

## **Budding Virologists – A Series of Lessons for the Instruction in Biotechnology and the Study of Emergent Pathogens in the Standard Biology Public High School Classroom**

Eileen Colon-Linares Roach  
Winter Springs High School  
Winter Springs, FL 32708  
[Eileen\\_Roach@scps.k12.fl.us](mailto:Eileen_Roach@scps.k12.fl.us)

### **Abstract**

In light of the recent scare with swine flu and other emergent pathogens, education in careers in biotechnology and the role of virologists and other researchers in the eradication of this and other pathogens is of utmost importance. Emergent pathogens are a concern for all individuals. This proposal delineates instruction in the field of biotechnology and emergent pathogens in a series of lessons. The purpose of these series of lessons is threefold; first to expose the standard biology students to the nature of science, and possible careers in biotechnology; second to teach the structure and function of viruses, and how advances in the field of biotechnology are used to fight pathogens and improve human health. The third purpose of this proposal is to share information with educators at the high school level to advance content knowledge in biotechnology and emergent pathogens.

After various instructional activities, students will evaluate the impact of biotechnology on the individual, society and the environment, and explain the relationship of pathogenic agents to health. (New Generation Sunshine Standards SC.912.L.16.10, SC.912.L.14.6)

### **Mission Statement**

The development of this module will motivate standard biology students to become interested in the field of biology/biotechnology. Students will discover the relevance of biology and biotechnology to the global community, their community, and individuals. The lessons and activities presented will lead the students to consider a career path in biotechnology, and realize its importance in preventing, treating, and curing diseases caused by emergent pathogens. The principal instructor will articulate with other teachers at the same school and at the middle school level.

### **Plan of Action/Description and Expected Outcomes of Teaching Modules**

As my biology students begin the school year, they will explore, discover and discuss the nature of science, the nature of biology, and the career opportunities in the field. The students will explore careers in biotechnology by accessing the following websites, which give details about various jobs and their descriptions. [http://www.accessexcellence.org/RC/CC/bio\\_career\\_1.php](http://www.accessexcellence.org/RC/CC/bio_career_1.php) [http://www.accessexcellence.org/RC/CC/bio\\_career\\_2.php](http://www.accessexcellence.org/RC/CC/bio_career_2.php). Students will each assume the role of a technician in a particular field of biotechnology, and report to the class without revealing what their job is, and have the class identify which career they are representing. After students learn about the various career opportunities in the field of biotechnology, they will learn about

the importance of measuring, being accurate when measuring, following directions, and having quality control of a product produced in the lab. At this point, students will make cheese by using chymozine, an enzyme that denatures the protein in milk. In order to do this, kits will be purchased from Wards Natural Science.

When students get to the appropriate place in their studies of biology, after they have learned genetics, DNA, natural selection, evolution, and classification, they will start their formal study of viruses. This study will require the students to identify the parts of a virus structure, explain the cycles of viral infection, research a disease caused by a particular viral pathogen, report on its transmission mode, symptoms of the disease, recent outbreaks, and treatments. At this point they will be introduced to the use of bioinformatics databases to discover the DNA/RNA genome of the particular virus or bacteria that causes the disease that the student is researching. The student will design epidemiology maps to illustrate the most recent outbreaks recorded. The principal instructor will conduct a series of lessons on the uses of genetic engineering to create vaccines and other medicines to fight pathogens. Students will identify a mystery pathogen by conducting a Blast search using a bioinformatics database, and perform a tomato spotted wilt virus (TSWV) assay to determine whether a particular plant is infected with the virus. In order to perform the TSWV assay, a kit from Agdia products will be purchased with moneys obtained through this grant. After the plants are identified as infected or non infected with the TSWV, the genome of infected plants will be compared to a plant which has been genetically altered to be resistant to the TSWV. To complete the comparison of both types of plants, the students will extract viral DNA/RNA from plants suspected of being contaminated with the tomato spotted wilt virus. The DNA/RNA will be amplified using polymerase chain reaction technique and a machine (thermocycler) borrowed from the ICORE department of the University of Florida. The plant's DNA/RNA will be separated by using gel electrophoresis and compared to a known sequence of tomato DNA/RNA. Students will keep data by producing film records which will be shared with teachers in the same school and in middle schools in the same district area.

