**🧱 Station 1: Build Your Catapult**

🔬 **NGSS: Engineering Design Prep – (Foundation for MS-PS2-1, MS-PS3-1)**
**Goal:** Construct a working catapult that can safely and consistently launch soft objects.

**Materials at this station:**

* Popsicle/craft sticks
* Rubber bands
* Plastic spoon or bottle cap
* Binder clips or clothespins
* Tape

✅ **Student Directions:**

**STEP 1:. Plan Your Catapult**

* Think about how a lever works: the spoon will be the arm, and you’ll need a base to hold it steady.
* Decide how many sticks to use for the base and how to position the launch arm.

**STEP 2: Build the Frame**

* Stack and rubber-band **at least 5–6 sticks** together for your base.
* Use **2–3 sticks** crossed or spaced out to make a base where the spoon can rest.
* Secure with rubber bands or tape so nothing wobbles or slides.

**STEP 3: Attach the Launch Arm**

* Tape or rubber-band the **spoon** or **bottle cap** to a stick that acts as the lever arm.
* Insert this lever through a small opening in the base so it can pivot (act like a seesaw).

**STEP 4: . Secure and Stabilize**

* Use **binder clips or clothespins** to hold the base firmly to the table if needed.
* Test how far the arm can pull back without snapping or breaking.
* Adjust as needed to make the launch smooth and consistent.

**✏️ Sketch Your Design Below:**

*(Label important parts like base, launch arm, and stabilizers)*
📐 Use arrows to show where energy is stored and released!

**💡 Helpful Tips:**

* The more the spoon bends back, the more potential energy you store!
* Stability = consistency → make sure your base doesn’t shift during launch.
* You’ll modify and test this design in other stations—this is just the start!

🧱 **Station 1: Build Your Catapult**
🔬 *NGSS Connection:* Engineering Design Foundations – Supports MS-PS2-1 (Forces and Motion) and MS-PS3-1 (Energy Transfer)

✅ **ITEEA STEL Standards – Middle School**

* **STEL 1F** – *Technological systems include inputs, processes, and outputs.*
 → Students explore how their design (inputs: materials and force) leads to a result (output: object motion).
* **STEL 2E** – *Systems thinking involves understanding how parts influence one another.*
 → Learners understand how changes in base stability or arm length affect performance.
* **STEL 3F** – *Design is a creative process for solving problems.*
 → Students design, test, and modify a working catapult to achieve consistent results.
* **STEL 4F** – *The engineering design process includes brainstorming, testing, and improving.*
 → The station encourages iterative design — plan, build, test, and adjust.
* **STEL 5E** – *Data and evidence are used to improve designs.*
 → Students observe and reflect on their build’s performance to make improvements later.

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

* **6.SP.B.4** – Display numerical data in plots on a number line, including dot plots and line plots.
 → Students can later graph launch distances or design changes.
* **6.EE.C.9** – Use variables to represent two quantities in a real-world problem that change in relationship to one another.
 → As students modify launch force or design, they relate input (pull-back angle or length) to distance traveled.
* **7.G.B.6** – Solve real-life problems involving area, surface area, and volume.
 → Can be extended by measuring and designing spatial dimensions of the base or arm for efficiency.
* **7.EE.B.3** – Solve multi-step real-life problems using numerical and algebraic expressions.
 → As the activity progresses, students may calculate average distances or predict outcomes from different setups.
* **8.F.B.5** – Describe qualitatively the functional relationship between two quantities by analyzing a graph.
 → Later, students might graph tension vs. distance to discuss increasing returns or limits.

💡 **Summary:**
This activity introduces middle schoolers to **engineering design, forces, and energy**, while laying the groundwork for math integration through **measurement, graphing, and prediction**. It aligns well with iterative design thinking and cross-cutting NGSS concepts like *cause and effect* and *energy transfer*.