*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. Initial speed:   
   Hypothesis: Do you think this would affect the *range* of a *projectile*? Circle YES or NO.
2. launch angle:   
   Hypothesis: Do you think this would affect the *range* of a *projectile*? Circle YES or NO.
3. 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.



Use the launch angles provided

|  |  |
| --- | --- |
| Set launch velocity to 40 m/s. Select the football. | |
| launch angle | range |
| 15o |  |
| 30o |  |
| 40o |  |
| 45o |  |
| 50o |  |
| 60o |  |
| 75o |  |

1. Conclusion: How was range effected as launch angle increased from 15o to 45o ?

How was range effected as launch angle increased from 45o to 75o ?

**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 10 m/s. Complete the table below:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Angle | Range | Time | Angle | Range | Time |
| Pair one  15o and75o | 15o |  |  | 75o |  |  |
| Pair two  30o and60o | 30o |  |  | 60o |  |  |
| Pair three  22o and68o | 22o |  |  | 68o |  |  |
| Pair four  40o and\_\_\_o | 40o |  |  |  |  |  |
| Pair five  5o and\_\_\_o | 5o |  |  |  |  |  |
| Last pair  45o and45o | 45o |  |  |  |  |  |

1. Compare the ranges of the angle pairs listed above. 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. Use the football and a starting velocity of 20 m/s.   
     
   Angle 1: **15o**  Time 1: \_\_\_\_\_\_\_\_\_\_\_\_\_\_ Angle 2: **75o** 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?