This lesson plan was designed for a conceptual physics class as an introduction to projectile motion. This lab is introduced before any lecture on the subject.

Name_____ Date_____

Projectile Motion Virtual Lab

With your partner, discuss the following questions.
Encourage dialog between students to ensure they understand the vocabulary.
How many dimensions does this piece of paper have?

Can you think of at least two names to describe these dimensions?
Length & width, across & up and down, x & y, horizontal & vertical etc.
How could you make this piece of paper linear or one dimensional?

What could you add to this piece of paper to make it 3D or three dimensional?

*Open the **Motion in Two Dimensions** simulation. A series of pictures of two balls are taken at equal time intervals. The three graphs on the right use color coding to describe the motion of each ball. Play with this sim until you are comfortable with it.*

What names can you give for the direction of the red ball? In how many dimensions does it travel?
Horizontal or x.

Describe the motion of the red ball.
The red ball moves with constant velocity. It covers equal distances during same time intervals.

How does the distance verses time graph support your description? (Use the terms constant slope, changing slope, or no slope in your answer.)

How does the velocity verses time graph support your description? (Use the terms constant slope, changing slope, or no slope in your answer.)

How does the acceleration verses time graph support your description? (Use the terms constant slope, changing slope, or no slope in your answer.)

What names can you give for the direction of the blue ball? In how many dimensions does it travel?

Vertical or y

Describe the motion of the blue ball.

The blue ball moves with changing velocity or acceleration. It covers more distance during each time interval.

How does the distance verses time graph support your description? (Use the terms constant slope, changing slope, or no in your answer.)

How does the velocity verses time graph support your description? (Use the terms constant slope, changing slope, or no slope in your answer.)

How does the acceleration verses time graph support your description? (Use the terms constant slope, changing slope, or no slope in your answer.)

*Open the **Using Vectors to Study Motion** simulation. Play with this sim.*

What color are the velocity vectors? They are green.

What do you notice about the velocity vectors of the red ball compared to those of the blue ball?

The velocity vector of red ball stays the same size while the velocity vector of the blue ball keeps increasing.

Does the distance verses time graph support your answer? How?

Does the velocity verses time graph support your answer? How?

Does the acceleration verses time graph support your answer? How?

Change the horizontal velocity.

How does this change in velocity affect your answers?

What color are the force vectors? They are black.

Which force do they show? They show the net or total force on the object.

Is the red ball obeying Newton's First or Second Law? first

In terms of net force, how do you know this? There is no net force. It is equal to zero.

Is the blue ball obeying Newton's First or Second Law? second

In terms of net force, how do you know this? There is a net force. It is equal to the force of gravity on the blue ball.

Projectile motion is the result of the merging of the motion of these two objects. Predict what you think this would look like.

The Airplane Drop

An airplane with a horizontal velocity of 600 miles per hour drops cargo while flying 35,000 feet in the air. Predict where the cargo will be in relation to the plane as it moves.

a. ahead of the plane
b. under the plane
c. behind the plane

*Open **Airplane Drop** simulation and press play.*

Was your prediction correct?

Does the speed of the plane affect your answer? (Use slider to change airplane speed.) no

The cargo from this plane is experiencing projectile motion.

Describe its horizontal motion.
Same as red ball.

Describe its vertical motion.

Same as blue ball.

Does the motion of the cargo look like your prediction of the merging of the motion of the two balls?