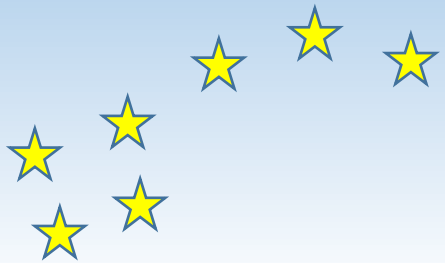


Our Home Star: The Sun

Physical Sciences

Broward College

Prepared for AST 1002

Horizons in Astronomy

Objectives

- What is the Sun?
- Sun’s Properties
- Fusion
- Sun’s Layers
- Solar Features and the Sun Cycle
- Solar Energy Production

What is the Sun?

- Our nearest star.
- The center of our Solar System.
- The main engine for all the heat produced in the solar system.

Solar Properties and the Calculation

Property	Calculation
Distance: 1.49 X 10^8 km = 1 A.U.	• Aristotle was the first person to consider the distance to the Sun. But Kepler was the first to obtain a precise measurement. • Recent measurements use radar bouncing off other planets to obtain more precise measurements.
Size: 1.4 X 10^6 meter = 0.5°	• Aristarchus was the first to consider the size of the Sun. • The modern method involves the angle of the light rays. • 150 Earths would fit across the diameter of the sun.
Mass: 2 X 10^{30} kg	• Newton was the first person to find accurately the mass of the sun with his theory of gravitation and the periods of the planets. • 300,000X more massive than the Earth.
Density: 1.4 g/cm^3	• The density is a simple calculation of the mass over the volume. • The density is only 40 percent higher than water suggesting a gaseous composition.

The Energy Production of the Sun

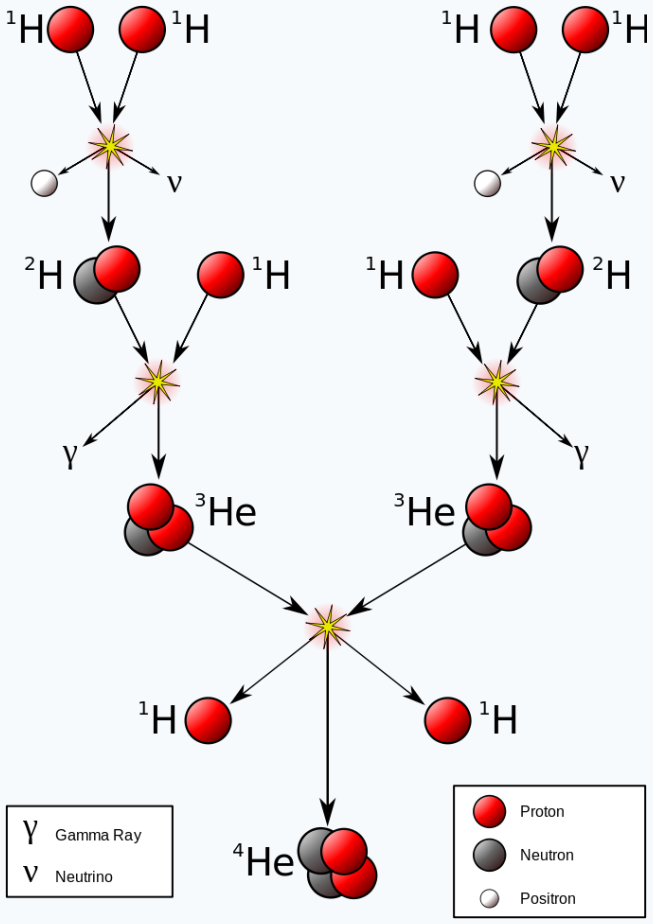


Figure 1. Solar Fusion (Wiki)

- The Sun's core is dense enough to overcome the atomic forces due to great gravity. This allows two hydrogen to form a bond to make dueterium (hydrogen with an extra electron). Then two dueterium combine to create a light helium (helium with one neutron). Finally, two light heliums combine to make a regular helium with a hydrogen to restart the cycle.
- The process creates a gamma-ray that is highest energy of light that we observe. It takes the light 100,000 years to escape the Sun as a visible photon.

