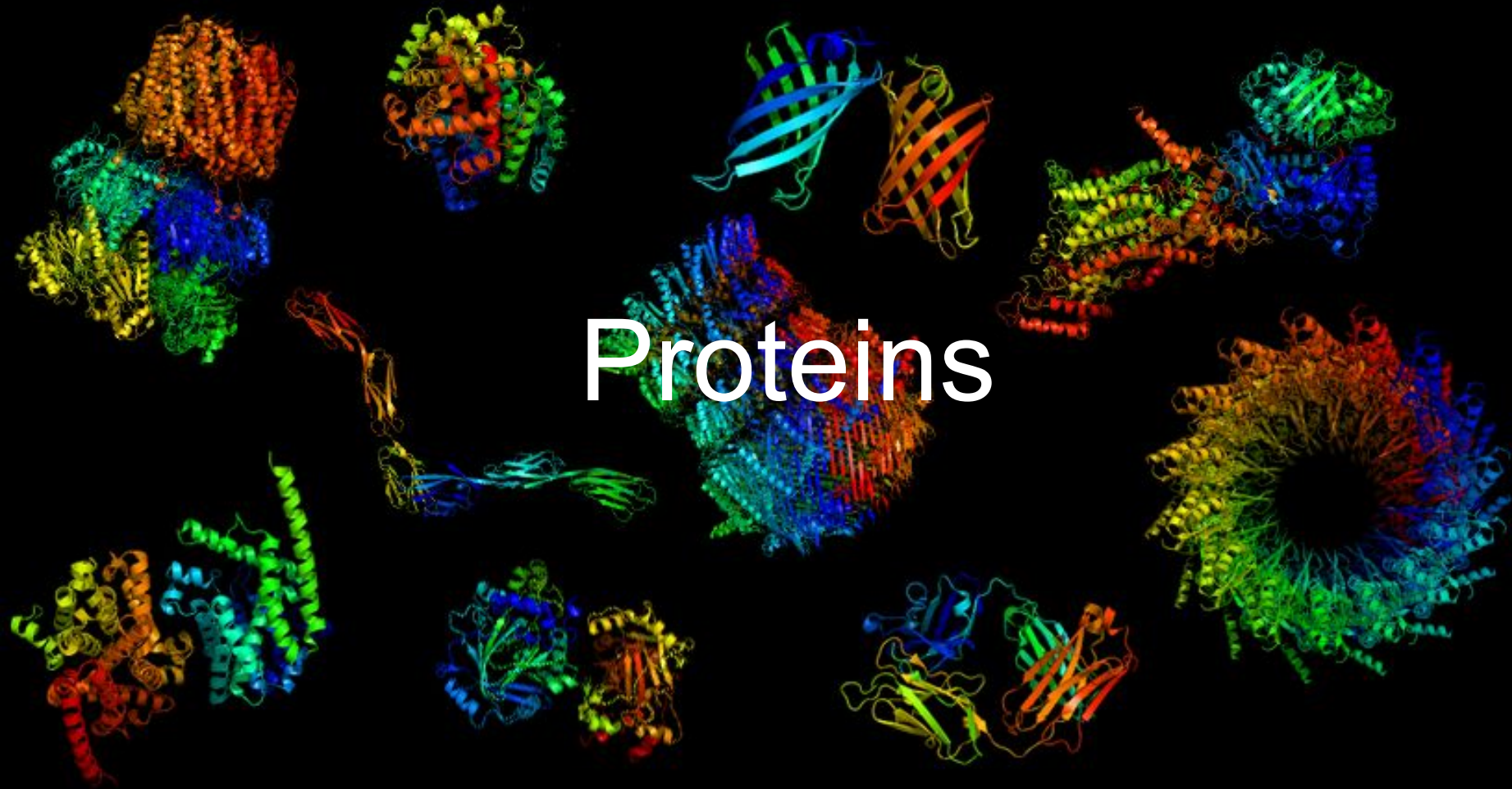


Proteins



History of Protein Crystallization

Potassium Channel

Nearly every fundamental biological process necessary for life is carried out by proteins. They create and maintain the shapes of cells and tissues; constitute the enzymes that catalyze life-sustaining chemical reactions; act as molecular factories, transporters and motors; serve as both signal and receiver for cellular communications; and much more.

