 14		1			
14, 16	13, 14	12, 14					
9, 14	13, 14	14					
11, 15	13, 15	14, 15					
13, 14	13, 15	13, 14					
13	13, 14	12, 13	1				
11, 13	13, 14	8, 13	2				
12, 14	13, 14	14, 15		1			
14	14, 15	11, 14			1		
14	14, 15	12, 14	1				
14	14, 15	14, 16					
10, 14	14, 15	12, 14					
10, 14	14, 15	13, 14		1			
11, 14	14, 15	14					
11, 14	14, 15	12, 14		1			
11, 14	14, 15	13, 14	1				

12, 14	14, 15	11, 14					
12, 14	14, 15	14, 16		1			
13, 14	14, 15	13, 14	1				
13, 14	14, 15	14, 16					
13, 15	14, 15	13, 15			1		
13, 15	14, 15	15, 16					
14, 16	14, 15	12, 14					
14, 16	14, 15	13, 14		1			
14, 17	14, 15	14, 16					
15, 16	14, 15	15					
15, 16	14, 15	12, 15					
15, 16	14, 15	15, 16					
9, 15	14, 15	8, 15					
14, 15	14, 16	14, 15		1			
15	14, 15	15		1			
12, 15	14, 15	13, 15		1			
13, 15	14, 15	15		1	1		
15, 17	14, 15	13, 15		1			
14, 17	14, 16	14, 15		1			
14, 17	14, 16	14, 17		1			
15	15, 16	13, 15					
11, 15	15, 16	15		2			
12, 15	15, 16	14, 15					
13, 15	15, 16	12, 15					
13, 15	15, 16	14, 15		1			
14, 15	15, 16	15					
14, 15	15, 16	13, 15	1				
14, 16	15, 16	12, 16					
13, 16	15, 16	14, 16		1			
10, 16	16, 17	13, 16		1			
13	9, 13	13, 14	1				

		Sum	15	25	12	0	
Indicate the number of cases.			30379	40492	15675	1058	
		Frequency	0.0004938	0.0006174	0.0007656	0.0000000	

D13S317 Mutations that are Indeterminate as to the Parental Origin

MOTHER'S ALLELES	CHILD'S ALLELES	FATHER'S ALLELES	Caucasian	Black	Hispanic	American Indian	East Asian (Oriental)
8, 10	8, 9	8, 11					
8, 10	8, 11	8, 12					
9, 11	9, 10	9, 12					
9, 11	9, 12	9, 10					
11	10, 11	9, 11					
11, 12	10, 11	11	1				
11, 13	10, 11	11, 12		2			
11, 12	10, 12	11, 12					
11	11, 12	11		1			
11	11, 12	10, 11	1				
12	11, 12	12		2			
12	11, 12	12, 14	1	1			
11, 13	11, 12	11					
11, 14	11, 12	11, 13	2	1			
8, 11	11, 12	11			1		
9, 12	11, 12	12	1	1			
9, 12	11, 12	10, 12					
11	11, 13	11, 14					
11, 12	11, 13	11, 12					
11, 12	11, 13	11, 14		1			
11, 12	11, 13	9, 11					

11, 14	11, 13	11, 12		1			
12, 13	11, 13	12, 13					
12	12, 13	12	1	3			
12	12, 13	10, 12					
12	12, 13	12, 14		2			
12	12, 13	9, 12	1	4			
13	12, 13	13, 14					
10, 12	12, 13	11, 12					
10, 13	12, 13	13			1		
10, 13	12, 13	13, 14					
10, 13	12, 13	8, 13					
11, 12	12, 13	12, 14					
11, 13	12, 13	13					
11, 13	12, 13	11, 13					
12, 14	12, 13	11, 12	1	1			
12, 14	12, 13	12, 14					
7, 12	12, 13	11, 12	3	1			
8, 12	12, 13	12	1				
8, 13	12, 13	11, 13	1				
8, 13	12, 13	8, 13					
9, 13	12, 13	11, 13					
12	12, 14	12, 13					
12, 13	12, 14	12, 15					
9, 13	13, 14	12, 13	2	2	2		
13, 14	14, 15	11, 14		1	1		
11, 12	12, 13	12		1			
11, 13	12, 13	9, 13		1			
11, 14	13, 14	12, 14		1			
10, 12	10, 11	10, 12	1				
11, 13	13, 14	13	1				
11, 14	11, 12	8, 11	1				

