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CRYSTAL BUDDIES: Exploring the Magic of Crystals





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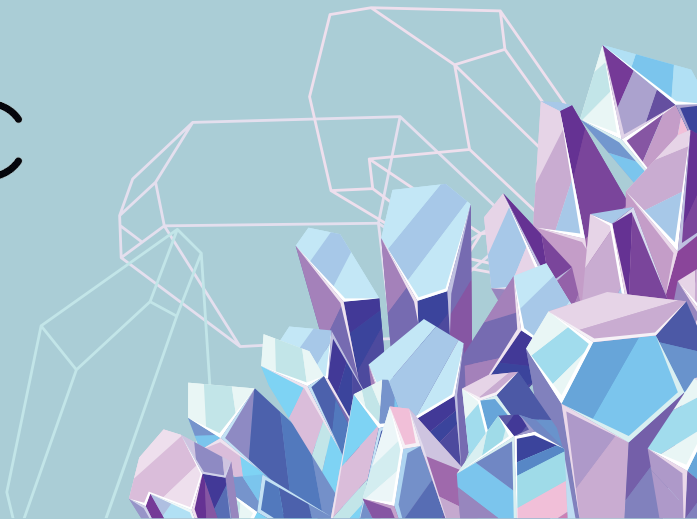
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Acknowledgments

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We would also like to extend our heartfelt thanks to Universiti Teknologi MARA (UiTM) for providing the supportive environment that nurtured our creativity and research. Your encouragement has been essential in our mission to inspire young minds through this comic.

Thank you, CCDC and UiTM, for believing in the importance of inspiring young minds and for helping us share the wonders of crystals with a new generation of explorers!

Preface

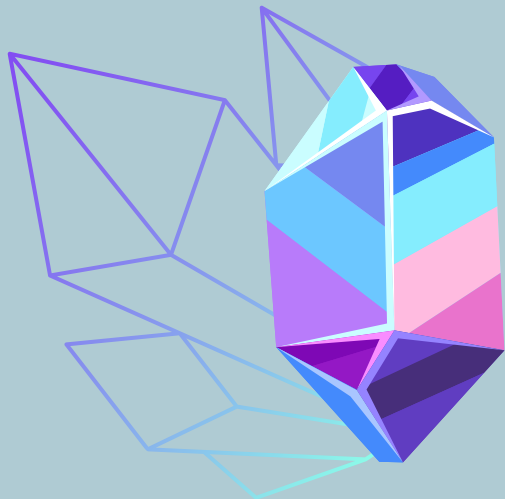
Hello, young explorers!

Welcome to the fascinating world of "Crystal Buddies: Exploring the Magic of Crystals!" This comic was created with one goal in mind: to spark your curiosity about crystallography and show you how it connects to the world around you.

Have you ever wondered what crystals are, how they are formed, or why glass is not a crystal? Crystals are all around us, and they play a vital role in our everyday lives, from the minerals in our favourite snacks to the technology in our gadgets!

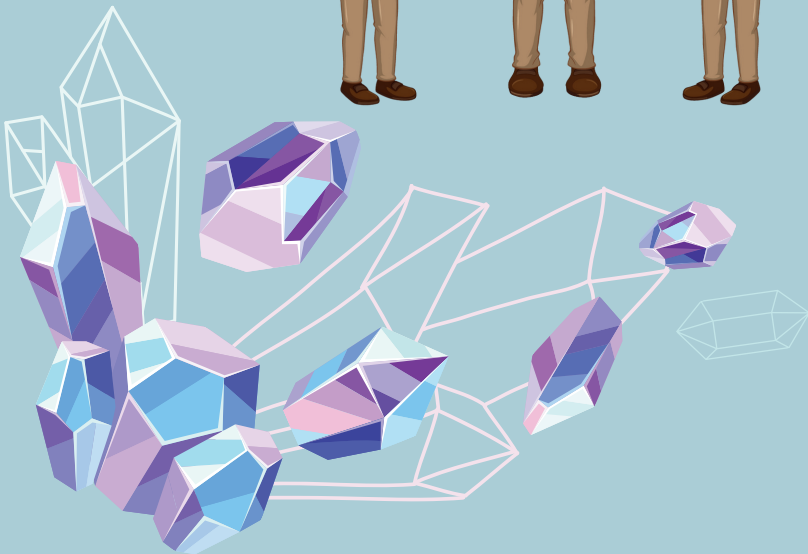
In these pages, you'll meet our three bubbly buddies, Nadia, Dona and Adrian, who will guide you through the basics of crystallography. Together, you'll embark on exciting adventures, learning about crystal structures, how they grow, and the science behind their beautiful shapes.

Our hope is that this comic inspires you to look closer at the world and discover the magic of crystals in nature and in your daily life. So, grab your magnifying glass, and let's dive into the crystalline wonders waiting for us!



Crystal Buddies : Exploring The Magic of Crystals

Story by *Siti Syaida Sirat Illustrated by *Ku Nurul Atiqah Ku Ahamad
Edited by *Nur Nadia Dzulkifli Translation by *Dzeelfa Zainal Abidin



