ANNUAL REPORT SUMMARY FOR TESTING IN 2008
Prepared by the Relationship Testing Program Unit

PREFACE

The goal of the survey is to ask relevant questions, gather pertinent data, track trends in testing, and to provide information on the state of the relationship testing community. As a reminder evaluation of these data is anonymous. None of the members of the Relationship Testing Standards Program Unit (RT SPU) is aware of which laboratories submitted data. Many of the laboratories report testing a broad range of cases, including relationship tests for routine paternity testing, immigration, prenatal evaluations, and post-mortem evaluations. Almost all of the laboratories reporting performed immigration testing and reconstruction (family study) cases. Presentation of the most current data occurs every year at the AABB annual meeting.

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

The RT SPU would also like to remind readers that the *Guidance for Standards for Relationship Testing Laboratories,* discusses the *Standards* in some detail and provides suggestions on how to achieve compliance with the *Standards*. The Guidance also contains explanations on how to properly implement standards, various calculations used, and other general issues in relationship testing. The 9th edition of *Standards* went into effect on January 1, 2010 and for the first time the guidance document appears on a CD packaged with the *Standards*. All accredited laboratories will receive a copy of the *Standards* with the attached guidance CD. The RT SPU encourages all laboratories to read and review the guidance document as they implement the 9th edition.

ANNUAL VOLUME OF TESTING

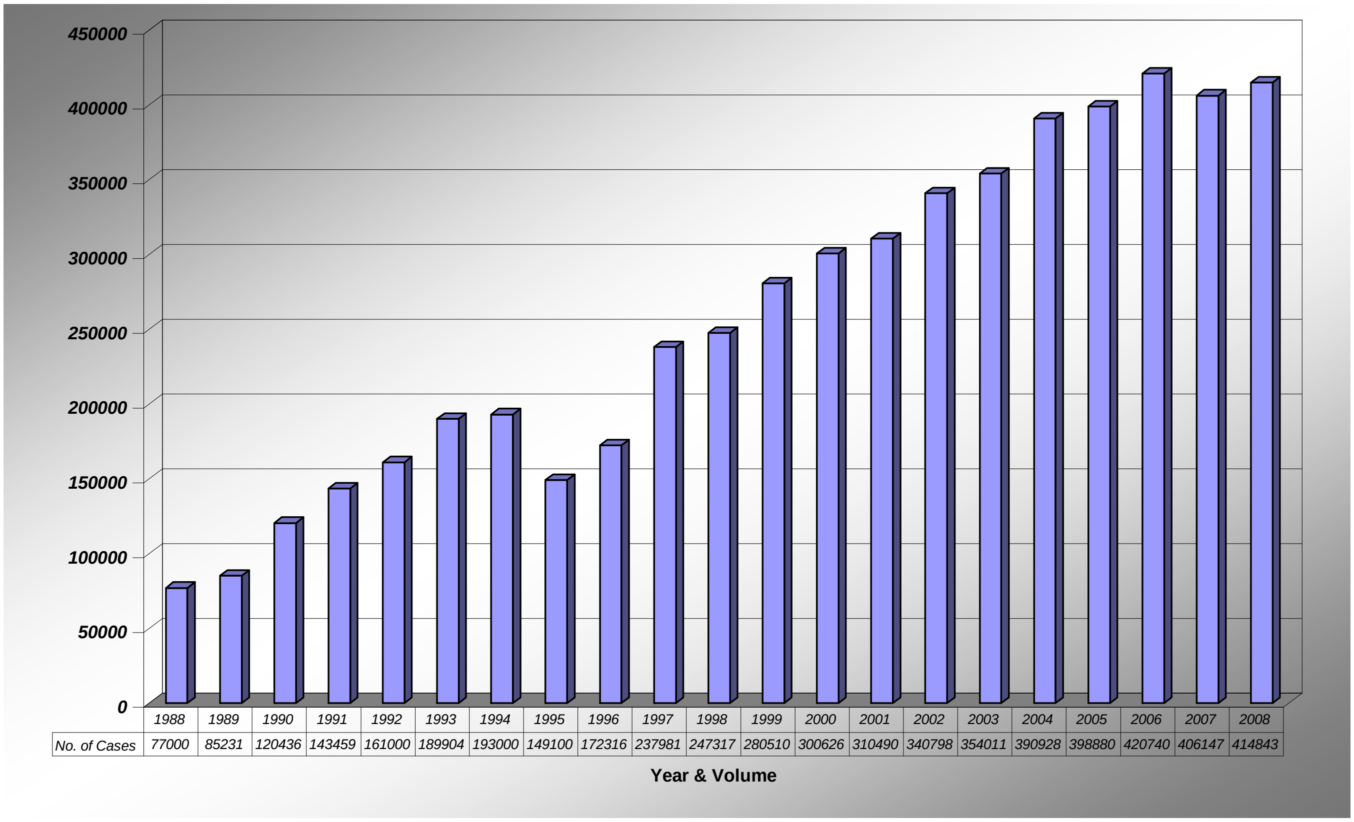
The total volume reported for cases tested in 2008 was 414,843, an increase of 1.99% over 2007. It should be noted that several laboratories did not provide data or responses to the survey. A summary of the total cases reported since 1988 is shown in Table 1 and Figure 1.

Table 1. The Number of Relationship Cases Reported for 1988-2009.

Year	No. of Cases	Year	No. of Cases
1988	77000	1999	280510
1989	85231	2000	300626
1990	120436	2001	310490
1991	143459	2002	340798
1992	161000	2003	354011
1993	189904	2004	390928
1994	193000	2005	398880
1995	149100	2006	420740
1996	172316	2007	406147
1997	237981	2008	414843

1998	247317		

Figure 1. Graph of the Case Volume for 1988-2008.



As in the past, laboratories were asked if they tested cases where the chain of custody did not meet the requirements of the *Standards for Relationship Testing*. The tested individuals, without a proper witness (see *Standards*), generally collect these so called “non-legal” tests. AABB has taken the position that it cannot prohibit accredited laboratories from performing these types of tests, but reminds laboratories that they cannot claim or advertise that their “non-legal” testing meets AABB *Standards*, nor may they state the “testing” meets the standards and only the chain of custody is lacking. Laboratories may only conform in all aspects of the *Standards* and cannot pick and choose standards to which they would like to adhere. Of the laboratories reporting, over half (58%) reported that they performed testing of this type. Those laboratories reported 5,707 non-legal cases or 1.38% of the total cases reported. This is down from the 3.35% reported in 2007; however some laboratories did not track the number of non-legal cases they evaluated or declined to provide this information. A liberal estimate would be that no more than 10% of all cases evaluated by the reporting laboratories were of a “non-legal” type. Of the laboratories performing non-legal testing, these tests account for 4.72% of their total volume.

During the revision cycle of the 9th edition, the Department of Homeland Security, United States Citizenship and Immigration Service (USCIS) and the US State Department met with the RT SPU to discuss the “non-legal” testing and potential fraud (with both legal and non-legal collections). Non-legal testing is not acceptable for immigration purposes. In 2008, the US State Department propagated new rules for collections at its overseas posts. These rules include:

1. All collections are performed at the embassy (post)
2. The collections must be witnessed by a “cleared” officer (post arranges this)

3. All kits must be sent directly to the post and must have a prepaid shipping label for shipment back to the laboratory.
4. Posts will not collect any money.
5. Posts will not be able to take pictures, so when arranging collections, the laboratories should tell their potential clients to bring a passport size photograph to the collection. The cleared officer will review the photograph to make sure it matches the person collected.
6. The sample will still be collected by a technician or panel physician (post arranges).
7. Because sibling studies do not meet their standards, they are instructing the post not to request sibling studies, other distant relationships, or "are they related" studies. Future US State Department collection should involve the parents of alleged siblings.
8. After collection, the witnessing officer then takes possession of the samples.
9. The US State Department is developing their own chain of custody form in conjunction with AABB, which will be made available to the laboratories at a later time.
10. Samples from third party administrators (TPA) are acceptable as long as the TPA has a formal (written) agreement with the laboratory that requires the TPA to follow AABB collection standards.

As they become available, other requirements will be transmitted to accredited laboratories. Note that these rules do not necessarily apply to samples collected for USCIS cases.

LABORATORIES BY SIZE

Table 2 indicates the size of the various responding laboratories by volume of cases reported. Not all of the responding laboratories provided total volumes, and only 24 laboratories out of over 40 accredited laboratories responded to the survey. This breakdown is by each laboratory, but be aware that a single corporation may own several laboratories.

Table 2. Laboratories by the Volume of Cases Reported.

Case Volumes	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
1-500	40	26	25	20	19	19	13	17	14	18	16	16	15	15	5
501-1,000	6	4	8	7	6	5	6	6	2	3	2	4	4	6	1
1,001-5,000	7	9	6	10	11	9	11	11	13	11	7	8	11	11	7
5,001-10,000	6	4	3	5	0	3	3	5	1	3	7	7	6	6	2
10,001-50,000	1	2	3	5	5	7	8	6	7	7	6	5	5	4	4
50,001 – 100,000	2	1	1	1	2	1	1	1	0	0	1	1	1	1	3

>100,000	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
Total Laboratories	**62**	**46**	**46**	**48**	**43**	**44**	**42**	**46**	**38**	**43**	**40**	**42**	**43**	**44**	**23**

EXCLUSION RATE

For 2008, some laboratories did not track the number of exclusions. For the laboratories tracking exclusions, there were 398,124 cases completed and 103,098 (25.90%) were reported as exclusions, similar to the 25.39% observed in 2007. The average exclusion rate for the laboratories reporting exclusions is 22.37% with a standard deviation of 8.05. The median exclusion rate is 23.33% with a range of 11.43% to 42.50%. The explanation for the range of exclusion rates is complex but appears related to the laboratories 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 609 exclusions from laboratories reporting exclusion data (total of 5,707 cases) or an exclusion rate of 28.67%, a higher percentage than the 25.90% seen for legal testing. The range for non-legal laboratories is 23.81 to 41.67% (one laboratory tested a single non legal case that excluded the relationship, which is not included in this range).

MISCONCEPTIONS IN PATERNITY TESTING – EXCLUSION RATE

AABB has seen the exclusion rate misused by those trying to claim that 30% of men are misled into believing they are the biological fathers of children when the mother knows this not to be true. This view is incorrect. The exclusion rate includes a number of factors. One is a woman may allege several men as possible fathers because she 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 sorts out which man is the biological father and excludes the others. Another factor is that the unexcluded alleged father, as part of his defense, will allege the mother had multiple sexual partners during the time of conception. These men are subsequently tested. Sometimes testing of a man is required because of a legal presumption, when the mother properly names the correct biological father but because the mother is married to a man who is not the child’s father (she is or was married to someone other than the biological father) there is a legal presumption the husband is the father. The husband is tested to rebut the legal presumption even though no one believes he is the biological father of the child. In each of these examples, 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 (COMBINED LIKELIHOOD RATIO)

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 (where the disputed parent is missing and other relatives are used to evaluate parentage). Some laboratories reported using varying 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 47.83% of laboratories using this value, with a range of 100 to 10,000. For mother not tested cases, the most common minimum CPI is 100 with 52.17% of laboratories using this value, with a range of 100 to 10,000. For the family study or reconstruction cases, 40% indicated that they report "whatever was obtained" and the majority considered a combined likelihood ratio of 101 or less reportable. Almost all laboratories considered a likelihood ratio of 100 or less as acceptable for sibling studies.

A common issue is the significance of the paternity index and the reliability of the AABB standard requiring a CPI of 100 to 1. The RT SPU is concerned about the meaning of the tests and thus the choice of the 100 to 1 for a reasonable level of significance. 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. The view that AABB is only concerned with the performance of the testing, but not the meaning of the test, is incorrect.

Another issue arises with regard to performing other relationship analyses such as reconstruction cases, trios with genetic anomalies, and samples from exhumations, coroners, and postmortem testing. Importantly, a CPI of less than 100 is not an indicator of no relationship, unless 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, as happens 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, who need to differentiate between reasonable science and what might be achieved under ideal conditions. The other 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.

SIBLING CALCULATIONS

Human identity laboratories are often called upon to help identify familial relationships in the absence of parental DNA, which is known as sibship testing. Sibship analyses, when submitting only two individuals for analysis, can be more demanding than parentage testing in that there are no obligatory alleles between siblings that make it possible to conclusively include or exclude the tested biological relationship. In addition, full siblings are as likely to share two alleles, identical by descent from common ancestors, as they are to share zero alleles at a given locus due to genetics. Thus a lack of shared alleles at any particular locus does not exclude a sibling relationship between two individuals. Many times additional loci will not necessarily help resolve a case.

The results for sibship analysis are expressed as a likelihood ratio and are often converted to a probability of sibship using an appropriate prior probability. Several small publications address the issues of sibship analysis and provide empirical data on the range of combined sibling-ship indices (likelihood ratios) encountered with individual pairs that are known full siblings, half-siblings, and unrelated individuals.[1,2,3]

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[1] Valentin, J. 1983. Positive Evidence of Paternity Calculated According to Essen-Moller: The Bayesian Approach. In Inclusion Probabilities in Parentage Testing. Ed. Richard H. Walker, M.D., pp 63-75.

[2] Reid, T.M., Wolf, C.A., Kraemer, C.M., Lee, S.C., Baird, M.L., and Lee, R.F. Specificity of sibship determination using the ABI Identifiler multiplex system. J. Forensic Science, 49: 1262-1264, 2004.