12	11, 12	10, 12	1				
8, 10	10, 11	10, 12			1		
12, 13	11, 12	8, 12			1		
12, 14	13, 14	11, 14			1		
12	11, 12	8, 12	1				
11, 13	11, 12	11, 13	1				
11, 12	12, 13	8, 12	1				
		Sum	23	27	8	0	0
		Indicate the number of cases.	32566	40572	15523	1041	
		Frequency	0.0007063	0.0006655	0.0005154	0.0000000	

D16S539 Mutations that are Indeterminate as to the Parental Origin

MOTHER'S ALLELES	CHILD'S ALLELES	FATHER'S ALLELES	Caucasian	Black	Hispanic	American Indian	East Asian (Oriental)
10, 12	10, 11	10, 12					
10, 11	10, 12	10, 12			1		
10	10, 13	10, 12					
10, 13	10, 14	10, 15					
10,12	10,11	10,13			1		
10,11	10,12	10,11		1			
10,14	10,13	10,12			1		
11	11, 12	11					
11	11, 12	11, 13		1	1		
11	11, 12	9, 11	1	1			
12	11, 12	10, 12	1				
12	11, 12	12, 13	1				
12	11, 12	9, 12					
11, 13	11, 12	11			1		
12, 13	11, 12	12	1		1		

12, 13	11, 12	9, 12	1	1			
8, 11	11, 12	10, 11		1			
9, 11	11, 12	11, 13					
9, 12	11, 12	12, 13					
11	11, 13	11, 12					
11, 12	11, 13	11, 12		2	1		
11, 12	11, 13	11, 14					
12, 13	11, 13	10, 13					
11	11, 14	11, 13					
12	11,12	12	2				
10,12	11,12	9,12		1			
11,13	11,12	11,13	1	1			
9,11	11,12	11		1			
11,14	11,13	11,14	2				
12	12, 13	12		1	1		
12	12, 13	11, 12		1			
10, 13	12, 13	10, 13					
11, 12	12, 13	12	1				1
11, 12	12, 13	10, 12		1	1		
11, 12	12, 13	12, 14					
11, 13	12, 13	13					
13, 14	12, 13	9, 13		1			
8, 12	12, 13	12					
9, 12	12, 13	12					
9, 13	12, 13	11, 13					
13	12,13	10,13			1		
13	13, 14	12, 13					
13	13, 14	9, 13					
11, 13	13, 14	11, 13					
11, 13	13, 14	12, 13					
12, 13	13, 14	10, 13		1			

12, 13	13, 14	12, 13	1				
11,13	13,14	13	1				
9, 13	9, 10	8, 9		1			
9, 10	9, 11	9, 10					
9, 12	9, 11	9, 10					
9, 12	9, 11	9, 12					
9, 12	9, 13	9, 14					
9,11	9,10	9,11		1			
		Sum	13	17	10	0	1
		Indicate the number of cases.	31803	39988	15458	1038	229
		Frequency	0.0004088	0.0004251	0.0006469	0.0000000	0.0043668

D18S51 Mutations that are Indeterminate as to the Parental Origin

MOTHER'S ALLELES	CHILD'S ALLELES	FATHER'S ALLELES	Caucasian	Black	Hispanic	American Indian	East Asian (Oriental)
19	10, 19	19, 20		1			
13, 17	12, 13	10, 13	1				
14, 15	12, 15	14					
12, 15	12, 13	12	1				
14	13, 14	14, 18					
12, 16	13, 16	12, 16		1			
15	14, 15	13, 15					
13, 14	14, 15	14, 16					
14, 18	14, 15	14					
14, 19	14, 15	13, 14					
15, 18	14, 15	15					
15, 19	14, 19	19					
14	14, 15	14, 18	1				
15	14, 15	15		1			

