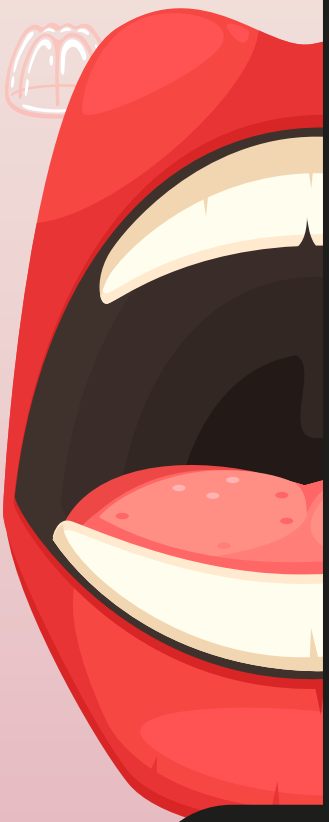
Enzymes & Fruit Jelly

WHAT ARE ENZYMES?

In chemistry, we learn of catalysts – substances that help to speed up certain chemical reactions by lowering the activation energy needed, without being used up in the process. Well, enzymes are organic catalysts that are found in living things – they help to speed up biochemical reactions in us!

THINK:
What types of enzymes do we have in our body? Can you name them and their functions?



You wouldn't have to look any further than inside your mouth. Your saliva contains amylase, an enzyme that helps to break down starch into sugars, kicking off the chemical process of digestion. Besides breaking down molecules, enzymes can also be involved in many different types of reactions! Here are some examples of enzyme activity:

- Breaking down of molecules (digestion)
- Combining molecules together
- Transfer of molecules from one substance to another
- Removal of molecules from a substance

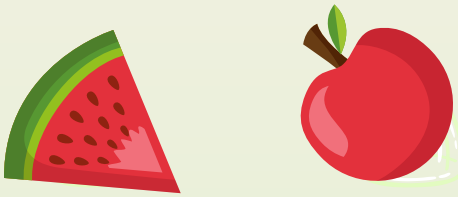
ACTIVITY: WANT TO SEE SOME ENZYMES IN ACTION?

Let's unravel the science behind jelly making and see how enzymes play a role in the success of making fruit jelly!

THINK:
Which types of fruits do you think would prevent jelly from forming? Get them ready for your experiment!

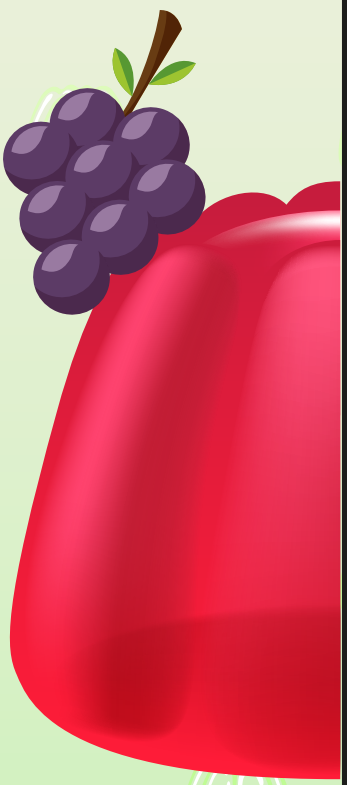
Things you'll need:

1. Gelatin or gelatin-based jelly powder
2. Different types of fresh fruit (pineapple, strawberry, orange, kiwi, etc.)
3. Some small bowls



Steps

1. Prepare the gelatin or jelly powder as instructed on the package. (For pure gelatin, dissolve 10g into 250ml of hot water.)
2. Chop the fruit up into smaller pieces, approximately 1cm cubes.
3. Separate an equal amount of prepared gelatin / jelly mixture into small bowls and place a different type of fruit in each bowl. Ensure that the amount of fruit in each bowl is similar or equal.
4. Leave one bowl with just jelly and no fruit in it. This will be the control.
5. Refrigerate for a few hours or overnight and check your results!



THINK:
What is the importance of the control setup?

WHAT DO YOU OBSERVE? FILL UP THE FOLLOWING TABLE AND TICK YOUR RESULTS!

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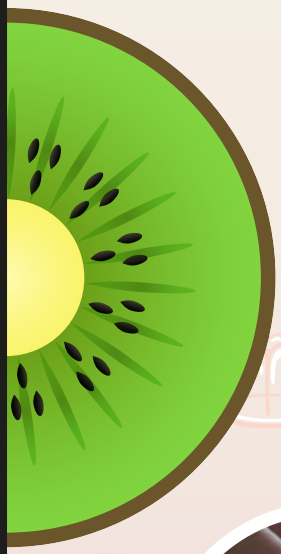
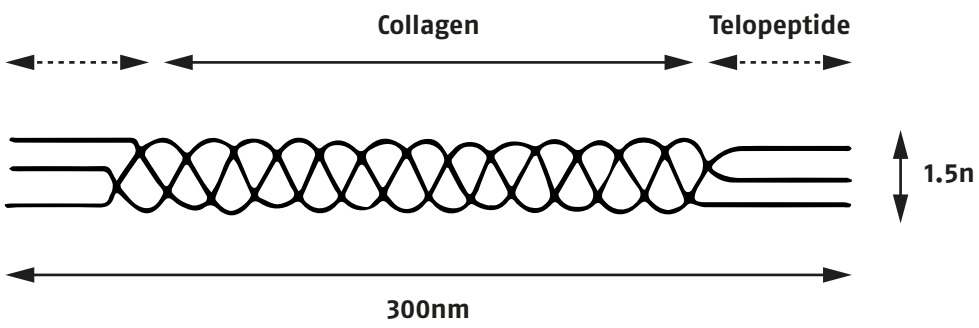


Fruit used	Did the jelly set? (✓/✗)
None (control)	

You should notice that the jelly in the control bowl (no fruits), as well as in some of the bowls with fruit, has set nicely.

