FAIRMONT STATE UNIVERSITY

MEMORANDUM

TO: Curriculum Committee

FROM: Jack Kirby

DATE: April 2, 2013

SUBJECT: Curriculum Proposal #12-13-44, REVISION #2

Final Faculty Senate Approval 4/23/2013

I recommend approval of the attached REVISION #2 of curriculum proposal #12-13-44 from the College of Science and Technology.

This is a proposal that received final approval by Faculty Senate on March 5, 2013. However, a final review revealed that ENGL 1104 was not included in the General Studies requirements. Additionally, it has become necessary to make one change to the Required Major Courses as well. CRIM 2236 (Criminal Investigation) was originally listed as a required major course. Because CRIM 2236 will not be offered on a regular basis, the required course has been changed to CRIM 2226 (Crime Scene Investigation), which is offered on a regular basis. With these substantive changes to the proposal, I believe it is necessary to have the proposal reviewed again by the Curriculum Committee and Faculty Senate.

c: Dr. Christina Lavorata
Dr. Anthony Gilberti
Dr. Mark Flood
Ms. Evie Brantmayer
Ms. Leslie Lovett

be First

CURRICULUM PROPOSAL (Submit one hard copy and an electronic copy to the Associate Provost by the second Tuesday of the month.)

Proposal Number: 12-13-44

School/Department/Program: Science and Technology/BCG/Chemistry

Preparer/Contact Person: Mark Flood

Telephone Extension: x4309

Date Originally Submitted: 10-30-2012

Revision (Indicate date and label it Revision #1, #2, etc.): April 2, 2013, REVISION #2

Implementation Date Requested: Fall 2013

I. **PROPOSAL**. Write a brief abstract, not exceeding 100 words, which describes the overall content of the proposal.

Based on changes in Chemistry course and seeking accreditation from the American Academy of Forensic Science, the B.S. in Forensic Science content is revised, credit hours, titles and prerequisites are changed, one new course is created, a new Forensic Science prefix (FORS) is created, and several courses are removed from the curriculum. In order to attain the 120 credit hour requirement, 8 credit hours of free electives will be eliminated.

II. **DESCRIPTION OF THE PROPOSAL**. Provide a response for each letter, A-H, and for each Roman Numeral II–V. If any section does not apply to your proposal, reply N/A.

A. Deletion of course(s) or credit(s) from program(s)

1. B.S. Forensic Science deletions:
CRJU 3300 Criminalistics (3 credits)
INTR 3300 Forensic Criminalistics Lab (1 credit)
CRJU 2236 Criminal Investigation (3 hours)
MATH 1113 Applied Statistics (course is changing from 4 credits to 3 credits)
Specialized Elective section
Transferred from 9 credits to 8 credits, with the following course options being removed

CRJU 2226	Crime Scene Investigation
CRJU 2246	Criminal Evidence
CRJU 2256	Homicide Investigation
CRJU 3320	Criminology

Total hours deleted. 6

B. Addition of course(s) or credit(s) from program(s)

1. B.S. Forensic Science additions:

FORS 2201 Intro to Forensic Science (4 credits)
CRIM 2226 Crime Scene Investigation (3 hours)
Specialized Elective section

Transferred from 9 credits to 8 credits, but the following course options being added

BIOL 4420	Developmental Biology
CHEM 3304	Inorganic Chemistry
CHEM 4404	Synthetic Methods and Materials

Total hours added. 4

C. Provision for interchangeable use of course(s) with program(s)

Not applicable.

D. Revision of course content. Include, as an appendix, a revised course description, written in complete sentences, suitable for use in the university catalog.

Revised catalog course descriptions for all the courses shown in the table in Section E are included in Appendix B.

E. Other changes to existing courses such as changes to title, course number, and elective or required status.

For all the courses listed below the only changes are in prefix:
CHEM 2225 is being changed to FORS 2225
INTR 4401 is being changed to FORS 4401
INTR 4441 is being changed to FORS 4441

F. Creation of new course(s). For each new course
1. Designate the course number, title, units of credit, prerequisites (if any), ownership (FSU, PC&TC, or shared) and specify its status as an elective or required course. If you are creating a shared course, attach a memo from the Deans of the affected Schools explaining the rationale for the course being shared.

Number	Course Title	Credits	Prerequisites	Ownership	Status
FORS 2201	Intro to Forensic Science	4	BIOL 1106 and CHEM 2200	FSU	required

2. Include, as an appendix, a course description, written in complete sentences, suitable for use in the college catalog.

Appendix B contains the catalog course descriptions for the proposed new course.

3. Include, as an appendix, a detailed course outline consisting of at least two levels.

Appendix C contains the two-level course outlines for the proposed new course.

4. In order to meet the requirements as outlined in Goal One of the Strategic Plan, please include Outcome Competencies and Methods of Assessment as an appendix. Examples are available upon request from the Chair of the Curriculum Committee.

Appendix C also contains the Outcome Competencies and Methods of Assessment for the proposed new course.

G. Attach an itemized summary of the present program(s) affected, if any, and of the proposed change(s).

1. Describe how this proposal affects the hours needed to complete this program. Specifically, what is the net gain or loss in hours? Use the format for Current and Proposed Programs in Appendix A.

2. Include proof that this proposal meets the degree definition policy (Board of Governor's Policy #52) as part of the Proposed Program in Appendix A.

3. Exceptions to the degree definition policy: As per policy #52, programs seeking exceptions to any of the maximum credit hour limits must submit formal requests to the Board of Governors for approval. Explain the rationale for the exception by documenting the existence of one or more of the criteria in paragraph 4.2.

III. **RATIONALE FOR THE PROPOSAL.**

A. **Quantitative Assessment**: Indicate the types of assessment data, i.e., surveys, interviews, capstone courses, projects, licensure exams, nationally-normed tests, locally developed measurements, accreditation reports, etc., that were collected and analyzed to determine that curricular changes were warranted. Quantitative data is preferred.

The Forensic Science Program is making some revisions based on feedback from a recent review of our program by the AAFS accrediting body.

B. **Qualitative Assessment**: Based upon the assessment data above, indicate why a curricular change is justified. Indicate the expected results of the change. Be sure to include an estimate of the increased cost, or reduction in cost of implementation. FOR EXAMPLE: Will new faculty, facilities, equipment, or library materials be required?

No new faculty, facilities, equipment or library materials will be needed to implement the changes in this proposal.

IV. Should this proposal affect any course or program in another school, a memo must be sent to the Dean of each school impacted and a copy of the memo(s) must be included with this proposal. In addition, the Deans of the affected schools must sign below to indicate their notification of this proposal.

By signing here, you are indicating your college's/school's notification of this proposal.

