BIOPHARMACEUTICAL careers

teacher guide

FOR USE WITH THE FOLLOWING VIDEOS, FOUND AT *ABOUTBIOSCIENCE.ORG*:

process development scientist
process engineer
process technician

DEVELOPED BY

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biogenidec.com/site/
company-foundation.html

september 2009

BIOPHARMACEUTICAL careers

teacher guide overview

Exciting career opportunities exist for students who are interested in working in the biopharmaceutical industry and making a positive contribution to the lives of millions of people who will benefit from the medical advances this industry creates.

This teacher guide is designed to be used in conjunction with the three biopharmaceutical career videos developed by the North Carolina Association for Biomedical Research (NCABR) for *North Carolina's Bioscience Clearinghouse* (**aboutbioscience.org**). Options are offered for middle and high school students.

The videos, and the written career profiles that accompany them, can be found at the following URLs:

Process development scientist
aboutbioscience.org/process_development_scientist.html

Process engineer
aboutbioscience.org/process_engineer.html

Process technician
aboutbioscience.org/process_technician.html

BIOPHARMACEUTICAL careers

activity #1: survey

TYPE: Knowledge and opinion survey

GRADE LEVEL: Middle school and high school

TIME NEEDED: 10 minutes in class

This survey is designed to be administered *before* the students see any videos.

1. Provide one survey per student and ask each student to quickly answer the 10 survey questions.
2. Collect the surveys and store them in a secure file.

At the conclusion of instruction about biopharmaceutical careers, you will hand out a clean set of surveys and have students "retake" the survey.

Then, return to each student his/her original survey and ask each student to compare his/her responses from the first survey to the second.

Discussion questions at the conclusion of this activity may include:

- What have you learned about biopharmaceutical careers?
- Would you consider pursuing a biopharmaceutical career? Why or why not?

Question 10 does not have a "correct" answer. Correct answers to the other questions are as follows:

- Question 1: Agree (3)
- Question 2: Agree (3)
- Question 3: Agree (3)
- Question 4: Agree (3)
- Question 5: Disagree (1)
- Question 6: Disagree (1)
- Question 7: Agree (3)
- Question 8: Disagree (1)
- Question 9: Disagree (1)

BIOPHARMACEUTICAL careers

activity #1: student response sheet

NAME: _____

DATE: _____

Please answer each question as honestly as possible. Your answers will be kept confidential. Use the following scale when selecting your answer:

3 = Agree **2 = Unsure** **1 = Disagree**

_____ 1. Working in the biopharmaceutical industry gives one person the chance to have an impact on many peoples' lives.

_____ 2. In a biopharmaceutical laboratory, it is important to wear special clothing to protect yourself from the potentially harmful cells, enzymes, etc., with which you are working.

_____ 3. Biotechnology involves the development of improvements in medicine *and* agriculture.

_____ 4. Biopharmacuetical jobs can involve architecture and engineering skills.

_____ 5. You must have a bachelor's degree to work in a biopharmaceutical career.

_____ 6. It is important that someone who works in a biopharmaceutical laboratory be able to work better alone than with others.

_____ 7. Precalculus and trigonometry skills are important for working in a biopharmaceutical career.

_____ 8. Many states have more opportunities for biopharmaceutical jobs than North Carolina.

_____ 9. The timeline for the development of a biopharmaceutical product is very short.

_____ 10. I would consider a biopharmaceutical career.

BIOPHARMACEUTICAL careers

activity #2: career poster

TYPE: Poster

GRADE LEVEL: Middle school and high school

TIME NEEDED: 30 minutes in class *or* homework assignment

This activity is designed to help students focus on the various aspects of a biopharmaceutical career.

