

# Rubber Band Car Experiment

Presented by Idaho EPSCoR and the University of Idaho

## Introduction

The Idaho EPSCoR office is pleased to bring the Science Educator in Residence rubber band car experiment presented by Dr. Richard Hermens back into Idaho classrooms. The following instructions have been redesigned in order to provide a more dynamic lesson format. The learning

objectives have been expanded to meet the Idaho Department of Education's learning requirements as outlined in Idaho's Integrated Instructional Guide found at:

<http://www.sde.state.id.us/admin/coursesofstudy/science.htm>

## Step 1 - Setup

Using a tape measure and masking tape, the instructor, or at the instructor's discretion, the students, should lay out a 20' track with even increments to measure the distance. Depending on the size of the class and number of cars available, the instructor may decide to have the students lay out multiple tracks. Alternatively, a starting line can be laid down with tape, and each car's distance can be measured and recorded separately.

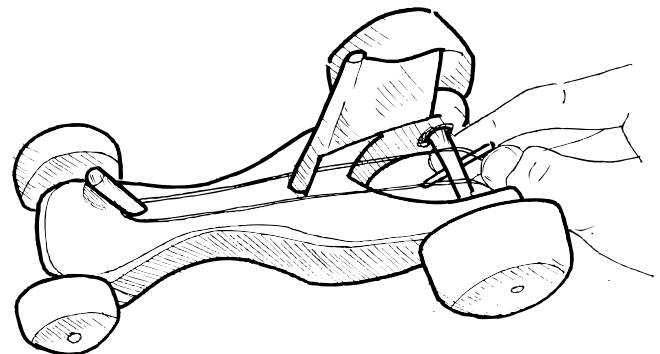
### Materials

- ∇ Rubber band car (wood car, lego car, coffee can car)
- ∇ Rubber bands of various lengths and thicknesses
- ∇ 20' measuring tape
- ∇ Masking tape
- ∇ Writing utensil
- ∇ Weights (optional: washers, nuts, pennies, etc.)

## Step 2 - Demonstration

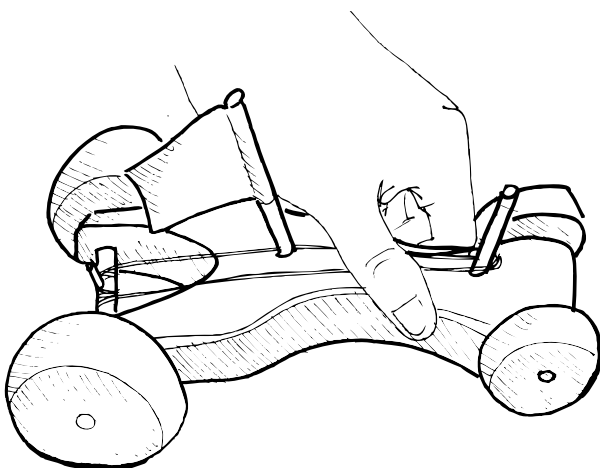
**A**

Show how to use the car by stretching the rubber band from the front peg on the car to the axle pegs. To make things more interesting, you may decide to have the students figure out how to make the car run.



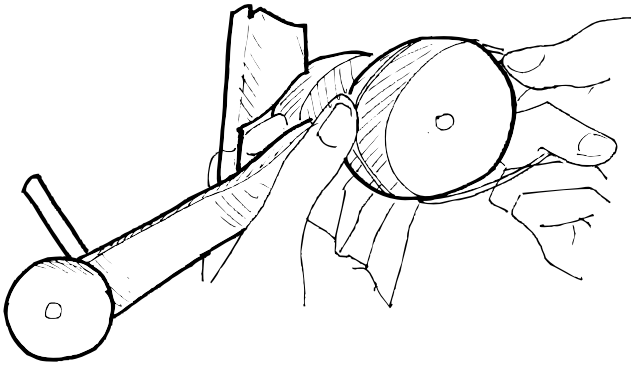
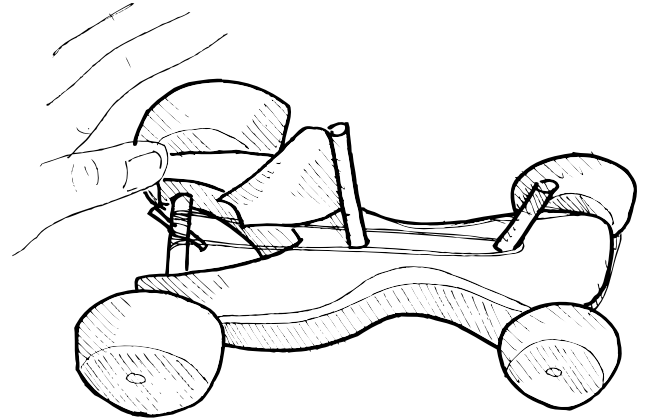
**B**

Place the car on a flat surface (e.g., the floor) then drag the car backward to wind the rubber band around rear axle several times. This will provide the tension or force (potential energy) necessary to propel the car, giving it motion.



