

# Forensic Science Education in United States

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Forensic science has long played an important role in the criminal justice system by providing scientific facts and information to the police and the court. Today, the application of forensic science is no longer limited to criminal investigation. Forensic evidence has emerged as a significant element in efforts to resolve civil disputes, environmental pollutant tracing, historical studies, public safety issues and national security, medical malpractice, nature and man made disasters, war crime, epidemic and infectious diseases, domestic and international terrorism investigation. The influence of forensic evidence will definitely extend into many other public safety issues and global investigative affairs in the future.

With the expansion in the scopes of forensic investigation and the demand of high quality of forensic services, there is an urgent need for qualified and well trained forensic scientists in the field. There are many fundamental and substantial changes in the field of forensic science education. Not only has the number of colleges and universities offering forensic degrees increased, but also the curriculum, course content, faculty and student make-up. The fundamental concepts of forensic education have also changed with time.

## A. The types and number of forensic educational programs have increased.

Popular TV shows such as "CSI", "Forensic Files". "Trace Evidence" and "Cold Cases" have spurred a record number of students interested in a career in forensic science. The forensic science educational programs have also increased from ten (10) universities in 1970 to thousands of forensic training programs in United States today. These programs can be divided into five different categories:

### 1. Graduate Program

Currently there are twenty graduate level forensic science degree programs in the U.S. The majority of the graduate level forensic science programs offer M.S. degrees in Forensic Science /Criminalistics. A few programs offer M.S. or Ph. D. in special areas of forensic science, such as toxicology, anthropology, or forensic biology. In addition, there are many universities offering Master of Science in a natural science (e.g. chemistry, biology, geology, anthropology) or in criminal justice (e.g. forensic administration, forensic investigation or forensic psychology) with a track emphasizing forensic science. Faculty specialty, university missions, available fa-

cilities, level of support, instrumental capability and other considerations have led to wide variations in the content and structure of these programs.

A typical graduate forensic science curriculum contains the following topics:

- \* Criminal Investigation/Crime Scene
- \* Law/Justice/Evidence
- \* Forensic/ Physical Evidence Concepts
- \* Laboratory Procedure/Operations/ethics
- \* Special courses include:
  - \* Analytical Chemistry/ Instrumentation
  - \* Toxicology/ Drug Chemistry
  - \* Microscopy/ Trace Evidence
  - \* DNA/ Forensic Biology
  - \* Pattern Evidence/ Fingerprint, Firearm, Document Examination

All graduate level programs are expected to offer rigorous graduate academic courses and research projects. Some universities offer specialization, tracks or concentrations in different areas of the forensic disciplines.

The minimum prerequisite for entry into a graduate forensic program is a baccalaureate degree in forensic science or other related natural science. In addition, college or universities will have entrance requirements such as G.R.E. scores and G.P.A. records.

## 2. Undergraduate Program

An undergraduate degree in forensic science is expected to be an interdisciplinary degree that provides a general university educational foundation, a strong natural science background and an understanding of the concepts and techniques used in the field of forensic science. These are the requirements that are essential for a student to have a successful career in forensic science. There are approximate 120 colleges and universities offering a B.S. degree in forensic science or degree in chemistry or biology with a concentration in forensic science. Table 1 is a

sample curriculum for a forensic science Undergraduate degree.

## 3. Continuing Education Program

Continuing education training program at graduate and post-graduate levels are essential for forensic scientists to maintain competency and proficiency. Continuing professional development is a mechanism through which a forensic scientist remains current with new methodologies or techniques and advances to a higher level of expertise. All forensic scientists have an ongoing obligation to remain current in the field through continuing education. Currently, many federal forensic agencies such as F.B.I. and A.T. F. offer specialized forensic courses for the forensic practitioner. Professional organizations, such as A.A.F.S., A.F.I.S., A.S.C.L.D. and I.A.I. also offer workshops and courses at their annual meetings. Many university, medical schools and private corporations also offer advanced forensic training courses and symposiums for forensic laboratory scientists.

Model training criteria include entry requirements, program structure, course content, instructor qualifications, assessment mechanisms and documentation.

