

Name

## Newton's Laws Investigation

Date

Your responses to the following questions will be assessed using the following criteria: B - Communication in Science, D - Scientific Inquiry, and E - Processing Data.

**Important information you need to understand prior to starting this lab**

**Momentum:** All moving objects have what Newton called a "quantity of motion." Today we call this **momentum**. **Momentum** is a characteristic of a moving object that is related to the **mass and velocity** of the object. **The momentum of a moving object can be determined by multiplying the object's mass and velocity.**

$$\text{Momentum} = \text{Mass (kg)} \times \text{Velocity (m/s)}$$

therefore the units we will use when looking at momentum are:

$$\text{kg(m/s)}$$

**Force:**

**Force is measured in kilograms times meters per second per second ( $\text{kg m/s}^2$ ).** The short form for this unit of force is the **newton (N)**. Recall that a newton is the SI unit of force. **You can think of 1 newton as the force required to give a 1-kg mass an acceleration of  $1 \text{ m/s}^2$ .**

**For this investigation, you will be using the PASCO force sensor to measure force in Newtons, and the motion sensor to measure velocity.**

1. On the paper given to you by Mr. Arnold, Draw an annotated (labeled) diagram of the sample experimental set up you see in the middle of the room. Every part of the experiment should be labeled.

### Questions 1 - 4 : Criterion D - Scientific Inquiry

1. **The Question:** A good science lab or experiment always begins with an **investigative question**. After looking over the experimental set-up, please **write in detail** the question you believe we will be investigating. **You must get this OK'd by Mr. Arnold before your group moves any further!**

**2. The Variables.** All experiments include three types of **variables**. **Variables** are factors (or parts) that can be changed in an experiment.

**Manipulated variable** – the **ONE** factor that you change in an experiment. This is very important!

What are three possible variables your group can change in this experiment:

- 1.
- 2.
- 3.

**Controlled variables** – factors that must stay the same throughout the experiment. There is always more than one.

Type or write three controlled variables in this experiment here:

**Responding variable** – This is what you measure in an experiment. This could be distance, volume, weight, mass, change in color, etc...

Type the responding variable in this experiment here:

3. Now that your group has determined your investigative question and your manipulated variable, please type what you **predict** will happen in this experiment.

**4. The Materials.** This is the complete list of everything you need in order to successfully conduct the experiment. (Things like paper and pencil don't need to be included).

Type or write a bulleted list of the materials we will use in this experiment:

**4. The Procedures.** A step-by-step, detailed set of instructions for successfully completing the experiment.

A couple hints for writing procedures:

1. Think of a recipe for baking cookies. It's very important that you read the instructions carefully or else you do all that work and the cookies come out terrible!
2. Write each step with so many **details** that a 3<sup>rd</sup> grade student could follow them.

Type or write the procedures here: Don't forget to **number each step! You should have a minimum of 10 steps. You must get this OK'd by Mr. Arnold before moving on.**

### The Data.

1. You will be using Pasco equipment to determine the **force (N)** generated by the car rolling down the ramp. However, you need to create a table in which to record that data. **Create a table** that you will use to record your data.

Here are some things your data table needs:

1. Enough rows or columns to record a **minimum of 5 trials**
2. The **units** that you are measuring.
3. Specifics about your **manipulated variable**. Example - If you added mass to the car, what is the mass of the car without added weights, and what is the mass of the car after you have added the weights?

