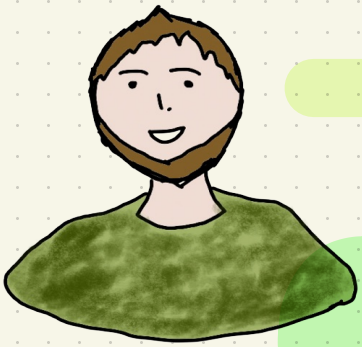
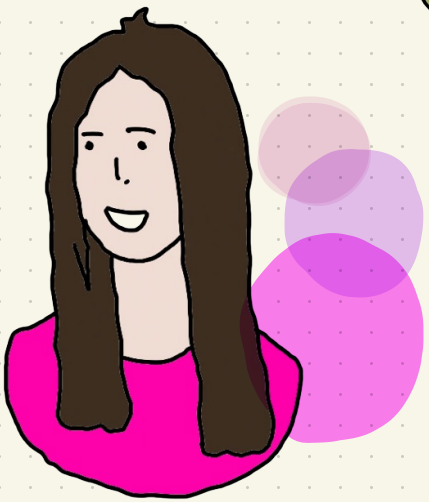

There is crystallochemistry
between us
CCDC
UNIVERSITÀ
DI PARMA
sma
SISTEMA
MUSEALE
DI ATENEO
©Giuditta Cicconi

Let us introduce ourselves

Alessia

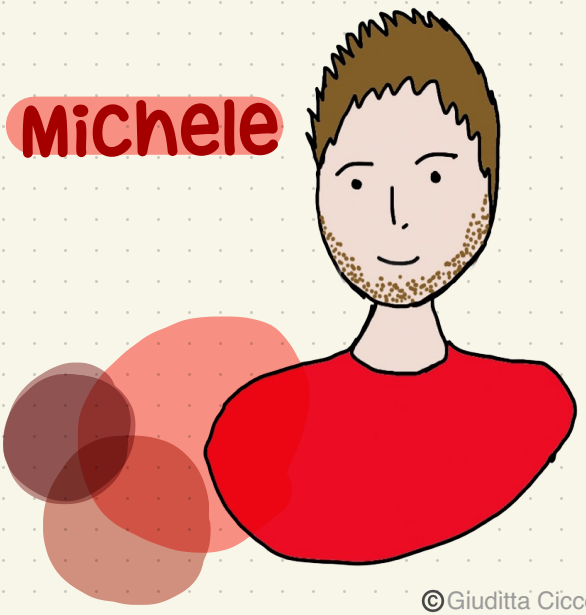


Paolo



Giuditta

Michele



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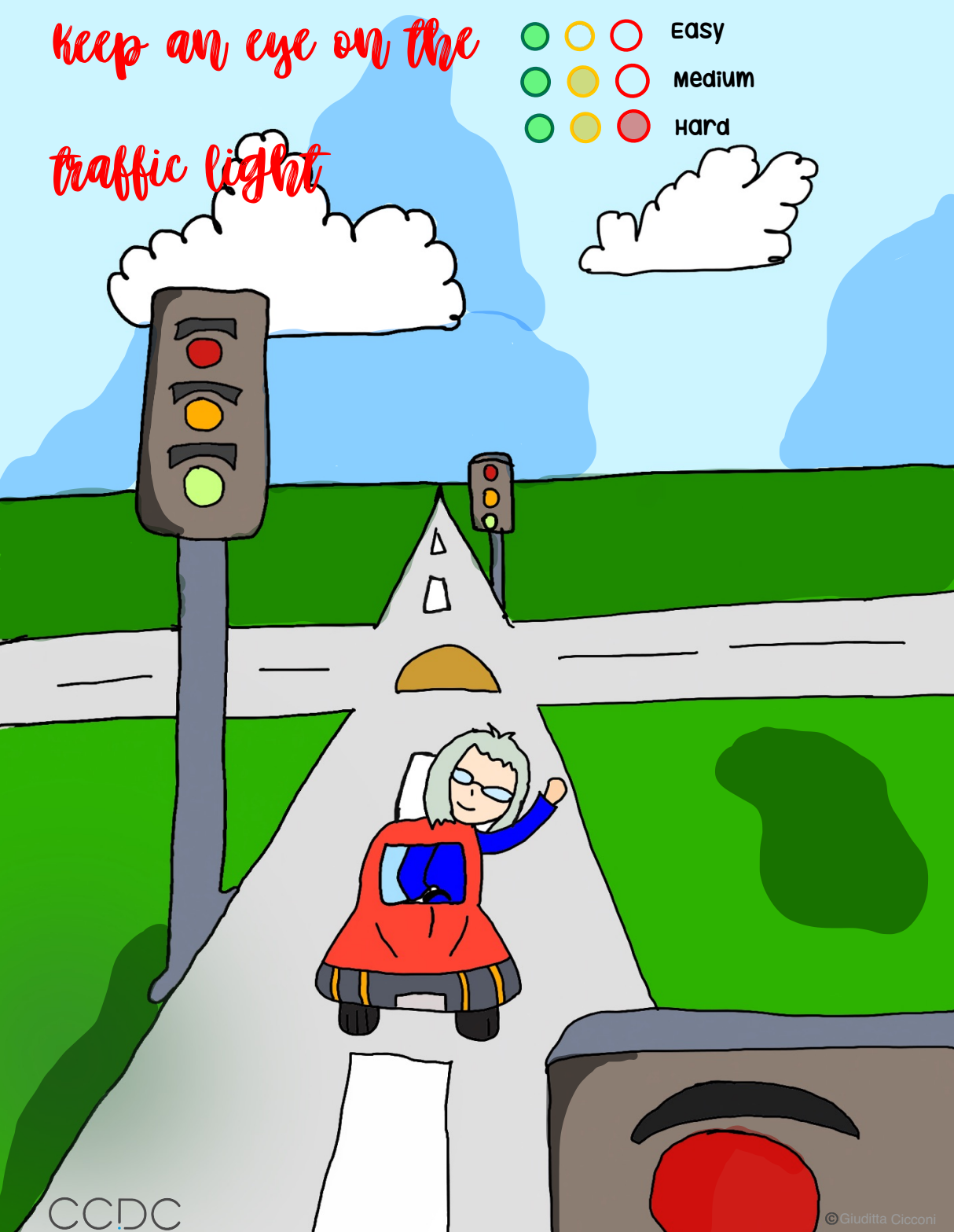
keep an eye on the traffic light

