

# 14

## Atmosphere and Climate

### READING

**M**OST OF EARTH'S weather occurs in the **troposphere** (TROH-poh-sfeer), the part of the atmosphere that is closest to Earth's surface. In the activity "The Causes of Climate," you learned that the ocean has currents that move warm and cold water from one place to another. The troposphere has currents as well. Similar to the oceans, atmospheric currents move air and the thermal energy it contains from one place to another. The patterns of the currents in the oceans and atmosphere are major factors that help determine regional climates.

### GUIDING QUESTION

**What role does the atmosphere play in weather and climate?**



## READING

Use the “Listen, Stop, and Write” strategy to help you with this reading. Listen as your teacher reads aloud. Whenever they stop reading, close your book. Write down the main ideas you just heard.

### Earth’s Atmosphere

As you learned in the activity “Local History of Severe Weather,” the atmosphere is the mixture of gases (“air”) that surrounds planet Earth. Compared with Earth’s radius (6,370 km or 3,952 miles), the atmosphere is very thin (~300 km or 186 miles). There are five distinct layers within the atmosphere that are defined by temperature change with altitude (see the table below).

The main gases in “dry air” are nitrogen (78.1%), oxygen (20.9%), and argon (0.9%). Carbon dioxide is the most common gas in the remaining 0.1%. The percentages of these gases remain the same within all five layers. Water vapor is not included in “dry air” percentages. Unlike the other gases, water vapor concentration varies from 0–4% of the atmosphere depending on where and when you take the measurement.

#### Earth’s Atmospheric Layers

ATMOSPHERIC LAYER	APPROXIMATE HEIGHT ABOVE EARTH’S SURFACE	WHAT HAPPENS IN THIS LAYER?
Exosphere	120 km+	Earth’s atmosphere merges into space.
Thermosphere	80–120 km	The space shuttle orbits the earth.
Mesosphere	50–80 km	Meteors usually burn up.
Stratosphere	12–50 km	Ozone layer absorbs some of the sun’s harmful ultraviolet radiation before it strikes Earth’s surface.
Troposphere	0–12 km	Most weather occurs. Cruising altitude of most commercial aircraft.