### **Indication of expertise of the Principal Instructor**

Eileen Colon-Linares Roach has a B.S. in biology and an M.A. in exceptional education. She has been a teacher in the private and public schools in the Central Florida area since 1977. Eileen has taught at the elementary, middle and high school levels. For the last 7 years she has taught biology to students in the exceptional education program, standard and honors levels. She has received the Purple and Gold Award at Winter Springs High School for her work in teaching biology to students with learning disabilities. She strives to bring a program that is rich in content and in experiential opportunities for all her students. She actively collaborates with other teachers in her department and has served as mentor to new teachers and interns in science education from the University of Central Florida.

### **Literature cited**

Arthyr, Michael B. (1996). **Examining contemporary careers: A call for interdisciplinary**

**inquiry.** Human Relations. Vol.61, p 163

Irani, Traci, Sinclair, Jana, and O'malley, Michelle (2002). The Importance of Being Accountable: The Relationship between Perceptions of Accountability, Knowledge, and Attitude toward Plant Genetic Engineering. Science Communication vol 23, p. 225

Sousa, David A. (1996) **Are We Teaching High School Science Backward?** NASSP Bulletin, vol 80, p.9

Tang, Jin-Ling, (2009) **Review Paper: Epidemiology, Evidence-Based Medicine, and Public Health**, Journal of Public Health, Vol. 21, No. 3,

Tate , Malancharuvil-Berkes , William M, Elizabeth (2006).A CONTRACT FOR EXCELLENCE IN SCIENTIFIC EDUCATION MAY I HAVE . *St.Louis Journal of Teacher Education*, Vol. 57, No. 3

### **Estimated Budget and Budget Justifications**

Though I have made yogurt in my class-- the old fashioned way, using a "starter" of Lactobacillus acidophilus from the Dannon yogurt-- having cheese making kits that use an enzyme to denature the protein in milk is a preferred method to introduce the students into the field of careers in biotechnology, and using the scientific method. Each kit is sold by Wards' Science for 29.95 and is good for 30 students. If I divide the students in groups of 4 at a station, I will need 2 kits for 180 students.

The spotted wilt virus activity requires specific strips to detect the virus and specific "bags" to process the plants to detect the presence of the virus. These kits are sold for \$100.00 each and are good for 25 students. If I divide the students in groups of 5 per station, I will need 2 kits for 180 students.

- **Cheese making kits 2 each 29.95 Ward's**  
<http://wardsci.com/product.asp?pn=IG0012270>
- **Tomato spotted wilt virus immuno strips—2 sets= 210\$**  
[https://orders.agdia.com/InventoryD.asp?loc=IN&collection=ISK%2039300&attribute\\_Size=25](https://orders.agdia.com/InventoryD.asp?loc=IN&collection=ISK%2039300&attribute_Size=25)

Total-- for both kits 270.00\*\*\*\* Principal instructor will secure funds for the difference between the grant money and actual cost of materials needed to implement this proposal

### **Biotech Job Descriptions - Part 1**

BIO. "Biotechnology: The Choice for Your Future. A Resource Guide." Washington, D.C.: Biotechnology Industry Organization.

## **Research & Development**

### **Glasswasher**

A glasswasher is responsible for washing and drying glassware and distributing it to appropriate locations within the laboratories. He or she maintains the glass-washing facility, keeping it clean and swept, and picks up dirty glassware. He or she may sterilize glassware and other items using an autoclave. A glasswasher performs routine maintenance of glass-washing equipment and performs other related duties as required. A glasswasher position requires a high school diploma or equivalent and a minimum of 0 to 2 years' laboratory experience.

### **Laboratory Assistant**

Laboratory assistants are responsible for performing a wide variety of research laboratory tasks and experiments, making detailed observations, analyzing data, and interpreting results. He or she maintains laboratory equipment and inventory levels for laboratory supplies. He or she may also write reports, summaries, and protocols regarding experiments. A laboratory assistant also performs limited troubleshooting and calibration of instruments. An entry-level laboratory assistant position requires at minimum an associate degree in a science and 0 to 2 years' laboratory experience.

