

Sources of Nutrients
in
Onsite Systems

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Biogeochemical Cycle

Limiting Nutrients

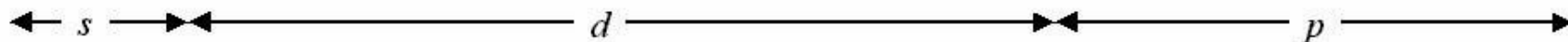
Freshwater - Phosphorus

Saltwater - Nitrogen

Periodic Table

1998 Dr. Michael Blaber

1 H 1.008																	2 He 4.003
3 Li 6.941	4 Be 9.012											5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18
11 Na 22.99	12 Mg 24.30	← VIII →										13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.07	17 Cl 35.05	18 Ar 39.95
19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.87	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55	30 Zn 65.39	31 Ga 69.72	32 Ge 72.61	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80
37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc 98.91	44 Ru 101.1	45 Rh 102.9	46 Pd 106.4	47 Ag 107.9	48 Cd 112.4	49 In 114.8	50 Sn 118.7	51 Sb 121.8	52 Te 127.6	53 I 126.9	54 Xe 131.3
55 Cs 123.9	56 Ba 137.3	La-Lu	72 Hf 178.5	73 Ta 180.9	74 W 183.8	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.1	79 Au 197.0	80 Hg 200.6	81 Tl 204.4	82 Pb 207.2	83 Bi 209.0	84 Po 210.0	85 At 210.0	86 Rn 222.0
87 Fr 223.0	88 Ra 226.0	Ac-Lr	104 Db	105 Jl	106 Rf	107 Bh	108 Hn	109 Mt	110 Uun	111 Uuu							

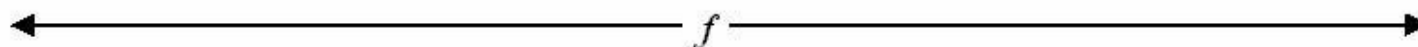


Lanthanides

57 La 138.9	58 Ce 140.1	59 Pr 140.9	60 Nd 144.2	61 Pm 146.9	62 Sm 150.4	63 Eu 152.0	64 Gd 157.2	65 Tb 158.9	66 Dy 162.5	67 Ho 164.9	68 Er 167.3	69 Tm 168.9	70 Yb 173.0	71 Lu 175.0
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Actinides

