

## Mitochondria and chloroplasts are the main energy transformers of cells

- Mitochondria and chloroplasts are the organelles that convert energy to forms that cells can use for work.
- **Mitochondria** are the sites of cellular respiration, generating ATP from the catabolism of sugars, fats, and other fuels in the presence of oxygen.
- **Chloroplasts**, found in plants and eukaryotic algae, are the site of photosynthesis.
  - They convert solar energy to chemical energy and synthesize new organic compounds from CO<sub>2</sub> and H<sub>2</sub>O.
- Mitochondria and chloroplasts are not part of the endomembrane system.
- Their proteins come primarily from free ribosomes in the cytosol and a few from their own ribosomes.
- Both organelles have small quantities of DNA that direct the synthesis of the polypeptides produced by these internal ribosomes.
- Mitochondria and chloroplasts grow and reproduce as semiautonomous organelles.
- Almost all eukaryotic cells have mitochondria.
  - There may be one very large mitochondrion or hundreds to thousands in individual mitochondria.
  - The number of mitochondria is correlated with aerobic metabolic activity.
  - A typical mitochondrion is 1-10 microns long.
  - Mitochondria are quite dynamic: moving, changing shape, and dividing.
- Mitochondria have a smooth outer membrane and a highly folded inner membrane, the **cristae**.
  - This creates a fluid-filled space between them.
  - The cristae present ample surface area for the enzymes that synthesize ATP.
- The inner membrane encloses the **mitochondrial matrix**, a fluid-filled space with DNA, ribosomes, and enzymes.
- The chloroplast is one of several members of a generalized class of plant structures called **plastids**.
  - Amyloplasts store starch in roots and tubers.
  - Chromoplasts store pigments for fruits and flowers.
- The chloroplast produces sugar via photosynthesis.
  - Chloroplasts gain their color from high levels of the green pigment chlorophyll.

- Chloroplasts measure about 2 microns x 5 microns and are found in leaves and other green structures of plants and in eukaryotic algae.
- The processes in the chloroplast are separated from the cytosol by two membranes.
- Inside the innermost membrane is a fluid-filled space, the **stroma**, in which float membranous sacs, the **thylakoids**.
  - The stroma contains DNA, ribosomes, and enzymes for part of photosynthesis.
  - The thylakoids, flattened sacs, are stacked into **grana** and are critical for converting light to chemical energy.

### **Peroxisomes generate and degrade $H_2O_2$ in performing various metabolic functions**

- **Peroxisomes** contain enzymes that transfer hydrogen from various substrates to oxygen
  - An intermediate product of this process is hydrogen peroxide ( $H_2O_2$ ), a poison, but the peroxisome has another enzyme that converts  $H_2O_2$  to water (*contain catalaze!*).
  - Some peroxisomes break fatty acids down to smaller molecules that are transported to mitochondria for fuel.
  - Others detoxify alcohol and other harmful compounds.
  - Specialized peroxisomes, glyoxysomes, convert the fatty acids in seeds to sugars, an easier energy and carbon source to transport.
- Peroxisomes are bounded by a single membrane.
- They form not from the endomembrane system, but by incorporation of proteins and lipids from the cytosol.
- They split in two when they reach a certain size.