JOURNEY THROUGH THE AIR

National Science Foundation
WHERE DISCOVERIES BEGIN

Have you ever watched the clouds float by or gazed at the stars? Have you ever looked up at the sky and wondered what was going on up there? You are not alone. In fact, some people are so interested in the space above us that they devote their lives to studying the atmosphere, the **gases and particles** that surround the Earth, determine the **weather**, and protect us from **harmful radiation** from the **Sun**.

Today I'm going to take you on a journey going up. We will explore the layers of the atmosphere and learn about what happens in each level.

Let's go!

TROPOSPHERE

Our first stop is the layer of the atmosphere in which we spend most of our time, and where most weather occurs: **the troposphere**!

This layer is about **7 miles** thick on average, but the height of the top of the troposphere varies. The height is **lower** at the poles and **higher** at the equator, and it's **lower** in winter and **higher** in the **summer**. This means that in any two places or times, the troposphere is never quite the same.

Have you ever felt cold on an airplane? Have you ever seen snow on the top of a mountain during the summertime? That's because air temperature **decreases** as you **rise** through the troposphere (by 2 degrees F for every 1000 ft.)

Most clouds, which are collections of **water** droplets, and the weather we feel happens within the troposphere. But this is just the **bottom** layer of the atmosphere—there is still so much more to go!

Now we are entering the second layer of the atmosphere, called the **stratosphere**. Unlike the layer below, the stratosphere is very **dry**, so there aren't many clouds or weather.