14, 15	14, 16	14, 17		1			
13, 15	15, 16	12, 15					
13, 15	15, 16	15, 17	1				
13, 15	15, 16	15, 19					
13, 16	15, 16	16, 20					
15, 17	15, 16	15					
15, 18	15, 16	14, 15					
16, 17	15, 16	16					
16, 17	15, 16	12, 16	1				
16, 17	15, 16	16, 17					
14, 17	15, 17	14, 17					
15, 16	15, 17	15, 16					
15, 17	15, 18	15, 17		1			
15, 18	15, 26	15, 21					
14, 16	15, 16	16		1			
15, 17	15, 16	15, 17		1			
16, 17	15, 17	16, 17			1		
17	16, 17	11, 17					
12, 16	16, 17	16, 20					
13, 17	16, 17	13, 17		1			
14, 16	16, 17	14, 16	2				
14, 16	16, 17	16, 20					
14, 17	16, 17	15, 17					
16, 18	16, 17	16					
16, 18	16, 17	16, 18	1				
16, 19	16, 17	14, 16					
16, 20	16, 17	16		1			
17, 18	16, 17	15, 17					
17, 20	16, 17	17, 20.2					
16, 17	16, 18	16, 17					
16, 19	16, 18	16, 17					

16, 20	16, 19	16, 20					
17	16, 17	15, 17		1			
15, 16	16, 17	16, 18		1			
17	17, 18	17					
17	17, 18	10.2, 17	1				
12, 17	17, 18	15, 17					
14, 17	17, 18	16, 17					
16, 17	17, 18	15, 17	1		1		
16, 17	17, 18	16, 17					
16, 18	17, 18	16, 18					
14.2, 17	17, 19	17, 20					
17	17, 18	17, 19		1			
13, 18	17, 18	18, 20		1			
19	18, 19	16, 19					
12, 18	18, 19	14, 18		1			
12, 18	18, 19	18, 20		1			
12, 19	18, 19	17, 19					
16, 18	18, 19	18, 20					
18, 21	18, 19	12, 18					
12, 19	19, 20	19		1			
14, 19	19, 20	13, 19					
15, 19	19, 20	15, 19					
15, 19	19, 20	17, 19					
16, 19	19, 20	16, 19					
21	20, 21	18, 21		1			
12, 20	20, 21	16, 20		1			
		Sum	10	18	2	0	0
		Indicate the number of cases.	31231	38315	14679	1007	
		Frequency	0.0003202	0.0004698	0.0001362		

D19S433 Mutations that are Indeterminate as to the Parental Origin

MOTHER'S ALLELES	CHILD'S ALLELES	FATHER'S ALLELES	Caucasian	Black	Hispanic	American Indian	East Asian (Oriental)
13, 14.2	12, 13	13					1
13	13, 14	13, 13.2					
14	13, 14	12, 14					
14	13, 14	14, 15					
12, 14	13, 14	14, 14.2		1			
13, 15	13, 14	13, 15				1	
13, 15	13, 14	13, 15.2					
14, 15	13, 14	14					
14, 15	13, 14	14, 15					
13, 16	13, 15	13, 14					
13, 14	14, 15	14					
13, 14	14, 15	13, 14					1
13, 15	14, 15	12, 15					
14, 17.2	14, 15	14, 16	1				
14, 16	16, 17	13, 16					
		Sum	1	1	0	1	2
		Indicate the number of cases.	2934	748			229
		Frequncy	0.0003408	0.0013369			0.0087336

D21S11 Mutations that are Indeterminate as to the Parental Origin

MOTHER'S ALLELES	**CHILD'S ALLELES**	**FATHER'S ALLELES**	**Caucasian**	**Black**	**Hispanic**	**American Indian**	**East Asian (Oriental)**
28	28, 29	28, 30					