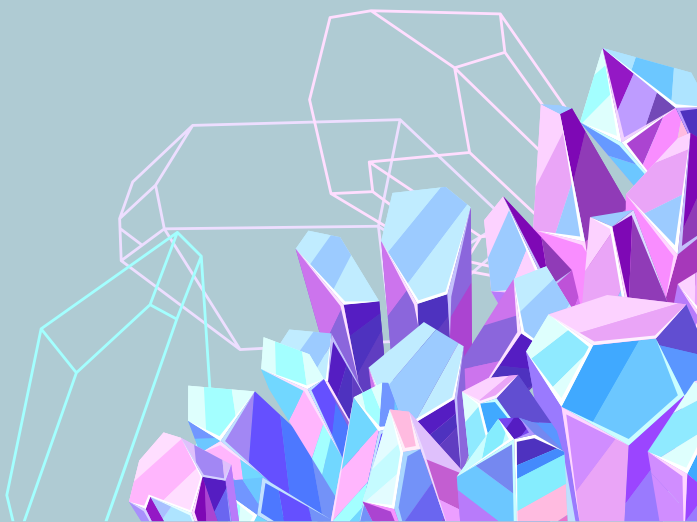
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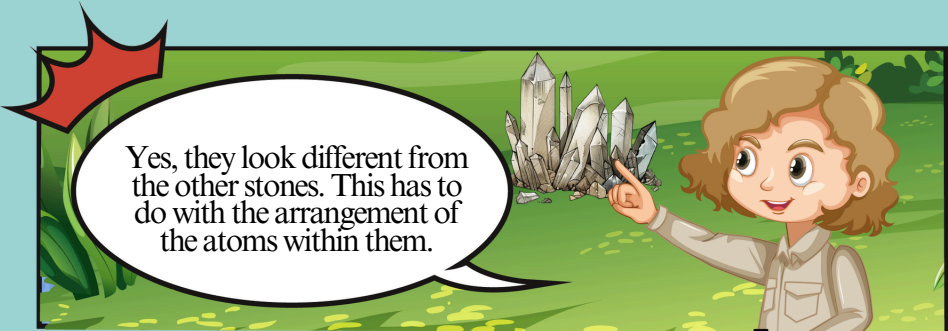
CHAPTER 1

What are crystals?



CHAPTER 1: What are crystals?





Yes, they look different from the other stones. This has to do with the arrangement of the atoms within them.



Now it's starting to sound like a serious science discussion!

Let us become crystal experts!



We should really learn more about crystals!



Let the mission begin!

Let's do it!

Let's do it!

Mission 1: Flavours of life





I will help put the salt into the bottle.



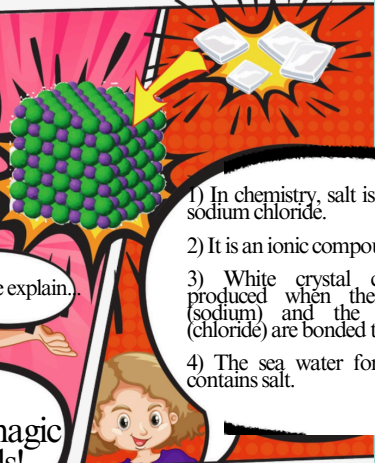
Nadia, why are salt shaped like cubes?

The atoms are tightly packed together and follow a particular pattern.



Let me explain...

Salt are magic crystals!

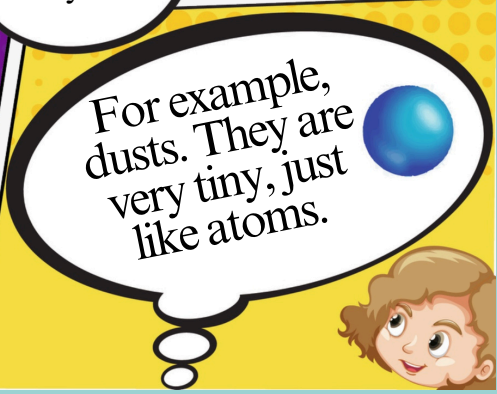


- 1) In chemistry, salt is known as sodium chloride.
- 2) It is an ionic compound.
- 3) White crystal cubes are produced when the Na^+ ion (sodium) and the Cl^- ion (chloride) are bonded together.
- 4) The sea water for example, contains salt.

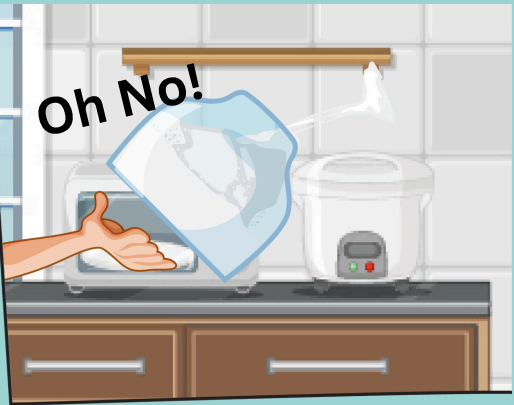


Everything around us is made of atoms. Atom is the smallest component of the matter.

