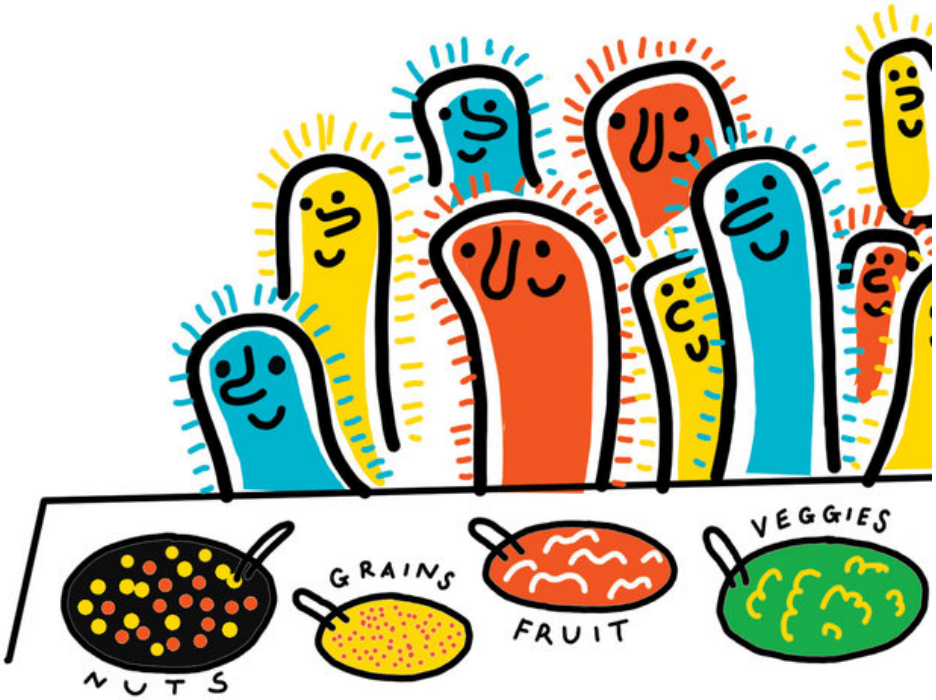
# Microbyte:

## Microbial Nutrition and CHONPS

(instructor use) - version: 03.12.21




# Microbial Nutrition

**Nutrition:** The study of how substances from the environment (i.e. *nutrients*) facilitate and modulate the functions of cells.

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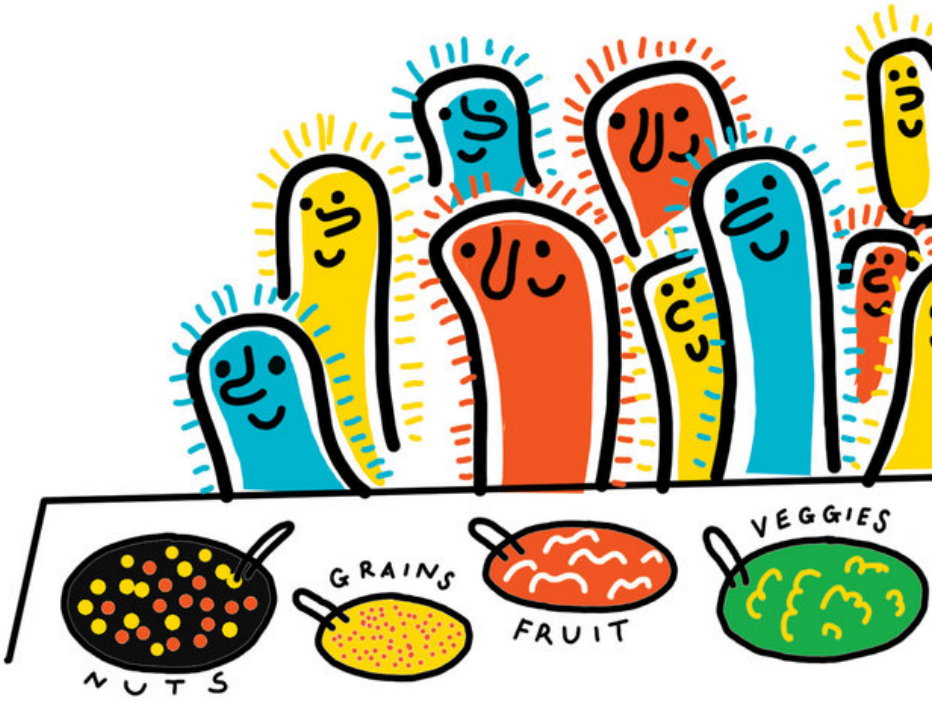


