

Arctic Ground Squirrel Body Temperature and Light Data Analysis Worksheet

Arctic ground squirrels spend between 5-8 months hibernating underground in burrows each year when temperatures drop and food supply dwindles. During hibernation, body temperature also decreases. As winter approaches, daylight hours decrease until there are 24 hours of darkness. Later, as summer approaches, daylight hours increase until there are 24 hours of sun.

In this activity, you will use data collected about two male arctic ground squirrels by researchers at Toolik Field Station in northern Alaska. Each squirrel wore a collar with an attached lightlogger to record light intensity, measured in lux. Light is detected and recorded when the squirrel is active (above ground) and not when they are in their burrows underground, where it remains dark. Each squirrel also had a small data logger implanted into their body cavity to record internal body temperature (°C).

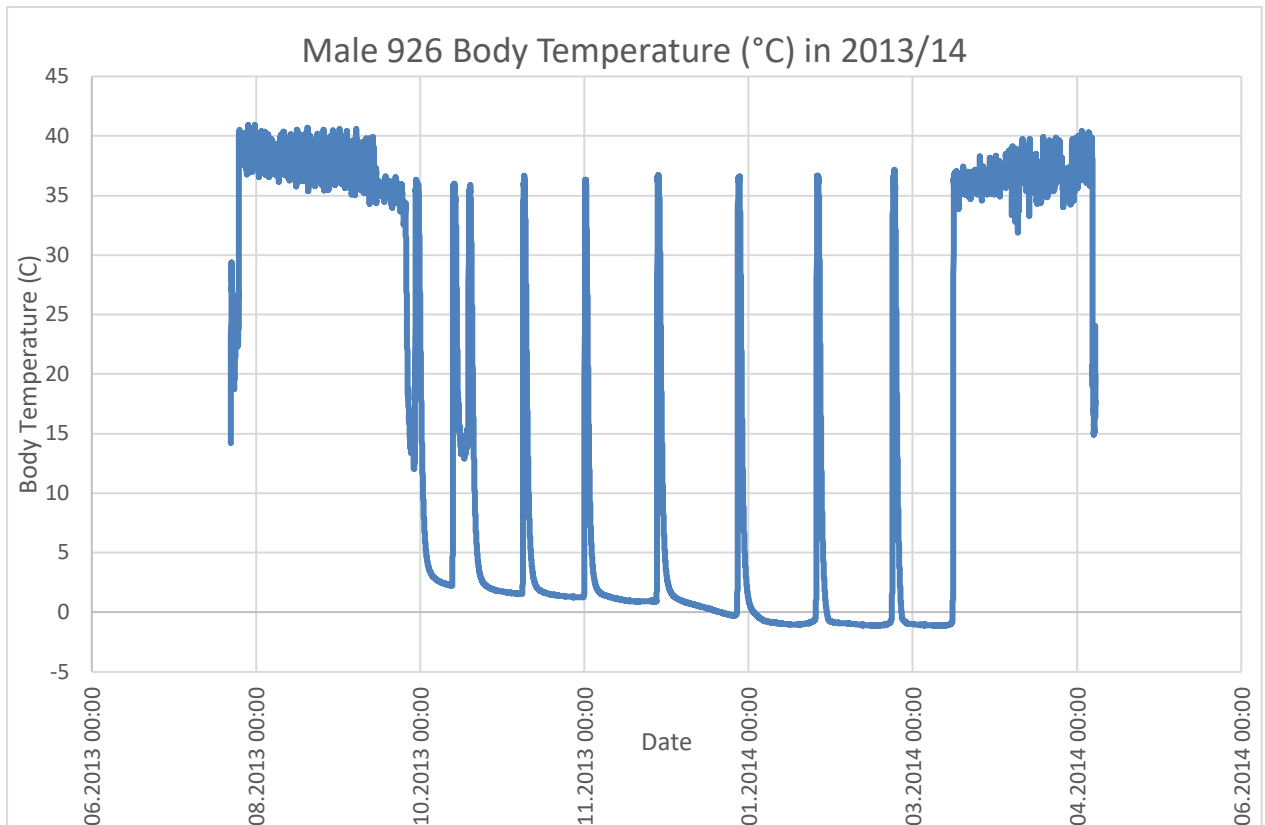
1. Choosing one of the two squirrels, use all of the data for body temperature and the date it was recorded to make a line graph with time on the x-axis and body temp on the y-axis. Give the graph a title and label the axes.
 - a. Sketch the general shape of the graph.
 - b. Outline the general pattern you see.
 - c. What happens to body temperature from mid-August to early October?
 - d. What happens to body temperature from early October through mid-April?
 - e. What is the lowest body temperature recorded?
2. Arctic ground squirrels are obligatory hibernators, meaning they must hibernate each year.
 - a. Estimate the start and end dates of hibernation for this squirrel.
 - b. What information did you use to estimate these dates?
3. Add a second y-axis to the graph using the light (lux) data. To do this, copy the data you need from the table and paste it into your graph. Once in the table, you will need to click on a data point, right-click on "format data series" and select "secondary axis" from the options. You can also delete the marker, and add a line in a different color in the same place. Don't forget to change the data series so that the correct dates are used. (You'll need to change column d for column a.)
 - a. Sketch the general shape of the graph.
 - b. Describe the general pattern of light measured by the lightlogger over the course of the year.
 - c. Does this data support your estimated hibernation dates?
4. To look more closely at what is happening during hibernation, make another graph of body temperature and date, using only data from January and February.
 - a. Sketch the general shape of the graph.
 - b. What pattern in body temperature do you notice?
5. Make a new temperature vs date graph, this time using only data from March 2 to April 6. Add a second y-axis with light (lux) data.
 - a. Sketch the general shape of the graph.
 - b. Which date does hibernation end? How do you know?
 - c. When do light levels change in regards to the end of hibernation?
 - d. What does this suggest about squirrel activity in this time?
 - e. How would you expect these dates to shift with climate change, if at all?
6. Can you think of other interesting ways to analyze and interpret this data? Try it out. What did you find?

