

# FALLING THROUGH THE SKY



## Chapter 3



This morning, when you awoke, did you crawl out from under a cozy thermal blanket? When I was a child, we lived in a very old house, and in the winter I used to wake up to *snow* sprinkled on my thermal blankets! I'd slip out of bed to the icy cold floor, and wonder how low the thermometer had plunged during the frosty night! Do you have a thermostat in your home to control the temperature? Where I lived as a child, there was no thermostat in our house to turn up to take the chill out of the air. We just had to stoke the wood up in the fireplace and wait for the warmth of the flames to heat up our old farmhouse.

Before I headed out the door to school, my mother often would pack steaming soup into my orange thermos bottle. In that thermos bottle, my soup would stay warm until I slurped it down during my lunch hour—so then I would be warm too!

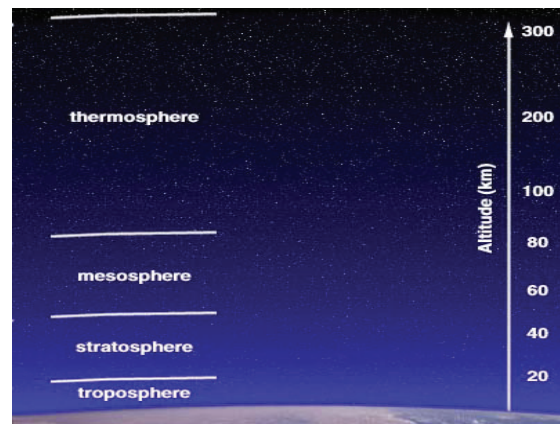
Did you notice all the words that began with “*therm*” during my morning? As noted geographers and fine detectives, have you discovered what the root word “*therme*” means? Yes! “**Therme**” means “heat” in the Greek language. So words that contain “*therm*” refer to how hot something is. Well, fellow-geographers, would you like to explore part of the Earth’s atmosphere called the **thermosphere**, a place that is sizzling hot—but is NOT! If you are eager to experience a very strange adventure, let’s head out into the Earth’s Upper Atmosphere!

Geographers often refer to a map to remember where they have been and to plot where they are going. So let’s pull out ours and recall the sights of the Lower Atmosphere. First we hiked through the **troposphere**, the layer of the atmosphere in which we live and where our weather occurs. Here we discovered the higher we traveled, the nippier our noses became! Then we headed up through the **stratosphere**, the layer in the atmosphere that actually got *warmer* as we traveled higher. (That was because of the *ozone* layer netting ultraviolet radiation from the sun, remember?) Then we found ourselves in the **mesosphere** where we were again wrapping our scarves tighter in the bone-

chilling temperatures, but we were still peeking out from behind our scarves in search of falling stars!

That is where we have traveled to this point in the Earth's atmosphere. What adventures lie ahead? Let's wave farewell to the mesosphere and the Earth's Lower atmosphere, and set off to discover the thermosphere of the **Upper Atmosphere!**

The **thermosphere** extends to 370 miles (600 km.) above our earth home. That means if you were driving in your car straight up, you would have left home after breakfast and it would now be mid-afternoon! That's a long time traveling straight up!



Check out the map of our atmosphere adventures—so where are we? NASA

The thermosphere indeed lives up to its name. (Remember that “**therme**” comes from the Greek word “heat” so thermosphere means “heat sphere.”) The higher we climb into the thermosphere, the higher the temperature climbs too! Actually, the temperature hikes so high, it is hard even to imagine—as high as 3,000 degrees F (1,700 degrees C)!! Why does the temperature keep climbing? The temperature spikes higher because we are climbing closer towards the Earth's source of heat, the sun.

You are probably thinking now might be good time to peel off your winter gear of scarf and mittens. Not too fast! If you exposed your skin to the thermosphere, you actually wouldn't feel hot in the least! Not even at those dizzyingly high temperatures! You would actually feel VERY cold! Isn't that puzzling?

Have you ever sat in a dark, cold room in front of a light bulb? The temperature of the light bulb would be very hot indeed. You would get burned if you wrapped your fingers around that glowing light bulb. However, since there is only one light bulb in the room, you would still be feeling pretty nippy!

The thermosphere is like that large, black room. The molecules floating around in the thermosphere are like only a few light bulbs in an enormous, empty arena. Those molecules are very, VERY hot, but there simply isn't very many of them! So you would be feeling cold in the thermosphere since there would not be enough molecules bumping into your skin to actually make your skin feel warm!