In one study, combined likelihood ratios for known full siblings ranged from 4.6 to over 1 billion and for random, unrelated individuals from 0.000000045 to 0.12. There was no overlap between the group of true siblings and the group of unrelated individuals.[2] In a study of known half-siblings, the combined likelihood ratio for known half-siblings ranged from 0.1 to 3763 with a median likelihood ratio of 24. The combined half-sibling indices for the unrelated pairs ranged from 0.0001 to 42 with a median likelihood ratio of 0.13. There is little overlap between the known half-siblings and unrelated pairs.[3] If a prior probability of 0.5 is correct, then a likelihood ratio of 10 to 1 (90% probability of a sibling relationship) may be considered reasonable evidence of either a full or half sibling relationship. There is need for further study.

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).

	Choice of Minimum Likelihood Ratios Used by Type of Case (% Using)				
W	**Trio**	**One Parent**	**Reconstruction**	**Full Sibling v. Unrelated**	**Half Sibling v. Unrelated**
What Ever is Obtained	**0.00**	**0.00**	**50.00**	**55.56**	**58.82**
5	**0.00**	**0.00**	**5.56**	**5.56**	**5.88**
10	**0.00**	**0.00**	**11.11**	**16.67**	**17.65**
100	**47.83**	**52.17**	**16.67**	**16.67**	**11.76**
101	**0.00**	**0.00**	**5.56**	**0.00**	**0.00**
150	**8.70**	**8.70**	**0.00**	**0.00**	**0.00**
200	**4.35**	**4.35**	**0.00**	**0.00**	**0.00**
500	**4.35**	**4.35**	**0.00**	**0.00**	**0.00**
1000	**17.39**	**17.39**	**11.11**	**5.56**	**5.88**
1001	**4.35**	**4.35**	**0.00**	**0.00**	**0.00**
2500	**4.35**	**0.00**	**0.00**	**0.00**	**0.00**
10000	**8.70**	**8.70**	**0.00**	**0.00**	**0.00**

TESTING WITHOUT THE MOTHER

There is still a strong concern about submitting disputed paternity cases without the mother since such testing presents a number of problems. First, the paternity index is, on average, 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. The mother is also an

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[3] Fu, J., Allen, R.W., Reid, T.M., and Baird, M. Considerations for the interpretation of STR results in cases of questioned half-sibship. Transfusion, 47: 515-519, 2007.

important QC step. If the mother is excluded, it may indicate a problem in 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 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, it improves the chance of obtaining clear results and is a quality control check for both the scientific and legal community. Every effort should be made to test the mother. Testing without the mother should only be done when the mother's location is unknown or she is deceased.

TECHNOLOGY USE

The 2008 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. In fact, at this time, the use of RFLP has dropped below the level of HLA molecular techniques. PCR technology was used in 99.6% and RFLP was used in 0.02% of reported cases. Y Chromosome testing continues to increase in use, albeit Y Chromosome analysis was used in only about 0.32% of cases reported. Note that the 9th edition of *Standards*, no longer contains standards for serologically tested red cell antigens, HLA serology, red cell enzymes, serum proteins, allotyping, and RFLP methods. These were dropped because of the current lack of their use in the industry. Proficiency testing may be difficult to obtain and finding any laboratory to do comparison testing may be problematic. However, if a laboratory wishes to use these methods the laboratory may refer to the appropriate testing standards in the 8th edition of *RT Standards*. Proficiency testing would need to meet the 9th edition of *RT Standards*.

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 methods for Class I HLA methods reported using serologic tables for calculating paternity indices.

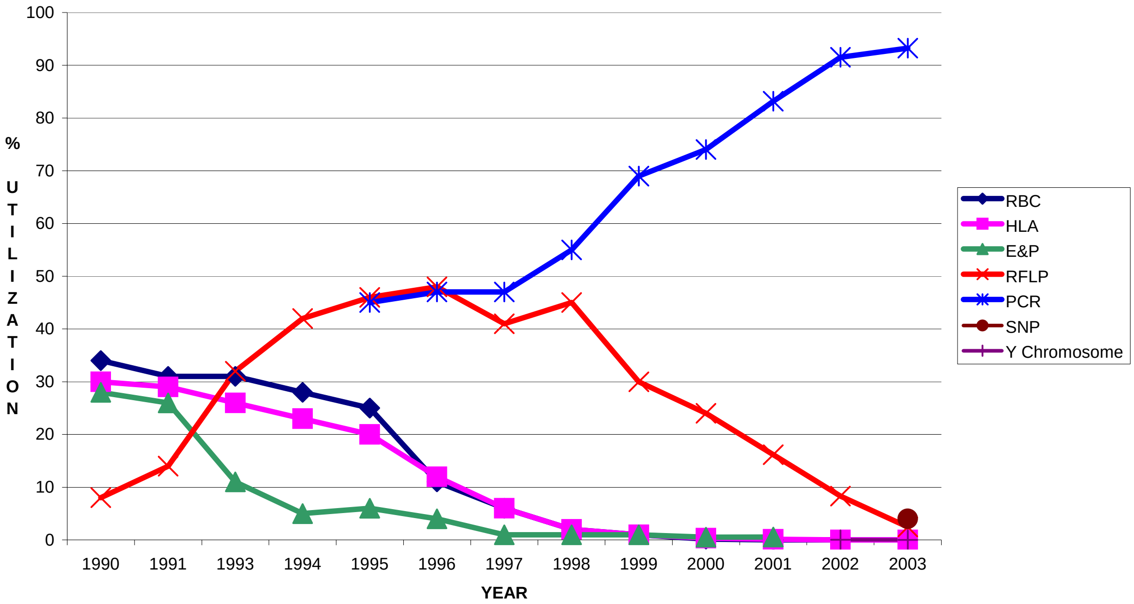
Table 4. The Technology Used in Cases Reported in 2008

Technology	Number of Cases	Utilization (%)
Red Cell Antigens	**0**	**0**
HLA Serology	**0**	**0**
HLA Class 1 Molecular	**315**	**0.08**
HLA Class II Molecular	**33**	**0.01**
Red Cell Enzymes/Serum Proteins	**0**	**0**
Allotyping	**0**	**0**
RFLP	**282**	**0.07**
STR	**412,833**	**99.59**
SNP	**0**	**0**
Y Chromosome	**1,078**	**0.26**
Total of All Technologies	**414,541**	**100**

*Note that some cases used more than one technology.

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 966,728 samples used for the casework in 2008. Of these samples, buccal swabs account for 98.5227% of the samples. Whole blood samples accounted for 0.38%. Various other samples were also reported (See Table 5). Not all laboratories reported the samples they used.

Table 5. Sample Source in 2008.

Sample	Number	Percent	Sample	Number	Percent
Buccal Swabs	952,447	98.5227	Hair	139	0.0144
Blood	3,674	0.3800	CVS	223	0.0231
Blood Spot Cards	9,279	0.9598	Products of Conception	23	0.0024
Amniotic Fluid	687	0.0711	Bone	42	0.0043

Misc. Tissues	170	0.0176	Teeth	8	0.0008
Paraffin Blocks	36	0.0037	Total	966,728	100

AMELOGENIN

A number of laboratories use the amelogenin locus to test for the gender of the sample. A number of males lacking the Y or X amelogenin allele were observed. Laboratories were asked to track the apparent X males observed in their laboratory. Like other DNA loci, amelogenin is subject to mutations. Therefore, occasionally normal males have only an X amelogenin phenotype or only a Y phenotype. There seems to be an interest in the laboratories in the East Asian (Oriental) and Asian Indian population and, as such, the data collected is presented here.

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

	Race/Ethnicity - 2008 Data - ABI Primers					
	Black	**White**	**Hispanic**	**American Indian**	**East Asian (Oriental)**	**Asian (India)**
Number X Males Observed	**7**	**16**	**15**	**0**	**6**	**3**
%	**0.0112**	**0.0345**	**0.0709**	**-**	**1.8293**	**0.0239**
Number Y Males Observed	**38**	**4**	**6**	**0**	**0**	**0**
%	**0.0607**	**0.0086**	**0.0284**	**-**	**-**	**-**
Total Number of Males Tested	**62,598**	**46,366**	**21,144**	**1,245**	**505**	**12,533**

MUTATION CALCULATION AND FREQUENCIES

Single inconsistencies are routinely seen in the testing of paternity cases. If a laboratory concludes 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 use one of several calculation methods. Some laboratories are most commonly using the mutation rate divided by the average probability of exclusion (65.22%). Some laboratories use Brenner’s method (30.43%) in looking at the repeat length difference between STR alleles and one laboratory claimed to use Fimmer’s method (4.35%).

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 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 both the 8th and 9th editions of *RT 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 there is limited data presented.

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. 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 times 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 changed 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 (indeterminate) may be incorporated. 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 = 0.00001481	0.00001481/0.0002167 = 0.0683	7 * 0.0683 = 0.478
16 to 17 Paternal	16 / 79247 = 0.0002019	0.0002019/0.0002167 = 0.9317	7 * 0.9317 = 6.522
Total	0.0002167	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 2008.

Locus	Paternal	Maternal
CSF1PO	0.002021	0.000283
D13S317	0.001743	0.000436
D16S539	0.001127	0.000481
D18S51	0.002530	0.000748
D19S453	0.000745	0.000596
D21S11	0.001709	0.001295
D2S1338	0.001526	0.000245
D3S1358	0.001691	0.000211
D5S818	0.001742	0.000300
D7S820	0.001348	0.000073
D8S1179	0.002031	0.000333
FGA	0.003713	0.000522
PENTA D	0.000259	<0.000253
PENTA E	0.000260	<0.000253
THO	0.000070	0.000043
TPOX	0.000130	0.000081
VWA	0.003258	0.000494

Appendix 2. Mutation Data

At the bottom of each table is a summary of the total mutations seen, the proportion of indeterminate mutations assigned from appendix 3, the total mutation including the indeterminate mutations, and the overall mutation rate without regard to race. The frequencies shown for the individual changes do not include indeterminate mutations. These can be incorporated following the discussion presented in the “mutation calculations and frequencies” found in the discussion above.

D8S1179 Paternal Mutations from Trios Only

Paternal Mutation – Allele:		**Caucasian**		**Black**		**Hispanic**	
From	**To**	**Number**	**Frequency**	**Number**	**Frequency**	**Number**	**Frequency**
8	**9**	**1**	**0.000015**				
9	**10**					**1**	**0.000042**
10	**8**					**1**	**0.000042**
10	**9**	**1**	**0.000015**				
10	**11**	**3**	**0.000045**	**3**	**0.000034**	**2**	**0.000084**
10	**12**			**1**	**0.000011**		
11	**10**	**2**	**0.000030**	**1**	**0.000011**	**1**	**0.000042**
11	**12**	**1**	**0.000015**	**2**	**0.000023**	**1**	**0.000042**
12	**11**	**4**	**0.000060**	**2**	**0.000023**		
12	**13**	**7**	**0.000105**	**2**	**0.000023**	**2**	**0.000084**
13	**11**	**1**	**0.000015**				
13	**12**	**10**	**0.000150**	**4**	**0.000045**	**2**	**0.000084**
13	**14**	**11**	**0.000165**	**4**	**0.000045**	**1**	**0.000042**
13	**12 or 14**			**1**	**0.000011**		
14	**12**	**1**	**0.000015**	**1**	**0.000011**		
14	**13**	**9**	**0.000135**	**10**	**0.000113**	**4**	**0.000168**
14	**15**	**8**	**0.000120**	**19**	**0.000215**	**4**	**0.000168**
14	**13 or 15**					**1**	**0.000042**
15	**14**	**8**	**0.000120**	**18**	**0.000204**	**5**	**0.000210**
15	**16**	**4**	**0.000060**	**16**	**0.000181**	**4**	**0.000168**
15	**14 or 16**			**1**	**0.000011**		
16	**15**	**4**	**0.000060**	**17**	**0.000192**	**4**	**0.000168**
16	**17**	**1**	**0.000015**	**10**	**0.000113**	**2**	**0.000084**
17	**16**	**5**	**0.000075**	**12**	**0.000136**	**1**	**0.000042**
17	**18**			**1**	**0.000011**		
18	**17**	**1**	**0.000015**	**1**	**0.000011**		
18	**19**			**1**	**0.000011**		
19	**18**	**1**	**0.000015**				
10 or 12	**11**					**1**	**0.000042**
10 or 12	**9 or 13**	**1**	**0.000015**				
10 or 15	**11 or 14**	**1**	**0.000015**				

11 or 13	12	1	0.000015	1	0.000011	1	0.000042
11 or 13	10 or 12	1	0.000015				
11 or 15	12 or 14			1	0.000011		
12 or 14	13	2	0.000030	2	0.000023	1	0.000042
12 or 15	13 or 14					1	0.000042
12 or 16	13 or 15			1	0.000011		
13 or 15	14	2	0.000030	5	0.000057	1	0.000042
13 or 15	12 or 14	1	0.000015				
13 or 16	14 or 15			1	0.000011	1	0.000042
13 or 17	14 or 16			1	0.000011		
14 or 16	15	2	0.000030	10	0.000113	1	0.000042
Total Meiosis		66604		88386		23814	
Mutations		94	0.001411	149	0.001686	43	0.001806
Indeterminate		25		42		11	
Total Mutations		119	0.001783	191	0.002159	54	0.002248
Without Race		0.002031					

