

San Jose State University

Department of Justice Studies

JS 111 Fluorescence Applications in Molecular Biology and Forensic Science (01, Fall 2010)

General Class Information:

Instructors:	Dr. Steven Lee and Dr. Bradley Stone
Lee Office Location:	MacQuarrie Hall 521
Lee Telephone:	408-924-2948
Emails:	sSteven.lee@sjsu.edu ; bstone@science.sjsu.edu sblee999@gmail.com .
Lee Office Hours:	Weds 1445-1845 in person. 1845-1945 by email. Set up 15 minute appointments by email.
Class Days/Time:	Monday and Wednesday 1330-1445
Classroom:	TBD
Lab:	TBD
Prerequisites:	Bio 1A, Bio 1B, Chem 1A, Chem 1 B, JS 113, all with C or Better.

Course Description:

This course covers scientific concepts, methods, practices, instrumentation, interpretation, statistics and court issues of fluorescence applications in molecular biology and forensic science. Atomic and molecular basis of fluorescence, emission, photophysical processes, energy transfer, QA, validation, accreditation, and admissibility will be covered in lectures, hands-on activities/laboratories, videos and guest lectures.

Student Learning Outcomes:

Students that successfully complete this course are expected to obtain the following learning outcomes.

1. Learn the basic scientific concepts of fluorescence.
2. Understand fluorescent applications, assays, and instrumentation utilized in selected methods.
3. Become familiar with court admissibility, validation, accreditation, interpretation, and statistical issues.
4. Acquire knowledge on potential interferences in fluorometric assays and the methods used to monitor and resolve the interferences where possible.
5. Discover where to look for more advanced information and acquire extensive lists of references and resources on fluorescence applications.

Assignments and activities to meet leaning outcomes:

The following assignments and activities will help students meet the learning outcomes above.

For outcome 1, learn the basics of fluorescence, students will:

1. Read introductory chapters 1-3 (Introduction, Absorption of UV-visible light and Characteristics of fluorescence emission) in the required textbook and assigned supplementary materials listed below.
2. Attend lectures that cover the scientific concepts of fluorescence in weeks 3 through 6
3. Apply the knowledge gained in reading and lectures in hands on activities

For outcome 2, Understand fluorescent applications, assays, and instrumentation utilized in selected methods, and outcome 4, Become familiar with court admissibility, validation, accreditation, interpretation, and statistical issues. students will:

1. Attend and perform activities in which they will conduct a variety of molecular and forensic fluorescent assays
2. Utilize instrumentation such as UV spectrometers, short and long wave UV lamps, fluorescent based real time PCR and capillary electrophoresis detectors in activities and demonstrations during weeks 3-5 and 9-10.
3. Perform troubleshooting and controls to monitor and mitigate interferences in fluorescent assays

For outcome 3, Become familiar with court admissibility, validation, accreditation, interpretation, and statistical issues students will:

1. Attend lectures that cover these topics in weeks 1-2 and 16
2. Read supplementary materials covering the topics and
3. Participate in activities and view videos on court admissibility covering topics of accreditation, validation and interpretation.

For outcome 5, Discover where to look for more advanced information and acquire extensive lists of references and resources on fluorescence applications, students will:

1. Be provided lists of references during the course
2. Obtain additional new information in journal article readings that will be required and optional assignments and
3. Acquire knowledge on additional information through exposure to library resources, professional societies, guest speakers, journal articles, web-based resources and other on-campus and off campus faculty and staff.

Assessment of student learning outcomes:

Assessment of student learning outcomes will be performed utilizing the following tools:

1. Performance on in class quizzes (one every week) and homework assignments
2. Performance on in class activities and group written assignments
3. Demonstration of understanding in student led reviews and participation throughout the course.
4. Written feedback collected during the course. and after the course
5. Final exam performance

Course Text and materials:

Required Text: Valeur, B. Molecular Fluorescence. Principles and Applications. Wiley-VCH. 2002.

Supplementary Text:

Lakowicz, JR. Principles of Fluorescence Spectroscopy. Springer Science 2006.

Forensic Science Laboratory Protocols. Steven Lee. Crime laboratory protocols (publicly available).

Protocols will be handed out and utilized for laboratory and hands-on exercises.

