Ancient Sports in the Americas and the Physics Behind It

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Introduction

What is Physics? The American Heritage dictionary defines it as "the matter and energy and of interactions between the two." What does that mean to a fifth grader? Not a thing. Hence, the reason why I would like to create a unit is to appeal to my 10 and 11 year olds by using something they all can relate to: Sports. On the Social Studies NC Standard Course of Study, 5th graders learn about various cultures which exist on the North American continent, which includes Canada, United States and Mexico. I had to devise a way to make the learning of history of these countries and their pastimes interesting and engaging. Sports are the perfect vehicle through which to learn not only the history, but the science behind each one. In the United States, we will study the ancient sport of lacrosse, and research the Native Americans who played it. Looking at Canada, we will investigate hockey, past and present. In ancient Mexico, we will study the Meso-American Ballgame, whose modern-day equivalent is volleyball. As an exploration, we will recreate various parts of each game and analyze the physics concepts which correspond to the physical acts of hitting, throwing, bouncing, and running, essential to each sport. As teachers, we all attempt to maximize our instructional days, and being able to incorporate Science and Social Studies is a more efficient way to cover both subjects simultaneously. It is almost a teacher's mantra to "integrate other subjects whenever possible."

Rationale

I chose this seminar as well as this topic with my fifth grade students solely in mind. My intention is to make these complex concepts more concrete for my students. Kids love sports and they love to move and have fun. What better vehicle to teach physics than sports? My second reason for creating this unit is to overcome my own personal fears with both of these subjects. During high school and college, physics was one of my least favorite subjects. I dreaded going into the classroom, only to have to listen to abstract ideas which seemed as if there were foreign or possibly even extraterrestrial. Ohm's Law? Sounds related more to meditation than science. A feather lands at the same time as a rock? Seriously! I can't even begin to discuss the formulas and the labs which tortured me even more. My professors tended to be brilliant, yet the material was unattainable. With me being a visual learner, I needed to see and do in order to understand. I needed concrete examples which happened in real life so that I could apply these topics to the lesson I learned each day, not something which could occur in a

hypothetical vacuum. I want to give my students the experiences I did not receive in a physics classroom. The second dimension is the sports factor. I was one of the most uncoordinated, untalented kids in gym class and I dreaded events such as field day and waiting in line to be picked for a team. I never played a team sport and I know the bare minimum of the mechanics of each game. Yet, I realize that it is not about me. I took this seminar so that I could be a more effective teacher and recognize the interests as well as the needs of my diverse students in my classroom. Sports are something one can do and when one understands the movements and plays in each sport, they will be able to link these to physics. I hope to capture an enthusiastic audience by incorporating the history of the people from our great continent, while learning the various ancient sports which helped shape the sports we play today. I anticipate that the physics will not just be a hard pill to swallow but an enjoyable experience where students will get to analyze, recreate and play in order to better understand the various games. They will see that physics is attainable and everywhere around us. My students will gain knowledge of the practical science which exists in the world and grasp a better understanding as to how we influence these surroundings with force and motion.

Background

I teach a self-contained fifth grade class of 22 students at David Cox Road Elementary School, which is located in one of the largest urban districts in the country, Charlotte-Mecklenburg Schools. Our school has over 900 students, where pre-kindergarten to fifth grade students are taught. Approximately 60% of the student population receives free and/or reduced lunch. Our school philosophy is based on the Basic School model, which was created by Ernest L. Boyer. The Basic School philosophy[1] is founded on four educational priorities: The School as a Community, A Curriculum with Coherence, A Climate for Learning, and A Commitment to Character. The Basic School views the parent as a first teacher and the teachers of the school are partners in a continuum of learning throughout the child's life. Character education and development are also essential components of the Basic School Philosophy. I teach a fifth grade class with four students who receive ESL services. I have one student with special needs, which only requires extended time on tests and assignments. There are 3 Hispanic; 1 Asian, 3 African; 2 Biracial; 1 White; 12 African-American students in the classroom. There are 9 boys and 13 girls.

