Cartoon Animation and Films in Literature: Intrinsic to Physics

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Contents of Curriculum Unit

Overview

This curriculum unit is written to increase basic knowledge and awareness for students and teachers in approaching the subject of physics in the English Language Arts classroom setting. Students should be able to learn what is apparent in combining everyday connections to the laws of physics and the world around them, in where they live, and in how they learn and play. In my English Language Arts classroom, I will prepare students to reach beyond just the standardized curricular literary canon in a way that will intrigue students to begin to notice physics. Students will be led to discover the uses of physics in cartoon animation and some film direction with consideration to editorial cut choices for use in cinematic technique and animation. In this way, I will introduce students to the language and problem solving found in the study of physics used in cartoons and film. Students will view the scope of science in its uses in animation, increasing their physics vocabulary and in continued understanding of literary terms. Having this knowledge introduced to them, students will learn formula abbreviations and mathematical equations used in physics.

The study will be arranged so that students can be brought to a level of higher order thinking and analysis. By thinking carefully about the relationship between physics and carton animation and film editorial techniques, they will discover the editorial choices driving the plot, which are guided by the forces of physics. This aspect of the study will be used in respect to mental imagery in both visual and written perspectives of fiction and non-fiction and how physics helps to progressively move the plot of the story. Students will learn that bringing scientific knowledge into the English Language Arts classroom will expand their breadth of knowledge and give them a broader foundation in the discovery of physics in their lives. Students will also be engaged to embrace science as a subject that does not have to be looked upon as a subject for the "smarter" student but a subject that all can learn and enjoy.

The curriculum unit, "Cartoon Animation & Films in Literature: Intrinsic to Physics" will allow students to explore the world around them through a scientific viewpoint. This unit will also offer students a glance at the concept of computer graphic animation in relation to the ever-growing and vast realms of film, which includes computer-animated characters. While looking at cartoon animation and film, with the focus on the story, students will examine the rules and laws of physics, in relation to principles that may or may not be broken, as written or viewed by varied authors and film animation directors/cartoonists.

In view of the central themes of this study, students will become more attentive in their own interest in science. This unit will further intrigue students to become interested in how the sciences guide many animation principles as seen through the lens of the laws of physics. These laws, specific in governing many cartoon animations and not as many in films in regard to their progression and development.

Rationale

By participating in the seminar, *Physics in the Arts*, I have discovered a clearer framework for understanding how physics relates to literature and cinema through the guiding laws and principles of the science. Looking at particular essentials of literature, science-based or otherwise, students will be taught in a more subject-friendly method and given a more approachable view of physics in reference to its value outside of the science classrooms. In an effort to expand students' appreciation for science, this unit will expose the increasing number of interactions between writers, film directors/cartoonists, and scientists. This unit will provide an opportunity for students to see relationships between science and the arts beyond the stereotypes found in books and in themes of few cartoons and vast numbers of films. Furthermore, students should be more attuned to the inclusion of physics in cartoon animation and film literature beyond stories such as "Frankenstein" or "Dr. Jekyll/ Mr. Hyde," which give the illusion that scientists and the study of science is left to people who are sometimes peculiar and/or unpredictable.

More specifically, in support of approaching this unit, teachers are being requested to instruct outside of their subject area of expertise. One goal of this instruction measure is to encourage students to reach beyond their own potentials of success in making Adequate Yearly Progress (AYP) in Pennsylvania State Standardized Assessments (PSSA). In the future, this assessment will measure students' science competencies within the No Child Left Behind (NCLB) guidelines. In acquiring scientific knowledge, students will be instructed to integrate their knowledge of writing and constructing hypotheses while observing, analyzing and reading scientific data in the English Language Arts content area. This will allow students to formulate useful questions that provoke scientific inquiry. Using the varied literary elements and themes, I will guide students by providing them with fundamental physics concepts that integrate with critical analysis of significant literary concepts. Since there are only a few fundamental concepts and processes that form the Pennsylvania State Standards around which science knowledge is organized, this unit will make for a smooth transition from one discipline to another while both subjects (science and literature) are intertwined.

Objectives

This curriculum unit will be targeted specifically at the high school Honors classroom programs, as well as the gifted or advanced classroom. This unit will utilize state standards of 10th and 12th grades in Science and Technology; the 11th grade state standards from Reading, Writing, and Speaking; and a few standards from 11th grade Mathematics. We will also look at and use some of the standards from the Arts and Humanities listing. As a result, students will be competent in encountering and including science knowledge and inquiry in more diverse subject areas. Students will be lead to investigate rules of physics as seen being broken in cartoons and film. Students will be encouraged to become accomplished in implementation of physics and the study of science.

