



5-E CLASSROOM STEM ACTIVITY:
PUBLIC PROTECTION PROTOTYPES

Dr. Alexandra Owens

STEM TO THE RESCUE: A CAREER IN EMERGENCY RESPONSE

BY ELLEN EGLEY



MARK SWANSON

DEPUTY DIRECTOR, VOLUSIA COUNTY
DEPARTMENT OF PUBLIC PROTECTION
DEGREES: ASSOCIATE IN
EMERGENCY MEDICINE, ASSOCIATE
IN CRIMINAL JUSTICE, BACHELOR'S
IN LEADERSHIP AND SUPERVISION
YEARS IN THE INDUSTRY: 36
STEM TYPE: ADVISOR



“AS A TEENAGER I WAS A VOLUNTEER FIREFIGHTER, WHICH I BELIEVE WAS THE BEGINNING OF MY PURSUIT IN OBTAINING AND MAINTAINING A CAREER AS A FIREFIGHTER, EMERGENCY MEDICAL TECHNICIAN (EMT), PARAMEDIC, AND POLICE OFFICER.”

There are some among us who feel compelled to rush in when everyone else is running out. These few put the lives and well-being of others before their own. Unfortunately, we tend to only stop and think about these heroes when tragedies occur. But for them, helping others isn't just a passion—it's a career. Yes, you read that correctly; those common childhood job aspirations such as firefighter and police officer are real, viable career options, and they require more STEM skills than you might imagine.

Few know that better than Mark Swanson, who serves as the deputy director of the Volusia County Department of Public Protection. Volusia County is home to Daytona Beach, dubbed “The World’s Most Famous Beach,” which means Mark has to prepare for and respond to emergencies typical for a busy Florida community as well as provide services like ocean rescue along the county’s coast.

This responsibility is one Mark takes very seriously—and spent a lifetime preparing for. “As a teenager I was a volunteer firefighter, which I believe was the beginning of my pursuit in obtaining and maintaining a career as a firefighter, emergency medical technician (EMT), paramedic, and police officer. When I began 36 years ago, I did not realize that my entire career would encompass being a public servant. I feel fortunate to have been given the opportunity to serve others in times of urgent need,” reflects Mark.

It is that lifetime of experience in various emergency-response roles that prepared Mark for his current


job. In addition to the degrees Mark completed, he is also required to earn and maintain several certifications, including those for firefighters, EMTs, paramedics, and law enforcement officers. He relies on that training and experience every day as he protects the approximately half a million residents and over 10 million tourists who visit the area each year.

Departments like Mark’s provide the services we all rely on for our safety and protection, yet often take for granted. “The Public Protection Department is composed of eight divisions providing services to the visitors and residents of Volusia County who are impacted most traumatically during emergencies resulting from accident, illness, and loss of property or life. The department attempts to mitigate the effects of those events through effective planning (Emergency Management), appropriate preventive actions (Animal Control, Beach Safety, and Fire Prevention), and prompt and efficient response to emergencies (Beach Safety, Emergency Medical Services, and Fire Rescue). The department also meets statutory responsibilities as required for Corrections and the Medical Examiner,” explains Mark.

Coordinating that many departments and personnel requires strong soft skills like critical thinking, problem solving, and organization. Mark also uses skills from each of the STEM fields to be successful, such as understanding the body’s systems in emergency medicine, keeping up with the latest medical technology, being able to fix equipment quickly and effectively in fire services, or using

math to ensure correct doses of medicine are being administered in an emergency.

Whether you live for an adrenaline rush or have a heart for helping others, a career in emergency response might just be the right path for you. So where do you start? “Complete the requirements for high school graduation which is the first requirement for any job in the emergency services field. I suggest starting with school as an EMT which is a requirement whether you choose the firefighter or paramedic route. If you choose to advance in the field as a paramedic, I would recommend functioning as an EMT for at least a year prior to entering paramedic school as this will allow you to gain the applicable skills needed to be a quality paramedic. This time will also allow you to recognize whether you have good critical-thinking skills that will allow you to advance in your career. If you choose to start a career in criminal justice, a law enforcement academy would be the first step in the path of a career in law enforcement which could lead to more advanced jobs in investigations and possible federal careers. The best advice I can give is to be true to yourself and always be willing to aid others in need. In life, there is always someone experiencing a greater issue than you are dealing with,” suggests Mark.