D8S1179 Maternal Mutations from Trios Only							
Maternal Mutation – Allele:		Caucasian		Black		Hispanic	
From	To	Number	Frequency	Number	Frequency	Number	Frequency
8	9	1	0.000013				
11	12					1	0.000051
11	13	1	0.000013				
12	11	1	0.000013				
13	12	1	0.000013				
13	14	3	0.000040	1	0.000014	2	0.000101
14	13	3	0.000040	3	0.000041	1	0.000051
14	15	1	0.000013	6	0.000082		
15	14			1	0.000014		
15	16	2	0.000027	6	0.000082		
16	15			3	0.000041		
16	17			1	0.000014		
17	16			1	0.000014		
12 or 14	13	1	0.000013	1	0.000014		
12 or 14	13 or 15					1	0.000051
13 or 16	14 or 15			1	0.000014		
Total Meiosis		74890		73265		19764	
Total Mutations		14	0.000187	24	0.000328	5	0.000253

Indeterminate	3		8		1	
Total Mutations	17	0.000231	32	0.000439	6	0.000328
Without Race	0.000333					

D21S51 Paternal Mutations from Trios Only

Paternal Mutation – Allele:		Caucasian		Black		Hispanic	
From	To	Number	Frequency	Number	Frequency	Number	Frequency
27	26			1	0.000011		
27	28	1	0.000015	4	0.000046		
27 or 29	28					1	0.000043
28	26					1	0.000043
28	27	1	0.000015	1	0.000011	1	0.000043
28	29	2	0.000030	6	0.000069	1	0.000043
28 or 30	29	1	0.000015				
29	28	5	0.000075	2	0.000023	3	0.000129
29	30	4	0.000060	15	0.000172		
29 or 31	30			3	0.000034		
29	28 or 30	1	0.000015				
30	28	1	0.000015				
30	29	3	0.000045	4	0.000046	3	0.000129
30	31	14	0.000211	19	0.000218	4	0.000172
30 or 32	31			2	0.000023		
30	29 or 31	2	0.000030				
30.2	31.2			2	0.000023		
30.2 or 32.2	31.2	1	0.000015				
31	30	5	0.000075	5	0.000057	2	0.000086
31	32	9	0.000136	11	0.000126	3	0.000129
31.2	30.2	1	0.000015	1	0.000011		
31.2	32.2	14	0.000211	5	0.000057	4	0.000172
31.2	32.2 or 30.2					1	0.000043
31.2 or 33.2	32.2	2	0.000030	1	0.000011	1	0.000043
32	31	3	0.000045	2	0.000023		
32	33	3	0.000045	2	0.000023	1	0.000043
32.2	31.2			1	0.000011	4	0.000172
32.2	33.2	5	0.000075	17	0.000195	3	0.000129
33	32			2	0.000023		
33	34			2	0.000023		
33.2	31.2			1	0.000011		
33.2	32.2	1	0.000015	6	0.000069	2	0.000086
33.2	34.2	5	0.000075	9	0.000103	2	0.000086

34	35			2	0.000023		
34.2	33.2	1	0.000015	3	0.000034		
34.2	35.2			1	0.000011		
35	34			2	0.000023		
35	36			3	0.000034		
35.2	34.2					1	0.000043
36	35			1	0.000011		
36	37			4	0.000046		
37	36			1	0.000011		
29 or 32	30 or 31			1	0.000011		
30 or 31.2	29 or 32.2	1	0.000015				
Total Meiosis		66257		87173		23307	
Total Mutations		86	0.001298	142	0.001629	38	0.001630
Indeterminate		13		16		7	
Total Mutations		99	0.001494	158	0.001812	45	0.001931
Without Race		0.001709					

D21S51 Maternal Mutations from Trios Only

Maternal Mutation – Allele:		Caucasian		Black		Hispanic	
From	To	Number	Frequency	Number	Frequency	Number	Frequency
27	28			1	0.000014		
27 or 29	28			1	0.000014		
28	26			1	0.000014		
28	29	2	0.000027	4	0.000055		
28 or 30	29	5	0.000067				
29	28	7	0.000094	5	0.000069	1	0.000050
29	30	6	0.000080	1	0.000014		
29 or 31	30	5	0.000067	2	0.000027	2	0.000101
30	29	8	0.000107	10	0.000137		
30	31	3	0.000040	3	0.000041		
30 or 32	31			1	0.000014		
30	29 or 31			1	0.000014		
31	30	19	0.000254	12	0.000165	3	0.000151
31	32	1	0.000013	2	0.000027	1	0.000050
31 or 33	32	1	0.000013				
31	30 or 32	1	0.000013				
31.2	30.2	2	0.000027	1	0.000014	1	0.000050
31.2	32.2	1	0.000013	2	0.000027		
31.2 or	32.2	1	0.000013	1	0.000014		

33.2							
32	31	5	0.000067	6	0.000082	1	0.000050
32	33			1	0.000014		
32.2	31.2			2	0.000027		
32.2	33.2	2	0.000027	2	0.000027	1	0.000050
33	32	2	0.000027				
33	32			2	0.000027	1	0.000050
33.2	32.2	8	0.000107	11	0.000151	4	0.000202
33.2	34.2			3	0.000041	1	0.000050
34.2	33.2	3	0.000040	3	0.000041	1	0.000050
35	34			1	0.000014		
35	36			1	0.000014		
36	35			3	0.000041		
36	37			1	0.000014	1	0.000050
37	36			1	0.000014		
28 or 30.2	27 or 29.2					1	0.000050
28 or 31	27 or 30			1	0.000014		
29 or 30	28 or 31			2	0.000027		
30 or 30.2	29 or 31.2	1	0.000013				
Total Meiosis		74857		72884		19810	
Total Mutations		83	0.001109	88	0.001207	19	0.000959
Indeterminate		11		12		4	
Total Mutations		94	0.001419	100	0.001147	23	0.000987
Without Race		0.001295					

D7S820 Paternal Mutations from Trios Only

Paternal Mutation – Allele:		Caucasian		Black		Hispanic	
From	To	Number	Frequency	Number	Frequency	Number	Frequency
8	7			1	0.000020		
8	9	1	0.000024			1	0.000054
10	9	1	0.000024			2	0.000109
10	11	2	0.000048	4	0.000080	1	0.000054
11	10	2	0.000048	3	0.000060	1	0.000054
11	12	3	0.000072	8	0.000159	2	0.000109
11	10 or 12	1	0.000024				
12	11	8	0.000192	5	0.000100	2	0.000109
12	13	3	0.000072	5	0.000100	2	0.000109
13	12	8	0.000192	4	0.000080	1	0.000054
13	14	1	0.000024	3	0.000060		
14	13	4	0.000096	1	0.000020	1	0.000054
14	15			1	0.000020		
10 or 12	11	2	0.000048	1	0.000020	2	0.000109
10 or 12	11 or 13			1	0.000020		
10 or 12	9 or 11	1	0.000024				
11 or 13	12	2	0.000048	2	0.000040	1	0.000054
12 or 14	13			1	0.000020	1	0.000054
8 or 10	9	1	0.000024	1	0.000020		
8 or 13	9 or 12	1	0.000024				
9 or 11	10	1	0.000024	2	0.000040		
9 or 11	10 or 12	2	0.000048				
Total Meiosis		41696		50225		18404	
Total Mutations		44	0.001055	43	0.000856	17	0.000924
Indeterminate		14		21		9	
Total Mutations		58	0.001393	64	0.001281	26	0.001427
Without Race		0.001348					

D7S820 Maternal Mutations from Trios Only

Maternal Mutation – Allele:		Caucasian		Black		Hispanic	
From	To	Number	Frequency	Number	Frequency	Number	Frequency
8	9	1	0.000023				
9	10	1	0.000023				
10 or 12	11	1	0.000023				
9 or 11	10			1	0.000026		
Total Meiosis		44130		38792		13478	
Total Mutations		3	0.000068	1	0.000026	0	<0.000074
Indeterminate		1		1		1	
Total Mutations		4	0.000091	2	0.000052	1	0.000074
Without Race		0.000073					

CSF Paternal Mutations from Trios Only

Paternal Mutation – Allele:		Caucasian		Black		Hispanic	
From	To	Number	Frequency	Number	Frequency	Number	Frequency
8	9			2	0.000042		
9	10			3	0.000063		
10	9	1	0.000025				
10	11	3	0.000075	2	0.000042		
11	10	7	0.000174	3	0.000063	3	0.000164
11	12	2	0.000050	7	0.000146	1	0.000055
12	11	3	0.000075	8	0.000167	1	0.000055
12	13	6	0.000150	12	0.000251	7	0.000383
12	10 or 11	1	0.000025				
12	11 or 13			1	0.000021		
13	12	8	0.000199	16	0.000335	3	0.000164
13	14	7	0.000174	2	0.000042	2	0.000109
14	13	5	0.000125	6	0.000126	2	0.000109
14	15	3	0.000075	1	0.000021		
15	14	1	0.000025				
15	16	1	0.000025				
10 or 11	9 or 12					1	0.000055
10 or 12	11	2	0.000050	3	0.000063	2	0.000109
10 or 12	11 or 13			1	0.000021		
10 or 13	11or 12	3	0.000075	1	0.000021		
11 or 13	12	9	0.000224	5	0.000105	2	0.000109
11 or 13	10 or 12	2	0.000050	2	0.000042		
12 or 14	13	1	0.000025				
13 or 15	14	1	0.000025				
8 or 10	9			1	0.000021		
9 or 11	10 or 12					1	0.000055
Total Meiosis		40125		47793		18267	
Total Mutations		66	0.001645	76	0.001590	25	0.001369
Indeterminate		15		24		9	
Total Mutations		81	0.002011	100	0.002099	34	0.001838
Without Race		0.002021					

CSF Maternal Mutations from Trios Only

Maternal Mutation – Allele:		Caucasian		Black		Hispanic	
From	**To**	**Number**	**Frequency**	**Number**	**Frequency**	**Number**	**Frequency**
10	11			1	0.000109	1	0.000077
11	10					1	0.000077
11	12	1	0.000024				
12	13	3	0.000071	1	0.000109	2	0.000154
12	11 or 13						
13	12	3	0.000071	1	0.000109		
13	14			1	0.000109	1	0.000077
10 or 12	9 or 13	1	0.000024				
11 or 13	12	2	0.000047				
12 or 14	13	1	0.000024				
Total Meiosis		42318		36755		12958	
Total Mutations		11	0.000260	4	0.000109	5	0.000386
Indeterminate		2		2		2	
Total Mutations		13	0.000307	6	0.000109	7	0.000540
Without Race		0.000283					

D3S1358 Paternal Mutations from Trios Only

Paternal Mutation – Allele:		Caucasian		Black		Hispanic	
From	To	Number	Frequency	Number	Frequency	Number	Frequency
14	12			1	0.000011		
14	13			1	0.000011		
14	15	2	0.000030	1	0.000011		
15	14	1	0.000015	6	0.000069		
15	16	4	0.000060	13	0.000149	8	0.000343
15	14 or 16			1	0.000011		
16	12			1	0.000011		
16	15	8	0.000120	13	0.000149	2	0.000086
16	17	3	0.000045	17	0.000195		
16	15 or 17			3	0.000034		
17	16	6	0.000090	13	0.000149	1	0.000043
17	18	5	0.000075	16	0.000184	5	0.000214
17	16 or 18			2	0.000023		
18	17	9	0.000135	6	0.000069	3	0.000129
18	19	5	0.000075	8	0.000092	2	0.000086
19	18	10	0.000151	1	0.000011	2	0.000086
19	20	2	0.000030				
20	19	1	0.000015	2	0.000023		
14 or 16	15	2	0.000030	2	0.000023	1	0.000043
14 or 16	15			1	0.000011		
14 or 16	13 or 15	1	0.000015				
14 or 16	15 or 17			1	0.000011		
14 or 17	15 or 16	1	0.000015	1	0.000011	1	0.000043
14 or 18	16			1	0.000011		
15 or 17	16	7	0.000105	14	0.000161		
15 or 19	14 or 18	1	0.000015				
16 or 18	17	5	0.000075	6	0.000069	4	0.000171
17 or 19	18	2	0.000030	1	0.000011		
Total Meiosis		66436		87073		23339	
Total Mutations		75	0.001129	132	0.001516	29	0.001243
Indeterminant		24		28		11	
Total Mutations		99	0.001490	160	0.001838	40	0.001714
Without Race		0.001691					

D3S1358 Maternal Mutations from Trios Only

Maternal Mutation – Allele:		Caucasian		Black		Hispanic	
From	To	Number	Frequency	Number	Frequency	Number	Frequency
14	15					1	0.000055
15	13			1	0.000014		
15	14	1	0.000013				
15	16			1	0.000014	1	0.000055
16	15	2	0.000027	2	0.000028		
16	17	1	0.000013	1	0.000014	2	0.000110
17	16	1	0.000013	1	0.000014	1	0.000055
17	18	1	0.000013	1	0.000014		
18	17	2	0.000027	3	0.000041		
19	18	1	0.000013	1	0.000014		
15 or 17	16	1	0.000013				
16 or 17	15 or 18	1	0.000013				
Total Meiosis		75104		72686		18127	
Total Mutations		11	0.000146	11	0.000151	5	0.000276
Indeterminate		3		3		2	
Total Mutations		14	0.000186	14	0.000193	7	0.000386
Without Race		0.000211					

THO Paternal Mutations from Trios Only

Paternal Mutation – Allele:		**Caucasian**		**Black**		**Hispanic**	
From	**To**	**Number**	**Frequency**	**Number**	**Frequency**	**Number**	**Frequency**
7	**6**			**1**	**0.000012**		
7	**9**			**2**	**0.000024**		
8	**7**	**1**	**0.000015**	**2**	**0.000024**		
8	**9**			**2**	**0.000024**		
9	**10**	**1**	**0.000015**				
10	**11**	**1**	**0.000015**				
7 or 9	**8**	**1**	**0.000015**				
Total Meiosis		**65243**		**85047**		**20818**	
Total Mutations		**4**	**0.000061**	**7**	**0.000082**	**0**	**<0.000048**
Indeterminate		**0**		**1**		**0**	
Total Mutations		**4**	**0.000061**	**8**	**0.000094**	**0**	**0.000000**
Without Race		**0.000070**					

