Investigating the Center of Gravity Classroom Kit

94-1390

TEACHER ACTIVITY GUIDE

Objectives

- Estimate the center of mass of a two-dimensional shape.
- Describe how to experimentally find the center of mass of a thin irregular object.

Resources

- Investigating the Center of Gravity Classroom Kit (enough for 6 student groups of 4 students)
  - Additional Student Sets and Teacher Sets may be purchased separately
- Student Worksheet
- Ring Stand for each group
- Clamp or Clamp Holder for each group or student.

Prior Knowledge

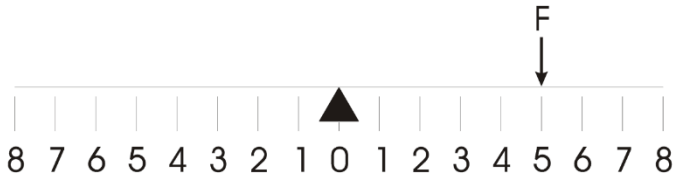
Students should understand weight and mass and the relationship between these two concepts.

Outline

- Direct students to identify the distance of force from the fulcrum in the first question.
- Run through the solutions and explain the results (where necessary). Reinforce the relationship between mass and weight, namely that weight is a force defined by the acceleration of gravity acting on a mass.
- Explain the meaning of “center of gravity.”
- Have students estimate the center of gravity of the shapes on their worksheet.
- Check the solutions and explain why uniform density is important.
- Introduce irregular objects and hand out the acrylic shapes from the student kits.
- Have students estimate and mark the center of gravity on their shape with a dry-erase marker.
- Explain that determining the center of gravity of an irregular object is difficult to do by inspection, but is remarkably easy through experiment. Explain the process and direct students to perform the experiment.
- Show Shape E with the XL pendulum and have students estimate the center of gravity on the outline in Summary Question #2. Determine the center of gravity to be in a place without mass.

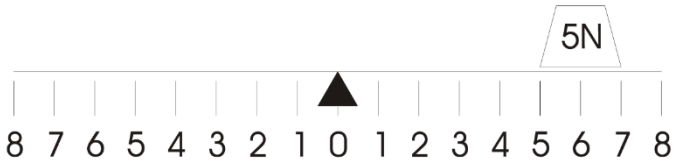
Teacher Notes

1. For each of the diagrams below, identify the distance between the force and the pivot. Assume uniform density.

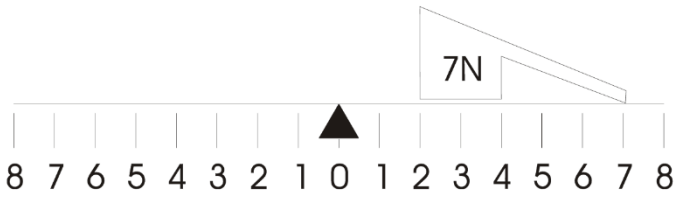


Distance from pivot:

1. 5

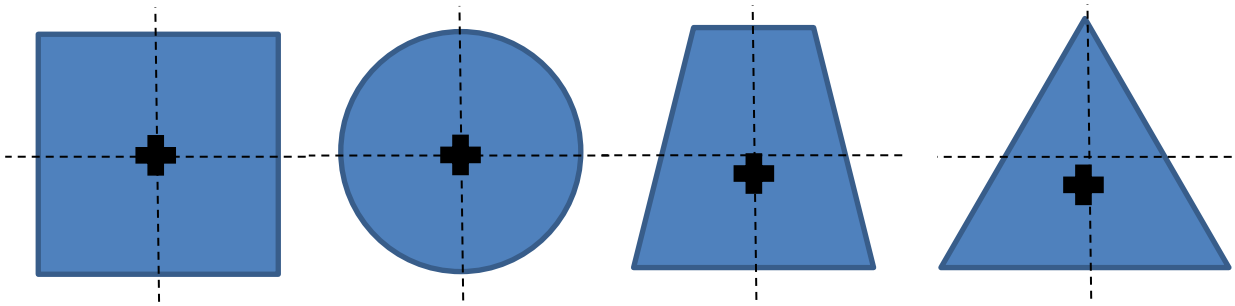


2. 6



3. Somewhere to the right of 3 but less than 4

2. Mark with a cross where you think the center of gravity lies on the following shapes.



For objects with a regular mass distribution such as a square or circle the center of gravity is at the center of the shape. For shapes without regular mass distribution, the center of gravity is more difficult to determine by inspection. Since the shapes are symmetrical around the vertical axis, the center of gravity will lie on this line, but not on the horizontal axis—the center of gravity will be shifted down for the rhombus and triangle.

3. Explain why you could not estimate the center of gravity if the objects did NOT have uniform density.

Without uniform density, it is impossible to determine the center of gravity geometrically since there is no visual indication the mass of an object is distributed evenly around a certain point.

