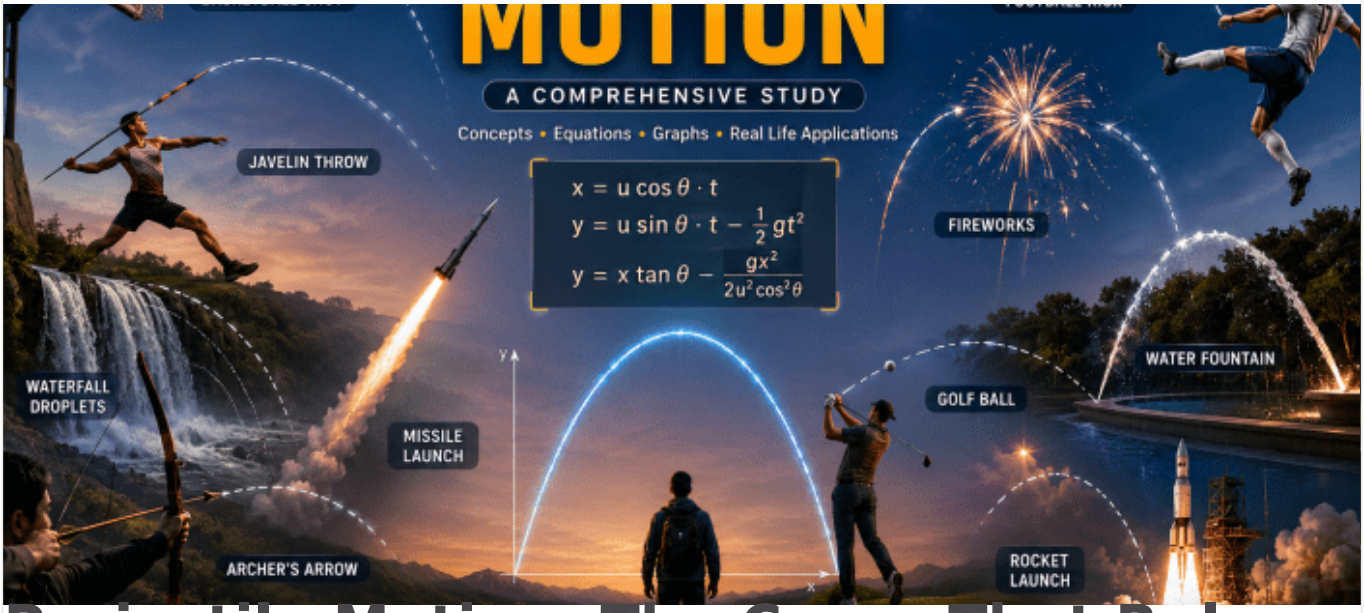


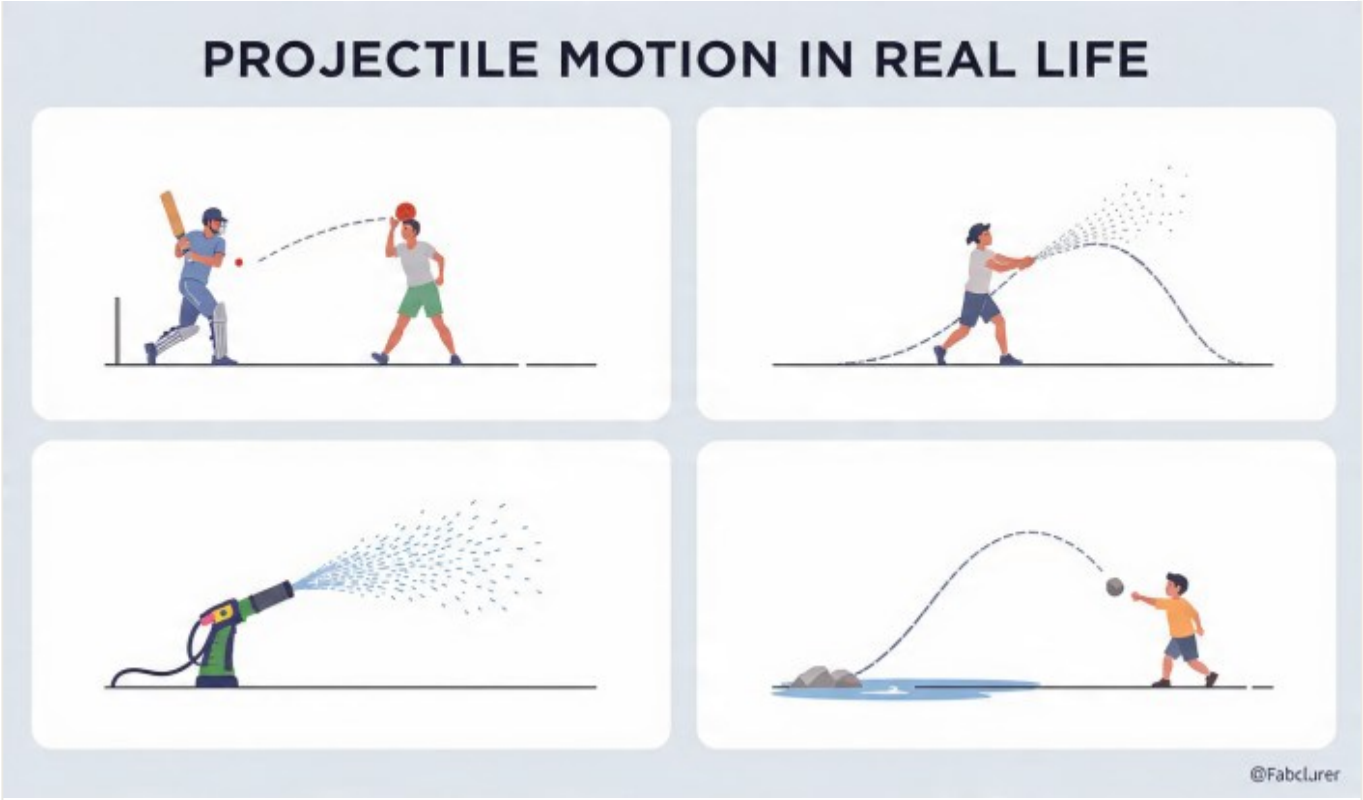
Projectile Motion: The Curve That Rules Your World

