

Sink or Float: Dropping Objects into Liquid Layers

2nd Grade

Testable Question:

Which one out of 5 objects (marble, stone, Play-Doh, dice, LEGO ball) will sink fastest? Where will they stop in the 3 liquid layers (oil, water, syrup)?

Prediction:

Heavier objects (e.g. stone) may sink faster and hit the bottom. Lighter objects (e.g. LEGO ball) may sink slower and not hit the bottom.

Procedure:

1. Prepare clean, transparent glass cups to mix liquids in.
2. Use a marker to draw lines outside the glass cup where you want each liquid (syrup, water, oil) to fill up to. This way each liquid layer we pour will have the same thickness (about $\frac{1}{4}$ of the cup). **Tips:** You will need to put a ruler into the glass cup & mark on the glass (using an EXPO marker or something similar) where each layer will have the equal thickness.
3. Pour a small amount of 3 liquids into 3 separate measuring cups. **Tips:** Gently pour water, oil, and syrup (changed from honey) into the corresponding measuring cup.
4. Sequentially pour the liquid in the measuring cups into the glass cup (order: syrup -> water -> oil). **Tips:** Pour a little liquid at a time (make sure not to spill, overfill, dirty the cup). If you pour oil second & water third, oil will float up to the top of water and that step will create a layer of bubbles between the “oil” and “water” layers.
5. Taking videos (changed from using a timer) of the procedure of dropping each one out of 5 objects (changed from 3) into the liquids. **Tips:** Hold the object right at the surface of the oil layer (the top layer). Start the video before counting down from 3 to 1 (otherwise the video is too short to measure the time accurately). Drop the object when you counted to 1. Gently take the object out of the glass cup with a spoon or chopsticks (make sure not to mix up the liquid layers).
6. Replay the videos to measure the time each object takes to sink to the bottom or stop at one position in the 3 liquid layers. **Tips:** analyze the observations and take snapshots in the videos.
7. We also compared the sinking time of marbles in **a full cup** of water, syrup, or oil by taking another 3 videos. **Tips:** Objects would sink very fast if you only use **half a cup** of liquids. It is also hard to measure the minor difference if we changed the ratio of liquid layers.

Background:

I chose this project because I like the pretty looks when we mix 3 liquid layers in one glass cup (done this before in Dad's house). I also like playing the 5 objects I chose after school time. I really wanted know which one of these objects are the heaviest.

In my research I found out that all 5 objects sank really fast in the liquid layers. The marble & stone sank to the bottom; the Play-Doh and the dice both stopped between the water and syrup layers (the dice stopped a little higher in the water); the LEGO ball had part of it being immersed in the oil layer (the other part left in air). When we changed to a full cup of liquids, the marble sank the fastest in oil, second fastest in water (very similar to oil though), slowest in syrup.

This project is important because the results of the experiments may indicate which object on my list has the most mass. We can also find out which liquid will slow down the objects.

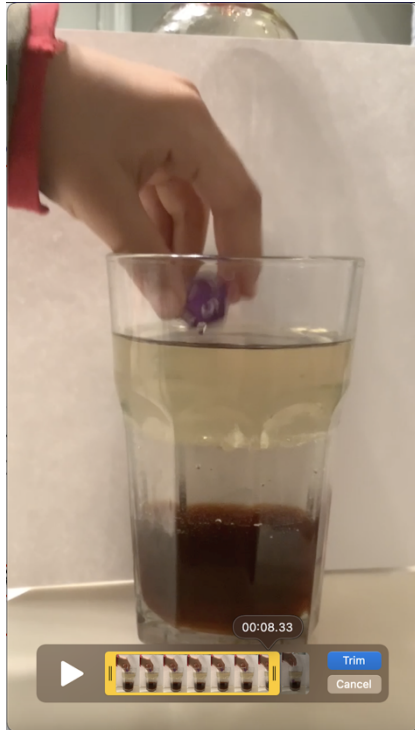
Constant Conditions:

Independent Variable: 1) the type of liquid in each glass cup; 2) the object you choose to drop in the glass cup

Dependent Variable: 1) **the time** each object takes to either sink to the bottom or stop at a position within 3 liquid layers; 2) **the position** of each object stopped in the cup (to the bottom of the cup if the object is heavy)

Constant Conditions: 1) use the same glass cup with 3 liquid layers when I sequentially dropped 5 different objects; 2) pour the same amount of liquids in 3 different cups when I compare the sinking time of marbles in them; 3) for experiment in step 1), make sure the starting position of the object is at the surface of the top liquid layer (oil); for experiments in step 2), make sure the starting position of the object is at the liquid surface in each cup.