In order to teach this unit, there are some physics terms[2] you should be familiar with as you explore the various sports with your students.

1. Scalars-these are quantities that are fully described by a magnitude, or a numerical value.
2. Vectors-these are quantities that are fully described by a number and a direction.
3. Distance- this refers to how much ground is covered during its motion.

4. Displacement- this is the difference between a starting point and an ending point and is the object's overall change in position. If you started at point A and went in a full circle, thus landing back at point A, your displacement would be zero.
5. Speed-this is a scalar quantity which could be thought of as the rate at which an object covers a certain distance, measured in meters/second, miles/hour, feet/second, etc. For example, a car travels down a highway at 65 miles per hour. This is the car's speed.
6. Velocity-this is a vector quantity and is defined as the rate in which an object changes its position. In layman's terms, this could be described as how fast an object goes and in which direction it travels. For example, a car travels down a highway at 65 miles per hour, north. Another car is traveling down the same highway in the opposite direction, south. Their speeds are identical but their velocities are different because they are traveling in different directions.
7. Acceleration-this is a vector quantity and is defined as the rate in which an object changes its velocity, which could be positive or negative, or even change direction. An example of acceleration is a car moving in a straight line which increases its speed from 35 miles per hour to 45 miles per hour. The acceleration would be 10 miles per hour for every one second interval. However, if the velocity was constant, the acceleration would be zero because there would be no change in velocity. This is shown if a car was traveling down a highway at 65 miles per hour north and stayed at the same velocity without changing. Acceleration can be measured in meters/second^2 or miles/hour/second.
8. Force- this is a push or a pull which acts on an object resulting from the object's interaction with another object. There are contact forces and at-a-distance forces. Force is measured in newtons.
9. Contact Forces- these are forces that result in two interacting objects have physical contact with each other. Examples of these types of forces are: friction, tension, spring, and air resistance.
10. At-A Distance Forces- these are types of forces that result even when two objects are not in direct physical contact with each other, yet are able to exert a push or a pull despite their physical separation. Examples of these types of forces are: gravitation force, electrical force, magnetic force.
11. Mass- this is the amount of matter that a particular object is made of. The more mass an object contains the more force it takes to change its state of motion. When looking at an object such as rock, will have the same mass on the earth as it has on the moon or even in outer space. The rock is made of the same amount of material and its mass does not change. However, the weight of an object will change depending on its location. Mass can be measured in kilograms.
12. Weight- often incorrectly confused with mass, it refers to the force in which gravity pulls on an object. For example, the rock in the earlier example would have different weights on the earth, the moon and in outer space. The rock would weigh one-sixth of the weight it would have on the earth. If an object weighs 600 lbs. on the earth, it would weigh 100 lbs on the moon. If the rock were in a region

of space that had no gravity, the rock would weigh zero lbs. Weight can be measured in pounds or newtons, since it is a force.

