

Trotwood-Madison Middle School STEM

Description

The acronym STEM stands for Science, Technology, Engineering and Mathematics. The Middle School program will involve application of mathematics principles to science principles and an appreciation of the interdependence of these disciplines. The classroom will showcase a transformation from the typical teacher-centered experience into a learning environment that is driven by problem solving, discovery, exploratory learning and the active engagement of students in a problem in order to find its solution. Our students will benefit by being taught independent innovation as they explore the greater depths of mathematics by using 21st Century skills - skills that are going to be required in our ever-changing society. Our authentic lessons will allow our students to apply the principles of STEM in contexts that make connections between school, community, work and global citizenry.

Purpose

The STEM class at Trotwood-Madison Middle School is designed to give students an introduction into the application of STEM concepts in real world situations. Students enrolled in this class should be prepared to create, communicate, think critically and collaborate with each other as much as the class is based upon the tenets of 21st Century learning. Technology and hands-on experiences will be interwoven throughout the curriculum on a daily basis. The ultimate goal is to produce a well-rounded, mathematically sound individual capable of using knowledge in an authentic manner.

Class Design

Each day the students will use many of the Common Core Mathematics Standards of Number & Quantity, Algebra, Functions, Geometry and Statistics & Probability learned in previous courses. Many of these standards will be applied in conjunction with science standards. This class will emphasize the Modeling Standard along with the Standards for Mathematical Practice as past knowledge will be given relevance. The STEM class is designed around active, hands-on learning experiences involving the following units:

Abbreviation Key

LS – Life Science

ESS – Earth and Space Science

PS – Physical Science

EVS – Environmental Science

CHM – Chemistry

RP – Ratio and Proportion Relationships

NS – Number System

EE – Expressions and Equations

MD – Measurement and Data

G – Geometry

S - Statistics

Environment & Ecology

Who's not conscious today of protecting the natural environment? Students learn about recycling, availability of clean water, and the effects of acid rain. They perform water testing, acid rain and hydroponics experiments under controlled conditions. This experience provides a real world simulation of bio-related challenges that students will need to address as adults.

Common Core Mathematics and Revised Academic Standards for Science used as the focal point of instruction through real-world application:

LS.68.4b Identify the term “photosynthesis” as the process by which plants make their own food.

LS.68.4a Identify what is required for photosynthesis to occur (carbon dioxide, water, sunlight).

CHM.912.5b Given a pH scale with common ingredients (orange juice, water, baking soda), determine if they are acid, neutral or basic.

CHM.912.5a Use litmus paper to test and determine the pH of a substance.

EVS.912.5a Explain how resources can be preserved to reduce the impact on Earth (e.g., planting new trees after chopping down others).

EVS.912.5c Recognize what makes a resource renewable or non-renewable.

EVS.912.6b Identify ways humans have changed the global environment (e.g., water quality, air quality, waste management).

EVS.912.6c Recognize that humans can change their environment.

EVS.912.3a Identify a consequence of soil, water or air pollution.

Forensic Science

Students explore the history of forensics and gain an understanding of how the use of science and math have augmented criminal investigation. They learn how to lift a latent fingerprint, and using the scientific method, match the fingerprint to the classroom “criminal.” Students also use a computer based microscope to investigate fiber samples and paper chromatography.

Common Core Mathematics and Revised Academic Standards for Science used as the focal point of instruction through real-world application:

S.MD.6 - Use probabilities to make fair decisions (e.g., drawing by lots, using a random number generator).

S.MD.7 - Analyze decisions and strategies using probability concepts (e.g., product testing, medical testing, pulling a hockey goalie at the end of a game).

Alternative Energy

Students will use a model wind turbine to determine efficiency and use mathematics to calculate voltage output. They will use a solar panel to gain an understanding of the photovoltaic process and will calculate the number of solar panels needed to power a typical household. Using a hydrogen fuel cell, they will generate hydrogen gas to power a model fuel cell vehicle. They will explore other alternative energy sources including nuclear, biomass and geothermal.

Common Core Mathematics and Revised Academic Standards for Science used as the focal point of instruction through real-world application:

PS.68.7a Identify an energy transfer (e.g., electricity to heat in a circuit).

PS.68.7c Demonstrate energy transfer by completing a circuit (e.g., switch to activate a mechanical item).

ESS.35.1b Identify a resource as renewable or nonrenewable.

ESS.35.1a Sort resources into categories of renewable and nonrenewable.

EVS.912.4b Describe forms of alternative energy.

EVS.912.4a Describe the benefit(s) of alternative energy.

EVS.912.4c Identify an alternative source of energy.

Research and Development

Research & Development integrates the principles of design and engineering with computer applications, measurement and problem solving. Students will design and construct a CO₂ powered racer and produce sketches, layouts and prototypes. They will apply mathematical formulas to anticipate performance, study the effects of weight, aerodynamics and alignment. Students measure the speed of a vehicle they designed and built using a digitally timed raceway.

Common Core Mathematics and Revised Academic Standards for Science used as the focal point of instruction through real-world application:

EE.68.6a Solve a 1-step linear equation (e.g., $y + 3 = 5$).

PS.H.912.10c Recognize that diverse surface types cause friction differently.

PS.68.2b Identify the speed and direction of a moving object.

Airbag Systems

Students will learn the basics of chemical reactions and how it is used in a standard feature found in all of today's automobiles. They learn about the history of airbags and the principles of the true chemical reaction in real airbag deployments. The unit then asks students to create their own "airbag" to protect an egg. To do this, they used a graduated cylinder and triple beam balance to find the proper ratio of reactants.

