

Physical activity for Chocolate Milk and Mixture Problems

Chemistry experiments and algebra problems sometimes ask students to create percent mixtures or to change a mixture into a stronger or weaker solution by adding more of an ingredient. Students often have difficulty isolating the key concepts involved in this sort of problem. This investigation introduces the notion of changing percent mixtures through a fun class day that ends with a yummy treat.

You will need:

- 1 gallon of low fat milk for each class + 1 quart of lactose-free milk (or check with your class for requirements and allergies)
- 1 can of Hershey's chocolate syrup
- small paper cups
- at least two glass measuring cups or pitchers

Set up a table in the back of your room. (For fun make it a different place than where you usually work) and invite your students to bring chairs or stand and surround your table.

Activity begins: **What percent chocolate do you like your chocolate milk?**

Show students your thick chocolate syrup in a glass measuring cup and your milk in a larger measuring cup. Encourage a discussion about the approximate percent of chocolate in their chocolate milk that they imagine that they prefer. Then suggest that we try to make a sample of one of their percent suggestions.

A 50% chocolate milk solution is a great place to start. Hopefully someone in your class will have suggested it.

Ask how you should create a 50% chocolate milk solution. Students are generally pretty good at encouraging you to use the same amounts of chocolate syrup and milk to get a 50% chocolate mixture. Create it.

Then mention that you have used the same amount of chocolate and of milk. Milk and chocolate are 1 to 1. But what two quantities must you consider to show that this is a 50% solution?

Answer will hopefully emerge: chocolate syrup to total quantity of mixture.

Students will probably suggest that this mixture is too dark. So, now the real work begins. You don't want to waste the dark chocolate milk that you have created.

The next question would be how much plain milk should you add to get a less dark solution ... say a 25% solution of chocolate milk.

After some suggestions from the class, start creating a chart on the board.

% Chocolate mixture	Pure milk	Pure chocolate syrup	Mixture final quantity
50%	1/2 cup	1/2 cup	1 cup

You now have a 50% solution that includes 1/2 cup of pure chocolate and 1/2 cup of pure milk. Or, 50% of the whole mixture is pure chocolate.

Or, maybe I should write my little chart in a different order:

% Chocolate mixture	Total mixture quantity	Pure chocolate syrup
50%	1 cup	$= 0.50 * \text{mixture quantity} = \frac{1}{2} \text{ cup}$

So to use that chocolate milk that you made to make another, weaker, batch of chocolate milk you would need to add more plain milk. Try a new chart.

% Chocolate mixture	Total mixture quantity	Pure chocolate syrup

25%	1 cup of your 50% choc milk + X amount of plain milk	= 0.25 * (1 + X) cups = same amount of chocolate syrup that we started with = 1/2 cup
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$$0.25(1 + X) = \frac{1}{2} \text{ cup}$$

$$0.25 + 0.25(X) = 0.5 \text{ cup}$$

$$0.25(X) = 0.25 \text{ cup}$$

$$X = 1.0 \text{ cup}$$

So you must add 1 cup of milk. Ask students if that seems right and listen for their explanations.

They might say that 1/4 of the final mixture has to be pure chocolate and 1/2 cup is one-fourth of the 2-cup final mixture. Enjoy the conversation and reasoning

Or

$$\begin{aligned} &1 \text{ cup of milk} + (\frac{1}{2} \text{ cup of milk} + \frac{1}{2} \text{ cup of chocolate}) \\ &= \frac{1}{2} \text{ cup of chocolate} + 1.5 \text{ cups of milk} \\ &\frac{.5 \text{ cups of chocolate}}{2 \text{ cups of mixture}} = 25\% \text{ solution} \end{aligned}$$

Now play with your mixture again. Take the lead from your students about whether to make the mixture darker or lighter. Keep using charts to calculate percent mixtures.

Serve the final milk mixture in small cups. Ask students to summarize the process of changing solution strengths.