THO Maternal Mutations from Trios Only

Maternal Mutation – Allele:		**Caucasian**		**Black**		**Hispanic**	
From	**To**	**Number**	**Frequency**	**Number**	**Frequency**	**Number**	**Frequency**
7	**8**			**1**	**0.000014**		
8	**7**			**1**	**0.000014**	**1**	**0.000056**
9	**8**	**1**	**0.000014**	**1**	**0.000014**		
10	**9**	**1**	**0.000014**				
Total Meiosis		**73568**		**70891**		**17884**	
Total Mutations		**2**	**0.000027**	**3**	**0.000042**	**1**	**0.000056**
Indeterminate		**0**		**0**		**1**	
Total Mutations		**2**	**0.000027**	**3**	**0.000042**	**2**	**0.000112**
Without Race		**0.000043**					

D13S317 Paternal Mutations from Trios Only

Paternal Mutation – Allele:		Caucasian		Black		Hispanic	
From	**To**	**Number**	**Frequency**	**Number**	**Frequency**	**Number**	**Frequency**
8	9	3	0.000072				
9	10	1	0.000024				
10	9					1	0.000054
10	11					1	0.000054
10	12	1	0.000024				
11	10	1	0.000024	1	0.000020		
11	12	6	0.000144	5	0.000100	1	0.000054
12	11	2	0.000048	7	0.000140	1	0.000054
12	13	6	0.000144	7	0.000140	2	0.000108
12	11or 13			1	0.000020		
13	12	11	0.000264	5	0.000100	3	0.000163
13	14	2	0.000048	6	0.000120		
13	14	1	0.000024	1	0.000020		
13	12 or 14	1	0.000024				
14	13	4	0.000096	8	0.000160	8	0.000434
14	15	4	0.000096	3	0.000060	4	0.000217
14	15	1	0.000024	1	0.000020		
15	14	4	0.000096	3	0.000060		
15	14			2	0.000040		
15	16	1	0.000024				
10 or 12	11	1	0.000024	1	0.000020	1	0.000054
10 or 13	11 or 12	1	0.000024				
11 or 13	12	1	0.000024	10	0.000200	1	0.000054
11 or 13	12	1	0.000024	1	0.000020		
11 or 13	12 or 14			1	0.000020	1	0.000054
11 or 14	12 or 13			1	0.000020		
12 or 14	13	5	0.000120	5	0.000100		
9 or 11	8 or 12	2	0.000048				
Total Meiosis		41593		50102		18434	

Total Mutations	**60**	**0.001443**	**69**	**0.001377**	**24**	**0.001302**
Indeterminate	**11**		**20**		**8**	
Total Mutations	**71**	**0.001707**	**89**	**0.001776**	**32**	**0.001736**
Without Race	**0.001743**					

D13S317 Maternal Mutations from Trios Only

Maternal Mutation – Allele:		**Caucasian**		**Black**		**Hispanic**	
From	**To**	**Number**	**Frequency**	**Number**	**Frequency**	**Number**	**Frequency**
11	**10**			**1**	**0.000025**		
11	**12**	**3**	**0.000068**	**2**	**0.000051**		
12	**11**	**2**	**0.000045**	**1**	**0.000025**		
12	**13**	**3**	**0.000068**	**4**	**0.000101**	**1**	**0.000066**
13	**11**	**1**	**0.000023**				
13	**12**	**2**	**0.000045**	**1**	**0.000025**		
13	**14**	**1**	**0.000023**	**3**	**0.000076**	**1**	**0.000066**
14	**15**			**1**	**0.000025**		
15	**14**			**1**	**0.000025**		
10 or 11	**9 or 12**					**1**	**0.000066**
10 or 12	**11**			**1**	**0.000025**		
11 or 13	**12**	**2**	**0.000045**	**2**	**0.000051**		
Total Meiosis		**44036**		**39429**		**15207**	
Total Mutations		**14**	**0.000318**	**17**	**0.000431**	**3**	**0.000197**
Indeterminate		**2**		**6**		**1**	
Total Mutations		**16**	**0.000363**	**23**	**0.000583**	**4**	**0.000263**
Without Race		**0.000436**					

D16S539 Paternal Mutations from Trios Only

Paternal Mutation – Allele:		**Caucasian**		**Black**		**Hispanic**	
From	**To**	**Number**	**Frequency**	**Number**	**Frequency**	**Number**	**Frequency**
9	**8**			**1**	**0.000011**		
9	**10**	**1**	**0.000015**	**2**	**0.000023**		
10	**11**	**1**	**0.000015**	**3**	**0.000034**		
11	**10**			**1**	**0.000011**		
11	**12**	**6**	**0.000090**	**9**	**0.000103**	**1**	**0.000043**
12	**10**			**1**	**0.000011**		
12	**11**	**6**	**0.000090**	**3**	**0.000034**	**1**	**0.000043**
12	**13**	**10**	**0.000151**	**13**	**0.000149**	**2**	**0.000086**
13	**12**	**5**	**0.000075**	**8**	**0.000092**	**2**	**0.000086**
13	**14**	**10**	**0.000151**	**16**	**0.000184**	**2**	**0.000086**
14	**13**	**7**	**0.000105**	**5**	**0.000057**	**3**	**0.000130**
14	**15**	**3**	**0.000045**	**8**	**0.000092**	**2**	**0.000086**
15	**14**	**3**	**0.000045**				
15	**16**	**1**	**0.000015**				
10 or 12	**11**			**1**	**0.000011**		
11 or 12	**10 or 13**			**1**	**0.000011**		
11 or 13	**12**	**2**	**0.000030**	**8**	**0.000092**		
11 or 14	**10 or 13**			**1**	**0.000011**		
12 or 14	**13**	**3**	**0.000045**	**2**	**0.000023**		
12 or 15	**13 or 14**						
13 or 15	**14**	**1**	**0.000015**				
9 or 11	**10 or 12**					**1**	**0.000043**
Total Meiosis		**66374**		**87098**		**23148**	
Total Mutations		**59**	**0.000889**	**83**	**0.000953**	**14**	**0.000605**
Indeterminate		**16**		**24**		**3**	
Total Mutations		**75**	**0.001130**	**107**	**0.001229**	**17**	**0.000734**
Without Race		**0.001127**					

D16S539 Maternal Mutations from Trios Only							
Maternal Mutation – Allele:		**Caucasian**		**Black**		**Hispanic**	
From	**To**	**Number**	**Frequency**	**Number**	**Frequency**	**Number**	**Frequency**
9	10					1	0.000051
11	10	1	0.000013				
12	11	5	0.000067	5	0.000069	3	0.000152
12	13	1	0.000013	1	0.000014	1	0.000051
12	11 or 13			1	0.000014		
13	12	6	0.000081	6	0.000083	2	0.000102
13	14	3	0.000040	3	0.000042	1	0.000051
13	12 or 14					1	0.000051
14	13	2	0.000027	4	0.000055	1	0.000051
14	15	1	0.000013				
15	14	2	0.000027				
10 or 12	11			1	0.000014		
10 or 12	9 or 11			1	0.000014		
11 or 13	12	3	0.000040				
11 or 13	10 or 12			1	0.000014		
11 or 13	12 or 14	1	0.000013				
12 or 14	13	1	0.000013	1	0.000014		
12 or 14	11 or 13	1	0.000013				
9 or 11	10	1	0.000013				
Total Meiosis		74511		72089		19688	
Total Mutations		28	0.000376	24	0.000333	10	0.000508
Indeterminate		7		8		3	
Total Mutations		35	0.000470	32	0.000444	13	0.000660
Without Race		0.000481					

D2S1338 Paternal Mutations from Trios Only

Paternal Mutation – Allele:		Caucasian		Black		Hispanic	
From	**To**	**Number**	**Frequency**	**Number**	**Frequency**	**Number**	**Frequency**
16	17	1	0.000035	1	0.000026	1	0.000215
17	16	1	0.000035	1	0.000026		
17	18	3	0.000105	1	0.000026		
18	19	1	0.000035				
19	18			1	0.000026		
19	20	1	0.000035	2	0.000052		
20	18						
20	19	2	0.000070	6	0.000157		
20	21	2	0.000070	2	0.000052		
21	20			2	0.000052	1	0.000215
21	22	1	0.000035	2	0.000052		
22	21			1	0.000026	1	0.000215
22	23			4	0.000105		
23	22	2	0.000070	5	0.000131		
23	24	4	0.000140	2	0.000052		
23	22 or 24			1	0.000026		
24	23	1	0.000035	2	0.000052	1	0.000215
24	25	2	0.000070	7	0.000183		
25	23			1	0.000026		
25	24	1	0.000035	6	0.000157		
25	26	3	0.000105				
26	25	3	0.000105	6	0.000157		
26	27			1	0.000026		
16 or 19	17 or 20					1	0.000215
17 or 19	18			1	0.000026		
18 or 20	17 or 19			1	0.000026		
18 or 21	19 or 22			1	0.000026		
19 or 21	20			1	0.000026		
20 or 22	21			1	0.000026		
21 or 23	22			1	0.000026		

22 or 24	23	1	0.000035	3	0.000079		
24 or 26	25	1	0.000035	2	0.000052		
Total Meiosis		28602		38167		4653	
Total Mutations		30	0.001049	65	0.001703	5	0.001075
Indeterminate		3		6		0	
Total Mutations		33	0.001154	71	0.001860	5	0.001075
Without Race		0.001526					

D2S1338 Maternal Mutations from Trios Only

Maternal Mutation – Allele:		Caucasian		Black		Hispanic	
From	To	Number	Frequency	Number	Frequency	Number	Frequency
16	17	1	0.000029				
17	16			1	0.000029		
17	18			1	0.000029		
18	16			1	0.000029		
18	19			1	0.000029		
19	21			2	0.000058		
20	19			1	0.000029		
21	20	1	0.000029				
22	20	1	0.000029				
22	21			1	0.000029		
24	25			1	0.000029		
24	28			1	0.000029		
25	26	1	0.000029	2	0.000058		
26	25	1	0.000029				
Total Meiosis		34259		34730		4425	
Total Mutations		5	0.000146	12	0.000346	0	<0.000226
Indeterminate		0		1		0	
Total Mutations		5	0.000146	13	0.000374	0	0.000000
Without Race		0.000245					

D19S453 Paternal Mutations from Trios Only							
Paternal Mutation – Allele:		Caucasian		Black		Hispanic	
From	To	Number	Frequency	Number	Frequency	Number	Frequency
11	13			1	0.000025		
12	11	1	0.000034				
12	13	1	0.000034				
12.2	11.2			1	0.000025		
12.2	13.2	1	0.000034				
13	15	1	0.000034				
13.2	12.2			1	0.000025		
14	13	7	0.000237	1	0.000025		
14	15	1		3	0.000074	1	0.000210
14.2	15.2	1		1	0.000025		
15	14	1		1	0.000025		
15	16	2					
15.2	14.2	1		2	0.000049	1	0.000210
15.2	16.2			2	0.000049		
16	17	1	0.000034			1	0.000210
16.2	15.2	2		1	0.000025	1	0.000210
17	16	2		1	0.000025	1	0.000210
17.2	16.2	1		2	0.000049		
11 or 13	12			1	0.000025		
13 or 15	14			1	0.000025	1	0.000210
14 or 16	15			1	0.000025		
Total Meiosis		29525		40845		4764	
Total Mutations		23	0.000779	20	0.000494	6	0.001259
Indeterminate		4		2		1	
Total Mutations		27	0.000914	22	0.000543	7	0.001469
Without Race		0.000745					

D19S453 Maternal Mutations from Trios Only							
Maternal Mutation – Allele:		Caucasian		Black		Hispanic	
From	To	Number	Frequency	Number	Frequency	Number	Frequency
12	11			2	0.000054		
13	12	4	0.000113	1	0.000027		
13	14			1	0.000027		
13.2	11.2			1	0.000027		
13.2	12.2			2	0.000054		
14	13	2	0.000056	3	0.000081		
14	15	1	0.000028	1	0.000027		
14.2	13.2			1	0.000027		
14.2	15.2			1	0.000027		
15	14	3	0.000085	1	0.000027	2	0.000440
15	16			1	0.000027		
15	14 or 16	1	0.000028				
15.2	16.2			1	0.000027		
16	15			1	0.000027		
16	17			1	0.000027		
16.2	15.2	1	0.000028	2	0.000054		
12 or 15.2	11 or 14.2			1	0.000027		
13 or 15	14			2	0.000054		
14 or 15	13 or 16			1	0.000027		
14 or 16	15	1	0.000028	1	0.000027		
15 or 17	16	1	0.000028				
Total Meiosis		35430		37177		4550	
Total Mutations		14	0.000395	25	0.000672	2	0.000440
Indeterminate		2		3		0	
Total Mutations		16	0.000452	28	0.000753	2	0.000440
Without Race		0.000596					