### Wind and Weather

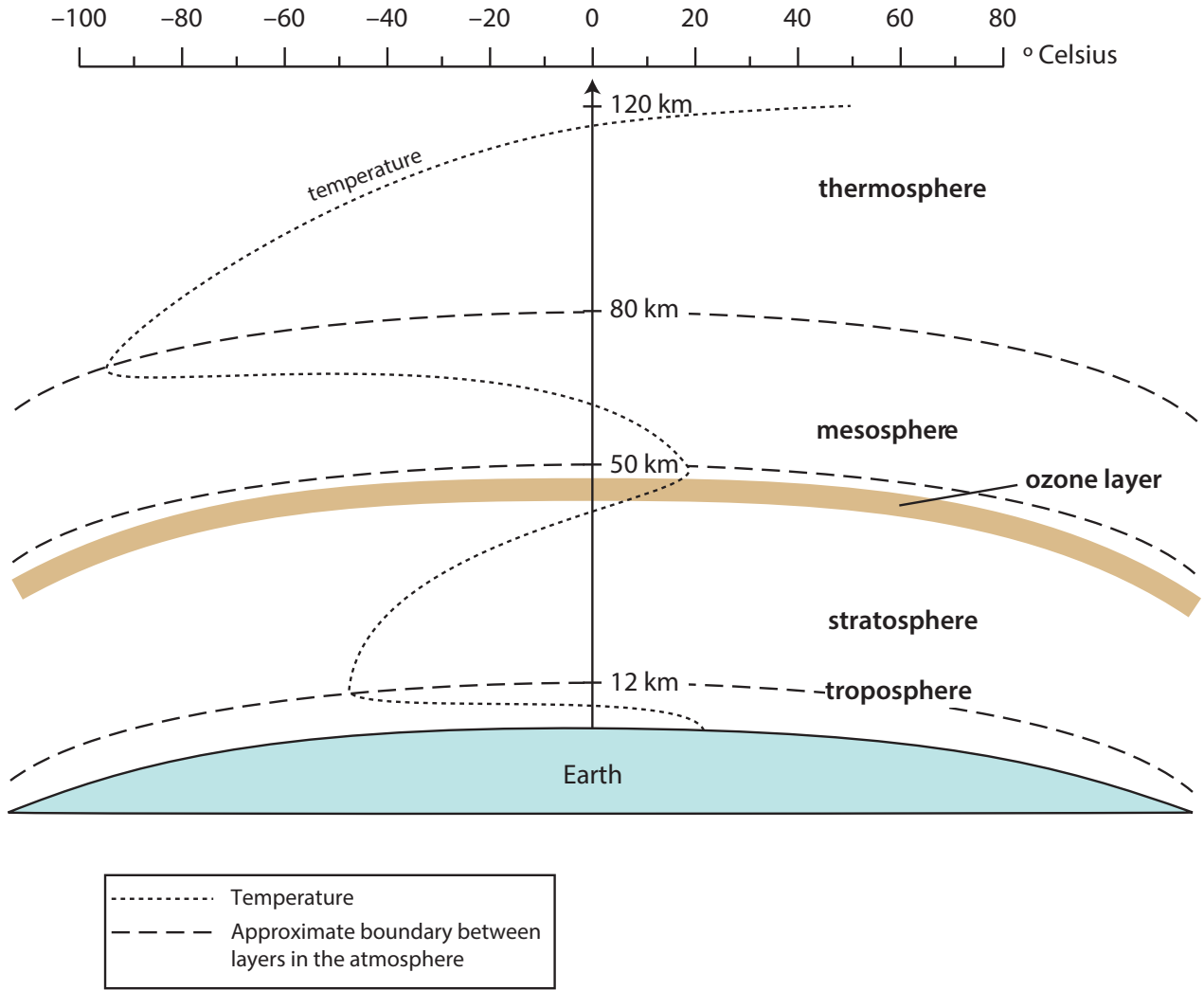
Weather occurs in the layer closest to Earth, called the troposphere. Because the troposphere is heated from the ground up, the temperature tends to decrease as the altitude increases. The materials on Earth’s surface (e.g., rocks, water, plants) absorb some of the sun’s energy and heat up. These materials then heat up the air in the lower troposphere. Since some areas of Earth’s surface heat up faster than others, different areas have different temperatures. Warmer, lower density air rises, creating an area of lower air pressure below it. Differences in air pressure are a driving force of weather and weather systems.



