The Physics Olympics: Learning Newton's Laws through Sports

Crystal Salazar

Introduction

"Millions saw the apple fall, but Newton was the only one who asked WHY"- Bernard Baruch

The central goal of this unit is to inspire all learners to ask why! This unit will explore the discoveries of Sir Isaac Newton, particularly his Three Laws of Motion and Law of Gravitation. The students will learn about these concepts by participating in interactive activities, a variety of sporting events, and thoughtful discussions that require student involvement and inquiry. The strategies used in the unit offer ways to keep students engage and can be used when teaching any science concepts. At the end of the unit the students will demonstrate their knowledge by identifying Newton's Laws during several different sporting events and using technology to present observations they make in their daily lives of Newton's Laws in action.

Physics can be intimidating for adults and students alike. Therefore, this unit offers background information for teachers about Newton's laws to help teachers better understand these concepts. This unit also provides a list of resources for teachers interested in learning more. Also included in this unit is a list of students reading materials and resources to supplement instruction in the classroom. This Unit was written for a fifth grade class, but can be adapted for third through eighth grade classrooms.

Rationale

I have always been curious about the world around me. Growing up I was always asking "why?" The first time I ever felt like I was having my "why" questions adequately answered was when I took physics for the first time during my senior year of high school. This is when my passion for physics began. It only grew when I took a physics course in college. When I was assigned to fifth grade and discovered that the curriculum included

Newton’s Laws I was ecstatic. Up until the time when I first taught science I had assumed that everyone was as curious about everything as I was. Much to my surprise I realized that not all of my students were.

As an educator I want my enthusiasm to become contagious. I believe that teaching Newton’s Laws through sports and interactive activities is the best way to accomplish this. I want to first engage my students in a way in which they will become curious about their world and begin to ask “why?” Then, I want them to feel the excitement that I feel while they are exploring to reach a conclusion. Finally, I want them to continue to wonder and discover throughout their lives.

Background

Though I find physics intriguing, the ideas are at times difficult to grasp. In order to teach Newton’s Laws of Motion and Gravity, you must first have a comprehensive understanding. In this section I will first give a brief overview of each law and then explain the key concepts needed to understand the laws in more detail.

Newton’s First Law

Newton’s first law of motion states, “*An object at rest will remain at rest unless acted on by an unbalanced force and an object in motion continues in motion with the same velocity (same speed and in the same direction) unless acted upon by an unbalanced force*.” The first half of this law is something everyone already knows, children and adults alike, but just never thought about and most likely never stated because it is so obvious. Simply put, the law states that if an object is not moving it will not begin moving unless something or someone moves it (an unbalanced force). The second half of the law is more difficult to understand because it is an abstract concept. Objects do not continue in motion with the same velocity on Earth because there are always other forces acting on Earth’s objects; namely gravity and friction. If we were to remove gravity and friction then an object’s speed and direction would never change unless something or someone changed it. To make this abstract idea more concrete you need to soar into outer space where gravity and friction are removed and the velocity of the planets do not change.

Newton’s Second Law

Newton’s second law of motion is usually expressed as the equation

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Where *F* represents force and is measured in Newtons (N), *m* represents mass and is measured in kilograms (kg), and *a* represents acceleration and is measured in meters per second squared (m/s^2). The purpose of this law is to show the relationships between force and acceleration and between mass and acceleration. The relationship between force and acceleration is direct, meaning that as the force increases the acceleration increases. The relationship between mass and acceleration is inverse.Therefore, as the mass increases the acceleration decreases. The greater the mass (of the object being accelerated) the greater the amount of force needed to accelerate the object. This concept is also something everyone has observed in daily life. The harder you push an object the faster it goes, and if you push two objects with the same amount of force the one with more mass will accelerate slower than the one with less mass. Acceleration is produced when a force acts on a mass.

