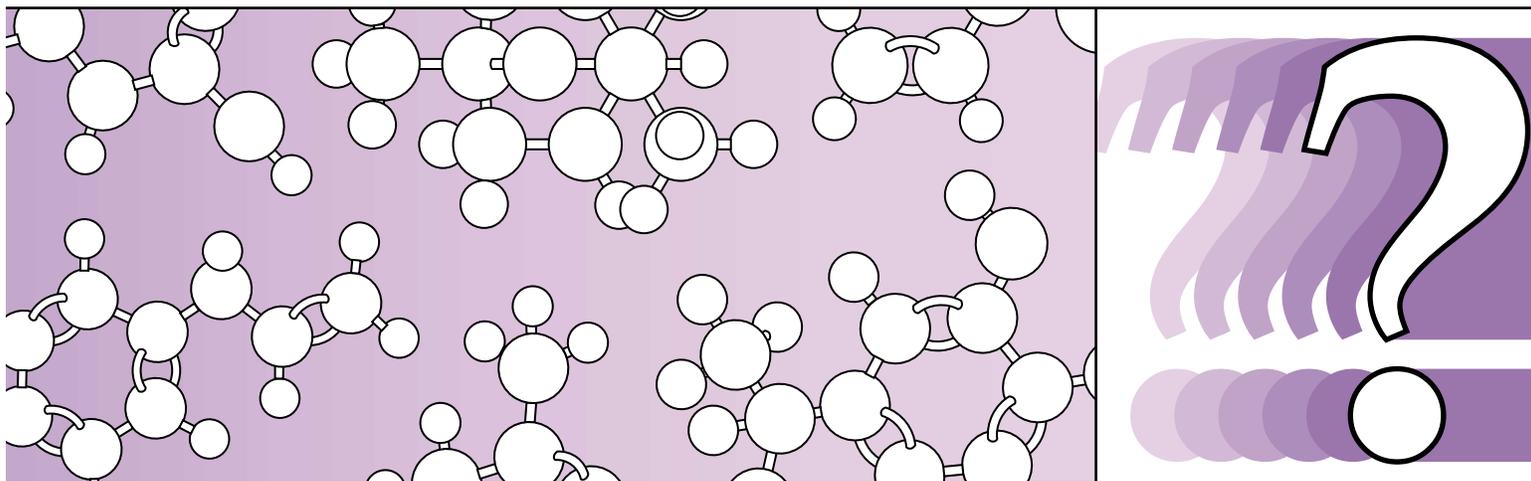


*The Pfizer Foundation Biochemistry*

# Discovery Lab

## What chemical reaction makes cheese?



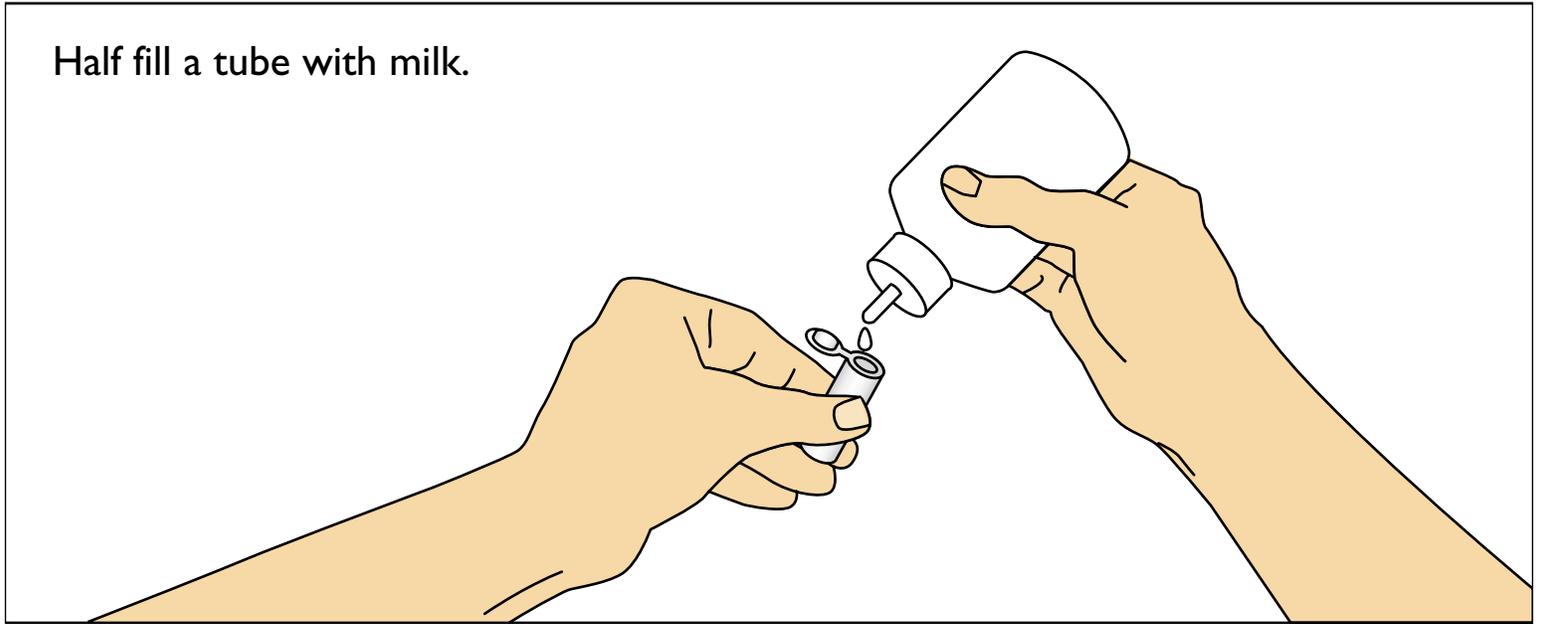
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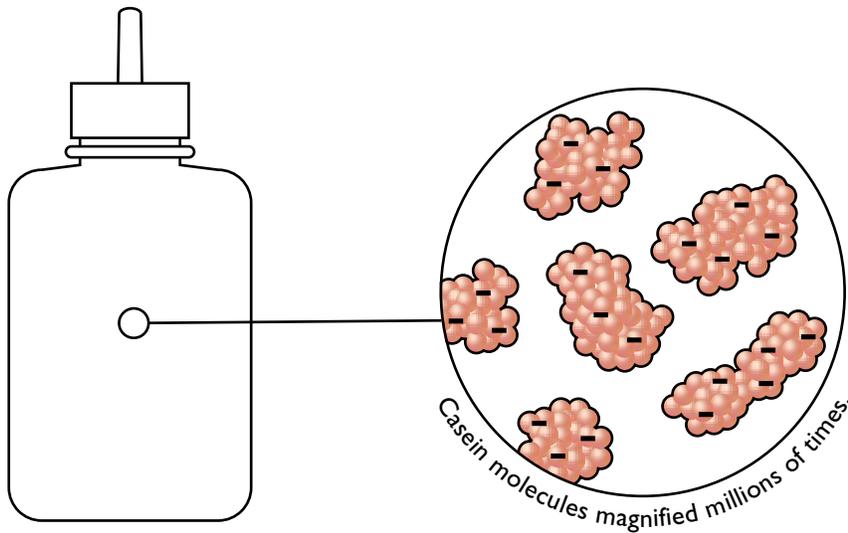
**Make your own cheese  
and learn about the chemical  
reaction it comes from.**

