# Periodic Trends in Electronegativity

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# Periodic Trends in Electronegativity

# **Lesson Objectives**

The student will:

- define electronegativity.
- describe the trends that exist in the periodic table for electronegativity.
- use the general trends to predict the relative electronegativities of atoms.

## Vocabulary

#### electronegativity

the ability of an atom in a molecule to attract shared electrons

#### Introduction

Around 1935, the American chemist Linus Pauling developed a scale to describe the attraction an element has for electrons in a chemical bond. In this lesson, we will gain an understanding of this concept and recognize its trend on the periodic table.

#### **Electronegativity Defined**

In a molecule, some electrons are shared between the atoms making up the molecule. The ability of an atom in a molecule to attract shared electrons is called **electronegativity**. The higher the electronegativity of an atom, the greater its ability to attract shared electrons. The electronegativity of atoms has been defined in several ways. One method that is widely accepted is that developed by Linus Pauling.

On the Pauling scale, shown below, fluorine is the most electronegative element with an electronegativity of close to 4.0, and cesium and francium are the least electronegative with electronegativities of around 0.7.

1 H 2.20																
3 <b>Li</b> 0.98	4 <b>Be</b> 1.57		Pau	uling	Elec	tron	egat	ivity	Valu	es		5 <b>B</b> 2.04	6 <b>C</b> 2.55	7 <b>N</b> 3.04	8 0 3.44	9 F 3.98
11 <b>Na</b> 0.93	12 <b>Mg</b> 1.31											13 <b>Al</b> 1.61	14 <b>Si</b> 1.90	15 <b>P</b> 2.19	16 <b>S</b> 2.58	17 <b>CI</b> 3.16
19 <b>K</b> 0.82	20 <b>Ca</b> 1.00	21 <b>Sc</b> 1.36	22 <b>Ti</b> 1.54	23 V 1.63	24 <b>Cr</b> 1.66	25 <b>Mn</b> 1.55	26 <b>Fe</b> 1.83	27 <b>Co</b> 1.88	28 <b>Ni</b> 1.91	29 <b>Cu</b> 1.90	30 <b>Zn</b> 1.65	31 <b>Ga</b> 1.81	32 <b>Ge</b> 2.01	33 <b>As</b> 2.18	34 <b>Se</b> 2.55	35 <b>Br</b> 2.96
37 <b>Rb</b> 0.82	38 <b>Sr</b> 0.95	39 <b>Y</b> 1.22	40 <b>Zr</b> 1.33	41 <b>Nb</b> 1.6	42 <b>Mo</b> 2.16	43 <b>Tc</b> 1.9	44 <b>Ru</b> 2.2	45 <b>Rh</b> 2.28	46 <b>Pd</b> 2.20	47 <b>Ag</b> 1.93	48 <b>Cd</b> 1.69	49 <b>In</b> 1.78	50 <b>Sn</b> 1.96	51 <b>Sb</b> 2.05	52 <b>Te</b> 2.1	53 I 2.66
55 <b>Cs</b> 0.79	56 <b>Ba</b> 0.89	57 <b>La</b> 1.1	72 Hf 1.3	73 <b>Ta</b> 1.5	74 <b>W</b> 2.36	75 <b>Re</b> 1.9	76 <b>Os</b> 2.2	77 Ir 2.20	78 Pt 2.28	79 <b>Au</b> 2.54	80 <b>Hg</b> 2.00	81 <b>Ti</b> 1.62	82 <b>Pb</b> 2.33	83 <b>Bi</b> 2.02	84 <b>Po</b> 2.0	85 At 2.2
87 <b>Fr</b> 0.7	88 <b>Ra</b> 0.9															

# **Group and Period Trends in Electronegativity**

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The electronegativity of atoms increases as you move from left to right across a period in the periodic table. This is because as you go from left to right across a period, the nuclear charge is increasing faster than the electron shielding, so the attraction that the atoms have for the valence electrons increases.

