

Basic Curriculum for 16-Week DNA Academy Northeast Regional Forensic Institute

Week 1: Molecular Biology and Forensic DNA Typing University at Albany, State University of New York

Course Title	Instructor	Comments
ABIO 501 Fundamentals: Molecular Biology and Forensic DNA Typing	NERFI	Lectures prepared from Butler Second Edition, Watson et al Molecular Biology of the Gene 5 th edition, and primary scientific literature.

Course Instruction and Description:

Primary Instructors: NERFI teaching staff and experts from the field of Forensic Science

Description: Bio 501 Molecular Biology and Forensic DNA Typing provides the student with the foundational knowledge of forensic science and molecular biology that is required to understand forensic DNA identification. The student will learn how these fundamental concepts and techniques are applied in the specific DNA methods that include DNA extraction, DNA quantification, PCR-based methods, multiplex amplification of STR loci, capillary electrophoresis of amplified products, and analysis, interpretation and reporting of single source and mixture data samples, ethics, quality assurance, contamination and documentation.

Lectures: Daily lectures on the theory and practice of Forensic Molecular Biology will be given from 8:30 am to 10:15 am and 12:30 pm to 2:30 pm during Week 1.

Assignments: Each day during Week 1, students will do assigned readings and homeworks from 10:30 am to noon and from 2:45-4:00 pm.

Primary Textbook: Butler J. 2005. *Forensic DNA Typing*, 2nd Edition. Elsevier Academic Press. Burlington, MA (ISBN 0121479528)

Additional Resources: Watson, JD. 2004. *Molecular Biology of the Gene*. 5th Ed. Benjamin Cummings, San Francisco, CA. Additional readings from primary literature

Attendance: Mandatory—Unexcused absences on your part will result in a failing grade for all assignments that day.

Academic Integrity: See Graduate Bulletin for details. Deviations will be treated according to university regulations.

Final Grade for Bio 501

Exam (50 pts.)	50
Assignments	25
Participation	10
Performance (Weekly Assessment Memos, Attitude, etc.)	15
TOTAL POINTS	100

Note: Each student must earn at least 80 points to pass (Bio. 501) Topics in Forensic Molecular Biology course at the graduate-level.

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Week 1: Fundamentals Schedule

	Monday	Tuesday	Wednesday	Thursday	Friday
Homeworks and assessment memos submitted via email		Homework due	Homework due	Homework due	Homework due
8:30 – 10:15 am	Basic Genetics Central Dogma	Structure of DNA and RNA The Replication of DNA in Eukaryotes	Mechanisms of Transcription and Translation	DNA Damage and Repair Homologous Recombination	Repetitive DNA and other polymorphisms used as genetic markers
10:30 – 12:00	Assigned Readings and Assignments	Assigned Readings and Assignments	Assigned Readings and Assignments	Assigned Readings and Assignments	Assigned Readings, Assignments and Review
12:30 – 2:30	DNA Isolation	PCR DNA Amplification	DNA Quantitation	<i>History of Forensic DNA Testing</i> <i>Quality Assurance / Quality Control</i>	Electrophoresis and Fluorescent DNA Detection
2:45 – 4:00	Assigned Readings and assignments	Assigned readings and assignments	Assigned readings and assignments	Assigned Readings and assignments	Assigned readings and assignments
	Homework due	Homework due	Homework due	Homework due	Homework due



Week 2: Fundamentals Exam and Laboratory Analyses

Day	Morning	Afternoon	Comments
Monday	<p>Assessment memo due</p> <p>Last homework due</p> <p>Review for written exam covering fundamentals of molecular biology</p>	<p>Last homework from Fundamentals Week returned to trainees</p> <p>Study for written exam</p>	<p>During the 16-week on-site training, all trainees must submit weekly Assessment Memos to the instructors. Assessment Memos are due every Monday at 8:00am.</p>
Tuesday	<p>Written exam covering fundamentals of molecular biology</p>	<p>Safety and Lab QC procedures</p>	<p>Readings: Protocols for</p> <ul style="list-style-type: none"> • Sample prep • Organic extraction • Differential extraction • Quantification of DNA • Amplification • CE 3130xl
Wednesday	<p>Demonstration of sample prep and organic extraction</p>	<p>Organic extraction demonstration, continued</p>	
Thursday	<p>Demonstration of Quant/ Q-PCR ABI 7500</p>	<p>Demonstration of Amplification ABI 9700</p>	
Friday	<p>Demonstration of CE Set-up</p>	<p>SAMPLE SET 1: Sample prep</p>	



