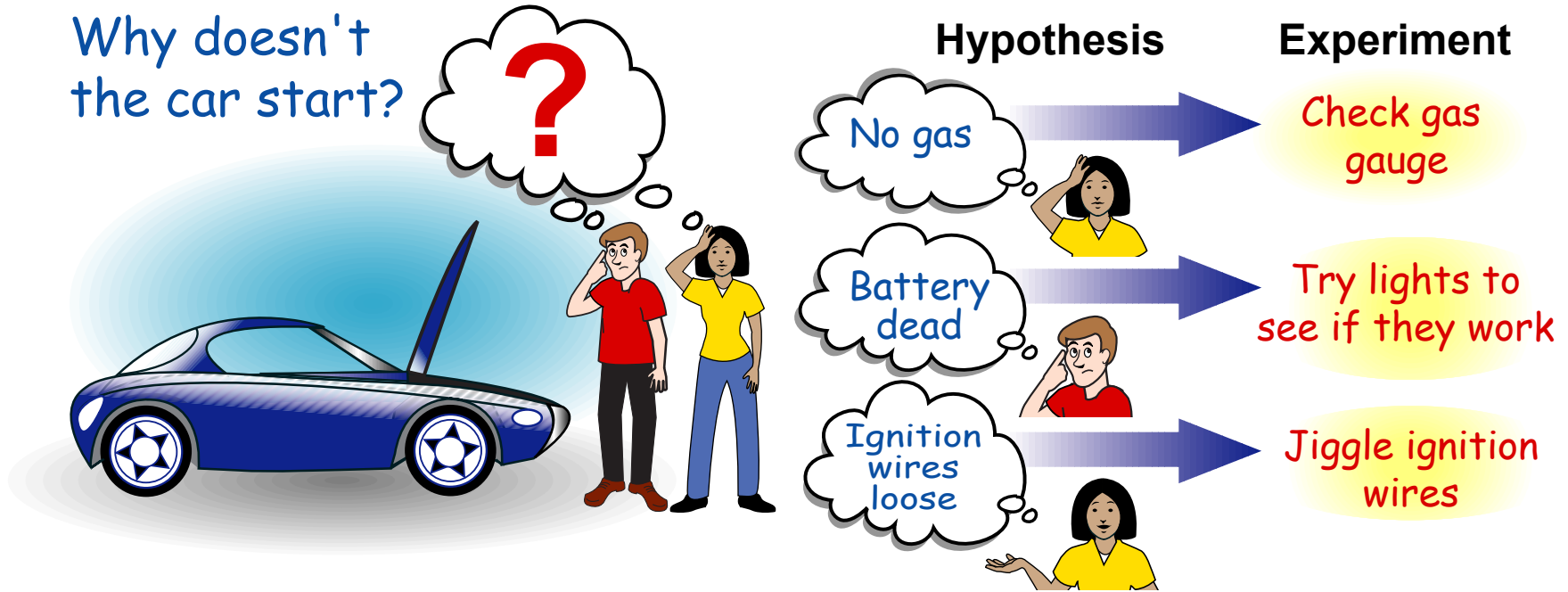


Scientific Method

Why doesn't the car start?