Newton's Third Law

Newton's third law of motion states, "*For every action there is an equal and opposite reaction*."This law is most difficult for the students and me to understand. This means that for every force there is a reaction force that is equal in size, but opposite in direction. Simply put whenever an object pushes another object it gets pushed back in the opposite direction equally as hard. To understand this concept it is helpful to think of a person on ice skates standing at the wall in an ice rink. If said person pushes on the wall she moves backward. When she pushed on the wall the wall pushed back in the opposite direction. The amount of force used to push against the wall determines the amount she will move backward because the wall pushes back with equal force, the harder she pushes the further back she will move. Observing a rocket launch is also helpful when trying to understand this concept. Letting go of a blown up balloon is a great way to gain hands on experience for the comprehension of this law.

Newton's Law of Gravitation

This law states, "*Every object in the universe attracts every other object with a force that is directly proportional to the product of the masses of the objects and inversely proportional to the square of the distance between them*." In simpler terms all objects exert the force of gravity on other objects, objects with more mass exert a larger amount of force, and objects with more distance exert a smaller amount of force. This law is also referring to relationships. The relationship between gravity and mass is direct meaning the more mass an object has the more gravitational pull it exerts. The relationship between gravity and distance is inverse meaning; the more distance between two objects the less gravitational pull they exert. This can be easily understood by thinking of the moon, the Earth and a tennis ball. Objects are pulled to the surface of Earth due to the short distance they are from the center of Earth. Imagine someone playing with a tennis ball. If he were to throw the ball into the air it would return to him. Now if the tennis ball was in outer space it would not return to Earth because of the great distance between the ball and Earth, gravity has weakened. But the moon, because it has more mass than the tennis ball, is pulled toward the Earth causing it to orbit around the Earth. Furthermore if the moon were closer to Earth, decreasing the distance between the two objects, gravity would increase causing the moon to come to Earth's surface.

Newton showed this relationship in the equation

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Where F is equal to the force of gravity between two objects, m_1 and m_2 are the masses of the two objects, and r is the distance between the two objects. The two masses are multiplied causing the gravitational force to increase. The distance is squared and then used to divide the masses causing the gravitational force to decrease. The gravitational constant is G. The result is very small, equal to approximately 6.674 x 10 -11 N m^2 kg $^{-2}$. It is important to note that Newton did not have the gravitational constant when making his calculations. This formula was refined with Einstein's theory of general relativity but, it still gives a very accurate calculation of gravitational forces.

Force

A force is commonly defined as a push or pull. When forces are balanced they are canceling each other out, and the object receiving the force does not move. When forces are unbalanced one force is said to be stronger than the other and the object will move. On Earth the force of gravity is always being applied to all objects. Also, friction is typically exerted onto nearly all objects in motion acting in a direction opposite to the velocity of the object.

Motion

If an object is set into motion, then the position of the object is changed.

Friction

Friction is a type of force. It is a force that opposes the motion of an object across a surface or through a gas or liquid. Friction is always exerting force in the opposite direction of an objects velocity. Without force nothing could stop or start. It is easy to understand why objects would not stop but to understand why objects would not be able to start it is helpful to think about a surface with a minimal amount of friction such as ice. When you push on the ground to take a step your foot slides backward, but then it eventually (hopefully) gets a grip and you are able to move your foot forward (because the ground is pushing back – Newton's Third Law). When exploring the idea of friction it is important to discuss and experiment with surfaces that have different amounts of friction.

Gravity

Gravity is also a type of force. It is a pull that all objects exert on all other objects at all times. The pull that we are most affected by in our daily lives is the pull that the earth is exerting, because the Earth has an extreme amount of mass and is in close proximity. The gravitational pull of the Sun on Earth also affects our daily life, in that it causes the Earth's rotation around the sun, which attributes to the different seasons.

Distance

The distance an object has traveled is measured by calculating its change in position.

Speed

The speed of an object is measured by the distance an object travels in a specific amount of time. The equation used to calculate speed is

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Where *s* is equal to speed, *d* is equal to distance, and *t* is equal to time. We most commonly think about speed while driving a car, when we use the measurements miles for distance and hours for time. This is why we report our speed in in miles per hour (m/h).

