**SUMMARY:**

The activities in both day 1 and day 2 will enable students to understand how modern rockets work through smaller models. **Day 1** will focus on relating math and simple projectile motion to the activity of building a paper rocket with a nose-cone, then a bottle rocket with a nose-cone. Students will visualize the scaling up between the paper and bottle rocket as well as investigate the effects of fins on the rocket. Points can be awarded for distance or for hitting a target.

**Day 2** will focus on explaining the physical properties of projectiles such as aerodynamics and drag as well as the effects of atmospheric conditions. Students will construct two-stage rockets that can carry and deploy a payload during the flight. Starting with paper rockets, they will be able to use the previous day's experience with fin design and incorporate it into a payload carrying rocket. Students will then use a similar design for a bottle rocket with a water balloon as a payload. Points can be awarded for successful separation between the payload and the main rocket.

**Terms, Topics, and Guiding Questions -**

* **Terms: Propulsion, Payload, Velocity, Acceleration, Pressure (PSI), Gravity, Projectile, Parabola/Quadratics, Force, Trajectory, Volume, Units, Newtons, Pascals**
* **Guiding Questions: What do you notice about the path of things that are thrown? How does pressure move objects? Why do we need to use fins?**
* **Helpful Equations: Yf = Yi + Vi\*t + ½ \* a \* t^2, Xf = Xi + Vi\*t, y = ax^2 + bx + c**
* **Engineering Topics: Iterative Design, Scalability, Material Properties and their effects, Quality control, Points of failure, pressure testing**

**Activities:**

1. Project 1 (Stomp-Rockets):
   1. Students see prebuilt paper rockets launched using stomp rocket setup
   2. Each or pairs of students design their own paper rockets with nose-cone and fin design
   3. Test for distance and maybe aiming at a target (pyramid of cups)
2. Project 2 (Bottle Rockets if weather is okay):
   1. Pair of students design a bottle rocket using similar fin design and nose cone design from their paper rockets
   2. Go outside to the field and launch Rockets!
3. Project 3 (Payload Stomp-Rockets)
   1. Students see prebuilt payload carrying paper rockets launched using stomp rocket setup
   2. What causes for separation? Drag
   3. Pick a type of payload (aluminum foil, tape ball, paperball, etc.)
   4. Each or pairs of students design their own paper rockets with a payload and fin design
   5. Test for separation and maybe aiming at a target
4. Project 4 (Payload Bottle Rockets if weather is okay)
   1. Pair of students design a bottle rocket using similar fin design and payload carry design from their paper rockets
   2. Go outside to the field and launch Rockets!