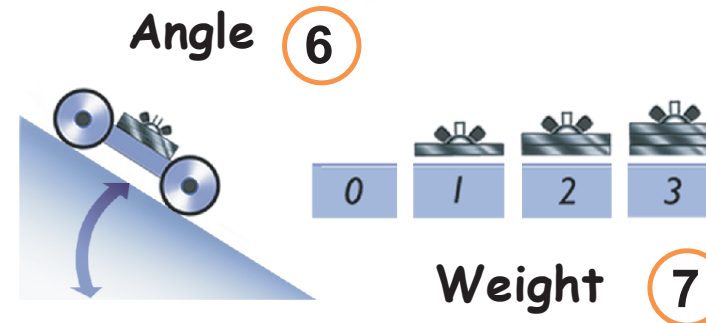
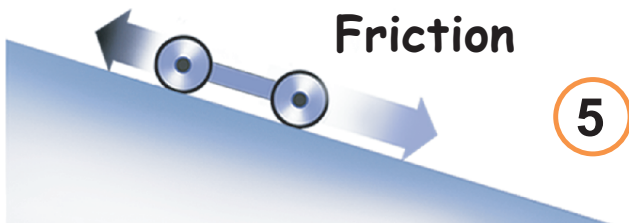
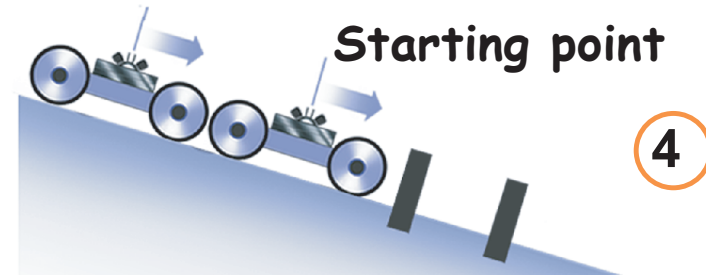
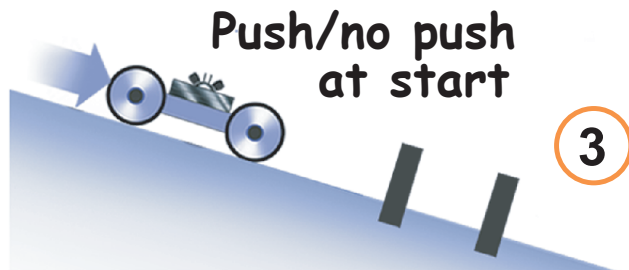
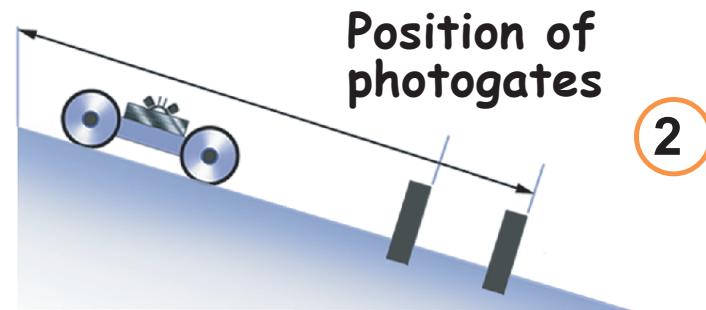
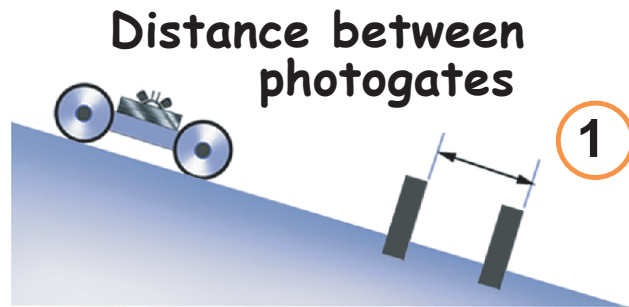


Steps in the scientific method

STEP	EXAMPLE
1. Ask a question.	1. Why doesn't the car start?
2. Formulate a hypothesis.	2. Maybe the battery is dead.
3. Design and conduct an experiment.	3. Turn the lights on to test the battery.
4. Collect and analyze data.	4. The lights go on.
5. Make a tentative conclusion.	5. Battery is OK.
6. Test conclusion, or if necessary, refine the question, and go through each step again.	6. Are the ignition wires loose or wet?

