Horizontally-Launched Projectiles

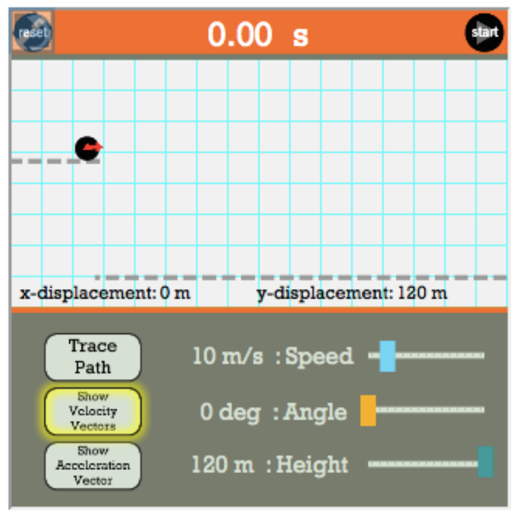
Goal: To understand the conceptual nature of the motion of a horizontally-launched projectile.

Background: A projectile is an object that is projected or launched into the air and then moves through the air under the sole influence of gravity. In this sense, a projectile is a free-falling object that experiences a downward acceleration of approximately 10 m/s/s.

Getting Ready: Navigate to the Projectile Simulator in the Physics Interactives section of The Physics Classroom website:

http://www.physicsclassroom.com/Physics-Interactives/Vectors-and-Projectiles/Projectile-Simulator

Path:
physicsclassroom.com => Physics Interactives => Vectors and Projectiles => Projectile Launcher



Once the Interactive opens, resize it to whatever size you wish. Then set the **Speed** to 10 m/s. Set the **Angle** to 0 degrees. Set the **Height** to 120 m. Select **Show Velocity Vectors** in order to enable this feature.

Directions and Questions:

1. Click the **Start** button and observe the simulation. The red arrows are velocity vectors. They are indicators of how fast the object is moving horizontally and vertically. The length of the arrow indicates how fast the object is moving in that direction. Does the object change how fast it is moving in the horizontal direction? _________ Explain why you answered this way.

2. **Reset** and **Start** the animation again to answer the following question: Does the object change how fast it is moving in the vertical direction? _________ Explain why you answered this way.

3. How does the initial horizontal velocity (right after it starts moving) compare to the final horizontal velocity (just before hitting the ground)?
   a. They are equal. b. The initial is greater c. The final is greater

4. How does the initial vertical velocity (right after it starts moving) compare to the final vertical velocity (just before hitting the ground)?
   a. They are equal. b. The initial is greater c. The final is greater

5. Acceleration involves a change in speed. In which direction does a projectile accelerate?
   a. Horizontally only b. Vertically only
   c. Both horizontally and vertically d. Neither horizontally and vertically

6. Now run the several trials to fill in the table. Click **Reset** after each trial to prepare for the next. Keep the initial height at 120 m and the angle at 0 degrees.

Trial	Speed (m/s)	Time (s)	x-Displacement (m)
1	10		
2	20		
3	30		
4	40		
5	60		

Analyze the data above to answer the following questions.

7. Describe the effect that increasing launch speed has upon the time to fall.

8. Describe the effect that increasing launch speed has upon the horizontal or x-displacement.

9. A doubling of launch speed causes the time to fall to _____ and the x-displacement to _____.
a. double, double b. halve, double c. not change, double
d. double, not change e. double, halve f. not change, halve

10. Which two trials could be used to show the effect that a tripling of the launch speed has upon the time and x-displacement?
a. Trials 1 and 2 b. Trials 2 and 4 c. Trials 2 and 5

11. Experiment with the Interactive in order to determine *what changes must be made in order to decrease the time to fall*. Describe what you changed, what you observed, and what you conclude:

What I changed:

What I observed:

What I conclude regarding what changes must be made to decrease the time to fall: