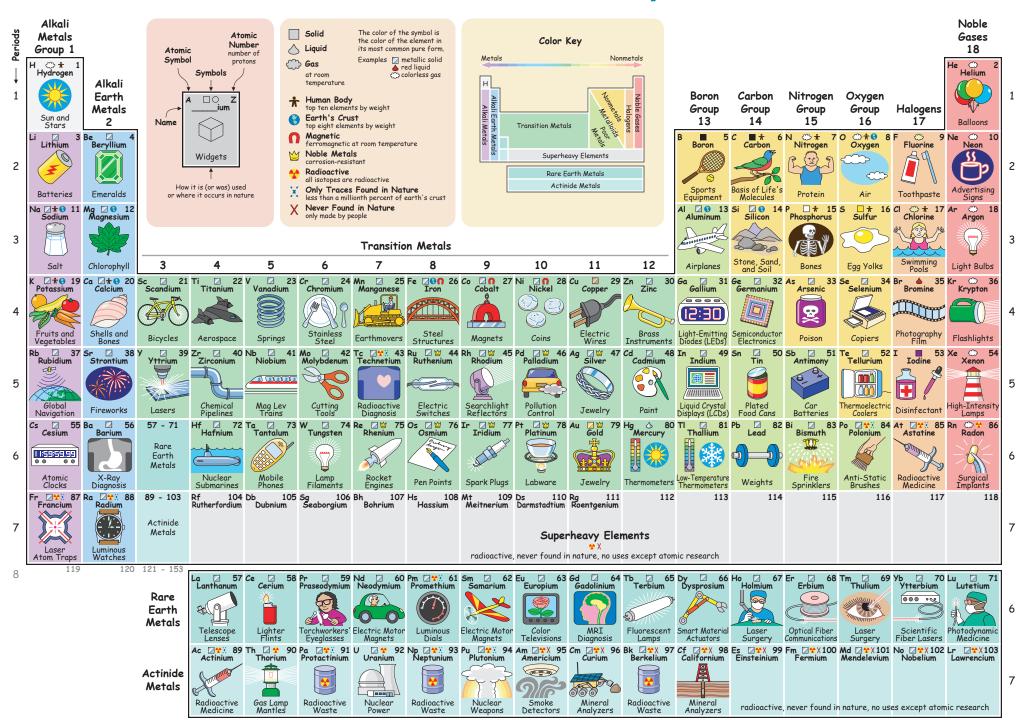
## The Periodic Table of the Elements, in Pictures



The Periodic Table of the Elements, in Words Noble Gases are inactive, or inert. Each atom Hydrogen belongs to no definite group. It forms compounds by either donating an electron like an alkali has exactly the number of electrons it needs to have metal or accepting an electron like a halogen. a full outer shell, so these atoms almost never bond Atoms Chemical Bonding with other atoms. That is why these are all gases. Atoms form molecules by bonding together. Atoms give, take, or Nucleus of Particles Alkali Metals are very reactive share electrons to achieve full outer electron shells. protons and +1 Proton Metalloids are and readily form compounds but are Nonmetals in Halogens are reactive €₩ . neutrons 18 Group 1 0 Neutron (Ag)(Ag)partly like metals and their solid state, nonmetals and readily not found free in nature. They form Ag Ag Ag
Silver Ag Ag -1 • Flectron partly like non-metals. are usually brittle form compounds but are salts and alkali (acid-neutralizing) H Hydrogen Flectron Helium For example, they are (they break rather not found free in nature. compounds such as baking soda. In challe explosive ags inert aas second semiconductors, which than bend) and They combine with alkali pure form, they are very soft metals An atom has a nucleus, made of protons and neutrons. means they conduct they are insulators metals to form salts which catch fire on contact with 90% of atoms in fuel for nuclear surrounded by electrons orbiting in cloud-like shells. Ionic bond Covalent bond Metallic bond electricity in some of both heat and (halogen means the universe water fusion in sun Smaller shells are surrounded by larger shells sun and stars One atom takes an Atoms share their Shared outer salt-former) conditions electricity and stars, The atomic number is the number of protons in an atom. water (H2O) electron from another outer electrons. electrons flow balloons, lasers Alkali Earth This determines the chemical properties of the atom. supercold refrigerant life's organia atom and the oppositely conducting heat 2 15 14 16 17 molecules Metals are reactive Protons have positive electric charge, neutrons are neutral, charged ions attract and electricity and electrons are negative. Normally, an atom has equal 3 Be Beryllium and readily form Groups Nitrogen 7 0 Oxygen Fluorine Neon numbers of protons and electrons. An ion is a charged atom lightest metal, compounds but are hard black solid; Elements in the same aroup, or column, are similar because they hard diamond yellowish inert gas with more or fewer electrons than protons soft reactive: non-sparkina borax soap, fertilizer. 78% of air 21% of air H20 noison ons orange-red not found free in typically have the same number of outer electrons. This table lightweight copper alloy tools most reactive organic molecules nature. Their oxides The atomic weight of an element is the average number of shows some easy-to-remember common numbers for each group. aluminum alloys, advertising sign: aerospace, stiff fibers otein, muscles, organic molecules element; protons plus neutrons. You can easily estimate the atomic are called alkali Group number 1 2 3-12 13 14 15 16 17 18 blood, breathing, DNA, ammonia, glowing fluorite, toothpaste, batteries ports equipment animals, plants. Insers weight: it is usually 2 to 2.5 times the atomic number supercold impact-resistant beryl aems: earths. In pure CO2, wood, paper fertilizer fire half of Outer electrons\* 1 2 2 