89 Ac 227.0	90 Th 232.0	91 Pa 231.0	92 U 238.0	93 Np 237.0	94 Pu 239.1	95 Am 241.1	96 Cm 244.1	97 Bk 249.1	98 Cf 252.1	99 Es 252.1	100 Fm 257.1	101 Md 258.1	102 No 259.1	103 Lr 262.1
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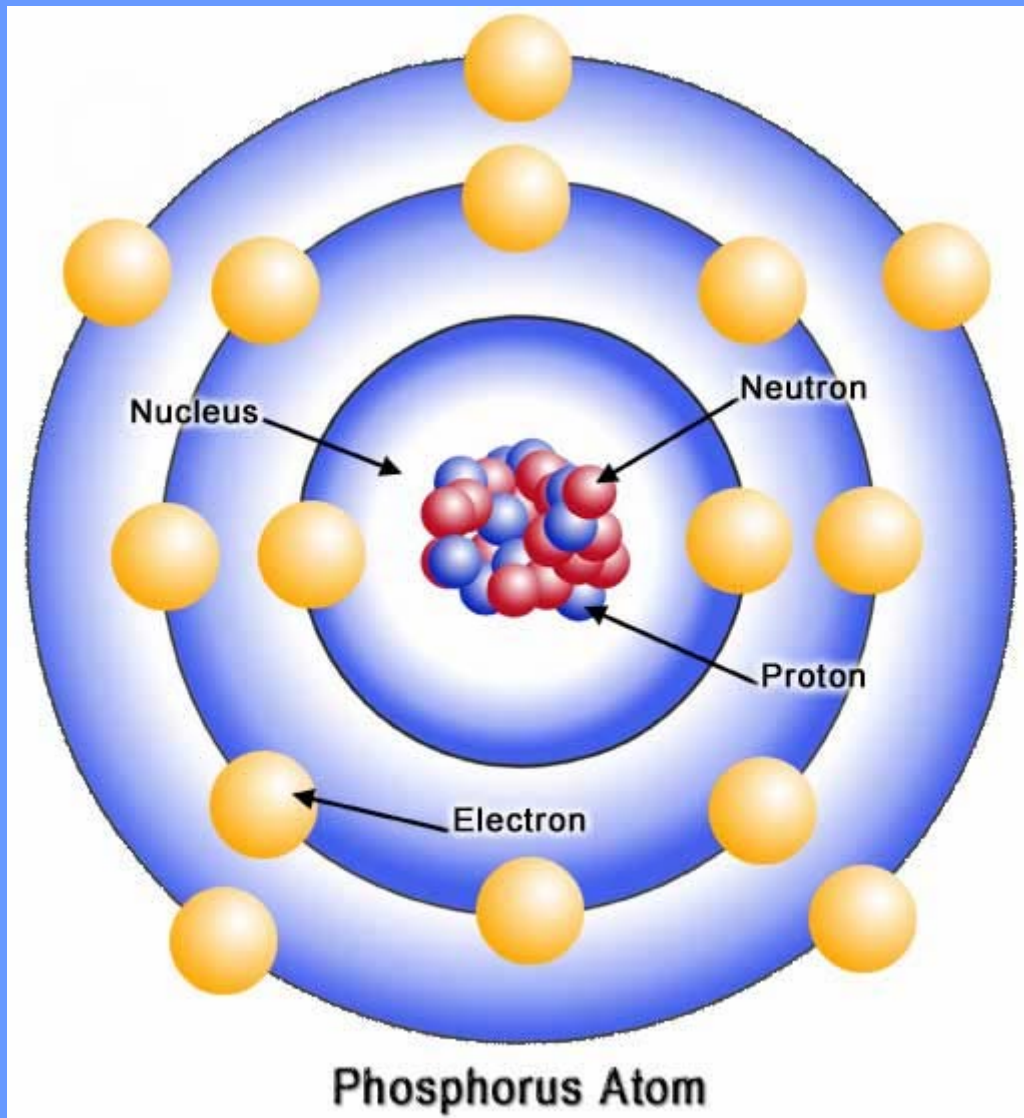