1. Determine if this will be a classroom activity or a homework assignment.
2. Make sure you have the proper materials for the activity, which might include one poster board per student, as well as ample markers and art materials. If this is to be a homework assignment, make sure students know the expectations for the poster board needed to complete the assignment and allow plenty of time for students to obtain the needed supplies.
3. Explain to students they will be creating a poster to illustrate a biopharmaceutical career.
4. Have students watch each of the three videos (process development scientist, process engineer and process technician) and *take notes* during the videos about the important aspects of each career.
5. After viewing the videos, review important concepts about each career in class. It is best to ask students to share observations and allow them to write down additional ideas about each career.
6. Assign students to select one of the three careers and develop a poster that illustrates the specific career. The poster must include the name of the career (process development scientist, process engineer and process technician) and should include words and pictures that show the tasks, setting and value of the career. Suggest to students they explore the accompanying career profiles at **aboutbioscience.org/bc_title.html** to find information that will help them get even more information. They also can explore the "Day in the Life" section of the *Mapping Your Future: Careers in Biomanufacturing* curriculum manual, which starts on page 55 (**ncabr.org/bioman/exploring_careers_in_biomanufacturing.pdf**).

Use the *Activity #2: Evaluation Rubric*, on page 5, to evaluate each poster, and display the posters around the school or the classroom.

BIOPHARMACEUTICAL careers

activity #2: evaluation rubric

STUDENT NAME: _____

DATE: _____

ITEM EVALUATED	POINTS ALLOCATED				
	SUPERIOR	EXCELLENT	GOOD	FAIR	POOR
Educational value					
a. Learning value of the poster	15	12	9	6	3
b. Interpretation of the career (creativity)	15	12	9	6	3
c. Poster contains accurate information	15	12	9	6	3
d. Information is clear, understandable and spelled correctly	15	12	9	6	3
Quality of work					
e. Imaginative and innovative design	15	12	9	6	3
f. Arrangement is visually appealing	10	8	6	4	2
g. Color and accent are used effectively	5	4	3	2	1
h. Overall appearance is neat and attractive	10	8	6	4	2

Total points (100 possible)

BIOPHARMACEUTICAL careers

activity #3: career chart

TYPE: Web-based research and videos

GRADE LEVEL: High school

TIME NEEDED: 30 minutes in class *or* homework assignment

This activity is designed to help students use the Internet to find information about instructional programs that lead to careers in the biopharmaceutical industry.

Give each student a copy of the chart.

Have the students watch all three videos (process development scientist, process engineer and process technician).

Ask students to fill in the "Tasks" column with information that was shared in the videos.

Have students complete the chart using the Internet. You might suggest to students they explore the accompanying career profiles at **aboutbioscience.org/bc_title.html** to find information. They also can explore the "Day in the Life" section of the *Mapping Your Future: Careers in Biomanufacturing* curriculum manual, which starts on page 55 (**ncabr.org/bioman/exploring_careers_in_biomanufacturing.pdf**).

The purpose of the activity is to reinforce the skills necessary to find information, as well as to identify local and state schools that have biopharmaceutical/biomanufacturing programs. One such school of particular note is North Carolina State University, in Raleigh, whose Biomanufacturing Training and Education Center (**www.btec.ncsu.edu**) is a leading training facility for a wide range of related careers.

BIOPHARMACEUTICAL careers

activity #3: student response sheet

NAME: _____

DATE: _____

CAREER	DESCRIPTION	TASKS	DETAILS	
Process development scientist	Researches and develops ways to manufacture products and monitor existing processes/products for quality and efficiency.		Annual earnings	
			Educational requirements	
			Nearest college	
Process engineer	Designs, specifies and installs equipment and processes in research or biomanufacturing environments.		Annual earnings	
			Educational requirements	
			Nearest college	
Process technician	Performs and documents daily manufacturing operations in biomedical, biopharmaceutical and bioindustrial settings.		Annual earnings	
			Educational requirements	
			Nearest college	

BIOPHARMACEUTICAL careers

activity #4: video review

TYPE: Video review

GRADE LEVEL: Middle school and high school

TIME NEEDED: 20 minutes in class *or* homework assignment

This activity is designed to help students learn about biopharmaceutical careers by watching the three videos (process development scientist, process engineer and process technician) and answering comprehension and application questions based on what they saw.

> **Teacher explanation:** "After watching all three videos, you should be able to come to some conclusions about biopharmaceutical careers. Read and answer the questions in the worksheet." *(Note: page 9 in this guide)*

BIOPHARMACEUTICAL careers

activity #4: student response sheet

NAME: _____

DATE: _____

1. What do the three careers have in common?

CAREER	HOW ARE THEY ALIKE?
Process development scientist (man in blue shirt)	
Process engineer (man in orange and purple shirts)	
Process technician (woman in yellow sweater)	

2. How is each career different from the other two?

CAREER	HOW IS EACH DIFFERENT?
Process development scientist (man in blue shirt)	
Process engineer (man in orange and purple shirts)	
Process technician (woman in yellow sweater)	

3. The process development scientist said his job is very important because he has the ability to impact the health of "literally millions of people." What kind of impact do you think he is talking about?

_____

_____

national health care skill standards

The following standards and accountability criteria are addressed in the videos and in this guide:

3.11 Understand the health care delivery system (public, private, government and nonprofit)

4.11 Classify personal traits or attitudes desirable in a member of the health care team.

4.12 Summarize basic professional standards of health care workers as they apply to hygiene, dress, language, confidentiality and behavior.

4.31 Compare careers within the health science career pathways (diagnostic services, therapeutic services, health informatics, support services or biotechnology research and development).

4.32 Recognize levels of education, credentialing requirements, employment opportunities, workplace environments and career growth potential.

6.21 Apply ethical behaviors in health care.

7.11 Explain principles of infection control.

7.21 Apply personal safety procedures based on OSHA and CDC regulations (including standard precautions).

7.31 Evaluate environment to recognize safe and unsafe working conditions.

8.12 Recognize characteristics of effective teams.

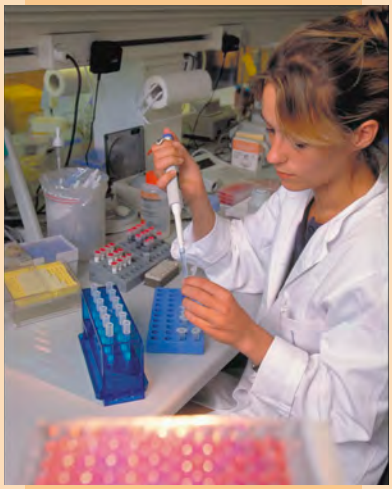
BIOPHARMACEUTICAL careers

career profile: process development scientist

quick facts

Salary range:
$45,000 to $85,000+ per year

Minimum education:
Bachelor's degree



Process development scientists research and develop ways to manufacture products and monitor existing processes and products for quality and efficiency. For example, a process development scientist might be responsible for developing a cell culture process for the manufacture of viruses or proteins that are used in the production of vaccines. Once a new product has been developed and approved for manufacture, a process development scientist finds out how to produce the product on a large scale with standardized protocols. In setting up and supervising initial and ongoing production, a process development scientist always is looking for ways to make improvements in methods and technology by reviewing and interpreting analytical test results and data.

Process development scientists often use sophisticated technology to monitor production and identify faults. They work closely with research scientists, with process engineers and with quality control technicians. Combining extensive knowledge of biotechnology and biomanufacturing, process development scientists also use computer-aided design models to develop manufacturing processes.

