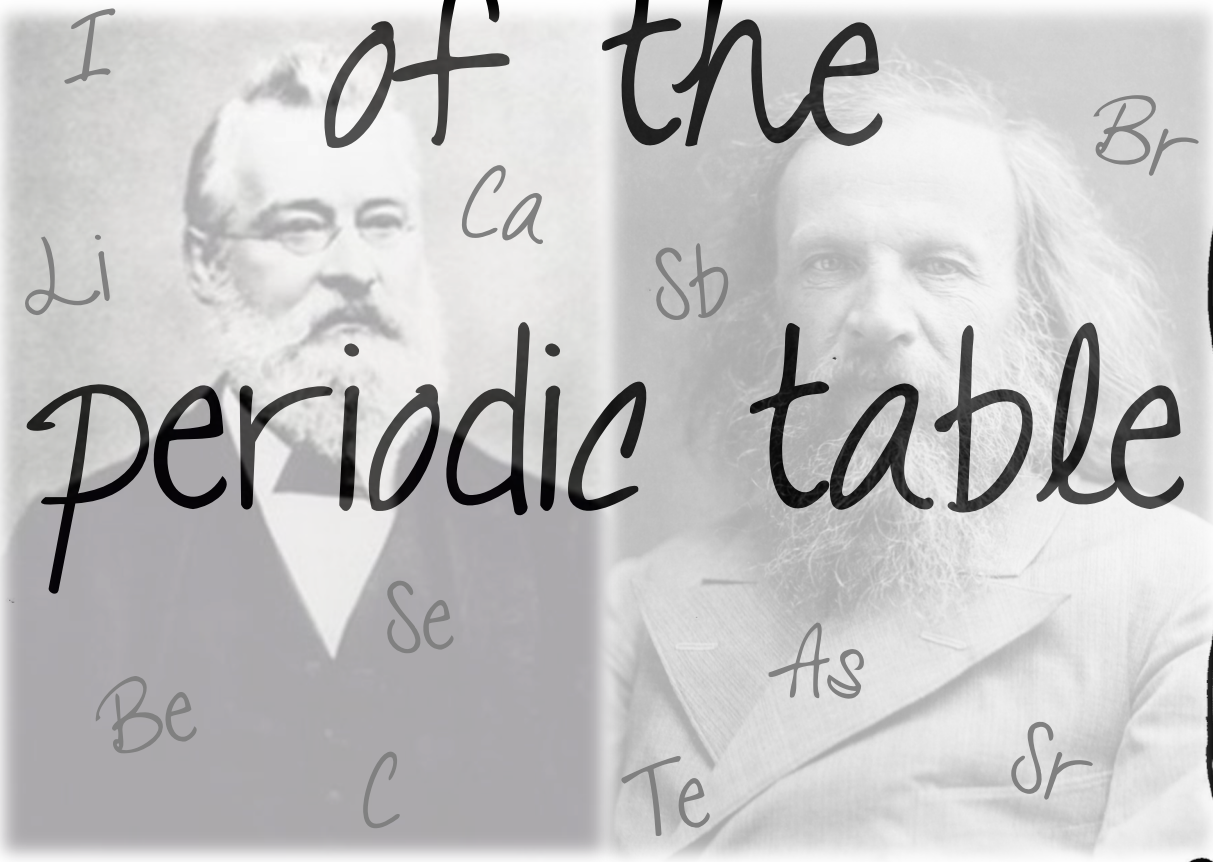
The history of the periodic table



Johann Wolfgang Döbereiner (1829)

Döbereiner's Law of Triads

In 1829, Döbereiner suggested a relationship between the properties of elements and their atomic mass. He sorted elements in groups of 3 that had **similar properties** (reacted the same way with other elements, formed the same compounds…) and called these groups "***triads***."

According to Döbereiner, the atomic mass of the middle element is **nearly the same** as average of the atomic masses of other two elements.

