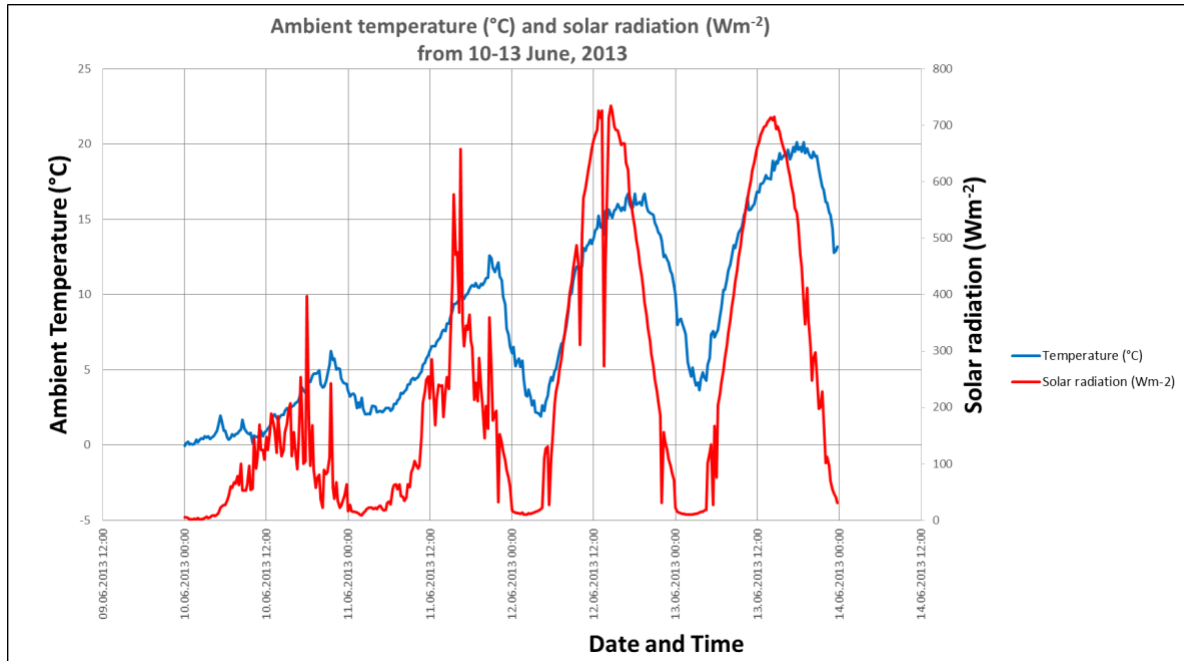


Arctic Ground Squirrel data-based question

Arctic ground squirrels live in arctic climates, where the temperature varies dramatically throughout the year, and sunlight varies from 24 hours of daylight in summer to 24 hours of darkness in winter. At Toolik Field Station in northern Alaska, temperature varied from -50 to 27°C in 2013.

Graph 1 shows ambient temperature ($^{\circ}\text{C}$) and solar radiation (Wm^{-2}) collected from 10-13 June, 2013.