Extension

7. Analyze the data from the second male ground squirrel and compare to the results of the first.

Arctic Ground Squirrel Body Temperature and Light Data Analysis Answer Key

1. a.

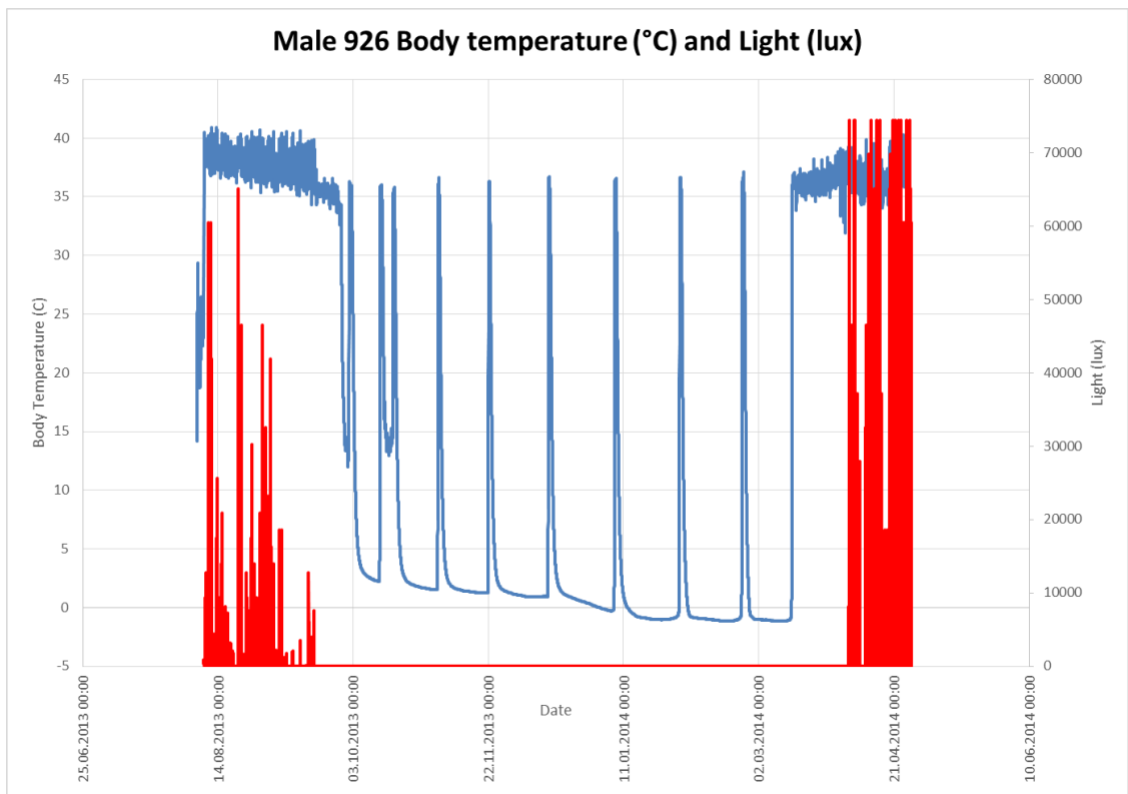


- b. Body temperature is high, then drops low for many months, then becomes high again, with short spikes back to normal several times.
- c. Body temperature ranges between 35-41C from mid-August until early October.
- d. Body temperature drops to just below zero for approximate three week intervals, with a spike back to normal 37C for one day every three weeks. From mid-March, body temperature is back between 35-41C.
- e. -1.5 (+/- 0.5)

2.

- a. Hibernation looks like it begins around October 4 and ends March 14.
- b. Looking at when body temperature decreases significantly for a period of time for hibernation, and when it rises for more than one day for the end of hibernation.