As long as natural disasters, wildfires, illnesses, accidents, and acts of violence occur, emergency response professionals will be needed to protect and serve, which means you could have a future getting paid to be someone’s real-life hero. 

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Here are some ideas for how high school teachers could use this story as a launching point for integrated STEM learning. Our activities follow the 5-E Learning Cycle Model.



Part 1: Engage

- ① Hold a class discussion about emergency response careers.
 - a. What are the different emergency response roles?
 - b. What skills are needed for this field?
 - c. How does STEM play a role in these careers?
- ② Have students read the article "STEM to the Rescue: A Career in Emergency Response" in *STEM Jobs* magazine. Discuss the following questions:
 - a. What soft skills are needed for a career in emergency response?
 - b. What STEM skills are required?
 - c. Did any branches under the Public Protection Department surprise you?
 - d. What is a good way to start on the track to this career?
- ③ Ask students to consider what problems the various branches discussed in the article may face, and how they would go about solving them.



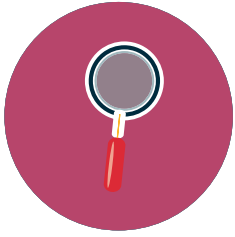
Part 2: Explore

- ① Break students into small groups of three or four students. Assign or allow groups to select one branch of the public protection department described in the article (you may choose to have students specifically research the branches within your own community, if some do not apply).
 - a. Emergency Management
 - b. Animal Control
 - c. Beach Safety
 - d. Fire Prevention
 - e. Emergency Medical Services (EMS)
 - f. Fire Rescue
- ② Ask each group to briefly research the responsibilities and challenges of their branch.
- ③ Present the challenge to the students. Using what they have learned, each group must design a product that will assist emergency workers in their branch. Their product may address a problem the department faces or improve efficiency. Allow students to conduct more research as necessary in order to identify a need to address.
- ④ Groups will work together to create a sketch of their design. If possible, have them create a digital model of their design using computer software. Once they are satisfied with their design, they will create a prototype of it using household materials. The prototype should be accurate in size if possible, or to an accurate scale if the size of the object is prohibitive.
- ⑤ Have groups create a presentation to show the class what they have created in order to get feedback for redesign.



Part 3: Explain

- ① Groups will present their product and prototype to the class. Each member should share the information that they were responsible for. Students should share their research, product, and prototype using presentation software such as PowerPoint or Google Slides. Students must be able to explain how the product meets the needs of their branch of the public protection department, what specific problem their product solves, and other information they deem important. This includes a mathematical representation illustrating the need of the branch based on student research, such as a data table or graph.
- ② After each presentation, ask audience members to provide constructive feedback about the product.
- ③ When all presentations are complete, ask groups to reflect on their feedback in order to improve their design.



Part 4: Elaborate

- ① Provide students time to redesign their product based on peer feedback.
- ② Arrange for emergency response workers from your community to visit your classroom for a showcase of student work. For additional career connections, ask visitors to briefly speak to the class.
- ③ Have students share their final products with community members through formal presentations or a gallery walk.



Part 5: Evaluate

Students will be evaluated for their presentation and prototype using the following rubric. Provide the rubric at the beginning of the lesson to clarify expectations and objectives. Each group will be graded, therefore all students in the group will receive the same score.

Scoring Rubric

___ /20 **Product Design and Prototype**

- Did both members of the partnership contribute?
- Is there significant research and data to support that each member did their part?

___ /20 **Participation**

- Did each student contribute to the overall project?
- Did each student assist in creating the presentation and prototype?

___ /10 **Presentation**

- Did the presentation include a description of the product and a representation of the needs of the branch?
- Was the presentation clean and easy to understand?

