Science Unit: ***Force and Motion***

Lesson 2: ***Force and Motion – Part 2***

School year:	2004/2005
Developed for:	Queen Alexandra Elementary School, Vancouver School District
Developed by:	Paige Axelrood (scientist), Nancy Arnold and Karen Dixon (teachers)
Grade level:	Presented to grades 1 - 2; appropriate for grades 1 – 5 with age appropriate modifications.
Duration of lesson:	1 hour and 20 minutes
Note:	This lesson requires 1 adult per station.

Objectives

1. Learn about different forces and how they act on matter.
2. Learn that gravity is a force that pulls matter downward and that gravity pulls on all matter equally.
3. Learn that friction can slow down or stop the movement of an object.
4. Learn that objects stay still unless a force causes the object to move and that force can stop a moving object.
5. Gain experience testing and making observations of different forces on different types of matter.

Background Information

Matter is anything that occupies space. Four properties of matter are mass, weight, volume and density. The three states of matter are solids, liquids and gases. Different types of forces act on matter. A force is a push or pull on an object. Force can be used to move an object or to change the shape of an object. Galileo discovered insights about force and motion and Sir Isaac Newton defined three laws of motion. The first law states that an object will remain still or keep moving in the same direction unless a force acts on the object. This law relates to inertia and momentum. The second law states that a force can act on an object to change the movement of the object, either by a change in speed or a change in direction. The amount of force needed to move an object or stop the movement of an object is related to the mass of the object. The third law states that as a force acts on an object, the object responds with a pull or push equal in strength but in the opposite direction (for example, the force needed to bounce a ball: the force travels in a downward movement from the hand to the ball and the ball bounces up after it hits the floor). Force and motion can be affected by many factors such as friction, air resistance, and the elasticity of an object. Gravity is a force that pulls matter downward on Earth. Energy causes things to happen and energy comes in different forms (for example: heat energy, light energy, chemical energy, electrical energy, nuclear energy, and mechanical energy). Energy can be defined as the ability to do work and energy can be stored for future work (potential energy).

Vocabulary

Matter: Something that occupies space; what something is made of.

Gravity: A force that pulls all matter downward; gravity holds everything down on Earth; gravity pulls on objects equally; gravity keeps the Earth in an orbit around the sun.

Weight:	The force of gravity pulling on an object.
Mass:	The amount of matter in an object; mass is measured in grams or kilograms.
Force:	The push or pull on an object; force can change the speed and direction of an object when it moves; it takes more force to move an object that has more mass compared to an object with less mass.
Energy:	The ability to do work or supply power; work is force multiplied by distance, for example the force needed to push a box of books a specific distance.
Motion:	The act of something moving; movement.
Speed:	How fast an object travels.
Friction:	A force caused by two different objects touching each other or moving against each other; friction can slow down or stop the movement of an object.
Inertia:	A tendency of matter to remain at rest if at rest or to keep moving if movement has started unless a force stops the movement.

Materials

- 2 clipboards
- Sheets of paper for data collection
- Marking pens
- Large table
- Wooden dominos and small ball
- Wooden building blocks and 3 balls of different sizes
- Large marshmallows
- 6 clear plastic bags
- Plastic scoop
- Net scoop with small solid fabric in the center of the net
- Long tape measure
- Playground slide
- Piece of carpet to sit on
- A towel to sit on
- A piece of thick poster paper to sit on

In the School Gym and Playground

Introductory Discussion

1. Review gravity, force, motion, friction and inertia with quick demonstrations with help from students.
    - For example, a student can be asked to jump as high as possible and gravity can be discussed in relation to Earth and on a space shuttle.
    - Student helpers can demonstrate different types of force and motion using objects such as a yo-yo, blowing soap bubbles, and pushing an object across the floor.
    - Friction can be discussed by using different materials creating different amounts of friction under an object that is pushed across the floor.
    - Review inertia by first observing a ball placed on the floor so that it sits still compared to the ball when it is gently pushed forward, followed by the ball rolling and then stopping.
2. Briefly describe the four activities that will be done during the lesson.
3. Safety rules: Don't drop, bounce or throw objects in the direction of people or your feet.

Science Activity/Experiment

Four Stations are set up in the Gym and/or on the Playground. One adult is needed to help students at each station.

Divide students into four groups. The students will spend approximately 15 minutes at each station and then rotate as a group to the next station. Save a few minutes at the end of each activity to discuss student observations.

Station 1 (in Gym), Dominos:

1. A table will be set up with a pile of a large number of wooden dominos.
2. Students will have 10 minutes to position dominos so that the force of toppling one domino will cause all dominos to tip over. Another object (such as a ball) can be placed at the end of the dominos before tipping and students can predict whether this object will move when the dominos fall over.
3. Students will then get to topple the dominos.
4. Students can experiment with different patterns of standing dominos.
5. Ask students if more or fewer dominos will change the outcome.