### **Research Associate**

A research associate is responsible for research and development in collaboration with others on projects. He or she makes detailed observations, analyzes data, and interprets results. Research associates prepare technical reports, summaries, protocols, and quantitative analyses. An incumbent maintains familiarity with current scientific literature and contributes to the process of a project within his or her scientific discipline, as well as investigating, creating, and developing new methods and technologies for project advancement. He or she may also be responsible for identifying patentable inventions and acting as principal investigator in conducting his or her own experiments. A research associate may also be asked to participate in scientific conferences and contribute to scientific journals.

### **Research Assistant**

The job description for a research assistant is similar to that of a research associate. At the entry level, the job can require a bachelor of science or advanced degree in a scientific discipline or equivalent, with little or no related experience.

### **Postdoctoral Fellow**

The postdoctoral fellow, with a Ph.D. but little or no job experience, joins the staff for a maximum of two to three years to gain necessary experience before moving onto a more senior scientist position.

### **Media Prep Technician**

A media prep technician is responsible for media preparation in the research and development area. He or she performs experiments as required and outlined, and develops and maintains record keeping for procedures and experiments performed. A media prep technician entry-level

position requires at minimum an associate degree in science and 0 to 2 years' related experience and/or completion of a company's on-the-job training program.

### **Greenhouse Assistant**

A greenhouse assistant performs a variety of greenhouse research tasks and experiments. He or she may be required to make detailed observations, detecting horticultural or pest problems, and instituting corrective action. Greenhouse assistants determine optimal cultural requirements and perform tasks related to disease and pest prevention; they often are required to collect, record, and analyze data, as well as interpret results. In addition, a greenhouse assistant may be called upon to perform troubleshooting and equipment maintenance. An entry-level greenhouse assistant position requires a high school diploma, an associate degree or equivalent, and a minimum of 0 to 2 years' relevant greenhouse/ plant experience.

### **Plant Breeder**

A plant breeder is responsible for the design, development, execution, and implementation of plant breeding research projects in collaboration with a larger research team. He or she may be responsible for project planning and personnel management within the project. Plant breeders may use exotic germ plasm and work with various mating systems and integrate them with biotechnology as needed to enhance selection methods and accelerate product development.

A plant breeder's diverse responsibilities can include making contributions to and developing good public relations with scientific and other professional communities. He or she may also act as an adviser to company management about long-range goals for a plant breeding department. He or she may participate in the development of patents or proposals and assist with the management and development of a plant breeding group.

A plant breeder entry-level position requires a bachelor of science degree or equivalent. A minimum of 0 to 2 years of plant breeding or agronomical experience and/or training in plant breeding or plant science is also required.

### **Quality Control**

#### **Quality Control Analyst**

A quality control analyst is responsible for conducting routine and nonroutine analysis of raw materials. He or she compiles data for documentation of test procedures and reports abnormalities. A quality control analyst also reviews data obtained for compliance with specifications and reports abnormalities. He or she revises and updates standard operating procedures and may perform special projects on analytical and instrument problem solving. An entry-level quality control analyst's position requires a bachelor of science degree in a scientific discipline or equivalent and a minimum of 0 to 2 years' experience in quality control systems.

#### **Quality Control Engineer**

A quality control engineer is responsible for developing, applying, revising, and maintaining quality standards for processing materials into partially finished or finished products. He or she designs and implements methods and procedures for inspecting, testing, and evaluating the precision and accuracy of products and prepares documentation for inspection testing procedures. Depending on the job level, a quality control engineer is responsible for ensuring conformance to in-house specifications and good manufacturing practices and may conduct training programs. He or she may also be responsible for and supervise the development and efforts of a quality control engineering group. The entry-level job requires a bachelor of science degree or equivalent and a minimum of 0 to 2 years' experience in quality control systems.

