SNS COLLEGE OF ALLIED HEALTH SCIENCE

Affiliated to The Tamil Nadu Dr M.G.R Medical University, Chennai

DEPARTMENT OF CARDIAC TECHNOLOGY

COURSE NAME: BIOCHEMISTRY

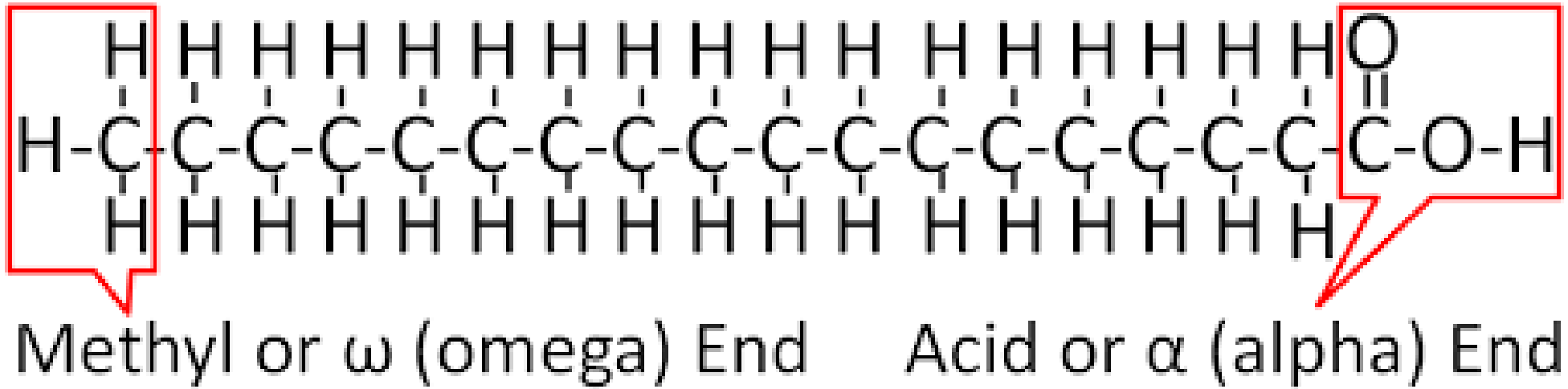
UNIT : 2

TOPIC : LIPIDS – FATTY ACIDS CLASSIFICATION

FACULTY NAME: MITHRA V

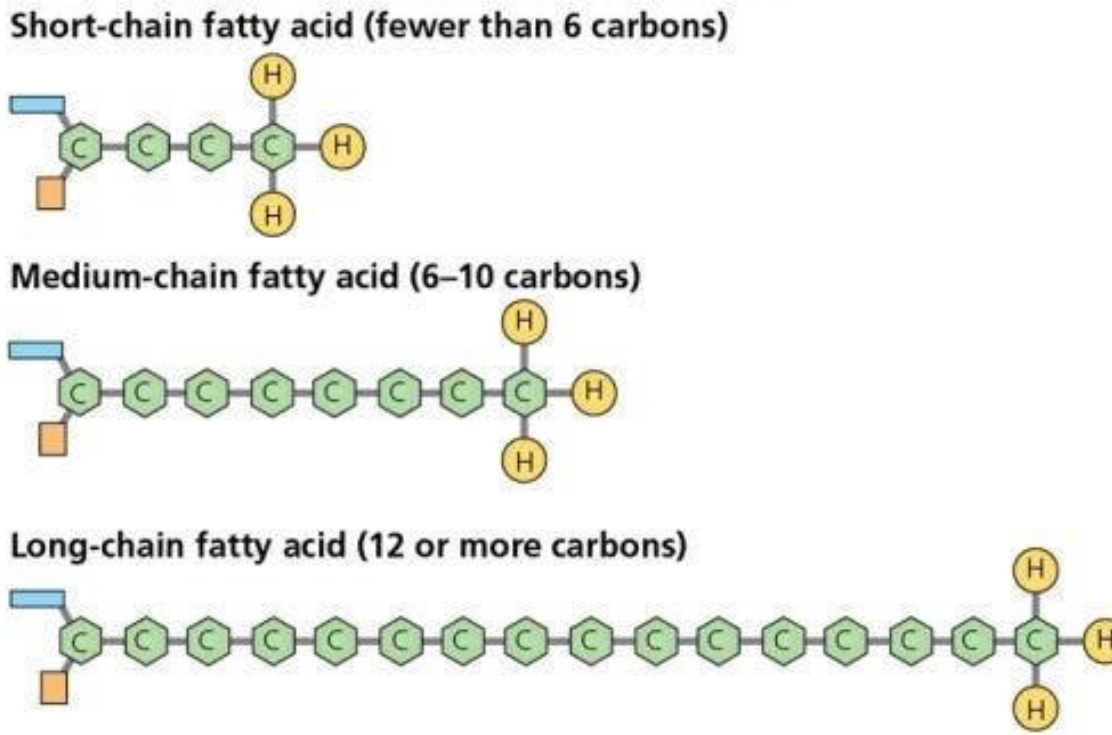
FATTY ACIDS (DEFINE)

