Big Blue Blocks and the Laws of Motion

PA CORE STANDARDS

3.4.4.C. Observe and describe different types of force and motion.

3.4.4.C.2. Recognize forces that attract or repel other objects and demonstrate them.

3.4.4.C.3. Describe various types of motions.

3.4.4.C.4. Compare the relative movement of objects and describe types of motion that are evident.

3.4.4.C.5. Describe the position of an object by locating it relative to another object or the background (e.g., geographic direction, left, up).

Physical Science

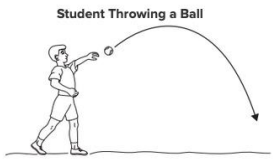
- Investigate the variables that may affect how objects move across a floor, down a ramp, etc.
- Construct an explanation for why an object subjected to multiple pushes and pulls might stay in one place or move.
- Through the use of objects, design an investigation and demonstrate that forces can cause changes on an object's speed or direction of motion.
- Take measurements of objects in motion and represent the movement of objects in multiple representations.
- Investigate the motion of objects to determine observable and measurable patterns to predict future motions.
- Provide evidence that a pattern can be used to predict future motion.
- Design and implement an investigation to demonstrate that objects in contact exert forces on each other.

Third Grade Unit Plan: Force and Motion

3.4.4.C. Observe and describe different types of force and motion

Unit Objectives:

- Students will be able to
  - identify and describe an object's motion.
  - demonstrate that forces can cause changes on an object's speed or direction of motion
  - measure and represent the movement of objects in multiple representations
  - design and implement an investigation to demonstrate that objects in contact exert forces on each other
  - construct an explanation for why an object subjected to multiple pushes and pulls might stay in one place or move
  - provide evidence that a pattern can be used to predict future motion
  - investigate the motion of objects in order to determine observable and measurable patterns to predict future motions.

Title	*Standard (s)*	*Lesson Description*	*Assessment*
Simon Says: Move!	3.4.4.C.3 3.4.4.C.5	Students and teachers will define motion as the act or process of moving. The class will discuss the ways you can describe the motion of an object. Together, the class will explore the concept of "inertia" and, after discussing that the Earth is always moving, will debate whether an object is ever at rest. Using a variety of Big Blue Blocks, students will play "Simon Says" to gain an understanding of the different ways an object can move: start/stop, up/down, left/right, faster/slower, and spinning.	 Which of the following **best** describes the motion of the ball? A. left, then right B. in, then out C. up, then down D. forward, then backward

The Friction Factor!	3.4.4.C.2 3.4.4.C.4	Students will design an investigation about the variables that may affect how Big Blue Block balls move across the floor. Students will take time measurements of objects in motion across smooth & textured surfaces as well as across surfaces with obstacles.	**Friction Factor Choice Board!** 1. Create a graph of the times it took the ball to get to the finish line when it encountered changes in the surface where it was rolled. Write a description of what you notice. 2. Design and label a picture to explain friction impact motion. 3. Use a Venn diagram to compare and contrast the motion of the ball when faced with different surfaces. 4. Use a cause/effect chart to explain the impact of different surfaces on the movement of the ball.
Strike a Balance! Balanced Forces	3.4.4.C.2 3.4.4.C.4	Students will exert balanced forces on Big Blue Blocks to demonstrate how, when equal forces are exerted the object does not move. -**Pushing** (squeezing a block between hands, holding a block against a wall) -**Pulling** (tug-of-war with Big Blue Block "Noodles") ● Even/balanced teams	Students will write a journal critiquing the following statement: Javier says that everything is always moving. Potential Correct Responses: ● Javier is correct. ● Movement is relative. ● The Earth is always moving around the Sun. ● Something may be at rest relative to another object, but is still moving. ● Example: A book may not be moving in relation to the desk it is on, but it is still moving in relation to the sun
Defy Gravity!	3.4.4.C.2 3.4.4.C.3 3.4.4.C.4 3.4.4.C.5	A teacher will attach strings with paper clips at each end to a Big Blue Block noodle. The teacher will tip the noodle to demonstrate that even when the stick is tilted, Earth's gravitational pull exerts its	**Defy Gravity Choice Board!** 1. Create a graph of the differences in times. Write a description of what you notice.