3 4 5 6 7 8 heat-resistant ceramic cookware emeralds and form they are soft An element is a substance made from one or more atoms of explosives (TNT) earth's crust nonstick cookware refrigerant Valence number\* +1 +2 +2 +3 +4,-4 -3 -2 -1 0 mond stabilizer and somewhat brittle the same atomic number. A compound is a substance made semiconductors coal, oil, gasoline refrigerants minerals, oxides CFC refrigerants aquamarines The valence number is the number of electrons from two or more elements chemically bonded. metals Sulfur 16 Cl Chlorine 17 Ar Na Sodium 11 Mg Magnesium 12 given (+) or taken (-) when bonding Al Aluminum 13 Si Silicon 14 P Phosphorus 15 S Argon soft metal hard metalloid: glowing white waxy brittle yellow solid; greenish poison aas: ghtweight metal; chlorophyll in lightweight noncorroding metal; 1% of air quartz, granite, Poor Metals are usually Transition Metals are typical metals: they are strong, shiny, salt (NaCl), nerves. green plants, kitchenware, cans. sand soil, clay and black forms): egg yolks, onions. stomach acid. most abundan soft and have low melting malleable (they can be hammered into shape), flexible (in thin 3 foil, machinery bakina soda talc basalt ceramics alass bones DNA garlic skunks disinfectant inert gas light bulbs, "neon" tubes ntacids, lye, soap, aluminum allovs sheets or wires), and they conduct both heat and electricity. temperatures. cars, planes, bikes algae, diatoms. energy-storing hot springs, drinking water soda ash, glass, cars, planes, bikes feldspar, granite, semiconductors phosphates (ATP) volcanos, gypsum swimming pools papermaking, flares sparklers clay, ceramics computer chips fertilizer acids rubber acids PVC plastic lasers 5 12 3 4 10 11 pipes and bottles silicone rubber welding gas corundum, aems deteraent, matches papermakina Potassium 19 Ca Calcium 20 Sc Titanium 22 Vanadium 23 Cr Chromium 24 Cobalt 27 Ni Nickel 28 Copper 29 Zn 30 Ga Gallium 31 Ge Germanium 32 As soft metal: soft lightweight strongest ahtweiaht metal hard metal; hard shiny meta medium-hard hard metal, medium-hard colored metal soft metal, melts brittle metalloid: brittle metalloid; brittle gray solid; soft metal dark red liquid; reactive. hones teeth milk metal hard strong stainless steel hard tough steel metal magnetic magnetic metal magnetic conducts heat and metalon a hot day semiconductors noisons nhotoconiers disinfectant semiconductors. salts, nerves, leaves, vegetables aluminum alloys, heat-resistant: resilient steel earthmovers. steel allovs hard strong steel stainless steel electricity well: aalvanized stee semiconductors pools and spas. utrients in fruits shells, coral, racing bikes, aerospace structures, kitchenware rock crushers are mostly iron, cutting tools, (Fe-Cr-Ni) wires, cookware brass (Cu-Zn), light-emitting rectifiers, diodes, light-emitting photocells photo film flashlights, and venetables limestone chalk stadium lamps racina bikes. ichrome heaters rails, plows, axes structures kitchenware brass (Cu-Zn) hatteries white diodes (LEDs photocells. diodes (LEDs) red alass flame retardant lanterns vehicles, magnets, magnets (Al-Ni-Co). bronze (Cu-Sn). artificial joints, driveshafts, tools, (GaAs) lenses, (GoAs) dandruff shampoo, "neon" tubes. soon fertilizer avpsum, plaster furnace bricks car trim, paints batteries. nichrome heaters paint, phosphors leaded aasoline. fertilizer aquamarines aerospace earth's core, gunpowder marble antacids blue sapphires violet sapphires emeralds & rubies amethysts red rocks, blood vitamin B-12 coins, earth's