

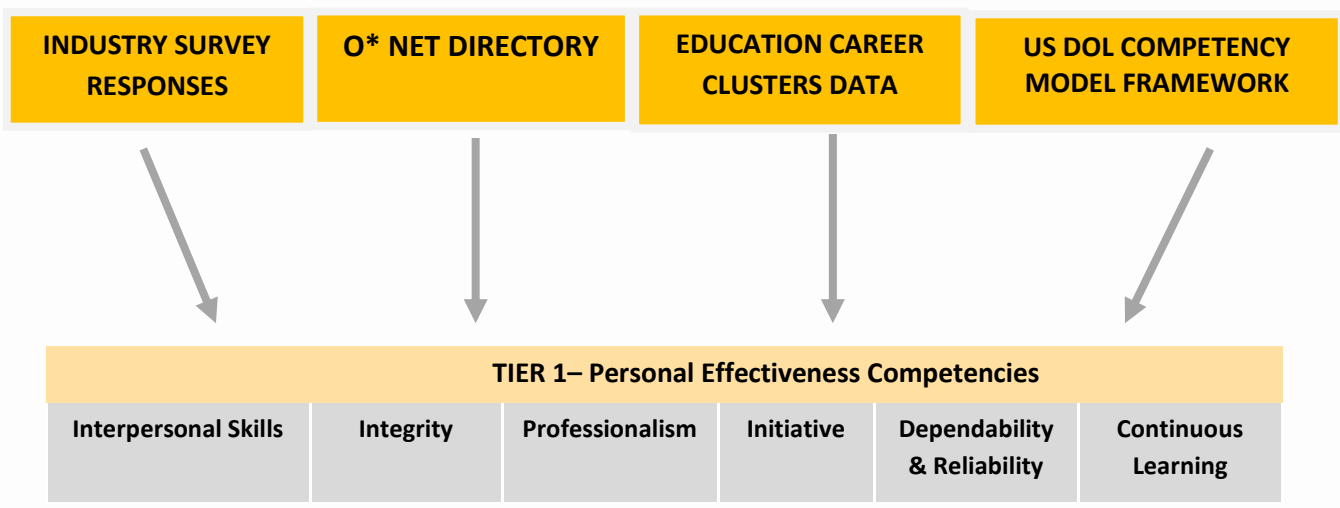


Foundational Competencies

The **Foundational Competencies** block includes Tiers 1 through 3 and the essentials for early success in school and work life are identified. These competencies are integral for all workers to be successful in any organization and across all occupations in all industries. An industry survey with a specific set of questions was designed and administered to Life Science industry professionals in the region to identify the competencies in this tier. Often business leaders elaborated on certain competencies outside the survey questions, which was also incorporated into the tiers.

Tier 1: Personal Effectiveness Competencies

Starting at the bottom of the pyramid this tier is comprised of competencies that are often referred to as “soft skills” and essential in all life roles. Using the US-DOL competency model as a framework, the survey results were mapped against O*Net(a system that serves as the nation's primary source of occupational information, providing comprehensive information on key attributes and characteristics of workers and occupations)¹¹ and Education Clusters data to develop this tier.



Each competency is then described in terms of behavioral attributes.





Interpersonal Skills

Attributes
Maintains open communication with others, recognizes and accurately interprets the verbal and non verbal behavior of others
Demonstrate culture and diversity awareness
Display adequate concern for others by being sensitive to their needs and feelings

Integrity

Attributes
Treat others with honesty, fairness and respect
Comply with ethical standards for your field
Take responsibility for accomplishing work goals within accepted timeframes
Accept responsibility for one's decisions and actions

Professionalism

Attributes
Demonstrate self discipline, self-worth and positive attitude in a work situation
Is free from substance abuse
Maintains a professional appearance
Complies with organizational policies and procedures
Take responsibility for one's own work assignment

Initiative

Attributes
Pursue work with energy, drive and goes beyond routine demands of the job
Strive to exceed standards and expectations
Establishes and maintains personally challenging but realistic work goals
Is able to perform effectively even with minimal direction and support

Dependability & Reliability

Attributes
Follow policies and procedures, thus exhibiting commitment to the organization
Diligently follow through on commitments and consistently meets deadlines
Demonstrate regular and punctual attendance

Continuous Learning

Attributes
Demonstrate an interest in personal and professional lifelong learning and development
Treat unexpected circumstances as opportunities to learn and adopt new techniques



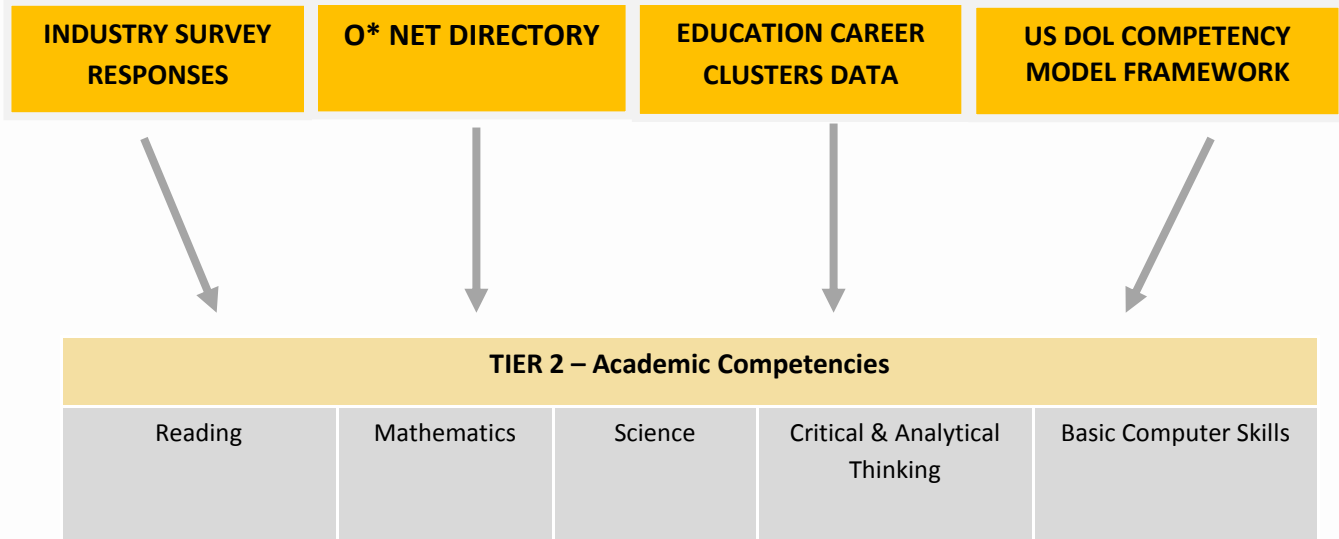


- Seek feedback and modify behavior for improvement
- Broaden knowledge and skills through reading publications, job shadowing and continuing education
- Use newly learned knowledge and skills to complete specific tasks
- Take charge of personal career development by identifying personal interests, strengths, options and opportunities

Tier 2—Academic Competencies

The second tier in the Foundational competencies block covers basic educational competencies that are learned in an educational setting along with cognitive functions and thinking styles. Typically these competencies form the foundation for the Occupation and Industry specific Competencies. This tier was also developed by mapping the survey results against O*Net and Education Clusters data.

