Physics for Physics Teacher 1

Kittipong S. (Ph.D. Physics)

DEPARTMENT OF PHYSICS
FACULTY OF SCIENCE AND TECHNOLOGY

KINEMATICS UNIT

Straight Motions

Kittipong S. (Ph.D. Physics)

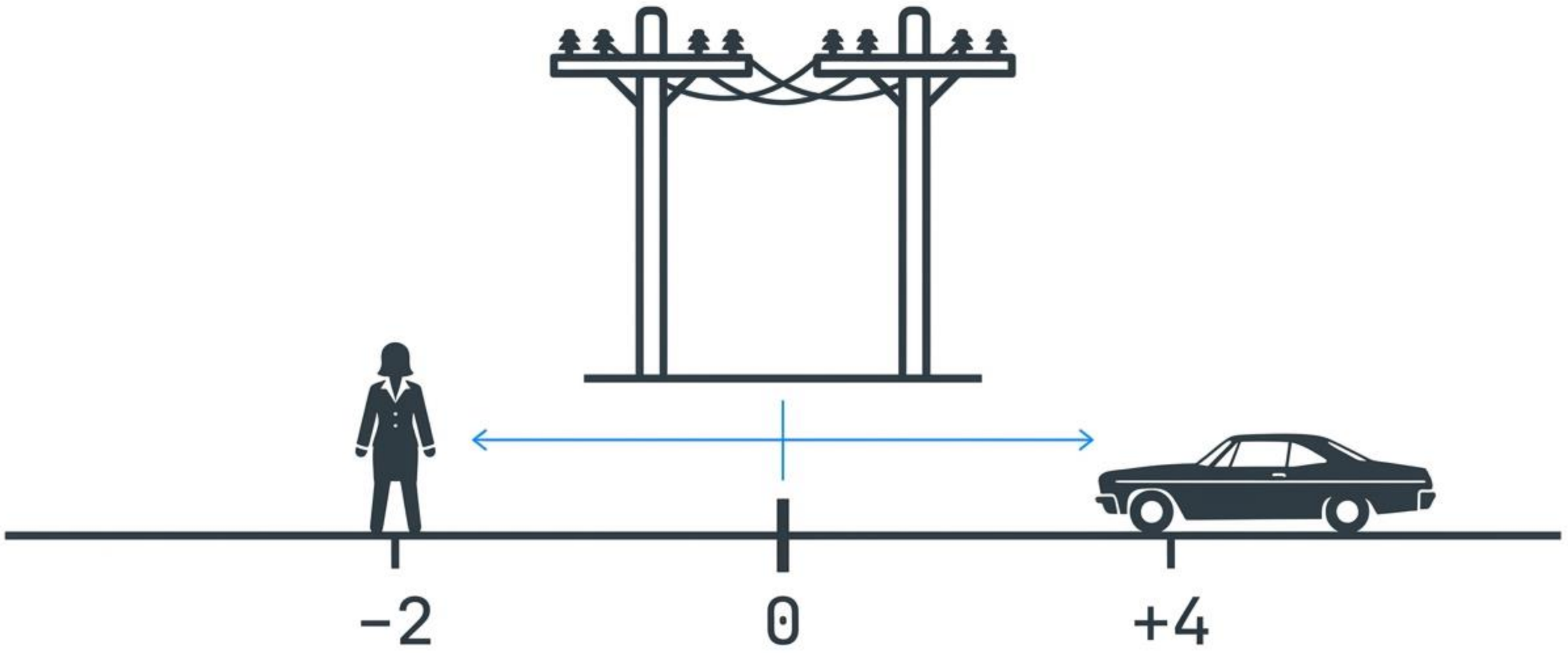
DEPARTMENT OF PHYSICS
FACULTY OF SCIENCE AND TECHNOLOGY