___ /50 **Total Score**

Standards Addressed:

Common Core State Standards – Math

CCSS.MATH.PRACTICE.MP1 Make sense of problems and persevere in solving them.

CCSS.MATH.PRACTICE.MP2 Reason abstractly and quantitatively.

CCSS.MATH.PRACTICE.MP4 Model with mathematics.

Common Core State Standards - ELA

CCSS.ELA-LITERACY.RST.9-10.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.

CCSS.ELA-LITERACY.RST.9-10.4 Determine the meaning of symbols, key terms, and other domain-specific words

and phrases as they are used in a specific scientific or technical context relevant to grades 9-10 texts and topics.

CCSS.ELA-LITERACY.SL.9-10.1 Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 9-10/11-12 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.

CCSS.ELA-LITERACY.RST.11-12.4 Determine the meaning of symbols, key terms, and other domain-specific words

and phrases as they are used in a specific scientific or technical context relevant to grades 11-12 texts and topics.

CCSS.ELA-LITERACY.RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g. quantitative data, video, multimedia) in order to address a question or solve a problem.

CCSS.ELA-LITERACY.RST.11-12.9 Synthesize information from a range of sources (e.g., texts, experiments, simulations)

into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.

CCSS.ELA-LITERACY.SL.11-12.1 Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led)

with diverse partners on grades 9-10/11-12 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.

CCSS.ELA-LITERACY.SL.11-12.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements)

in presentations to enhance understanding of findings, reasoning, and evidence and to add interest.

CCSS.ELA-LITERACY.WHST.9-12.7 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.WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research.

Next Generation Science Standards

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.

Science and Engineering Practices

Asking Questions and Defining Problems. Analyze complex real-world problems by specifying criteria and constraints for successful solutions.

Disciplinary Core Ideas

ETS1.A: Defining and Delimiting Engineering Problems

Criteria and constraints also include satisfying any requirements set by society, such as taking issues of risk mitigation into account,

and they should be quantified to the extent possible and stated in such a way that one can tell if a given design meets them.

Humanity faces major global challenges today, such as the need for supplies of clean water and food or for energy sources that minimize pollution, which can be addressed through engineering. These global challenges also may have manifestations in local communities.

Crosscutting Concepts

Influence of Science, Engineering, and Technology on Society and the Natural World. New technologies can have deep impacts on society and the environment, including some that were not anticipated. Analysis of costs and benefits is a critical aspect of decisions about technology.

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, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.

Science and Engineering Practices

Constructing Explanations and Designing Solutions. Evaluate a solution to a complex real-world problem, based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.

Disciplinary Core Ideas

ETS1.B: Developing Possible Solutions

When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts.

Texas Essential Knowledge and Skills- Math

A.1.A apply mathematics to problems arising in everyday life, society, and the workplace.

A.1.B use a problem-solving model that incorporates analyzing given information, formulating a plan or strategy, determining a solution, justifying the solution, and evaluating the problem-solving process and the reasonableness of the solution.

A.1.D communicate mathematical ideas, reasoning, and their implications using multiple representations, including symbols, diagrams, graphs, and language as appropriate.

A.1.E create and use representations to organize, record, and communicate mathematical ideas.

Texas Essential Knowledge and Skills- Science

Depending on the Designs Chosen, Possible Standards Include:

B.3, C.3, P.3 The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions within and outside the classroom.

B.4.C Compare the structures of viruses to cells, describe viral reproduction, and describe the role of viruses in causing diseases, such as human immunodeficiency (HIV) and influenza.

B.10.A Describe the interactions that occur among systems that perform the functions of regulation, nutrient absorption, reproduction, and defense from injury of illness in animals.

B.11.A Describe the role of internal feedback mechanisms in the maintenance of homeostasis.

B.11.C Summarize the role of microorganisms in both maintaining and disrupting the health of both organisms and ecosystems.

P.6.F Contrast and give examples of different processes of thermal energy transfer, including conduction, convection, and radiation.