Catapults, Projectiles, & Parabolic Flight (part 1)

Drexel NSF/GK-12/Seaperch Program

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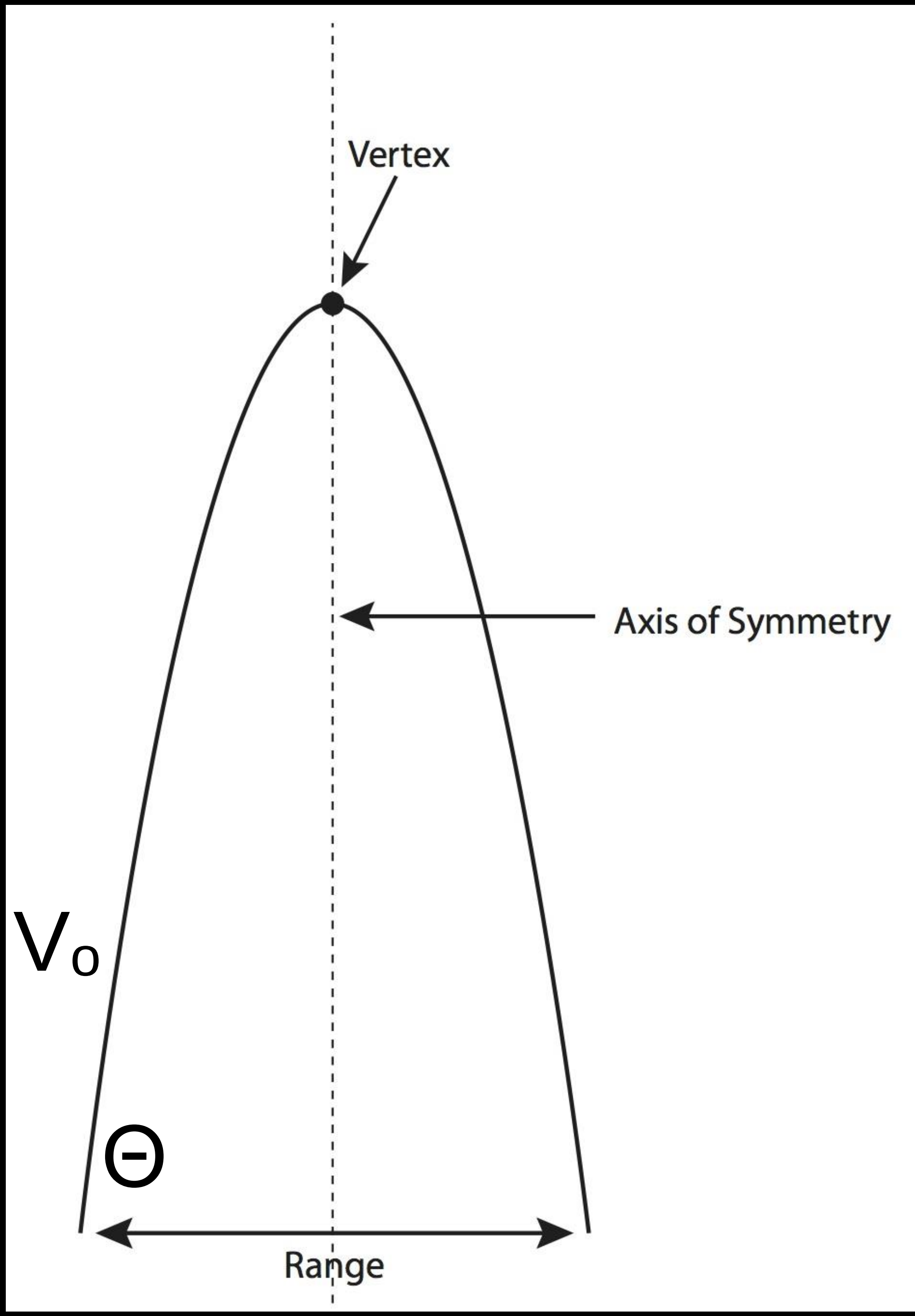
Catapult Challenge

- What is projectile motion?
- What are some examples in the real-world where we see projectile motion?
- What is the shape of the trajectory of any projectile object?
- What factors/forces impact the trajectory of a projectile object?