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Half fill a tube with milk.

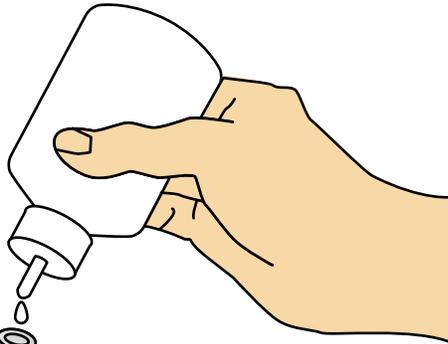


Milk is made up of many different molecules.  
One kind of molecule in milk is called casein (*cay-sin*).



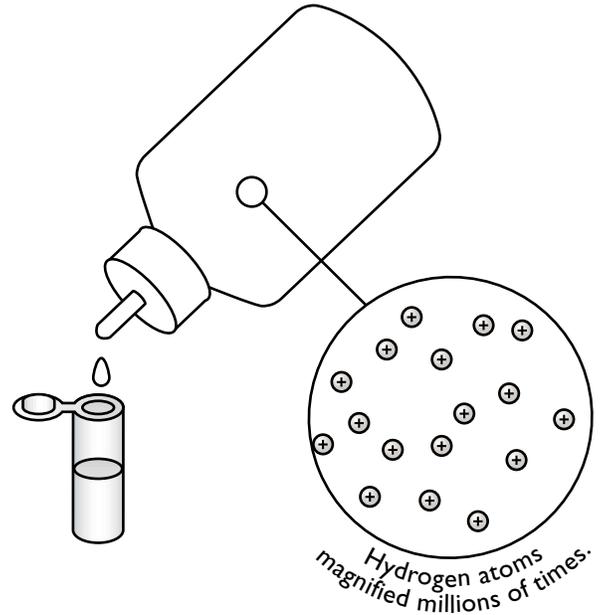
Molecules and atoms  
are tiny particles that  
make up us and  
everything around us.

Add 3 drops of vinegar (an acid) to the tube.

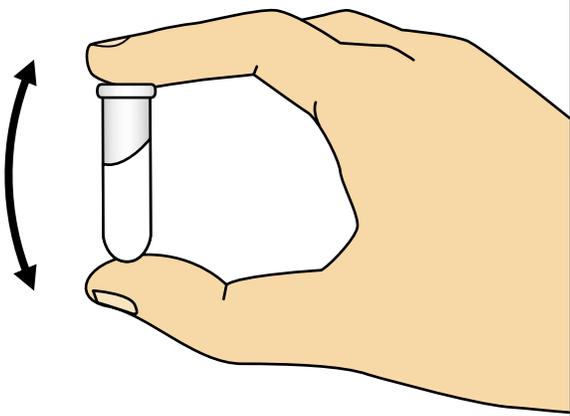


Instead of adding acid directly to milk, most cheese-makers add a bacteria which slowly releases acid as it grows.

