SJSU | DEPARTMENT OF JUSTICE STUDIES

FS- 160: Special Topics in Forensic Science: Advanced topics in forensic DNA analysis
Spring 2020

Instructor:	Dr. Mark Barash
Office Location:	HB 216
Telephone:	408-924-5513
Email:	mark.barash@sjsu.edu
Office Hours:	Tuesdays & Thursdays: 3:00am to 4:00pm; Wednesdays: 11:00am to 12:00pm; Online (Zoom): by appointment
Class Days/Time:	Tuesdays 12:00pm-2:30pm
Classroom:	HB 207
Canvas Course Website:	https://sjsu.instructure.com/courses/1363732 Login using your Tower ID Card and Password → Courses → FS 160
Prerequisites:	Justice Studies majors or minors: JS 10; Forensic Science majors or minors: FS-11; both majors or minors: senior standing (90+ units) or by instructor consent. It is recommended to take FS 167 or/and a molecular biology/genetics course prior to this course.
FS Library Liaison:	Nyles Monday: Nyles.Monday@sjsu.edu
FS Lib Guide:	http://libguides.sjsu.edu/content.php?pid=57768&sid=2450175
FS Program Website:	https://www.sjsu.edu/justicestudies/degrees/undergraduate-degrees/bs-forensic-science/

Course description

The forensic application of DNA analysis was first introduced in the mid-1980s and began with restriction fragment length polymorphism (RFLP) pattern detection that required micrograms of DNA template. It has quickly progressed to PCR-based short tandem repeat (STR) genotyping, which is capable of obtaining a full DNA profile from just a few cells. During the last thirty years, forensic DNA analysis became the gold standard of forensic science due to its unprecedented levels of sensitivity, specificity and accuracy and played a key role in a countless number of criminal cases worldwide.

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In recent years, rapid technological advancements in DNA sequencing methods have enabled additional progress in the area of forensic DNA genotyping, adding even more powerful tools to the forensic arsenal. This research–inspired course focuses on the chemical, immunological and molecular biological techniques necessary to locate and identify biological materials and their origin on a variety of crime scene items, and to extract, purify and analyze DNA from these items. DNA extraction, amplification and examination using standard technologies are highlighted, as required for court admissible evidence.

In addition to the contemporary DNA analysis methods, we will also discuss future trends and various aspects of emerging forensic DNA technologies and their implementation into operation casework. Specifically, we will talk about novel genetic and epigenetic markers of forensic relevance, such as single nucleotide polymorphisms (SNPs) and DNA methylation; advanced genotyping technologies, such as massively parallel sequencing and high – density microarrays; population genetics and genetics of complex traits; analysis and interpretation of complex bioinformatic data; application of the aforementioned tools to generate forensic intelligence, such as biogeographic ancestry and externally visible traits prediction; ethical and legal considerations related to implementation of these novel forensic tools. All the aforementioned topics are addressed in the interdisciplinary context and in relation to the relevance and the probative value of generated results for forensic investigation and implications on the criminal justice system.

Important dates

- Tuesday, Feb 4 – Last Day to Drop Classes without a W grade
- Tuesday, Feb 11 – Last Day to Add Classes via MySJSU

Course Learning Objectives (CLO)

Upon successful completion of this course students should be able to:

- **CLO1** Describe the basic principles of forensic DNA profiling using Short Tandem Repeat loci and other autosomal and non-autosomal DNA profiling technique.
- **CLO2** Understand the basic principles of the latest DNA sequencing technologies and their applications in forensic DNA analysis.
- **CLO3** Describe complex interactions between genetics, epigenetics, statistics, bioinformatics and other disciplines and their applicability to the emerging forensic DNA profiling practices.

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- **CLO 4** Understand and make an educated opinion on ethical and legal controversies associated with application of forensic molecular phenotyping, investigative genealogy and other potentially controversial forensic tools.

Course requirements and assignments

- **Classroom Protocol**

Please note that lectures are not recorded and will not be repeated. You will be evaluated in part based upon your contributions to class discussions, hence class participation is expected. It is essential that you come prepared to participate so keep up with the reading and plan to speak up.