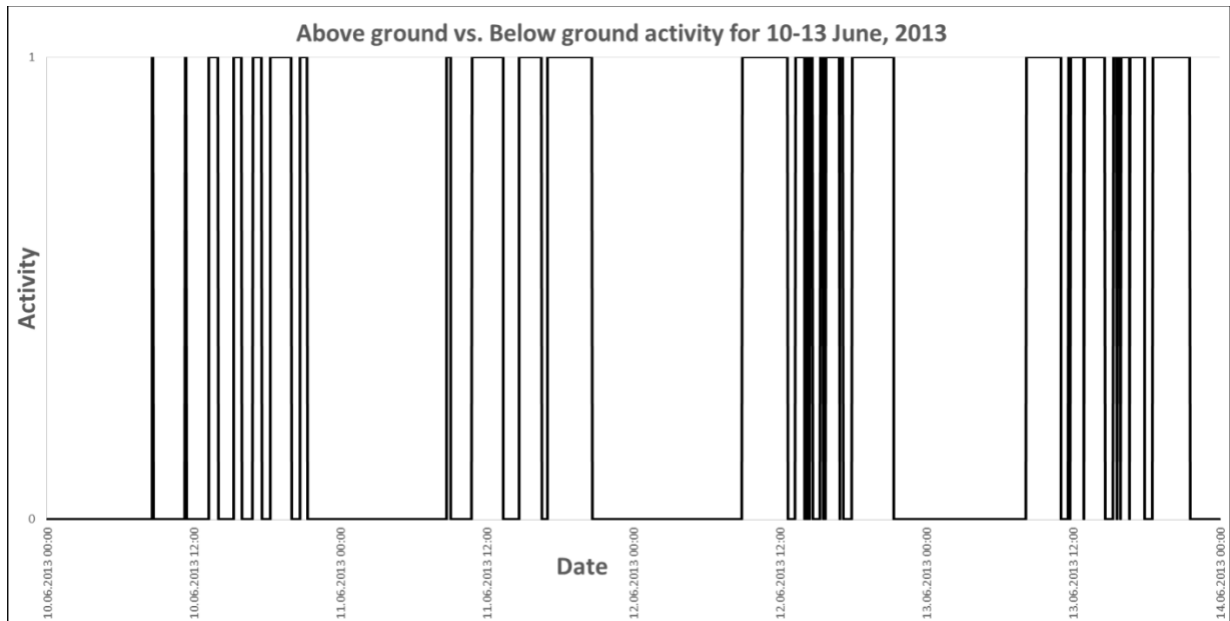


Graph 1

1. Identify the highest recorded temperature. (1)
2. Outline the relationship between ambient temperature and solar radiation. (2)
3. There are 24 hours of daylight in June, yet the solar radiation levels appear to reach near zero at certain times. Suggest an explanation for this. (2)

Many arctic animals do not use a daily internal clock, or circadian rhythm that is based on daily patterns of light and dark, due to the large fluctuations shown in daylight shown between summer and winter. In June, for example, there is 24 hours of daylight per day.

Light levels were recorded by a data logger attached to the collar of a male arctic ground squirrel in June 2013. Because light is detected when the squirrel is active above ground and no light is detected when the squirrel is below ground, light can be used as an indication of squirrel location/activity. This light data has been converted to 0 (below ground) and 1 (above ground) in Graph 2.