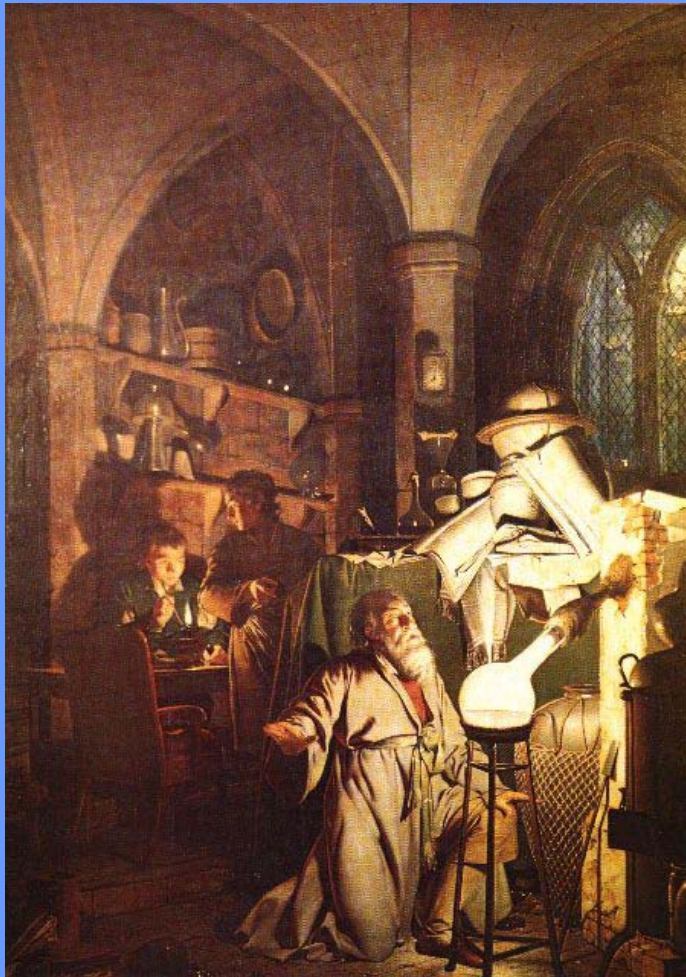
Phosphorus

#15 in the Periodic Table

15 protons, usually 16 neutrons in nucleus

5 electrons in the outer shell





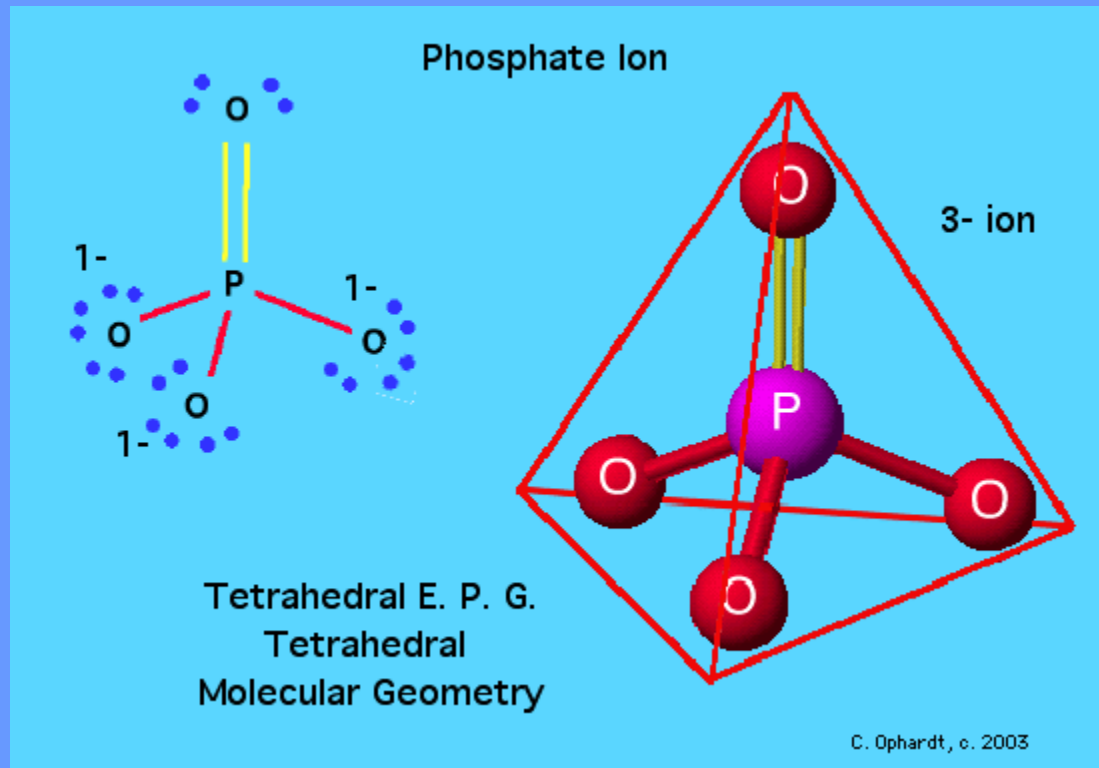
1669

The alchemist
Henning Brand
discovers
phosphorus while
trying to turn urine
into gold.

After 1775, using urine to produce phosphorus was abandoned.

There was phosphorus in bones.

What is the Phosphate Ion?



Phosphorus makes up 1% of the body's weight.

85% of the phosphorus in the body can be found in bones and teeth.

Small amount of phosphorus are needed for cell membranes, ATP, DNA and RNA, for enzymes and hormones. Many life processes depend upon the availability of tiny amounts of phosphorus.

