Name _____

ELEMENTS OF PHYSICS
MOTION, FORCE, AND GRAVITY

Pre-Test

Directions: This will help you discover what you know about the subject of motion before you begin this lesson. Answer the following true or false.

1. Aristotle believed that all objects fell to Earth at the same rate of speed. T_____ F_____.

2. Galileo expressed his observations on the rate of speed of falling objects in a mathematical formula. T_____ F_____.

3. Nicolaus Copernicus concluded the sun was the center of the universe. T_____ F_____.

4. Newton's second law of motion is called the "principle of inertia." T_____ F_____.

5. Mass is a term used by physicists to indicate the total quantity of an object's matter. T_____ F_____.

6. Newton's third law of motion states that for every action there is an equal and opposite reaction. T_____ F_____.

7. Vectors are a measure of the friction on an object. T_____ F_____.

8. Newton's law of gravity states that the attraction between two objects is only dependent on the distance between them. T_____ F_____.

9. Einstein's theory of general relativity completely repudiates Newton's law of gravity. T_____ F_____.

10. Einstein believed that all of the forces - gravity, electromagnetism, and the weak and strong nuclear force - were different aspects of the same force. T_____ F_____.

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Vocabulary Definitions

The following words and terms used in the program may be unfamiliar to you. Try to listen for these terms while viewing the program, pay close attention so you can later include them in your scientific descriptions, observations, and creative writing assignment activities.

Aristotle - ancient Greek philosopher, 384 - 322 BC.

calculus - a type of mathematics developed by Newton and others.

Copernicus, Nicolaus - Polish astronomer, 1473 - 1543.

Einstein, Albert - German-American physicist, 1879 - 1955.

first law of motion - called the "principle of inertia."

first revolution of physics - synthesis of Isaac Newton, which was built on the work of earlier physicists.

force - to a physicist the only forces in nature are gravity, electromagnetism, and the weak and strong nuclear force. Einstein and others believed these were different aspects of the same force.

four-dimensional universe - Einstein showed that the universe had four dimensions: length, width, height, and time.

friction - resistance to the motion of an object.

Galileo, Galilei - Italian physicist and astronomer, 1564 - 1642.

gravity - universal force of the attraction of the mass of an object.

Kepler, Johannes - German astronomer and mathematician, 1571 - 1630.

mass - total quantity of an object's matter.

motion - movement of objects.

Newton, Sir Isaac - English physicist, mathematician, and philosopher, 1642 - 1727.

rate of acceleration - the change in the velocity of the motion of an object.

second law of motion - describes how an object changes direction when a force is applied to it. The formula that expresses it is: $F = ma$ (applied force equals mass times acceleration).

space-time - Einstein showed that space and time were similar and that both were influenced by gravity.

third law of motion - for every action there is an equal and opposite reaction.

three laws of motion - laws that govern the movement of all objects, at all time, and in all circumstances. These laws were formulated by Newton.

vector analysis - the analysis of the different forces on an object resulting in the calculation of net force.

velocity - rate of motion in a particular direction. The formula that expresses it is: $v = gt$ (velocity equals acceleration multiplied by time).

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Use the Right Word

Directions: Find the right word from the physics vocabulary list that completes the following sentences.

1. The rate of motion in a particular direction is called _____.

2. The universal force of the attraction of the mass of an object is called _____.

3. The resistance to the motion of an object is _____.

4. The change in the velocity of the motion of an object is its rate of _____.

5. The total quantity of an object's matter is called its _____.

6. The second law of motion describes how an object changes direction when a _____ is applied to it.

7. The analysis of forces on an object resulting in the calculation of net force is called _____ analysis.

8. The first law of motion is often called the principle of _____.

9. Isaac Newton developed the mathematics called _____.

10. Einstein's general theory of relativity explains the impact that gravitational force had on _____.

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Word Match

Directions: Connect the word with the proper definition.

calculus	his synthesis is said to be the "first revolution of physics"
Einstein	movement of an object
F = ma	resistance to the motion of an object
friction	formula for velocity
gravity	showed the universe had four dimensions
mass	universal force of the attraction of the mass of an object
motion	rate of motion in a particular direction
Newton	type of mathematics
v = gt	formula that expresses the second law of motion
velocity	total quantity of an object's matter

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Connected/Not Connected

Directions: Place the following words in the proper sentences.

