**Subject area/course**: Science/Physics

**Grade level/band**: 11-12

**Task source**: Educational Policy Improvement Center (EPIC)

**NFL Ready**

**TEACHER'S GUIDE**

1. **Task overview**:

Students gather real-world data and then analyze the data using kinematics equations. Students need to review video footage of a selected college quarterback and NFL quarterback. Students evaluate this data to determine how far the ball is thrown. Students make approximations of the horizontal and vertical distances that the ball was thrown down the field. Students use vector algebra to determine the actual displacement of the ball. Students also evaluate the video footage to determine the time of flight of the ball. The students need to solve kinematics equations in two dimensions to determine the initial velocity with which the ball left the quarterback’s hand. As a final product, students write a 3-page paper to a NFL team, recommending whether they should recruit the college football player for their team.

1. **Aligned standards:**
2. **Common Core State Standards**

[CCSS.Math.Content.HSN-VM.A.3](http://www.corestandards.org/Math/Content/HSN/VM/A/3/) Solve problems involving velocity and other quantities that can be represented by vectors.

[CCSS.Math.Content.HSA-SSE.A.1](http://www.corestandards.org/Math/Content/HSA/SSE/A/1/) Interpret expressions that represent a quantity in terms of its context.

[CCSS.Math.Content.HSA-REI.C.5](http://www.corestandards.org/Math/Content/HSA/REI/C/5/) Prove that, given a system of two equations in two variables, replacing one equation by the sum of that equation and a multiple of the other produces a system with the same solutions.

[CCSS.ELA-Literacy.RST.11-12.3](http://www.corestandards.org/ELA-Literacy/RST/11-12/3/) Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.

[CCSS.ELA-Literacy.RST.11-12.7](http://www.corestandards.org/ELA-Literacy/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.

1. **Critical abilities**

Research: Conduct sustained research projects to answer a question (including a self-generated question) or solve a problem, narrow or broaden the inquiry when appropriate, and demonstrate understanding of the subject under investigation. Gather relevant information from multiple authoritative print and digital sources, use advanced searches effectively, and assess the strengths and limitations of each source in terms of the specific task, purpose, and audience.

Analysis of Information: Integrate and synthesize multiple sources of information (e.g., texts, experiments, simulations) presented in diverse formats and media (e.g., visually, quantitatively, orally) in order to address a question, make informed decisions, understand a process, phenomenon, or concept, and solve problems while evaluating the credibility and accuracy of each source and noting any discrepancies among the data.

Communication in Many Forms: Use oral and written communication skills to learn, evaluate, and express ideas for a range of tasks, purposes, and audiences. Develop and strengthen writing as needed by planning, revising, editing, and rewriting while considering the audience.

Modeling, Design, and Problem Solving:Use quantitative reasoning to solve problems arising in everyday life, society, and the workplace, e.g., to plan a school event or analyze a problem in the community, to solve a design problem or to examine relationships among quantities of interest. Plan solution pathways, monitoring and evaluating progress and changing course if necessary, and find relevant external resources, such as experimental and modeling tools, to solve problems. Interpret and evaluate results in the context of the situation and improve the model or design as needed.

1. **Other standards**

Texas College and Career Readiness Standards

VIII.C.1. Understand the fundamental concepts of kinematics.

Next Generation Science Standards

HS-ESS3-4. Design or refine a solution to a complex real-world problem, based on scientific knowledge, student- generated sources of evidence, prioritized criteria, and tradeoff considerations.

HS-PS2-6. Communicate scientific and technical information (e.g. about the process of development and the design and performance of a proposed process or system) in multiple formats (including orally, graphically, textually, and mathematically).

1. **Time/schedule requirements:**

The student will need 3 to 4 hours to complete this task. Approximately half the time should be spent analyzing the data, gathering statistics, and solving equations of motion. The remainder of the time should be spent writing the paper. All of this may be done in or out of class. At the beginning of the task, you may want to show students clips of another sport (e.g., basketball for two dimensional motion or hockey for one dimensional motion) and ask students to explain how they would gather data from the available statistics and analysis of the videos.

1. **Materials/resources:**
	* Students will need access to video footage of NFL and college football players. This video footage should be easily accessible on the Internet.
	* An introductory physics textbook may be helpful in solving necessary kinematics equations.
2. **Prior knowledge:**

Students should be able to:

* Analyze real-world situations by taking measurements and examining the results
* Solve kinematics problems, evaluating the credibility and accuracy of the data collected and noting any discrepancies among the data
* Use kinematics to analyze motion
* Utilize vector algebra, displacement, velocity and acceleration
1. **Connection to curriculum:**

This exercise would be most appropriate for students to work on after the completion of two-dimensional kinematics. Sharing the data in the reports will be useful in furthering the understanding of kinematics.

1. **Teacher instructions:**
* Provide class time for research on students’ topics.
* Provide students with the rubric to be used to score their final product.
* Students should be directed to use video clips of quarterbacks throwing the ball and analyze the clip using tools available to them such as a stopwatch. Students should also look up the dimensions of a football field and assess the displacement in two dimensions which can be done by looking at the yard markers as well as the hash lines.
* Students should discuss the limitations of their measurements.
	+ The analysis method the student uses should be clearly presented in the paper.
* If video analysis is used, students will need instruction on the limitations of the software as well as how to utilize the software.
	+ Students should work independently throughout this task.
1. **Student support:**

The following suggestions are examples of scaffolding that can be used to meet the diverse student needs within the classroom.

* For the final product, all learners will benefit from peer assistance while brainstorming their topics, as well as a peer or teacher review of their papers before final submission.
* Some students will have good research skills, but some will need guidance in the determination of appropriate sources and where to look for them. It is important to spend class time in review of what constitutes an appropriate source in advance of students’ independent work time.
* Student accommodations should be provided for struggling students and ELL. This may include:
	+ Analyzing one video ahead of time (such as basketball).
	+ Have students work in groups to analyze the data then write an individual paper.
1. **Extensions or variations:**
	* Students could present the results of their research to the class via an oral or multimedia presentation.
	* If there is a particularly interesting and/or controversial topic, a debate could be organized where students choose sides on the topic and defend their views.
	* The teacher might hold an “NFL draft,” picking quarterbacks based on the student’s research.
2. **Scoring:**

Student work can be scored using the College and Career Ready (CCR) Task Bank Scoring Rubric.