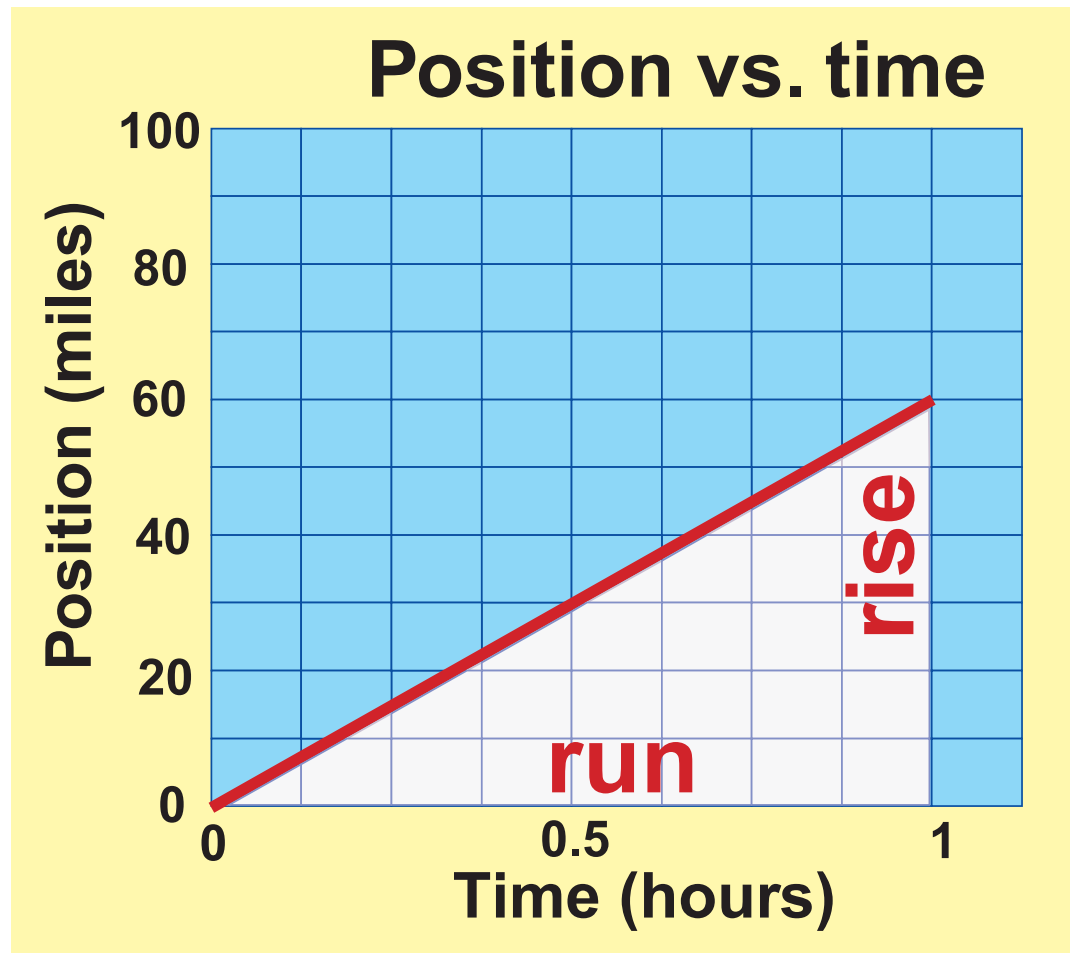
Variables

Seven variables that affect speed



Speed

Speed is the slope of the position vs. time graph.