### **Environmental Health and Safety Specialist**

An environmental health and safety specialist is responsible for developing, implementing, and monitoring industrial safety programs within the company. He or she inspects plant areas to ensure compliance with Occupational Safety and Health Administration (OSHA) regulations. He or she evaluates new equipment and raw materials for safety, and monitors employee exposure to chemicals and other toxic substances. A safety specialist, depending on the job level, may also conduct training programs in hazardous waste collection, disposal, and radiation safety regulations. An entry-level safety specialist job requires a bachelor of science degree or equivalent and a minimum of 0 to 2 years' related experience.

### **Quality Assurance Auditor**

A quality assurance auditor is responsible for performing audits of production and quality control. He or she ensures compliance to in-house specifications, standards, and good manufacturing practices. The job requires a bachelor of science degree in a scientific discipline or equivalent and a minimum of 0 to 2 years' experience in biological or pharmaceutical manufacturing.

### **Validation Engineer**

A validation engineer is responsible for the calibration and validation of equipment and systems and for assisting in the selection, specification, and negotiation of competitive pricing of equipment. He or she maintains all of the documentation pertaining to qualification and validation and serves as an information resource for validation technicians, contractors, and vendors.

At the entry-level, the job requires a bachelor of science degree or equivalent, with 0 to 2 years' related experience.

### **Validation Technician**

An entry-level validation technician would be responsible for developing, preparing the installation of, and revising test validation procedures/protocols to ensure that a product is manufactured in accordance with appropriate regulatory agency validation requirements, internal company standards, and current industry practices. A validation technician compiles and analyzes validation data, prepares reports, and makes recommendations for changes and/or improvements. He or she may also investigate and troubleshoot problems and determine solutions. He or she maintains appropriate validation documentation and files. An entry-level

validation technician requires a high school diploma or equivalent and a minimum of 0 to 2 years' related experience.

## **Clinical Research**

### **Clinical Research Administrator**

A clinical research administrator is responsible for clinical data entry and validation to ensure legibility, completeness, and consistency of data. He or she assists users with requests for clinical documents and is responsible for working with physicians and/or their staff to clarify any questionable information. He or she may be responsible for auditing internal patient files and studies and for assisting with the development and evaluation of clinical record documents. A clinical research administrator, at the entry level, typically develops internal record keeping system(s), including maintaining and auditing data and providing status and activity reports as required. The job requires a high school diploma or equivalent, with a minimum of 0 to 2 years' related experience.

### **Clinical Coordinator**

A clinical coordinator must be familiar with the scientific/investigative process. Expertise may be limited to a specific functional area. A clinical coordinator must have good communications skills, both written and oral. He or she must also have project team experience and a familiarity with standard computer applications. Responsibilities include coordinating the clinical development plan as outlined by the company or Clinical Department, defining objectives, strategy, and studies. The clinical coordinator must provide support for planning, including detailed effort estimates, scheduling, and critical path analysis. He or she must monitor clinical activities to identify issues, variances, and conflicts, and analyze and recommend solutions. The clinical coordinator is responsible for project staffing requirements and tracking drug supply to outside vendors, as well as providing ongoing, objective updates on progress and problems with projects, tracking and following up on action items. The position requires a bachelor of science or a bachelor of arts degree in Health Science, Information Technology, or Business and 3-5 years of experience in the health care industry.

### **Clinical Programmer**

A beginning clinical programmer is responsible for coordinating and monitoring the flow of clinical data into the computer database. He or she analyzes and evaluates clinical data, recognizes inconsistencies, and initiates the resolution of data problems. He or she implements data management plans designed to meet project and protocol deadlines, and consults in the design and development of clinical trials, protocols, and case report forms. A clinical programmer also acts as liaison between clinical management and subcommittees and project teams on an as-needed basis. An entry-level position as a clinical programmer requires a bachelor of science degree or equivalent, although a master of science degree is often preferred. A minimum of 0 to 2 years' experience in pharmaceutical programming in the clinical research area is also required.

**Biostatistician**

A biostatistician works with others to define and perform analyses of databases for publications, presentations to investigator meetings, and for meetings of professional societies. A position as a biostatistician requires at least a master's degree in biostatistics and 1 to 4 years' related experience.

