**🎯 Station 5: Redesign for Accuracy**

🔬 **NGSS: MS-PS2-1 – Motion & Net Force (Accuracy through redesign)**  
**Goal:** Modify your catapult to improve accuracy and hit a 100 cm target.

**🚀 YOUR MISSION:**

You’re a design engineer in the Precision Launch Lab! Your challenge is to improve your catapult by adjusting one part at a time—like the angle, force, or mass—to hit a target exactly 100 cm away. Redesign, test, and repeat until your launcher is accurate and consistent!

**🎯 FOCUS:**

Motion, Accuracy & Variable Testing through Redesign

**Materials at this station:**

* Catapult
* Paper hoops or target markers
* Measuring tape
* Projectiles of different mass (e.g., cotton balls, mini pom-poms, etc.)
* Stopwatch (optional for timing launches)
* Ruler or protractor (optional for angle measurements)

**Student Directions:**

**Step 1: Set up your target.**

* Place your paper hoop or designated target **exactly 100 cm away** from the front of the catapult.
* Use the tape measure to be as accurate as possible.

**Step 2: Initial test launch (No modifications).**

* Use your default catapult setup.
* Launch your projectile **5 times** toward the target.
* Count how many times you hit the target.
* Write your score here:  
  **🎯 Target Hits (out of 5): \_\_\_\_\_\_**

**Step 3: Start redesigning!**

* Choose one variable to adjust at a time. You can try:
  + ⬆️ **Changing the angle** of the catapult arm
  + 🟰 **Adjusting rubber band tension**
  + ⚖️ **Switching to a different projectile mass**
  + 🪵 **Changing the base height or stability**

**Step 4: Test your redesigned catapult.**

* After making a change, **launch again 5 times**.
* Record the number of hits and what you changed.

**Step 5: Repeat and refine.**

* Keep redesigning, but only **change one variable at a time** so you can tell what made the difference.
* Try **at least 2 redesigns**.

**Redesign Notes Table (Use your notebook or worksheet):**

| **Redesign #** | **What did you change?** | **Hits out of 5** |
| --- | --- | --- |
| 1 |  |  |
| 2 |  |  |
| 3 (if any) |  |  |

**Which change improved accuracy the most?**  
→ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Wrap-Up Reflection**

**NGSS Connections: MS-PS2-1, MS-PS2-2, MS-PS3-1, MS-PS3-2**

1. 💥 **How did energy change from potential to kinetic in your catapult?**  
   → \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. 🏹 **Which variable had the biggest effect on motion—force, angle, or mass? Why?**  
   → \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. 💪 **If you needed to launch a heavier object farther, what would you change?**  
   → \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**🎓 ITEEA Standards (Standards for Technological and Engineering Literacy – STEL)**

**Standard 7: Design in Technology and Engineering Education**

* **Core Disciplinary Concept 7F**: Refine a design by using prototypes and modeling to ensure quality, efficiency, and productivity of the final product.
* **Core Disciplinary Concept 7G**: Apply design principles to develop and improve products and systems to meet desired outcomes.

**Standard 9: Engineering Design**

* **Core Disciplinary Concept 9D**: Evaluate and test design solutions to identify problems and make modifications.
* **Core Disciplinary Concept 9E**: Interpret and apply data from testing to improve a design.

**Standard 11: Apply the Design Process**

* **Core Disciplinary Concept 11B**: Make decisions about technologies considering the results of design evaluations and experimentation.

**📐 Common Core Math Standards (CCSS.MATH)**

**6.SP.5** – Summarize numerical data sets in relation to the context:

* (a) Reporting the number of observations.
* (c) Describing the nature of the attribute under investigation (e.g., number of hits out of trials).
* (d) Relating measures to the context of the data set.

**7.SP.1** – Understand that statistics can be used to gain information about a population by examining a sample.

**7.SP.3** – Informally assess the degree of visual overlap of two numerical data distributions (e.g., compare before and after redesigns).

**8.F.5** – Describe qualitatively the functional relationship between two quantities by analyzing a graph (optional if students graph hits vs. changes).

These standards support engineering practices such as **iteration**, **data-driven redesign**, and **testing for accuracy**, which are central to this station’s goals. Let me know if you’d like printable versions or if you need similar standards for high school levels.