Introduction to Physical Science: Force and Motion (Steamed Up) Activity #2

**Link to Instructional Video:** <http://www.youtube.com/watch?v=PD7a1EWjsTc> (force and motion)

<http://www.youtube.com/watch?v=sabH4bJsxWA> (more for teachers for Newton’s First law)

<http://www.youtube.com/watch?v=pgH-4P73e0A> (for teachers Newton’s Second Law)

<http://www.youtube.com/watch?v=e3OMCKD_rS4>(for teachers Newton’s Third Law)

<http://www.youtube.com/watch?v=ctpRmvUkSz0> (demo to assist with friction with marbles)

<http://www.youtube.com/watch?v=1R098YvFfjM> (all three laws with two marbles)

<http://www.youtube.com/watch?v=hRBPirh0VGY> (Bill Nye- Motion

<http://www.youtube.com/watch?v=rrx5Viqa1Kc> (best one yet as an example of what students could do to demonstrate their level of understanding)

Grades: 3&5

 **Objectives**

Students will be able to do the following when the task is finished.

* Understand the ideas of motion and force
* Be able to demonstrate Newton’s three laws of motion using the materials provided.

Task:

Test Newton's three laws of motion in a game of marbles and be able to demonstrate and discuss at the end of the task.

**Materials**

* Marbles, about 10 per student group
* Chalk, 1 piece per student group
* Paper and pencils
* Computer with Internet access (optional) or class notes

**Procedures**

1. Discuss the concept of motion and the factors that control motion.
2. After watching a video clip, talk about Newton's three laws of motion. What are Newton's laws? What is inertia? Write the three laws of motion on the chalkboard or on a large piece of paper in front of the class.
3. Ask student volunteers to read the laws aloud and explain them in their own words. Ask for students to break up into groups of 4-5 and position themselves at one of the pieces of chart paper. The students will have three minutes to write down examples that they can think of when they have seen these laws at work. Switch after three minutes so that each group has an opportunity to write something or disagree with something written. Take two minutes to do a whole class review.
4. Give each group about 10 marbles. Take the class outside and have one student per group draw a circle about two-feet in diameter with the chalk. Ask each group to sit on the outside of their circle. Have each student select a marble to be used as a "shooter." Remind students to pay attention to how their shooters look so that they can pick it out if it winds up in a group of marbles at any point.
5. Demonstrate how to play the game: players hold on to their shooters, the rest of the marbles are placed in an "X" formation in the center of the circle. When it is your turn you flick your marble into the circle, attempting to hit other marbles out. Any marble your shooter sends out of the circle goes into your pile. If you hit marbles out of the circle, or if your shooter travels outside the circle, you get to pick up the shooter and safely wait for your next turn. If your shooter gets caught in the circle on a turn and you don't flick any other marbles out, your shooter has to stay where it is until all other players have had their turn. If this occurs, other players can attempt to flick your shooter out of the circle. If they do, you have to give them all the marbles you have captured and you are out of the game. The person with the most marbles at the end of the game wins.
6. Allow students to play several rounds of marbles. While they are playing, walk around the groups and ask them questions about what is happening in the circle. Encourage the students to change the size of the circle, the place where they are playing the game and so forth. Have each group write down what they observe.
	* What happens to a marble that hasn't been hit by a shooter?
	* Will a shooter keep on moving if it doesn't hit any marbles?
	* Talk about the laws of motion while you walk around the circles, pointing out examples of the laws at work in the marble games.
7. After several rounds of marbles, ask students to clean up and return to the classroom. Once students have returned to their desks, read Newton's laws of motion aloud and ask volunteers to talk about examples of these laws at work in their marble games.
	* When a shooter hit a marble in the circle, what happened to it?
	* What happened to marbles that were at rest if they were never hit by another marble? What happened to the shooters if they were not blocked by a marble after being flicked?
8. Have students write each of the three laws of motion on a piece of paper in their own words, and write a paragraph describing examples of each law that occurred during their marble games. When students have finished, ask volunteers to read their paragraphs aloud

**Evaluation:**

Use the following three-point rubric to evaluate students' work during this lesson.

* **Three points:** Students were highly engaged in class discussions; fully participated in their group marble games; and wrote well-organized paragraphs correctly describing examples of how each of Newton's three laws of motion worked during the marble games.
* **Two points:** Students participated in class discussions; somewhat participated in their group marble games; and wrote adequate paragraphs that correctly described examples of how two of Newton's three laws of motion worked during the marble games.
* **One point:** Students participated minimally in class discussions; did not participate in their group marble games; and wrote incomplete paragraphs that did not correctly address Newton's three laws of motion.

**Vocabulary**

**Force**
*Definition:* A measurable strength or power that has an effect on an object
*Context:* Our world is full of forces that push and pull on everything in it.

**Gravity**
*Definition:* The force that attracts bodies toward the center of Earth, or towards any other physical body having mass
*Context:* Gravity pulls objects toward the Earth, keeping them from floating into space.

**Inertia**
*Definition:* The tendency of objects to resist changes in their states of motion
*Context:* Inertia causes motionless objects to remain motionless and moving objects to continue moving until they come in contact with an outside force.

**Matter**
*Definition:* Physical substance or material which occupies space and has mass
*Context:* Almost everything around you is matter.

**Molecule**
*Definition:* A substance made up of one or more atoms
*Context:* As matter changes from one state to another it is important to remember that changes are happening to the molecules inside the matter.

**Motion**
*Definition:* The act of changing position
*Context:* The marble's motion is slowed when it hits another marble.

**Credits** (original Tamar Burris, former elementary teacher and freelance education writer)

Rewrite with STEAM extensions Cathy Dalimonte, Michelle Chadwick and Shelly Alford

Force and Motion – 3rd and 5th grades Marbles

Science – (Shelly provided 5th standards)

3rd Grade – Science

3. P.1.1 – Infer changes in speed or direction resulting from forces acting on an object

3. P.1.2 – Compare the relative speeds (faster or slower) of objects that travel the same distance in different amounts of time.

**ARTS** – As students shoot the marbles, they record the movement to create a marbles “line art” piece using a different color for each marble and their reaction (can use MS Word using Insert Shapes – circle and lines) – in the example the marble was shot and hit another marble and that marble changed directions

3. V.1.4 Understand the characteristics of the Elements of Art, including **lines,** shapes, colors, **textures**, **form**, space, and value.

3. CX.2.2 Understand how to use information learned in other disciplines, such as math, science, language arts, social studies, and other arts in visual arts.

5. CX.2.2 Exemplify how information and skills learned in art can be applied to other disciplines

**Math**

Reinforcement of types of lines – perpendicular/parallel; weight vs. mass (<http://www.diffen.com/difference/Mass_vs_Weight>) – which leads to measurement objectives –

[CCSS.Math.Content.3.MD.A.2](http://www.corestandards.org/Math/Content/3/MD/A/2) Measure and estimate liquid volumes and masses of objects using standard units of grams (g), kilograms (kg), and liters (l)

[CCSS.Math.Content.5.MD.A.1](http://www.corestandards.org/Math/Content/5/MD/A/1) Convert among different-sized standard measurement units within a given measurement system (e.g., convert 5 cm to 0.05 m), and use these conversions in solving multi-step, real world problems.

**Technology** 3.TT.1 and 5.TT.1 - Use technology tools and skills to reinforce classroom concepts and activities