Eclipse in Your Hand

Color the layers of the Sun. Which are visible during an eclipse?

Age: 6 +

Activity Time: 25 min

Prep Time: 10 min

Summary

What parts of the Sun can be seen during an eclipse? Students make a model showing the layers of the Sun, with the inner layers hidden behind a flip-up opaque photosphere. A cutout of the Moon shows which parts of the Sun are obscured during a solar eclipse and demonstrates how the highly-structured corona takes center stage when the bright photosphere is blocked. Students use their creativity to color in the layers and depict the wispy corona.

Credit: Activity created by Chabot Science Center and adapted by NSO
http://www.chabotspace.org/assets/teacher/sunion.pdf

Objectives

- Students learn about each layer of the Sun, their temperatures and characteristics.
- Students learn that during a solar eclipse, the Moon perfectly obscures the Sun's bright photosphere.
- Students learn about interesting features of the Sun that can easily be seen during a total solar eclipse.

Materials

Materials Needed (per student)

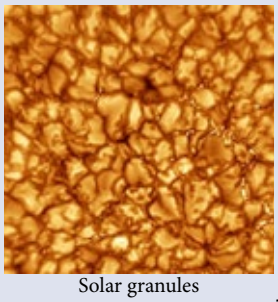
- ❑ 1 sheet black construction paper or cardstock
- ❑ 1 printed copy of the internal and external layers of the Sun sheet (provided)
- ❑ Scissors
- ❑ Glue (school glue, craft glue or glue stick)
- ❑ 1 Popsicle stick or coffee stir stick

Science Background

Core: The Sun's core is 15 million degrees! A handful of the hydrogen and helium plasma in the core would weigh more than 5 pounds! The core is so dense that the Sun fuses hydrogen into helium in the core and releases the great amount of energy and light that powers the Sun.

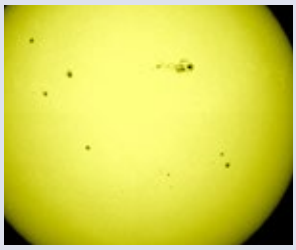
Radiative Zone: In the radiative zone, energy generated in the fusion reaction travels outwards towards the convection zone. Even though this energy is moving at the speed of light, it bounces back and forth in every direction, and may take hundreds of thousands of years or more to travel through the radiative zone. The temperature in this region is 5 million degrees.

Convection Zone: In the convection zone, the temperature drops to 2 million degrees, allowing electrons to reunite with atoms of carbon, nitrogen, oxygen, calcium and others. That makes this region more opaque and the transport of energy radiation more difficult. The radiative zone is very hot at the base and relatively cool at the top, allowing for convection that cools the interior. You have likely seen this phenomenon in action when boiling water or soup at home. The liquid closest to the bottom of the pot gets hot, rises and then releases energy as steam, then the water cools and sinks, creating a roiling boil. In the Sun, the energy that is released at the top of the convection zone shines into space from the photosphere as visible light.

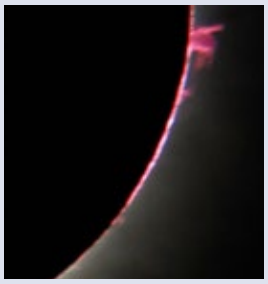


Solar granules
Credit: BBSO/NJIT

Photosphere: The "Sphere of Light," it's 6000 degrees! It has "cooler" spots (only 4000 degrees) we call sunspots, which we can think of as magnetic "storms" on the Sun's surface. It is also speckled all over by convection cells, where hot gases rising from inside the Sun dump their heat into space and the cooler material sinks. The photosphere shines in mostly visible light.



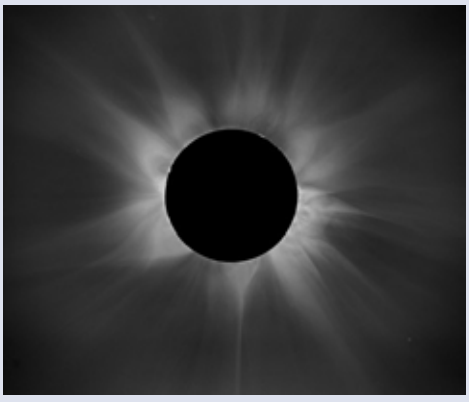
Photosphere with sunspots.
Credit: NASA/SDO and the AIA, EVE, and HMI science teams



Chromosphere
Credit: NCAR, HAO

Chromosphere: The "Sphere of Color," it's above the photosphere, is 50,000 degrees and has arcs and plumes of gases called prominences. Because it's hotter, it shines with a lot of energetic ultraviolet light—though there is a lot of red light from hydrogen as well.

Corona: The "Crown, " it's the hottest of all the Sun's atmosphere, a million degrees! It is a very hot, thin gas which forms looping and arcing shapes due to the Sun's powerful magnetic fields. The corona is so hot that it emits a lot of very energetic X-rays.



