

Capstone: Design & Test a Force-Powered Vehicle

Name: _____ Date: _____

LEARNING OBJECTIVE

The student will design, build, and test a simple vehicle powered by a non-motor force (balloon, rubber band, or gravity/ramp), applying and explaining the physics concepts learned this quarter.

MATERIALS NEEDED

- A small cart base (recycled cardboard, bottle caps as wheels, skewers or straws as axles) or a simple toy car
- a balloon or rubber band for propulsion (or a ramp for a gravity-powered design)
- tape
- scissors
- measuring tape
- stopwatch
- paper
- pencil

HANDS-ON ACTIVITY

1. Design your vehicle on paper first, sketching your build and labeling the force that will power it (balloon thrust, rubber band tension, or gravity down a ramp) and predicting which force/motion law explains how it will move.
2. Build your vehicle using your chosen materials, attaching wheels/axles so it can roll freely and mounting your power source (balloon, wound rubber band, or ramp setup).
3. Test your vehicle at least three times, measuring the distance it travels or the time it takes to cross a fixed distance each time, and record all results.
4. Make one deliberate design change (more air in the balloon, a lighter frame, a steeper ramp, added weight, etc.) based on what you learned about forces this quarter, then retest three more times.
5. Prepare a short presentation (poster, index cards, or verbal) explaining your design, your results, and which Newton's Law(s) and force concepts explain why your vehicle moved the way it did -- present it to a family member.

QUESTIONS

1. What force powered your vehicle, and what change did you make between your first and second design?
-

2. How did your design change affect performance (distance or speed), and does that match what you'd predict from Newton's Second Law ($F = \text{mass} \times \text{acceleration}$)?

3. Identify at least two of Newton's Laws (or other force concepts like friction or momentum) that explain how your vehicle worked, citing specific parts of your design.

4. Looking back across this whole quarter's experiments (inertia, force/mass/acceleration, action-reaction, friction, gravity, levers, momentum), which single concept do you think mattered most to your vehicle's success, and why?