Students will be prompted to further their knowledge and/or span the uses of language through literary works and scientific terminology and symbols. This will aid in increasing students' ability to read, analyze and comprehend informational text that translate for use in their everyday lives. No matter how intimidating the tasks for learning, we will ask students to forge ahead in the study of physics and animation; and physics as it is used in film literature. Teachers of all the aforementioned subject disciplines will be able to include the School District of Philadelphia's core curriculum guidelines in its urging teachers to move students to become proficiently competent across the curriculum in individual classrooms.

This curriculum unit will begin with a series of mini-lessons that will focus on basic principles of visual perception, cartoon and film technique, and finally physics. Then students will view animation shorts to gain a clearer understanding of what is seen in cartoons and film. Additionally, we will dabble with concepts about the use of computer advancements in animation, yet in particular to animation in the days of the frame-by-frame editorial film cuts. Next, we will study color as a part of the perceptual development of cartoon and film since the days of only black and white cartoon animation. The unit will be greatly enhanced if teachers were able to schedule trips to the Franklin Institute and some large screen film showings. Finally, students will be guided in reading the written literature of the film story that includes physics and scientific "fact" for inquiry and discussion, and in proving the physics used in the cartoon animation and/or film literature right or wrong.

Strategies

This unit contains various teaching methods to instruct students in learning science through use of literature and film. By using these proposed strategies, humanities teachers also can gain a clearer understanding of the subject of science and little math. Many of these strategies are used in combination with popular movies. In instructing students in this way, teachers can illustrate the basic principles of physics. This will also motivate students in becoming critical observers of their world.

By using popular movies, and in some lessons, cartoons as the actual mode of instruction, teachers can provide a course framework, which includes physics that is more relevant to their daily lives. These strategies are also included in an effort to begin to correct the many misconceptions students have held about science. The goals of presenting the information in the varied ways that follow are to identify exactly what students require enticing them to learn physics and other sciences. Strategies chosen will be closely aligned with the standards-based curriculum that the School District of Philadelphia provides in its Core Curriculum guides. This unit's strategies are developed and designed in an attempt to provide a linkage between the curriculum and the student in multi-disciplines.

In creating an environment that will activate students' prior knowledge (popular movie use), instruction will help students comprehend, analyze and assess critically scientific examination in an informed manner. Students will be required to be attentive in thinking aloud, writing sample story passages and to develop simple experiments about the main idea from the narrative that heavily weighs on physics motivation.

Visual Perception

In discussing with students concepts of visual perception, teachers must include the knowledge that stems from the study of physics and other sciences. We will begin this discussion with the physiology of the eye. It is essential in approaching this study to do a quick overview of how our eyes work, how we see all things, and then how the information taken into the eyes is sent to the brain to interpret the message of the image.

The eye contains a lens, an iris, and a retina on which the cornea and lens form a real inverted image of objects within the field of view.[1] The cornea protects the eye to some extent and is transparent, while the iris controls the amount of light admitted. There are millions of light receptors called rods and cones within the walls of the retina. These receptors send electrical impulses via the optic nerve to the brain, which causes the eyes to produce sight. Rods are more sensitive to dim light and have no color sensitivity. Rods are used for visual detection of the periphery. Cones provide color sensitivity and visual detection in the center field of view.

Visual perception of the camera functions similarly to that of the human eye, in that the camera ultimately provides the image on film. The camera lens is needed to focus the image that is then sent to the diaphragm or iris, which controls the amount of light that reaches the film.

The teacher will instruct students to do an Internet research on these concepts of the human eye and the camera. They will be assigned to bring in visual diagrams of the physiology of the eye and the working mechanisms of the camera. It will be noted in this portion of the unit study about the similarities and differences in still photographs and human visual perception. Students will also analyze the process of making editorial decisions in textbooks in regards to the pictorial displays found nearby particular science fiction stories in their texts.

Color Perception and the Physics of Color

All things are seen in three colors with the addition (all colors equal to white) or subtraction (all colors equal to black) of light and variations in additional colors. Colors are commonly classified by scientists as lying on a spectrum, such as a rainbow. On the other hand, artists arrange colors on a color wheel. In either case, however, we find that the color white is really an equal mixture of all colors, while the color black is really the absence of any light or color.

