ORIGINAL

STATE OF WISCONSIN	CIRCUIT COURT BRANCH I	MANITOWOC COUNTY
STATE OF WISCONSIN vs. STEVEN A. AVERY,	MANITOWOC COUNTY STATE OF WISCONSIN FILED Plaintiff, JUN 15 2006 CLERK OF CIRCUIT COURT Defendant,	STATE'S MEMORANDUM OF LAW PERTAINING TO THE ADMISSIBILITY OF DNA EVIDENCE Case No. 05-CF-381

As grounds for its motion, the state relies upon the following statement of law regarding the admissibility of testimony related to DNA extracted and identified through the polymerase chain reaction (PCR) technique and genetic marker frequency determinations. The state seeks to introduce the results of PCR DNA testing which uses the Short Tandem Repeat (STR) method to develop a DNA profile. This type of testing is known as nuclear or chromosomal DNA testing. In this case, the testing was conducted by Sherry Culhane, Technical Leader of the DNA Unit at the Wisconsin State Crime Laboratory in Madison, Wisconsin. (Curriculum Vitae of Sherry Culhane attached). In addition to the PCR/STR DNA testing, the state seeks to introduce the results of DNA testing which uses PCR technology to derive a DNA profile from a part of the human cell known as the mitochondria. This type of testing is known as mitochondrial DNA testing (mtDNA). This testing was conducted by Douglas Hares, Ph.D., Forensic Examiner, at the Federal Bureau of Investigation, Washington, D.C. (Curriculum Vitae of Douglas Hares attached).

I. ADMISSIBILITY OF SCIENTIFIC EVIDENCE GENERALLY.

Under Wisconsin law, qualified experts may testify if they possess scientific or specialized knowledge that will assist the trier of fact to determine a relevant issue. See generally State v. Walstad, 119 Wis.2d 483, 516, 351 N.W2d 469 (1984). An expert may be

qualified by knowledge, skill, experience, training or education. Wis.Stat. §907.02. In State v. Peters, 192 Wis2d 674, 534 N.W.2d 867 (Ct.App.1995), the court discussed the standards by which scientific evidence should be admitted and the judge's limited gatekeeping role in this process.

> [T]he admissibility of scientific evidence is not conditioned upon its reliability. Rather, scientific evidence is admissible if: (1) it is relevant, §904.01, STATS.; (2) the witness is qualified as an expert, §907.02, STATS.; and (3) the evidence will assist the trier of fact in determining an issue of fact, §907.02. State v. Walstad, 119 Wis.2d 483, 516, 351 N.W.2d 469, 486 (1984). If these requirements are satisfied, the evidence will be admitted.

Moreover, scientific evidence is admissible under the relevancy test regardless of the scientific principle that underlies the evidence. Id. at 518-19, 351 N.W.2d at 487. As our Supreme Court noted in Walstad:

> The fundamental determination of admissibility comes at the time the witness is "qualified" as an expert. In a state such as Wisconsin, where substantially unlimited cross-examination is permitted, the underlying theory or principle on which admissibility is based can be attacked by cross-examination or by other types of impeachment. Whether a scientific witness whose testimony is relevant is believed is a question of credibility for the finder of fact, but it clearly is admissible.
>
> ....Wisconsin judges do serve a limited and indirect gatekeeping role in reviewing the admissibility of scientific evidence. Unlike judges in Frye and Daubert jurisdictions, this role is much more oblique and does not involve a direct determination as to the reliability of the scientific principle on which the evidence is based. For instance, in addition to the statutory requirements, Wisconsin judges may reject relevant evidence if they conclude: (1)the evidence is superfluous;...(2)the evidence will involve a waste of judicial time and resources;...(3)the probative value of the evidence is outweighed by its prejudice to the defendant;...(4)the jury is able to draw its own conclusions without it;...(5)the evidence is inherently improbable;...or (6)the area of testimony is not suitable for expert opinion.

Peters, 192 Wis.2d at 687-689 (footnotes and citations omitted). See also State v. Watson, 227 Wis.2d 167, 188, 595 N.W.2d 403 (1999) (Supreme Court rejects limiting admission of expert testimony to only those situations where the issue involves specialized knowledge, skill or experience on subjects not within the realm of ordinary human experience.)

