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Chemistry
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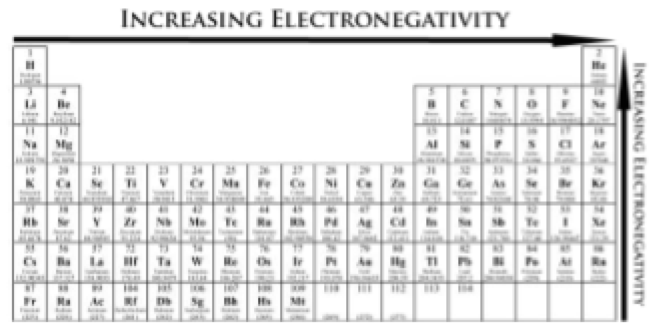
Periodic Trends

Claim: The periodic table is arranged to show trends in the physical and chemical properties of the elements. It is organized horizontally by increasing atomic number and vertically in groups of elements with similar properties.

It is the substructure of the atoms of an element that determine their physical and chemical properties. They have a small central region or nucleus-containing protons and neutrons-surrounded by a larger region containing electrons. Protons have a atomic mass of 1.672623×10^{-27} kg, neutrons have a atomic mass of 1.674929×10^{-27} kg, and electrons have a atomic mass of 9.109390×10^{-31} kg. The atomic mass of a substance is based on the sum of the mass of the protons and neutrons, because the mass of electrons aren't large enough to be noteworthy. Protons have a positive charge, electrons have a negative charge, and neutrons have a neutral charge. In order for a atom to be at a neutral charge it must contain the same number of protons and electrons. If electrons are lost/gained it becomes a ion. Cations are positive ions created by the loss of one or more electrons, and a anion is a negative ion caused by the gaining of one or more electrons. Protons and neutrons have a strong nuclear force within the atom, creating a dense core. If two protons get too close to each other they force themselves apart, and release energy. The neutron's job is to help separate protons, and keep the atom stable. In the periodic table if you add a proton to an atom, it changes its atomic number. Neutrons and electrons don't have a effect on the placement on the periodic table however. Isotopes are elements that are created when the number of neutrons doesn't equal the number of protons in a atom. This creates a change in atomic mass, but not a change in its chemical properties.The region in which electrons are found is divided into energy levels. The first energy level is the smallest and can contain two electrons, the the second eight, the third 18. The number of electrons in the outermost energy level is the same as an element's group number. It is from these subatomic particles and their arrangement that each element derives its characteristic chemical and physical properties.

Definition of Electronegativity: The tendency of an atom to attract a shared pair of electrons. On the periodic table electronegativity increases as you move from bottom to top, and left to right. (See Figure 1) The electronegativity of an element is dependent upon the force the nucleus pulls on electrons. As you increase the number of protons within a nucleus, it begins to have a greater pull upon electrons. However, if you begin to add more energy levels you begin to decrease electronegativity. The same is true for electrons that experience shielding, because shielding causes the pull of that electron to lessen. If you increase the distance between the furthest electrons to the nucleus, compared to the charge, distance will have a much greater effect.

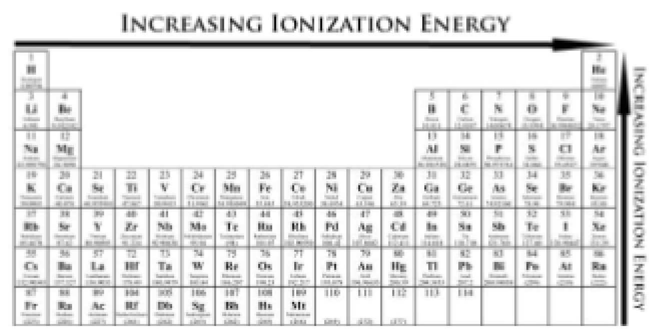
Figure 1: Periodic Table of Electronegativity



Source: Retrieved from: https://chem.libretexts.org . See Appendix A for student gathered data.

Definition of Ionization Energy: The amount of energy required to remove a election from the attraction of a nucleus.On the periodic table Ionization energy increases as you move from bottom to top, and left to right. https://chem.libretexts.org(See Figure 2). If you increase the number of protons in a nucleus, its ionization decreases because the electrons will feel a stronger pull to the nucleus. However, Ionization increases as distance increase. As electrons travel further and further from the nucleus, it loses its electronegativity. The outer electrons will also be easier to pull away, due to the electrons closer to the nucleus receiving an increased pull toward the nucleus (electron shielding). If two electrons are close to each other they want to separate, which causes paired electrons to more easily separate due to ionization. Therefore, increased distance, electron shielding, and paired electrons all contribute to a high ionization energy, and an increase in protons will lead to low ionization.