Cell phones / smart devices are NOT permitted in the class, unless they are required for class activities.

- **Assignments**

1. Quizzes: 40%
2. Final exam: 30%
3. Digital media project: 30%
4. Extra credit assignments: up to 10%

The assessment tasks are aimed at determining the level of understanding of the lecture materials and required readings. A brief description of each assessment task and the course objectives they address is provided below.

If you know you are going to be unavailable for ANY assignment for this course and you want to be considered for an extension or exemption, you must let me know BEFORE the assignment becomes available (unless, of course, this is impossible).

Examples of situations where extensions or exemptions for assessments MAY be granted include:

- Medical conditions that prevented the assessment being completed (with a valid medical certificate and statutory declaration).
- Family medical emergencies that required your attendance (with a valid medical certificate and statutory declaration).

Examples of situations where extensions or exemptions for assessments WILL NOT be granted include:

- Social functions (including weddings, concerts, Star Wars conventions, etc).
- Personal administration (eg. my homework has been eaten by a hungry Puma, I had to watch my favorite season of Game of Thrones, etc).

Assessment task 1: Quizzes

This assessment task is designed to encourage reflection and critical review of lecture and assigned reading materials. It will consist of answers to online quizzes; specifically:

- Four online quizzes in four separate weeks, each worth 10%, will contribute a total of 40% to your final assessment. Each quiz will consist of responses to approximately ten multiple-choice or short answer questions. The questions will cover the material learned during the lectures and assigned readings.

Type: Individual work

Due: The quizzes will be released on Canvas at intervals throughout the semester, usually after the relevant lecture. You will be advised of the dates of each quiz during the semester. You will have approximately one week to complete each quiz. You only have one attempt at each question, but you can leave the quiz and return to it as often as you like during the assigned time. The questions are presented in random order. The answers would have to be submitted via Canvas portal.

Grading criteria: The marking criteria for the quizzes will be based on the number of correct answers, reflecting an understanding of key concepts, question interpretation and problem-solving.

Assessment task 2: Digital media project

This assessment task is about understanding, summarizing and efficient communicating of a forensic DNA topic/controversy as a part of a teamwork activity.

This task would require coordinated work of between 2 to 3 students working together. You will be required to choose a relevant topic (either among those discussed in the class or from a list provided by the course instructor or by choosing your own topic, following approval by the instructor) and create a digital media artefact about this topic in a video format. The length of the video should be between 3 to 5 minutes. This video file should be uploaded into

one of the free online platforms, such as Youtube or Vimeo and a link to the file must be submitted via Canvas prior to its presentation in the class.

Digital media training will be provided to you with a lecture on digital media principles covering layout design, color theory, fonts, use of images and basic video techniques. Additional online modules will be available to provide assistance with digital media.

The digital media project will benefit you in various ways such as learning the course content and learning digital media principles to communicate effectively, as well as encouraging creativity. The digital media project is an authentic task that resembles real life scenarios, such as communicating the scientific findings to the jury or a police investigator.

This project however is not about using expensive equipment or technology. It is about learning to tell a story in a succinct, clear and visual manner using digital media principles to ensure the message will be conveyed appropriately. The digital "props" are not to be ignored of course, as they could be very helpful to deliver your ideas. Nonetheless, your media project will be primarily judged on its content and how well you communicate it to the audience, and less on how "fancy" or "sophisticated" your animations are.

Type: groupwork

Weight: 30%

Due date: this project will be due on the week 14. You will have approximately 5 weeks to prepare this project.

Grading criteria:

A marking rubric will be provided to you to understand what you need to achieve. You will be assessed on the content of your project report and application of digital media principles. Assessment criteria include:

- Disciplinary knowledge (35%)
    - Accuracy and completeness of information
- Professional skills (35%)
    - Understanding and explanation of underlying scientific principles of the topic
- Communication skills (15%)
    - Presentation of information

  - Use of digital media principles (layout design, fonts, color, graphics and video principles) to enhance communication of the topic
  - Creativity (how presentation approach enhances topic)
- Enquiry and innovation (15%)
  - Research using available resources (textbooks, peer-reviewed papers)

Overall assessment of this task will be performed jointly by the students (20% of the total mark) and course coordinator (80% of the total mark), accounting to the 30% of the final course grade.