Easy
Medium
Hard



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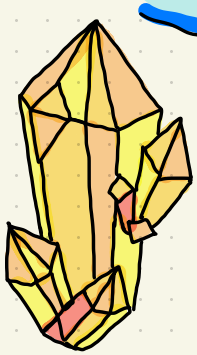
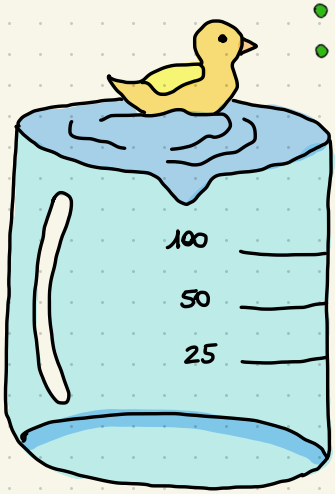
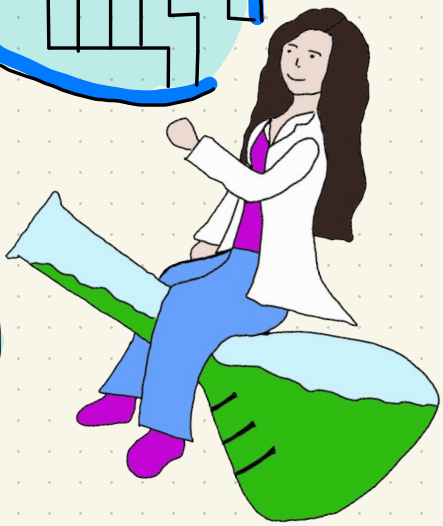
The lab is a giant maze!

Help me find the crystal I lost among the flasks!

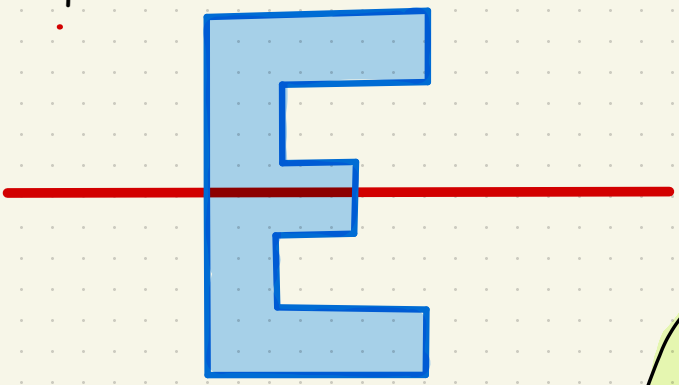






Let's play with symmetry!

Look at the picture below.



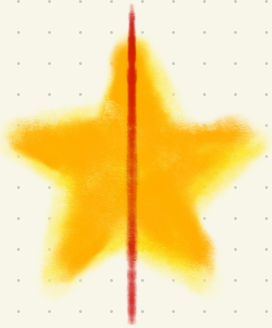
The red line cuts the picture into two perfetcly equal parts.

All the objects that can be divided into two or more equal parts by something, called an "element of symmetry", are called **SYMMETRICAL OBJECTS**.

The elements of symmetry can be axes (as represented above), planes (if we consider also the third dimension) and points too.

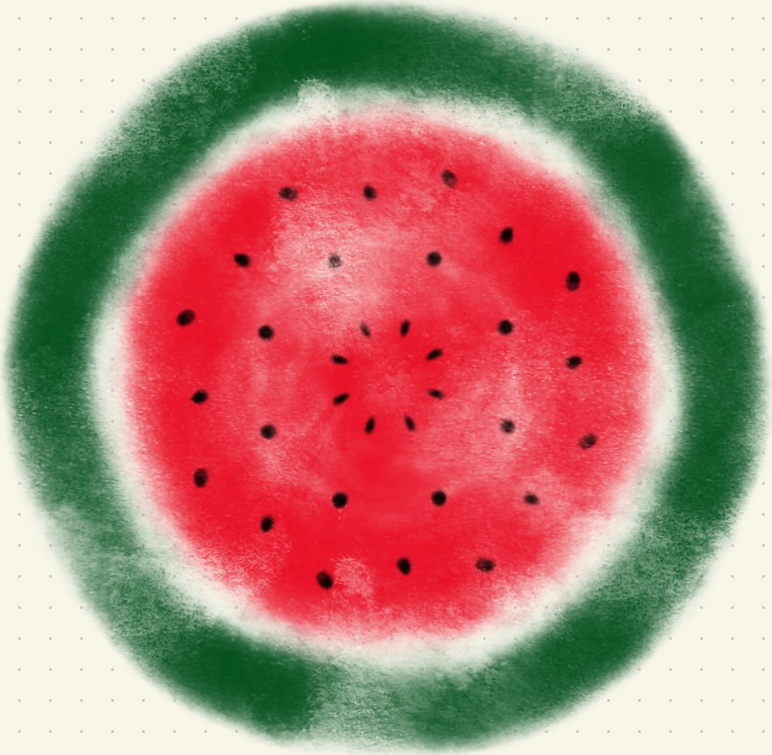
1) FIND AND DRAW, IF THERE ARE ANY, THE AXES OF SYMMETRY.