Week 3: Laboratory Analyses and Introduction to GMID

Day	Morning	Afternoon	Comments
Monday	Assessment memo due SAMPLE SET 1: Organic extraction	SAMPLE SET 1: Organic extraction	Side-by-side training audits will be conducted throughout the first two weeks to observe trainees' technique. Readings: <ul style="list-style-type: none"> • Protocols • Quantifiler Manual • Identifiler Manual • DNA Training Bibliography
Tuesday	SAMPLE SET 1: Quantitation	SAMPLE SET 1: Quantitation	
Wednesday	SAMPLE SET 1: Quant results <ul style="list-style-type: none"> • Whole group training • Individual assistance 	SAMPLE SET 1: Amplification	
Thursday	SAMPLE SET 1: CE Genetic Analysis	SAMPLE SET 1: CE Genetic Analysis	
Friday	Introduction to GeneMapper -- Genemapper ID lecture and instruction Individual data analysis assistance	SAMPLE SET 1: Data Analysis	



Week 4: Laboratory Analyses and Introduction to Case Report Writing

Day	Morning	Afternoon	Comments
Monday	Assessment Memo Due SAMPLE SET 2: Sample prep and extraction	SAMPLE SET 2: Sample prep and extraction	Trainers continue to monitor/observe trainees in the lab as needed through Sample Set #2. Oral quiz will be given individually to impact lab work as minimally as possible. Oral quiz 1 includes questions on laboratory procedures, extractions, and quantitation. Readings: <ul style="list-style-type: none"> • Quantifiler Manual • Identifiler Manual • DNA Training Bibliography Training checklist
Tuesday	SAMPLE SET 2: Organic extraction	SAMPLE SET 2: Organic extraction	
Wednesday	SAMPLE SET 2: Quant Basic case file & report writing instruction Basic pop stats training	SAMPLE SET 2: Quant	
Thursday	SAMPLE SET 2: Amplification Oral Quiz 1	SAMPLE SET 2: Amplification Oral Quiz 1	
Friday	SAMPLE SET 2: CE Genetic Analysis SAMPLE SET 2: Data analysis and case report preparation	SAMPLE SET 2: CE Genetic Analysis SAMPLE SET 2: Data analysis and case report preparation	



Week 5: Laboratory Analyses

Day	Morning	Afternoon	Comments
Monday	Assessment Memo Due SAMPLE SET 3: Sample Prep and organic extraction	SAMPLE SET 3: Sample Prep and organic extraction	Case review and sim set review by NERFI trainers.
Tuesday	SAMPLE SET 3: Organic extraction Sim sets assigned	SAMPLE SET 3: Organic extraction	
Wednesday	SAMPLE SET 3: Quantitation	SAMPLE SET 3: Quantitation	
Thursday	SAMPLE SET 3: Amplification	SAMPLE SET 3: Amplification	
Friday	SAMPLE SET 3: CE / Genetic Analyzer SAMPLE SET 3: Data analysis and case report preparation	SAMPLE SET 3: CE /Genetic Analyzer SAMPLE SET 3: Data analysis and case report preparation	

Notes

Trainees are expected to work on Sim Sets (simulated data sets) as time allows during the day – while samples are spinning, quanting, amplifying, being analyzed, etc., as necessary to complete all Sim Sets by the end of the Academy.



Week 6: Laboratory Analyses

Day	Morning	Afternoon	Comments
Monday	Assessment Memo Due SAMPLE SET 4: Sample Prep and organic extraction	SAMPLE SET 4: Sample Prep and organic extraction	Case review and sim set review by NERFI trainers.
Tuesday	SAMPLE SET 4: Organic extraction Sim Sets assigned	SAMPLE SET 4: Organic extraction	
Wednesday	SAMPLE SET 4: Quantitation	SAMPLE SET 4: Quantitation	
Thursday	SAMPLE SET 4 : Amplification	SAMPLE SET 4 : Amplification	
Friday	SAMPLE SET 4: CE / Genetic Analyzer SAMPLE SET 4: Data analysis and case report preparation	SAMPLE SET 4: CE / Genetic Analyzer SAMPLE SET 4: Data analysis and case report preparation	