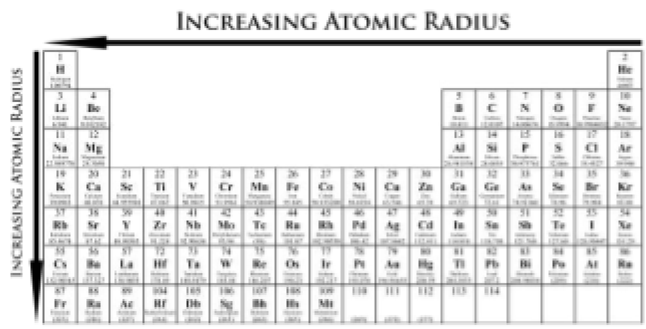
Figure 2: Periodic Table of Ionization Trend



Source: Retrieved from: https://chem.libretexts.org . See Appendix B for student gathered data.

Definition of Atomic Radius: The atomic radius of a chemical element is a measure of the size of its atoms, usually the mean or typical distance from the center of the nucleus to the boundary of the surrounding cloud of electrons. On the periodic table the atomic radius of elements increase as you move top to bottom, and left to right. (See Figure 3) The atomic radius of an element is dependent upon the number of energy levels, and the number of protons present in the nucleus. As you increase the number of energy levels, the atomic radius dramatically jumps in size and receives a much larger atomic radius. However, if you add protons to a nucleus its radius will shrink. This is because protons create a stronger pull on the electrons, and bring them closer to the nucleus. The addition of protons will change the atomic mass of the atom however.

Figure 3: Periodic Table of Atomic Radius Trend



Source: Retrieved from: https://chem.libretexts.org . See Appendix C for student gathered data.

Definition of Melting Point: The temperature that a substance changes from solid to liquid. On the periodic table the melting point of elements don’t have a definite trend that it follows. The melting point of an element depends upon the force of attraction between the particles that have to be overcome by KE.This attracted strength if strong, like ion-ion presents a polarity will result in a high melting point.

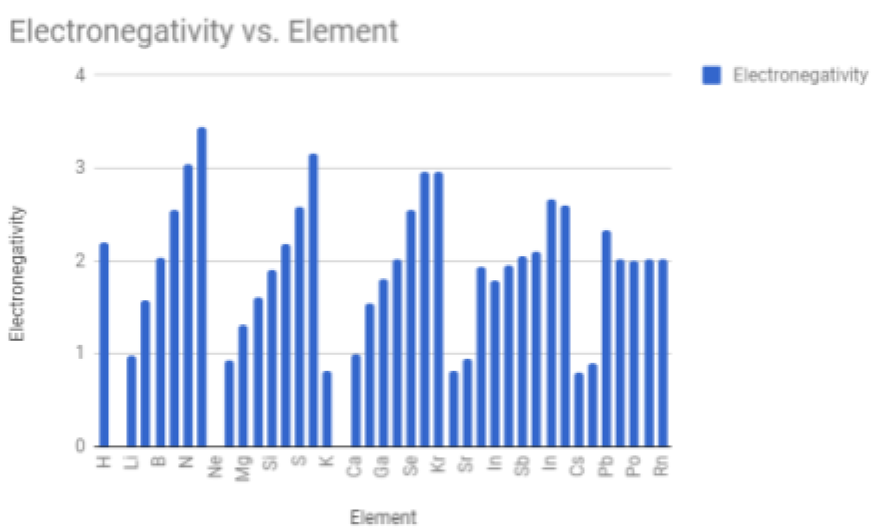
Conclusion: The Periodic Table was created, because a scientist during the late 1800’s noticed a trend that roughly applied to all discovered elements.This makes the table a useful tool to predict an element’s properties through its placement within the table. Early in the history of chemistry this was used to learn that there are holes in our science, and there were undiscovered elements. For example, if there was a large range of ionization energy where no element was present, then there maybe a element that has been undiscovered that fits that place. This makes it easier to find an element and where to place it in the table. Today the table can be used to determine the element that a substance is made of based off a few basic properties. It can also help us understand the behavior of elements, and allow us to experiment with them.

