Valentine Thaumatrope

Activity: Valentine Thaumatrope
Location: Inside
Time: 30 minutes
Grades: K-6
Standards:K.PS.3: Plan and conduct an investigation to compare the effects of different strengths or different directions of pushes and pulls on the motion of an object.

- **3.PS.1:** Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object.
- **4.PS.1:** Investigate transportation systems and devices that operate on or in land, water, air, and space and recognize the forces (lift, drag, friction, thrust, and gravity) that affect their motion.
- **4.PS.4:** Describe and investigate the different ways in which energy can be generated and/or converted from one form of energy to another form of energy.
- **3-5.E.2:** Construct and compare multiple plausible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.
- **3-5.E.3:** Construct and perform fair investigations in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can't be improved.
- **6.PS.3** Describe how potential and kinetic energy can be transferred from one form to another.
- **7.PS.4** Investigate Newton's first law of motion (Law of Inertia) and how different forces (gravity, friction, push and pull) affect the velocity of an object.
- **7.PS.5** Investigate Newton's second law of motion to show the relationship among force, mass, and acceleration.
- **7.PS.6** Investigate Newton's third law of motion to show the relationship between action and reaction forces.
- **7.PS.7** Construct a device that uses one or more of Newton's laws of motion. Explain how motion, acceleration, force, and mass are affecting the device.

Background Information: A thaumatrope is a simple optical illusion toy that was popular in the 19th century. It is simply a piece of strong paper with a image drawn on both sides and attached to a stick or two pieces of string as a means to spin it. When spun, the two images appear to merge or blend due to the persistence of vision.
Persistence of vision refers to the optical illusion whereby multiple discrete images are perceived as a single image in the brain. The retina in your eye sends visual information to your brain but the image produced by the retina lingers for 1/10 to 1/20th of a second. The thaumatrope tricks your brain by switching images faster than 1/10th of a second. The first image is still lingering on the retina when the second image is seen, thus the two images blend and are seen as one. This is called "the principle of the persistence of vision".

The thaumatrope was just one of many optical illusion toys popular in the 1800s. It is also credited with being the first cinematographic device and inspired the creation of moving pictures. Just like the thaumatropes we made, movies and cartoons use the persistence of vision to make flashing pictures appear to move.

Materials: Squares of cardstock with holes punched (as in picture above), markers, glue sticks, rubber bands

Procedures:

1. Introduce the term “thaumatrope” - A thaumatrope is a simple optical illusion toy that was popular in the 19th century. It is simply a piece of strong paper with a image drawn on both sides and attached to a stick or two pieces of string as a means to spin it. When spun, the two images appear to merge or blend due to the persistence of vision. (Can include more information for older students)
2. Have students cut the cardstock to size, or provide pre-cut cardstock for younger students. Students will then hole punch opposite sides in the center (see photo).
3. Demonstrate how to secure rubber bands to each end.
4. Students will work together to make the thaumatrope work. One person holds both ends of rubber bands taut, while another twists the card. They can test how many twists are necessary for the optical illusion to work.
5. Extensions: Students can test and record data about number of twists necessary for illusion to work. They can also test different sizes of cardstock to see if this effects the number of twists necessary.
6. Reflection - What other uses could this have? What other optical illusions do you know of? What do you wonder about how your eyes work or can be “tricked? What laws of motion did this experiment demonstrate?
   Source: adapted from a lesson found at
   https://www.playdoughtoplato.com/valentine-thaumatropes/