13. Inertia-developed by Galileo, this is the tendency to resist changes in its state of motion or rest which an object is in. For example, a Frisbee which sits on a table is at rest and will not move until a force (a person picking up the Frisbee and throwing the Frisbee) acts on it and changes its state of inertia. In a vacuum, moving objects would continue to move in a straight line forever. However, other forces such as friction and air resistance, act upon objects constantly, which would inhibit this scenario to take place in a real world context.
14. Gravity- this is the famous at-a-distance force which Isaac Newton was credited for discovering. It is also known as the force of attraction between any two massive bodies, which is directly proportional to their masses and inversely proportional to the square of the distance between them[3]. This is the force which pulls objects towards the earth and keeps objects on the ground. Gravity the reason why we do not float into outer space.
15. Newton's First Law- also known as the Law of Inertia. It states that "An object at rest stays 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." Objects tend to "keep on doing what they're doing." As an example, a see saw in a park is at rest and does not move when there are no children playing on it. The see saw will stay this way forever until a force is acting upon it. The change in motion occurs when a child pushes on it or sits on it. The opposite example shows a tennis ball being rolled down a hallway. The ball wants to continue in its current state of motion by rolling forever, until a force acts upon it. This force could be a wall or someone's foot, which in turn, would change its state of motion by slowing it down or stopping it.
16. Newton's Second Law- the second law states that the acceleration of an object is dependent upon two variables - the net force, or unbalanced force, acting upon the object and the mass of the object. The acceleration of an object depends directly upon the net force acting upon the object, and inversely upon the mass of the object. As the force acting upon an object is increased, the acceleration of the object is increased. As the mass of an object is increased, the acceleration of the object is decreased. The formula which demonstrates this law is :
    F=M x A or Force equals Mass times Acceleration. An example of balanced forces is if two children are playing tug-of-war. Each child is on the opposite ends of the rope and is pulling in the opposite directions. One child is using 5N (newtons) of force in one direction and the other child using 5N of force in the opposite direction. The net force is 0 N and there is no acceleration or movement because the forces are balanced. In contrast, if there are two children on one side of the rope pulling at a combined force of 10N and there is only one child on the opposite side of the rope pulling the rope at 5N, the net force would be 5N and there would be acceleration (change in velocity) because the forces are unbalanced.

17. Newton's Third Law- for every action there is an equal and opposite reaction. The statement means that in every interaction, there is a pair of forces acting on the two interacting objects. The size of the forces on the first object equals the size of the force on the second object. The direction of the force on the first object is opposite to the direction of the force on the second object. Forces always come in pairs - equal and opposite action-reaction force pairs. An example of this law is demonstrated when a football is kicked by a football player. The foot exerts a force on the ball and the ball exerts an equal but opposite force on the ball.

North America

History of Lacrosse

This is a Native American game which was played by various tribes in several versions known as "stick ball." Early versions of lacrosse were recorded by European settlers and missionaries as early as the 1400's in the Americas. Fashioning sticks out of sacred woods and net, the Native Americans played not only for sport. They believed that participating in these games pleased their Creator and had other important functions such as resolving conflicts and assisting in healing. The "Lacrosse" was named by French Jesuit missionaries and possibly meant "the cross", which made reference to the stick and its shape, which resembled the bishop's staff or crosier. When Native Americans played the sport, they would extend the length of the goals as far as 15 miles apart and would be played for days[4].

Rules of Lacrosse

This sport is played by both men and women. There are variations in each version. The objective of the game is to score a higher number of goals. Each goal is worth one point. In a men's game, there are ten players per side and in a women's game, there are twelve players per side. In a women's game, there is no body contact allowed and stick contact is limited. The overview of the game is players use long-handled sticks, called the stick or crosse, to throw, to catch, and scoop the ball and to try to throw the ball into the opponents' goal. Lacrosse is a combination of basketball, soccer, and hockey and requires quickness, speed and endurance. The game is approximately 60 minutes long. The equipment used is a rubber ball which is a solid yellow color, about 20 centimeters in circumference. The field crosse can be made of various materials such as aluminum, leather, plastic, wood, or rubber.

Canada

History of Hockey

The history of hockey has dubious beginnings. Some say that it originated from play by British soldiers on the frozen Lake Ontario in 1855, while residents of Halifax, Nova

Scotia, say the sport had already begun there. Others tend to trace this sport back as far as 4,000 years ago in ancient Rome, Egypt, and Scotland under various names. The general play of the game, however, was similar throughout different cultures. The name "hockie" began with the Irish and somehow stuck with today's popular game. It was not initially played on the ice but an open field or area. A man by the name of JG Creighton from Canada devised the modern day hockey rules and game play. These rules were put into effect at the very first ice hockey game played in 1875. Two stones frozen into both ends of the ice were used as goals in the first days of hockey. Since it will be difficult to gain access to an ice hockey rink during school hours, we will learn the game and play certain aspects of field hockey as an alternative based on our current resources.

