

Tech Prep Biotechnology Course of Study 2005



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Miami Valley Tech Prep Consortium/Sinclair Community College

Technical Competency Learning Expectations for the Secondary

Biotechnology Applied Science Associate Degree Program 2+2 Program

Unit 1: The Scientific Method

- 1.1.1 Define Scientific Research examples.
- 1.1.2 Distinguish between dependent and independent variables.
- 1.1.3 Apply critical thinking skill by providing lab experiences that require diagnosing a problem, identifying solutions, interpreting data, analyzing data for accuracy, integrating information, and correlating and drawing conclusions from the data.
- 1.1.4 Demonstrate problem solving skills through laboratory experiences that require definition of the problem, identify possible causes for the problem, define a plan of action, and apply methods for qualitative and quantitative analysis, data gathering, direct and indirect observations and predict results.

Unit 2: Basic Laboratory Routine

- 2.1.1 Demonstrate basic laboratory protocols by proper maintenance of lab equipment, inventory of lab supplies, clean and prepare equipment and materials for the lab.
- 2.1.2 Understand the receiving and maintaining of biological and chemical stocks.
- 2.1.3 Conduct experiments by demonstrating skills in setting up equipment, performing and monitoring processes, establishing quality controls, communicating results of an experiment.
- 2.1.4 Record and report experiment results by becoming proficient by maintaining a lab notebook documenting good lab practices and procedures concluding in scientific reports and logs.

Unit 3: Laboratory Safety and Maintenance

- 3.1.1 Practice correct laboratory safety and maintenance procedures each day.
- 3.1.2 Introduce the concept of regulatory compliance and give an overview of various regulatory agencies.
- 3.1.3 Practice personal safety procedures as it pertains to sight and eye protection.
- 3.1.4 Demonstrate an awareness and control of blood-borne pathogens.
- 3.1.5 Use appropriate personal protective equipment when using or dealing with hazardous chemicals, corrosive and explosive materials.
- 3.1.6 Demonstrate use of safety equipment such as safety glasses, showers, and eyewashes, fire protection devices and respiration emergency techniques.
- 3.1.7 Demonstrate correct practices of basic Red Cross Laboratory first aid skills.
- 3.1.8 Demonstrate employee safety training skills.
- 3.1.9 Identify local lab workplace safety hazards by identifying and practicing evacuation routes.
- 3.1.10 Have knowledge of a laboratory hygiene plan by identifying signage, symbols and use of safety equipment. (Chemical, electrical and physical)
- 3.1.11 Practice designed laboratory hygiene and safety plans by following procedures identified for the lab.
- 3.1.12 Demonstrate proper techniques in handling laboratory equipment safely.
- 3.1.13 Demonstrate proper use of safety valves, thermal devices, autoclaves and heat generating devices.
- 3.1.14 Demonstrate proper and safe use of chemicals by applied use of labels, symbols, and generating devices.
- 3.1.15 Demonstrate ability to read, interpret and prepare material safety sheets from reference handbooks, involving chemicals, gasses, liquids and solids.
- 3.1.16 Familiarize students with the format of MSDS sheets, and the usefulness of this document to the laboratory worker.
- 3.1.17 Describe and demonstrate techniques of handing, transferring, and mixing of acids, bases, oxidizers and strong reducing agents.
- 3.1.18 Demonstrate knowledge of hazardous material safety, and disposal regulatory guidelines and where such guidelines are located.
- 3.1.19 Demonstrate emergency medical response by practicing laboratory chemical, physical and liquid emergencies at the local classroom, field site or spontaneous exposure.
- 3.1.20 Develop an awareness of Bio-Tech Hazard Issues through research techniques and case studies.
- 3.1.21 Discuss GLPs and GMPs, and how they relate to research and manufacturing in the biotechnology industry.