Foundational Competencies



Each competency is then described in terms of behavioral attributes.

Reading

- | |
|--|
| Attributes |
| Locate, understand and interpret written technical and non-technical information in documents such as manuals, reports, memos, graphs, charts, tables, schedules and signs |
| Identify relevant details, facts, specifications and main ideas |
| Understand the essential message and purpose of written materials |
| Infer or locate meaning of unknown or technical vocabulary |

Mathematics

- | |
|---|
| Attributes |
| Know and apply mathematical principles: |
| <ul style="list-style-type: none"> Number Systems and Relationships – whole numbers, decimals, fractions and percentages |





- Number Operations, Computation, Estimation and Rounding – addition, subtraction, multiplication and division
- Measurement and Estimation – measurement of time, temperature, distances, length, width, height, perimeter, area, volume, weight, velocity and speed; unit conversions (e.g., English to metric)
- Mathematical Reasoning and Problem Solving – inductive and deductive reasoning, conjectures, arguments, strategies and interpretation of results
- Statistics and Data Analysis – collection, reporting and analysis of data
- Algebra and Functions - equations, patterns and functions
- Geometry – shapes and using geometric principles to solve problems
- Trigonometry – triangles and trigonometric functions

Science

Attributes
Know and apply scientific principles:
<ul style="list-style-type: none"> • Scientific Method – the systematic pursuit of knowledge involving the recognition and formulation of a problem, the collection of data through observation and experiment and the formulation and testing of a hypothesis • Laboratory Equipment and Procedures – using a scientific laboratory and its equipment • Biology – cellular structure, living organisms, structure, function and interdependence of organisms; heredity and evolution <ul style="list-style-type: none"> ○ Biochemistry – the chemical substances and vital processes occurring in living organisms ○ Genetics – the mechanisms of hereditary transmission and the variation of inherited characteristics among similar or related organisms ○ Immunology – all aspects of the immune system including its structure and function, disorders of the immune system, blood banking, immunization and organ transplantation ○ Microbiology – microorganisms and their effects on other living organisms ○ Molecular Biology – biology on a molecular level including the structure, function and makeup of biologically important molecules such as DNA, RNA and proteins • Chemistry – the composition, structure, properties and reactions of matter, especially of atomic and molecular systems <ul style="list-style-type: none"> ○ Analytical Chemistry – quantitative and qualitative identification of substances ○ Organic Chemistry – the chemistry of carbon compounds • Physics – matter and energy and physical interactions

Critical and Analytical Thinking

Attributes
Use interdisciplinary skills to integrate knowledge of various academic disciplines to solve problems
Use logic and reasoning to identify strengths and weaknesses of alternative solutions, conclusions, or approaches to problems
Use inductive and deductive reasoning to analyze, synthesize, compare and interpret information
Draw conclusions from relevant or missing information





Understand the underlying relationship among facts and connections between issues

Organize problems into manageable parts

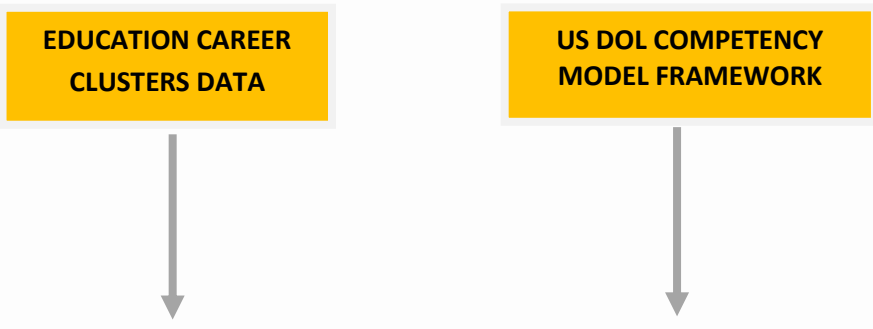
Basic Computer Skills

Attributes
Basic Computer Knowledge
<ul style="list-style-type: none"> • Basic computer hardware (e.g. PCs, printers) and software (e.g. word processing software, spreadsheet software) to perform tasks • Computer terminology (e.g., program, operating system) • Fundamental capabilities of computers • Computer and information security
Applications
<ul style="list-style-type: none"> • Word Processing – to compose, organize and edit simple documents and other business communications • Internet and E-mail – to search for information and communicate • Spreadsheet, database and presentation software – to store, retrieve and present data • Data entry and file storage and management – to store, retrieve and sort detailed records

Foundational Competencies

Tier 3 —Workplace Competencies

The competencies in this tier include those skills and abilities that permit an individual to conduct his/her work related activities in an effective and efficient manner. These competencies were derived from the Education Career Cluster Data and the US DOL Competency Model Framework.



TIER 3 – Workplace Competencies						
Teamwork	Planning & Organizing	Innovative Thinking	Working with Tools & Technology	Problem Solving	Checking Examining & Recording	Business Fundamentals

Each competency is then described in terms of behavioral attributes.





Teamwork

Attributes
Accepts membership in team and uses best practices for successful team functioning
Works effectively in multi-disciplinary teams
Gives and receives feedback constructively
Leverages the strengths of others to accomplish a common goal
Is open to considering new ways of doing things and the merits of new approaches to work

Planning & Organizing

Attributes
Planning & Organizing <ul style="list-style-type: none"> ▪ Approach tasks in a methodical and systematic manner ▪ Apply effective organizational skills ▪ Develop and implement a plan for a project ▪ Keep track of details to ensure work is performed accurately and completely ▪ Find new ways of organizing or planning work to accomplish tasks more efficiently
Adaptability/Flexibility <ul style="list-style-type: none"> ▪ Change gears in response to unpredictable or unexpected events, pressures, situations and job demands ▪ Effectively change plans, goals, actions, or priorities to deal with changing situations
Time Management <ul style="list-style-type: none"> ▪ Develop a timeline for sequencing the activities of a project ▪ Establish specific goals to accomplish work in a timely manner ▪ Prioritize various competing tasks and perform them efficiently according to their urgency ▪ Ensure that others receive needed materials in time ▪ Stay on schedule ▪ Keep all parties informed of progress and all relevant changes to project timelines

