STANDARD DEVIATIONS: The Mistletoe's Missing

Greetings,

Holiday-season traditions stretching back for centuries have linked wintertime romance to decorative sprigs of **mistletoe**. It's thought that the way that the plant tightly hugs the branches of the trees on which it grows inspired that association. The truth about this botanical intimacy is less romantic: **Mistletoe is a parasite**. Its leaves produce some sugars by photosynthesis, but instead of roots, it has structures that pierce the host tree's vital tissues to suck out water minerals and sugars.

The cells of all eukaryotic, multicellular organisms rely on the organelles called mitochondria to make their biochemical fuel — **all multicellular organisms except mistletoes**, that is. Not only do their mitochondria produce little if any of this fuel, they've lost many of the genes needed to make it.

{*Viscum album*, Left and *Candida albicans*, Right.

Mistletoe reminds me of yeast!?!}

Mitochondria appeared 2.1-1.6 billion years ago. The guessing popular today is that mitochondria are endosymbiont bacteria (from ribosome genealogy). Mitochondria can form interconnections, fuse with one another and split apart in response to a cell's needs and environmental signals.

Mitochondria are the cellular organelles that generate most of the energy cells need to function (as ATP from the Krebs cycle), and thus play an important role in maintaining cell health. ATP is essentially the gasoline that our cells run on.

But that ain't all.

Mitochondrial ATP production is also vital for cell division and differentiation. The variation in ATP levels at different stages of the cell cycle indicate that mitochondria play an important role in cell cycle regulation.

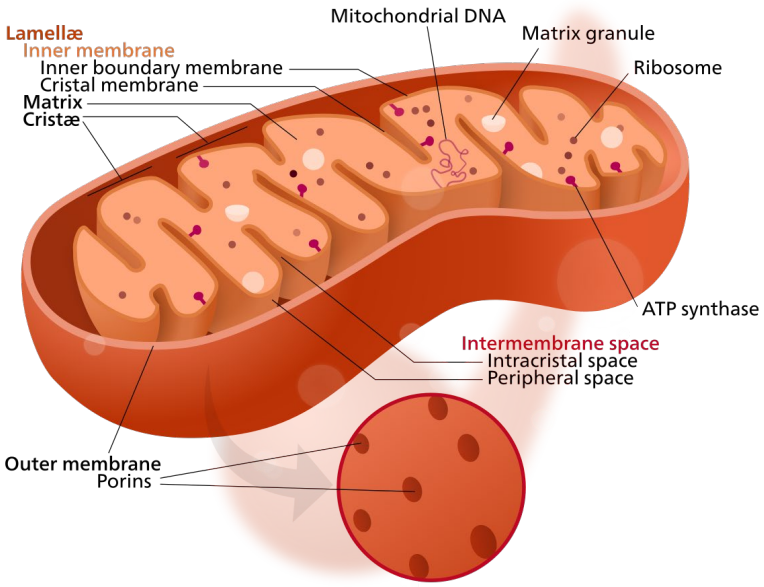
Tumor cells require buckets of ATP to synthesize bioactive compounds such as lipids, proteins, and nucleotides for rapid proliferation. ATP is also vital to accelerated replication of cells in immune response to infection.

One of the many ATP powered molecules produced by mitochondria are motor proteins (known as Kinesin).

The mitochondria's motor proteins carry tons of responsibility within the cell cytoskeleton. They control the movement of the entire cell by enabling the microtubules. They also motorize flagella and cilia.

Mitochondria can transiently store calcium, a contributing process for the cell's regulation (homeostasis) of calcium. Their ability to rapidly take in calcium for later release makes them good "cytosolic buffers" for calcium. While the endoplasmic reticulum (ER) is the most significant storage site of calcium, there is a significant interplay between the mitochondrion and ER with regard to calcium.

Mitochondria are crucial to support synaptic activity, particularly through ATP production and Ca2+ homeostasis. Neurotransmitters are transported along the cytoskeleton rail to the tips of nerve cell axons. Mitochondria are often anchored at key positions within neurons, such as near the synapses, apparently to help their function.



Cells in the body require mitochondria to function and survive. Various disease processes and toxic agents can harm cells by damaging mitochondria, and failure to eliminate damaged mitochondria can cause neurodegenerative diseases such as **Parkinson's, Huntington's, and Alzheimer's disease.**

Research hints that the energy-generating organelles of cells may play a surprisingly pivotal role in **mediating anxiety and depression**. The thinking is that over activity by mitochondria in response to stress makes them generate more of the molecules called **reactive oxygen species (ROS)**, which can be toxic for cells.

Your mitochondria only come from your mom. Both egg and sperm cells contain mitochondria, but after fertilization the mitochondria from the sperm are almost always destroyed. We don't understand why and the idea in vogue is that sperm trigger a self-destruct button in their mitochondria due to those ROS they create from over-work.

A very few organisms have lost mitochondrial DNA altogether. In these cases, genes encoded by the mitochondrial DNA have been lost or transferred to the nucleus. Cryptosporidium, have mitochondria that lack any DNA, presumably because all their genes have been lost or transferred.

Mistletoes lack effective mitochondria. Did they evolve with this or because of it? If there were any benefit to the loss then we'd expect to see other similar species; but we don't. It is thought more likely that something accidentally wiped out their abilities and then mistletoe just managed to cope with what happened. If it does turn out that the plants' loss of mitochondria function was a random occurrence then perhaps mistletoes are just like the rest of us: They're doing whatever it takes to survive the holidays.

Have a great week and be safe,

Bryan

p.s. Mature mammal RBCs do not contain mitochondria. Nuclear and mitochondrial extrusion may help mammal erythrocytes to better adapt to high-sugar and high-heme conditions by limiting reactive oxygen species molecules.