

CHAPTER 4: LAWS OF MOTION

Newton's Third Law of Motion

Understanding action, reaction, and the
symmetry of forces in mechanics.

Class 11 Physics • NEET/JEE Prep

To Every Action, There Is an Equal and Opposite Reaction

According to Newtonian mechanics, force never occurs singly in nature. Force is the mutual interaction between two bodies.

EQ. (4.8)

$$\mathbf{F}_{AB} = -\mathbf{F}_{BA}$$

(Force on A by B) = – (Force on B by A)

The Anatomy of a Force Pair

Same magnitude, opposite direction, different bodies.



Simultaneous occurrence: Action does not cause reaction; there is no cause-effect delay. They happen at the exact same instant.



Identical nature: The terms action and reaction both simply mean force.



Mutual interaction: You cannot touch something without being touched back with the exact same amount of force.



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$$E=mc^2$$



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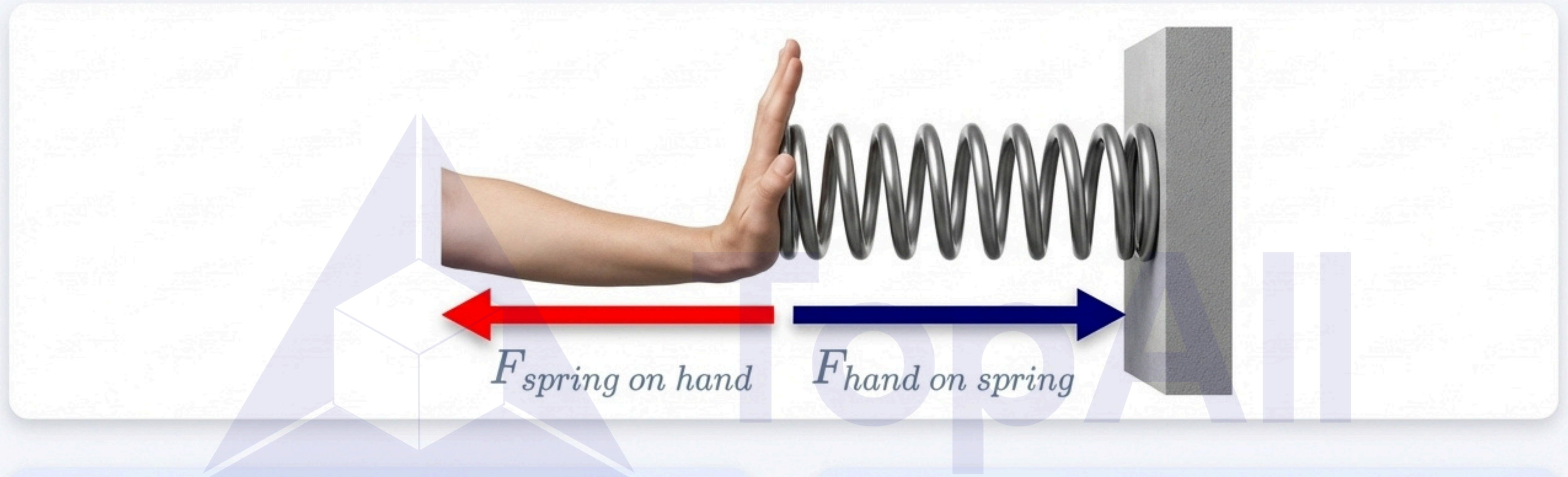
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Example 1: The Coiled Spring