**Temperature** actually measures how fast molecules are moving in the air around us. The molecules up here in the thermosphere are moving with incredible speed. Thus the temperature of the thermosphere reads high. But there just isn't that many molecules way up in the thermosphere! So while the temperature reads high, our skins feel bitingly cold!

Isn't it rather absurd that up here in the thermosphere, the "heat sphere," closer to the blazing sun, we would be shivering? The thermosphere is where it is hot—but it is NOT!

As thermosphere tourists, we would have more serious concerns than merely feeling frosty! Recall that the ozone layer is way *below* us in the stratosphere. It is that ozone layer that protects people on our home of Earth from harmful ultraviolet radiation from the sun. In the thermosphere we are not well defended from the sun's radiation. While we may think it a bit amusing that we would be *cold* up here in this "heat sphere," we wouldn't find this severe dose of ultraviolet radiation amusing in the least! (Then again, we *are* just imagining what it would be like if you really *could* take a walking tour through the earth's atmosphere!)



### ***Tell the folks at home all about it!***

*Let's take a wee rest here on our walking tour. Tell us, where have we been? What lies above the mesosphere? (**Memory Joggers:** What does thermosphere mean and how far does it extend above Earth? What would it feel like to walk through the thermosphere—and why? What else would be happening to us up in the thermosphere because the ozone layer is below us in the stratosphere?) Now that we are feeling refreshed, let's head out again!*



Doesn't the Aurora Borealis, or Northern Lights, shine magnificent above Alaska? God's love lights are breathtaking, reminding us of the ionosphere that protects our Earth!

As the stratosphere has a layer within it called the ozone layer, the thermosphere has a layer within it called the **ionosphere**. God also created the ionosphere in the thermosphere to protect our Earthly home.

If someone were pelting you with fiery darts, wouldn't you grab a shield to defend yourself? Well, the ionosphere is a unique shield that God created for

Earth. There are explosions happening on the surface of the sun called “solar flares.” Searing hot particles from the sun fling out into space at speeds over a million kilometers per hour! Even at such terrific speeds, these particles take two to three days to reach our atmosphere! And when these sun particles, these ions, come charging towards our home, our shield of the ionosphere defends Earth.

Did you know that from certain places on our Earth, on late, dark nights, you can actually see the ionosphere shielding Earth from these deadly particles? When these particles from the sun smash into the ionosphere, the collision creates the most glorious glowing lights—like fireworks way up in the ionosphere!

Have you ever lit off fireworks? Maybe you sit in a park on national holidays and gaze up at cascading fireworks to show your love for the country you live in. In my family, we also light off fireworks when we want to celebrate our love for each other! We shoot off these “love lights” into the sky to show our love on wedding days or days when little babies are born or on birthdays!

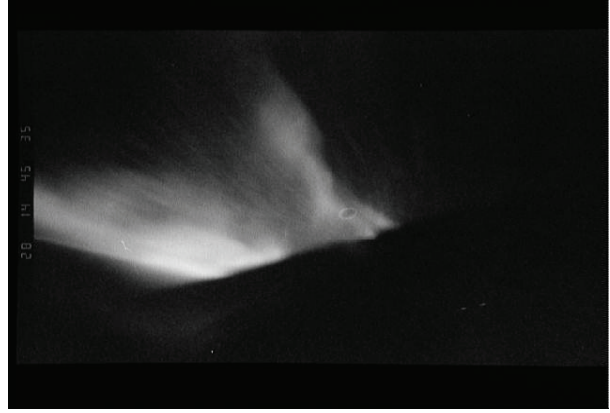
Well, the fireworks up in the ionosphere are *God’s* love lights to all of us who live on Earth. These stunning love lights, called an **aurora**, are a result of the ionosphere shielding Earth from deadly sun particles. If these dangerous sun particles reached our home, we could not live on this planet. Thus, the next time you see a breathtaking aurora, red and green lights fluttering like a shimmering curtain in the night sky, remember how much God loves all of us on Earth! Thankfully, He created the ionosphere to protect the home He loves and made for us.