Linear Motion: The Science of Moving Straight

From Stillness to Prediction

The Reference Point

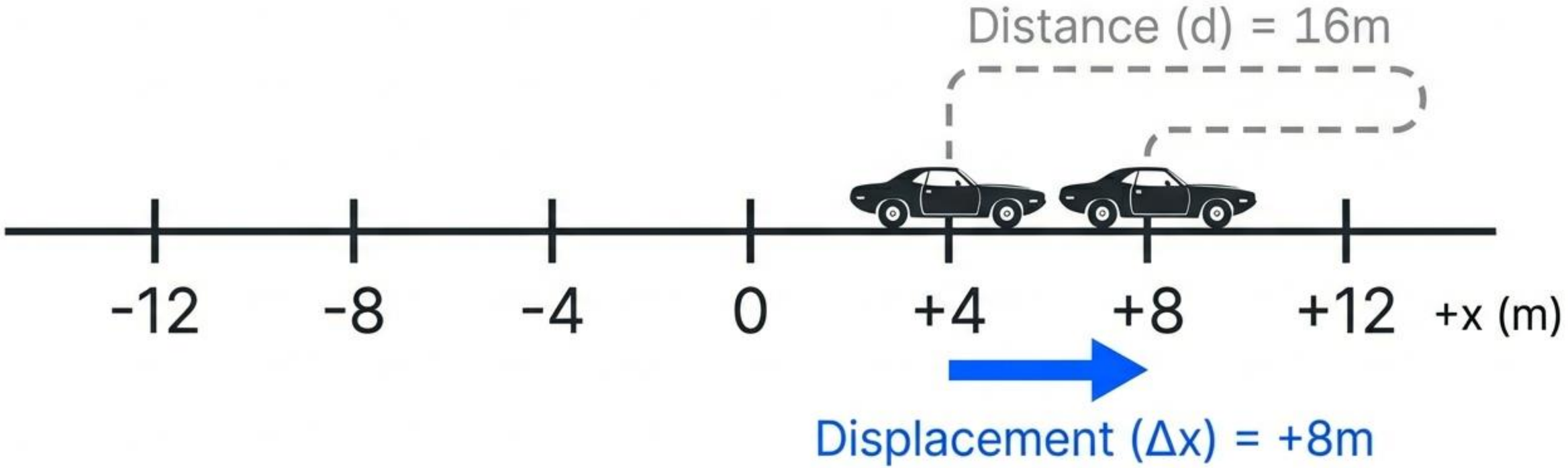
You aren’t lost; you just lack a reference point. Position is relative to x = 0.



The Path vs. The Result

Distance (d): Scalar.
How much ground was covered.

Displacement (Δx): Vector.
How far out of place the object is.



How Fast?

Speed tells you how fast. Velocity tells you where you are going.

Speed (Scalar)

How fast you are moving right now

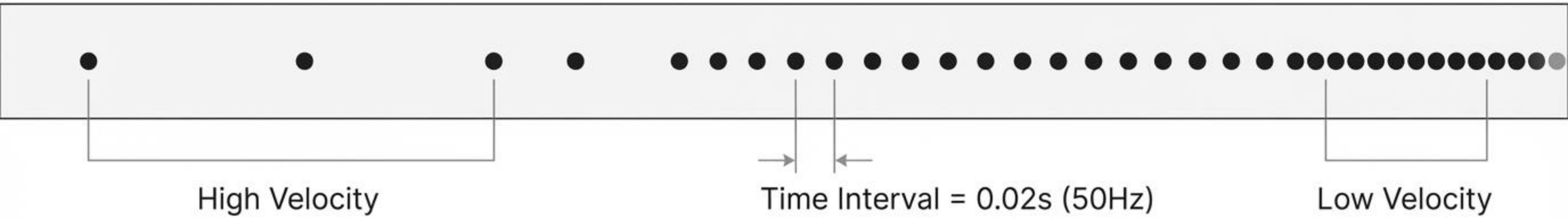
Velocity (Vector)

Speed + Direction

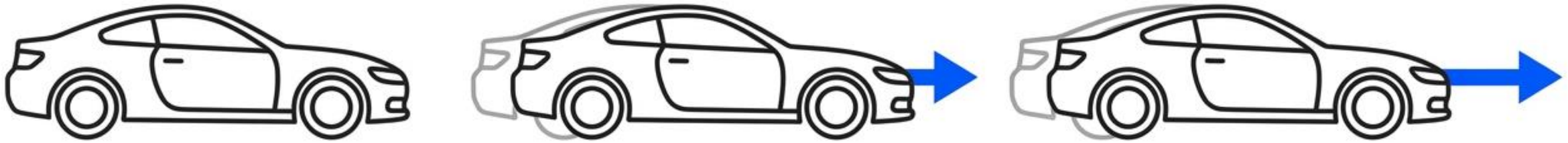
$$\vec{v}_{avg} = \frac{\Delta \vec{x}}{\Delta t}$$

Capturing Time

The space between the moments reveals the speed.