Rules of Hockey[5]

Hockey is a team sport in which a team of players attempts to score goals by hitting, pushing or flicking a ball into an opposing team's goal using sticks. It is most commonly known simply as "hockey", but in some countries, this simplified term may refer to ice or street hockey.

The game is played between two teams of up to sixteen players, eleven of whom are permitted to be on the pitch at any one time. The remaining five players, the substitutes, may be placed in the game at any time during the course of the game. The teams' objective is to play the ball into their attacking circle and, from there, hit, push or flick the ball into the goal, in order to score. The team with more goals after two 35-minute halves wins the game.

Players are permitted to play the ball with the flat of the 'face side' and with the edges of the head and handle of the hockey stick. The ball may not be struck 'hard' with a forehand edge stroke, because of the difficulty of controlling the ball. Players may not obstruct another's chance of hitting the ball in anyway. No shoving, using your body or stick to prevent the advancement of the opposing team. The result of any of these violations could cause the opposite team to receive the ball, and even "card" the offending player. Players are not allowed to swing their sticks too high, as this motion could be dangerous. Finally there may not be three players touching the ball at one time. Two players from opposing teams can battle for the ball, however if another player interferes, it is considered third party. When this occurs, the ball automatically goes to the team with one player involved in the third party.

The equipment used in hockey is astro gloves, shin guards, mouth guards, and a hockey stick and ball. Each player carries a "stick", normally between 36–37 inches long, but they make them shorter and longer, and are traditionally made of wood but now often made with fiberglass, Kevlar and carbon fiber composites, with a rounded handle, flattened on the left side and with a hook at the bottom. Metal is forbidden from use in hockey sticks.

Mexico

History of the Ball Game

The people of this area were the ancient Mayans. They played a sport simply called the Ball Game. The name, however, is quite deceiving. This game was played on an open stone court and was not only popular, but deadly. The goal of the game was to pass a rubber ball around, without having it touch your hands, and then get the ball to pass through one of the rings, placed high on the court. It was extremely difficult to get the ball through the ring, so when a player managed to do so, the game usually ended. Another way to possibly end the game was when the ball touched the ground. The winners were celebrated and honored by the common villagers, as well as the religious priests and wealthy chieftains. The losers were, unfortunately, killed and made to be sacrifices. I would like to discuss and possibly simulate the physics behind the game and what made it so difficult to play. We will look at the equipment used (the rings and their heights) in order to understand how the game would work or not work if we recreated it today. Information varies about the actual rules of the ancient sport but it has been linked in similarity to field hockey because sticks were sometimes used or modern-day volleyball without a net. For fifth grade, we will concentrate on volleyball and use this sport as a connection to our present time.

Rules of Volleyball[6]

Volleyball is an Olympic team sport in which two teams of six players are separated by a net. Each team tries to score points by grounding a ball on the other team's court.

A player on one of the teams begins a 'rally' by serving the ball (tossing or releasing it and then hitting it with a hand or arm) from behind the back boundary line of the court, over the net, and into the receiving team's court. The receiving team must not let the ball touch the ground within their court. The team that has possession of the ball may hit it no more than three times. The first two touches are to set up for an *attack*, known as an attempt to direct the ball back over the opposing team’s net, making them unable to return the volley.

The rally, or play, continues until either a team makes a kill, grounding the ball on the opponent's court and winning the rally or a team commits a fault and loses the rally. The team that wins the rally is awarded a point, and serves the ball to start the next rally. A few of the most common faults include catching and throwing the ball, a player hitting the ball twice in a row, four consecutive hits by the same team, and touching the net during the game.

The ball is usually played with the hands or arms, but players can legally strike or push (short contact) the ball with any part of the body. Regulations state that the ball must be spherical, made of leather or synthetic leather, have a circumference of 65–67 cm, a weight of 260–280 g and an inside pressure of 0.30–0.325 kg/cm.

