**NFL Ready**

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

**Grade level/band**: 11–12

**INSTRUCTOR PROCEDURES**

1. **Task overview**:

In this task, students gather real-world data and then analyze the data using kinematics equations. Students will review video footage of a selected college quarterback and NFL quarterback and evaluate this data to determine how far the ball is thrown. They will then make approximations of the horizontal and vertical distances that the ball was thrown down the field. Next, students will use vector algebra to determine the actual displacement of the ball and evaluate the video footage to determine the time of flight of the ball. They will 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. **Prior knowledge required:**

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. **Common Core State Standards aligned to this task:**

[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.

**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 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. This exercise would be most appropriate for students to work on after the completion of two-dimensional kinematics.

1. **Instructor materials to use during administration:**
   * 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. **Instructor procedures during administration:**
   * This task should be given at the completion of a unit on two-dimensional kinematics.
   * Students should work independently throughout this task.
   * The teacher might hold an “NFL draft” picking quarterbacks based on the student’s research. Sharing the data in the reports will be useful in furthering the understanding of kinematics. This exercise will provide students with feedback on their thought process.
   * 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.
   * If video analysis is used, students will need instruction on the limitations of the software as well as how to utilize the software.
   * Remind students that their papers should discuss the limitations of their measurements and the analysis method used should be clearly presented in the paper.
3. **Student support:**

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

* Provide class time for research on students’ topics.
* Provide students with the rubric to be used to score their final product.
* Provide instruction on two-dimensional kinematics ahead of time.
* 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 multi‐media 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.
2. **Scoring and assessment considerations:**

EPIC developed the *College and Career Ready (CCR) Task Bank Scoring Rubric* to accompany this task. If your school or department uses a standardized rubric that would fit the content and requirements of this task, you may choose to use your existing rubric. The following notes and suggestions are meant to clarify the intent of the rubric and include considerations for the assessment of student work.

* When assigning the task, provide students with the rubric that will be used to score their final product and discuss it as a class.
* Unlike some rubrics, the *CCR Task Bank Rubric* does not predetermine “point values” for the scoring criteria. The rubric thus allows for flexibility with different instructors’ scoring systems and individual determination of the “weight” of each criterion.
* Student work that scores at the *Accomplished* level is considered to be entry-level college work.
* The *Exceeds* category on the rubric provides an example of how a student can go above and beyond the *Accomplished* level. These examples are intended to be only ONE way a work product can exceed expectations, thus allowing room for your professional judgment.
* If needed, consider including task-specific criteria as an additional scoring category to the rubric or providing a checklist of requirements for the task.