WEEK 7 Statistics

Day	Morning	Afternoon
Monday	<p>Assessment Memo Due</p> <p>Probability, Statistics and Population Genetics Estimating the frequency of a DNA profile, Hardy-Weinberg Equilibrium Accuracy vs precision of statistical estimates Suspect population and relevance of defendant racial group Distribution of human genetic variation Probability axioms; frequentist vs Bayesian probability</p>	<p>Heterozygosity as a measure of genetic discrimination Conditional probability; odds; likelihood ratio Sample size; hypothesis testing; goodness-of-fit tests Bootstrap, jackknife, permutation test, exact tests Permutation test for HWE exercise</p>
Tuesday	<p>Applications to Transfer Evidence, Minimum allele frequency; database searches and calculations Calculations of relatives' genotypes; calculation of putative sibs Source attribution approaches (uniqueness)</p>	<p>NRC II recommendations; theta values; laboratory error Conditional DNA profile formulas Comparisons of formulas for profile frequency Counting method; Misinterpretation of random match probability</p>
Wednesday	<p>Paternity and Missing Persons Likelihood ratio evidence; exclusion probability Applying theta to paternity calculations Simple two-person kinship calculations</p>	<p>Calculations for more extended pedigree data Errors of interpretation; transposed conditional Prosecutor's fallacy, Defense attorney's fallacy Example paternity calculation exercises</p>
Thursday	<p>Mixtures and Presenting Statistics in Court Quantifying mixture interpretation Exclusion probability; likelihood ratio approach to mixture Example mixture calculation exercises</p>	<p>Exam (1-hour) Review and discussion of exam</p> <p>Presenting quantitative evidence in court Defense issues and attacks</p>
Friday	<p>Complete lab work and case reports for Sample Sets #1-4 and assigned Sim Sets</p>	<p>Complete lab work and case reports for Sample Sets #1-4 and assigned Sim Sets</p>

FBI Quality Assurance Standards for Forensic DNA Testing Laboratories (7/98) Section 5.3.1 (Personnel) requirement for Statistics.



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Week 8: Laboratory Analyses and Differential Organic Extraction

Day	Morning	Afternoon	Comments
Monday	Assessment Memo Due SAMPLE SET 3: Data analysis and case report preparation	SAMPLE SET 3: Data analysis and case report preparation	Each trainee will demonstrate sample prep for differential samples and differential extraction up to PCI extraction in side-by-side training audits with trainers. Case review and sim set review by NERFI trainers.
Tuesday	SAMPLE SET 4: Data analysis and case report preparation Sim sets addressing mixtures assigned	SAMPLE SET 4: Data analysis and case report preparation	
Wednesday	Differential organic extraction – demonstration by NERFI Staff	Differential organic extraction – demonstration by NERFI Staff	
Thursday	SAMPLE SET 5: Sample prep and differential extraction (side-by-sides) Quiz #2 – Written (differential extraction, quant, troubleshooting, QA)	SAMPLE SET 5: Sample prep and differential extraction (side-by-sides)	
Friday	SAMPLE SET 5: Quantitation	SAMPLE SET 5: Quantitation	



Week 9: Laboratory Analyses

Day	Morning	Afternoon	Comments
Monday	Assessment Memo Due SAMPLE SET 5: Amplification	SAMPLE SET 5: Amplification	<p>Trainees continue to work on Sim Sets at their own pace. Sim Sets become increasingly more complex – differentials, mixtures, numerous samples.</p> <p>Case review and sim set review by NERFI trainers.</p>
Tuesday	SAMPLE SET 5: CE / Genetic Analysis Sim Sets assigned	SAMPLE SET 5: CE / Genetic Analysis	
Wednesday	SAMPLE SET 5: Data analysis and case report preparation	SAMPLE SET 5: Data analysis and case report preparation	
Thursday	SAMPLE SETS 1-5: Data analysis and case report preparation Sim sets	SAMPLE SETS 1-5: Data analysis and case report preparation Sim sets	
Friday	SAMPLE SETS 1- 5: Data analysis and case report preparation Sim sets	SAMPLE SETS 1-5: Data analysis and case report preparation Sim sets	



Week 10: Laboratory Analyses

Day	Morning	Afternoon	Comments
Monday	Assessment Memo Due SAMPLE SET 6: Sample prep and differential extraction	SAMPLE SET 6: Sample prep and differential extraction	Case review and sim set review by NERFI trainers.
Tuesday	SAMPLE SET 6: Organic extraction Sim Sets assigned	SAMPLE SET 6: Organic extraction	
Wednesday	SAMPLE SET 6: Quant	SAMPLE SET 6: Quant	
Thursday	SAMPLE SET 6: Amplification	SAMPLE SET 6: Amplification	
Friday	SAMPLE SET 6: CE / Genetic Analyzer	SAMPLE SET 6: CE / Genetic Analyzer	



