(ENG) Finding Mass Center II

Introduction

#In-class activity #Inquiry-based learning #Experimental learning #Artwork

In physics you can simplify many problems, if you assume all of the mass of an object is at one place. Provided that you choose the correct position, the equations of motion work in the same way as the true, but more complicated, situation with the mass spread out. This special location is called the centre of mass.

If you support an object from underneath with a single point of contact, it will balance if the support is directly under the centre of mass.

Centres of mass typically lie on lines (or planes) of symmetry of objects. Highly symmetric objects like cubes and spheres have their centres of mass at the centre of the object.

This activity is using simple symmetrical constructions to help pupils experiment with the concept of centre of mass.

Learning Objectives

- [ ] Practice estimation and create hypotheses about the location of objects' centers of gravity
- [ ] Observationally determine the center of gravity by balancing objects
- [ ] Combine strategies to determine the center of gravity
- [ ] Calculate the center of gravity for complex shape

ACTIVITY DETAILS

Activity Details

Connection of the activity with Art

Drawing

Link to local, national School Curriculum

E.g. Physics 6th grade

Equipment required

- A variety of simple-shaped objects such as squares, triangles, rectangles, and circles
- Three colors of markers or pens (per student pair or group)
- Paper clips (other objects such as coins, erasers, etc. can be used)
- Rulers (one per student pair or group)
- Tape
- Blank cardstock (one piece per student pair or group)
- Scissors (one per student pair or group)
- String (two pieces, approximately 24 inches in length, per student pair or group)
- Weight to attach to string so it will hang straight down (roll of tape, etc. can be used)

Duration of activity

45 minutes

Sources

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Step 1 - Motivational Stage

Make a small introduction to your pupils, regarding Center of gravity. Ask them to throw a ball in the air and think of what causes its trajectory.

"Does every object move like this when gravity acts on it?"

Most objects do not have nice, neat shapes like balls. This means gravity acts on them in more complex ways. Even so, all objects behave as though their mass (the stuff they're made from) is concentrated at a point called thei**r center of gravity.**

A simple object like a ball has its center of gravity in a very obvious place: right at its center. But in a more complex object, like your body, the center of gravity is slightly higher than your waist because there's more weight in the top half of your body than in the bottom half.

Step 2 - Investigational Stage

STUDENTS' TASKS

1

Task 1 - Preparation

Give each pupil or group several simple-shaped objects (squares, triangles, rectangles, circles, ovals).

Each pupil or group also needs an additional piece of cardstock with which they can create their own irregular shape to use. pupils can search the internet or bring their own shapes (e.g. from some game they

like). Alternatively, pupils can also draw their favorite shapes based on their imagination.

2

Task 2 - Hypothesis

Ask your pupils to hypothesize where the center of gravity might be for each of the objects without manipulating it or using measurement devices such as rulers. Have them mark the hypothesized location with one color marker or pen. Then, have them write the reason they believe it is at the location they chose.

3

Task 3 - Trial and Error Balance Method

Have pupils adjust the location of a shape atop a finger (or small, fixed object) until it remains balanced on its own. This location should be marked with a second color marker or pen.

Have pupils change the center of gravity for an object by attaching paper clips to it in random locations. Use the balance method to determine the new center of gravity and mark this location with a third color marker or pen. Repeat with as many differently shaped objects as time allows.

Gravitational Balance Method

For this activity, pupils will use the irregularly shaped object they created and follow the steps presented.

Step 1

Unfold a paperclip forming a U shape.

Step 2

Attach weight to one end of a piece of string.

Step 3

Attach the other end of the string to the bottom of the U paperclip.

Step 4

About 2.5 centimeters from the edge of the irregularly shaped object, use the hole punch to make a hole.

Step 5

Put one end of the paperclip through the hole so the object hangs freely next to the string.

Step 6

Mark the point where the fold line on the object meets the hanging string.

Step 7

Remove the object and use the trial and error balance method test to confirm that this is the center of gravity.

Step 3 - Consolidation Stage

Evaluate pupils based on the notes they will take. You can pose the following questions:

"You hypothesized the location of the centers of gravity for the simple-shaped objects before determining them using the

gravitational balance method. Did the locations differ from your hypothesized locations? Did your experiment confirm your hypothesis? Explain."

"When you attached weight to the shapes, how did it affect the centers of gravity? How did you know whether it had moved?"

"How did you find the center of gravity for the real-world object(s) provided?"

End of the activity

EXIT