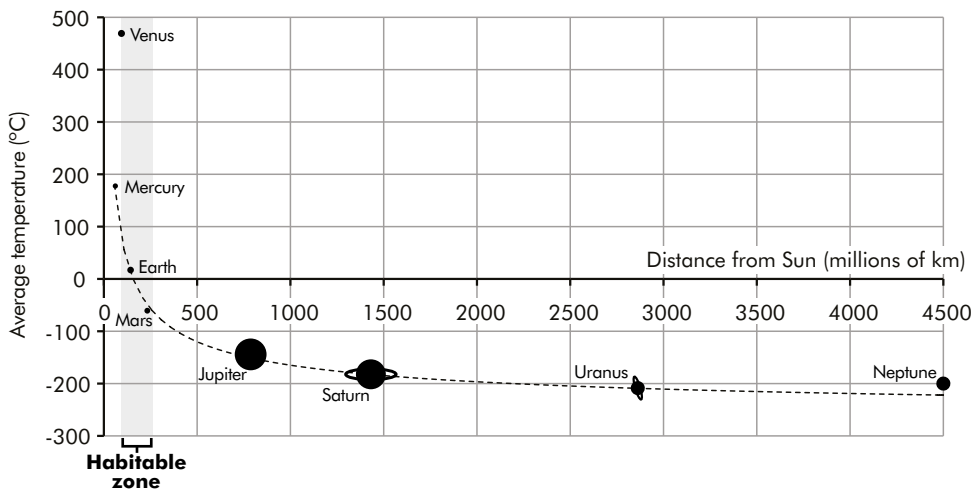


ESTIMATING TEMPERATURE: THE HABITABLE ZONE

If life is to exist on an exoplanet, it is likely to depend on liquid water. Water is liquid between 0°C and 100°C . If an exoplanet is too close to its star, it will be hotter than 100°C , and its water will boil away. Exoplanets that are colder than 0°C will be icy. For life to flourish, an exoplanet must be at just the right distance from its star, in the star's 'habitable zone'.



Note: The size of the planets is not shown to scale.

In this activity you will investigate how the temperature varies close to a radiant heat source. (This is your 'star'.) Find out how the temperature depends on its distance from the star for two thermometers (these are your 'planets').

What you'll need:

- Radiant heater or infrared light bulb
- 2 thermometers, one with a shiny bulb, the other with a blackened bulb.
- 2 clamps and stands
- Metre rule

Safety: Take care when working with a radiant heater. Do not get too close to it as you could be burned. If you are using a bulb do not look at it directly.

What you need to do:

1. Mount the shiny thermometer in a clamp. It should be vertical with its bulb at the same height as the heater/bulb. Repeat with the blackened thermometer.
2. Place each thermometer at a distance of 70 cm from the heater. Wait until the temperature has become steady. Record the distance and temperatures in a table.
3. Move the thermometers 5 cm closer to the heater. Record their temperatures when they are steady. Repeat at 5 cm intervals.

Safety: Take care that your temperature readings do not exceed 100°C (the limit of the thermometers)

4. Use the graph paper to draw a graph of temperature against distance for each thermometer. (Use the same graph axes for both.)

THE HABITABLE ZONE: TEMPERATURE-DISTANCE GRAPHS

1. The graph on the instruction sheet shows the average surface temperatures of the planets and their distances from the Sun.
 - (i) How does temperature change with distance?
 - (ii) Which planet does not fit this pattern?
 - (iii) Explain why the Earth is the only planet likely to sustain life.
2. Your graph shows temperature and distance from a heater.
 - (i) What was the lowest temperature reached in the experiment you carried out? What do you think the lowest temperature would be for temperature-distance graph for a star?
 - (ii) Can you explain why the shiny and black thermometers give different results?

Taking it further A star's habitable zone changes over time. Use the internet to find out about the lifecycle of stars. What will happen to the Sun in the future? How will this change the habitable zone?