**Clinical Data Specialist**

A clinical data specialist is responsible for collaborating with various departments on the design, documentation, testing and, implementation of clinical data studies. He or she develops systems for organizing data to analyze, identify, and report trends. A clinical data specialist also analyzes the interrelationships data and defines logical aspects of data sets. A starting position as a clinical data specialist requires a bachelor of science degree or equivalent and a minimum of 0 to 2 years' related experience.

**Drug Experience Coordinator**

The major responsibility of a drug experience coordinator is to handle the drug experience activities for marketed products. The candidate will also provide drug information on the products. He or she will oversee day-to-day processing of adverse event information for marketed products and will coordinate the receipt, classification, investigation, and processing of adverse experience reports. A position as a drug experience coordinator requires a Pharm D or equivalent clinical training and 0 to 2 years' related experience.

**Clinical Research Associate**

A clinical research associate is responsible for the design, planning, implementation, and overall direction of clinical research projects. He or she evaluates and analyzes clinical data and coordinates activities of associates to ensure compliance with protocol and overall clinical objectives. He or she may also travel to field sites to supervise and coordinate clinical studies. An entry-level clinical research associate position typically requires a bachelor of science, a registered nurse degree or equivalent, and a minimum of 0 to 2 years' clinical experience in medical research, nursing, or the pharmaceutical industry. Knowledge of FDA regulatory requirements is also preferred.

**Animal Handler**

An animal handler is responsible for the daily care of research animals for experimental purposes. He or she cleans animal cages and racks, maintains records to comply with regulatory requirements and standard operating procedures, and performs preventive maintenance on facility equipment. The incumbent may also perform animal observation, grooming, and minor clinical tasks. An animal handler position requires a high school diploma or equivalent experience with a scientific background. A minimum of 0 to 2 years' relevant laboratory experience is also expected.

**Animal Technician**

Animal technicians are responsible for the daily care of research animals for experimental purposes. They also coordinate with vendors and supervisors on operational, administrative, and technical responsibilities. They perform some surgery and postoperative care as directed



and are responsible for overseeing procurement of animals and supplies, preventive maintenance of facility equipment, cleaning of animal cages and racks, daily rounds, and observation to check animal health status. They develop standard operating procedures and maintain records to comply with regulatory requirements. An entry-level animal technician job requires a high school diploma or equivalent experience with a scientific background and a minimum of 0 to 2 years' related laboratory experience.

### **Technical Writer**

An entry-level technical writer is responsible for writing and editing standard operating procedures, clinical study protocols, laboratory procedure manuals, and other related documents. He or she edits and/or rewrites various sources of information into a uniform style and language for regulatory compliance, and assists in developing documentation for instructional, descriptive, reference, and/or informational purposes. An entry-level position requires a bachelor of science degree or equivalent and a minimum of 0 to 2 years of experience in writing technical documentation.

## **Biotech Job Descriptions - Part 2**

*BIO. "Biotechnology: The Choice for Your Future. A Resource Guide." Washington, D.C.: Biotechnology Industry Organization.*

### **Manufacturing and Production**

#### **Product Development Engineer**

A product development engineer, at the entry level, is responsible for the design, development, modifications to, and enhancements of existing products and processes. The position is involved in new product scale-up, process optimization, technology transfer, and process validation. He or she ensures that processes and design implementations are consistent with good labor and manufacturing practices. A product development engineer may also be responsible for contact with outside vendors and for the administration of contracts to accomplish goals. A product development engineer works on problems of moderate scope,

where analysis of a situation or data requires a review of identifiable factors. The job requires a bachelor of science degree or equivalent and 0 to 2 years' related experience.

### **Production Planner Scheduler**

A production planner scheduler is responsible for planning, scheduling, and coordinating the final approval of products through the production cycle. He or she coordinates production plans to ensure that materials are provided according to schedules to maintain production and provides input to management. When necessary, a production planner scheduler works with the Customer Service, Marketing, Production, Quality Control, and Sales departments to review back order status, prioritize production orders, and deal with other potential schedule interruptions or rescheduling. An entry-level production planner scheduler requires a bachelor's degree or equivalent and a minimum of 0 to 2 years' related experience.