Velocity

Velocity is the speed and direction an object is traveling. A force is needed to change the velocity of an object. If the speed and/or direction of an object changes it is said that the velocity has changed.

Acceleration

When an objects' velocity has changed it is said that it has accelerated. Acceleration is calculated by using the following equation:

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Where A represents acceleration, V_f represents the final velocity, V_i represents the initial velocity, and t represents time.

Mass

Mass is defined as the amount of matter in an object. It is important to point out the difference between mass and weight. To do this you may need to discuss density.

Momentum

Momentum and velocity are directly related as shown in the equation

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Where p is equal to momentum, m is equal to mass, and v is equal to velocity. Therefore a more massive object and an object with an increased amount of velocity will have more momentum than a less massive object and an object with a decreased amount of velocity, respectively. It requires more force to change the velocity of an object with more momentum. In simpler terms, it is more difficult to change the velocity of a massive, quickly moving object.

Inertia

There is a natural tendency of objects to keep doing what they are doing. All objects resist changes to their state of motion. An objects resistance to change is its inertia. A change in motion (acceleration) refers to a change in either the speed or the direct (velocity).

A helpful example to understand this is to think about when you are in a car. When the driver slams on the brakes it seems as if your body is thrown forward, but in actuality your body continues to move as it was (resisting change) and the car stops.Another example is when a sudden turn is made. When a car turns left it seems as if your body is pushed to the right. When in fact, your body continued to move in the same direction, as objects have a tendency to do, and the car moved to the left.

The more mass an object has the more inertia it has, this is stating the obvious. The more mass an object has the more difficult it is to move from rest or to stop from moving. In other words, it is more difficult to change its state of motion. If a car and a truck are both traveling at the same speed and brake at the same time the car will stop before the truck. This is because the truck has more mass, and subsequently more inertia, which means it is more resistant to stop, or change its state of motion.

Strategies

Inquiry

The strategy that will be implemented throughout this unit is inquiry. The students will be compelled to generate questions and use their curiosity to discover the answers through observations and discussions in class. The teacher will be managing through the unit in order to stay on topic but the students will be guiding the discussions. With this in mind the unit may not be carried out exactly as planned. I will let the students shape it based on their questions and interests.

Cooperative Learning Groups

The students are placed in carefully selected cooperative learning groups. The students will work in these groups throughout this unit. There are two different types of groups, heterogeneous and homogeneous. The heterogeneous group consists of one student performing above grade level, two students performing at grade level, and one student performing below grade level. Each of the homogeneous groups consists of all students at the same level. The students are unaware of how these groups are selected. In the heterogeneous groups the struggling students benefit from the knowledge of the high achieving students, the high achieving students benefit from explaining their thinking to the rest of the group, and all of the students benefit from the critical thinking discussion.The purposes of the homogeneous groups are to allow the high achieving students to work with one another in order to challenge each other and to ensure that the students at the other levels are thinking critically and not simply relying on the students performing at a higher level.

Science Notebook

Each student will have their own science notebook that will be treated as a valuable resource. This is where students will use written and artistic expression to record their questions, predictions, key vocabulary, observations, and insights. The goal is for the students to realize that every time we ask "why" there is an opportunity to investigate.

Vocabulary

In science many new vocabulary words are introduced that are often not used in daily life. It is extremely important that the students have a deep enough understanding that they are able to accurately use the science terminology. Several vocabulary strategies are implemented in the classroom in order to achieve this goal.

One way to insure a deep understanding of the vocabulary words is to have the students create vocabulary boxes. In order to create a vocabulary box the students will fold their paper in half horizontally and vertically, so that there are four squares on the page. They will write the word or phrase in the middle, the definition, a definition in their own words, a sentence with the word used correctly, and an illustration/diagram that shows the meaning in each of the four boxes. Several resources will be referred to while completing this. The students will finish this in a multiple of ways: independently, in groups, and through jigsaw. A jigsaw activity is done by assigning each student or group one word, the group or student completes a vocabulary box for the word and then presents the word to the class.