Innovative Thinking

Attributes
<ul style="list-style-type: none"> ▪ Employ unique analyses and generate new, innovative ideas in complex areas ▪ Reframe problems in a different light to find fresh approaches ▪ Entertain wide-ranging possibilities to develop unique approaches and useful solutions ▪ Understand the pieces of a system as a whole and possess a big picture view of the situation





- Integrate seemingly unrelated information to develop creative solutions
- Develop innovative methods of obtaining or using resources when insufficient resources are available
- Demonstrate innovative thinking by using new and existing technology in new ways
- Demonstrate new ways of thinking, not merely about what is, but of what might be

Working with Tools & Technology

Attributes
Selection & Application
<ul style="list-style-type: none"> ▪ Identify, select and apply tools or technological solutions appropriate to the task at hand ▪ Identify potential hazards related to the use of tools and equipment ▪ Operate tools and equipment in accordance with established operating procedures and safety standards ▪ Use information technology and computer applications as it supports the gathering, storage, manipulation and transfer of data and information
Keeping Current
<ul style="list-style-type: none"> ▪ Demonstrate an interest in learning about new and emerging tools and technologies ▪ Identify sources of information concerning state-of-the-art tools, equipment, materials, technologies and methodologies ▪ Seek out opportunities to improve knowledge of tools and technologies that may assist in streamlining work and improving productivity
Maintenance
<ul style="list-style-type: none"> ▪ Perform routine maintenance on tools, technology and equipment ▪ Determine causes of operating errors and decide what to do about it ▪ Troubleshoot maintenance problems in accordance with established procedures

Problem Solving

Attributes
Identify the Problem
<ul style="list-style-type: none"> ▪ Anticipate or recognize the existence of a problem ▪ Identify the nature of the problem by analyzing its component parts and defining critical issues ▪ Locate, obtain and review information relevant to the problem
Generate Alternatives
<ul style="list-style-type: none"> ▪ Generate a variety of approaches to the problem ▪ Think creatively to develop new ideas for and answers to work related problems ▪ Use logic and reasoning to identify the strengths and weaknesses of alternative solutions, conclusions, or





approaches to problems

- Apply concepts of probability to help make decisions

Choose and Implement a Solution

- Decisively choose the best solution after contemplating available approaches to the problem
- Commit to a solution in a timely manner
- Use strategies, tools, resources and equipment to implement the solution
- Observe and evaluate the outcomes of implementing the solution to assess the need for alternative approaches and to identify lessons learned

Checking, Examining & Recording

Attributes

- Use observational techniques for gathering and checking data and controlling processes
- Ensure accuracy of work by checking that all details have been considered
- Record data with the correct number of significant figures
- Detect and correct errors or inconsistencies, even under time pressure
- Organize records and files to maintain data

Business Fundamentals

Attributes

Situational Awareness

- Understand trends in the industry and the company's position in the market
- Recognize one's role in the functioning of the company
- Understand the potential impact one's own performance can have on the success of the organization
- Stay current on organizational strategies to maintain competitiveness

Entrepreneurship

- Develop new ideas for and applications of processes and products
- Seek out and act on opportunities for innovation and invention

Project Management

- Develop, maintain and abide by project timelines and resource plans and work directly with other team members to ensure deliverables meet target due dates
- Coordinate and track projects, train project teams and report performance metrics to supervisors

Customer Focus

- Understand customer needs and goals





- Provide personalized service
- Act professionally with internal or external customers
- Keep customers informed about decisions that affect them

Business Ethics

- Act in the best interest of the company, the community and the environment
- Comply with applicable laws and rules governing work and report loss, waste, or theft of company property to appropriate personnel
- Ensure equipment and systems are designed to be environmentally friendly and strive to continually minimize the resulting carbon footprint
- Practice sustainability by using processes that are non-polluting, conserving of energy and natural resources, economically efficient and safe for workers, communities and consumers

Sales & Marketing

- Able to achieve commercial goals through sales and marketing of products in order to improve company profit



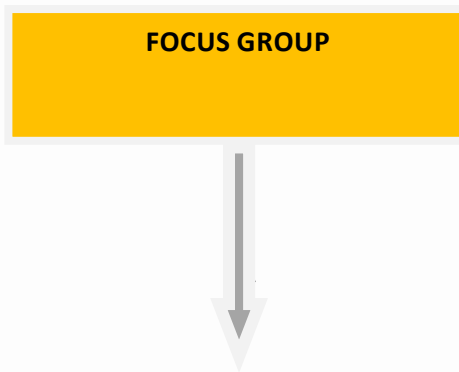


Industry Related Competencies

The second block of the pyramid are **Industry Related Competencies** that are common to all jobs within a particular industry i.e. Life Sciences in this case. Tiers 4 & 5 reflected the consensus of industry professionals collected from these experts in a tightly-focused work session. The panel consisted of business leaders, managers and education and training providers.

Tier 4 —Industry-Wide Technical Competencies

The first tier in Industry related competencies represents the knowledge, skills and abilities required by all occupations within a specific industry. Each industry has a unique set of technical competencies that have been defined by the respective subject matter experts (SME’s). To derive these competencies representatives from Missouri’s Life Science industry met and brainstormed in a focus group setting.



TIER 4 – Industry-Wide Technical Competencies				
Bioscience Foundations	Research & Development	Manufacturing & Production	Quality Control & Assurance	Health, Safety & Security

Each competency is further divided as:

- Critical Work functions – the main areas of work under this competency
- Technical Content Areas – the technical aspects of this competency





Bioscience Foundations

Critical Work Functions:

- Understand the major application areas of bioscience
- Describe the major technologies and historical development of bioscience
- Explain legal and ethical issues affecting the application of bioscience
- Research emerging and future applications of bioscience
- Understand the social impact of bioscience
- Participate in bioscience industry and professional organizations

Technical Content Areas :

Major Application Areas

- Agricultural Feedstock and Chemicals
- Drugs and Pharmaceuticals
- Medical Devices and Equipment
- Research, Testing and Medical Laboratories

Major Technologies

- Bioprocessing
- Genetic Engineering
- Bioinformatics

Legal Issues and Ethics

- Intellectual Property
 - Documentation
 - Patents
- Confidentiality
- Genetics Ethics
- Scientific Accountability

Research and Development

Critical Work Functions:

- Set up and conduct tests/assays: chemical, biological, clinical, environmental, robotic, or mechanical
- Evaluate, document and report results of experiments and tests
- Prepare documents including experimental protocols, technical reports and numerical analyses
- Understand the role of pre-clinical and clinical trials in bioscience product development
- Isolate, identify and prepare specimens for examination
- Clean, sterilize, troubleshoot, calibrate, operate and maintain lab instruments and equipment
- Participate in the care, use and inventory of research plants and animals
- Understand and utilize good control and inventory standards