Classroom Activities

Background Activities to teach the Basic Physics Concepts on Newton's Laws

Activity 1

Forces acting upon an object: I will use the website phet.colorado.edu in order to teach the various forces which act on an object. Click the button "play on sims" and you will find a multitude of activities one can simulate based on the skill being taught in the grade level needed to teach. Next, click on the Physics tab. Click on the Force and Motion virtual lab. In this particular lab, we will discuss the various forces acting upon one object in order to make it move. F represents the forces acting upon the 100N crate. We will discuss what each F, or force, stands for. F (a), or applied force, represents the force of the man acting upon the crate. F (g) represents the gravitational force pulling down the crate toward the earth. F (f) represents the frictional force acting upon the crate. F (N), or normal force, represents the force of the crate acting upon the Earth. This activity will highlight force, friction, gravity, and Newton's Second and Third Laws.

Activity 2

Net Forces and Collisions: As a real world application, I will show the students a video "Brandon Jacobs hits as hard as a running bull and is bigger than Bo Jackson" at www.youtube.com. Brandon Jacobs, one of the largest running backs in the NFL, charges towards the host of the show and tackles him. The host does not hit back, but stands there and allows the hit. The force of Brandon Jacob's is then measured to be 2,480 lbs. of force. This shows that there was no acceleration on the host's part. In the second trial, they used a dummy suspended on a line which accelerated towards Brandon. Simultaneously, Brandon was also accelerating towards the dummy. Brandon's force was more, reading at 4,000 lbs. of force. The net acceleration was the charging force of Brandon and the charging force of the dummy, creating a net force of 4,000 lbs. This means that it took the difference of the two forces, 1520 lbs. to stop the dummy. This could be compared to car accidents and how when one car is at rest and one car collides with the car at rest, the force is less than when there are two cars accelerating toward each other in opposite directions and they collide. There is a force from each car, which is added together to create a net force of the two forces together. As an exercise, the students can create their own examples of net forces by creating their own football problem in which they create a specific story problem about a specific play. They will draw the two players, assign the

forces of each player's values, and switch with another group in order to have them solve the net force for their created story problem.

Activity 3: Sprinting

Students will participate in a sprinting activity in which they will run a 100 meter dash. We will choose the fastest student in the class and the slowest student. We will place cones with students next to the cones with signs, marking intervals of 5 meters, 10m, 20, 30m, 40m, 50m, 60m, 70m, 80m, 90m, and 100 m. We will use a video camera to tape the race and count how many seconds it takes for each student to run the race at each interval. Once the students create a table of the recorded data, I will provide the class with the data of fastest man in the world, Usain Bolt. Before graphing, we will have a discussion about spacing and setting up the graph paper in order to create the most accurate graph. We will then graph the data, remembering to use their finger to track up and across when plotting the points. Once the three sets of data have been graphed, we will find the slope of each line in order to determine the speed of each runner. We will also interpret the results and analyze various places on the graph where Usain Bolt was slower than the students but then accelerated later in the race for the fastest finish.

Activity 4: History of the People and their way of life

We begin the unit discussing the three countries which make up North America. We discuss the life of a Mayan or Olmec child. We will read excerpts from the book, Me Oh Maya and The Royal Diaries, Lady of Palenque in order to learn about the ways of life of these people during this particular time period. We will do a writing prompt comparing the lives of the characters from each book to their own lives. We will begin by using a Venn diagram and then have the students identify and list similarities and differences. Then, the students will use their bullet points from the Venn diagram to write a comparative essay in their journal.

Activity 5: History of the Ball Game or Pok-ta-Pok

We will visit the website www.ballgame.org and learn about the history of the game and its rules, equipment, what a court looks like and the consequences of the losers. We will discuss the religious importance of the game and how it was linked to their everyday way of life. We will play some interactive activities on the website. The students will then complete an activity reinforcing and reviewing concepts learned while interacting with the website.