Cross Section of the Sun

- Core:8,000,000K
- Radiative Zone:~100,000K
- Convective Zone:~500,000K
- Photosphere: 5,700K
- Chromosphere: 4,300-40,000K
- Corona:2,000,000K

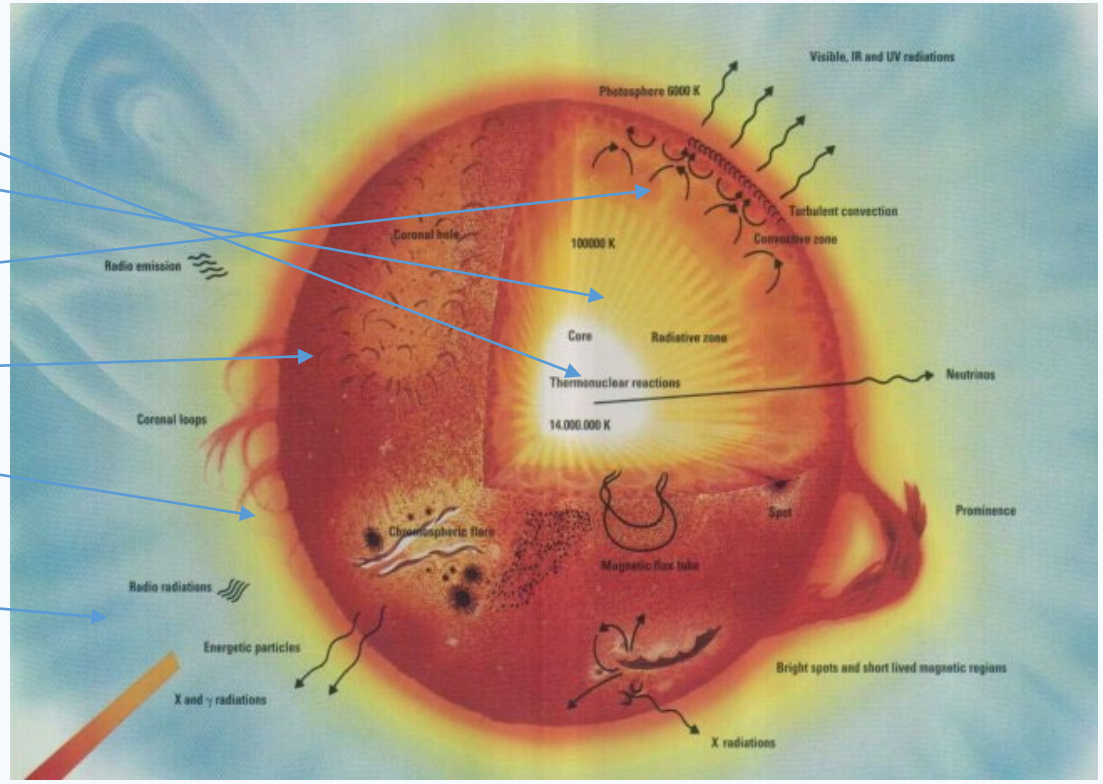


Figure 2. Sun's Cross Section (Wiki)

Surface Features of the Sun

- Prominences
  - Steam from the sun with some charge, can be large
- Flares
  - Associated with sun spots, charged particles driven out by magnetic field
- Spots
  - Cooler areas of the Sun due to solar flares
- Granules/Spicules
  - Larger/Smaller “bubbles” on the photosphere of the Sun