Solar Corona. Credit: Robert B. Slobins

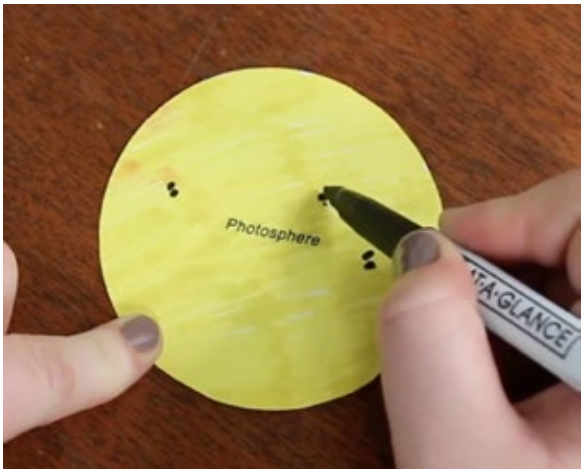
Procedure

1. Print off the internal and external layers of the Sun sheets on the following page (be sure to print them out on separate pages!). Print off one set of sheets for each student.

2. Have the students cut out all of the Sun's layers (and the Moon), or do this ahead of time.

3. Have the students paint or color the internal layers of the Sun (the core, radiative zone and convective zone) in different colors. These layers cannot be seen in visible light, so your students can feel free to use whatever colors they like.

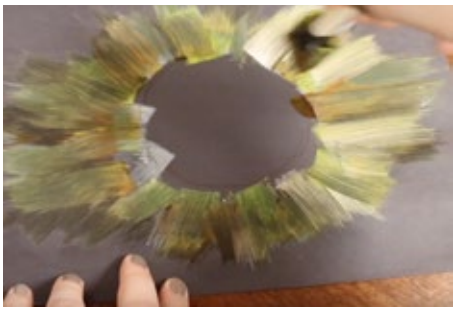
4. Next, it's time for the photosphere. Explain to your students that the photosphere is opaque (it hides the layers below) and is the region where sunspots are found. This layer of the Sun is responsible for the visible light that reaches Earth, so have your students make this layer yellow. Show them an image of sunspots and explain that they are often found in pairs. Because they are cooler than the rest of the photosphere, they appear much darker. Have your students add a few sunspots to their photosphere using black.



5. Next, explain that the chromosphere contains loops and prominences. These can be seen using a solar telescope or during a solar eclipse. This region of the Sun appears red due to light given off by hydrogen atoms. Have your students color this layer red. Since it will be covered up by the radiative zone, it can either be colored in completely or just left as a red ring (make sure your coloring extends to the portion covered up by the radiative zone).

Procedure

6. Its time to color in the corona. This layer has a lot of structures - streamers and magnetic fields that are visible during an eclilpse, so encourage your students to reflect this in the way they color in the corona.



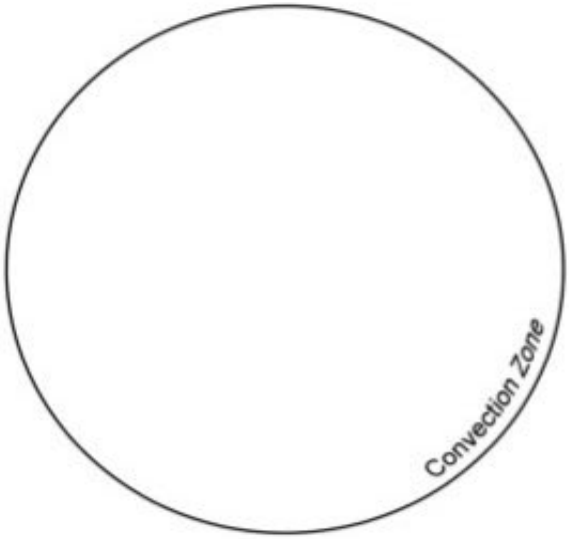
(Optional: paint the corona directly on your background by tracing out the photosphere).

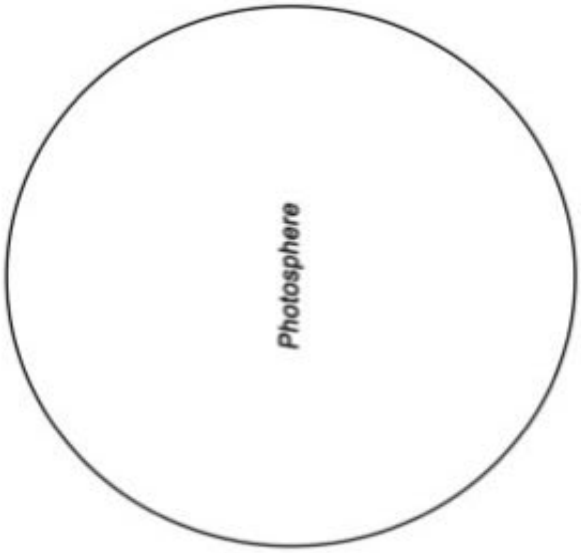
7. Have your students glue the corona to the background. On top of it, the chromosphere, convective zone, radiative zone and core should be glued down, making sure that each layer is centered on the last.