Acceleration: The Rate of Change



`t=0, v=0` `t=1s, v=10 m/s` `t=2s, v=30 m/s`

$$a = \Delta v / t$$

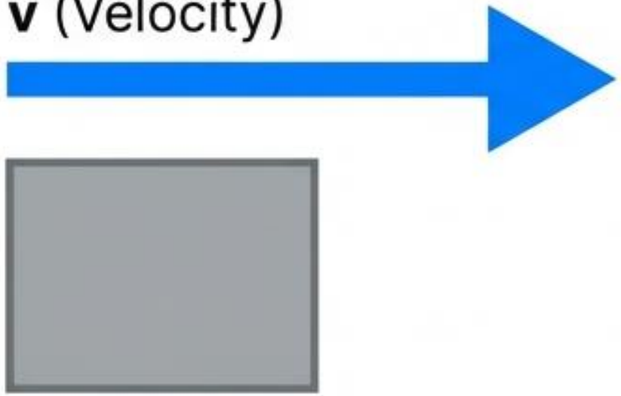
It is not about going fast. It is about getting fast.

The Myth of Deceleration

Physics defines deceleration simply as acceleration in the opposite direction of motion.

Speeding Up

v (Velocity)

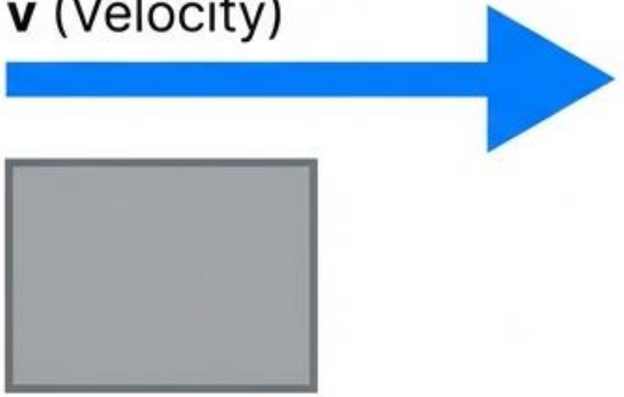


`Signs Aligned`
`(+,+) or (-,-)`
= Speeding Up

a (Acceleration)

Slowing Down

v (Velocity)