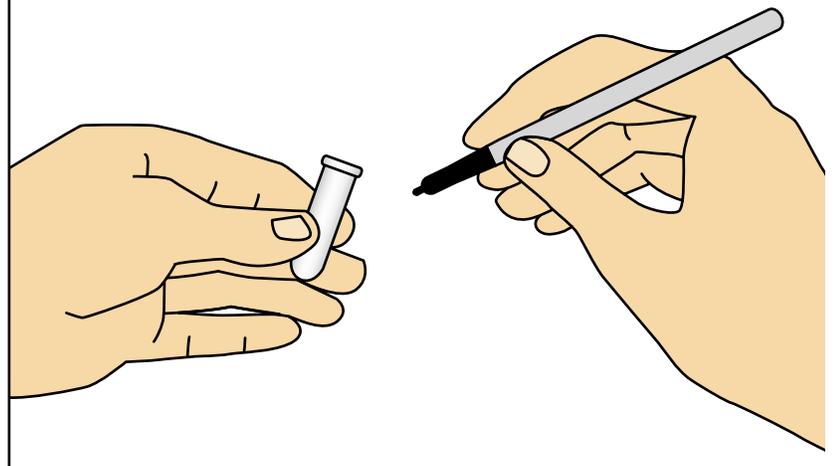
The acid contains loose hydrogen atoms.



Snap the tube closed and shake it a couple of times.

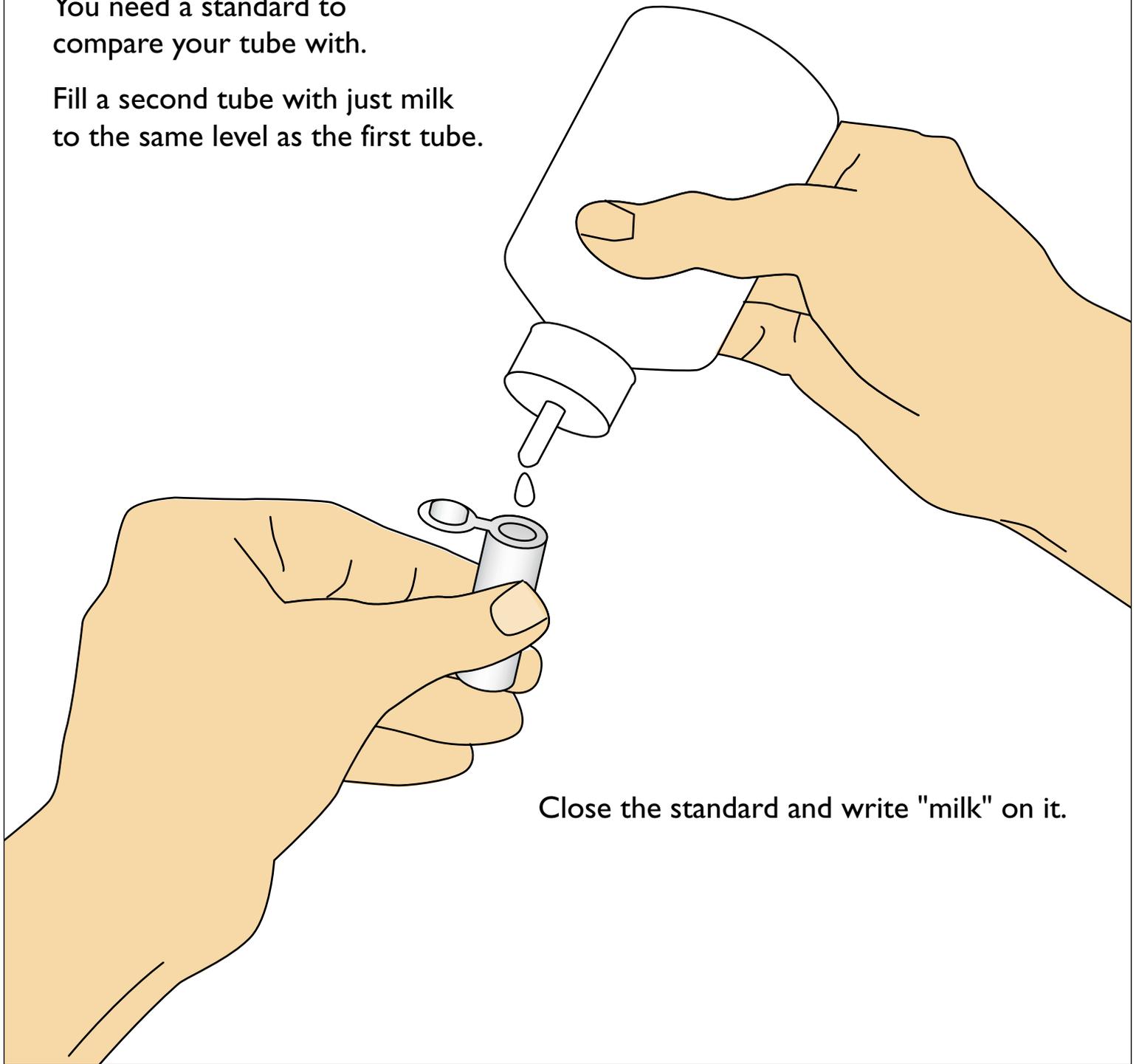


Write "milk + acid" on the side of the tube.