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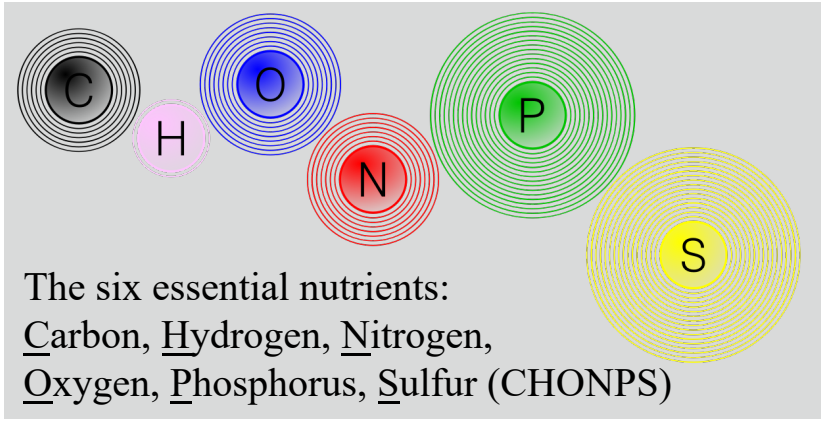


The six essential nutrients:
Carbon, Hydrogen, Nitrogen,
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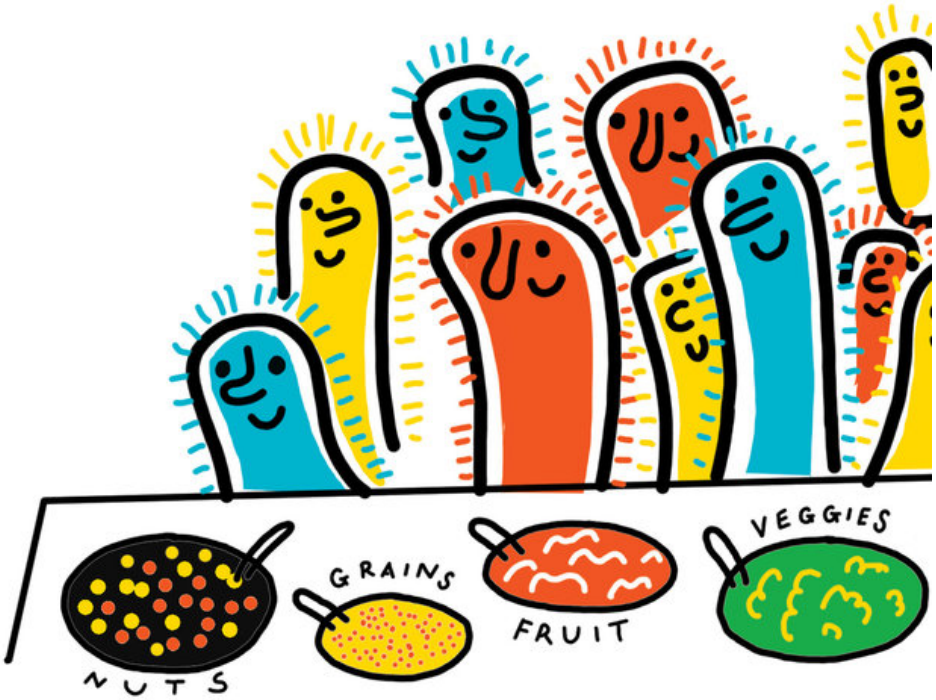


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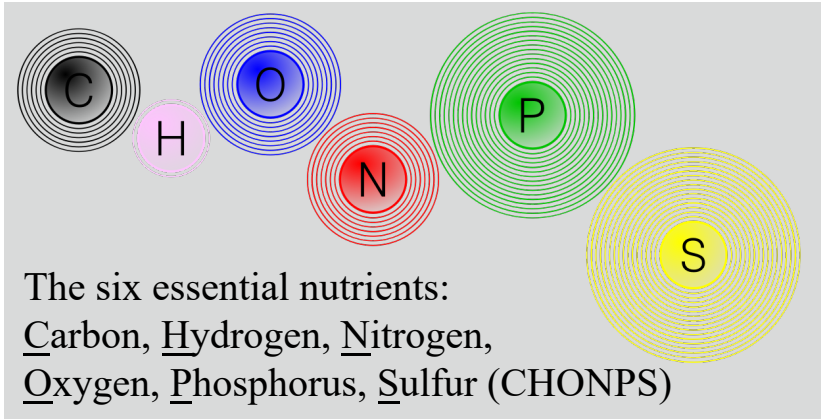