VWA Paternal Mutations from Trios Only

Paternal Mutation – Allele:		Caucasian		Black		Hispanic	
From	To	Number	Frequency	Number	Frequency	Number	Frequency
From	To						
13	14			1	0.000011		
15	14	3	0.000045	4	0.000046	1	0.000042
15	16	4	0.000060	6	0.000068	2	0.000084
15	17	1	0.000015				
16	14	2	0.000030			1	0.000042
16	15	1	0.000015	8	0.000091	2	0.000084
16	17	5	0.000075	11	0.000125	3	0.000126
17	15	1	0.000015				
17	16	20	0.000299	19	0.000216	5	0.000209
17	18	16	0.000239	20	0.000228	7	0.000293
17	16 or 18	2	0.000030				
18	17	19	0.000284	23	0.000262	6	0.000251
18	19	20	0.000299	20	0.000228	7	0.000293
18	17 or 19	1	0.000015				
19	18	19	0.000284	26	0.000296	9	0.000377
19	20	16	0.000239	20	0.000228	4	0.000167
20	19	7	0.000105	14	0.000159	4	0.000167
20	21	3	0.000045	5	0.000057	1	0.000042
21	20	2	0.000030	9	0.000103		
21	22			1	0.000011	1	0.000042
22	21			2	0.000023		
23	22			1	0.000011		
14 or 16	15			2	0.000023		
15 or 17	16	4	0.000060	10	0.000114		
15 or 17	14 or 16			1	0.000011		
15 or 17	16 or 18			1	0.000011		
15 or 18	14 or 17	1	0.000015				
15 or 18	16 or 17			2	0.000023		
15 or 19	16 or 18	1	0.000015				

16 or 20	18			1	0.000011		
16 or 17	15 or 18			2	0.000023		
16 or 18	17	9	0.000134	14	0.000159	7	0.000293
16 or 18	15 or 17			1	0.000011	2	0.000084
16 or 18	17 or 19	1	0.000015	1	0.000011	1	0.000042
16 or 19	17 or 18			1	0.000011	1	0.000042
17 or 18	16 or 19	1	0.000015				
17 or 19	18	14	0.000209	7	0.000080	2	0.000084
17 or 19	16 or 18	1	0.000015				
17 or 19	16 or 20			1	0.000011		
18 or 20	19	3	0.000045	3	0.000034		
18 or 20	19	2	0.000030	1	0.000011		
Total Meiosis		66978		87779		23884	
Total Mutations		179	0.002673	238	0.002711	66	0.002763
Indeterminate		48		41		10	
Total Mutations		227	0.003389	279	0.003178	76	0.003182
Without Race		0.003258					

VWA Maternal Mutations from Trios Only

Maternal Mutation – Allele:		Caucasian		Black		Hispanic	
From	To	Number	Frequency	Number	Frequency	Number	Frequency
14	15	1	0.000013				
14	16			1	0.000014		
15	14			2	0.000028		
15	16			1	0.000014		
16	15			1	0.000014		
16	17	1	0.000013	6	0.000083	1	0.000055
17	15					1	0.000055
17	16			1	0.000014		
17	18	2	0.000027	5	0.000069		
18	16			1	0.000014		
18	17	2	0.000027	2	0.000028	1	0.000055
18	19	4	0.000053	5	0.000069	1	0.000055
19	18	1	0.000013	1	0.000014	1	0.000055
19	20			4	0.000055	1	0.000055
20	19	2	0.000027	1	0.000014		
20	21	2	0.000027	3	0.000041		
21	20	3	0.000040	1	0.000014		
15 or 17	16			1	0.000014		
16 or 18	17	2	0.000027				
16 or 19	17 or 18			1	0.000014		
17 or 19	18	1	0.000013				
17 or 19	18 or 20	1	0.000013				
17 or 20	16 or 19	1	0.000013				
19 or 21	20			1	0.000014		
Total Meiosis		75254		72673		18139	
Total Mutations		23	0.000306	38	0.000523	6	0.000331
Indeterminate		6		8		1	
Total Mutations		29	0.000385	46	0.000633	7	0.000386
Without Race		0.000494					

TPOX Paternal Mutations from Trios Only

Paternal Mutation – Allele:		**Caucasian**		**Black**		**Hispanic**	
From	**To**	**Number**	**Frequency**	**Number**	**Frequency**	**Number**	**Frequency**
8	**7**					**1**	**0.000059**
10	**11**			**1**	**0.000020**		
11	**10**	**1**	**0.000024**	**3**	**0.000061**		
11	**12**					**1**	**0.000059**
12	**11**	**1**	**0.000024**			**1**	**0.000059**
10 or 12	**11**					**1**	**0.000059**
9 or 11	**10**					**1**	**0.000059**
Total Meiosis		**41445**		**49307**		**16846**	
Total Mutations		**2**	**0.000048**	**4**	**0.000081**	**5**	**0.000297**
Indeterminate		**2**		**1**		**0**	
Total Mutations		**4**	**0.000097**	**5**	**0.000101**	**5**	**0.000297**
Without Race		**0.000130**					

TPOX Maternal Mutations from Trios Only

Maternal Mutation – Allele:		**Caucasian**		**Black**		**Hispanic**	
From	**To**	**Number**	**Frequency**	**Number**	**Frequency**	**Number**	**Frequency**
9	**10**			**1**	**0.000026**		
11	**10**	**1**	**0.000023**			**2**	**0.000130**
11	**12**	**1**	**0.000023**	**1**	**0.000026**		
12	**11**					**1**	**0.000065**
Total Meiosis		**44271**		**38608**		**15441**	
Total Mutations		**2**	**0.000045**	**2**	**0.000052**	**3**	**0.000194**
Indeterminate		**1**		**0**		**0**	
Total Mutations		**3**	**0.000068**	**2**	**0.000052**	**3**	**0.000194**
Without Race		**0.000081**					

D18S51 Paternal Mutations from Trios Only

Paternal Mutation – Allele:		Caucasian		Black		Hispanic	
From	To	Number	Frequency	Number	Frequency	Number	Frequency
12	11			3	0.000037		
12	13	3	0.000048	1	0.000012	1	0.000045
12	14			1	0.000012		
13	12	3	0.000048	3	0.000037	1	0.000045
13	14	1	0.000016	3	0.000037		
14	12	1	0.000016				
14	13	3	0.000048	1	0.000012		
14	15	4	0.000064	3	0.000037	2	0.000089
15	14	2	0.000032	10	0.000124		
15	16	4	0.000064	9	0.000112	2	0.000089
16	13	1	0.000016				
16	14	1	0.000016	1	0.000012		
16	15	4	0.000064	3	0.000037	2	0.000089
16	17	4	0.000064	15	0.000186	3	0.000134
16	18			1	0.000012		
16	15 or 17	1	0.000016	1	0.000012		
17	14	1	0.000016				
17	15			1	0.000012		
17	16	1	0.000016	12	0.000149		
17	18	4	0.000064	13	0.000161	5	0.000223
17	16 or 18	1	0.000016	1	0.000012		
18	17	5	0.000079	9	0.000112		
18	19	7	0.000111	20	0.000248	2	0.000089
18.2	19.2			1	0.000012		
19	17	1	0.000016	1	0.000012	1	0.000045
19	18	4	0.000064	10	0.000124	2	0.000089
19	20	8	0.000127	20	0.000248	1	0.000045
19.2	18.2			1	0.000012		
19.2	20.2			1	0.000012		
20	19	4	0.000064	20	0.000248	1	0.000045
20	21	4	0.000064	14	0.000174	1	0.000045
21	19			2	0.000025		
21	20	1	0.000016	12	0.000149	1	0.000045
21	22			6	0.000074		
21.2	22.2			1	0.000012		
22	21			7	0.000087	1	0.000045
22	23	2	0.000032	4	0.000050	1	0.000045

23	**21**	**1**	**0.000016**				
23	**22**	**2**	**0.000032**	**6**	**0.000074**	**3**	**0.000134**
23	**24**			**2**	**0.000025**	**1**	**0.000045**
24	**23**	**1**	**0.000016**	**3**	**0.000037**		
24	**25**	**1**	**0.000016**				
25	**24**			**1**	**0.000012**		
12 or 14	**13**	**1**	**0.000016**				
12 or 15	**13 or 16**			**1**	**0.000012**		
13 or 15	**14**	**2**	**0.000032**	**2**	**0.000025**		
14 or 16	**15**	**3**	**0.000048**	**1**	**0.000012**		
14 or 18	**13 or 17**	**1**	**0.000016**				
15 or 17	**16**	**1**	**0.000016**	**5**	**0.000062**		
15 or 19	**16 or 18**			**1**	**0.000012**		
15 or 21	**16 or 20**			**1**	**0.000012**		
16 or 18	**17**	**3**	**0.000048**	**4**	**0.000050**		
16 or 18	**20**	**1**	**0.000016**				
17 or 19	**18**	**1**	**0.000016**	**7**	**0.000087**	**1**	**0.000045**
18 or 20	**19**			**5**	**0.000062**		
18 or 20	**17 or 19**			**1**	**0.000012**		
20 or 22	**21**			**2**	**0.000025**		
21 or 23	**22**			**1**	**0.000012**		
Total Meiosis		62932		80662		22390	
Total Mutations		**93**	**0.001478**	**254**	**0.003149**	**32**	**0.001429**
Indeterminate		**14**		**25**		**2**	
Total Mutations		**107**	**0.001700**	**279**	**0.003459**	**34**	**0.001519**
Without Race		**0.002530**					

D18S51 Maternal Mutations from Trios Only

Maternal Mutation – Allele:		Caucasian		Black		Hispanic	
From	To	Number	Frequency	Number	Frequency	Number	Frequency
10	11			1	0.000015		
11	12	1	0.000014				
12	13	2	0.000028				
12	14	1	0.000014	1	0.000015		
13	12	1	0.000014				
13	14	3	0.000043				
14	15	3	0.000043			2	0.000108
15	13	1	0.000014				
15	14			1	0.000015		
15	16	2	0.000028	2	0.000030	2	0.000108
16	15					1	0.000054
16	17	2	0.000028	4	0.000059	1	0.000054
16	18			1	0.000015		
17	16			2	0.000030		
17	18	3	0.000043	5	0.000074	2	0.000108
17	19			1	0.000015		
18	17			2	0.000030		
18	19	4	0.000057	5	0.000074	1	0.000054
18	20			1	0.000015		
18	17 or 19	1	0.000014				
19	18	1	0.000014	1	0.000015		
19	20	2	0.000028	4	0.000059	3	0.000162
20	18			1	0.000015		
20	19			1	0.000015		
20	21	1	0.000014	7	0.000104	1	0.000054
21	20			1	0.000015		
21	22	2	0.000028	1	0.000015	1	0.000054
22	21	1	0.000014	1	0.000015		
22	23			2	0.000030	1	0.000054
23	22	1	0.000014	2	0.000030		
24	25			1	0.000015		
26	27			1	0.000015		
12 or 14	13			1	0.000015		
13 or 15	14	1	0.000014			1	0.000054

15 or 16	**14 or 17**			**1**	**0.000015**		
15 or 17	**16**			**1**	**0.000015**		
15 or 17	**16 or 18**	**1**	**0.000014**	**1**	**0.000015**		
17 or 19	**18**			**1**	**0.000015**		
18 or 20	**17 or 19**			**1**	**0.000015**		
Total Meiosis		**70480**		**67402**		**18478**	
Total Mutations		**34**	**0.000482**	**55**	**0.000816**	**16**	**0.000866**
Indeterminate		**4**		**7**		**1**	
Total Mutations		**38**	**0.000539**	**62**	**0.000920**	**17**	**0.000920**
Without Race		**0.000748**					

D5S818 Paternal Mutations from Trios Only

Paternal Mutation – Allele:		**Caucasian**		**Black**		**Hispanic**	
From	**To**	**Number**	**Frequency**	**Number**	**Frequency**	**Number**	**Frequency**
8	**9**			**1**	**0.000020**		
9	**10**	**1**	**0.000024**				
11	**10**	**2**	**0.000048**	**6**	**0.000119**	**1**	**0.000059**
11	**12**	**2**	**0.000048**	**2**	**0.000040**	**1**	**0.000059**
12	**11**	**4**	**0.000096**	**6**	**0.000119**		
12	**13**	**8**	**0.000191**	**15**	**0.000298**	**5**	**0.000296**
12	**11 or 13**	**2**	**0.000048**				
13	**12**	**5**	**0.000119**	**8**	**0.000159**	**1**	**0.000059**
13	**14**	**3**	**0.000072**	**11**	**0.000219**	**1**	**0.000059**
13	**15**	**1**	**0.000024**				
14	**13**	**9**	**0.000215**	**9**	**0.000179**	**2**	**0.000118**
14	**15**			**3**	**0.000060**		
15	**14**	**2**	**0.000048**	**2**	**0.000040**		
10 or 12	**11 or 13**			**1**	**0.000020**	**1**	**0.000059**
10 or 12	**9 or 11**	**1**	**0.000024**				
11 or 13	**12**	**6**	**0.000143**	**4**	**0.000079**	**2**	**0.000118**
11 or	**10 or**					**1**	**0.000059**

13	**12**						
12 or 14	**13**	**6**	**0.000143**	**7**	**0.000139**		
12 or 14	**11 or 13**			**1**	**0.000020**		
11	**10**			**1**	**0.000020**		
Total Meiosis		**41853**		**50335**		**16891**	
Total Mutations		**52**	**0.001242**	**77**	**0.001530**	**15**	**0.000888**
Indeterminate		**19**		**19**		**8**	
Total Mutations		**71**	**0.001696**	**96**	**0.001907**	**23**	**0.001362**
Without Race		**0.001742**					