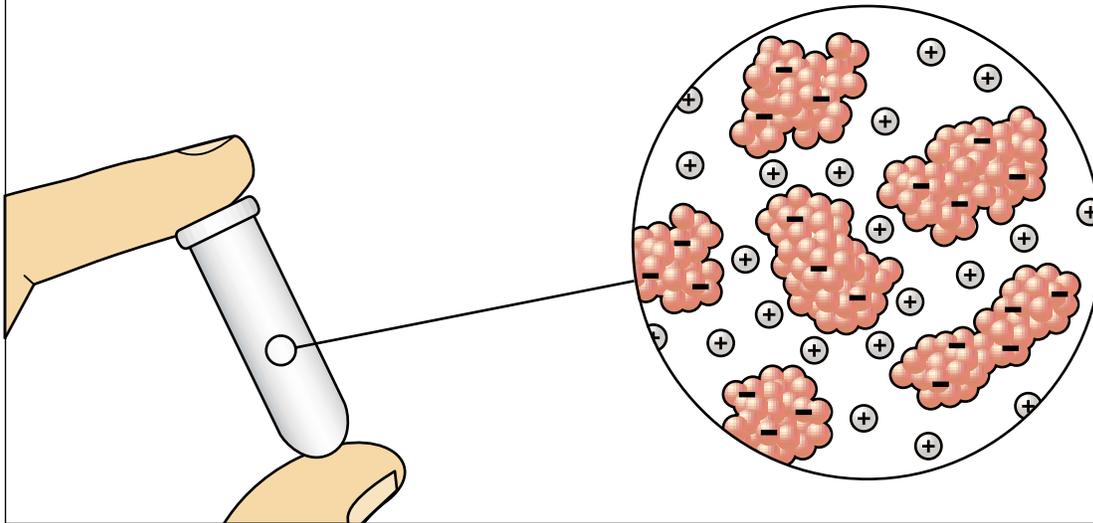
You need a standard to compare your tube with.

Fill a second tube with just milk to the same level as the first tube.



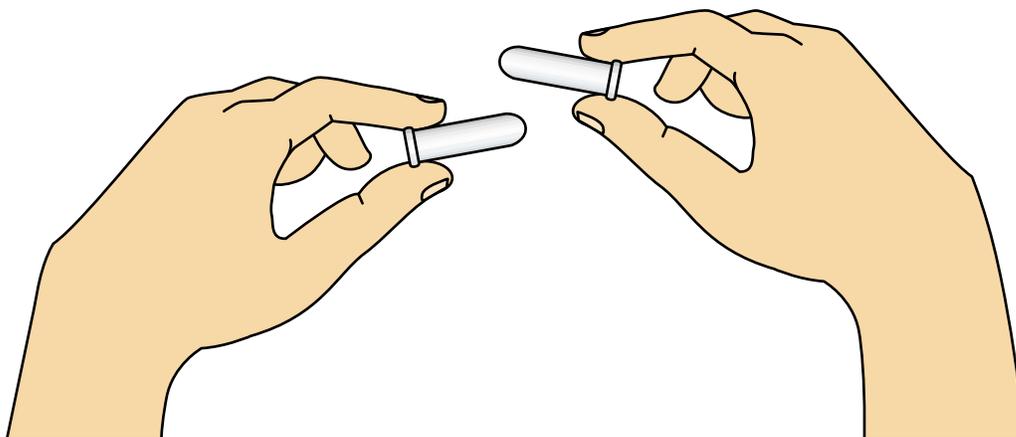
Close the standard and write "milk" on it.

In the tube with the acid, the molecules of the milk mix with the loose hydrogen atoms in the acid ...



... and a chemical reaction happens.

Hold the tubes up to the light and slowly tip them over.



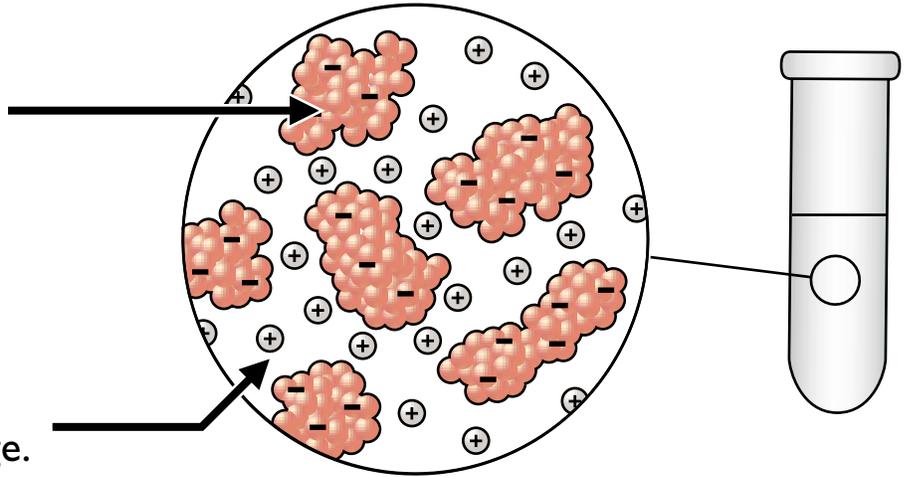
Compare the tubes with and without the acid.

