

## Thyroid Hormone and Oxygen Consumption

Endotherms maintain a relatively constant body temperature, above that of their environment, by using heat produced as a by-product of metabolism. When the core temperature of such animals drops below an internal set point, their cells are triggered to reduce the efficiency of ATP production by the electron transport chains in mitochondria. At lower efficiency, more fuel must be consumed to produce the same number of ATP molecules, generating additional heat.

Researchers designed an experiment to test the hypothesis that thyroid hormone might be responsible for this cellular response. Liver cells were isolated from sibling rats that had low, normal, or elevated thyroid hormone levels. The oxygen consumption rate due to activity of the mitochondrial electron transport chains of each type of cell was measured under controlled conditions.

**Table 1: Oxygen consumption for three cell types**

Thyroid Hormone Level	Oxygen Consumption Rate (nmol O <sub>2</sub> /min x mg cells)
Low	4.3
Normal	4.8
Elevated	8.7

1. Draw a bar graph of the data. Why is a bar graph an appropriate graph for these data?
2. Describe the effect of thyroid hormone on the rate of oxygen consumption.
3. Do the data support the researchers' hypothesis? Justify your response.
4. Based on what you know about mitochondrial electron transport and heat production, predict which rats had the highest, and which had the lowest, body temperature.
5. The mechanism responsible for the increased fuel consumption is believed to be increased leakiness of the inner mitochondrial membrane to protons. Propose an explanation for this suggested mechanism.