

Lab CMb: CENTER OF MASS

BALANCED OBJECTS

teacher notes:

assumed prior knowledge of students:

- definition of center of mass
- meaning of base of support, or point of support
- use of a plumb bob
- meaning of equilibrium and stability

materials and set up

- Teacher gathers various interesting objects that illustrate center of mass and how it correlates with base of support.
- Teacher sets up stations around the room through which the students will rotate.
- Teacher provides written instructions for each station.
- Teacher is available to offer guiding questions as students go through the stations.
- Teacher provides a "tally sheet" after activity to help students organize their findings and get a better view of the "big picture".

purpose of this activity:

- Students see and manipulate objects illustrating center of mass and equilibrium.
- Students use their knowledge to determine the location of the center of mass of each object.
- Students write explanations of the behavior of each object.
- Students construct labeled sketches to illustrate their written explanations.

extension activity:

Each student is required to present his/her 2-3 minute explanation of one object before the class. Students are given some time to prepare for this presentation. This not only requires each student to do a presentation, but also helps the other students review and evaluate their own understanding and explanations.

Lab CMb: CENTER OF MASS Exploration

BALANCED OBJECTS

General Instructions: Visit each of the stations with a partner. Experiment with each setup and discuss what you observe and understand with your partner. Explain (in full written sentences) how the object behaves as it does. Be sure to convey your understanding of center of mass, support base or point, and equilibrium. Also, be sure to leave each station in good shape for the next person.

Station 1. Toppling Block

See page 140 of the handout. Place the block on the platform. Gradually increase the angle of incline for the platform and block. At what angle does the block topple? Why does the block topple at this and any larger angle? (Answer in terms of center of mass and support base and include a sketch or two.)

Station 2. Stacking Blocks

How can the three identical blocks be stacked so that the top brick has maximum overhang over the bottom brick, with all bricks oriented horizontally? Include a well labeled sketch of your design. (Hint: Start with the top brick and think your way down.) (see number 6 page 149 of the handout)

Station 3. The Weird Hat

Place the object on your head. Then try balancing it with the sharp bent part on your finger. Where is the CM of this strange thing? How do you know? Is it at the point of support? Below the point of support? Above the point of support? Try another support point or two. Draw a sketch of the object and the location of its CM. What happens if you vary the masses on the ends? Try it and see but leave the object as you found it. You should also vary the point of support to narrow down the location of the CM. (see page 143 of the handout)

Station 4. Odd Flat Shape (Map of North Carolina or flat metal shape)

Find the center of mass. How can you locate the CM with the provided T-pin and plumb line? Be sure the object is “free to swing” when using the plumb line. Don't make any permanent marks on the object--leave it as you found it. Describe your method of locating the CM. Where is the CM? How can you check if you are correct? Sketch the objects and show the location of the CM of each. (see page 139 of the handout)

Station 5. Topsy Pop can

By adding 'just the right amount' of water to an empty soda can, you will be able to make it stand tilted on the table, at a considerable angle.

Find the smallest and largest amount (ml) of water that lets the can balance. _____ & _____

You need three sketches of the can. 1) Sketch the balanced can. Your sketch must indicate the location of the CM. 2) Sketch the can and its CM location with too much water and indicate which way too **MUCH** water will make the can topple. Include the CM location. 3) Sketch the can and its CM location with too little water and indicate which way too **LITTLE** water will make the can topple. Include the CM location.

Station 6. Hangin' Hammer

Explain why this set up of the ruler and hammer doesn't fall (see page 148 of handout). A careful sketch should be included--indicate CM location (of the balanced ruler hammer combination) too. You can carefully adjust the ruler position to see just what the "limit" is. Beware of falling hammers! Be sure to leave the objects balanced for the next person.

Station 7. On a Pedestal

Explain how the creatures and such can be balanced that way. A sketch should be included for three of the objects—carefully indicate the CM location of each on the sketch.

Balanced Objects Tally Table

Station	Object(s) name / describe	CM lies along a vertical line through support point or base? Choose - yes or no	CM lies ????? base or point of support? Choices are - above or below	small sketch indicating vertical line through support and CM location
1				
2				
3				
4				
5				
6				
7				