Posted on May 21, 2026 by EduSpark

What is it? Anytime you throw, kick, spray, or drop something and let gravity do the rest, that thing is a **projectile**. It does NOT fly straight. It always makes a smooth curve called a **parabola**.

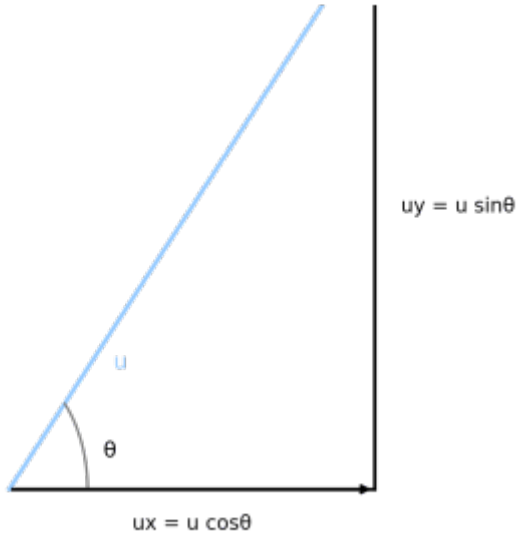
Think of:

- A cricket six by **Dhoni** – ball up, then down
- Water from a garden hose – same curve
- Your phone slipping from your hand – half a curve
- A basketball free throw – perfect parabola



Big idea in one line: Every throw is two separate stories happening at the same time – one sideways, one up-down.

The Secret – Two Motions in One



Imagine you throw a ball at an angle. Your hand gives it one push. We split that push:

1. Sideways motion (X)

No force after you let go (ignore air). So speed stays constant. Like a car on cruise control.

$u_x = u \times \cos\theta$

2. Up-down motion (Y)

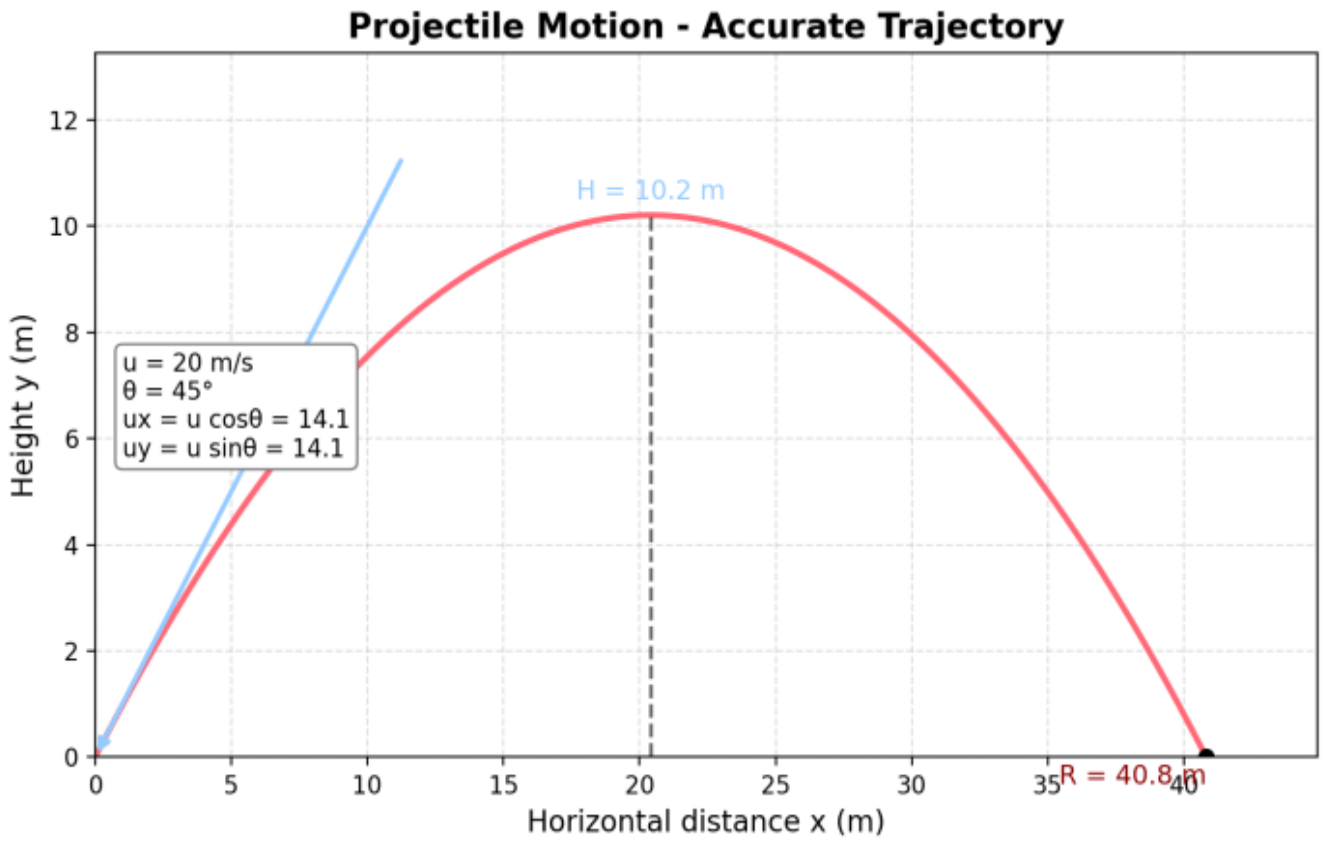
Gravity pulls down at 9.8 m/s² every second. So the ball slows going up, stops for a blink, then speeds down.