- Long hydrocarbon chain at one end + terminal carboxyl group (-COOH)
- Usually even number of carbon atoms
- Building blocks of most lipids, used as energy when glucose is unavailable



CLASSIFICATION – BASED ON CHAIN LENGTH

- **Short-chain fatty acids (SCFA) – ≤6 carbons**
- Butyric acid (4:0) – found in butter, cheese
- **Medium-chain fatty acids (MCFA) – 6–12 carbons**
- Caprylic acid (8:0) – found in coconut oil, breast milk
- **Long-chain fatty acids (LCFA) – 13–21 carbons**
- Palmitic acid (16:0) – common in palm oil, meat, dairy
- **Very long-chain fatty acids (VLCFA) – ≥22 carbons**
- Behenic acid (22:0) – found in peanut oil, canola oil

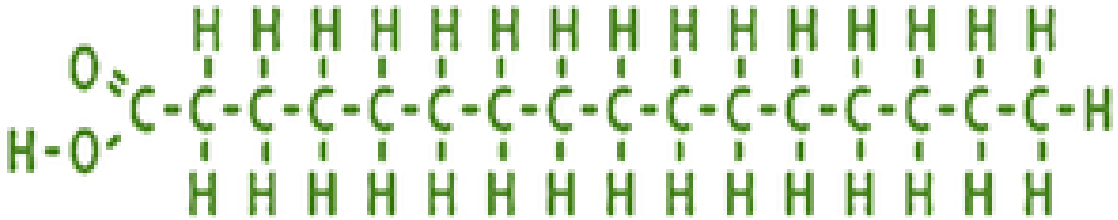


CLASSIFICATION – BASED ON TOTAL NUMBER OF CARBON ATOMS

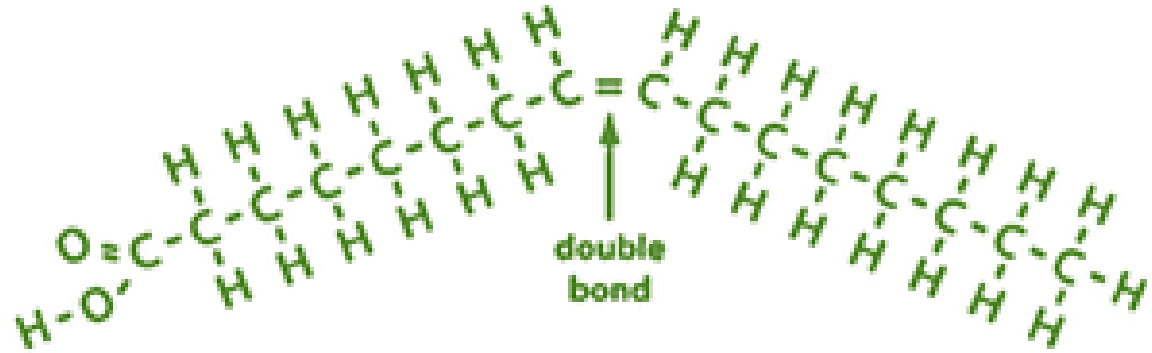
- **Even-chain:** Most common, have an even number of carbons
- Example: Palmitic, Stearic, Oleic acid
- **Odd-chain:** Less common, have odd number of carbons found in some dairy products
- Examples: Pentadecanoic acid, Heptadecanoic acid

