Summary (online only)

Mammals maintain their core body temperature (CBT) despite changes in environmental temperature. Exceptions include suspended animation-like states such as hibernation, torpor, and estivation. These states are all characterized by dramatic decreases in metabolic rate followed by a loss of homoeothermic control in which CBT approaches that of the environment. Here we report that hydrogen sulfide can induce a suspended animation-like state in a non-hibernating species, the mouse (Mus musculus). Importantly, this suspended animation-like state is readily reversible and does not appear to be detrimental to the animal. This work suggests a possibility for inducing suspended animation-like states for medical applications.

Effects of ambient temperature on core body temperature of mice exposed to 80 ppm hydrogen sulfide:

There is a dramatic effect on the core body temperature (CBT) of mice that are exposed to 80 ppm hydrogen sulfide (H\textsubscript{2}S) where the average CBT of these mice reach a minimum of 15°C in an ambient temperature of 13°C. To assess what role the ambient temperature has on CBT of mice exposed to 80 ppm H\textsubscript{2}S, we varied the environmental temperature over a wide range. There is a linear relationship between the environmental temperature and the resulting CBT over the range of 6°C to 30°C when mice are exposed
to 80 ppm H$_2$S (Fig S1). This suggests that the effect of H$_2$S is not temperature dependent. Once metabolism is inhibited by H$_2$S, mice are unable to generate enough internal heat to maintain a CBT more than a few degrees C above the ambient temperature.

Figure S1. Core Body Temperature at Different Ambient Temperatures in Mice exposed to 80 ppm H$_2$S. The relationship between the ambient temperature and the final core body temperature reached after six hours exposure to H$_2$S is indicated by boxes. The black line is a linear regression with an R$^2$ value = 0.99. H$_2$S concentration was held constant at 80 ppm for these of experiments.
Experimental Procedures

Female C57BL/6J mice (Jackson Laboratories – Bar Harbor, Maine) were implanted with telemetry devices (Series 3000 XM-FH transmitters - MiniMitter Inc. – Bend, Oregon) to measure core body temperature according to standard protocol provided by MiniMitter. Mice were allowed to recover for several weeks after surgery. Each mouse was exposed to 1L/min of either an atmosphere containing 500ppm H\textsubscript{2}S balanced nitrogen (Byrne Specialty Gas – Seattle, Washington) mixed with room air (using a 3 channel gas proportioner meter from Aalborg – Orangeburg, New York) to give a final concentration of 80ppm H\textsubscript{2}S and 17.5% O\textsubscript{2}, or an atmosphere of nitrogen mixed with room air to give a final concentration of 17.5% O\textsubscript{2}. H\textsubscript{2}S and O\textsubscript{2} measurements were taken using an Innova GasTech GT series portable gas monitor (Thermo Gas Tech – Newark, California). The mice were housed in a Shel Lab (Sheldon Manufacturing Inc. – Cornelius, Oregon) low temperature diurnal illumination incubator to regulate temperature and light cycle (8am lights on, 8pm lights off). During the exposure the mice were in a glass cage (with drinking water and no food) fitted with FEP tubing from Cole-Parmer (Vernon Hills, Illinois) and the glass lid was sealed using Dow Corning silicone vacuum grease (Sigma – St. Louis, Missouri.) When the mice were exposed to the regulated atmosphere, the temperature inside the incubator was dropped to 13°C. After the exposure the mice were returned to a normal cage and allowed to recover at 22°C. Metabolic rate was assayed by determining the CO\textsubscript{2} output of mice in the environmental chamber with a LI-7000 (LI-COR Biosciences – Lincoln, Nebraska.) O\textsubscript{2} consumption was assayed using a PA-10a oxygen analyzer (Sable Systems – Las Vegas,
Nevada). Core body temperature and movement of the mice were continuously monitored via the telemetry devices and recorded using VitalView software (provided by MiniMitter) on a PC.

Panel A is the average of three experiments with one mouse per experiment. Panel B is the average of seven experiments (one mouse per experiment) for the hydrogen sulfide exposed animals and the average of four experiments (one mouse per experiment) for the animals exposed to the control atmosphere. Panel C is data from five experiments (one mouse per experiment). Panel D is data from one particular experiment, but representative of many (>10) experiments.