Students will learn that because of three cone cells found within the eye, they can see color. In physics, color is not viewed or studied in the form of a circle; it is viewed as a spectrum with value given to color in terms of lightness and darkness. Hence, the value of color depends on the temperature (seen in a flame). The hotter the color, the bluer the color is seen. The cooler it is, the redder color will become.

Therefore, the identification of certain colors as being “primary” has more to do with the physiology of the eye. The perceived color depends on the frequency or wavelength of the light that reaches our eyes. Students will become familiar with color being defined as a visual sensation that enables us to distinguish otherwise identical objects.[2] Students can begin to understand the physics of light and color when applying visual perception to a rainbow. Students can brainstorm colors they see in rainbows, in what order, and the source of its origin. Questions to stimulate the discussion can lead to interesting findings through literature, math and science.

At this point, it will be vital for students to comprehend measurement abbreviations. Distance and light play an important role in the measurement of certain actions and reactions as seen by the camera and as viewed by the human eye. As part of the language necessary to use when discussing color, distance and light, it will be useful in referencing light to distance using the following terms:
nm = nanometer, a unit of distance equal to 10^{-9} meter.
µm = micrometer, a common metric unit of distance equal to 0.001 millimeter or about 0.039 370 mil.
mm = millimeter, equals 0.001 meter, 0.1 centimeter, about 0.039 370 inch, or 39.370 mils.
cm = centimeter, equal to 0.01 meter.
m = meter, is equal to approximately 1.093 613 3 yards, 3.280 840 feet, or 39.370 079 inches.
km = kilometers, equals exactly 1000 meters, about 0.621 371 19 mile, 1093.6133 yards, or 3280.8399 feet. [3]

In using these metric measurements of distance as a tool in this study, students will come to more true answers of measurement when dealing in the mathematics of reasoning and answers in laws of physics when viewing scheduled film and cartoon clips. Students will be guided in constructing simple mathematical equations using these measurements in order to challenge the physics in the film. They will also be able to reconstruct the correct measurements for proposing a new visual composition that would use physics correctly.

Viewing the Moving Image

When seeing cartoons and films, students must first understand the mechanics of the movies. Movies are a collection of still photographs that when shown rapidly one after the other, usually 30 frames per second, it makes visually the impression of continuous motion. After the frames are placed in a specific order with the addition of an audio track it creates the modern movie. Therefore, photographs make the standard movie and drawings are used to create cartoons or in the creations of computer-aided cartoon drawing (i.e. - Shrek, Toy Story, etc.)

Laws of physics more or less are synonymous with “physical reality”. In real life, students will gain knowledge of us having to obey the laws of physics all the time. Most movies are taken directly from real life (a physical set) therefore; the movie scenes obey laws of physics by default. However, in principle, anything can happen in a movie, and laws of physics are often broken either deliberately or accidentally. To increase students' perception of physics principles, they will be guided in making an animation of their own using a phenakistascope[4].

Cartoon and Film Techniques

The cartoon is most seen today on television screens across the country. Owing to this major component of American societal pastime for both young and older learners, students will eagerly engage in participating in scientific discussion using cartoon animation and a few Hollywood computer-aided cartoon blockbuster films. It may be logical to assume the effect of television on students' scientific conceptions, together with peer interaction, would seem to be the decisive element for acquiring scientific information outside the classrooms. Therefore, it gives the teacher a base to begin to de-mystify scientific fact and/or fiction as presented in cartoon presentations.

In this section of the unit, students are encouraged to engage in viewing a few cartoon and computer-aided cartoon film clips such as: “Looney Tunes, Shrek, etc. Not only will students view what actually happens but also what does not happen in its presentation. This will prompt students to find and investigate other alternative physical actions based on laws of physics and equations of simple algebraic functions. Laws of gravity, motion (three), and acceleration will be analyzed while viewing the cartoons. Questions will be posed to students concerning what is real and what is not real. They will learn the basic algebraic equations to determine specific physics laws.

In explaining to students the mathematical representation for solving problems while viewing, they must understand how each aspect of relativity is accepted in physics. First, force will be represented as F, mass represented as m, and acceleration as a; therefore $F = ma$. Next, gravity is represented as an equation itself. Students must understand that G represents the gravitational constant, and r is the distance between the two mass points m_1 and m_2.

$$F = G\frac{m_1 m_2}{r_2}$$

Mathematically, the above equation reads, gravitational force equals the gravitational constant times the mass of body 1 times the mass of body 2 which are all divided by the square of the distance apart. An object of mass m feels a downward force equal to $m\,g$, where $g = 9.8\ m/s^2$. Speed s of the downward movement is considered as well. This is true only if the object is near the surface of the earth. This is very relevant when viewing objects in orbit.