2) Draw the missing axes of symmetry

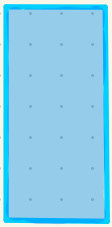


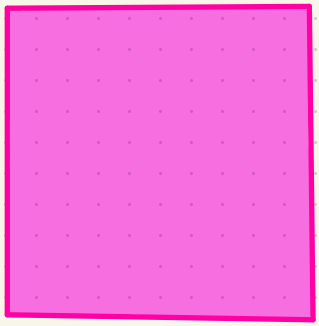
3) Crop the watermelon below, and put a pencil through its centre.
Now spin it faster and faster: what do you see?

In this case, we can call the pencil a "**ROTATION AXIS**", because the picture you cropped doesn't change by rotating (spinning) it.



4) Imagine to spin all the figures represented below.
Do they have one or more rotation axis? For which angles?



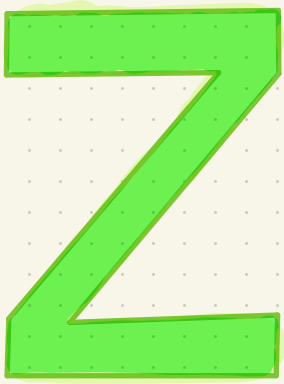


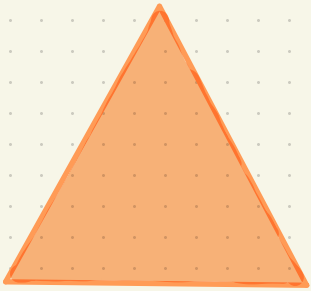
ANGLES

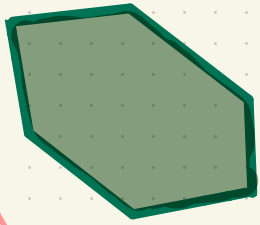
90° - right angle

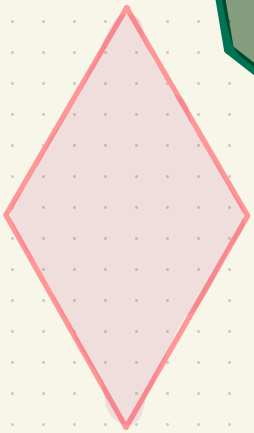
180° - flat angle

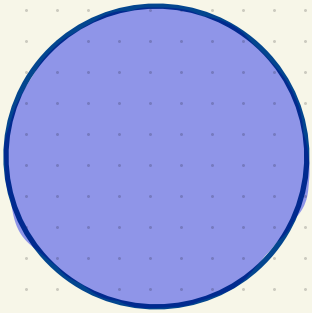
120° - obtuse angle









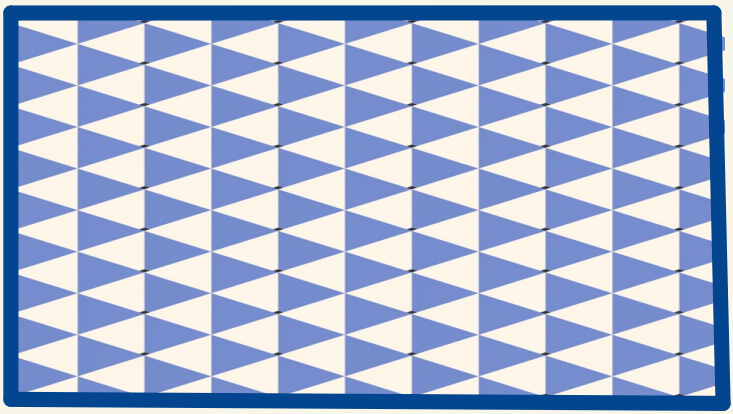


Let's play with patterns!

When you repeat many times the same shape, following a certain order, you create a "PATTERN".

In a crystal, atoms or molecules are displayed periodically in a precise order, without leaving any portion of space empty.

The tricky thing is, not every geometric shape can completely fill a 2D (or a 3D space).