← PLANT-BASED →
PROTEIN SOURCES



LENTIL FLOUR
28g/100g
8g/1oz



PUMPKIN SEEDS
24g/100g
7g/1oz



PEANUT BUTTER
23g/100g
6g/1oz



TAHINI
22g/100g
6g/1oz



ALMONDS
21g/100g
6g/1oz



PISTACHIOS
21g/100g
6g/1oz



FLAX SEEDS
18g/100g
5g/1oz



CASHEWS
18g/100g
5g/1oz



OATS
17g/100g
5g/1oz



SOYBEANS
17g/100g
5g/1oz



CHIA SEEDS
16g/100g
4g/1oz



TOFU
15g/100g
4g/1oz



HAZELNUT
15g/100g
4g/1oz



WALNUT
15g/100g
4g/1oz



WHOLE WHEAT BREAD
11g/100g
3g/1oz



LENTILS
9g/100g
3g/1oz



CHICKPEAS
9g/100g
3g/1oz



RED BEANS
9g/100g
3g/1oz



PECANS
9g/100g
3g/1oz



LIMA BEANS
8g/100g
2g/1oz



MACADAMIA NUTS
8g/100g
2g/1oz



PEAS
5g/100g
1g/1oz



QUINOA
4g/100g
1g/1oz

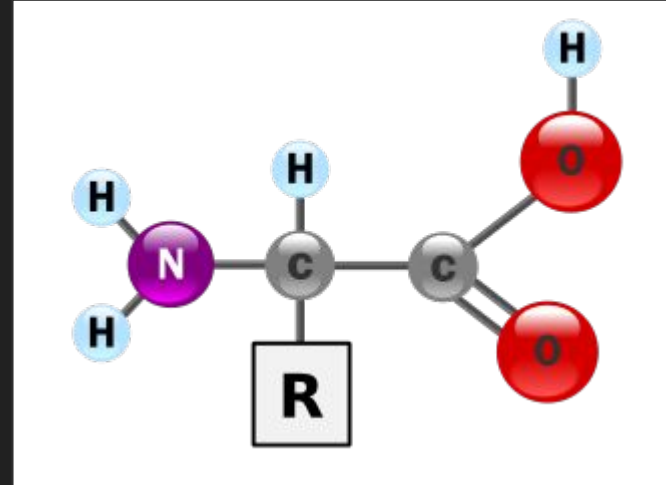
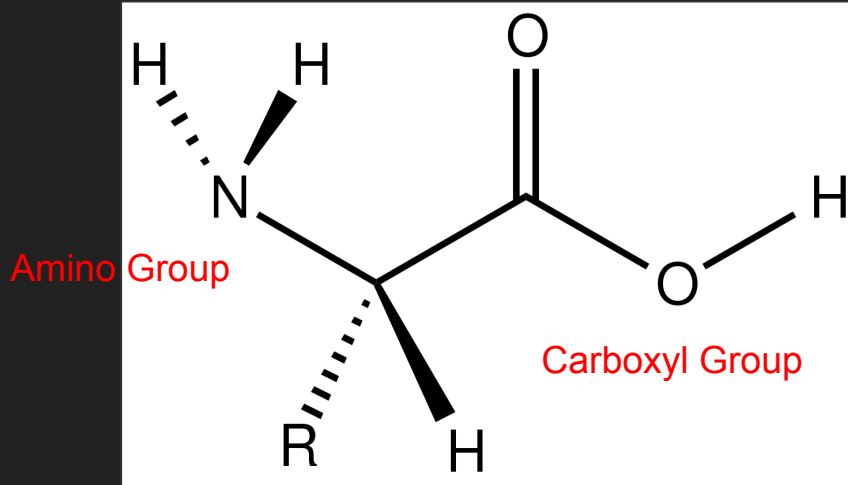


SPINACH
3g/100g
1g/1oz



POTATO
2g/100g
1g/1oz

Proteins are polymer chains made of amino acids linked together by peptide bonds.