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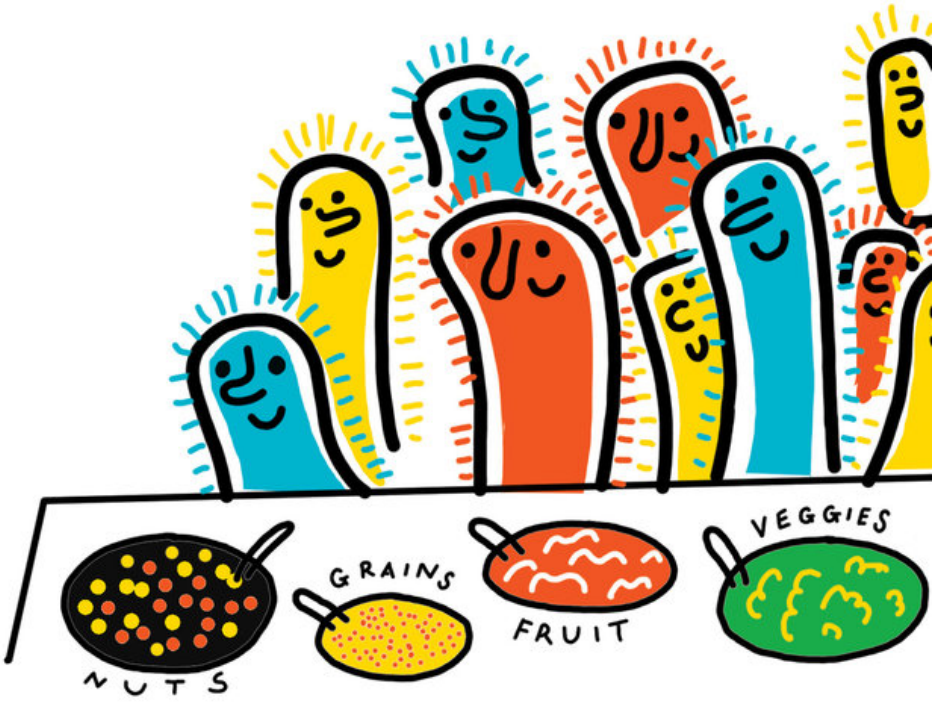


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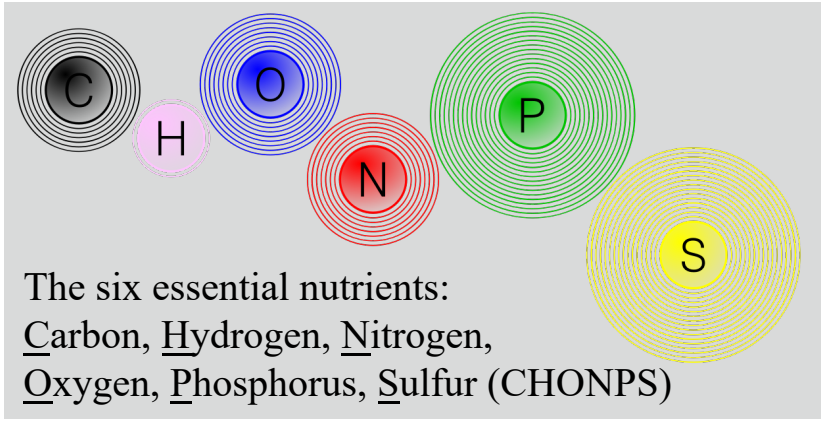


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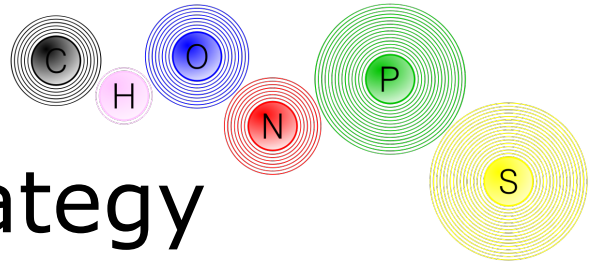
**Micronutrients:** Involved in enzyme function and maintenance of protein structure. These are also called “trace elements” and are required in relatively small quantities.

# CHONPS: Microbial Nutritional Strategy




- **Carbon:**
  - Autotrophs (i.e. self-feeders) convert $CO_2$ into other carbon compounds.
  - Heterotrophs (i.e. other-feeders) use organic carbon sourced from other life forms
  - Sources: carbon dioxide ($CO_2$) and glucose ($C_6H_{12}O_6$)

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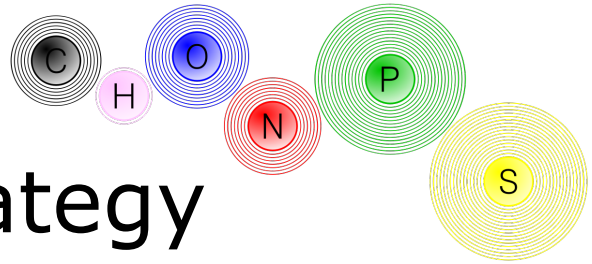