Required reading and Internet materials:

Journal articles and other readings will be accessible at the SJSU library, on reserve or will be accessible on line. Citations and URLs for on line materials will be provided in assignments and on the greensheet.

These will include:

Molecular Probes Handbook-Excellent resource for fluorescent dye information- see:

<http://www.invitrogen.com/site/us/en/home/References/Molecular-Probes-The-Handbook.html>

Introduction to Fluorescence-

<http://www.invitrogen.com/site/us/en/home/References/Molecular-Probes-The-Handbook/Introduction-to-Fluorescence-Techniques.html>

Chroma- : www.chroma.com FMBIO filter supplier

* Link and Handbook: <http://www.chroma.com/>

<http://www.chroma.com/resources/filter-handbook>

Univ. of Maryland Medicine- Center for Fluorescence Spectroscopy:

<http://cfs.umbi.umd.edu/>

Peer reviewed literature, publications, courses on fluorescence

<http://cfs.umbi.umd.edu/cfs/publications.html>

Fluorescence microsphere resource center – U Washington:

<http://fmrc.pulmcc.washington.edu/fmrc.shtml>

Excellent references on standards, controls, instrumentation, etc.

Fluorescence spectrum viewer: Two links with good resources to view and understand excitation and emission spectral properties

<http://www.bdbiosciences.com/research/multicolor/tools/index.jsp>

<http://www.invitrogen.com/site/us/en/home/support/Research-Tools/Fluorescence-SpectraViewer.html>

Salk flow cytometry table of fluorochromes: <http://pingu.salk.edu/flow/fluo.html>

Lists dyes with excitation and emission max

Supplementary Texts (Optional) - Course material may include citations from the following:

Saferstein, R. 2004. Forensic Science Handbook, Vol. 2. Pearson. pp 1 -528.

Saferstein, RE. 2007. Criminalistics: An Introduction to Forensic Science (College Version), 9/E. Prentice Hall. pp 1 -672.

[An Introduction to Forensic Science at:](http://vig.prenhall.com/catalog/academic/product/0,1144,0132216558,00.html)

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Course Format:

The course will include **lectures by the instructor and guest lectures** including scientists from crime laboratories, **hands-on demonstrations and activities, discussions, videos, and small-group hands-on activities.** If possible, on-line chats and a visit to a crime lab will be scheduled (TBA).

Course requirements:

Exams - 350 points:

Three exams will be given in this course. Exams will be cumulative and will include all material covered up to the date of the exam. Exams may include multiple choice, matching, true/false, short answer, diagrams, drawings and sketches, short essay and/or long essay.

The final will be comprehensive. Exam 1 and exam 2 are both worth 100 points. The final is worth 150points.

Quizzes and Small Group Activities - 100 points:

Quizzes on assigned readings, small group activities and other assigned materials will be given during the semester. These will generally be multiple choice, matching, true/false and short answer but may also include essay questions.

Hands-on Demonstrations/activities- 40 points:

Demos and activities will be held throughout the semester. These activities will include as many of the following as time will permit: safety and report guidelines, measurements and errors, proper collection methods, lights and applications in forensic science, UV, Vis, IR, and Lasers, UV-vis spec- Screening for blood and semen with UV fluorescence, FTIR, qPCR: taqman- DNA quant, Multiplex STR PCR and moot court testimony. Participation will also be considered in the grades.

Participation point grading- 50 points:

For in class and activity participation, you will be able to earn 50 points. You will be graded on your participation. For “outstanding” participation, you will be awarded 40-50 points. These will be awarded to students who participate fully each week including being on time, completing all assigned work, actively participating in group activities, providing several comments and questions during the activity/laboratory and on occasion, bringing to light additional information and references relevant to the topic. For “good” participation, you will be awarded 30-40 points. This level will be achieved by those that are on time most of the time, completing nearly all assigned work, participating some in group activities and providing some comments and questions during the activities. “Fair” participation (some assigned work completed, a few comments or questions made, or students who participate considerably but arrive more than 15 minutes late or leave more than 15 minutes early or those missing 2-3 activity sessions) will be awarded 20-30 points. Minimal participation (very little completed work, almost no comments, consistently late arrival or early to leave) will be awarded 10-20 points. Students who are completely silent or are absent more than 4 times from activities will receive no participation points.

