

Center of Mass Simulation

Website:

<http://physics.bu.edu/~duffy/sims.html> → Click on “Center of Mass” simulation under **Momentum and Energy** or use the direct link to the [center of mass simulation](#).

Instructions for Students:

1. In the sim, you will see **three circles (red, green, and blue)** at fixed positions on a grid.
 2. You can **change the mass of each circle** using the sliders at the bottom.
 3. The simulation will automatically show the **center of mass** as a purple dot.
 4. Your job is to **record the masses and positions (position should not change)**, then calculate the theoretical center of mass (space for scratch work on next page) and compare it to the simulation’s purple dot.
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Data Table (fill out for 4 different setups):

Trial	Mass Red (kg)	Pos Red (m)	Mass Blue (kg)	Pos Blue (m)	Mass Green (kg)	Pos Green (m)	Center of Mass (from Sim)	Center of Mass (Calculated)
1								
2								
3								
4								

Calculation Reminder:

Use the center of mass formula for both the x and y coordinate:

$$X_{com} = \frac{x_1m_1 + x_2m_2 + \dots + x_Nm_N}{m_1 + m_2 + \dots + m_N}$$

$$Y_{com} = \frac{y_1m_1 + y_2m_2 + \dots + y_Nm_N}{m_1 + m_2 + \dots + m_N}$$

Simulation Reflection Questions:

1. What happens to the center of mass when all three masses are equal?
2. What happens when one mass is heavier than the others?
3. Which mass has the greatest effect on the center of mass's position — the lightest or the heaviest?
4. Was your calculated center of mass close to what the simulation showed? Explain any differences.
5. Why is the center of mass important in real-world design (e.g., furniture, vehicles, sports)?

Scratch Work Area:

Extension Activity: DIY Fidget Spinner

Objective:

You will use the idea of **center of mass** to find the balance point of a set of coins. Then you'll cut out your design and build a **working fidget spinner** that spins around the center of mass!

Materials (per student or group):

- 3 coins (all different, like a penny, nickel, and quarter)
 - Digital scale (to measure mass of each coin)
 - Graph paper (standard 1 cm squares)
 - Ruler
 - Pencil and colored markers
 - Scissors
 - Push pin or paper fastener (or sharp pencil and eraser)
 - Tape
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Step-by-Step Instructions:

Part 1: Measure and Place Your Coins

1. **Find the mass of each coin.**

Use a digital scale. Write the mass in **grams** for each coin:

- o Coin A: _____ g
- o Coin B: _____ g
- o Coin C: _____ g
- o

2. **Place the coins on your graph paper.**

- o Create a grid on your graph paper of less than 10 boxes in any direction.
 - o Choose where you want to place your coins on the graph.
 - o **Trace around each coin** and label them A, B, and C.
 - o Use a **dot to mark the center of each coin** (approximately the middle of the circle).
 - o Write down the **coordinates** (x, y) for each center. These will be used to calculate the center of mass!
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Part 2: Calculate the Center of Mass

3. Use this formula to find the x- and y-position of the center of mass:

$$X_{com} = \frac{x_1m_1 + x_2m_2 + \dots + x_Nm_N}{m_1 + m_2 + \dots + m_N}$$

$$Y_{com} = \frac{y_1m_1 + y_2m_2 + \dots + y_Nm_N}{m_1 + m_2 + \dots + m_N}$$

- Plug in the **mass** and **(x, y)** of each coin. Write out your work above next to the formula.
 - Round your answers to 1 decimal place.
 - Plot your calculated **center of mass** on the graph paper using a **star or different colored dot**.
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Part 3: Build Your Spinner

4. **Cut out your coin design**
 - Tape your coins to your paper. Carefully cut around the outer shapes of your coins. Be sure to leave a little space between coins so the paper stays strong.
 5. **Poke a hole through the center of mass.**
 - Use a **push pin**, pencil tip, or paper fastener.
 - The hole should go directly through the point you calculated as the center of mass.
 6. **Spin test!**
 - Stick the push pin through the center and into the **eraser of a pencil** or lightly between your fingers.
 - Give it a spin!
 - If it wobbles or tips to one side, check: Did you place a heavier coin farther away from the center? Does your math seem right?
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Post-lab Questions:

1. What did you notice about how coin weight and position affected the balance?
2. Did your spinner balance and spin well? Why or why not? If not, what might be affecting it and how can you fix it?

This worksheet was created by Rebecca Eaton from Highlands High School at AAPT SM25 on August 3rd, 2025.