

THE SYMBOLS OF THE CHEMICAL ELEMENTS

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The names of the chemical elements have received a certain amount of attention in Word Ways over the years. The very first issue of Word Ways in February 1968 presented a quiz on 20 transposed element names. Later articles have offered more extensive transpositions, transadditions, old names for some of the elements, elements in US placenames, and words composed solely of the element symbols, such as CoAgULaTe.

In this article, I want to examine the symbols of the chemical elements as an ordered collection of letters. Many earlier items in Word Ways have treated the typewriter (computer) keyboard as an ordered sequence of letters (QWERTYUIOPASDFGHJKLZXCVBNM) and have posed questions such as:

- What is the longest word with its letters spelled in keyboard order?
- What is the longest word with its letter spelled in reverse keyboard order?
- What is the longest word with letters from the first letter row?

Similar questions can be raised with regard to the elemental symbols. First off, let's take a look at the periodic table, the listing of chemical elements in atomic number order and the corresponding symbols. The list below contains 109 elements, with atomic numbers from 1 to 109. For three of the elements (aluminum, sulfur, cesium) there exist variant British spellings (aluminium, sulphur, caesium). For elements 104 to 109 I have used the new provisional names rather than the earlier suggested names. My 1998 printing of the Merriam-Webster Collegiate Dictionary, 10th edition, lists three new names for elements 104, 105 and 109; my 1995 edition of The Concise Oxford Dictionary lists the new names for elements 104-108; and my 1998 edition of The Chambers Dictionary has the new names for elements 104-107 and 109 (but not 108). Putting these three sources together gives me the new names for all the elements 104-109.

The atomic numbers (1-109), the symbols of the chemical elements and their names are given in the list below. This is the raw material for the remainder of this article.

1-5 H hydrogen He helium Li lithium Be beryllium B boron
 6-10 C carbon N nitrogen O oxygen F fluorine Ne neon
 11-15 Na sodium Mg magnesium Al aluminum Si silicon P phosphorus
 16-20 S sulfur Cl chlorine Ar argon K potassium Ca calcium
 21-25 Sc scandium Ti titanium V vanadium Cr chromium Mn manganese
 26-30 Fe iron Co cobalt Ni nickel Cu copper Zn zinc
 31-35 Ga gallium Ge germanium As arsenic Se selenium Br bromine
 36-40 Kr krypton Rb rubidium Sr strontium Y yttrium Zr zirconium
 41-45 Nb niobium Mo molybdenum Tc technetium Ru ruthenium Rh rhodium
 46-50 Pd palladium Ag silver Cd cadmium In indium Sn tin
 51-55 Sb antimony Te tellurium I iodine Xe xenon Cs cesium
 56-60 Ba barium La lanthanum Ce cerium Pr praseodymium Nd neodymium
 61-65 Pm promethium Sm samarium Eu europium Gd gadolinium Tb terbium

66-70 Dy dysprosium Ho holmium Er erbium Tm thulium Yb ytterbium
 71-75 Lu lutetium Hf hafnium Ta tantalum W tungsten Re rhenium
 76-80 Os osmium Ir iridium Pt platinum Au gold Hg mercury
 81-85 Tl thallium Pb lead Bi bismuth Po polonium At astatine
 86-90 Rn radon Fr francium Ra radium Ac actinium Th thorium
 91-95 Pa protactinium U uranium Np neptunium Pu plutonium Am americium
 96-100 Cm curium Bk berkelium Cf californium Es einsteinium Fm fermium
 101-105 Md mendeleevium No nobelium Lr lawrencium Unq unnilquadium Unp unnilpentium
 106-109 Unh unnilhexium Uns unnilseptium Uno unniloctium Une unnilennium

We can view the symbols as an ordered sequence of 210 letters.

Question 1: Using the 210-letter sequence, what real words (three letters and longer) are spelled out in order by adjacent letters of the symbols?

As an example, the word SIP is spelled out by the symbol sequence Si, P (atomic numbers 14, 15). The longer SIPS is spelled out by the sequence Si, P, S (atomic numbers 14,15,16). Note that some words use a single letter from a two-letter symbol—for example, the word GALS is spelled out from the sequence Mg, Al, Si (atomic numbers 12,13,14). Some words stretch across three symbols (SIPS, CLARK, CONIC), but there are no examples stretching across four.

