

Sunspots

A sunspot is any dark, cooler spot that appears from time to time on the Sun's surface.

Sunspots are usually only visible through a telescope but were first recorded by the Chinese thousands of years ago. Galileo Galilei was one of the first people to study the Sun (around 1611) using the then newly discovered 'optick tube' (unknowingly risking blindness in the process).

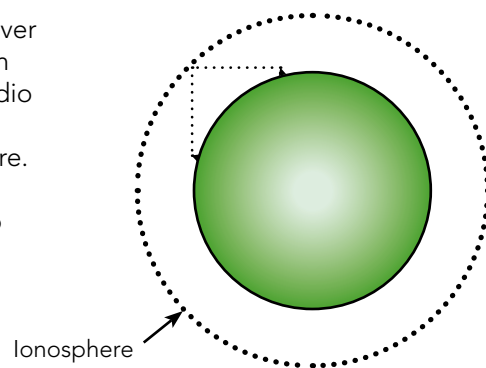
1 What is another name for an optical tube? _____

Little research was done on sunspots until Samuel Heinrich Schwabe (1789-1875), a German pharmacist and amateur astronomer, discovered the periodicity (regularly occurring cycles) of sunspots. Schwabe was originally looking for an 'unknown planet passing in front of the Sun, which he reasoned would be detected as a dark spot. He made observations on every day that he could from 1826 to 1843 and noticed a regular variation (there appeared to be a maximum of sunspot activity about every 11 years). This 'solar cycle' of increasing and decreasing sunspots has been confirmed by many astronomers as ranging from 9.5 to 11 years (averaging 10.8 years) between periods of maximum activity. The Sun's magnetic field reverses its polarity over the same time scale.

Many people have tried to find a connection between the pattern of sunspots and the Earth's weather. Although there doesn't seem to be a connection between sunspot activity and day-to-day weather conditions on Earth, there may be a link with long-term climate patterns. Between 1645 and 1715 there were very few sunspots. This phenomenon (referred to as the 'Maunder Minimum') coincided with very cold conditions in Europe and North America known as the 'Little Ice Age'.

As they wax and wane, sunspots can vary in number from as many as 200 to none. Sunspots can differ in size, with diameters from 2500 km to 50 000 km. Smaller sunspots last a few days and large ones can last for months. Sunspots are cooler (about 4300 K) than the Sun's surface (6000 K). Sunspots are formed when a change in a magnetic field rises to the Sun's surface. The magnetic fields of the Sun can be over two thousand times stronger than those of Earth.

The ionosphere is a layer of the Earth's atmosphere lying between 60 km and over 600 km from the surface. It contains ionised (electrically charged) gases that can act as a 'mirror' for some radio waves. The ionosphere can reflect shortwave radio signals from one part of the Earth's surface to another, reaching places farther from the transmitter than might be expected. Sunspots influence the ionosphere. During solar maxima the ionosphere is denser than during solar minima and communication depending on certain radio frequencies can be affected. Radio astronomers find it difficult to detect cosmic radio signals during solar maxima because the more dense ionosphere reflects incoming signals.



2 Why should you avoid looking at the Sun directly through a telescope? _____

3 Give a description of a sunspot. _____

4 What is the 'solar cycle' discovered by Schwabe? _____

5 What causes sunspots? _____

6 What was the 'Maunder Minimum'? _____

7 What is the average temperature of the Sun's surface? _____

8 What is the ionosphere? _____

9 What is the best time for a radio astronomer to make observations: during a time when sunspots are many or when they are few? Explain your answer. _____

10 What does 'wax and wane,' mean? _____

11 'The ionosphere is an electrically charged layer of Earth's atmosphere.' True or false? _____