II. ADMISSIBILITY OF DNA-RELATED TESTIMONY.

A. Wisconsin courts have upheld the admissibility of DNA testimony.

In Peters, the Court of Appeals previously upheld the admissibility of DNA testimony in a criminal case. In passing, the court noted that it did not have to determine the reliability of the DNA evidence, including the statistical probability evidence. Rather, once the DNA evidence's relevancy was established and the witness qualified as an expert, issues as to the evidence's reliability go to its weight and credibility. Peters, 192 Wis.2d at 690. Though not required to determine the reliability of the DNA evidence and the statistics derived therefrom, the Peters court did so. Specifically, it found (1) that the methodology underlying the testimony was scientifically valid; (2) the statistical method for calculating probability was subject to peer review and publication; (3) the evidence would assist the jury in resolving issues of disputed relevant fact. Peters, 192 Wis.2d at 692.

B. DNA based upon the PCR methodology is admissible.

Peters concerned the admissibility of DNA evidence generated through the Restriction Fragment Length Polymorphism (RFLP) methodology. The state now relies upon Polymerase Chain Reaction (PCR) testing for developing and analyzing DNA evidence.

The PCR method is commonly used in DNA analysis today. The PCR method is most useful when relatively small amounts of DNA are available for testing. See, e.g., Comment, 71 U.Colo.L.Rev. at 228 and n.32. The PCR method is commonly used in both civil and criminal cases, and enjoys "widespread application in many areas of science and medicine.... In forensic cases, PCR can be extremely valuable when the amount of tissue is limited." Randi B. Weiss, et al., *The Use of Genetic Testing in the Courtroom*, 34 Wake Forest L. Rev 889, 897-900 (1999).

Numerous state appellate courts have found PCR DNA testing to be scientifically reliable and admissible in criminal cases. PCR-based DNA testing, which encompasses STR and Mitochondrial testing, has been found to be a reliable technique by a vast majority of courts in other jurisdictions. A non exhaustive list of appellate courts finding PCR-based DNA testing to be reliable includes Seritt v. State, 647 So.2d 1, 4 (Ala.Crim.App.1994); Harmon v. State, 908 P.2d 434, 442 (Alaska Ct.App.1995); People v. Groves, 854 P.2d 1310 (Colo.Ct.App.1992); Redding v. State, 464 S.E.2d 824, 828 (Ga.Ct.Appl.1995); State v. Hill, 895 P.2d 1238, 1247 (Kan.1995); State v. Spencer, 663 So.2d 271, 275 (La.Ct.App.1995); People v. Lee, 537 N.W.2d 233, 257-58 (Mich.Ct.App.1995) ("[T]rial courts in Michigan may take judicial notice of the reliability of DNA testing using the PCR method"); State v. Hoff, 904 S.W.2d 56, 59 (Mo.Ct.App.1995); State v. Gollehon, 906 P.2d 697 (Mont.1995); State v. Williams, 599 A.2d 960, 968 (N.J. Super.Ct.App.Div.1991) ("[H]ighly qualified Scientists testified at the overwhelming acceptance within the scientific community of PCR-applied DNA testing"); People v. Palumbo, 618 N.Y.S.2d 197, 201 (N.Y.1994); State v. Moeller, 548 N.W.2d 465 (S.D.1996); Campbell v. State, 910 S.W.2d 475, 479 (Tex.Crim.App.1995); State v. Begley, 956 S.W.2d 471, 477 (Tenn.1997); State v. Belken, 633 N.W.2d 786, 798 (Iowa.2001)(PCR method has emerged as the predominate DNA typing method); People v. Morganti, 50 Cal.Rptr.2d 837,855 (Ct.App. 1996); People v. Pope, 672 N.E.2d 1321,1327 (Ill.App. 1996); Ingram v. State, 699 N.E.2d 261,263 (Ind.1998); State v. Burke, 606 N.W.2d 108,112 (N.D.2000); Clarke v. State, 813 S.W.2d 654,655 (Tex.App.1991); Spencer v. Commonwealth, 393 S.E.2d 609, 620 (Va.1990) ("The[PCR] theory was conceived about ten years ago and has become one of the most widely-used technical procedures in molecular biology since 1985, being used in many diagnostic applications having 'life or death' implications"); State v. Russell, 882 P.2d 747, 768 (Wash.1994)("We see no question that the principles and methodology underlying PCR at the