Projectile Vocabulary

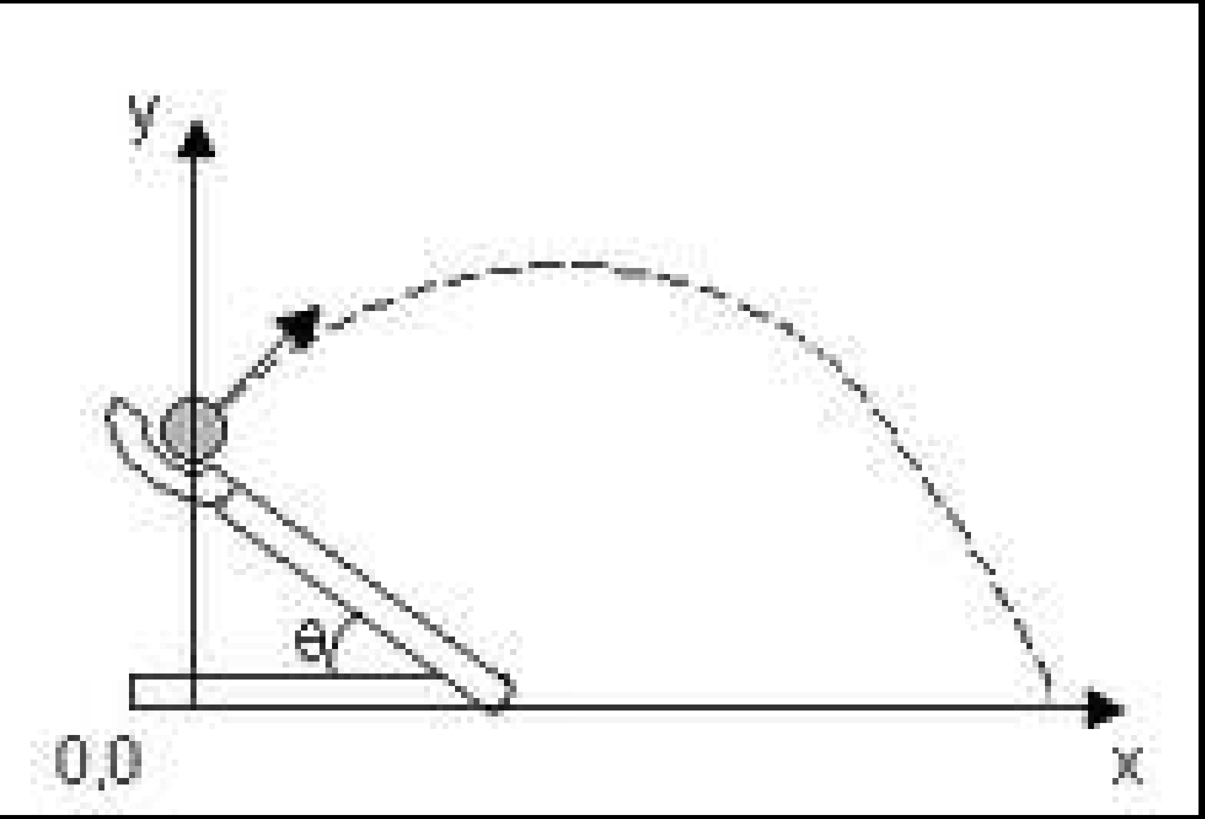
- **Vertex**: the highest point of flight (x-value is 1/2 of the range)
- **Range:** the horizontal distance traveled (starting point to where it hits ground)
- **Axis of Symmetry:** a vertical line through a parabola's vertex (creates 2 perfect halves)
- **Launch Angle (Θ):** the angle at which an object is released
- **Launch Velocity (V_o):** the initial speed that an object is released



Catapult Challenge: Part 1

Range, Velocity & Launch Angle

- Make teams of 4 students
- Teams will launch ping-pong balls, testing how different launch angles and initial velocities affect the range.
- Record and graph the trajectory of each launch as the launch angle changes. (Complete handout #1)



Range, Velocity & Angles

- This formula represents the relationship between distance, velocity and launch angle:

$$D = \frac{V_0^2 \cdot \sin 2\Theta}{g}$$

- D = Distance (range)
- V_0 = Initial Velocity
- Θ = Launch Angle
- g = 9.81 m/s^2 (acceleration of gravity)