Unit 4: Laboratory Instrumentation

- 4.1.1 Demonstrate proficiency of the metric system in measuring liquids, solids and gases.
- 4.1.2 Demonstrate applications and use of measuring and calibration of laboratory instrumentation such as pipettes, scales, pH meters, and metric measurement devices.
- 4.1.3 Become confident in the use of pipettors, and serological pipettes.
- 4.1.4 Become familiar with an introductory knowledge of Filtration.
- 4.1.5 Become familiar with an introductory knowledge of sedimentation and separation of biological materials.
- 4.1.6 Discuss water quality and the importance of using different grades of water for different applications.
- 4.1.7 Demonstrate proficiency in the use of microscopes through the understanding of microscope principles and then apply those skills through examination of biological specimens.
- 4.1.8 Introduce the electromagnetic spectrum concept of ultraviolet light and measurement using light absorbance.
- 4.1.9 Demonstrate equipment calibration using available classroom instruments and graph appropriate plots.
- 4.1.10 Maintain laboratory instrument stations by utilizing proper instrument instruction, maintenance and calibration checks.
- 4.1.11 Practice using instrument usage logs for PH meters, conductivity meters, balances and other laboratory instruments.

Unit 5 and 6: Chemical Materials and Physical Property Measurement

- 5.1.1 And 6.1.1 Demonstrate the Basic Chemistry Skills by successfully passing a high school Chemistry course with a C+ or better.
- 6.1.2 Practice calculations that require determining the amount of solutes for the various laboratory solutions, and prepare solutions according to the proper procedures.

Unit 7: Biohazard Storage, Handling and Disposal

- 7.1.1 Define an infectious agent.
- 7.1.2 Demonstrate knowledge of proper handling of infectious agents as safely by describing prevention, basic strategies of safe handling, disposal, labeling, and standard operating procedures of bio-infectious agents.
- 7.1.3 Describe safe disposal of infectious agents by containment methods, sterilization.

Unit 8: Basic Microbiology

- 8.1.1 Introduce the microbiological principles of microbial taxonomy, metabolism, reproduction and cell structure by collecting and testing cultured specimen.
- 8.1.2 Introduce and demonstrate microbiology procedures of operating a microscope, incubator and handling, sampling and analyzing cultures.
- 8.1.3 Successfully perform bacteria lab exercises such as isolation, harvesting transforming and maintaining pure cultures utilizing proper techniques of materials and equipment.
- 8.1.4 Demonstrate proper clean up and sterilization of disposal and inventory of lab materials and equipment.
- 8.1.5 Define prokaryotic and eukaryotic cells explaining all parts of the cell, function and description.
- 8.1.6 Explain endospore formation and plasmids.
- 8.1.7 Identify groups of bacteria, algae and fungi.
- 8.1.8 Develop introductory knowledge of culturing microbial growth in bacteria applying measurement and growth variables.

Unit 9: Biochemical Technology

- 9.1.1 Demonstrate knowledge of Chemical Laboratory hands on skills and application by successfully passing a Chemistry Laboratory course with a C+ or better.
- 9.1.2 Define mole, molarity, and normality.
- 9.1.3 Perform serial dilutions.
- 9.1.4 Describe and prepare buffers.
- 9.1.5 Adjust and dilute stock solutions.
- 9.1.6 Prepare sterile solutions...
- 9.1.7 Demonstrate combinations of chemical lab skills.
- 9.1.8 Perform critical lab calculations and measurements.
- 9.1.9 Practice and demonstrate the use of mathematics as it pertains to the lab activity protocols.

- 9.1.10 Introduce protein properties
- 9.1.11 Identify and describe an introductory knowledge of amino acids, peptides, proteins, enzymes, nucleotides and nucleic acids.
- 9.1.12 Demonstrate an introductory knowledge of DNA and RNA transcription and replication.
- 9.1.13 Demonstrate an introductory knowledge of carbohydrates.
- 9.1.14 Demonstrate an introductory knowledge of lipids.

Unit 10: Molecular Biology

- 10.1.1 Demonstrate knowledge of genetics and heredity by defining Mendel's working of genetic crosses, meiosis/mitosis, genetic recombination, and family tree mapping.
- 10.1.2 Describe historical DNA developments by researching and reporting via word processing skills discoveries of genetics within the past three years.
- 10.1.3 Simulate application of DNA lab exercises that apply the characteristics of cloning and purification of DNA/RNA.
- 10.1.4 Relate recent advances in molecular biology as it relates to medicine, food science, agriculture and gene sequencing by completing a Cap Stone Project.