Technical Content Areas:

Lab Skills

- Experiments, Tests and Analyses
 - Separation Techniques





- Microbiology Techniques
- Cell Biology Techniques
- Nucleic Acid Techniques
- Protein Techniques
- Laboratory Notebooks and Documentation
- Standard Labeling Techniques
- Care For and Use of Plants and Animals
- Laboratory Safety Skills
- Inventory

Manufacturing and Production

Critical Work Functions

- Understand upstream and downstream processes and the life cycle of a product
- Perform and monitor the process to make the product or provide the service
- Monitor gauges and recording instruments to ensure that specified conditions are maintained
- Participate in the installation, modification and upgrade of equipment
- Communicate with co-workers and/or customers to ensure production or service requirements
- Coordinate inventory
- Maintain the production equipment and control systems
- Keep records on process and product

Technical Content Areas:

Procedures

- Standard Operating Procedures (SOP) and Batch Records
- Good Manufacturing Practices (GMP)
- Aseptic Procedures

Production Process

- Obtaining, weighing, measuring and checking raw materials
- Setting up equipment for the production process
- Cleaning (manual and Clean in Place (CIP)) and sterilization (autoclave and Sterilize in Place (SIP))
- Preparing buffers and solutions
- Inspecting materials at all stages of process to determine quality or condition
- Operating reactors and recovering products
- Purification techniques
- Formulating, filling and Inspecting product
- Labeling, packaging and distributing final product

Quality Control and Assurance

Critical Work Functions:

- Monitor, inspect and verify quality of the product, procedure, or specimen to ensure compliance with standards and specifications
- Develop, install and revise validation procedures and protocols
- Control and maintain documentation about qualification and validation





- Calibrate and validate equipment systems and assess equipment performance
- Revise and update standard operating procedures
- Take and document corrective and preventive action according to Standard Operating Procedures or as directed
- Know and comply with current federal, state, local and industry regulations
- Participate in compliance training

Technical Content Areas:

Quality Control/Quality Assurance

- Continuous Improvement
- Audits
- Validation Testing
- Documentation
- Product Specifications
- Statistical and Data Analysis
- Inventory Management
- Test Standards and Controls
- Quality Assurance Logs
- Standard Operating Procedures
- Proficiency Testing
- Plant or Material Flow

Regulatory Compliance

- Good Laboratory Practices (GLP) and Good Manufacturing Practices (GMP)
- Federal Regulatory Agencies (including but not limited to):
 - U.S. Food and Drug Administration (FDA)
 - U.S. Department of Agriculture (USDA)
 - National Institutes of Health (NIH)
 - National Research Council (NRC)
 - Department of Transportation (DOT)
 - Center for Disease Control and Prevention (CDC)
 - Nuclear Regulatory Commission (NRC)
 - Clinical Laboratory Improvement Amendments (CLIA)
- State and Local Regulations
- Industry and Professional Regulations

Health, Safety and Security

Critical Work Functions:

- Demonstrate personal safety, laboratory safety and security procedures
- Identify first aid supplies, safety personnel, emergency protection areas and evacuation plans
- Demonstrate appropriate use of personal protective equipment
- Participate in safety and security training and emergency drills
- Identify unsafe or insecure conditions and take corrective action
- Maintain a sanitary and clutter-free lab or work environment
- Monitor, use, store and dispose of hazardous materials properly





- Follow applicable health, safety and security regulations

Technical Content Areas:

Laboratory and Industrial Safety

- Safe Use of Laboratory Equipment
- Common Lab or Plant Hazards
- Aseptic and Sterilizing Techniques
- Safety Equipment
- Safety Symbols and Signs
- Emergency Procedures and Protocols
- Electrical and Physical Safety

Hazardous Materials

- Safe Handling and Disposal of Chemical, Biological and Radioactive Materials
- Material Safety Data Sheets (MSDS)
- Chemical Hygiene Plans
- Universal Precautions for Biological Pathogens

Bioscience Security

- Secure Use and Handling of Biological Materials
- Infectious Diseases
- Food Security
- Security Agencies and Regulations

Health and Safety Regulations

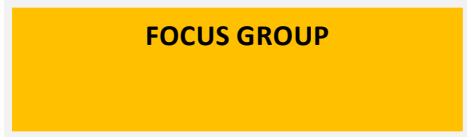
- Occupational Safety and Health Administration (OSHA) and Other Applicable Health and Safety Regulations
- Environmental Protection Agency (EPA) and Other Applicable Environmental Protection Regulations
- Worker Protection Standards (WPS)





Tier 5 —Industry-Specific Technical Competencies

This tier includes competencies that represent knowledge, skills and abilities required for occupations within a specific industry sector. Missouri staffing patterns reflected high employment in specific sectors such as **Agricultural Feedstock & Chemicals, Drugs & Pharmaceuticals, Medical Devices & Equipment** and **Research, Testing & Medical Laboratories**. Within each of these sectors, Knowledge Areas (KAs) were identified. These KA's provide a list of competencies that workers in the specific industry must have to be effective in their occupations.



Industry Related Competencies

TIER 5 – Industry-Specific Technical Competencies

Agricultural Feedstock & Chemicals	Drugs and Pharmaceuticals	Research, Testing and Medical Laboratories	Medical Devices & Equipment and Research
Animal Production Management Bacteriology Bioinformatics/ Cheminformatics Crop Sciences Diagnostics Disease modeling Ecotoxicology Epidemiology Genetic Analysis Greenhouse testing / Field testing Medicinal Chemistry Nematology Parasitology Pesticide Residue Plant and/ Animal metabolism Transgenics Virology	Assay Development Biomarkers Clinical Development Drug Stability Formulations High Throughput Screening In vitro Skills Intro Analysis Method Development and Validation Pharmacodynamics Pharmacokinetics Safety & Toxicology Structure based drug design Synthetic and Structural Chemistry Target Identification	Animal Production Management Anti bodies Bacteriology Conjugation Bioinformatics/ Cheminformatics Biomarkers Biomolecules Bio safety Pathogens detection Cell line Engineering Crop Sciences Diagnostics Disease modeling DMPK Drug Stability Ecotoxicology Epidemiology	Bio- imaging Biochips Electronics Flourescence Chemistry Nanotechnology