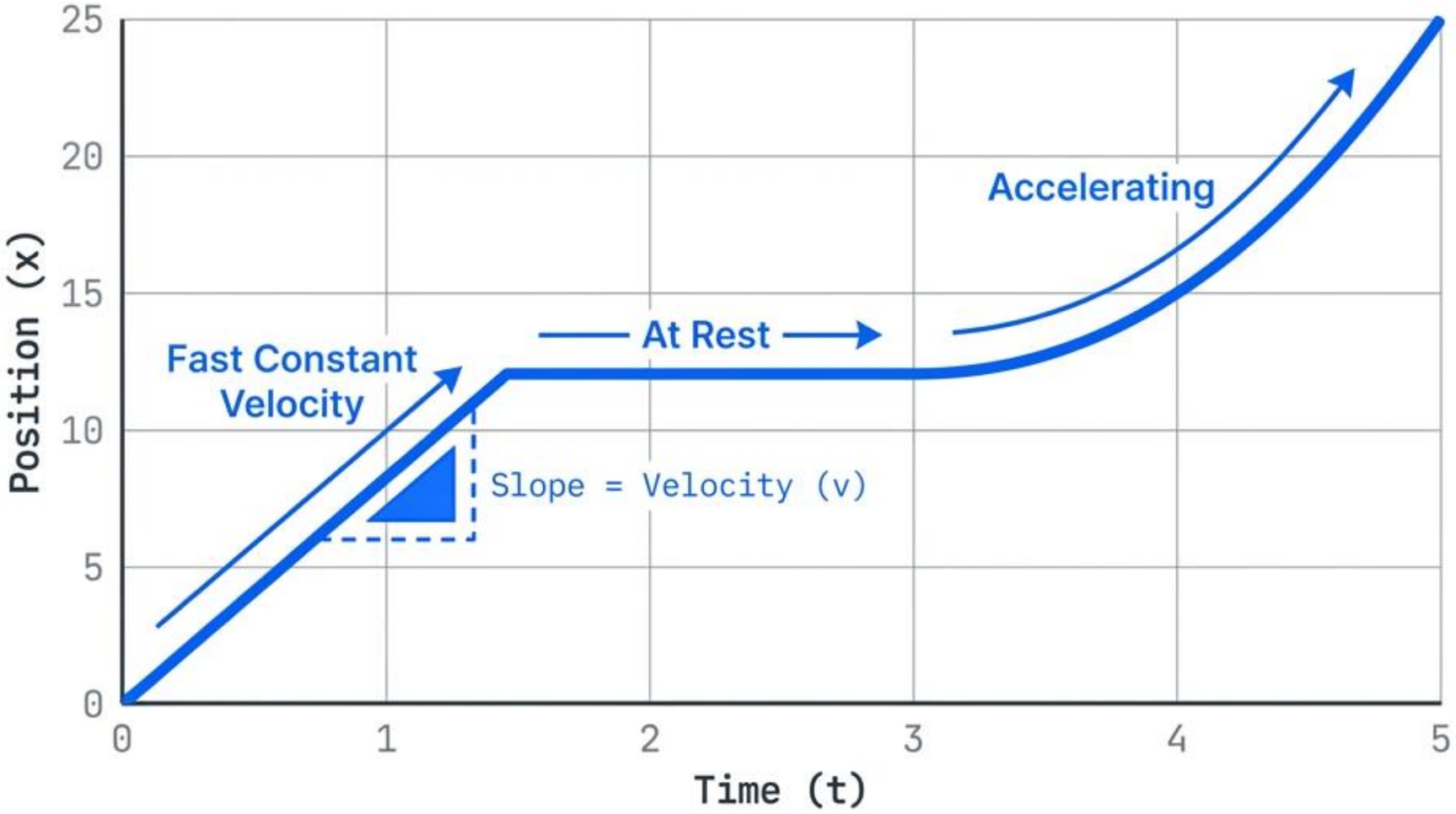


`Signs Opposed`
`(+,-) or (-,+)`
= Slowing Down

a (Acceleration)