What did the chemical reaction between the milk and the acid do?

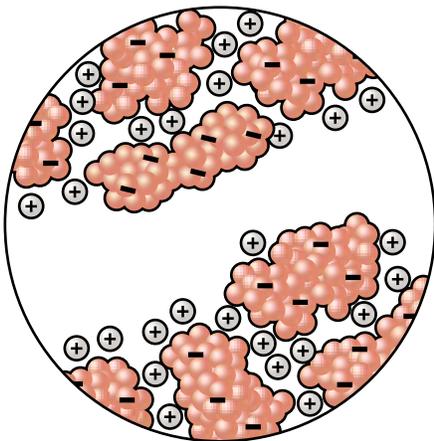
# How did the chemical reaction make lumps?

The casein molecules in the milk have a negative charge.

The loose hydrogen atoms in the acid have a positive charge.

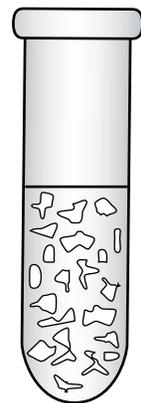


Opposite charges attract, so the casein molecules and loose hydrogen atoms group together ...



... and make clumps that you can see.

The clumps are called curds, and are used to make cheese.



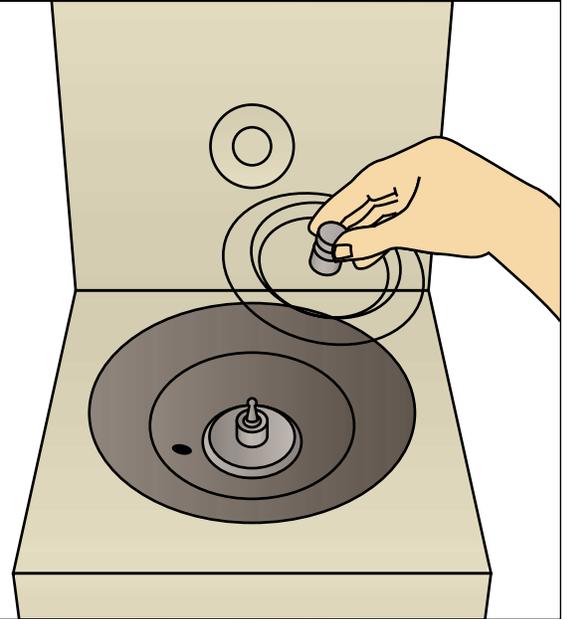
The liquid is called whey.

## How to press the cheese curds together

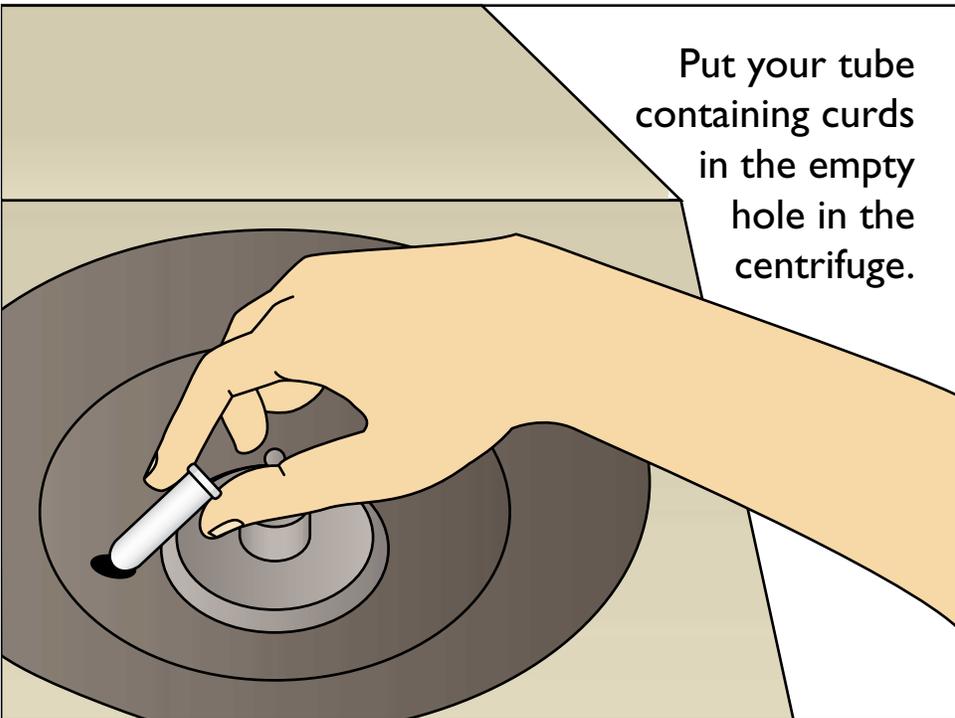
If the centrifuge is closed, press the "lid" button and open the lid.