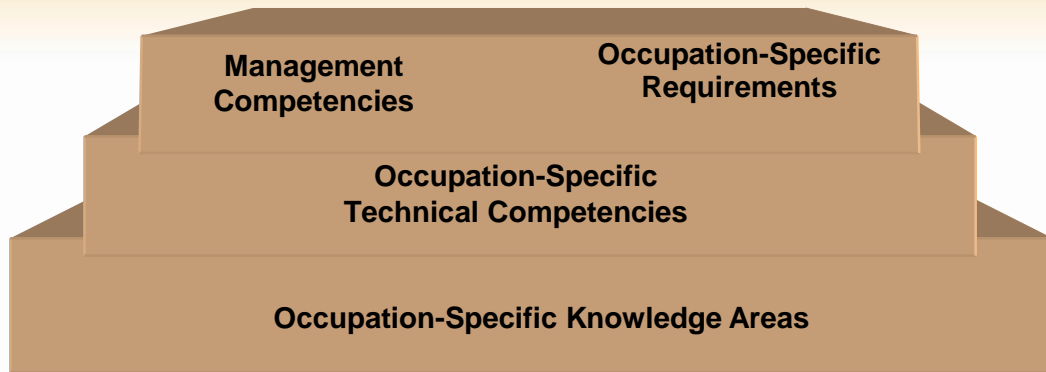




TIER 5 – Industry-Specific Technical Competencies (cont'd)

Agricultural Feedstock & Chemicals	Drugs and Pharmaceuticals	Research, Testing and Medical Laboratories	Medical Devices & Equipment and Research
		Epigenetics Experimental Design Genetic Analysis Greenhouse testing / Field testing Instrumental Analysis Medicinal and Fluorescence Chemistry Method Development and Validation Nematology Parasitology Pesticide Residue Plant and/ Animal metabolism Reagents Regenerative Medicine Spectroscopy Stem Cell Research Transgenics Virology	





Occupation Related Competencies

The last group consists of **Occupation related competencies** and is defined in terms of occupation related knowledge, education, credentials and performance. They are derived from the O*Net directory. A specific list of Life Science occupations has been focused on in these tiers. The eleven Targeted Life Science occupations were identified as follows: a custom industry staffing pattern was identified for the Life Sciences industry cluster in Missouri. These were sorted by their impact on the economy and then mapped against the US DOL’s In Demand occupation list for Life Sciences. This list was then vetted by the State’s industry specialists and is as described below:

O*NET-SOC Code	Title
11-9121	Natural Science Managers
17-2031	Biomedical Engineers
17-2041	Chemical Engineers
19-1021	Biochemists and Biophysicists
19-1022	Microbiologists
19-1042	Medical Scientists, except Epidemiologists
19-2031	Chemists
19-4021	Biological Technicians
29-2011	Medical and Clinical Laboratory Technologists
29-2012	Medical and Clinical Laboratory Technicians
41-4011	Sales Representatives, Wholesale and Manufacturing, Technical and Scientific Products

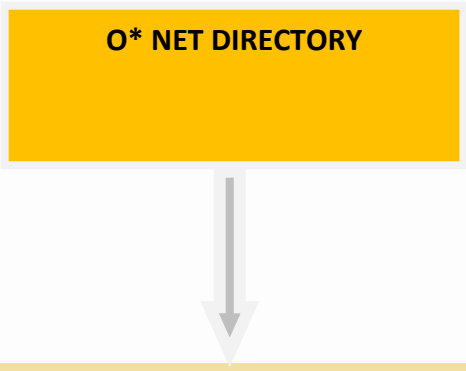
It is important to note that the occupations in this list are obtained from the state’s list of occupations in the Life Sciences cluster and do not include the entire gamut of occupations available within this industry.





Tier 6 —Occupation-Specific Knowledge Areas

This tier contains the specific **knowledge areas** that are required for the eleven targeted Life Science occupations. Each knowledge area covers an area of expertise that the respective occupation requires.



TIER 6 —Occupation Specific Knowledge Areas for :
Natural Science Managers
Biomedical Engineers
Chemical Engineers
Biochemists and Biophysicists
Microbiologists
Medical Scientists, except Epidemiologists
Chemists
Biological Technicians
Medical and Clinical Laboratory Technologists
Medical and Clinical Laboratory Technicians
Sales Representatives, Wholesale and Manufacturing, Technical and Scientific Products

Occupation Related Competencies





Natural Science Managers

- Chemistry
- Law and Government
- English Language
- Administration and Management
- Mathematics
- Biology
- Engineering and Technology
- Customer and Personal Service
- Computers and Electronics

Biomedical Engineers

- Computers and Electronics
- Engineer and Technology
- Customer and Personal Service
- Mathematics
- Mechanical
- English Language
- Clerical
- Design
- Physics
- Public Safety and Security

Chemical Engineers

- Engineering and Technology
- Chemistry
- Mathematics
- Physics
- Production and Processing
- English Language
- Design
- Administration and Management
- Computers and Electronics
- Mechanical

Biochemists and Biophysicists

- Biology
- Chemistry
- Engineering and Technology
- Production and Processing
- Education and Training
- English Language
- Computer and Electronics
- Mathematics
- Administration and Management
- Mechanical





Microbiologists

- Biology
- English Language
- Chemistry
- Mathematics
- Education and Training
- Medicine and Dentistry
- Administration and Management
- Computers and Electronics

Medical Scientists, except Epidemiologists

- Biology
- English Language
- Chemistry
- Medicine and Dentistry
- Mathematics
- Administration and Management
- Communications and Media
- Education and Training
- Personnel and Human Resources
- Clerical

Chemists

- Chemistry
- Mathematics
- Computers and Electronics
- English Language
- Production and Processing
- Customer and Personal Services
- Clerical
- Engineering and Technology

Biological Technicians

- Biology
- Chemistry
- Mathematics
- English Language





Medical and Clinical Laboratory Technologists

- Biology
- Chemistry
- Customer and Personal Service
- Medicine and Dentistry
- English Language
- Mathematics
- Clerical
- Computers and Electronics
- Mechanical
- Education and Training

Medical and Clinical Laboratory Technicians

- Biology
- Chemistry
- Medicine and Dentistry
- Computers and Electronics
- Mechanical
- Customer and Personal Service
- Mathematics

Sales Representatives, Wholesale and Manufacturing, Technical and Scientific Products

- Sales and Marketing
- Customer and Personal Services
- English Language
- Computers and Electronics
- Production and Processing





Tier 7 —Occupation-Specific Technical Competencies

All occupations require certain technical competencies to perform the job. This tier contains **technical competencies** that are specific to the eleven targeted Life Science occupations as listed below.

