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**Question**

1a. What are coenzymes

b. Differentiate between fat and water soluble vitamins

c. Describe niacin in relation to its coenzymic function

1a. A coenzyme is a non-[protein](https://en.m.wikipedia.org/wiki/Protein) [chemical compound](https://en.m.wikipedia.org/wiki/Chemical_compound) or [metallic ion](https://en.m.wikipedia.org/wiki/Metal_ions_in_aqueous_solution) that is required for an [enzyme](https://en.m.wikipedia.org/wiki/Enzyme)'s activity as a [catalyst](https://en.m.wikipedia.org/wiki/Catalysis), a substance that increases the rate of a [chemical reaction](https://en.m.wikipedia.org/wiki/Chemical_reaction).

1b.

|  |  |  |
| --- | --- | --- |
|  | **Water soluble vitamins** | **Fat-soluble vitamins** |
| Vitamins | B, C | A, D, E, K |
| Site of Absorption | Small intestines | Small intestine |
| Dietary Intake | Excess intake usually detected and excreted by the kidneys | Excess intake tends to be stored in fat -storage sites |
| Solubility | Hydrophilic | Hydrophobic |
| Capitalize | Easily absorbed the blood, travels freely in the bloodstream | Absorbed into the lymphatic system, many require protein carriers to travel in the blood |
| Body storage | Not generally | Yes |
| Deficiency | Deficiency symptoms appear relatively quickly | Deficiency symptoms are slow to develop |
| Toxicity | Low risk | Higher risk |
| Need for daily consumption | Yes | No |

**1c.** Niacin is a coenzyme, like [thiamine](https://www.sciencedirect.com/topics/food-science/vitamin-b1) and [riboflavin](https://www.sciencedirect.com/topics/food-science/riboflavin), that is responsible for energy release from carbohydrates. A niacin deficiency can lead to *pellagra*, a disabling disease with symptoms that may be characterized by four “Ds”: depression, diarrhea, delirium and dementia.

Niacin is found in fortified breads and cereals. Protein foods, such as eggs, fish, meat, dairy milk and poultry, are naturally rich in niacin. They are also plentiful in the amino acid [*tryptophan*](https://www.sciencedirect.com/topics/food-science/tryptophan), which can be synthesized into niacin by the liver.

Chicken breast, ground beef, halibut, tuna and turkey are particularly good sources of tryptophan. In the vegetable kingdom, asparagus, baked potatoes and cantaloupe have significant amounts of tryptophan.

Niacin has been used to lower LDL cholesterol and raise HDL cholesterol when administered as a drug under medical guidance. In heavy doses, niacin has been known to cause a *“niacin flush”* due to the capillaries increasing in size. This condition can lead to fatigue and even liver damage. Caution should be used if one is taking niacin or B-complex supplements.

Sources of niacin: eggs, fish, legumes, meats nuts, peanuts, poultry, pork

Roles in body: coenzyme, digestive and nervous system functions, healthy skin

Deficiency: appetite loss, confusion, fatigue, flaky skin, indigestion, pellagra

Toxicity: cramping, flushing, headaches, irregular heartbeat, irritated ulcers, liver dysfunction

#### **Cooking Foods with Niacin**

Niacin is one of the more stable water-soluble vitamins and is minimally at risk for destruction by air, heat or light.

Living organisms derive most of their energy from [redox](https://lpi.oregonstate.edu/mic/glossary#redox-reaction) reactions, which are processes involving the transfer of [electrons](https://lpi.oregonstate.edu/mic/glossary#electron). Over 400 [enzymes](https://lpi.oregonstate.edu/mic/glossary#enzyme) require the niacin [coenzymes](https://lpi.oregonstate.edu/mic/glossary#coenzyme), NAD and NADP, mainly to accept or donate electrons for redox reactions. NAD and NADP appear to support distinct functions. NAD functions most often in energy-producing reactions involving the degradation ([catabolism](https://lpi.oregonstate.edu/mic/glossary#catabolism)) of [carbohydrates](http://lpi.oregonstate.edu/infocenter/glossary.html#carbohydrate), fats, [proteins](http://lpi.oregonstate.edu/infocenter/glossary.html#protein), and alcohol. NADP generally serves in biosynthetic (anabolic) reactions, such as in the [synthesis](https://lpi.oregonstate.edu/mic/glossary#synthesis) of [fatty acids](https://lpi.oregonstate.edu/mic/glossary#fatty-acid), [steroids](https://lpi.oregonstate.edu/mic/glossary#steroid) (e.g., [cholesterol](http://lpi.oregonstate.edu/infocenter/glossary.html#cholesterol), bile acids, and steroid [hormones](https://lpi.oregonstate.edu/mic/glossary#hormone)), and building blocks of other macromolecules. NADP is also essential for the regeneration of components of detoxification and [antioxidant](https://lpi.oregonstate.edu/mic/glossary#antioxidant) systems. To support these functions, the cell maintains NAD in a largely oxidized state (NAD+) to serve as oxidizing agent for catabolic reactions, while NADP is kept largely in a reduced state (NADPH) to readily donate electrons for reductive cellular processes.