EXAMPLE:

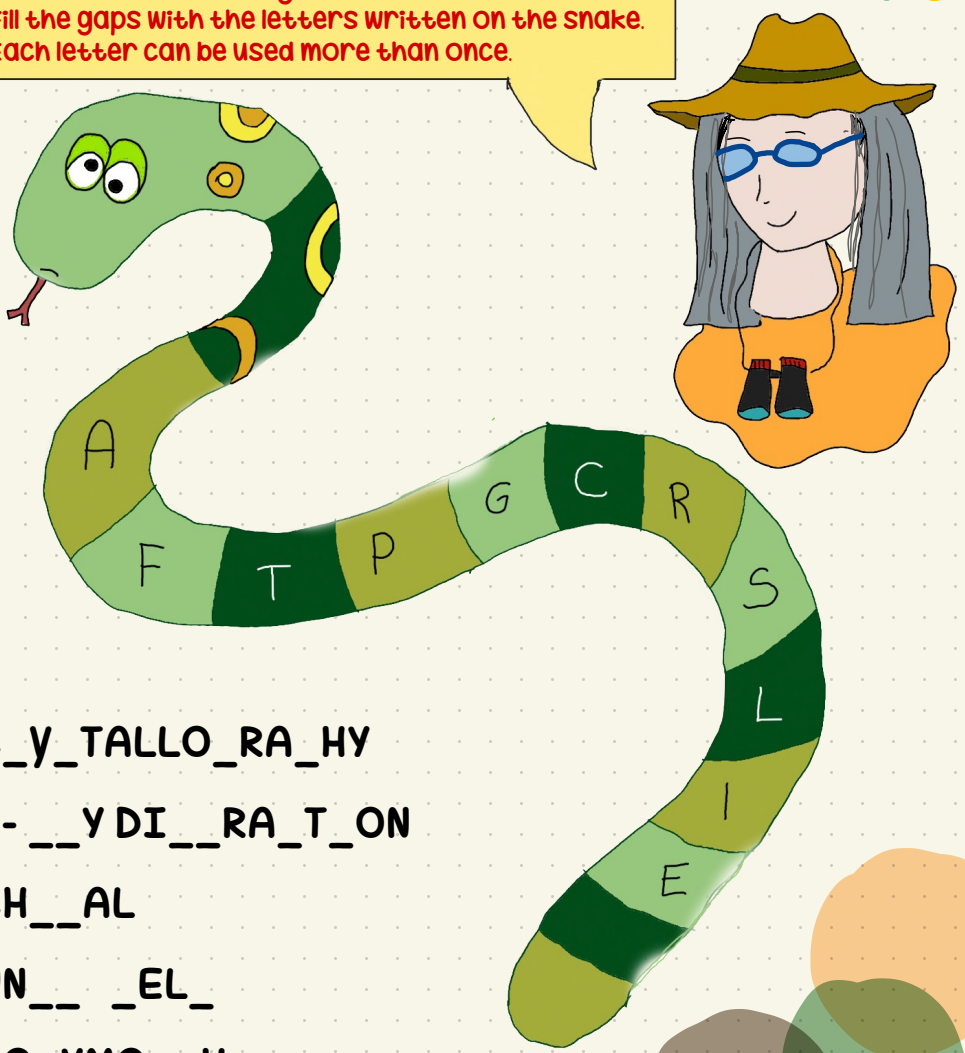
This is a pattern created using triangles. The triangles can be displayed without leaving any empty space between them.

Is it possible to create a pattern with these shapes?

Parallelograms

Pentagons

The snake was starving and ate some letters!
Fill the gaps with the letters written on the snake.
Each letter can be used more than once.



C_Y_TALLO_RA_HY

X-__Y DI__RA_T_ON

CH__AL

UN__ _EL_

_O_YMO__H

A__O_RO_E

_RA_H_TE

ID_OXY_PATH_IT_

_RY_TAL _AT__CE

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ROSALIND FRANKLIN: a story about an incredible scientist and how sometimes life is not fair.
Fill the gaps with the words written below.

Rosalind Franklin

WORDS

DNA, British, 1920, X-ray diffraction, Watson, Crick, Nobel, 1958, London.

Rosalind Franklin was a _____ scientist and crystallographer, who was born in _____ in ____.

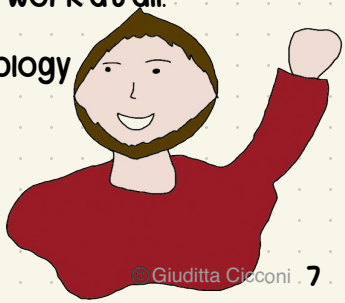
Today she is well known for her beautiful pictures of the double helix of ___, obtained by _-___ _____.

Anyway, two scientists of the cambridge university, _____ and _____, stole her work and put their names on it.

Rosalind Franklin died in ____, after a long illness and without being awarded for her discoveries.

In 1962, watson and crick received the _____ prize for discovering the structure of DNA, and they didn't refer to Franklin's work at all.

Rosalind Franklin's contribution to chemistry and biology was recognized by thescientific community many years after her death.



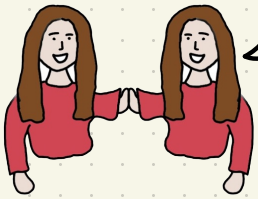
The lab is a mess! Help with the tidying up looking for:

- a rubber duckie and a bag
- two boxes ordered on the Net, a fast-food paper bag
- a turtle and a pink, smiling jelly
- an intruder and a smiling little ball
- something left on the floor by the intruder

I'm doing the stock list: how many flasks and Erlenmeyer flasks you can count in the labware closet?