The following is a reasonably full list of words that can be spelled out, including a few proper names. I am sure that additional words could be added by including obsolete words from the Oxford English Dictionary and increasingly obscure placenames.

In my opinion, the best word on the list is the five-letter CONIC. There are 47 words in this list. Anyone get it up to 50?

HHeLiBeBCNOFNeNaMgAlSiPSClArKCaScTiVCrMnFeCoNiCuZnGaGeAsSeBrKrRbSrY

Eli nam sip clark coni gag ass
 lib gal lar conic gage
 gals lark cuz age
 sips ark

ZrNbMoTcRuRhPdAgCdInSnSbTeIXeCsBaLaCePrNdPmSmEuGdTbDyHoErTmYbLuHfTaW

mot dag din bal cep meu hoe taw
 cru dins ala hoer
 ins lac
 lace
 ace

ReOsIrPtAuHgTlPbBiPoAtRnFrRaAcThPaUNpPuAmCmBkCfEsFmMdNoLrUnq

sir tau poa act run
 oat

UnpUnhUnsUnoUne

pun uns noun
 hun
 huns
 unsun
 sun

Question 2: Using the 210-letter sequence, what sets of adjacent symbols can be transposed to create real words? Within this question, I am looking to use all the letters of the symbols used, rather than just one of two letters (or two of three letters). As an example, the word BIBLE can be generated from the three symbols Li, Be, B (atomic numbers 2,3,4). There are some examples of transposals generated from four symbols (MAGILPS from Mg, Al, Si and P (atomic numbers 12,13,14,15) and DANCINGS from Ag, Cd, In and Sn (atomic numbers 47,48,49,50). There are no examples of five adjacent symbols being transposable to make a real word.

The best word on this list, again in my opinion, is the eight-letter SPORTIER. There are other eight-letter words, but I feel this is the commonest. There are 141 transposals here. What others can be added?

HHeLiBeBCNOFNeNaMgAlSiPSClArKCaScTiVCrMnFeCoNiCuZnGaGeAsSeBrKrRbSrY

heh ebb fon mang pis carl cist cion ages
 elhi con Anne ails carls cits coin gaes
 heil conf mangal clarks tics icon sage
 bile foen glam unci seas
 bible fone Glamis caracks basser
 fen magilps brases
 nef sail sabers
 sial sabres
 lapis rebs
 pails Serb
 spail
 spial
 spails
 spials
 psi
 piss
 psis

ZrNbMoTcRuRhPdAgCdInSnSbTeIXeCsBaLaCePrNdPmSmEuGdTbDyHoErTmYb

curt dancings tie bacs emus yodh hatful
 inns excites alec meus hero haft
 best cabs muse hore
 bets scab degums mother
 besit cabals mudgets term
 bites alba smudge
 baal gude
 capabler budget
 carple
 craple
 parcel
 placer

LuHfTaWReOsIrPtAuHgTlPbBiPoAtRnFrRaAcThPaUNpPuAmCmBkCfEsFmMdNoLrUnq

hatful eros tapu atop raca pun emfs lorn
 haft ores galuth parton charta puma fems
 wat sori patron chat
 tawer ript tarpon tach
 water trip rant path

wrate	tarn	phat
rew		
owers		
owres		
resow		
serow		
sower		
swore		
worse		
worries		
roes		
rose		
sore		
rosier		
pierrots		
sportier		
prosit		
ripost		
tripos		

UnpUnhUnsUnoUne

pun
 hun
 nus
 sun

Question 3: If we remove the constraint imposed in Question 2 (using only complete symbols), what transposals can be found from adjacent symbols, that is by allowing one letter from a two-letter symbol, or two letters from a three-letter symbol?

Some words appear in the following list as well as in answer to Question 2. In Question 2, FON appears as a transposal of N, O and F (atomic numbers 7,8,9); FON reappears in the following list as a transposal of O, F and the N of Ne (atomic numbers 8,9,10). Also, CLARK makes a reappearance. In Question 2, CLARK is generated as a transposal of Cl, Ar, K (atomic numbers 17,18,19), but in Question 3, it is generated from {C}l, Ar, K, C(a) (atomic numbers 17,18,19,20). That is, the C in CLARK comes from the C of Ca instead of the C of Cl. Other repeated examples include COIN and its mutual transposals.

