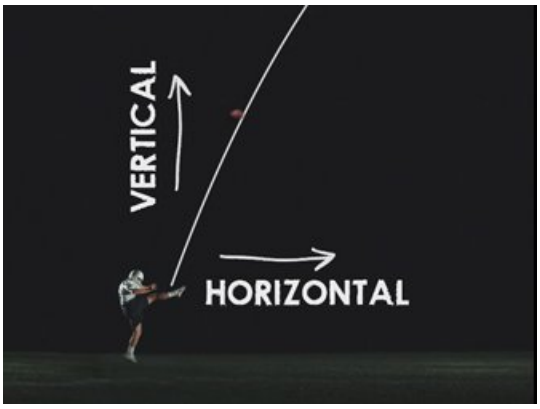
Punting and Projectile Motion

By *NBCLearn*
Created *09/08/2010 - 03:42*

Title:
Punting and Projectile Motion
Grade Level:
5,6,7,8
Subject:
Science,Physical Science, Physics
Author:
NBCLearn
Time:
50-90 minutes

Lesson Plan Type:
Interactive Instruction
Keywords:
Projectile, range, initial speed, simulation, trajectory, parabola
Brief Description:
After a short intro activity in which students throw various objects into buckets, the class will watch "Science of NFL Football – Projectile Motion and Parabolas [1]". Students will then use a computer simulation program to investigate the variables that affect a projectile's range and time in the air. Finally, students will apply what they learn from the simulations to analyze punting strategies in different situations.



California State Standards Addressed:
Science/8/Focus on Physical Science)1.0,2.0

Related Links:
Link 1:
Link 2:
Goal(s):

Specific Objectives:
Students will be able to:
1. Use a computer simulation to investigate how certain variables influence the range of a projectile (angle, initial velocity, air resistance, mass, shape).

2. Explain why increasing the initial velocity will increase the range a projectile travels.
3. Identify that the angle for maximum range is 45ï; if there is no air drag.
4. Express that for a given initial velocity, there are 2 angles that will produce the same range, and that for the larger angle, the object will be in the air longer.
5. Describe how a punter might use concepts of projectile motion in different situations (for example, at times it is preferable to maximize hang time, while other times it is preferable to maximize distance).

Required Materials:

- Some targets for introductory investigation (garbage cans, buckets, or boxes)
- Assorted materials for students to attempt tossing into targets (paper, cotton, tennis balls, feathers, pencils, specks of sand, drinking straws….anything)
- Computers for individuals (or groups of 2-3 students)
- Internet access

Anticipatory Set (Lead-in):

Inform the students that the upcoming lesson will be a fun activity related to the physics of football, but that the introductory activity will have more resemblance to basketball. Ask the students to briefly discuss what basketball, baseball, football, shot put, tennis, golf, volleyball, and soccer all have in common. Introduce the term “projectile” and agree upon a working definition (an object thrown, kicked, hit, or launched through the air). Let students know that the laws of physics for projectile motion are the same for all sports, and in fact the same laws are used to help design skate-park ramps, certain weapons, and satellites.

Lesson Plan Procedure:

Part I: Intro Discussion/Demo (15 minutes)

1. Ask students to predict which items will be the easiest to toss into the targets from 5 feet away.
2. Define some of the terms needed for the lesson: projectile, initial speed, launch angle, range, and air resistance. Have them record these definitions on the activity worksheet question 1.
3. Give students a few minutes to investigate for themselves in small groups and to answer questions 2 and 3.
4. Discuss the answers and make sure to explicitly discuss the role of air resistance on a projectile.
5. Show the NBClearn.com video, “Science of NFL Football – Projectile Motion and Parabolas [1]”.

Part II: Investigation using PHET projectile motion simulation (30-60 minutes)

(Students can work in groups of 2-3)

1. Briefly introduce the simulation (but there is no need to spend too much time as the students will quickly figure the simulation features out on their own).
2. Depending upon the experience and level of the students, you may need to spend some time discussing the variables to change and record for each part of the investigation. You may want to help students create data tables in advance for different parts of the simulation.
3. Give them 30-60 minutes to conduct the worksheet investigations. If limited to 30 minutes, you may encourage the students to focus on recording the data for each investigation (and for homework they can complete the activity worksheet sections that involve description and analysis).

Part III: Post Investigation Discussion (Day 2, 20 minutes)

1. After the students complete the activity worksheet, have them share results and facilitate a discussion to reach a class consensus.
2. Reinforce the main concepts before administering the quiz.

Closure (Reflect Anticipatory Set):

Ask students to explain how the concepts of projectile motion relate to other sports (basketball, baseball, soccer, golf, shot put, etc.). Ask them to think of other situations in their lives where the concepts of projectile motion might be important. (The laws of projectile motion apply also to throwing anything, diving, skateboard jumps, etc.)

Plan for Independent Practice:

As mentioned in the lesson plan procedure section, the description and analysis questions on the activity worksheet can be assigned as homework.

Assessment Based on Objectives:

Quiz: Punting and Projectile Motion

Possible Connections to Other Subjects:

Language Arts: Students can write a reflection about a punter's ability to, in a split second, precisely calculate a kicking velocity and angle that will produce the desired result. How is the brain able to make such a complex calculation?

Students can write a short story describing how a particular sport may be different if air resistance was not present.

Math: Students can explore in more detail the parabolic nature of the projectile trajectories. Such an exploration would depend upon the sophistication of the particular math curriculum.

Students can produce graphs of data sets. The angle vs. range graph might be particularly interesting if students record the results for many angles between 0 and 90 (for example every 5 degrees).

Adaptations and Extensions:

Many adaptations can be explored for example:

- Explore the effects of mass and diameter on a projectile's range and time in the air.
- Investigate the relationship between launch angle and height.
- Investigate and explain in more detail the different ranges of different objects in the simulation.

- Discuss the advantages and disadvantages of computer simulations to investigate physical phenomena. (This is a very important, relevant, and at times divisive issue in the field of engineering.)
- Graph data from the investigations.
- Compare and discuss the drag coefficient for different objects.
- Use concepts of projectile motion to analyze the best strategies and techniques for athletes of other sports such as shot put and golf.

Additional Notes:

Links:
[1] http://www.nbclearn.com/portal/site/learn/nfl/cuecard/50689/