

Review

Mitochondria: More Than Just a Powerhouse

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- **Summary**

- Pioneering biochemical studies have long forged the concept that the mitochondria are the 'energy powerhouse of the cell'. These studies, combined with the unique evolutionary origin of the mitochondria, led the way to decades of research focusing on the organelle as an essential, yet independent, functional component of the cell. Recently, however, our conceptual view of this isolated organelle has been profoundly altered with the discovery that mitochondria function within an integrated reticulum that is continually remodeled by both fusion and fission events. The identification of a number of proteins that regulate these activities is beginning to provide mechanistic details of mitochondrial membrane remodeling. However, the broader question remains regarding the underlying purpose of mitochondrial dynamics and the translation of these morphological transitions into altered functional output. One hypothesis has been that mitochondrial respiration and metabolism may be spatially and temporally regulated by the architecture and positioning of the organelle. Recent evidence supports and expands this idea by demonstrating that mitochondria are an integral part of multiple cell signaling cascades. Interestingly, proteins such as GTPases, kinases and phosphatases are involved in bi-directional communication between the mitochondrial reticulum and the rest of the cell. These proteins link mitochondrial function and dynamics to the regulation of metabolism, cell-cycle control, development, antiviral responses and cell death. In this review we will highlight the emerging evidence that provides molecular definition to mitochondria as a central platform in the execution of diverse cellular events.