Reactive oxygen species (ROS) are chemically reactive molecules containing oxygen. Examples include oxygen ions and peroxides (a compound containing an oxygen–oxygen single bond). ROS are formed as a natural byproduct of the normal metabolism of oxygen and have important roles in
cell signalling

> *Part of a complex system of communication that governs basic cellular activities and coordinates cell actions. The ability of cells to perceive and correctly respond to their microenvironment is the basis of development, tissue repair, and immunity as well as normal tissue homeostasis. Errors in cellular information processing are responsible for diseases such as cancer, autoimmunity, and diabetes.*

and **homeostasis**.

> *The property of a system in which variables are regulated so that internal conditions remain stable and relatively constant.*

However, during times of environmental stress (e.g., UV or heat exposure), ROS levels can increase dramatically. This may result in significant damage to cell structures. Cumulatively, this is known as oxidative stress.
Effects of ROS on cell metabolism are well documented in a variety of species. These include not only roles in apoptosis (programmed cell death) but also positive effects such as the induction of host defence genes and mobilisation of ion transport systems.
This implicates them in control of cellular function. In particular, platelets involved in wound repair and blood homeostasis release ROS to recruit additional platelets to sites of injury. These also provide a link to the adaptive immune system via the recruitment of leukocytes.
Reactive oxygen species are implicated in cellular activity to a variety of inflammatory responses including cardiovascular disease. They may also be involved in hearing impairment via cochlear damage induced by elevated sound levels, in ototoxicity of drugs such as cisplatin, and in congenital deafness in both animals and humans. ROS are also implicated in mediation of apoptosis or programmed cell death and ischaemic injury. Specific examples include stroke and heart attack.

Hypoxia-inducible factors (HIFs) are **transcription factors**

> *A protein that binds to specific DNA sequences, thereby controlling the rate of transcription of genetic information from DNA to messenger RNA.*

that respond to changes in available oxygen in the cellular environment, to be specific, to decreases in oxygen, or hypoxia.
The HIF signaling cascade mediates the effects of hypoxia, the state of low oxygen concentration, on the cell. Hypoxia often keeps cells from **differentiating**.

> *The process by which a cell changes from one cell type to another. Usually this is because a less specialized type becomes a more specialized type, such as during cell growth.*

However, hypoxia promotes the formation of blood vessels, and is important for the formation of a vascular system in embryos, and cancer tumors. The hypoxia in wounds also promotes the migration of keratinocytes and the restoration of the epithelium.
In general, HIFs are vital to development. In mammals, deletion of the HIF-1 genes results in perinatal death. HIF-1 has been shown to be vital to **chondrocyte**

> *the only cells found in healthy cartilage. They produce and maintain the cartilaginous matrix, which consists mainly of collagen and proteoglycans.*

survival, allowing the cells to adapt to low-oxygen conditions within the growth plates of bones. HIF plays a central role in the regulation of human metabolism.

Cellular respiration (*linky cause there's more interesting stuff*) is the set of metabolic reactions and processes that take place in the cells of organisms to convert biochemical energy from nutrients into **adenosine triphosphate (ATP)**,

> *Adenosine triphosphate (ATP) is a **nucleoside***
>
> > *Nucleotides are organic molecules that serve as the monomers, or subunits, of nucleic acids like DNA and RNA*
>
> ***triphosphate***
>
> > *In organic chemistry, a phosphate, or organophosphate, is an **ester***
> >
> > > *chemical compounds derived from an acid (organic or inorganic) in which at l east one -OH (hydroxyl) group is replaced by an -O-alkyl (alkoxy) group*
> >
> > *of phosphoric acid.*
>
> *used in cells as a coenzyme, often called the "molecular unit of currency" of intracellular energy transfer.*

and then release waste products. The reactions involved in respiration are **catabolic**

> *Catabolism (from Greek κάτω kato, "downward" and βάλλειν ballein, "to throw") is the set of metabolic pathways that breaks down molecules into smaller units to release energy. Catabolism breaks down large molecules (such as polysaccharides, lipids, nucleic acids and proteins) into smaller units (such as monosaccharides, fatty acids, nucleotides, and amino acids, respectively). As molecules such as polysaccharides, proteins, and nucleic acids comprise long chains of these small monomer units (mono = one + mer = part), the large molecules are called polymers (poly = many).*
>
> *Cells use the monomers released from breaking down polymers to either construct new polymer molecules, or degrade the monomers further to simple waste products, releasing energy. Cellular wastes include lactic acid, acetic acid, carbon dioxide, ammonia, and urea. The creation of these wastes is usually an oxidation process involving a release of chemical free energy, some of which is lost as heat, but the rest of which is used to drive the synthesis of adenosine triphosphate (ATP). This molecule acts as a way for the cell to transfer the energy released by catabolism to the energy-requiring reactions that make up anabolism. (Catabolism is seen as destructive metabolism and anabolism as constructive metabolism). Catabolism therefore provides the chemical energy necessary for the maintenance and growth of cells. Examples of catabolic processes include glycolysis, the citric acid cycle, the breakdown of muscle protein in order to use amino acids as substrates for gluconeogenesis, the breakdown of fat in adipose tissue to fatty acids, and oxidative deamination of neurotransmitters by monoamine oxidase.*

reactions, which break large molecules into smaller ones, releasing energy in the process, as weak so-called "high-energy" bonds are replaced by stronger bonds in the products. Respiration is one of the key ways a cell gains useful energy to fuel cellular activity. Cellular respiration is considered an exothermic **redox reaction**

> *Red(uction)ox(idation) reactions include all chemical reactions in which atoms have their oxidation state changed; in general, redox reactions involve the transfer of electrons between species.*

which releases heat. The overall reaction occurs in a series of biochemical steps, most of which are redox reactions themselves. Although technically, cellular respiration is a combustion reaction, it clearly does not resemble one when it occurs in a living cell due to slow release of energy from the series of reactions.