I constantly encourage my students to use new vocabulary in their daily lives as much as possible. I tell them their parents' should be learning everything we are learning. In order to motivate them to do this they participate in an ongoing game of "Vocabulary Challenge". I teach two different classes so my two classes play against each other, but you could also have different table groups play against each other. To earn points for their team the students must use a vocabulary word in their daily life. When they tell me about it they must explain the context in which the word was used and demonstrate an understanding of the meaning and concept. Every year my students enjoy this game more than I could have ever imagined.

The students are required to use the proper terminology orally during class and group discussions as well as in their writing. I have created a Science Word Wall as a tool to aid students while they are participating in conversations and completing writing assignments in class. The Science Word Wall is a designated area where the science words are written on one side of a card large enough for the students to see from anywhere in the room. This serves as a reminder of the words the students are to be using. On the reverse side of the card is the meaning of the word. This serves as a reference tool. The students are able to go to the Science Word Wall and turn the card over if they need a reminder. Students are allowed to go to the word wall twice a day.

When discussing science concepts in class it is imperative that both the teacher and the students use the correct terminology.

Activities

First Objective: The students will have a basic understanding of motion, time, distance, speed, velocity, and acceleration.

Activity One: Track Star

We will begin this unit by going outside and running! This activity has two purposes. The first purpose is to gain the students' interest and get them excited about learning Newton's Laws. The second purpose is to give all the students a common experience to refer back to throughout the unit.The ultimate goal is to time how long it takes the students to run the different distances (10m, 20m, 30m, 40m, 50m, etc.), record the data on a chart and graph the data to make comparisons. There are several different ways to carry out this activity. I will provide you with several different options. I will allow every student who wants to run the opportunity to do so. Some students may not want to and that is fine, they will still be an active participant.

The first task is to place markers at a starting point andevery ten meters. You can go up to a hundred meters or shorten it to fifty meters due to limited time or space. The meter can be marked off by simply placing backpacks on the ground or spraying the grass with spray paint. You then may want to have the students who do not want to run stand at these marks. This will make it easier to see the markers on video.

Now it is time for the fun, running! There are a few different ways to do this. You may just time, chart, and graph two or three students; this is all you need to do to accomplish the main objective. However, an alternate objective is to get the students excited about the unit. With this in mind you may want to time every student who wants to be timed. Remember that at this age they begin to be self-conscious, so some children may not want to be timed. If you do have students running but not being timed they may run together.There are two different ways to time the students. One way is to video record the students running and then watches the videos in class. While watching, you will use a stop watch to time how long it took to run each distance. First, time the student's first 10 meters by stopping the stop watch when he passes the first marker and record the time on a chart. Then, rewind and stop the stop watch when he passes the second meter marker and record the time. Continue until you have every meter completed. This way is the most accurate because the teacher is operating the stop watch. If you do not have a video recorder available or you want to save time, then you may have students standing at the meter markers with a stop watch and paper. They will stop the stop watch when the student runs past them and record the time. As previously noted this is not the most accurate way, but it will still work.

After the data is recorded on a chart, choose two or three different children and graph theirresults and make comparisons. This activity leads to a discussion about the meanings of the terms *motion*, *time*, *distance*, *speed*, *velocity*, and *acceleration* in this order. Referring to the race and graphs will make it easy to explain and, more importantly, easy for the students to understand.Students will be taught that speed equals distance divided by time so that they may calculate the speeds of two runners. Students will then be taught that velocity is just the speed with the direction. We will then use compasses to figure out the direction to determine the velocity. At this time we will briefly discuss what mass means and calculate the mass of the two runners. Next, we will discuss acceleration and calculate it. An introduction to and basic understanding of these key terms is needed before students are able to learn Newton's Laws with the outcome of deep understanding.

Second Objective: The students will have an understanding of force, friction, and inertia and will be able to apply that knowledge to Newton's First Law.