D5S818 Maternal Mutations from Trios Only

Maternal Mutation – Allele:		**Caucasian**		**Black**		**Hispanic**	
From	**To**	**Number**	**Frequency**	**Number**	**Frequency**	**Number**	**Frequency**
9	**10**			**1**	**0.000026**		
11	**12**	**3**	**0.000068**	**1**	**0.000026**		
12	**11**			**1**	**0.000026**		
12	**13**	**1**	**0.000023**	**1**	**0.000026**		
13	**12**			**1**	**0.000026**		
13	**14**	**1**	**0.000023**	**3**	**0.000077**		
14	**13**	**1**	**0.000023**			**1**	**0.000073**
14	**15**			**1**	**0.000026**		
15	**14**	**1**	**0.000023**				
10 or 12	**11 or 13**			**1**	**0.000026**		
11 or 13	**12**	**1**	**0.000023**	**2**	**0.000051**		
Total Meiosis		**44314**		**38850**		**13615**	
Total Mutations		**8**	**0.000181**	**12**	**0.000309**	**1**	**0.000073**
Indeterminate		**3**		**4**		**1**	
Total Mutations		**11**	**0.000248**	**16**	**0.000412**	**2**	**0.000147**
Without Race		**0.000300**					

<table>
<tr><th colspan="8">FGA Paternal Mutations from Trios Only</th></tr>
<tr><th colspan="2">Paternal Mutation – Allele:</th><th colspan="2">Caucasian</th><th colspan="2">Black</th><th colspan="2">Hispanic</th></tr>
<tr><th>From</th><th>To</th><th>Number</th><th>Frequency</th><th>Number</th><th>Frequency</th><th>Number</th><th>Frequency</th></tr>
<tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>17</td><td>18</td><td></td><td></td><td>1</td><td>0.000012</td><td></td><td></td></tr>
<tr><td>18</td><td>19</td><td></td><td></td><td>1</td><td>0.000012</td><td></td><td></td></tr>
<tr><td>18.2</td><td>17.2</td><td></td><td></td><td>1</td><td>0.000012</td><td></td><td></td></tr>
<tr><td>19</td><td>18</td><td></td><td></td><td>1</td><td>0.000012</td><td>1</td><td>0.000043</td></tr>
<tr><td>19</td><td>20</td><td>1</td><td>0.000015</td><td>2</td><td>0.000024</td><td></td><td></td></tr>
<tr><td>20</td><td>19</td><td>5</td><td>0.000077</td><td></td><td></td><td></td><td></td></tr>
<tr><td>20</td><td>21</td><td>6</td><td>0.000092</td><td>4</td><td>0.000048</td><td></td><td></td></tr>
<tr><td>20.2</td><td>18.2</td><td></td><td></td><td>1</td><td>0.000012</td><td></td><td></td></tr>
<tr><td>20.2</td><td>21.2</td><td></td><td></td><td>1</td><td>0.000012</td><td></td><td></td></tr>
<tr><td>21</td><td>20</td><td>2</td><td>0.000031</td><td>2</td><td>0.000024</td><td></td><td></td></tr>
<tr><td>21</td><td>22</td><td>14</td><td>0.000216</td><td>13</td><td>0.000155</td><td>1</td><td>0.000043</td></tr>
<tr><td>22</td><td>19</td><td></td><td></td><td>1</td><td>0.000012</td><td></td><td></td></tr>
<tr><td>22</td><td>20</td><td>2</td><td>0.000031</td><td>3</td><td>0.000036</td><td></td><td></td></tr>
<tr><td>22</td><td>21</td><td>6</td><td>0.000092</td><td>8</td><td>0.000095</td><td>2</td><td>0.000085</td></tr>
<tr><td>22</td><td>23</td><td>10</td><td>0.000154</td><td>26</td><td>0.000310</td><td>3</td><td>0.000128</td></tr>
<tr><td>22</td><td>21 or 23</td><td></td><td></td><td></td><td></td><td>1</td><td>0.000043</td></tr>
<tr><td>22.2</td><td>23.2</td><td>1</td><td>0.000015</td><td></td><td></td><td></td><td></td></tr>
<tr><td>23</td><td>21</td><td></td><td></td><td>2</td><td>0.000024</td><td></td><td></td></tr>
<tr><td>23</td><td>22</td><td>6</td><td>0.000092</td><td>17</td><td>0.000203</td><td>2</td><td>0.000085</td></tr>
<tr><td>23</td><td>24</td><td>11</td><td>0.000170</td><td>34</td><td>0.000406</td><td>1</td><td>0.000043</td></tr>
<tr><td>23</td><td>22 or 24</td><td></td><td></td><td>1</td><td>0.000012</td><td></td><td></td></tr>
<tr><td>23.2</td><td>22.2</td><td>1</td><td>0.000015</td><td></td><td></td><td></td><td></td></tr>
<tr><td>24</td><td>23</td><td>13</td><td>0.000200</td><td>18</td><td>0.000215</td><td>7</td><td>0.000299</td></tr>
<tr><td>24</td><td>25</td><td>24</td><td>0.000370</td><td>35</td><td>0.000418</td><td>5</td><td>0.000213</td></tr>
<tr><td>24</td><td>26</td><td>1</td><td>0.000015</td><td></td><td></td><td></td><td></td></tr>
<tr><td>24</td><td>23 or 25</td><td>1</td><td>0.000015</td><td></td><td></td><td>1</td><td>0.000043</td></tr>
<tr><td>25</td><td>23</td><td>1</td><td>0.000015</td><td>1</td><td>0.000012</td><td></td><td></td></tr>
<tr><td>25</td><td>24</td><td>10</td><td>0.000154</td><td>22</td><td>0.000263</td><td>8</td><td>0.000341</td></tr>
<tr><td>25</td><td>26</td><td>15</td><td>0.000231</td><td>33</td><td>0.000394</td><td>8</td><td>0.000341</td></tr>
<tr><td>25</td><td>24 or 26</td><td>1</td><td>0.000015</td><td>1</td><td>0.000012</td><td>1</td><td>0.000043</td></tr>
<tr><td>26</td><td>25</td><td>15</td><td>0.000231</td><td>12</td><td>0.000143</td><td>9</td><td>0.000384</td></tr>
<tr><td>26</td><td>27</td><td>5</td><td>0.000077</td><td>8</td><td>0.000095</td><td>12</td><td>0.000512</td></tr>
<tr><td>27</td><td>25</td><td>1</td><td>0.000015</td><td></td><td></td><td></td><td></td></tr>
<tr><td>27</td><td>26</td><td>5</td><td>0.000077</td><td>4</td><td>0.000048</td><td>4</td><td>0.000171</td></tr>
<tr><td>27</td><td>28</td><td>2</td><td>0.000031</td><td>7</td><td>0.000084</td><td></td><td></td></tr>
<tr><td>28</td><td>27</td><td></td><td></td><td>3</td><td>0.000036</td><td>2</td><td>0.000085</td></tr>
<tr><td>28</td><td>29</td><td>2</td><td>0.000031</td><td>6</td><td>0.000072</td><td></td><td></td></tr>
</table>

29	**30**			**1**	**0.000012**	**2**	**0.000085**
30	**31**			**1**	**0.000012**		
30.2	**31.2**			**1**	**0.000012**		
31	**32**			**1**	**0.000012**		
31.2	**30.2**			**1**	**0.000012**		
43.2	**42.2**			**1**	**0.000012**		
46.2	**45.2**			**2**	**0.000024**		
46.2	**47.2**			**1**	**0.000012**		
47.2	**46.2**			**1**	**0.000012**		
48.2	**47.2**			**1**	**0.000012**		
19 or 21	**20**			**1**	**0.000012**		
20 or 22	**21**	**4**	**0.000062**	**2**	**0.000024**	**2**	**0.000085**
20 or 24	**19 or 23**	**1**	**0.000015**				
20 or 25	**21 or 24**	**1**	**0.000015**				
21 or 22	**20 or 23**	**1**	**0.000015**				
21 or 23	**22**	**2**	**0.000031**				
21 or 23	**20 or 22**			**1**	**0.000012**		
21 or 24	**22 or 23**	**1**	**0.000015**				
21 or 26	**22 or 25**			**1**	**0.000012**		
22 or 23	**21 or 24**	**1**	**0.000015**				
22 or 24	**23**	**5**	**0.000077**	**5**	**0.000060**		
22 or 26	**21 or 25**					**1**	**0.000043**
23 or 25	**24**	**5**	**0.000077**	**7**	**0.000084**		
23 or 25	**24 or 26**					**1**	**0.000043**
24 or 25	**23 or 26**					**1**	**0.000043**
24 or 26	**25**	**2**	**0.000031**	**4**	**0.000048**	**2**	**0.000085**
24 or 26	**23 or 25**					**1**	**0.000043**
25 or 27	**26**	**1**	**0.000015**	**4**	**0.000048**		
Total Meiosis		**64892**		**83774**		**23449**	
Total Mutations		**185**	**0.002851**	**305**	**0.003641**	**78**	**0.003326**
Indeterminate		**30**		**30**		**11**	
Total Mutations		**215**	**0.003313**	**335**	**0.003999**	**89**	**0.003795**
Without Race		**0.003713**					

FGA Maternal Mutations from Trios Only

Maternal Mutation – Allele:		Caucasian		Black		Hispanic	
From	To	Number	Frequency	Number	Frequency	Number	Frequency
18	19	1	0.000014				
19	20	2	0.000027	2	0.000029		
20	19			1	0.000014		
20	21	3	0.000041			1	0.000050
21	20	3	0.000041	2	0.000029		
21	22					1	0.000050
22	20			1	0.000014		
22	21	2	0.000027	1	0.000014		
22	23			2	0.000029	1	0.000050
23	22	2	0.000027	3	0.000043	1	0.000050
23	22			4	0.000057		
23	24			2	0.000029	1	0.000050
24	23	1	0.000014	5	0.000072		
24	25	2	0.000027	1	0.000014		
24	23 or 25	1	0.000014				
25	21					1	0.000050
25	24	3	0.000041	2	0.000029		
25	26	4	0.000055	2	0.000029		
26	25	2	0.000027	1	0.000014		
26	27	1	0.000014	2	0.000029		
27	26	1	0.000014	1	0.000014		
27	28			2	0.000029		
28	27			2	0.000029		
21 or 23	22			1	0.000014		
22 or 24	23	1	0.000014				
23 or 24	22 or 25	1	0.000014				
23 or 25	24	1	0.000014	1	0.000014		
23 or 25	22 or 24					1	0.000050

Total Meiosis	**73090**		**69861**		**19976**	
Total Mutations	**31**	**0.000424**	**38**	**0.000544**	**7**	**0.000350**
Indeterminate	**4**		**4**		**1**	
Total Mutations	**35**	**0.000479**	**42**	**0.000601**	**8**	**0.000400**
Without Race	**0.000522**					

Appendix 3.

At the bottom of each table are the numbers used to apportion the indeterminate mutations between paternal and maternal origin. The method used is described in the “mutation calculation and frequency” section. The numbers used in the apportionment include the paternal and maternal mutations from Appendix 2, the relative percent of maternal and paternal mutations, and the number of mutations assigned to either paternal of maternal origin.

D7S820 Mutations that are Indeterminate as to the Parental Origin - Not including parent (mother or father) not tested cases

MOTHER’S ALLELES	CHILD’S ALLELES	FATHER’S ALLELES	Caucasian	Black	Hispanic
10	10, 11	10			1
10	10, 11	10, 12		3	
10	10, 11	8, 10			1
10, 12	10, 11	9, 10			1
10, 13	10, 11	8, 10			1
8, 10	10, 11	10	1	1	
8, 10	10, 11	8, 10			1
8, 11	10, 11	8, 11			1
9, 10	10, 11	10, 12	1		
10, 11	10, 12	10, 11		1	
12	11, 12	10, 12	1		
10, 11	11, 12	11			1
10, 12	11, 12	9, 12		1	
11, 13	11, 12	9, 11	1		
12, 14	11, 12	10, 12	1		
9, 11	11, 12	9, 11	1	1	
12	12, 13	12	1		
13	12, 13	11, 13			1
10, 12	12, 13	12, 14		1	
10, 12	12, 13	12, 14	1		
10, 13	12, 13	13, 14		1	
12, 13	12, 14	12, 13		1	
13	13, 14	13, 15	2		
11, 13	13, 14	13, 15			1
12, 13	13, 14	13, 16	1		
14, 15	13, 14	14		1	
13, 15	13, 16	13, 15			1
14	14, 15	11, 14		1	
14, 16	14, 15	14	1	1	
14, 16	14, 15	11, 14		1	

11, 16	15, 16	13, 16		1	
13, 15	15, 16	15		1	
8, 9	7, 8	8, 12	1		
8, 10	8, 11	8, 12		1	
8, 12	8, 11	8, 10		1	
9	9, 10	8, 9	1		
10	9, 10	10, 12		1	
10	9, 10	8, 10		1	
10, 11	9, 10	10, 10.1		1	
9, 10	9, 11	9, 12	1		
8, 12	9, 12	8, 12		1	
	Total Mutations		15	22	10
Total Mutations Paternal			0.001055	0.000856	0.000924
Total Mutations Maternal			0.000068	0.000026	0.000074
Total			0.001123	0.000882	0.000998
	% Paternal		0.939478	0.970770	0.925830
	% Maternal		0.060522	0.029230	0.074170
	Paternal		14	21	9
	Maternal		1	1	1

D21S11 Mutations that are Indeterminate as to the Parental Origin - Not including parent (mother or father) not tested cases

MOTHER'S ALLELES	CHILD'S ALLELES	FATHER'S ALLELES	Caucasian	Black	Hispanic
27, 29	27, 30	29, 31		1	
27, 32	27, 31	27, 32		1	
28	28, 29	28			1
29	28, 29	27, 29	1		
27, 29	28, 29	29, 31.2		1	
28, 30	28, 29	28, 30	1		1
28, 30	28, 29	28, 31.2	2		
28, 30	28, 29	28, 33.2		1	
28, 31.2	28, 29	28, 32.2		1	
28, 32.2	28, 29	28		2	
29, 31.2	28, 29	29, 30		2	
28, 31	28, 30	28, 31	1		1
29, 30	28, 30	29, 30		1	
28, 32	28, 31	28, 30	1		
28, 34.2	28, 35.2	28, 34.2		1	