## 4. Forensic Training Program

The application of forensic science in criminal and civil proceedings, and the utilization of physical evidence in forensic investigations have all increased. Most law enforcement agencies, court systems and the general public all realize the importance of proper recognition, collection and preservation of physical evidence, especially after recent high profile trials such as the O.J. Simpson case, Ramsey investigation. These cases have also contributed to the understanding of the importance and consequences of legal and scientific requirements of recognition, collection and preservation of forensic evidence.

Federal, State and local law enforcement agencies, colleges and universities, professional societies and organizations have offered a variety of forensic investigation and physical evidence training for followings target groups:

- \* Police officers and detectives
- \* Prosecutors and defenses attorneys
- \* Judges and judicial personnel
- \* Emergency physician and nurses
- \* Social workers and victim actives
- \* Reporter and mystery writers
- \* General public interested in forensics

#### 5. High School Educational Program

With the recent interest in forensic movies and TV shows, many high schools have offered forensic science courses as an alternative for students to learn science or for those who intend to chose forensic science as their career.

**B. The qualification of Forensic faculty has shift from forensic practitioner to non – forensic natural scientist.**

Forensic science is a multidisciplinary and somewhat complex field. Recently both undergraduate and graduate forensic education programs are sprouting out nationwide. In addition, forensic science has become a common required course for most criminal justice majors. In the past, most of forensic faculty are retired forensic laboratory scientist. With the large demand for forensic science faculty and only few retired forensic scientist with doctoral degrees, "non forensic scientist" have entered into the forensic classroom. These "Psuedo forensic scientists" sometimes try to teach real forensic courses using fictional examples from television programs and movies. This so called "CSI" forensic teaching technique does not teach scientifically based principles and creates students with a education based on fantasy.

Although the heart of forensic science lies

the principles of the natural science, the interpretation and reconstruction aspects of forensic science are unique. Both natural and forensic sciences invoke the scientific method to pose a question, develop hypotheses, design experiments, gather data, and ultimately solve a scientific problem. The difference between forensic science and natural science is the experience in recognition, collection, identification, individualization, interpretation and reconstruction of real life cases through scientific methods and logic, not just observing a reaction and reaching a conclusion. Therefore, an ideal forensic science educational program should have both types of faculty: natural scientists to teach principles and methods of basic science to provide students with a solid science background and forensic scientists to teach technique, modeling, judicial interaction and reconstruction of the case. Only with this type of combined approach could provide students with the necessary skill set to function well in the modern forensic laboratory.

**C. The basic curriculum and course content in forensic programs have changed.**

The traditional forensic science education program attempts to provide students with a strong science foundation that emphasizes the forensic laboratory techniques and the application of problem solving skills in both classroom and laboratory settings.

In recent years, contemporary advances in molecular biology, chemistry, medicine, toxicology, electronics, instrumentation, micro circuitry, computer technology, data base management and artificial intelligence have virtually revolutionized the capability of forensic science laboratories. Though focused research and development activities, new forensic technologies are systematically being applied to criminal investigations. These technologies include STR, SNP

and LCN DNA testing, or image enhancement, ridge tracing, artificial intelligence, color correction and expert system. While hundreds of new methods and techniques are emerging, laboratories need to determine which are practical in conducting their analysis and investigation. Forensic science training has change from a generalist concept to a specialist model. Table 2 shows some of sub-specialties in forensic science. There is also an urgent need for incorporating new scientific knowledge and forensic techniques in forensic educational curriculum.

In addition, forensic experts in their field have an ethical responsibility to correctly convey the exact procedures, the results and the test limitations to the tiers of fact so they can reach an appropriate conclusion in their casework. Some programs focus on the different forensic specialties, the unique approaches for the examination of forensic evidence, operation of modern forensic laboratory, and interaction of law and science but fail to consider the ethical aspect of the field. A model forensic curriculum has to include not only advanced technology, the art of crime reconstruction and the science of case analysis, but also the ethical standards for objectivity and professionalism.

