We are addicted to using four-letter words.

There are so many of these words that it is impossible to communicate effectively without them. Cryptographic studies show that 31 of the 100 most frequently used words are four-letter ones. A baker's dozen, drawn from the top 60: FROM, HAVE, MORE, SOME, THAN, THEM, THEY, THIS, UPON, WHAT, WHEN, WITH, YOUR. These particular examples are "pure" words, each one using four different letters, and must be distinguished from "contaminated" specimens in which a letter is repeated (THAT, WERE, BEEN and others).

If we take the 26 letters of the alphabet and arrange them in an entirely random linear order, a careful examination of the letter sequence before us will disclose various common words hidden in the sequence: words spelled in correct order, though seldom with consecutive or even nearly consecutive letters of the sequence.

For illustrative purposes, let's consider the most popular of all letter orders, the alphabetic order:

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

Interested scrutiny of this particular letter sequence uncovers words such as AHoy, AIRy, BEvY, BLOW, CHIN, CRUX, DEFY, DIRT, EGIS, ERST, FILM, FLUX, GIST, GORY, HINT, HOST, IMPS, KNOT, KNOW, LOPS, LOST, MOPS, MOST, and NOsy. All of these are quite common words. There are some other equally common words that we have failed to point out. How many of them can you spot?

In a typical, random letter arrangement, several dozen common or near-common four-letter words can be discovered. Those of us with a logological passion must inevitably wrestle with two questions: which one of all possible letter sequences will yield the smallest number of four-letter words, and which one the largest such number?

The simple, obvious way of finding out is to test each possible arrangement of the alphabet. Unfortunately, there is an insurmountable roadblock in the way. The 26 letters of the alphabet may be arranged in more than 403 septillion different ways. If we had access to a supercomputer capable of tossing different arrangements to us at the rate of ten million sequences per second, and if we kept this supercomputer in continuous operation for one trillion years, the list of possible letter
sequences would still not be complete. Since it may take from one hour to three hours to test even one letter arrangement, the time investment required to solve our two problems is prohibitive. There must be a more practical method!

Before considering ways and means, we must define what we are going to accept as allowable words. The unabridged dictionaries, praiseworthy as they are in many respects, include too many words alien to us both in meaning and in spelling. Since we are interested in reasonably common words, recognizable more or less at sight, let us make The New Merriam-Webster Pocket Dictionary our standard, accepting all regular four-letter words that appear in this dictionary in boldface type in the main alphabetical section (pages 1 through 592). In specifying regular words, we mean to exclude "crippled" words also in the dictionary: hyphenated and apostrophized words, parts only of hyphenated words and of multi-word phrases, multi-word phrases in their entirety, abbreviations, prefixes, suffixes, and acronym-like words. These restrictions will keep out of our lists terms such as CAN'T, CO-ED, SUEY (part of "chop suey"), AFRO (part of "Afro-American"), AS IF, SEMI-, -ENCY, AWOL, and, possibly, XMAS (which may be thought of as an abbreviated form of "Christmas").

The results obtained by using the pocket dictionary should be representative of ordinary English, undistorted by the many strange words included in much larger dictionaries.

The easier of our two problems is minimizing the number of four-letter words in a 26-letter sequence. It ought to be possible to produce an alphabet in which not a single tetragram can be found.

Reflecting on the problem, we realize that all words in which consonants and vowels are mixed can be excluded simply by placing all consonants first and all vowels last. This will prohibit movement back and forth between the two kinds of letters, and will also exclude all words beginning with vowels, because there are no all-vowel words in the pocket dictionary.

Our next task is to exclude words beginning with two or more consecutive consonants. We achieve that goal by placing all consonants first and all vowels last. This will prohibit movement back and forth between the two kinds of letters, and will also exclude all words beginning with vowels, because there are no all-vowel words in the pocket dictionary.

Remaining to be considered are words spelled with one consonant followed by three vowels. There are only 7 such words in the dictionary: BEAU, BUOY, KAYO, LIEU, MOUE, QUAI, and ROUE. By noting the vowel arrangements in these 7 words, we can easily place the six vowels of the alphabet in such an order that none of the 7 words can be spelled out.
These reflections permit us to construct a letter sequence such as the following:

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HLMNWRBCDFGJKPQTVXZSYEUAO
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Study this arrangement diligently. If you can find any four-letter word in it, allowable under our rules, telegraph the editor of Word Ways immediately, requesting a plaque certifying you as a member of the Logological Hall of Fame.

The second problem, that of maximizing the number of four-letter words that may be read in an alphabetic sequence, is much the more difficult one. To begin with, we do not know what word total is to be achieved, except for the vague feeling that there must be some letter sequences permitting "hundreds" of tetragrams to be formed.

