
Amp It Up! Engineering/Technology and Industry Lesson Extension

Teacher Name(s), School and District: Leonina Russo, Danvers High School
Course Name: Biotechnology

Lesson/Unit Name: Work Place Skills

Science or Education Topic(s): Careers in Biotechnology and Engineering

Engineering Technology Industry Related Field/Activity: This lesson includes career exploration, engineering design process and ELA literacy skill development. Specifically students will have the opportunity to develop their competencies in these standard areas:

- CCSS.ELA-Literacy.WHST.11-12.7 - Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
- CCSS.ELA-Literacy.SL.9-10.4- Present information, findings, and supporting evidence clearly, concisely, and logically such that listeners can follow the line of reasoning and the organization, development, substance, and style are appropriate to purpose, audience, and task.

The following standards come from the national Next Generation Science Standards:

- HS-ETS1-1. Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
- HS-ETS1-2. Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
- HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, and reliability, and aesthetics as well as possible social, cultural, and environmental impacts.
- HS-ETS1-4. Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

When Taught: June 2015

Abstract: In 200 words or less, please provide a summary of your objectives, implementation, and the results of your implementation.

1. Students will be asked to research a field of engineering (plastics, chemical, electrical, packaging, Biomedical, devices) and report to others their findings.
2. Students will be given a fictitious scenario and asked to write job descriptions for creating teams of engineers to design a chimerical product.

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Objectives and Assessment: Using the table below, identify at least 3-5 learning objectives (content and/or pedagogical) and describe how each will be assessed.

Objectives <i>By the end of this lesson/unit, the students will be able to:</i>	Assessment <i>How was the objective assessed? List the example of formative or summative assessment.</i>
Identify the various types of engineers that work at Medtronic.	Students will complete a graphic organizer (formative)
Infer which roles each type of engineer plays in the development of a commercial product	Groups will create fictitious job listings for Medtronic. (summative)
Research various types of engineering programs across the country.	Students will complete a graphic organizer (formative)
Present their findings to a small group of their peers	Students will speak to their peers and share their findings. (formative)

Engineering/Technology Link: Please check the appropriate box(es) in question 1. And provide a brief answer to question 2.:

- How did you *introduce* engineering/ technology concepts or the company/industry focus in your course? Check the appropriate box(es) or choose other.
 - X Defined terms (science, engineering, technology)
 - X Described the engineering design process
 - X Engineering design challenge related to industry
 - X Overview of the company
 - X Challenge based on ‘industry specific’ area of focus (manufacturing process, quality control, measurement, development, teamwork etc.)
 - Other: _____
- After introducing the concepts, what did/will the students do to explore and apply the engineering/technology and industry specific concepts? (include information about the actual activity students did, discussions they had, or instructional strategies you used)

Students will be asked to research a field of engineering. They will have to find a school that offers a program in that field and discuss the requirements to finishing a Bachelor’s degree.

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Level of Inquiry: Which of the following best describes the level of inquiry (adapted from Bell 2005) you used for this lesson/unit? Check the appropriate level.

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- X** **Structured inquiry:** Instructor provides question and procedure. Students determine the results based on given procedures.
- Guided inquiry:** Instructor provides question. Students design procedure and determine the results.
- Open inquiry:** Students investigate their own research question. Students design procedures and implement the procedure on their own.

Lesson Extension Plan:

Title/Topic: Who wants to be an ENGINEER?
Time (minutes): 2 class periods and 1 homework assignment.
Company Name and brief Description: Medtronic, Danvers, MA
Overview of the Lesson : Students will learn the various types of engineers that are employed at Medtronic.
Standard(s)/Unit Goal(s) to be addressed in this lesson: <u>HS-ETS1-2</u> - Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering. <u>CCSS.ELA-LITERACY.W.9-10.7</u> Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
Essential Question(s) addressed in this lesson: What types of engineers exist in the work force today?

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Objectives:

1. Identify the various types of engineers that work at Medtronic.
2. Infer what roles each type of engineers plays in the development of a commercial product
3. Research various types of engineering programs across the country.
4. Present their findings to a small group of their peers

Link to Industry:

Students will become aware of the types of programs that exist to train engineers.
Students will become aware of what exactly engineers do for a living.
Students will become aware of the types of engineers that are needed in the manufacturing sector.

What students should know and be able to do before starting this lesson

1. Students should be able to use the Internet and be able to organize the information they find.
2. Students should be able to present their findings to their teacher or peer group.