This never changes, unlike its representation of gravity in cartoons and films. Students will know this equation and be able to place it into perspective while viewing for critically analyzing. In introducing and sometimes reintroducing scientific concepts in this way, the animation along with the equations will provide students with two different visual attributes: images and motion. Using this method will be essential for understanding and memorization in describing theories and constructing problem solving procedures.

In learning descriptive both written and mathematical scientific concepts, animation can be used as mnemonic devices to facilitate memorization of principles and rules in understanding physics. The viewing of cartoon animation serves several different instructional purposes – scientific procedural concepts, mathematical concepts and gives students ways to analyze the story plot.

Cartoon Laws of Physics

Once cartoons had been established as a recognized genre, it was noted by scientists and others that the laws of physics were often broken in cartoons. At the same time, like many genres, cartoons have their own internal rules, which have been codified in several places as "cartoon laws of physics." These are the rules (somewhat tongue in cheek) that appear to govern physics in cartoons as distinct from physics in the real world. Students can begin to understand what it is they are viewing in very simple terms. They will learn that many images of physics account for a large majority of science data as seen in cartoons.

First, students will be introduced to animation through its working definition as a means to give life as expression and to create the illusion of motion. The art of character animation imbues synthetic figures with expressive behavior. The science of physics and genetic algorithms can generate lifelike motions, however, in viewing and studying cartoon laws of physics many physics laws are changed. Sometimes these laws are changed for view ability, while at other times they are changed for humor. Still at other times, the physics laws are altered because real physics was ignored.

This will lead students to investigate for an even deeper understanding of the science and mathematics involved. In addition, students can be assigned to visit the Franklin Institute for a special scheduled program, *Cartoon Physics*.[5] While there, students can participate and interact in the physics seen in cartoon animations. More importantly, students will review classroom lessons of cartoon laws versus real world (physics) laws:
Cartoon World

1. A person running through a wall makes a perfect silhouette marking upon going through that wall.

2. When two objects fall from the same point at the same time, the lighter weighted object reaches land first and the heavier weighted object falls atop and crushes the light object.
3. All characters can dive or fall into smaller objects and fit in it.
4. The pogo stick ride is a ride where characters are found jumping above the earth and the action defies all laws of gravity, as well as spatial laws.
5. Characters are suspended in mid-air and fall upon noticing they are in mid-air.
6. Projectiles of any matter just do not work or move backward.

Real World

1. A perfect silhouette is not possible because shockwaves and vibrations leave a mess
2. Galileo found that no matter the weight of the object, it will accelerate downwards at the same rate of speed and hit the ground at the same time (gravitational pull)
3. According to the three states of matter: gas, liquid, and solid – solids cannot reform their structure in order to fit into smaller spaces
4. Friction and the gravitation pull keeps anything jumping up and down in a particular range
5. Gravity pulls a mass down, no matter what, at the time the mass is suspended in the air
6. The force and acceleration of a horizontal motion. Once an object is launched into the air, its future path is completely determined, and cannot be determined by wishful thinking. The horizontal component of the velocity is constant and it undergoes constant downward acceleration.

Students will be paired with partners to experiment with the above-stated laws to determine what really can be proved in the classroom. They will view particular clips from predetermined cartoons and then set-up the experiment for proving the carton and physics laws. For further testing and experimentation, the instructor will pair with a science teacher during a portion of the instruction process for an even greater depth of understanding of the knowledge content.

Physics within the Story Plot

While many students will not be convinced that physics is included in the narration of the story, teachers will review with students the definitions of the terms plot and story. Plot means the series of events consisting of an outline of the action of a narrative or drama, as well as a secret plan. Story means the narrating or relating of an event or series of events. Thereafter, students will determine why and how physics came to be an important factor in the telling of a particular story or framed in certain parts of the story's telling.

As seen is in the film, *Independence Day*, students will critique how physically the world would have had to have been destroyed in total because of the heat radiated from the enormous space ships of the enemy. The several space ships strategically placed hovering over major cities across the world, could be possible yet; it contradicts accepted scientific data and experimentation. Still, the film's premise is presented as scientific. Students will note in their visual discovery that a mistake or error in presenting scientific data does not signal only error, that it sometimes signals an intentional misrepresentation of facts or scientific data that move the plot along for view ability.