Example: If we take lithium, sodium, and potassium, the atomic mass of sodium is the mean of the atomic mass of lithium and potassium: $\frac{7+39}{2} = 23$.

In this activity you will repeat the process Döbereiner went through and find different triads. You have a deck of cards representing some of the elements known when Döbereiner developed his theory. On those cards, you can find the element's name, symbol, atomic mass, and the main compounds they form.

1. Using your deck of cards and Döbereiner's theory, find 3 triads amongst the following elements: P, S, Cl, Ca, As, Se, Br, Sr, Sb, Te, I, Ba.
2. For 3 of the triads you've found, calculate the mean of the heaviest and lightest element in each triad you found and fill the following table.

Triad									
Atomic mass									
Mean									

Is the atomic mass of the middle element of each triad similar to the mean of the atomic masses of the two others?

……

……

……

3. Why did Döbereiner's system fail?

……

……

……

……

……

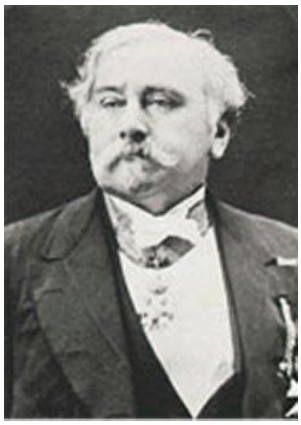
……

……

……

……

Alexandre-Émile Béguyer de Chancourtois (1862)



In 1862 – seven years before Dmitri Mendeleev, French mineralogist Émile Béguyer de Chancourtois developed a system to arrange all the then-known elements according to their relative atomic masses. He called his system "vis tellurique" or, in English, the ***telluric screw***.

In this activity you will repeat the process Béguyer went through and develop your own telluric screw.

1. The numbers shown are what we now call relative atomic masses. On your telluric screw and with the help of your deck of cards, write the symbols of the first 17 elements (H to Ca) under their atomic mass.
2. Cut out the rows, **keeping the grey tabs attached to them**. Stick the three rows together using tabs 1 and 2 to form one long row from atomic mass 1 to atomic mass 40.
3. Gently crease along the line between each atomic mass.
4. Curl the strip to create a helix with a circumference of 16 atomic mass units, i.e., the element with an atomic mass of 17 lies below the element with an atomic mass of 1. Use tabs 3 and 4 to secure the helix in place.
5. What do you notice about the elements directly below each other on the helix?

……

……

……

6. Are there any elements that don't fit the pattern?

……

7. Let's imagine we make this screw longer. Think about what circumference (in atomic mass units) future turns of the helix will need in order for similar elements to lie beneath each other.

……

……

……

8. Later on, noble gases were discovered (atomic masses: He: 4; Ne: 20; Ar: 40). Is it possible to arrange them in this table without disturbing its organization?

……

……

9. Why has this theory not been taken seriously?

……

……

……

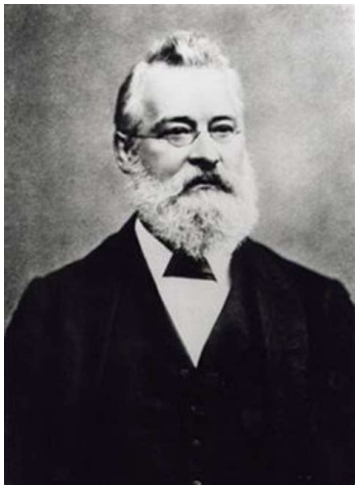
……

……

……

John Newlands (1864)

Newlands Law of Octaves



In 1864, English chemist John Newlands proposed an organizational scheme for the elements. He noticed that when the elements were arranged by increasing atomic mass, their properties repeated every eighth element. A pattern such as this is called periodic because it repeats in a specific manner. Newlands named the periodic relationship that he observed in chemical properties the ***law of octaves***, after the musical octave in which notes repeat every eighth tone.