Table 1¹
Phosphorus content of Foods

Food	Serving	Phosphorus (mg)
Milk, skim	8 ounces	247
Yogurt, plain nonfat	8 ounces	383
Cheese, Mozzarella;	1 ounce	131
Egg	1 large, cooked	104
Beef	3 ounces, cooked	173
Chicken	3 ounces, cooked	155
Turkey	3 ounces, cooked	173
Fish, halibut	3 ounces, cooked	242
Fish, salmon	3 ounces, cooked	252
Bread, whole wheat	1 slice	64
Bread, enriched white	1 slice	24
Carbonated cola drink	12 ounces	44
Almonds [#]	1 ounce	139
Peanuts [#]	1 ounce	101
Lentils [#]	1/2 cup, cooked	356

¹ <http://lpi.oregonstate.edu/infocenter/minerals/phosphorus/>

Adults require 0.8 - 1.2 grams of phosphorus a day.

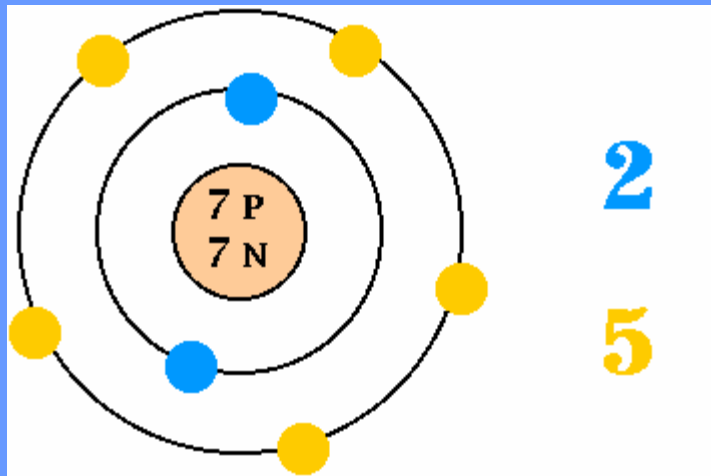
Children require 0.5 grams of phosphorus a day.

