WINTER BREAK LEARNING PACKET

STEM

8TH GRADE STUDENT

DEC 22ND – JAN 5TH

DEPARTMENT OF CURRICULUM & INSTRUCTION

Week One: December 22-26, 2025

Welcome to Your Winter Break STEM Challenge Packet!
Have fun exploring these activities and remember, always get your parents' permission and have adult supervision for every experiment. Stay curious and enjoy your break!

Standard: 8.PS2.6

Evaluate and interpret that for every force exerted on an object there is an equal force exerted in the opposite direction.

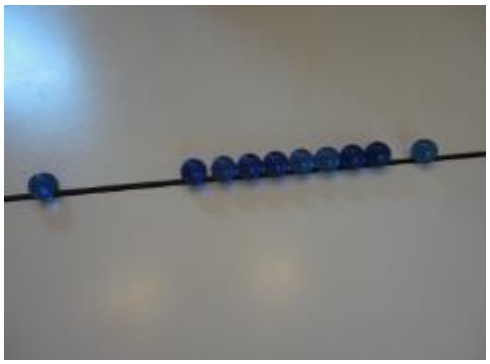
Overview:

This lesson introduces students to Newton's Third Law of Motion through a marble experiment that demonstrates equal and opposite forces. Students will create a simple track and roll marbles into a stationary row to observe how force transfers along the line. The activity focuses on scientific practices such as controlling variables, making predictions, recording observations, and analyzing results. After multiple trials, students will diagram their findings, summarize the law in their own words, and connect it to real-world applications. Through this hands-on investigation, students discover a universal principle of motion and learn how it applies to everyday experiences.

Objective(s):

Students will:

- **investigate Newton's Third Law of Motion** through a hands-on marble experiment.
- **control variables** to ensure fair testing during the activity.
- **observe and record data** from multiple trials using diagrams and written notes.
- **make predictions** about outcomes when changing the number of marbles rolled.
- **analyze patterns** in their observations to explain the relationship between action and reaction forces.
- **define Newton's Third Law** in their own words based on experimental evidence.
- **apply their understanding** of equal and opposite forces to real-world examples in daily life.



Materials:

- **About 10 identical marbles.**
- **A table with a pull-out leaf or a large picture book or a gift wrap tube cut in half lengthwise. (See Image Above)**

Pre Lesson Questions (write your answers on a separate sheet of paper)

1. What do you already know about Newton's 3rd Law of Motion?
2. Ask at least one person in your household what they already know about Newton's 3rd Law of Motion.

Activity:

1. If you have a kitchen table with a leaf in it, pull the table open slightly to make a track for some marbles. Otherwise, use a large picture book or a gift wrap tube cut in half lengthwise to create a track for the marbles.
2. Place all but one of the marbles into the track (or put them onto the tube or book) and make sure they all touch each other.
3. Roll one marble directly into the line of marbles and see what happens!
4. Once you see this, make a prediction about rolling two or more at a time into the line of marbles and try it.
5. Repeat the process, flicking 2 marbles, then 3 marbles at the row & drawing what you observe. The number of marbles that are flicked into the row of marbles on one end will be the same as the number of marbles that fly off on the other end.
6. Draw a diagram of your observations for each trial in the space below.
7. Summarize your understanding of how this activity relates to the 3rd law of motion in the space below & think of another application of the law in your everyday life.

6.

7.

Explanation of the Activity and Outcome

In this activity, you investigated Newton's Third Law of Motion, which states:
For every action, there is an equal and opposite reaction.

When you rolled a marble into the row of marbles, the moving marble applied a force to the first stationary marble (**the action force**). That marble tried to move, but because it was touching the next marble, the force was transferred down the line. Each marble passed the force along until it reached the last marble. Since there was nothing behind the last marble to resist the force, it moved away in the opposite direction (**the reaction force**).

When you rolled two or three marbles at once, you saw that the same number of marbles moved off the other end. This shows that the amount of force applied on one side is balanced by an equal force on the other side, but in the opposite direction.

Key Takeaways:

- Forces always come in pairs: action and reaction.
- The reaction force is equal in size but opposite in direction to the action force.
- This principle explains many everyday situations, like why you move backward slightly when you push something heavy, or why rockets launch by pushing exhaust gases downward.

Week Two: December 29, 2025-January 2, 2026

Standard:

8.PS2.5

Plan and conduct an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.

Overview:

In this lesson, students will explore how the motion of an object is influenced by the sum of forces acting on it and its mass. Through a hands-on investigation using marbles of different sizes and cups of varying mass, students will observe and measure how these factors affect the distance an object moves. This activity reinforces concepts of potential and kinetic energy, force, and mass, helping students connect theoretical principles to real-world applications.

Objective(s):

Students will:

1. **Investigate** how the mass of an object affects the amount of force needed to move another object.
2. **Measure** and record the distance that cups of different sizes move when impacted by marbles of varying mass.
3. **Calculate** average distances for each trial to analyze patterns in the data.
4. **Predict** outcomes based on prior knowledge and **compare** predictions to actual results.
5. **Explain** the relationship between mass, force, and motion using evidence from their investigation.