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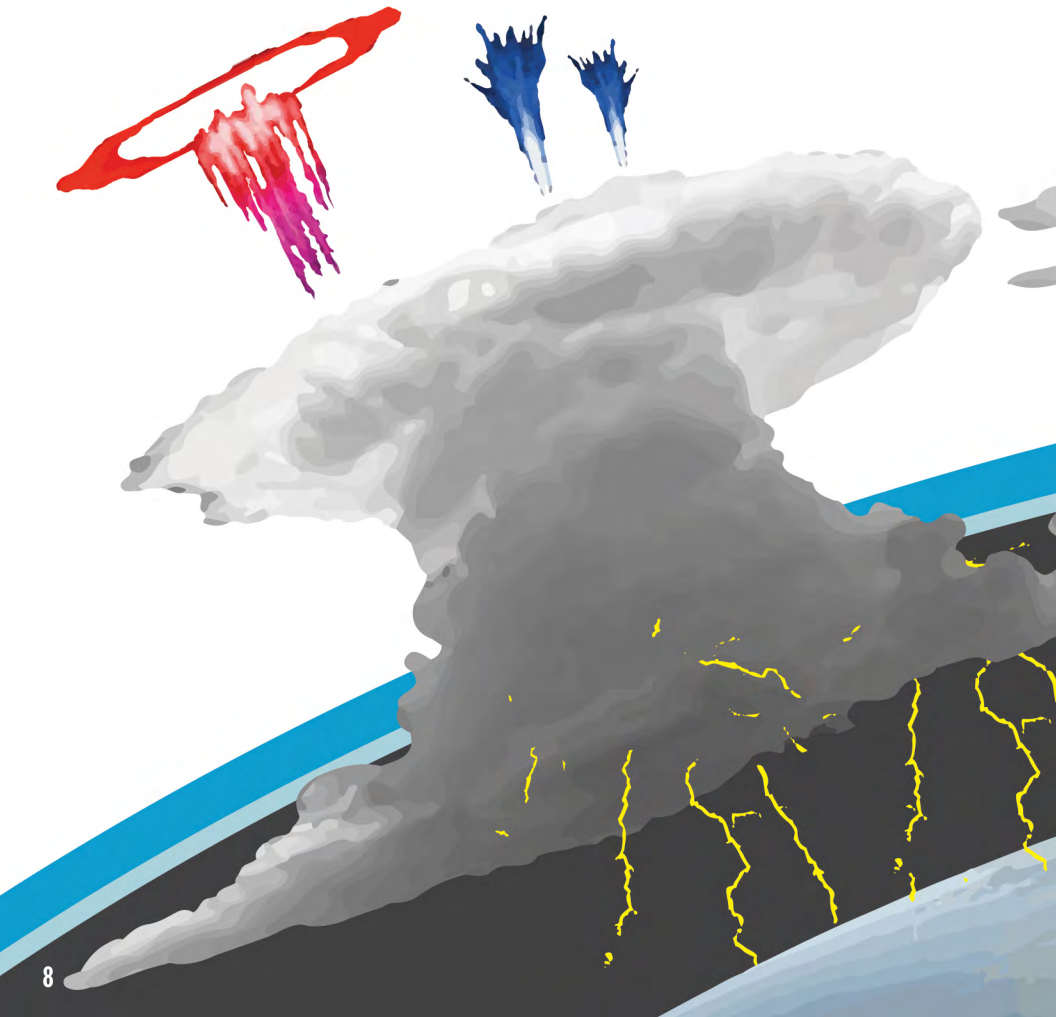
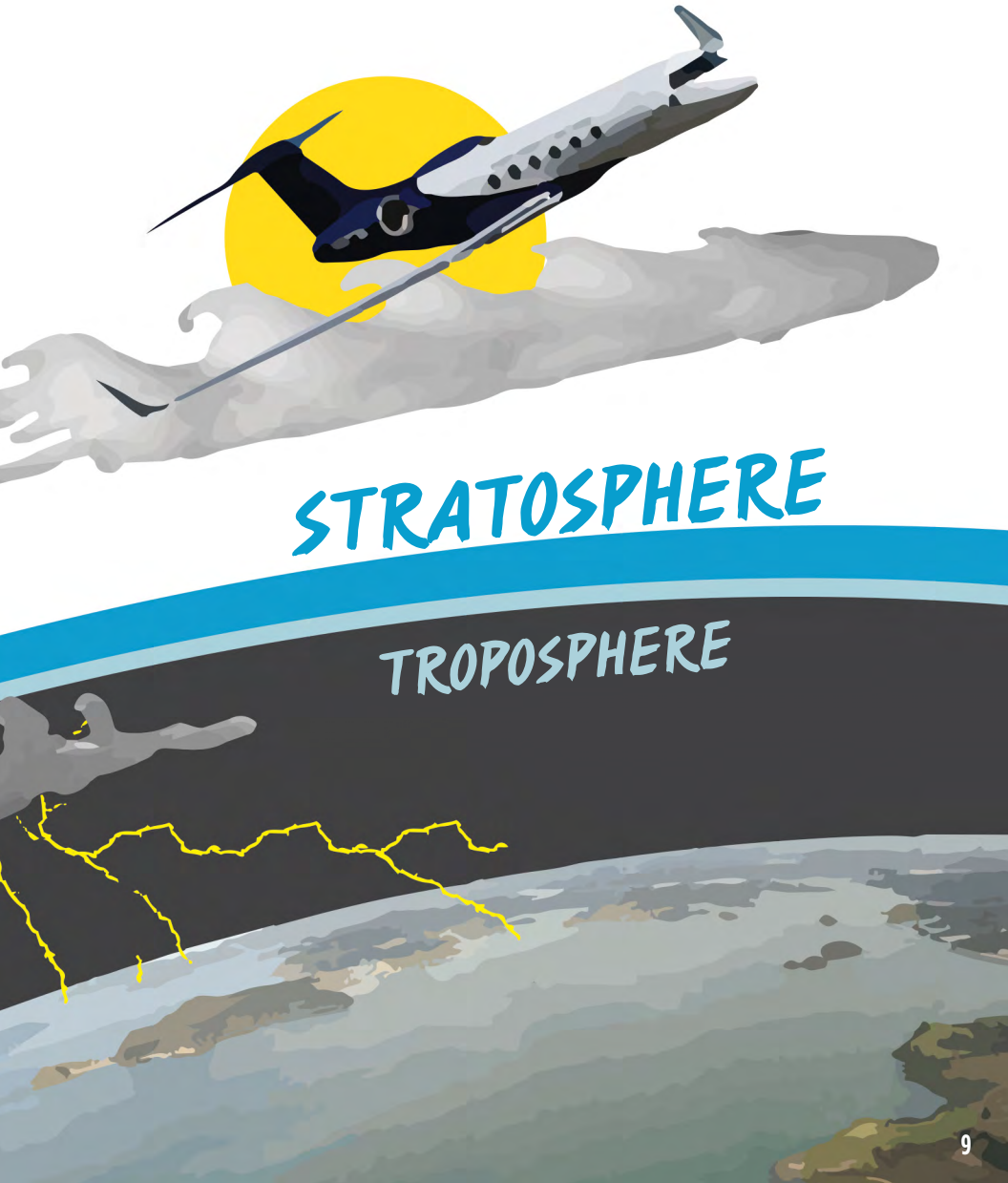
Have you ever taken a bumpy ride in an airplane? Those bumps are called **turbulence**, which is caused by **gusts** and **lulls** in the wind. These movements are common in the **troposphere**, but the air moves **less** in the **stratosphere**, so sometimes planes fly in the lower stratosphere for a smoother ride (and better gas mileage), which is perfect for pilots. Sometimes during **thunderstorms** (the tops of which are about 8 miles high!), big sprays of light appear going upwards into the **stratosphere**.