CLASSIFICATION – BASED ON DEGREE OF SATURATION/UNSATURATION

- Saturated Fatty acids : No double bonds (only C–C single bonds)
- Unsaturated Fatty acids : One or more C=C double bonds
- Monounsaturated Fatty acids (MUFA) : 1 double bond
- Polyunsaturated Fatty acids (PUFA) : ≥2 double bonds



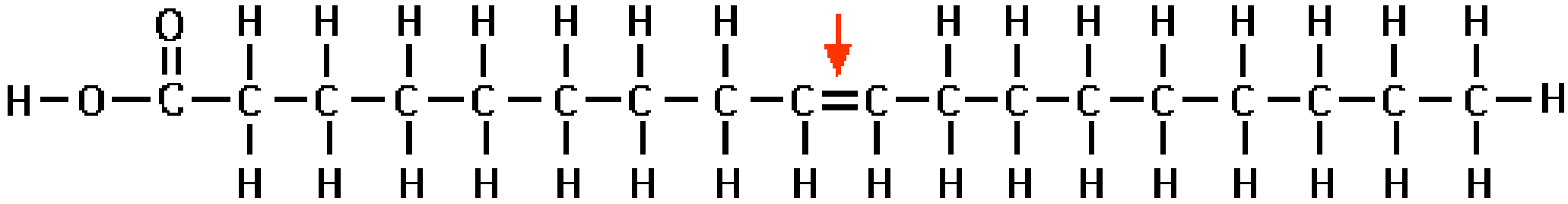
SATURATED



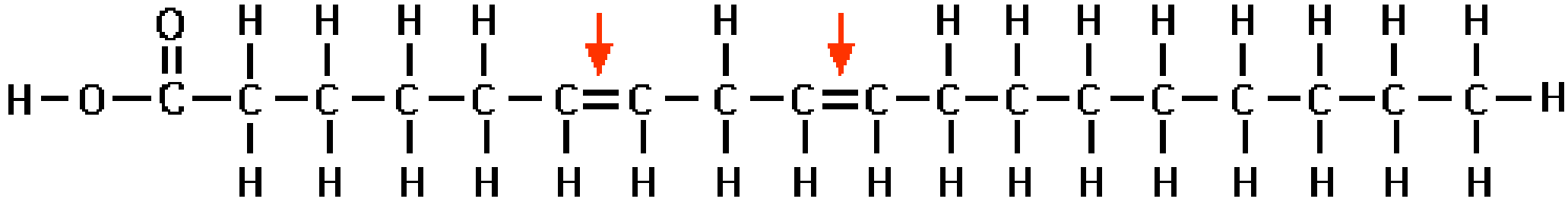
UNSATURATED

- **SATURATED FATTY ACIDS**
- Only single C–C bonds
- Pack tightly → high melting point → solid at room temperature
- **Examples:** Palmitic acid (16:0), Stearic acid (18:0)
- **UNSATURATED FATTY ACIDS**
- Contain one or more C=C double bonds
- Monounsaturated (MUFA): e.g., Oleic acid (18:1)
- Polyunsaturated (PUFA): e.g., Linoleic acid (18:2)

- **MONOUNSATURATED FATTY ACIDS (MUFA)**
- Healthy fat molecule, One C=C double bond, Liquid at room temp, solidify when chilled
- **Rich sources:** Olive oil (75%), canola oil, avocados, nuts, seeds, sesame, peanut.
- **POLYUNSATURATED FATTY ACIDS (PUFA)**
- Two or more C=C double bonds, Remain liquid even when cold
  - Omega-3 - Fish, flaxseeds, chia seeds, walnuts - (e.g., α-linolenic, Eicosapentaenoic Acid (EPA), Docosahexaenoic Acid (DHA)
  - Omega-6 - Soybean, sunflower, corn oil, nuts, seeds - (e.g., linoleic acid, arachidonic acid)