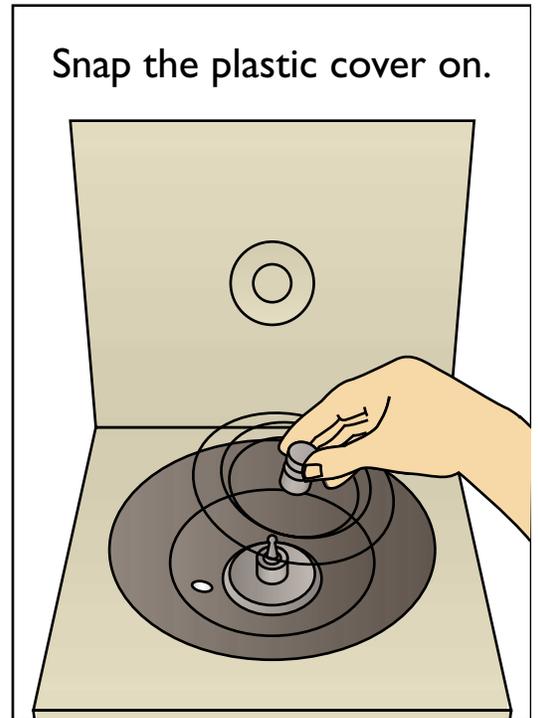
If the plastic cover is on, take it off by pulling it up.



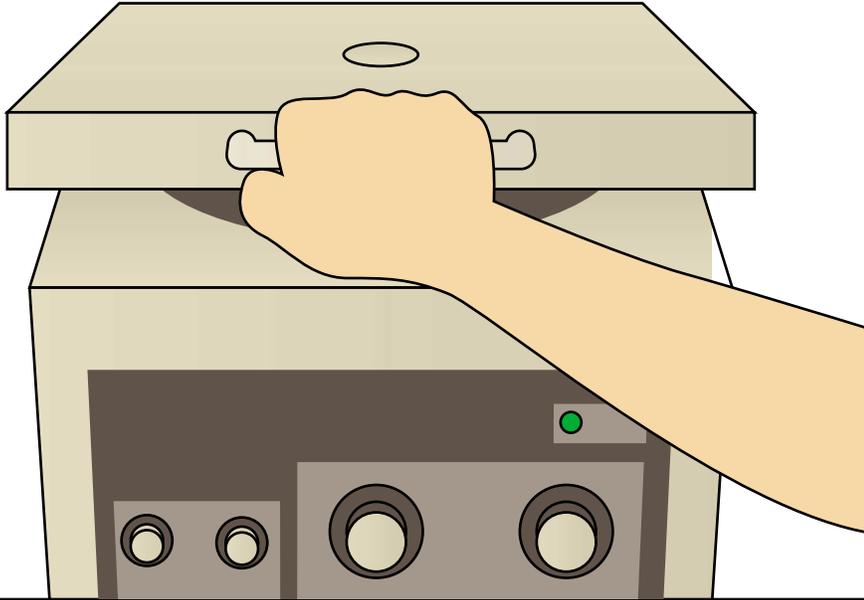
Put your tube containing curds in the empty hole in the centrifuge.



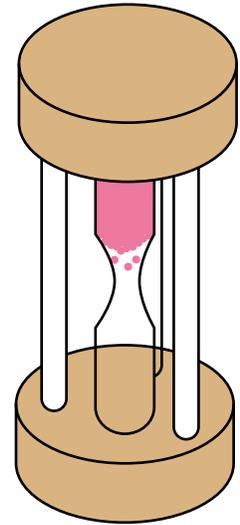
Snap the plastic cover on.



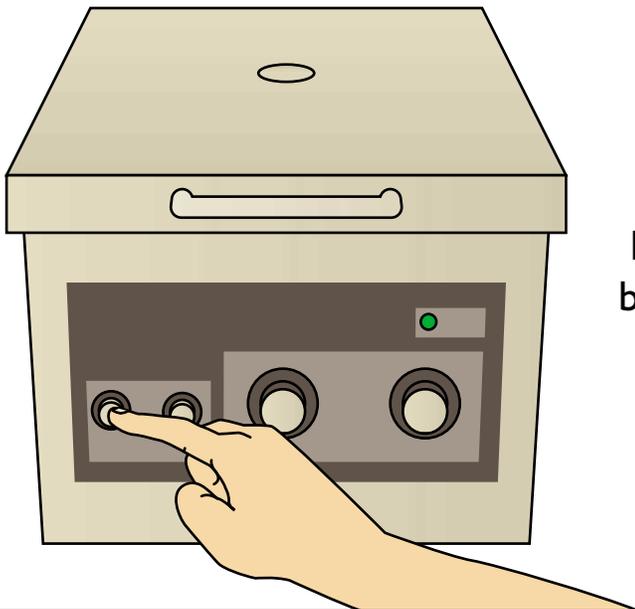
Close the lid. Make sure it clicks shut.