4. On the acrylic shapes in front of you, mark where you think the center of gravity is.

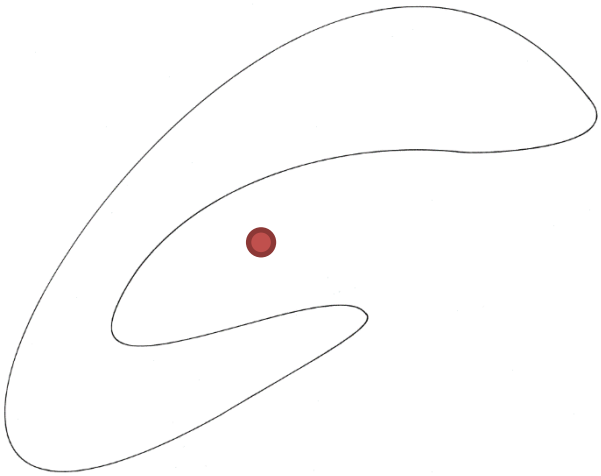
5. Determine the center of gravity experimentally as described by the teacher.

Summary Questions:

1. Define the “Center of Gravity” of an object.

   The center of gravity is the point at which the entire *mass* of a body may be considered concentrated.

2. Estimate the center of gravity of the shape below and indicate the position with a dot.



Show the students “Shape E” and have them answer this question. Then, demonstrate in the same experimental manner where the center of gravity must be for this shape.

3. Explain the experimental process to determine the center of gravity for an irregular shape.

   1. Suspend the shape at one point.
   2. Use a pendulum/plumb bob to determine a vertical axis.
   3. Indicate on the shape where the vertical axis is—the center of gravity must be on this line.
   4. Hang the shape from another point.
   5. Use a pendulum/plumb bob again to determine another vertical axis.
   6. Again, indicate on the shape where the new vertical axis is.
   7. The center of gravity is at the intersection of the two lines.

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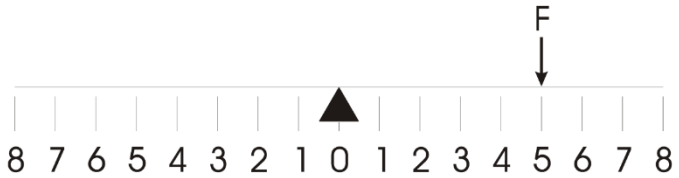
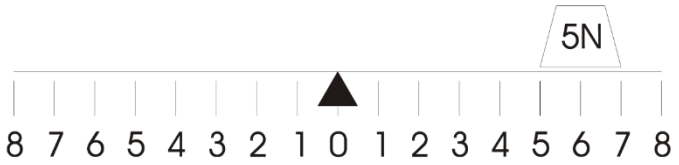
Student Activity

1. For each of the diagrams below, identify the distance between the force and the pivot. Assume uniform density.

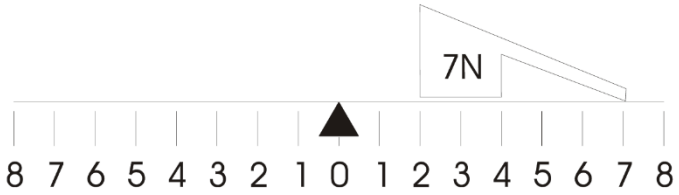


Distance from pivot:

4. _____

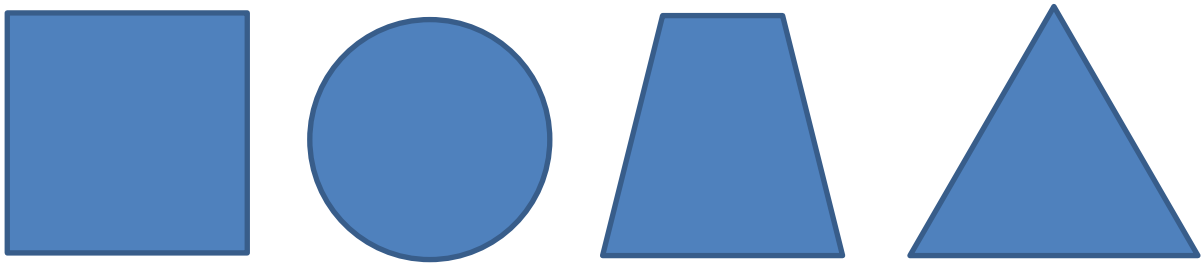


5. _____



6. _____

2. Mark with a cross where you think the center of gravity lies on the following shapes.



3. Explain why you could not estimate the center of gravity if the objects did NOT have uniform density.

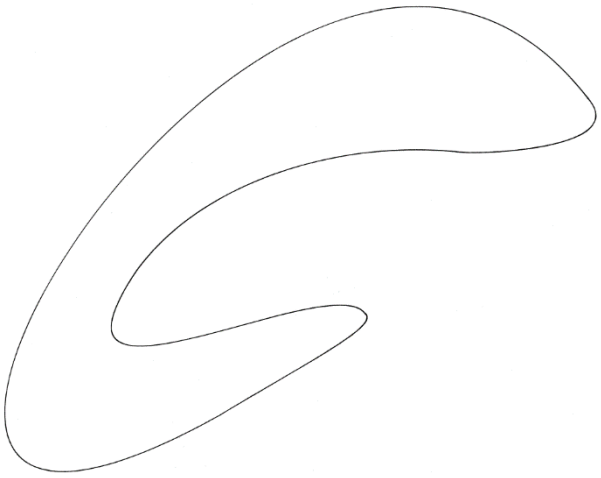
4. On the acrylic shapes in front of you, mark where you think the center of gravity is.

5. Determine the center of gravity experimentally as described by the teacher.

Summary Questions:

1. Define the “Center of Gravity” of an object.

2. Estimate the center of gravity of the shape below and indicate the position with a dot.



3. Explain the experimental process to determine the center of gravity for an irregular shape.