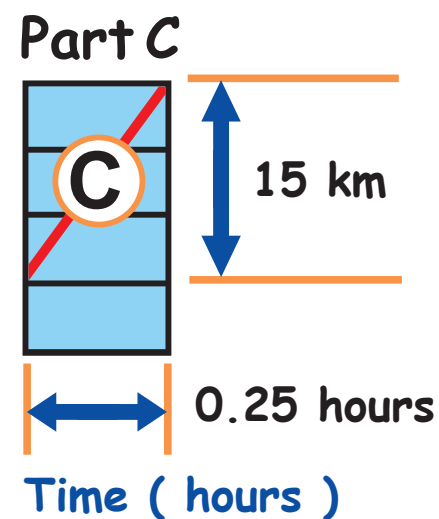
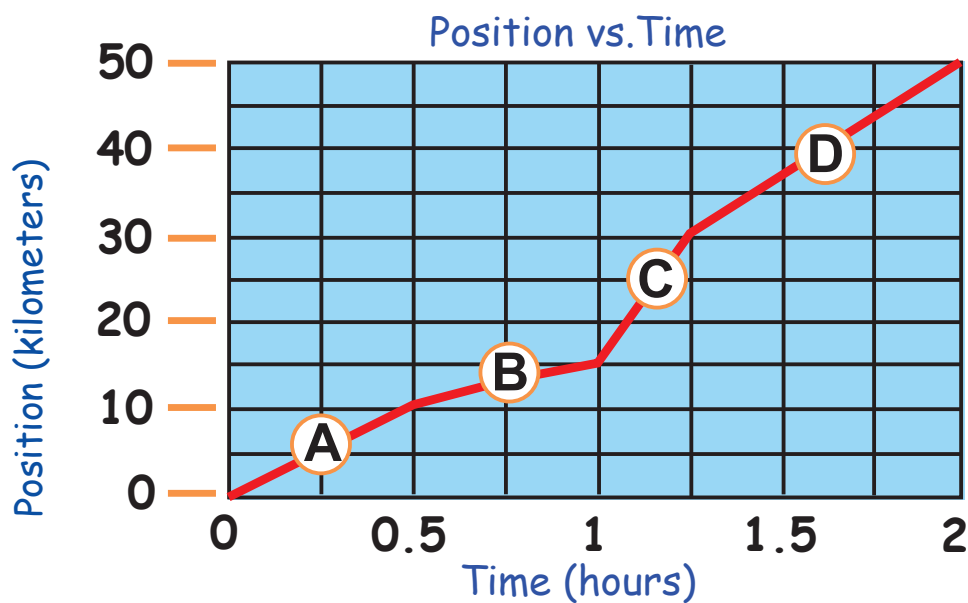
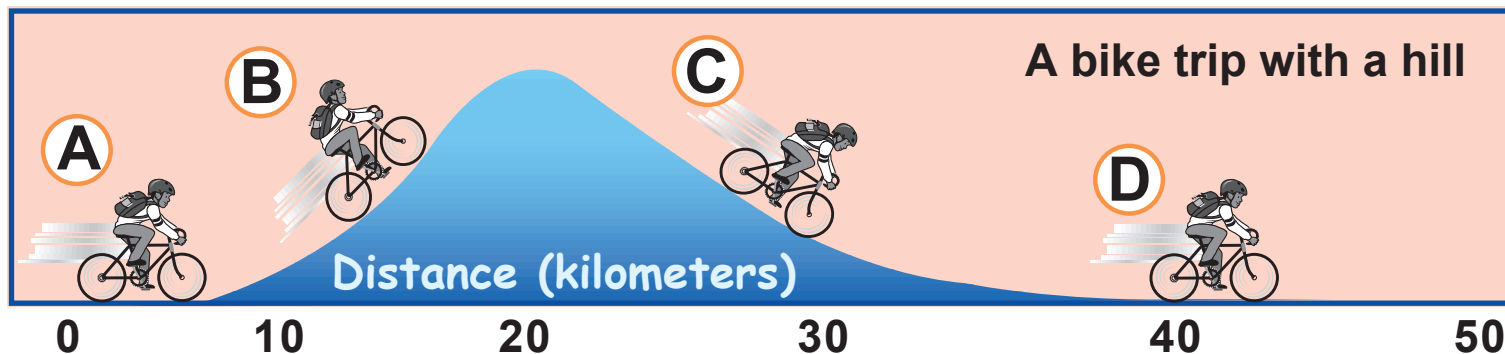


