



STEM Program of Study (page 2 of 2)

Proficiencies Needed to be Successful in STEM:

Science:

Physical Sciences: Structure/Properties of Matter, Forces and Interactions

- Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.
- Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron state of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.
- Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.
- Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy.
- Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs.
- Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.
- Develop models to illustrate the changes in the composition of the nucleus of the atom and the energy released during the processes of fission, fusion, and radioactive decay.
- Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.
- Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system.

Physical Sciences: Energy, Waves and Electromagnetic Radiation

- Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.
- Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as either motions of particles or energy stored in fields.
- Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics).

Science (cont'd):

Engineering, Technology and Application of Science

- Define and delimit engineering problems: Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
 - a. Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy
- Develop possible solutions: 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; AND 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.
 - a. Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.
 - b. Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.
 - c. Evaluate competing design solutions for developing, managing, and utilizing energy and mineral resources based on cost-benefit ratios.
 - d. Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.
 - e. 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.
- Optimize the Design Solution Design a solution to a complex real world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
 - a. Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.
 - b. Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.
- Links among Engineering, Technology, Science and Society
 - a. Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.
 - b. Communicate technical information about how some technological devices use the principles of wave behavior and wave interactions with matter to transmit and capture information and energy.

Education and Career Pathways out of STEM:

Post-Secondary Education:

- Acceptance with advanced standing at VTC, NHTI and other Project Lead the Way institutions.
- STEM students have been accepted at:
Rensselaer Polytechnic Institute (RPI), University of Rochester, Worcester Polytechnic Institute (WPI), United States Military Academy West Point, Vermont Technical College, University of Vermont, University of Oregon, and many other institutions.

Apprenticeships:

- Hypertherm
- TomTom North America
- City of Lebanon Civil Engineering Department
- American Precision Museum

Employability:

- Hypertherm
- TomTom North America
- American Precision Museum
- Most technology firms in the Upper Valley
- GW Plastics
- Timken

Certifications:

- WorkKeys National Career Readiness Certification (NCRC)
- OSHA 10 training