Grading:

Quizzes/Activities	100 points;
Exam 1	100 points;
Exam 2	100 points;
Participation	50 points;
Final exam	150 points;
Total required	500 points.

Extra Credit:

A total of 10 points may be granted for additional extra credit small group assignments and other assignments during the semester. Each assignment will be worth 1-2 points each. These extra credit points may be used to augment your final point total.

Grading Policies:

Make-up exams will not generally be permitted. However, under extraordinary circumstances, with proper documentation and approval by the instructor, a 15 page single-spaced term paper of an instructor assigned topic, may substitute for 1 exam.

Grading Scale (plus/minus)

<i>From</i> - <i>To</i>	<i>Gra</i> <i>de</i>
483.5-500	A plus
467-483.4	A
450-466.9	A minus
433.5-449.9	B plus
417-433.4	B
400-416.9	B minus
383.5-399.9	C plus
367-383.4	C
350-366.9	C minus
333.5-349.9	D plus
317-333.4	D
300-316.9	D minus
<300	F

Instructor:

Professor Lee holds an MS from NYU and PhD from University of California, Berkeley in Molecular Biology. Lee holds several concurrent positions including a consulting position as Director of R&D at MiraiBio Inc. a small biotech company in Alameda, CA, Visiting Scholar at UC Berkeley, and holds adjunct professor appointments in Biological Sciences at San Francisco State University and Chemistry at Florida International University. He was formerly the Director of R&D at CA Dept of Justice DNA Laboratory from 1994-2000 where he served as an expert witness in DNA and conducted DNA training courses. He is a full member of the American Association for the Advancement of Science, American Academy of Forensic Sciences, the California Association of Criminalists, and is an American Society of Crime Laboratory Directors Laboratory Accreditation Board certified inspector. He also served on the FBI Technical Working Group on DNA Analysis Methods group from 1994-2000. He has taught courses in molecular biology at SFSU (1996-1998), Forensic genetics at UC Davis (1997), and most recently forensic DNA Typing of STRs at FIU (2003).

Bradley M. Stone is currently Professor and Chair of the Department of Chemistry at San Jose State University. He joined the Astrochemistry Group in Spring of 1995 as a Stanford Fellow in the NASA-ASEE Summer Faculty Fellowship Program. He received his B.S. in Chemistry from the University of Illinois, Chicago in 1977 with Honors and High Distinction. He went on to do a Ph.D. in Chemical Physics at Indiana University, working with Charles Parmenter using laser spectroscopy to study intramolecular vibrational redistribution in polyatomic molecules (particularly p-fluorotoluene). After finishing his Ph.D. in 1984, he was a postdoctoral research associate for Edward K.C. Lee at the University of California, Irvine, where he studied laser spectroscopy of the formyl radical (HCO) and formaldehyde H₂CO) in a supersonic jet. He accepted the position of Assistant Professor of Chemistry at San Jose State in 1985. He has been associated with NASA Ames Research Center since 1989 - first collaborating with Thomas Scattergood in the Solar System Exploration Branch in studying the photochemistry and photophysics of aerosol formation by the photolytic polymerization of organics in the atmosphere of Titan; and more recently collaborating with Louis J. Allamandola in the Astrophysics Branch, studying the spectroscopy of polycyclic aromatic hydrocarbon cations in cryogenic matrices for the purposes of detection of the species in the interstellar medium. From 1995 to 1999, Dr. Stone was principally responsible for building the laser fluorescence laboratory for the Astrochemistry group, for the study of the laser-induced fluorescence of polycyclic aromatic hydrocarbon cations. In 2000, San Jose State University took over the administration of the NASA Faculty Fellowship Program for Ames Research Center and Dryden Flight Research Center from Stanford University. Dr. Stone has been the Co-Director of the program since that time.

University Policies:

Course Add/Drop Statement:

Instructors are permitted to drop students who fail to attend the first scheduled class meeting and who fail to inform the instructor prior to the second class meeting of the reason for any absence and their intention to continue in the class. Some instructors will drop students who do not meet the stated course prerequisites. However, instructors are not required to drop a student from their course. **It is the student's responsibility to make sure classes are dropped.**

You, the student, are responsible for understanding [the policies and procedures about add/drops, academic renewal, withdrawal, etc. found at: http://sa.sjsu.edu/student_conduct](http://sa.sjsu.edu/student_conduct)

Dropping and Adding:

Students are responsible for understanding the policies and procedures about add/drops, academic renewal, etc.