Activity 2:Friction Fun

In this activity the students will run and try stopping on different surfaces. Different surfaces include, but are not limited to, the tile in the halls, the wood floor in the gym, the carpet in the classroom, and the black top. During this activity they will observe how friction causes objects to stop and how different surfaces have different amounts of friction. After the fun, a short discussion will be held to insure that the students understand what they observed and that it is called friction.

At this time we will view the Discovery Education Video: “Let’s Move It: Newton’s Laws of Motion”. We will watch the first segment and the first three minutes and twenty-five seconds of the second segment. Watching this video will reiterate the concept of friction causing objects to stop moving and introduce the vocabulary word *force*, the concept of *inertia*, and *Newton’s First Law*.

Activity 3: Stop right There!

During this activity the students will participate in a kickball game to observe and experience how inertia makes it difficult for a baseball player to stop on second and third base. After the kickball game,in order to assess the students’ understanding at this point in the unit, each student is required to write two paragraphs. In the first paragraph they must give examples of when they observed *motion*, *time*, *distance*, *speed*, *velocity*, and *acceleration* during the kickball game. In the second paragraph the students will explain how Newton’s First Law of Motion was observed during the kickball game. They must use the words *force*, *friction*, and *inertia* in the second paragraph.

Third Objective: The students will apply their understanding of Newton’s Third Law of Motion by providing an example from their previous experiences.

Activity 4: Balloon Blow and Let Go!

In this activity the students will blow up a balloon and then let it go. The purpose of this is to see that the balloon moves in the opposite direction of the movement of the air. This demonstrates Newton’s Third Law, as the air moves out of the balloon the balloon moves in the opposite direction. Since we are unable to see the air coming out of the balloon, I would insure that the students understand this by drawing it on the board.

We will view the one minute twenty-eight second segment titled “Newton’s Third Law of Motion” of the Discovery Education Video: “Let’s Move It: Newton’s Laws of Motion” to see other examples of Newton’s Third Law in action.

Activity 5: Bouncing Basketballs

Students will experience and observe Newton's Third Law of Motion while playing basketball. While playing we will exert different amounts of force to bounce the ball. We will observe that the more force we exert downward on the ball, the more force the ground exerts up on the ball, causing it the bounce higher. The students' understanding of this concept will be assessed by requiring them to apply this knowledge to other situations. Each student must independently think of an example of when they have seen Newton's Third Law of Motion in action. The example must be one that was not seen or discussed in class. They must use the words *force*, *exert*, *action*, and *reaction* to write a paragraph explaining how theirexample demonstrates Newton's Third Law of Motion.

Fourth Objective: The students will understand how force, mass, and acceleration relate to each other Newton's Second Law of Motion.

Activity 6: Coin Collision

In this activity the students are given two pennies, nickels, dimes, and quarters. The students will select two coins at a time and experiment with the coins by sliding them into each other. They will first predict what will happen when one coin hits the other. Through this activity students will observe that objects with more mass must have more force exerted on them in order to get them to move.

To help the students better understand mass and to introduce Newton's Second Law of Motion we will view the two minute eight second segment titled "Newton's Second Law of Motion" of the Discovery Education Video: "Let's Move It: Newton's Laws of Motion".

Activity 7: NASCAR

This activity will review and reinforce the previously learned conceptsof *force*, *speed*, *velocity*, *mass*, and *acceleration*. This activity will also deepen the students understanding of these concepts by focusing on how they relate to one another, particularly how *force*, *mass*, and *acceleration* relate; Newton's Second Law of Motion. The students will create a "NASCAR" by selecting parts from a variety of different wheels, chassis, and balloons (engine). The students will blow up the balloons to make the car accelerate. First they will measure the distance and time. Students will be reminded that *speed equals distance divided by time* and calculate the speed of their car. Students will then be reminded that velocity is just the speed with the direction. We will then use compasses to figure out the direction to determine the velocity. At this time we will discuss what mass means and calculate the mass of our cars. Next, we will discuss acceleration and calculate it. Once we have done all this we can finally determine the amount of force we used to put our "NASCAR" in motion.

