3RD GRADE
AIR AND OTHER AMAZING FORCES

Summary: Students explore multiple examples of forces and their effect on the motion of objects. Blowing air through a straw can suspend a Ping-Pong ball in motion until the pushing force of air is ceased. Inserting a turned over cup into a tub of water keeps a napkin dry because air exerts a stronger pressure on water and keeps it out of the cup. An experiment will be conducted on how the height a ball is let go from effects the distance the ball travels. Finally, students observe how differently massed objects in a collision move different distances after the collision.

Intended Learning Outcomes for 3rd Grade:
1a. Observe simple objects and patterns and report their observations.
1b. Make simple predictions and inferences based upon observations.
1d. Compare things and events.
1e. Use instruments to measure length, temperature, volume, and weight using appropriate units.
1f. Conduct a simple investigation when given directions.
1h. Use observations to construct a reasonable explanation.
3a. Know science information specified for their grade level.
3c. Explain science concepts and principles using their own words and explanations.
4a. Record data accurately when given the appropriate form and format.
4b. Report observation with pictures, sentences, and models.
4c. use scientific language appropriate to grade level in oral and written communication.

Utah State Core Curriculum Tie:
Standard III Objective 1:
b. Compare the forces of pushing and pulling.
Standard III Objective 2:
a. Predict and observe what happens when a force is applied to an object.
b. Compare and chart the relative effects of forces of different strengths on an object.
c. Compare the relative effects of forces of different strengths on an object. d. Conduct a simple investigation to show what happens when objects of various weights collide with one another.
e. Show how these concepts apply to various activities in terms of force, motion, speed, direction and distance.

Preparation time: 30 min
Lesson time: 50 min
Small group size: works best with one adult for every 5 students

Materials: Hot Wheels cars, race track, Ping-Pong balls and the bouncy balls can probably be donated/borrowed from students so that no purchases are needed.

1. flexible straws, one for each student
2. 5 Ping-Pong balls
3. bouncy balls, 2 bouncy balls of different masses for each group
4. plastic cups
5. napkins
6. large bowl or container to push a cup into
7. 3 interlocking pieces of hot wheels race track for each group. Purchased from Toys 'R' Us for $0.99 each.
8. rulers and measuring tape
9. masking tape
10. balance
11. hot wheels or other brand of cars, 2 per group

Background information:

Forces have the ability to do work or cause change. All forces in nature are either a push or a pull. Examples of forces are: gravity which pulls objects towards earth, magnets that either push or pull against each other, and when our bodies move they are moving from a combination of the pushing and pulling of our muscles.

Force exerted on an object causes a change in the speed or the direction the object moves. The strength of this force determines how much change in speed or direction occurs. The stronger the force the further an object moves. Think of moving a cotton ball vs. moving a large boulder. The amount of force applied will determine how much either moves.

Mass can determine the strength of a force. A larger massed object rolled down a ramp will move a further distance than a lighter massed object. A larger massed object will displace a smaller massed object in a collision. For example, when two cars collide the smaller car is pushed back a further distance than the larger car.

Pre-lab discussion: Ask students what the word force means. Talk about being forced to clean your room and a force pushing a box across the floor. They both cause work to happen. Show a set of magnets and explain that a magnetic force causes either a push or a pull on the magnets. Then use a basketball and ask the students how to move the basketball from one side of the room to the other. Discuss throwing or pushing the ball. Also, discuss the strength of your throw and how far the ball moves. If you have a Newton's Cradle you can use it to demonstrate forces and the strength of forces.

Instructional procedure:

EXPERIMENT 1: Demonstrate pushing and pulling forces.

1. Act out a few examples of a push or pull force: brushing your hair, clapping your hands, and reaching for a pencil. In each example, describe whether they are pushing, pulling or using a combination of both.