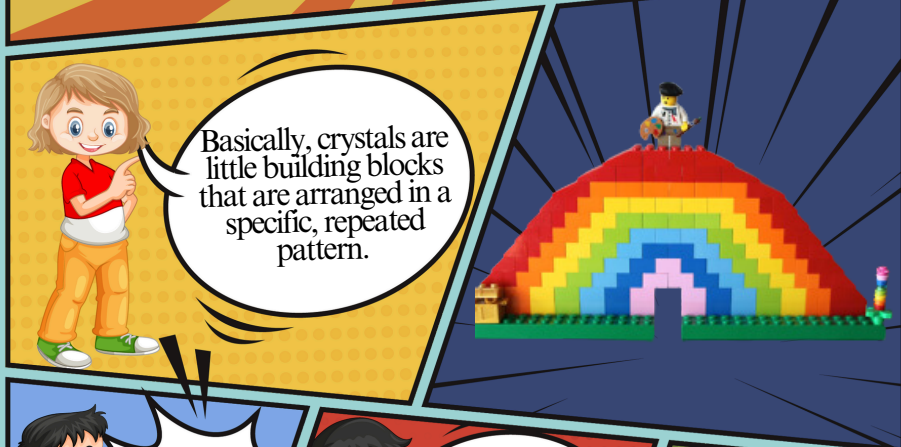
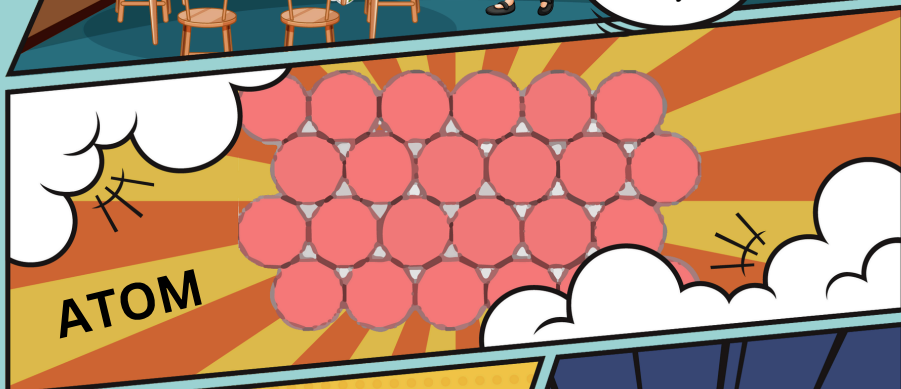
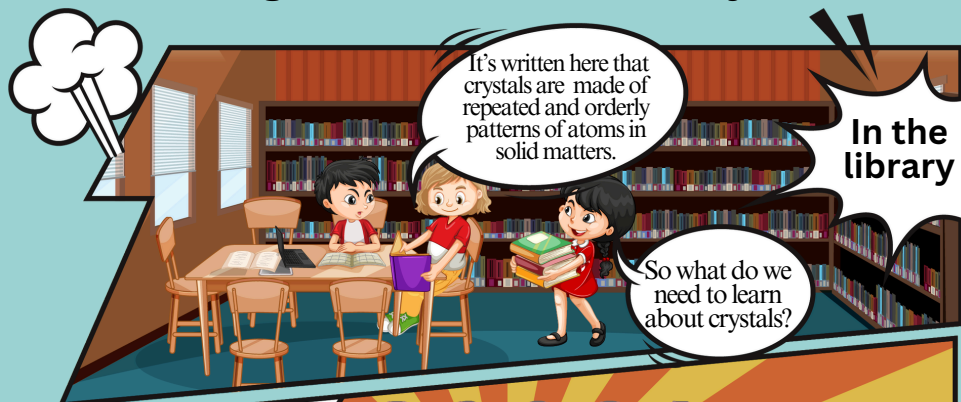
What's an atom?



For example, dusts. They are very tiny, just like atoms.



Mission 2: Arrangement of Atoms in a Crystal





Some of the examples of crystals around us are salt, diamond and quartz!



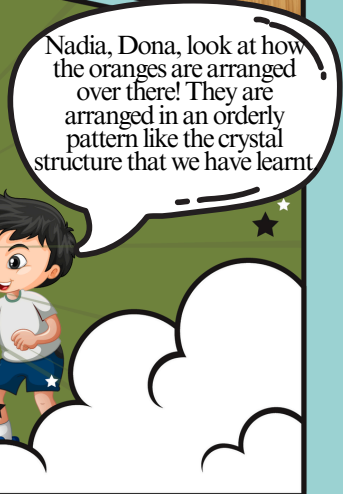
Hey look! That's a beautiful quartz crystal!

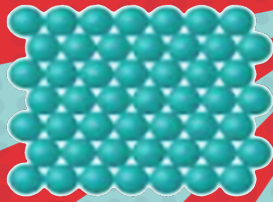


Crystals are amazing! Who would have thought that science can be so interesting!

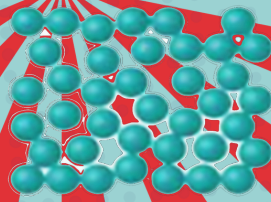


Mission 3: Crystal vs Amorphous





CRYSTAL



AMORPHOUS



That's right! The atoms in the crystals occupy specific spaces within the repeated patterns just like the oranges at the supermarket. Solids can be divided into crystals and amorphous.

The fruits that are not properly arranged are amorphous?



Amorphous are solids that are made up of atoms that are randomly arranged, unlike crystals.

Like glass?



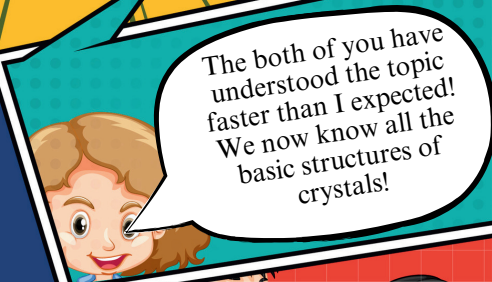
Exactly! That's a great example. Crystals are repeated patterns of atoms and amorphous are randomly arranged atoms.



Oh, like glass! And it's not structure like crystals!



Correct! Glass is a perfect example of an amorphous solid.



The both of you have understood the topic faster than I expected! We now know all the basic structures of crystals!



