Sun is A Dynamic Star

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Bentonville Public Library
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Overview

- Basics
- Energy Source
- History
- Food production
- Sunspots
- CME
- Solar wind
- Energy production
The Basics

**Radius:**
6.9 \times 10^8 \text{ m}
(109 times Earth)

**Mass:**
2 \times 10^{30} \text{ kg}
(300,000 Earths)

**Volume:**
\sim 1 \text{ million Earths}

**Luminosity:**
3.8 \times 10^{26} \text{ watts}

70\% \text{ Hydrogen (H)}
and 28\% \text{ Helium (He)},
and only 2\% other elements
### The Basics

<table>
<thead>
<tr>
<th>Element</th>
<th>Value in Sun</th>
<th>Value in Earth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydrogen</td>
<td>91.2</td>
<td>71.0</td>
</tr>
<tr>
<td>Helium</td>
<td>8.7</td>
<td>27.1</td>
</tr>
<tr>
<td>Oxygen</td>
<td>0.078</td>
<td>0.97</td>
</tr>
<tr>
<td>Carbon</td>
<td>0.043</td>
<td>0.40</td>
</tr>
<tr>
<td>Nitrogen</td>
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<td>Sulfur</td>
<td>0.015</td>
<td>0.040</td>
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Fe/H: 0.00032
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<thead>
<tr>
<th>Element</th>
<th>Value 1</th>
<th>Value 2</th>
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Our Sun

* For centuries humans wondered about, and worshipped, the Sun
Our Sun

* For centuries humans wondered about, and worshipped, the Sun
Is sunshine like fire? (a chemical bonding change)

Chemical energy content

Luminosity

~ 10,000 years

So... No.
Sun Shine?

* Is the sun contracting?

Gravitational potential energy

\[
\frac{\text{Luminosity}}{\text{~ 25,000 million years}}
\]

So... No.
Sun Shine?

* Is sunshine due to nuclear energy? (a chemical bonding change)

Nuclear potential energy
Luminosity

~ 10,000 billion years

So... Yes!!!
History

- 150 CE Greek scholar Claudius Ptolemy writes *Almagest*

- 1543 Nicolaus Copernicus publishes *On the Revolutions of the Celestial Spheres*
History

- 1610 First observations of sunspots through a telescope made independently by both Galileo Galilei and Thomas Harriot

- 1645-1715 Maunder Minimum Sunspot activity declines to almost zero

Corresponds with "Little Ice Age"
Changes in the Sun

- Neutrinos leave the sun all the time. When there is a solar prominence or CME (coronal mass ejection) there are more.
STEREO

* When
SDO

* When
Hinode

* When
Changes on Earth
When those neutrinos from the sun interact with atoms in the Earth’s atmosphere, the atoms glow...
Ice Ages

* When the Sun has fewer Sunspots, it gives off less energy, less energy makes its way to Earth, and our planet cools down.
Ocean Currents

* The heat of the sun controls thermohaline circulation, or more simply, the “Global Conveyor Belt”
Questions?