THINK:
What causes jelly to solidify?

Gelatin is the key component in jelly. It is a form of collagen, made up of animal proteins. It contains long chains of interconnected amino acids. When gelatin is dissolved in warm water and cooled down, these chains tangle up into a net-like structure with water molecules trapped in between. This forms the springy and smooth jelly!



Did you know that collagen makes up about 30% of the protein in the bodies of humans and other mammals? It is important for the maintenance of cell structure and for the linkage between cells in a tissue or organ. It is made of long chains of amino acids, strung in a triple helix structure.

Yum! Proceed to enjoy that refreshing and delicious fruit jelly!

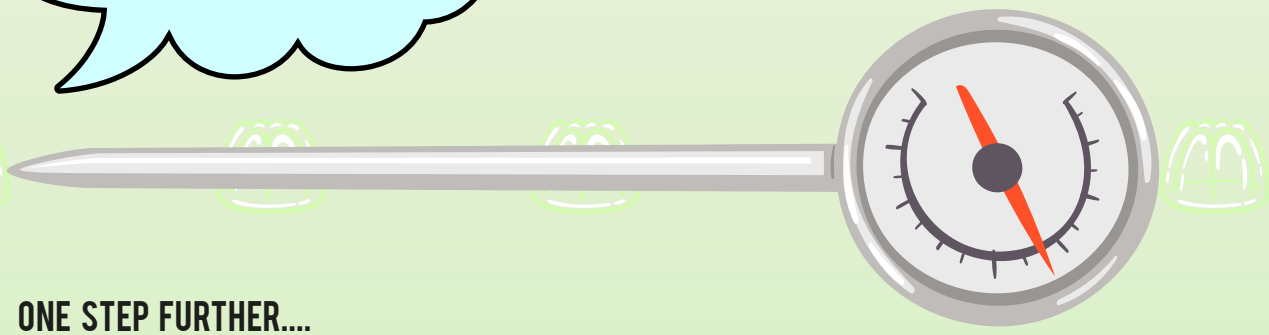
Strangely enough, you would also have observed that for some bowls containing certain fruits, the mixture did not solidify and instead remains liquid. You may see this result for pineapple, kiwi and papaya.

WHY IS THIS SO?

Pineapple contains bromelain, a kind of enzyme known as a protease. Proteases digest proteins, including the ones found in gelatin. As bromelain breaks down the linkages between the amino acids, the gelatin proteins are unable to form the net-like structure. This prevents the jelly from setting.

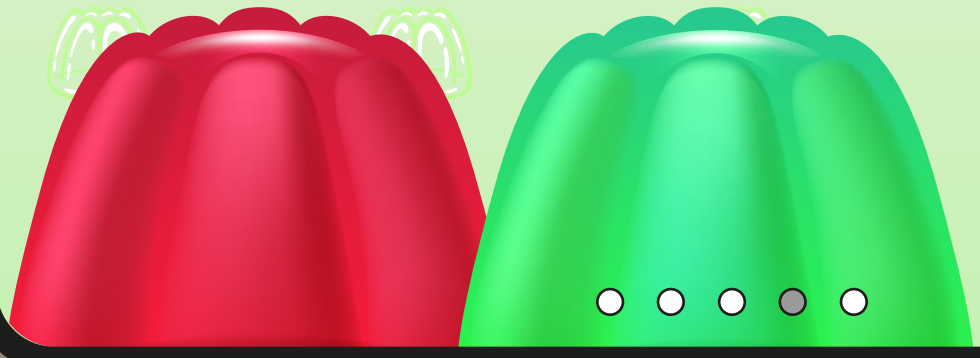
Because of this, pineapple juice is also sometimes used as a marinade in cooking. The bromelain makes an excellent meat tenderizer – by breaking down protein chains, it helps to soften up tough meat!

THINK:
What other types of fruits contain enzymes similar to pineapples?



ONE STEP FURTHER....

Enzymes are usually proteins as well. They are made up of amino acid building blocks which are then folded into a 3D structure. Because of this, they tend to be temperature and pH sensitive, as changes in these conditions may disrupt the protein's folding. Since the enzyme's function relies heavily on its structure and folding, the enzyme can be denatured or destroyed just by heating or changing the pH.



ACTIVITY:

Is there any way we could exploit this to allow your pineapple jelly to set? Construct a similar experiment and test it out!

WHAT DO YOU OBSERVE? FILL UP THE FOLLOWING TABLE AND TICK YOUR RESULTS!

Fruit used	Did the jelly set? (✓/✗)
None (control)	
Fresh fruit	
Treatment 1:	
Treatment 2:	

THINK:

Did you manage to make your pineapple jelly set? What can you conclude from your experiment?