Data and Trials:



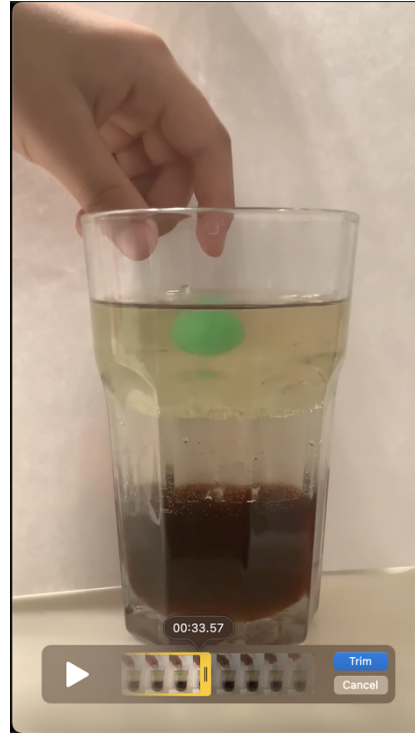
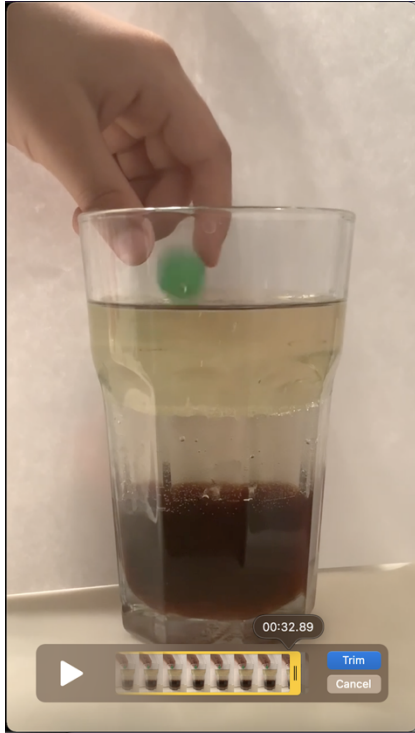
Video snapshots of dropping the die:

(Left) Started at 8.33 s

(Right) Stopped at 8.87 s

Stopped at the bottom of the water layer, taking 0.54 s

Data and Trials:



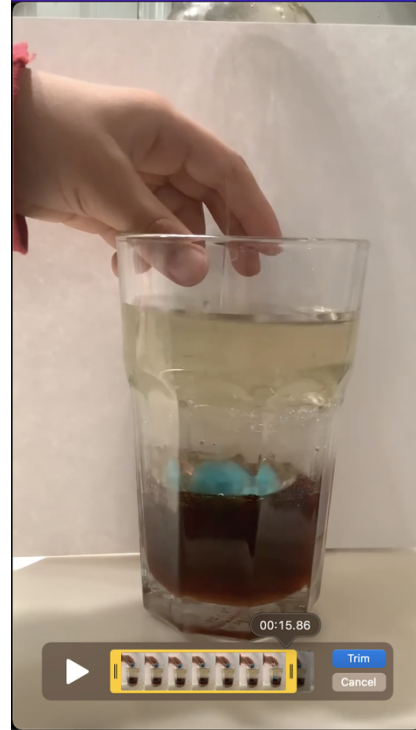
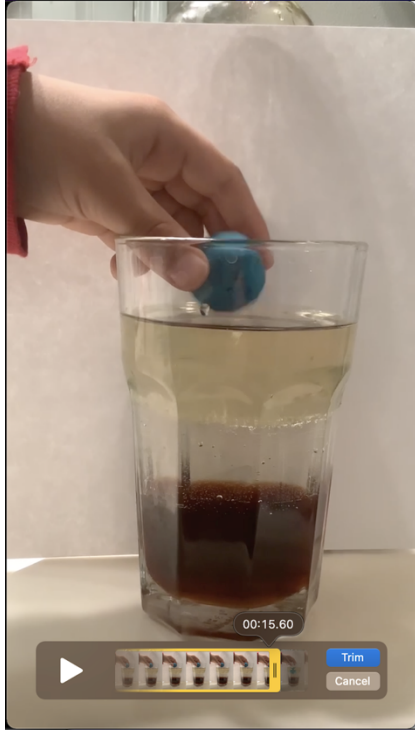
Video snapshots of dropping the LEGO ball:

(Left) Started at 32.89 s

(Right) Stopped at 33.57 s

Stopped near the surface of the oil layer, taking 0.68 s

Data and Trials:



Video snapshots of dropping the Play-Doh:

(Left) Started at 15.60 s

(Right) Stopped at 15.86 s

Stopped at the interface of the water layer and the syrup layer, taking 0.26 s

Data and Trials:



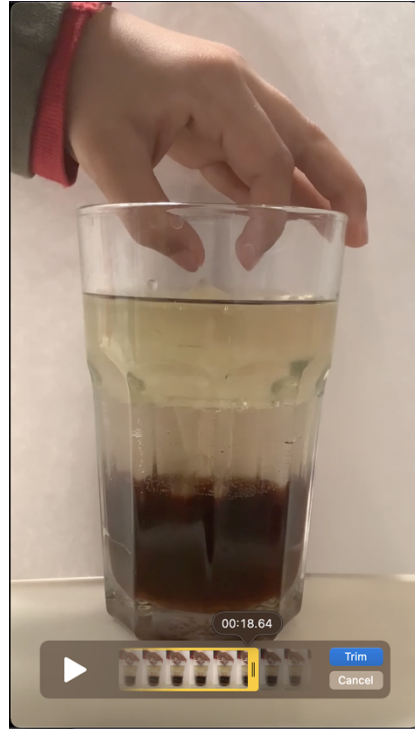
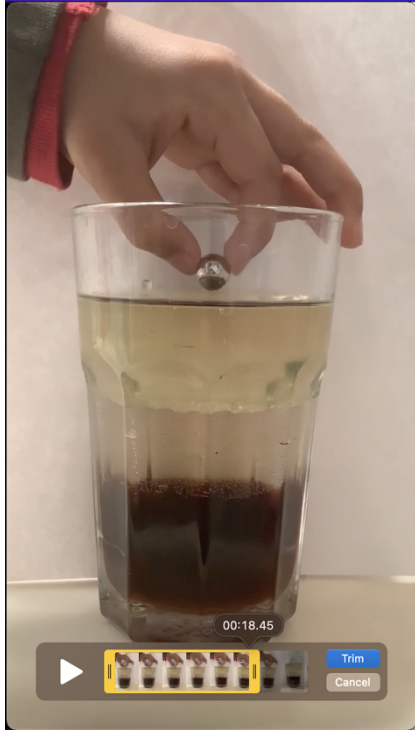
Video snapshots of dropping the stone:

(Left) Started at 19.80 s

(Right) Stopped at 19.95 s

Sank to the bottom of the cup, taking 0.15 s

Data and Trials:



Video snapshots of dropping the marble (steel):

(Left) Started at 18.45 s

(Right) Stopped at 18.64 s

Sank to the bottom of the cup, taking 0.19 s

Data and Trials:



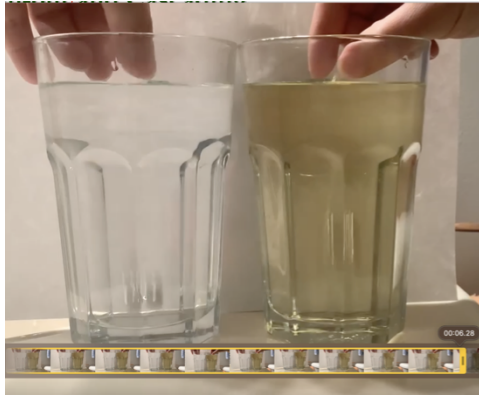
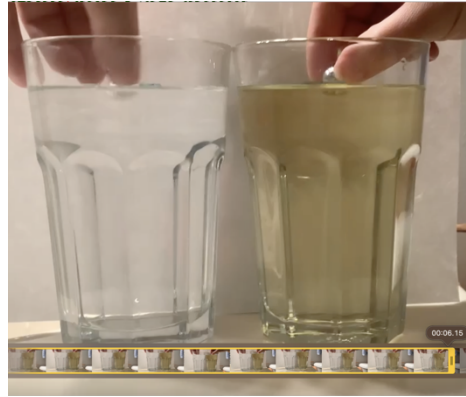
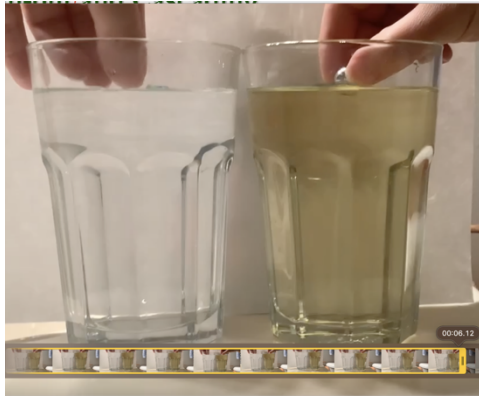
Video snapshots of dropping the marble in a HALF cup of liquids (water vs oil):

(Left) The marble in the **water** cup started at 5.22 s (top) and stopped at 5.35 s (bottom), taking 0.13 s to sink to the bottom.

(Right) The marble in the **oil** cup started at 5.18 s (top) and stopped at 5.30 s (bottom), taking 0.12 s to sink to the bottom

They are so close! HALF cups are hard to see the difference.

Data and Trials:



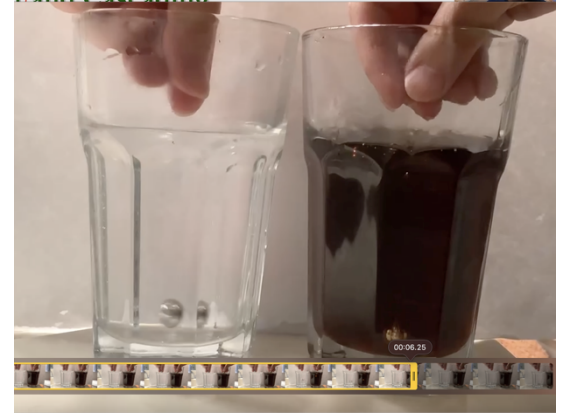
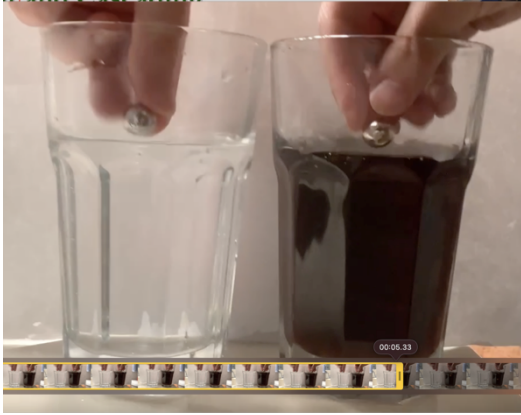
Video snapshots of dropping the marble in a FULL cup of liquids (water vs oil):

(Left) The marble in the **water** cup started at 6.12 s (top) and stopped at 6.28 s (bottom), taking 0.16 s to sink to the bottom.

(Right) The marble in the **oil** cup started at 6.15 s (top) and stopped at 6.30 s (bottom), taking 0.15 s to sink to the bottom

Even the FULL cups are hard to see the difference. Even the reaction time to drop the ball matters.

