

Biofuel Student Glossary

This glossary will help understand the vocabulary used in the Biofuels for Students section.

acid: A solution that has an excess of hydrogen ions (H^+).

alcohol: An alcohol is an organic compound with a carbon bound to a hydroxyl group. Examples are methanol, CH_3OH , and ethanol, CH_3CH_2OH .

aromatic: A chemical that has a benzene ring in its molecular structure (benzene, toluene, xylene). Aromatic compounds have strong, characteristic odors.

B20: A mixture of 20% biodiesel and 80% petroleum diesel based on volume.

bacteria: A small single-cell organism. Bacteria do not have an organized nucleus, but they do have a cell membrane and protective cell wall. Bacteria can be used to ferment sugars to ethanol.

base: A solution that has an excess of hydroxide ions (OH^-) in aqueous solution.

benzene: An aromatic component of gasoline, which is a known cancer-causing agent.

biodiesel: A biodegradable transportation fuel for use in diesel engines that is produced through the transesterification of organically- derived oils or fats. It may be used either as a replacement for or as a component of diesel fuel.

biofuels: Biomass converted to liquid or gaseous fuels such as ethanol, methanol, methane, and hydrogen.

biomass: An energy resource derived from organic matter. These include wood, agricultural waste and other living-cell material that can be burned to produce heat energy. They also include algae, sewage and other organic substances that may be used to make energy through chemical processes.

by-product: Material, other than the principal product, generated as a consequence of an industrial process or as a breakdown product in a living system.

carbohydrate: A class of organic compounds including sugars and starches. The name comes from the fact that many (but not all) carbohydrates have the basic formula CH_2O .

carbon dioxide: (CO_2) A colorless, odorless gas produced by respiration and combustion of carbon-containing fuels. Plants use it as a food in the photosynthesis process.

carbon monoxide: (CO) A colorless, odorless, poisonous gas produced by incomplete combustion.

cellulase: A family of enzymes that break down cellulose into glucose molecules.

cellulose: A carbohydrate that is the principal component of wood. It is made of linked glucose molecules that strengthens the cell walls of most plants.

catalyst: A substance that increases the rate of a chemical reaction, without being consumed or produced by the reaction. Enzymes are catalysts for many biochemical reactions.

combustion: A chemical reaction between a fuel and oxygen that produces heat (and usually, light).

E-10: A mixture of 10% ethanol and 90% gasoline based on volume.

E-85: A mixture of 85% ethanol and 15% gasoline based on volume.

energy crop: A crop grown specifically for its fuel value. These include food crops such as corn and sugarcane, and nonfood crops such as poplar trees and switchgrass.

enzyme: A protein or protein-based molecule that speeds up chemical reactions occurring in living things. Enzymes act as catalysts for a single reaction, converting a specific set of reactants into specific products.

ester: An ester is a compound formed from the reaction between an acid and an alcohol. In esters of carboxylic acids, the -COOH group of the acid and the -OH group of the alcohol lose a water and become a -COO- linkage.

ethanol: (CH₃CH₂OH) A colorless, flammable liquid produced by fermentation of sugars. Ethanol is used as a fuel oxygenate. Ethanol is the alcohol found in alcoholic beverages.

fatty acid: A fatty acid is a carboxylic acid (an acid with a -COOH group) with long hydrocarbon side chains.

fermentation: A biochemical reaction that breaks down complex organic molecules (such as carbohydrates) into simpler materials (such as ethanol, carbon dioxide, and water). Bacteria or yeasts can ferment sugars to ethanol.

fossil fuel: A carbon or hydrocarbon fuel formed in the ground from the remains of dead plants and animals. It takes millions of years to form fossil fuels. Oil, natural gas, and coal are fossil fuels.

fungi: Fungi are plant-like organisms with cells with distinct nuclei surrounded by nuclear membranes, incapable of photosynthesis. Fungi are decomposers of waste organisms and exist as yeast, mold, or mildew.

global warming: A term used to describe the increase in average global temperatures due to the greenhouse effect. Scientists generally agree that the Earth's surface has warmed by about 1 degree Fahrenheit in the past 140 years.