[Information on add/drops are available at http://info.sjsu.edu/web-dbgen/narr/soc-fall/rec-324.html.](http://info.sjsu.edu/web-dbgen/narr/soc-fall/rec-324.html)

[Information about late drop is available at http://www.sjsu.edu/sac/advising/latedrops/policy/](http://www.sjsu.edu/sac/advising/latedrops/policy/)

Students should be aware of the current deadlines and penalties for adding and dropping classes.

Academic integrity:

Students should know that [the University's Academic Integrity Policy is available at http://www.sa.sjsu.edu/download/judicial_affairs/Academic_Integrity_Policy_S07-2.pdf](http://www.sa.sjsu.edu/download/judicial_affairs/Academic_Integrity_Policy_S07-2.pdf)

Your own commitment to learning, as evidenced by your enrollment at San Jose State University and the University's integrity policy, require 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 website for Student Conduct and Ethical Development is available at:](http://www.sa.sjsu.edu/judicial_affairs/index.html)

[http://www.sa.sjsu.edu/judicial_affairs/index.html.](http://www.sa.sjsu.edu/judicial_affairs/index.html)

Instances of academic dishonesty will not be tolerated. Cheating on exams or plagiarism (presenting the work of another as your own, or the use of another person's ideas without giving proper credit) will result in a failing grade and sanctions by the University. For this class, all assignments are to be completed by the individual student unless otherwise specified. If you would like to include in your assignment any material you have submitted, or plan to submit for another class, please note that SJSU's Academic Policy F06-1 requires approval of instructors.

Academic integrity is essential to the mission of San José State University. As such, students are expected to perform their own work (except when collaboration is expressly permitted by the course instructor) without the use of any outside resources. Students are not permitted to use old tests, quizzes when preparing for exams, nor may they consult with students who have already taken the exam. When practiced, academic integrity ensures that all students are fairly graded. Violations to the Academic Integrity Policy undermine the educational process and will not be tolerated. It also demonstrates a lack of respect for oneself, fellow students and the course instructor and can ruin the university's reputation and the value of the degrees it offers.

We all share the obligation to maintain an environment which practices academic integrity. *Violators of the Academic Integrity Policy will be subject to failing this course and being reported to the Office of Judicial Affairs for disciplinary action which could result in suspension or expulsion from San José State University.*

[The policy on academic integrity can be found at](http://www.sa.sjsu.edu/download/judicial_affairs/Academic_Integrity_Policy_S07-2.pdf)

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Campus Policy in Compliance with the American Disabilities Act:

If you need course adaptations or accommodations because of a disability, or if you need to make special arrangements in case the building must be evacuated, please make an appointment with me as soon as possible, or see me during office hours. Presidential Directive 97-03 requires that students with disabilities requesting accommodations must register with the DRC (Disability Resource Center) to establish a record of their disability.

Cheating:

At SJSU, cheating is the act of obtaining or attempting to obtain credit for academic work through the use of any dishonest, deceptive, or fraudulent means. Cheating at SJSU includes but is not limited to:

- Copying in part or in whole, from another's test or other evaluation instrument.
- Submitting work previously graded in another course unless this has been approved by the course instructor or by departmental policy.
- Submitting work simultaneously presented in two courses, unless this has been approved by both course instructors or by departmental policy.
- Altering or interfering with grading or grading instructions.
- Sitting for an examination by a surrogate, or as a surrogate.
- Any other act committed by a student in the course of his or her academic work which defrauds or misrepresents, including aiding or abetting in any of the actions defined above.

Plagiarism:

At SJSU plagiarism is the act of representing the work of another as one's own (without giving appropriate credit) regardless of how that work was obtained, and submitting it to fulfill academic requirements. Plagiarism at SJSU includes but is not limited to:

The act of incorporating the ideas, words, sentences, paragraphs, or parts thereof, or the specific substances of another's work, without giving appropriate credit, and representing the product as one's own work; and representing another's artistic/scholarly works such as musical compositions, computer programs, photographs, painting, drawing, sculptures, or similar works as one's own.