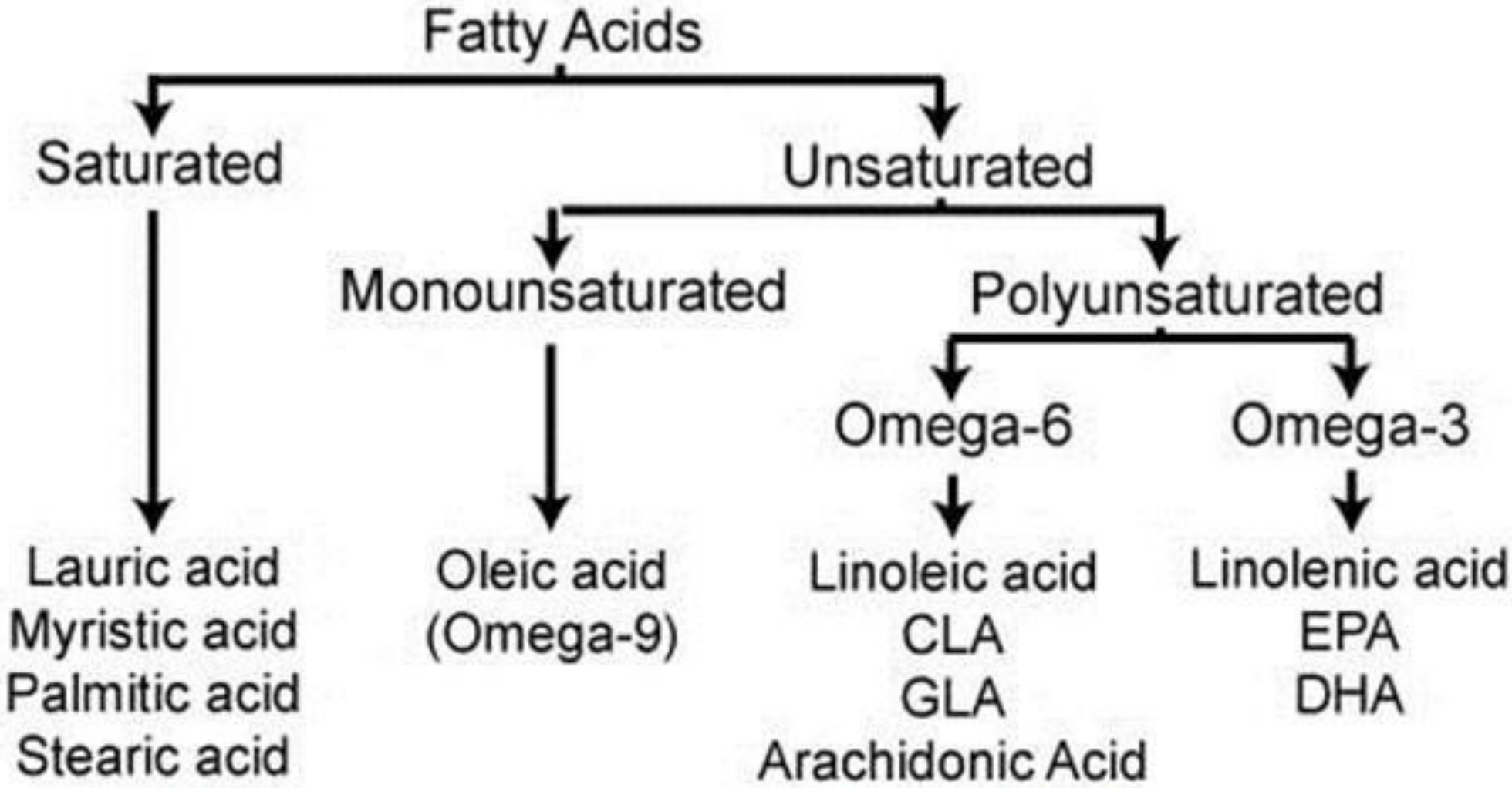
Oleic Acid- Monounsaturated Fatty Acid



Linoleic Acid- Polyunsaturated Fatty Acid

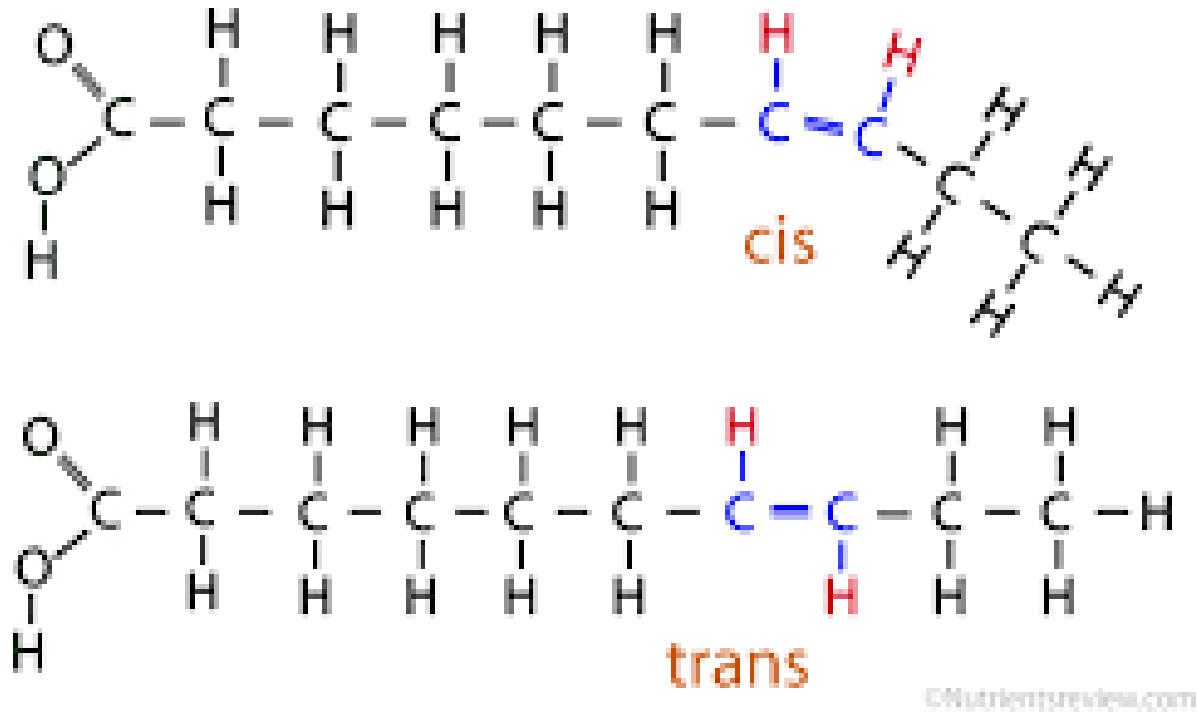
CLINICAL SIGNIFICANCE OF MUFA & PUFA

- **Omega-3 fatty acids:** Strong anti-inflammatory → reduce heart disease & Alzheimer's risk
- **Omega-3:** Improve vision, brain health, mood; reduce depression & anxiety
- **Omega-3:** Support normal fetal development
- **MUFA:** Improve insulin sensitivity → control blood sugar
- **MUFA & Omega-3 (PUFA):** Prevent hyperglycemia, hypoglycemia, prediabetes
- **MUFA:** ↓ LDL (bad) cholesterol, ↑ HDL (good) cholesterol
- Help in cell membrane & nerve maintenance and aid digestion


Fatty Acids
Saturated
Unsaturated
Monounsaturated
Polyunsaturated
Omega-6
Omega-3
Lauric acid
Myristic acid
Palmitic acid
Stearic acid
Oleic acid
(Omega-9)
Linoleic acid
CLA
GLA
Arachidonic Acid
Linolenic acid
EPA
DHA

CIS AND TRANS FATTY ACIDS

- **CIS:** Both H atoms on same side of double bond (natural, kinked shape)
- **TRANS**: H atoms on opposite sides (straight shape, mostly artificial)



