

The Physics of ‘*Phootball*’ (soccer)

BACKGROUND INFORMATION: I am not currently teaching, but most of my teaching experience has been in international schools; when I saw a resource about the aerodynamics of football (*soccer*) on the PSIM resource page (<https://www.us-satellite.net/nasa/endeavor/resources/psimlinks.html>), I knew that would be quite engaging for most of my students who love football. However, after perusing through the online resource, I think it would work best at the *elaborate/extend* part of the 5E lesson plan. Based on the topics/visuals presented in the online NASA resource (<https://www.grc.nasa.gov/WWW/K-12/airplane/soccer.htm>) this resource seems to be a great lesson enhancement after having completed the physics units on 1-D Kinematics, Newton’s Laws, and Vectors-Motion and Forces in Two Dimensions; the physics units mentioned are based on the primary resource I have used for my high school physics/AP physics students (<https://www.physicsclassroom.com/>). My background is chemistry and biology; so when I have been assigned to teach high school physics/AP physics in addition to the other sciences, I have been quite dependent on outside resources to help teach the physics concepts. Physicsclassroom.com and its curricular resources (iPad interactive iBooks, worksheets that guide students through the interactive lessons on the website, etc) have been quite helpful, and I have been fortunate to have international students who are really bright and good at independent study. I have only experienced a couple years of being assigned to teach physics courses, but I know that I should begin to think of enhancing my lessons for the next time I am assigned to teach physics. So far, I have been ‘sticking to the book,’ but I think my international students would greatly enjoy a lesson that incorporates football and the physics of football. At my most recent school of employment, the high school physics level students and the AP physics students were in my classroom at the same time; the lesson planned takes into consideration this factor, and I think it would be a great lesson for the students from both courses to work together.

GRADE LEVEL: Grades 11/12

SUBJECT: High School Physics/AP Physics

STUDENT POPULATION: International Students – students from a variety of countries – proficient in English language –
advanced learners

SMALL CLASS SIZE - typically fewer than 10 students in the classroom

LEVEL OF INQUIRY: This lesson will intentionally try to incorporate *Discovery Learning/Interactive Demonstration*; depending on the progression of the lesson/student learning, it could also eventually include/lead to an *Inquiry Lesson*.

LEARNING OUTCOMES: Without having yet facilitated this lesson, my main goal of this lesson is to make it sort of an informal 'summative' assessment of the previous units -- to see which previously learned concepts come up during this lesson - and to encourage review of the concepts from the previous units. I expect this lesson to take about **2 weeks**.

MOST RELEVANT NGSS STANDARD:

HS-PS 2-1. Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.

OTHER STANDARDS:

RST.11-12.7 Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem. (HS-PS2-1)

WHST.1-12.9 Draw evidence from informational texts to support analysis, reflection, and research. (HS-PS2-1)

5E Lesson Plan		3
<p>Engage The purpose for the ENGAGE stage is to pique student interest and get them personally involved in the lesson, while pre-assessing prior understanding.</p>	<p>*Ideally, the weather will be decent enough to go outside and play a little football.*</p> <ul style="list-style-type: none"> • Go outside to the school’s football field (or any open field space that works for playing a little football). • Before playing around with the football, ask the students to verbally explain the game’s rules to the teacher. • Start playing a little...then stop and review some of the moves/motions that happened...and ask students to explain the <i>forces</i> involved in different movements. ‘Are there any other aspects of physics...which we have learned in class...that you could add to this discussion?’ (i.e. projectile motion? displacement? velocity? acceleration? Newton’s Laws?) <p>*Move inside, and get out the student whiteboards!*</p>	
<p>Explore The purpose for the EXPLORE stage is to get students involved in the topic; providing them with a chance to build their own understanding.</p>	<ul style="list-style-type: none"> • First, teacher facilitates/reviews discussion from outside – writes some notes on board based on discussion. • After review of the discussion from outside, students work individually to make notes/drawings of their personal explanations of the physics involved in football. • Then, students work in pairs/small groups on another set of whiteboards to collaborate and bring their ideas (from individual whiteboards) <i>together</i>. • Student pairs/small groups share out their ideas of the “Physics of <i>Ph</i>ootball” with the rest of the class. 	
<p>Explain The purpose for the EXPLAIN stage is to provide students with an opportunity to communicate what they have learned so far and figure out what it means.</p>	<p>*For further <i>explanation</i>, students will be allowed research time in the classroom/library/computer lab/at home to <i>explore</i> and discover other literature/resources that discuss the physics of football and/or other related sports/activities. Students can also use this time to review concepts from the previous units.*</p> <ul style="list-style-type: none"> • After further personal research/review, students come back to their pairs/small groups; they gather together more of their “Physics of <i>Ph</i>ootball” ideas, and they prepare presentations about the “Physics of <i>Ph</i>ootball” -- via posters/Prezi/Powerpoint/etc 	
<p>Elaborate/Extend The purpose for the EXTEND stage is to allow students to use their new knowledge and continue to explore its implications.</p>	<ul style="list-style-type: none"> • Students will work individually/in pairs (depending on their learning style preferences) to <i>extend</i> even further their perspectives of the “Physics of <i>Ph</i>ootball” – via the following website/applet: https://www.grc.nasa.gov/WWW/K-12/airplane/soccer.htm *This NASA resource takes into consideration other factors (i.e. weather factors) that have not explicitly been discussed during the first few units.* • After ‘playing around’ with this website/applet, the students will take another look at their previous work (i.e. the whiteboarding activities for this lesson and the pair/group presentations) and <i>add more commentary</i> to their understanding of all the “Physics of <i>Ph</i>ootball” – this additional commentary could be noted in front of the classroom by the teacher and/or “lead student” while the students discuss 	
<p>Evaluate The purpose for the EVALUATE stage is to assess student understanding of the concepts and skills learned during the lesson.</p>	<p>*Evaluation* was taking place during the discussions, whiteboarding, presentations, and added commentary after perusing through the NASA website/applet. However, as a sort of conclusion to</p>	