Activity 6: The Ball Game

We will go to www.youtube.com and search for "the road to el dorado 7" in order to see an animated depiction of the Mesoamerican ball game. It is a clip which shows how the players looked, dressed and played the game. The students will get construction paper, feathers, and various crafts and they will make their own helmets and symbols as if they were the ball players on the Mesoamerican team. They will choose an animal that they represent and create a design for their upcoming match.

Activity 7: How would we play the game today?

We will discuss the current sport linked to the game of volleyball and will explore this sport as a class. We will use a volleyball and a net and have students attempt to keep the volleyball off of the floor. We will discuss the state of motion that the ball is in when it's resting in the hands of a student before he or she serves the ball and the state of motion when trying to keep it off the ground. We could record the time the ball stays in the air without dropping for three trials. As a second part of the activity, we will use a large beach ball and a net and record the time the ball stays in the air without dropping, also for three trials. During the analysis and the discussion, I will connect this to Newton's First Law and discuss inertia. We will also measure the weight of the ball and try to conclude whether weight affects the amount of time in the air or the surface area of the ball.

Activity 8: Playing Hockey-Mass versus Acceleration

Students will participate in an activity in which they will look at how mass affects the rate of acceleration using hockey pucks. The students will hit a single hockey puck in the multipurpose room/gym from one side of the gym to the other. They students will record the distance of three trials. Then each student will hit two hockey pucks taped together, one on top of the other, and will record the distance in three trials. Then the students will hit three hockey pucks taped together, one on top of the other, and will record the distance in three trials. They will analyze the results and determine the effect of adding more pucks and how distance changes with each addition.

Activity 9: Playing Hockey-Does the surface of the floor matter?

Students will look at friction and how this force can affect the distance of an object. The students will hit a single hockey puck on the gym floor, hitting from the same starting point each time. They will then measure the distance the puck goes in three trials. Then, the students will hit a single hockey puck on a classroom floor which is carpeted. The students will hit from the same starting point each time and record the distance the puck travels in three trials as well. As a class, analyze the results and discuss the differences in the distances. (Note: The puck on the smoother surface should travel farther because there is less friction present.)

Lacrosse:

Activity 10: The History of the People and Their Way of Life

As an extension of our Social Studies Unit on The Native American tribes of the Americas, in which we will specifically focus on the Eastern Woodland Indians and the Plains Indians. We will learn about their way of life and culture by watching the video "Native Americans: People of the Forest" from www.discoveryeducation.com. There students will get a visual picture of the daily lives of children their age and can see them playing various games, including lacrosse. As a check for their comprehension of the video, the students will take a quick oral quiz from Discovery Education based on the information presented. As an extension, the students will write in their journals about three things they learned about the People of the Forest and their way of life and make one comparison to their own lives, whether similar or different.

Activity 11: Playing Lacrosse

The students will partner up with another student and will practice tossing the ball to each other, using the lacrosse stick. With each trial, the students will get farther away from each other and will attempt to catch the ball. The students will throw the ball at three different distances at each trial. They will then analyze the effects the amount of distance and the amount of force has on the students' ability to catch the ball with ease or difficulty.

Teaching Strategies

1. Cooperative Learning Groups-Cooperative learning groups is a skill that not only helps students to process concepts and complete activities with peer help and guidance, but allows the development of social skills, along with cooperation, team building and leadership skills. Students can benefit from being exposed to the various ideas and thought processes of other peers in order to assist in developing their own thought processes.

2. Usage of Non-Linguistic Representations (pictures, diagrams, graphic organizers) Using pictures, diagrams, and graphic organizers is essential to students who may process information in other ways besides verbal and auditory. This strategy makes learning the difficult concepts and vocabulary they may encounter in their daily interaction with unknown or complex vocabulary.

3. Incorporating Technology- Using technology as a strategy incorporates 21st century learning applications into the instruction. Students respond positively when technology is present and are readily engaged in the material presented by

the instructor. There are also benefits for the visual learners in the classroom.