28	28, 29	28, 32, 2					
29	28, 29	29, 30.2					
28, 30	28, 29	28, 31					
28, 30	28, 29	28, 31.2	1				
28, 31	28, 29	28, 30		1			
29, 30	28, 29	29					
29, 31.2	28, 29	29, 30					
28, 31	28, 30	28, 29					
28, 31	28, 30	28, 31.2					
29	29, 30	29					
29	29, 30	29, 31.2					
29	29, 30	29, 32.2					
29	29, 30	29, 35					
30	29, 30	30					
30	29, 30	24.2, 30		1			
28, 29	29, 30	29, 30.2	1		1		
28, 30	29, 30	30					
28, 30	29, 30	27, 30					
29, 31	29, 30	29					
29, 31	29, 30	29, 31.2		1			
30, 31	29, 30	30	2		1		
30, 32.2	29, 30	30					
30, 32.2	29, 30	27, 30	1				
30, 34.2	29, 30	28, 30	2				
29, 30	29, 31	29, 30		1			
30, 31	29, 31	29, 31					
30	30, 31	30					
30	30, 31	28, 30		2			
30	30, 31	30, 32.2					
28, 31	30, 31	31, 32.2		1			
29 , 30	30, 31	29, 30	4	2			

29, 30	30, 31	28, 30					
30, 31.2	30, 31	30, 30.2		1			
31, 31.2	30, 31	31, 31.2					1
31, 32.2	30, 32.2	28, 32.2					
30, 32.2	30, 33.2	30, 33					
28, 32	31, 32	30, 32					
31.2	31.2, 32.2	28, 31.2					
29, 31.2	31.2, 32.2	30, 31.2	1				
30, 33.2	32.2, 33.2	30.2, 33.2					
28, 29	29, 30	29	1	1			
28, 30	28, 29	28		1			
28, 31	30, 31	29, 31		1			
28, 31	31, 32	30, 31	3	1			
28, 32.2	28, 29	27, 28		2			
28, 32.2	32.2, 33.2	32, 32.2	1	2			
29, 31	30, 31	29, 31		1			
31.2, 33.2	31.2, 32.2	29, 31.2		1			
31.2, 32.2	30.2, 31.2	29, 31.2		1			
27, 31	30, 31	29, 31	2				
28, 31	28, 29	28	1				
28, 30	30, 31	30			1		
28, 32.2	28, 31.2	28, 32.2			2		
31, 33.2	31, 32.2	31, 33.2					1
		Sum	20	21	5	0	2
		Indicate the number of cases.	33312	40408	15654	1057	229
		Frequency	0.0006004	0.0005197	0.0003194	0.0000000	0.0087336

FGA Mutations that are Indeterminate as to the Parental Origin

MOTHER'S ALLELES	CHILD'S ALLELES	FATHER'S ALLELES	Caucasian	Black	Hispanic	American Indian	East Asian (Oriental)
19, 24	19, 20	19, 22					
19, 20	19, 21	19, 22		1			
20, 23	20, 22	20, 23					
21, 22	20, 22	21, 23		1			
22, 25	20, 22	22, 23					
20, 22	20, 23	20, 24					
24, 25	20, 24	23, 24					
20, 25	20, 26	20, 27					
20, 25	20, 26	25, 27					
19, 21	21, 22	21, 23					
20, 21	21, 22	21, 25					
21, 24	21, 22	21					
22, 25	21, 22	22, 24					
21, 22	21, 23	21, 24					
21, 24	21, 25	21, 23		1			
21, 24	21, 25	21, 24			1		
21, 26	21, 25	20, 21					
21, 26	21, 25	21, 26			1		
21, 23	21, 26	21, 25					
20, 22	21, 22	22	1				
21, 23	21, 22	21, 23		1			
21, 24	21, 23	21, 22		1			
22	22, 23	22	1				
22	22, 23	22, 24		1			
22	22, 23	22, 25		1	1		
18.2, 23	22, 23	21, 23					
21, 22	22, 23	22		1			
21, 22	22, 23	22, 24	2		1		
21, 22	22, 23	22, 25			1		