O* NET DIRECTORY



TIER 7 —Occupation Specific Technical Competencies for:
Natural Science Managers
Biomedical Engineers
Chemical Engineers
Biochemists and Biophysicists
Microbiologists
Medical Scientists, except Epidemiologists
Chemists
Biological Technicians
Medical and Clinical Laboratory Technologists
Medical and Clinical Laboratory Technicians
Sales Representatives, Wholesale and Manufacturing, Technical and Scientific Products

Occupation Related Competencies





Natural Science Managers

Tools used in this occupation	Technology used in this occupation
Desktop computers	Analytical or scientific software – SAS software, SPSS software; StataCorp Stata; StatSoft STATISTICA software
High capacity removable media drive – Universal serial bus USB flash drives	Graphics or photo imaging software – Adobe Systems Adobe Photoshop software; Graphic software
Notebook computers – Laptop computers	Project management software – Microsoft Project
Personal computers	Spreadsheet software – IBM Lotus 1-2-3; Microsoft Excel
Plotter printers – Color plotting printers	

Biomedical Engineers

Tools used in this occupation	Technology used in this occupation
Electrometers – Biomedical device electricity safety testers; Electrosurgery testing devices; Pressure and temperature measurement devices; Ventilator performance analyzers	Analytical or scientific software – SNOINO Ttree; Stratasys FDM MedModeler; The Mathworks MATLAB; Wolfram Research Mathematica
Medical magnetic resonance imaging MRI scanners - 3Tscanners ; Biomagnetic imaging scanners; Magnetic resonance imaging MRI systems; Ultra high speed magnetic resonance imaging MRI scanner machines	Computer aided design CAD software – Mathsoft Mathcad; SolidWorks CAD software; ViewLogic software; Zuken software
pH electrodes – Electrode bevelers; Electroplating apparatus; Microelectrode	Development environment software - Advanced computer simulation language ACSL; C; Hardware description language HDL; National Instruments LabVIEW
Physiological recorders – Activity monitoring devices; Axial – torsional testing systems; Torsiometers; Two-point discriminators	Medical Software – Electromyograph analysis software; Gait analysis software; Medical information software; Virtual instrument software
Pressure indicators – Environmental conditions measurement devices; Force platforms; Pinch gauge; Posturographic measurement systems	Requirements analysis and system architecture software – IBM Rational RequisitePro; Requirements management software; Unified modeling language UML

Chemical Engineer

Tools used in this occupation	Technology used in this occupation
Freezedryers or lyophilizers	Analytical or scientific software – Chempute Software Engineer’s Aide SINET; G&P Engineering Software EngVert; SoftLab PHEdesign; Thermal Analysis Systems The Energy Analyst
Heat exchangers	
Laboratory mixers – Benchtop mixers; Mixing tanks; Powder mixing equipment	Computer aided design CAD software – CD-adapco STAR-CAD; SolidWorks CAD software
Microcontrollers – Programmable logic controllers PLC	
Vacuum Pumps	Database user interface and query software- Chempute Software E-Notebook; G&P Engineering Software PhysProps; Microsoft Access; Relational database software





Object or component oriented development software – C++; Microsoft Visual C#.NET
 Spreadsheet software – Microsoft Excel

Biochemists and Biophysicists

Tools used in this occupation	Technology used in this occupation
<p>Benchtop centrifuges – Continuous flow centrifuges; Cytospin centrifuges; Megafuge centrifuges; Tabletop centrifuges</p> <p>Binocular light compound microscopes – Large upright microscopes; Microscopes; Transillumination microscopes; Video enhanced differential interference contrast microscopes</p> <p>Lasers – Argon lasers; Neodymium-doped Yttrium Aluminium Garnet Nd; YAG lasers; Sapphire lasers; Solid state diode lasers</p> <p>Light scattering equipment – Laser Doppler zeta potential analyzers; Light scattering devices; Multi-angle elastic-light scattering systems</p> <p>Spectrometers- Circular dichroism spectrometers; Laser induced temperature jump nanosecond relaxation spectrometer systems; Mossbauer spectrometers; Raman difference spectrometers</p>	<p>Analytical or scientific software – Accelrys QUANTA; SAS software; The Mathworks MATLAB; Wavefunction Titan</p> <p>Computer aided design CAD software – 3D graphics software ; Accelrys Insight II; ChemInnovation Software Chem 4_D</p> <p>Graphics or photo imaging software – Adobe Systems Adobe Photoshop software; GE Healthcare ImageQuant TL; Intelligent Imaging Innovations; SlideBook; Molecular Simulations WebLab ViewerPro</p> <p>Presentation software – Microsoft Power Point</p> <p>Word Processing software- Microsoft Word</p>

Microbiologists

Tools used in this occupation	Technology used in this occupation
<p>Air samplers or collectors – Bioaerosol impactors; Dichotomous particulate matter samplers; Liquid impingers; Multistage agar impactors</p> <p>Dry baths or heating blocks – Dry bath incubators; Heat blocks</p> <p>Infrared spectrometers – Fourier transform infrared FTIR spectrometers; Infrared IR spectrometers; Mid-infrared spectrometers</p> <p>Microbiology analyzers – Automated microbial identification systems; Flow cytometers; Fluorescence activated cell sorters</p> <p>Steam autoclaves or sterilizers – Autoclaves; Electronic sterilizers; Steroclaves</p>	<p>Analytical or scientific software – Assistant Software for Antimicrobial Susceptibility Interpretation ASASI; BD Biosciences CellQuest; TreeView; Verify Software House ModFit LT</p> <p>Database user interface and query software – Database management software; WHONET</p> <p>Medical software – Computer Service & Support CLS- 2000 Laboratory System; Orchard Software Orchard Harvest LIS</p> <p>Presentation software - Microsoft Power Point</p> <p>Word processing software – Microsoft Word</p>





Medical Scientists, Except Epidemiologists

Tools used in this occupation	Technology used in this occupation
<p>Benchtop centrifuges – Automated centrifuges; Centrifuges; High-speed centrifuges; Tabletop centrifuges</p> <p>Laboratory flasks – Erlenmeyer flasks; Flasks; Volumetric flasks</p> <p>Manual or electronic hematology differential cell counters- Coulter counters; Differential counters</p> <p>Refrigerated benchtop centrifuges – Refrigerated centrifuges; Refrigerated swinging bucket centrifuges</p> <p>Spectrophotometers – Atomic absorption AA spectrophotometers; Graphite furnace atomic absorption spectrophotometers; Recording spectrophotometers; Ultraviolet-Visible UV/VIS spectrophotometers</p>	<p>Analytical or scientific software – BioArray Software Environment BASE software; The Mathworks MATLAB; Waters MassLynx; Waters Q-DIS/QM LIMS</p> <p>Database user interface and query software – Database software; Waters eLab Notebook; Waters Empower 2</p> <p>Graphics or photo imaging software – Adobe Systems Adobe Photoshop software</p> <p>Spreadsheet software – Microsoft Excel</p> <p>Word Processing software- Microsoft Word</p>