As a process development scientist, you must have an investigative and analytical mind and a methodical approach to testing new processes. You will need to be creative and have strong problem-solving skills as well. Good teamwork and motivation skills are essential, as is the ability to write and communicate effectively.

career opportunities

Process development scientists will find jobs available across the manufacturing industry, on products ranging from biopharmaceuticals to foods, fuels and cosmetics.

post-high school education/training

Process development scientists will need at least a four-year Bachelor of Science (B.S.) degree. Advanced degrees such as a Master's or a doctorate often are required as well. Degrees in chemistry or biology will provide solid foundations, while more targeted degrees might include biochemistry, biotechnology, genetics, microbiology, molecular biology and pharmaceutical science.

salary

Process development scientists can expect to earn between $45,000 and $85,000 per year — and perhaps even more — depending on their level of education, number of years' experience, type of industry and geographic location. The average salary is approximately $70,000 per year. Salary information is current as of June 2008.

recommended high school courses

FROM *CAREER PATHWAYS: FOCUS ON BIOTECHNOLOGY*, 2006, NORTH CAROLINA DEPARTMENT OF PUBLIC INSTRUCTION

GRADE 9	GRADE 10	GRADE 11	GRADE 12
English I	English II	English III	English IV
Algebra I *or* Integrated Math I	Geometry *or* Integrated Math II	Algebra II *or* Integrated Math III	Higher-Level Math *(Algebra II prerequisite)*
Earth Science/ Environmental Science	Biology	Science Elective *(Chemistry recommended)*	Science Elective *(Physics or Principles of Technology I & II recommended)*
World History	Civics & Economics	U.S. History	Elective
Health/Physical Education	Second Language	Second Language	Elective *(Second Language recommended)*
Elective	Elective	Advanced Science *or* Mathematics Elective	Advanced Science *or* Mathematics Elective
Elective	Elective	Elective	Elective
CTE Elective	CTE Elective	CTE Elective	CTE Elective

NOTE: Science course sequences may vary by school. All students are encouraged to take any available higher-level mathematics and science courses, beginning in middle school. Courses in business, computers and communications are valuable to develop necessary career skills. Students pursuing a College Tech Prep course of study need four related Career Technical Education (CTE) credits; ask your counselor for your school's guidelines.

▶ go to aboutbioscience.org/process_development_scientist.html to watch the process development scientist video

BIOPHARMACEUTICAL careers

career profile: process engineer

Process engineers design, specify and install equipment and processes in research or biomanufacturing environments. A process engineer might be involved in the design of equipment and processes in a facility that is just being built or might oversee the manufacturing process in a facility that has been operating for many years. Process engineers also may be responsible for maintaining and/or overseeing the maintenance of existing equipment and providing troubleshooting and support to process technicians who are involved in the everyday manufacturing of biomedical and biopharmaceutical products. Process engineers may interact with manufacturing and research technicians and scientists, regulatory agencies, customers, investors, top-level managers and construction foremen and personnel.

In addition to knowledge specific to biotechnology, process engineers need to be competent with visualization and design software. Good communication and project management skills also are imperative. A process engineer could be involved in installing a piece of equipment on the manufacturing floor one day, while the next day he or she might be sitting at a desk researching or designing a new piece of equipment.

quick facts

Salary range:
$45,000 to $85,000+ per year

Minimum education:
Bachelor's degree

career opportunities

Jobs for process engineers are available in biotechnology-based industries, including biopharmaceutical, agricultural, energy and chemical companies. Process engineers also might work in government or academic research environments.

post-high school education/training

Most process engineer positions will require a four-year Bachelor of Science (B.S.) degree. Specific degrees to pursue include biochemical and bioprocess engineering, biomedical engineering or biological and agricultural engineering. In addition, many community colleges offer two-year Associate of Science (A.S.) degrees in pre-engineering that can help students get on the right path toward a career as a process engineer.

During high school, an emphasis on math and science courses is helpful if you would like to pursue a career path as a process engineer.

salary

Entry-level engineering positions usually pay from approximately $45,000 to $50,000 per year, while more experienced engineers can expect to earn between approximately $75,000 and $85,000 per year — and perhaps even more based on educational level, number of years in the field, the type of organization and geographic location. The average salary is approximately $70,000 per year. Salary information is current as of June 2008.