Assessment task 3: Final exam

A final, 2-hours online open book examination based on the whole course, including lectures and additional reading material. This test will assess understanding of the key concepts, problem solving and ability to integrate information from a range of topics discussed during lectures and in the assigned reading materials. The format of the exam will contain multiple-choice questions, short-answer questions and true/false questions, similar to the quizzes format.

Type: individual work

Weight: 30%

Grading criteria: The marking criteria for the final exam will be based on the number of correct answers, reflecting an understanding of key concepts, question interpretation and problem-solving.

Due: The final exam will be performed as either in-class or online activity (similar to quizzes), apart from time restriction (2-hr slot at a specific time and date). You will be advised of the time and specific format of the final exam during the course.

Extra Credit Opportunities

Extra credit opportunities may be available throughout the semester and may be used to cumulatively augment your final grade up to 10% total. These opportunities will also be announced on Canvas and required documentation would need to be uploaded and/or submitted online. You can choose any of the activities listed below:

1. Contributions to class and online discussions – up to 1% of the final grade.

2. A bonus quiz – up to 2% of the final grade.
3. Attend a Forensic Science seminar and write a two-page, double-spaced, typewritten paper that includes a synopsis of the seminar/lecture and your reaction/response. Your paper is due within one week of the event. Up to 2% of the final grade.
4. Complete a short course offered by the National Institute of Justice marked "extra credit" during the Forensic Bio module and submit your certificate of completion by the end of that module. Up to 3% of the final grade.
5. Students can write a research paper about a career in criminalistics that is of interest to the student. The paper will be in APA format and contain an introduction, the body of the research, and a conclusion. The length of a paper should be between 2 and 3 standard pages in 1.5 font. The paper must contain in-text citations from at least three sources (preferably peer-reviewed papers). Up to 1% of the final grade.

Please note, the maximum cumulative bonus grade you can get is 100, which can be used to adjust your final grade up to 5%. In other words, if you choose both the second and fourth bonus assignment tasks (a bonus quiz and a short online course), you would theoretically improve your final grade by up to 5 points. If you complete only the first task, it would improve your grade by 2% and so on.

Late Work and Make-Ups

Real-life has deadlines and so do college classes. Generally, you will have plenty of time to work and submit each of the assignments in this course. With this in mind, manage your time responsibly with the knowledge that late work will generally not be accepted.

If you know ahead of time that you will be unavailable when an assignment is due, complete it early. Make-ups will generally not be given unless extraordinary, documented circumstances exist.

If you have a genuine problem, contact me ASAP and I will gladly do all I can to help you. If you are in any doubt about the requirements of an assignment, or due dates/times, please re-read the assignment and/or schedule. If your question is still unanswered, please contact me for clarification.

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Overall grading scale for all assignments

Letter Grade	***Percent***	***Letter Grade***	***Percent***	***Letter Grade***	***Percent***
A plus (+)	97-100	C plus (+)	77-79.9	F	<60
A	94-96.9	C	74-76.9		
A minus (-)	90-93.9	C minus (-)	70-73.9		
B plus (+)	87-89.9	D plus (+)	67-69.9		
B	84-86.9	D	64-66.9		
B minus (-)	80-83.9	D minus (-)	60-63.9		

Note: **A grade of C or better is required for all Justice Studies major and minor coursework, and desirable for students enrolled in the Forensic Science majors and/or minor.**

Assessment feedback

Assessment feedback will be provided in the form of marks and comments. Additional information may be sought from the subject instructor.

Success in this course is based on the expectation that students will spend, for each unit of credit, a minimum of 45 hours over the length of the course (normally three hours per unit per week) for instruction, preparation/studying, or course-related activities, including preparing for class, participating in course activities, completing assignments, and so on. Other course structures will have equivalent workload expectations as described in the syllabus. More details about student workload can be found in University Policy S12-3 at http://www.sjsu.edu/senate/docs/S12-3.pdf

Assignment preparation

Here is some advice to help you get on the right track with the completion and preparation of assignments:

It really does pay to try to get started with your assignments as early as possible. Always read the question carefully. Underlining key words and 'unpacking' the question can help you understand the main elements and different sections to the task. Then you can move on to planning out your answer and brainstorming initial ideas.