Aristotle	first law	interacting	space-time
calculus	friction	light	stress
Einstein	Galileo	mass	v = gt
F = ma	gravity	matter	vector
falling objects	inertia	opposing	velocity

1. _____ is connected to _____ because an object's attraction is dependent on its size.

2. _____ is NOT connected to _____ because Newton was the physicist who developed this mathematics.

3. _____ is connected to _____ because this formula is an expression of the rate of motion of an object.

4. The principle of _____ is NOT connected to _____ forces because it describes the motion of one object, not two or more objects.

5. _____ are connected to _____ because this Italian scientist studied the acceleration and rate of speed of objects as they fall.

6. _____ is NOT connected to _____ because it is a formula that measures force between objects not resistance.

7. _____ analysis is connected to _____ in buildings and bridges because this form of analysis calculates the net force on structures.

8. The _____ of motion is NOT connected to _____ forces because it is the third law that states for every action there is an equal and opposite reaction.

9. _____ is connected to _____ because he showed that gravity bent the fabric of space.

10. _____ is NOT connected to the total quantity of an object's _____ because it has no mass.

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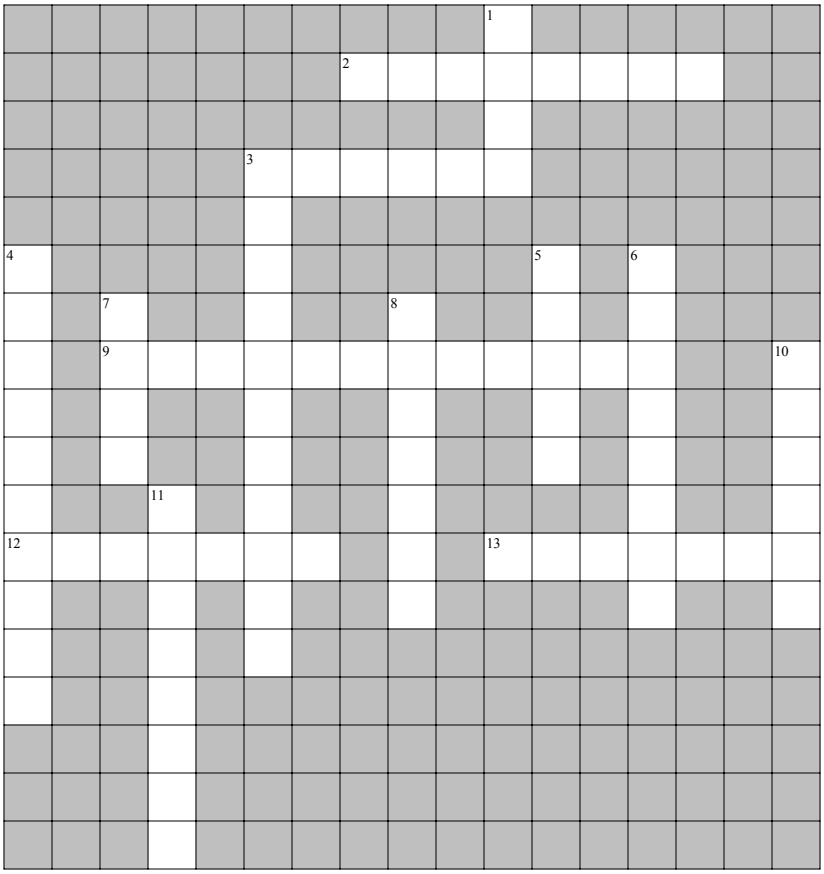
Crossword Puzzle



Across

2. rate of motion in a particular direction
3. movement of an object
9. increase in speed
12. state of rest, or motion in a straight line
13. found all objects fell at the same rate of speed in a vacuum