Nitrogen

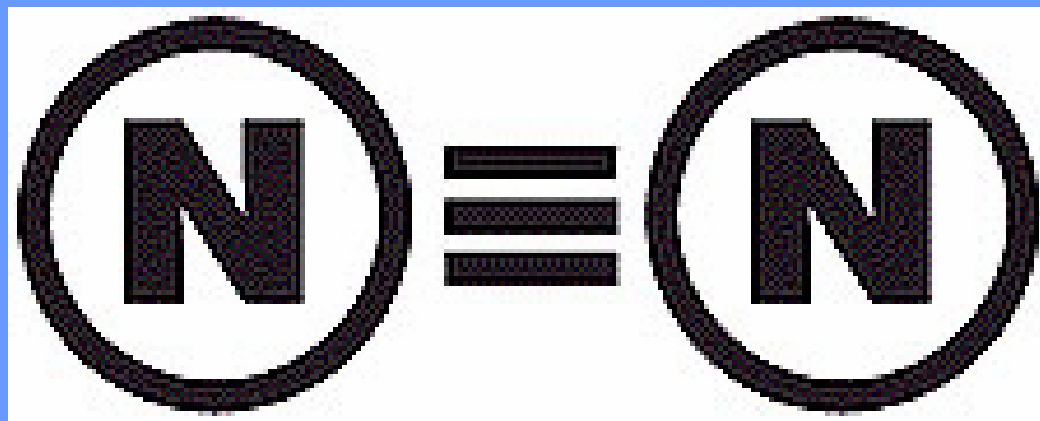
#7 in periodic table

7 protons and 7 neutrons in nucleus

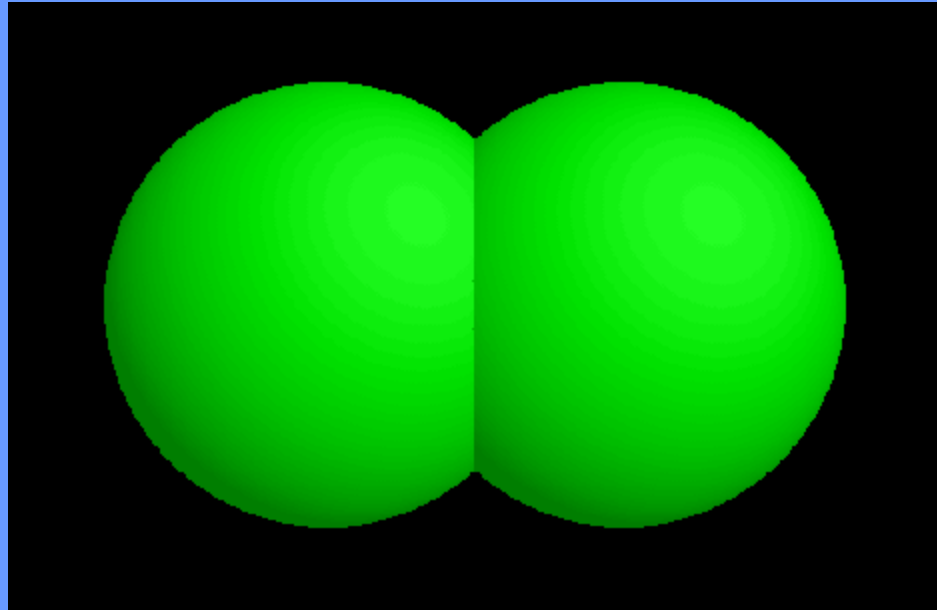
5 electrons in outer shell



The Nitrogen Atom



Nitrogen gas, N₂ is bound together by three bonds



Nitrogen gas model



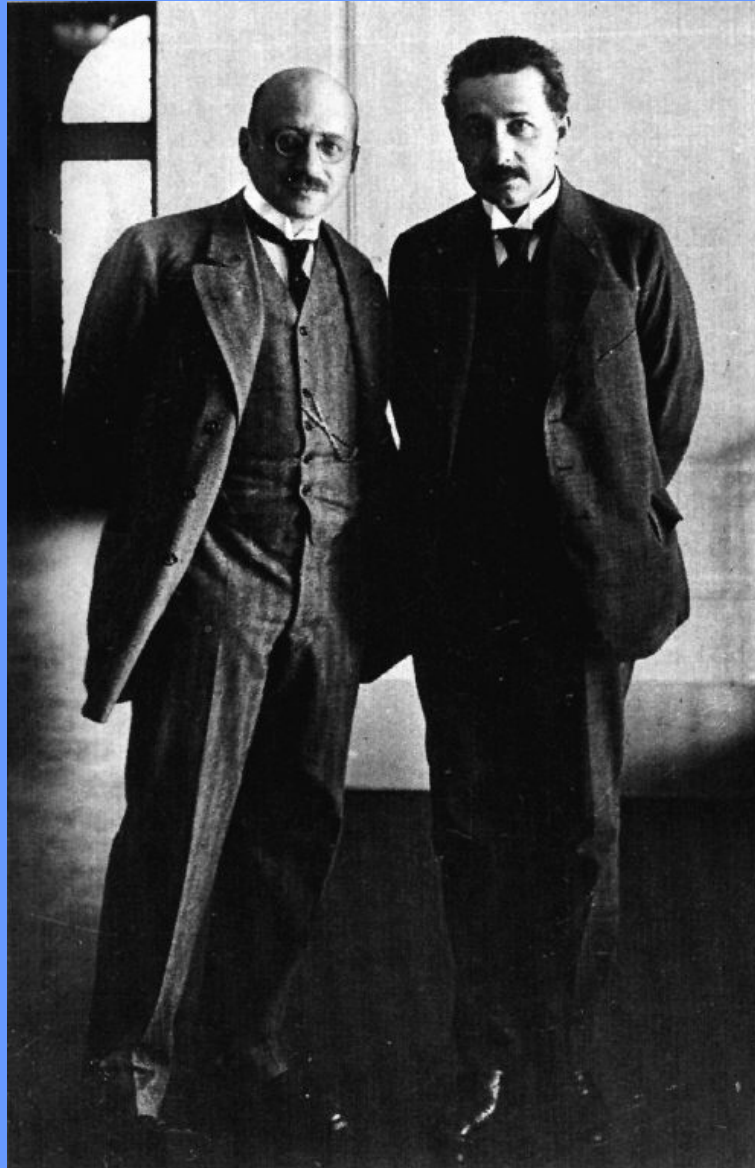
The nitrate ion NO_3^{-1}



Nodules on Legumous Plant Roots



Fritz Haber - developed Haber process in 1913.