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Do not procrastinate, there's no time like the present to get started. If you are lacking direction or motivation, do some background reading on the subject/task to get you started and build your confidence and motivation. Do not leave assignments to the last minute; there's no need to do so, and it will save you lots of anxiety and stress if you do not.

If you are not sure how to complete a particular assignment, always contact the professor as soon as possible. Don't leave your assignment for the very last minute!

Presentation tips

Here is some advice to help you with the preparation of your final presentation:

- Put a title at the top of each slide that states the slide's main point
- Use large, easy-to-read font (e.g., Arial) throughout
- Font size: 18 point minimum, 24 point recommended, 36 point or larger for a title
- Don't use too much text. Bullet points are generally better than full sentences or paragraphs. Try to avoid reading the slide to the audience.
- Don't forget to include references in your slides
- Use primary colors for the font and background when possible, especially red and blue. Don't use colors which are hard to read (e.g. too bright/dark).
- Speak loudly and clearly. Face forward as much as possible. Try not to rush.
- Practice what you will say about each slide so that you present the essential points as clearly and efficiently as possible.
- Practice your presentation with a timer to make sure that you are at or under fifteen minutes.

Recommended texts

The following textbook by Dr. John Butler provides an excellent overview of the traditional methods of forensic DNA analysis, including associated methodology and interpretation of the genotyping results.

- Butler (2010) Fundamentals of forensic DNA typing. Academic Press (Elsevier). This book is freely available online from the MLK Library: https://sjsu-primo.hosted.exlibrisgroup.com/primo-explore/fulldisplay?docid=01CALS_ALMA71476600890002901&context=L&vid=01CALS_SJO&lang=en_US

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The following texts provide a more in-depth overview of the main topics discussed in this course:

- Butler (2012) Advanced topics in forensic DNA typing: Methodology. Academic Press (Elsevier). Available from MLK library.
- Butler (2015) Advanced topics in forensic DNA typing: Interpretation. Academic Press (Elsevier). Available from MLK library.
- Making sense of forensic genetics https://www.euroforgen.eu/dissemination-activities/making-sense-of-forensic-genetics/ European Forensic Genetics (EuroForGen) Network of Excellence.
- Forensic genetics explained https://www.euroforgen.eu/dissemination-activities/forensic-genetics-explained/ European Forensic Genetics (EuroForGen) Network of Excellence.
- Molecular Biology Education by ThermoFisher Scientific: https://www.thermofisher.com/us/en/home/brands/invitrogen/molecular-biology-technologies/mol-bio-school.html
- Roewer L. (2013) DNA fingerprinting in forensics: past, present, future. Investigative Genetics 2013, 4:22 http://www.investigativegenetics.com/content/4/1/22
- McCord B. et.al. (2019). Forensic DNA analysis. Analytical Chemistry Vol. 91, p.673-688.
- Frudakis T. Molecular Photofitting: Predicting Ancestry and Phenotype Using DNA. (2007). MLK library link.
- Kayser, M. de Knijff, P. (2011) Improving human forensics through advances in genetics, genomics and molecular biology. Nature Reviews Genetics, Vol. 12 Issue 3, p179-192.
- Kayser M. (2015) Forensic DNA Phenotyping: Predicting human appearance from crime scene material for investigative purposes. Forensic Science International: Genetics, Vol. 18, p33-48.
- Liu YY., Harbison S. (2018) A review of bioinformatic methods for forensic DNA analyses. Forensic Science International: Genetics, Vol 33, Pages 117-128.
- Sijen T. (2015) Molecular approaches for forensic cell type identification: On mRNA, miRNA, DNA methylation and microbial markers. Forensic Science International: Genetics, Vol. 18, p21-32.
- Shabani M. et.al. (2018). Forensic Epigenetic Age Estimation and Beyond: Ethical and Legal Considerations. Trends in Genetics, Vol34:7, p489-491.