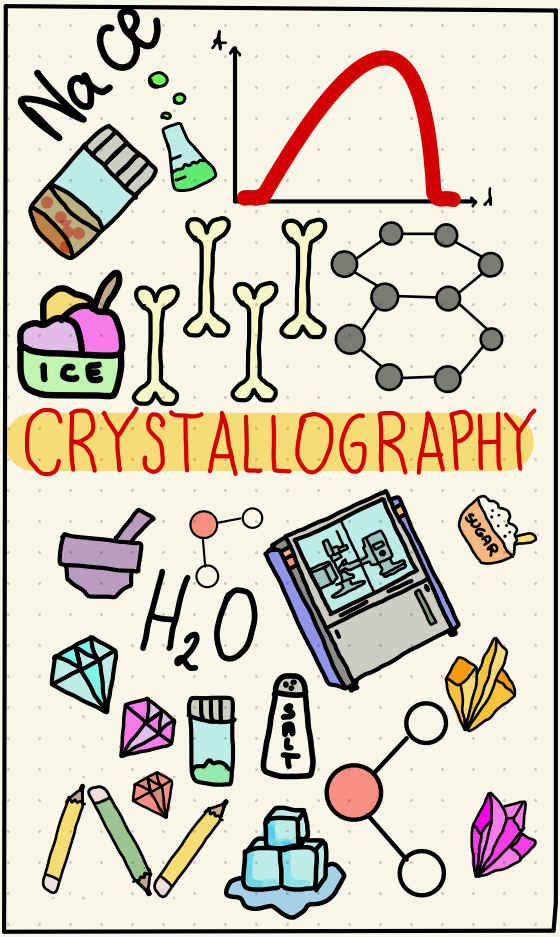
FLASKS:

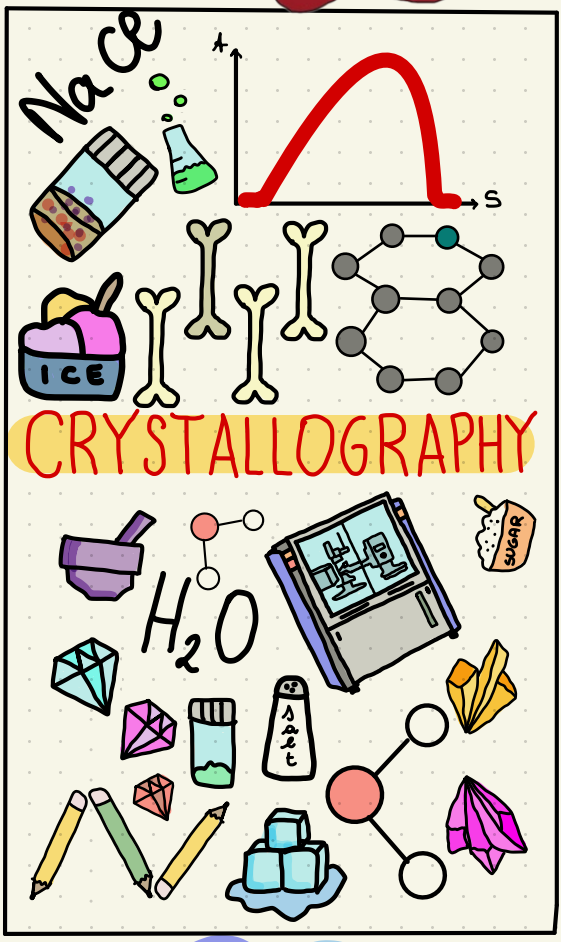
ERLENMEYER FLASKS:



Just one crystal has its twin! can you find them?

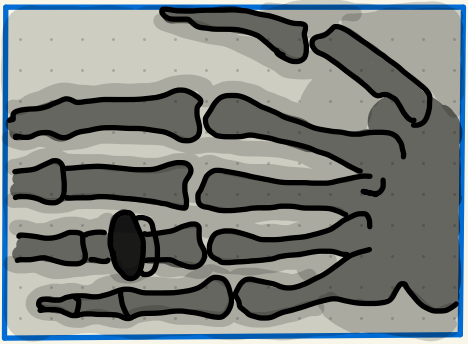
Find the 10 differences in the pictures below





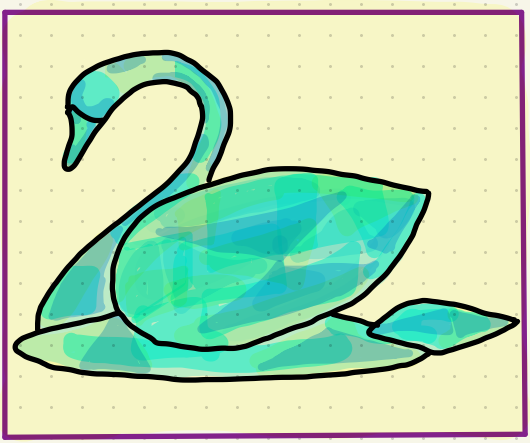
Gotta catch 'em all

How bizarre



Roentgen discovered x-rays, but he used his wife as lab rat for his first experiments. The famous picture represents his wife's hand with a giant ring!

In Mexico there is a cave, known as Naica cave, where crystals longer than 15 metres and wider than 2 metres grow naturally



Famous swarowsky crystals are just made of frosted glass!
And as you may know, glass is not a crystal, but an amorphous solid!

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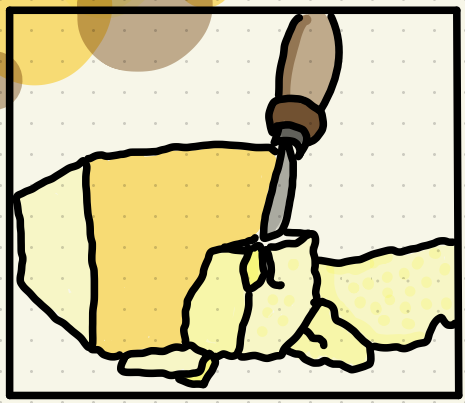
Michele couldn't catche the bus and he is now late for chemistry class! Help him reach the class at centre of the building.

