Density: Brown Sugar Lab

Lesson Concept Density is a physical property of matter that depends on the mass and volume of a substance. Density is how closely the molecules of a substance are packed in a given space.

Link Students have previously been introduced to mass and volume as two physical properties of matter. Density is another physical property of matter.

Time 75 minutes

Materials

Whole class

Masking tape

Per Group (groups of 4)

1 tray

2 plastic cups, one labeled *A* and one labeled *B*

240 ml (1 cup) brown sugar

1 spoon

1 fork

1 triple-beam balance

Individual

Brown Sugar Lab Worksheet

Pencil

Advance Preparation

1. Use masking tape to make two squares on the floor: a 50x50 cm square and a 1x1 m square.
2. Photocopy: Brown Sugar Lab Worksheet
3. Gather group materials and place on trays.

Procedure:

Engage ***(10 minutes) Volume is the amount of space taken up by matter. Mass is how much matter is in an object. Density is how closely the molecules of a substance are packed in a given space.***

1. Review the terms mass and volume from the previous lesson.
2. Ask for four volunteers to pretend to be matter. Have those students come up to the part of the room where you have taped off the two squares.

3. Tell the four volunteers to pretend they are particles of matter and stand in the larger square. Teacher note: the square is 2-dimensional. Have the students imagine the square is actually a 3-dimensional cube.
4. Explain to the class that the number of volunteers represents the mass of the matter in the "cube."
5. Ask the class to review the definition of mass.
6. Explain to the class that the "cube" represents the volume.
7. Ask the class to review the definition of the volume.
8. Tell the volunteers to move to the smaller "cube" and ask them what they notice.
9. Ask the class to explain why the volunteers now feel crowded. They will most likely respond that they now have less space. Prompt them to use the vocabulary words (they have the same mass with less volume).
10. Ask students how the volunteers could have more space to move around. Students will most likely respond that they can take out a volunteer or two, or they can move back to the larger "cube." Prompt students to use the vocabulary words to describe this relationship (decrease the mass or increase the volume).
11. Introduce the term *density* and explain that it is another physical property that defines how closely the particles of matter are packed in a given space.

Explore/ Explain (45 minutes) Density is how closely the molecules of a substance are packed in a given space.

12. Tell the students they will now work with brown sugar to learn more about density and how it relates to mass and volume.
13. Distribute group materials and lab sheets (See Brown Sugar Lab Sheet).
14. Ask students to measure 40 grams of loosely packed brown sugar into the clear plastic cup marked *A.* Do the same for cup *B.*
15. Have students lightly pat the sugar in each cup to level it off equally.
16. Write the following on the board: Step 1

Mass in Cup A O Mass in Cup B

Volume in Cup A O Volume in Cup B

Density in Cup A O Density in Cup B

17. Have students identify which cup has greater mass (equal) and greater volume (equal).
18. Write an equal sign in the circle for the first two equations.
19. Ask students to review what *density* means.

20. Have students identify which cup has greater density. Prompt the students by reminding them that the mass and volume is equal in both cups.
21. Have students discuss their ideas in their groups and share out. Require the students to justify their responses.
22. Confirm that the density in both cups is equal.
23. Ask student to pack down the brown sugar in cup *A,* and fluff up the sugar in cup *B*
24. Write on the board: Step 2

Mass in Cup A O Mass in Cup B

Volume in Cup A O Volume in Cup B

Density in Cup A O Density in Cup B

25. Have students identify which cup has greater mass (still equal because there was no brown sugar added or taken away) and greater volume (*B* because it takes up more space).
26. Ask students to discuss which cup has greater density and share out. Require the students to justify their responses. A correct response might be, "Cup A has greater density because the brown sugar is packed more tightly than the brown sugar in Cup B."
27. Complete the equations on the board with appropriate symbols.

Extend ***(15 minutes) Density is how closely the molecules of a substance are packed in a given space. Density is a physical property that depends on the mass and volume of a substance.***

28. Ask students to keep adding more packed brown sugar to cup *A,* until the level is the same as cup *B.*
29. Write on the board: Step 3

Mass in Cup A O Mass in Cup B

Volume in Cup A O Volume in Cup B

Density in Cup A O Density in Cup B

30. Have students identify which cup has more mass (Cup *A* because brown sugar was added to that cup, but not to Cup B). Have students identify which cup has more volume (the volume is equal because the cups take up the same amount of space). Have students identify which cup has the greater density (Cup A because more brown sugar was packed down into a smaller volume).
31. Complete the equations on the board with appropriate symbols.

32. Encourage students to pick up the cups of brown sugar and describe what they notice about the sugar in each cup. The students will be able to actually see that the granules of brown sugar are packed much more tightly in Cup A than in Cup B.
33. Allow students to discuss any relationship they may have noticed between mass, volume, and density.
34. Prompt students to generalize that when greater mass is packed into a smaller volume, it is denser than when the substance is packed into a larger volume.

Evaluate (15 minutes) and the concept for this section

35. Erase the equations written on the board.
36. Distribute the Density Vocabulary and Concept Worksheet.
37. Have students complete these individually.