Physics is a subject that requires students to increase their verbal and mathematical skills. Problems in physics are most times word problems; students will be instructed to think logically in order to decipher true physics and improbable physics. Analogies can used to give subtle meaning to an understanding of how the film's plot is intrinsic to the physics used. It has been found through study and research that filmmakers sometimes lack the knowledge or simply ignored the principles of physics in their interpretation of presentation in the final editing process.

Lesson Plan 1

Physics Conversation subsequent to Word Play

Objectives: This lesson focuses students in learning physics vocabulary that will give them the ability to identify physics elements in cartoons and films that they will view. It is necessary to involve students in this new manner of scientific conversation in order for them to have intelligent contributions in their classroom discussions and in their writing responses. This lesson is driven by use of the Before, During, After (BDA) technique[6].

The academic standards applicable to this lesson are as follows: PA State Academic Standards for Reading, Writing, Speaking and Listening 1.1.11.C; 1.7.11.C. PA State Academic Standards for Science and Technology 3.2.10.A; 3.2.10.B; 3.2.10.C.[7]

Materials: Vocabulary list (PowerPoint presentation or paper) in Appendix A; 3x5 index cards (colored preferred); chart or poster paper; colored strip poster cards; colored permanent markers.

Audience: This lesson is designed to use in the high school English Language Arts (ELA) classroom. It can be used in a learning support, honors, or advanced placement ELA classes. The lesson can be adapted to accompany lesson units in a physical science and physics classroom.

Procedure: This lesson will be used over a three days of 45-55 minute periods. Students will first be shown or given the list of physics vocabulary terms. This lesson will be performed throughout the entire class period or broken into smaller increments of vocabulary learning.

Day 1: They will initially be asked to generate definitions from their levels of understanding in their life's learning (connect to life), then to categorize their definitions into classification groups. Students will be allowed to Think-Pair-Share with other students sitting in close proximity. Discussion of terms and definitions will be closely monitored by the teacher (circulate the room), listening for students' who make personal connections to the vocabulary terms and definitions. In addition to the literary student, artistic students will be asked to graphically define terms. These graphics will be used later in the classroom. (The teacher can then scan the artwork and add it to the PowerPoint presentation of the vocabulary terms. Make sure you give the students' credit in placing their name on the artwork.) At around ten minutes before dismissal, ask several students to report out their thinking from their vocabulary log. At the end of the class, assign students homework: find the definitions for all the vocabulary terms, and then determine how the terms should be categorized.

Day 2: Have students tape their one page of their homework lists to available wall space. Give each student two 3x5 cards, they will be assigned to write down two vocabulary terms from other student's work that really catch their eye or thinking. Next, the class (in smaller groups of 5 – 6 students at a time) will take a Gallery Walk[8] through the room, noting differences and similarities in completing definitions. Students waiting to take the Gallery Walk, seated in groups of 5-6, will be given chart paper and three colored permanent markers. They will also be given an additional vocabulary film/cartoon technique literary term (previously written on a 3x5 card by the teacher) that was not added to the list. They will write the term at the top of the page in an artistic form. These pages, for later use, are to be added to the already established classroom Word Wall. Assign homework: Write a six-line poem[9] using six of the vocabulary terms. Teachers can either provide a prompt for students to be guided in their writing or not.

Day 3: Students will be given back chart paper to complete vocabulary art gallery works while other students are presenting their poetry from the front of the classroom.

Assessment: Students will be graded on class participation, following classroom norms, and on completed class work and homework assignments. 3x5 card class work (pasted/taped to poster or chart paper) will be used to as a vocabulary log (hung in the classroom) to be seen as reminder snip-its while viewing cartoons and film clips that use physics techniques.

Lesson Plan 2

Amidst the Narrative - Find Physics

Objectives: Students will view several films to find elements of physics. Instruction will begin with using several film clips, and in viewing, an entire film that includes many science elements. Students will have to look for right and wrong fundamentals of physics laws and uses. As well, students will determine what physics elements were needed to influence the plot for the viewers' likeability. Furthermore, students will analyze the characterization choice filmmakers use to create the scientists in some of the films.