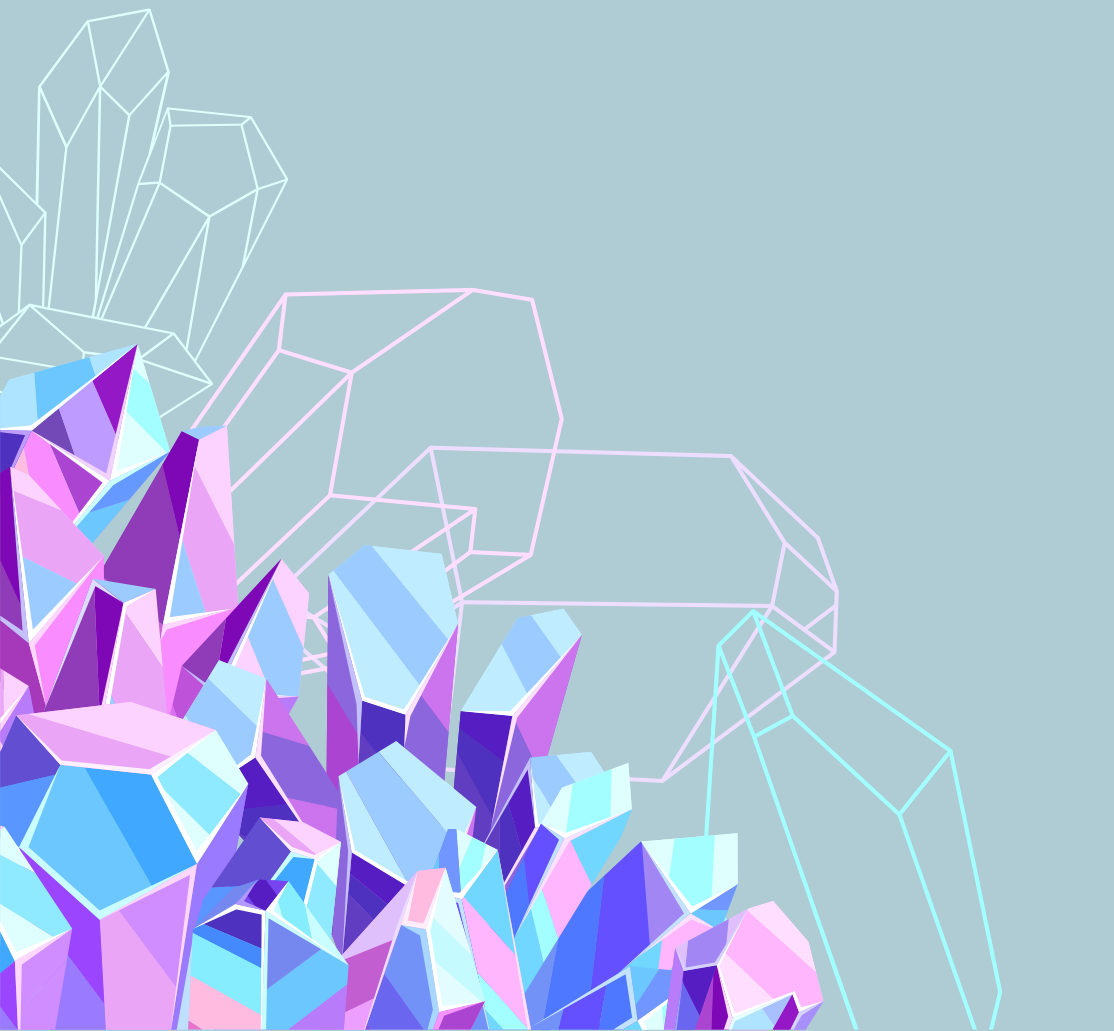
YEAYYY!!



Hooray! We are now crystal experts!

CHAPTER 2

Crystal candy



Chapter 2 Crystal Candy

Adrian, Dona, did you bring the things we need for the science project?

Yes! I have everything here with me!

I can't wait to do the experiment. We will be making crystal candies! Nyum Nyum

We will ask help from Miss Sofia for this science project.

They are walking towards the school laboratory.

Good morning everyone! Sure, I'd love to help you.

Hey Adrian...they are not for eating. They will be used to explain how crystals are made.

Good morning Miss Sofia, could you help us produce crystal candies?

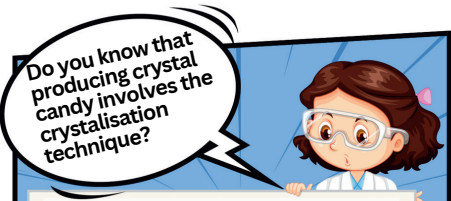
Let us start!

Do you know that producing crystal candies involves the crystallisation technique?

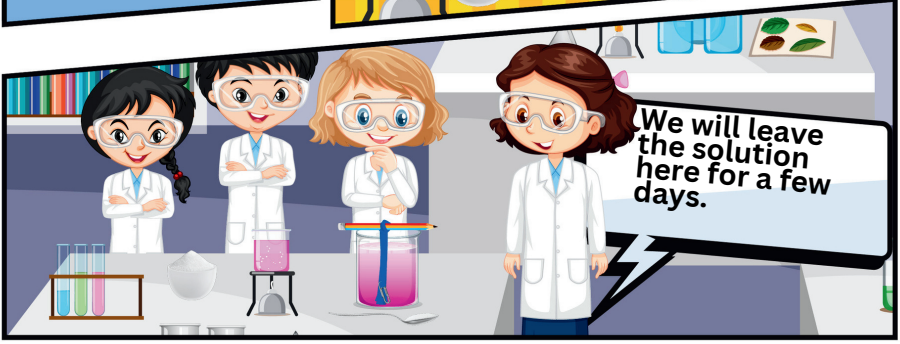
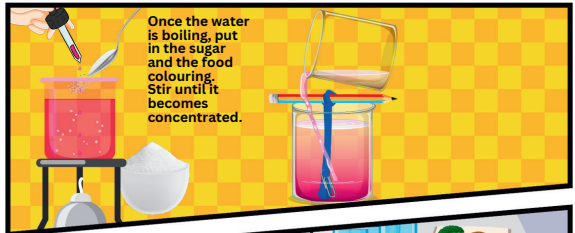
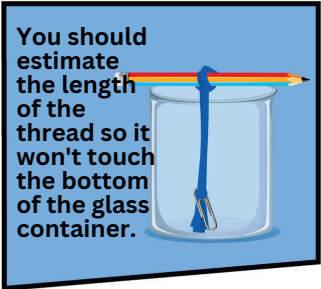
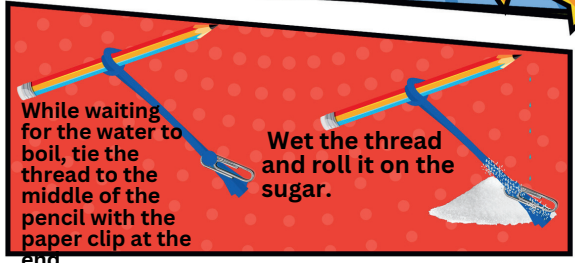
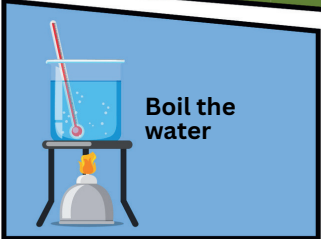
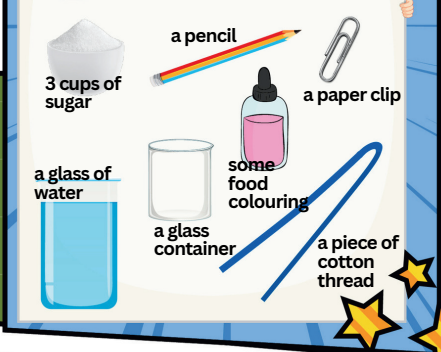
The crystal candies that we are producing come in solid form.

