It’s a Wild Ride | Learning That Works
Phase Two Science: Investigating Laws of Motion

In Phase 2 Science, students complete several lab investigations on the Laws of Motion over a couple of periods.

Theresa Maves organizes investigations in a consistent way. She begins the period with a brief demonstration, usually a discrepant event, which initiates discussion about the principle demonstrated. Students then work in groups to complete a set of short investigations. Each group receives a shoebox with the needed supplies. The period ends with brief summaries of findings from each group.

There are many great investigations for Newton’s Laws and there are also many software programs that explore the same ideas, but I find that 8th graders need the more kinesthetic, hands on activities at the beginning.

---Theresa Maves

Theresa chose the following investigations for their simplicity and use of everyday objects from two published curricula.

**Newton’s First Law of Motion:** Students set up, observe, and describe results in terms of inertia for the following four activities:

1. **Money Going Nowhere**—Flick a card from under a coin resting on a glass.
2. **Checker Inertia**—Flick a checker toward a stack of checkers.
3. **Inertia Breaks a Pencil**—Compare the difference when a pencil hanging over a table is struck slowly and fast.
4. **Egg Inertia Challenge**—Compare the spin of hard- and soft-boiled eggs. Find the center of gravity.

**Newton’s Second Law of Motion:** Students complete two small group explorations and a homework assignment on the relationship between force, mass, and acceleration:

1. **Newton’s Acceleration Ramp**—Construct a tabletop ramp with a grooved ruler raised on one end with a 1” block. A bar magnet is placed to one side of the low end. Compare and describe in terms of Newton’s Laws, the distance and location where three balls stop rolling: a marble and a small and a large ball bearing.
2. **The Earth Obey the Laws**—Spin a Styrofoam ball attached to a string tied on a nail that is pushed halfway into a ball. Go outside and compare the path of the ball when you whirl the ball gently to what happens when you speed up the rotation and the ball leaves the string.
3. **Satellites Also Obey the Laws (homework)**—Attach a ball tightly to a string. Thread the string through a spool with the ball on one end of the string. Attach weights to the other end of the string. Observe and explain what happens when you swing the ball slowly in a circle while holding on to the spool. Repeat, spinning it rapidly.
Newton's Third Law of Motion: Students carry out investigations on action and reaction:

1. **Balloon Rockets**—Thread about 10m of string through a straw and fasten one end to the ceiling. Have a student hold the other end of the line at the floor. Blow up a balloon, and hold the air inside while tapering it to the straw. Release the balloon. Repeat the activity with a horizontal string with some slope. Observe and discuss what occurs.
   - Balloon Rocket Handout

2. **Match Missiles**—Wrap a match in tinfoil and lean it at an angle against a paper clip. Heat the head of the wrapped match with a lit match. Observe and discuss what occurs.

3. **Newton’s Action Reaction Puzzler**- Students predict which way a cork (tied to a string in the center) will move in floating water when it is jerked in certain directions.

   *The balloon rockets and the match missiles are the students' favorites; they get plenty of experience with collecting data, measuring and using the formulas for speed as well as exploring Newton's Laws.*
   —Theresa Maves

**Velocity, Acceleration, Momentum, and Gravity:** Students complete four investigations of falling objects and two investigations on the transfer of energy:

1. **How Fast and How Far Does It Fall?** Toss a ball as high as you can and time how long it takes to fall from the highest point. Calculate final velocity (assuming no air resistance): \( V = g \times T \), where \( V \) is velocity, \( g \) is acceleration due to gravity, and \( T \) is time. Calculate distance it fell: \( D = \frac{g \times T^2}{2} \)

2. **Falling Fun**—Try to catch a ruler falling between your thumb and index finger. Record the inches. Convert inches into falling time.

3. **Will Paper Fall Like Stone?** Predict and compare the time it will take to drop a book, a piece of paper, and a paper resting on top of the book.

4. **Falling Pennies**—Flip a folded card with two pennies on it. Observe the rate of the two pennies falling in different directions.

5. **Transferring the Energy of Motion**- Students experiment with marbles to explain momentum.

6. **Pendulums in Motion**—Students create a pendulum and conduct experiments with different string lengths, arcs, and weights.

   *The falling investigations are the most intriguing and thought-provoking activities for the students. We had the best class discussions.*
   —Theresa Maves