DQ alpha locus have been generally accepted by the Scientific community.") In State v. Lyons, 924 P.2d 802, 813-14 (Or.1996), the Oregon Supreme Court cited numerous state appeals courts that have approved the admission of PCR evidence. Regarding peer review, the Supreme Court cited a bibliography listing over 4,000 scientific articles and publications relating to PCR.

Additionally, federal circuit courts have found that PCR testing satisfies federal requirements for admissibility. See United States v. Beasley, 102 F.3d 1440, 1448 (8th Cir.1996) ("[T]he reliability of the PCR method of DNA analysis is sufficiently well established to permit the courts of this circuit to take judicial notice of it in future cases"); United States v. Hicks, 103 F.3d 837, 846-47 (9th Cir.1996).

C. STR DNA testing is admissible

This type of forensic testing is known as chromosomal DNA testing or nuclear DNA testing. The most widely used method of PCR testing is now based on Short tandem Repeats (STR). This is the method used to obtain the results that the state intends to introduce at trial as found by the DNA Unit of the Wisconsin State Crime Laboratory.

Numerous courts around the country have addressed the admissibility of PCR-based STR DNA testing and have held that the techniques and procedures used in such testing are scientifically reliable. Published opinions include Commonwealth v. Rosier, 685 N.E.2d 739, 743 (Mass. 1997)(trial court properly concluded that the methodology underlying the PCR-based tests, including the STR testing, was scientifically valid and relevant); People v. Allen, 85 Cal. Rptr.2d 655, 659 (Cal. App. 1999)(finding STR DNA testing generally accepted in scientific community); State v. Jackson, 582 N.W.2d 317,325 (Neb. 1998)(PCR STR DNA test used was generally accepted within the scientific community); State v. Butterfield, 27 P.3d 1133, 1144 (Utah. 2001)(concluding that judicial notice of the inherent reliability of the PCR STR method of DNA testing is appropriate); Lemour v. State, 802 So.2d 402, 408 (Fla.Dist.Ct.App.

2001)(PCR/STR method is generally accepted by the scientific community); and State v. Salmon, 89 S.W.3d 540, 545 (Mo.Ct.App.2002)(PCR/STR technique is generally accepted in the scientific community). The Supreme Court of Colorado also found STR testing to be scientifically reliable. People v. Shreck, 22 P.3d 68 (en banc)(Col.2001). *See also*, People v. Owens, 187 Misc.2d 838, 725 N.Y.S.2d 178, 181 (Sup.Ct.2001)(recognizing that courts throughout the country have found that STR DNA profiling is reliable and generally accepted in the scientific community); People v. Hill,107 Cal.Rptr.2d 110,119 (Ct.App. 2001)(PCR and STR testing methods are generally accepted by the scientific community); State v. Traylor, 656 N.W.2d 885, 893 (Minn.2003)(PCR-STR technology for DNA typing for forensic identification is generally accepted in the relevant scientific community); State v. Fernando-Granados, 682 N.W.2d 266,283 (Neb.2004)(finding that PCR-STR DNA testing methodology is reliable, validated and generally accepted in scientific community and peered reviewed); United States v. Morrow, 374 F.Supp.2d 51,61 (D.C. Dist. Ct. 2005)(as a general matter, PCR/STR DNA testing is admissible under Daubert); and United States v. Trala, 386 F.3d 536, 541 (3d Cir. 2004) (PCR/STR DNA typing meets the standards of reliability and admissibility). In State v. Deloatch, 354 N.J.Super. 76, 804 A.2d 604 (2002), the court found that PCR-based STR DNA testing is recognized and used in virtually every State and by the Federal Bureau of Investigation. Id. at 611. *See also*, State v. Whittey, 821 A.2d 1086 (N.H. 2003)(the methods and techniques used in PCR-based STR DNA testing are generally accepted in the scientific community).