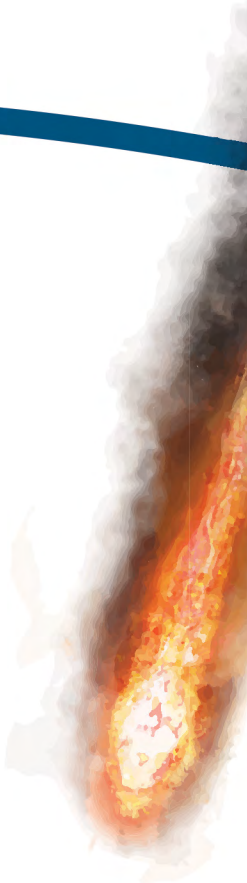


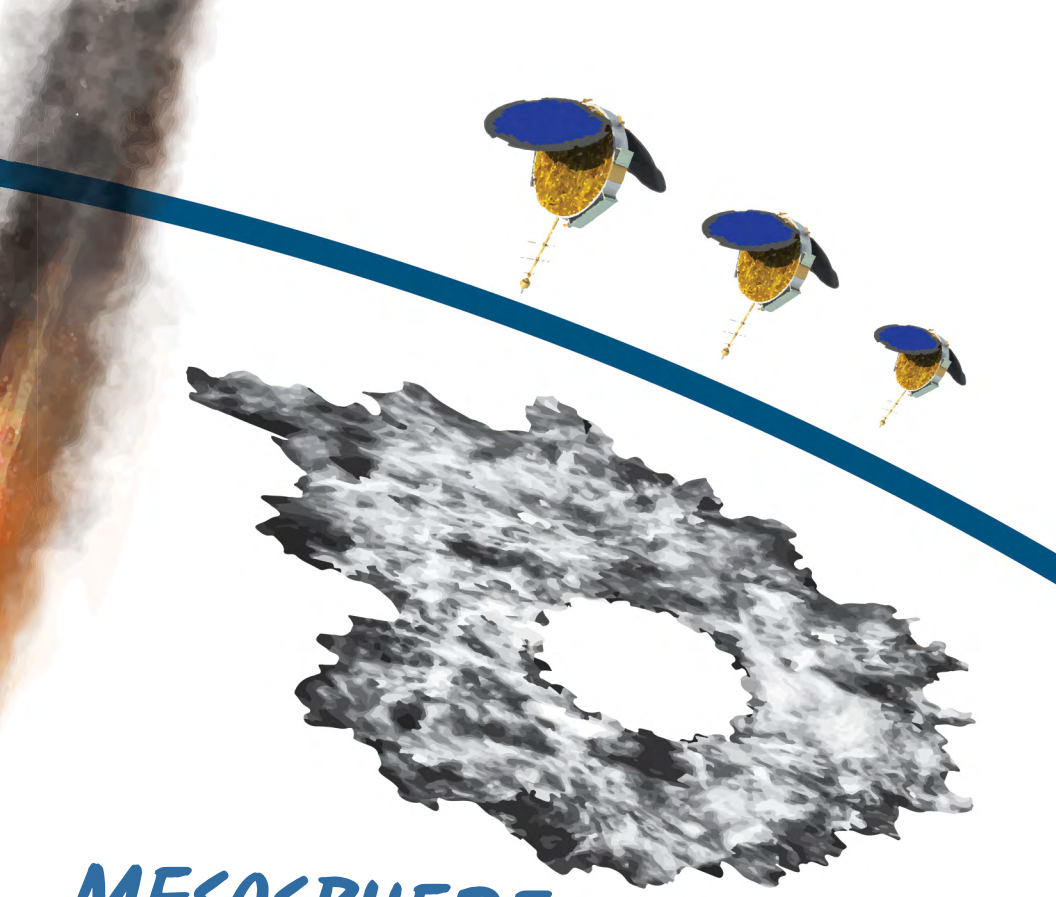
There are many different types, and all have whimsical names—red sprites, blue jets, elves, pixies, and trolls. They will appear in different colors and shapes, and they only last a few seconds before disappearing.