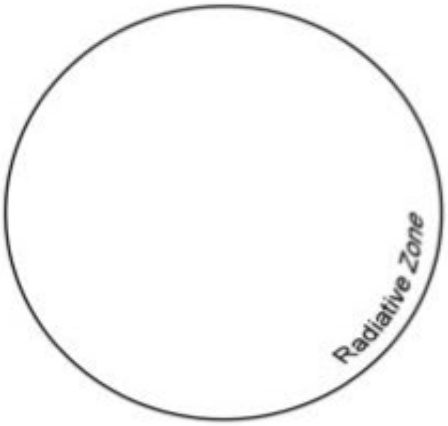
8. Staple, or glue a corner of, the photosphere over the convection zone. You should be able to lift up the photosphere to reveal the layers below.

9. Glue the moon to the popscicle stick. Show the students how the Moon perfectly obscures the Sun during a solar eclipse, leaving the corona visible.

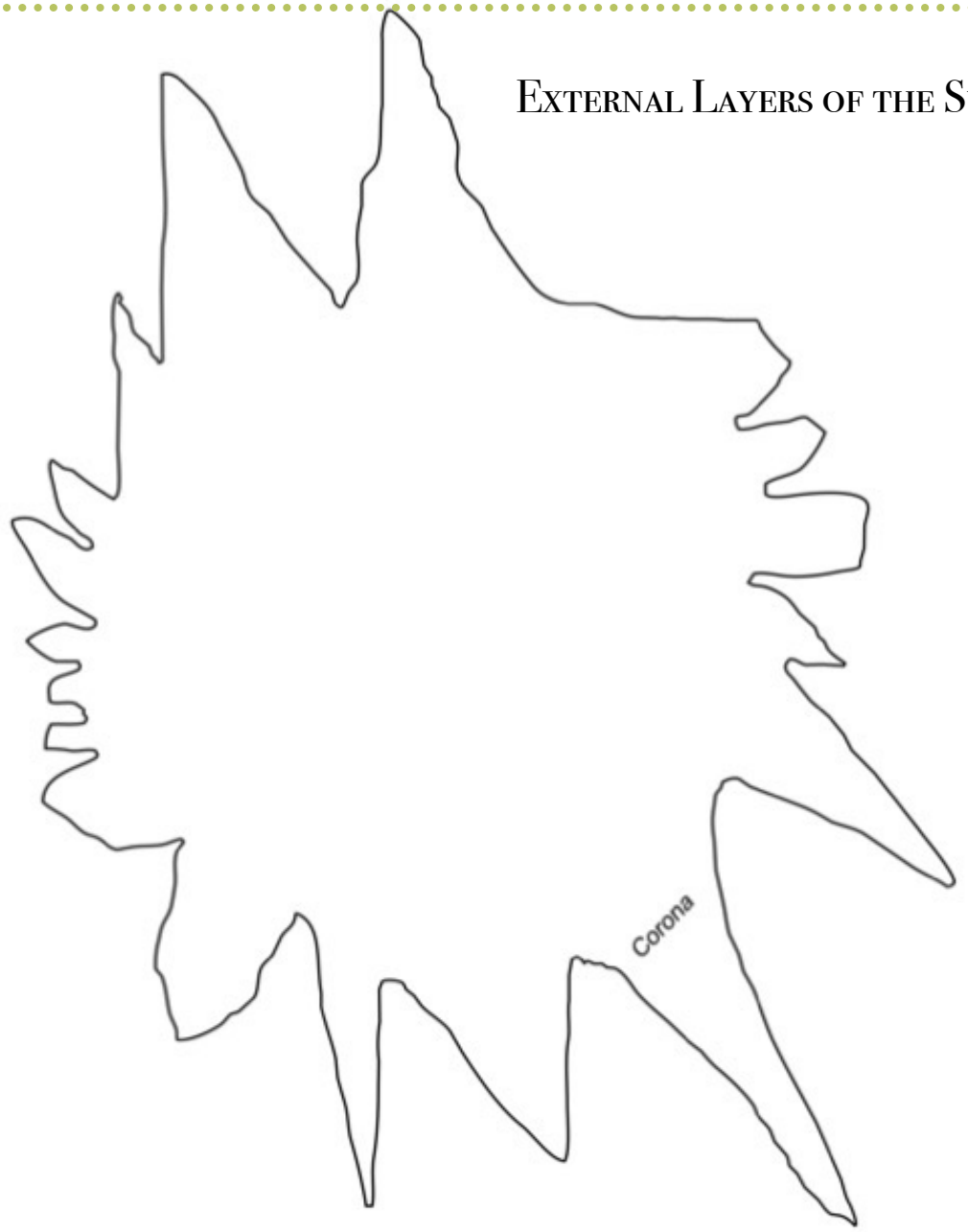
Internal Layers of the Sun + The Moon







External Layers of the Sun



Watch a video tutorial of this activity on YouTube:
http://bit.ly/EclipseInYourHand

Find out more by watching our solar magnetism webcast:
http://bit.ly/Webcast2-TheLayersOfTheSun

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