Celebrity
Scientists

Agricultural Production and Fritz Haber

From 1908 on, food production was no longer a function of natural sources of nitrogen.

Table 2 ¹	
Protein Content of Various American Foods (percentage, based on 6.35 x TKN)	
Food	Percentage Protein
Carrots	2
Eggplant	1.2
Peas	2.2
Lettuce	1.8
American cheese	28.8
Flour	7 – 14
Beef	10-25
Chicken	~22
Bass	18
Whole Milk	8.8
Skim Milk	8.4
Condensed Milk	24.2
Eggs	17.4

¹ <http://www.nal.usda.gov/fnic/foodcomp/Data/Classics/es028.pdf> USDA Bulletin #28, 1896.

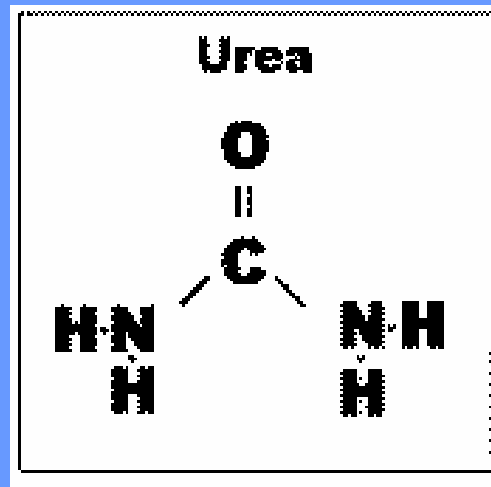
Table 2 ¹		
Average Per Capita Human Excrement per Day		
Feces	120 grams	4.4 ounces
Urine	1.1 Liter	2.3 pints

¹ Wagner, E.G. and Lanois, J.N., Excreta Disposal for Rural Areas and Small Communities, Geneva, Switzerland: World Health Organization (1958)

Table 3¹
Pollution Character of Excrement in grams

	BOD ₅	TN	PO ₄
120 grams feces	12	1.2	0.36
1.1 liter urine	11	11	3.30

¹ Laak, Rein, Wastewater Engineering Design for Unsewered Areas, 2nd edition, Technoivic Publishing Co, Inc. Lancaster, PA, 1986, p.21



Urea breaks down
to form ammonia.

Table 4 ¹ Characteristics of Typical Residential Wastewater	
	Concentration in Water mg/Liter
BOD ₅	200-290
Total Nitrogen	35-100
Ammonia	6-18
Nitrates and Nitrites	<1
Total Phosphorus	18-29
Phosphate	6-24

11.EPA Design Manual – Onsite Wastewater Treatment and Disposal Systems.
Publication 625, 1980, Office of Water Program Operations, Washington, D.C. 20460.

Table 5 ¹			
Concentration of Pollutants from Household Fixtures (mg/L)			
	BOD ₅	Total Nitrogen	PO ₄
Toilet	300	200	100
Bath	200	2	1
Bathroom Sink	200	2	50
Kitchen	700	5	10
Laundry	300	10	0
Garbage Disposal	2380	79	13

¹ Laak, Rein. Page __ modified.

Table 6
Organophosphorus Flame retardants.¹

- Triphenyl phosphate
 - Tricresyl phosphate
 - Resorcinol bis(diphenylphosphate)
 - Phosphonic acid, (2-((hydroxymethyl)carbonyl)ethyl)-, dimethyl ester
 - Phosphorus and nitrogen constituents for thermosets
-

Conclusion:

There is a wide variation in the amount of nutrients that enter an onsite wastewater system, but they can be calculated if the habits of the residents are determined.

Number of users

Amount of time using the house

Products used in the house

Number of automatic dishwashing and laundry loads

Cleaning habits

Garbage disposal use

The End