PHYSICS

GRADE 3

ASSESSMENT PACKET

We're going to study velocity, acceleration, forces, and Newton's three laws of motion in this section. You'll get to throw things, and build accelerometers as you uncover the basis of all physics in our crash-course in projectile motion. Build balloon racers, detect electric fields, construct a bridge that holds over 400 times its own weight, and more.

Created by Aurora Lipper, Supercharged Science

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This curriculum is aligned with the National State Standards and STEM for Science.

Educational Goals

We're going to study velocity, acceleration, forces, and Newton's three laws of motion in this section. You'll get to throw things, build g-force accelerometers, and much more as you uncover the basis of all physics in our crash-course in projectile motion. Newton has a famous quote that goes "If I have seen farther than others, it is because I have stood on the shoulders of giants." One of the giants he was referring to was Galileo. Thanks to the discoveries of Galileo and others, Newton was able to make many of his own discoveries. The most famous of which are Newton's Laws of Motion.

Newton's Laws are all they used to get the first man to the moon. They are an amazingly powerful and wonderful area of physics. I like them because evidence of them is everywhere. If something moves or can be moved, it follows Newton's Laws. You can't sit in a car, walk down the road, drink a glass of milk, or kick a ball without using Newton's Laws. I also like them because they are relatively easy to understand and yet open up worlds of answers and questions. They are truly a foundation for understanding the world around you.

Here are the scientific concepts:

- The motion of objects can be observed and measured.
- The position of an object can be described by locating it relative to another object or the background.
- An object's motion can be described by recording the change in its position over time.
- The way to change how something is moving is to give it a push or a pull. The size of the change is related to the strength, or the amount of "force," of the push or pull.
- Tools and machines are used to apply pushes and pulls (forces) to make things move.
- Objects near the Earth fall to the ground unless something holds them up.
- Each force acts on one particular object and has both a strength and a direction.
- An object at rest usually has multiple forces on it, but they add up to give a net force sum of zero. Forces that don't sum to zero are imbalanced, and cause an object to change speed or direction of motion (or both).
- The patterns of an object's motion can be observed and measured, and also predicted.
- Objects exert forces on each other.
- Electric and magnetic forces between a pair of objects do not require the objects be in contact. The size of the forces depend on the properties of the objects, their distance apart, and in the case of magnets, their orientation.

By the end of the labs in this unit, students will be able to:

- Design and build an experiment that shows how forces are balanced and unbalanced, and how unbalanced forces cause motion in an object.
- Make observations and measurements on an objects motion to figure out the predictable pattern of motion.
- Figure out the electric and magnetic relationship interactions between two objects.
- Differentiate observation from inference (interpretation) and know scientists' explanations come partly from what they observe and partly from how they interpret their observations.
- Measure and estimate the weight, length and volume of objects.
- Follow a set of written instructions for a scientific investigation.

Physics Grade 3 Evaluation

Teacher Section

Overview: Kids will demonstrate how well they understand important key concepts from this section.

Suggested Time: 45-60 minutes

Objectives: Students will be tested on the key concepts of Forces & Motion:

- An object's motion can be described by recording the change in its position over time.
- For any pair of interacting objects, the force exerted by the first object on the second object is equal in strength to the force that the second object exerts on the first, but in the opposite direction (Newton's Third Law).
- Electric and magnetic forces between a pair of objects do not require the objects be in contact. The size of the forces depends on the properties of the objects, their distance apart, and in the case of magnets, their orientation.
- Gravitational forces are always attractive. There is a gravitational force between any two masses, but it is very small except when one or both of the objects have large mass—e.g., Earth and the sun.

Students will also demonstrate these principles:

- Make observations and measurements on an object's motion to figure out the predictable pattern of motion.
- Design an experiment that shows when the arrangements of objects interacting at a distance changes, different amounts of potential energy are stored in the system.
- Show that when the motion energy of an object changes, energy is transferred to or from the object.
- Show that gravitational interactions are attractive and depend on the masses of the objects.
- Differentiate observation from inference (interpretation) and know scientists' explanations come partly from what they observe and partly from how they interpret their observations.
- Measure and estimate the weight, length and volume of objects.
- Formulate and justify predictions based on cause-and-effect relationships.
- Conduct multiple trials to test a prediction and draw conclusions about the relationships between predictions and results.
- Construct and interpret graphs from measurements.
- Follow a set of written instructions for a scientific investigation.

Materials (one set for entire class)

- a ball

Lab Preparation

1. Print out copies of the student worksheets, lap practical, and quiz.
2. Have a tub of the materials in front of you at your desk. Kids will come up when called and demonstrate their knowledge using these materials.

Lesson

The students are taking two tests today: the quiz and the lab practical. The quiz takes about 20 minutes, and you'll find the answer key to make it easy to grade.

Lab Practical

Students will demonstrate individually that they know how to demonstrate Newton's Three Laws of Motion. While other kids are waiting for their turn, they will get started on their homework assignment. You get to decide whether they do their assignment individually or as a group.