Chemists

Tools used in this occupation	Technology used in this occupation
<p>Benchtop centrifuges – Chemical centrifuges; High-speed centrifuges; Table top centrifuges</p> <p>Hematology or chemistry mixers – Automatic peptide synthesizers; Mini synthesizers</p> <p>Lasers – Diode lasers; Dye lasers; Nitrogen lasers; Picosecond lasers</p> <p>Spectrometers – Luminescence spectrometers; Ultraviolet-visible spectrometers</p> <p>X-ray diffraction equipment – Single crystal x ray diffractometers</p>	<p>Analytical or scientific software – Agilent ChemStation; Laboratory information management system LIMS software; Waters Empower Chromatography Data Software; Wavefunction Spartan</p> <p>Computer aided design CAD software – ChemInnovation Software Chem 4-D; ChemSW Molecular Modelling Pro; Hypercube HyperChem</p> <p>Database user interface and query software – Chem SW Buffer Maker; Microsoft Access; Molsearch Pro; Structured query language SQL</p> <p>Graphics or photo imaging software – Digital imaging software; MolDraw</p> <p>Inventory management software – ChemSW Chemical Inventory System CIS: Item Tracker software; UBI Biotracker</p>

Biological Technicians

Tools used in this occupation	Technology used in this occupation
<p>Inverted microscope – Light/tissue culture microscopes</p> <p>Manual or electronic hematology differential cell counters; Coulter counters; Hematology cell counters</p> <p>Microplate readers – Automated microplate ELISA readers</p> <p>Robotic or automated liquid handling systems – Automatic pipette; Liquid handling robots; Robotic laboratory</p>	<p>Analytical or scientific software – BD Biosciences CellQuest; Primer3 software; SAS software; Systat Software Table Curve</p> <p>Database user interface and query software- Database software; Microsoft Access; Thomson EndNote</p> <p>Graphics or photo image software –Adobe Systems Adobe</p>





equipment Temperature cycling chambers or thermal cyclers – Polymerase chain reactions PCR machines; Polymerase chain reaction PCR thermocyclers	Photoshop software; Graphic software; Harvard Graphics software Spreadsheet software- IBM Lotus 1-2-3; Microsoft Excel Word processing software- Corel WordPerfect software; Microsoft Word
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Medical and Clinical Laboratory Technologists

Tools used in this occupation	Technology used in this occupation
Chemistry analyzers – Automated chemistry analyzers; Automated/ semi-automated dipstick analysis systems; Heterologous test systems; Homologous test systems Coagulation analyzers – Automated coagulation analyzers; Portable coagulation analyzers Hematology analyzers – 5-part differential automated hematology analyzers; Automated platelet analyzers; Hemaglobinometers; Hematology task-targeted automation TTA systems Laminar flow cabinets or stations – Laminar flow cabinets; Laminar flow hoods Phlebotomy trays or accessories – Collection tube holders/ adapters ; Unopettes	Database user interface and query software – Database software Electronic mail software – Email software Medical software – Laboratory information systems LIS software; Specimen tracking software; Test result delivery software; Test routing software Spreadsheet software Word Processing software

Medical and Clinical Laboratory Technicians

Tools used in this occupation	Technology used in this occupation
Chemistry analyzers – Automated chemistry analyzers; Automated/ semi-automated dipstick analysis systems; Heterologous test systems; Homologous test systems Coagulation analyzers – Automated coagulation analyzers; Portable coagulation analyzers Hematology analyzers – 5-part differential automated hematology analyzers; Automated platelet analyzers; Hematology task-targeted automation TTA systems; Semi- automated hematology analyzers Phlebotomy trays or accessories – Collection tube holders/ adapters ; Unopettes Vacuum blood collection tubes or containers – Evacuated blood collection tubes; Vacutainer tubes	Accounting software – Billing software Database user interface and query software – Database software Medical software – Laboratory information systems LIS software ; Microscopic image capturing software; Specimen tracking software; Test result delivery software Spreadsheet software Word Processing software





Sales Representatives, Wholesale and Manufacturing, Technical and Scientific Products

Tools used in this occupation	Technology used in this occupation
<p>Notebook computers – Laptop computers</p> <p>Personal computers</p> <p>Personal digital assistant(PDA)s or organizers</p> <p>Tablet computer</p>	<p>Customer relationship management CRM software- Action Ware; FrontRange Solutions Goldmine software; NetSuite NetCRM; Sybase iAnywhere Pharma Anywhere</p> <p>Database user interface and query software- Data entry software; Microsoft Access</p> <p>Electronic mail software – IBM Lotus Notes; Microsoft Exchange; Microsoft Outlook</p> <p>Presentation software- Microsoft PowerPoint</p> <p>Word Processing software – Microsoft Word</p>

Occupation Related Competencies

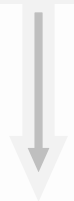




Tier 8 – Occupation Specific Requirements

This tier includes **occupation specific job credentials** such as educational degrees, certifications, licensures, physical training requirements specific to a particular occupation within an industry. The US Department of Education provides a taxonomic scheme of programs of study and descriptions called Classification of Instructional Programs (CIP). The National Crosswalk Service Center linked this data with the list of occupations in the O*NET Directory and created a comprehensive list of instructional programs for each occupation in each industry.

O* NET DIRECTORY



TIER 8 –Occupation Specific Requirements for:
Natural Science Managers
Biomedical Engineers
Chemical Engineers
Biochemists and Biophysicists
Microbiologists
Medical Scientists, except Epidemiologists
Chemists
Biological Technicians
Medical and Clinical Laboratory Technologists
Medical and Clinical Laboratory Technicians
Sales Representatives, Wholesale and Manufacturing, Technical and Scientific Products

Occupation Related Competencies





Natural Science Managers

CIP Code	CIP Title
14.3701	Operations Research
26.0101	Biology/Biological Sciences, General
26.0202	Biochemistry
26.0203	Biophysics
26.0204	Molecular Biology
26.0209	Radiation Biology/Radiobiology
26.0301	Botany/Plant Biology
26.0305	Plant Pathology/Phytopathology
26.0307	Plant Physiology
26.0399	Botany/Plant Biology, Other
26.0401	Cell/Cellular Biology and Histology
26.0403	Anatomy
26.0499	Cell/Cellular Biology and Anatomical Sciences, Other
26.0502	Microbiology, General
26.0503	Medical Microbiology and Bacteriology
26.0504	Virology
26.0505	Parasitology
26.0507	Immunology
26.0701	Zoology/Animal Biology
26.0702	Entomology
26.0707	Animal Physiology
26.0799	Zoology/Animal Biology, Other
26.0804	Animal Genetics
26.0805	Plant Genetics
26.0910	Pathology/Experimental Pathology
26.1001	Pharmacology
26.1004	Toxicology
26.1101	Biometry/Biometrics
26.1102	Biostatistics
26.1201	Biotechnology
26.1301	Ecology
26.1302	Marine Biology and Biological Oceanography
26.1303	Evolutionary Biology
26.1399	Ecology, Evolution, Systematics &





