Standards Analysis

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Science Standards

Since I am a middle school science teacher in Kentucky, I reviewed and analyzed the following

standards in science:

- MS-LS1-8 Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.
- MS-PS1-6. Undertake a design project to construct, test, and modify a device that either releases or absorbs thermal energy by chemical processes.
- MS-ESS3-2. Analyze and interpret data on natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.

When examining these science standards, I observe that they all require the problem

solver to have some context of the subject matter. For example, in standard MS-LS1-8, the

person needs to have some working knowledge of the nervous system and the various levels of

organization in living organisms. In other words they need to have declarative knowledge as well

as a mental model of the cells, organs, and systems and how they work because the task is to

gather how they various sensory cells are able to transmit nerve impulses through different

regions of the brain so they result in a memory being collected and/or a response being formed

so that an organism can respond to the stimulus.

These science standards also require the person to generate a model to explain how the

process works which is asking the problem solver to ask questions, to conduct investigations in

which they collect data, and then analyzing the data to evaluate whether or not the model they

developed works and represents a possible solution to the overall problem. As they evaluate, they

are having to predict and make modifications to their design model to have the best

representation of how it works and solves the problem. For example, in the standard,

MS-PS-1-6, the problem solver is having to design a model of a device that will help regulate the temperature of something such as regulating the temperature of an organism that can't regulate its own temperature or a device that might help a patient reduce swelling of an injured area. All of this asks the problem solver to use his/her own background experiences and content knowledge to develop a possible solution to the problem, however they define the problem to be.

Math Standards Analysis

The science standards above also overlap with the following math standards:
- MP.2 Reason abstractly and quantitatively.
- 6.EE.B.6 Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set.
- 7.EE.B.4 Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities.

As students generate questions to the science standards mentioned above they are also having to think in an abstract and a quantitative way about concepts that they may not have had a great deal of experience with in their life. So they are having to research and gather information as well as conducting experiments to test their ideas whether that is a nerve model, thermodynamic device, or looking at the past geological events to make predictions about possible future events. They are constantly evaluating and making changes to their models to make improvements to improve the situation/problem.

Technology and Engineering Literacy Standards Analysis

Technology is also a natural part of this problem solving process and helps make researching, organizing, collecting of data, and analysis of data a little easier. I can see an application of many of the various technology and engineering, but based on the science standards above, the technology and engineering standards that might overlap the best include the following:

- 1J. Develop innovative products and systems that solve problems and extend capabilities based on individual or collective needs and wants.

- 7R. Refine design solutions to address criteria and constraints.

- 7U. Evaluate the strengths and weaknesses of different design solutions.

Each of these technology and engineering standards are asking the problem solver to again ask questions, try out possible solutions, evaluate solutions, and ultimately draw conclusions about which solutions best "fixes the problem".

When comparing technology, math, and science standards to see how they overlap with each other in the area of engineering design and problem solving, I noticed that they are similar to each other in that they ask the problem solver to create and test out ideas, make improvements, retest, and finally settle on the best solution. The difference occurs when the problem-solver defines the problem. For example, if the focus is on science, the problem solver will need to draw on their own personal experiences as well as add to the experience through research which might involve the technology aspect. After they define the problem, the problem-solver then might switch his/her focus to a more mathematical approach using their creative/designing skills to generate a solution model in conjunction with science to best solve the problem. All of this could incorporate the various aspects of technology that helps the problem solver to organize and evaluate the best solution as well as communicate the chosen solution to various audiences. The overlapping of these standards demonstrates how engineering design problem solving is really a unifying idea and skill. They are different tools for the problem solver to use to find the best solution to the currently defined problem.