



Class Title: Blue / Orange STEM Challenge Lab

Subjects Covered: Science

Teacher Name: Anna Roman

Class Day: Monday

Class Size: 18

Overall Class Cost: \$70

Individual Student Supply Fee: \$0

Class Fee: \$192

Ages or color group served: Blue and Orange

What level is this class: Level 2

Prerequisites: Students should be able to write with a pencil, use scissors, and glue appropriately.

Graduation Requirements: NA

Homework Requirements: NA

Class Description:

STEM Challenge Lab is a hands-on engineering and problem-solving course where students learn by building, testing, failing, redesigning, and trying again.

Rather than simply learning about STEM concepts from a textbook, students will be presented with a challenge and work in small teams to determine how to solve it using the provided materials.

Throughout the course, students will follow the engineering design process:

ASK → PLAN → BUILD → TEST → REDESIGN → TEST AGAIN

Students will work in teams of three, with opportunities to rotate through different roles such as:

Builder – helps construct the design

Designer/Engineer – helps develop and modify the design

Tester/Recorder – tests the design, records results, and helps determine what should change

Students will learn that an unsuccessful design is not necessarily a failure. In engineering, testing a design and discovering what does not work is part of the process.

Throughout the 12 weeks, students will practice:

- Creative problem-solving
- Engineering design
- Planning and communication
 - Teamwork
 - Measurement
 - Observation

- Recording data
- Making predictions
- Understanding cause and effect
- Structural design
- Force and motion
- Stability and balance
- Energy
- Material properties
- Simple machines and mechanisms
- Iteration and redesign
- Working within limitations and constraints

Students will also maintain a STEM Record Book throughout the course. They will use it to record predictions, sketches, measurements, test results, redesign ideas, and reflections from each challenge.

Week 1:

Tallest Tower Challenge

Focus: Structural Engineering, Stability & Balance

Students will begin by learning how engineers design structures that need to stand while supporting their own weight.

Teams will receive a limited amount of building materials and will be challenged to construct the tallest freestanding tower possible.

Students will experiment with different shapes, bases, supports, and construction techniques.

They will test whether their towers remain standing and determine what caused a structure to become unstable.

Students will practice:

- Planning a structure

- Understanding balance and stability
 - Creating strong bases
 - Measuring height
- Identifying structural weaknesses
- Redesigning after a failed test

Week 2:

Straw Rockets

Focus: Force, Motion & Air Pressure

Students will investigate how forces can cause objects to move.

Using straws and lightweight materials, students will design and test their own rockets.

They will predict how their design will affect its movement and then test different modifications.

The challenge will encourage students to consider shape, weight, air resistance, and the force required to launch the rocket.

Students will practice:

- Making predictions
- Understanding force and motion
- Observing how design affects movement
 - Measuring distance
 - Comparing test results
 - Modifying a design

Week 3:

Bridge Builders

Focus: Structural Engineering, Loads, Tension & Compression

Students will become bridge engineers.

Each team will design and construct a bridge using limited materials. The finished bridge will then be tested to determine how much weight it can support.

Students will explore why some shapes and structures are stronger than others.

Students will practice:

- Structural planning
- Weight distribution
- Reinforcing weak areas
- Understanding loads
- Testing strength
- Redesigning structures

Week 4:

Balloon-Powered Cars

Focus: Propulsion, Friction & Newton's Laws

Students will design a small vehicle powered only by the air released from a balloon.

They will investigate how wheels, axles, weight, friction, and the balloon's direction affect how far their vehicle can travel.

Students will build an initial vehicle, test it, identify problems, and redesign it.

Students will practice:

- Mechanical design
- Understanding propulsion
- Reducing friction
- Creating aligned axles
- Measuring distance
- Improving a design through testing

Week 5:

Earthquake Engineers

Focus: Stability, Vibrations & Structural Design

Students will be challenged to build a structure that can withstand simulated earthquake movement.

After constructing their buildings, teams will test them on a shaking surface and observe what happens.

Students will investigate why some structures collapse while others remain standing.