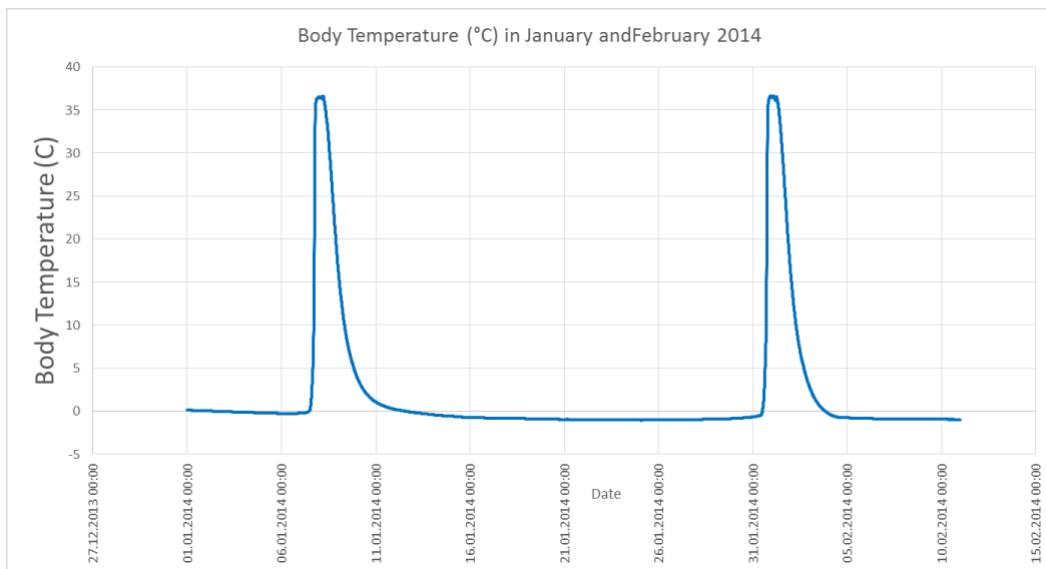
3.



- a.
- b. From August to October, there is an overall decrease in the light detected, until the light detected is zero, suggesting that the squirrel starts to spend more time in the burrow up until the onset of hibernation, when the squirrel does not leave the burrow at all, and no light is detected. From mid-April onward, light is detected again, suggesting the squirrel is leaving the burrow.
- c. Yes, the trend is reflected in both body temperature and light detected. There is also a period of time leading up to hibernation and after hibernation where the body temperature is normal, but no light is detected, suggesting that the squirrel is spending time in the burrow awake, but not leaving.

4.

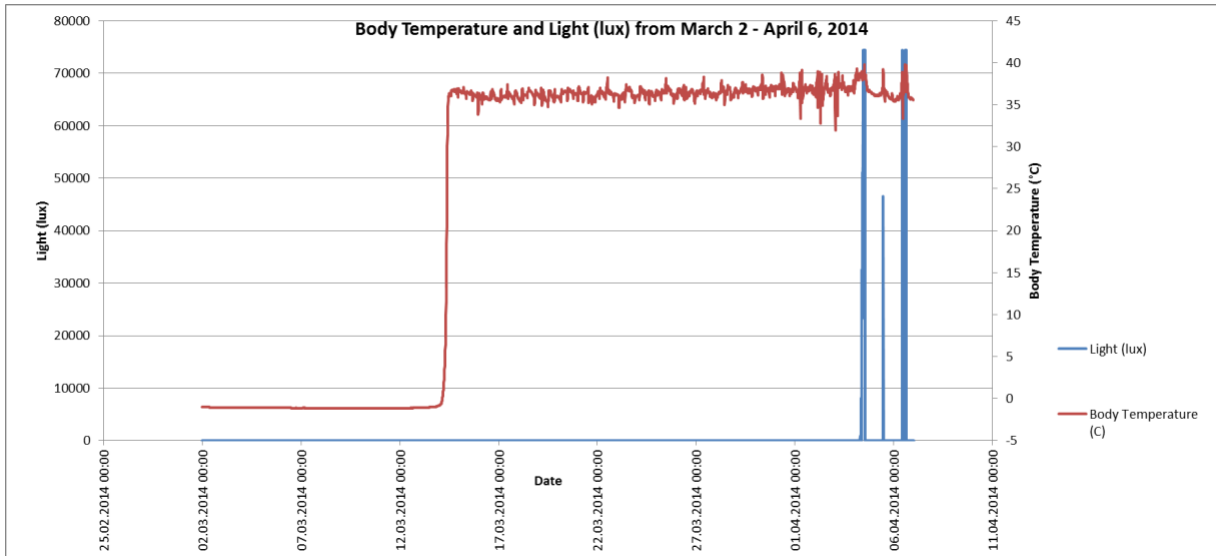
a.



- b. Here you can clearly see the pattern of internal body temperature stays at or just below freezing for about three weeks before rising back to normal for one day.

5.

a.



- b. Hibernation ends March 14. You can clearly see where that this is the date when body temperature rises back to normal and does not drop again.
- c. No change in light levels is detected until April 4.
- d. This suggests that the squirrel has roused from hibernation almost three weeks before leaving the burrow.
- e. Hibernation might end earlier, if temperatures are warmer and snows less severe.