Zoe and the Pirate Forces Adventure

Grade 6 science pirates

Students will be able to identify, describe, and predict how balanced and unbalanced forces affect the motion of objects in a pirate adventure context.

Name: _____ Date: _____

1. Zoe stands on the pirate ship deck holding a treasure map. She pushes a gold doubloon across a flat wooden plank. The doubloon slides forward, then slows down, then stops. What type of force caused the doubloon to stop? Circle one: gravity / friction / magnetism.

2. Zoe notices a treasure chest sitting still on the ship's deck. She has not touched it yet. True or False: The forces acting on the treasure chest right now are balanced. Write True or False, then write one reason for your answer.

3. Zoe finds the treasure map and reads a clue. She must push the heavy treasure chest across the deck to reach the hatch below. Zoe pushes the chest with a force of 40 newtons to the right. Friction pushes back with 40 newtons to the left. Fill in the blank: The forces on the chest are _____, so the chest will _____.

4. Zoe pushes harder! Now she pushes the treasure chest with 65 newtons to the right. Friction still pushes back with 40 newtons to the left. Explain: Are the forces balanced or unbalanced? What will happen to the chest? Use the words 'net force' in your answer.

5. Zoe reaches the hatch and drops a gold doubloon straight down into the hold below. The doubloon falls faster and faster until it hits a pile of coins. What force pulled the doubloon downward, and what force stopped it at the bottom? Name both forces and describe each one.

6. Zoe finds the ship cannon near the bow. She reads the treasure map — it says fire the cannon to open the sealed cave door. The cannonball leaves the cannon and travels toward the cave wall. Three forces act on the cannonball in flight: the explosive push forward (300 N), air resistance backward (80 N), and gravity downward (120 N). Is the cannonball in balanced or unbalanced motion? Identify the net horizontal force and describe the cannonball's horizontal motion.

7. The cannonball hits the cave door and stops. Zoe observes that the door did not open. She hypothesizes that the door did not move because the cave wall pushed back on the cannonball with a force equal to the cannonball's force. Write a hypothesis using an if-then statement. Then explain: if the wall's push had been less than the cannonball's push, what would have happened to the door? Use Newton's second law in your explanation.

8. Zoe finally blasts the door open with a second, stronger cannon shot. She rushes inside and finds the treasure chest full of gold doubloons. Now she must drag it onto the ship using a rope. As Zoe pulls the rope, the chest moves at a constant speed across the cave floor. Her pulling force is 90 newtons forward. Explain what this tells you about the friction force acting on the chest. Then connect this to a real-world example:

engineers designing a cargo sled use this same force principle. Describe how they would use balanced forces on purpose to move cargo safely at a steady speed.

Answer Key: Zoe and the Pirate Forces Adventure

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Before Q6, ask students to predict whether Zoe's cannon shot will move the chest — this mirrors the balanced vs. unbalanced force reasoning students must apply in Q6 and Q7, making the transition to those harder questions feel like a natural reveal.

1. Zoe stands on the pirate ship deck holding a treasure map. She pushes a gold doubloon across a flat wooden plank. The doubloon slides forward, then slows down, then stops. What type of force caused the doubloon to stop? Circle one: gravity / friction / magnetism.

Answer: Q1: The doubloon was sliding across the wooden plank. The rough surface of the plank pushed back against the moving doubloon. That opposing contact force is friction. Answer: friction caused the doubloon to stop.

2. Zoe notices a treasure chest sitting still on the ship's deck. She has not touched it yet. True or False: The forces acting on the treasure chest right now are balanced. Write True or False, then write one reason for your answer.

Answer: Q2: The treasure chest is sitting still — it is not moving and not changing motion. When an object is at rest, all forces on it are balanced (gravity pulling down equals the deck pushing up — this is the normal force). Answer: TRUE. The chest is not moving, so gravity and the deck's push are balanced forces.

3. Zoe finds the treasure map and reads a clue. She must push the heavy treasure chest across the deck to reach the hatch below. Zoe pushes the chest with a force of 40 newtons to the right. Friction pushes back with 40 newtons to the left. Fill in the blank: The forces on the chest are _____, so the chest will _____.