	Population Biology, Other
26.9999	Biological and Biomedical Sciences, Other
27.0101	Mathematics, General
27.0102	Algebra and Number Theory
27.0103	Analysis and Functional Analysis
27.0104	Geometry/Geometric Analysis
27.0105	Topology and Foundations
27.0301	Applied Mathematics
27.0303	Computational Mathematics
27.0399	Applied Mathematics, Other
27.0501	Statistics, General
27.9999	Mathematics and Statistics, Other
30.0101	Biological and Physical Sciences
30.0801	Mathematics and Computer Science
30.1001	Biopsychology
30.1501	Science, Technology and Society
30.1801	Natural Sciences
30.1901	Nutrition Sciences
30.2401	Neuroscience
38.0102	Logic
40.0101	Physical Sciences
40.0201	Astronomy
40.0202	Astrophysics
40.0203	Planetary Astronomy and Science
40.0401	Atmospheric Sciences and Meteorology, General
40.0402	Atmospheric Chemistry and Climatology
40.0403	Atmospheric Physics and Dynamics
40.0404	Meteorology
40.0499	Atmospheric Sciences and Meteorology, Other
40.0501	Chemistry, General
40.0502	Analytical Chemistry
40.0503	Inorganic Chemistry
40.0504	Organic Chemistry
40.0506	Physical and Theoretical Chemistry
40.0507	Polymer Chemistry
40.0508	Chemical Physics





40.0599	Chemistry, Other
40.0601	Geology/Earth Science, General
40.0602	Geochemistry
40.0603	Geophysics and Seismology
40.0604	Paleontology
40.0605	Hydrology and Water Resources Science
40.0606	Geochemistry and Petrology
40.0607	Oceanography, Chemical and Physical
40.0699	Geological and Earth Sciences/Geosciences, Other
40.0801	Physics, General
40.0802	Atomic/Molecular Physics
40.0804	Elementary Particle Physics
40.0805	Plasma and High-Temperature Physics
40.0806	Nuclear Physics
40.0807	Optics/Optical Sciences
40.0808	Solid State and Low-Temperature Physics
40.0809	Acoustics
40.0810	Theoretical and Mathematical Physics
40.0899	Physics, Other
40.9999	Physical Sciences, Other

Biomedical Engineers

CIP Code	CIP Title
14.0501	Biomedical/Medical Engineering

Chemical Engineers

CIP Code	CIP Title
14.0701	Chemical Engineering





Biochemists and Biophysicists

CIP Code	CIP Title
01.1202	Soil Chemistry and Physics
01.1203	Soil Microbiology
26.0202	Biochemistry
26.0203	Biophysics
26.0205	Molecular Biochemistry
26.0206	Molecular Biophysics
26.0210	Biochemistry/Biophysics and Molecular Biology
26.0499	Cell/Cellular Biology and Anatomical Sciences, Other

Microbiologists

CIP Code	CIP Title
01.1203	Soil Microbiology
26.0207	Structural Biology
26.0210	Biochemistry/Biophysics and Molecular Biology
26.0405	Neuroanatomy
26.0499	Cell/Cellular Biology and Anatomical Sciences, Other
26.0502	Microbiology, General

Medical Scientists, Except Epidemiologists

CIP Code	CIP Title
26.0102	Biomedical Sciences, General
26.0202	Biochemistry
26.0203	Biophysics
26.0204	Molecular Biology
26.0401	Cell/Cellular Biology and Histology
26.0403	Anatomy
26.0503	Medical Microbiology and Bacteriology
26.0507	Immunology
26.0806	Human/Medical Genetics
26.0901	Physiology, General
26.0902	Molecular Physiology
26.0903	Cell Physiology
26.0904	Endocrinology





Medical Scientists, Except Epidemiologists (cont'd)

CIP Code	CIP Title
26.0905	Reproductive Biology
26.0906	Neurobiology and Neurophysiology
26.0907	Cardiovascular Science
26.0908	Exercise Physiology
26.0909	Vision Science/Physiological Optics
26.0910	Pathology/Experimental Pathology
26.0911	Oncology and Cancer Biology
26.0999	Physiology, Pathology and Related Sciences, Other
26.1001	Pharmacology
26.1002	Molecular Pharmacology
26.1003	Neuropharmacology
26.1004	Toxicology
26.1005	Molecular Toxicology
26.1006	Environmental Toxicology
26.1007	Pharmacology and Toxicology
26.1099	Pharmacology and Toxicology, Other
26.1102	Biostatistics
26.1309	Epidemiology
51.1401	Medical Scientist (MS, PhD)

Chemists

CIP Code	CIP Title
40.0501	Chemistry, General
40.0502	Analytical Chemistry
40.0503	Inorganic Chemistry
40.0504	Organic Chemistry
40.0506	Physical and Theoretical Chemistry
40.0507	Polymer Chemistry
40.0508	Chemical Physics
40.0599	Chemistry, Other





Biological Technicians

CIP Code	CIP Title
41.0101	Biology Technician/Biotechnology Laboratory Technician

Medical and Clinical Laboratory Technologists

CIP Code	CIP Title
51.1002	Cytotechnology/Cytotechnologist
51.1005	Clinical Laboratory Science/Medical Technology/Technologist
51.1007	Histologic Technology/Histotechnologist
51.1010	Cytogenetics/Genetics/Clinical Genetics Technology/Technologist
51.1011	Renal/Dialysis Technologist/Technician
51.1099	Clinical/Medical Laboratory Science & Allied Professions, Other

Medical and Clinical Laboratory Technicians

CIP Code	CIP Title
51.0802	Clinical/Medical Laboratory Assistant
51.1001	Blood Bank Technology Specialist
51.1003	Hematology Technology/Technician
51.1004	Clinical/Medical Laboratory Technician
51.1008	Histologic Technician

Sales Representatives, Wholesale and Manufacturing, Technical and Scientific Products

CIP Code	CIP Title
52.1804	Selling Skills and Sales Operations
52.9999	Business, Management, Marketing, & Related Support Services, Other





Tier 9 – Management Competencies

This tier includes competencies that are specific to supervisory and managerial occupations within this industry. These competencies are:

- Manpower Planning
- Delegating
- Managing Work Flow
- Entrepreneurship
- Leadership
- Developing & Monitoring
- Preparing and Managing Budgets
- Team Building
- Developing an Organizational Vision
- Managing Resources