Additional resources will be posted on Canvas during the semester. Check the site frequently!

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University Policies

Per University Policy S16-9 (http://www.sjsu.edu/senate/docs/S16-9.pdf), relevant university policy concerning all courses, such as student responsibilities, academic integrity, accommodations, dropping and adding, consent for recording of class, etc. and available student services (e.g. learning assistance, counseling, and other resources) are listed on Syllabus Information web page (http://www.sjsu.edu/gup/syllabusinfo), which is hosted by the Office of Undergraduate Education. Make sure to visit this page to review and be aware of these university policies and resources.

Department of Justice Studies Reading and Writing Philosophy

The Department of Justice Studies is committed to scholarly excellence. Therefore, the Department promotes academic, critical, and creative engagement with language (i.e., reading and writing) throughout its curriculum. A sustained and intensive exploration of language prepares students to think critically and to act meaningfully in interrelated areas of their lives–personal, professional, economic, social, political, ethical, and cultural. Graduates of the Department of Justice Studies leave San José State University prepared to enter a range of careers and for advanced study in a variety of fields; they are prepared to more effectively identify and ameliorate injustice in their personal, professional and civic lives. Indeed, the impact of literacy is evident not only within the span of a specific course, semester, or academic program but also over the span of a lifetime.

Academic integrity

San Jose State University encourage students to undertake their academic studies with the highest integrity and take seriously any instances of student misconduct. Student misconduct can include cheating (examples of which may be in formal or informal examinations, copying work from another student for individual reports or assignments, altering data, submitting work which has been written by another person as your own, resubmitting work that has been submitted previously for academic credit) or plagiarism (presenting the work of another as your own, or the use of another person's ideas without giving proper credit). Plagiarism detection software such as Turnitin or other methods to detect plagiarism will be used to check your work.

The University Academic Integrity Policy S07-2 at http://www.sjsu.edu/senate/docs/S07-2.pdf requires you to be honest in all your academic course work. Faculty members are required to report all infractions to the office of

Student Conduct and Ethical Development. The Student Conduct and Ethical Development website is available at http://www.sjsu.edu/studentconduct/.

Instances of academic dishonesty will not be tolerated. Cheating on exams or plagiarism will result in a failing grade and sanctions by the University.

Student Resources

- **Forensic Science Student Group (FSS)**

Forensic Science Students is a campus group open to all students interested in forensic science. The group meets biweekly during the semester and offers friendship, forensic science-related activities, networking opportunities, and mentorship. Members of the FSS participate and assist at conferences, CSI camps, guest speaking events, and other extra-curricular activities. FSS Peer Mentors assist forensic science students in navigating the major, understanding requirements and prerequisites, and making wise choices in their college careers. Mentors may also offer limited tutoring, and facilitate educational and professional opportunities. Contact sjsu.fss@gmail.com for more information, or to get an application for membership.

- **Student Technology Resources**

Computer labs for student use are available in the Academic Success Center located on the 1st floor of Clark Hall and on the 2nd floor of the Student Union. Additional computer labs may be available in your department/college. Computers are also available in the Martin Luther King Library. A wide variety of audio-visual equipment is available for student checkout from Media Services located in IRC 112. These items include digital and VHS camcorders, VHS and Beta video players, 16 mm, slide, overhead, DVD, CD, and audiotape players, sound systems, wireless microphones, projection screens and monitors.

- **Learning Assistance Resource Center**

The Learning Assistance Resource Center (LARC) located in Room 600 in the Student Services Center assists students in the development of their full academic potential and motivates them to become self-directed learners. The center provides support services, such as skill assessment, individual or group tutorials, course advising, learning assistance, summer academic preparation and basic skills development. http:/www.sjsu.edu/larc/

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- **SJSU Writing Center**

The SJSU Writing Center located in Room 126 in Clark Hall offers a variety of resources to help students become better writers, including one-on-one tutoring sessions and numerous writing workshops. All services are free for SJSU students. http://www.sjsu.edu/writingcenter/