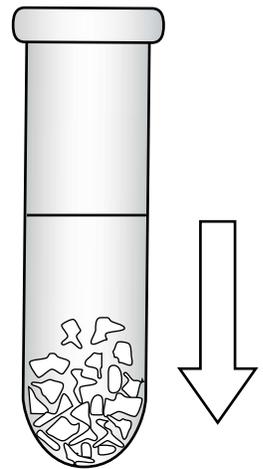
Start the timer.



Press and hold the "quick" button.

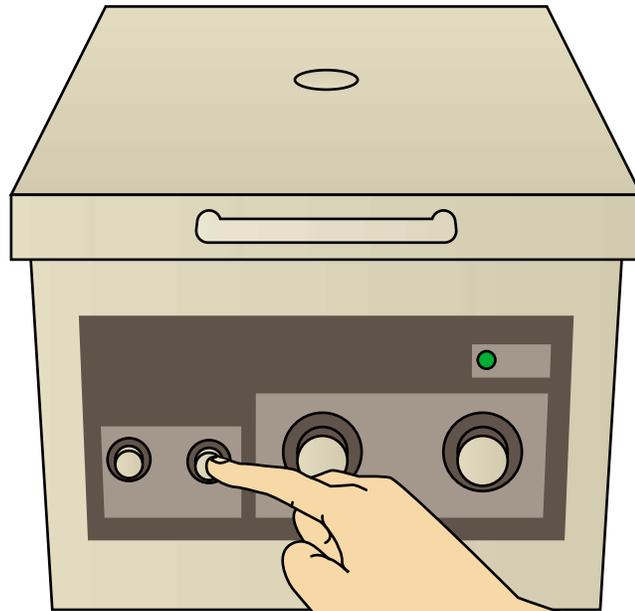


Release the button when the timer runs out.



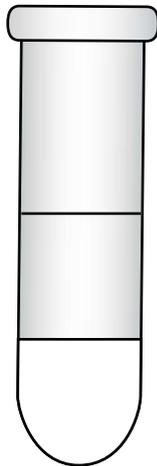
The centrifuge spins the tubes very fast and forces lumps to the bottom.

When the green light goes out, press the "lid" button.



Take out your tube.

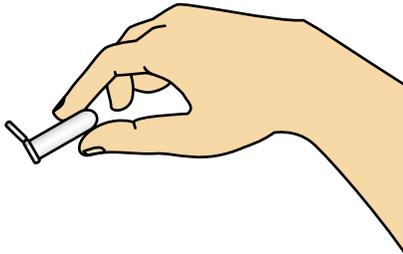
Look for two layers in the tube.



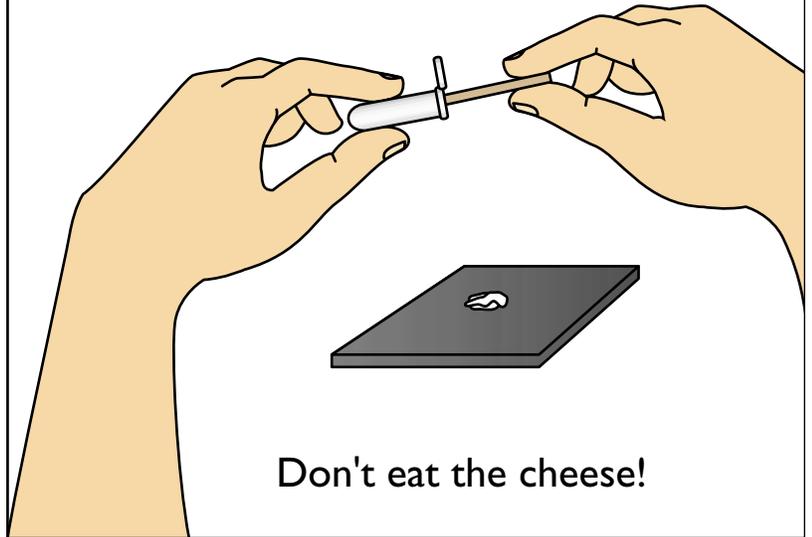
Which layer is the curd?

Which is the whey?

Drain the liquid whey into the trash can.

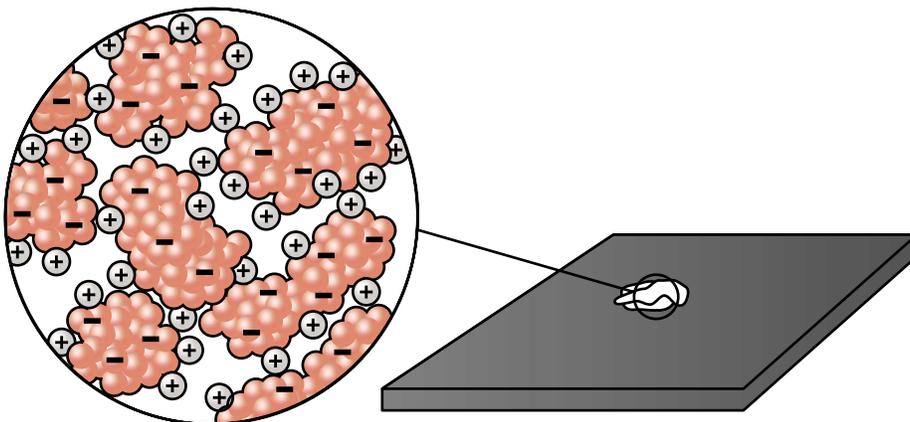


Scoop out the cheese curd with a wooden stick onto the black plastic.