Twenty-One Amino Acids

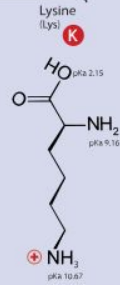
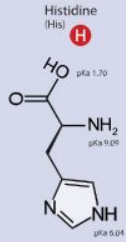
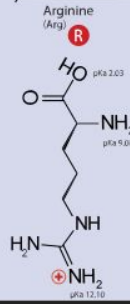
⊕ Positive

⊖ Negative

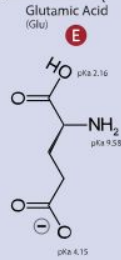
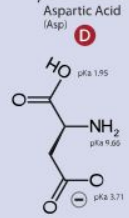
• Side chain charge at physiological pH 7.4

A. Amino Acids with Electrically Charged Side Chains

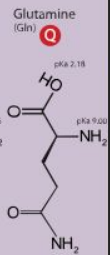
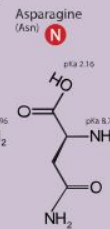
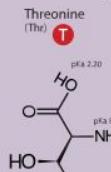
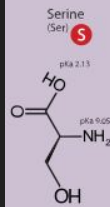
Positive



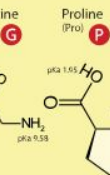
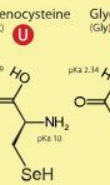
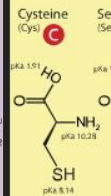
Negative



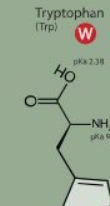
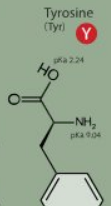
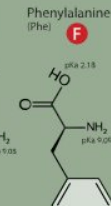
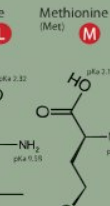
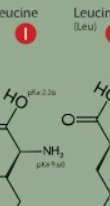
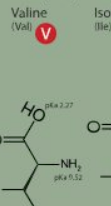
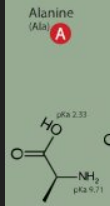
B. Amino Acids with Polar Uncharged Side Chains



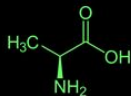
C. Special Cases



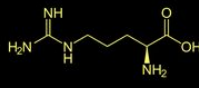
D. Amino Acids with Hydrophobic Side Chains



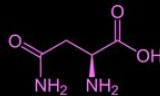
How amino acids got their names



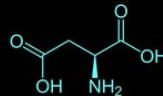
ALANINE
Al- is a shortening of *aldehyde*.
The infix *-an-* was added to make it easier to pronounce.



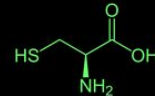
ARGININE
From the Greek word *argínēis*, which meant "silver" due to the appearance of arginine nitrate.



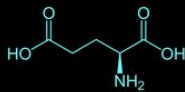
ASPARAGINE
First extracted in 1806 from a sample of asparagus juice, after which it was named.



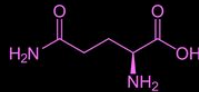
ASPARTIC ACID
Named after *asparagine*, because it was first isolated from it by hydrolysis in 1827.



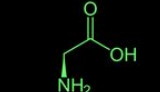
CYSTEINE
Had an earlier spelling of *cystine*. That comes from the Ancient Greek word for "bladder", *kústis*.



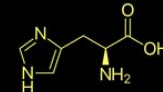
GLUTAMIC ACID
Glut- refers to how the compound was first isolated from gluten in 1866 by chemist Karl Ritthausen.



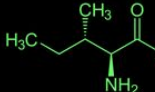
GLUTAMINE
Named before it was isolated, because it was hypothesized to be similar to *glutamic acid*.



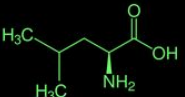
GLYCINE
From the Greek word *glúkuis*, meaning "sweet", because it was first isolated from gelatin.



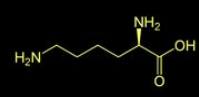
HISTIDINE
From Greek *histós*, meaning "tissue", because it was thought to be important to tissue function.



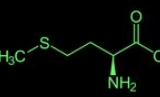
ISOLEUCINE
Named in 1904 by Felix Ehrlich, who observed that it was similar but not identical to leucine.



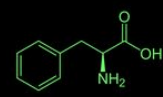
LEUCINE
First used in 1826 by chemist William Henry. Comes from the Greek word *leukós*, "white".



