Thermosphere and Beyond

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CHAPTER 1 Thermosphere and Beyond

- Describe the characteristics of the far outer atmosphere.
- Explain how aurora form.

How can people live in the thermosphere?

The inhabitants of the International Space Station and other space stations live in the thermosphere. Of course, they couldn't survive in the thermosphere environment without being inside the station or inside a space suit, but right now people are living that far from Earth's surface.

Thermosphere

The density of molecules is so low in the **thermosphere** that one gas molecule can go about 1 km before it collides with another molecule. Since so little energy is transferred, the air feels very cold (See opening image).

Ionosphere

Within the thermosphere is the **ionosphere**. The ionosphere gets its name from the solar radiation that ionizes gas molecules to create a positively charged ion and one or more negatively charged electrons. The freed electrons travel within the ionosphere as electric currents. Because of the free ions, the ionosphere has many interesting characteristics.

At night, radio waves bounce off the ionosphere and back to Earth. This is why you can often pick up an AM radio station far from its source at night.

Magnetosphere

The Van Allen radiation belts are two doughnut-shaped zones of highly charged particles that are located very high the atmosphere in the **magnetosphere**. The particles originate in solar flares and fly to Earth on the solar wind. Once trapped by Earth's magnetic field, they follow along the field's magnetic lines of force. These lines extend from above the Equator to the North Pole and also to the South Pole, then return to the Equator.

Aurora

When massive solar storms cause the Van Allen belts to become overloaded with particles, the result is the most spectacular feature of the ionosphere — the nighttime **aurora** (**Figure** 1.1). The particles spiral along magnetic field lines toward the poles. The charged particles energize oxygen and nitrogen gas molecules, causing them to light up. Each gas emits a particular color of light.

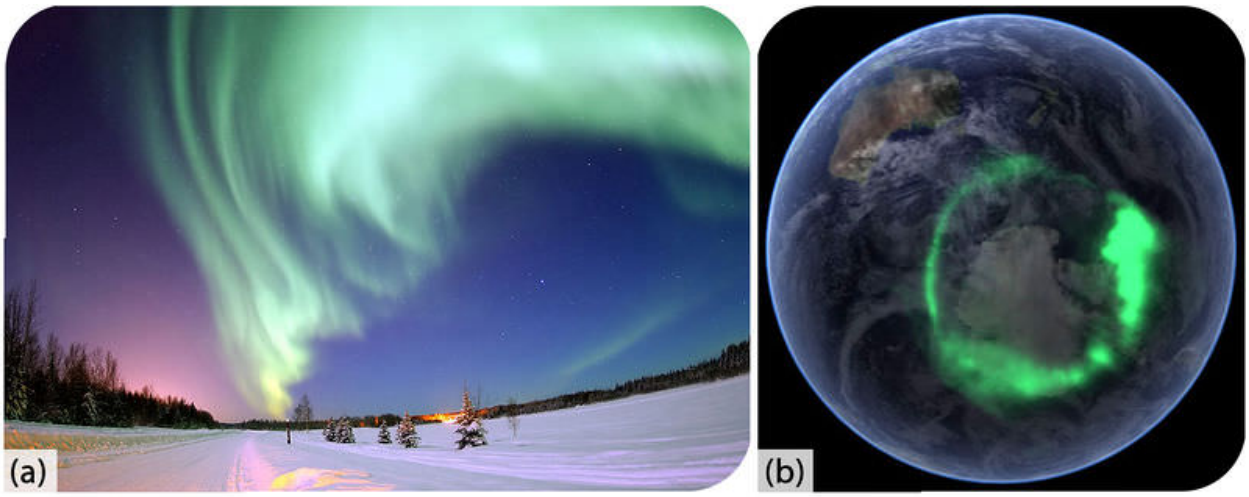

FIGURE 1.1

(a) Spectacular light displays are visible as the aurora borealis or northern lights in the Northern Hemisphere. (b) The aurora australis or southern lights encircles Antarctica.

What would Earth's magnetic field look like if it were painted in colors? It would look like the aurora! This QUEST video looks at the aurora, which provides clues about the solar wind, Earth's magnetic field and Earth's atmosphere.

MEDIA

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Exosphere

There is no real outer limit to the **exosphere**, the outermost layer of the atmosphere; the gas molecules finally become so scarce that at some point there are no more. Beyond the atmosphere is the solar wind. The **solar wind** is made of high-speed particles, mostly protons and electrons, traveling rapidly outward from the Sun.

Summary

- The solar wind is made of high speed particles from the Sun that travel through the solar system.
- The particles that create the aurora travel along Earth's magnetic field lines.
- Solar radiation ionizes gas molecules that travel as electric currents.

Review

1. How did the ionosphere get its name?
2. Why and when can you pick up AM radio stations far from their sources?
3. What causes the aurora and where in the atmosphere does it take place?

Explore More

Use this resource to answer the questions that follow.

MEDIA

Click image to the left or use the URL below.

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1. Where is the thermosphere?
2. What is the temperature gradient of the thermosphere? What sub-layer is at the top of the thermosphere?
3. What are the two sources of ions in the ionosphere?
4. What creates the aurora?
5. How can people hear a radio station that is far from there location?

References

1. (a) Courtesy of Senior Airman Joshua Strang, United States Air Force; (b) Courtesy of NASA. Picture of the aurora borealis and aurora australis . Public Domain