# Out of this World Rocketry

## Lesson 7
## Launch Day

**Materials**

- rocket launcher
- air compressor/ foot pump
- clinometers
- stopwatch
- tape measurer
- launch data sheet
- post-launch student sheet
- **rockets**

**<u>Introduction</u>**

This lesson will help prepare for your launch. Each group can gather the information they need to calculate final statistics for rockets. Four flights will be conducted; one flight-launched perpendicular, to measure altitude. The other three flights will be launched at 60, 45 and 30 degree angles measured for horizontal distance traveled. All four of the flights will be timed to measure the time from launch to touchdown.

**<u>Materials</u>**

1. rocket launcher
2. air compressor/foot pump
3. clinometers
4. stopwatch
5. tape measure or measuring wheel
6. launch data sheet
7. rockets

Students can be in groups of four and each can have a specific responsibility.

1. Launch Director: responsible for the launch countdown and the launching of the rocket.
2. Range Measurement Officer: responsible for measuring distances with the measuring wheel or tape measurer.
3. Clinometer Operator: responsible for operating the clinometer during each of the launches and measuring the maximum height of each rocket launch.
4. Science Officer: responsible for operating the stopwatch and recording measurements from other team members.

Experiment 1 – 90 degrees (perpendicular)

Have each team launch their rocket with the launch tube set at 90 degrees and record the clinometer reading, length of flight in seconds and distance of flights on the launch statistics data sheet.

**Experiment 2 – 60 degrees**

Have each team launch their rocket with the launch tube set at 60 degrees and record the clinometer reading, length of flight in seconds and distance of flights on the data sheet.

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**Experiment 3 – 45 degrees**

Have each team launch their rocket with the launch tube set at 45 degrees and record the clinometer reading, the length of flight in seconds and distance of flight on the data sheet.

**Experiment 4 – 30 degrees**

Have each team launch their rocket with the launch tube set at 30 degrees and record the clinometer reading, the length of flight in seconds and distance of flight on the data sheet.

**Apply**

Which angle made the rocket go the farthest?
Which angle made your rocket reach the highest elevation?
Was the rocket damaged on any flights?
    If yes – how did that affect the other flights?
Why is it important to use the same amount of air pressure in the launcher on each flight?
What are some of the design characteristics of the more successful rockets?
What is the relationship between the launch angle and the distance traveled?
What is the relationship between the launch angle and the elevation?
What should the launch angle of the rocket be to achieve maximum distance?
What should the launch angle of the rocket be to achieve maximum elevation?

Notes – Choosing a launch site
Consider:

1) availability of a power source for the air compressor
2) available flat surface
3) large enough area for rockets to fly at least 100 meters down wind
4) being far enough away from buildings so rockets don't land on buildings

Pressure: Make sure rockets are launched at the same pressure from the launcher. Standard launch pressure is 40 psi with a PVC launcher. **NEVER EXCEED 60 psi.

**Vocabulary**
Measuring wheel: a device for measuring distance that counts the number of revolutions of wheel with a known circumference.
Launch: the release, catapult or send off a self-propelled object.
Touchdown: the moment at which an object returns to the level it was launched at.

# Launch Statistics Data Sheet

Apogee – Tan = opposite leg (b)/ adjacent leg (a)

90 degree launch

Length of flight in seconds: ¬¬¬¬______

Clinometer angle reading at apogee: T = ______

Distance from the launch pad to the touchdown point in meters: _______

60 degree launch

Length of flight in seconds: _______

Clinometer angle reading at apogee: T = _______

Distance from the launch pad to the touchdown point in meters: _______

45 degree launch

Length of flight in seconds: _______

Clinometer angle reading at apogee: T = _______

Distance from the launch pad to the touchdown point in meters: _______

30 degree launch

Length of flight in seconds: _______

Clinometer angle reading at apogee: T = _______

Distance from the launch pad to the touchdown point in meters: ________

# Post Launch

**Introduction**

This activity has students calculate their results from launch day and compile those results into a final statistical report that can be compared to other teams' results. This activity provides an opportunity for team members to assess their results and theorize on ways that they can improve the design of the rocket that their team built.

**Materials**

1. scientific balance
2. launch statistics data sheet
3. rocket performance report

**Experiment 1**

1. Have students measure the mass of their rockets using the balance.
2. Have students complete the rocket performance report using the data that was collected on launch day.
3. List the results to each group on the board so that other groups can see how their rockets performance compared to other designs in the class.

**Reflect**

1. Have students discuss which rockets demonstrated the greatest stability and what characteristics these rockets share that may have resulted in greater stability.
2. Have students discuss which rockets obtained the highest altitude and flew the greatest distance and what characteristics those rockets shared that may have resulted in better performance.
3. Have students discuss which rockets showed the least amount of wear and damage after four flights and what design characteristics resulted in these models showing greater durability.

**Apply**

1. Have students write a summary on what they learned during the unit, have them focus on how they would change their design characteristics in the models for greater durability.

Oklahoma State Cooperative Extension, 2007
Taken from Jay Staker, Iowa State University E-Set

# Post-Launch Student Sheet

**Stability**

1. Were there any external factors that affected your launch data such as wind or rain? If so, describe how they may have affected your results.

2. How could rockets be tested so that external factors could be removed?

3. Did you rockets fly in a smooth controlled arc displaying good stability or was it er ratic and unstable? What factors affected the stability of your rockets?

**Durability**

1. How many additional flights do you believe your rocket could perform?

2. Examine another group or member’s rocket and compare it to your own. Is it in better condition after flight or poorer?

3. How does the other group’s rocket compare to yours in mass?

4. Is there a relationship between mass and durability? If so what relationships do you see?

5. What are some of the characteristics of a durable rocket and why is it important that durability be considered when designing a rocket?