Materials:

- **3 marbles (Different sizes/weights)**
- **Inclined plane**
- **Ruler (centimeter)**
- **8 Ounce Styrofoam cup (or something of equal size you may have)**
- **12 Ounce Styrofoam cup (or something of equal size you may have)**

Pre Lesson Question:

1. If you put the marbles at the top of the inclined plane without releasing them, would they have energy? Why? **Discuss this with someone in your house before reading the background information on the next page.**

Background Information: The energy your marble will have sitting at the top of the inclined plane is called **Potential energy, (PE) the energy before the marble is released or stored energy**. **The energy of a moving object is Kinetic energy. (KE)** PE changes to KE as the marble rolls down the ramp towards the cup. Each marble will have a different amount of **mass**; the measurement of how much matter is in an object. Since the marbles are made out of the same matter, the larger the marble, the more **mass** it has. Also, the larger the size of the cup, the more **mass** it has.

Read the information below related to the activity and predict which cup will move the greatest distance once the marbles reach the end of the incline plane and go inside the cups. Also, **predict** which marble (**small, medium, large**) will have the greatest impact on the distance the cups move.

Prediction #1: The _____ cup will move the greatest distance because

_____.

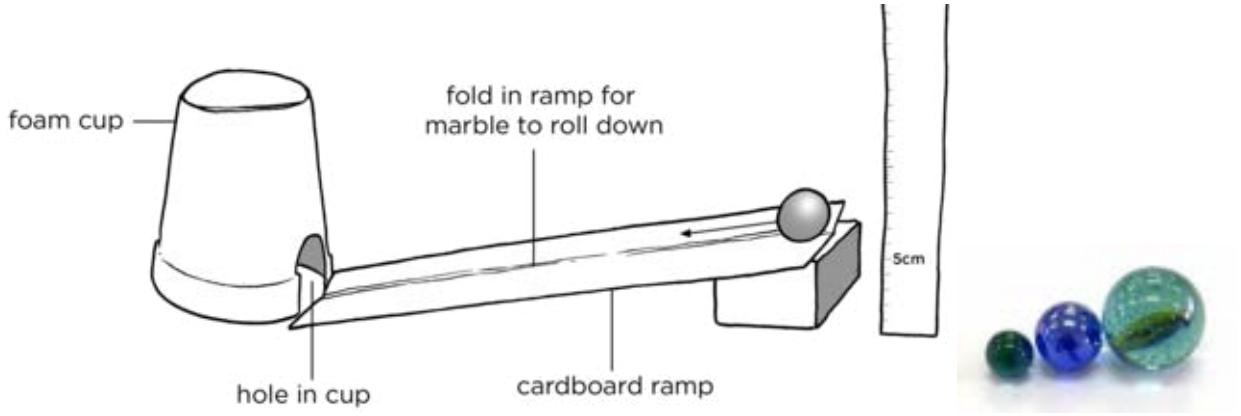
Prediction #2: The _____ marble will move the cups the greatest distance because

_____.

Activity:

1. Place the largest marble at the top of your inclined plane while placing the 8-ounce cup at the end to catch the marble once you release it.
2. Release the marble and measure how far your cup moves. Record your results on the chart.
3. Repeat three times using the larger marble and calculate the average distance. Record your results in the chart below.
4. Repeat using the second and third marbles and record your results.
5. Repeat steps 1-3 using the 12-ounce cup. Record the results.

Below is an example of the set-up of your activity:



Follow-up Questions: (write your answers on a separate sheet of paper)

1. Using the average distance moved, determine which marble moved both cups the greatest distance.
2. Using the average distance moved, determine which cup moved the greatest distance.
3. Were your predictions correct? Explain.
4. Using the results on your chart, explain the relationship between the distance the cups moved and the size (mass) of the marble.
5. Using the results on your chart, explain the relationship between the distance the cups moved and the size (mass) of the cup.

	Distance 8-ounce cup moved (centimeters): Trial #1	**Distance 8-ounce cup moved (centimeters): Trial #2**	**Distance 8-ounce cup moved (centimeters): Trial #3**	**Average Distance 8-ounce cup moved (centimeters):**
Marble #1 (smallest)				
Marble #2 (medium)				
Marble #3 (largest)				

	Distance 12-ounce cup moved (centimeters) Trial #1	Distance 12-ounce cup moved (centimeters) Trial #2	Distance 12-ounce cup moved (centimeters) Trial #3	Average Distance 12-ounce cup moved (centimeters):
Marble #1 (smallest)				
Marble #2 (medium)				
Marble #3 (largest)				

Explanation of the Activity and Outcome

In this activity, you explored how the motion of an object depends on its mass and the forces acting on it. When you placed the marbles at the top of the inclined plane, they had potential energy (PE) because of their position. As the marbles rolled down the ramp, that potential energy changed into kinetic energy (KE), which is the energy of motion.

The size (and therefore mass) of each marble affected how much force it could apply to the cup when it hit. A larger marble has more mass, so it carries more momentum when moving. This means it can push the cup farther compared to a smaller marble.

You also observed that the size of the cup matters. A heavier cup (like the 12-ounce one) requires more force to move than a lighter cup (like the 8-ounce one). That's why the same marble moved the smaller cup farther than the larger cup.

Key Takeaways:

- The greater the mass of the marble, the more force it applies when moving.
- The greater the mass of the cup, the harder it is to move.
- Motion depends on both the force applied and the mass of the object being moved.

This investigation demonstrates Newton's Second Law of Motion, which states that the acceleration of an object depends on the net force acting on it and its mass. In simple terms: more mass = more force needed to move it.