Crystals in disguise

Inside ice-cream you can find tiny ice crystals, mixed with sugar in a well defined proportion. When ice-cream is left in the fridge for some days, the number of ice crystals grows: now the proportion is lost and ice-cream is not as tasty as it was.

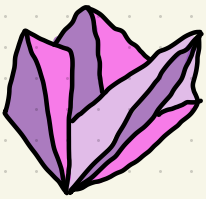
Did you know that pencil leads are made of graphite? Graphite is a crystalline and carbon-based material, where atoms are displayed in layers and, in each layer, they are found in an hexagonal pattern, just like a beehive!

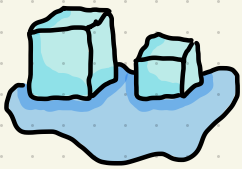


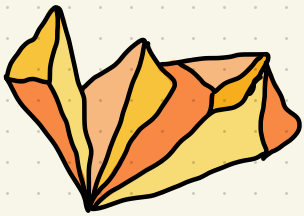
Have you ever eaten Parmesan cheese? If yes, you may have noticed some white spots on it surface: no worries, it's not mold, those spots are just tyrosine crystals, and they are index of long seasoning. That cheese will be delicious!

Match the crystals (on the left) to their use in everyday life (on the right)

Sucrose	Ice cream
Tyrosine	Watches
Silicon	Cheese
Sodium chloride	Jewelry
Graphite	Salt
Diamond	Technology
Quartz	Pencils
Ice	Sugar







Read the text and answer the questions: true or false?

There's magic in chocolate

Chocolate: just hearing this name is enough to imagine how a piece of it would melt in your mouth. It's so yummy an tasty!.

And then…you leave it in the fridge for more or less a week and what happens?

On its surface you can see a white powder, and the chocolate is not as tastier as it was. But why?

Inside chocolate there are many cocoa butter crystals, that can be ordered in six different ways, each one of them is called "polymorph". Sadly, not all the six polimorphs are yummy to eat: just the so called "polymorph 5" is! Leaving the chocolate in the fridge for a while, polymorph 5 becomes "polymorph 6", with different chemical and physical properties, such as the melting point. Don't worry! Polymorph 6 is just less tastier than polymorph 5, but you can eat it as well!

1) There aren't crystals in chocolate. True or false?
2) Chocolate doesn't change with time. True or false?
3) Leaving chocolate untouched for a while, ploymorph 5 becomes polymorph 6: True or false?
4) Polymorph 5 is white chocolate, while polymorph 6 is dark chocolate. True or false?
5) You can still eat polymorph 6 chocolate: true or false?

Another polymorph in the wall

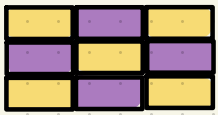
A crystal is a solid material where atoms, or molecules or even ions are packed and ordered in 3D space.

The same atoms (or molecules) can be ordered in different ways, called polymorphs. Now imagine that the bricks represented below are atoms (or molecules). By imaging the walls in three dimensions, can you say which wall is a crystal? And which walls are polymorphs with respect one to another ? you can use each brick more than once.

BRICKS:

WALLS:

1)



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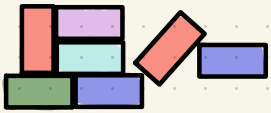

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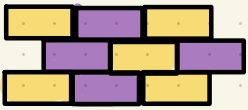

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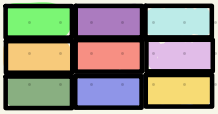
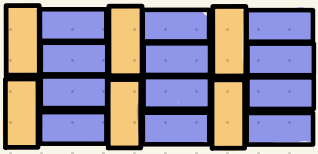


5)



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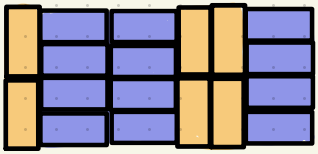

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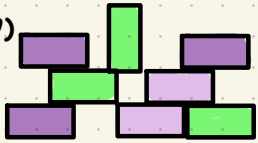

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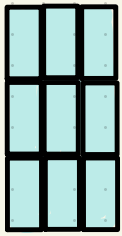

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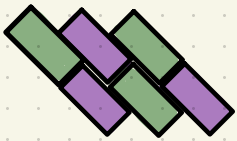

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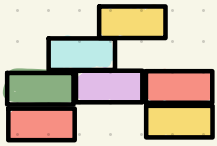
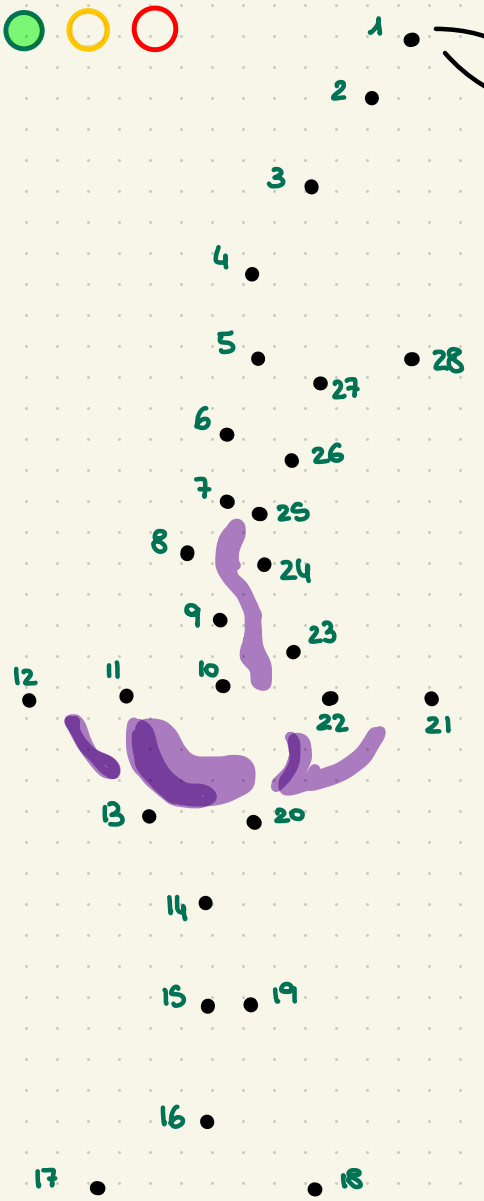