Physics Grade 3 Evaluation

Student Worksheet

Overview: Today you're going to take two different tests: the quiz and the lab practical. You're going to take the written quiz first, and the lab practical at the end of this lab. The lab practical isn't a paper test – it's where you get to show your teacher that you know how to do something.

Lab Test & Homework

1. Your teacher will call you up so you can share how much you understand about forces and motion as we've studied it in these lessons. Since science is so much more than just reading a book or circling the right answer, this is an important part of the test to find out what you really understand.
2. While you are waiting for your turn to show your teacher how much of this stuff you already know, you get to get started on your homework assignment. The assignment is due next week, and half the credit is for creativity and the other half is for content, so really let your imagination fly as you work through it. Choose one:
    a. Write a short story or skit about Newton's Laws of Motion from the perspective of the object (like a ball or a planet). You'll read this aloud to your class.
    b. Make a poster that teaches the main concepts of Newton's Three Laws of Motion. When you're finished, you'll use it to teach to a class in the younger grades and demonstrate each of the principles that you've learned.
    c. Write and perform a poem or song about a ball flying through the air from the perspective of the ball as it encounters gravitational forces, magnetic forces, and forces from impacting other objects. This will be performed for your class.

Physics Grade 3 Quiz

Teacher's Answer Key

1. What is Newton's Third Law of Motion? (For every action, there is an equal and opposite reaction.)
2. What is velocity? (It's the measure of speed combined with the direction an object is traveling.)
3. Which forces can be attractive or repulsive? Do their sizes depend on the magnitudes of the charges? Give an example. (Electric and magnetic, and yes it does – the currents, or magnetic strengths depend on the distances between the interacting objects. Two magnets can interact without touching – one can push on the other when the same poles are facing each other.)
4. Gravitational forces are always: attractive, repulsive, or both? (Attractive.)
5. True or false? Gravity pulls on all things equally. (False!)
6. True or false? Gravity accelerates all things equally. (True!)
7. How is acceleration different from speed and velocity? (Speed is distance per unit time, velocity is speed and direction, and acceleration is the change in velocity, which means a change in the speed or a change in the direction.)
8. What is Newton's First Law? (Objects at rest stay at rest, and an object in motion stays in motion with the same speed and in the same direction unless acted upon by an unbalanced force.)

Physics Grade 3 Quiz

Name_____

1. What is Newton's Third Law of Motion?

2. What is velocity?

3. Which forces can be attractive or repulsive? Do their sizes depend on the magnitudes of the charges? Give an example.

4. Gravitational forces are always: attractive, repulsive, or both?

5. True or false? Gravity pulls on all things equally.

6. True or false? Gravity accelerates all things equally.

7. How is acceleration different from speed and velocity?

8. What is Newton's First Law?

Physics Grade 3 Lab Practical

Teacher's Answer Key

This is your chance to see how well your students have picked up on important key concepts, and if there are any holes. Your students also will be working on their homework assignment as you do this test individually with the students.

Materials:

- A ball

Lab Practical: Ask the student *Note: Answers given in italics!*

- Students will demonstrate Newton's Three Laws of Motion. Hand the student a ball and ask them to teach you the three laws of motion.

  Here they are for your reference:

- Newton's First Law of Motion states that objects in motion will tend to stay in motion unless they are acted upon by an external force. A force is a push or a pull, like pulling a wagon or pushing a car. Gravity is also a force, but it's a one-way force that attracts things to each another. *Student throws the ball, showing that the ball will go in a straight line until gravity pulls it down to the ground.*
- Newton's Second Law of Motion is for objects experiencing unbalanced forces. The first law, usually called the law of inertia, says that if all the forces acting on an object are balanced then the object is in equilibrium and does not accelerate. The object can either be at rest or in motion, but not accelerating (the object can be at a constant speed and traveling in a straight line). Objects not in equilibrium experience unbalanced forces, which causes them to accelerate. Acceleration is a change in speed, direction, or both. *Students throw the ball, demonstrating that the force of the throw (F) can be calculated by knowing the ball's mass (m) and how fast the ball's velocity is changing (acceleration, or a).*
- Newton's Third Law of Motion states that for every action, there is an equal and opposite reaction. This means that for every interaction, there's a pair of forces acting on the objects, which are equal in size and opposite in direction. *Students place a ball on the desk and point out how the weight of the ball is balanced by the desk pushing up on the ball. If the ball were massive enough, when you tossed it out of a canoe, the canoe would travel in the opposite direction.*

Physics Grade 3 Lab Practical

Student Worksheet

This is your chance to show how much you have picked up on important key concepts, and if there are any holes. You also will be working on a homework assignment as you do this test individually with a teacher.

Materials:

- A ball

Lab Practical:

- Demonstrate Newton's Three Laws of Motion using the ball provided. You'll need to explain what you're up to as you perform your experiments. (Extra credit if you can design an experiment that demonstrates all three laws at the same time!)