

Density: Layering Liquids

Lesson Concept	Substances that are less dense will float on top of substances with a greater density.
Link	Students are aware that the relationship between mass and volume is density.
Time	2 hours

Materials

Whole class

Colored Liquids

400 ml glycerin and 10 drops blue food coloring, mixed

400 ml isopropyl alcohol and 10 drops red food coloring, mixed

400 ml water and 10 drops yellow food coloring, mixed

400 ml water, 120 g (1/2 cup) table salt, 10 drops green food coloring, mixed

50 ml water, 1 drop red food coloring, and 1 drop blue food coloring, mixed

1 picture of a sedimentary rock w/ clear layers or real sedimentary rocks to pass around

1 copy Layering Liquids Quick Check

Per Group (8 groups of 4 students)

1 tray

1 test tube rack

9 test tubes

4 pipettes

50 ml each of the colored liquids (see above) red liquid, blue liquid, yellow liquid, and green liquid in small plastic cups

Individual

1 copy Layering Liquids data sheet

1 pair safety goggles

Advance

Preparation 1. Copy Layering Liquids data sheet

2. Make the 4 colored liquids
3. Set up group materials.
4. Practice making the liquid layers before you demonstrate to the class.

Procedure:

Engage (5 minutes) *A layer is a thickness of a substance that sits on a surface. Multiple layers can sit on top of one another.*

1. Show students a picture of a sedimentary rock (or pass around real sedimentary rock).
2. Ask students to brainstorm what they notice about the picture or rock.
3. Write all responses on the board and prompt students to eventually come up with the word “layers.”
4. Now that students have made accurate observations of the physical properties of the rock, have students focus on the layers of the rock
5. Circle the word “layers.”
6. Ask, “What does “layers” mean?”
7. Develop the definition using student responses and write the definition on the board.
8. Tell students that this concept is important for their next lab.

Explore (60 minutes) *Different liquids can layer on top of one another.*

9. Show students the bottles of red, blue, yellow, and green liquids and ask the students to describe them.
10. Tell the students that today they will each work in groups to attempt to layer these four unknown colored liquids in the same test tube so that none of the colored liquids mix.
11. Caution the students not to taste any of these unknown liquids.
12. Demonstrate the technique of using a pipette to drop the liquid into the test tube.
 - a. Squeeze the bulb to expel the air, and continue squeezing as you insert the tip into the liquid.
 - b. Release the bulb so the liquid is drawn up into the pipette.
 - c. Hold the test tube at a 45 degree angle so the liquid can run down the inside of the test tube and fall gently to the bottom.
 - d. Carefully squeeze the liquid out into the test tube one drop at a time.
13. On the board, show how to record predictions on the data sheet.

- a. Mention that, before each test, groups must predict the order in which the liquids might layer.
 - b. The students should write the first letter of each color on the lines to the right of each straw pictured.
 - c. Start with the first liquid on the bottom, the second liquid above it, and so on.
 - d. Demonstrate this and write G, P, R, B (For your demonstration, you will replace the yellow water with purple water so as not to give anything away.)
14. Gently add some green liquid, drop by drop, down the side of the test tube until about 1 cm (one finger width) of liquid accumulates.
 15. Add some purple liquid to the test tube, also about 1 cm of liquid.
 16. Hold a piece of white paper behind the test tube to show students what successful layering looks like.
 17. Tell students that they can use their data sheets to make a white background.
 18. Caution students not to mix liquids in the different cups and to keep the pipette in the same cups so as not to contaminate the solutions.
 19. Check for understanding. Before students begin, make sure they understand their challenge: to layer all four liquids in the test tube so none mix together.
 20. Demonstrate how, after each test, groups should circle their prediction if it layered successfully. If it does not layer, they should leave it blank.
 21. Tell students to use the information from the previous test to make a new prediction with their group. Then, groups complete another test.
 22. Divide the class into groups of four students.
 23. Distribute one equipment tray to each team, and have the students begin.
 24. Circulate around the room to encourage and assist as needed. Remind students to record their prediction before they begin a test.
 25. Have teams clean up their materials when most groups have successfully layered the four liquids.

Explain **(20 minutes) Substances that are less dense will float on top of substances with greater density.**

26. Ask students to report how they ordered the layers. Have students record their step in their science notebooks.
27. Ask the students to make claims about the liquids and use evidence to support their claims. Have students write their claims and evidence in their science notebooks
28. Write each claim that has valid supporting evidence on the board.

29. Reveal the identity of each liquid and write it next alongside one of the claims on the board. Most groups will have found that the liquids will layer, from bottom to top, blue, green, yellow, red.
30. Ask the students why they think the liquids layered the way they did. Some students may mention that some liquids were heavier or thicker. Others might mention differences in density. If they do use this word, ask them what they mean by it. Encourage alternative explanations and discussion.
31. Encourage students to conclude that liquids that are less dense float on top of denser liquids.
32. If teams have different results, ask the students why they think different teams came up with different ways to layer the liquid.

Extend **(15 minutes) Substances that are less dense will float on top of substances with greater density, but that doesn't mean they can never mix.**

33. Ask the students to predict what might happen to the layers in the test tube if it is turned upside down.
34. Allow students to make predictions, and write them on the board. Use the sentence frame: If the test tube is turned upside down, then _____ because _____.
35. Add the liquids to a straw in the order that most students determined would result in layering (blue, green, yellow, red).
36. Hold your finger over the open end, invert the test tube for the class to see what happens. Some liquids will mix easily and some will stay separate. Even with time the original layers will not settle out again.
37. Ask you students if they can think of any liquids that separate after they have been mixed together. Oil and vinegar; and water and oil will separate after they have been mixed together.

Evaluate **(10 minutes) Substances that are less dense will float on top of substances with greater density.**

38. Display the Layering Liquids Quick Check on the document camera. Distribute one 3x5 index card to each student to use as an exit slip. Have students draw a triangle on their exit slip and write 3 things they have learned today.