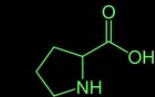
LYSINE
Named in 1889 from the Ancient Greek word *lúsis*, meaning "loosening".



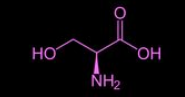
METHIONINE
Coined in 1926 by Barger and Coyne as a contraction of *γ-methyl-α-aminobutyric acid*.



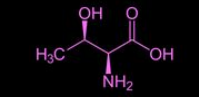
PHENYLALANINE
Named by Erlenmeyer and Lipp in 1883 because it looks like alanine with a phenyl group.



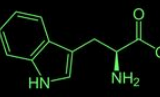
PROLINE
The name is a contraction of *pyrrolidine*, which makes up a side chain of the compound.



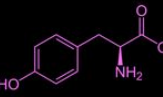
SERINE
From the Latin word *sericum*, meaning "silk" because it was first obtained from silk protein.



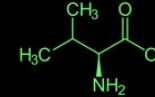
THREONINE
Named in 1938 after *threose*, a type of monosaccharide that it was thought to resemble.



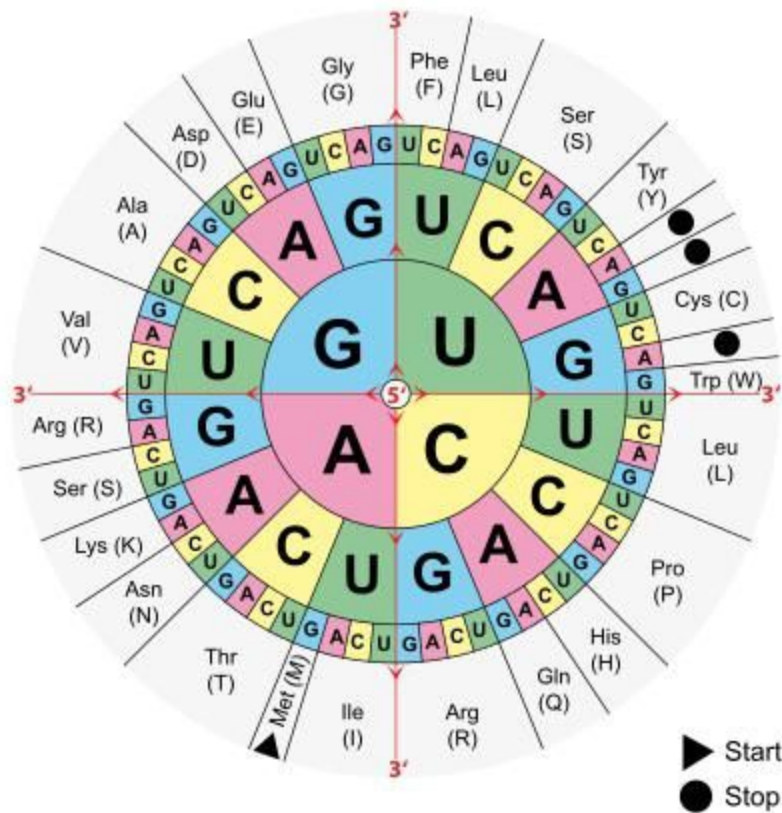
TRYPTOPHAN
Traces to the Greek roots *tripsis*, meaning "rubbing", and *phainein*, meaning "to show".

