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### Link(s)

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### Education

Brown University: AB (Biology), 1973.

Brown University: PhD (Physiological Chemistry), 1977.

Brown University: MD, 1978.

## Research Interests

- The regulation of growth and metabolism

**Key words:** Insulin, growth, Akt/PKB, diabetes, drosophila, metabolism, glucose transport, membrane protein trafficking, signal transduction.



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## Description of Research

The ability to respond to nutritional stress is one of the most primitive adaptations that organism must accomplish. The pathways that alert the organism to an absence of food and initiate an appropriate response are remarkably well-conserved and involve such critical signaling molecules as the protein kinases Akt and AMP-activated protein kinase (AMPK) as well as nutrient sensors such as the carbohydrate response element binding protein (ChREBP). The Birnbaum lab studies this complex biological response in two contexts: the initiation of cell growth after a transition from nutritional deprivation to abundance and the insulin-dependent redistribution of simple substrates into long-term energy stores. The latter process involves a number of distinct but interacting components such as glucose-stimulated insulin secretion, and the insulin-dependent acceleration of hepatic lipid synthesis and glucose uptake into adipocytes and muscle. Two aspects of the regulation of glucose transport by insulin, both of which are studied in the Birnbaum lab, are the way in which insulin regulates the movement of hormone-sensitive Glut4 glucose transporter from the inside of the cell to the plasma membrane, and the signaling pathway by which insulin accomplishes this. There are also a number of projects underway aimed at understanding how the evolutionarily conserved sensor of nutritional stress, AMP-activated protein kinase, regulates carbohydrate and fat metabolism. These fundamental biological problems are addressed using experiments performed in tissue culture cells, mice and the genetically tractable organism *Drosophila melanogaster*.

## Recent Publications

Easton, R.M., Cho, H., Roovers, K., Shineman, D.W., Mizrahi, M., Forman, M.S., Lee, V. M.-Y., Szabolcs, M., de Jong, R., Oltersdorf, T., Ludwig, T., Efstratiadis, A., and **Birnbaum, M.J.** (2005). Role for Akt3/PKBgamma in Attainment of Normal Brain Size. *Mol. Cell. Biol.* 25:1869-78.

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Holland, W. L., Brozinick, J. T., Wang, L. P., Hawkins, E. D., Sargent, K. M., Liu, Y., Narra, K., Hoehn, K. L., Knotts, T. A., Siesky, A., Nelson, D. H., Karathanasis, S. K., Fontenot, G. K., **Birnbaum, M. J.**, Summers, S. A. (2007) Inhibition of ceramide synthesis ameliorates glucocorticoid-, saturated -fat-, and obesity-induced insulin resistance. *Cell Metab.* 5:167-79.

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Li, X., Monks, B., Ge, Q., **Birnbaum, M. J.** (2007) Akt/PKB regulates hepatic metabolism by directly inhibiting PGC-1a. *Nature.* 447:1012-6.