The academic standards applicable to this lesson are as follows: PA State Academic Standards for Reading, Writing, Speaking and Listening 1.1.11.D; 1.2.11.C; 1.3.11.B; 1.3.11.C; 1.4.11.A; 1.4.11.D; 1.5.11.A; 1.5.11.D; 1.6.11.F; and 1.8.11.B. PA State Academic Standards for Science and Technology 3.1.12.D; 3.2.12.A; 3.2.10.B; 3.2.12.B; 3.2.12.C; 3.4.12.A; 3.4.10.C; 3.4.12.C; 3.6.12.B; 3.7.10.A; 3.7.10.C; 3.7.10.D; and 3.8.12.A. PA State Academic Standards for the Arts and Humanities 9.1.12.C; 9.1.12.D; 9.1.12.J; 9.2.12.A; 9.3.12.A; 9.3.12.B; 9.3.12.C; 9.3.12.E; 9.4.12.A; 9.4.12.C; and 9.4.12.D.

Goal: Students will be able to determine the physics implemented in popular films. Students will be able to establish the plot of the story. Students will be able to recreate physics presentation options for filmmakers in writing stories and mini screenplays. Students will be able to examine the characterization of scientists or physicists in films.

Materials: Film clips (5 to 10 minute segment); projection or television system; interactive whiteboard; DVD or VHS player; concept map (*Inspiration™ Software*)[10]; character map; vocabulary log from previous lesson; film's screenplay copies or use them projected on the interactive whiteboard.

Procedure: This is a three to five day lesson. For students who have interacted with viewing physics and it principles in cartoons, three days for this lesson will be sufficient. Day 1: Teacher should begin this lesson by modeling for students what it is they must do to accomplish the goals for learning. Show a film segment of 5 to 10 minutes that has little dialogue and lots of action. After viewing the segment, write a descriptive summary of the scene using a concept map, Next go to the written film script of the scene, read the scene directions aloud, then compare the two forms of the art. Students can at this point being a dialogue with the teacher.

Remind the class that filmmakers tell a story with pictures. Students will use visual images from a film and descriptive writing to tell the story. Rewind the videotape or DVD and show the first minute of the film clip. Ask students to describe the action and scenery of that segment. As students describe the film clip, use a computer word processing program to type the sentences they dictate. As you type, project the text from the computer screen onto the interactive whiteboard, the class can read the dictated sentences as you type. An alternative method would be to record the sentences on large chart paper or on the chalkboard. When a student's description is vague or confusing, ask probing questions to help clarify ideas. You may need to occasionally rewind the film, look at a scene again, and ask the entire group to help describe the scene more clearly.

Students should first be able to identify if the events are in the correct sequence as detailed in the script. Students should also be able to discuss whether "good" or "bad" physics were used to convey the message. Next, using the concept map, students will place in the center circle the physics law that is the focus of the clip. In the circles surrounding the main topic, students will place in the sequential events that determine the physics fact (good or bad). Following their notating the events, student will be asked to question the film's maker. They must write five questions that will help to evaluate how well or how inadequate the sequential frames of events function.

Assignment: Have students formulate their five questions for the filmmaker. In addition, students can create a mathematical equation to support their judgment of the film's segment.

Day 2: Begin this day by reviewing the student-developed questions from the homework assigned from the previous day. Some questions that may be generated are: what message was the filmmaker trying to convey; why did the filmmaker decide to create physics that were not at all real; did the filmmaker have other options to create the same message without destroying the physics principles and laws; who did the filmmaker consult for information about the scientific presentation in the film. Thereafter, begin a discussion about the film clip segment or reshow it to the class. Following this brief discussion, watch the film in its entirety. This may take two class periods of 55 minutes to complete. While viewing, ask students to record specific events using a story map structure for notations. Assignment: Students must review and complete the day's story map.

Day 3: Review the film, question students the sequence of events using a K-W-L mode for questioning. Students should be able to begin to justify some the filmmaker's choices for visual presentation and they should be able to connect some of the story's events to the first segment they saw. Next, continue viewing the film. Assignment: Complete the story map.

Day 4: Assessment: Student will be given a moment to discuss the film's conclusion and their findings in a grouped session. Then, give each student lined paper. Students will be required to write a five-paragraph informational summary about how the narrative drives the physics presentation throughout the film. In addition, they must include examples taken from the film that they included in their story map in their summary.

Day 5: As a final project, students give a performance in which they read their written summary while showing the film segment of their focus in the background. Compare their writing to the screenplay and the film.

Lesson Plan 3

Cartoon Physics is the Law

Objectives: Students will watch several cartoon clips from the famous Looney Tunes, Warner Brothers, and Walt Disney collections. They will be guided in naming basic laws of physics versus basic laws of cartoon physics.

