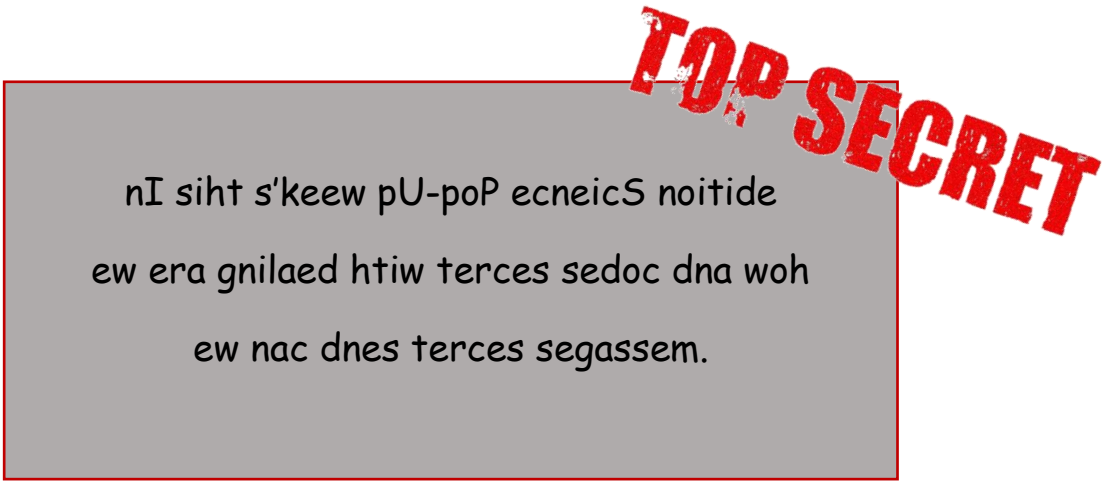
Top secret!

To find out with which topic we are dealing in this week's edition of Pop-Up Science, you have to decipher this secret language:



Hint: Read the single words from right to left!

Then write down one word after the other.

_____

_____

_____

A. Read the following text and underline the most important pieces of information!

A secret code is a special language that is only intended for a selected group of people. All other people should not be able to read the message. Writing in a secret code is a way to communicate secret information. For example, messages can be written with invisible ink. A piece of paper then looks totally blank, although something has been written on it. This type of secret writing is called steganography. For example, ink eraser, onion or lemon juice can be used as invisible ink. Through heat or some other treatment, the writing becomes visible. You will find detailed instructions about how to create invisible ink from lemon juice in part C of this worksheet.

If messages are encrypted using a certain code, other people can see the message, but they do not understand it. Only if you know the code, you can decode the message. This type of secret writing is based on a method called cryptography. Did you know that this word is Greek and means "hidden writing"?

Cryptography plays an important role in banks, secret services or on the internet. It is very important that top secret information is not decoded by the wrong people. Also, digital currencies such as the Bitcoin make use of cryptography, which is why it they are called “cryptocurrencies”. Many modern encryption methods can only be solved by computers. This is because heavy calculations are necessary for decoding. The more difficult it is to crack the code, the safer is it is!

Prime numbers are very important in cryptography. These are natural numbers that can only be divided by the number one and by themselves (e.g. the numbers 3, 7 or 11). Multiplying two prime numbers creates a key with which information can be encrypted on the internet. Finding out which two prime numbers were used for the code is hard. This can only be done by computers with a very strong computing power. Therefore, encryption with prime numbers can be very safe!

B. Crossword puzzle

Answer each question with one word. Write this word in the appropriate line of the crossword puzzle on the next page.

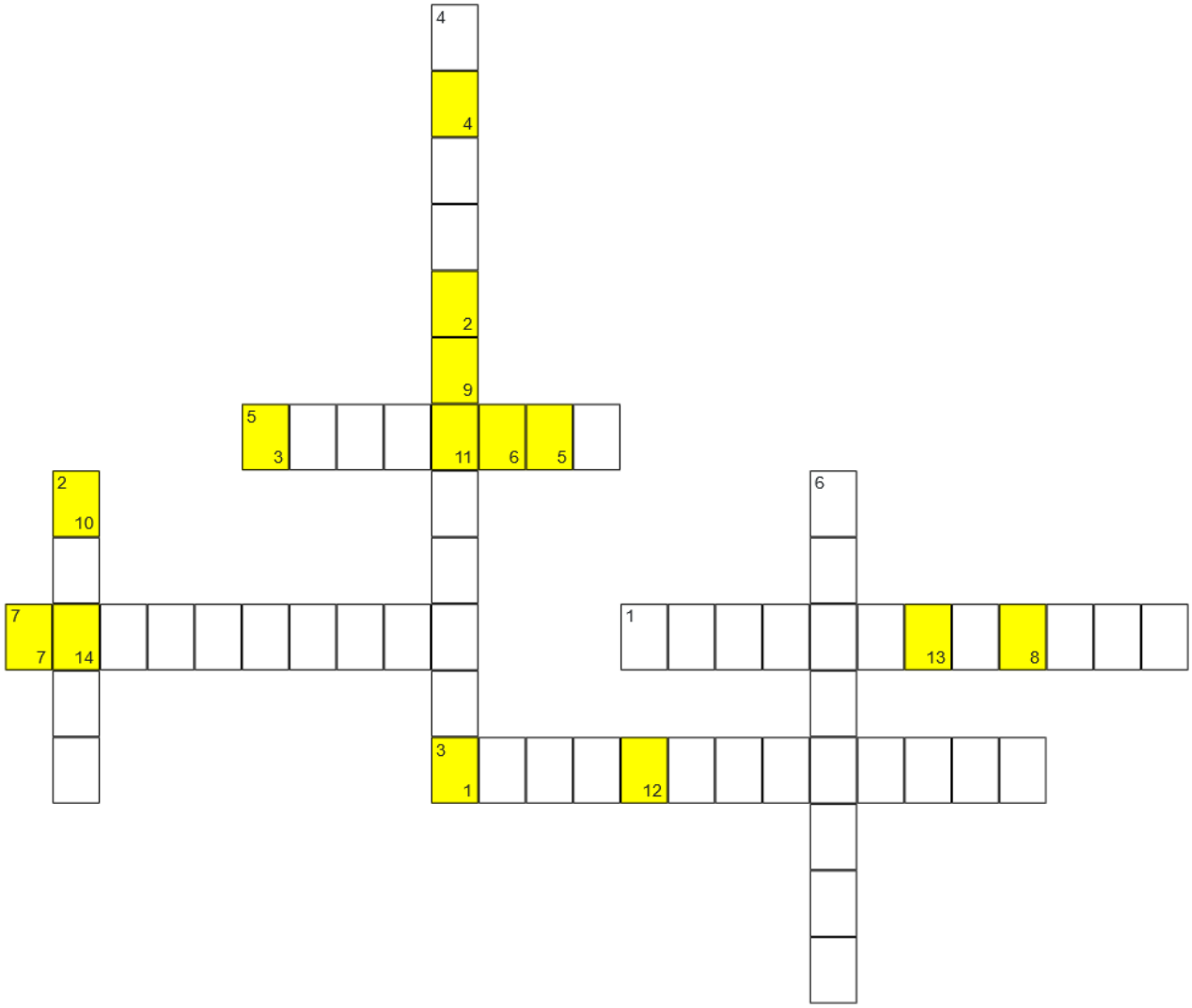
If you answer all the question correctly, you will find out the solution. Good luck!

Horizontal words

1. What is the name of the secret writing which encrypts messages in a code?
3. What is the name of the secret code that is written in invisible ink?
5. Which device is used to decode modern encryption methods?
7. What can be used as invisible ink?

Vertical words

2. Which language does the word cryptography come from?
4. What is the name of the natural numbers that can only be divided by the number one and by themselves?
6. Where does cryptography play an important role?



Solution word

1	2	3	4	5	6	7	8	9	10	11	12	13	14

You find the solution on the last page of this work sheet.

C. Invisible ink with lemon juice

Lemon juice can be used as an invisible ink because it becomes invisible when it dries!

To read the message in invisible ink, we need to put the paper in the hot oven.

IMPORTANT! Ask an adult person for help when using the hot oven!

For the experiment you'll need:

- a lemon
- a knife
- a cutting board
- a lemon squeezer
- a small bowl
- a white piece of paper
- and oven (200 degrees)
- a cotton swab or a brush

Here is how it works:

1. Place the lemon on the chopping board. Cut the lemon into two parts using the knife.
2. Squeeze the lemon with the squeezer and pour the juice into the bowl.
3. Wash your hands and dry them well.
4. Dip the cotton swab or the brush in lemon juice and write or draw the secret message on the piece of paper.
5. Let the juice dry until it is invisible.
6. Now you can send the secret message!

Have fun!

Source: BioRender.com

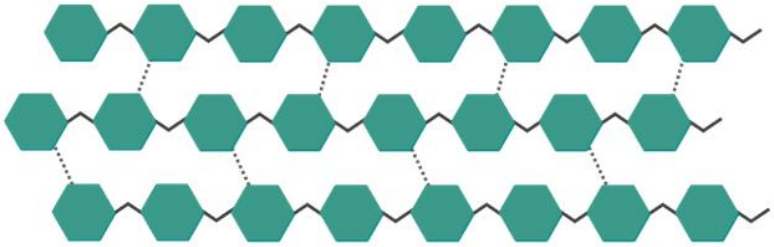
On the next page you will learn how to make the secret message visible.

Here is how you can make the secret message visible:

1. Together with an adult, turn on the oven and heat it to 200 degrees.
2. Place the piece of paper on a baking tray and put it in the oven. It is best to use oven gloves to do this!
3. Wait about 20 minutes until the message becomes visible again.
4. Together with an adult, take the baking tray out of the oven. Use the oven gloves again!
5. Do not touch the piece of paper until it has cooled down!
6. Now you can read the secret message!

Why does lemon juice become visible again when it is hot?

Paper is made of cellulose. And cellulose is a chemical compound that consists of many thousands of glucose molecules that are linked together. Glucose is a form of sugar.
In a simplified way, the chemical composition of paper looks like this:



Source: BioRender.com

Each green hexagon is one glucose molecule. All these glucose molecules are chemically linked to one another.

When you spread the lemon juice on the piece of paper, the bonds between the glucose molecules in the paper are weakened. Some molecules completely break away from the bond.
If the piece of paper is now heated above 170°C, these sugar molecules caramelize! In a chemical process, new compounds are formed which produce the brown color of the ink. This way, the ink becomes visible!

D. Color the picture. Have fun!

Source: Ausmalbilder-malvorlagen.org

The solution word of the crossword puzzle is: SECRET LANGUAGE