Solids are categorised into crystals and amorphous.

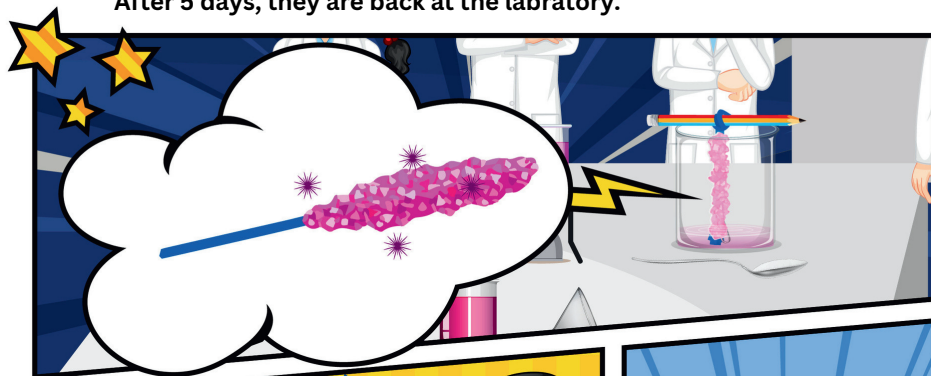
Yes



- The things we need are:
- a glass of water
 - 3 cups of sugar
 - a cotton thread
 - a paper clip
 - some food colouring
 - a pencil

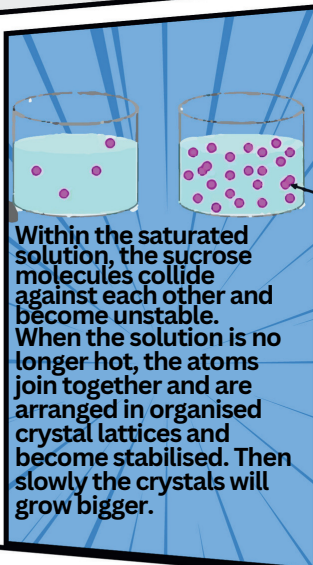


After 5 days, they are back at the laboratory.

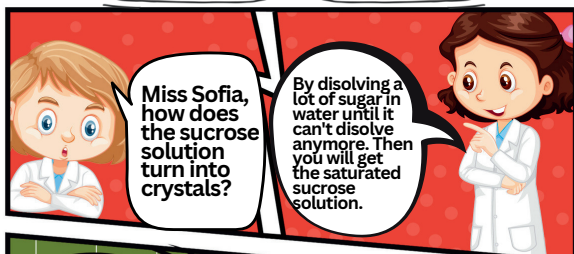


Yeay! ...we made crystal candy!

How beautiful. It's just like my mom's bracelet.

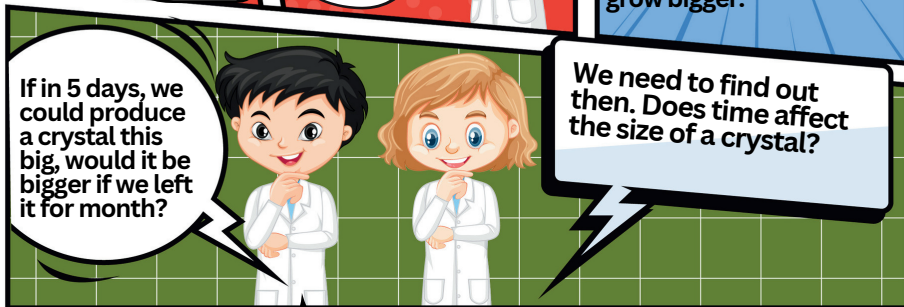


Within the saturated solution, the sucrose molecules collide against each other and become unstable. When the solution is no longer hot, the atoms join together and are arranged in organised crystal lattices and become stabilised. Then slowly the crystals will grow bigger.



Miss Sofia, how does the sucrose solution turn into crystals?

By dissolving a lot of sugar in water until it can't dissolve anymore. Then you will get the saturated sucrose solution.



If in 5 days, we could produce a crystal this big, would it be bigger if we left it for month?

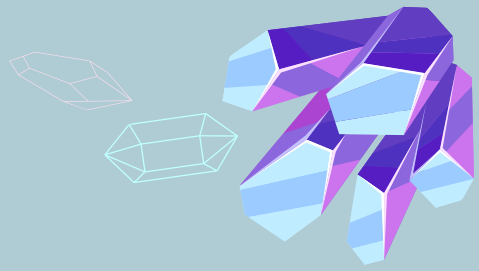
We need to find out then. Does time affect the size of a crystal?



Well done, guys for producing the crystal candies!



Thank you, Miss Sofia!

