Group 4B elements:
- carbon is the “backbone” of the organic life on Earth (above the surface)
- silicon is the most abundant element at the surface of Earth

Organic Chemistry: chemistry of carbon based molecules – breaking, forming, twisting, and stretching C-Z bonds, where Z represents main-group elements

What kind of C-Z bonds we talk about?
- Z=C: stoichiometry C\(_n\) ⇒ carbon allotropes such as diamond, graphite, fullerenes/buckyballs, nanotubes
- Z=H,O,N,S to list the biologically most important examples

What do we know already about the C-Z bonds?
- C electron configuration: 1s\(^2\) 2s\(^2\) 2p\(^2\) → promotion → 1s\(^2\) 2s\(^1\) 2p\(_x\)\(^1\) 2p\(_y\)\(^1\) 2p\(_z\)\(^1\) ⇒ hybrid orbitals
  - can accommodate up to 4 electrons to become coordinatively saturated = noble gas configuration
    (note that Si has [Ne]3s\(^2\) 3p\(^2\) 3d\(^0\) and needs 14 e\(^-\) to become coordinatively saturated)

  | hybridizations: | sp\(^3\) | sp\(^2\) | sp |
  | bonds: | 4 \(\sigma\) (equivalent) | 3 \(\sigma\), 1 \(\pi\) | 2 \(\sigma\), 2 \(\pi\) |
  | bond order: | 4×1 | 2×1, 1×2 | 1×1, 1×3 |
  | geometry: | tetrahedral saturated | trigonal planar unsaturated | linear |

- remember these hybridizations as fragments/building blocks for a wide variety of organic molecules

Let’s start combining the three different C environments with various main group elements (Z):

Z=H – family of hydrocarbons – literally, they are the backbone of organic molecules
- only sp\(^3\) C atoms ⇒ C-C and C-H bonds from overlap of C 2p/C 2p and C 2p/H 1s orbitals ⇒ alkanes
  - simplest example is the methane
  - Exercise 23-24: C\(_6\)H\(_{14}\) note than the stoichiometry follows C\(_n\)H\(_{2n+2}\) this must be a chain-like alkane can have 3 structural isomers – total stoichiometry is not enough to describe naming conventions: longest chain, smallest numbers
  - chemically inert due to strong C-C and C-H bonds
    - homolitic cleavage: formation of radicals by hv or Δ
    - heterolitic cleavage: formation of carbanions and carbocations
    - combustion: oxidation products → partial CO, H\(_2\); complete CO\(_2\), H\(_2\)O
    - by closing the chains (C\(_n\)H\(_{2n}\)) forming cyclic alkanes: cyclopropane >> cyclobutane >> cyclopentane > cyclohexane ~ … gradually decreasing strain
    - geometrical (conformational) isomerism: eclipsed & staggered conformations of acyclic alkanes; chain & boat of cyclic alkanes with axial/equatorial positions