- **CASA Student Success Center**

The Student Success Center in the College of Applied Sciences and Arts (CASA) provides advising for undergraduate students majoring or wanting to major in programs offered in CASA Departments and Schools. All CASA students and students who would like to be in CASA are invited to stop by the Center for general education advising, help with changing majors, academic policy related questions, meeting with peer advisors, and/or attending various regularly scheduled presentations and workshops. If you are looking for academic advice or even tips about how to navigate your way around SJSU, check out the CASA Student Success Center. Location: MacQuarrie Hall (MQH) 533. Contact information: 408.924.2910 Website: http://www.sjsu.edu/casa/ssc/. The CASA Student Success Center also provides study space and laptops for checkout.

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Tentative course schedule

Notes about the course schedule: The order of the discussed topics and specific and focus might change, according to students' progress. I reserve the right to change the schedule including the due dates, but only in a manner that benefits students (e.g., due dates can only be pushed back, never moved forward). Only the main required texts are listed below due to space limit. Please check Canvas for additional resources.

Week	Date	Topics, Readings, Assignments, Deadlines
1	01/28/20	• Course introduction • Overview of assignments and expectations • Quick recap on cell biology and genetics • Reading for today: Syllabus **Readings** • Butler JM (2010): Chapters 1, 2 & 3 • Jobling & Gill (2004) Encoded evidence: DNA in forensic analysis. Nature Reviews Genetics, 5: 739–751. • Jeffreys (2005) Genetic fingerprinting. Nature Medicine, 11(10):1035-1039.
2	02/04/20	• Introduction to Forensic Genetics • Contemporary forensic DNA markers and technologies **Readings** • Butler JM (2010): Chapters 5 & 6 OR Butler JM (2012): Chapters 2 & 3
3	04/11/20	• DNA extraction and quantitation **Readings** • Butler JM (2010): Chapters 7, 8 & 9 OR Butler JM (2012): Chapters 4, 5 & 6
4	04/18/20	• DNA amplification & capillary electrophoresis **Readings** • Butler JM (2010): Chapters 10, 11 & 12
5	02/25/20	• Lecture on digital media technologies

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		Readings • Butler JM (2010): Chapter 14 • Check Canvas webpage;
6	03/03/20	• STR genotyping and data interpretation **Readings** • Butler JM (2010): Chapters 17 & 18 • Butler JM (2012): Chapters 12 & 17 • van Daal and Budowle (2008). Forensically relevant SNP classes. BioTechniques 44, No. 5 • van Daal and Budowle (2008). Extracting evidence from forensic DNA analyses: future molecular biology directions. BioTechniques 46:339-350
7	03/10/20	• Emerging technologies: novel forensic genotyping markers **Readings** • Check Canvas webpage
8	03/17/20	• Sanger sequencing and its applications • Microarrays **Readings** • Metzger, M. (2010). Sequencing technologies —the next generation. Nature Reviews 11, p31-46. • Van Dijk E. et.al. (2014) Ten years of next-generation sequencing technology. Trends in Genetics, Vol. 30, p.418-426. • Kayser, M. de Knijff, P. Improving human forensics through advances in genetics, genomics and molecular biology. Nature Reviews Genetics. Mar 2011, Vol. 12 Issue 3, p179-192 • Zaaijer S. et.al. (2017) Rapid re-identification of human samples using portable DNA sequencing. eLife 6:e27798 • Check Canvas webpage
9	03/24/20	• Massively Parallel Sequencing **Readings** • Check Canvas webpage

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10	03/31/20	**NO Lecture – Spring Recess**
11	04/07/20	• Forensic epigenetics • Forensic DNA intelligence **Readings** • Check Canvas webpage
12	04/14/20	• Forensic molecular phenotyping • Biogeographic ancestry prediction **Readings** • Check Canvas webpage
13	04/21/20	• Investigative genealogy: Long-range familial searching using public DNA databases **Readings** • Check Canvas webpage
14	04/28/20	• Course summary • Students presentations
15	05/05/20	• Students presentations • Discussion: what's next in forensic DNA analysis?
16	05/20/20 9:45 am – 12:00 pm	• Final exam