$$\text{Slope} = \frac{\text{rise}}{\text{run}}$$

$$= \frac{60 \text{ miles}}{1 \text{ hour}}$$

$$= 60 \text{ mph}$$

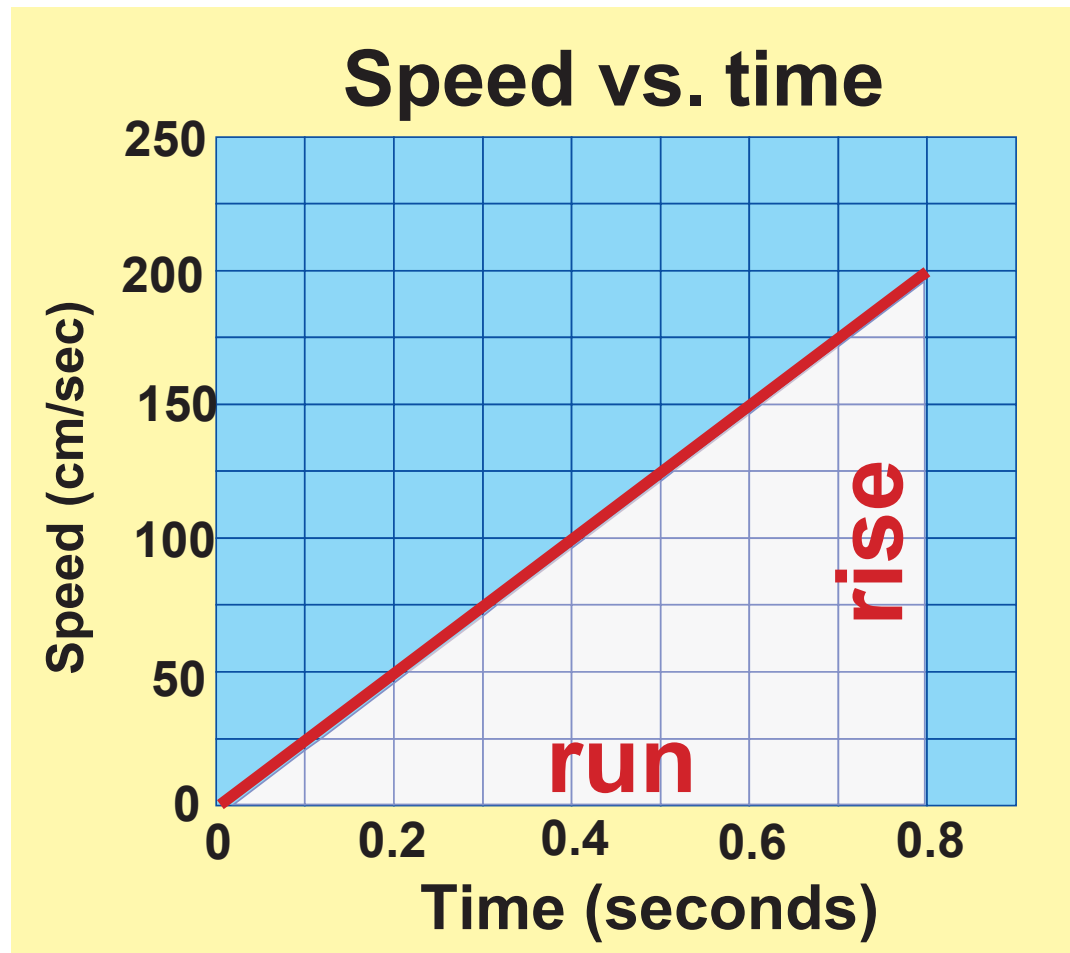
Position vs. Time Graph



$$\text{Average speed for Part C} = \frac{15 \text{ km}}{0.25 \text{ hours}} = 60 \text{ km/h}$$

Acceleration

Acceleration is the slope of the speed vs. time graph.



$$\text{Slope} = \frac{\text{rise}}{\text{run}}$$

$$= \frac{200 \text{ cm/sec}}{0.8 \text{ seconds}}$$

$$= 250 \text{ cm/sec}^2$$

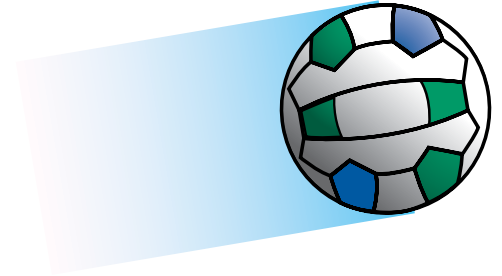
Newton's First Law of Motion



An object at rest will remain at rest...

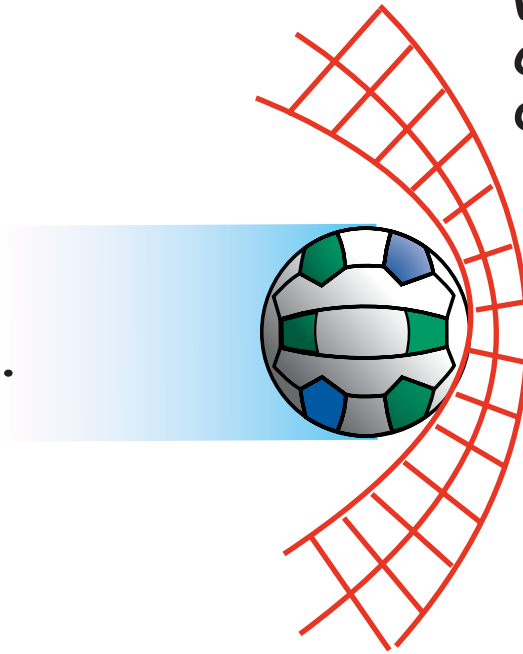


Unless acted on by an unbalanced force.