To fully comprehend Newton's Second Law of Motion the students need to understand that force and acceleration are directly related and mass and acceleration are inversely related. To achieve this we will calculate the acceleration of three cars with different masses and apply the same amount of force (puffs of air in the balloons). This will show the inverse relationship between mass and acceleration. To show the direct relationship between force and acceleration we will use the same car three times and apply different amounts of force. All information will be recorded on a chart and comparisons and conclusions will be made.

Fifth Objective: Students will understand momentum.

Activity 8: Sprinting Momentum

This activity begins by reading a few different sports headlines in which reporters say phrases like, "They have won the last three games and have a lot of momentum going into the finals." We will discuss how these relate to the scientific definition of momentum. We will discuss the fact that the more momentum an object has the harder it is to stop. To calculate momentum a student will sprint down the hall while several students line the hall with meter sticks to measure the distance and others will operate stop watches to calculate the time. The students will independently use this information to calculate the speed and then determine the velocity. The students will be given the mass of the sprinter and the equation *momentum equals mass multiplied by velocity*.They will use this information to determine the momentum of the sprinter. We will then discuss how this information is important to car manufacturers because a small compact car will be easier to stop than a SUV, and therefore they would need different braking systems.

We will review Newton's Three Laws of Motion by watching the last three segments of the Discovery Education Video: "Let's Move It: Newton's Laws of Motion".

Sixth Objective: The students will understand Newton's Law of Gravitation.

Activity 9: The Big Drop!

In this activity the students will drop objects of different weights and sizes in order to come to the conclusion, through experimentation and observation, that all the objects hit the ground at the same time. The students will choose two objects from the room. The only requirements are that they will not break when they hit the ground, and that they are two different weights or sizes.Before they drop them they will predict which object will hit the ground first. They will undoubtedly predict that the bigger or heavier object will hit the ground first.They will drop two objects at the same time and from the same height. After doing this about three or four times they will begin to realize that the objects hit the ground at the same time.

This is a very difficult concept for most students to believe even when they see it with their own eyes. Some refuse to believe it and will even manipulate the experiment so that the objects do not hit the ground at the same time. An alternate way to introduce this experiment is by challenging the students to find out what they have to do to get the objects to hit the ground at the same time. They will begin by holding the heavier object higher in the air because they think it will fall faster. When it hits the floor after the lighter object they will move it down more and more until they are an equal distance from the ground.

Discuss the fact that all objects fall at the rate of . The best way I have found to explain this is by drawing a diagram of an object falling for a set amount of time and calculating its speed one second at a time.

Seventh Objective: The students will apply their knowledge of Newton's Laws of Motion by relating them to everyday activities.

Activity 10: Show What You Know

The students will demonstrate their knowledge by creating a visually appealing presentation and presenting it to the class. Some options they may choose from to create their presentation include, but are not limited to, Prezi, glogster, power point, poster, exhibit, and SmartBoard Notebook. Their presentation must meet the following requirements: 1)They must explain Newton's Three Laws of Motion by giving real life examples and explaining how the examples show the laws using the proper science terms accurately. 2)When explaining an example of Newton's First Law of Motion they must use the terms *rest*, *force*, and *motion*. 3)The explanation of Newton's Second Law of Motion must include the terms *force, mass*, *acceleration*, *inverse*, *direct*, and *relationship*. 4) The terms *action*, *reaction*, *equal*, and *opposite* are required when explaining Newton's Third Law of Motion. 5) They must give real life examples of and explain how *gravity*, *acceleration*, *mass*, *inertia* and *friction* affect their daily lives.

