

# Center of Mass

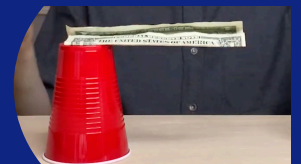
**Goal:** Students will understand the concept of center of mass and how it impacts balance. Students will understand that any object will balance as long as its center of mass is being supported from directly below or directly above.

**Standards:** NGSS 5-PS2 ; MS-PS2-2



## Objective:

The student will be able to demonstrate how center of mass impacts balance through a series of experiments and tricks.



## Procedure

**Hook:** Ask students to stand and balance on their toes on their right foot without moving their arms. Students will likely move their left arm and leg for balance and then come off their toes.

**Ask:** Why did your left hand and foot move? Students will likely explain that they needed to balance the weight in order to stay on their right toes.

**Explain** that the center of mass is any point where the mass of an object is concentrated, and when they stood on their right toes, they moved their center of mass and needed to counterbalance it to maintain equilibrium or balance.

## Materials:

- A broom or yard stick
- A dollar bill
- Two cups
- A quarter
- A pencil
- A paperclip or safety pin
- A washer



## Review vocabulary:

### Vocabulary:

Mass - The amount of matter, or substance, that makes up an object.

Center of Mass - any point where the mass of an object is concentrated. When an object is supported at its center of mass, it will remain in static equilibrium (balanced) in all directions.

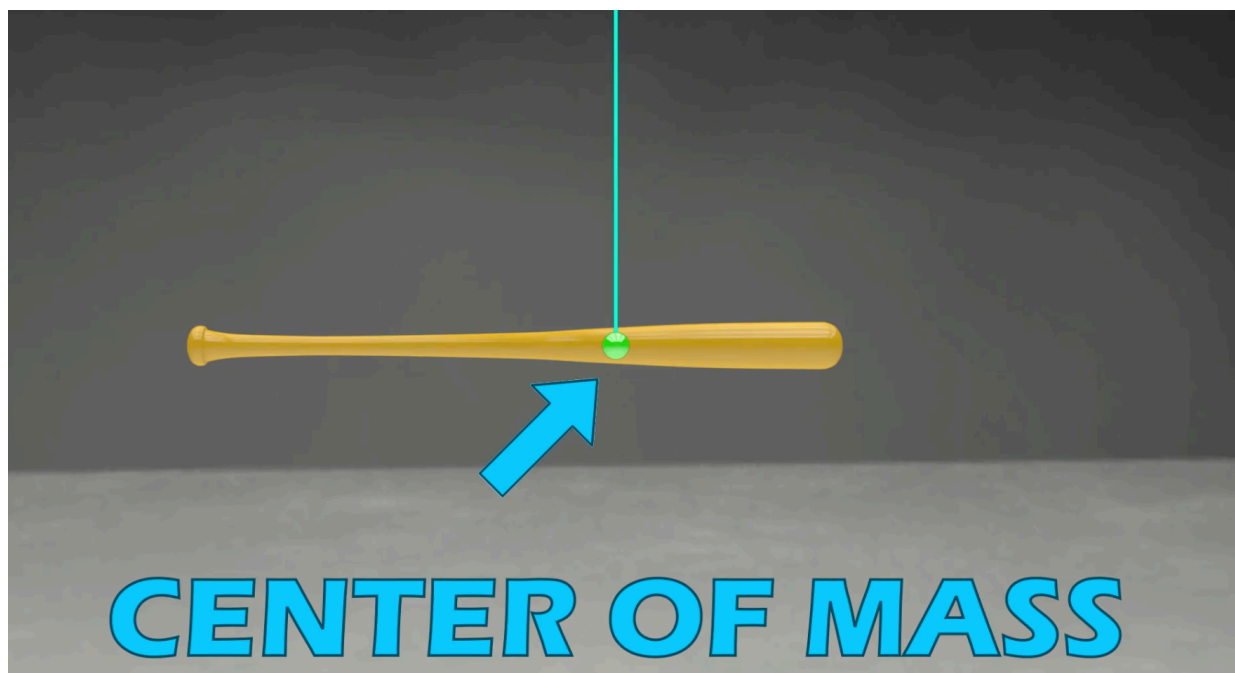
Gravity - the force that attracts a body toward the center of the earth, or toward any other physical body having mass. (Center of Mass and Center of Gravity can be used interchangeably unless in a zero gravity environment where Center of Mass is the correct term).

Equilibrium - a state of achieved balance.

Centroid - the center of mass of a geometric object with uniform density.

**Demonstrate** center of mass, and how it is not always the center of gravity, by holding a broom horizontally and asking students where you should hold it in order for it to balance. Have students discuss for one minute in break out rooms (on Zoom) and then survey their answers.

**Show** clip from Impossible Science with the broom.



**Show** students the clip of the dollar bill trick, pausing before the coin is revealed. Ask students to predict how the dollar bill might be balancing, and have them try it at home.

**Show** students the solution and have them practice it.

**Discuss** why how the coin affected the balance of the bill by moving the center of mass.

**Show** students the balancing pencil.

**Have** partners or mixed-ability groups predict how the pencil might be balancing using what they now know about center of mass.

**Have** students try to make the pencil balance on their own and share their process or idea.

**Show** students the remainder of the video with the paperclip and washer below as the solution.

### Assessment:

Students should create their own balancing trick demonstrating their understanding of center of mass and share with a written explanation of how and why it works.

### Modifications:

**Challenge:** Create your own video with three magic tricks balancing objects by moving the center of mass.

**Remediation:** Allow student to recreate the dollar bill trick with a family member to solidify understanding and write a short explanation of why it worked.