D. Mitochondrial DNA testing is admissible.

There is another source of DNA in the human cell beyond that which is found in the nucleus of cells. The source of mitochondrial DNA is the mitochondria. The following excerpt is taken from *The Evaluation of Forensic DNA Evidence*,(National Academy Press, Washington, D.C. 1996), which was issued by the National Research Council in 1996.

> Another class of genetic marker is mitochondrial DNA. Mitochondria are microscopic particles found in the cell, but outside the nucleus, so they are not associated with chromosomes. The transmission of mitochondria is from mother to child; the sperm has very little material other than chromosomes. Ordinarily, all the mitochondrial particles in the cell are identical. There is no problem distinguishing heterozygotes from homozygotes, since only one kind of DNA is present. Since mitochondrial DNA is always transmitted through the female, all the children of one woman have identical mitochondrial DNA. Therefore, siblings, maternal half siblings, and others related through female lines are as much alike in their mitochondrial DNA as identical twins. Mitochondrial DNA is particularly useful for associating persons related through their maternal lineage, for example, for associating skeletal remains to a family. A highly variable region of mitochondrial DNA is used for forensic analysis. The techniques have been validated, and there is a growing body of frequency data. NRC Report 1996, pp 72-73.

The following excerpt is taken from *The Future of Forensic DNA Testing: Predictions of the Research and Development Working Group*, a report from the National Commission on the Future of DNA Evidence, (2000), p.18:

> Techniques for using mitochondrial DNA (mtDNA) have been available for some years, but application to problems of forensic identification began in 1990. Several laboratories now have the necessary equipment and techniques to use this system. Mitochondria are intracellular particles (organelles) outside the nucleus in the cytoplasm of the cell. They contain their own small DNA genomes; circular molecules of 16,569 base pairs and the variants are identified by sequence determination. Each cell contains hundreds to thousands of mitochondria. For this reason, a single hair shaft, old bones, or charred remains, which are generally unsuitable for chromosomal DNA, sometimes provide enough intact material for mtDNA analysis.

These features of mitochondrial DNA have made it useful in the identification of battlefield remains (including the identification of the unknown soldier from the Vietnam War who was recently identified as Lt. Michael Blassie), victims of human rights abuses, victims of war crimes, and the victims of airplane crashes. Mitochondrial DNA analysis was used to identify the remains of the family of Czar Nicholas II and to disprove a claim that Ms. Anna Anderson was Anastasia, the daughter of the czar. Mitochondrial DNA was also used to positively identify the remains of gunfighter Jesse James and Louis Charles, the last dauphin and son of King Louis XVI and Marie Antoinette.

Every appellate court that has addressed the admissibility of mitochondrial DNA has ruled in favor of its admissibility. The Supreme Court of Connecticut in State v. Pappas, 776 A.2d 1091 (Conn. 2001) ruled mtDNA was admissible under the Daubert standard. The Court also ruled the statistical techniques used to interpret the evidence were admissible. Id. at 1108-1112. The Court of Appeals of the State of Mississippi found no error in the admission of mtDNA in Adams v. State, 794 So.2d 1049, 1065 (Miss. App. 2001). In State v. Council, 515 S.E.2d 508 (S.C. 1999), the South Carolina Supreme Court admitted mtDNA evidence. The Supreme Court of South Carolina held: "We conclude the trial judge was well within his discretion in finding the results of the mitochondrial DNA analysis admissible...Mitochondrial DNA analysis has been subjected to peer review and many articles have been published about the technology. The FBI has validated the process and determined its rate of error. Its underlying science has been generally accepted in the scientific community." Id.at 518. *See also*, People v. Klinger, 185 Misc.2d 574,713 N.Y.S. 823 (2000) where the New York court found that "...that the credible evidence adduced at the hearing established that mitochondrial DNA analysis and interpretations are generally accepted as reliable in the scientific community and that the procedures followed in this case establish a foundation for the admission of such evidence." Id. at 831. In State v. Scott, 33 S.W.3d 746, 759 (Tenn. 2000), the Tennessee Criminal Appeal Court admitted the evidence finding that mtDNA analysis met the general standards of admission of scientific evidence. The Court of Appeals of North Carolina found no error in the admission of mtDNA evidence in State v. Underwood, 518 S.E.2d 231 (Ct.App.2000) stating "[w]e hold that mitochondrial DNA testing is sufficiently reliable to warrant its admissibility into evidence." Id. at 240. In Magaletti v. State, 847 So.2d 523, 528 (Fla.App.2003), the court upheld the admission of mtDNA evidence noting the general acceptance of both the science and statistical methodology used in mtDNA analysis. In People