Data and Trials:



Video snapshots of dropping the marble into a full cup of liquid (water vs syrup):

(Left) Both marbles started at 5.33 s

(Middle) The marble in the water cup sank to the bottom at 5.47 s

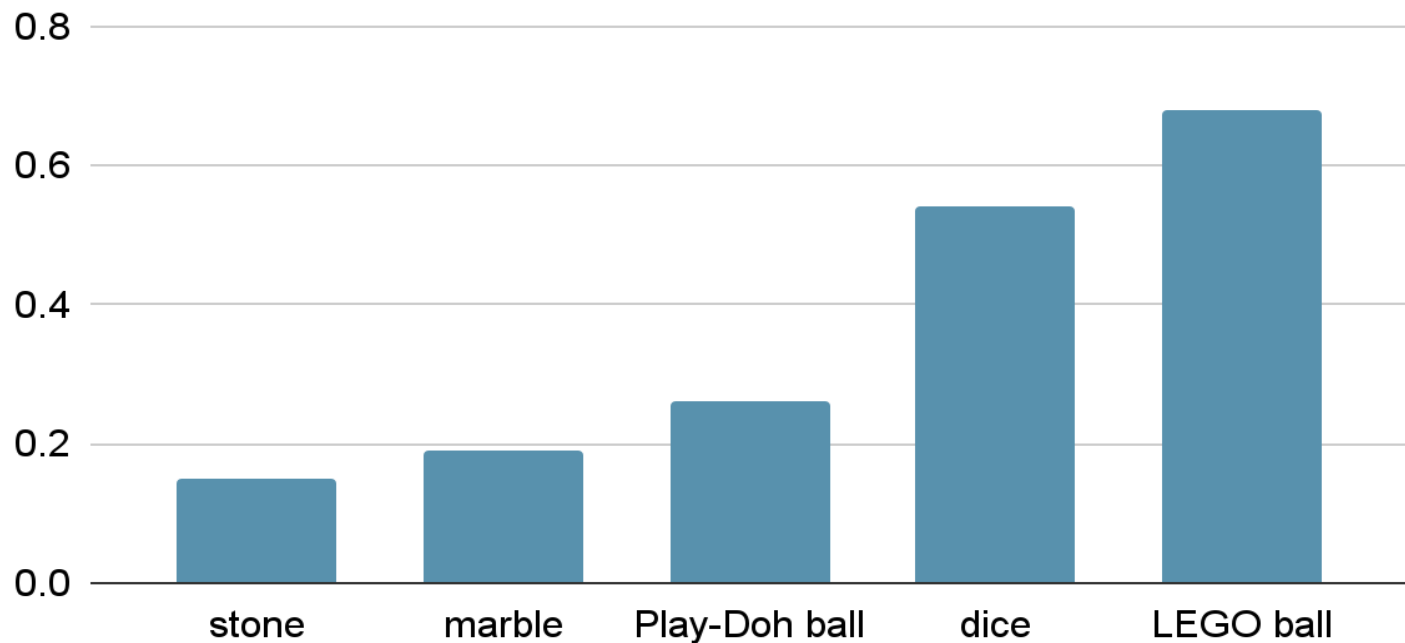
(Right) The marble in the syrup cup sank to the bottom at 6.25 s

The marble took 0.14 s to sink in the water cup, 0.92 s to sink in the syrup cup

Thoughts: syrup is denser and stickier, so the marble sank slower.