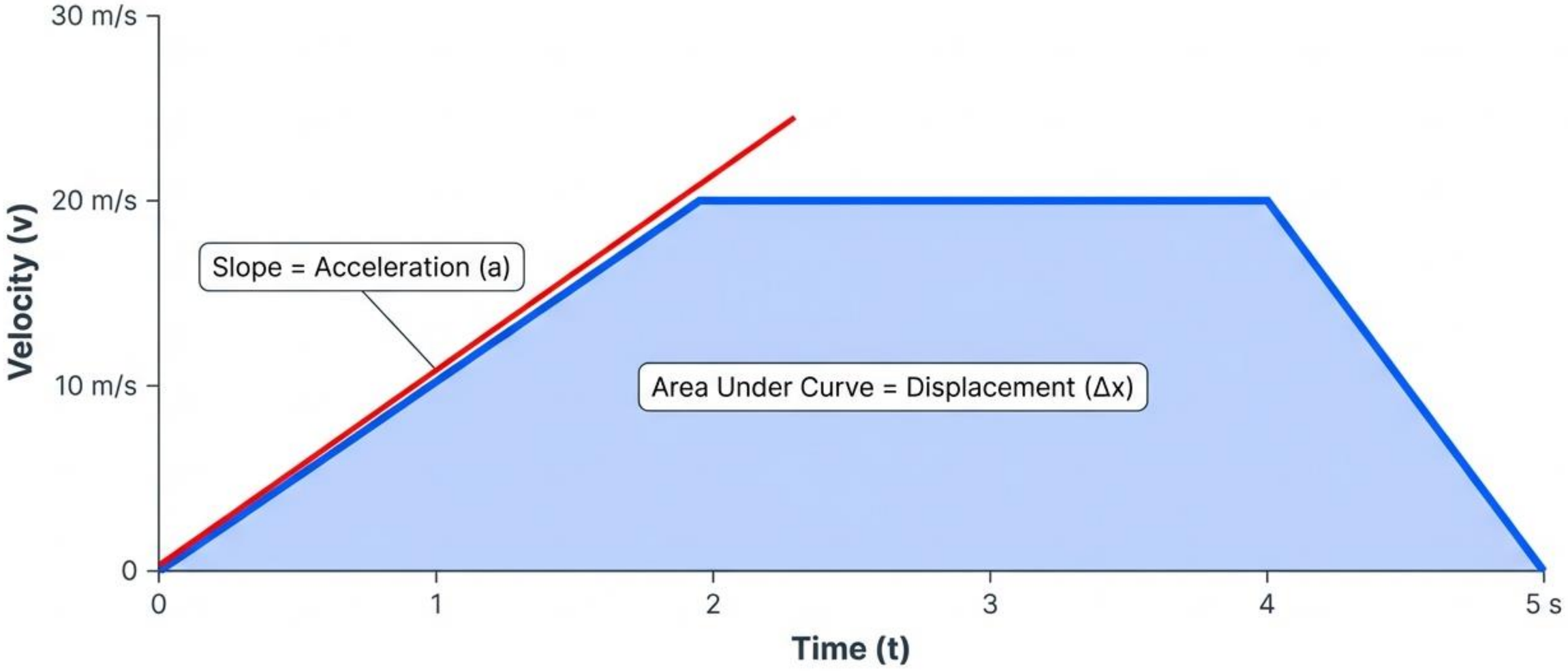
Position vs. Time: The Storyteller

Reading the slope tells the story of speed.



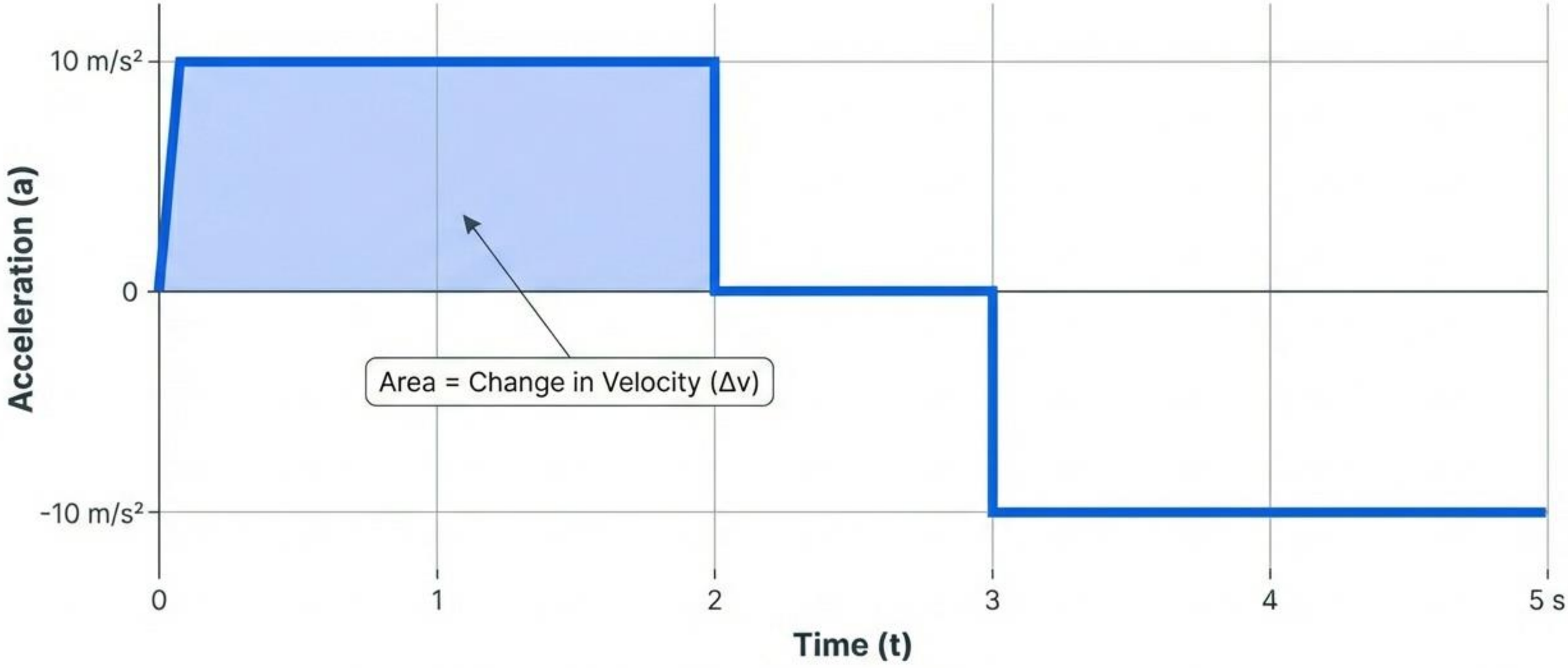
Velocity vs. Time: The Analyzer

The steepness is the force; the area is the journey.