Common Core Mathematics and Revised Academic Standards for Science used as the focal point of instruction through real-world application:

RP.68.4a Use proportional reasoning to find the whole when given both the part and the percent. (50% = 20 out of x)

CHM.912.4b Perform a chemical reaction (baking soda and vinegar).

Flight Technology

What captures the imagination more than the exploration of flight? Students quickly understand that the science of rocketry and flight requires knowledge and application of mathematics and physics. By building, flying and testing their pneumatic powered rockets, students realize that their designs and craftsmanship determine flight performance.

Common Core Mathematics and Revised Academic Standards for Science used as the focal point of instruction through real-world application:

EE.68.6a Solve a 1-step linear equation (e.g., $y + 3 = 5$).

PS.68.9b Identify the direction of the different forces acting on an object.

Virtual Architecture

Students design a virtual dwelling. These cyber-images, which can be entered and explored, permit students to add furnishings, windows, doors and other requirements to meet aesthetic and design specifications. Students modify the interior design and furnishings of a home or office. They learn how to read a blueprint and the fundamentals of space planning and layout.

Common Core Mathematics and Revised Academic Standards for Science used as the focal point of instruction through real-world application:

RP.68.2c Identify a unit rate in a word problem.

RP.68.5a Given a visual model, identify ratios involving fractions.

RP.68.1a Identify unit rate and solve problems that describe a relationship between quantities (e.g., for every vote candidate A received, candidate C received nearly three votes.).

Milk Carton Car

In this unit, students build a simple car from a milk carton and other materials. They then collect data using different masses and ramp heights. These numbers are used to examine potential and kinetic energy and how acceleration and distance is affected by those variables.

Common Core Mathematics and Revised Academic Standards for Science used as the focal point of instruction through real-world application:

PS.68.1a Identify when an object has the greatest/least kinetic and/or potential energy.

PS.68.2a Recognize that speed involves both distance and time.

PS.68.3a Compare potential energy with kinetic energy

PS.68.1b Recognize that the potential energy of an object changes based on its height.

PS.68.3b Recognize that the kinetic energy of an object changes based on its speed.

PS.68.3c Identify kinetic energy in a model.

PS.68.7b Describe what happens to an object as it loses energy (e.g., pendulum swings less, toy car slows down).

NS.68.3a Fluently add, subtract, multiply and divide multi-digit decimals.

EE.68.1a Write and evaluate numerical expressions involving whole-number exponents (e.g., $3^2 = 3 \times 3$; $2^3 = 2 \times 2 \times 2$).

EE.68.6a Solve a 1-step linear equation (e.g., $y + 3 = 5$).

MD.35.6a Convert within one system of units (e.g., convert between km, m, cm; kg, g; lb., oz.; L, mL; hr., min, sec).

Design Squad

Students are given a series of challenges. Each challenge is a hands-on task that implements either a simple machine or structural property. Students are given a limited set of materials and asked to design, through drawings and written explanation, build and modify their products. Throughout the units, students learn the basic design process along with construction principals, the importance of detail, and problem solving.

Common Core Mathematics and Revised Academic Standards for Science used as the focal point of instruction through real-world application:

EE.68.1a Write and evaluate numerical expressions involving whole-number exponents (e.g., $3^2 = 3 \times 3$; $2^3 = 2 \times 2 \times 2$).

G.68.6b Identify the scaled drawing of a geometric figure (e.g., which shape is twice the size of another shape).

G.68.4c Identify cubes, rectangular prisms, cones, cylinders and spheres (e.g., cubes, rubber eraser, funnel, paper towel roll, ball).

G.68.1a Demonstrate that the area of a right triangle is $\frac{1}{2} \times \text{length} \times \text{height}$ (e.g., two same right triangles combined make a rectangle and the area of a triangle is half the area of the rectangle it can be composed into).

PS.68.3a Compare potential energy with kinetic energy

PS.68.1b Recognize that the potential energy of an object changes based on its height.

PS.68.3b Recognize that the kinetic energy of an object changes based on its speed.

PS.68.3c Identify kinetic energy in a model.

PS.68.1a Identify when an object has the greatest/least kinetic and/or potential energy.

Google SketchUp

Google SketchUp is a 3-D drawing program. Students learn how to use the software and by doing so, learn about perspective and dimensional measurements. Throughout the course, we also examine the parts of a right triangle, how to calculate area, and how to apply the Pythagorean Theorem.

Common Core Mathematics and Revised Academic Standards for Science used as the focal point of instruction through real-world application:

G.68.1a Demonstrate that the area of a right triangle is $\frac{1}{2} \times \text{length} \times \text{height}$ (e.g., two same right triangles combined make a rectangle and the area of a triangle is half the area of the rectangle it can be composed into).

G.68.1b Demonstrate that the area of all rectangles is $\text{length} \times \text{width}$ (e.g., multiply side lengths to find the area of rectangles with whole-number side lengths).

G.68.1c Find the area of rectangles and triangles with whole-number side lengths by counting unit squares.

G.68.4c Identify cubes, rectangular prisms, cones, cylinders and spheres (e.g., cubes, rubber eraser, funnel, paper towel roll, ball).

G.68.6b Identify the scaled drawing of a geometric figure (e.g., which shape is twice the size of another shape).

G.68.13b Identify the parts of a right triangle (right angle, legs, hypotenuse).