



# Why is Alien life commonly depicted as silicon base



(Luke and Saif)



# Science fiction

---

Has long imagined alien worlds inhabited by silicon based life. Like Korg for example but life as we know it is carbon based but does it have to be that way?



# Life as we know it is carbon based

---

All machinery of life all biochemistry is based around the carbon atom. If you look around you every living thing you can see is possible due to carbon. Why you may ask?

It's due to these key features:

- ❖ It provides scaffolding to form complex molecules
- ❖ It can form stable structures
- ❖ Can bond with multiple molecules

# Would alien life be different to us?

---

For this to happen there would have to be an element which has similar chemical properties to carbon and could form complex molecules. To narrow down our options we need to look at the type of bonds carbon makes.

What types of bonds are there (Question):

- Ionic (are too unstable)
- Metallic (repeating structures don't have the chemical variety for life)
- Covalent ✓

# Narrowing down the elements

We first have to look at the periodic table:

- Rule out elements that don't form covalent bonds

Periodic Table

1 H Hydrogen																	2 He Helium
3 Li Lithium	4 Be Beryllium											5 B Boron	6 C Carbon	7 N Nitrogen	8 O Oxygen	9 F Fluorine	10 Ne Neon
11 Na Sodium	12 Mg Magnesium											13 Al Aluminum	14 Si Silicon	15 P Phosphorus	16 S Sulfur	17 Cl Chlorine	18 Ar Argon
19 K Potassium	20 Ca Calcium	21 Sc Scandium	22 Ti Titanium	23 V Vanadium	24 Cr Chromium	25 Mn Manganese	26 Fe Iron	27 Co Cobalt	28 Ni Nickel	29 Cu Copper	30 Zn Zinc	31 Ga Gallium	32 Ge Germanium	33 As Arsenic	34 Se Selenium	35 Br Bromine	36 Kr Krypton
37 Rb Rubidium	38 Sr Strontium	39 Y Yttrium	40 Zr Zirconium	41 Nb Niobium	42 Mo Molybdenum	43 Tc Technetium	44 Ru Ruthenium	45 Rh Rhodium	46 Pd Palladium	47 Ag Silver	48 Cd Cadmium	49 In Indium	50 Sn Tin	51 Sb Antimony	52 Te Tellurium	53 I Iodine	54 Xe Xenon
55 Cs Caesium	56 Ba Barium	57 La Lanthanum	72 Hf Hafnium	73 Ta Tantalum	74 W Tungsten	75 Re Rhenium	76 Os Osmium	77 Ir Iridium	78 Pt Platinum	79 Au Gold	80 Hg Mercury	81 Tl Thallium	82 Pb Lead	83 Bi Bismuth	84 Po Polonium	85 At Astatine	86 Rn Radon
87 Fr Francium	88 Ra Radium	89 Ac Actinium	104 Rf Rutherfordium	105 Db Dubnium	106 Sg Seaborgium	107 Bh Bohrium	108 Hs Hassium	109 Mt Meitnerium	110 Ds Darmstadtium	111 Rg Roentgenium	112 Cn Copernicium	113 Nh Nihonium	114 Fl Flerovium	115 Mc Moscovium	116 Lv Livermorium	117 Ts Tennessine	118 Og Oganesson
58 Ce Cerium	59 Pr Praseodymium	60 Nd Neodymium	61 Pm Promethium	62 Sm Samarium	63 Eu Europium	64 Gd Gadolinium	65 Tb Terbium	66 Dy Dysprosium	67 Ho Holmium	68 Er Erbium	69 Tm Thulium	70 Yb Ytterbium	71 Lu Lutetium				
90 Th Thorium	91 Pa Protactinium	92 U Uranium	93 Np Neptunium	94 Pu Plutonium	95 Am Americium	96 Cm Curium	97 Bk Berkelium	98 Cf Californium	99 Es Einsteinium	100 Fm Fermium	101 Md Mendelevium	102 No Nobelium	103 Lr Lawrencium				

1 H Hydrogen								2 He Helium
6 C Carbon	7 N Nitrogen	8 O Oxygen	9 F Fluorine	10 Ne Neon				
14 Si Silicon	15 P Phosph...	16 S Sulfur	17 Cl Chlorine	18 Ar Argon				
32 Ge Germani...	33 As Arsenic	34 Se Selenium	35 Br Bromine	36 Kr Krypton				
50 Sn Tin	51 Sb Antimony	52 Te Tellurium	53 I Iodine	54 Xe Xenon				
82 Pb Lead	83 Bi Bismuth	84 Po Polonium	85 At Astatine	86 Rn Radon				
114 Fl Flerovium	115 Mc Moscov...	116 Lv Livermor...	117 Ts Tenness...	118 Og Oganess...				