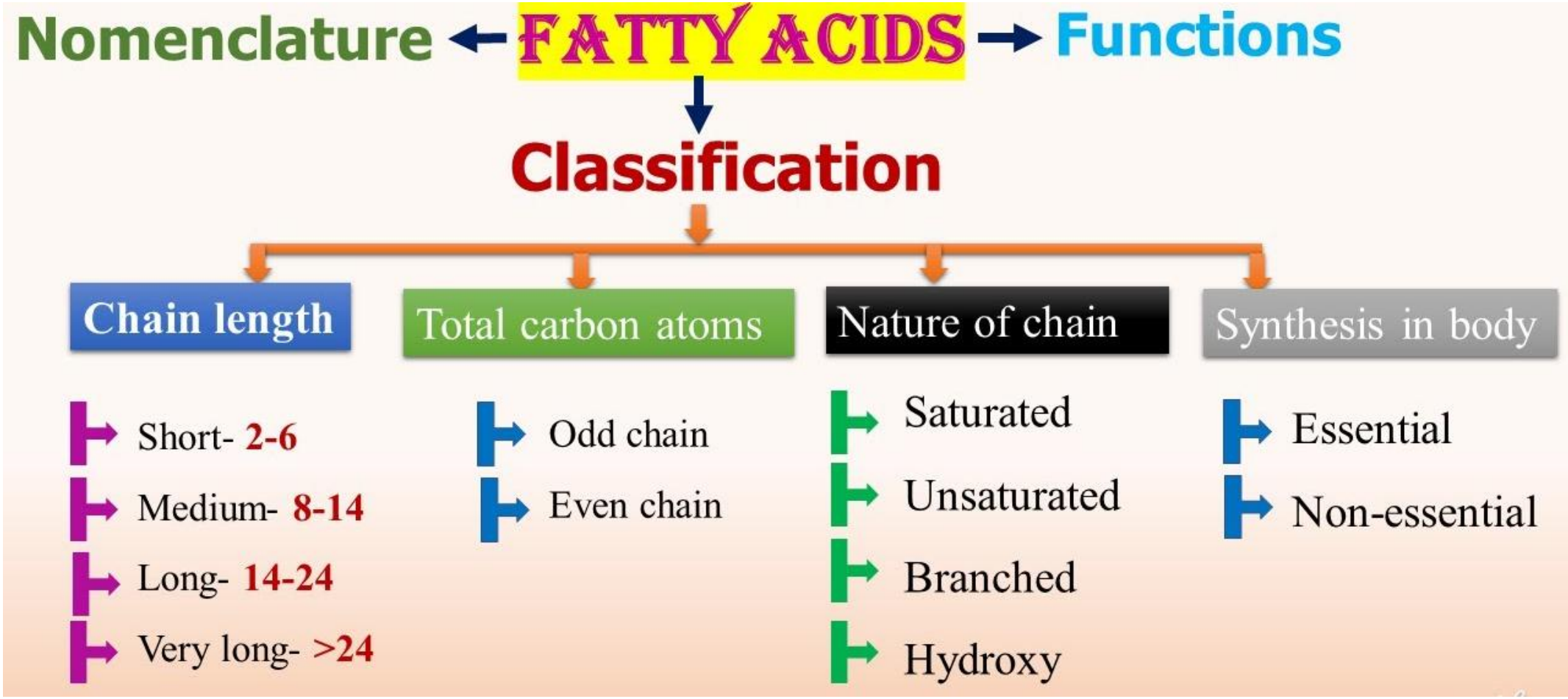
CLASSIFICATION – BASED ON SYNTHESIS IN THE BODY

- **ESSENTIAL VS NON-ESSENTIAL FATTY ACIDS**
- Essential (cannot be synthesized by our body, need to be taken through a diet)
- Eg: Linoleic (ω-6), α-Linolenic (ω-3), Arachidonic
- Non-essential (body can be synthesized)
- Eg: Palmitic, Oleic, Butyric acid

USES OF FATTY ACIDS

- Food industry (emulsifiers, stabilizers)
- Soaps, detergents, cosmetics (Na/K salts)
- Skin care products
- Energy source for body
- **Health Risks of Excess Fatty Acids**
- High saturated fat intake → obesity, heart disease, some cancers
- Excess trans fats → strongly linked to cardiovascular disease

SUMMARY


Nomenclature
FATTY ACIDS
Functions
Classification
Chain length
Short- 2-6
Medium- 8-14
Long- 14-24
Very long- >24
Total carbon atoms
Odd chain
Even chain
Nature of chain
Saturated
Unsaturated
Branched
Hydroxy
Synthesis in body
Essential
Non-essential

REFERENCES

- **Lipids: Biochemistry, Biotechnology & Health** (6th Edition), Michael I. Gurr, John L. Harwood.
- **Biochemistry of Lipids, Lipoproteins and Membranes** (6th Edition) by Neale Ridgway and Roger McPherson
- **Lipid Biochemistry** (5th Edition) by John L. Harwood and Keith N. Frayn
- https://www.sciencedirect.com/book/9780444634382/biochemistry-of-lipids-lipoproteins-and-membranes
- https://onlinelibrary.wiley.com/doi/book/10.1002/9780470774366

THANK YOU