Week 11: Laboratory Analyses

Day	Morning	Afternoon	Comments
Monday	Assessment Memo Due SAMPLE SET 6: Data analysis and case report preparation	SAMPLE SET 6: Data analysis and case report preparation	Oral quiz will be given individually to impact lab work as minimally as possible.
Tuesday	SAMPLE SET 7: Sample prep and differential extraction Quiz #3 – Oral (court definitions, CE troubleshooting)	SAMPLE SET 7: Sample prep and differential extraction Quiz #3 – Oral (court definitions, CE troubleshooting)	
Wednesday	SAMPLE SET 7: Organic extraction	SAMPLE SET 7: Organic extraction	
Thursday	SAMPLE SET 7: Quant	SAMPLE SET 7: Quant	
Friday	SAMPLE SET 7: Amplification	SAMPLE SET 7: Amplification	



Week 12: Laboratory Analyses

Day	Morning	Afternoon	Comments
Monday	Assessment Memo Due SAMPLE SET 7: CE / Genetic Analyzer	SAMPLE SET 7: CE / Genetic Analyzer	
Tuesday	SAMPLE SET 7: Data analysis and case report preparation Sim Sets assigned	SAMPLE SET 7: Data analysis and case report preparation	SS #5, 6, and 7 will be reviewed prior to beginning SS #8 – the competency test. SS #8 will be reviewed for all DNA analysis competencies.
Wednesday	SAMPLE SET 7: Data analysis and case report preparation	SAMPLE SET 7: Data analysis and case report preparation	SS #8 is the Competency Test. All procedures must be done independently by each trainee without assistance from any source.
Thursday	Finish/Revise case reports Sim Sets	Finish/Revise case reports Sim Sets	
Friday	Finish/Revise case reports Sim Sets	Finish/Revise case reports Sim Sets	

For Competency Test, trainees must make their own master mixes and must not discuss techniques being addressed in specific competencies or results with other trainees. FOR COMP TEST, ALL WORK MUST BE DONE INDEPENDENTLY, INCLUDING MASTER MIXES and QUANTITATIONS. NO BATCHING OF SAMPLES.



Week 13: Laboratory Analyses

Day	Morning	Afternoon	Comments
Monday	Assessment Memo Due SAMPLE SET 8 (Comp Test) : Sample prep and differential extraction	SAMPLE SET 8 (Comp Test) : Sample prep and differential extraction	Quiz #4 – Oral (statistics, QA)
Tuesday	SAMPLE SET 8 (Comp Test) : Organic extraction SAMPLE SET 8(Comp Test) : Quantitation	SAMPLE SET 8 (Comp Test) : Organic extraction SAMPLE SET 8 (Comp Test): Quantitation	
Wednesday	SAMPLE SET 8(Comp Test): Amplification Quiz #4 – Oral	SAMPLE SET 8 (Comp Test): Amplification Quiz #4 – Oral	
Thursday	SAMPLE SET 8 (Comp Test): CE / Genetic Analysis	SAMPLE SET 8 (Comp Test): CE / Genetic Analysis	
Friday	SAMPLE SET 8 (Comp Test): Data analysis and case report preparation	SAMPLE SET 8 (Comp Test): Data analysis and case report preparation	



Week 14: Laboratory Analyses and Final Laboratory Exam

Day	Morning	Afternoon	Comments
Monday	<p>Assessment Memo Due</p> <p>Complete lab work, case reports for all sample sets and all sim sets</p>	Complete lab work, case reports for all sample sets and all sim sets	Training Checklist
Tuesday	Complete lab work, case reports for all sample sets and all sim sets	Complete lab work, case reports for all sample sets and all sim sets	
Wednesday	<p>Complete lab work, case reports for all sample sets and all sim sets</p> <p>Study for final exam</p>	<p>Complete lab work, case reports for all sample sets and all sim sets</p> <p>Study for final exam</p>	
Thursday	<p>Complete lab work, case reports for all sample sets and all sim sets</p> <p>Study for final exam</p>	<p>Complete lab work, case reports for all sample sets and all sim sets</p> <p>Study for final exam</p>	
Friday	<p>Final Laboratory Exam</p>	Complete lab work, case reports for all sample sets and all sim sets	



Weeks 15 and 16
Moot Court Preparation and Trials
 SWGDAM Training Guidelines (1/01) Section 7. Legal Issues.

