

Modern Periodic Table

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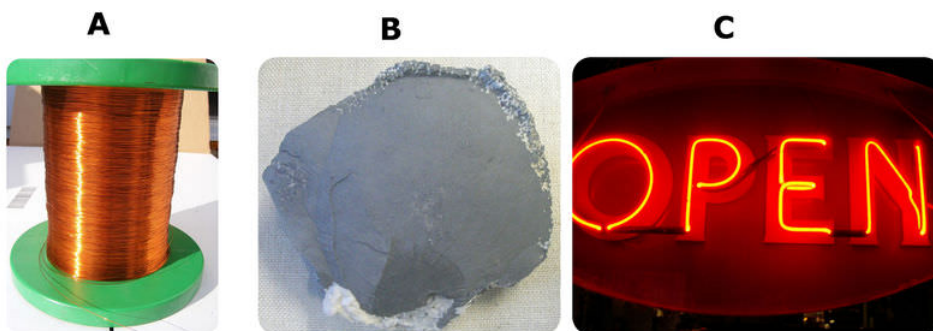


CHAPTER

1

Modern Periodic Table

- Describe the modern periodic table of the elements.
- Demonstrate how to read the modern periodic table.
- Compare and contrast periods and groups of the modern periodic table.
- Identify classes of elements in the modern periodic table.



Look at substances A-C in the photos above. They look very different from one another, but they have something important in common. All three are elements, or pure substances. Can you identify which elements they are? For ideas, listen to the amazing elements song below. The singer rapidly names all of the known elements while pictures of the elements flash by. Even if the video doesn't help you name the elements pictured above, it will certainly impress you with the need to organize the large number of elements that have been discovered.



MEDIA

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The First Periodic Table

In the 1860s, a scientist named Dmitri Mendeleev also saw the need to organize the elements. He created a table in which he arranged all of the elements by increasing atomic mass from left to right across each row. When he placed eight elements in each row and then started again in the next row, each column of the table contained elements with similar properties. He called the columns of elements groups. Mendeleev's table is called a **periodic table** and the rows are called periods. That's because the table keeps repeating from row to row, and periodic means "repeating."

The Modern Periodic Table

A periodic table is still used today to organize the elements. You can see a simple version of the modern periodic table in the **Figure 1.1**. The modern table is based on Mendeleev's table, except the modern table arranges the elements by increasing atomic number instead of atomic mass. Atomic number is the number of protons in an atom, and this number is unique for each element. The modern table has more elements than Mendeleev's table because many elements have been discovered since Mendeleev's time.