glucose: ($C_6H_{12}O_6$) A six-carbon fermentable sugar.

glycerin: ($C_3H_8O_3$) A liquid by-product of biodiesel production. Glycerin is used in the manufacture of dynamite, cosmetics, liquid soaps, inks, and lubricants.

greenhouse effect: The heat effect due to the trapping of the sun's radiant energy, so that it cannot be reradiated. In the earth's atmosphere, the radiant energy is trapped by greenhouse gases produced from both natural and human sources.

greenhouse gas: A gas, such as water vapor, carbon dioxide, tropospheric ozone, methane, and low level ozone, which contributes to the greenhouse effect.

hydrocarbon (HC): An organic compound that contains only hydrogen and carbon. In vehicle emissions, these are usually vapors created from incomplete combustion or from vaporization of liquid gasoline. Emissions of hydrocarbons contribute to ground level ozone.

hydrolysis: A chemical reaction that releases sugars, which are normally linked together in complex chains. In ethanol production, hydrolysis reactions are used to break down the cellulose and hemicellulose in the biomass.

municipal solid waste (MSW): Any organic matter, including sewage, industrial, and commercial wastes, from municipal waste collection systems. Municipal waste does not include agricultural and wood wastes or residues.

nitrogen oxides (NOx): A product of photochemical reactions of nitric oxide in ambient air, and the major component of photochemical smog.

non-renewable resource: A non-renewable energy resource is one that cannot be replaced as it is used. Although fossil fuels, like coal and oil, are in fact fossilized biomass resources, they form at such a slow rate that, in practice, they are non-renewable.

organic compound: An organic compound contains carbon chemically bound to hydrogen. Organic compounds often contain other elements (particularly O, N, halogens, or S).

oxygenate: An oxygenate is a compound which contains oxygen in its molecular structure. Ethanol and biodiesel act as oxygenates when they are blended with conventional fuels. Oxygenated fuel improves combustion efficiency and reduces tailpipe emissions of CO.

ozone: A compound that is formed when oxygen and other compounds react in sunlight. In the upper atmosphere, ozone protects the earth from the sun's ultraviolet rays. Though beneficial in the upper atmosphere, at ground level, ozone is called photochemical smog, and is a respiratory irritant and considered a pollutant.

particulates: A fine liquid or solid particle such as dust, smoke, mist, fumes, or smog, found in air or emissions.

petroleum: Any petroleum-based substance comprising a complex blend of hydrocarbons derived from crude oil through the process of separation, conversion, upgrading, and finishing, including motor fuel, jet oil, lubricants, petroleum solvents, and used oil.

photosynthesis: A complex process used by many plants and bacteria to build carbohydrates from carbon dioxide and water, using energy derived from light. Photosynthesis is the key initial step in the growth of biomass and is depicted by the equation: $\text{CO}_2 + \text{H}_2\text{O} + \text{light} + \text{chlorophyll} = (\text{CH}_2\text{O}) + \text{O}_2$

polymer: A large molecule made by linking smaller molecules ("monomers") together.

polysaccharide: A carbohydrate consisting of a large number of linked simple sugar, or monosaccharide, units. Examples of polysaccharides are cellulose and starch.

reaction: A chemical reaction is a dissociation, recombination, or rearrangement of atoms.

renewable energy resource: An energy resource that can be replaced as it is used. Renewable energy resources include solar, wind, geothermal, hydro and biomass. Municipal solid waste (MSW) is also considered to be a renewable energy resource.

starch: A molecule composed of long chains of glucose molecules. Many plants store the energy produced in the photosynthesis process in the form of starch.

toxics: As defined in the 1990 Clean Air Act Amendments, toxics include benzene, 1,3 butadiene, formaldehyde, acetaldehyde, and polycyclic organic matter.

transesterification: A chemical process which reacts an alcohol with the triglycerides contained in vegetable oils and animal fats to produce biodiesel and glycerin.

triglyceride: A triglyceride is an ester of glycerol and three fatty acids. Most animal fats are composed primarily of triglycerides.

volatile: A solid or liquid material that easily vaporizes.

yeast: Any of various single-cell fungi capable of fermenting carbohydrates.