College/School	Dean	Signature

V. Should this proposal affect any course to be added or deleted from the general studies requirements, a memo from the chair of the General Studies Committee indicating approval of the change must be included with this proposal.

VI. ADDITIONAL COMMENTS.

APPENDIX A

B.S. Degree in Forensic Science
Current Program

Required Major Courses			HRS
BIOL 1106		Biological Principles II	4
BIOL 3360		Biochemistry	4
BIOL 3380		Genetics	4
BIOL 3390		Molecular Biotechnology	4
BIOL 4495 or CHEM 4403		Problems in Biological Science/Independent Research	2
CHEM 1105		Chemical Principles I	5
CHEM 2200		Foundational Biochemistry	4
CHEM 2201		Organic Chemistry I	4
CHEM 2202		Organic Chemistry II	4
CHEM 2205		Analytical Chemistry	4
CHEM 3315		Instrumental Analysis	4
CHEM 2225		Forensic Microscopy and Spectroscopy	3
CRJU 1100		Intro to Criminal Justice	3
CRJU 2236		Criminal Investigation	3
CRJU 3300		Criminalistics	3
INTR 3300		Forensic Criminalistics Lab	1
INTR 4401		Capstone Seminar in Forensic Science	3
INTR 4411		Forensic Science Internship	2
MATH 1113		Applied Statistics	4
Specialization Electives – 9 hours, but no more than 6 hours of CRJU courses			
BIOL 2224		Microbiology	4
CHEM 3301		Physical Chemistry I	4
CHEM 4412		Physical Chemistry II	4
CRJU 2226		Crime Scene Investigation	3
CRJU 2246		Criminal Evidence	3
CRJU 2256		Homicide Investigation	3
CRJU 3320		Criminology	3
TOTAL HOURS FOR MAJOR			**74**

Required General Studies Courses				
First Year Experience				16
ENGL	1104	Written English I	3	
ENGL	1108	Written English II	3	
INFO	1100	Computer Concepts and Applications	3	
MATH	1185 or 1190	Applied Calculus I or Calculus I	4	
COMM	2200, 2201, OR 2202	Communication	3	
Scientific Discovery				8
PHYS	1101 and 1102	Introduction to Physics I and II		
Cultural / Civilization Exploration				9

Society / Human Interactions	6
Artistic / Creative Expression	6
TOTAL GENERAL STUDIES HOURS	**45**
TOTAL FREE ELECTIVES	**9**
TOTAL HOURS	**128**

B.S. Degree in Forensic Science
Proposed Program

Required Major Courses		**HRS**
BIOL 1106	Biological Principles II	4
BIOL 3360	Biochemistry	4
BIOL 3380	Genetics	4
BIOL 3390	Molecular Biotechnology	4
BIOL 4495 or CHEM 4403	Problems in Biological Science/Independent Research	2
CHEM 1105	Chemical Principles I	5
CHEM 2200	Foundational Biochemistry	4
CHEM 2201	Organic Chemistry I	4
CHEM 2202	Organic Chemistry II	4
CHEM 2205	Analytical Chemistry	4
CHEM 3315	Instrumental Analysis	4
CRIM 1100	Intro to Criminal Justice	3
CRIM 2226	Crime Scene Investigation	3
FORS 2201	Introduction to Forensic Science	4
FORS 2225	Forensic Microscopy and Spectroscopy	3
FORS 4401	Capstone Seminar in Forensic Science	3
FORS 4411	Forensic Science Internship	2
MATH 1113	Applied Statistics	3
TOTAL Required Major Courses		64
Specialization Electives - 8 hours		
BIOL 2224	Microbiology	4
BIOL 4420	Developmental Biology	4
CHEM 3301	Physical Chemistry I	4
CHEM 3304	Inorganic Chemistry	4
CHEM 4404	Synthetic Methods and Materials	4
CHEM 4412	Physical Chemistry II	4
		8
TOTAL HOURS FOR MAJOR		**72**

Required and Recommended General Studies Courses

Attribute IA – Critical Analysis		3
	ENGL 1108 (required)	
Attribute IB – Quantitative Literacy		4
	MATH 1185 or 1190 (required)	
Attribute IC – Written Communication		3
	ENGL 1104 (required)	
Attribute ID - Teamwork		3
	CRIM 2295 (required)	
Attribute IE – Information Literacy		IA
	ENGL 1108 (required)	
Attribute IF – Technology Literacy		3
	TECH 1100	
Attribute IG – Oral Communication		3
	COMM 2200	
Attribute III - Citizenship		3
	POLI 1103	
Attribute IV - Ethics		ID
	CRIM 2295 (required)	
Attribute V - Health		3
	CRIM 2212	
Attribute VI - Interdisciplinary		III
	POLI 1103	
Attribute VIIA - Arts		3
	INTR 1120	
Attribute VIIB - Humanities		VIIA
	INTR 1120	
Attribute VIIC – Social Sciences		V
	CRIM 2212	
Attribute VIID - Natural Science		4-5
	PHYS 1101 or 1105 (required)	
Attribute VIII – Cultural Awareness		3
	Any course in VIII	
Additional General Studies hours		4-5
	PHYS 1102 and 1106 (required)	
Writing Intensive	BIOL 3390	X
TOTAL GENERAL STUDIES HOURS		**39-41**
TOTAL FREE ELECTIVES		**7-9**
TOTAL HOURS		**120**