Let's keep going to the next layer—the mysterious **mesosphere**. Why so mysterious, you ask? This layer is more difficult for scientists to study because it is hard to get to. Airplanes and weather balloons can't travel high enough to collect data on the mesosphere, and satellites can only orbit above the mesosphere. That means that we still have a lot to learn about this layer!

Have you ever seen a shooting star? That's what most people call a meteor that burns up as it streaks across the sky. Most meteors fall apart in the **mesosphere**.





MESOSPHERE

STRATOSPHERE

Every now and then, way high up in the **mesosphere**, mysterious silvery blue clouds appear. They are called **noctilucent clouds** and they usually appear at the poles. But why do they glow? Scientists think that they reflect the sunlight that is just over the horizon. There is still so much to learn about these clouds and the rest of the mesosphere—maybe one day it will be you exploring the secrets of the atmosphere!

Let's move on to the next layer: the **thermosphere**! The **thermosphere** extends from about **55 miles** above the Earth to between **300** and **620 miles** above the planet. This big range in thickness is because of the Sun. When it heats up the thermosphere, this layer **expands**.

The thermosphere is the layer in which most **satellites** orbit, including the **International Space Station**, where astronauts can live for long periods of time! This orbiting lab allows scientists to study the **thermosphere**, and its interaction with the **sun**.