connect the dots: what can you see?



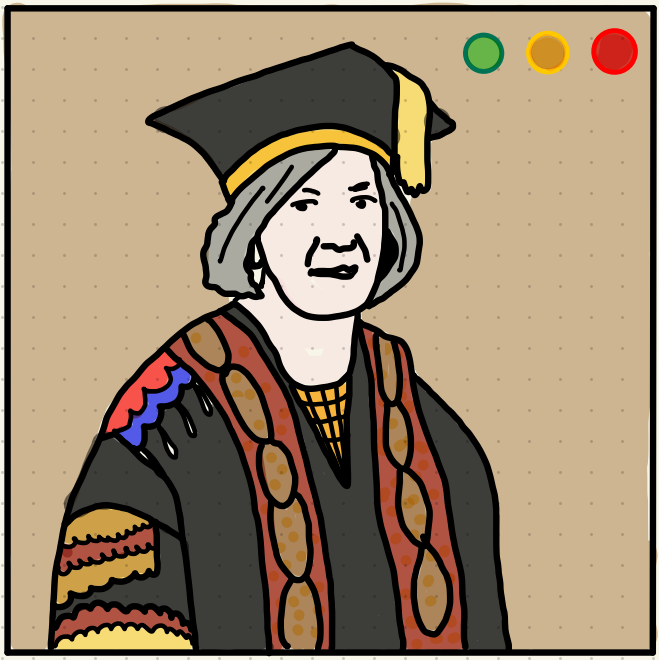
... I can see

Tartrate crystals

on the bottom of w__e b_____s, you can find some very particular crystalline sediments of some salts: these are tartrate crystals!
These crystals exists in two forms, and one is the mirror image of the other. such compounds, as well as tartrate crystals, are known to be "chiral".
something is chiral if its image can't be overlapped to its mirror image, just like our hands.

can you think about some other chiral objects in everyday life?

Dorothy Crowfoot Hodgkin



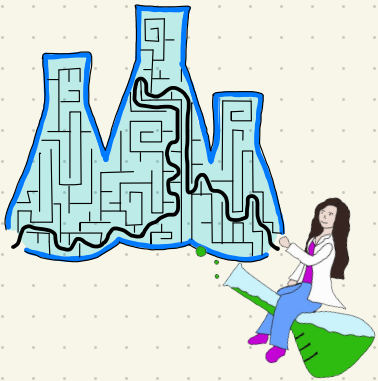
Read the text and choose the correct option.

Dorothy Hodgking was born in Cairo, Egypt, in 1910. She was a british scientist and crystallographer who lived and worked during the 20th century/ 19th century Thanks to her discoveries in the field of crystallography/ quantum chemistry, she won in 1964 the Nobel prize for chemistry/ Fields Medal.

In 1934, while she worked at the Oxford University, she succeded in capturing, using X-ray diffraction, the structure of insuline, a very important antibiotic/hormone as far ad physics/biology is concerned. In the following years, Hodgkin captured by X-ray diffraction the structure of fundamental other atoms/other molecules, for example cholesterol and penicillin, a very important antibiotic/ dangerous virus. Sadly, in those old times, women contributions were not considered among the scientific comunity, which there were almost only men, but Dorothy Hodgking was an incredible scientist and crystallographer anyway. She died in Shipstone-on-Stour in 1910/ 1994.

solutions

pag. 1



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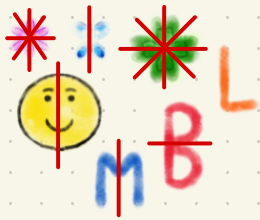
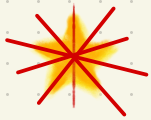


pag. 3



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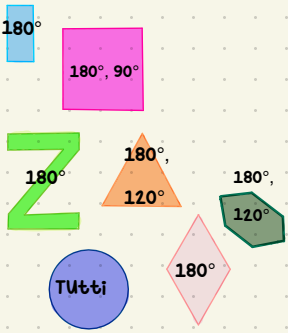

pag. 5

Parallelograms: YES

Pentagons: NO

pag. 6

CRYSTALLOGRAPHY
X-RAY DIFFRACTION
CHIRAL
UNIT CELL
POLYMORPH
ALLOTROPE
GRAPHITE
IDROXYAPATHITE
CRYSTAL LATTICE

pag. 7

Rosalind Franklin was a British scientist and crystallographer, who was born in London in 1920.

Today she is well known for her beautiful pictures of the double helix of DNA, obtained by X-RAY diffraction.