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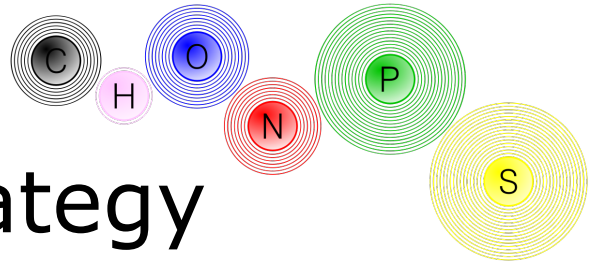
- **Hydrogen:**
  - Involved in biochemistry of cell
  - Help maintains pH, forms hydrogen bonds between molecules, & serves as the source of free energy in oxidation-reduction reactions of respiration
  - Sources: molecular hydrogen ($H_2$), water ($H_2O$), hydrogen sulfide ($H_2S$), methane ($CH_4$)
- **Oxygen:**
  - Major component of carbohydrates, lipids, nucleic acids, and proteins; plays an important role in structural and enzymatic functions
  - Sources: molecular oxygen ($O_2$), water ($H_2O$), nitrate ($NO_3^-$), phosphate ($PO_4^{3}$)

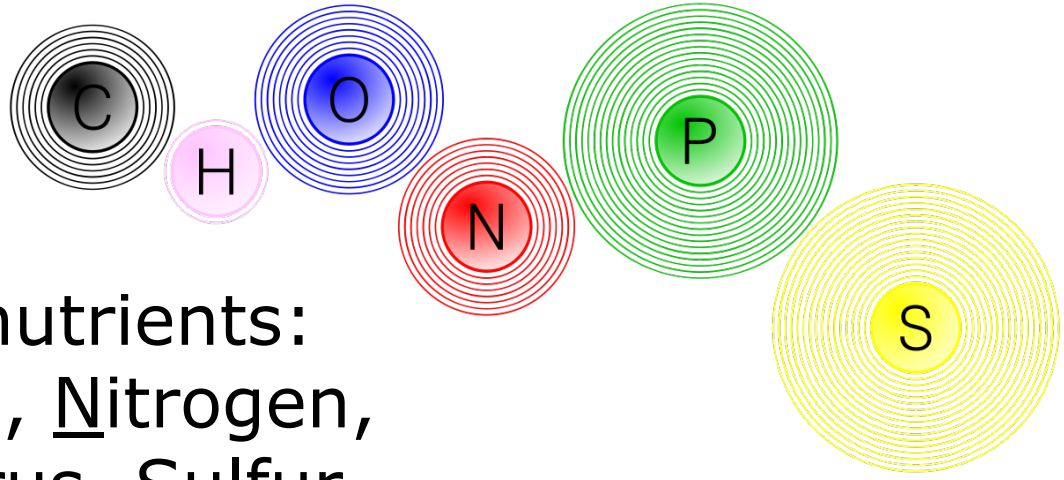
# CHONPS: Microbial Nutritional Strategy




- **Nitrogen:**
  - Indispensable to the structure of  nitrogenous bases found in nucleic acids (e.g. DNA, RNA) and ATP
  - Heterotrophs degrade DNA and RNA into their fundamental building blocks
  - Nitrogen is also found in the structure of many amino acids
  - Inorganic nitrogen must be converted into to ammonia ($NH_3$) prior to amino acid synthesis
  - Sources: $N_2$, nitrite ($NO_2^-$), nitrate ($NO_3^-$), ammonium ($NH_4^+$)

- **Phosphorous:**
  - Indispensable to the structure of nitrogenous bases found in nucleic acids (e.g. DNA, RNA) and ATP
  - Essential to membranes, hence phospholipid bilayers.
  - Main source: phosphate ($PO_4^{3-}$) which is typically derived from phosphoric acid ($H_3PO_4$)

- **Sulfur:**
  - Essential component of many vitamins and a few amino acids.
  - Widely distributed in the environment in mineral form (i.e combined with metals).
  - Sources: hydrogen sulfide ($H_2S$) and sulfate ($SO_4^{2-}$)




# The six essential nutrients: Carbon, Hydrogen, Nitrogen, Oxygen, Phosphorus, Sulfur

"Are we alone in this cosmos? It seems unlikely considering the most abundant elements found throughout the universe are carbon, hydrogen, oxygen, and nitrogen*. It is no coincidence that these are also some of the most common elements necessary for the life found on the aggregate of rock and minerals we call Earth. In vast plumes of dust circling newly formed stars and in the aftermath of colossal explosions in which stars spill their hearts into the surrounding space, the very essence of life is lurking, waiting for the cosmos to play out its story. And it is no stretch of the imagination to think that in some distant realm of the universe the stuff of life may be composed of a very similar kind of chemistry. It very well may be that the immense void of cosmic darkness is teeming with yet to be discovered forms of life."

*excluding the inert gases helium and neon

artist credit: Canis Minor Art

# Micro is Magikal!