The academic standards applicable to this lesson are as follows: PA State Academic Standards for Reading, Writing, Speaking and Listening 1.1.11.D; 1.2.11.A; 1.4.11.B; 1.4.11.D; 1.5.11.A; 1.5.11.B; 1.5.11.E; 1.5.11.F; 1.5.11.G; 1.6.11.A; 1.6.11.C; 1.6.11.D; 1.6.11.F; and 1.8.11.C. PA State Academic Standards for Science and Technology 3.1.12.A; 3.1.10.B; 3.1.10.E; 3.2.12.A; 3.2.12.B; 3.2.10.C; 3.2.10.D; 3.4.12.A; and 3.4.10/12.C. PA Academic State Standards for Mathematics 2.2.11.A; 2.2.11.B; 2.4.11.B; 2.4.11.C; 2.4.11.E; 2.5.11.B; 2.5.11.C; 2.5.11.D; and 2.8.11.B.

Goal: After students become more confident in their observations, they will be required to list five to ten examples of situations that involve physics. They will also have to apply the Newtonian law to each situation and discuss the relationship of that law to the situation. This activity reinforces the laws of motion while students realize that physics can be found everywhere in their daily lives.

Materials: Cartoon clips; projection or television system; VCR or DVD player. Note, it is much better to view cartoon clips for study of motion when clips can be viewed on a large screen. With this in mind, it is highly recommended to use a projection system when and if possible. Students will need to have notebooks and pencils for describing particular scene situations.

Procedure: This is a three to five day lesson depending on the number of students in the class and the academic levels at which they learn. The teacher must prepare cartoon clips days in advance. This will take more time than the lesson itself. Day 1: Students will be given notes on Newton's laws of motion, the first day of the lesson before cartoon viewing. Students will then be separated into three groups; each student group will represent at least one principle of Newton's laws. They will do an Internet I-search[11] of the physics law and its impact in society. They will also determine its uses in real world activities. They will then give a partial report of their findings to the entire class. Assignment: Write a three-paragraph essay discussing several facts they knew, and what they want to know, they learned (K-W-L strategy[12]) about physics before the day's lesson.

Day 2: Students will watch three cartoon presentations that vary in viewing (black & white drawings, color drawings, and computer animated toons). A brief discussion will follow the presentation of each. Thereafter students will be instructed to write sentences discussing at least three laws of physics they saw from each clip. Instructors should note that students might have to watch each clip more than once. Assignment: Have students complete notes from the day's lesson. The written work must be performed using complete sentences. The cartoon title must be noted for each physics notation entry. At least nine physics notations are expected to be turned in the following day.

Day 3: Several prepared students will be asked to present two or three of their entries. Other students in the class will listen first and make remarks later. This may give rise to having to watch cartoon clips for a third time. It is highly suggested to stop clips frequently to have individual students go to the screen to point out the systematic process of their presented notation. Instructors can ask other students in the class if they agree or not with the notation/presentation of the cartoon physics law. Next, students will correct or prove by re-watching the cartoon clip if their notation was correct. Assignment: Ask students to write the real world physics law opposite to each of the cartoon physic laws they noted and viewed. Assignment: Review the notes of the day and make any changes that might be needed. Additionally, ask your science teacher for input in making suggestions or changes to the students' work. (Forewarn science teachers that students will approach them.)

Assessment: Students will be graded on class participation, following classroom norms, and on completed class work and homework assignments. Students' physics notations will also be critically assessed by peers first, teacher next. At the end of all the lessons listed above, students will be given a written test while viewing a new (one not seen in class before) cartoon clip. Teachers can design a constructed response essay test using the principles of Bloom's Taxonomy. The test should reflect the topics of focus that were chosen in the lessons.

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[1] Thomas D. Rossing. *Light Science: Physics and the Visual Arts*, p. 93.
[2] Rossing. p.7.
[3] Russ Rowlett. A Dictionary of Units of Measurement. www.unc.edu/~rowlett/units/index.html
[4] Phenakistascope is a movie animation device used in the 1830's providing people with moving pictures. This device was re-created by Optical Toys.
[5] The Franklin Institute Science Museum. 20th & Ben Franklin Parkway, Philadelphia, PA.
[6] BDA is a technique used for establishing motivation for reading by assessing prior knowledge, questioning during reading of the text, and summarizing what has been read. *School District of Philadelphia's Core Curriculum Book 1 – Literacy*, p. A4.
[7] Pennsylvania Academic State Standards definitions are found on the PDE website, noted in the bibliography. http://www.pde.state.pa.us.
[8] After completing the assignment, student groups post comments, questions, or response on cards then to be placed for whole class viewing, as if in an art gallery. Students examine and discuss classmates' responses.
[9] A six-line poem is written with each line representing one of each of the six senses (sight, sound, taste, touch, smell, and motion or intuition. Students must determine a theme for their poem or the teacher can give them a theme. Providing a theme makes for an easier task.
[10] *Inspiration™ Software* is available on most computers in the Philadelphia School District. It is available on the web at www.inspiration.com. Also, see appendix for a sample.
[11] I-search technique is developed from a student's search of information that might include observations and experiments. *School District of Philadelphia's Core Curriculum Book 1 – Literacy*, p. A60.