2. Ask each student to take a turn acting out one of the motions listed below and have them describe to the group when it is a push and when it is a pull.

a. using a mop
b. putting dishes into the dishwasher
c. giving a book to a friend, receiving a book from a friend
d. typing on a keyboard
e. have them come up with one of their own examples to share

EXPERIMENT 2: Using the pushing force of air to float a Ping-Pong ball above a straw.

1. Bend up the end of a flexible straw. Hold the Ping-Pong ball above the end of the bent straw.

2. Take a deep breath and blow somewhat hard through the straw. Let go of the ball and it will stay above the straw as long as you keep blowing.

3. Make sure the students put their used straws in the trash.

What happened? The fast moving air coming up and out of the straw goes up and around the ball and keeps it floating. We are using a pushing force of air from our mouths to move the ball. **The harder we blow, the stronger the force and the higher the Ping-Pong ball floats.** Discuss with the kids how a stronger force of air moves the Ping-Pong ball a farther distance. Have them try this.

4. Try this once with a bouncy ball. Why doesn't it work? The force of air from our mouth isn't strong enough to lift the heavier bouncy ball.

EXPERIMENT 3: Observing the pushing forces of air and water and determining which is the stronger force.

1. Crumble a napkin and push it down inside a dry cup. Hold the cup upside down.

2. Push the cup straight down into a bowl or tub of water until the cup is under the water. Do not tip the cup.

3. Pull the cup straight out and check your napkin.

What happened? The glass was full of air. The water could not enter the glass because the air inside the glass exerted a force on the water. **The air in the glass had a force stronger than the water. The napkin stayed dry because the force of the water could not push the air out of the way and wet the napkin.** Can you feel the force of the air in the cup when you push it down into the water? Try it.

4. If you tilt the cup, however, the air escapes, the force lessens and water enters. Now the water has the stronger force. Demonstrate this example with your cup and see what happens to the napkin.

EXPERIMENT 4: Explore how increasing a force can increase the distance an object moves up hill.

1. Take a 3-piece section of flexible track. Hold one end of the track 4 inches above the ground and the other end 12 inches above the ground. Make sure the middle of the track touches the ground.

2. Take a ball and release it from the 4-inch high top of the track. Mark with a piece of tape how high the ball moves up the 12-inch high end of the track. Make a table with two columns: height ball was let go from and distance ball moved from drop point. Using a measuring tape, measure the distance from the 4-inch end of the track to the height the ball moved up the opposite side of the track and place it in your table.

3. Raise the 4-inch high starting end of the track to 8 inches. Have the students predict what they think will happen. Repeat the experiment and discuss the different result. Record your measurement in the table.

4. Finally, raise the 8-inch high starting end of the track to 12 inches. Have the students predict what they think will happen. Repeat the experiment and discuss the different result. Record your measurement in the table.

5. Make a graph of your data. Be sure and give it a title and label the two axes. Place the starting heights on the x-axis and the measured distance the ball traveled on the y-axis. Discuss your graph results.

What happened? The higher the students raised the starting point the farther the ball should have moved up the end of the track. **When you increased the height the ball was released from you increased the force. A stronger force caused the ball to move a higher distance.**

EXPERIMENT 5: Explore how a larger massed object will displace a smaller massed object in a collision

1. Take the two bouncy balls to the balance and see which ball is heavier. Make sure the students know which is the heavier and which is the lighter ball before you start the experiment.

2. Using the track again raise both ends of the track 6 inches off the ground.

3. You will release the two balls from separate ends of the track and let them collide in the middle. Before you do the experiment, have the students predict what they think will happen when the balls collide.

4. Release the balls and observe the results. Repeat this a couple of times so that the students can make sure they see the difference.

5. With any extra time, use different sets of cars or two differently massed balls and see if you get the same results each time.

What happened? The students should have seen that when the balls collided, the lighter ball was bounced back up the hill farther than the heavier ball. **The heavier ball had a larger mass, which caused a larger force, and this force pushed the lighter ball a farther distance in the collision.**