Collision Design Lab

Use force pairs to make horizontal collisions safer.

MS-PS2-1 "Apply Newton's Third Law to design a solution to a problem involving the motion of two colliding objects. Clarification Statement: Examples of practical problems could include the impact of collisions between two cars..."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline each statement that describes an equal-and-opposite force pair, and circle the two objects in that pair. Then number the design features that increase collision time.

Designing for a Crash

1. When two objects collide, each object pushes on the other. Newton's Third Law says these forces are equal in size and opposite in direction. The forces happen at the same time, even if one object is much heavier. During a horizontal crash, a moving delivery cart pushes forward on a parked cart. At that same moment, the parked cart pushes backward on the delivery cart. The two forces act on different objects, so they do not cancel each other.

2. Suppose the delivery cart must pass a work area where a second cart may be parked. A designer can add a thick foam bumper to the front of each cart. In a collision, the foam compresses, so the carts take longer to slow down or start moving. For the same change in motion, a longer collision time can reduce the average force on each cart. The foam does not make one cart's force smaller than the other's. Each cart still exerts an equal and opposite force on the other.

3. Newton's Third Law also guides designs for a cart that might hit a fixed wall. As the cart pushes on the wall, the wall pushes back on the cart with an equal force in the opposite direction. A padded barrier can compress during the collision. This increases the time over which the cart stops and can reduce the average force. The wall may not move, but it still exerts a force. A design must consider both objects in the collision, not only the moving cart.

2 ANSWER WITH EVIDENCE

Use the passage

1. A rolling suitcase bumps into a stationary suitcase in a hallway. Describe the force pair during the collision.

2. Why do the two forces in a collision not cancel each other out?

3. Two shopping carts might collide. How could foam bumpers help, and what would remain true about the forces?

4. A moving cart hits a padded wall. Even if the wall does not move, what force does it exert?

3 YOUR TURN

Your own words

Design one safety feature for a horizontal collision between two objects not named in the reading. Write exactly 3 sentences that name both objects, describe their equal and opposite force pair, and explain how your feature could reduce the average force.

ANSWER KEY

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GRADES 6-8 · MS-PS2-1

PART 1 · READ AND MARK

Underline each statement that describes an equal-and-opposite force pair, and circle the two objects in that pair. Then number the design features that increase collision time. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	A rolling suitcase bumps into a stationary suitcase in a hallway. Describe the force pair during the collision.	**The rolling suitcase pushes forward on the stationary suitcase, and the stationary suitcase pushes backward on the rolling suitcase with an equal force.**
2	Why do the two forces in a collision not cancel each other out?	**They act on different objects, not on the same object.**
3	Two shopping carts might collide. How could foam bumpers help, and what would remain true about the forces?	**The foam can lengthen the collision time and reduce the average force. Each cart's force on the other is still equal in size and opposite in direction.**
4	A moving cart hits a padded wall. Even if the wall does not move, what force does it exert?	**The wall exerts a force back on the cart that is equal in size and opposite in direction to the cart's force on the wall.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

I would put a compressible bumper on the front of a school hallway cart that may hit a storage cabinet. When the cart pushes forward on the cabinet, the cabinet pushes backward on the cart with an equal force. The bumper compresses, lengthening the stopping time and reducing the average force on both objects.

Accept any horizontal collision design that correctly identifies forces as equal in size, opposite in direction, and acting on different objects. For Part 3, accept a feasible feature that lengthens collision time and a complete three-sentence response.