ACTION-REACTION PAIR

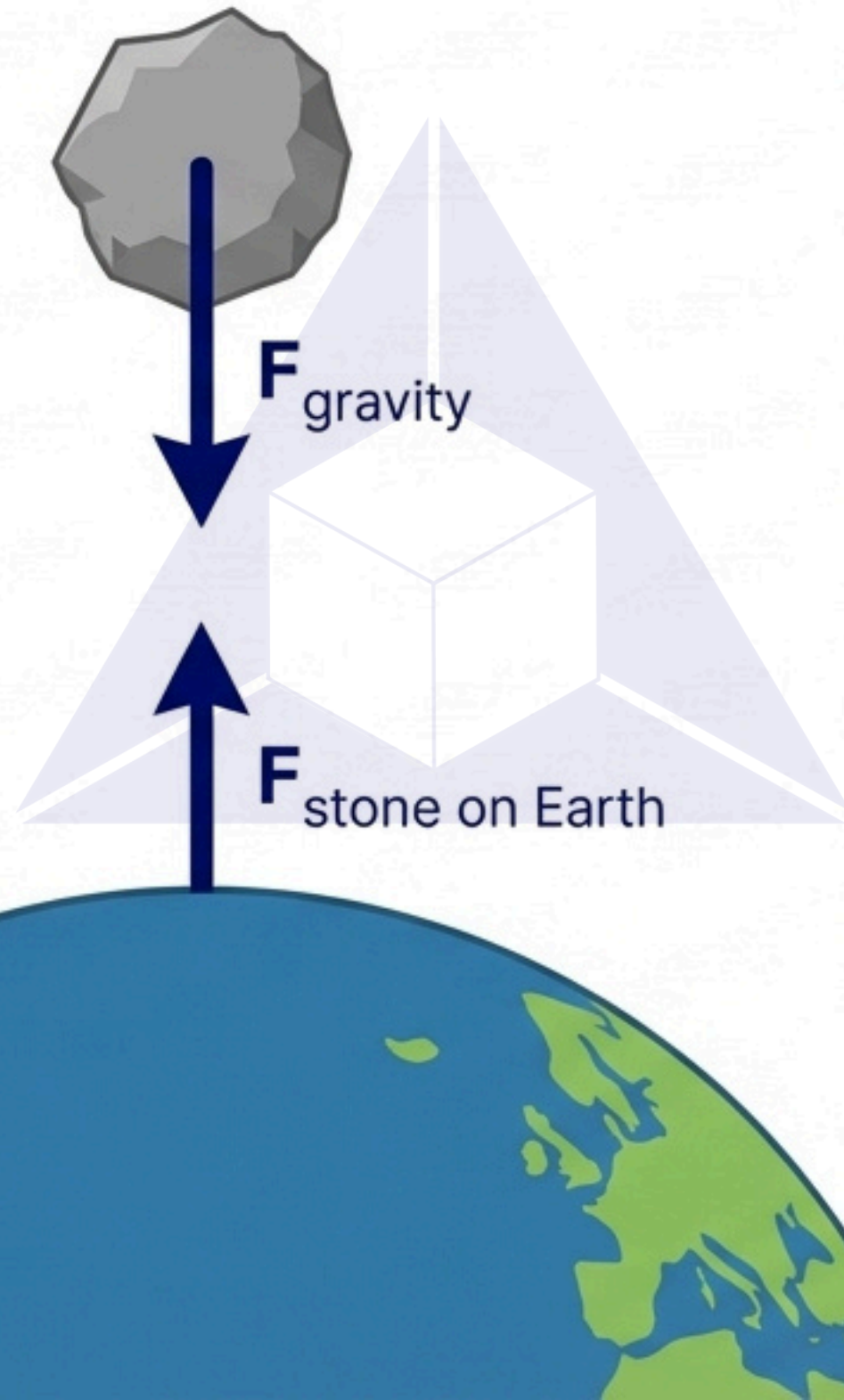


Action: Your hand applies a compressive force to the spring.

Reaction: The compressed spring pushes back against your hand.

Because the bodies are in direct contact, the mutual interaction is easily felt.

Non-Contact Forces Act the Same Way



CONCEPT CHECK

Does a falling stone exert a gravitational pull on the Earth? **Yes.**

The Earth pulls the stone down, and the stone pulls the Earth up with the **exact same force.**

Why don't we see the Earth move? Because of Newton's Second Law ($a = F/m$). The Earth's mass is so overwhelmingly large that the resulting acceleration is completely negligible.

Why Don't Action and Reaction Cancel Out?

If $F_{AB} = -F_{BA}$, shouldn't the net force always be zero?

THE MISTAKE

Adding F_{AB} and F_{BA} together on a single Free Body Diagram and claiming the net force is zero.

THE REALITY

- Action and reaction forces act on **different bodies**.
- When analyzing the motion of Body A, you only consider the forces acting ON Body A.
- Force ON A by B (F_{AB}) controls A's motion.
- Force ON B by A (F_{BA}) controls B's motion.

Key Takeaways

- Forces always occur in pairs—never singly.
- Action and Reaction mean simultaneous, mutual forces.
- $F_{AB} = -F_{BA}$ (Same magnitude, opposite direction).
- Action and reaction act on different bodies, so they never cancel each other out on a single body's free-body diagram.

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