"Levels" of Metabolism

These things don't have exact definitions! Further, the categories are not as separate as they might appear: in some cases, secondary metabolites are known to regulate primary metabolites.

Primary Metabolism

Primary metabolism is typically defined as the reactions and processes necessary to stay alive in the short term. Of course, comparing a bacterium versus a human, the "short term" is quite different. The most relevant reactions are those of energy production, such as glycolysis and the citric acid cycle, as well as β-oxidation of fatty acids. In the short run you don't need to make more proteins or nucleic acids. You need energy.

Primary Metabolites – The Major Biomolecules

- Carbohydrates
- Lipids
- Proteins
- Nucleic acids

The enzymes of primary metabolism have high stringency, because they must work on particular molecules selectively. They are found in virtually all organisms (they are universal) and are highly conserved. Over a slightly longer term, because of on-going cell death and growth, one needs to be able to make proteins and nucleic acids too, so these are part of primary metabolism.

Secondary Metabolism

These reactions are ones that in principle aren't needed, at least for an individual organism in a benign environment. Examples include compounds produced to attract other organisms (mates: hormones/pretty colors/pheremones/odors, pollinators: pretty colors/various odors), and compounds produced to deter predators/herbivores. Many of our drugs are derived from plants, bacteria or fungi, and are defensive compounds in the original organism. Many of the secondary metabolites, while not needed for individual survival in a benign environment, are essential to the reproduction and survival of a population and species.

Some important classes of secondary metabolites, also called "natural products", include:

- Alkaloids (many human drugs come from alkaloids)
- Terpenoids
- Tannins
- Flavonoids
- Polyketides

The enzymes of secondary metabolism are typically highly plastic or promiscuous, meaning they may accept and transform a range of similar structures to their active site. This is a very important source of variation in evolution. If you have two copies of a gene (and the corresponding enzyme), one of them is "free" to gradually, over many generations, develop a new function.