21, 23	22, 23	21, 23					
22, 24	22, 23	22, 25					
23, 24	22, 23	23					
23, 24	22, 23	23, 46					
23, 24	22, 24	21, 24					
23, 26	22, 26	23, 26					
20, 22	22, 23	20, 22	1				
22, 23	22, 24	22, 23		1			
22, 25	22, 24	22, 25		1			
23	23, 24	23	1				
23	23, 24	21, 23					
23	23, 24	23, 23.3					
24	23, 24	20, 24	1		1		
19, 23	23, 24	18, 23					
19, 23	23, 24	22, 23	1				
20, 24	23, 24	22, 24		1			
21, 23	23, 24	20, 23					
22, 23	23, 24	23, 25		1			
22, 24	23, 24	24					
22, 24	23, 24	20, 24					
23, 25	23, 24	23, 25					
23, 26	23, 24	23, 25					
24, 25	23, 24	22, 24					
24, 26	23, 24	21, 24	2	1			
24, 26	23, 24	24, 28		1			
24, 27	23, 24	21, 24					
22, 25	23, 25	24, 25					
24	23, 24	24		1			
18, 2, 24	23, 24	24		1			
22, 23	23, 24	23		1			
23, 25	23, 24	22, 23	1				

24	24, 25	20, 24	1	1			
24	24, 25	21, 24					
18, 25	24, 25	21, 25	1				
18.2, 24	24, 25	23, 24					
20, 24	24, 25	21, 24			1		
20, 24	24, 25	22, 24					
20, 24	24, 25	23, 24					
21, 24	24, 25	24	1		1		
21, 24	24, 25	23, 24					
22, 24	24, 25	21, 24	1	1			
22, 24	24, 25	21, 24					
22, 25	24, 25	22, 25	1				
23, 24	24, 25	24, 26	1	1	1		
25, 26	24, 25	23, 25					
24	24, 25	24	1	1			
18, 2, 25	24, 25	25		1			
23, 25	24, 25	20, 25			1		1
25	25, 26	23, 25	1				
21, 25	25, 26	25					1
23, 26	25, 26	22.3, 26					
23, 26	25, 26	23, 26					
26, 27	25, 26	21, 26			1		
22, 25	25, 26	21, 25		1			
24, 25	25, 26	25, 28	1	1			
21, 27	27, 28	24, 27					
27	27, 28	24, 27		1			
29	28, 29	23, 29		1			
		Sum	20	26	11	0	2
		Indicate the number of cases.	29002	39572	15277	1038	229
		Frequency	0.0006896	0.0006570	0.0007200	0.0000000	0.0087336

THO Mutations that are Indeterminate as to the Parental Origin

MOTHER'S ALLELES	**CHILD'S ALLELES**	**FATHER'S ALLELES**	**Caucasian**	**Black**	**Hispanic**	**American Indian**	**East Asian (Oriental)**
7, 8	8, 9	7, 8		1			
9, 9.3	9, 10	7, 9		1			
		Sum	0	2	0	0	0
		Indicate the number of cases.	29270	40510	15665	1056	
		Frequency		0.0000494			

D2S1338 Mutations that are Indeterminate as to the Parental Origin

MOTHER'S ALLELES	CHILD'S ALLELES	FATHER'S ALLELES	Caucasian	Black	Hispanic	American Indian	East Asian (Oriental)
17, 19	17, 18	17					
17, 25	17, 19	17, 18					
17	17, 25	17, 18					
17, 26	17, 27	17, 26					
16, 21	20, 21	19, 21					
23, 24	23	20, 24					
19, 23	22, 23	20, 23					
20, 23	22, 23	21, 23					
22	22, 23	21, 22					
16, 23	23, 24	21, 23					
19, 23	23, 24	23, 25					
17, 25	24, 25	22, 25	1				
24	24, 26	24, 25					
18, 26	25, 26	17, 26					

