Appendix N

SCIENCE, TECHNOLOGY, ENGINEERING, AND MATH (STEM) YOUTH APPRENTICESHIP

SCIENCE & MATH PATHWAY
BIOSCIENCE LAB FOUNDATIONS (UNIT 6)

Unit 6: Science & Math Pathway
Bioscience Lab Foundations

Competency
1. Apply Bioscience Lab knowledge

Performance Standard Condition

Competence will be demonstrated

- at the worksite

Performance Standard Criteria

Performance will be successful when learners:

- Demonstrate Bioscience Lab systems understanding based on ***current training and knowledge***
- Read Bioscience Lab materials discerning the information and concepts
- Locate and read reference materials and scientific publications

Learning Objectives

SCIENCE CONCEPTS

- Explain the importance of the scientific method to research
- Explain the steps in conducting research
- Explain the importance of controlled research
- Identify the major parts of a research report
- Define biotechnology/bioscience

BIOLOGY PRINCIPLES

- Compare types, chemical make-up, and function of bio-molecules
- Describe the basic components and functions of the cell
- Explain the structures of DNA and RNA
- Explain the process of replication, transcription and translation in a cell
- Explain the molecular basis for heredity and how genotype influences phenotype
- Discuss the genetic code and expression of a gene
- Analyze factors that influence gene expression
- Describe how biological life forms are structured from cells to organisms
- Discuss the inheritability of traits and evolution of new traits through genetic bio-molecules

CHEMISTRY PRINCIPLES

- Differentiate between physical and chemical properties of matter
- Describe the structure of the atom and its effect on molecular formulas
- Identify different chemical reactions
- Identify between ionic and molecular compounds

HISTORY, TRENDS, & IMPACT

- Explain how protein biochemistry, molecular biology, microbiology and genetics are interrelated
- Identify the major innovations in the development of biotechnology/bioscience
- Describe current applications of bioscience
- Research emerging and future applications of bioscience
- Describe the emergence, evolution, and implications of bioethics
- Identify the steps in bringing a new bioscience product to market
- Describe the testing procedures to determine the safety of a new product

- Describe the processes used in the production of molecules/organisms for use in industrial applications

Comments:

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Competency
2. Use aseptic technique

Performance Standard Condition

Competence will be demonstrated

- at the worksite

Performance Standard Criteria

Performance will be successful when learners:

- Wear the appropriate Personal Protective Equipment (PPE) as required
- Disinfect surfaces before and after use as required
- Gather all materials prior to beginning procedure
- Prevent unwanted air current flow from doors and windows
- Sterilize or use sterilized equipment, reagents and/or supplies
- Hold caps or tops when removing them
- Hold open plates, tubes, lids, etc. at an angle in a manner to prevent unwanted exposure to uncontrolled environment
- Keep lids on as much as possible
- Avoid talking, sneezing, coughing when working with exposed analytes
- Discard contaminated materials properly

Learning Objectives

- Define asepsis
- Compare sterilization to disinfecting
- Compare different sterilization procedures for equipment, reagents and supplies
- Compare disinfecting products
- Compare equipment or lab lay-out, such as laminar flow hoods and clean rooms, used in maintaining asepsis
- Describe basic aseptic techniques in the bioscience laboratory
- Explain the purpose of reducing air currents and holding open items at an angle
- Demonstrate proper removal and holding of lids when removed

Comments:

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Competency

3. Clean & prepare glassware & instruments

Performance Standard Condition

Competence will be demonstrated

- at the worksite

Performance Standard Criteria

Performance will be successful when learners:

- Rinse items thoroughly, as required, with the appropriate solvent
- Soak glassware & other items in warm aqueous solution of detergent
- Clean items to remove all residual matter
  - Consults worksite professional for more aggressive cleaning protocols if required
- After cleaning, rinse thoroughly with water
- Dry items in required manner
- Place cleaned & dried items in sterilization pouches or wraps if required
  - Perform following steps as applicable to lab setting
  - Label and seals items properly
  - Place items in sterilization equipment
  - Ensure items remain apart during the sterilization cycle
  - Place empty canisters upside-down in order to prevent accumulation of water
  - Does not overload sterilizer trays
  - Allow a distance between trays to permit steam circulation
- Document cleaning procedure if required
- Return clean glassware & instruments to their proper storage locations

Learning Objectives

- Identify common glassware, instruments, and reusable testing supplies used in the laboratory
- Describe the use of common lab glassware and instruments
- Explain the sensitivity and care of glassware
- Describe proper dish washing technique for chemical glassware
- Describe other aggressive cleaning procedures to be used with residual materials
- Describe clean-up procedures used for flammable, corrosive and organic materials
- List the glassware and items requiring sterilization in your lab
- Describe the sterilization procedures required for glassware, instruments, or testing supplies in your lab

Comments:

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Competency

4. Prepare reagents, solutions, and/or buffers

Performance Standard Condition

Competence will be demonstrated

- at the worksite

Performance Standard Criteria

Performance will be successful when learners:

- Review the appropriate protocol for safely preparing the item required including safety precautions
- Determine the concentration and amount required
- ***Calculate the amount*** of solute and solvent needed to prepare the desired amount
- Verify calculations with worksite professional
- ***Weigh or measure the solute***
- Add solute to mixing flask
- Measure the solvent if needed
- Fill flask with about 2/3 solvent
- Stopper and mix flask by inverting OR as required by protocol
- Complete filling of remaining required solvent to mixing flask
- Mix as required
- Test and adjust pH if required by protocol
- Return solute and solvent to proper storage area
- Label and store prepared item as required per protocol
- Clean up

Learning Objectives

- Describe the proper storage and handling of various chemicals: Inorganic, Organic, acids, chlorinated chemicals, flammable, corrosive
- Define the common uses of reagents, solutions, and buffers in bioscience testing labs
- Explain how to avoid contaminating reagents during preparation
- Compare and contrast the properties of reagents, solutions, and buffers used in your lab
- Describe hazards associated with the reagents, solutions and/or buffers used in your lab
- Define the uses of biological media
- Define the pH scale

Comments:

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Competency
5. Perform calculations and conversions

Performance Standard Condition

Competence will be demonstrated

- at the worksite

Performance Standard Criteria

Performance will be successful when learners:

- Review the appropriate chart or reference materials to make calculations or conversions
- Identify given values
- Identify unknown values
- Determine the calculations or conversions and formulas that need to be performed
- Perform calculations or conversions as required
  EXAMPLES
  - Perform calculations on parts per million and similar concentrations
  - Calculate the concentration of solutions in percent composition by mass
  - Calculate the concentration of solutions in percent composition by volume
  - Calculate to prepare molar solutions
  - Calculate to prepare dilutions from stock solutions using the law of conservation of mass
- Verify calculations or conversions with worksite professional
- Record calculations or conversions as required

Learning Objectives

- Explain how to convert between U.S. standard measurements and metric measurements
- Explain the link between significant figures in calculations and the measuring devices used
- Describe the units involved in concentrations of mass, volume, molarity, molality, normality, ppm and ppb
- Use the mole concept to convert between moles and grams
- Explain how to calculate Percent by mass, Percent by volume, Molarity, Molality, Normality, parts per million (ppm) and parts per billion (ppb)

Comments:

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Competency
6. Weigh and measure accurately

Performance Standard Condition

Competence will be demonstrated

- at the worksite

Performance Standard Criteria

Performance will be successful when learners:

- Review the protocol for accurately using the measuring equipment including safety precautions
- Ensure equipment is usable and current for calibration

MASS

- SOLIDS
  - Add pan or weighing paper
  - Tare scale
  - Add solid to be weighed
  - Note reading
- LIQUIDS
  - Add container to scale
  - Tare scale
  - Add liquid to be weighed
  - Note reading

VOLUME

- LIQUIDS- Cylinder
  - Choose smallest container available to hold desired volume
  - Position at eye level to the device markings
  - Pour liquid into measuring device until it reaches the mark or measurement you need
  - Add liquid drop by drop until bottom of curved surface matches desired line
- LIQUIDS- Pipets
  - Choose appropriate sized pipet for sample required
  - Attach pump to pipet if needed
  - Set pipet volume OR pull up required amount of liquid
  - Drain/dispense liquid to desired amount in container

TEMPERATURE

  - Verify thermometer probe is operational OR that thermometer has no gaps in the liquid
  - Place thermometer or probe in middle area of material or space
  - Allow thermometer or probe time to reach equilibrium
  - Note reading
- Record measurements in appropriate units and amount of significant figures as required
- Clean up equipment

Learning Objectives

- Explain how to properly carry and pour solid and liquid chemicals
- List common units used in Bioscience labs for mass, volume, & temperature

- Explain how to zero and use scales
- Identify the proper glassware to deliver and contain specific volumes
- Demonstrate reading volume in glassware
- Explain how to pipette and micropipette different volumes of liquid correctly
- Convert measurements from U.S. Standard to metric and vice versa
- Correspond the correct number of significant figures in given values to the measuring device

Comments:

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Competency
7. Operate lab equipment properly

Performance Standard Condition

Competence will be demonstrated

- at the worksite

Performance Standard Criteria

Performance will be successful when learners:

- Review the protocol for the procedure or lab equipment to be used including safety precautions
- Operate only equipment that he/she is trained on
- Choose correct equipment for the task
- Follow and completes any equipment check list prior to use
- Verify equipment is available for use and in working order
- Verify equipment is current for preventative maintenance and/or calibration
- Verify safety requirements and any Personal Protective Equipment (PPE) needed for equipment use
- Inspect equipment and work area for safety considerations
- Set up and prepare equipment for safe operation
  - Check settings
  - Check power
  - Check lubrication and fluid levels
- Monitor equipment for safe operation while operating
- Follow protocol for clean up and shut down after use
- Properly shut down and label any equipment that is not operating as expected, if applicable
  - Follow Lock Out/Tag Out procedures as applicable
  - Promptly report abnormal equipment conditions to worksite professional
- Document use as required