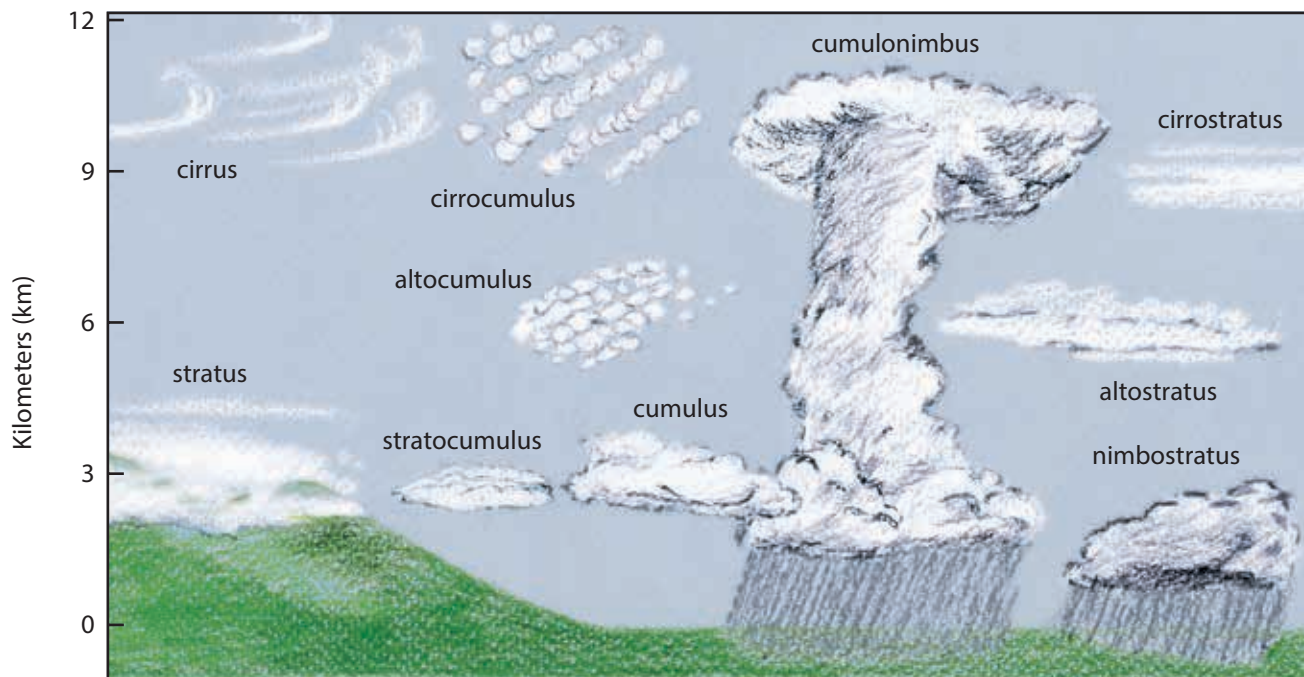
*Listen as your teacher reads aloud.*

*Stop when you see this yellow pencil and close your book.*

*Write down the main ideas you just heard.*

**Atmospheric Layers and Temperature**

Wind is the movement of air. Wind blows leaves off trees, pushes clouds across the sky, and moves water and thermal energy around the world. Air moves when there is a difference in air pressure. Wind blows from areas of higher pressure towards areas of lower pressure. When there is very little or no difference between pressure in two neighboring regions, the air is calm and there is little or no wind. When there is a lot of difference in air pressure between two neighboring regions, strong winds can occur. In general, wind speeds tend to be higher in the daytime when sunlight can heat earth materials and create greater differences in air temperature and pressure. The fastest wind speed recorded as of 2017 is 513 km (318 miles) per hour during a 1999 tornado in Oklahoma.



Clouds are described by their height in the atmosphere and their shape.

Thermal energy is spread through the troposphere because air moves and contains water vapor. Air near Earth’s surface absorbs water vapor, and as moist air rises in the atmosphere, the water vapor begins to condense. As water vapor condenses, it releases thermal energy and forms clouds. On average, clouds cover 40–50% of Earth at any given time. Clouds are carried through the atmosphere by wind.