recommended high school courses

FROM *CAREER PATHWAYS: FOCUS ON BIOTECHNOLOGY*, 2006, NORTH CAROLINA DEPARTMENT OF PUBLIC INSTRUCTION

GRADE 9	GRADE 10	GRADE 11	GRADE 12
English I	English II	English III	English IV
Algebra I *or* Integrated Math I	Geometry *or* Integrated Math II	Algebra II *or* Integrated Math III	Higher-Level Math *(Algebra II prerequisite)*
Earth Science/ Environmental Science	Biology	Science Elective *(Chemistry recommended)*	Science Elective *(Physics or Principles of Technology I & II recommended)*
World History	Civics & Economics	U.S. History	Elective
Health/Physical Education	Second Language	Second Language	Elective *(Second Language recommended)*
Elective	Elective	Advanced Science *or* Mathematics Elective	Advanced Science *or* Mathematics Elective
Elective	Elective	Elective	Elective
CTE Elective	CTE Elective	CTE Elective	CTE Elective

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▶ go to aboutbioscience.org/process_engineer.html to watch the process engineer video

BIOPHARMACEUTICAL careers

career profile: process technician

quick facts

Salary range:
$30,000 to $45,000+ per year

Minimum education:
Associate degree

Process technicians perform and document the daily manufacturing operations in biomedical, biopharmaceutical and bioindustrial settings. These individuals operate process equipment "on-the-floor," usually in a sterile or clean-room environment. The environment often has large stainless steel vats with many pipes and control equipment linked together. Because there are many different complex steps in biomedical research and biomanufacturing environments, a process technician must be detail-oriented, alert and thorough.

Sometimes called **manufacturing associates** or **operators**, process technicians need to be proficient with computer and electronic equipment and need to have an understanding of basic biotechnology processing. A process technician might be involved in mixing and measuring chemicals and reagents to synthesize cell cultures, make finished drugs (capsules, tablets, liquids or ointments) or perform purification or formulation of complex products. A process technician also might be involved in cleaning and sterilizing production equipment and glassware or in operating the equipment that packages and labels a finished product.

Process technicians wear personal protective gear, including sterile clothing and masks, to protect both themselves and the products. This position often is part of a 24-hour manufacturing shift schedule; the hours can include 12-hour shifts, three or four days a week. At many facilities, the process technicians may be required to alternate shifts, sometimes working the night shift.

Process technicians are required to follow specific safety guidelines and to work within Food and Drug Administration requirements. Though many of the tasks performed by process technicians are routine, this career carries a great deal of responsibility because of the potential for harm if the product is not made correctly — and because the product batches being created sometimes are valued in the millions of dollars.

career opportunities

Process technicians will find many opportunities at biomedical, biopharmaceutical and biomanufacturing organizations where products such as vaccines, medicines, enzymes and cell cultures are created. Opportunities at agricultural, energy and chemical companies also exist.

post-high school education/training

Process technician positions generally require a two-year Associate in Applied Science (A.A.S.) degree, and many community colleges have created degrees and certificates aimed specifically at readying individuals for process technician work. These degrees or certificates may be named biowork, biotechnology, bioprocess technology or industrial pharmaceutical technology. Another pathway to a career as a process technician is to obtain a four-year Bachelor of Science (B.S.) degree from a college or university in biology, chemistry, biochemistry, microbiology or biopharmaceutical science.

salary

The average starting salary for a process technician is approximately $30,000 per year, while more experienced technicians can expect to earn an average annual salary of approximately $45,000. Some process technicians can earn salaries that are significantly higher, based on increased education and experience. Salary information is current as of June 2008.

recommended high school courses

FROM *CAREER PATHWAYS: FOCUS ON BIOTECHNOLOGY*, 2006, NORTH CAROLINA DEPARTMENT OF PUBLIC INSTRUCTION

GRADE 9	GRADE 10	GRADE 11	GRADE 12
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Health/Physical Education	Elective *(Second Language recommended)*	Elective *(Second Language recommended)*	Elective *(Second Language recommended)*
Elective	Elective	Advanced Science Elective	Advanced Science Elective
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▶ go to aboutbioscience.org/process_technician.html to watch the process technician video