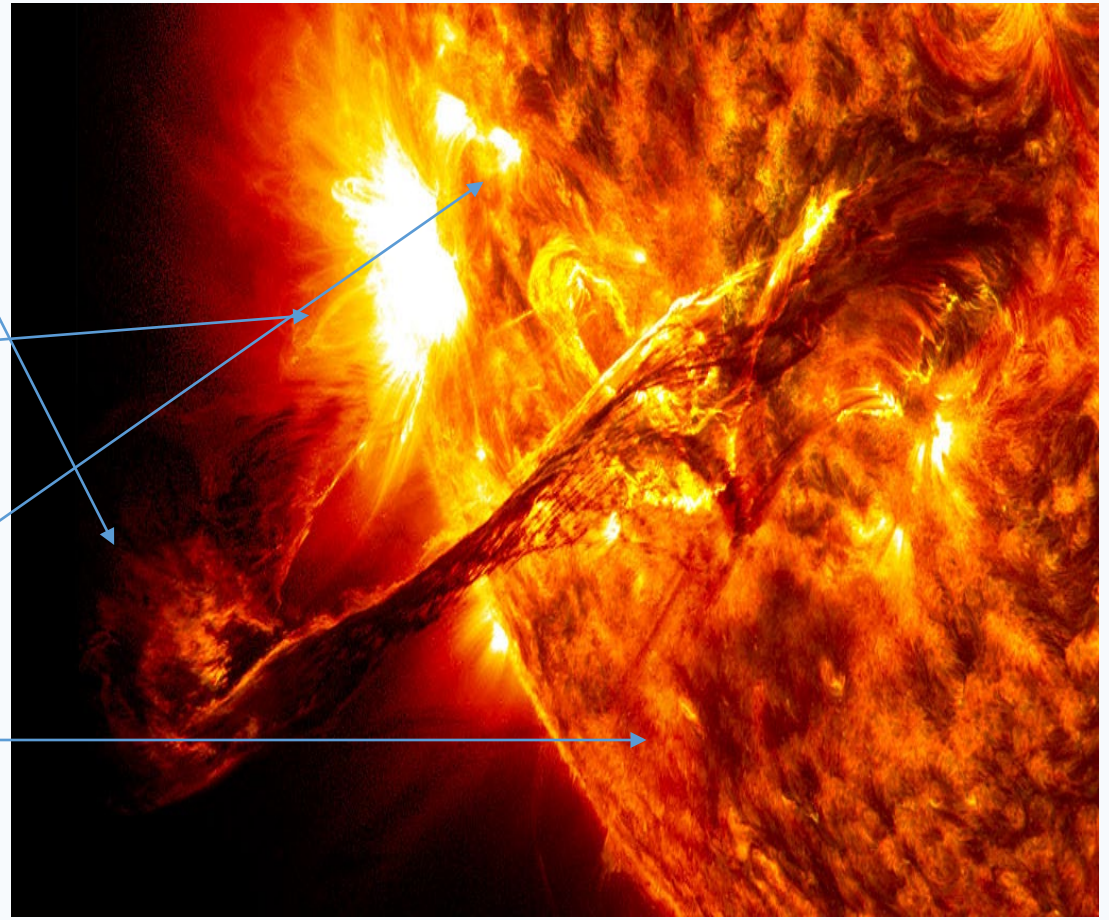


Figure 3. Surface of the Sun with a Prominence (Wiki)

Solar Spectrum

- The spectrum that we observe from the Sun is mainly from the photosphere, chromosphere, and the corona. These layers received their energy from the lower layers of the Sun.
- Some of the layers are absorbed by the atmospheric layers of the Earth thus creating the Greenhouse effect.