Appendix A

Element	Electronegativity
H	2.2
He	0
Li	0.98
Be	1.57
B	2.04
C	2.55
N	3.04
O	3.44
Ne	0
Na	0.93
Mg	1.31
Al	1.61
Si	1.9
P	2.19
S	2.58
Cl	3.16
K	0.82
Ar	0
Ca	1
Ti	1.54
Ga	1.81
Ge	2.01
Se	2.55
Br	2.96
Kr	2.96
Rb	0.82
Sr	0.95
Ag	1.93
In	1.78
Sn	1.96

Sb	2.05
Te	2.1
In	2.66
Xe	2.6
Cs	0.79
Ba	0.89
Pb	2.33
Bi	2.02
Po	2
At	2.02
Rn	2.02

Periodic Trend of Electronegativity



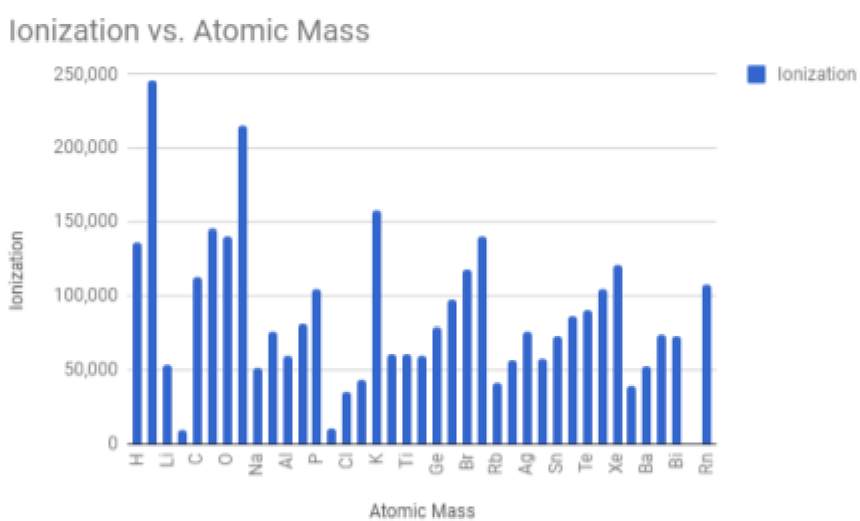
Source: Data was gathered from multiple sources by the students of 4th period Chemistry. (2018)

Appendix B

Atomic Mass	Ionization
H	135,984
He	245,874
Li	53,917
B	9,298
C	112,603
N	145,341
O	139,996
Ne	215,645
Na	51,391
Mg	76,462
Al	59,858
Si	81,517
P	104,867
S	10,360
Cl	35,453
Ar	43,407
K	157,596
Ca	61,132
Ti	61,082
Ga	59,993
Ge	78,994
Se	97,524
Br	118,138
Kr	139,996
Rb	41,771
Sr	56,949
Ag	75,762
In	57,864
Sn	73,439
Sb	86,084

Te	90,096
I	104,513
Xe	121,298
Cs	38,939
Ba	52,117
Pb	74,167
Bi	72,856
At	9,3
Rn	107,485

Periodic Trend of Ionization



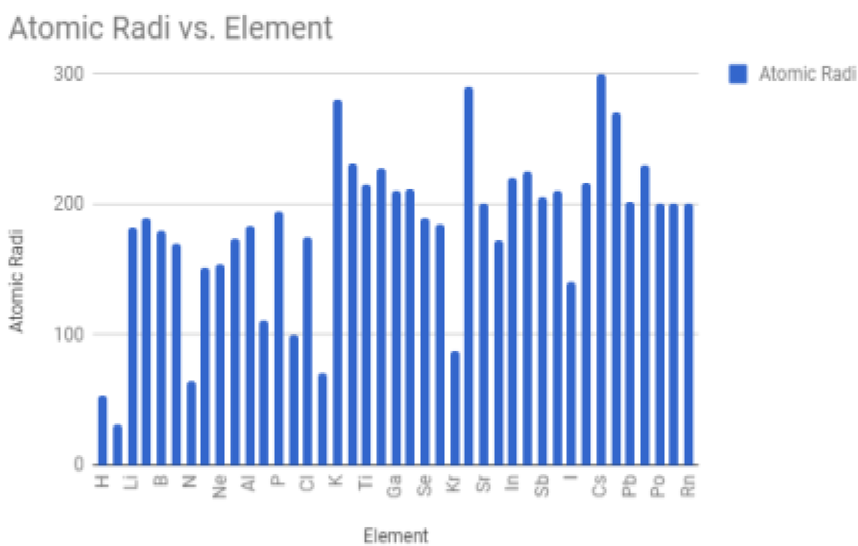
Source: Data was gathered from multiple sources by the students of 4th period Chemistry. (2018)

Appendix C

Element	Atomic Radii
H	53
He	31
Li	182
Be	190
B	180
C	170
N	65
O	152
Ne	154
Mg	173
Al	184
Si	111
P	195
S	100
Cl	175
Ar	71
K	280
Ca	231
Ti	215
Na	227
Ga	210
Ge	211
Se	190
Br	185
Kr	88
Rb	290
Sr	200
Ag	172
In	220
Sn	225

Sb	206
Te	210
I	140
Xe	216
Cs	300
Ba	270
Pb	202
Bi	230
Po	200
At	200
Rn	200

Periodic Trend of Atomic Radii



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