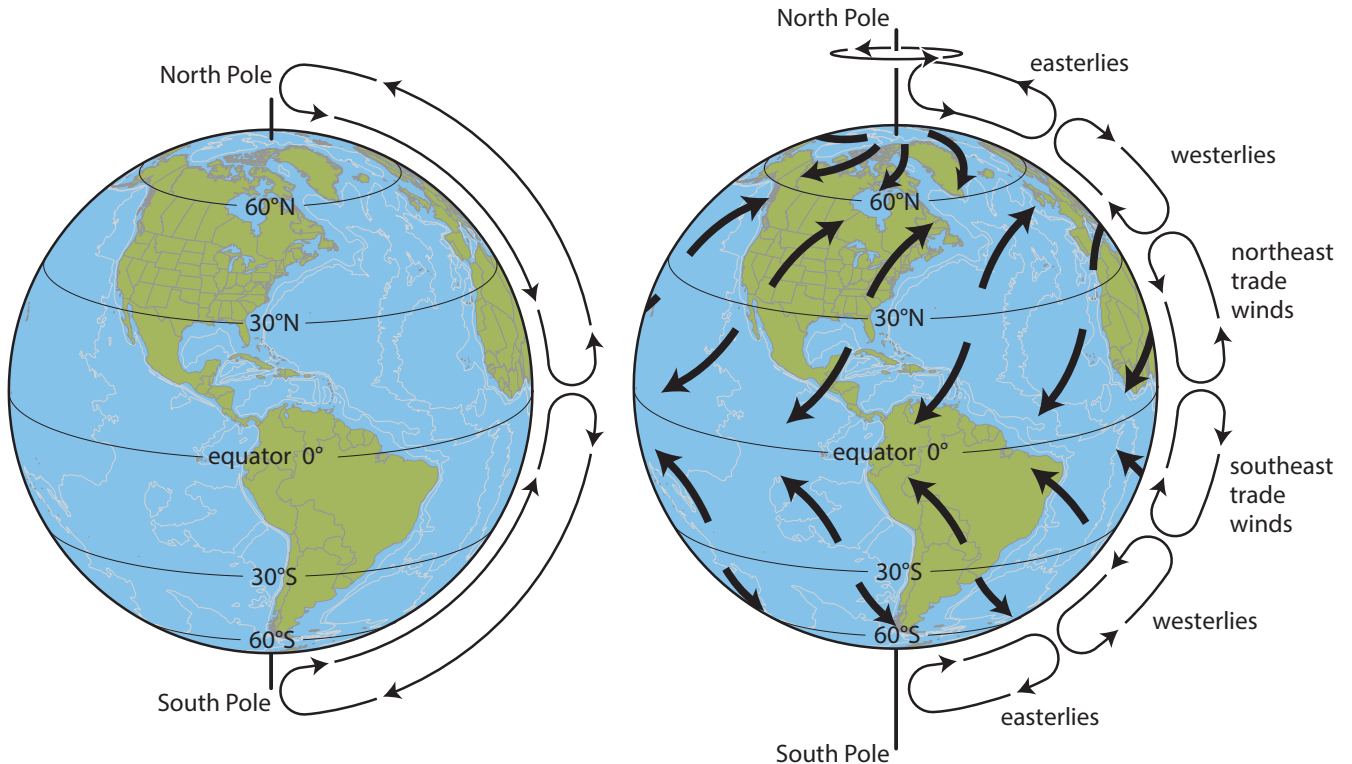
Weather is strongly affected by how stable or unstable the atmosphere is. Stable air is air that is not moving vertically very much, or at all. With stable air, it may rain or snow or it may be sunny, but the weather will not be severe or change quickly. Unstable air moves vertically, which can cause the weather to change quickly with very little warning. The more unstable the atmosphere is, the more likely you are to see clouds and experience storms or even more severe weather, such as tornadoes.

### Atmosphere and Climate

The way Earth’s atmosphere interacts with the sun’s energy and the oceans helps determine Earth’s average temperatures and its different climate zones. Because areas nearest the equator receive the most direct sunlight, air around the equator is typically warmer than air at other latitudes. Similar to the oceans, air heated at the equator moves north



and south towards the poles, and this circulation affects climates in all regions. If Earth weren't rotating, there would be only two cells that circulated air, one between each pole and the equator. However, due to the Coriolis force caused by the Earth's rotation, the direction of air (and water) currents bend, creating six cells—three north of the equator and three south of the equator. You found evidence of the existence of these cells in the activity, "Worldwide Wind."



*Earth's rotation toward the east causes air currents to bend to the right in the northern hemisphere and to the left in the southern hemisphere. This is the Coriolis effect.*

As well as helping move moisture and thermal energy around, the atmosphere affects global climate in another important manner. Some of the sun's energy that strikes Earth radiates back from Earth's surface and would be lost to space if there were no atmosphere. Some surfaces on Earth, such as ice, reflect a lot of the sun's energy back into space. Other surfaces, such as concrete and asphalt, absorb the sun's energy and radiate thermal energy, warming the atmosphere. Some clouds reflect sunlight back into space and cool the planet, while other clouds act more like a blanket and warm it. There are gases in the air that absorb and hold thermal energy that would otherwise escape from Earth. This is called the **greenhouse effect**, and the gases are called greenhouse gases. By trapping some

of this radiated energy, the atmosphere helps create and maintain the different climates on Earth.


