

## Newton's 3<sup>rd</sup> Law

For every action.....

Newton's Third Law

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### Action and Reaction

- Newton's third law describes something else that happens when one object exerts a force on another object.
- According to **Newton's third law of motion**, forces always act in equal but opposite pairs. **1**

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### Action and Reaction

- Another way of saying this is for every action, there is an equal but opposite reaction.
- This means that when you push on a wall, the wall pushes back on you with a force equal in strength to the force you exerted.

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### Action and Reaction Forces Don't Cancel

- The forces exerted by two objects on each other are often called an action-reaction force pair.
- Either force can be considered the action force or the reaction force.
- Action and reaction force pairs don't cancel because they act on different objects.

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### Action and Reaction Forces Don't Cancel

- You constantly use action-reaction force pairs as you move about.
- When you jump, you push down on the ground.
- The ground then pushes up on you. It is this upward force that pushes you into the air.



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### Action and Reaction Forces Don't Cancel

- When a bird flies, its wings push in a downward and a backward direction.
- This pushes air downward and backward.
- By Newton's third law, the air pushes back on the bird in the opposite directions—upward and forward.
- This force keeps a bird in the air and propels it forward.

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**Large and Small Objects**

- When you walk forward, you push backward on the ground.
- Your shoe pushes Earth backward, and Earth pushes your shoe forward.



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**Large and Small Objects**

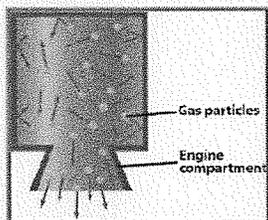
- Earth has so much mass compared to you that it does not move noticeably when you push it.
- If you step on something that has less mass than you do, like a skateboard, you can see it being pushed back.

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**A Rocket Launch**

- When the rocket fuel is ignited, a hot gas is produced.
- As the gas molecules collide with the inside engine walls, the walls exert a force that pushes them out of the bottom of the engine.



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**A Rocket Launch**

- This downward push is the action force.
- The reaction force is the upward push on the rocket engine by the gas molecules.
- This is the thrust that propels the rocket upward.

## Newton's Third Law

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**Weightlessness**

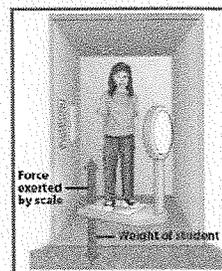
- You might have seen pictures of astronauts floating inside a space shuttle as it orbits Earth.
- The astronauts are said to be weightless.
- Yet the force of gravity on the shuttle is almost 90 percent as large as at Earth's surface.
- Newton's laws of motion can explain why the astronauts float as if there were no forces acting on them.

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**Measuring Weight**

- When you stand on a scale, your weight pushes down on the scale.
- This causes the scale pointer to point to your weight.



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**Measuring Weight**

- At the same time, by Newton's third law the scale pushes up on you with a force equal to your weight.
- This force balances the downward pull of gravity on you.

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**Free Fall and Weightlessness**

- Now suppose you were standing on a scale in an elevator that is falling.
- A falling object is in free fall when the only force acting on the force is gravity.
- You and the scale are both in free fall.

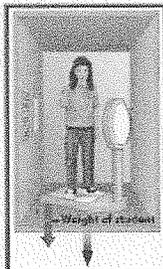


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**Free Fall and Weightlessness**

- Because the only force acting on you is gravity, the scale no longer is pushing up on you.
- According to Newton's third law, you no longer push down on the scale.



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**Free Fall and Weightlessness**

- So the scale pointer stays at zero and you seem to be weightless.
- Weightlessness is the condition that occurs in free fall when the weight of an object seems to be zero.