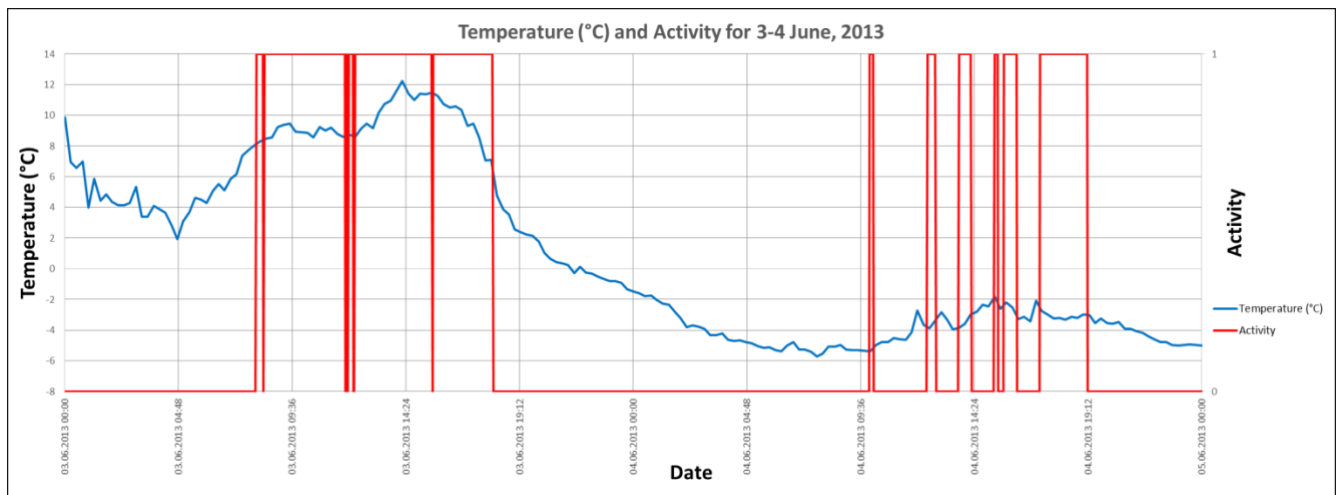
Graph 2

4. Compare and contrast the activity of the squirrel seen over the four days. (2)

5. Suggest a reason the squirrel might have entered his burrow during the day. (1)

6. Evaluate whether the hypothesis that arctic squirrels show a regular pattern consistent with a 24 hour circadian rhythm is supported by the data. (2)

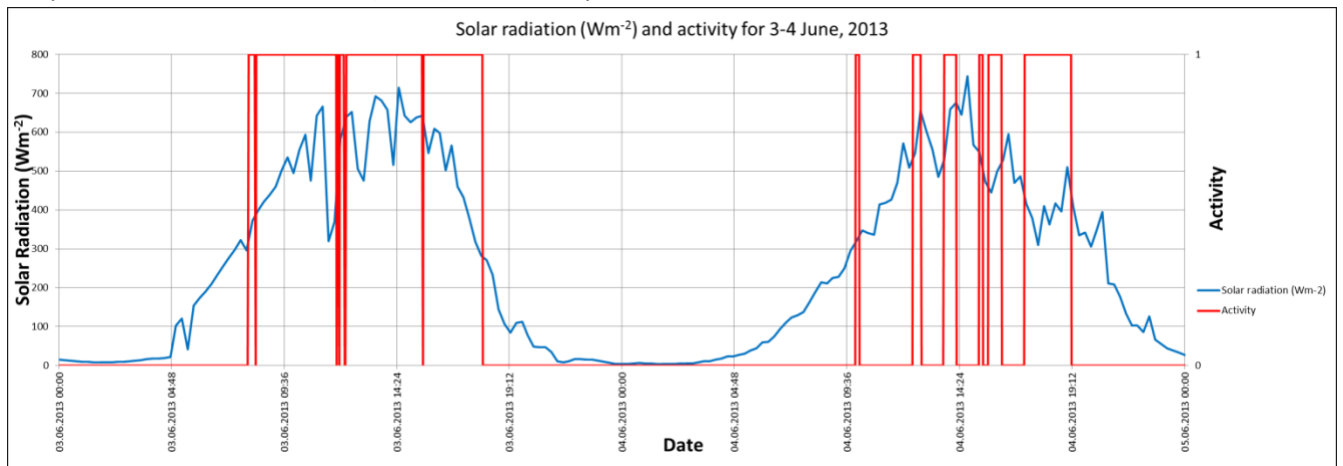
Graph 3 shows ambient temperature ($^{\circ}\text{C}$) and activity levels between 3-4 June, 2013.



Graph 3

7. Identify the date with the coldest temperature. (1)
8. Looking at Graph 3, describe the relationship between ambient temperature and squirrel activity. (2)
9. Suggest a reason for this pattern. (1)

Graph 4 shows solar radiation (Wm^{-2}) and activity levels between 3-4 June, 2013.