THERMOSPHERE

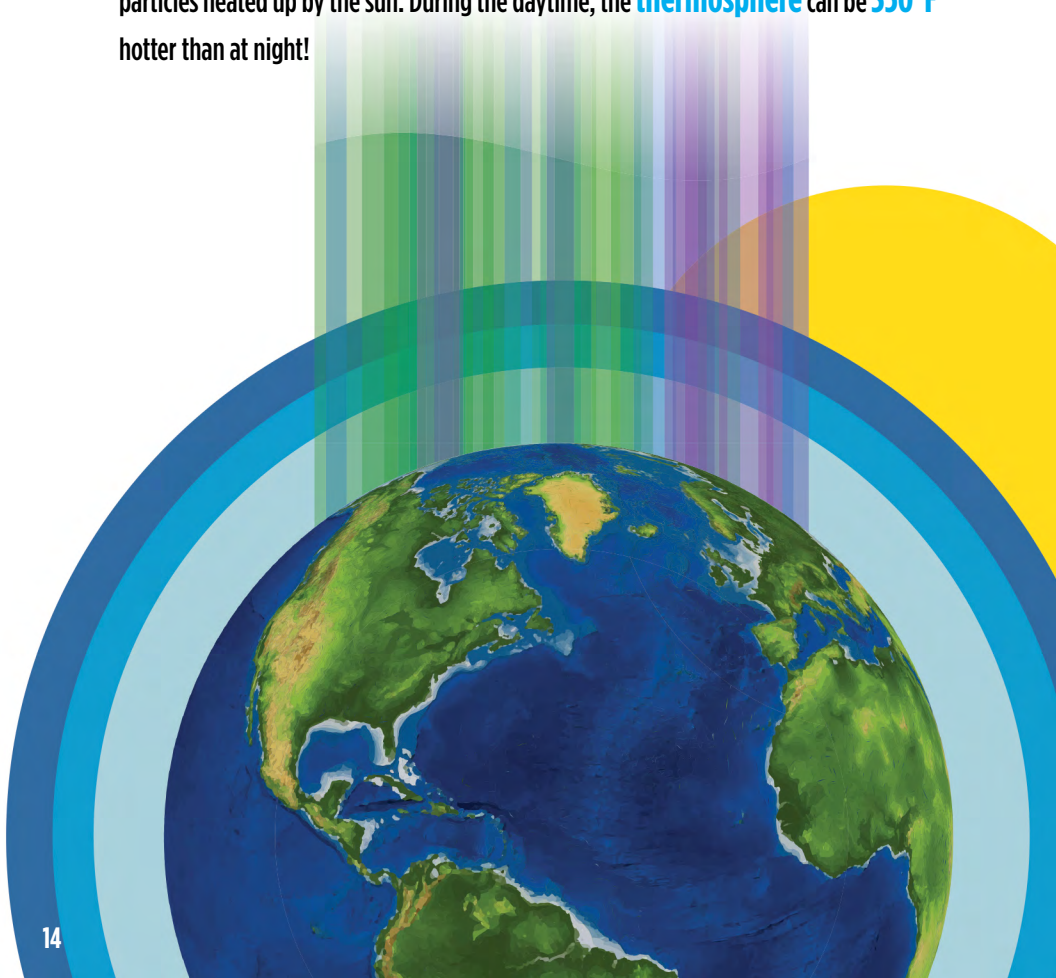
MESOSPHERE

STRATOSPHERE

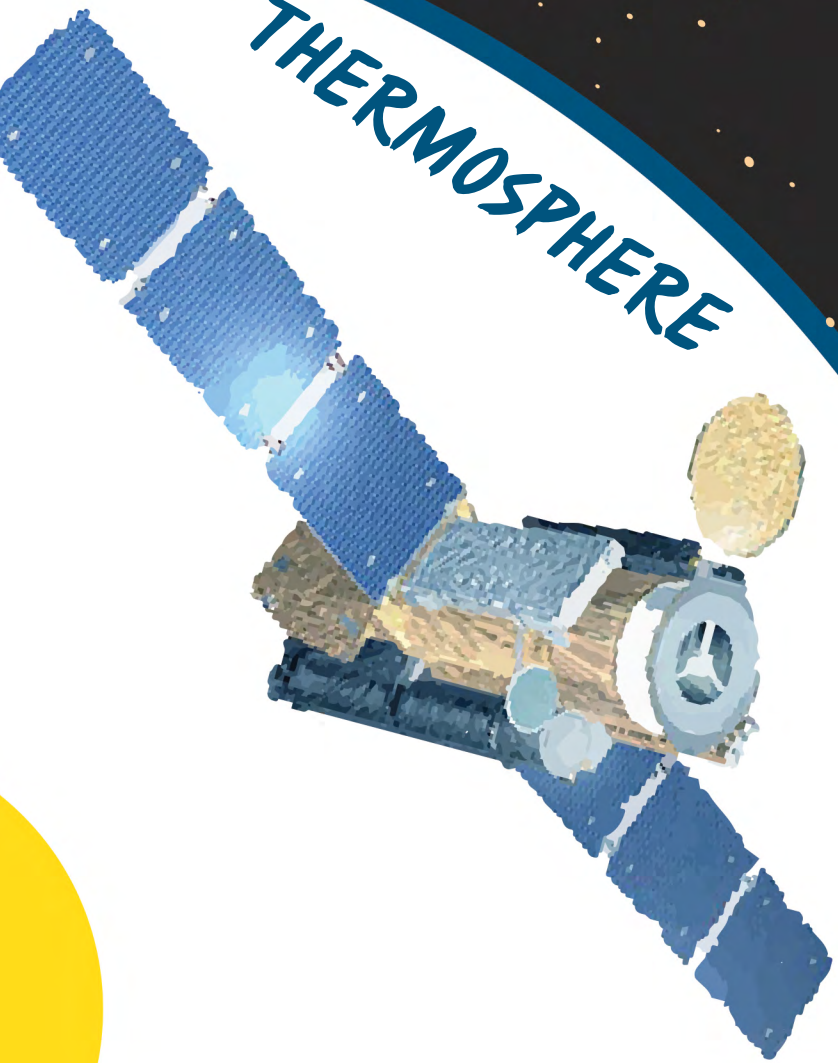
TROPOSPHERE

Have you ever gone far north and seen big green waves of light in the sky? These are called the **Northern Lights**. They come from charged **particles** that **collide** with molecules high up in the thermosphere, which excites them into high energy states. They express this extra energy by emitting the pretty lights that are so fun to find!

Things get pretty warm in this layer. At the top of the **thermosphere**, temperatures can range from **900°F-3,500°F**—or higher! This temperature represents high energy particles heated up by the sun. During the daytime, the **thermosphere** can be **350°F** hotter than at night!



THERMOSPHERE



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It's time to travel to the last layer of the atmosphere: the exosphere. The air in this layer is so thin that some scientists think it isn't even part of the atmosphere. Instead, they would call this area outer space. Maybe it is inner outer space!

There isn't a clear upper boundary of the exosphere. The particles in the exosphere don't move very much and the temperature is very cold. But some particles move more quickly and escape—that is why there are some traces of atmospheric gases way beyond the exosphere! At the top of the exosphere, radiation pressure from the sun results in a geocorona—a faint, luminous glow of ultraviolet light! This belt of light is seen only by satellites because it is so far away from the Earth.

OUTER SPACE

Now that we have moved through every layer of the atmosphere, we are in outer space. I hope you enjoyed learning more about the atmosphere that protects the Earth every day.


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Special thanks to Claire Bratzel, Marianne Cartagena and Andrew Ligeralde.
Source for material: UCAR

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