



Forces & Motion Investigation

Test how mass, applied force, and friction change motion. Compare continuous-force and push-and-release trials using live force data and motion graphs.

NGSS: HS-PS2-1 - Analyze data to support the claim that Newton's second law describes the mathematical relationship among net force, mass, and acceleration.

Name: _____ Class / Period: _____ Date: _____

Before You Begin

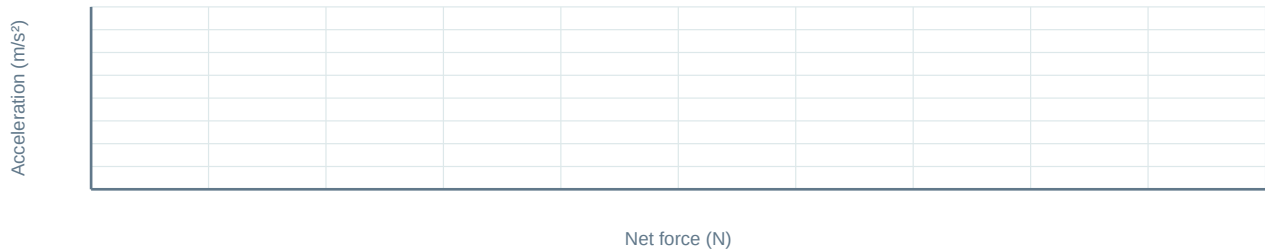
1. A cart experiences 8 N of applied force and 3 N of friction. What is the net force? Predict the direction of acceleration.

Part A - Net Force and Acceleration

Choose the **Lab cart**, select **Frictionless track**, and use **Continuous force**. Keep mass constant and change only applied force. On a frictionless track, applied force equals net horizontal force.

Trial	Mass (kg)	Applied force (N)	Net force (N)	Acceleration (m/s ²)
1				
2				
3				
4				

2. Describe the relationship between net force and acceleration when mass is constant.



Part B - Mass and Acceleration

Stay on the **Frictionless track** with **Continuous force**. Choose one applied-force value and keep it unchanged while you vary mass. Because friction is zero, the net force remains equal to the applied force.

Trial	Mass (kg)	Applied / net force (N)	Acceleration (m/s ²)
1			
2			
3			
4			

3. Describe the relationship between mass and acceleration when net force is held constant.

Part C - Friction

4. Switch to a low-, medium-, or rough-friction track. Compare maximum static friction with kinetic friction. What must happen before the object begins moving?

5. Record one moving trial: applied force, actual friction, net force, and acceleration. Explain how friction changes the net force.

Part D - Continuous Force vs. Push-and-Release

Run one continuous-force trial and one push-and-release trial using similar starting conditions. Compare the velocity and acceleration graphs.

Trial type	What happens to velocity?	What happens to acceleration?	Why?
Continuous force			
Push and release			

6. On a frictionless track, why can an object keep moving after the push ends even though the applied force is no longer present?

Newton's Second Law Conclusion

7. Use one of your trials to show numerically that $F_{\text{net}} = m \times a$.

8. Write a CER explaining how your Part A and Part B data support Newton's second law.