The electronegativity of atoms decreases as you move from top to bottom down a group in the periodic table. This is because as you go from top to bottom down a group, the atoms of each element have an increasing number of energy levels. The electrons in a bond are thus farther away from the nucleus and are held less tightly.

Atoms with low ionization energies have low electronegativities because their nuclei do not have a strong attraction for electrons. Atoms with high ionization energies have high electronegativities because the nucleus has a strong attraction for electrons.

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reases	y Incr	yy Incı	19 K POTASSEM	Ca Ca CLCRM	SCANDRUM	TITANUN	23 V 10.547 VANADAM	CHROMUM	25 Mn MANGANESE	Fee	COULT	28 Ni NCREL	Eu Corren	Zn zw	Ga Ga	Gee Gee Commentation	ASENE	SELEMEN	Br Br BROMUM	BAG Kr KNYPTON
ze Incı	gativit	Enerç	BUDIENN	STRONTRIM	ая Чакоб Мантту	Tressed and the second	NDORUM	42 Мо истоским	43 Тс тесниетии	RU RU NUTHENUM	INCOME.	PALLADOUM	AT Ag SILVER	LCCC CCCC CADMUM	In In NORM	so Sn In	S1 Sb NTMONY	TELLUNUM	SJ IN SUA KOINE	S4 Xee XENCH
mic Siz	ctrone	zation	CESIM	Ba Ba MRUN	57-71 La-Lu	72 Hf HJNEM	Ta Ta tastalaw		REPRESENT	26 OS (90.233 (55MRJM		PLATEM	Z9 Au Int. Int? COLD	BO Hg MERCURY	DI TI EPHANAZ DIA MARI THALLEAM	Pb Pb S4.365 LEAD	BI SOL THE REMUTH	PO PO POLONIUM	ASTATINE	BS Rn RADON
Atoı	Elec	Ioni	BT Fr MANCUM	Ra	89-103 AC-Lr	INTERVOIDUM	DUENNIM	SEASONCIAM	BRANCES	108 HS HASSAUM	109 Mt MITHERIAM	DIS DIS DISTUTION	Rg	Concision	Uut			Uuh	UUUSEPTUM	
			LANT	THANIDES	Land Land	за Ссещи ссещи		BO Nd HEDDYMRUM	PROMETHICAN	62 Sm SAMARAN	63 EU EUROPEUN	GAG GAGOLINEM	65 Tb HARS TURKAN	ее руунезани	67 Ho No. 114	68 Er 107250 ENSIUM	FINITE THE STATE	то Трана УПРЕНИЗИИ		
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Here is another video that describes ionization energy trends in the periodic table (1c): http://www.youtube.com/w atch?v=q3AiM1BYX-c (9:39).

Ionic vs. Covalent							
lonic compounds are compounds that are comprised of a metal and a non-metal. lonic compounds form repeating units - opposite charges attract NaC	MEDIA						
Covalent compounds share their electrons They form distinct molecules	Click image to the left for more content.						

## **Lesson Summary**

- American chemist Linus Pauling developed the electronegativity scale to describe the attraction an element has for electrons in a chemical bond.
- The higher the electronegativity of an atom, the greater its ability to attract shared electrons.
- The electronegativity of atoms increases as you move from left to right across a period in the periodic table.
- The electronegativity of atoms decreases as you move from top to bottom down a group in the periodic table.

# **Further Reading / Supplemental Links**

A series of selectable videos that show the properties and discuss the bonding of various elements.

http://www.periodicvideos.com/#

#### **Review Questions**

- 1. Define electronegativity.
- 2. Choose the element in each pair that has the lower electronegativity.
  - a. Li or N
  - b. Cl or Na
  - c. Ca or K
  - d. Mg or F
- 3. Which of the following will have the largest electronegativity?
  - a. Se
  - b. F
  - c. Ne
  - d. Br
- 4. Which of the following will have the smallest electronegativity?
  - a. Na
  - b. Ne
  - c. Al
  - d. Rb
- 5. Describe the general trend for electronegativity in period 2.