Acceleration vs. Time: The Driver

Sudden jumps in the graph represent sudden changes in force.



The Prediction Toolkit

Constant Acceleration Only. If you know 3 variables, you can find the 4th.

$$v = u + at$$

Missing
Displacement

$$x = \frac{1}{2}(u + v)t$$

Missing
Acceleration

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

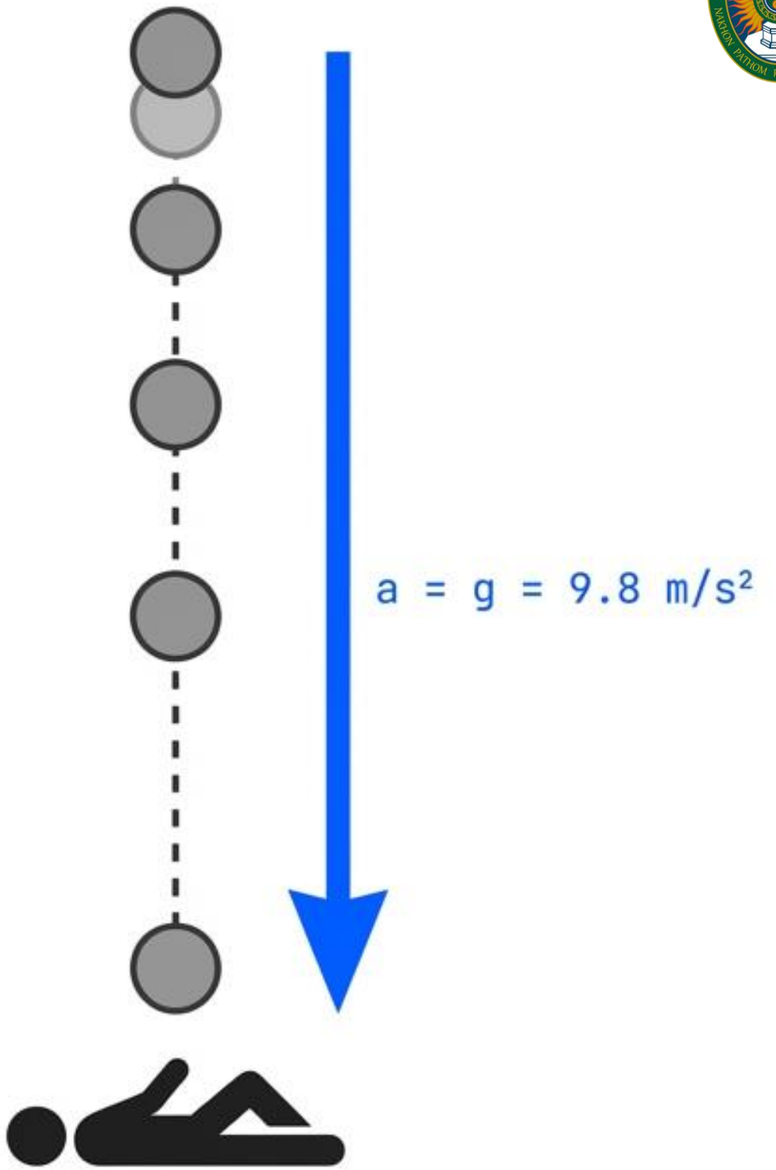
Missing
Final Velocity

$$v^2 = u^2 + 2ax$$

Missing
Time

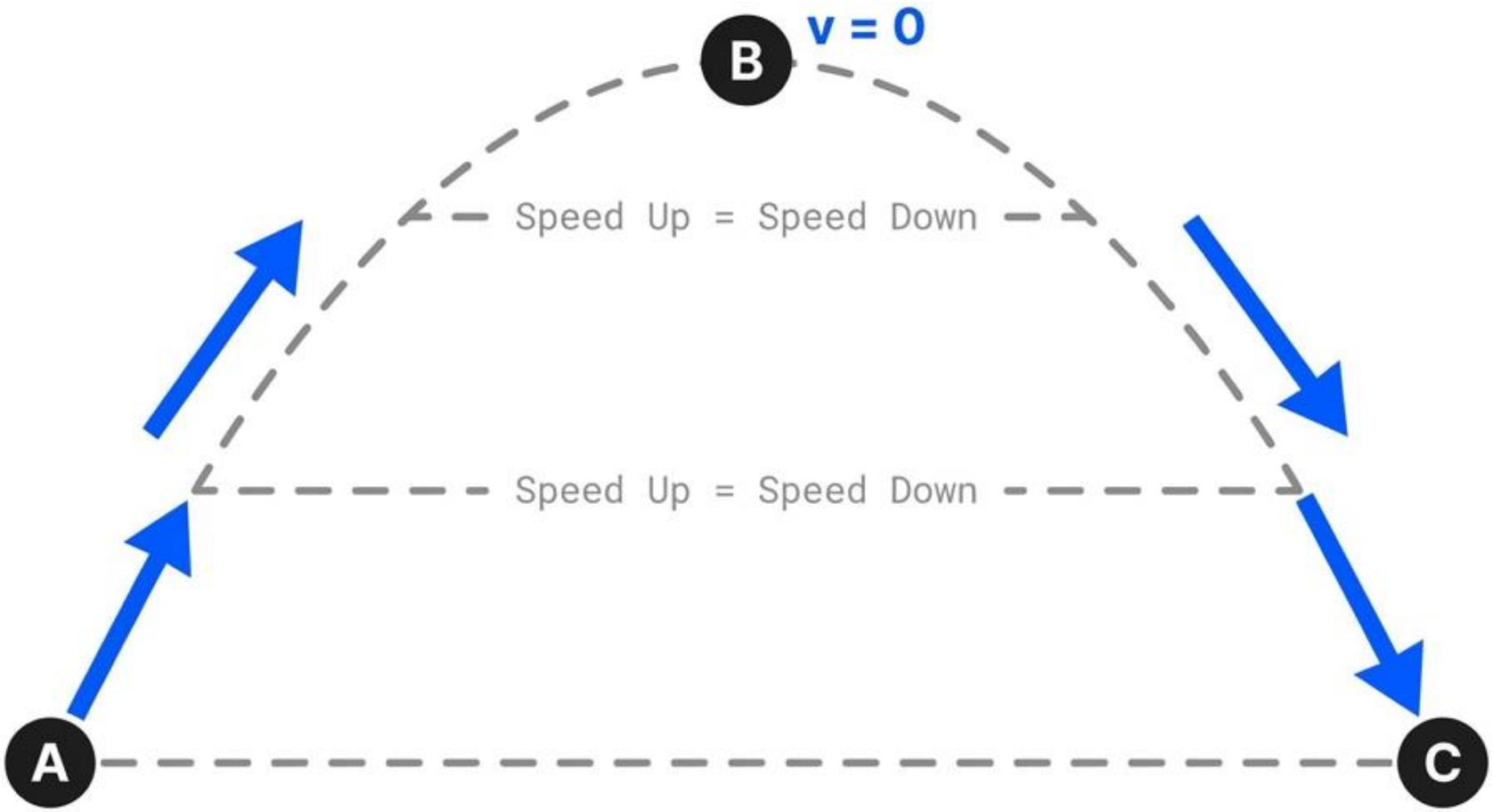
The Invisible Hand: Free Fall

Gravity is just constant acceleration. Mass is irrelevant.