Natural processes such as respiration, digestion, and volcanic eruptions add such greenhouse gases as water vapor, methane, and carbon dioxide to the atmosphere. There are also natural processes that remove greenhouse gases, keeping things in balance. Living organisms play a key role in keeping the atmosphere, and thus Earth's climate, stable. Almost all living organisms require gases in the atmosphere for essential life processes. Plants, for instance, require carbon dioxide and produce oxygen; both plants and animals require oxygen and produce carbon dioxide. The cycling of gases between different organisms and the atmosphere helps maintain an environment that supports life and keeps the chemistry of the atmosphere relatively steady. However, a change in the amount of greenhouse gases in the atmosphere can disturb this balance and affect climates around the world.



## ANALYSIS

1. What is the relationship between Earth's atmosphere, its weather, and its climate?
2. Acting in the role of an atmospheric scientist, write a paragraph describing the atmosphere and its layers for a weather website entry. Be sure to describe significant similarities and differences among the different layers.
3. All of Earth's organisms interact with Earth's atmosphere in some way.
  - a. How does the atmosphere affect living organisms?
  - b. How do living organisms, including humans, affect the atmosphere?
4. Explain, using a written description and diagram(s), how
  - energy from the sun helps create air and ocean currents.
  - Earth's rotation affects these currents.
  - these currents can affect an area's climate.
5. **Reflection:** If you were an atmospheric scientist, what aspect of Earth's atmosphere would you most like to study? Why?





# Atmosphere and Climate

What role does the atmosphere play in weather and climate?



## IMAGINE

Imagine flying at different altitudes above the earth's surface to collect data about the atmosphere. Think about the gases that are in the air, the air temperature, and the air pressure.

Do you think that the atmosphere would be the same at every altitude?



## KEY WORDS

- **Atmosphere** - The gases that surround a planet or moon, the air that plants and animals need to survive
- **Troposphere** - lowest layer of the earth's atmosphere, where people live and most weather occurs.
- **Stratosphere** - ranges from 5-31 miles above the earth's surface, where jet planes fly



## KEY WORDS

- **Mesosphere** - the coldest layer of the earth's atmosphere where temperature decreases with altitude, can reach 130° below zero, most meteors are found here
- **Thermosphere** - Greek word "thermos" means heat, temperature steadily increases with altitude, it absorbs ionizing radiation causing the temperature to increase
- **Exosphere** - the uppermost layer of the earth's atmosphere, about 6,200 miles thick, no air to breathe, merges with space



## TEST YOUR KNOWLEDGE

What factors influence climate?

Energy from the sun  
Heating and cooling of land and water  
Ocean currents  
Latitude  
Elevation  
Landforms



## ACTIVITY #1

- **Video #1 ~ Earth's Atmosphere**
  - <https://www.youtube.com/watch?v=JrGuomu9NGY>
  - Use the atmosphere worksheet in google classroom to take notes on about each of the layers

If you don't have access to the internet skip the video and go to Activiy #2.



## ACTIVITY #2

- You will now read the pages I have attached in google classroom.
- Record additional facts about each layer of the atmosphere on your worksheet.
- Turn in your worksheet to your science teacher and share your answer to the following question:
  - What is the relationship between Earth's atmosphere, its weather, and its climate?



## ACTIVITY #3

There are 3 more videos you can watch for fun

- **Video #2 ~ Where Does Space Actually Start**
  - <https://www.youtube.com/watch?v=gLf0dT3To4M>
- **Video #3 ~ Northern Lights**
  - [https://www.youtube.com/watch?feature=player\\_embedded&v=VV4aNNy2mkY](https://www.youtube.com/watch?feature=player_embedded&v=VV4aNNy2mkY)
- **Video #4 ~ Space Station**
  - <https://www.youtube.com/watch?v=SOcixRhRGDw>
- **Tom Cruise, Elon Musk & NASA**
  - <https://deadline.com/2020/05/tom-cruise-movie-shot-in-outer-space-elon-musk-spacex-unprecedented-in-hollywood-1202925849/>





EXOSPHERE

THERMOSPHERE

MESOSPHERE

STRATOSPHERE

TROPOSPHERE