		force on the paper clips pulling them straight down toward the Earth. Students will use Big Blue Block chutes to change the slope of a "run" used to race balls. As students add or remove blocks, they will hypothesize whether the ball will move through the chute faster or slower. Students will drop different shaped/sized Big Blue Blocks from the same height and will time the object's fall. Students will hypothesize how the size/shape of the object will impact the length of time it takes for the object to reach the ground.	2. Design and label a picture to explain how shape & friction impact motion. 3. Use a Venn diagram to compare and contrast the motions of different objects. 4. Use a cause/effect chart to explain the impact of different variables on movement.

I Lost my Balance!
Unbalanced Forces
	3.4.4.C.2
	3.4.4.C.4
		Students will hypothesize how the outcome of a tug-of-war game will change with uneven/unbalanced teams. To test the hypothesis, students will conduct an experiment by playing tug-of-war with Big Blue Block "Noodles" using unbalanced teams.
		
		Students will engage in a "Big Blue Block Battle" to exert unbalanced forces on Big Blue Blocks in order to demonstrate how exerting unbalanced forces on an object causes the object to move.
		• Competitions:
		  ○ "Lil Cheese" rolling contest
		  ○ Ball throwing contest
		  ○ Block kicking contest
			Students will create a comic strip OR a song to demonstrate the ways that forces can cause changes in the speed and direction of an object's motion.

Predict the Future!	3.4.4.C.2 3.4.4.C.3 3.4.4.C.4 3.4.4.C.5	Students will formulate a hypothesis predicting how the movements of new objects will compare to the movement of the Big Blue Blocks from previous	Students will recreate the experiments with new objects and will describe their findings in writing, pictures, and/or graphs.

		experiments. They will conduct experiments to test their educated guesses.	

The Friction Factor

Standards	3.4.4.C. Observe and describe different types of force and motion. 3.4.4.C.2. Recognize forces that attract or repel other objects and demonstrate them. 3.4.4.C.4. Compare the relative movement of objects and describe types of motion that are evident.

Materials	• Big Blue Block ball
	• Stopwatch
	• Recording Sheet
	• Materials to alter the rolling surface:
	  ○ Flat/linoleum floor
	  ○ Wood chips
	  ○ Sand
	  ○ Felt
	  ○ Pebbles
	• Choice Board

Learning Objectives	• **Students will be able to** demonstrate that forces can cause changes on an object's speed or direction of motion. • **Students will be able to** measure and represent the movement of objects in multiple representations. • **Students will be able to** design and implement an investigation to demonstrate that objects in contact exert forces on each other.
Anticipatory Set	*Activate Prior Knowledge:* The teacher will ask students to "turn-and-talk" with their peers to recall important information from the prior lesson about "movement." The teacher will encourage students to recall the definition of **motion** and **inertia**. *Preview Lesson:* The teacher will ask students to visualize themselves riding a bike. The teacher will ask students to share how they make their bikes move forward. Then, the teacher will ask students to explain a situation when it is really easy to ride their bikes really quickly (*downhill, flat road, smooth road*). Finally, the teacher will ask the students to share situations, which make it really difficult for them to make their bikes move quickly (*sand, gravel, steep hill, wind*). The teacher will help students make the connection between these added challenges and their reduced speed.

Teaching & Modeling	The teacher will ask students to recall how they can make their bikes stop moving on their own *(brakes)*. The teacher will explain to the students that when they use the breaks on their bike, the brake pads press against the wheel, which causes **friction**, which is a force that is created by two objects rubbing together. The teacher will ask the students to think back on the bike example. The teacher will explain that smoother surfaces *(like a smooth, flat road)* cause less friction, while rougher surfaces *(like sand and gravel)* cause more friction. The teacher will ask students to "turn-and-talk" to answer the following question: ● Does an object move faster if there is more friction or if there is less friction? After the students share, the teacher will confirm that when objects encounter friction, they slow down or stop.
Guided Practice	The teacher will guide the class through an experiment to determine how friction impacts the speed at which a Big Blue Block ball can travel a predetermined distance. NOTE: The teacher will discuss with students the importance of keeping the distance that the ball is rolling **constant** whenever a new **variable** (change in the rolling surface) is added. The first time measurement will be taken on a hard, flat surface without any obstacles *(i.e. an Linoleum floor)*. The teacher can conduct the experiment as a whole class or they could choose to split the class into smaller groups to enable more students to participate in the experiment. In either scenario, one individual should serve as the "roller" in each of the phases of the experiment and another should serve as the timer. When the ball crosses the "starting line," the timer should be started and when the timer passes the "finish line," the timer should be stopped. Another student can serve as the recorder. The next measurements should include changes to the surface on which the ball is rolled. Depending on the classroom/school setups, teachers can use their discretion and resources to alter the surface on which the ball is rolled. ○ Examples: ■ Wood chips ■ Sand ■ Grass ■ Felt ■ Pebbles ■ Cardboard ■ Blanket As with the first round, one individual should serve as the "roller" in each of the subsequent phases of the experiment and another should

	serve as the timer. When the ball crosses the "starting line," the timer should be started and when the timer passes the "finish line," the timer should be stopped. Another student can serve as the recorder. NOTE: Before each new phase of the experiment, the teacher should encourage the students to hypothesize whether the ball will be faster or slower than previous rounds. Students should be encouraged to suppor their responses with critical thinking and reasoning.
Check for Understanding	In between each round of the experiment, teachers should check that students are understanding why the time it takes the ball to cross the same distance changes. *Below are several options to check for understanding:* 1. Asking open-ended questions **Some examples of potential questions include:** ● *Can you tell me more about why...* ● *I wonder why...* ● *How do you know...* ● *What can you tell me about...* ● *Can you think of another way...* ● *What do you think would happen if...* ● *What can you do next time?* ● *Tell me what happened.* ● *What do you think will happen next?* 2. Use thumbs! ● *Thumb up*→ I've got it! ● *Thumb sideways*→ I'm almost there/A little confused ● *Thumb down*→ I don't understand 3. Give it a Four-Finger Rating! ● *1*→ I do not understand the concept ● *2*→ I am still a little confused ● *3*→ I understand and can do it myself ● *4*→ I understand and can teach it to a friend 4. Teachers can use their own creative ways for checking for understanding throughout the lesson! NOTE: Don't wait until the end to learn that students are confused. Be sure to check frequently!
Adjust Instruction	After checking for understanding, teachers should adjust instruction as necessary for struggling students. Depending on how the experiment is being conducted, the teacher could: ● Allow confident students to break off and continue the experiment with their peers and create a small group of students who still require teacher support. ● Redirect students to the initial analogy of the bike. ● Ask confident students to re-explain the concert to the class

Independent Practice	Once each round of the experiment is completed, the teacher should provide students with a choice board form which they can choose the way that they want to demonstrate their understanding of the relationship between friction and movement. Teachers can opt for students to work independently or with a group. Alternatively, the teacher could guide the class through one (or more of the activities). Friction Factor Choice Board! 1. Create a graph of the times it took the ball to get to the finish line when it encountered changes in the surface where it was rolled. Write a description of what you notice. 2. Design and label a picture to explain friction impact motion. 3. Use a Venn diagram to compare and contrast the motion of the ball when faced with different surfaces. 4. Use a cause/effect chart to explain the impact of different surfaces on the movement of the ball.