### **Manufacturing Technician**

Manufacturing technicians are responsible for the manufacture and packaging of potential and existing products. They operate and maintain small production equipment; weigh, measure, and check raw materials, and ensure that manufactured batches contain the proper ingredients and quantities. They maintain records and clean production areas to comply with regulatory requirements, good manufacturing practices, and standard operating procedures. A manufacturing technician may also assist with in-process testing to make sure that batches meet product specifications. An entry-level position requires an associate degree in science and a minimum of 0 to 2 years' related experience in a manufacturing environment.

### **Packaging Operator**

A packaging operator uses manual and/or automated packaging systems to label, inspect, and package final container products. He or she also enters data and imprints computer-generated labels, maintains records, and maintains the manufacturing/ production area to comply with regulatory requirements, good manufacturing practices, and standard operating procedures. A packaging operator may also perform initial checks of completed documents for completeness and accuracy. The position requires a high school diploma or equivalent and a minimum of 0 to 2 years' experience in a manufacturing environment.

### **Manufacturing Research Associate**

A manufacturing research associate is responsible for the implementation of production procedures to optimize manufacturing processes and regulatory requirements, and has responsibilities in packaging and distribution processes. He or she may also help maintain production equipment. The position requires a bachelor of science degree in a scientific discipline or equivalent and a minimum of 0 to 2 years' experience in a manufacturing environment.

### **Instrument / Calibration Technician**

An entry-level instrument/calibration technician is responsible for performing maintenance, testing, troubleshooting, calibration, and repair on a variety of circuits, components, analytical equipment, and instrumentation. He or she also calibrates instrumentation, performs validation studies, and specifies and requests purchase of components. He or she analyzes results, may

develop test specifications and electrical schematics, and maintains logs and required documentation. An instrument/calibration technician also maintains spare parts inventories and may prepare technical reports with recommendations for solutions to technical problems. An associate degree in electronics technology or equivalent is required, as is a minimum of 0 to 2 years' related experience.

### **Biochemical Development Engineer**

A biochemical development engineer is responsible for the design and scale-up of processes, instruments, and equipment from the laboratory through the pilot plant and manufacturing process. He or she assists the manufacturing operations in problem solving with regards to equipment and systems and participates in the design and start-up of new manufacturing facilities and equipment. He or she develops and recommends new process formulas and technologies to achieve cost effectiveness and product quality. A biochemical development engineer also establishes operating equipment specifications and improves manufacturing techniques. A biochemical development engineer is involved in new product scale-up, process improvement, technology transfer, and process-validation activities. He or she works with various departments to ensure that processes and designs are compatible for new product technology transfer and to establish future process and equipment automation technology. The position requires a bachelor of science degree in biological, chemical, or pharmaceutical engineering, or a related discipline. A minimum of 0 to 2 years' experience is also required, preferably in the areas of pharmaceutical processes or research product development.

### **Process Development Associate**

A process development associate is responsible for the implementation of production procedures to optimize manufacturing processes and regulatory requirements. He or she may also assist in process development, in creating scalable processes with improved product yield and reduced manufacturing systems costs. A process development associate, at the entry level, may also be involved in packaging and distribution processes and in the maintenance of production equipment. He or she may research and implement new methods and technologies to enhance operations. The position requires a bachelor of science degree in a scientific discipline or equivalent and a minimum of 0 to 2 years' experience.

### **Assay Analyst**

An assay analyst is responsible for doing cell cultures and performing assays and tests on tissue and cell cultures following standard protocols. He or she prepares glassware, reagents and media for cell culture use. He or she also performs, prepares and maintains tissues and cell cultures and maintains records required by good manufacturing procedures. An assay analyst also participates in the modification of assay procedures for routine implementation. The position requires a high school diploma or equivalent and a minimum of 0 to 2 years' related experience.

