**🧪 Measurement Matters! – Exploring Forces, Energy, and Materials**

**Name:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_    **Date:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  
**Class/Group:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_   **Partner(s):** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

🎯 **Your Mission:**  
You are a Measurement Detective! Your job is to use real scientific tools to investigate how size, mass, voltage, and energy affect motion and materials. Rotate through each station, follow the instructions, and record your observations.

**📍 Station 1: Ruler Runway**

**Focus:** Measuring Distance, Speed & Kinetic Energy  
**NGSS:** MS-PS3-1, MS-PS3-5, 2-PS1-1

**Goal:**

Investigate how the **height of a ramp** affects the **speed** and **distance** of a moving object (toy car or marble). Learn how height, speed, and kinetic energy are connected!

### **Materials Needed:**

* Ramp (build with a binder, clipboard, or stack of books)
* Toy car or marble
* Ruler or measuring tape
* Stopwatch or timer (a phone works)
* Notebook or worksheet to record your data

**Student Directions:**

#### tep 1: Build Your Ramp

1. Use 1 book to start. Lay a ruler, clipboard, or flat board on top to make a ramp.
2. Place the **bottom of the ramp on the floor** and the top on the book stack.

#### 🔹 Step 2: Test Run

1. Place the toy car or marble at the top of the ramp.
2. **Let it go—don’t push it!** Start your timer as it begins to move.
3. Stop the timer when the car reaches the bottom of the ramp.

#### 🔹 Step 3: Measure

1. Use the ruler to measure how far the car or marble travels after it leaves the ramp (distance).
2. Record how long it took (time).
3. Repeat the run **2 times for each ramp height** to get an average.

#### 🔹 Step 4: Change Ramp Height

1. Add one more book under the ramp. Repeat the test steps above.
2. Do the same again with 3 books.

### 📊 What to Record:

Use a table like this in your notebook:

| **Ramp Height (Books)** | **Distance Traveled (cm)** | **Time (s)** | **Speed = Distance ÷ Time (cm/s)** |
| --- | --- | --- | --- |
| 1 Book |  |  |  |
| 2 Books |  |  |  |
| 3 Books |  |  |  |

### 💬 Reflection & Discussion:

1. **What happened to the distance and speed as the ramp got taller?**  
   → \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  
   → \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. **What does this tell you about energy and motion?**  
   → \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. **If we used a heavier object, what might happen? Why?**  
   → \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**What to Record:**

* Ramp Height: \_\_\_\_\_\_\_\_
* Distance Traveled: \_\_\_\_\_\_\_\_
* Time Taken: \_\_\_\_\_\_\_\_
* Speed (Distance ÷ Time): \_\_\_\_\_\_\_\_

📝 **What did you notice when the ramp got taller?**  
→ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  
→ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

## 🧪 Measurement Matters! – Station 1: Ruler Runway

**NGSS Standards:**

* **MS-PS3-1** – Construct and interpret graphical displays of data to describe the relationships of kinetic energy to the mass of an object and to the speed of an object.
* **MS-PS3-5** – Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.
* **2-PS1-1** – Plan and conduct an investigation to describe and classify different kinds of materials by their observable properties.

### ✅ ITEEA STEL Standards – High School

**STEL 1E** – Technological systems use inputs, processes, outputs, and feedback to solve problems.  
→ Students measure and test how height (input) changes speed and energy output (process/output) in physical systems.

**STEL 2E** – Technological systems are made up of interactive parts.  
→ Ramp angle, surface material, object mass, and motion interact to affect outcomes—demonstrating system behavior.

**STEL 6F** – Energy can be transferred and transformed through systems.  
→ Students observe how potential energy is transformed into kinetic energy as the object moves down the ramp.

**STEL 7F** – Technological products and systems can be used to apply energy in a variety of ways.  
→ Learners examine how gravitational potential energy is applied to create forward motion.

**STEL 11F** – Modeling, testing, evaluating, and modifying are used to transform ideas into practical solutions.  
→ Students model speed and motion relationships using measurement tools and testing multiple variables.

### ✅ Common Core Math Standards – High School

**CCSS.MATH.CONTENT.HSN.Q.A.1** – Use units as a way to understand problems and to guide the solution of multi-step problems.  
→ Students calculate and compare speed using consistent units (cm/s) and interpret numerical results.

**CCSS.MATH.CONTENT.HSN.Q.A.2** – Define appropriate quantities for the purpose of descriptive modeling.  
→ Students decide what quantities (ramp height, time, distance, speed) to measure to model kinetic energy.

**CCSS.MATH.CONTENT.HSN.Q.A.3** – Choose a level of accuracy appropriate to limitations on measurement.  
→ Students improve accuracy by timing and measuring carefully and averaging repeated trials.

**CCSS.MATH.PRACTICE.MP4** – Model with mathematics.  
→ Calculating average speed and comparing it across ramp heights involves mathematical modeling of real-world motion.

**CCSS.MATH.PRACTICE.MP5** – Use appropriate tools strategically.  
→ Students use rulers, timers, and charts to gather and analyze physical data to draw conclusions about motion.

### ✅ Summary:

This station aligns with high school-level **engineering, systems thinking, energy transfer**, and **mathematical modeling**. It supports both **ITEEA STEL** and **Common Core Math** by requiring students to:

* Measure and analyze real-world variables
* Use tools precisely
* Interpret how energy and force apply to motion systems