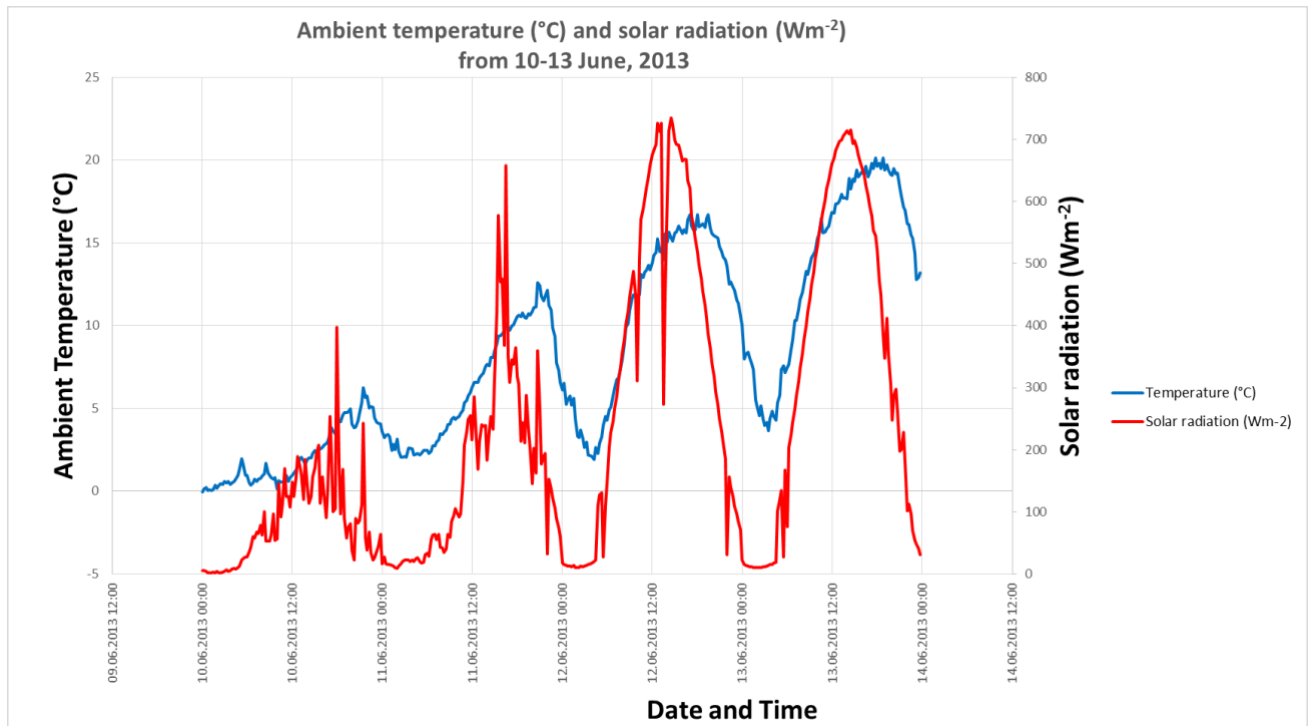
Graph 4

10. Looking at Graph 4, describe the relationship between solar radiation and squirrel activity. (2)

Arctic Ground Squirrel data-based question Answer Key

Arctic ground squirrels live in arctic climates, where the temperature varies dramatically throughout the year, and sunlight varies from 24 hours of daylight in summer to 24 hours of darkness in winter. At Toolik Field Station in northern Alaska, temperature varied from -50 to 27°C in 2013.

Graph 1 shows ambient temperature ($^{\circ}\text{C}$) and solar radiation (Wm^{-2}) collected from 10-13 June, 2013.



Graph 1

1. Identify the highest recorded temperature. (1)

20.5°C (+/- 0.5)

2. Outline the relationship between ambient temperature and solar radiation. (2)

As solar radiation increases, temperature increases;

Both rise and fall each day;

Solar radiation increases and decreases slightly before temperature;

3. There are 24 hours of daylight in June, yet the solar radiation levels appear to reach near zero at certain times. Suggest a reason for this. (2)