v. Holtzer,660 N.W. 2d 405 (Mich.App.2003), the court found mtDNA testing to be useful and reliable, and robust and validated based on the "vast base of experience" of the forensic scientific community. Id. at 411. In Wagner v. State, 864 A.2d 1037, 1049 (Md.App.2005), the court found the procedures used by the FBI in mtDNA analysis to be generally reliable scientific procedures. *See also*, United States v. Coleman, 202 F.Supp.2d 962 (E.D.Mo.2002) (admitting evidence based upon mtDNA testing) and United States v. Beverly, 369 F.3d 516 (6th Cir. 2004)(the scientific basis for the use of mtDNA testing is well established).

III. CONCLUSION

Based upon the admissibility provisions for DNA testing in Wisconsin Statutes sections 939.74(2d)(a) and 971.23(9) and the vast acceptance in appellate courts around the country of PCR based STR DNA and Mitochondrial DNA testing, the state moves the court to find that the DNA testing results derived from STR and Mitochondrial DNA testing in this case are admissible evidence at trial.

Respectfully submitted this 9th day of June, 2006.

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Curriculum Vitae
of
Sherry Culhane

Wisconsin Department of Justice
Crime Laboratory-Madison
4706 University Avenue
Madison, Wisconsin 53705-2157

Current Position: Technical Leader – DNA Unit (3/97 – present)
Forensic Scientist – (Forensic Serology 1984 – present)

Principal Duties: Examination of physical evidence for the presence of possible biological stains; primarily blood, semen and saliva. Identification and genetic individualization of these stains, utilizing chemical and immunological methods as well as STR/DNA typing methods. Comparison and interpretation of all typing results from known samples (standards) and unknown case samples. Microscopic hair examinations and comparisons of standard hair samples.

Preparation of technical reports based on results of the above listed scientific analyses and presentation of expert testimony in Courts of Law. Participation in technical case review of completed cases.

Develop and maintain Quality Assurance program for DNA Unit. Provide in-house training for entry level analysts as well as existing analysts. Direct case assignments and general case flow of DNA Unit. Work closely with the Supervisor to ensure the continued quality of the analyses performed and development of new techniques in the DNA Unit.

Oral presentations to peers and outside agencies regarding new technologies as well as assisting in the understanding of current DNA theory.

Participate in the coordination of Policy among the three Laboratories in the Wisconsin System.

Participate in the planning, purchasing and implementation of new as well as replacement of existing equipment.

Education: Millsaps College
Jackson, MS 1976

Mississippi College
Clinton, MS
Bachelor of Science, 1978
Major: Biological Science

EXPERIENCE: Jefferson Parish Sheriff's Office Crime Lab
3300 Metairie Road
Metairie, Louisiana 70001
Forensic Analyst: 3 years

Further Training: Serology and Hair Comparison Training. New Orleans City Crime Laboratory

Semen and Body Fluid Analysis Training. Training conducted at the Crime Laboratory in Shreveport, Louisiana by Brian Wraxall, Serological Research Institute (SERI), Richmond, California

Biochemical Methods in Bloodstain Analysis. FBI Academy, Quantico, Virginia.

Semen Analysis Seminar. Edward Blake, Forensic Science Associates, Emeryville, California.

Forensic Sciences and Immunogenetics Seminar. Chicago, Illinois.

DNA Analysis Seminar. Geoffrey Hudson, Promega Corporation, Madison, Wisconsin.

DNA Analysis Workshop. John Waye, Royal Canadian Mounted Police.

DNA Theory and Protocols. Dale Dykes, Bureau of Criminal Apprehension, Forensic Science Lab, St. Paul, Minnesota.

The International Symposium on Human Identification. Sponsored by Promega Corporation, Madison, Wisconsin; November 30 - December 1, 1989 and April 10-12, 1991.