29	29, 30	29, 31		1	
29	29, 30	29, 32.2	1		
30	29, 30	30	2		
28, 29	29, 30	29		1	
28, 30	29, 30	27, 30		1	
29, 31	29, 30	29	2	1	
29, 31	29, 30	28, 29	1		
29, 31	29, 30	29, 31.2		1	
29, 33.2	29, 30	27, 29		1	
30, 32.2	29, 30	30		1	1
29, 33.2	29, 34.2	29, 33.2			1
30	30, 31	30	1	1	1
28, 31	30, 31	31, 32.2	2	1	
29 ,30	30, 31	29, 30	1		1
29, 30	30, 31	30	1		1
29, 30	30, 31	27, 30	1		
29, 30	30, 31	28, 30		1	
29, 30	30, 31	30, 32		1	
30, 31.2	30, 31	30, 30.2	1		1
30, 31.2	30, 31	30, 32		1	
30, 32	30, 31	30	1		1
30, 32	30, 31	30, 33.2	1		
30, 36	30, 31	28, 30		1	
30.2, 31	30, 31	29, 31		1	
30, 30.2	30, 31.2	30, 32.2	1		
29, 32.2	30, 32.2	29, 32.2		1	
30, 33.2	30, 33.2	29, 32.2		1	
28, 31.2	30.2, 31.2	28, 31.2		1	
30.2, 32	31, 32	28, 32	1		
28, 31.2	31.2, 32.2	31, 31.2	1		
32.2	32.2, 33.2	29, 32.2			1
	Total Mutations		24	28	11
Total Mutations Paternal			0.001298	0.001629	0.001630
Total Mutations Maternal			0.001109	0.001207	0.000959
Total			0.002407	0.002836	0.002590
	% Paternal		0.539305	0.574312	0.629618
	% Maternal		0.460695	0.425688	0.370382
	Paternal		13	16	7
	Maternal		11	12	4

CSF1PO Mutations that are Indeterminate as to the Parental Origin - Not including parent (mother or father) not tested cases

MOTHER’S ALLELES	CHILD’S ALLELES	FATHER’S ALLELES	Caucasian	Black	Hispanic
10	10, 11	10		1	
10	10, 11	10, 12	1	2	
10	10, 11	10, 13	1		
10, 12	10, 11	10, 12		1	1
11, 12	10, 11	11		1	
7, 11	10, 11	9, 11		1	
10, 11	10, 12	10, 11	1	1	
10, 11	10, 12	10, 13	1		
10, 13	10, 12	10, 11		1	
11, 12	10, 12	11, 12	1		
10, 12	10, 13	10, 12		2	
11	11, 12	11		1	1
11	11, 12	10, 11	2		
11	11, 12	11, 13		3	1
11	11, 12	7, 11		1	
10, 11	11, 12	10, 11		1	
10, 11	11, 12	11, 13	2		1
10, 12	11, 12	12		2	
10, 12	11, 12	10, 12	1		
11, 13	11, 12	11, 13	1		
12, 13	11, 12	10, 12		1	
8, 11	11, 12	11, 14		1	
9, 11	11, 12	11, 13		1	1
11, 13	11, 14	11, 13		1	
11, 13	11, 14	11, 15	1		
12	12, 13	10, 12			1
12	12, 13	11, 12			2
12	12, 13	12, 14			1
12	12, 13	8, 12			1
10, 12	12, 13	12			1
10, 12	12, 13	12		1	
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	1	
8, 12	12, 13	12	1		

8, 12	12, 13	8, 12			
11, 13	13, 14	10, 13	1	1	
	Total Mutations		17	26	11
Total Mutations Paternal			0.001645	0.001590	0.001369
Total Mutations Maternal			0.000260	0.000109	0.000386
Total			0.001905	0.001699	0.001754
	% Paternal		0.863536	0.935946	0.780067
	% Maternal		0.136464	0.064054	0.219933
	Paternal		15	24	9
	Maternal		2	2	2

D3S1358 Mutations that are Indeterminate as to the Parental Origin - Not including parent (mother or father) not tested cases					
MOTHER'S ALLELES	CHILD'S ALLELES	FATHER'S ALLELES	Caucasian	Black	Hispanic
15	14, 15	15		1	
14, 16	14, 15	14, 17	1		
14, 18	14, 15	14, 16		1	
15, 16	14, 15	9, 15		1	
15, 17	14, 15	15			1
15, 17	14, 15	15, 18			1
15, 18	14, 15	15, 17	1		
14, 16	14, 17	14, 18		1	
14, 18	14, 17	14, 16		1	
15	15, 16	15	2	1	
15	15, 16	15, 17		1	
16	15, 16	16	1		1
16	15, 16	14, 16		1	
16	15, 16	16, 17		1	
16	15, 16	16, 17	1	1	
13, 16	15, 16	14, 16		1	
14, 15	15, 16	15, 18		1	
14, 16	15, 16	14, 16	1		
14, 16	15, 16	16, 17		1	
15, 17	15, 16	15	2		
15, 17	15, 16	15, 17	2		1
15, 18	15, 16	15, 17		1	1
16, 17	15, 16	16		3	
16, 17	15, 16	14, 16	1		

16, 18	**15, 16**	**16**			
15, 16	**15, 17**	**15, 16**	**1**		
15, 17	**15, 18**	**15, 17**			**1**
15, 18	**15, 19**	**15, 18**	**1**		
16	**16, 17**	**16**	**1**		
16	**16, 17**	**14, 16**		**1**	
16	**16, 17**	**16, 18**		**1**	
17	**16, 17**	**17**		**1**	
17	**16, 17**	**15, 17**			**1**
17	**16, 17**	**17, 18**	**1**		
14, 16	**16, 17**	**15, 16**			**2**
14, 16	**16, 17**	**16, 18**			**1**
14, 17	**16, 17**	**15, 17**		**1**	
15, 16	**16, 17**	**16**		**1**	**1**
15, 16	**16, 17**	**15, 16**	**1**		
15, 17	**16, 17**	**17**			**1**
15, 17	**16, 17**	**17, 18**	**1**		
16, 18	**16, 17**	**16**		**1**	
16, 18	**16, 17**	**16, 18**	**1**		
16, 20	**16, 17**	**14, 16**	**1**		
17, 18	**16, 17**	**14, 17**	**2**		
17, 19	**16, 17**	**15, 17**	**1**		
16, 19	**16, 18**	**16, 17**		**1**	
17, 18	**16, 18**	**15, 18**	**1**		
14, 17	**17, 18**	**15, 17**	**1**		
14, 18	**17, 18**	**15, 18**	**1**		
15, 17	**17, 18**	**15, 17**		**2**	
16, 17	**17, 18**	**16, 17**		**2**	
16, 17	**17, 18**	**17, 19**			**1**
16, 18	**17, 18**	**18**	**1**		
15, 18	**18, 19**	**16, 18**		**2**	
17, 18	**18, 19**	**16, 18**		**1**	
	Total Mutations		**27**	**31**	**13**
Total Mutations Paternal			**0.001129**	**0.001516**	**0.001243**
Total Mutations Maternal			**0.000146**	**0.000151**	**0.000276**
Total			**0.001275**	**0.001667**	**0.001518**
	% Paternal		**0.885160**	**0.909233**	**0.818339**
	% Maternal		**0.114840**	**0.090767**	**0.181661**
	Paternal		**24**	**28**	**11**
	Maternal		**3**	**3**	**2**

THO Mutations that are Indeterminate as to the Parental Origin - Not including parent (mother or father) not tested cases

MOTHER'S ALLELES	CHILD'S ALLELES	FATHER'S ALLELES	Caucasian	Black	Hispanic
7, 9	7, 8	7			1
7, 9	7, 8	7, 9		1	
	Total Mutations		0	1	1
Total Mutations Paternal			0.000061	0.000082	0.000048
Total Mutations Maternal			0.000027	0.000042	0.000056
Total			0.000088	0.000125	0.000104
	% Paternal		0.692799	0.660436	0.461912
	% Maternal		0.307201	0.339564	0.538088
	Paternal		0	1	0
	Maternal		0	0	1

D13S317 Mutations that are Indeterminate as to the Parental Origin - Not including parent (mother or father) not tested cases

MOTHER'S ALLELES	CHILD'S ALLELES	FATHER'S ALLELES	Caucasian	Black	Hispanic
11, 12	10, 11	11		1	
11, 12	10, 11	9, 11		1	
8, 11	10, 11	11, 13	1		
9, 11	10, 11	8, 11	1		
12, 14	10, 12	12, 14		1	
11	11, 12	10, 11	3		
11	11, 12	11, 13	1	1	
11, 13	11, 12	11	1		
11, 13	11, 12	11, 13		1	
11, 14	11, 12	11, 13		1	2
8, 11	11, 12	11		1	
9, 12	11, 12	12, 13		1	
11	11, 13	11, 14			
11, 12	11, 13	11, 12	1	1	

11, 13	11, 14	11, 13		1	
12	12, 13	12		3	
12	12, 13	12, 14		1	
12	12, 13	9, 12		1	
10, 12	12, 13	11, 12			1
11, 12	12, 13	10, 12	1	1	
11, 13	12, 13	13		1	
11, 13	12, 13	11, 13			1
12, 14	12, 13	12		1	
7, 12	12, 13	11, 12	1	1	
8, 12	12, 13	12	3	2	2
12	12, 14	11, 12			1
12, 13	12, 14	12, 13		1	
13, 14	12, 14	11, 14		1	
12, 14	13, 14	11, 14			1
9, 13	13, 14	13			1
9, 13	13, 14	12, 13		3	
	Total Mutations		13	26	9
Total Mutations Paternal			0.001443	0.001377	0.001302
Total Mutations Maternal			0.000318	0.000431	0.000197
Total			0.001760	0.001808	0.001499
	% Paternal		0.819411	0.761575	0.868413
	% Maternal		0.180589	0.238425	0.131587
	Paternal		11	20	8
	Maternal		2	6	1

D16S539 Mutations that are Indeterminate as to the Parental Origin - Not including parent (mother or father) not tested cases

MOTHER'S ALLELES	CHILD'S ALLELES	FATHER'S ALLELES	Caucasian	Black	Hispanic
11	10, 11	11		1	
11, 12	10, 11	11		1	
9, 11	10, 11	11		1	
9, 11	10, 11	9, 11		1	

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

9, 14	9, 13	9, 12		1	
9, 14	9, 13	9, 14		1	
	Total Mutations		23	32	6
Total Mutations Paternal			0.000889	0.000953	0.000605
Total Mutations Maternal			0.000376	0.000333	0.000508
Total			0.001265	0.001286	0.001113
	% Paternal		0.702864	0.741092	0.543533
	% Maternal		0.297136	0.258908	0.456467
	Paternal		16	24	3
	Maternal		7	8	3

D2S1338 Mutations that are Indeterminate as to the Parental Origin - Not including parent (mother or father) not tested cases

MOTHER'S ALLELES	CHILD'S ALLELES	FATHER'S ALLELES	Caucasian	Black	Hispanic
19, 23	19, 20	19, 23		2	
18, 20	20, 21	20, 25		1	
21, 25	20, 25	21, 25		1	
22, 23	21, 22	17, 22		1	
17, 23	22, 23	23, 25		1	
19, 23	22, 23	18, 23		1	
18, 24	23, 24	24	1		
18, 25	24, 25	18, 25	1		
19, 25	25, 26	19, 25	1		
	Total Mutations		3	7	0
Total Mutations Paternal			0.001049	0.001703	0.001075
Total Mutations Maternal			0.000146	0.000346	0.000226
Total			0.001195	0.002049	0.001301
	% Paternal		0.877851	0.831334	0.826231
	% Maternal		0.122149	0.168666	0.173769
	Paternal		3	6	0
	Maternal		0	1	0

D19S433 Mutations that are Indeterminate as to the Parental Origin - Not including parent (mother or father) not tested cases

MOTHER'S ALLELES	CHILD'S ALLELES	FATHER'S ALLELES	Caucasian	Black	Hispanic
13, 15.2	11, 13	13, 14	1		
13, 14	12, 13	13, 14		1	
13	13, 14	13		1	
13	13, 14	13, 15	1		
12.2, 14	13, 14	14, 14.2		1	
13, 14	14, 15	14, 16	1		
13, 15	14, 15	13, 15		1	
14, 16	14, 15	14	1		1
15, 16	14, 15	13, 15	1		
13, 15.2	14.2, 15.2	15.2	1		
13, 15	15, 16	12, 15		1	
	Total Mutations		6	5	1
Total Mutations Paternal			0.000779	0.000494	0.001259
Total Mutations Maternal			0.000395	0.000672	0.000440
Total			0.001174	0.001166	0.001699
	% Paternal		0.663462	0.423509	0.741284
	% Maternal		0.336538	0.576491	0.258716
	Paternal		4	2	1
	Maternal		2	3	0

VWA Mutations that are Indeterminate as to the Parental Origin - Not including parent (mother or father) not tested cases

MOTHER'S ALLELES	CHILD'S ALLELES	FATHER'S ALLELES	Caucasian	Black	Hispanic
15, 17	14, 15	15		1	
15	15, 16	15, 17		1	
16	15, 16	16, 17		1	1
15, 17	15, 16	15, 17		1	
15, 17	15, 16	15, 18	1		
15, 18	15, 16	15, 18		1	
16, 17	15, 16	16			1
16, 18	15, 16	16, 17		1	
16, 19	15, 16	16		1	
16, 20	15, 16	16		1	