Some words appear twice in the following list. For example, RACK appears twice, first as a transposal of Ar, K, C(a), and then as a transposal of (A)r, K, Ca. OSIER and MOTHERY each appear twice for a similar reason.

No words in the response to Question 1 (words formed by the symbol letters in sequence) have been automatically repeated in the following response.

In my opinion, the best words in this list are the nine-letter PRIORATES and the unexpected CATARRH. There are 263 transposals here, counting repeated words. What others can be added? There is such a concentration of words around atomic numbers 75,76,77,78 that I wouldn't be surprised if some fairly obvious words have been missed! Obviously, searching progressively more obscure references will certainly throw up many additional items.

HHeLiBeBCNOFNeNaMgAlSiPSClArKCaScTiVCrMnFeCoNiCuZnGaGeAsSeBrKrRbSrY

lei	bonce	ane	lips	clark	cit	fen	ion	gan	seas
lie	fon		lisp	lark	tic	nef		nag	eases
bile		ean	slip	cark		confine		gang	bases
belie		nae	lisps	rack		cone		gag	basse
		amen	slips	cark		once		gases	
		mane	clips	rack		cion		sages	
		name	spic	racks		coni		baskers	
		nema	claps	sack		icon		Serbs	
		mange	clasp	sac				berks	
		agname	lacs	sac				kerbs	
		manage	lac	acts				berk	
		gamelan		cracks				kerb	
		gamelans		cast					
				cats					
				scat					

ZrNbMoTcRuRhPdAgCdInSnSbTeIXeCsBaLaCePrNdPmSmEuGdTbDyHoErTmYb

mob	cur	dap	nid	bents	sec	palace	mems	hoy	buhl
mot		pad	nids	bite	abs	cape	ems	mothery	
tom		gad	sind	exit	bas	pace	mes	other	
cot			nis	excite	cabal		geums	throe	
toc			sin	excise	caple		geum	mothery	
torc					sab	caper		ore	
court					albs	pec		roe	
curr					bals	per		rote	
churr					labs	pre		tore	
					slab	rep		metro	
					albas			ret	
					baals				
					balas				
					balsa				
					basal				
					capable				
					carpale				
					place				
					crape				
					pacer				
					recap				
					prance				

LuHfTaWReOsIrPtAuHgTlPbBiPoAtRnFrRaAcThPaUNpPuAmCmBkCfEsFmMdNoLrUnq

aft	osier	apt		poi	arar	hap	pup	efs	don
fat	prosier	hug		patio	carrat	puna	amu	effs	nod
waft	oes	pat		atropin	catarrh		pupa		
wafter	sir	uta		aport	carat		caum		
wart	ios	tap		porta	carta		cam		
raw	iso	haut		tao	acta		mac		
war	sri	Utah		rato	chapt				
arew	pirs	aught		rota	patch				
ware	rips	ghaut		taro	chapt				
wear	risp	thug		orant	patch				
ower	pir			toran	pah				
owre	rip			trona					
wore	atrip			afront					
priorates				art					
ose	aught			rat					
osier	ghaut			tar					

poiser
 posier
 periost
 poriest
 prostie
 reposit
 riposte
 ropiest
 airpost
 airstop
 parotis
 spirit
 sprit
 stirp
 strip
 trips
 partis
 rapist
 tapirs
 upstairs
 parti
 tapir
 part
 prat
 rapt
 tarp
 trap
 pruta
 prutah
 taught

UnpUnhUnsUnoUne

pun shun
 hun onus
 nus
 sun
 nouns

Most words in this article are in Official Scrabble Words, International Edition. A few well-known proper names have been included (ELI, ANNE, UTAH) plus one or two words from the OED and Webster's Second Edition. A thorough search of Webster's Third, the OED and other references is likely to unearth additional items.

This article has concentrated on the symbols for the chemical elements with atomic numbers 1 to 109. A later article will consider the theoretical elements with atomic numbers of 110 and higher.