Population Genetics and Statistics for Forensic Biologists (workshop). Sponsored by Midwestern Association of Forensic Scientists; October 10, 1993. (Instructor: Dr. Bruce Weir)

Training Program in DNA typing (DNA Theory and Protocols, Southern Blotting, Autoradiography, Sizing and Interpretation of Autorads, Match Criteria, Application of Population Statistics, Probe Labeling and Hybridization). Instructor: Marie Varriale (Supervisor), Wisconsin

Crime Laboratory. July 10, 1995 - March 1996.

DNA Advisory Board Meeting sponsored by the FBI (Arlington, VA) February 1, 1996: CODIS USER'S GROUP MEETING (Arlington, VA) February 2, 1996.

CODIS training for Local Operation and System Administrator; Sponsored by SYNETICS Corporation Vienna, VA; May 13-16, 1996.

STATISTICS WORKSHOP covering basic concepts in Probability and Statistics, Population Substructure and Concepts in Generating, Validating and Evaluating Databases: September 16-18, 1996: Scottsdale, AZ

The Seventh International Symposium on Human Identification sponsored by PROMEGA Corporation: September 19-21, 1996: Scottsdale, AZ

STR WORKSHOP covering general aspects of STRs and silver staining techniques sponsored by PROMEGA Corporation: August 5-6, 1998: Madison, WI

Forensic Statistics Workshop sponsored by Wisconsin Department of Justice Division of Law Enforcement: presented by Dr. George Carmody: February 23-25, 1998

In-house training from Perkin-Elmer on the operation of the 310 Capillary Electrophoresis Genetic Analyzer. 6/22 – 23/98.

DNA Report Writing Workshop sponsored by Midwestern Association of Forensic Scientists (MAFS) mediated by Dan Bergman, Minnesota BCA Crime Laboratory.

Mitochondrial DNA Sequence Analysis in Forensic Casework (Methods and Issues). September 29, 1999 (Orlando, FL). Sponsored by PROMEGA Corporation

The Tenth International Symposium on Human identification sponsored by PROMEGA Corporation: September 29 – October 2, 1999 Orlando, FL

Advanced 310 Genetic Analyzer and AmpFlSTR™ Training presented by PE Biosystems, Catherine Caballero, Human Identification Specialist March 07-10, 2000.

Molecular and Cell Biology, University of California Extension, Center for Media and Independent Learning, 5/10/2000 thru 10/13/2000

STR Working Group sponsored by PROMEGA corporation, St. Louis, MO, May 2001.

The 12th International Symposium on Human Identification sponsored by PROMEGA Corporation: Biloxi, MS September 2001.

Statistical Genetics for Forensic Scientists (Web-based class), North Carolina State University, Dr. Bruce Weir, Fall 2002.

DNA Auditor Class, FBI Laboratory: April 7-8, 2004 Quanico, VA.

The 15th International Symposium on Human Identification sponsored by PROMEGA Corporation: October 4-7th Phoenix, AZ

Y-STR workshop: Practical considerations and Interpretation Issues, sponsored by PROMEGA October 7, 2004

Promega Working Group Meeting, sponsored by Promega Corp., St.Louis, Missouri, January 24-25, 2006

Professional Affiliations:

Midwestern Association of Forensic Scientists (MAFS – previously)

Louisiana Association of Forensic Scientists (LAFS - previously)

Curriculum Vitae

DOUGLAS R. HARES, Ph.D.
FBI Laboratory
DNA Analysis Unit II
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Quantico, VA 22135
703-632-7576

EDUCATION

1998 Ph.D., Molecular Biology
University of North Texas, Denton, Texas

1991 B.S., Biochemistry
University of North Texas, Denton, Texas

EXPERIENCE

2000-present Forensic Examiner, FBI Laboratory, Washington, D.C.

Responsibilities: Receive evidence from criminal cases, perform mitochondrial DNA analyses on evidence, report results from examinations, and testify to results.