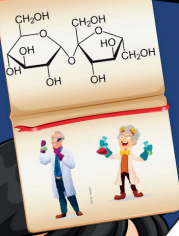


CHAPTER 3

Sucrose structure



Chapter 3 Sucrose Structure



Come and look...here's a sugar structure known as sucrose.



Sucrose is made of carbon, oxygen and hydrogen atoms. It was found by two scientists named G.M. Brown and H.A.

Oh? I didn't know that! But how do they know that it's a sucrose structure?



They used the x-ray diffraction technique. The first step involves the growth of high quality sucrose crystals.



Next, the crystals are exposed to the x-ray and the diffraction pattern is collected to determine the crystal structure. The machine is called the Single Crystal X-ray Diffractometer.



Then, crystallographers will analyse the data. Crystallographers are scientists who study the atom pattern in crystal solids.

Could you please explain that again?

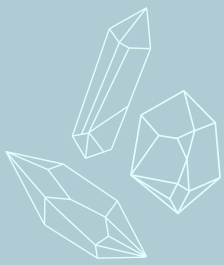
Imagine you have crystals that are arranged like tiny and organised building blocks. To see how the blocks are arranged, scientists emit the x-ray on them. When the x-ray reaches the crystals, it will be reflected to a different direction, producing dotted patterns like fingerprints that are unique.



WOW

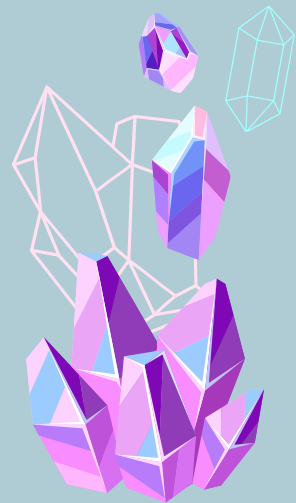
This field of study is called crystallography.

By studying the dotted pattern, the scientists could see exactly how the blocks which are actually atoms, are being arranged in the crystals.

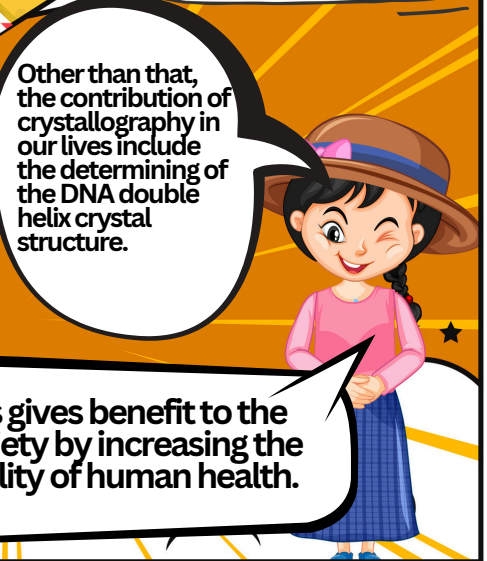
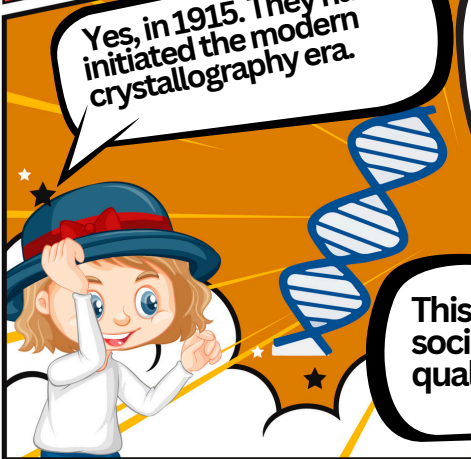
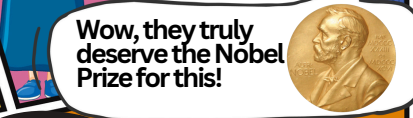
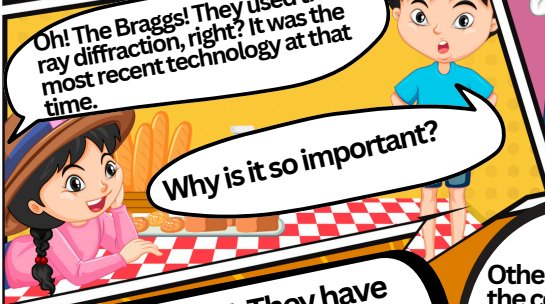
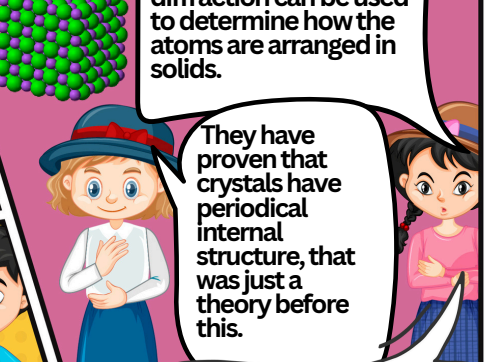


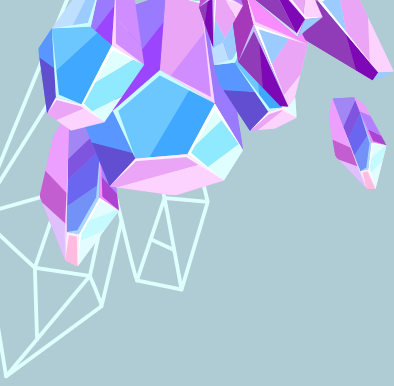
Chapter 4

The History of Crystallography



Chapter 4 The History of Crystallography





Chapter 5

The Magical World of Crystallography



Chapter 5 The Magical World of Crystallography



Nadia fell into a rabbit hole and came into a world of glittering and colourful crystals.



AHHHHHHHHHHHHH!!!!



Oh no! Where am I? This place is so bright and glittery!