Learning Objectives

- Explain the function of common bioscience laboratory tools and equipment
- Explain the safety precautions and routine care of common bioscience laboratory tools and equipment
- List mechanical, chemical, electrical, compressed air, and other equipment safety hazards at your facility
- Describe the basic procedure to be followed when a piece of equipment is not functioning properly in your lab
- Discuss the need for quality control (QC) samples and/or equipment controls in some bioscience lab equipment
- Explain how Lock Out/Tag Out procedures prevent accidents
- Explain standard use of common heating equipment
- Explain standard use of electrical current/power supply equipment
- Explain proper use of magnetic stirrers and hot plates

- Describe the safety and procedures involved in the use of flame
- Explain how to use a pipet and micropipetter
- Describe use of simple centrifugation
- Describe use of simple filtration
- Explain standard use of a microscope

Comments:

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Competency
8. Conduct testing according to protocol

Performance Standard Condition

Competence will be demonstrated

- at the worksite

Performance Standard Criteria

Performance will be successful when learners:

- Review the testing protocol including safety precautions
- Select and set-up the correct equipment and supplies
- ***Prepare reagents, solutions, and/or buffers***
- Prepare any controls required
- Locate and identify the sample(s) to be tested
- Prepare samples for testing according to protocol
- Test the sample(s) according to protocol ***Using Aseptic Lab Technique*** and Standard/Universal Precautions
  - Include Quality Control (QC) samples, if applicable
  - ***Operate lab equipment properly***
- ***Records results***
- ***Clean glassware and instruments***
- Segregate, Recycle or Dispose of chemical, biohazardous, or infectious waste according to facility guidelines using Standard/Universal Precautions

Learning Objectives

- Discuss the need for quality control (QC) samples and/or equipment controls in bioscience testing
- Define positive and negative control
- Explain the procedures for safe Handling and Disposal of Chemical, Biological, and Radioactive Materials
- Define the purpose of Standard/Universal Precautions
- Explain the procedure for Standard/Universal Precautions in your lab
- Discuss the purpose of fume hoods and biological safety cabinets/hoods
- Explain how to handle and dispose of laboratory wastes safely

Comments:

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Competency
9. Record results of testing accurately

Performance Standard Condition

Competence will be demonstrated

- at the worksite

Performance Standard Criteria

Performance will be successful when learners:

- Select appropriate forms/records
- Use appropriate note-taking methods
- Record results, readings, measurements, calculations, times, etc. with appropriate scientific units carefully without transcription
- Record your identification
- Report any discrepancies or unexpected results to worksite professional
- Add data in electronic files if applicable

Learning Objectives

- Explain the importance of keeping laboratory records
- Explain the purpose and structure of a laboratory data book
- Describe the procedures followed in maintaining a laboratory notebook

Comments:

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Competency
10. Maintain accurate records

Performance Standard Condition

Competence will be demonstrated

- at the worksite

Performance Standard Criteria

Performance will be successful when learners:

- Select appropriate forms/records
- Label and/or code documents as required
- File forms/records in appropriate location
- Use appropriate computer codes, formatting, macros, charts, spreadsheets, etc.
- Verify data prior to entry/storage
- Maintain files as required
- Add Edit, Verify and Query data in electronic files if applicable

Learning Objectives

- Explain the purpose of Standard Operating Procedures (SOPs)
- Define terms used in bioscience lab records
- Demonstrate how electronic data is manipulated such as in a spreadsheet system
- Explain how data & files are stored and "backed up"
- Describe the purpose of security and ID information within record keeping systems

Comments:

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Competency

11. Monitor & maintain lab &/or personal inventory

Performance Standard Condition

Competence will be demonstrated

- at the worksite

Performance Standard Criteria

Performance will be successful when learners:

- Check incoming containers for damage or contamination of items
- Verify that items ordered match the purchase order and description
- Identify any defective items
- Notify worksite professional and take appropriate corrective action when defective or missing items are identified
- Assist worksite professional to perform inventory checks
- Check that proper storage levels are maintained
- Rotate items to minimize old and outdated inventory
- Care for plants and animals as required by protocol
- Monitor temperature and atmospheric controlled spaces

Learning Objectives

- Explain the importance of maintaining an accurate inventory of biological and chemical materials
- Discuss the Chemical Hygiene Plan at your lab
- Identify the main types of inventory in bioscience labs
- Identify the costs of maintaining inventory
- Describe techniques used to order, stock, and maintain biological, chemical, and radioactive items
- Identify and describe hazards associated with biological, chemical, and radioactive items
- Explain how common safety, chemical, radioactive, and biological hazards are indicated on shipping labels
- Describe the proper storage, handling and disposal of various chemicals: Inorganic, Organic, acids, chlorinated chemicals, flammable, corrosive, radioactive
- Describe the proper storage, handling and disposal of biologic items

Comments: