*Honors Physics*

*Winnetonka High School* Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Hour: \_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_

**Projectile Motion**

**'Launched at an Angle’ Virtual Lab**

**Learning Targets:**

I can name the factors that affect how far a projectile will travel before hitting the ground.  
I can design experiments to carefully test one experimental question at a time.**:**

Define the following terms, and answer the questions below:

1. projectile:
2. range:
3. initial speed:   
   Hypothesis: Do you think this would affect the *range* of a *projectile*? Circle YES or NO.
4. launch angle:   
   Hypothesis: Do you think this would affect the *range* of a *projectile*? Circle YES or NO.
5. projectile’s mass:   
   Hypothesis: Do you think this would affect the *range* of a *projectile*? Circle YES or NO.

**What is the effect of launch velocity (initial speed) on range?**

Take out your laptop. Go to “bitly.com/phet-projectile”. Get acquainted with the projectile simulator.

1. Conduct an experiment to determine how ***initial speed*** affects the range of a projectile.  
   What will be your independent variable?   
     
   What will be your dependent variable?
2. Make a table and a sketch to record your results.



|  |  |
| --- | --- |
| Set launch angle to 30o. Select the football. | |
| Initial speed | Range |
|  |  |
|  |  |
|  |  |
|  |  |

1. Conclusion: Explain what you found about the effect of ***initial speed*** on the range of a projectile.

**What is the effect of launch angle on range?**

1. Conduct an experiment to determine how launch angle affects the range of a projectile.  
   What will be your independent variable?   
     
   What will be your dependent variable?
2. Make a table and a sketch to record your results.



|  |  |
| --- | --- |
| Set launch velocity to 40 m/s. Select the football. | |
| launch angle | range |
|  |  |
|  |  |
|  |  |
|  |  |

1. Conclusion: Explain what you found about the effect of launch angle on the range of a projectile.

**What is the effect of projectile mass on range?**

1. Conduct an experiment to determine how ***mass*** affects the range of a projectile.  
   What will be your independent variable?   
     
   What will be your dependent variable?
2. Make a table and a sketch to record your results.



|  |  |
| --- | --- |
| Set launch velocity to 40 m/s. Set angle to 30o. | |
| mass | range |
|  |  |
|  |  |
|  |  |
|  |  |

1. Conclusion: Explain what you found about the effect of ***mass*** on the range of a projectile.

**Discover the relationship between complementary angles and range**

1. Select the ***football*** with a launch velocity of 40 m/s. Complete the table below:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Angle | Range | Time | Angle | Range | Time |
| Pair one | 15o |  |  | 75o |  |  |
| Pair two | 30o |  |  | 60o |  |  |
| Pair three | 22o |  |  | 68o |  |  |
| Pair four | 40o |  |  |  |  |  |
| Pair five | 45o |  |  |  |  |  |
| Pair six | 5o |  |  |  |  |  |

1. What is the sum of the angles that produce the same range?
2. Compare the time in the air for each of these angles, and explain any difference.  
     
   Angle 1: \_\_\_\_\_\_\_\_\_ Time 1: \_\_\_\_\_\_\_\_\_\_\_ Angle 2: \_\_\_\_\_\_\_\_\_\_\_\_ Time 2: \_\_\_\_\_\_\_\_\_\_\_\_\_\_  
     
   Explain:

**Apply what you learned:**

1. What advice about angle and kicking speed would you give to a punter who wants to maximize the distance of a punt? Why?
2. What advice about angle and speed would you give a punter that is not trying to maximize distance, but instead wants a long “hang time” to allow his teammates as much time as possible to get downfield?