

Applying Physical Science Concepts to Real World Situations ConVal High School

Essential Question: How can I use physical science concepts to solve a problem or answer a question? As the semester progresses, students develop their own essential questions based on their individual projects.

Area(s) of Study: Physical Science

Duration: One semester

Type and amount of credit earned: Honors designation for Physical Science on transcript

Student Activities (up to 10):

1. **Phase one: Skill development.** Students complete 3-4 STEM mini-projects involving research, application, and reflection. Each activity is scaffolded, with detailed research sources, guidance, and structured questions provided for the first. Supports are gradually removed as the semester progresses. Modifications for students with IEPs or 504s are met through this scaffolding. Whole group meetings are held biweekly for ten weeks to allow for group discussion and collaboration. The actual STEM projects can vary. Below is a list of those that were used in 2015-2016.
 - a. Buoyancy – build a boat out of recycled materials to support loads of increasing mass
 - b. Flight – build and modify a glider to travel as large a distance as possible.
 - c. Simple machines – compare the efficiency of different simple machines
 - d. Triangles – explore what makes the triangle a highly effective form in architecture
 - e. Optics – use two lenses to build a magnifying device

2. **Phase two: Individual project.** Each student designs an engineering solution to a local, regional, or global problem **OR** designs and carries out a laboratory experiment to investigate a physics or chemistry concept. Each student follows these steps:
 - a. Visit CTE class (engineering, computer science, automotive, or building trades) to gain ideas for individual project.
 - b. Draft ELO individual project proposal and review with teacher. The teacher ensures that the project chosen is rigorous yet attainable by the individual student. Students continue to consult with teacher as needed during steps 4-9. Consultations occur on regular, scheduled basis for students with IEPs or 504s as prescribed by their individual modifications, particularly those calling for “chunking” of long term projects.
 - c. Begin background research.
 - d. Consult with community partner.
 - e. Carry out experiments for laboratory investigation or build model of engineering solution.
 - f. Collect and analyze data.
 - g. Draw conclusions and reflect on final outcome.
 - h. Create and present final display.

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Competencies: This ELO enables students to demonstrate the ability to carry out all eight NGSS Science and Engineering Practices.

- 1) Asking questions (for science) and defining problems (for engineering)
- 2) Developing and using models
- 3) Planning and carrying out investigations
- 4) Analyzing and interpreting data
- 5) Using mathematics and computational thinking
- 6) Constructing explanations (for science) and designing solutions (for engineering)
- 7) Engaging in argument from evidence
- 8) Obtaining, evaluating, and communicating information

Community Partner:

- 1) The engineering group from New Hampshire Ball Bearing, a local manufacturing company, visits the students at school to discuss their individual projects in small groups. This ensures that every student has a least one community partner.
- 2) Some students are able to connect with an adult they know through their own or their community connections. This person has some expertise with the student's topic.
- 3) If appropriate, students meet with school personnel, including teachers, coaches, or athletic trainers. We have particularly made use of our chemistry, physics, and computer programming teachers, our IT director, and our athletic trainer.

Community Partner responsibilities in this ELO:

- 1) Listen to students' ideas and help them develop a more precise question.
- 2) Advise on protocol for experiment or building model.
- 3) Help provide tools and/or materials.
- 4) Suggest research sources.
- 5) Help students review their results/prototypes and make sense of their findings.

Assessment:

- 1) Successful completion of preliminary STEM assignments.
- 2) Accomplished or exemplary ratings on the school-wide Self-Management Rubric (see below).
- 3) Accomplished or exemplary ratings on the school-wide Problem Solving Rubric (see below).
- 4) Presentation of final project on a three-sided display board with model/lab apparatus at open house for parents, faculty, community partners, and other invited guests.

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ConVal High School || Self-Management

Student Name _____

Assignment _____

	Beginning	Developing	Accomplished	Exemplary
Self-Motivation	Rarely: arrives in class prepared to learn. stays on task. participates in all learning activities. perseveres in difficult situations.	Sometimes: arrives in class prepared to learn. stays on task. participates in all learning activities. perseveres in difficult situations.	Usually: arrives in class prepared to learn. stays on task. participates in all learning activities. perseveres in difficult situations.	Always: arrives in class prepared to learn. stays on task. participates in all learning activities. perseveres in difficult situations.
Responsibility	Rarely: follows attendance and tardy procedures. accepts responsibility for effort and actions. meets deadlines. demonstrates self-control in challenging situations.	Sometimes: follows attendance and tardy procedures. accepts responsibility for effort and actions. meets deadlines. demonstrates self-control in challenging situations.	Usually: follows attendance and tardy procedures. accepts responsibility for effort and actions. meets deadlines. demonstrates self-control in challenging situations.	Always: follows attendance and tardy procedures. accepts responsibility for effort and actions. meets deadlines. demonstrates self-control in challenging situations.
Relationships	Rarely: shows self-control and respect for others. interacts positively with others. respects others' opinions and differences.	Sometimes: shows self-control and respect for others. interacts positively with others. respects others' opinions and differences.	Usually: shows self-control and respect for others. interacts positively with others. respects others' opinions and differences.	Always: shows self-control and respect for others. interacts positively with others. respects others' opinions and differences.

Notes:

ConVal High School || Problem Solving

Student Name _____

Assignment _____

	Beginning	Developing	Accomplished	Exemplary
Understands the problem	Shows little evidence of understanding the problem .	Shows some evidence of understanding the problem .	Shows evidence of fully understanding the problem .	Shows evidence of fully understanding the problem and adds new insight.
Identifies a strategy and uses a variety of resources	Does not identify a strategy to address the problem . Uses little to no appropriate resources .	Develops a strategy that addresses some aspects of the problem . Uses at least one appropriate resource .	Develops a strategy that addresses all or nearly all aspects of the problem . Uses multiple appropriate resources .	Develops multiple strategies that fully address the problem and uses multiple, appropriate resources .
Implements strategy	Does not implement an effective strategy to solve the problem .	Implements a partially effective strategy to solve the problem .	Implements an effective strategy to solve the problem .	Demonstrates advanced skills/techniques to implement an effective strategy.
Monitors progress and revises strategy	Rarely monitors progress toward a solution and makes no adjustment to the strategy when needed.	Occasionally monitors progress toward a solution and makes minimal adjustments to the strategy when appropriate.	Consistently monitors progress toward a solution and appropriately adjusts strategy to achieve further progress.	Insightfully monitors progress toward a solution. Actively reflects on strategy and adjusts it to maximize progress.
Evaluates the solution	Communicates little about the solution's effectiveness.	Communicates some ideas about the solution's effectiveness.	Communicates several ideas about the solution's effectiveness.	Communicates insightful ideas about the solution's effectiveness and proposes alternative solutions.
Demonstrates independence	Ongoing assistance required.	Some assistance required.	Little to no assistance required.	No assistance required and assists other students.

Notes:

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Connection to student's measurable postsecondary goals (for students with IEPs): This ELO allows students to explore a STEM topic of their own interest and make connections with adults who work in this field. This exposes students to potential college and career options.

Comments and suggestions for other schools implementing a similar ELO: Scaffolding projects, frequent monitoring of student progress and individual choice are the key elements to success.

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Supporting materials:

- 1) Examples of STEM mini-projects
 - a. Buoyancy
 - b. Flight
 - c. Triangles
 - d. Simple Machines
 - e. Lenses
- 2) Blank ELO template used for planning of student project
- 3) Final presentation requirements