One way of attacking the problem would seem to be arranging the letters in order according to the relative frequency with which they appear as first letters of four-letter words. Another way would seem to be arranging them in reverse order according to the relative frequency with which they appear as fourth letters of such words. Using published positional word lists compiled from the pocket dictionary, it is a simple matter to count the number of eligible words that begin or end with each letter of the alphabet. Such counts establish that S, B, and C are far and away the most common initial letters, while E, D, and T are conspicuously the most common terminal letters. This suggests that our letter sequence should begin with S B C ••• and end with ••• D T E.

These two approaches are both one-sided ones. To close in on our objective, it might be best to combine them, particularly as regards the 20 letters in between our tentative start and finish. Thus, if a letter ranks 7th on our initial list and 21st on our reverse terminal list, perhaps it ought to be assigned the 14th position on a combined tentative list. The rare letters of the alphabet (J, Q, X, Z, K, V) can be studied as a separate phenomenon, and shunted to the front end or the tail end of the sequence depending on whether there are more words beginning or ending with them.

The results of our combined approach will tend to place most of the vowels (A, I, O, U) near the middle of the sequence. Their relative order is determined by inspecting the common vowel digraphs in English: AI, AU, OA, OI, OU, UI. Each of these occurs with far greater frequency than its reversal. There is only one relative vowel order that incorporates all 6 of these digraphs: O A U I. Accordingly, this particular order must be maintained, irrespective of whether or not any consonants are eventually interspersed among these vowels.

Some relative letter orders cannot be predicted solely on the basis of a priori considerations. Are there more words with the digraph IM or the digraph MI? The only way is to count the number of each that appear in pocket dictionary four-letter words. In this case, IM gets...
the nod.

Very careful analysis of all pertinent considerations bearing on letter order finally produces the following suggested alphabet sequence:

BSFPWCHJQMOAVUIRNGLKTDFXZ

There are many possible switches that can be made in this sequence without affecting the number of four-letter words that it will yield. For instance, the first three letters can be juggled in any of the mathematically possible 6 orders with no effect on the results. Similarly, the four letters H J Q M can be arranged in 24 different ways, and the three letters K T D can be arranged in 6 different ways.

How many eligible words can be read in this sequence? There are 398 given in the list below:

bade bore silt swag fund pore whir char
ball born sing swan funk pork whit chat
bait bout sink swat furl port whiz chid
bake bulk sire sway fury pour wide chin
bald bung site swig fuze pout wild chit
bale bunt size fade page prey wile chon
balk bunt smog fail paid puke wilt chug
band burn smug fain pail pule wily cite
bane bury smut fair pain punk wind city
bang sage soak fake pair punt wine coal
bank said soar fane pale puny wing coat
bard sail soil fang pane pure wink coax
bare sake sold fare pang purl wire code
bark sale sole fate pant wade wiry coll
barn salt song faun pard wage woad coin
bate sand sore faze pare wail woke coke
bide sade sort file park wain wold cold
bikc sang soul find part wait wont colt
bile sank sour fine pate wake word cone
bilk sate span fire pave wale worn conk
blind savc spar flex phiz walk work cony
bird scan spat foal pike wand worn cord
bite scar spay fogly pile wane wort core
boar Scat spin fold pine want wove cork
boat scud spit fold ping ward cage corn
bode shad spot folk pink ware cagy cote
body shag spry fond pint warn cake cove
bogy shin spud font pity wart cark cozy
boll shod spin ford pixy wary cane cult
bold shoe spur fore poke wave cant curd
bolc shot suit fork poky wavy card cure
bolt shun sulk fort pole waxy care curl
bond shut sung foul pond what cart curt
bone side sunk four pone whey cave cute
bony silk sure foxy pony Whig cavy hail

It is interesting to note that any of the above words bear the 5 letter note that no excusive letters four exist.

Read the increase in

COMMERCIAL search on August using any Webster's which one?

Can a list from the come such?

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Pocket
It is interesting to note that not a single word in the list begins with any of the last 11 letters in our arrangement, and that 380 of the 398 words begin with one of the first 10 letters in the sequence: the next 5 letters contribute only another 18 words. It is also of interest to note that none of the 398 four-letter words are spelled out by consecutive letters of the sequence; MORN and MAIN, each interrupted by four extraneous letters, are the most compact.

Readers are invited to try altering our letter sequence so as to increase the number of words of four letters it yields.

COMMENT (A. Ross Eckler): Ms. Xixx has done a fine piece of research on a problem originally introduced by Dave Silverman in the August 1971 Kicksaws. He reported there that Darryl Francis, using an unspecified word-source (but one larger than the Merriam-Webster Pocket Dictionary), had constructed a letter sequence in which only the word LAOS appeared:

UAOEYSDBPMHTGNLKRCKFWVJQXZ

Can a letter sequence be constructed which bars all three-letter words from the Pocket Dictionary? The answer appears to be no, but one can come surprisingly close. The sequence

UAOEYJQXVGMHKTPSZDBFCNRW

admits only the word OBI, which appears in the current edition of the Pocket Dictionary, but not in some older editions.