Answer: Q3: Zoe pushes 40 N right. Friction pushes 40 N left. 40 N right minus 40 N left = 0 N net force. When net force equals zero, forces are balanced and the object does not change its motion. Answer: The forces on the chest are BALANCED, so the chest will NOT MOVE (or: stay still).

4. Zoe pushes harder! Now she pushes the treasure chest with 65 newtons to the right. Friction still pushes back with 40 newtons to the left. Explain: Are the forces balanced or unbalanced? What will happen to the chest? Use the words 'net force' in your answer.

Answer: Q4: Zoe's push = 65 N right. Friction = 40 N left. Net force = 65 N minus 40 N = 25 N to the right. Because the net force is greater than zero, the forces are UNBALANCED. An unbalanced net force of 25 N to the right means the chest will accelerate — it will start moving to the right.

5. Zoe reaches the hatch and drops a gold doubloon straight down into the hold below. The doubloon falls faster and faster until it hits a pile of coins. What force pulled the doubloon downward, and what force stopped it at the bottom? Name both forces and describe each one.

Answer: Q5: Force 1 — Gravity pulled the doubloon downward toward the center of the Earth. Gravity is a non-contact force that acts between the Earth and all objects with mass. Force 2 — The normal force (contact force) from the pile of coins pushed upward on the doubloon, stopping it. Answer: Gravity pulled it down; the normal force from the coin pile stopped it.

6. Zoe finds the ship cannon near the bow. She reads the treasure map — it says fire the cannon to open the sealed cave door. The cannonball leaves the cannon and travels toward the cave wall. Three forces act on the cannonball in flight: the explosive push forward (300 N), air resistance backward (80 N), and gravity

downward (120 N). Is the cannonball in balanced or unbalanced motion? Identify the net horizontal force and describe the cannonball's horizontal motion.

Answer: Q6: Horizontal forces only — explosive push forward = 300 N, air resistance backward = 80 N. Net horizontal force = 300 N minus 80 N = 220 N forward. Because net horizontal force = 220 N (not zero), horizontal forces are UNBALANCED. The cannonball will accelerate forward horizontally. Vertical forces (gravity 120 N down, no upward lift) are also unbalanced, so the cannonball curves downward. Answer: Net horizontal force = 220 N forward; forces are unbalanced; the cannonball accelerates toward the cave.

7. The cannonball hits the cave door and stops. Zoe observes that the door did not open. She hypothesizes that the door did not move because the cave wall pushed back on the cannonball with a force equal to the cannonball's force. Write a hypothesis using an if-then statement. Then explain: if the wall's push had been less than the cannonball's push, what would have happened to the door? Use Newton's second law in your explanation.

Answer: Q7: Sample hypothesis — IF the cave wall pushes back on the cannonball with a force equal to the cannonball's force, THEN the net force on the door will be zero and the door will not move. Explanation: If the wall's push had been LESS than the cannonball's push, the net force on the door would be greater than zero (unbalanced). By Newton's second law (F = ma), an unbalanced net force causes acceleration — the door would have accelerated and opened (moved). Answer: Hypothesis uses if-then format; unbalanced force would cause the door to accelerate and move open.

8. Zoe finally blasts the door open with a second, stronger cannon shot. She rushes inside and finds the treasure chest full of gold doubloons. Now she must drag it onto the ship using a rope. As Zoe pulls the rope, the chest moves at a constant speed across the cave floor. Her pulling force is 90 newtons forward. Explain what this tells you about the friction force acting on the chest. Then connect this to a real-world example: engineers designing a cargo sled use this same force principle. Describe how they would use balanced forces on purpose to move cargo safely at a steady speed.

Answer: Q8: The chest moves at CONSTANT speed — this means no change in motion. By Newton's first law and the definition of balanced forces, if speed is constant, net force = zero. Therefore friction must equal 90 N backward to balance Zoe's 90 N pull forward. Real-world connection: Engineers designing a cargo sled calculate the friction force of the surface first. They then design the pulling engine or motor to produce a force EQUAL to that friction force. This creates balanced forces, giving a steady, controlled speed — safe for fragile cargo, just like Zoe safely dragging her treasure. Answer: Friction = 90 N backward (balances Zoe's 90 N pull); engineers intentionally match pull force to friction to achieve safe, steady-speed transport — Zoe successfully drags the treasure aboard and sails home.