Name_____ Date_____

Understanding Newton's Laws

Ancient people believed the universe was controlled by the gods. They thought an invisible power caused the seasons to change, the sun to rise, and the tides to shift. Today we understand that the universe stays on course because nature follows certain cycles and rules. Scientists call these rules laws, and use them to better understand our world and make predictions about the future.

One of the most famous scientists to study the laws of nature was Sir Isaac Newton. Newton was born in the 1600's in England. He devoted his life to the study of astronomy, mathematics, philosophy, and theology. He is best known, though, for his contribution to the field of physics and classical mechanics. After careful study of the way objects react to force and motion, Newton developed the Three Laws.

The First Law: Inertia

Although the law of Inertia is commonly known as Newton's first law, Newton did not discover it. Galileo and Descartes were actually the first to recognize the universal rule. **Inertia** is the force that keeps an object at rest or in motion. The law of inertia states that an object moving in a certain direction will keep moving at the same speed and in the same direction unless another force pushes or pulls on it. It also states that an object at rest, or not in motion, will remain at rest unless another force acts on it.

Imagine a football sitting on the grass. The law of inertia tells us that the football will remain sitting still unless someone or something moves it. If you kick the ball, it will fly in the direction you kicked it, at a certain speed, until a force stops the ball or slows it down. If the football doesn't hit anything, the force of gravity will cause it to slow down and fall to the ground.

Why does the football continue in the same direction? Why does it travel at a certain speed? These questions are answered by Newton's second law.

The Second Law: Motion

The law of motion states that "the net force of an object is equal to the mass of the object multiplied by its acceleration." To understand this rule, let's break it down into three parts.

a. When an object is acted upon by a force, that object moves in the direction *of* the force. If you kick the football to the left, you are applying a force that sends the ball to the left.

b. If the mass of an object does not change, more force will cause it to accelerate, or go faster. The harder you kick the football, the farther and faster it will travel in the direction you kicked it.

c. If the mass of an object increases, but the force does not, the object will travel slower, or decelerate. If the football tripled in size, but you kicked it with the same force, it would travel slower and less distance than the first, smaller football.

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Understanding Newton's Laws (Cont'd)

The Third Law: Law of Force Pairs

Newton's third law states that for every action there is an equal and opposite reaction. In this explanation, "action" and "reaction" both mean "force." For every force applied, another force follows. This is easy to visualize with objects in motion. If a wrecking ball swings into a building, the force applied causes the wall to break. There is an equal and opposite reaction to the force of the wrecking ball. So why is this law called the force *pairs* law?

The law of force pairs only applies when at least two objects are involved. We know that the wrecking ball exerts force on the wall. It may not be as easy to see, but the wall also exerts force on the wrecking ball. When it hits the wall, the ball slows down, stops, and swings backward. This is visual evidence that the wall is exerting equal force upon the wrecking ball.

We can also use objects that are not in motion to understand the third law. Imagine a dish sitting on a table. The earth's gravity force is acting on the dish. This force would pull the dish to the ground if it were not for the table. The table is between the dish and the ground, exerting force on the dish and keeping it from falling to the ground.

Summing Up

Newton had a lifetime of accomplishments, but his most famous discoveries had to do with objects and motion. Newton did not invent the laws of motion. He simply recognized that certain things in the world were constant. Because of his ground-breaking work, scientists who came after him were able to develop more advanced technologies and tools.

Name_____ Date_____

Understanding Newton's Laws Questions

Read the questions below and circle the letter of the correct answer.

1. Which of the following is NOT one of Newton's laws?
   a. Law of Inertia
   b. Law of Force Pairs
   c. Law of Equal Force
   d. Law of Motion

2. Which word is defined as the force that keeps an object in motion or at rest?
   a. Kinetic
   b. Energy Equality
   c. Reaction Force
   d. Inertia

3. Why is Newton's third law called the Law of Force Pairs?
   a. Force can only affect one object at a time.
   b. Energy is always dispersed to two objects at once.
   c. When force is applied, there is a second equal and opposite force.
   d. None of the above

4. An object in motion will stay in motion unless _____.
   a. Gravity stops it
   b. It comes in contact with another object
   c. Another object hits the object in motion
   d. All of the above

5. What happens when force is applied to an object at rest?
   a. It moves in the direction and at the same speed of force.
   b. It moves in the direction and at a slower speed than the force.
   c. It moves in the opposite direction and the same speed as the force.
   d. It moves in the opposite direction and a faster speed than the force.

Match the law to its definition.

Inertia	For every action, there is an equal and opposite reaction.
Motion	An object in motion will stay in motion, and an object at rest will stay at rest.
Force Pairs	If mass does not change, an object will accelerate in the direction and at the speed of the force.

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Understanding Newton's Laws Questions (Cont'd)

Read each description. On the line, write which of Newton's laws is demonstrated.

1. A cannon rolls backward as it fires a cannonball.
   _____

2. A baseball flies toward the outfield. It hits the fence and falls to the ground.
   _____

Using Newton's laws, explain why engineers include seatbelts in automobiles. Write your answer on the lines below.

_____

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