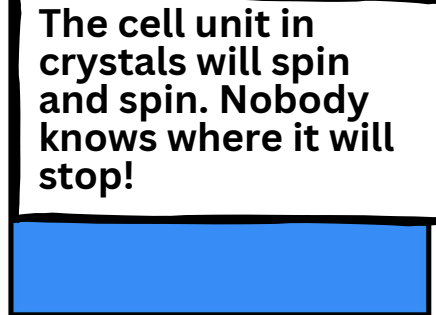
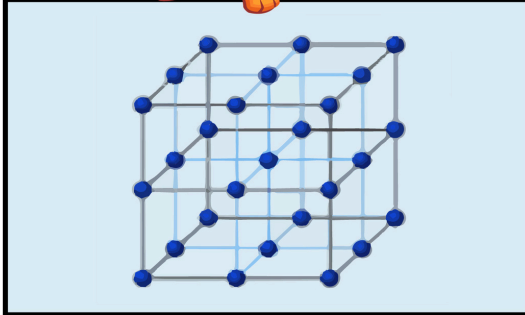
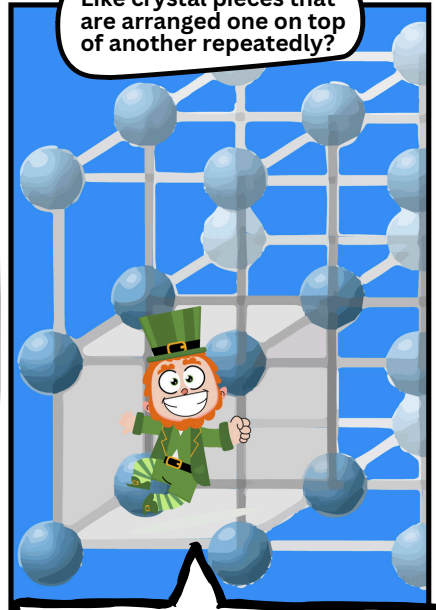
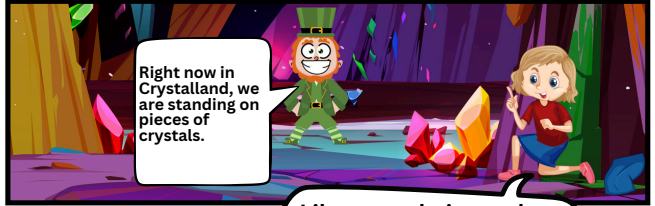


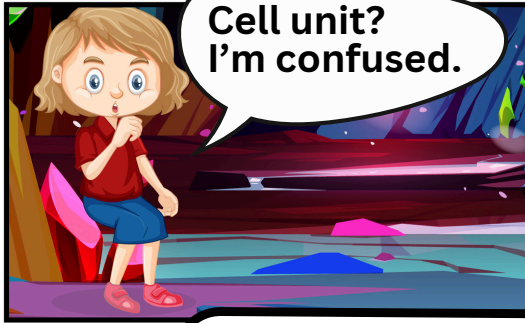
Nadia, my dear.. Crystals have preferred directions of breaking! This is the basis of crystallography!



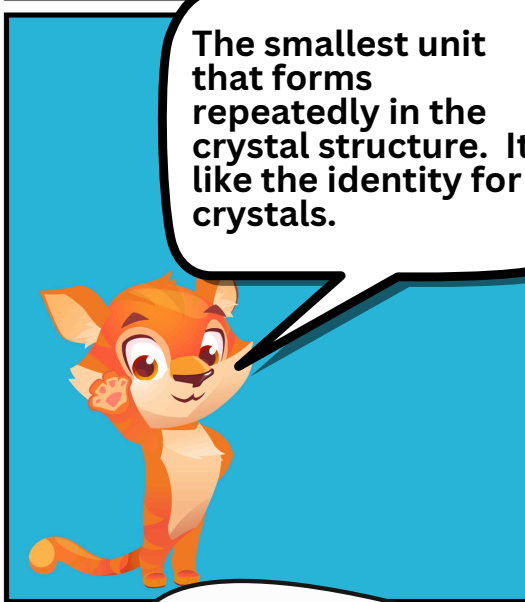
You are now in Crystalland! Mind your step. We don't want the crystals to crack, do we?

What do you mean, Mr. Oyen?

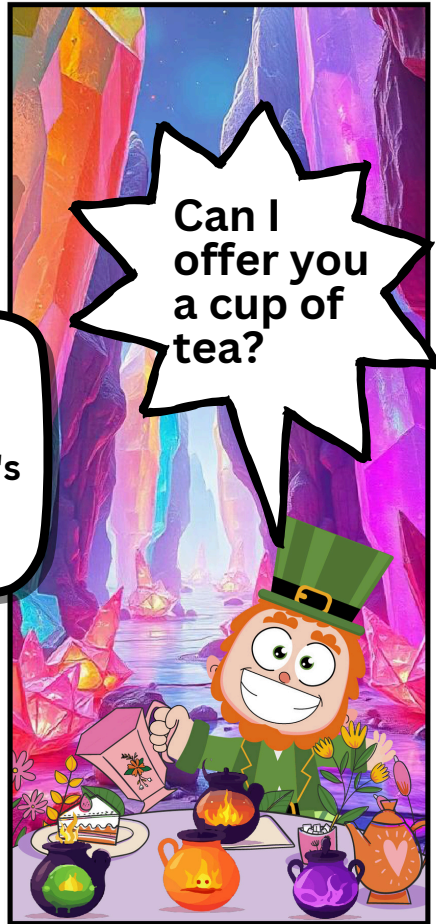




Cell unit?
I'm confused.



The smallest unit that forms repeatedly in the crystal structure. It's like the identity for crystals.



Can I offer you a cup of tea?



I need to wake up from this dream now.



Come on, Nadia! Let us go Mexico!