Instructional Materials/Resources/Tools

1. We will need the use of the lap top carts at DHS.
2. Student work sheets will be sent to them electronically.

Lesson Delivery**Lesson Opening:**

Prior to this lesson, student will have completed the activity "Biotech Careers Interactive."
Please see attached lesson plans.

During the Lesson (activities/labs/challenges)

1. Students will be given a template to fill in as they research various engineering programs across the country. These programs will include but not be limited to : Plastics, Packaging, Biomedical, Chemical, and Electrical Engineering programs.
2. after their individual research, students will be asked to present their findings to a small group of peers. Each member of the groups presents information on a different type of engineer.
3. The group together decides which types of engineers will be needed by the company to develop the commercial product.
4. Students will use the model job listing to construct their own job listings for their team of engineers.

Lesson Closing

Students can present their job listings to other students.

or

Students can write a letter applying for each position and explain why they would be a good candidate for the job.

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Assessment

Student Assessment:

Students will determine which types of engineers they will need to create a team to get this commercial product made.

Students will write job descriptions that demonstrate their knowledge of the subject and the inferences made.

Delivery Assessment: Students will be assessed using a rubric for their presentation, content of research and completion of the design process.

Additional resources and assessments: List the attachments here.

Attachments should include handouts, readings (with references), lab write-ups, rubrics, exams/quizzes, and/or other similar materials.

Other attachments:

1. [Introductory Lesson Biotech careers Interactive - From PBS.org](#)
2. [Student Worksheet outlining the problem.](#)
3. [Student template to present their findings.](#)
4. [Model Job Listing for students.](#)

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(INTRODUCTORY LESSONS) [Biotech Careers Interactive PBS.org](#)

The biotechnology industry has shown steady growth since the late 1980s and is projected to continue growing. Many biotechnology companies begin small—a group of researchers seeking to create a new technology or solve a problem using biotechnology. Others are large multinational corporations that use the tools of biotechnology to advance their research or improve their production processes. Biotechnology products have widespread applications—from human and animal health, to agriculture and environmental cleanup—and are produced using a wide variety of biological processes. However, most biotechnology companies operate in a similar way.

Simply defined, biotechnology is the use of living cells, including their genes and proteins, to solve problems and make products. The range of products is wide and varied, and includes new therapies for fighting cancer, drought-resistant crops, plastic made from corn instead of petroleum, microorganisms that clean up oil spills, and fuel (ethanol) from fermentation. The responsibilities for developing these products are fulfilled by people with different levels of education and experience.

A biotechnology company may combine the work of a scientist researching the structure of a human protein involved in disease; a laboratory technician conducting experiments designed to learn about that protein; a facilities technician repairing equipment; and/or a clinical research associate overseeing a large clinical trial. The knowledge and skills required for a job in biotechnology are highly transferable between industry sectors. Someone employed by a chemical company can conceivably move to a pharmaceutical or a food products company within the biotechnology sector. Jobs can be performed in a laboratory, in a field, or in a manufacturing facility.

Because the biotechnology industry is experiencing such rapid growth, the demand for skilled workers is high. There are often more jobs available than there are skilled workers to fill them. Many companies hire graduates of technical institutes or community colleges, or those who have completed college-level courses in chemistry, biology, mathematics, or engineering. While most biotechnology jobs require the application of scientific and technical know-how, there is considerable opportunity to pursue a career in nonscientific and nontechnical areas. Companies rely on people performing all kinds of jobs to be successful, including people in administrative, business development, financial, and legal and advisory roles.

Discussion Questions

1. Select one career path from this interactive activity that appeals to you and discuss the reasons why.
2. Select one job that appeals to you within your chosen career path and summarize the duties listed under the position description.
3. List the education and experience needed for the job you selected.
4. Explain what you would hope to achieve in a biotechnology career

<http://mass.pbslearningmedia.org/resource/biot09.biotech.car.careers/careers-in-biotechnology/>

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STUDENT WORKSHEET OUTLINING PROBLEM

Congratulations! You've just been asked by your boss to create a team of engineers that will work on a brand new commercial project, the Micra, a transcatheter heart pacing system. A team of engineers has just created this monitor but they need your help. A new group of engineers is being assembled and they need to figure out how to get this monitor into a patient's heart. Feel free to watch the following video that explains how the system works.

https://www.youtube.com/watch?v=uJRdQUTHs_Y

First: You must figure out what kinds of engineers you will need. You must research college level programs that train those types of engineers. To help guide your decisions and research, please fill in the attached template.