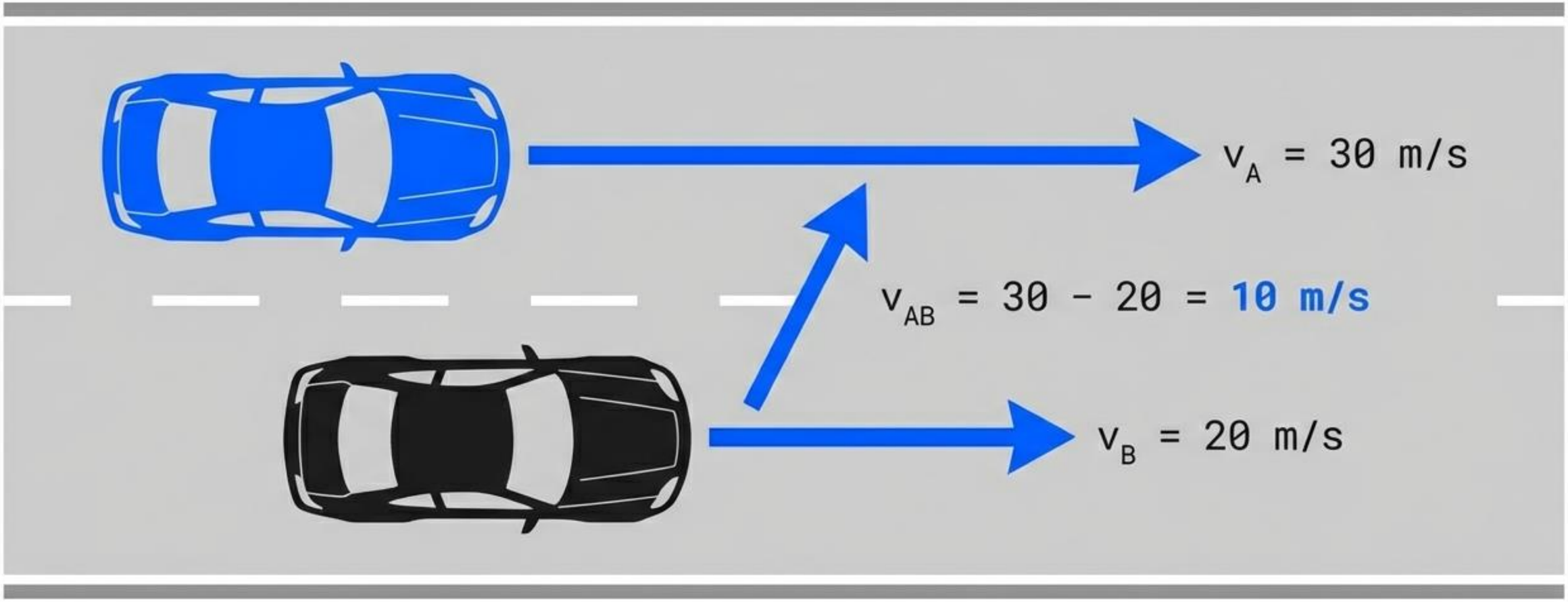
Symmetry of Free Fall

Time up equals time down. Speed at launch equals speed at catch.



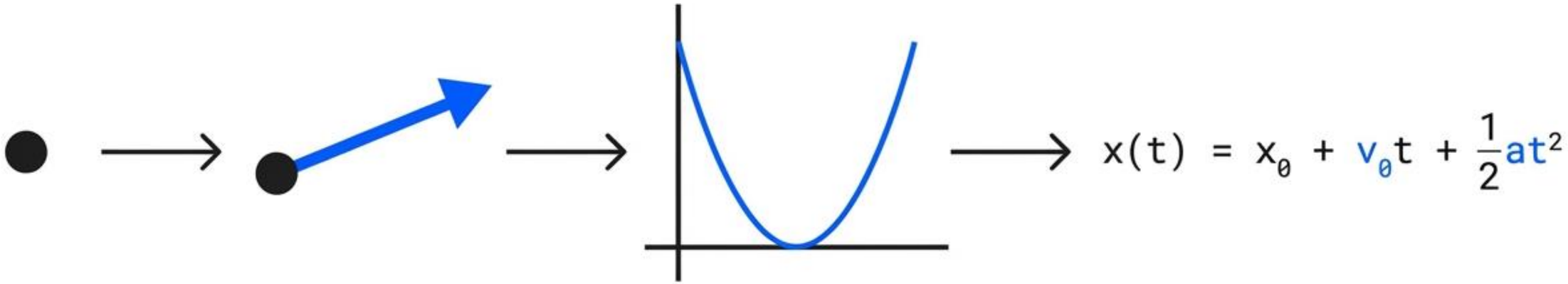
Relative Motion

To the driver of Car B, Car A is drifting away at only 10 m/s.



Motion is Predictable

We began with a point in space. We ended with the ability to calculate the future position of any object in the universe.



$$x(t) = x_0 + v_0 t + \frac{1}{2}at^2$$

Position Velocity Graph (x vs. t) Prediction

Physics is the language of prediction.