**TABLE 2: Forensic Science Specialties**

- |                       |                        |
|-----------------------|------------------------|
| • Forensic Medicine   | • Forensic Engineering |
| • Forensic Pathology  | • Forensic Radiology   |
| • Odontology          | • Forensic Nursing     |
| • Anthropology        | • Forensic Sociology   |
| • Forensic Entomology | • Forensic Psychology  |
| • Forensic Toxicology | • Forensic Geology     |
| • Criminalistics      | • Forensic Botany      |
| • Material Science    | • Forensic Meteorology |

**D. The make –up of forensic students has changed from white male, police officer to female, non–sworn personnel.**

Before the 1970's, the forensic laboratory workforce is predominately male, white and with police background, especially in the field of fingerprint, firearms, documents and other traditional identification work. With the expansion of forensic laboratory services into drug analysis, serology, chemistry and toxicology, more non-police personnel have entered the profession from the 1970s to the 1990s. However, the work force still dominated by white males.

Changes in the way the U.S. media and TV shows portray woman in science and medicine have had a positive effect on woman seeking careers in science. In the 1990's women and minorities were under represented as leading actors in national television series with scientific theme; however, the recent, popular forensic shows including CSI have greatly improved the representation of women and minorities in the laboratory.

In recent years, with the encouragement of government programs for woman to pursue science, engineering and technology careers, the forensic science field has attracted an inordinate number of female applicants. Table 4 shows the percentages of male/female workers in select forensic laboratories.

The composition of applicants to forensic science degree programs also reflect similar changes. In most forensic science education programs in the nation, females are now in the majority. The University New Haven forensic science program has changed from 75 % male students in 1975 to 25 %, meanwhile female students has increased over 3 fold. West Virginia University forensic science program has been 62 to 67 % female since its inception.

TABLE 3: Representation of Women and Minorities Scientists on TV

	US Population	Science Prime Time	Scientist in CSI
White Male	41.0 %	75.0%	41.2 %
White Female	42.1	13.2	23.5
Black Male	6.0	8.3	11.8
Black Female	6.6	1.4	11.8
Hispanic	11.0	0.0	1.8
Asian	3.0	0.7	0.0

### The Future of Forensic Education

Forensic Scientists around the globe are facing increasing demands to assist in and solve vital national and international incidents related to death as well as to help resolve historical and civil disputes. The application of forensic science will definitely increase in the future and

TABLE 4: % of Female Applicants in Selected Forensic Laboratories

Laboratory	Connecticut State Police Forensic Science Lab	Minnesota Bureau of Criminal Apprehension Lab	South Carolina forensic Science Lab	New York State Police Forensic Science Lab
Male %	32 %	28 %	40 %	39 %
Female %	68 %	72 %	60 %	61 %

extend its influence into multiple levels of criminal justice systems and issues.

With the advent of newer, better and more sensitive forensic testing techniques, comes great power and responsibility. Forensic evidence has gained tremendous power in the outcome of both criminal and civil cases. New technological advances can assist in solving crime; resolve disputes; exonerating the wrongful convicted as well as lead to the true perpetrator of the criminal act. The correct interpretation of the laboratory test results in light of the crime scene and all subsequent actions associated with the evidence requires adequate training and experience by all personnel involved with the case. This includes

not only the first responding officer, detective, the crime scene technicians, investigators and forensic scientists but also the judges, attorneys, court room clerks and evidence technicians, who may handle and assess the evidence. Therefore, we expect to see tremendous growth in all aspects of continuing and in service forensic education. However, we will experience in the near future, a slight decrease in enrollment in degree programs (both at the graduate and undergraduate levels). This downward trend is directly related to the limited expansion of laboratory services, the manpower demands and self adjustment due to over supply of graduates in forensics.

We will definitely experience an improvement in the quality of forensic instruction with the increase in number of non-forensic, highly qualified natural scientist entering the field. Their knowledge in natural science and research experience will bring a new perspective in forensic education. With the increase in N.I.J. research funding and the improvements in forensic laboratory equipment and facilities, there will always be a demand for highly qualified and well trained forensic scientists.

### Reference:

- [1] Lee, H. C, Taft, G. and Anderson Forensic Science Today, Judges and Lawyer publishing, 2006
- [2] Forensic Science Implications for higher Education 2004, available on-line at <http://www.physaci.heacademy.ac.uk> 2004
- [3] Peterson J L. Taking Stock of the forensic Science: Need for a System Wide Perspective, AAFS Abstract, 2006
- [4] Houck M.M. Woman in Forensic Science, AAFS Abstract B-146, 2006
- [5] NIJ Report on Education and Training in Forensic Science, US Department of Justice, 2004.