4. Summarizing and Note Taking- It is important for students to learn the strategy of summarizing and note taking. Students need to know how to synthesize and process information in a meaningful way. They need to learn how to take a large amount of text and filter through it in order to find the information that meets their needs. The students also need to be able to take the information and concisely list only the pertinent information into a summary.

5. Journal Writing-I will use this strategy throughout my unit in order to have my students respond to various prompts and ideas we discuss in class. I will use journal writing in order for students to respond to the presented literature and websites shared during the unit. They will compare, contrast and think critically as they write in their journals. This allows the students to process the information in a space of their own.

Teacher Resources

Costello, Robert B., ed. *The American Heritage Dictionary*. USA: Houghton Mifflin Company, 1994.

Discovery Education. "Native Americans: People of the Forest". 2011. http://discoveryeducation.com/.

This website is a wonderful resource for science concepts as well as other subjects. There are interactive activities in which students learn and explore. There are also great videos and teacher resources, as well as student activities through which one can teach the sciences. This website keeps students thoroughly engaged.

Hanlon, Thomas. *The Sports Rule Book: Essential Rules for 47 Sports. Human Kinetics with Thomas Hanlon.* Champagne, Ill: Human Kinetics, 2004.

This book is a comprehensive guide on the rules to 47 different sports. It gives concise and easy-to-follow rules for each game and also includes historical facts about each game, as well as pictures and diagrams.

Henderson, Tom. "The Physics Classroom." 1996, http://www.physicsclassroom.com/.

This website is a wonderful resource for teachers and students as well. With the concepts simplified and in-depth information, anyone can learn physics and be self-taught by this website.

Hewett, Paul G. *Conceptual Physics: A High School Physics Program.* USA: Addison-Wesley Publishing Company Inc., 1987.

This is a high school Physics textbook which will provide one with the basic knowledge of the concepts needed to teach your students. It contains humorous examples and visuals which assist the reader in making these concepts easier to understand.

Hurley, Chad. "Brandon Jacobs hits as hard as a running bull and is bigger than Bo Jackson." February 14, 2005. http://www.youtube.com/.

The Mint Museum of Art Inc. "The Sport of Life and Death: The Meso-American Ballgame." 2001. http://ballgame.org/.

This website gives an in-depth look at the Meso-American Ballgame. There are videos, interactive games and activities one could use in order to teach students about this ancient sport.

University of Chicago. "Interactive Simulations." http://phet.colorado.edu/.

This is an interactive website created by the University of Colorado for student and teacher use. It is a fun way to learn physics by using these simulations in order to apply various physics concepts.

Wikimedia Foundation Inc. "Field Hockey." October 2008. http://www.wikipedia.org/

Wikimedia Foundation Inc. "Volleyball." February 2011. http://www.wikipedia.org/

Student Resources

Craig, Steve. *Sports and Games of the Ancients.* St. Westport: Greenwood Press, 2002.

This book is extremely informative and discusses the various sports which existed in the past. It is organized by continent/area in the world. There are pictures and lists options for modern play.

Day, Nancy. *Ancient Mayan Civilization.* Minneapolis: Runestone Press, 2001.

This book allows you to travel back in time and reads like a modern-day travel guide. It discusses major cities of Mesoamerica and shows vivid pictures of ancient d and trading sites. It also gives details about dress, religion, traditions, laws, food, currency, etc. It's kid-friendly and is a fun informational read.

Fletcher, Alice C. *Indian Games and Dances with Native Songs.* New York: AMS Press Inc., 1915.

This book is a collection of games and dances of Native American tribes such as the Omaha, and showcases how they celebrated through various ceremonies and sports. There are lyrics and music to the songs as well as a detailed recount of the dances and their purposes. A personal journey for the author, she seemed to realize the spiritual and purposeful spirit which flowed throughout each activity in which they participated.

