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.
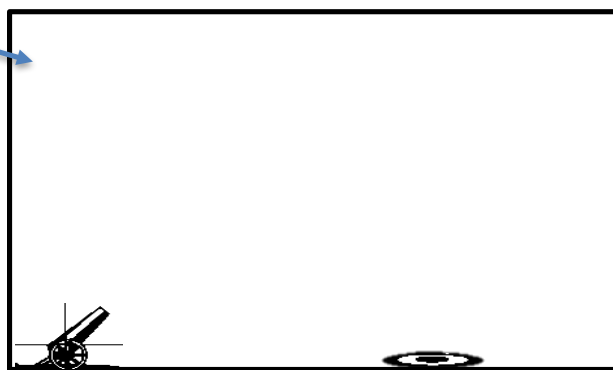
4. Conduct an experiment to determine how ***initial speed*** affects the range of a projectile.
   What will be your independent variable? _____

   What will be your dependent variable? _____
5. Make a table and a sketch to record your results.

Set launch angle to 30°. Select the football.	
Initial speed	Range

6. 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?

7. Conduct an experiment to determine how _launch angle_ affects the range of a projectile.
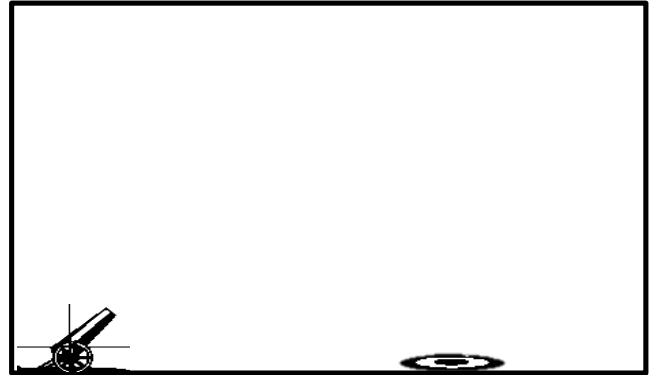   What will be your independent variable? _____

   What will be your dependent variable? _____

8. 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
15°	
30°	
40°	
45°	
50°	
60°	
75°	

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

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

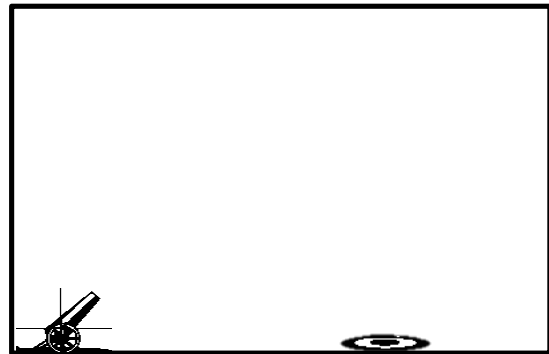## What is the effect of projectile mass on range?

10. 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? _____

11. Make a table and a sketch to record your results.

Set launch velocity to 40 m/s. Set angle to 30°.	
mass	range

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

Discover the relationship between complementary angles and range

13. Select the *football* with a launch velocity of 10 m/s. Complete the table below:

	Angle	Range	Time	Angle	Range	Time
Pair one 15° and 75°	15°			75°		
Pair two 30° and 60°	30°			60°		
Pair three 22° and 68°	22°			68°		
Pair four 40° and ___°	40°					
Pair five 5° and ___°	5°					
Last pair 45° and 45°	45°					

14. Compare the ranges of the angle pairs listed above. What is the sum of the angles that produce the same range?

15. 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:   **15°**   Time 1: _____   Angle 2: **75°**   Time 2: _____

    Explain:

    _____

    _____

    _____

16. What advice about angle and kicking speed would you give to a punter who wants to maximize the distance of a punt? Why?

_____

_____

_____

17. 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?

_____

_____

_____