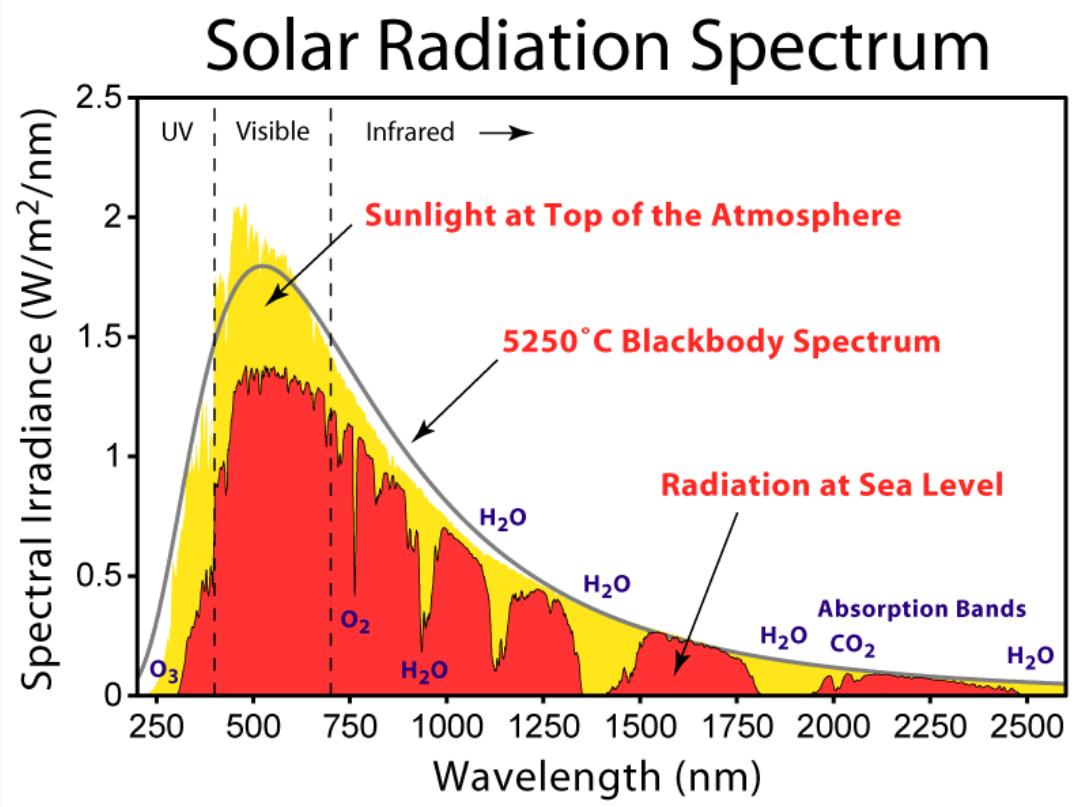
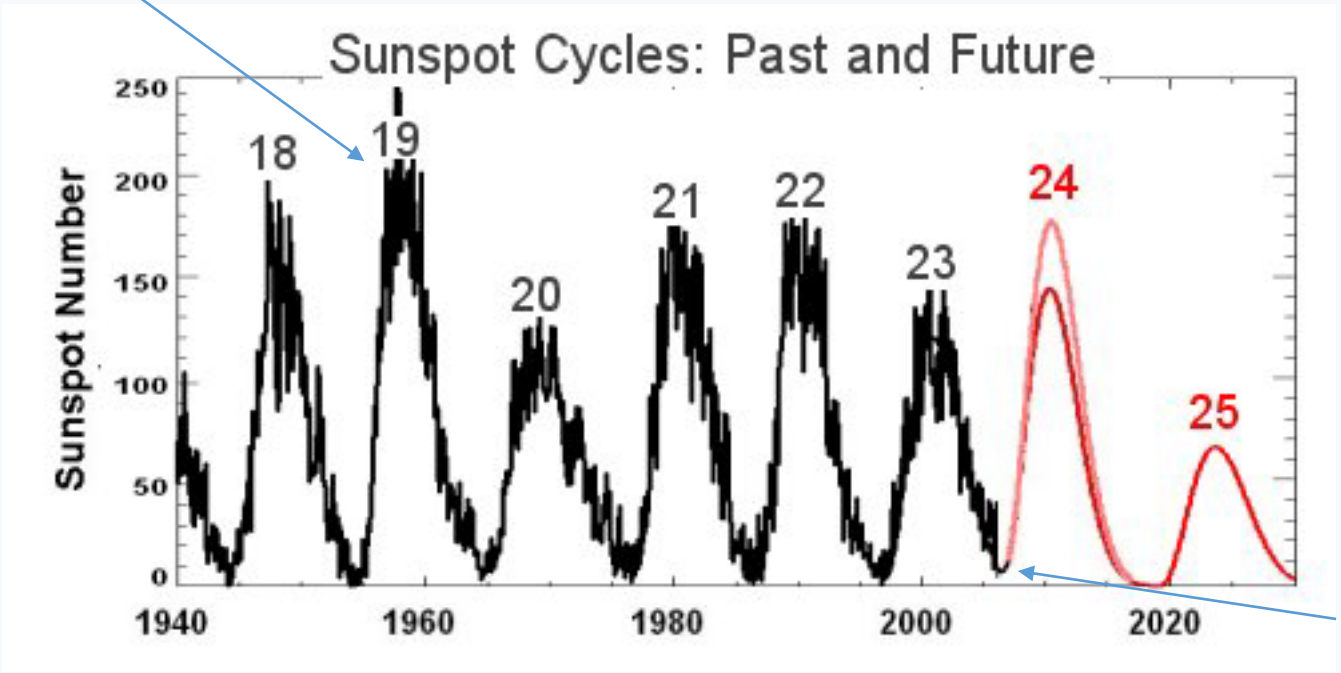