Station 2 (in Gym or Playground), Launching Marshmallows:

1. Label 10 large marshmallows with a code for the three methods (such as A for arm, P for plastic scoop, and N for net scoop). Place groups of 5 marshmallows coded with the same letter into a clear plastic bag labeled with the corresponding launching method. The marshmallows tend to get squashed and sticky during the activity so it's helpful to have extra marshmallows in case they are needed.
2. Students will launch large marshmallows in a forward direction by using the following methods:
    - Launch marshmallows using the arm and hand
    - Launch marshmallows using a plastic scoop
    - Launch marshmallow using a net scoop
3. Begin the activity by having 1 student launch 1 marshmallow for each of 3 methods. Ask student to check that the label on the marshmallow matches the launch method. The others students sit on a bench a safe distance away from the student that is launching the marshmallows.
4. All students in the group can launch marshmallows before measurements of travel distance are recorded. Give each student a job to help with measuring and recording the distance that the marshmallows travel. Each marshmallow is picked up after each measurement is recorded. Each marshmallow is placed in a plastic bag with a corresponding label of the launch method. One bag of 5 marshmallows per method can be reused by 2 groups of students. It's best to start with fresh bags of marshmallows for the remaining 2 groups of students. Results can be summarized in a large graph in the classroom to follow up on this activity.

Station 3 (in Gym), Build a Wooden Block Tower and Knock it Down:

1. Students will build a tower with wooden blocks and try to make the structure of the tower as strong as possible.
2. Students will use 3 different sized balls to try to knock the tower down. First, students will roll a small ball towards the tower using a small amount of force, followed by a medium and large ball with a small amount of force. This procedure can be repeated using greater amounts of force until the tower falls down.

3. Students can experiment with different building designs and discuss the influence of force, motion, and the mass of the difference balls on knocking down the tower.

Station 4 (in Playground), Slide with Friction:

1. Students will first slide down the slide and then sit on different pads that create different amounts of friction, and slide down the slide. Suggested materials for sit pads include carpet, a towel, a piece of thick poster paper, and non-skid rubber material.

2. The teacher will use a stop watch and record the type of sit pad and the amount of time it takes for each student to reach the bottom of the slide.

3. The speed of travel will be compared for the different sit pads and no sit pad. Results can be summarized in a large graph in the classroom to follow up on this activity.

Science Journal: Students will record discoveries that they made about force and motion and what surprised them about force and motion.

Closure Discussion

Ask questions so that students can share their discoveries and build on their knowledge. Promote discussion about force, motion, mass, friction, gravity, inertia, and the laws of motion. Examples of questions are below.

1. Dominos: What forces were used to topple the dominos? Did you need a lot of force to start the movement? Why did the dominos stop moving after falling over? What did you discover?

2. Launching Marshmallows: What forces were used to launch the marshmallows? What caused the marshmallows to stop moving? Why did some launching methods cause the marshmallows to travel a greater distance? How else can you launch marshmallows? Would it be easier or more difficult to launch a bowling ball? Why? What did you discover?

3. Build a Wooden Block Tower and Knock it Down: What forces were used to build the tower, roll the balls, and topple the tower? Why did the ball stop moving forward after it hit the tower? How can you increase the force used to topple the tower? How does increased force affect the speed that the ball traveled? What would happen if the balls were rolling on carpet instead of the ground? What did you discover?

4. Slide with Friction: Why do you slide down to the bottom of a slide when you sit on the top of the slide and let go of the slide with your hands? What causes you to slide faster? What causes you to slide more slowly? How does your body weight affect the speed that you travel down the slide? What is similar about a person sliding down a slide compared to sliding a wooden wedge down an inclined bench surface? What is friction? What did you discover?

References

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5. White, Jack R. 1987. The Hidden World of Forces. Dodd, Mead & Co. New York, NY.

Extension of Lesson Plan

1. Paper airplanes (force, motion, lift, and air pressure)
2. Spin tops on different surfaces (friction, force, motion)
3. Spin objects in a salad spinner (force, motion, centrifugal force)
4. Build a Newton's cradle (force, motion, and inertia)
   http://www.fi.edu/pieces/knox/automaton/newtoncradle.htm
5. Build a boat, float the boat on water, how many ways can you move the boat, how much weight can you put on the boat before the boat sinks (force, motion, buoyancy)
6. Simple machines (wedge, lever, pulley, wheel and axle, crank, and inclined plane)

Name: _____

Force and Motion Experiments

I learned that:

I was surprised by:
