PERIODIC TABLE OF THE ELEMENTS

Making Science Make Sense®

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Bayer Corporation has long been committed to improving science education and formally created its ***Making Science Make Sense®*** *(MSMS)* program in 1995. ***MSMS*** is an award-winning initiative that advances science literacy through hands-on, inquiry-based science learning, employee volunteerism and public education.

Hundreds of employee-volunteers at Bayer sites across the country engage students in hands-on, inquiry-based science learning during classroom and extra-curricular programs. Many of these sites also are part of a nationwide network of education and corporate partners who are reforming the way science is taught and learned at the elementary school level.

As a science and research-based company, Bayer Corporation has a solid stake in helping to ensure that today's students are well prepared for tomorrow's workplace, regardless of the careers they choose. Bayer's commitment stems from the fact that new technologies, concepts and increasing global market competition will continue to demand a workforce that is flexible, scientifically literate and equipped with the critical-thinking, problem-solving and team working skills fostered by a quality science education.

PERIODIC TABLE OF THE ELEMENTS

Making Science Make Sense®

Used as:

- Chemical Symbol
- Name and Atomic Number
- Elemental Form
- Alloy, Blend or Mixture
- Compound
- Raw Material For
- Atomic Weight
- Indicates Most Stable Isotope

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Element 00
o ....
+ ....
v ....
- ....
x ( )

Appearance in nature:

Unshaded	Shaded	Half-Shaded
Compound Form	Element Form	Sometimes Compound Form

Visit our interactive periodic table at MakingScienceMakeSense.com

At room temperature the element is:

Black	Gas
Light Blue	Liquid
Dark Blue	Natural solid
Green	Man-made solid

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Hydrogen 1 o **Rocket fuel** o Hydrogenation of fats o Petroleum desulphurization o Water, ammonia x 1.0079																	**Helium 2** o **Balloons, blimps** o Diving bell atmosphere o Lasers, leak detectors o Nuclear plant coolant x 4.00260
Lithium 3 o **Pacemaker batteries** + Alloys used in space v Lubricant additive v Glass and pharmaceuticals x 6.941	**Beryllium 4** o X-ray tube windows + **Watch springs** + Spark-free tools x 9.01218											**Boron 5** v Regulator in nuclear plants v **Tennis rackets** v Heat-resistant glass v Eye disinfectant x 10.81	**Carbon 6** o Diamonds, **pencils** o Tire colorant, steel o Controls nuclear reactions v Plastics, life x 12.011	**Nitrogen 7** o **Cryogenic surgery** o Coolant (liquid nitrogen) o Ammonia production v Rocket fuels x 14.0067	**Oxygen 8** o **Combustion** o Steel production o Water purification v Sand, water, cement x 15.9994	**Fluorine 9** v Uranium enrichment v Refrigerator coolants v **Toothpaste additives** v Teflon x 18.9984	**Neon 10** o **Neon lights** o Fog lights o TV tubes, lasers o Voltage detectors x 20.179
Sodium 11 o **Street lights** + Nuclear reactor control + Batteries v Kitchen salt, soda, glass x 22.9898	**Magnesium 12** o **Flash bulbs** + Airplanes, racing bikes v Bricks for fireplaces v Pigments, fillers x 24.305											**Aluminum 13** o Window frames, doorknobs o Tube, cable, foil o Fireworks, flash bulbs + Cars, rackets, **planes** x 26.9815	**Silicon 14** o Microchips, **solar cells** v Tools v Quartz, cement, glass v Silicon greases and oils x 28.0855	**Phosphorus 15** o Fireworks, **matches** v Fertilizers, detergents v Toothpaste v Pesticides x 30.9738	**Sulfur 16** o Matches, fireworks o Batteries o Vulcanization of rubber v **Permanent wave lotion** x 32.06	**Chlorine 17** o **Water purification** v Bleach, hydrochloric acid v Plastics (PVC) v Stain removers x 35.453	**Argon 18** o **Lightbulbs** o Gas discharge tubes o Lasers, geiger counters o Welding blanket gas x 39.948
Potassium 19 v **Fertilizer** v Glass, lenses v Matches, gun powder v Salt substitute x 39.0983	**Calcium 20** o Metallurgy + Cable insulation, batteries v Fertilizer v Concrete, **Plaster of Paris** x 40.08	**Scandium 21** o Leak detectors + Space industry materials + **Seed germinating agents** x 44.9559	**Titanium 22** o Heat exchanger + Airplane motors + **Bone pins** v Pigments for paint and paper x 47.88	**Vanadium 23** + Construction materials + **Tools** + Springs + Jet engines x 50.9415	**Chromium 24** o **Plating for car parts** + Tools, knives v Lasers, camouflage paints v Stereo, videotapes x 51.996	**Manganese 25** + Steel for rail switches + Tools, axles v Safes, **plows** v Batteries x 54.9380	**Iron 26** o **Bikes**, cars, bridges o Magnets, machines + Nails, tools + Tin cans x 55.847	**Cobalt 27** o Gamma radiation source + **Razor blades** + Permanent magnet v Catalytic converters x 58.9332	**Nickel 28** o **Coins** + Knives, forks, spoons + Crucibles, white gold v Rechargeable batteries x 58.69	**Copper 29** o Cable, wire + Pennies, bronze sculpture + Statue of Liberty + Bells, carillons x 63.546	**Zinc 30** o Corrosion resistant coating o Batteries, **gutters** + Water and gas valves v White pigments in rubber x 65.39	**Gallium 31** o **Quartz thermometers** v Computer memory v Transistors, laser diodes v Used to locate tumors x 69.72	**Germanium 32** o Infrared prisms o Reflector in projectors o **Wide-angle lenses** + Dentistry x 72.59	**Arsenic 33** o **Shotgun pellets** + Metal for mirrors v Glass, lasers v Light emitting diodes = LED x 74.9216	**Selenium 34** o **Light meter** o Copy machines v Solar cells v Anti-dandruff shampoos x 78.96	**Bromine 35** v Tear gas v Fire retardants v Disinfectants v **Photographic film** x 79.904	**Krypton 36** o **Fluorescent bulbs** o Flash bulbs o Wavelength standard v UV lasers x 83.80
Rubidium 37 o Photoelectric cells o **Gas scavenger in vacuum tubes** o Heart muscle research x 85.4678	**Strontium 38** v Nuclear batteries in **buoys** v Beta radiation source v Phosphorescent paint v Fireworks x 87.62	**Yttrium 39** v **Color TV screens** v Radar, lasers v Camera lenses v Fireproof bricks x 88.9059	**Zirconium 40** o Nuclear fuel rods o Catalytic converters + **Percussion caps** v Furnace bricks x 91.224	**Niobium 41** + Cutting tools + Pipelines + Super magnets + **Welding rods** x 92.9064	**Molybdenum 42** o **Filament in electric heaters** + Rocket motors v Lubricants o Source of radio isotopes x 95.94	**Technetium 43** o **Radiation source for medical research** x (98)	**Ruthenium 44** o **Eye Treatment** v Thickness meters for eggshells + Fountain pen point + Electrical contacts x 101.07	**Rhodium 45** o **Headlight reflectors** o Telephone relays + Fountain pen point + Electrical contacts x 102.91	**Palladium 46** o Catalytic converters v Hydrogen separation + **Dental crowns** + Telephone relays x 106.42	**Silver 47** o Mirrors, batteries + **Silverware** v Photographic film and paper v Photosensitive glass x 107.868	**Cadmium 48** o **Rechargeable batteries** o Plating of screws, bolts + Regulator in nuclear reactors v Red and yellow pigments x 112.41	**Indium 49** o Solar cells, mirrors + Regulator in nuclear power v Photo cells, **transistors** v Blood and lung research x 114.82	**Tin 50** + Cups and plates + Coins + **Organ pipes** v Opalescent glass, enamel x 118.71	**Antimony 51** + Solder, type for printing + Lead batteries, bearings v Infrared detectors v **Mascara** x 121.75	**Tellurium 52** o Percussion caps o **Vulcanization of rubber** o Battery plate protector + Electrical resistors x 127.60	**Iodine 53** o **Disinfectant** o Halogen lamps v Ink pigments v Salt additive x 126.905	**Xenon 54** o UV lamps, **sun lamps** o Paint testers o Protection lamps o Electronic flashes x 131.29
Cesium 55 o **Photoelectric cells** o Gamma radiation source o Atomic clock o Infrared lamps x 132.905	**Barium 56** + **Spark plugs** + Gas scavenger in vacuum tubes v Fireworks v Fluorescent Lamps x 137.33	**Lanthanum 57** + **Lighter flints** + Battery electrodes v Catalytic converters v Camera lenses x 138.906	**Hafnium 72** o **Nuclear submarines** o Controls nuclear reactions o Gas scavenger in vacuum tubes x 178.49	**Tantalum 73** o Condensers + Vacuum tube filaments + Cutting tools + **Weights** x 180.948	**Tungsten 74** o Welding electrode o **Lamp filaments**, TV + Rocket nozzles v Cutting and boring tools x 183.85	**Rhenium 75** + Oven filaments + Jewelry plating + Electrodes + **Thermocouples** x 186.207	**Osmium 76** + Decorations + Compass needles + **Fountain pen points** + Clock bearings x 190.2	**Iridium 77** o Cancer irradiation + **Hypodermic needle** + Standard one meter bar + Helicopter Spark plugs x 192.22	**Platinum 78** o Catalyst for nitric acid production o **Crucibles** + Dental crowns v Anti-tumor agents x 195.08	**Gold 79** o Precious metal + **Jewelry** + Electrical contacts + Dental crowns x 196.967	**Mercury 80** o Barometers, **thermometers** o Street lights + Dental fillings v Seed protection x 200.59	**Thallium 81** + Thermometer filling v Infrared detectors v Heart muscle research + **Insecticides** x 204.383	**Lead 82** o Radiation protection o Roof coverings, **batteries** + Solders, ammunition v Gasoline additives x 207.2	**Bismuth 83** o Catalyst in rubber protection + **Fuses** + Sprinklers v Glass, ceramics x 208.980	**Polonium 84** o **Nuclear batteries** o Neutron source o Antistatic agents o Film cleaner x (209)	**Astatine 85** - Radioactive and essentially unavailable in nature. - Not possible to make other than in a nuclear reactor. x (210)	**Radon 86** o **Earthquake prediction** o Health threat in homes built on granite - Seldom found in nature. x (222)
Francium 87 - An intensely radioactive metal found in uranium minerals–but usually made from radium in nuclear reactors. x (223)	**Radium 88** v Neutron source v **Glow-in-the-dark paint** x (226)	**Actinium 89** o **Neutron source** - Dangerously radioactive and found naturally in uranium ores. x 227.028	**Rutherfordium 104** - A synthetic element that is not present in the environment. x (261)	**Dubnium 105** - A synthetic element that is not present in the environment. x (262)	**Seaborgium 106** - A synthetic element that is not present in the environment. x (266)	**Bohrium 107** - A synthetic element that is not present in the environment. x (264)	**Hassium 108** - A synthetic element that is not present in the environment. x (269)	**Meitnerium 109** - A synthetic element that is not present in the environment. x (268)	**Darmstadtium 110** - A synthetic element that is not present in the environment. x (271)	**Roentgenium 111** - Currently has no use outside of basic research. x (272)	**Copernicium 112** - A synthetic element that is not present in the environment. - Used only in research. x (285)	**Ununtrium 113** - A synthetic element that is not present in the environment. - Used only in research. x (284)	**Flerovium 114** - A synthetic element that is not present in the environment. - Used only in research. x (289)	**Ununpentium 115** - A synthetic element that is not present in the environment. - Used only in research. x (288)	**Livermorium 116** - A synthetic element that is not present in the environment. - Used only in research. x (293)	**Ununseptium 117** - A synthetic element that is not present in the environment. - Used only in research. x (292)	**Ununoctium 118** - A synthetic element that is not present in the environment. - Used only in research. x (294)

Lanthanoid Series

Ce: Cerium 58 + Lighter flints v Catalytic converters v Kluge lights v Fluorescent tubes x 140.12	**Pr: Praseodymium 59** + Lighter flints + Permanent magnets v Search lights v Ceramic coloring x 140.908	**Nd: Neodymium 60** + Permanent magnets + Coloring for spectacles v Ceramic condensers v Glass for lasers and lenses x 144.24	**Pm: Promethium 61** v Nuclear batteries v Thickness meters x (145)	**Sm: Samarium 62** v Ceramic condensers + Permanent magnets v Neutron scavenger v Masers x 150.36	**Eu: Europium 63** v Color TV tubes v X-ray screens v Mercury lamps v Neutron scavenger x 151.96	**Gd: Gadolinium 64** + Chromium steel + Permanent magnets v X-ray tubes v Computer memory x 157.25	**Tb: Terbium 65** v X-ray screens v Fluorescent lamps x 158.925	**Dy: Dysprosium 66** + Airplane metal v Optical memory v Permanent magnets v Lasers x 162.50	**Ho: Holmium 67** - A rare earth metal found in monazite, gadolinite and other minerals. + Magnets (alloys are used in) x 164.930	**Er: Erbium 68** + Vanadium steel v Glass coloring x 167.26	**Tm: Thulium 69** - A rare earth metal found in minerals, such as monazite. x (168.934)	**Yb: Ytterbium 70** - A silvery metal more abundant than tin but mostly used for research. x 173.04	**Lu: Lutetium 71** - A silvery white rare earth metal used mostly for research. x 174.967

Actinoid Series

Th: Thorium 90 o Coating on filament wire v Fuel for breeder reactors v Gaslight mantles v Crucibles x 232.038	**Pa: Protactinium 91** - A highly toxic and radioactive rare earth metal. - One of the rarest and most expensive naturally occurring elements. x 231.036	**U: Uranium 92** o Breeder reactor fuel o Nuclear reactor fuel + Gyro compasses v Glass coloring x 238.029	**Np: Neptunium 93** - A radioactive rare earth metal named for the planet Neptune. x (237)	**Pu: Plutonium 94** v Nuclear batteries- pacemakers v Nuclear reactor fuel v Film cleaner x (244)	**Am: Americium 95** v Crystal research v Smoke detectors v Glass thickness meters v Neutron source x (243)	**Cm: Curium 96** - A radioactive rare earth metal made in nuclear reactors from plutonium. x (247)	**Bk: Berkelium 97** - A radioactive rare earth metal obtained from plutonium in nuclear reactors. x (247)	**Cf: Californium 98** - A radioactive metal made in nuclear reactors from plutonium. - Used mainly for cancer research. v Neutron source x (251)	**Es: Einsteinium 99** - A radioactive rare earth metal named after Albert Einstein. - Made from plutonium in nuclear reactors. x (252)	**Fm: Fermium 100** - A radioactive rare earth metal obtained only in milliionth-of-a-gram quantities in nuclear reactors. x (257)	**Md: Mendelevium 101** - A radioactive rare earth metal named after Dmitri Mendeleev, father of the Periodic Table. - Created by bombarding einsteinium with helium. x (258)	**No: Nobelium 102** - A radioactive rare earth metal named after Alfred Nobel, who discovered dynamite. - Made by bombarding californium with carbon. x (259)	**Lr: Lawrencium 103** - A man-made element of which only a few atoms have ever been created by bombarding californium with boron. x (262)

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Making Science Make Sense® is a Bayer initiative that advances science literacy through hands-on, inquiry-based science learning, employee volunteerism and public education.

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