Physical Science: Forces And Motion

Grade Level: Grade Five
Content Area: Physical Science
Core Area: Forces And Motion

Lesson Overview: Students will use mathematical and computational thinking to express quantitative observations using appropriate metric units; collect and analyze data, or understand patterns, trends and relationships between variables to describe motion in terms of position, direction, and speed.

2005 Standards Correlation:
Grade Five
Forces and Motion
Standard 5-5: The student will demonstrate an understanding of the nature of force and motion.
(Physical Science) Indicators
5-5.1 Illustrate the affects of force (including magnetism, gravity, and friction) on motion.
5-5.2 Summarize the motion of an object in terms of position, direction, and speed.
5-5.3 Explain how unbalanced forces affect the rate and direction of motion in objects.
5-5.4 Explain ways to change the effect that friction has on the motion of objects (including changing the texture of the surfaces, changing the amount of surface area involved, and adding lubrication).
5-5.5 Use a graph to illustrate the motion of an object.
5-5.6 Explain how a change of force or a change in mass affects the motion of an object.

2014 Standards Correlation:
Grade Five
Physical Science: Forces And Motion
Standard 5.P.5: The student will demonstrate an understanding of the factors that affect the motion of an object.
5.P.5A. Conceptual Understanding: The motion of an object can be described in terms of its position, direction, and speed. The rate and motion of an object is determined by multiple factors.
Performance Indicators: Students who demonstrate this understanding can:
5.P.5A.1 Use mathematical and computational thinking to describe and predict the motion of an object (including position, direction, and speed).
5.P.5A.2 Develop and use models to explain how the amount or type of force (contact and non-contact) affects the motion of an object.
5.P.5A.3 Plan and conduct controlled scientific investigations to test the effects of balanced and unbalanced forces on the rate and direction of motion of objects.
5.P.5A.4 Analyze and interpret data to describe how a change of force, a change in mass, or friction affects the motion of an object.
5.P.5A.5 Design and test possible devices or solutions that reduce the effects of friction on the motion of an object.
**Required Materials:**

**Materials:**
Word Wall or pocket chart for 2 sets of Vocabulary words (Position Words and Motion Words)
Human Skeleton
Punching bag
Plastic toy racetrack with ramp and loop
Different balls of the same size: foam, ping pong, steel, rubber, glass
Wooden ramps with ability to change inclination
Textured surfaces to cover wooden ramp: sandpaper, felt, aluminum foil, plastic, cloth, etc.
Toy cars
Inclined planes of various lengths
Bricks, force measurements
Different balls of various sizes: foam, ping pong, steel, rubber, glass
Dominoes
Car, truck, mini skateboard, dolls
Paper for data collection

**Procedures:**
1. Use Think-Pair-Share to brainstorm a list of position words such as up, down, over, under, above, below, beneath, front, back, behind, left, right, inside, outside, around. Then brainstorm a list of motion words such as push, pull, forward, backward, fast, slow, straight, zigzag, circular.
2. Skeleton:
   a. Look at the skeleton. Can it move by itself? Can we move it? If a force is applied to a stable object, the object moves and changes position.
   b. Force can be applied from different directions. Stand in front of the skeleton and push. Stand behind the skeleton and pull.
3. We can apply force to make an object move, but will it move forever? (Punch the punching bag) What stops it? (gravity and friction)
4. Explain the stations. Students will work in small groups at each station.
   1. Loop the Loop: Roll different balls with different masses down the loop the loop racetrack. Determine optimum height to allow each ball to roll all the way through the loop.
   2. Rolling on a Ramp: Release a toy car from the top of the ramp and mark where it stops. Measure the distance it traveled on the floor. Repeat and record your best distance. Choose a new material to cover the ramp. Test and record your best distance for each surface (sandpaper, felt, aluminum foil, and plastic wrap). Which material worked best? Why? Is there anything else we could do to improve our results?
   3. Inclined plane: Test the force required to move a brick up various inclined planes.
   4. Push Me, Push You: Push various objects between you and a partner.
   5. Dominoes: Line up dominoes and apply force to the first domino. Watch the energy transfer to create the domino effect (momentum). Can you make a Z and an S fall with one push?
   6. Riding on Wheels: Investigate the effects of not wearing seatbelts in cars. Investigate how motion of one object affects the motion of another object in or on the first.
5. Discuss data collection. Allow students to explore how best to record data. Provide some examples but encourage students to devise their own data collection sheet.
7. Which surface worked best on the racetrack? Friction is a force that works against motion. Some friction is good. Some friction makes movement difficult.

8. Ask students to demonstrate how a push or a pull can affect the motion of an object in three ways:
   a. It can make it go faster.
   b. It can make it slow down.
   c. It can change the direction of the motion.

9. Test different balls (heavy, light, glass, wood, plastic, etc.) on a bare racetrack to see which finishes the loop. Which ball completes the track? How was it different from the others? Use a balance and gram masses to compare the balls. Did the difference in mass change its speed? Is there anything else we could do to improve our results? (manipulate slope)
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<td>Elicit</td>
<td>A person climbs into a tree and is 20 feet from the ground. Later, the person is lying on the ground. Explore the events that could have occurred between the time the person was in the tree and on the ground.</td>
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| Engage | • Look at the skeleton. Can it move by itself?  
• Force can be applied from different directions. Stand in front of the skeleton and push. Stand behind the skeleton and pull.  
• We can apply force to make an object move, but will it move forever? (Punch the punching bag)  
What stops it? (gravity and friction) | Plan and conduct investigations; Analyze and interpret data | Cause & Effect; Energy & Matter     |
| Explore | Explain the stations. Students will work in small groups at each station.  
1. Loop the Loop:  
2. Rolling on a Ramp:  
3. Inclined plane:  
4. Push Me, Push You:  
5. Dominoes:  
6. Riding on Wheels: | Develop and use models; Construct explanations and design solutions | Cause & Effect; Energy & Matter     |
| Explain | • Which surface worked best on the racetrack? Why?  
• Linear motion is motion in straight lines. Demonstrate the Newton balance balls.  
• Circular motion spins around an axis. Demonstrate circular motion with the bicycle tire. | Engage in scientific argument from evidence | Systems & Models                   |
| Elaborate | What are examples of balanced and unbalanced forces? | Obtain, evaluate, and communicate information | Cause & Effect                     |
| Evaluate | Ask students to demonstrate how a push or a pull can affect the motion of an object in three ways:  
• It can make it go faster.  
• It can make it slow down.  
• It can change the direction of the motion. | Construct explanations and design solutions; Use mathematical, computational thinking | Energy & Matter; Structure & Function |
| Extend | Test different balls (heavy, light, glass, wood, plastic, etc.) on a bare racetrack to see which finishes the loop. Which ball completes the track? How was it different from the others? Use a balance and gram masses to compare the balls. Did the difference in mass change its speed? Is there anything else we could do to improve our results? (manipulate slope) |                                                                 |                                    |