core blue crab blood fertilizer tiny lasers Rhodium 45 Pd Palladium 46 Ag 50 Sb Antimony 51 Te Tellurium 52 I Rh Rubidium 37 Sr Strontium 38 Vttrium 39 7r 7irconium 40 Nb Niobium 41 McMolybdenum 42 Tc Technetium 43 Ru Ruthenium 44 Rh Silver 47 Cd Codmium 48 Tn Indium 49 Sn Tin Todine 53 Xe Xenon brittle metalloid; soft metal, soft metal; soft metal non-corroding high-melting-point niah-melting-poin non-corroding non-corrodina soft shiny metal soft metal; non-corroding brittle metalloid; violet-black solid inert gas; radioactive non-corroding non-corroding reactive soft metal: atomic clacks flores color TVs metalmetalhard steel. first human-made electric contacts labware absorbs hydrogen electricity best electronloted alass seals solders lead hardener semiconductors wounds and lamns headlight lasers (YAG, YLF) plated food cans batteries bullets leaf switches reflectors of all elements: photocopiers stadium lamps alobal navigation phosphors chemical pipelines hemical pipelines cutting tools element only labware stee alass coatings drinking water nuclear batteries, furnace bricks. nuclear reactors. superconductors. drill bits. races on earth electric contacts. electric contacts bronze (Cu-Sn). semiconductors. computer disks. magnetic pewter cups photocells vacuum tube medical high-temperature furnace bricks armor plate, but found in stars catalyst thermocounles dentistry silverware coins. red and vellow displays (LCDs) thermo-electric to prevent strobes losers scavenger diagnostic tracer superconductors abrasives evitation trains gun barrels, medical hydrogen catalyst catalyst dentistry semiconductors alassmakina matches coolers and thyroid disease spacecraft MRI magnets production pollution control pollution control photo film fire sprinklers diodes, photocells fire sprinklers flame retardant nuclear fallout fertilizer diagnostic tracer photo film ion engines zircon gems generators Cs Cesium 55 Ba Barium 56 57 - 71 Hafnium 72 Ta Tantalum 73 Rhenium 75 Os Osmium 76 radioactive gas, soft metal, melts soft metal high-melting-point highest-meltingigh-melting-point non-corroding most malleable liquid metal, soft metal, dense, soft, low-melting-point radioactive radioactive non-corroding non-corroding non-corroding on a hot day absorbs X-rays metal non-corrodina naint metal dense: dense metal. high-melting-point hard metal, hard metal dense metal element dense toxic toxic. non-corroding brittle metal. long-lived short-lived short-lived Rare rocket engines reactive, largest metal: filaments in ensest elemen thermometers solders, fuses small traces environmenta contrast enhancer labware stable atoms; Farth nuclear reactor lamps and TVs densest element (same as osmium) spark plugs colored metal barometers mercury alloys, eights, solders fire sprinklers element found, in nature hazard atomic clacks green firworks, vhitener and filler control rods in surgical tools cutting tools, lab filaments (same as iridium) lahware catalyst jewelry, coins, ultra-thin thermostats low-temperature hatteries hullets (pluas melt small traces concer medicine surgical implants Metals artificial joints, submarines, alobal navigation abrasives electric contacts electric contacts spark pluas pollution control, street lamps thermometers. crystal glass, for cancer gold leaf. (GPS), vacuum thermocouples pen tips, needles pen tips, needles troleum cracking uorescent lamps cosmetics pigment anti-static brushe dentistry tube scavenger electrodes mobile phones fingerprint powder processing fats electric contacts