Sum	1				
Indicate the number of cases.	2934				
Frequency	0.0003408				

VWA Mutations that are Indeterminate as to the Parental Origin

MOTHER'S ALLELES	CHILD'S ALLELES	FATHER'S ALLELES	Caucasian	Black	Hispanic	American Indian	East Asian (Oriental)
15, 16	12, 16	16, 19					
15	13, 15	15, 17			1		
15	14, 15	15, 20					
14, 18	14, 15	14					
14, 17	14, 18	14, 17					
14, 17	14, 18	14, 19	1				
15	15, 16	15, 19					
16	15, 16	16, 18					
15, 17	15, 16	15, 17					
15, 19	15, 16	15, 17					
15, 19	15, 16	15, 18					
16, 17	15, 16	16, 18					
15, 18	15, 17	15, 18	1				
15, 17	15, 18	15, 17					
15	15, 16	15		1			
14, 15	15, 16	15		2			
16, 18	15, 16	14, 16		1			
17	15, 17	17, 18	1				
15, 18	15, 17	15, 16		1			
15, 18	15, 19	15, 18		1			
17	16, 17	17, 19			1		
16	16, 17	15, 16		1			

16	16, 17	16, 18	2	2	1		
14, 16	16, 17	16					
14, 16	16, 17	14, 16		1			
14, 17	16, 17	17					
15, 16	16, 17	16	1				
15, 17	16, 17	17, 18					
15, 17	16, 17	17, 19					
16, 18	16, 17	15, 16					
16, 18	16, 17	16, 18	1				
16, 18	16, 17	16, 19					
17, 18	16, 17	17					
17, 18	16, 17	14, 17		1			
17, 19	16, 17	17					
17, 19	16, 17	17, 19					
16	16, 18	16, 17					
15, 16	16, 18	16, 17					
16, 17	16, 18	16, 17	1				
16, 17	16, 18	16, 19		2			
16, 19	16, 18	16, 17					
16, 19	16, 18	16, 19					
17, 18	16, 18	17, 18					
16, 18	16, 19	16, 18			1		
16, 18	16, 19	16, 20					
17	16, 17	17	1				
14, 17	16, 17	17, 19	1				
15, 16	16, 17	16, 18	2	1			1
15, 17	16, 17	15, 17		2			
16, 19	16, 17	16, 19		1			
17, 18	16, 17	15, 17	2				
17, 18	16, 17	17, 18	1				
15, 18	16, 18	15, 18	1				

15, 17	17, 18	17, 19					
16, 18	17, 18	18	1				
17, 19	17, 18	17					
16, 17	17, 19	17, 20					
17	17, 18	17					
17	17, 18	13, 17					
17	17, 18	14, 17	1				
17	17, 18	15, 17	1				
17	17, 18	16, 17					
17	17, 18	17, 19					
18	17, 18	18					
18	17, 18	14, 18					1
13, 18	17, 18	15, 18		1			
16, 17	17, 18	16, 17		4	1		
16, 17	17, 18	17, 19	1		1		
17, 19	17, 18	17					
18, 19	17, 18	14, 18					
18, 20	17, 18	18					
14, 17	17, 20	17, 19					
18	17, 18	16, 18	1		1		
17, 19	17, 18	15, 17		1			
16, 19	17, 19	18, 19		1			
17, 18	17, 19	17, 20	1	1			
18	18, 19	16, 18					
14, 19	18, 19	17, 19					
15, 18	18, 19	17, 18					
15, 19	18, 19	16, 19					
16, 18	18, 19	14, 18	3				
16, 18	18, 19	17, 18	1	2			
17, 18	18, 19	18	1				
17, 18	18, 19	16, 18					

17, 18	18, 19	18, 20	1				
17, 19	18, 19	19					
18, 21	18, 19	17, 18					
19, 10	18, 19	17, 19					
19	18, 19	16, 19	1				
16, 19	18, 19	19			1		
17, 19	19, 20	16, 19					
16, 20	19, 20	17, 20	2	1			
19, 20	20, 21	18, 20					
		Sum	31	28	8	0	2
		Indicate the number of cases.	34044	41110	15718	1059	229
		Frequency	0.00091059	0.0006811	0.00050897	0.0000000	0.008733624