**🔁 STATION 3: "Energy Detective" – Potential → Kinetic**

**NGSS Connection: HS-PS3-1 & HS-PS3-2**
**Student Directions:**

**Your Mission:**

You are an **Energy Detective**! Your task is to uncover how energy is stored in your launcher before a launch (potential energy) — and how it transforms into motion energy (kinetic energy) once released. Your job is to test different pull-back distances and track what happens to your projectile’s speed and distance.

**🧰 Materials:**

* Spoon launcher or catapult (from Station 1)
* Ruler or measuring tape
* Marker or tape for measuring pull-back distance
* Cotton balls or safe projectiles
* Stopwatch or phone timer
* Data recording sheet

**🧠 Student Directions:**

**🔧 Setup:**

1. Get your **spoon launcher** or mini catapult from Station 1.
2. Use a ruler to **mark pull-back distances** on the spoon or arm (e.g., 2 cm, 4 cm, 6 cm). You can mark them with a small piece of tape or pen.
3. Set up a **launch area** with enough space to test how far your cotton ball will travel.

**🚀 Experiment:**

1. Choose your **first pull-back distance** (start with 2 cm).
2. Place the cotton ball in the spoon and pull it back to the marked point.
3. Let go to launch the cotton ball.
4. Use your measuring tape to **measure how far it traveled** (from launcher to landing spot).
5. Use a stopwatch to **record the time of flight** (optional if accurate timing is difficult).
6. Repeat steps 4–8 for **each pull-back distance** (e.g., 4 cm and 6 cm).
7. Make careful **observations** about height, speed, or other noticeable changes.

**📊 Data Table – Record Your Results**

| **Trial** | **Pull-Back Distance (cm)** | **Estimated Potential Energy** | **Distance Traveled (m)** | **Observations** |
| --- | --- | --- | --- | --- |
| 1 | 2 cm | Low |  |  |
| 2 | 4 cm | Medium |  |  |
| 3 | 6 cm | High |  |  |

**🔍 Science Notes:**

* **Potential Energy**: This is the stored energy when you bend the spoon back.
* **Kinetic Energy**: This is the energy of motion when the cotton ball flies through the air.

Use this idea to think:

More pull-back = more stored energy = more powerful launch!

**💬 Energy Detective Reflection:**

1. **Where was the energy stored before the launch?**
→ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. **Where did the energy go after the launch?**
→ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. **What happened when you increased the pull-back distance?**
→ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
4. **How do real machines (like springs, slingshots, or bows) use this same idea?**
→ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

🔁 **Station 3: "Energy Detective" – Potential → Kinetic**
**NGSS Connection**:

* **HS-PS3-1** – Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.
* **HS-PS3-2** – Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of objects and the relative positions of objects.

✅ **ITEEA STEL Standards – High School**

* **STEL 1H** – *Energy can be used to do work using many technologies.*
 → Students explore how stored mechanical energy (potential) transforms into motion (kinetic) using a launcher, a real-world example of energy conversion.
* **STEL 2H** – *Systems thinking applies logic and creativity with appropriate compromises in complex real-life problems.*
 → Learners must analyze how system inputs (like pull-back distance) affect outputs (launch distance, speed), reinforcing the cause-effect relationship in engineered systems.
* **STEL 3I** – *Design and research in technology and engineering contexts use models and simulations.*
 → Students use a catapult as a model system to simulate energy transformations, observing how design choices influence energy behavior.
* **STEL 4G** – *The engineering design process is a purposeful, iterative approach to problem solving.*
 → Repeated trials help students optimize their launcher setup and understand energy changes through hands-on experimentation.
* **STEL 5G** – *Data informs decisions about technological systems.*
 → Students gather, record, and analyze data about energy input (pull-back) and output (motion), interpreting how potential energy impacts results.

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

* **HSN.Q.A.1** – Use units as a way to understand problems and guide the solution of multi-step problems; choose and interpret units consistently in formulas.
 → Students measure pull-back distance (cm), launch distance (m), and time (s), using consistent units to compare energy effects.
* **HSN.Q.A.2** – Define appropriate quantities for the purpose of descriptive modeling.
 → Students assign relative “energy levels” (low, medium, high) based on distance pulled and relate them to measurable outcomes.
* **HSA.CED.A.2** – Create equations in two or more variables to represent relationships between quantities.
 → Students explore relationships between pull-back distance (as a proxy for potential energy) and resulting motion, which could be graphed or modeled mathematically.
* **F.IF.B.4** – Interpret key features of functions in terms of the quantities they represent.
 → Students can represent how increasing pull-back distance affects travel distance or motion time, identifying trends in kinetic behavior.

💡 **Summary**
This station emphasizes energy transformation from potential to kinetic in a hands-on, measurable way. By launching objects at different energy levels, students apply engineering design thinking, scientific modeling, and mathematical analysis — making the concept of energy transfer tangible and testable.