**🔺 Station 3: Launch Angle & Flight**

🔬 **NGSS: MS-PS2-2 – Motion Patterns Based on Angle**
**Goal:** Test how the angle of launch affects projectile distance.

**YOUR MISSION:**

You’re on a mission to unlock the secret of the perfect launch! Your job is to test how changing the launch angle affects how far your projectile flies. Use your catapult, adjust the angles, and find out which one gives the best flight path. Ready, aim, launch!

**🎯 FOCUS:**

Motion, Angles & Projectile Patterns

**Materials at this station:**

* Your completed catapult
* Protractor or printed angle guides (for 30°, 45°, 60°)
* Ruler or tape measure
* Cotton ball or pom-pom (same projectile for all tests)
* Notebook or recording sheet

✅ **Student Directions:**

 **1. Set Up Your Launch Angle**

* Use a **protractor or angle guide** to tilt your catapult arm to each target angle.
* You can also mark pull-back positions if that helps keep your angles consistent.

**2. Test at 30°**

* Launch your projectile at a 30° angle.
* Measure from the front of your catapult to where the projectile lands.
* **Record your measurement** in the table.

 **3. Repeat for 45° and 60°**

* Adjust the angle carefully each time.
* Keep everything else (pull-back amount, projectile type) the same.
* Launch and measure for both 45° and 60° angles.

 **Data Table:**

| **Launch Angle** | **Distance Traveled (cm)** |
| --- | --- |
| 30° | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| 45° | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| 60° | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |

**✏️ Analysis Question:**

**Which angle gave the longest launch distance? Why do you think that angle worked best?**
→ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
→ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**💡 Hints for Success:**

* Make sure to launch from the same surface and height.
* Keep the rubber band tension and projectile consistent.
* Record any observations—Did the projectile go higher, shorter, or straighter?

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🔬 *NGSS Connection:* MS-PS2-2 – Plan an investigation to provide evidence that the change in an object’s motion depends on the forces acting on the object.

✅ **ITEEA STEL Standards – Middle School**

* **STEL 1F** – *Technological systems include inputs, processes, and outputs.*
 → Students input different launch angles and measure the resulting output in projectile motion.
* **STEL 2F** – *Systems can be designed to monitor and control motion.*
 → By adjusting and observing angle changes, students gain control over a motion system.
* **STEL 3F** – *Design is a creative process for solving problems.*
 → Students modify launch angle to optimize flight distance.
* **STEL 4F** – *The engineering design process involves testing and refining designs.*
 → This investigation supports iterative testing and data-driven refinement of the launch mechanism.
* **STEL 5D** – *Data is used to evaluate technological systems.*
 → Students use measurement data to determine which launch angle provides the greatest distance.

✅ **Common Core Math Standards – Middle School**

* **6.SP.B.5** – Summarize numerical data sets in context.
 → Students analyze launch distances associated with different angles.
* **7.RP.A.2** – Recognize and represent proportional relationships between quantities.
 → Students may begin to notice proportional trends between angle and distance traveled.
* **7.EE.B.4** – Use variables to represent quantities in real-world problems and solve word problems involving equations.
 → Students can extend the activity by creating simple models (e.g., graphing angle vs. distance).
* **8.F.B.5** – Describe qualitatively the functional relationship between two quantities.
 → Students describe the relationship between angle and launch performance.

💡 **Summary:**
This hands-on engineering activity supports key **STEM standards** by encouraging students to **test, observe, and record the effects of variable angles** on projectile motion. It blends **physical science, design thinking, and mathematical reasoning**, helping students draw evidence-based conclusions through real-world exploration.