Figure 4. The Solar Spectrum

Sunspot Cycle

Maximum – Magnetic Field Flipping



Minimum – Magnetic Field Stabilizing

Figure 5. Sunspot Cycle (Wiki)

What is Solar Energy?

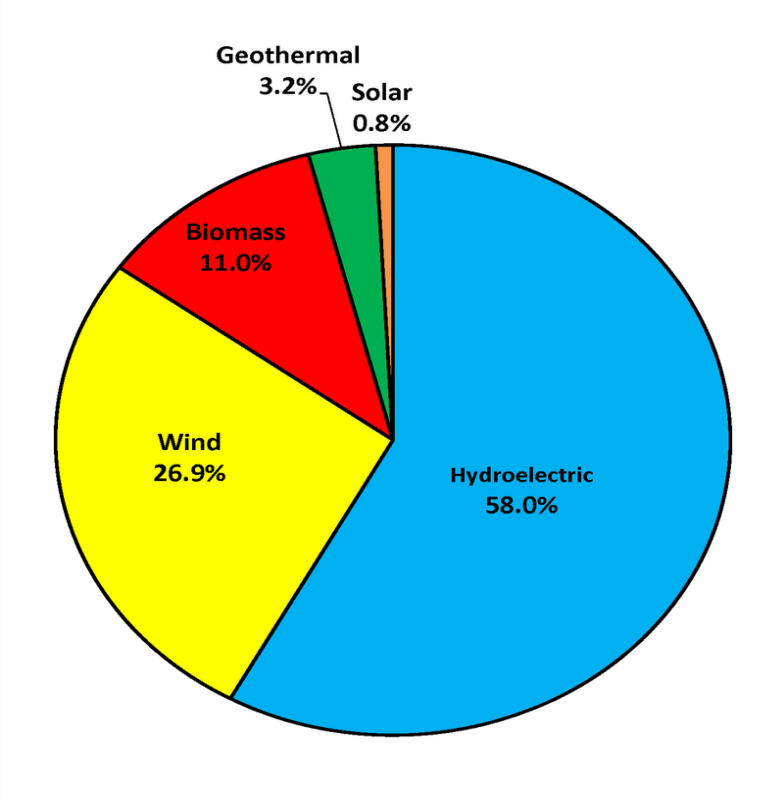


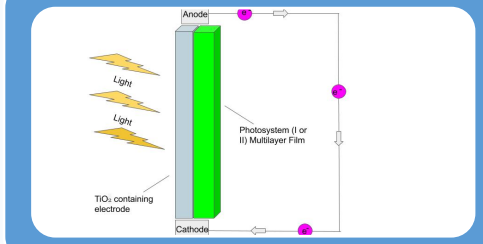
Figure 6. Renewable Energy Resources (Wiki)

- Hydroelectric, Wind, Peat Moss, Geothermal, and Solar are all considered renewable energy resources as they can be replaced in our lifetimes.
- We use the Sun's energy to create power here on Earth.
- Solar energy is the conversion of solar radiation into either mechanical energy, heat, electricity.
- Solar technologies use the radiative energy of the sun to heat material directly or to convert mechanical energy using turbines or semi-conductive materials.