In this activity you will repeat the process Newlands went through and recreate his table. You have a deck of cards representing some of the elements known when Newlands developed his theory. On those cards, you can find the element's name, symbol, atomic mass, and the main compounds in which we can find them.

1. Sort the elements of your deck of cards according to Newlands' theory.
2. Letting H on the side, fill the following table with the elements' symbols.

3. Do all the elements in a column have similar properties?

……

……

……

4. Up to which element this theory seems to work?

……

5. Would the elements later discovered, noble gases for example (atomic masses: He: 4; Ne: 20; Ar: 40) fit in this table?

……

……

……

……

Dmitri Mendeleev (1869)

Mendeleev's Periodic Law

The first really successful arrangement of elements was that of Dmitri Ivanovich Mendeleev, a Russian chemist, gave a scheme for the classification of elements in 1869.

Mendeleev stated the famous ***periodic law*** according to which "*properties of elements are a periodic function of their atomic mass*."
He arranged elements in the order of their increasing atomic mass in the form of a table, which is known as Mendeleev's Periodic Table. Some gaps were left as the elements to fill up these gaps had not been discovered at that time.

In Mendeleev's periodic table, there were six horizontal rows of elements which are called periods of elements. The seven vertical rows of elements are called groups. Elements with similar chemical properties were placed in the same group, and within a group, various elements showed a regular gradation in their properties.

In this activity you will repeat the process Mendeleev went through and recreate his table. You have a deck of cards representing some of the elements known when Mendeleev developed his theory. On those cards, you can find the element's name, symbol, atomic mass, and the main compounds in which we can find them.

1. Sort the elements of your deck of cards according to Mendeleev's theory.
2. Fill the following table with the elements' symbol. Some of the boxes will be empty due to the fact that you don't have all the elements card. But as Mendeleev did, you need to leave gaps for the future elements that will be discovered.

3. Which difficulty did you face to fill this table?

……

……

……

……

4. Later on, noble gases were discovered (atomic masses: He: 4; Ne: 20; Ar: 40; Kr: 84). Is it possible to arrange them in this table without disturbing its organization? How would you do that?

All these elements are inert; they mostly do not react with other chemical species.

……

……

……

……

……

5. Is there any mistakes/problems with Mendeleev's table? If yes, which one(s)?

……

……

……

……

……

6. How different is our current periodic table compared to Mendeleev's one?

……

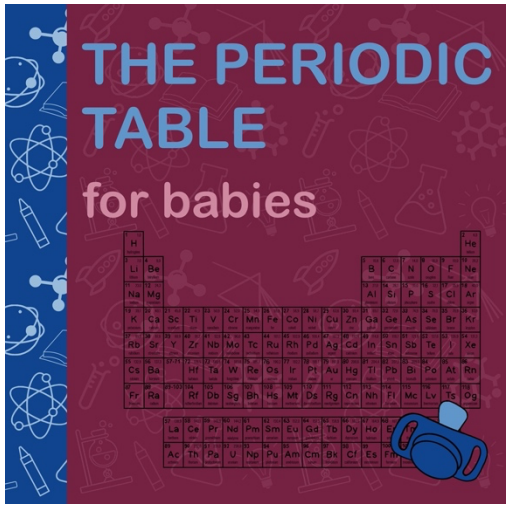
……

……

……

Final task

Due date: ……



You will have to create a short book for children telling the story of the periodic table and explaining roughly how the elements are arranged.
Your book must contain 6 pages:

- one for each scientist we will have studied together
- one for a scientist of your choice who also have worked on the periodic table (from the past or the present)
- one for the construction of today's periodic table.

Each page must have a square shape, contain an illustration of the theory, and a few sentences (explaining the base of the theory, its strength, and its weakness). Since it's a children's book, write short and simple sentences. Don't hesitate to look at the books your teacher brought for inspiration.

Each page will be assessed likewise: 1 point for the title, 1 point for the illustration, 3 points for the text.
The quality of your English will be taken into consideration (5 points) as well as the attention to details—shape, colors, care…—(5 points).