Don't eat the cheese!

Your cheese is made of casein molecules packed together as well as some fat.



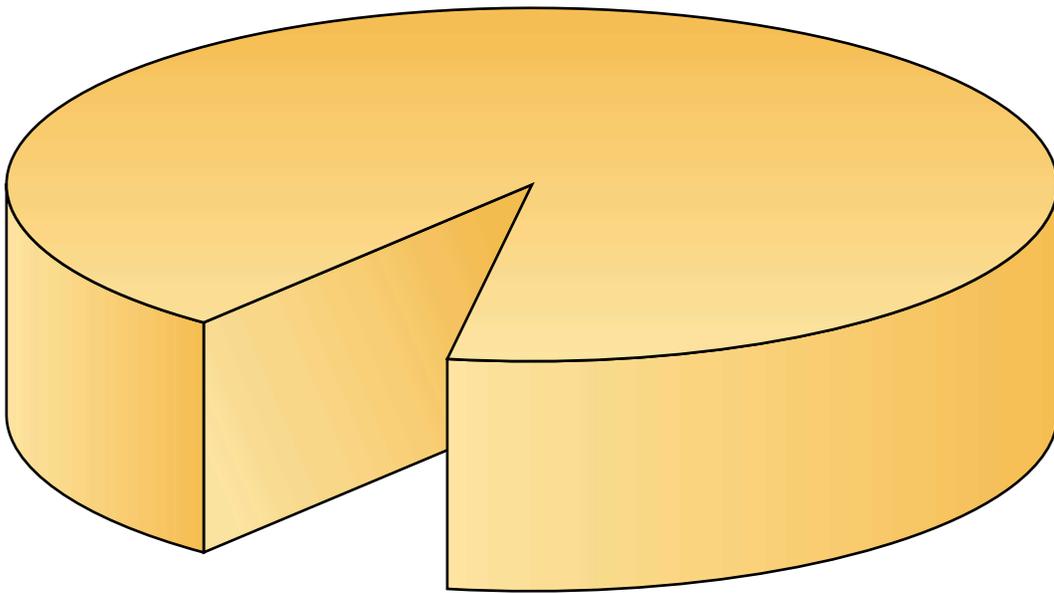
What is the texture of your cheese?

What kind of cheese does it look like?

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Instead of using a centrifuge, most cheeses are made by draining or pressing out the liquid whey.

This takes much longer, but makes cheese that's less mushy.



Bacteria and mold are also added to give the cheese more flavor.

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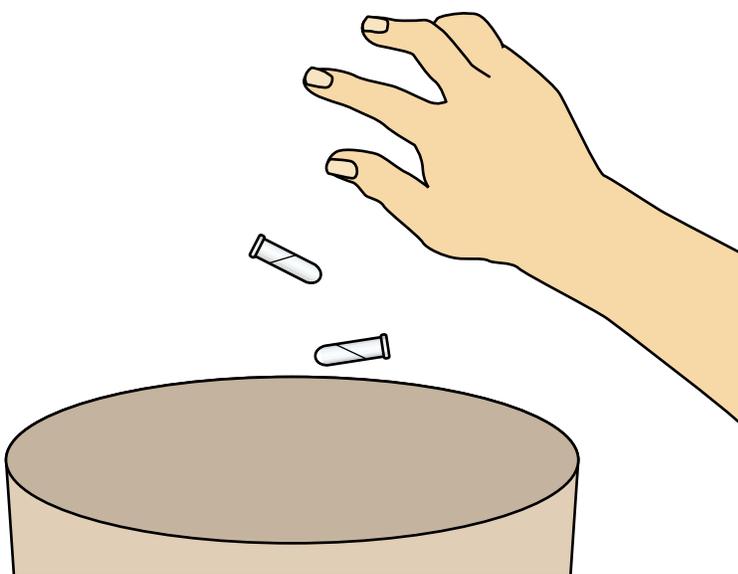
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Do you have a question about your experiment,  
or about molecules and cheese?

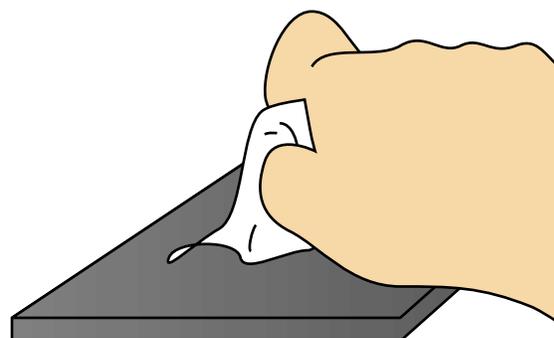
Maybe you can find the answer by  
experimenting some more.

Ask a staff person if  
you need help.

When you are done, please throw the  
tubes and the wooden stick in the trash.



Wipe off the black plastic  
with a tissue.



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