Types of Solar Power Production

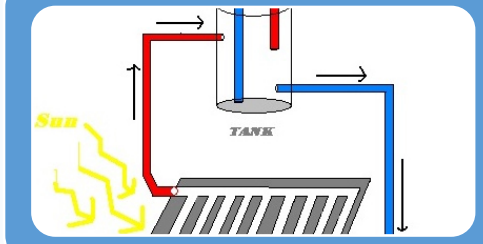
Solar Power Farm

- Warm convection from sunlight directed by mirrors causes a turbine to spin. Extra energy is directed to wind turbines Figure 6 (Wiki)



Solar Photovoltaic Panels

- Photons from the Sun strike the upper layer creating potential energy for the electrons in the silicon layer of the panel.
- The conductive silicon of the lower layer attracts the electrons in the “holes” and the electrons flow through the circuits to create a current.
- The current heats water or charge a battery. Figure 7 (Wiki)



Solar Water Heater

- Solar radiation directly heats the water through transparent panels. Figure 9 (Wiki)

Designing a Solar House

Active – Moves a Turbine	Passive – Direct Heating
Photovoltaic Panels	Earth Berms
Space Heater	Plate Collectors
Solar-tough collectors	Updraft Towers

A south facing house with better insulation with a combination of these technologies can be a Solar House

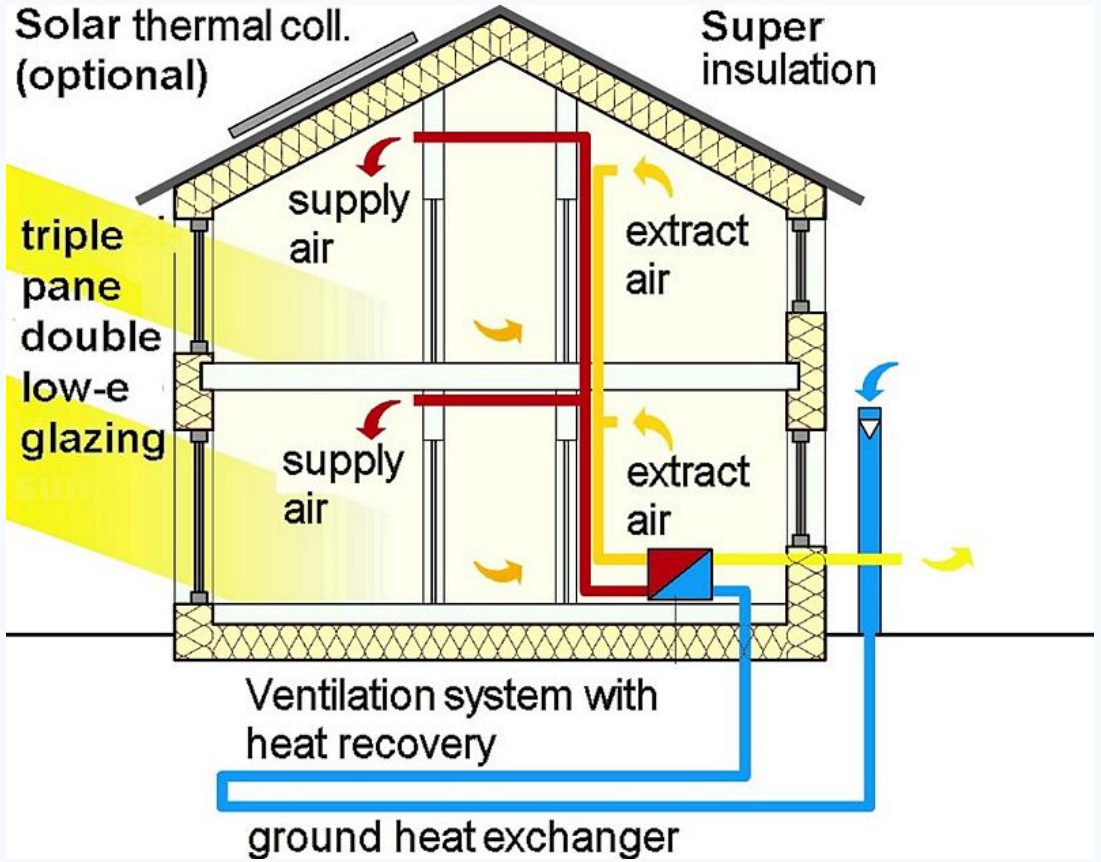


Figure 10 A Solar House (Wiki)

Wiki Commons/Wikipedia Image References

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