Activity 11: Physics Olympics

This is the final activity of the unit. It will actually be a final assessment piece, but the students will be having so much fun they will not even notice it is a test. The students will be divided up into teams and put into brackets. Ideally the entire grade level would participate together. The teams with the most points will continue in the bracket until there is a champion. The first round will consist of three events. During this round half the teams will play at a time while the rest of the students make observations. The observing students will have certain requirements as to the general types of observations that need to be made and record their observations. Each event will last for five minutes. After five minutes the observers will become the players, and the players will become the observers. At the end of each event the winning team will be awarded two points. If there is a tie, those teams will be awarded one point each. During the following rounds the teams that move on in the bracket get to continue playing while the other teams observe. This can be done with just about any sport. I would change the sports I use based on student interest. For example, during the first round, the first event could be soccer, the second event basketball, and the third event kickball. Then, during the second round, you could use one of the same sports again or play a new sport.

Bibliography

Teacher Resources

Books

Gardner, Robert. *Experimenting with science in sports*. New York: F. Watts, 1993.

This book is full of exciting experiments that show the relationship between Newton's Laws and sports.

Burnett, Betty. *The laws of motion: understanding uniform and accelerated motion*. New York: Rosen Pub. Group, 2005.

This informative book explains the important concepts and includes easy-to-understand examples. It is one of a series of books. Each title in the series concentrates on a specific physics concept.

Gondhalekar, Prabhakar. *The grip of gravity: the quest to understand the laws of motion and gravitation*. Cambridge: Cambridge University Press, 2001.

This book is for teachers who are very interested in this topic and want to complete additional reading. It will give an overall understanding of the history leading

up to Newton’s discoveries and what came of Newton's findings later. It is written at an advanced level.

Zimba, Jason. *Force and motion: an illustrated guide to Newton's laws*. Baltimore: Johns Hopkins University Press, 2009.

This book is great if you want an in-depth understanding of Newton’s three Laws of Motion. It is written at an advanced level.

Gamow, George. *Gravity* . Garden City, N.Y.: Anchor Books, 1962.

This is a great resource if you want a more in-depth understanding of gravity. It is written at an advanced level.

Gibilisco, Stan. *Advanced Physics Demystified*. 1 ed. New York: McGraw-Hill Professional, 2007.

This book is also for teachers who want a deeper understanding of the physics they are teaching. This book is easier to understand and uses fewer mathematical formulas than Gamow’s more complex explanations. Chapter 1 explains the concepts of velocity, acceleration, mass, force, and momentum. Chapter 8 focuses on gravity.

Friedhoffer, Robert. *Physics Lab in a Housewares Store (Physical Science Labs)*. United States: Franklin Watts, 1997.

This book provides activities to explore simple machines. Simple machines were not covered in this unit, but may be part of your physics unit. It also has brief, but easy-to-understand, sections on friction, mass, and weight.

Websites

"The Physics Classroom."The Physics Classroom. http://www.physicsclassroom.com/ (accessed November 27, 2011).

This website explains several physics conceptsextensively. It goes beyond thelevel necessary for this unit.

Student Resources

Books

Gianopoulos, Andrea, Phil Miller, and Charles Barnett.*Isaac Newton and the laws of motion*. Mankato, Minn.: Capstone Press, 2007.

This book is written in a graphic novel format and tells the story of how Isaac Newton developed the laws of motion and the law of universal gravitation. It is unique and may get the attention of your reluctant readers.

Leary, Denyse. *What are Newton's laws of motion?*. New York, N.Y.: Crabtree Pub., 2011.

This book includes eye catching pictures and a brief discussion of the laws of motion as well as explanations of how friction and gravity affect things in motion.

Mayer, Lynne, and Sherry Rogers.*Newton and me*. Mount Pleasant, SC: Sylvan Dell Pub., 2010.

This is a very rudimentary book, intended for young children,I suggest using for struggling students or as a read aloud to introduce the unit.

Asimov, Isaac. *Isaac Asimov's Guide to Earth and Space*. 1991. Reprint, Robbinsdale, Minnesota: Fawcett, 1992.

This book has a series of very short articles each answering a specific question including “What is Mass?”, “Does the Earth Move?”, and “When You Jump Up, Why Don’t You Come Down in a Different Place?”