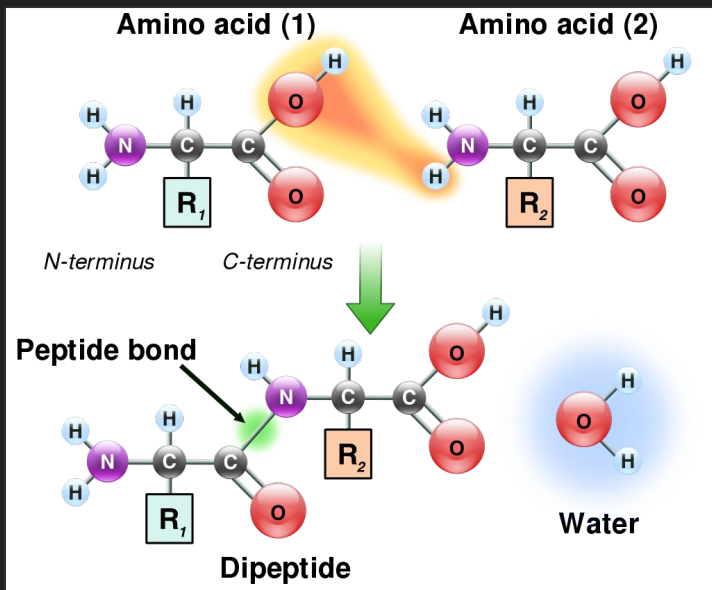
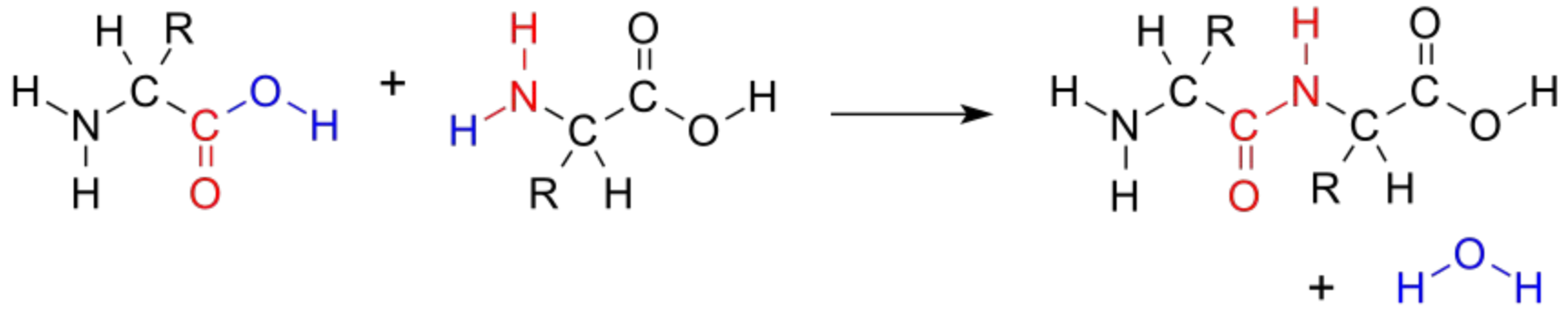


TYROSINE
From Greek *tyros*, meaning "cheese" because it was obtained from old cheese.



VALINE
Named in 1906 after a type of acid that occurs in the roots of the *valerian* plant.

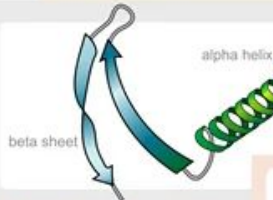
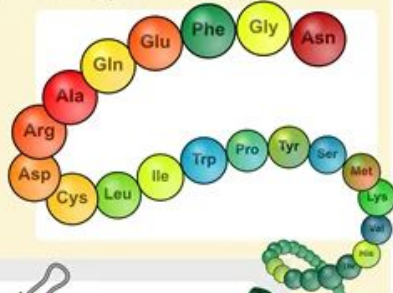




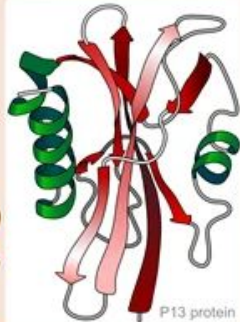
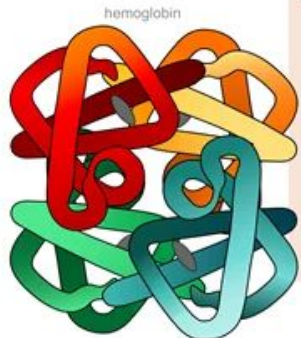
The amide bond is synthesized when the carboxyl group of one amino acid molecule reacts with the amino group of the other amino acid molecule, causing the release of a molecule of water (H₂O), hence the process is a dehydration synthesis reaction.

The folding revolution

Primary structure
amino acid sequence



Secondary structure
regular sub-structures



Tertiary structure
three-dimensional structure

Quaternary structure
complex of protein molecules