Week 15

Day	Morning	Afternoon	Comments
Monday	Assessment Memo Due Pre-Trials and final review	Pre-Trials and final review	NERFI staff and New York Prosecutors' Training Institute (NYPTI)
Tuesday	Pre-Trials and final review	Pre-Trials and final review	
Wednesday	Pre-Trials and final review	Pre-Trials and final review	
Thursday	Pre-Trials and final review	Pre-Trials and final review	
Friday	Pre-Trials and final review	Pre-Trials and final review	

Week 16

Day	Morning	Afternoon	Comments
Monday	Assessment Memo due Final review for Moot Court	Final review for Moot Court	NERFI staff and New York Prosecutors' Training Institute (NYPTI)
Tuesday	Moot Court / NYPTI	Moot Court / NYPTI	
	Moot Court / NYPTI	Moot Court / NYPTI	Evaluations by trainees and lawyers of each expert witness testimony
Wednesday	Moot Court / NYPTI	Moot Court / NYPTI	
Thursday	Complete case reports for all sample sets and sim sets Final Training Checklist sign-off	Complete case reports for all sample sets and sim sets Final Training Checklist sign-off	



ABIO 522 Forensic DNA Analysis Laboratory (10)

The overall goal of this forensic laboratory course is to provide students with the theoretical foundation and tools to perform DNA analysis on mock evidence employing methods commonly used in today's accredited forensic laboratories. Students will learn the theory and practice of forensic DNA analysis; past and current state-of-the-art-technologies; legal issues and statistical analyses. Students will perform analytical procedures that include DNA extraction, DNA quantification, PCR-based methods, multiplex amplification of STR loci, capillary electrophoresis of amplified products, and analysis, interpretation and reporting of single source and mixture data samples.

Textbooks: John Butler *Forensic DNA Typing*, 2nd Edition (ISBN 0121479528) and all pertinent literature required by SWGDAM and agency. NRCII Report

Attendance: Mandatory--Unexcused absences on your part will result in a failing grade for all assignments that day.

Academic Integrity: See Graduate Bulletin for details. Deviations will be treated according to university regulations.

Final Grade for ABIO 522: Each student must earn at least 80 points to pass ABIO 522 at the graduate level. Final pass/fail grade is determined by scores from four oral and written quizzes, final lab exam, and moot court evaluation.



IMPORTANT POINTS:

1. Software: Genemapper ID 3.2.1 and Data Collection 3.0.
Platforms: ABI 7500; ABI 9700, and ABI 3130XL/310
Kits: ABI *Quantifiler (Human and/or Y), Identifiler, Cofiler, Profiler*
2. SWGDAM Guidelines- as they apply to the 50 Sample recommendation:
Section 5.5 of the Training Guidelines (Jan. 01) states the following: A new DNA laboratory trainee must complete a training notebook documenting his/her own experiences performing evidentiary or known sample analysis. The type of samples included must vary, reflecting the range, type, and complexity of casework or database analyses routinely handled by his/her laboratory duties. To assist in ensuring basic competency, this training notebook must document analysis of a minimum of 50 samples for nuclear DNA analysis.
3. SWGDAM Guidelines- as they apply to the 20 data set recommendation:
Section 6.4.2 of the Training Guidelines (Jan. 01) states the following: The trainee will review 20 sets of data representative of casework and provide a written interpretation of the data according to the laboratory policy. The trainer will review and assess the reports for accuracy. These data sets can be samples representative of typical casework or actual casework data. The laboratory can maintain a standard file of data sets or share sets with other laboratories.

Primary Instructors: NERFI teaching staff and experts from the field of Forensic Science

Attendance is mandatory -- Unexcused absences on your part will result in a failing grade for all assignments that day.

Competency Exam: There will be one competency exam that will be graded pass/fail. Those students failing the competency exam on the first try will be allowed only one additional attempt to pass that exam. Failure to pass the competency exam on the second try will result in a failure for that exam.

Laboratory Attire: All students must wear a lab coat and appropriate eye protection when working in the DNA Academy Laboratory area. Eating and drinking are prohibited in these areas.

Training Checklist: At the end of each week NERFI staff, in conjunction with Training Coordinator, will update each trainee's DNA Training Checklist



Assessment Memos: Each trainee must submit by e-mail a weekly Assessment Memo to the instructors. Assessment Memos are due every Monday at 8:00 AM except on holidays that fall on a Monday.

All Assessment Memos submitted must contain the following information:

1. Total number of samples extracted to date.
2. Total number of independent setups and operations on appropriate instruments.
3. Any comments, concerns, and opportunities for improvement. In the "Opportunities for Improvement" section, the following are included:
 - A discussion of any mistakes made during procedures that week,
 - Report of discussions with trainers about mistakes,
 - corrective actions taken,
 - how to prevent the same mistake from re-occurring in the future, and/or what was learned from mistakes – to improve techniques or to better understand theoretical basis of DNA typing.
 - A description of areas of improvement and/or areas of proficiency.
4. Instructors provide individualized feedback on these memos and return to trainees for their permanent record.

