## **Exploring Lipids**

**Authors**: Shuchismita Dutta, Rutgers University, NJ

**Lesson Overview**:

This lesson reviews a few different types of lipid and lipid-like molecules.

**ASBMB Learning Objectives**

(<https://www.asbmb.org/education/core-concept-teaching-strategies/foundational-concepts/structure-function>)

1. Biological macromolecules are large and complex

* Students should be able to **describe the basic units of the macromolecules** and the types of linkages between them *(Introductory)*.

4. Macromolecular interactions

Students should be able to discuss the **interactions between a variety of biological molecules** (including proteins, nucleic acids, lipids, carbohydrates and small organics, etc.) and describe how these interactions impact specificity or affinity leading to changes in biological function *(Intermediate)*.

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The main property of a lipid molecule is its solubility in organic solvents and insolubility in water and aqueous solvents.

1. Explore a [selection of lipid-like molecules](https://www.rcsb.org/search?request=%7B%22query%22%3A%7B%22type%22%3A%22group%22%2C%22nodes%22%3A%5B%7B%22service%22%3A%22chemical%22%2C%22parameters%22%3A%7B%22type%22%3A%22descriptor%22%2C%22descriptor_type%22%3A%22SMILES%22%2C%22value%22%3A%22CCCCCCCCCCCC(%3DO)O%22%2C%22match_type%22%3A%22sub-struct-graph-relaxed%22%7D%2C%22label%22%3A%22chemical%22%2C%22type%22%3A%22terminal%22%7D%5D%2C%22logical_operator%22%3A%22and%22%7D%2C%22return_type%22%3A%22mol_definition%22%2C%22request_options%22%3A%7B%22paginate%22%3A%7B%22rows%22%3A100%2C%22start%22%3A100%7D%2C%22results_content_type%22%3A%5B%22experimental%22%5D%2C%22sort%22%3A%5B%7B%22sort_by%22%3A%22score%22%2C%22direction%22%3A%22desc%22%7D%5D%2C%22scoring_strategy%22%3A%22combined%22%7D%2C%22request_info%22%3A%7B%22query_id%22%3A%22213aeb584c5203a6e22676b94026bb27%22%7D%7D) in the PDB. Make a gallery of these small molecules by clicking on the  icon at the top of the list. Note each small molecule has a unique identifier (or alphanumeric code) that is used to represent it in the coordinate file. For example the identifier for a fatty acid derived from coconut oil is DAO. Examine the small molecules and answer the following questions.
   1. Which two elements make up the majority of atoms found in each of the small molecules in this list?

1. Explore the molecule [DAO](https://www.rcsb.org/ligand/dao) and answer the following questions:
   1. What is the complete name and chemical formula of this molecule?

* 1. Save an image of the molecule DAO and point out with labels, where the acid group is located. Is this molecule charged?
  2. Which of the following describe the nature of the long tail of this molecule?
     + Polar
     + Nonpolar
     + Aromatic
     + Positively charged
     + Negatively charged
  3. What types of non-covalent interactions can this fatty acid form?
  4. Is this molecule used as a drug or supplement? How did you figure this out? (Hint: Look for links to DrugBank on the Ligand Summary page and explore)

1. Explore the two ligands [GEY](https://www.rcsb.org/ligand/GEY) and [3X1](https://www.rcsb.org/ligand/3X1) and answer the following questions:
   1. List one way in which the ligands 3X1 and GEY are similar and one way in which they are different.
   2. List at least one way in which the ligands 3X1 and GEY are similar to the ligand DAO. Hint - you may wish to support your written answer by including an annotated/labeled image of the molecules you are comparing.
2. Explore the following molecules in PDB’s Chemical Component Dictionary by clicking on the link included in the first column in the following table. Complete the table by:
   1. Indicating the “Molecule Type” by selecting from the following terms: **fatty acid, triglyceride (fat/oil), steroid,** and **phospholipid**.
   2. Filling in the “Reason” and “Evidence” columns to include the reason for your classification in words and in a figure respectively. Follow the example shown for MYR.

| Ligand ID | Chemical structure | Type of molecule (Claim) | Evidence | Reason |
| --- | --- | --- | --- | --- |
| [MYR](https://www.rcsb.org/ligand/myr) |  | Fatty acid |  | The molecule has an acidic group and an aliphatic tail. |
| [DXC](https://www.rcsb.org/ligand/DXC) |  |  |  |  |
| [4RF](https://www.rcsb.org/ligand/4RF) |  |  |  |  |
| [LHG](https://www.rcsb.org/ligand/LHG) |  |  |  |  |