Appendix B. Course Descriptions for Existing and Revised/New Courses

Old Catalog Course Description	New Catalog Course Description
	FORS 2201 Introduction to Forensic Science. 4 hrs. This activities-based course is designed to engage students in the scientific study of collecting and analyzing physical evidence. Students will be involved in 3 hours of lecture/discussion and a 3 hr lab session each week. Students will experience a variety of comparison science procedures to analyze such things as fingerprints, blood, ink, soils, textiles, glass, drugs, tool marks, and ballistics. The culminating experience will engross students in solving a mock crime using techniques learned during the course. PR: CHEM 2200, BIOL 1106. Fall semester only
CHEM 2225 Forensic Microscopy and Spectroscopy. 3 hrs. This course is an introduction to the microscopy and spectroscopic techniques employed by forensic scientists to analyze trace evidence including hairs, fibers, paint chips, glass fragments, etc. The course will consist of two hours of classroom instruction and two hours of laboratory each week. PR: CHEM 2200, MATH 1115 or higher.	FORS 2225 Forensic Microscopy and Spectroscopy. 3 hrs. This course is an introduction to the microscopy and spectroscopic techniques employed by forensic scientists to analyze trace evidence including hairs, fibers, paint chips, glass fragments, etc. The course will consist of two hours of classroom instruction and two hours of laboratory each week. PR: CHEM 2200, MATH 1115 or higher. Spring semester of even years.
INTR 4401 Capstone Seminar in Forensic Science. 3 hrs. Designed to help students synthesize and apply, in a forensic science context, the approaches, knowledge and skills acquired in criminal justice, biology, chemistry, mathematics and physics courses. The course structure consists of student-driven case studies and discussions from recent literature, student presentations describing internship experiences and an explicit formal introduction to established professional and laboratory practices in forensic sciences, including ethics. PR: BIOL 3390 and CHEM 2215 and CRJU 3300.	FORS 4401 Capstone Seminar in Forensic Science. 3 hrs. Designed to help students synthesize and apply, in a forensic science context, the approaches, knowledge and skills acquired in criminal justice, biology, chemistry, mathematics and physics courses. The course structure consists of student-driven case studies and discussions from recent literature, student presentations describing internship experiences and an explicit formal introduction to established professional and laboratory practices in forensic sciences, including ethics. PR: FORS 4411.
INTR 4411 Forensic Science Internship .2 hrs. This course provides a practical experience for junior or senior forensic science majors who are planning on careers in forensic science or related fields. The internship program offers the student an opportunity for observation of practitioners at work, as well as involvement in the day-to-day operation of a forensic science agency. Students participate in guided observation and activities and complete a reflection paper and log of the internship hours as well as other course requirements. Students will be engaged for a minimum of 85 hours with the participating agency that has been approved by the Forensic Science Program Coordinating Committee. PR: INTR 3300.	FORS 4411 Forensic Science Internship .2 hrs. This course provides a practical experience for junior or senior forensic science majors who are planning on careers in forensic science or related fields. The internship program offers the student an opportunity for observation of practitioners at work, as well as involvement in the day-to-day operation of a forensic science agency. Students participate in guided observation and activities and complete a reflection paper and log of the internship hours as well as other course requirements. Students will be engaged for a minimum of 85 hours with the participating agency that has been approved by the Forensic Science Program Coordinator. PR: Junior status or Senior status.

Appendix C. Course Descriptions, Outlines and Outcomes for New Courses

1. **FORS 2201 – Introduction to Forensic Science**

FORS 2201 Introduction to Forensic Science. 4 hrs.
This activities-based course is designed to engage students in the scientific study of collecting and analyzing physical evidence. Students will be involved in 3 hours of lecture/discussion and a 3 hr lab session each week. Students will experience a variety of comparison science procedures to analyze such things as fingerprints, blood, ink, soils, textiles, glass, drugs, tool marks, and ballistics. The culminating experience will engross students in solving a mock crime using techniques learned during the course. PR: CHEM 2200, BIOL 1106. Fall semester only

Introduction to Forensic Science Course Outline

I. Introduction
   a. What is Forensic Science?
   b. History of Forensic Science
      i. Sherlock Holmes fictional Forensic Scientist
      ii. Alphonse Bertillion – anthropomorphic measurement to identify people
      iii. Francis Galton – fingerprinting
      iv. Leone Lattes – blood typing from dried bloodstains
      v. Calvin Goddard – comparison dissection microscope for ballistics comparison
      vi. Albert Osborn – document examination
      vii. Mathieu Orfila – forensic toxicology
      viii. Walter McCrone – using microscopy to apply to evidence processing
      ix. Edmond Locard – Locard's exchange principle
   c. Crime lab basic units
      i. Physical science unit
      ii. Biology unit
      iii. Firearms unit
      iv. Document unit
      v. Photography unit
      vi. Optional services are typically
         1. Toxicology
         2. Latent Fingerprints
         3. Polygraph unit
         4. Voiceprint analysis
         5. Evidence collecting unit
   d. WV State Police Crime lab units
      i. Drug ID
      ii. Latent Prints
      iii. Biochemistry
      iv. Trace Evidence
      v. Firearm/Toolmark
      vi. Questioned Document
      vii. Toxicology
   e. How the courts influenced Forensic Science

i. Frye v United States – helped develop scientific standards for criminal investigation
ii. Daubert v Merrell Dow Pharmaceutical – judges are gatekeepers, but gave criteria for judging how science could be used.

II. The crime scene
  a. First steps to take
    i. Make sure to get immediate medical help for anyone who needs it
    ii. Secure the crime scene
    iii. Record evidence
  b. Recording methods
    i. Photography
      1. Make sure to start from big to small
      2. Make sure to include a scale
    ii. Sketches
      1. Rough sketch of crime scene
      2. Finished sketch which is drawn to scale
    iii. Notes
      1. Details of distances and location of items to help with sketching
      2. Additional information that may help with investigation
  c. Searching the crime scene
  d. Packaging and chain of custody
    i. Proper ID on every item collected
    ii. Proper type of packaging for different items
    iii. Make sure someone knows where evidence is at all times
  e. Obtain reference samples from victims and suspects
  f. Safety
    i. Protect against hepatitis B and AIDS
    ii. Follow International Association for Identification Safety Committee guidelines

III. Physical evidence
  a. What is physical evidence?
  b. Purposes for examining physical evidence
    i. Identification
    ii. Comparison analysis – either compare to know or a database for a common origin
      1. The Integrated Automated Fingerprint Identification System (IAFIS)
      2. The Combined DNA Index System (CODIS)
      3. The National Integrated Ballistics Information Network (NIBIN)
      4. The International Forensic Automotive Paint Data Query (PDQ)
      5. SICAR (shoeprint image capture and retrieval)
  c. Levels of classification of physical evidence
    i. Class characteristics – evidence associated with a group
    ii. Individual characteristics – just one common source
      1. Role of probability in defining common origin

IV. Soil and glass analysis
  a. Properties of materials

i. Physical
ii. Chemical

b. Measurement using metric system
c. Important physical properties
    i. Temperature
    ii. Mass
    iii. Size
    iv. Volume
    v. Density
    vi. Refraction
d. Glass analysis
    i. What is glass?
    ii. Analyzing cracks in glass
        1. Class activity to analyze direction and order for each crack in glass
    iii. What is in glass?
        1. Network components- formers
        2. Fluxes – softeners
        3. Stabilizers – chemical/corrosion resistance
    iv. Types of glass based on manufacturing process
        1. Sheet glass
        2. Float (plate) glass
        3. Safety glass
        4. Laminated glass
    v. Types of glass based on composition
        1. Soda lime silicate glass
        2. Borosilicate glass
        3. Aluminosilicate glass
        4. Lead alkali silicate
    vi. How to collect glass
    vii. Analysis of glass fragments
        1. Color – munsell color chart
        2. Thickness and density
            a. Flotation method
            b. Immersion method
        3. Refractive index
        4. Determine chemical composition
            a. Inductively coupled plasma analysis
            b. Scanning electron microscopy + energy dispersive x-ray spectroscopy (SEM-EDS)
            c. Neutron activation analysis
            d. X-ray fluorescence
e. Soil analysis
    i. Collection of soil

ii. Major components of soil
    1. Pore space – air and/or water
    2. Soil space – organic and mineral matter
iii. Types of soil based on organic composition
    1. Mineral soil - < 20% organic carbon
    2. Organic soil - > 20% organic carbon
iv. Soil particle types and classification
    1. Sand
    2. Silt
    3. Clay
    4. Determine soil type using triangular soil type chart
v. Determination of soil texture
    1. Feel field procedure
        a. Use texture flowchart to determine texture
    2. Lab procedures
        a. Hydrometer
        b. Pipette
vi. Other analysis techniques
    1. Density gradient tube
    2. Particle size distribution
    3. Analysis of nitrogen, phosphorus and potassium
    4. Mineral analysis
        a. X-ray diffraction
        b. SEM - EDS

