



Velocity and Acceleration

Motion involves two important properties. They are **velocity** (vuh-LOS-uh-tee) and **acceleration** (ak-sel-uh-RAY-shuhn).

Velocity is the change in position over a set amount of time. It has both speed and direction. That means that velocity is not only how fast something is going, but also the direction in which it is moving. You have a certain velocity as you drive straight down the road in a car. If you go around a curve, your speed may stay the same. Your velocity does not though, because the direction has changed.

Acceleration is the change in velocity of an object. It is changing speed or direction. Acceleration is what you feel when the car starts moving from a stoplight. Negative acceleration, or **deceleration (dee-sel-uh-REY-shuhn)**, is what you feel when a car is slowing down.

For an object to move, force is needed. This involves a push or a pull. Force creates acceleration. The amount of acceleration depends on the mass of the object. **Mass** is the measure of how much matter the object is made of.

Objects in motion feel the effects from more than one force at a time. For example, a ball thrown into the air feels the force of the arm throwing it. Also, the ball feels the force of gravity when it is pulled back to Earth. The acceleration, velocity, and direction of the ball change because of the forces on it.

Can You Outrun the Laws of Physics?

Want to run faster? Use the laws of physics. Try this. Bend your arms and legs when running. That takes less force and energy. Lean forward and let the force of gravity pull you. Just remember to lean from your ankles and not your waist. To get the most out of leaning, place your foot down below or behind your center of gravity. Don't use your leg muscles to press down and back on the ground. It takes a lot of force to move your weight this way. Use your muscles to pick up your foot, and then let gravity do the work to lower it again.

Many forces act on a cheetah leaping into the air after prey. The back legs force it up into the air as its velocity pushes it forward. Gravity forces it back down. At the exact moment the cheetah peaks in the air, it is balanced between the two forces.



force of leap and velocity

balanced forces

force of gravity

Rotation

Another kind of motion in mechanics is **rotation**. Rotation happens when an object spins. A two-dimensional object rotates around a center point. If you spin a sheet of paper on a surface, the paper spins around a center of rotation. A three-dimensional object rotates around an **axis** (AK-sis). Imagine a spinning basketball. Picture a line going through the center of the ball. This axis is the center of rotation.



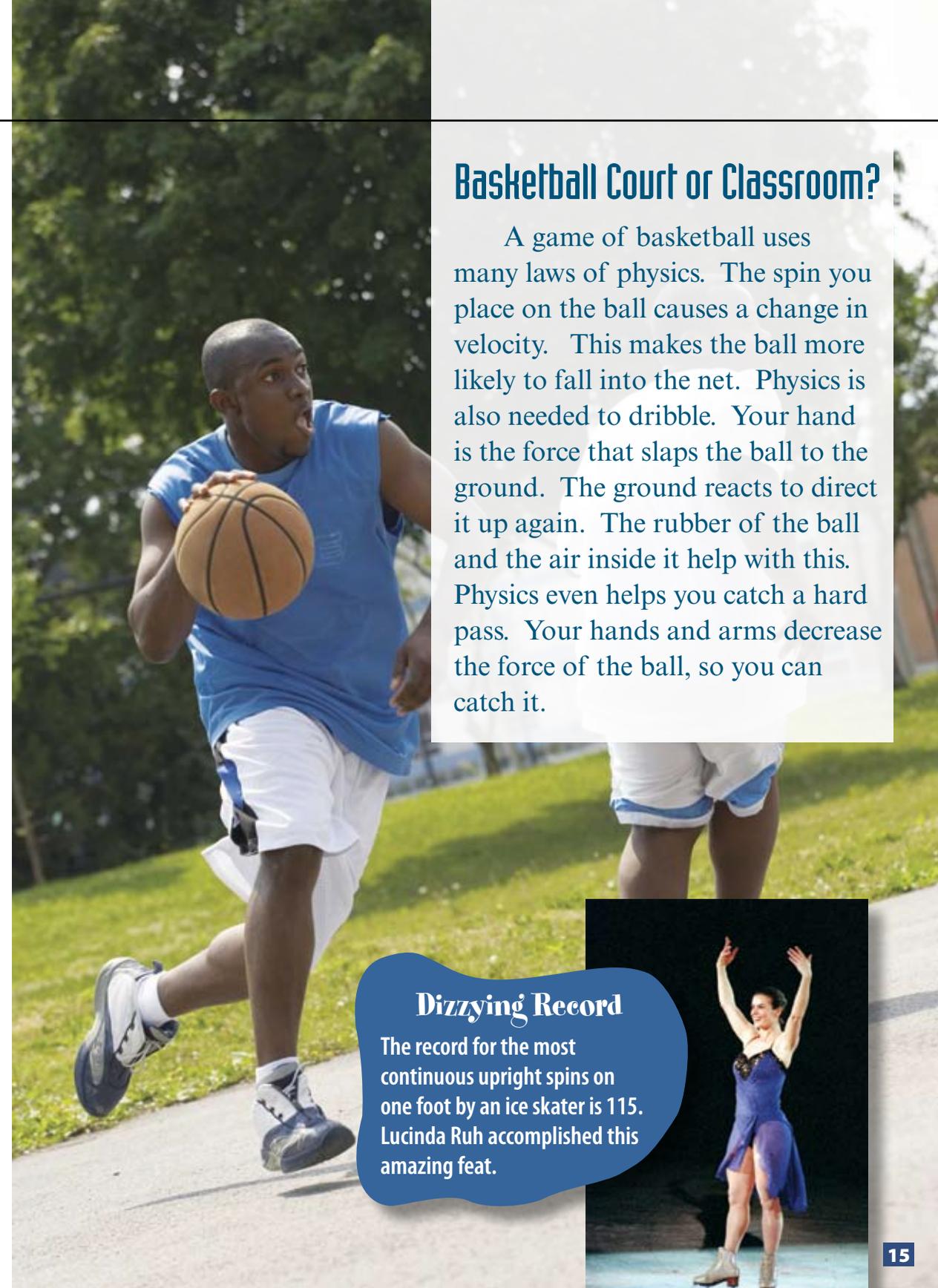
This Ferris wheel spins around an axis.



↑ The finger shows where the axis of rotation is.

Basketball Court or Classroom?

A game of basketball uses many laws of physics. The spin you place on the ball causes a change in velocity. This makes the ball more likely to fall into the net. Physics is also needed to dribble. Your hand is the force that slaps the ball to the ground. The ground reacts to direct it up again. The rubber of the ball and the air inside it help with this. Physics even helps you catch a hard pass. Your hands and arms decrease the force of the ball, so you can catch it.



Dizzying Record

The record for the most continuous upright spins on one foot by an ice skater is 115. Lucinda Ruh accomplished this amazing feat.

