Descriptions of Motion

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Advanced Educational Psychology
Lesson Plan Assignment
Instructional Model: Constructivist Approach
Subject(s): Physics/Science
Grade Level 11 or 12
Spring 2008

Resources/Materials: Several Flat boards, spheres, meter sticks, stop watches, and computers

Instructional Objectives:

Power Point Presentations: The first presentation will include the definition of displacement in equation form. Students will be asked to determine displacement and describe displacement in several scenarios shown on slides. Students will be asked to define displacement in word form. The textbook definition of displacement will be given. Students will be asked to solve word problems presented on slides, involving displacement. Students will be asked to compare displacement in different descriptions of motion. This presentation will also review units and measurements.

The second power presentation will be on all of the descriptions of motion. Both word and equations forms of all three descriptions (displacement, velocity, and acceleration will be given). Students will also be given the kinematical equations necessary to complete word problems involving descriptions of motion. Students will then complete word problems on descriptions of motions given on slides with the aide of the instructor.

Activity 1: Students will be assigned to work in groups and discover ways to describe the motion of the spheres as they roll down the flatbeds. Students will be required to determine the causes for the differences in the motions of the spheres at different set-ups. Flat beds will be set at varying slopes.

Students will be expected to use stopwatches and meter sticks to record the positions of the spheres along the flatbeds. They will record the positions, displacements, and velocities. The students will be expected to make position-versus time graphs. The students will then use the position versus time graphs to create velocity versus time graphs. The students will then use the velocity versus time graphs to make acceleration versus time graphs. Finally, they will compare the acceleration and different set-ups.

Purpose of Activity 1: To have students discover the basic relationships involving distance (position), displacement, time, and speed (velocity), and acceleration by looking at the motion of a spheres on an inclined planes.

Activity 2: Students will use the computer simulations available at the PhET website to shoot an object from a cannon into a bulls eye. Students must predict the angle and initial speed that will cause the object to hit the bullseye. Students can choose from different objects: football, adult human, pumpkin, piano, Buick, baseball, golfball, football, and more. (This will help students to see that the kinematic equation is independent of mass.) The mass, diameter, and drag-coefficient are set according to the object chosen. The students can also add air resistance. Students will test their written predictions using the computer simulation. If target is not reached, students will repeat the process of making predictions based on solved equations and testing their predictions using the computer simulation until they are able to reach the target. The word "score" will appear on the screen in addition to the animation falling into the target range when the students have determined the correct velocity (magnitude and direction).

Purpose of Activity 2: To have students apply the knowledge they have gained of descriptions of motion and the kinematic equations to real life problems.

Instructional Objectives and Learning Outcomes

Power Point Presentation	Learning Outcome 1
	Learning Outcome 2
	Learning Outcome3
	Learning Outcome 4
	Learning Outcome 5
	Learning Outcome 6
	Learning Outcome 7
	Learning Outcome 8
	Learning Outcome 9
	Learning Outcome 10
Activity 1	Learning Outcome 1
	Learning Outcome 2
	Learning Outcome 3
	Learning Outcome 5
	Learning Outcome 8
	Learning Outcome 9
	Learning Outcome 10
Activity 2	Learning Outcome 4
	Learning Outcome 5
	Learning Outcome 6
	Learning Outcome 7
	Learning Outcome 10

Learning Outcomes:

1. Students will be able to define displacement, velocity, and acceleration in word form and equation form.
2. Students will be able to describe the three descriptions of motion (displacement, velocity, and acceleration) and how they relate to the movement of three objects: a car, a rock dropping from a cliff, a football being kicked across a field.
3. Students will be able to compare and discuss the relationships between the three descriptions of motion.
4. Students will be able to solve for missing variables (i.e. time, displacement, position, velocity, or acceleration) given all other variables in equation form.
5. Students will be able to use kinematics equations to solve for missing variables (i.e. time, displacement, position, velocity, or acceleration) given a one-dimensional problem word problem in the y-direction (i.e. a rock falling from a cliff).
6. Students will be able to use kinematics equations to solve for missing variables (i.e. time, displacement, position, velocity, or acceleration) given a one-dimensional problem word problem in the x-direction (i.e. a car applying brakes at a given speed).
7. Students will be able to use kinematics equations to solve for missing variables (i.e. time, displacement, position, velocity, or acceleration) given a two-dimensional word problem (i.e. a football being kicked across a field).
8. Students will be able to match up corresponding velocity, position, and acceleration graphs given the motion of an object in word form.
9. Students will be able to match up corresponding velocity, position, and acceleration graphs given the motion of an object in equation form.
10. Students will be able to state the factors that affect motion (i.e. time, displacement, velocity, angle of velocity, and acceleration) and the factors that do not affect motion (i.e. mass, acceleration in the x-direction) in a two-dimensional kinematics problem involving free fall.

An Overview:

1) Students will begin with bell work on how to make graphs from data (5 minutes)

2) Bell work will be discussed (5 minutes).