Unit 11: Cell Culturing

- 11.1.1 Introduce different types of cell cultures and historical advances.
- 11.1.2 Identify the equipment needs of a tissue culture lab and the consumables needed to create scientific experiments.
- 11.1.3 Describe the aseptic technique of culturing tissues.
- 11.1.4 Demonstrate the environment factors that influence cell growth by applying incubation studies that compare work surfaces, dishes, plates and vessels that grow tissues.
- 11.1.5 Prepare media for culturing cells by utilizing proper lab etiquette of sterilization, media preparation techniques and test for sterile conditions.
- 11.1.6 Develop an understanding of ethical animal use describing, care and use within, Federal, state and Local regulations.

Unit 12: Protein Bioseparation

- 12.1.1 Develop and introductory knowledge of basic chromatography
- 12.1.2 Observe a field lab experience in chromatography and develop an introductory understanding of gel permeation analysis by spectrophotometer measures and the results of such a demonstration.

Unit 13: Exploration and Knowledge of Biotechnology Career Fields

- 13.1.1 Develop a working knowledge of Biotechnology Careers by creating a notebook of biotech careers supported with clippings and timely articles from professional magazines.
- 13.1.2 Categorize types of jobs within a variety of Biotech career fields.
- 13.1.3 Observe by field experience a Bio Tech career job site.
- 13.1.4 Interview field workers at Biotech career job site.
- 13.1.5 Use the Internet to gather Biotech career information.
- 13.1.6 Select a biotech job of interest and research the characteristics of the job formalizing the research in a formal presentation utilizing a variety of communication modes (written/verbal/class/ presentation) using available technologies.

Unit 14: Basic Computer Concepts and Applications for Biotechnology

- 14.1.1 Demonstrate basic computer literacy by creating directories and folders, formatting disks, and manipulating files.
- 14.1.2 Use printers, scanners, video equipment and modems to apply computer hardware skills for the application of Biotechnology data.
- 14.1.3 Use word processing packages.
- 14.1.4 Use spreadsheet packages.
- 14.1.5 Use databases.
- 14.1.6 Use electronic mail
- 14.1.7 Demonstrate knowledge of the Internet
- 14.1.8 Use the Internet for research.
- 14.1.9 Operate software packages for science technology

Unit 15: Bioethics

- 15.1.1 Identify basic principles of ethics:
- 15.1.2 Define bioethics
- 15.1.3 Identify ethical and unethical behavior in lab setting
- 15.1.4 Identify ethical and unethical behavior in personal life.
- 15.1.5 Apply principles of ethics to scientific problems.
- 15.1.6 Compare and contrast ethical behavior to a variety of science/Bio-tech case studies.

Unit 16: Bioinformatics

- 16.1.1 Introduce the concept of how statistical methods and probability play important roles in predictions and the presentation of data in today's world.
- 16.1.2 Apply databases to actual situations and school problems
- 16.1.3 Introduce the terms: sorting queries, group data, imbed and import data, link data & graphics and demonstrate making calculations for a database.
- 16.1.4 Introduce the use of introductory line charts, bar charts and measures of central tendency (mean, median, mode)
- 16.1.5 Design a database to solve a business problem or other real-life problem situation.

Reoccurring Themes & Process Skills Which Relate to the Technical Competencies.

I. Scientific Inquiry:

- Scientific Method
- Experimentation
- Data Collection & Analysis

II. Laboratory Safety & Maintenance

- Personal Protection Equipment
- Emergency Procedures
- Chemical/Radiological Hazards
- Biological Hazards
- Equipment Hazards
- Established Laboratory Policies & Protocols

III. Preparation of Common Laboratory Reagents

- Calculations
- Weighing and Measuring
- Adjusting pH
- Sterilizing Solutions
- Storing Buffers and Solutions
- Serial Dilutions

IV. Instrumental Methods of Analysis

- Making & Reporting Measurements
- Precision & Error
- Calibration
- Mass, Volume, Temperature & Pressure
- Density, Concentration & pH
- Absorbance, Transmittance & Standard Curves
- Microscopy
- Methods of Separation: Filtration
- Methods of Separation: Centrifugation
- Methods of Separation: Chromatography
- Methods of Separation: Electrophoresis
- Polymerase Chain Reaction (PCR)

V. Scientific Writing

- Recording Data
- Organizing Data
- Presenting Data
- Peer-Reviewed Publication

VI. Relationship of Science to Everyday Life

- Bioethical Considerations
- Environmental Considerations
- Social Considerations
- Economic Considerations
- Political Considerations
- Medical Considerations
- Industrial Considerations
- Business Considerations