BALLZOOKA:
PNEUMATIC PROJECTILE LAUNCHERS

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CAPSULE — *Capstone Unique Learning Experience*

TARGET TEAM ACTION

Develop a course where students will apply the EDP along with their knowledge of physics to solve Capstone problems.

PROJECT DEFINITION

Students will research, design, CAD model, build, and test a Pneumatic Tennis Ball Launcher constructed from PVC pipe.

Students will then apply their knowledge of Projectile Motion to analyze their data and determine optimum pressure to hit a target of a given distance, height, and angle of launch.

PRELIMINARY SOLIDWORKS MODELS
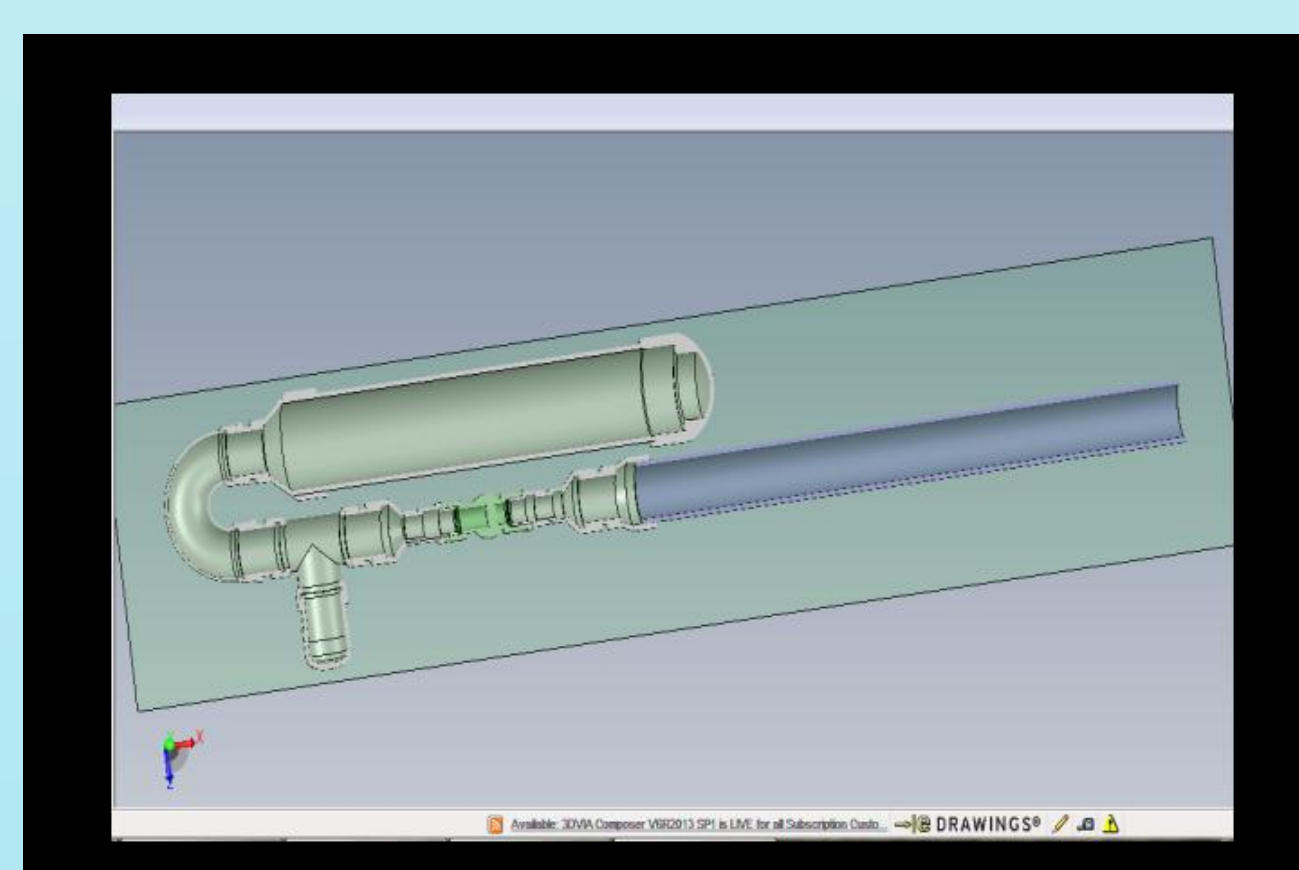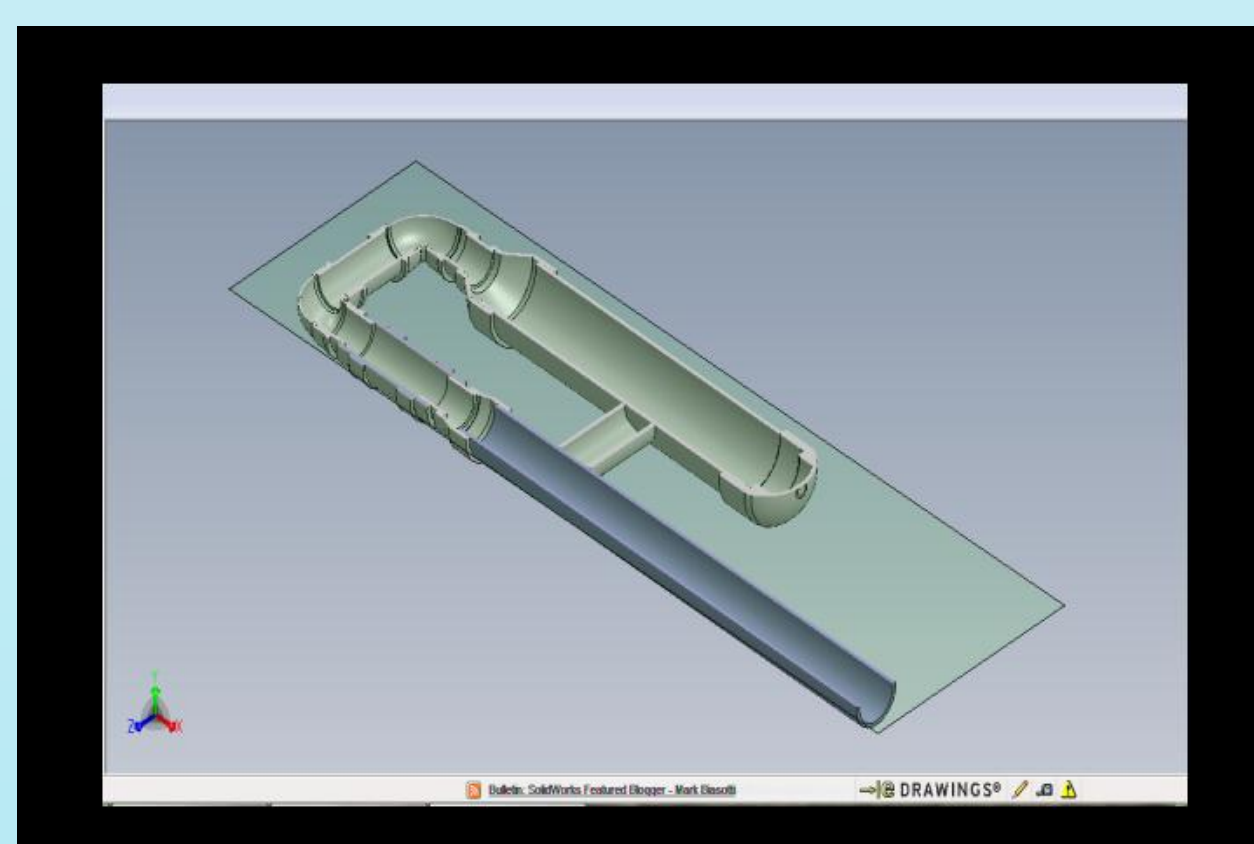
ACTION PLANS & IMPLEMENTATION SCHEDULE