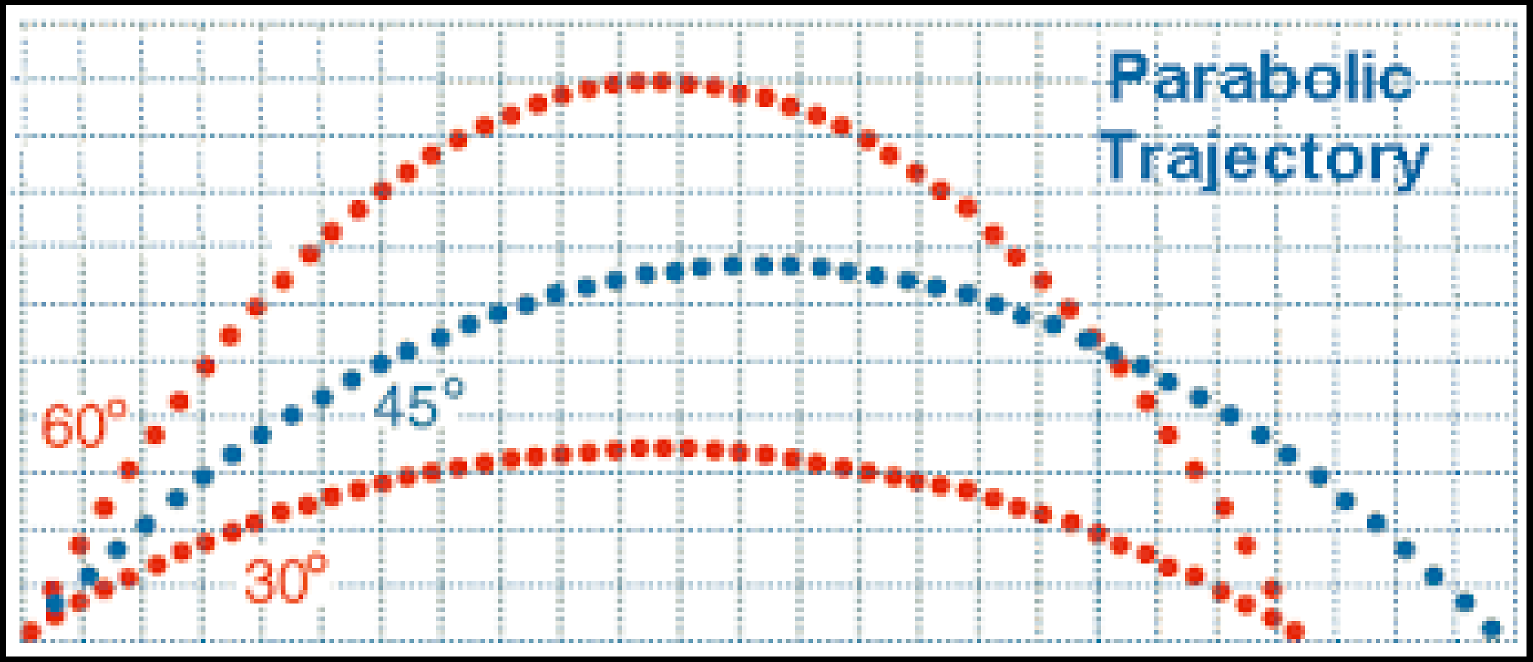
What if velocity is held constant?

$$D = \frac{V_0^2 \cdot \sin 2\Theta}{g}$$

The launch angle is the only other variable to consider.

45° is the optimal launch angle.

Complimentary launch angles have equal ranges (ex: 30°, 60°) but different trajectories



Connections - Seaperch: Launch Angle, Velocity and Distance

You are sent into dangerous waters to explore an aircraft accident. Unfortunately, you can't get close enough to drop your robot into the water, and you are 50 meters away from the center of the site.

You use your custom Seaperch launcher and set it at a 45° angle. You must enter the initial launch velocity, so that your Seaperch reaches the center of the debris.

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References

Bouma, Craig. (2013, May 29). *Slow Motion Batting: projectile motion* [Video file]. Retrieved from https://www.youtube.com/watch?v=pXhIGo9179s