V. Organic analysis
a. Organic versus inorganic
b. Qualitative versus quantitative
c. Chromatography
    i. Thin layer chromatography (TLC)
    ii. Gas chromatography (GC)
        1. Flame ionization
        2. Mass spec
    iii. High performance liquid chromatography (HPLC)
d. Electrophoresis
    i. Agarose
    ii. Acrylamide
e. Spectroscopy
    i. Parts of spectrophotometer
    ii. Types of specs
        1. Visible
        2. Ultraviolet (UV)
        3. Infrared (IR) – most frequently use in Forensic Science
    iii. Beer's law helps quantitate amount of something

iv. Relationship of wavelength and frequency

VI. Inorganic Analysis
   a. Techniques used in inorganic analysis in Forensic Science and where they are typically used
      i. Emission spectroscopy
      ii. Inductively coupled plasma
         1. Ballistics
         2. Soil analysis
         3. Glass analysis
      iii. Atomic absorption spectrophotometry
      iv. Neutron activation analysis
         1. Drug analysis
         2. Paint analysis
         3. Soil analysis
         4. Gunpowder analysis
         5. Hair analysis
      v. X-ray diffraction
         1. Soil analysis
         2. Glass analysis

VII. Drug analysis
   a. Narcotics help relieve pain
   b. Opiates
      i. Morphine
      ii. Codeine
      iii. Heroin
   c. Hallucinogens
      i. Marijuana
      ii. LSD
      iii. PCP
      iv. MDMA (Ecstasy)
   d. Depressants
      i. Alcohol
      ii. Barbiturates
      iii. Tranquilizers
      iv. Inhaling various substances like airplane glue
   e. Stimulants
      i. Amphetamines
      ii. Cocaine
      iii. Crack
   f. Club drugs
      i. Roofies
      ii. GHB
      iii. Ketamine
      iv. Methamphetamine

g. Bath salts
    i. Designer drugs made from the synthetic stimulants mephedrone, MDPV, and methylone
    ii. Stimulant and hallucinogen effects
    iii. Side effects
    iv. No effective way to test for designer drugs
h. Anabolic steroids
i. Drug control act and 5 schedules for classification of drugs
j. Drug identification
    i. Screening with color test like NIK system
    ii. Confirmatory tests
        1. GC-MS typically
        2. IR spectrometry
k. Collection of drugs at crime scene

VIII. Hair, Fibers and Paint analysis

a. Types of fibers
    i. Natural
    ii. Manufactured
    iii. Synthetic
b. Microscopic analysis of fiber evidence
    i. Color
    ii. Diameter
    iii. Lengthwise striations on the surface of the fiber
    iv. The presence of delustering particles that reduce shine
    v. The cross-sectional shape of the fiber
c. Methods for fiber comparison
    i. Visible light microspectrophotometer
    ii. Chromatography of dye composition
    iii. IR spectrophotometry
    iv. Refractive index using polarized light microscopy
    v. Other techniques will be conducted in lab setting, including burn test, dye test, solubility, nitrates and sulfates
d. Collection of fiber evidence
e. Morphology of hair
    i. Root or bulb embedded in follicle
    ii. Shaft which contains cuticle, cortex and medulla
f. Hair growth
    i. Anagen – early growth
    ii. Catagen – middle growth
    iii. Telogen – final phase of growth
g. Cuticle analysis
    i. Scales always point to tip of hair
    ii. Useful in species determination
h. Cortex analysis

i. Pigment granules found here
ii. Color, shape and distribution of granules are points of comparison

h. Medulla analysis
i. Medullary index – diameter of medulla/diameter of hair
ii. Useful for species ID
iii. Medulla may be continuous, interrupted, fragmented or absent
iv. Medulla varies from individual to individual as well as among same individual

j. Root analysis
i. May find follicular tag, which are cells attached to hair root

k. DNA analysis from hair
i. Nuclear DNA may be found from follicular tag
ii. Use mitochondrial DNA analysis from shaft of hair

l. Collection of hair

m. Paint composition
i. Pigments
ii. Additives
iii. Binder

n. Methods for paint comparison
i. Pyrolysis GC
ii. IR spectrophotometry
iii. Stereoscopic microscope for color layer sequence – compare to PDQ database

o. Collection of paint samples

IX. Firearms, tool marks and other impressions

a. Tool mark analysis
i. Comparison microscope
ii. Size and shape of tool must match
iii. Scratches or indentations must match
iv. Don't fit tool in tool mark

b. Other types of impressions often collect by casting a mold to preserve evidence
i. Tire marks
ii. Shoe marks
iii. Fabric impression
iv. Serial numbers

c. Gun barrel markings
i. Drilling out core
ii. Rifling – produces lands and grooves
iii. Diameter of gun barrel is caliber

d. Parts of "bullet"
i. Bullet
ii. Casing
iii. Propellant
iv. Primer

e. Parts of shotgun shell

i. Shot
ii. Wad
iii. Powder
iv. Primer

f. Basic parts of gun that may leave markings on bullets and casings
i. Barrel
ii. Chamber
iii. Firing pin
iv. Breechblock
v. Ejector
vi. Extractor
vii. Magazine or clip

g. Comparison of bullets or casings
i. The National Integrated Ballistics Information Network, NIBIN for repeat offenders
ii. Side by side comparison for local and regional cases

h. Gunpowder residue
i. Greiss test
ii. Scanning electron microscope looking for lead, barium and antimony

i. ID of shooting distance
i. Stellate appearance of bullet tear pattern indicates point blank distance
ii. Halo of vaporous lead indicates firing from around 0.3-0.5 meters
iii. Presence of unburned gunpowder with no halo indicates about 1 meter
iv. More than a meter will only have bullet wipe, which is dark ring around bullet hole

j. Collection of firearms

X. Forensic Serology

a. Composition of blood
i. Cells
1. RBC
2. WBC
3. Platelets
ii. Plasma
1. Clotting factors
2. Serum
a. Mostly water
b. Albumens
c. Antibodies
d. Lots of other stuff typically not tested for in forensic cases

b. Serology
i. Antigen
ii. Antibody

c. Steps in blood analysis
i. Is it blood?
1. Kastle-meyer

2. Luminol
3. Microcrystalline tests

ii. Species ID
1. Precipitin test

iii. Blood typing
1. Agglutination
2. ABO and Rh typing
3. Why do we use only these two types when so many have been documented?
4. May also look for polymorphic blood proteins in some cases

iv. DNA analysis

d. Immunoassay mainly used for detection of drugs in urine and blood

e. Blood spatter
i. Can determine direction from which blood hits surface
ii. Can determine angle at which blood hits surface
1. Make standards using protractor and dropping blood
2. Measure length and width of each blood drop
3. Divide length/width and compare to angle using standard table

f. Collection of blood evidence

g. Screening for other body fluids – semen as an example
i. Test for acid phosphatase
1. Purple color in presence of sodium alpha naphthylphosphate and Fast Blue B solutions
2. Fluorescence under UV light with 4-methly umbelliferyl phosphate
3. Cross reacts with fruit juices, contraceptive creams and vaginal secretions

ii. Prostate specific antigen (PSA) or p30 proteins
iii. Find sperm under 400X magnification using light microscope

h. Collection of potential semen and other samples in rape cases

XI. Forensic Toxicology

a. Main thing test for in forensic cases is alcohol

b. Factors that affect blood alcohol content
i. Amount of alcohol consumed
ii. Time to consume drink
iii. Food present in stomach or not
iv. How fast alcohol is metabolized

c. Metabolism of alcohol
i. >95% oxidized to carbon dioxide and water in liver
ii. Remainder is excreted via breathing, urination and perspiration

d. Field testing for sobriety
i. Nystagmus test
ii. Walk and turn
iii. One leg stand

e. Measurement of alcohol levels
i. Breathalyzer

1. Correlated with blood alcohol content
2. Older models are based on chemical reaction and using visible light spectrophotometer
3. Newer portable models are fuel cell detector based
4. Stationary devices are IR spectrophotometers

ii. GC/MS often used for blood alcohol content

f. Alcohol and the law
   i. 1939 to 1964 the legal limit was 0.15% w/v
   ii. 1965 to 1972 lowered to 0.1%
   iii. After 1972 the expectation was 0.08%, but was not enforced until 2003
g. Analytical scheme for detection of other material by toxicologist
   i. Detect
   ii. Isolate
   iii. Specifically ID
      1. Screening
         a. TLC
         b. GC
         c. Immunoassay
      2. Confirmation
         a. GC/MS
   iv. Drug Recognition Expert program
      1. Standardizes what information to collect

XII. Fingerprints
   a. History
      i. Francis Galton publishes textbook *Finger Prints*
      ii. Galton convinces British government to add fingerprints to Bertillion system
      iii. Will West and William West could not be distinguished without fingerprints
      iv. Sir Edward Henry devised fingerprint classification system
   b. Why do skin ridges exist?
   c. Fingerprint principles
      i. Fingerprints are individualized
      ii. Fingerprints remain unchanged during a lifetime
      iii. General ridge patters exist to systematically classify fingerprints
         1. ID of loops, arches and whorls
         2. Primary classification using Henry formula
   d. FBI standards are 12 point for exact match including:
      i. Ridge endings
      ii. Ridge counts
      iii. Bifurations
      iv. Trifurations
      v. Islands
      vi. Dots
      vii. Divergence

viii. Delta's
ix. Core's

e. Types of prints
i. Plastic
ii. Latent
iii. Visible

f. Detecting latent prints
i. Depends on surface and age of print
ii. Iodine fuming
iii. Superglue fuming
iv. Ninhydrin
v. Physical developer
vi. Dusting using powders
vii. Alternative light sources
viii. Fluorescence is the newest approach

g. Collecting and transporting fingerprints

XIII. DNA fingerprinting

a. History
i. Narborough Village murders in 1983-1986
ii. Sir Alec Jefferies developed techniques to separate sperm and vaginal cells
iii. Jefferies also used DNA testing, which he term "DNA fingerprinting" to solve the case

b. Combined DNA Index System (CODIS)
i. 13 different Short tandem repeat (STR) regions
ii. For convicted offenders, unsolved cases, and missing persons

c. DNA fingerprinting tests
i. RFLP (restriction fragment length polymorphism)
ii. STR using PCR (polymerase chain reaction)
1. Very sensitive
2. Contamination can be an issue
iii. DNA sequencing

d. PCR
i. Steps
1. Denature
2. Anneal
3. Synthesis
ii. Advantages

e. Nuclear versus mitochondrial DNA testing

f. Example cases where DNA evidence was used
i. OJ Simpson
ii. BTK
iii. 911
iv. Tsunami

XIV. Fire and arson analysis

a. Chemistry of fire
    i. Oxidation
    ii. Ignition temperature
    iii. Heat of combustion
    iv. Rate of oxidation
    v. Flash point versus pyrolysis
b. The fire scene
    i. Look for hottest and lowest point for potential initiation point
    ii. Look for streamers for spreading from one area to another
    iii. ID of point of origin can also happen with assistance of K9
c. Collection of evidence
d. Processing of evidence collected using gas chromatography

XV. Explosives
a. Nature of explosion
    i. Rapid oxidation
    ii. Sudden buildup of gas pressure
b. Low explosive
    i. Black powder
    ii. Smokeless powder
c. High explosive
    i. Dynamite
    ii. TNT
    iii. PETN
    iv. RDX
d. Collection of explosives
e. Analysis in the lab
    i. Screening tests
        1. TLC
        2. HPLC
        3. GC-MS
    ii. Confirmatory ID
        1. IR spectrophotometry
        2. X-ray diffraction

XVI. Document examination
a. Handwriting analysis
    i. What to look for in a handwriting sample
    ii. Exemplars for comparison
b. Typewriters and printing devices
    i. Impressions may show up on ribbon
    ii. Look for defect marks
    iii. Toner and application method

Outcome Competencies and Methods of Assessment

LEARNING OBJECTIVES for Introduction

1. Explain what forensic science is
2. Discuss who major contributors were to the development of forensic science.
3. Explain the structure of the typical crime laboratories as they exist on the national, state, and local levels of government in the United States.
4. Compare the main services of the WV State Police Crime Lab with the typical crime lab
6. Explain the different approaches espoused by the *Frye* and *Daubert* decisions to the admissibility of scientific evidence in the courtroom.
7. Explain the proper collection and packaging protocols for common types of physical evidence

LEARNING OBJECTIVES for Crime Scene

1. Explain what physical evidence is.
2. Discuss the responsibilities of the first police officer who arrives at a crime scene.
3. Explain the steps to be taken for thoroughly recording the crime scene.
4. Explain the proper procedures for conducting a systematic search of crime scenes for physical evidence.
5. Explain the proper techniques for packaging common types of physical evidence.
6. Explain what chain of custody is.
7. Explain what steps are typically required to maintain appropriate health and safety standards at the crime scene.