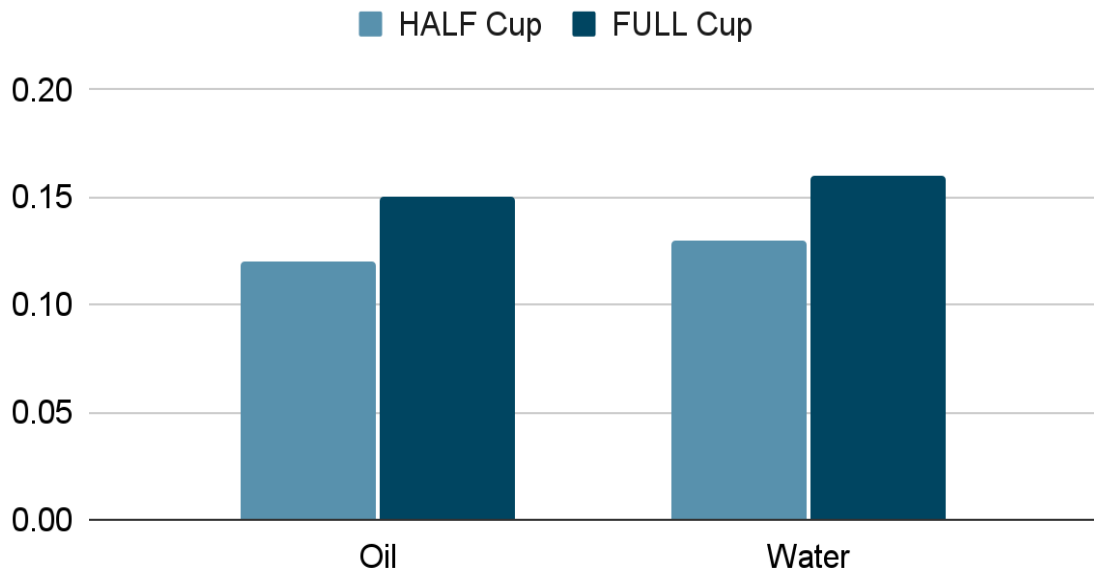
Data and Trials:

Time for the Object to Fall into the Liquids Before It Stops
(seconds)

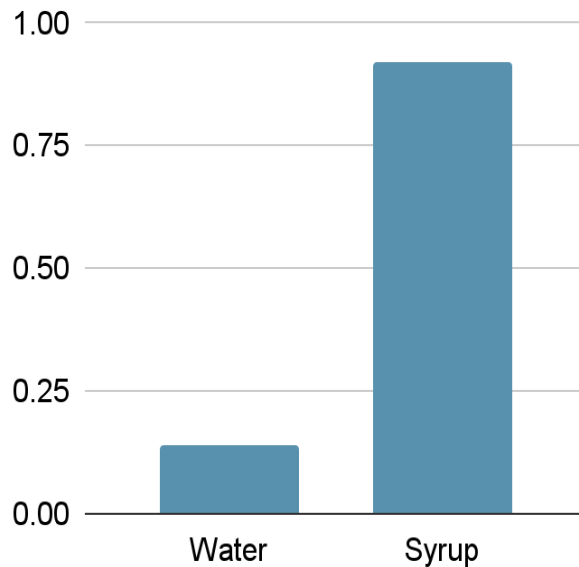


Data and Trials:

Time for the Object to Fall into the Liquids Before It Stops (seconds)



Time for the Object to Fall into the Liquids Before It Stops (seconds)



Conclusion and Reflection:

I found out that: 1) all 5 objects sank/stopped within 1 second (very fast!); 2) From the fastest to the slowest: stone (0.15s, to the bottom), marble (0.19s, to the bottom), Play-Doh (0.26s, between water and syrup), dice (0.54s, bottom of the water), and LEGO ball (0.68s, the surface of the oil). This means stone is heavier, the LEGO ball is lighter; 3) The marbles sank similarly fast in water and oil (oil is slightly faster); the marbles sank even faster in the second half of the water or oil (0.03s vs 0.12/0.13s!); 4) The marbles sank much slower in syrup than in water (0.92 s vs 0.14s!) since the syrup is denser and stickier.

I was surprised that: 1) The marbles sank similarly fast in water and oil (oil is slightly faster); 2) the marbles sank even faster in the second half of the water or oil (0.03s vs 0.12/0.13s!)

If I did this project again, I would: 1) use taller glassware instead of the glass cups to make the sinking/stopping time longer (easier to compare the difference); 2) choose objects with the same size (constant condition); 3) repeat the experiments to find the average time (to be more accurate).