$u_y = u \times \sin\theta$

Layman trick: Close one eye. Watch only the shadow on the ground – it moves at steady speed. Now watch only the height – it goes up then down like a lift with broken brakes.

Because they are independent, we can solve them separately, then combine.

All Derivations – No Magic, Just Logic



Starting tools (from Class IX)

$v = u + at$

$s = ut + \frac{1}{2} at^2$

$v^2 = u^2 + 2as$

Step 1 – Position at any time t

Horizontal:

$x = u_x \times t = (u \cos\theta)t$ [no acceleration]

Vertical:

$y = u_y \times t - \frac{1}{2}gt^2 = (u \sin\theta)t - 4.9t^2$ [a = -g]

Step 2 – Time of Flight

When it lands, y = 0

$0 = u_y t - \frac{1}{2}gt^2$

$t(u_y - \frac{1}{2}gt) = 0$

$T = 2u_y/g = 2u \sin\theta/g$

Step 3 – Maximum Height

At top, vertical speed = 0

$0 = u_y^2 - 2gH$

$H = u_y^2/2g = u^2\sin^2\theta/2g$

Step 4 – Horizontal Range

Range = horizontal speed × total time

$R = u_x \times T$

$R = (u \cos\theta)(2u \sin\theta/g)$

$R = u^2\sin 2\theta/g$

Quick check: Throw at 20 m/s, 45°. Range ≈ 40.8 m. At 30°, range drops. At 60°, same range as 30°. Best angle for distance is 45°.

Link With Real Life and Other Subjects

Values you feel

- **Sports:** Javelin throwers release near 36°. Basketball arcs are usually above 50°.
- **Home:** A water pipe at 45° reaches the farthest.
- **Safety:** Never throw keys straight up. Time up = time down.

Cross-subject links

- **Maths:** The path is a parabola.
- **Biology:** Kangaroos optimize jump angles.
- **History:** Galileo explained projectile motion in 1638.
- **Art & PE:** Draw and physically experience the curve.
- **Life lesson:** The ball rises before it travels far — growth before success.

Make It Experiential – 3 Activities

Activity 1 – Table Top Shooter

Roll a marble off a table. Measure height and landing distance. Calculate speed using projectile equations.

Activity 2 – Hose Angle Test

Spray water at different angles and compare ranges. 45° reaches farthest.

Activity 3 – Phone Slow-Mo Lab

Use slow-motion video to observe constant horizontal motion and changing vertical motion.

Safety: Use soft balls and open spaces only.

Question Bank – Test Yourself

1. Why do a dropped ball and a horizontally thrown ball hit together?
2. A cricketer hits at 25 m/s and 60°. Find horizontal speed.
3. Why is 45° best for maximum range?
4. You throw a stone upward at 10 m/s. Time to reach top?
5. Draw velocity vectors at launch, top, and landing.
6. Which other angle gives same range as 30°?
7. Explain projectile motion to a child.
8. Why do long jumpers run before jumping?
9. How does lower gravity on Moon affect range?
10. Design a simple experiment to prove horizontal motion is uniform.
11. Name careers using projectile motion daily.
12. Challenge: A ball thrown from 2 m height lands 30 m away at 45°. Estimate initial speed.

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