LEARNING OBJECTIVES for Physical evidence

1. Discuss the common types of physical evidence encountered at crime scenes.
2. Explain the difference between the identification and comparison of physical evidence.
3. Compare individual and class characteristic and provide examples of physical evidence possessing these characteristics.
4. Discuss the value of class evidence to a criminal investigation.
5. Discuss the number and types of computerized databases relating to physical evidence that are currently in existence.

LEARNING OBJECTIVES for Glass and Soil analysis

1. Discuss what physical and chemical properties are.
2. Discuss and explain what the metric system's basic units and prefixes are.
3. Compare metric and English units: length, volume, and mass.
4. Compute from one system of measurement to the other.
5. Compare the Celsius and Fahrenheit temperature scales.
6. Compare mass from weight.
7. Explain what density is.
8. Discuss how the density of irregular-shaped objects is determined.
9. Explain what refractive index is.
10. Compare crystalline from amorphous solids.
11. Discuss what double refraction and birefringence are.
12. Compare the different methods for comparing glass specimens.
13. Explain how to examine glass fractures to determine the direction of impact and order in which projectiles hit a piece of glass.

14. Explain the proper collection of glass evidence.
15. Explain the methods for comparing soil specimens.
16. Explain the proper collection of soil evidence.

LEARNING OBJECTIVES for Organic Analysis

1. Discuss what elements and compounds are and give examples of each.
2. Compare solid, liquid, and gas.
3. Compare organic and inorganic compounds.
4. Compare qualitative and quantitative analysis.
5. Explain how a liquid reaches equilibrium with its gaseous phase as defined by Henry's Law.
7. Explain the process of chromatography.
8. Discuss the importance of each part of a gas chromatograph.
9. Explain what retention time is.
10. Explain the difference between thin-layer and gas chromatography.
11. Discuss the importance of Rf value to chromatography.
12. Explain what electrophoresis is and how it is used in forensic science.
13. Compare the wave and particle theories of light.
14. Discuss the significance of the electromagnetic spectrum to spectrometry.
15. Explain the relationship between color and the selective absorption of light by molecules.
16. Explain how Beer's Law is important to spectrometry.
17. Discuss the importance of each part of a simple absorption spectrophotometer.
18. Discuss the utility of an ultraviolet and infrared absorption spectrum for the identification of organic compounds.
19. Explain the concept of mass spectrometry.
20. Explain the significance of a mass spectrum.

LEARNING OBJECTIVES for Inorganic Analysis

1. Discuss the usefulness of trace elements for the forensic comparison of various types of physical evidence.
2. Compare a continuous and a line emission spectrum.
3. Discuss the importance of each part of a simple emission spectrograph.
4. Discuss the importance of each part of a simple atomic absorption spectrophotometer.
5. Discuss protons, neutrons, and electrons, including their mass and charge relationships.
6. Discuss what atomic number and atomic mass number are.
7. Explain what the orbital energy levels are.
8. Expalin what happens when an atom absorbs a definite amount of energy.
9. Explain the phenomenon of an atom releasing energy in the form of light.
10. Discuss what an isotope is.
11. Discuss what radioactivity is.
12. Explain how elements can be made radioactive.
13. Explain why an X-ray diffraction pattern is useful for chemical identification.

LEARNING OBJECTIVES for Drug Analysis

1. Compare psychological and physical dependence.
2. Compare the classification of the commonly abused drugs.
3. Discuss the tendency to develop psychological and physical dependency for the

more commonly abused drugs.
4. Discuss the schedules of the Controlled Substances Act.
5. Explain what laboratory tests that forensic chemists normally rely upon to comprise a routine drug identification scheme.
6. Explain the testing procedures utilized for the forensic identification of marijuana.
7. Discuss the proper collection and preservation of drug evidence.

LEARNING OBJECTIVES for Fiber, Hair and Paint

1. Compare the cuticle, cortex, and medulla of hair.
2. Compare the three phases of hair growth.
3. Explain the distinction between animal and human hairs.
4. Explain what hair features are useful for the microscopic comparison of human hairs.
5. Explain the proper collection of hair evidence.
6. Discuss the role of DNA typing in hair comparisons.
7. Compare and classify fibers.
8. Discuss the structure of a polymer.
9. Explain what properties of fibers are most useful for forensic comparisons.
10. Discuss the proper collection of fiber evidence.
11. Explain what the components of paint are.
12. Explain what examinations are most useful for performing a forensic comparison of paint.
13. Discuss the proper collection and preservation of paint evidence.

LEARNING OBJECTIVES for Forensic Serology

1. Compare the A-B-O antigens and antibodies found in the blood for each of the four blood types: A, B, AB, and O.
2. Explain why agglutination occurs.
3. Explain how whole blood is typed.
4. Explain the tests that are used to characterize a stain as blood.
5. Explain the significance of the precipitin test to forensic serology.
6. Compare the laboratory tests necessary to characterize seminal stains.
7. Explain how suspect stains are to be properly preserved for laboratory examination.
8. Discuss the collection of physical evidence related to a rape investigation.
9. Discuss the information that can be gained from bloodstain pattern analysis about the events involved in a violent crime.
10. Explain how surface texture, directionality, and angle of impact affect the shape of individual bloodstains.
12. Compute the angle of impact of a bloodstain using its dimensions.
13. Discuss the methods to determine the area of convergence and area of origin for impact spatter patterns.
14. Discuss the methods for documenting bloodstain patterns at a crime scene.

LEARNING OBJECTIVES for Fingerprints

1. Discuss the individuals who have made significant contributions to the acceptance and development of fingerprint technology.
2. Explain what ridge characteristics are.
3. Explain why a fingerprint is a permanent feature of the human anatomy.
4. Compare the three major fingerprint patterns and their respective subclasses.
5. Compute and classify a set of fingerprints by the primary classification of the Henry system.

6. Discuss the concept of an automated fingerprint identification system.
7. Explain what is meant by visible, plastic, and latent fingerprints.
8. Compare the techniques used for developing latent fingerprints on nonporous objects.
9. Compare the chemical techniques used for developing prints on porous objects.
10. Discuss the proper procedures for preserving a developed latent fingerprint.
11. Explain how a latent fingerprint image can be enhanced by digital imaging.

LEARNING OBJECTIVES for DNA Fingerprinting

1. Explain the technology of polymerase chain reaction (PCR) and how it's applied to forensic science.
2. Explain the latest DNA typing technique, short tandem repeat (STR) analysis.
3. Explain the difference between nuclear DNA and mitochondrial DNA.
4. Discuss the application of a DNA computerized database to criminal investigation.
5. Discuss the necessary procedures to should be taken for the proper preservation of bloodstained evidence for laboratory DNA analysis.

LEARNING OBJECTIVES for Firearms and Tool Marks

1. Discuss the techniques for rifling a barrel.
2. Compare the class and individual characteristics of bullets and cartridge cases.
3. Explain the utilization of the comparison microscope for the comparison of bullets and cartridge cases.
4. Demonstrate the difference between caliber and gauge.
5. Explain the NIBIN data test system in relationship to firearm comparison.
6. Explain the procedure for determining the distance from a target a weapon was fired.
7. Discuss the laboratory tests utilized for determining whether an individual has fired a weapon. Emphasize the limitations of the present techniques.
8. Explain why it may be possible to restore an obliterated serial number.
9. Demonstrate the procedures for the proper collection and preservation of firearm evidence.
10. Explain how a suspect tool is compared to a tool mark.
11. Explain the forensic significance of class and individual characteristics to the comparison of impressions.

LEARNING OBJECTIVES for Forensic Toxicology

1. Explain how alcohol is absorbed into the bloodstream, transported throughout the body, and finally eliminated by oxidation and excretion.
2. Explain the important parts of the human circulatory system as related to human toxicity.
3. Discuss the process by which alcohol is excreted in the breath via the alveoli.
4. Explain the concept of infrared and fuel-cell breath-testing devices.
5. Compare some common field sobriety tests.
6. Compare common laboratory procedures for measuring alcohol's concentration in the blood.
7. Discuss the precautions to be taken to properly preserve blood for analysis for its alcohol content.
8. Explain what the legal impairment level for blood alcohol in WV is
9. Explain the significance of the implied consent law to traffic enforcement.
10. Discuss some of the techniques that forensic toxicologists use for isolating and identifying drugs and poisons.
11. Discuss the significance of finding a drug in human tissues and organs.

12. Discuss how best the drug recognition expert and the forensic toxicologist can coordinate their efforts to support the significance of a positive drug finding.

LEARNING OBJECTIVES for Fire and Arson Analysis

1. Explain what oxidation is.
2. Discuss energy and give examples of its different forms.
3. Discuss the role of heat energy in chemical reactions.
4. Discuss heat of combustion and ignition temperature.
5. Explain what the requirements necessary to initiate and sustain combustion are.
6. Discuss how physical evidence must be collected at the scene of a suspected arson.
7. Discuss laboratory procedures used for the detection and identification of hydrocarbon residues.

LEARNING OBJECTIVES for Document Analysis

1. Explain what is meant by "questioned document."
2. Compare common individual characteristics associated with handwriting.
3. Compare the important guidelines to be followed for the collection of known writings for comparison to a questioned document.
4. Discuss the precautions to be taken to minimize deception when a suspect is requested to write exemplars for comparison to a questioned document.
5. Compare some of the class and individual characteristics of a typescript comparison.
6. Discuss the proper collection of typewritten or printed exemplars.

Assessment for lecture/discussion LEARNING OBJECTIVES

Learning objectives will be assessed by standard exam questions that are multiple choice or matching or essay format. Items that are not answered appropriately by the majority of students will be rewritten. If similar items continue to be a problem over multiple years, then a new strategy for teaching that particular topic will be explored.

LEARNING OBJECTIVES for Lab

Students will also conduct lab activities to assess what is the best method for the approach to several of the topics covered in lecture. Lab reports will be graded using the rubric provided under the Assessment section

Assessment for lab LEARNING OBJECTIVES

INTRO TO FORENSIC SCIENCE
LABORATORY REPORT FORMAT

Each week that there is a lab there will generally be a corresponding laboratory write-up due for each experiment one week from the date the experiments are performed (exact dates are given on Blackboard). **All lab reports are to be submitted via Blackboard (no lab reports will be accepted in print copy) in Microsoft Word format (no other word processing program formatting will be accepted). Lab reports submitted within 24 hours of the due date will receive ½ credit (at most) and lab reports submitted more than 24 hours after the due date will not be allowed. Lab reports will be graded using the objective PTA (primary trait analysis) rubric that is located at the end of this document.**

Enough detail should be included so that someone who is taking this course in the future would be able to repeat the experiment. If you are unsure if you have included enough detail, have a friend read your report to see if they understand what you did. Lab reports should meet the format guidelines given below with the following divisions:

Title page- This should include the title of the experiment(s) (either the one proposed or one you make up yourself), the experimenter's name(s), and date the experiment was performed.
Introduction - Briefly introduce the topic to the reader, presenting the relevant information that someone should know before they perform this experiment. Citations should use superscript numbers at the end of sentences[1]. At the end of this section the objective(s) and the hypothesis of the experiment should be given.
Materials and Methods - Describe the procedures conducted in enough detail that someone could repeat the experiment using this section of your lab report. Don't include a separate list of materials used, but rather incorporate the needed items into your description of methods. Also, avoid simply listing step by step procedures in this section, bur rather write out the procedures utilized in complete and coherent sentences.
Results - Present the results of your data collection in written and graphical (or in some rare cases tables) forms. The graphs must have not have a title, but should contain accurately labeled axes and a legend underneath such as what is shown below.

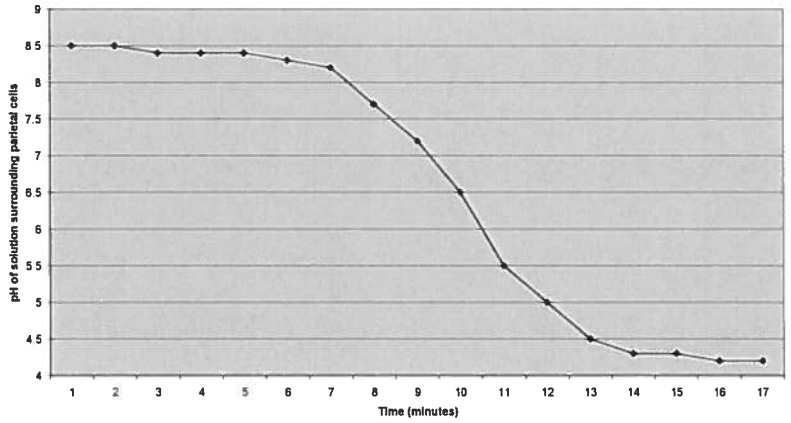

Figure 1. The change in pH surrounding parietal cells incubated at 37°C for 17 minutes.