15, 16	15, 17	15, 16		1	
15, 16	15, 17	15, 18	1		
15, 18	15, 17	15, 16		1	
17, 18	15, 17	17, 18			1
16	16, 17	16, 18	2	1	1
16	16, 17	16, 19			1
17	16, 17	17	1		
17	16, 17	14, 17	1		
17	16, 17	15, 17		1	
11, 16	16, 17	16, 18		1	
13, 17	16, 17	15, 17	1		
14, 16	16, 17	14, 16		1	
15, 16	16, 17	15, 16		2	
15, 16	16, 17	16, 18		1	
15, 17	16, 17	17, 18	1	1	
15, 17	16, 17	17, 19		1	1
16, 18	16, 17	16	2		
16, 18	16, 17	16, 18	2		
16, 18	16, 17	16, 19	2		
16, 19	16, 17	14, 16	1		
16, 19	16, 17	16, 18		1	
16, 19	16, 17	16, 19	1		
17, 18	16, 17	17, 18	1		
17, 20	16, 17	17, 18		1	
16, 17	16, 18	16, 17		3	1
16, 17	16, 18	16, 19	1		
16, 19	16, 18	16, 17	1		
16, 18	16, 19	16, 18	1		
17, 20	16, 20	17, 20		1	
16, 20	16, 21	16, 20	1		
16	16. 17	16	1		
17	17, 18	17	2	2	
17	17, 18	14, 17	1	1	
17	17, 18	15, 17	1	1	
17	17, 18	16, 17	1		
17	17, 18	17, 19	2		
17	17, 18	17, 20	1		
18	17, 18	15, 18	1		
18	17, 18	15, 18		1	
18	17, 18	16, 18	1		
14, 18	17, 18	18	1		
15, 17	17, 18	17			1
15, 17	17, 18	15, 17		1	

15, 17	**17, 18**	**17, 19**		**1**	
15, 18	**17, 18**	**13, 18**		**1**	
15, 18	**17, 18**	**16, 18**		**2**	
16, 17	**17, 18**	**17**	**2**	**1**	
16, 17	**17, 18**	**16, 17**	**1**	**1**	**2**
16, 17	**17, 18**	**17, 19**		**1**	
16, 18	**17, 18**	**18**		**1**	
16, 18	**17, 18**	**11, 18**			**1**
18, 19	**17, 18**	**18**		**1**	
16, 19	**17, 19**	**18, 19**		**1**	
17, 18	**17, 19**	**17, 18**	**1**	**1**	
18	**18, 19**	**18, 20**	**1**		
14, 18	**18, 19**	**18**	**1**		
14, 18	**18, 19**	**15, 18**	**1**		
14, 19	**18, 19**	**17, 19**	**1**		
15, 18	**18, 19**	**18**		**1**	
15, 18	**18, 19**	**15, 18**		**1**	
15, 19	**18, 19**	**16, 19**	**1**	**2**	
16, 18	**18, 19**	**14, 18**	**1**	**1**	
16, 19	**18, 19**	**15, 19**	**1**		
17, 18	**18, 19**	**18**	**1**		
17, 18	**18, 19**	**16, 18**	**2**	**1**	
17, 18	**18, 19**	**18, 20**	**1**		
17, 19	**18, 19**	**16, 19**	**2**		
16, 20	**19, 20**	**17, 20**	**1**		
17, 19	**19, 20**	**15, 19**	**1**		
17, 19	**19, 20**	**16, 19**	**1**		
17, 20	**19, 20**	**15, 20**	**1**	**1**	
	Total Mutations		**54**	**49**	**11**
Total Mutations Paternal			**0.002673**	**0.002711**	**0.002763**
Total Mutations Maternal			**0.000306**	**0.000523**	**0.000331**
Total			**0.002978**	**0.003234**	**0.003094**
	% Paternal		**0.897375**	**0.838327**	**0.893095**
	% Maternal		**0.102625**	**0.161673**	**0.106905**
	Paternal		**48**	**41**	**10**
	Maternal		**6**	**8**	**1**

TPOX Mutations that are Indeterminate as to the Parental Origin - Not including parent (mother or father) not tested cases

MOTHER'S ALLELES	CHILD'S ALLELES	FATHER'S ALLELES	Caucasian	Black	Hispanic
8, 11	11, 12	8, 11	1		
8, 11	7, 8	8, 10	1		
6, 8	8, 9	8, 10		1	
8, 10	8, 9	8, 12	1		
	Total Mutations		3	1	0
Total Mutations Paternal			0.000048	0.000081	0.000297
Total Mutations Maternal			0.000045	0.000052	0.000194
Total			0.000093	0.000133	0.000491
	% Paternal		0.516485	0.610292	0.604378
	% Maternal		0.483515	0.389708	0.395622
	Paternal		2	1	0
	Maternal		1	0	0

D18S51 Mutations that are Indeterminate as to the Parental Origin - Not including parent (mother or father) not tested cases

MOTHER'S ALLELES	CHILD'S ALLELES	FATHER'S ALLELES	Caucasian	Black	Hispanic
12	11, 12	12	1		
12, 17	12, 13	12	1		
12, 15	12, 16	15, 18		1	
14, 18	13, 14	12, 14	1		
15, 19	13, 15	15, 22		1	
13, 14	14, 15	14, 16			1
13, 15	14, 15	15, 19		1	
15, 19	14, 15	15		1	
13, 16	14, 16	15, 16	1		
14, 18	14, 16	12, 14	1		
14, 19	14, 18	14, 19		1	
14, 18	14, 19	14, 20		1	
15	15, 16	15	1		
15	15, 16	12, 15		1	
11, 16	15, 16	16, 17		1	
12, 16	15, 16	13, 16		1	
13, 15	15, 16	12, 15	1		

13, 15	15, 16	15, 19	1		
13, 16	15, 16	12, 16		1	
14, 15	15, 16	15		1	
14, 16	15, 16	16	1		
15, 17	15, 16	15, 18		1	
16, 19	15, 16	12, 16		1	
15, 16	15, 17	15, 18		1	
15, 18	15, 17	15, 16			1
16, 17	15, 17	14, 17		1	
15, 20	15, 19	15, 18		1	
12, 16	16, 17	15, 16		1	
12, 16	16, 17	16, 18		1	
14, 16	16, 17	16	1		
15, 17	16, 17	12, 17	1		
15, 17	16, 17	17, 19		2	
16, 18	16, 17	15, 16			1
16, 18	16, 17	16, 18	1		
16, 17	16, 18	16, 19		1	
16, 19	16, 20	16, 21		1	
18	17, 18	18, 19		1	
12, 17	17, 18	15, 17	1		
13, 17	17, 18	17, 19	1	1	
14, 17	17, 18	15, 17		1	
15, 17	17, 18	15, 17		1	
16, 17	17, 18	16, 17	1		
16, 18	17, 18	18, 19		1	
17, 19	17, 18	17	1		
18	18, 19	16, 18		1	
12, 18	18, 19	14, 18	1	1	
14, 18	18, 19	18	1		
16, 19	18, 19	12, 19		1	
14, 20	19, 20	9, 20		1	
18, 20	20, 21	16, 20		1	
	Total Mutations		18	32	3
Total Mutations Paternal			0.001478	0.003149	0.001429
Total Mutations Maternal			0.000482	0.000816	0.000866
Total			0.001960	0.003965	0.002295
	% Paternal		0.753898	0.794196	0.622721
	% Maternal		0.246102	0.205804	0.377279
	Paternal		14	25	2

	Maternal		**4**	**7**	**1**

D5S818 Mutations that are Indeterminate as to the Parental Origin - Not including parent (mother or father) not tested cases

MOTHER'S ALLELES	CHILD'S ALLELES	FATHER'S ALLELES	Caucasian	Black	Hispanic
11, 12	**10, 11**	**11, 12**	**1**		
11	**11, 12**	**11, 13**			**1**
12	**11, 12**	**8, 12**	**1**	**1**	
10, 11	**11, 12**	**7, 11**			**1**
11, 13	**11, 12**	**11**			**1**
11, 13	**11, 12**	**11, 13**		**1**	
9, 11	**11, 12**	**11**		**1**	**1**
11, 12	**11, 13**	**11, 12**	**1**		**1**
11, 12	**11, 13**	**11, 14**	**1**		
12	**12, 13**	**12**	**2**		
12	**12, 13**	**11, 12**	**2**	**1**	**1**
13	**12, 13**	**10, 13**		**1**	
11, 12	**12, 13**	**12**	**3**	**2**	**1**
11, 12	**12, 13**	**10, 12**			**1**
11, 12	**12, 13**	**11, 12**	**4**	**1**	
11, 12	**12, 13**	**12, 14**	**1**	**1**	
11, 12	**12, 13**	**9, 12**			**1**
11, 13	**12, 13**	**13**	**1**	**1**	
11, 13	**12, 13**	**11, 13**	**1**	**3**	
11, 13	**12, 13**	**13, 14**	**1**		
12, 14	**12, 13**	**12**		**1**	
8, 13	**12, 13**	**13**		**1**	
8, 13	**12, 13**	**8, 13**		**1**	
12, 14	**12, 15**	**12, 14**		**1**	
13	**13, 14**	**13**	**1**		
13	**13, 14**	**12, 13**	**1**	**1**	
11, 13	**13, 14**	**13**		**1**	
12, 13	**13, 14**	**13**		**1**	
12, 13	**13, 14**	**11, 13**	**1**	**2**	
10, 14	**14, 15**	**11, 14**		**1**	

	Total Mutations		22	23	9
Total Mutations Paternal			0.001242	0.001530	0.000888
Total Mutations Maternal			0.000181	0.000309	0.000073
Total			0.001423	0.001839	0.000961
	% Paternal		0.873132	0.832005	0.923610
	% Maternal		0.126868	0.167995	0.076390
	Paternal		19	19	8
	Maternal		3	4	1

FGA Mutations that are Indeterminate as to the Parental Origin - Not including parent (mother or father) not tested cases					
MOTHER'S ALLELES	CHILD'S ALLELES	FATHER'S ALLELES	Caucasian	Black	Hispanic
19, 26	19, 20	19, 23		1	
20, 21	19, 20	20, 24	2		
21, 22	19, 21	21, 23			1
19, 21	20, 21	21, 22	1		
20, 23	20, 21	19, 20		1	
20, 24	20, 21	20, 22	1		1
20, 25	20, 21	20, 25			1
21, 25	20, 21	21	1		
20, 21	20, 22	20, 21	1		
20, 22	20, 23	20, 22	1		
21, 23	20, 23	19, 23		1	
21	21, 22	21		1	
22	21, 22	22, 24	2		
20, 21	21, 22	21, 25	1		
21, 23	21, 22	21, 25		1	
21, 24	21, 22	21, 23		1	
21, 25	21, 22	19, 21	1		
22, 25	21, 22	20, 22	1		
22, 25	21, 22	22, 24	1	2	
21, 22	21, 23	21, 24	1		
21, 24	21, 23	21, 24			1
23, 25	21, 23	23	1		

22	22, 23	22, 24	1	2	
19, 23	22, 23	18, 23	1		
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21, 22	22, 23	22		1	
21, 23	22, 23	21, 23	1		
23, 23.2	22, 23	23, 24		1	
23, 24	22, 23	23		1	
23, 24	22, 23	23, 46		1	
22, 23	22, 24	22, 25	2		
23	23, 24	23	1		
23	23, 24	22, 23	1		
23	23, 24	23, 25		1	
24	23, 24	20, 24			1
24	23, 24	20, 24		1	
24	23, 24	22, 24		1	
19, 23	23, 24	19, 23		1	
21, 23	23, 24	23, 25	1		
21.2, 23	23, 24	21, 23		1	
22, 24	23, 24	20, 24	1	1	
23, 25	23, 24	22, 23		1	
24, 25	23, 24	22, 24	1		
24, 26	23, 24	24, 26			1
22, 25	23, 25	22, 25		1	
24	24, 25	21, 24		1	
18, 25	24, 25	21, 25		1	
19, 25	24, 25	25	1		1
20, 24	24, 25	21, 24		1	
22, 24	24, 25	21, 24		1	
22, 24	24, 25	21, 24			1
22, 25	24, 25	19, 25	1		
23, 24	24, 25	24	1		
23, 24	24, 25	24, 26	1		
23, 25	24, 25	23, 25	1		
24, 26	24, 25	20.2, 24	1		
24, 27	24, 25	20, 24		1	
25, 26	24, 25	23, 25		1	
25, 27	24, 25	25		1	
25, 27	24, 25	23, 25		1	
25	25, 26	23, 25	1		
19, 25	25, 26	22, 25		1	
21, 25	25, 26	21, 25			1
22, 25	25, 26	20, 25			2
23, 25	25, 26	23, 25	1		

23, 26	**25, 26**	**22, 26**		**1**	
25, 27	**25, 26**	**22, 25**		**1**	
23, 27	**26, 27**	**23, 27**			**1**
19, 28	**27, 28**	**24, 28**		**1**	
	Total Mutations		**34**	**34**	**12**
Total Mutations Paternal			**0.002851**	**0.003641**	**0.003326**
Total Mutations Maternal			**0.000424**	**0.000544**	**0.000350**
Total			**0.003275**	**0.004185**	**0.003677**
	% Paternal		**0.870494**	**0.870017**	**0.904694**
	% Maternal		**0.129506**	**0.129983**	**0.095306**
	Paternal		**30**	**30**	**11**
	Maternal		**4**	**4**	**1**