

Name \_\_\_\_\_

Date \_\_\_\_\_

### Projectile Motion Virtual Lab

*With your partner, discuss the following questions.*

How many dimensions does this piece of paper have?

Can you think of at least two names to describe these dimensions?

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?

Describe the motion of the red ball.

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

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

How does the acceleration versus 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?

Describe the motion of the blue ball.

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

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

How does the acceleration versus 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?

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

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

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

Does the acceleration versus 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?

Which force do they show?

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

In terms of net force, how do you know this?

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

In terms of net force, how do you know this?

Projectile motion is the result of the merging of the motion of these two objects. Predict what you think this would look like. (If the blue and red balls were one object instead of two, what would the path of that object 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.)

*The cargo from this plane is experiencing projectile motion.*

Describe its horizontal motion.

Describe its vertical motion.

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