Inertia

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CHAPTER 1 Inertia

- Define inertia.
- Describe how inertia affects motion.
- State the relationship between inertia and mass.
- Explain how to overcome inertia.

At Newton's Skate Park, Lauren is pushing her twin cousins, Jonathan and Cody, on her skateboard. She has to push hard to get the skateboard started, but once it begins moving, it takes much less effort to keep it rolling over the smooth, flat pavement. In fact, if Lauren tries to stop the rolling skateboard, it may take as much effort to stop it as it did to start it rolling in the first place.

Q: Why is it harder to start and stop the skateboard than it is to keep it rolling?

A: The reason is inertia.

What Is Inertia?

Inertia is the tendency of an object to resist a change in its motion. All objects have inertia, whether they are stationary or moving. Inertia explains Newton's first law of motion, which states that an object at rest will remain at rest and an object in motion will stay in motion unless it is acted on by an unbalanced force. That's why Newton's first law of motion is sometimes called the law of inertia.

Q: You probably don't realize it, but you experience inertia all the time, and you don't have to ride a skateboard. For example, think about what happens when you are riding in a car that stops suddenly. Your body moves forward on the seat and strains against the seat belt. Why does this happen?

A: The brakes stop the car but not your body, so your body keeps moving forward because of inertia.

FIGURE 1.1

Inertia explains why it's important to always wear a seat belt.

Inertia and Mass

The inertia of an object depends on its mass. Objects with greater mass also have greater inertia. It would be easier for Lauren to push just one of her cousins on her skateboard than both of them. With just one twin, there would be only about half as much mass on the skateboard, so there would be less inertia to overcome.

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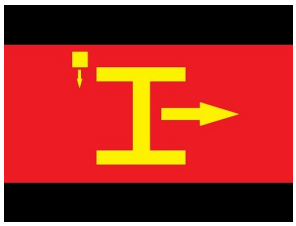

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Overcoming Inertia

To change the motion of an object, inertia must be overcome by an unbalanced force acting on the object. The unbalanced force that starts Lauren's cousins rolling along on the skateboard is applied by Lauren when she gives it a push. Once an object starts moving, inertia keeps it moving without any additional force being applied. In fact, it won't stop moving unless another unbalanced force opposes its motion. For example, Lauren can stop the rolling skateboard by moving to the other end and pushing in the opposite direction.

Q: What if Lauren didn't stop the skateboard in this way? If it remained on a smooth, flat surface, would it just keep rolling forever?

A: The inertia of the moving skateboard would keep it rolling forever if no other unbalanced force opposed its motion. However, another unbalanced force does act on the skateboard

Q: What other force is acting on the skateboard?

A: The other force is rolling friction between the skateboard's wheels and the ground. The force of friction opposes the motion of the rolling skateboard and would eventually bring it to a stop without any help from Lauren. Friction opposes the motion of all moving objects, so—like the skateboard—all moving objects eventually stop moving even if no other forces oppose their motion.

Later that day, Jonathan rode his skateboard and did some jumps. You can see him in the picture 1.2. When he's in the air, there is no rolling friction between his wheels and the ground, but another unbalanced force is acting on the skateboard and changing its motion.

Q: What force is acting on the skateboard when it is in the air above the ground? And how will this force change the skateboard's motion?

A: The force of gravity is acting on the skateboard. It will pull the skateboard back down to the ground. Once it's on the ground, friction will slow its motion.

FIGURE 1.2

Summary

- Inertia is the tendency of an object to resist a change in its motion. Because of inertia, a resting object will remain at rest, and a moving object will keep moving.
- Objects with greater mass have greater inertia.
- To change the motion of an object, inertia must be overcome by an unbalanced force acting on the object.

Review

1. What is inertia?
2. How does inertia affect the motion of an object?
3. What is the relationship between inertia and mass?

4. Jonathan and Cody's older brother Josh, who is pictured in the **Figure** 1.3, is standing at the top of a half-pipe at Newton's Skate Park. Gravity is exerting a downward force on the skateboard, as seen in the picture. Why doesn't it tip over the edge and start rolling down the side of the half-pipe?

FIGURE 1.3

References

1. State Farm. Wearing a seat belt is important because of inertia . CC BY 2.0
2. Rooney (Flickr: rooneyjohn). Skateboarder in midair . CC BY 2.0
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