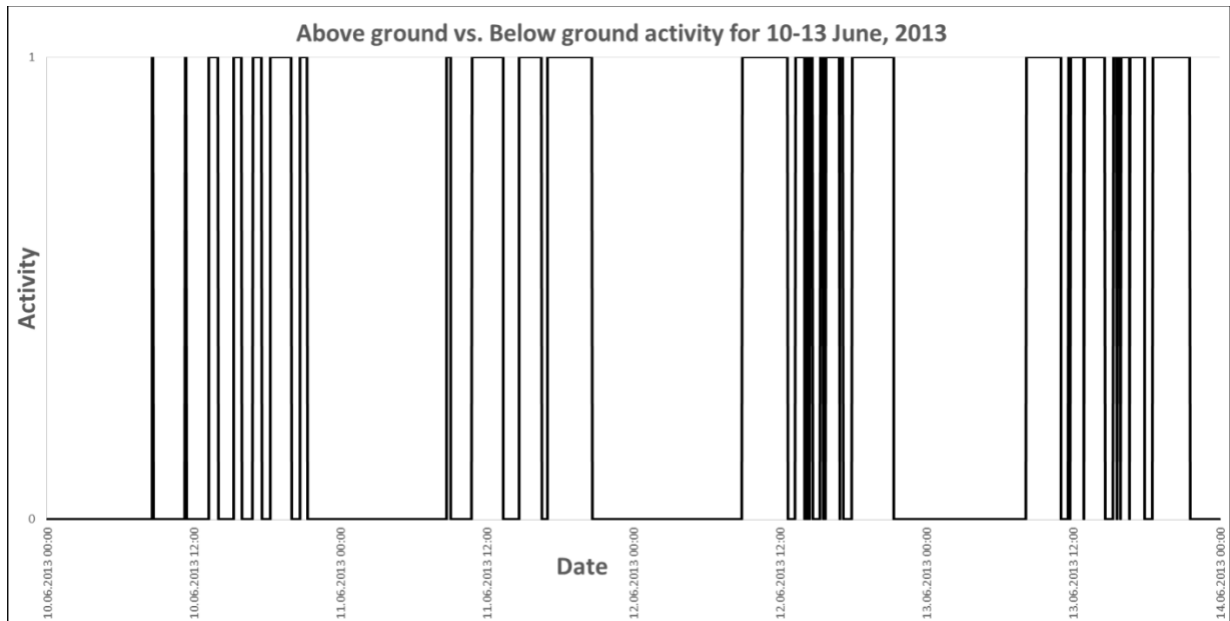
The sensor points directly upwards;

At midday, the sun is directly overhead and the sensor reads brighter;

Late in the day, the sun is low on the horizon and the sensor reads darker;

Many arctic animals do not use a daily internal clock, or circadian rhythm that is based on daily patterns of light and dark, due to the large fluctuations shown in daylight shown between summer and winter. In June, for example, there is 24 hours of daylight per day.

Light levels were recorded by a data logger attached to the collar of a male arctic ground squirrel in June 2013. Because light is detected when the squirrel is active above ground and no light is detected when the squirrel is below ground, light can be used as an indication of squirrel location/activity. This light data has been converted to 0 (below ground) and 1 (above ground) in Graph 2.



Graph 2

4. Compare and contrast the activity of the squirrel seen over the four days. (2)

The squirrel is active during the same approximate times each day (7:00-21:00);
Some days (11th and 13th) have more time spent above ground than the others;
Some days (10th and 12th) the squirrel visits the burrow more frequently;

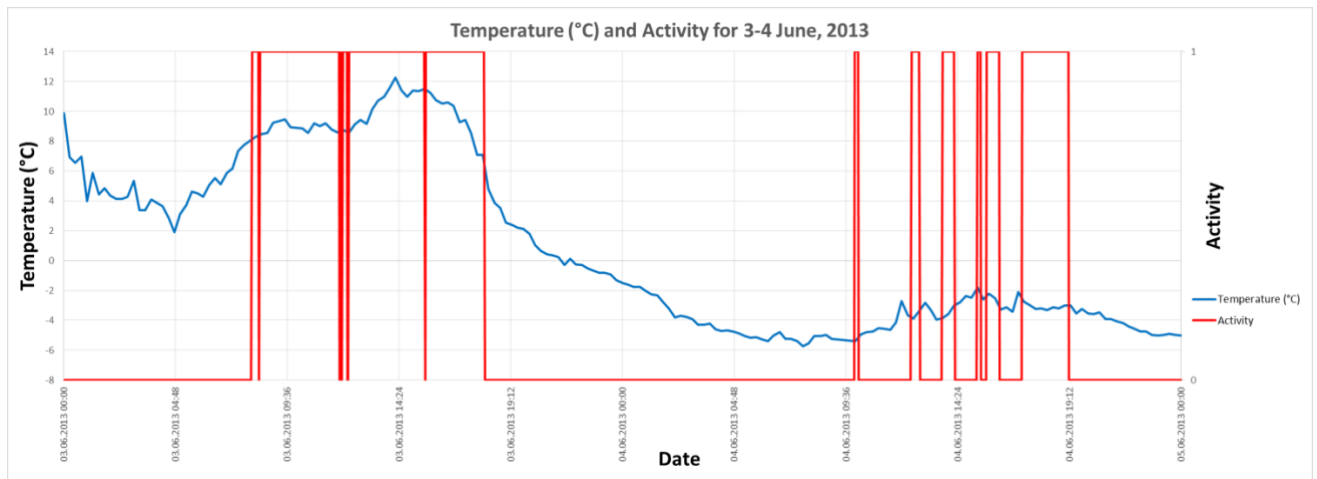
5. Suggest a reason the squirrel might have entered his burrow during the day. (1)