Websites

"Laws of Motion - Kids Science Videos, Games and Lessons that Make Learning Fun and Easy." Educational Videos and Games for Kids about Science, Math, Social Studies and English. http://www.neok12.com/Laws-of-Motion.htm (accessed November 27, 2011).

This website is perfect for children to review specific conceptsindependently by playing interactive games.

"Newton's 3 Laws of Motion."CEEE GirlTECH Home Page. http://teachertech.rice.edu/Participants/louviere/Newton/ (accessed November 27, 2011).

The web site provides a basic understanding of the three laws of motion with simple graphic.

Classroom Materials

Books

Phelan, Glen. *Newton's laws*. Washington, D.C.: National Geographic Society, 2004.

This book introduces Sir Isaac Newton and some of his scientific discoveries and accomplishments. It includes examples of how Newton's laws explain the movements of everyday objects.

Gleick, James. *Isaac Newton*. New York: Vintage, 2004.

This book is a biography on the life of Isaac Newton.

Websites

"Welcome to Discovery Education | Discovery Education."Welcome to Discovery Education | Discovery Education. http://discoveryeducation.com (accessed November 27, 2011).

This site has thousands of beneficial videos and interactive explorations. This site does require paymentfor use, but many schools district have purchased a license.

"BrainPOP - Animated Educational Site for Kids - Science, Social Studies, English, Math, Arts ."BrainPOP - Animated Educational Site for Kids - Science, Social Studies, English, Math, Arts . http://brainpop.com (accessed November 27, 2011).

This website has eye-catching videos followed by a quiz that test their comprehension.

"StudyJams."StudyJams. http://studyjams.com (accessed November 28, 2011).

This website also has intriguing videos accompanied with a quiz.

"Glogster EDU - 21st century multimedia tool for educators, teachers and students | Text, Images, Music and Video ."Glogster EDU - 21st century multimedia tool for educators, teachers and students | Text, Images, Music and Video . http://edu.glogster.com/ (accessed November 27, 2011).

This in an interactive website for creating digital posters.

"Newton's Laws of Motion - FREE presentations in PowerPoint format, interactive activities, lessons for K-12 ." SCIENCE - FREE Presentations in PowerPoint format, Free Interactives& Games for Kids . http://science.pppst.com/newtonmotion.html (accessed November 27, 2011).

This website is full of information. It includes power point presentation, games, quizzes, interactive explorations, videos and more!

"Prezi - The Zooming Presentation Editor."Prezi - The Zooming Presentation Editor. http://prezi.com (accessed November 27, 2011).

This is an interactive tool for creating a presentation similar to a power point presentation.

Here are five Olympic sports where physics makes all the difference: Swimming. Olympic swimming races are often decided by tenths or hundredths of a second.Â Newton's third law of motion also plays a great role in gymnastics. The law states that for every action, there is an equal and opposite reaction. Gymnasts take advantage of this by pushing hard against the floor, the balance beam or the vault, so that these surfaces push back hard against them, giving them lift into the air. Diving.Â Fletching offers aerodynamic stability through air resistance. If some force, such as air turbulence, tries to push the arrow off its straight course, the fletching produces a drag against that change in motion, hindering the movement off course. Check out the physics behind these 16 Olympic sports, including some of the ways athletes apply what we know about physics to help them on their quest for gold. It indicates an expandable section or menu, or sometimes previous / next navigation options. 1/.Â As a cyclist cuts through the air, he produces a slipstream that trails behind him. Another cyclist riding in this slipstream will use about one third less energy. Paul Hanna.Â This is all thanks to Newton's Third Law of Motion, which says for every action there is an equal and opposite reaction. Tim Windborne. Source: LiveScience. Newtonâ€™s Third Law: For every action there is an equal and opposite reaction. When your stone collides directly with one of the previously thrown stones, it pushes it forward. But that action also has a reaction â€“ your stone is slowed down.Â I am sure that there are other ways in which Newtonâ€™s Laws of Motion are at play in curling, and in every other Olympic sport. Comment below and share how you see Newtonâ€™s Laws at work this Olympics. Share this