**C**

Release the car to demonstrate the conversion of stored or potential energy to kinetic energy as the car accelerates.

**!**

Note: Operator of the car may discover when car is released that it does not go very far. This is most likely caused by low traction on the wheels. Add more traction by wrapping smaller length rubber bands around the circumference of the wheels.

## STEP 3 - Lessons

You can choose to let the class, as one group, or each student individually, form his/her own hypotheses before conducting these experiments, or even before demonstrating the car.

Appropriate questions to ask may be: “Will the car go further or stop sooner if . . .

- Several rubber bands are stretched around the tires for traction?
- Weight is added?
- An inclined plane is used?”

Some of these lessons / experiments may not be possible due to lack of materials. In this case a class discussion about the lesson’s principle can be substituted. Either during or at the end of the lesson you may choose to incorporate Newton’s laws as they apply to each lesson.

### 1. Friction

Have the students run the cars along the track. Measure the distances. You may opt to label pieces of masking tape with students’ names for distance markers. Repeat these races with the addition of rubber bands wrapped around the wheels to increase traction or friction. Again, have the students measure the results and compare the results with previous trials.

### 2. Gravity

If materials are available, create a ramp and have the students run the cars up the ramp and down the ramp. Explain how gravity affects the distance the car will travel.

### 3. Inertia and Mass vs Weight

Discuss with the students the effects of mass on inertia and how mass differs from weight. Add weight to the cars by placing weights on the car. Suggested ways to attach weights to car include: placing washers over large pegs on top of car, tape pennies, magnets, ball bearings, etc., to top flat part of car. Again, release the cars and mark the distance.

## Scientific Vocabulary

### Force

Force is an external agent that changes the motion or state of rest of an object. Throwing a football or pulling a kite are examples of applying force.

### Friction

Friction is the opposing force between two objects in contact with each other. Friction can cause heat and even physical warping.

### Gravity

Gravity is the force of attraction between two particles or objects that have mass. The larger an object, the more force it exerts on its surroundings. This force is so small that until you get to objects the size of planets, it is difficult for human senses to notice.

### Hypothesis

Hypothesis, in science, is a statement of a possible explanation for some natural phenomenon. A hypothesis is tested by drawing conclusions from it; if observation and experimentation show a conclusion to be false, the hypothesis is false.

### Inertia

Inertia is the property that causes an object to resist its change in motion, or, if it is at rest, causes it to remain at rest. Due to inertia, an object in motion tends to stay in motion, and an object at rest tends to stay at rest, unless it is acted upon by a force (such as friction or gravity). Inertia is the key to Newton's first law of motion.

### Kinetic Energy

Kinetic energy is energy that causes motion. When an object is in a state of movement, it is said to have kinetic energy. A bicyclist can use chemical energy from food to accelerate to a speed and gains kinetic energy; the bike will continue to move at speed until it is acted upon by outside elements (the bike will eventually be slowed by friction and wind resistance, converting the kinetic energy to heat).

### Mass

Mass is the amount of matter (material) in an object; it is not affected by the type or how much force is exerted on an object. Mass and weight are different, because weight is affected by the gravitational force exerted on an object. A bowling ball and a basketball are about the same size, but a bowling ball contains more matter (it's solid and has more mass).

### Motion

Motion is a change in position of an object from one place to another.

### Newton's Laws of Motion

1. An object at rest will remain at rest, and an object in motion will remain in motion, unless it is acted on by an external force (such as gravity or friction).
2. An object that is acted on by a force will accelerate in the direction of that force. The acceleration depends on the mass of the object and the net force. Net force is the sum of all of the forces acting on an object. If there are two equal forces acting on an object in opposite directions, the forces will cancel each other out.
3. Every action has an equal and opposite reaction.

### Potential Energy

Potential energy is the capacity of an object to do work (or move) due to its position. For example, if you hold a ball above the floor, it has potential energy. If you drop it, it has kinetic energy as it falls. A compressed spring also has potential energy.

### Simple Machine

A simple machine is a device that only requires one application of force to function. There are six simple machines: the inclined plane, the wheel and axle, the lever, the pulley, the wedge, and the screw. These are the basis for all other machines.

### Weight

Weight is a measure of the earth's gravitational force on an object. Weight can change, depending on an object's position relative to the earth. For example, an object in space weighs less than the same object on the earth's surface. Also, an object weighs less on the moon, because the moon has a lower gravitational force.

## Concerning Educational Standards

If you choose to incorporate them, this rubber band car activity meets the following educational guidelines as set forth by the State of Idaho:

1. Simple machine: the wheel and axle of the rubber band car is a simple machine.
2. Hypothesis formation: a hypothesis can be formed before developing the test that can accept or reject the hypothesis.
3. Technology design: the making of the car and subsequent alterations in the design support experiences in technology design.
4. Newton's Laws of Motion: the car can be used to demonstrate two of Newton's laws.