Second, you and your team need to decide what types of engineers will be needed for this team. Just like the New England Patriots carefully pick their team members for their individual skills, you, too, need to carefully pick the engineers needed for this team. Brainstorm how each member would play a key role in the development of this product.

Third, write **ENTRY** level job descriptions for EACH member of the team. Use the sample to help guide your writing. Think about the types of skills needed for each position. What kinds of education would a person need to have in order to be a member of this team?

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STUDENT TEMPLATE TO PRESENT FINDINGS

Type of Engineer	
School Name:	
Requirements to Complete a B.A. or B.S.:	Are internships with local companies available through the school?
What types of projects would a engineer work on? Engineers with this degree level have starting salaries around	School Statistics Annual Tuition: Lab Fees: Room/ Board: Ave. SAT scores: High School Requirements to get into this program?

Additional Notes :

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SAMPLE JOB LISTING FROM MEDTRONIC

Together Medtronic and Covidien are working to improve how health care addresses the needs of more people, in more ways and in more places around the world. As one company, we can accelerate and advance our ability to create meaningful innovations - but we will only succeed with the right people on our team. This is the ideal opportunity to join us, and be part of our commitment to the health of others.

We know the combined resources of Medtronic and Covidien will be transformative, creating new methodologies and new opportunities. Whatever your specialty or ambitions, you can make a difference at Medtronic - both in the lives of others and your career.

Medtronic is a \$27.8b company with 85,000+ employees in more than 160 countries.

POSITION DESCRIPTION - Senior Engineering Manager

Responsible for the development and implementation of activities within the Manufacturing/Engineering area to meet production goals, quality, and cost objectives. Manage the development of manufacturing engineers ensuring alignment with production needs. Plans and administers procedures and budgets. Selects and develops personnel to ensure the efficient operation of the manufacturing/engineering function including schedules and manpower requirements. Participates and may lead other cross-functional activities.

POSITION RESPONSIBILITIES

- Provide project planning with milestones for technology or engineering projects. Lead team members through project and decision-making. Ensure all protocols are followed.
- Assist in developing and implementing long range strategic plans for Manufacturing including long term and short term facility and resource planning.
- Interface extensively with other Medtronic manufacturing sites, customers and other relevant contacts.
- Develop, mentor and counsel engineering staff, perform performance appraisals, and initiate hiring process for prospective team members.
- Insure that engineering project schedules are completed.
- Develop and monitor operational controls and indicators to monitor progress and to drive improvements in areas such as yield, quality, labor and material variances, lead time, etc.
- Responsible for managing the implementation of Lean initiatives within Manufacturing (i.e., Six Sigma, Cost of Quality, Lean Manufacturing)
- Responsible for adherence to departmental and project budgets.
- Insure compliance relative to safety regulations, company policies and quality system requirements is met by all direct report employees.

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BASIC QUALIFICATIONS

- * BS Engineering
- 8-12 years related technical experience
- Demonstrated effective project management experience
- 5-8 years supervisory experience, to include hiring and performance feedback

DESIRED/PREFERRED QUALIFICATIONS

- MS in related discipline or MBA
- Experience leading project teams
- Project management skills
- Leadership/people skills
- Communication and influence skills
- Written communication skills
- Presentation skills
- Knowledge of product development, manufacturing, clinical, regulatory and business management requirements.
- PC skills; word processing, project management, and spreadsheet software.
- Knowledge of medical device industry, specifically cardiovascular catheters.
- Microsoft word and project management and Excel

PHYSICAL JOB REQUIREMENTS

The physical demands described within the Responsibilities section of this job description are representative of those that must be met by an employee to successfully perform the essential functions of this job. Reasonable accommodations may be made to enable individuals with disabilities to perform the essential functions

While performing the duties of this job, the employee is regularly required to be independently mobile. The employee is also required to interact with a computer, and communicate with peers and co-workers. It is the policy of Medtronic to provide equal employment opportunity (EEO) to all persons regardless of age, color, national origin, citizenship status, physical or mental disability, race, religion, creed, gender, sex, sexual orientation, gender identity and/or expression, genetic information, marital status, status with regard to public assistance, veteran status, or any other characteristic protected by federal, state or local law. In addition, Medtronic will provide reasonable accommodations for qualified individuals with disabilities.