Student Rights and Responsibilities:

"The classroom is the essential part of any university. Both freedom to teach and freedom to learn should flourish in the classroom. The professor has the right and responsibility to control the classroom; however, as this control is exercised, the rights of students as set forth in this document should not be denied.

1. Students have the right to consistent and judicious evaluation by the instructor.
2. Students are free to take reasoned exception to the data or views offered in courses of study. They may be required to know the material set forth by the instructor, but they are free to reserve personal judgment as to the truth or falsity of what is presented.
3. Students have the right to have faculty meet their classes at the scheduled times and make presentations appropriate to the course. When circumstances require cancellation of a class, the instructor shall make an effort to notify students.
4. While faculty and administrators have primary responsibility in curricular matters, students shall have opportunity for participation in revising and improving the curriculum by serving on operational curriculum committees.
5. Students are responsible for meeting standards of academic performance established for each course. Performance in the course shall be the sole criterion by which students are measured and the professor shall take no action to penalize students because of their opinions or because of their conduct outside the classroom in matters unrelated to the class. Students have the right to a course grade which is a just measurement of performance in the course.
6. Information about a student's performance, views, beliefs, and political association which professors acquire in the course of their work as instructors, advisers, and counselors is considered confidential.
7. Students enrolled in a class may be denied admission to the classroom or may be expelled for the remainder of a class period only for considerations relevant to the educational purposes of the class. A faculty member may recommend to the Dean of Student Services that a student be permanently withdrawn from a course if after suitable warning a student's disruptive actions are determined to be in violation of the University policy on "Student Discipline Relating to Conduct on State University Campuses".

8. Students have the right to have instructional faculty schedule a reasonable number of office hours for student conferences”.

Tentative Course Schedule:

Dates	Topic	1° Inst	Chapter	Applications/Demos/Activities
<u>Unit I. Introduction and Basic Forensic Science Concepts</u>				
8/25	Introduction and Course Overview	SL		Safety and report guidelines
8/30-9/1	Basics of Physical Evidence- Handling, Collection, Preservation	SL		Measurement and Errors
9/4	FS apps: latent prints, trace, QD, semen, body fluids, explosives	SL		Proper collection methods
	Fluorescent detection methods in Forensic Science	SL		Biological fluids, drugs, fiber, paint
9/6	No Class			
<u>Unit II. Introduction to Fluorescence</u>				
9/13-15	A brief history of fluorescence and phosphorescence	SL	1	Lights and Apps in for. sci.
	Characteristics of fluorescence emission –Spectral Overlap	SL	3	IR&IR Spec- blood,QD,drugs
9/20-22	Atomic and Molecular Basis of Fluorescence - Fluoroprobes	BS	3	UV, Vis, IR, and Lasers
	Absorption of UV–visible light	BS	2	UV-vis spec
	(Note SL inspection of Chaminade University)			
09/27	Student Led Reviews	SL		
9/29	<u>Exam I</u>	SL		
<u>Unit III. Fluorescent Applications in Microscopy and Molecular Biology</u>				
10/4-6	Effects of intermolecular photophysical processes on emission	BS/SL	4	Polarizing Microscopy-trace
10/11-13	Principles of steady-state and time-resolved fluor techniques	BS	6	Spectro-fluorimeters-organics
	(Note SL at International Symposium on Human ID)			
10/18-20	Resonance energy transfer and its applications	SL	9	qPCR: taqman- DNA quant
10/25-27	Additional FRET applications, beacons, scorpions	SL		
	Multiplex STR PCR and Capillary Electrophoresis	SL		Forensic STR amplification
11/1	Student Led Reviews	SL/BS		
11/3	<u>Exam II</u>	SL/BS		
<u>Unit IV. Advanced Fluorescent Methods</u>				
11/8-10	Fluorescent molecular sensors of ions and molecules	BS	10	pH sensing by fluorescence
11/15-17	Advanced techniques in fluor. Spectroscopy & Microscopy	SL	11	FISH, Saliva on skin
11/22-24	Advanced Biotech and Forensic Applications	BS/AdM		Imaging, Screening, SNPs
11/29-12/1	High throughput and Molecular Diagnostic Applications	SL		DNA Sequencing
12/6-8	Quality Control, Validation, Training, Legal and Ethical Issues.	SL		Moot court testimony

Final Exam : Friday December 17 1215-1430