photocells' radiation shield tohacco Fr Francium 87 Ra Radium 88 89 - 103 104 Db 105 Sg 106 Bh 108 Mt 109 Ds 110 Rg 117 118 Rutherfordium Dubnium Bohrium Hassium Darmstadtium radioactive radioactive Seaboraium short-lived atoms larger luminous watches Actinide than cesium; (now banned) Metals Superheavy Elements in nature production. studied in radiography laser atom traps radwaste radioactive, short-lived; never found in nature, no uses except atomic research 121 - 153 La Lanthanum 57 Ce Cerium 58 Pr Praseodymium 59 Nd Neodymium 60 Pm Promethium 61 Sm Samarium 62 Eu Europium 63 Gd Gadolinium 64 Tb Terbium 65 Dy Dysprosium 66 Ho Holmium 67 Er Erbium 68 Tm Thulium 69 Yb Ytterbium 70 Lu Lutetium 71 soft metal; soft metal, best soft metal; Rare Farth Metals are all soft metals neutron absorber infrared lasers fiber optic signal amplifiers, fiber optic signal amplifiers, ontical alass most abundant torchworkers' long-lived; magnets (Sm-Ca) nuclear rarest stable densest and (Nd-Fe-B). laser surgery They are chemically similar to scandium and telescope rare earth metal didymium eye human-made electric motors color TVs and magnetic: color TVs and control rods rare earth metal hardest alasses (Pr-Nd) small traces speakers and richromatic lamps richromatic lamps MRI phosphors infrared lasers infrared lasers infrared rare earth meta 6 eyepieces yttrium and are difficult to separate from in nature, headphones, rangefinders, laser surgery, camera lenses lighter flints, speakers and luminous paint imaging (MRI) computer disks computer disks laser surgery, fiber lasers cancer-fighting , each other self-cleaning arc lamps headphones. luminous dials infrared sensors lasers contrast enhancer magnetostrictive magnetostrictive computer disks. pink alass phosphors stainless steel photodynamic sheet thickness yellow glass filters light-activated arc lamps ovens lasers, infrared-absorbing phosphors, neutron sunalasses alloys Actinide Metals are all radioactive glass polishing lighter flints (Terfenol-D®) heavy metals. They are used mainly for Plutonium 94 Am Americium 95 Cm Curium 96 Bk Berkelium 97 Cf 101 No their radioactive properties. Ac Actinium 89 Th Thorium 90 Pa Protactinium 91 U Uranium 92 No Neptunium 93 Pl Californium 98 100 Md 102 Lr Nobelium radioactive Einsteinium Fermium Mendelevium Lawrencium long-lived, dense; lona-lived Iona-lived: long-lived long-lived; long-lived: lona-lived Iona-lived lona-lived Radioactivity. Atoms with the same number of protons never found small traces most abundant small traces small traces never found never found small traces never found but different numbers of neutrons are called isotopes. in nature, reactor fuel in nature, in nature, in nature radioactive element in nature in nature in nature in nature Some isotopes are stable: others are radioactive smoke detectors scientific cancer medicine, itron detectors scientific nuclea no uses nuclear weapons nuclear no uses their nuclei eventually disintegrate. The radioactive reactor fuel, sheet thickness neutron source. dosimeters. reactor fuel instruments instruments half-life is the time for half the nuclei to disintegrate gas lamp mantles radwaste armor piercing nuclear weapons nuclear weapons gauges mineral analyzers mineral analyzers radioactive, short-lived; never found in nature, no uses except atomic research On this chart, an element is called long-lived if the tunasten filaments bullets radwaste radwaste radwaste radwaste half-life of any of its isotopes is more than one year

otherwise it is called short-lived.