3) Students will be asked to describe the motion of several objects (i.e. a car, a bouncing ball, etc.). Students will receive an introduction to the descriptions of motion used in kinematics. (5 minutes).

4) An interactive Power Point presentation on distance and displacement will be given. Displacement will be defined (5 minutes).

5) Students will work in groups to discover the relationship between position, displacement, time, and speed (velocity), and acceleration in their activity (20 minutes).

6) The class as a whole will then discuss their discovery of the descriptions of motion (10 minutes).

7) An interactive Power Point presentation on all of the descriptions of motion (position, velocity, and acceleration) will be given. The three descriptions will be tied together and their use in real-life problems will be given (i.e. dropping an object off of a cliff). (10 minutes)

8) Students will be assigned to work in groups on a computer simulated kinematics activity on the PhET (Physics Education Technology at CU Boulder website) to be presented during the next class. Students will be required to determine the angle and distance at which to place the cannon in order to shoot the ball in the target. Students will have to record and later present to the class their method, equations used, their trials, and their results (20 minutes).

9) Class will be dismissed.

Total Time: 1 class period = 80 minutes.

Assessment/Evaluation Procedures:

Essay: Students must write an essay comparing the motion of Coyote falling over the edge of a cliff in pursuit of a rooster and a basketball being thrown in a hoop by a basketball player. Students must include which kinematics equations are relevant for both scenarios. **(Learning Outcomes 1, 2, 3, &10).**

Quiz: Students will solve one-dimensional and two-dimensional word problems using kinematics equations. **(Learning Outcomes 5 &6).**

Performance: Students must measure the velocity at which a bebe leaves a gun and the height at which it is placed to determine where to put a bullseye for the bebe to fall in. Students grades will be based on how close they are to hitting the bullseye with the bebe gun. **(Learning Outcomes 4 & 7)**.

Team Activity: Each student will be given a sheet of paper. The sheet will contain one of the following: a position versus time graph, a velocity versus time graph, an acceleration versus time graph, a word description of motion (i.e. a ball being thrown into the air), or an equation describing motion. Students will then consult each other and form groups according to matched sheets. The teams will be graded on how long it takes them to group and a presentation they give explaining how they figured out they belonged together and a description of the motion that is taking place in the scenario given to their group. **(Learning Outcomes 8 & 9)**

Tying it all together: Descriptions is one of the first lessons taught in a physics course. However, the information learned in this lesson can be related to measurement, units, and vectors; all of which are used in kinematics. Students can be helped to see how a check of units can help them to determine whether or not they are using the correct givens in an equation or whether or not their answer makes sense.

In this lesson students cover descriptions of motion rather quickly. A more robust understanding of kinematics will arrive from subsequent assessment activities (which all serve as instructional sessions). Assigned textbook readings on kinematics and homework problems will also supplement the classroom instruction.

Physical concepts build in the same manner as mathematics. Students should be helped to see the relationship between kinematics and Newtonian mechanics, a subject they will section they will study after kinematics.

Periodic Review Procedures: Physics, like mathematics, builds on itself. Subsequent physics lessons should incorporate things students have learned in this lesson. For example, word problems on Newton's Second Law should be modified to require students to determine acceleration using kinematics equations.

Reference: Madsen, Mark (1994). Modified Lesson Plan #:AELP-PHS0019 Site—the Educator's Reference Desk http://www.eduref.org/Virtual/Lessons/Science/Physics/PHS0019.html

I'm Inclined to See (Exploration)

An Educator's Reference Desk Lesson Plan

Submitted by: Mark Madsen, Tempe High School, Tempe, AZ
Endorsed by: These lesson plans are the result of the work of the teachers who have attended the Columbia Education Center's Summer Workshop. CEC is a consortium of teacher from 14 western states dedicated to improving the quality of education in the rural, western, United States, and particularly the quality of math and science Education. CEC uses Big Sky Telegraph as the hub of their telecommunications network that allows the participating teachers to stay in contact with their trainers and peers that they have met at the Workshops.
Date: May 1994

Grade Level(s): 9, 10, 11, 12

Subject(s):

- Science/Physics

PURPOSE:_The purpose of this activity is to look at the motion of a sphere on an inclined plane and to discover basic relationships involving distance, time, speed (velocity), and acceleration.

RESOURCES/MATERIALS:_Flat board, several spheres, meter stick, stop watch

ACTIVITIES AND PROCEDURES:_Roll a sphere, starting from rest, down an inclined plane. Observe the motion from the top, middle, or another starting point. Look for any patterns. Decide on the variables that are important to describe the motion of the sphere. Organize a data table using the variables you have chosen. Make a graph of distance versus time, using distance as the independent variable. Make a graph of average velocity versus time, using time as the independent variable. Finally, make a graph of average velocity versus distance, using distance as the independent variable.

Summing Up:

. Qualitatively describe the motion of the rolling sphere.
. Is your graph of distance versus time a straight line? Why, or why not?
. Suggest a way to modify the variables of the graphs which are not straight lines, such as squaring one of the variables, then make new graphs for the ones that are straight lines.

Compare the slopes of all of the straight line graphs.