### **Manufacturing Engineer**

A manufacturing engineer is responsible for developing, implementing, and maintaining methods, operation sequences, and processes in manufacturing. He or she works with the engineering department to coordinate the release of new products. He or she estimates

manufacturing costs, determines time standards, and makes recommendations for process requirements of new or existing product lines. As required, a manufacturing engineer also maintains records and reporting systems for the coordination of manufacturing operations. An entry-level job as a manufacturing engineer requires a bachelor of science degree in a scientific discipline or equivalent and a minimum of 0 to 2 years of related experience, preferably in research product development or a manufacturing environment.

## **Regulatory Affairs**

### **Regulatory Affairs Specialists**

A regulatory affairs specialist, at the entry level, coordinates and prepares document packages for submission to regulatory agencies, internal audits, and inspections. He or she compiles all material required for submissions, license renewals, and annual registrations. An incumbent monitors and improves tracking and control systems and keeps abreast of regulatory procedures and changes. He or she may work with regulatory agencies and recommend strategies for earliest possible approvals of clinical trial applications. An entry-level position requires a bachelor of science degree or equivalent and a minimum of 0 to 2 years' related experience.

### **Documentation Coordinator**

A documentation coordinator provides clerical and administrative support related to a company's documentation system requirements. He or she audits all documentation manuals to ensure that they are accurate and up-to-date and available to appropriate personnel. A documentation coordinator also files and retrieves all master documents. The position requires a high school diploma or equivalent and a minimum of 0 to 2 years' related experience.

### **Documentation Specialist**

An entry-level documentation specialist is responsible for coordinating all activities related to providing required documentation and implementing related documentation systems. He or she coordinates the review and revision of procedures, specifications, and forms. He or she also assists in compiling regulatory filing documents and in maintaining computerized files to support all documentation systems. The job requires a bachelor of science degree in a related field or equivalent and a minimum of 0 to 2 years' experience in documentation, quality assurance, technical writing or the equivalent.

## **Information Systems**

### **Library Assistant**

A library assistant maintains serial control, and locates and orders journal articles and/or books

that are unavailable at local libraries on relevant subjects. He or she performs special data-gathering projects as requested, and is responsible for on-line computer searching of scientific databases. The position of entry-level library assistant requires an associate degree or equivalent and a minimum of 0 to 2 years' relevant library experience or the completion of an on-the-job training program.

### **Scientific Programmer Analyst**

Scientific programmer analysts design, develop, evaluate, and modify computer programs for the solution of scientific or engineering problems and for the support of research and development efforts. He or she analyzes existing systems and formulates logic for new systems. A scientific program analyst also devises logical procedures, prepares flow charts, performs coding, tests, and debugs programs. He or she provides input for the documentation of new or existing programs, and determines system specifications, input/output processes, and working parameters for hardware/software compatibility. An analyst also contributes to decisions on policies, procedures, expansion strategies, and product evaluations.

An entry-level scientific programmer analyst position requires a bachelor of science degree in a related discipline or equivalent and a minimum of 0 to 2 years' experience.

## **Marketing & Sales**

### **Market Research Analyst**

A market research analyst is responsible for researching and analyzing the company's markets, competition, and product mix. He or she performs literature research, analyzes and summarizes data, and makes presentations on new market and technical areas. He or she also analyzes the competitive environment, as well as future marketing trends, and makes appropriate recommendations. He or she conducts market surveys, summarizes results, and assists in the preparation, presentation, and follow-up of research proposals. An entry-level position as a market research analyst requires a bachelor's degree or equivalent and a minimum of 0 to 2 years of experience in market research, competitive analysis, and product planning, as well as excellent writing skills.

### **Systems Analyst**

A systems analyst is responsible for system level software and for maintenance of the operating system(s), various layered products, system tuning, and various levels of user assistance. The systems analyst is responsible for the operation of all system software, performing upgrades, and maintaining related system and user documentation. He or she assists in the implementation of system validation and documentation, in system capacity planning, and system configuration. In addition, the systems analyst trouble shoots system-related problems and interacts with vendors. An entry-level position as a systems analyst requires a degree in data processing and a minimum of 0 to 2 years of experience.