Down

1. Newton showed the _____ is held in its orbit by the Earth's gravity.
3. major tool of physics
4. astronomer who concluded the sun was the center of the universe
5. for every action there is an equal and opposite reaction is the _____ law of motion
6. his theory showed that gravity affects light
7. total quantity of an object's matter
8. universal force of the attraction of all objects
10. his synthesis is said to be "the first revolution of physics"
11. resistance to the motion of an object

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Creative Writing Story Ideas

Directions: Choose from one of the ideas listed below and write a story or dramatization. Include plot lines that follow scientific principles and key vocabulary terms.

1. Two Renaissance era students witness strange people dropping stones from the Leaning Tower of Pisa. Write a story from the students' point of view describing this odd event. Do they finally understand its significance?

2. Isaac Newton is a man obsessed with the motion of objects and the force of gravity. Some young people from the village drop in to visit him and he tries to describe his ideas to them. Write a dialogue of their interaction.

3. The scientist living next door has developed an anti-gravity material. You notice disturbing things going on. What do you do? The scientist argues that the anti-gravity material will be of great benefit to society. What are your conclusions?

4. A group of physicists have been sent into space to study the three laws of motion. Write a research report describing their experiments and their findings. Are the three laws validated or not?

5. "Help!" Dr. Ebenezer Rothschild, a world famous physicist, has been caught in the principle of inertia. He has been ejected from his spacecraft and according to the first law of motion he will travel in a straight line through space forever. You are aboard a nearby spacecraft and orders are given to divert your course to rescue Dr. Rothschild. What happens?

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Video Quiz

Directions: Answer the following true or false, or fill in the blank with the correct word to make it true.

1. Galileo is often called the "father of science" because he was the first to test his ideas by experimentation and observation. T_____ F_____.

2. Galileo studied the rate of _____, or change in the velocity of a falling object.

3. Copernicus concluded that the Earth was the center of the universe. T_____ F_____.

4. Newton's first law of motion is sometimes called the principle of _____.

5. The second law can be written as F = ma, when applied force (F) equals mass (m) times acceleration (a). T_____ F_____.

6. The third law of motion states: "For every action there is another action." T_____ F_____.

7. Vector analysis is a means of analyzing different forces on an object. Together these forces combine to make up _____ force.

8. Without friction the balls on a pool table would roll forever. T_____ F_____.

9. Newton was the first to understand that gravitation caused planets to follow irregular orbits. T_____ F_____.

10. Einstein's general theory of relativity looks at the impact of gravitational force on _____.

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Post-Test

Vocabulary
Directions: Fill in the blank with the appropriate term from the list below.

accelerates	friction	inertia	rate
analysis	gravity	moon	sun
Aristotle	laws	motion	universe
Einstein	mass	per second	vector
force	mathematics	planets	weight

1. The rate of acceleration of falling objects is a constant, 9.8 meters _____.

2. The major analytical tool of physics is _____.

3. Newton's second law of motion describes how an object _____ when a force is applied to it.

4. Newton's law of _____ says that the gravitational force between two objects is proportional to the quantity of their masses and inversely proportional to the square of the distance between them.

True or False
Directions: Fill in the blank with True or False. If the statement is false, change it to make the statement true. Rewrite the true statement in the space provided.

5. _____ Aristotle believed all objects fall at the same rate of speed.

6. _____ The third law of motion states that opposing forces always balance out.

7. _____ The three laws of motion govern the movement of all objects at all times and in all circumstances.

8. _____ Gravitation accounts for the movement of planets but not for the motion of objects like apples falling to earth.

9. _____ Einstein's general theory of relativity explains that light is unaffected by gravity.

Essay Section
Directions: Answer the following questions in complete sentences. Use the back of this page or a separate sheet of paper if you need more space to complete your answer.

10. Explain the difference between mass and weight.

11. How did Newton explain why the moon did not fall to Earth?

12. What did Einstein mean when he said that gravity warps space?

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