1999 - 2000 Adjunct Faculty, Department of Biological Sciences, University of North Texas, Denton, Texas

Responsibilities: Team taught BIOL 4770 *Current Applications in Biotechnology*, Guest lecturer in BIOL 1700 *General Biology* and BIOL 6010 *Topics in Molecular Biology*. Also served on doctoral advisory committees for two graduate students .

1997 - 2000 Director, Upward Bound Math and Science Regional Center, University of North Texas, Denton, Texas

Responsibilities: Directing the center on day to day operations, hiring and supervising 20+ personnel, maintaining relationship with Departmental Chairs and faculty members, managing a $250,000/year project budget, and maintain extramural funding for the Center. Co-managed the TRIO Center for Student Development with four other Directors.

1991 - 1996 Teaching Assistant/Laboratory Coordinator, Department of Biological Sciences, University of North Texas, Denton, Texas
Responsibilities: Taught laboratory courses: *General Chemistry*, *Biochemistry & Molecular Biology of the Gene*, *Advanced*

Techniques in Molecular Biology (graduate level), *Microbiology*, and *Cell Biology*. Coordinated laboratory courses: *Biochemistry & Molecular Biology of the Gene* and *Advanced Techniques in Molecular Biology*.

TRAINING

1/2006 Meeting,	Scientific Working Group on DNA Analysis Methods (SWGDAM) Fredericksburg, Virginia
11/2005	Eleventh National CODIS Conference, Crystal City, Virginia
6/2005 Meeting,	Scientific Working Group on DNA Analysis Methods (SWGDAM) Quantico, Virginia
10/2004	**Fifteenth International Symposium on Human Identification, Phoenix, Arizona**
2/2004	Forensic Human Mitochondrial DNA Analysis Workshop, Chairman, American Academy of Forensic Sciences 56th Annual meeting, Dallas, TX (8 hours)
9/2003	Applied BioSystems 3100 DNA Sequencer Training, Applied BioSystems, San Francisco, California (26 hours)
4/2002	Evidence Response Team, ERT Basic Course, Federal Bureau of Investigation, Quantico, Virginia (80 hours)
2/2002	Forensic Mitochondrial DNA Analysis: A Community Forum, American Academy of Forensic Sciences 54th Annual meeting, Atlanta, Georgia (8 hours)
10/2001	**Twelfth International Symposium on Human Identification, Biloxi, Mississippi**
2000 - 2001	Forensic Examiner Training Program, Mitochondrial DNA Analysis Unit (DNAU II), Federal Bureau of Investigation, Washington D.C. (12 + months)
9/2000	DNA Auditor's Training, Mid-Atlantic Association of Forensic Scientists, Quantico, Virginia (20 + hours)
6/2000	Human Mitochondrial DNA Analysis, FBI Academy, Quantico Virginia (80 + hours)
1991 - 1998	Doctoral Dissertation research project, *Physical and Functional Characterization of the xylXYZ Region from TOL pDK1 and its Associated*

Downstream Regulatory Elements. Project provided training in numerous molecular biology techniques with a focus on DNA sequencing and DNA sequence analysis.

1991 - 1998 Graduate coursework relevant to mitochondrial DNA analysis: *Advanced Genetics, Advanced Cell Biology, Forensic Biology, Biostatistics, Population Genetics, Population Genetics Analysis, Introduction to Molecular Biology* and *Advanced Techniques in Molecular Biology*

PRESENTATIONS/PUBLICATIONS

7/2002 ***An Improved Method for Post-PCR Purification for mtDNA Sequence Analysis*** **Dugan, K. A., H. S. Lawrence, D. Hares, C. Fisher, and B. Budowle. Journal of Forensic Sciences**, July 2002, Vol. 47, No. 4, pgs. 811-818.

3/2002 Update on Forensic DNA Analysis, National Sheriff's Association Annual Mid-Winter Conference, Washington, D.C.

10/2001 Poster presentation at the **Twelfth International Symposium on Human Identification**, ***An Improved Method for Post-PCR Purification for mtDNA Sequence Analysis***, Biloxi, Mississippi

3/2001 Mitochondrial DNA Analysis, National Sheriff's Association Annual Mid-Winter Conference, Washington, D.C.

1/2001 Mitochondrial DNA Analysis, New Jersey Prosecutor's Association DNA Conference, Princeton, New Jersey