[12] The K-W-L strategy is a three part graphic organizer in which a student writes what they know; what they want to know and then what they learned after completing the assignment. *School District of Philadelphia's Core Curriculum Book 1 – Literacy.*

Appendix A

Vocabulary List to accompany "*Physics Conversation subsequent to Word Play*"

1. Matter (science)
2. Law (science)
3. Theory
4. Patterns
5. Vector
6. Velocity
7. Force
8. Motion
9. Scientific notation
10. Powers
11. Inductive reasoning
12. Deductive reasoning
13. Equation
14. Exponent
15. Algorithm
16. Inquiry
17. Primary source
18. Secondary source
19. Assess
20. Aesthetics
21. Critical analysis
22. Formal criticism
23. Intuitive criticism
24. Multimedia
25. Principles
26. Style
27. Technique
28. Physics
29. Cartoons
30. Film/Movie
31. Animation
32. Narrative
33. Plot
34. Story
35. Process
36. Hypothesis
37. Conjecture
38. π
39. Evaluate

40. Characterization

Appendix B

Pennsylvania Academic Standards

Pennsylvania Academic Standards for the Arts and Humanities

The use of the arts and humanities in this unit represents society's capacity to integrate human experience with student creativity. The inclusion of the 12th grade standards in the arts and humanities provides students with an opportunity to observe, reflect and participate both in the arts of their culture and the cultures of others. Sequential study in the arts and humanities provides the knowledge and the analytical skills necessary to evaluate and review a media-saturated culture.

9.1. Production, Performance & Exhibition of Dance, Music, Theatre and Visual Arts (C, D, J)
9.2. Historical and Cultural Contexts (A)
9.3. Critical Response (A, B, C, E)
9.4. Aesthetic Response (A, C, D)

Pennsylvania Academic Standards for Mathematics

Using the mathematical standards in this unit allows students to be able to communicate mathematically. Although it is an interesting and enjoyable study for its own sake, mathematics is most appropriately used as a tool to help organize and understand information from the other academic disciplines included in the unit. Students' capacity to deal with all things mathematical is changing rapidly; therefore, students must be able to bring the most modern and effective technology to bear on their learning of mathematical concepts and skills. The standards included in this unit describe what students will be able to do in Mathematics at the 11th grade level.

2.2. Computation and Estimation (A, B)
2.4. Mathematical Reasoning and Connections (B, C, E)
2.5. Mathematical Problem Solving and Communication (C, D)
2.8. Algebra and Functions (B)

Pennsylvania Academic Standards for Reading, Writing, Speaking & Listening

The language arts standards are unique because they are processes that students use to learn and make sense of their world. Students do not read "reading"; they read about history, science, mathematics and other content areas as well as about topics for their interest and entertainment. Similarly, students do not write "writing"; they use written words to express their knowledge and ideas and to inform or entertain others. The use of these standards included in this unit describes what students will be able to do with the English language arts at the 11th grade level.

1.1. Learning to Read Independently (C, D)
1.2. Reading Critically in All Content Areas (A, C)
1.3. Reading, Analyzing and Interpreting Literature (B, C)
1.4. Types of Writing (A, B, D)
1.5. Quality of Writing (A, B, D, E)
1.6. Speaking and Listening (A, C, D, F)
1.7. Characteristics and Function of the English Language (C)
1.8. Research (B, C)

Pennsylvania Academic Standards for Science and Technology

Students will acquire scientific knowledge that involves constructing hypotheses using observations and knowledge in the content area in order to formulate useful questions that provoke scientific inquiry. The standards used in this unit reflect those of the 10th and 12th grade levels.

3.1. Unifying Themes of Science (A, B, D)
3.2. Inquiry and Design (A, B, C)
3.4. Physical Science, Chemistry and Physics (A, C)
3.6. Technology Education (B)
3.7. Technological Devices (A, C, D)
3.8. Science, Technology and Human Endeavors (A)