STEM Explore, Discover, Apply – A Middle School Elective (Curriculum Exchange)

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NICERC™
National Integrated Cyber Education Research Center

STEM EDA
EXPLORE • DISCOVER • APPLY

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Course Summary

STEM: Explore, Discover, Apply (STEM EDA) is a three course elective sequence for middle school grades 6-8. The curriculum is based on a modular approach; and students spend three weeks on one of the design projects before progressing to the next module. The engineering design process (EDP) guides the students through the design and implementation of the projects and concepts. In addition to learning STEM fundamental topics, students also apply English language arts concepts and soft skills to each module. This approach allows students to improve their problem-solving and critical thinking skills while they develop invaluable competencies in leadership, team building, creativity, and communication.

Target Grade Levels

Explore - 6th grade, Discover - 7th grade, Apply - 8th grade

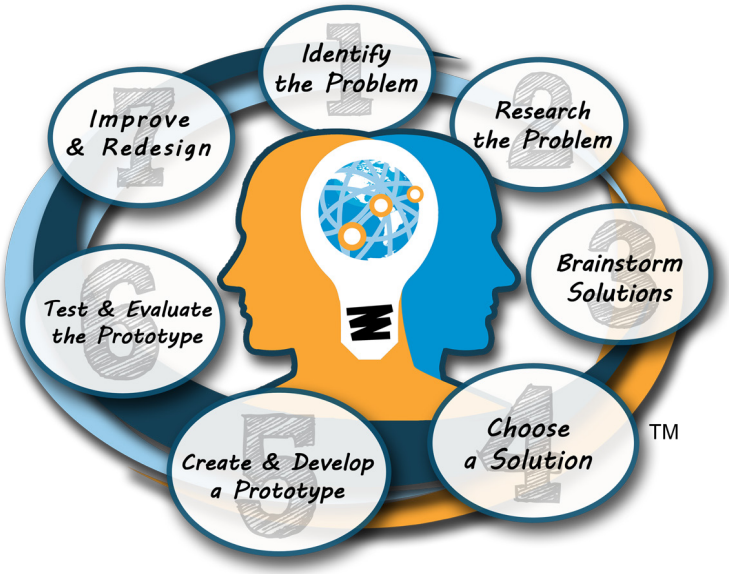
Course Implementation

Schools can implement the STEM EDA curriculum in a variety of ways: as an elective, after school program, or inserted into their existing classes. The current eight modules developed are as follows: Egg Drop (introduces the EDP), Volcanoes, Roller Coasters, Catapults, Genetics, Electricity, Music, and Earthquakes. Additional modules (e.g., Race Cars, Boats, Bridges, Solar Ovens, Bacteria, Immune System, etc.) are being developed to provide schools with multiple module options.

Example Module

Figure 1 is the engineering design process graphic that guides students through each module. Annotated by each step in the process is a sample of the STEM Discover Catapult module in which students build a trebuchet. Additionally, a creative writing opportunity is included (between Steps 5 and 6); students research heraldry and create a coat of arms and motto to be included on their trebuchets.

Figure 1: Engineering Design Process



Because the school mascot is the medieval knights, the 7th graders have been asked to build trebuchets to throw prizes into the crowd at pep rallies and sporting events.

Students research three main areas: trebuchets in general, Middle Ages and classes of people, and components of trebuchets (base, supports, lever, fulcrum, counterweight, and sling).

Develop three ideas broken down by the following: base, support, lever/fulcrum, counter weight, sling, and overall design.

Assess and rate each design over nine factors in two categories: Components (base, supports, lever/fulcrum, sling, and counter weight) and Assembly (use of materials, ease of construction, function and performance, and uniqueness of design).

Build a prototype for the design chosen in Step 4, and utilize the iterative nature of design.

Create a system based on counterweight mass and the amount the lever is pulled back to hit specified distances. Calculate potential energy for different masses and pull back amounts. Calculate theoretical maximum range for trebuchets. Test various launches of the trebuchet.

Calculate range efficiency, discuss/determine improvements, make improvements, and test the trebuchets again.