



Activity – Controlling brown adipose tissue thermogenesis

Scientists have learned a lot about brown adipose tissue by studying mice at cold temperatures.

Read the sections called “Classical nonshivering thermogenesis” and “The mechanism of heat production in brown adipose tissue,” including Figure 5, here:

<http://jeb.biologists.org/content/214/2/242.full>

1. So brown adipose tissue thermogenesis is controlled by the sympathetic nervous system. What part of the body do you think regulates the activity of the sympathetic nervous system? (Hint: what part of your body do you know 1) receives information about temperature and 2) controls mechanisms to adjust body temperature?)
2. What is the “chemical messenger” used by the sympathetic nervous system to regulate the activity of brown adipocytes?
3. What happens to the size of a mouse’s brown adipose tissue after it has lived in the cold for a long time?

So brown adipose tissue thermogenesis is controlled by the **brain** via the **sympathetic nervous system**, which releases **norepinephrine** to “switch on” brown adipocyte heat production. We can define this as the control of **brown adipose tissue activity**. Brown adipose tissue can also **grow bigger** when a mouse is kept in a cold environment for a long time.

Brown adipose tissue in humans

It has been known for a long time that **human babies** have brown adipose tissue that helps them to maintain their core body temperature. However, it was assumed that a baby’s brown adipose tissue becomes more like white adipose tissue as it grows up. However, in the last decade brown adipose tissue was identified in **adult humans**.

Read this article to find out more about how brown adipose tissue was found in adult humans and what technology was used:

<http://www.scientificamerican.com/article/supercharging-brown-fat-to-battle-obesity/>

4. What is the evidence that a person’s brown adipose tissue can be “switched on” by cold?
5. What happens when a person is exposed to cold temperature for a long time?
6. How is this similar to what we know happens in mice under the same conditions?



Turning white adipose tissue brown

The article above mentioned “beige,” also known as “brite,” adipocytes.

Find out what these are in this article, under the section “Brown adipocyte nomenclature”:

<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3917931/>

When mice get used to living at very cold temperatures, such as 4°C, something very interesting happens to their white adipose tissue. Specifically, some white adipocytes start to express UCP1 in their mitochondria, meaning that they gain the ability to generate heat like brown adipocytes. These cells are called “beige” or “brite” adipocytes, and the brain controls this process in the same way that it controls brown adipose tissue thermogenesis---via the sympathetic nervous system, and using the chemical messenger norepinephrine.