Green, Dan and Simon Basher. *Physics: Why Matter Matters!* New York: Kingfisher Publications Plc, 2008.

This is a fun and quirky way to grasp the difficult physics concepts. Students will be highly attracted to the anime-like illustrations and the humorous wording of the author. This book gives great descriptions and definitions for vocabulary and organizes the concepts by their properties by personifying each physics term as if it were a character with a unique personality.

Kirwan, Anna. *The Royal Diaries: Lady of Palenque: Flower of Bacal.* New York: Scholastic Inc., 2004.

This is a story about a young Mesoamerican princess who has to marry a man from a neighboring tribe in order to prevent war in their villages. The story gives an up close look into the daily life of this group of historic people in 749 A.D. Yaxchal Pacal, does not want to leave home at the tender age of 13 and marry a thirty-something man which she must live with away from her own family. However, she has no choice, as she has been chosen by her father to go off into the world a woman, and keep peace in her beloved homeland.

Miller, Jay. *American Indian Games.* New York: Children's Press, 1996.

This book discusses various activities and games that exist in the Native American communities. The author shares the reasons behind the importance of games in the communities, various popular games, and traditional toys and equipment used in each game. There are great visuals of historic and current depictions of sports played by different groups.

Scieszka, Jon. *The Time Warp Trio: Me Oh Maya.* USA: Penguin Group Inc., 2003.

This book is about a group of three friends who travel time using a magical book, which is responsible for transporting them to far-off places. These Brooklyn boys are in the middle of a basketball game of H-O-R-S-E, and are transported to Mesoamerica in the middle of their famous ball game. There are nearly sacrificed and quickly had to adjust to the rules of this life-or-death game. It discusses the costumes and gear worn during the game as well as how to play the game. Another interesting feature of this book is that Scieszka teaches the Mayan number system and discusses the accuracy of the Mayan calendar in respect to our calendar.

Implementing District Standards

This unit falls under the new Common Core Standards of Force and Motion listed as follows:
5.P.1 Understand force, motion and the relationship between them.

The sub-standards which fall under this are as follows:

5.P.1.1 Explain how factors such as gravity, friction, and change in mass affect the motion of objects.

5.P.1.2 Infer the motion of objects in terms of how far they travel in a certain amount of time and the direction in which they travel.

5.P.1.3 Illustrate the motion of an object using a graph to show a change in position over a period of time.
5.P.1.4 Predict the effect of a given force or a change in mass on the motion of an object.

We will discuss and investigate the various forces and how they affect motion of equipment in certain sports. We will also discuss, analyze as well as graph the relationship between distance and time. Throughout the unit, we will explore Newton's Laws in various activities and learn basic physics concepts through labs and hands-on activities.

North Carolina Standard Course of Study[7]-5th grade

Competency Goal 3: The learner will examine the roles various ethnic groups have played in the development of the United States and its neighboring countries.

I will implement this standard in my unit by introducing the various historical and cultural connections the various sports had on the communities they evolved from.

Notes

[1]Boyer, Ernest L. *The Basic School: A Community for Learning.* Princeton, NJ: Carnegie Foundation for the Advancement of Teaching, 1995.

[2]Henderson, Tom. "The Physics Classroom." 1996, http://www.physicsclassroom.com/.

[3]Costello, Robert B., ed. *The American Heritage Dictionary.* USA: Houghton Mifflin Company, 1994.

[4]Hanlon, Thomas. *The Sports Rule Book: Essential Rules for 47 Sports. Human Kinetics with Thomas Hanlon.* Champagne, Ill: Human Kinetics, 2004.

[5]Wikimedia Foundation Inc. "Field Hockey." October 2008. http://www.wikipedia.org/

[6]Wikimedia Foundation Inc. "Volleyball." February 2011. http://www.wikipedia.org/

[7]Department of Public Instruction. "NC Standard Course of Study" State Board of Education Department of Public Instruction, http://www.ncpublicschools.org/curriculum.