One or two sentences for the written summary of the data is generally not thorough enough! Don't describe why the results occurred - this happens in the next section.
Discussion - Discuss all results (interesting, expected and unusual results included) from a physiological standpoint, and be related to previous studies (which means that literature citations should be included in this section of the lab report). Be sure to include "big picture" as well as "little picture" items. Also, be sure to include possible sources of error (reasons for obtaining results which differ from those anticipated) that may occur during the experiment. *Your understanding of scientific concepts will be best demonstrated by your discussion of the data.*
Conclusions - Make any summary remarks, including how the experiment could be conducted differently if you were to repeat the experiment. If you have any suggestions for improvement of the lab exercise (or you thought the lab was just great the way it was) this section would be most appropriate place to put those comments.
Literature cited – A minimum of 6 references must be included in each lab report using the format given below. The citations should be numbered as they occur in the lab report, not in alphabetical order. The 6 required references cannot include internet sites, dictionaries, encyclopedias, CDs or any other video source, or any reference material that is not related to the topic of the lab report. At least 2 references must be peer-reviewed journal articles.

For books:
1. Armitage, P.D., Cranston, P.S. & C.V. Pinder. (Eds.) 1995. Lambda, the incredible virus. FSC Press, London, England, pp. 10-15.

2. Flood, M.R. 2003. Molecular Biotechnology Protocols. 2nd Edition. McGraw Hill, Boston, MA, pp. 1-2.

For journal articles:
3. Connors, M. & R. Curtis. 1999. Pipetting error: A real problem with a simple solution. American Laboratory 31:20-22.

4. Mobley, R.C., Altman, R.E. & R.M. Duvall. 1992. Developing a relationship with your favorite plasmid: pBLU as a model. Journal of Morality. 30:69-169.

Primary Trait Scoring Scale For FORS 2201 Lab

Title Page

1 – Contains (1) title of experiment and experiment number, (2) the date the experiment was performed, (3) your name, and (4) the name(s) of lab partner(s).
0 – One or more of the above parts of the title page is absent.

Introduction

10 - Clearly (1) provides adequate background information appropriate to the topic with correctly cited references, (2) provides the objective(s) of the experiment, and (3) accurately states the hypothesis(es) to be tested.
7 – Introduction does not state the objective(s) of the experiment or lacks an accurately state hypothesis. All other parts of introduction are present.

6 – Introduction lacks a thorough background. All other parts of introduction are present.
3 – Lacking in two of the areas described above.
0 – Introduction is completely missing or is incoherent.

Methods and Materials Section

4 - Contains effectively, quantifiably, concisely organized information that allows the experiment to be replicated; is written so that all information inherent to the document can be related back to this section; identifies sources of all data to be collected; identifies sequential information in an appropriate chronology; does not contain unnecessary, wordy descriptions of procedures.
2 - Presents an experiment that is definitely replicable; all information in document may be related to this section; however, fails to identify some sources of data and/or presents sequential information in a disorganized, difficult pattern (such as outline format).
1 - Presents an experiment that is marginally replicable; parts of the basic design must be inferred by the reader; procedures not quantitatively described; some information in Results section cannot be anticipated by reading the Methods and Materials section.
0 - Describes the experiment so poorly or in such a nonscientific way that it cannot be replicated.

Results

7 - Student (1) selects quantifiable experimental factors and/or defines and establishes quantitative units of comparison; (2) measures the quantifiable factors and/or units in appropriate quantities or intervals; (3) student selects appropriate statistical information to be utilized in the results; (4) student displays results in graphs with correctly labeled axes; (5) data are presented to the reader in text as well as graphic form; (6) tables or graphs have self-contained legends underneath them.
5 – Contains all the expected elements of the results section except tables or graphs do not contain appropriate legends, or axes on graphs are inappropriately labeled.
3 – Contains all the expected elements of the results section except the data reported in graphs or tables contain materials that are irrelevant and/or not statistically appropriate.
2 – Contains all the expected elements of the results section except it either lacks data represented in a graph or table where appropriate, **or** lacks a thorough written description of the results.
0 - Student does not select, collect, and/or communicate quantifiable results.

Discussion

10 - Clearly (1) explains expected results, how the data collected compares to the expected results, and offers explanations and/or suggestions for further research for unexpected results; (2) draws inferences that are consistent with the data and scientific reasoning and relates these to interested audiences (3) relates data to the scientific literature (where this was used in criminal cases, for example); (4) identifies at least 4 major sources of error in the experiment; (5) summarizes the purpose and the findings of the research; and (6) student accepts or rejects the hypothesis.

7 – Lacks in one of the critical elements of the discussion section.
5 – Lacks in two of the critical elements of the discussion section.
2 – Lacks in three or more of the critical elements of the discussion section.
0 – Nothing beneficial can be gleaned by the reader of this section.

Conclusion

3 – Clearly (1) summarize the major findings of the experiment, (2) explain how to improve the experiment if it was to be conducted again, and (3) describe future research possibilities on this topic.
1 - Lacks one of the three major components of the conclusion section.
0 – Lacks the majority of the main components of the conclusion section.

Literature Cited

5 – The minimum of 6 references specified are present and in the correct format.
3 - Lacks one of the required references, but all are in the correct format.
2 – Lacks the correct citation format, but all elements of references are present.
0 – Lacks the correct citation format with some of the elements of the reference are missing **or** two or more of the required references are not given.

Organization

5 - All material placed in correct sections; organized logically within each section; runs parallel among different sections.
3 - Material placed in the right sections, but not well organized within the sections; disregards parallelism.
1 - Some information placed in the wrong sections.
0 – The majority of information is placed in wrong sections or not sectioned; poorly organized wherever placed.

Grammar and spelling

5 - Sentence structure and grammar are exceptional. No spelling or typos are present.
4 - A few (less than 3) minor typos are present, but overall sentence structure and grammar are still exceptional.
2 - Some minor problems with sentence structure, or several spelling mistakes/typos are present.
0 - Lab report is unprofessional in that there are several typos/spelling mistakes and/or sentence structure is a severe problem

Grade Sheet for FORS 2201 Laboratory Reports

Student Name _____

Section of Lab Report	Grade you received (circled)	Comments
Title Page	1 0	
Introduction	10 7 6 3 0	
Materials and Methods	4 2 1 0	

Results	7 5 3 2 0	
Discussion	10 7 5 2 0	
Conclusion	3 1 0	
Citations	5 3 2 0	
Organization	5 3 1 0	
Grammar and spelling	5 4 2 0	
Overall Grade	**_____ out of 50 points possible**	