Using The Engineering Design Process

Day Seq.	Plan
1	Spitball Straw Rocket Design Project
2	Spitball Wrap Up and PE & KE Intro Problems
3	PE & KE Lab
4	PE & KE Lab (cont.)
5	Pressure and Valves
6	Go Over Reasearch Questions/Design: Overal Picture
7	Research/Design
8	CAD Intro
9	CAD Assembly
10	CAD Assembly
11	Compare Designs, Choose Best Model(s)
12	CAD Combination
13	Build: Cut Pieces/Schrader Valve/Dry Construction
14	Build: Continue
15	Build: Cement
16	Build: Test for Air Leaks/Fix 'Em Theoretical Muzzle Velocity
17	Build: Test for Air Leaks/Fix 'Em (Set Up P vs D Data Table)
18	Pressure vs Distance Data Collection
19	Pressure vs Distance Data Collection
20	Pressure vs Distance Data Collection

Applying The Physics

Day Seq.	Plan
1	1-Dimensional Kinematics/Motion Graph Review
2	Proejctile Properites Demo
3	PM: Launched Horizontally (Determine Experimental Muzzle Velocity)
4	PM: finding vector components and launching at an angle
5	PM: launched at an angle and landing at a different height
6	PM: launched at an angle and landing at a different height
7	Use PvsD data to calculate Muzzle Velocity at different Pressures
8	Use PvsD data to calculate Muzzle Velocity at different Pressures
9	Give Students dx and Θ. Solve for required muzzle velocity and pressure
10	Try To Hit The Target
11	Try To Hit The Target
12	Try To Hit The Target
13	Try To Hit The Target

TEACHER DELIVERABLES

Spitball Straw Rocket Design Project Handout
- Drawings
- Procedure
- Spit-Ball Launcher
- Brief reflection)

"GPE & KE" Lab Handout

Projectile Motion Problem Set

Cannon Report Outline and Rubric
- Definition of Problem
- Research and Resources
- Design Priority Matrix
- Initial Sketches and CAD Assembly
- Pressure vs Distance Data Table and Graph
- Muzzle Velocity Hand Calculations
- Reflection

STUDENT OUTCOMES

Technology & Engineering

3.1 Explain the basic differences between open fluid systems (e.g., irrigation, forced hot air system, air compressors) and closed fluid systems (e.g., forced hot water system, hydraulic brakes).

3.5 Identify and explain sources of resistance (e.g., 45º elbow, 90º elbow, changes in diameter) for water moving through a pipe.

Physics

1.2 Illustrate how to represent vectors graphically and be able to add them graphically.

1.3 Distinguish between, and solve problems involving, velocity, speed, and constant acceleration.

1.4 Create and interpret graphs of motion (position vs. time, speed vs. time, velocity vs. time, constant acceleration vs. time).

2.1 Interpret and provide examples that illustrate the law of conservation of energy.

2.2 Interpret and provide examples of how energy can be converted from gravitational potential energy to kinetic energyand vice versa.

2.3 Describe both qualitatively and quantitatively how work can be expressed as a change in mechanical energy.