**Mechanics of a Water Rocket
Using Vernier Technology
Lesson Plan**

*This project constitutes 2 100-point test grades. It is implemented as a formal assessment at the end of our study of mechanics.*

**Objectives**:

TSW using the Engineering Design Process to create and build a water-pressure rocket out of a 2-L bottle.

TSW will use Vernier technology to collect data that will allow students to describe the mechanics of the

rocket within a visual aide.

TSW will calculate initial velocity, average impulse, average change in momentum, momentum at key points in flight, mechanical energy (and its types) at various points of flight, range, altitude, etc.

TSW will then translate their knowledge of Rocket Physics and the Engineering Design Process into a 2nd visual aide that will be used to teach 6th grade students about both Rocket Physics and Engineering Design.

TSW mentor these 6th grade students through the design process and help them launch rockets of their own.

**Materials**

*Pre-Labs*

Vernier LoggerPro

Vernier Force Plate (demo)

Vernier Force Sensors (2/lab group)

*Rocket Launch*

The Science Source, Rocket Launch Pad

The Science Source, Single Bottle Rocket Launcher

Bicycle Air Pump

Tent Stakes (To Hold Launcher in Ground)

*Data Collection*

Altitude Finder

Circular Meter Stick Roller

Vernier Video Physics

Vernier Graphical Analysis

**Pre-Labs**

*Introducing Force- The Normal Force*

Using the Vernier Force Plate, I project data from LoggerPro onto the white board. I ask students to draw a Free Body Diagram based on what they think is happening for various situations. I let the plate rest on the ground. I set the plate on a paint ladder. I stand on the plate while its on the paint ladder. Then, I stand on the plate while it is on a ramp. I push the plate against a wall. I do a push up on the wall. I do a push up on the paint ladder. I do a push up on the floor.

*Examining Newton’s 3rd Law- How the water pushes the rocket up when its moving down*

Students use the Vernier *AP Physics-Mechanics* “Newton’s 3rd Law” Lab to investigate “equal but opposite force.”

**The Design Project**

(See Attached Rubric)

Day 1 (30 min)- Students are placed in groups of 3 and given time to complete the Identify the Problem, Brainstorming, and Design steps of the design process.

Day 2 (45 min)- Students build rockets in class and take the mass of the rocket.

Day 3 (1.5 hours)- Students launch their first prototype on the football practice field.

Day 4 (1.5 hours)- Students launch their FINAL prototype (adjustments were made at home) on the football practice field.

Day 5 (1.5 hours)- Calculations & Visual Aides are started in class. They are finished for homework.

**The Middle School Project**

(See Attached Rubric)

Day 1 (1.5 hours)- Students meet with their 6th grade mentees and teach them about Rocket Physics and the Engineering Design Process. They guide them through their own Identify the Problem, Brainstorm, and Design steps.

Day 2 (1.5 hours)- Students help their 6th grade mentees launch their rocket and measure the range and altitude of the rocket.