

Lesson Plan

NEUROHEADWAY

Neuroscience Into Education

Slide	Subject	Description and key notes	Timing
1	Contents	Description: Introduction to this lesson Key notes: In this lesson, students will first learn the mechanism to light up aurora, and then learn the new words "space weather". The beautiful aurora is sometimes a big alert for bad weather in space, which can damage many kinds of human activities based on electric infrastructures including electric power networks and smartphone communications.	3 min.
2	Title of the 1st part	Description: Introduction to the first part of this lesson Key notes: The background of this slide is a photo of aurora taken in Alaska. Let's learn what lights up such a beautiful aurora.	1 min.
3	Origin of aurora	Description: Introduction to the Sun-Earth system Key words: The left figure (made by NASA) illustrates the Sun-Earth system. In the last one hundred years, scientists have been exploring many important aurora physics. One of the most important discoveries is that the origin of aurora is our dynamic Sun.	3 min.
4	Solar wind	Description: Introduction to the solar wind which directly connects between the Sun and the Earth Key notes: Explosions on the surface of the Sun like solar flares are producing energetic solar wind flowing away from the Sun. The solar wind is made of "hot" and "ionized (charged)" gas called plasma. The solar wind plasma consists mostly of electron (e^-) and proton (H^+).	3 min.
5	Obstacles to the solar wind journey.	Description: Explanation of what happens when the solar wind hits the Earth's magnetic field Key notes: An important feature of the solar wind plasma is that it is basically "stuck" to the magnetic field – in other words, it cannot move across the magnetic field. Therefore, the solar wind basically cannot move across the Earth's magnetic field. That is, the Earth's magnetic field acts as a big barrier to the solar wind. Inside of the barrier, a region filled with the Earth's magnetic field, is called the Earth's magnetosphere.	3 min.

Power point Example

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Obstacles to the solar wind journey

- ◆ Plasma basically cannot move crossing the magnetic field.
- ◆ The Earth's magnetic field is a big barrier to the solar wind.
- ◆ The region inside the barrier is called the ***magnetosphere***.



Credit: NASA



Credits: NASA/GSFC

Solar wind leak

- ◆ But, inside of the magnetosphere is NOT ALWAYS safe
- a part of the solar wind is leaking...
- ◆ Energy of the leaked solar wind is stored in the night-side of the magnetosphere.
- ◆ The stored energy is released by a plasma explosion called ***magnetic reconnection***.

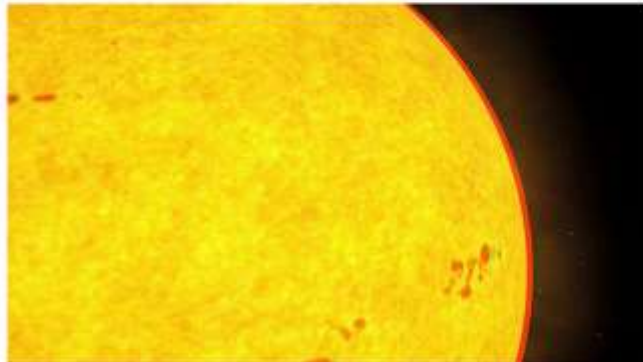


Credits: NASA/GSFC

Turning on the aurora

- ◆ Electrons flowing into the polar region from the reconnection site eventually hit the atmosphere and light up the aurora like Neon lights.

- Aurora shows off its *different colors* in response to *different compounds* in the atmosphere.
- **Oxygen:** green/red, **Nitrogen:** blue/purple



Credits:
NASA/GSFC
Conceptual Image Lab

Storm in space

- ◆ When a huge amount of solar wind energy leaks into the magnetosphere, an intense disturbance of the Earth's magnetosphere called the **geomagnetic storm** is driven.
- ◆ During a storm time, we can see very big and beautiful auroras.
- ◆ BUT, the geomagnetic storm sometimes damages human activities severely.

- We recently call the condition in space as "**space weather**".
- We need to *forecast the space weather* and predict bad geomagnetic storms to sustain our activities.



Photo of aurora taken near
Aberdeen, UK on Nov. 27, 2000

Credit: ESA