Predator spotted/bad weather/store food/other reasonable answer

6. Evaluate whether the hypothesis that arctic squirrels show a regular pattern consistent with a 24 hour circadian rhythm is supported by the data. (2)

Hypothesis supported;
Time above ground starts (7am) and ends (9pm) at similar times each day;

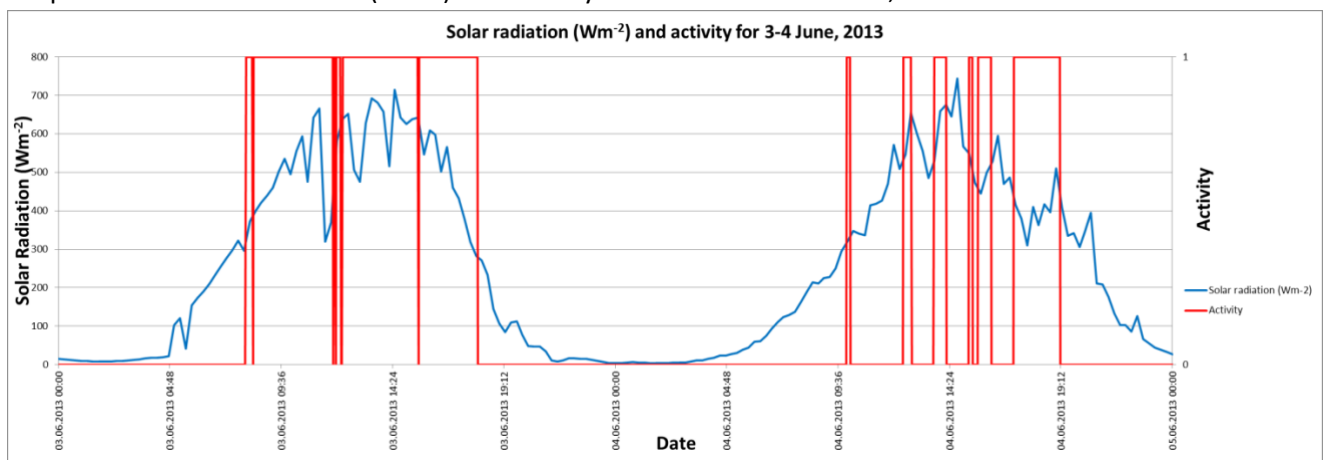
Graph 3 shows ambient temperature (°C) and activity levels between 3-4 June, 2013.



Graph 3

7. Identify the date with the coldest temperature. (1)
June 4
8. Looking at Graph 3, describe the relationship between ambient temperature and squirrel activity. (2)
The squirrel spent more time above ground on the warmer day than the colder day;
Longer times spent above ground on warmer day;
Below 0°C, more time is spent below ground;
9. Suggest a reason for this pattern. (1)
Difficult to maintain body temperature in colder temperatures/cold might come with snow that makes food finding difficult or makes squirrel more visible to predators;

Graph 4 shows solar radiation (Wm⁻²) and activity levels between 3-4 June, 2013.



Graph 4

10. Looking at Graph 4, describe the relationship between solar radiation and squirrel activity. (2)
As solar radiation increases, activity above ground increases;
Start of daily activity correlates with increase in solar radiation;