1 1A																	18 8A							
1 H 1.00794 HYDROGEN																	2 He 4.0026 HELIUM							
3 Li 6.941 LITHIUM	4 Be 9.0122 BERYLLIUM	METALS										METALLOIDS			NONMETALS				5 B 10.811 BORON	6 C 12.011 CARBON	7 N 14.007 NITROGEN	8 O 15.999 OXYGEN	9 F 18.998 FLUORINE	10 Ne 20.180 NEON
11 Na 22.990 SODIUM	12 Mg 24.305 MAGNESIUM	3 3B	4 4B	5 5B	6 6B	7 7B	8 8B	9 8B	10 8B	11 1B	12 2B	13 Al 26.982 ALUMINUM	14 Si 28.086 SILICON	15 P 30.974 PHOSPHORUS	16 S 32.065 SULFUR	17 Cl 35.453 CHLORINE	18 Ar 39.948 ARGON							
19 K 39.098 POTASSIUM	20 Ca 40.078 CALCIUM	21 Sc 44.956 SCANDIUM	22 Ti 47.867 TITANIUM	23 V 50.942 VANADIUM	24 Cr 51.996 CHROMIUM	25 Mn 54.938 MANGANESE	26 Fe 55.845 IRON	27 Co 58.933 COBALT	28 Ni 58.693 NICKEL	29 Cu 63.546 COPPER	30 Zn 65.38 ZINC	31 Ga 69.723 GALLIUM	32 Ge 72.631 GERMANIUM	33 As 74.922 ARSENIC	34 Se 78.96 SELENIUM	35 Br 79.904 BROMINE	36 Kr 83.80 KRYPTON							
37 Rb 85.468 RUBIDIUM	38 Sr 87.62 STRONTIUM	39 Y 88.906 YTTORIUM	40 Zr 91.224 ZIRCONIUM	41 Nb 92.906 NIOBIUM	42 Mo 95.94 MOLYBDENUM	43 Tc 98.906 TECHNETIUM	44 Ru 101.07 RUTHENIUM	45 Rh 102.905 RHODIUM	46 Pd 106.42 PALLADIUM	47 Ag 107.868 SILVER	48 Cd 112.411 CADMIUM	49 In 114.818 INDIUM	50 Sn 118.710 TIN	51 Sb 121.760 ANTIMONY	52 Te 127.603 TELLURIUM	53 I 126.905 IODINE	54 Xe 131.29 XENON							
55 Cs 132.905 CESIUM	56 Ba 137.327 BARIUM	57-71 La-Lu LANTHANIDES	72 Hf 178.49 HAFNIUM	73 Ta 180.95 TANTALUM	74 W 183.84 TUNGSTEN	75 Re 186.207 RHENIUM	76 Os 190.23 OSMIUM	77 Ir 192.22 IRIDIUM	78 Pt 195.084 PLATINUM	79 Au 196.967 GOLD	80 Hg 200.59 MERCURY	81 Tl 204.384 THALLIUM	82 Pb 207.2 LEAD	83 Bi 208.980 BISMUTH	84 Po 209 POLONIUM	85 At 209 ASTATINE	86 Rn 222 RADON							
87 Fr 223 FRANCIUM	88 Ra 226 RADIUM	89-103 Ac-Lr ACTINIDES	104 Rf 261 RUTHERFORDIUM	105 Db 262 DUBNIUM	106 Sg 263 SEABORGIUM	107 Bh 264 BOHRIUM	108 Hs 265 HASSIUM	109 Mt 266 MEITNERIUM	110 Ds 271 DARMSTADTIUM	111 Rg 272 ROSGENIUM	112 Cn 277 COPERNICIUM	113 Uut 277 UNUNTRIUM	114 Uuq 277 UNUNQUADIUM	115 Uup 277 UNUNPENTIUM	116 Uuh 277 UNUNHEXIUM	117 Uus 277 UNUNSEPTIUM	118 Uuo 277 UNUNOCTIUM							
LANTHANIDES		57 La 138.905 LANTHANUM	58 Ce 140.12 CERIUM	59 Pr 140.908 PRASEODYMIUM	60 Nd 144.242 NEODYMIUM	61 Pm 144.913 PROMETHIUM	62 Sm 150.362 SAMARIUM	63 Eu 151.964 EUROPIUM	64 Gd 157.253 GADOLINIUM	65 Tb 158.925 TERBIUM	66 Dy 162.505 DYSPROSIUM	67 Ho 164.930 HOLMIUM	68 Er 167.259 ERBIUM	69 Tm 168.934 THULIUM	70 Yb 173.043 YTTERIUM	71 Lu 174.967 LUTETIUM								
ACTINIDES		89 Ac 227.027 ACTINIUM	90 Th 232.038 THORIUM	91 Pa 231.036 PROTACTINIUM	92 U 238.029 URANIUM	93 Np 237.048 NEPTUNIUM	94 Pu 244.064 PLUTONIUM	95 Am 243.061 AMERICIUM	96 Cm 247.070 CURIUM	97 Bk 247.070 BERKELIUM	98 Cf 251.080 CALIFORNIUM	99 Es 252.083 EINSTEINIUM	100 Fm 257.085 FERMIUM	101 Md 258.108 MENDELEVIUM	102 No 259.108 NOBELIUM	103 Lr 260.105 LAWRENCIUM								

FIGURE 1.1

Reading the Table

In the **Figure 1.1**, each element is represented by its chemical symbol, which consists of one or two letters. The first letter of the symbol is always written in upper case, and the second letter—if there is one—is always written in lower case. For example, the symbol for copper is Cu. It stands for *cuprum*, which is the Latin word for copper. The number above each symbol in the table is its unique atomic number. Notice how the atomic numbers increase from left to right and from top to bottom in the table.

Q: Find the symbol for copper in the **Figure 1.1**. What is its atomic number? What does this number represent?

A: The atomic number of copper is 29. This number represents the number of protons in each atom of copper. (Copper is the element that makes up the coil of wire in photo A of the opening sequence of photos.)

Periods of the Modern Periodic Table

Rows of the modern periodic table are called **periods**, as they are in Mendeleev's table. From left to right across a period, each element has one more proton than the element before it. Some periods in the modern periodic table are longer than others. For example, period 1 contains only two elements: hydrogen (H) and helium (He). In contrast, periods 6 and 7 are so long that many of their elements are placed below the main part of the table. They are the elements starting with lanthanum (La) in period 6 and actinium (Ac) in period 7. Some elements in period 7 have not yet been named. They are represented by temporary three-letter symbols, such as Uub. The number of each period

represents the number of energy levels that have electrons in them for atoms of each element in that period.

Q: Find calcium (Ca) in the **Figure 1.1**. How many energy levels have electrons in them for atoms of calcium?

A: Calcium is in period 4, so its atoms have electrons in them for the first four energy levels.

Groups of the Modern Periodic Table

Columns of the modern table are called **groups**, as they are in Mendeleev's table. However, the modern table has many more groups—18 compared with just 8 in Mendeleev's table. Elements in the same group have similar properties. For example, all elements in group 18 are colorless, odorless gases, such as neon (Ne). (Neon is the element inside the light in opening photo C.) In contrast, all elements in group 1 are very reactive solids. They react explosively with water, as you can see in the video and **Figure 1.2**.



MEDIA

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FIGURE 1.2

The alkali metal sodium (Na) reacting with water.

Classes of Elements

All elements can be classified in one of three classes: metals, metalloids, or nonmetals. Elements in each class share certain basic properties. For example, elements in the metals class can conduct electricity, whereas elements in the nonmetals class generally cannot. Elements in the metalloids class fall in between the metals and nonmetals in their properties. An example of a metalloid is arsenic (As). (Arsenic is the element in opening photo B.) In the periodic table above, elements are color coded to show their class. As you move from left to right across each period of the table, the elements change from metals to metalloids to nonmetals.

Q: To which class of elements does copper (Cu) belong: metal, metalloid, or nonmetal? Identify three other elements in this class.

A: In the **Figure 1.1**, the cell for copper is colored blue. This means that copper belongs to the metals class. Other elements in the metals class include iron (Fe), sodium (Na), and gold (Au). It is apparent from the table that the majority of elements are metals.

Summary

- The modern periodic table is used to organize all the known elements. Elements are arranged in the table by increasing atomic number.
- In the modern periodic table, each element is represented by its chemical symbol. The number above each symbol is its atomic number. Atomic numbers increase from left to right and from top to bottom in the table.
- Rows of the periodic table are called periods. From left to right across a period, each element has one more proton than the element before it.
- Columns of the periodic table are called groups. Elements in the same group have similar properties.
- All elements can be classified in one of three classes: metals, metalloids, or nonmetals. Elements in each class share certain basic properties. From left to right across each period of the periodic table, elements change from metals to metalloids to nonmetals.

Review

1. What is the modern periodic table?
2. Compare and contrast the periods and groups of the modern periodic table.
3. In the modern periodic table in **Figure 1.1**, find the element named lead (Pb). How many protons do atoms of lead have? To which class of elements does lead belong?
4. Which groups of the modern periodic table contain elements that are classified as metalloids?

References

1. Christopher Auyeung. [Periodic Table](#) . CC BY-NC 3.0
2. User:Ajhalls/Wikimedia Commons. [Sodium reacting with water](#) . Public Domain