- Rule out noble gases because they are unreactive and don't form covalent bonds

1 H Hydrogen					2 He Helium
6 C Carbon	7 N Nitrogen	8 O Oxygen	9 F Fluorine	10 Ne Neon	
14 Si Silicon	15 P Phospho...	16 S Sulfur	17 Cl Chlorine	18 Ar Argon	
32 Ge Germani...	33 As Arsenic	34 Se Selenium	35 Br Bromine	36 Kr Krypton	
50 Sn Tin	51 Sb Antimony	52 Te Tellurium	53 I Iodine	54 Xe Xenon	
82 Pb Lead	83 Bi Bismuth	84 Po Polonium	85 At Astatine	86 Rn Radon	
114 Fl Flerovium	115 Mc Moscovi...	116 Lv Livermor...	117 Ts Tenness...	118 Og Oganes...	



5 B Boron	6 C Carbon	7 N Nitrogen	8 O Oxygen	9 F Fluorine
13 Al Aluminium	14 Si Silicon	15 P Phosph...	16 S Sulfur	17 Cl Chlorine
31 Ga Gallium	32 Ge Germani...	33 As Arsenic	34 Se Selenium	35 Br Bromine
49 In Indium	50 Sn Tin	51 Sb Antimony	52 Te Tellurium	53 I Iodine
81 Tl Thallium	82 Pb Lead	83 Bi Bismuth	84 Po Polonium	85 At Astatine
113 Nh Nihonium	114 Fl Flerovium	115 Mc Moscovium	116 Lv Livermorium	117 Ts Tenness...



- 
- Rule out halogens because they do form covalent bonds but it is hard to get them to form covalent bonds with more than one element

1 H Hydrogen	6 C Carbon	7 N Nitrogen	8 O Oxygen
	14 Si Silicon	15 P Phospho...	16 S Sulfur
	32 Ge Germani...	33 As Arsenic	34 Se Selenium
	50 Sn Tin	51 Sb Antimony	52 Te Tellurium
	82 Pb Lead	83 Bi Bismuth	84 Po Polonium
	114 Fl Flerovium	115 Mc Moscovi...	116 Lv Livermor...

- 
- Remove elements row 4 and below due to them being too heavy and the bonds they form too unstable

1 H Hydrogen	6 C Carbon	7 N Nitrogen	8 O Oxygen
	14 Si Silicon	15 P Phospho...	16 S Sulfur

# We are left with:

---

Hydrogen, carbon, nitrogen, oxygen, phosphorus and sulfur. These elements make up the biochemistry of all life. However Silicon is separated being less involved in biological molecules than trace elements such as carbon.

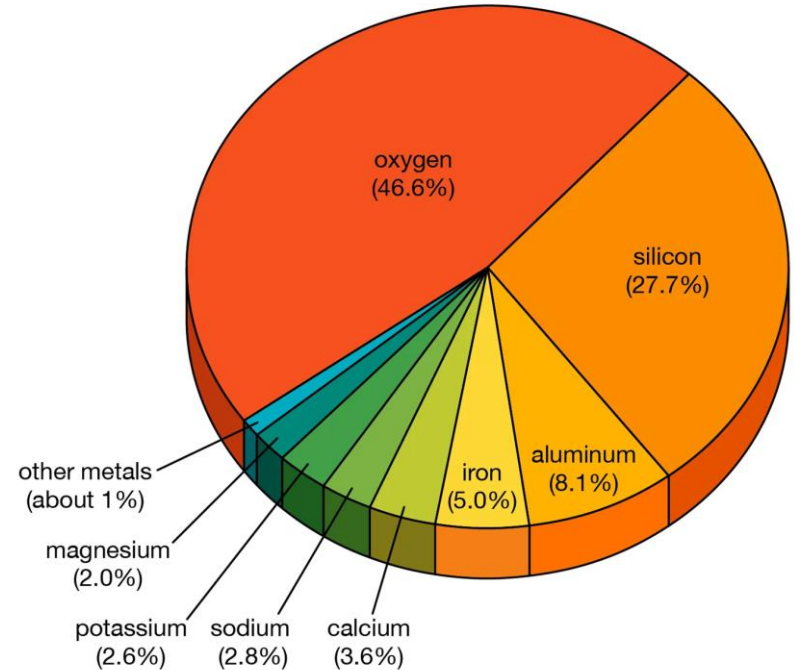
1 H Hydrogen	6 C Carbon	7 N Nitrogen	8 O Oxygen
	14 Si Silicon	15 P Phospho...	16 S Sulfur

# This begs the question:

So if silicon is far more abundant than elements such as carbon. Why is it not more prevalent in biochemistry?

This means that carbon must have major advantages in forming the scaffolding of biological molecules compared to silicon.

Mineral composition of Earth's crust



# Problems with silicon

---

Problems with silicon	Solutions to this problem
<ul style="list-style-type: none"><li>• Silicon is far more reactive with water than carbon - meaning when placed into water solvents they break down destroying their structure</li></ul>	<ul style="list-style-type: none"><li>• Silicon is stable in solvents such as hydrocarbons (methane) which are present in large quantities on the moons of gas giants in our solar system.</li><li>• Silicon is also stable in most acids such as sulfuric acids.</li></ul>

# Benefits to Silicon

---



When breaking the bonds of between silicon dioxide compared to carbon dioxide, silicon releases more energy due to silicon forming stronger bonds.

However the benefit of CO<sub>2</sub> is that it can be easily respired whereas SiO<sub>2</sub> is silica which is sand which is difficult to respire due to it being sand.