### **Sales Representative**

A sales representative is responsible for direct sales of company products or services. He or

she calls on prospective customers, provides product information and/or demonstrations, and quotes appropriate customer prices. A sales representative is also responsible for new account development and growth of existing accounts within an established geographic territory. A sales representative must meet assigned sales quotas and may handle key company accounts or act as an account manager for national or major accounts. Depending on the level of the position, an experienced incumbent may also assist in the training of other sales representatives. An entry-level sales representative position requires a bachelor's degree or equivalent, and a minimum of 0 to 2 years of related sales experience and some knowledge of the company's products.

### **Customer Service Representative**

Customer service representatives are responsible for ensuring product delivery in accordance with customer requirements and manufacturing capabilities and for responding to customer product inquiries and satisfaction issues. He or she answers telephones, takes product orders, and inputs sales order data into consumer data systems. He or she also investigates problems related to the shipment of products, credits, and new orders. He or she may also be responsible for sale order administration and/or inside sales. The entry-level position requires a college education or equivalent, with preference toward a bachelor of science degree in a technical or scientific field. A minimum of 0 to 2 years' related experience in diagnosing and troubleshooting products in the pharmaceutical industry may also be required.

### **Technical Services Representative**

A technical services representative provides technical direction and support to customers on the operation and maintenance of company products. He or she also serves as a contact for customers on technical and service-related problems. A technical services representative also demonstrates uses and advantages of products. An entry-level technical services representative position requires an associate's degree or equivalent and a minimum of 0 to 2 years of experience.

## **Administration**

### **Technical Recruiter**

A technical recruiter is responsible for recruiting, interviewing, and screening applicants for technical exempt and nonexempt positions. He or she coordinates preemployment physicals, travel, reporting dates, security clearances, and employment processing for new hires. He or she also conducts employee advertising and reviews employment agency placements. In addition, a technical recruiter maintains college recruiting, affirmative action, and career development programs. An entry-level position as a technical recruiter requires a bachelor of science degree or equivalent and a minimum of 0 to 2 years' experience.

### **Human Resources Representative**

A representative in human resources is responsible for a variety of activities in personnel administration, including employment, compensation and benefits, employee relations, equal employment opportunity, and training programs. He or she conducts job interviews, counsels employees, maintains records, and conducts research and analyzes data on assigned projects. An entry-level position as a human resources representative requires a bachelor of science degree or equivalent and a minimum of 0 to 2 years' related experience.

### **Buyer**

A buyer is responsible for obtaining materials, scientific equipment, and services. He or she checks requisitions, obtains price quotations, examines bids, and awards contracts. A buyer develops new supply sources where vendors and suppliers are inadequate. He or she coordinates purchasing activities with other departments to maintain inventory at planned levels. As required, a buyer also monitors the cost, schedule, and scope of assigned subcontracts to ensure the quality and value of the contract. An entry-level buyer position requires a bachelor of science degree in a scientific discipline or equivalent and a minimum of 0 to 2 years' experience in purchasing, preferably in a scientific area.

### **Patent Administrator**

A patent administrator is responsible for preparing and coordinating all procedural documentation for patent filings and applications. He or she tracks in-house research studies and recommends the need for and timing of patent filings. A patent administrator also assists attorneys with the drafting and editing of patent applications and collects and evaluates supporting data. This position requires the maintenance of a tracking system to comply with trademark regulations. He or she may also be called upon to assist with determining the necessity and approach to contracts to ensure protection of the company's proprietary technology. A patent administrator is also typically responsible for tracking and paying legal fees. An entry-level patent administrator position requires a bachelor of science degree or equivalent and a minimum of 0 to 2 years' experience.

### **Patent Agent**

A patent agent is responsible for preparing, filing, and processing patent applications for the company. He or she negotiates and drafts patent licenses and other agreements. A patent agent also conducts state-of-the-art searches and may assist with appeal and interference proceedings. A patent agent also performs other duties as required. The entry-level patent agent position requires a bachelor of science degree or equivalent with 0 to 2 years' related experience. It also requires registration to practice before the U.S. Patent and Trademark Office.