

The Sun



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Basic Solar Data

100 times larger than the Earth

One million times as massive as Earth

Surface Temperature ~10,500 F (5,800 K)

Rotates once per month

Is half a degree in size on the sky

Basic Solar Data

Table 18-1 Sun Data

Distance from the Earth:	Mean: 1 AU = 149,598,000 km Maximum: 152,000,000 km Minimum: 147,000,000 km
Light travel time to the Earth:	8.32 min
Mean angular diameter:	32 arcmin
Radius:	696,000 km = 109 Earth radii
Mass:	1.9891×10^{30} kg = 3.33×10^5 Earth masses
Composition (by mass):	74% hydrogen 25% helium 1% other elements
Composition (by number of atoms):	92.1% hydrogen 7.8% helium 0.1% other elements
Mean density:	1410 kg/m ³
Mean temperatures:	Surface: 5800 K Center: 1.55×10^7 K
Luminosity:	3.86×10^{26} W
Distance from center of Galaxy:	8000 pc = 26,000 ly
Orbital period around center of Galaxy:	220 million years
Orbital speed around center of Galaxy:	220 km/s

(NOAO)

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Solar Atmosphere

Photosphere
("Light" region)

Chromosphere
("Color" region)

Corona
("Crown")



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Photosphere



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The photosphere is the “surface” that we see. It is not a *physical* boundary but an *optical* one. The absorption of light by the H^- molecule produces the sharp edge.

Height 400 km

Temperature
5800 K (down to 4500 K)

Surface is covered with **granules**.

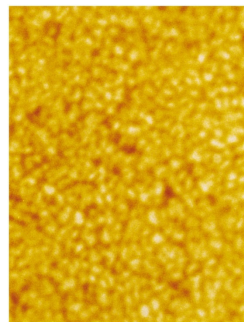
Photosphere

Granulation

Size of Texas + Oklahoma

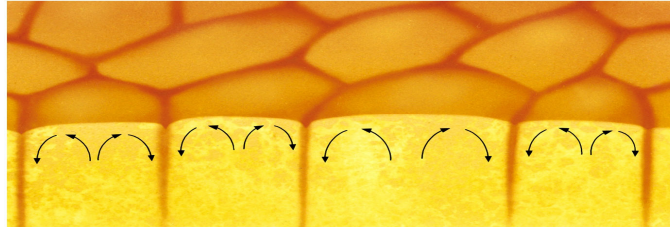
Centers are 50 – 100 K hotter than edges

Persist for ~8 minutes



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Photosphere



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Convection

Hot gas rising upward produces the bright granules. Cooler gas sinks downward along the boundaries between granules. This gas is about 50 K cooler, so it is slightly less bright.

Rotation of the Sun

Sunspots were used by Galileo to determine the Sun's rotation

Differential Rotation

25 days	0° latitude
28 days	40° latitude
36 days	80° latitude



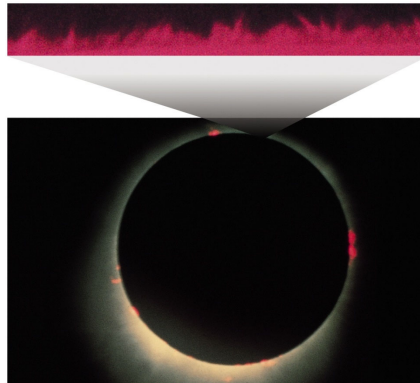
Chromosphere

The chromosphere is the region of color. Namely, helium, which has red emission lines, was first detected in this region during solar eclipses.

Height 2000 km to 3000 km

Temperature
4,500 K to 10,000 K

Contains millions of **spicules**



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Chromosphere

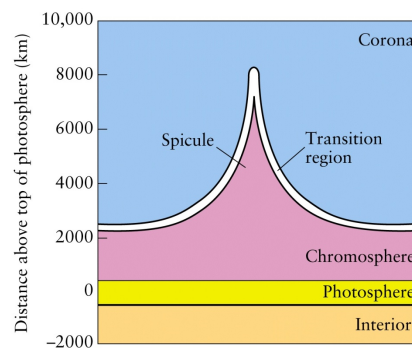
Spicules

As much as 10,000 km high

Temperature quickly rises to
1,000,000 K

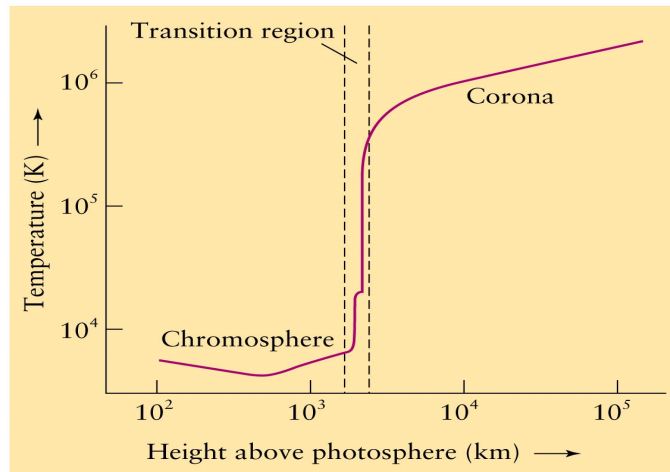
Lasts for about 15 minutes

About 300,000 spicules exist
at any given time



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Transition Region



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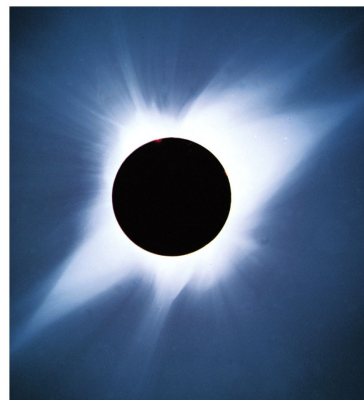
Corona

The corona is the “crown” of the Sun. It is best seen during a total solar eclipse.

Height **millions of km**

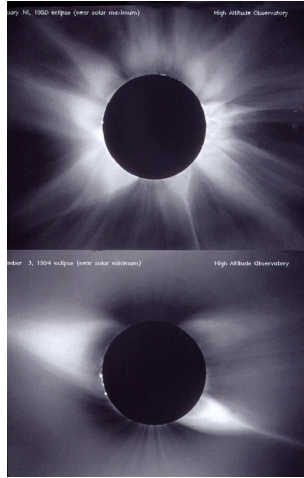
Temperature **millions of K**

Heated by magnetic fields. Best viewed in the X-ray. Can be a very violent region.



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Images of the Corona



Solar Wind



Composed of charged particles, mainly electrons. The solar wind exists because the gases in the corona are too hot to be confined by solar gravity.

The speed of the solar wind near the Earth's orbit averages about 400 km/s, and its density is usually two to ten ions per cubic centimeter. But both are highly variable.

The solar wind's interaction with the Earth's atmosphere creates **aurora**.