Students will practice:

- Structural stability
- Creating strong foundations
- Understanding vibration
- Identifying weak points
- Designing for movement
- Redesigning structures

Week 6:

Water Filtration Challenge

Focus: Material Properties & Filtration

Students will investigate how different materials can be used to separate unwanted particles from water.

Teams will create a simple filtration system using materials such as cotton, gravel, sand, and coffee filters.

Students will compare different arrangements and determine which design produces the clearest result.

Students will practice:

- Observing material properties
- Planning a filtration system
- Comparing materials

- Making observations
- Recording results
- Improving a system

Important: The water used in this activity is for the experiment only and is not drinking water.

Week 7:

Egg Drop Rescue

Focus: Gravity, Impact & Energy Absorption

Students will be challenged to protect a raw egg from the impact of a fall.

Teams will receive a limited set of materials and must design a protective system around their egg.

Before testing, students will predict which parts of their design will protect the egg.

After the drop, teams will analyze what happened and determine how the design could be improved.

Students will practice:

- Understanding impact
- Energy absorption
- Protective structures
- Material selection
- Prediction and testing
- Learning from failure

Week 8:

Wind Power Challenge

Focus: Renewable Energy, Aerodynamics & Motion

Students will explore how moving air can be used to create motion.

Teams will design a simple wind-powered device and test it using a fan.

Students will experiment with the shape, size, and positioning of their designs to determine how they can capture the most wind.

Students will practice:

- Understanding wind as a source of energy
- Aerodynamic design
- Testing variables
- Measuring performance
- Redesigning for efficiency

Week 9:

Wind-Resistant Structures

Focus: Force, Stability, Aerodynamics & Structural Design

Students will take what they have learned about structures and apply it to a new problem: building against the wind.

Teams will be challenged to construct the tallest structure possible that can withstand a controlled wind test.

Unlike the earthquake challenge, where the force comes primarily from movement beneath the structure, this challenge introduces a horizontal force pushing against the structure.

Students will need to consider the shape, height, base, weight, and overall stability of their design.

The class will test structures using a fan and observe what happens as wind is applied.

Teams will then have an opportunity to redesign their structures and test them again.

Students will practice:

- Understanding how forces affect structures
- Stability and balance
- Structural reinforcement

- Aerodynamics
- Identifying weak points
- Working with height and weight
- Comparing different structural designs
- Redesigning after testing

Week 10:

Marble Roller Coaster

Focus: Potential Energy, Kinetic Energy & Gravity

Students will design a marble roller coaster using a limited amount of materials.

The goal is to create a track that allows the marble to successfully travel through the course.

Students will experiment with hills, drops, curves, and support structures to learn how gravity affects the marble's motion.

Students will practice:

- Understanding potential and kinetic energy
- Using gravity
- Designing slopes and curves
- Supporting structures
- Testing movement
- Troubleshooting

Week 11:

Survival Engineering

Focus: Systems Engineering & Adaptation

Students will be presented with a fictional survival scenario requiring them to solve an engineering problem with limited resources.

Teams may need to design a shelter, transportation system, water collection system, signal device, or another survival-related solution.

The specific challenge will require students to consider multiple needs simultaneously rather than simply building a single object.

Students will practice:

- Systems thinking
- Prioritizing needs
- Resource management
- Team communication
- Designing under constraints
- Applying skills from previous challenges

Week 12:

STEM Olympics

Focus: Review, Application & Engineering Challenges

The final class will be a STEM challenge competition where students apply the skills they have developed throughout the semester.

Teams will rotate through several challenges based on concepts from previous weeks.

Possible challenges include:

- Tallest Tower
- Strongest Bridge
- Balloon-Powered Car
- Straw Rocket
- Egg Protection
- Mystery Engineering Challenge

Students will have to quickly analyze a problem, create a plan, build, test, and make adjustments.

The goal is to demonstrate how much students have learned about the engineering process rather than simply determining which team "wins."

Students will practice:

- Rapid problem-solving
 - Teamwork
 - Communication
 - Engineering design
- Applying previous knowledge
- Working under constraints
- Testing and redesigning