An object in motion will continue with constant speed and direction,...

... Unless acted on by an unbalanced force.



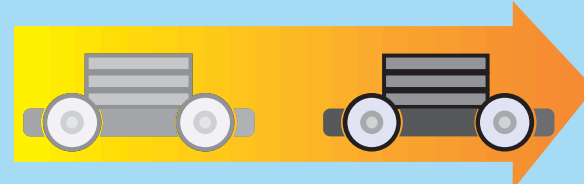
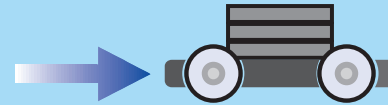
Newton's Second Law of Motion

Push with force F ...



and the car will accelerate.

Add mass to the car and push with the same force F ...

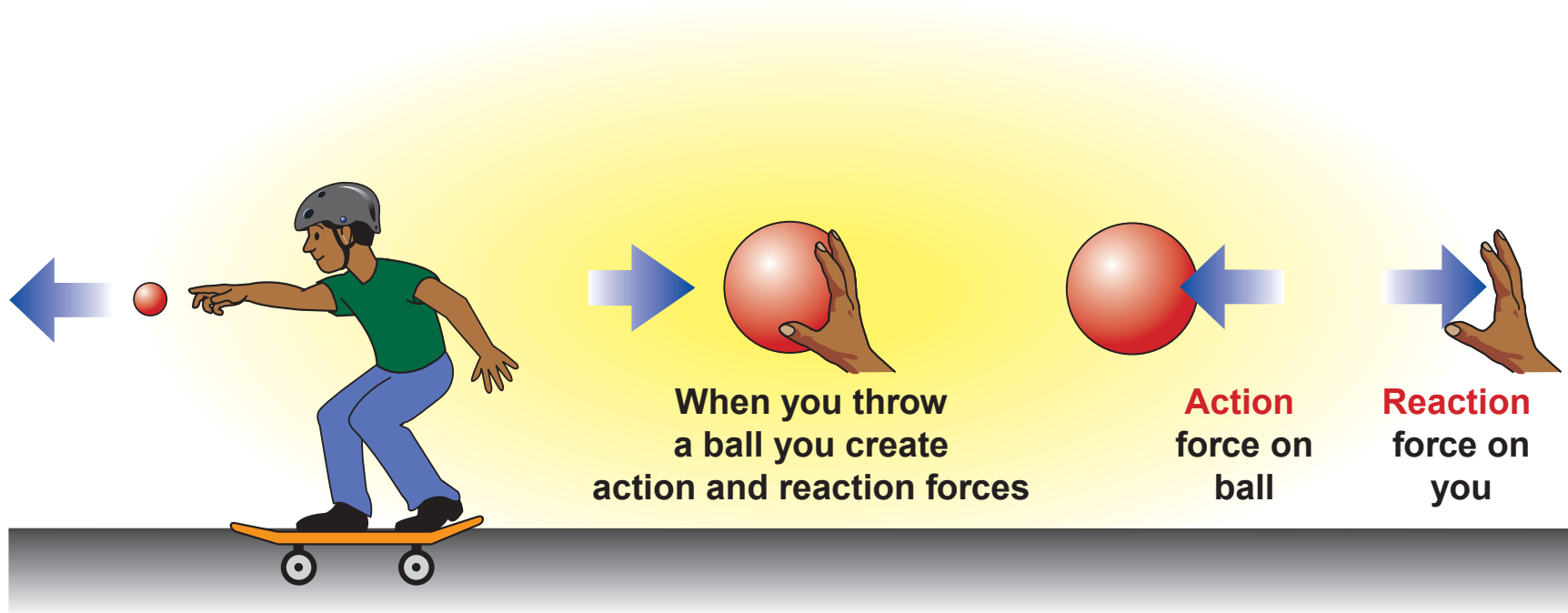


and you get less acceleration.

$$\text{Acceleration (m/sec}^2\text{)} \text{ — } \mathbf{a} = \frac{\mathbf{F}}{\mathbf{m}} \text{ — Force (newtons, N)}$$

— Mass (kg)

Newton's Third Law of Motion



For every **action force**, there is a **reaction force** equal in strength and opposite in direction.