Anyway, two scientists of the cambridge university, Watson and Crick, stole her work and put their names on it.

Rosalind Franklin died in 1958, after a long illness and without being awarded for her discoveries.

In 1962, Watson and Crick received the Nobel prize for discovering the structure of DNA, and they didn't refer to Franklin's work at all.

Rosalind Franklin's contribution to chemistry and biology was recognized by the scientific community many years after her death.

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FLASKS: 19

ERLENMEYER FLASKS: 15

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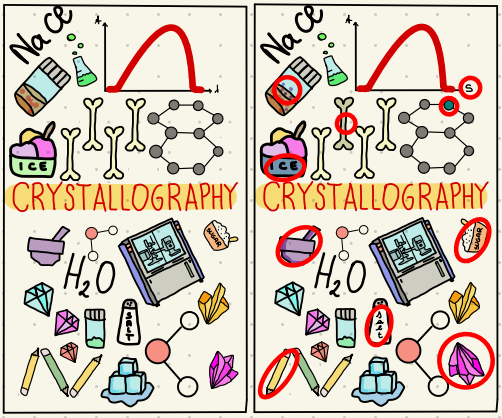
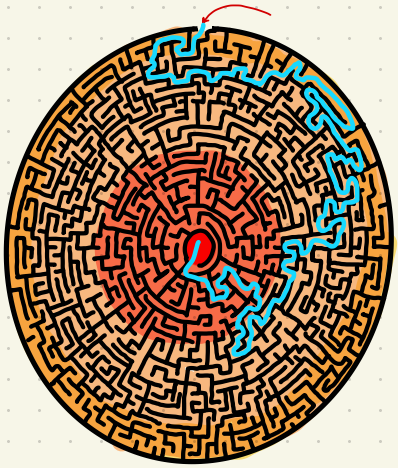
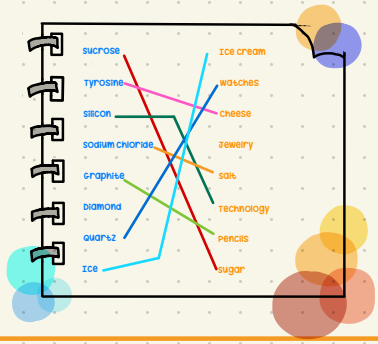
Pag. 11



Pag. 13



Pag. 15



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False

False

True

False

True

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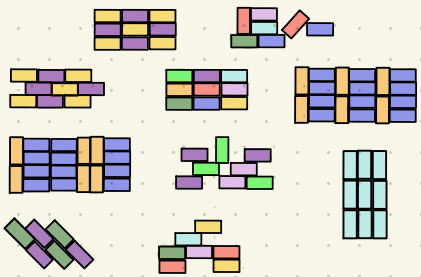
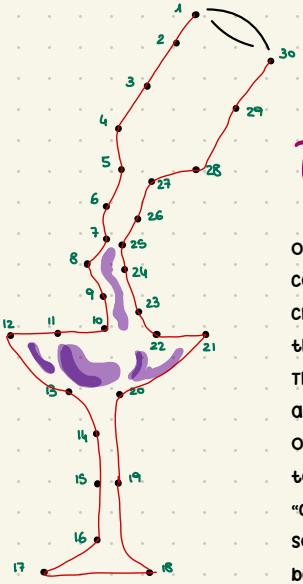
crystals: 1,3,5,6,8,9

polymorphs: 1 e 3, 5 e 6





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... I can see wine being poured in a glass

Tartrate crystals

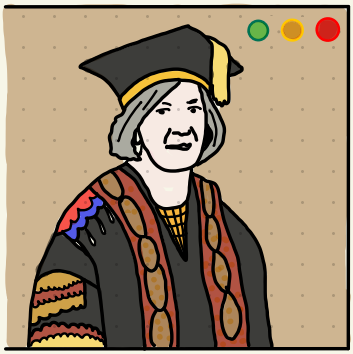
on the bottom of wine bottles, you can find some very particular crystalline sediments of some salts: these are tartrate crystals!
These crystals exists in two forms, and one is the mirror image of the other. such compounds, as well as tartrate crystals, are known to be "chiral".
something is chiral if its image can't be overlapped to its mirror image, just like our hands.

Can you think about some other chiral objects in everyday life?

scissors

Pag. 19

Dorothy Crowfoot Hodgkin



Read the text and choose the correct option.

Dorothy Hodgking was born in Cairo, Egypt, in 1910. She was a british scientist and crystallographer who lived and worked during the 20th century/ ~~20th century~~. Thanks to her discoveries in the field of crystallography/ ~~quantum chemistry~~, she won in 1964 the Nobel prize for chemistry/ ~~Fields Medal~~.

In 1934, while she worked at the Oxford University, she succeded in capturing, using X-ray diffraction, the structure of insuline, a very important ~~molecule~~/hormone as far ad ~~physics~~/biology is concerned. In the following years, Hodgkin captured by X-ray diffraction the structure of fundamental ~~other atoms~~/other molecules, for example cholesterol and penicillin, a very important antibiotic/ ~~danger old times~~. sadly, in those old times, women contributions were not considered among the scientific comunity, which there were almost only men, but Dorothy Hodgking was an incredible scientist and crystallographer anyway. She died in Shipstone-on-Stour in ~~1994~~ 1994.

I'd like to thank the cambridge crystallographic data centre in cambridge (UK) for the opportunity granted and the funds provided to ensure the creation and spreading of this document.