Mexico's Giant Crystal Cave



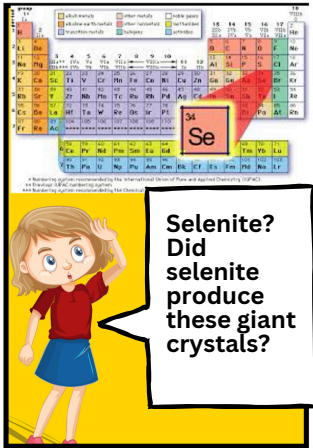
Oh dear...
It's so hot in
here! Oh
wow...the
crystals
here are
really big!



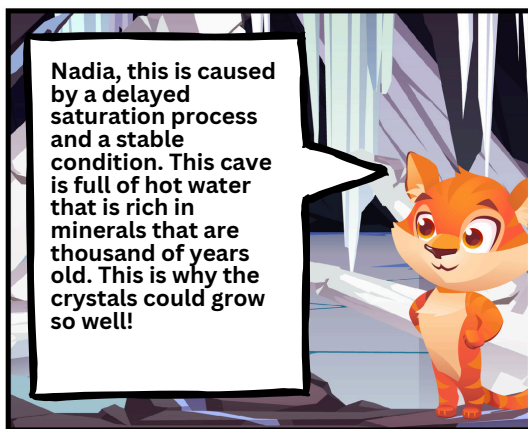
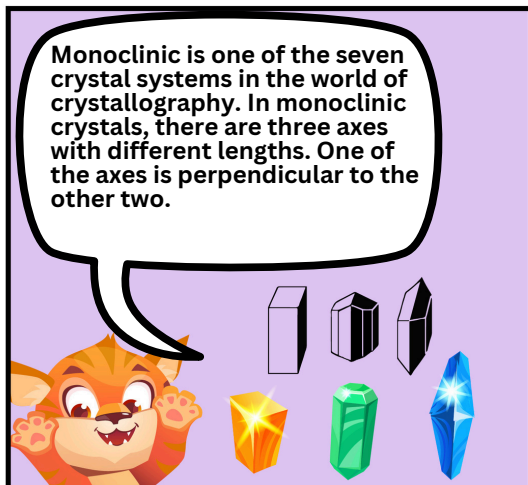
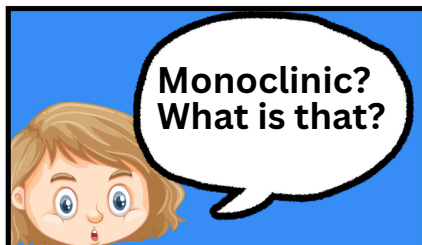
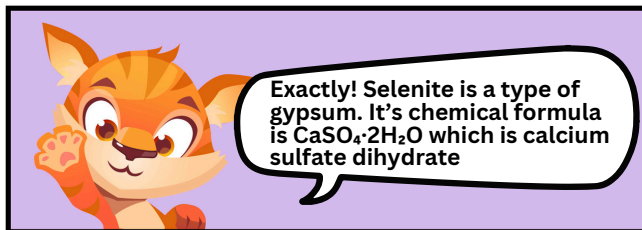
Of course! We are
now in a crystal
cave, which is part
of the Naica mines
in Chihuahua,
Mexico. We are
now at least 980
feet underground
and the
temperature is
136°F with the
moisture level of
90 to 100%!



Crystals can
grow really big
in conducive
environments.
My dear Nadia,
this beautiful
selenite has
grown for
almost 500 000
years!



Selenite?
Did
selenite
produce
these giant
crystals?



It's like being in a giant geod. I've never imagined crystals could become huge like this!



That's the beauty of crystallography. It helps us understand how atoms could self-arrange to form fascinating structures- from snow flakes to giant selenite crystals.



Actually, if the surroundings change even for a bit, these crystals will go through distortion.

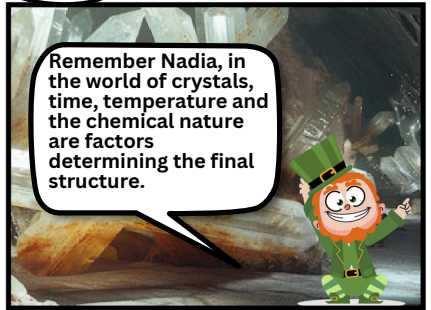
Oh no! Is it dangerous?



That's why this cave has to be protected. The surroundings need to be conserved to retain the magic of crystallography for research and future display.



Remember Nadia, in the world of crystals, time, temperature and the chemical nature are factors determining the final structure.



I am beginning to understand this. Crystallography isn't just about beautiful shapes and forms but about understanding the basics of building blocks.



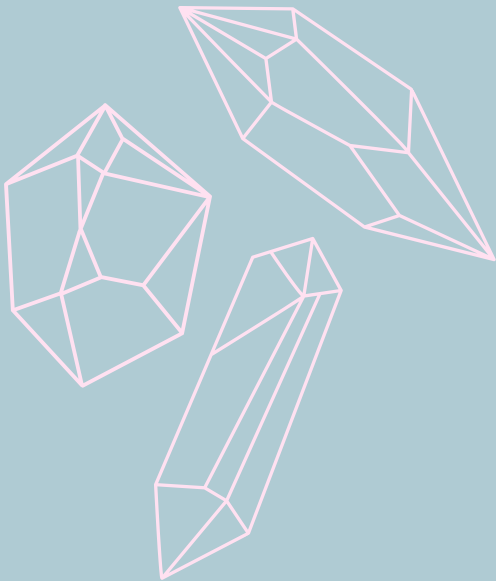
Help!
Help!



Ohhhh...it was just a dream. I need to tell Dona and Daniel. In the dream everything seems so real.



"Crystallography reveals the hidden beauty of nature, where the tiniest atoms dance together to form the magnificent structures that shape our world."



THE END

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