When you see fireworks explode overhead, do you “ooohh” and “aaahhh”? When people gaze upon God’s love lights of auroras up in the ionosphere, the glorious sight captivates them too! Auroras are most easily seen in the northern and southern regions of Earth; that is why they are often called the “Northern Lights” and “Southern Lights.” One famous Northern poet, Robert Service, wrote this poem of wonder describing an aurora:

*[T]he skies of night were alive with light...,  
They were rose and silver shod;  
It was not good for the eyes of man —  
'Twas a sight for the eyes of God.*

Some believe that the prophet Ezekiel in the Bible was the first person to ever write down a description of an aurora. Ezekiel wrote “**And as I looked, behold, a storm wind was coming from the north, a great cloud with fire flashing continually and a bright light around it, and in its midst something like glowing metal in the midst of the fire.**” (Eze. 1:4) Do you think Ezekiel may have seen God’s love lights, an aurora?

What would an aurora look like if you were up in the ionosphere during one of these clashes between bullet-fast sun particles and the gases in the ionosphere? You'd notice a faint glow all around. People who study the atmosphere think standing in an aurora up in the ionosphere would be a bit like standing in a rainbow—which is another love sign from God, isn't it?!



The dancing aurora borealis dazzles in the night sky! NASA



## *Tell the folks at home all about it!*

Tell us what you know about the layer that lies within the thermosphere. (**Memory Joggers:** Why did God create the ionosphere? What happens when particles from the sun collide with the ionosphere? Why do we call an aurora “love lights”? Describe an aurora.)  
Let's move on!



As tourists of the atmosphere, wandering through the thermosphere and ionosphere, we are a long way from our home of Earth. Have you ever been a long way from home? I was once a long way from home for a long time in a place where everyone spoke a different language than I did. And I became sick—homesick. Homesick is a peculiar word because it does *not* mean that you are sick of your home. It means that you are sick because you are *away* from your beloved home. And in that far away land, I was sick because I missed my home so badly.

Do you know what cured my homesickness? The ionosphere cured my homesickness! Far from home, I would wake in the wee, dark hours of the morning. Tiptoeing out of bed, I would quietly turn on my radio. Do you know what I would hear? I could hear the voices of people, speaking my language, who lived near my home! Even though my home was many hundreds and hundreds of miles away! It was the ionosphere that allowed me to hear those dearly loved voices from home!

The ionosphere has layers of particles, called ions, which reflect radio signals. The radio station in my hometown sent out radio waves. Those radio waves bumped into those ion layers in the ionosphere, and returned to Earth, much

like you bounce a rubber ball. The waves then bounced again up to the ionosphere and returned to earth. Those radio waves kept bouncing and bumping, bouncing and bumping, from earth to the ionosphere—all the way to me—that homesick kid in that far away place. The ionosphere brought me a little bit of home in those radio waves and I wasn't so homesick anymore!

If there were no ionosphere, the radio waves would have left my hometown radio station and just drifted off into space. If there were no ionosphere, there would be pretty much radio silence! If there were no ionosphere, I would have been one *very* homesick kid with no voices from home to listen to!



*(But why did I have to wake up in the middle of the night to hear that radio station from my hometown? Well, when the sun goes down, changes happen in the ionosphere. Those changes allow some radio waves to then bounce further along. So that is why late at night you might turn on your radio and hear voices from hundreds and hundreds of miles away! It is all because of the way God created the ionosphere!)*

Weren't there many sights to marvel at here in the thermosphere where the ionosphere is? Hold onto those memories of auroras and radios so we later can tell our tales!

We are almost finished touring the Earth's atmosphere. Our final stop is the **exosphere**. The exosphere lies beyond 300 to 620 miles (500-1000 km.) away from Earth. The exosphere is the utmost layer of the atmosphere, like the outer skin of an onion.

We have a box in our house that just stores onions. If you peeked inside our onion box, you'd find the bottom of the box covered with outer onion skins that have just fallen off their onions.

Something similar happens in the exosphere. **Exo** means "**out of**" in Greek. And up in the exosphere, lighter molecules escape *out of* the atmosphere and drift off into space, a bit like onion skins peeling off the onion!

But be careful that *you* don't escape out of the Earth's atmosphere as we travel through the exosphere. Once you leave the exosphere, you have left the blanket of air swaddling Earth which is our atmosphere... and you are wandering out into outer space! As lighter molecules can escape out of the exosphere, you too would be feeling lighter and lighter and could easily drift off!



## *Tell the folks at home all about it!*

*How might the ionosphere comfort a homesick kid?*

*(Memory Joggers: What do ions in the ionosphere reflect? Can you describe how radio waves travel? What would happen if God had not created the ionosphere? Why can you hear radio stations from further away at night?) What does “exosphere” mean and what happens in the exosphere?*

As we have come to the end of our atmospheric journey, now would be a good time to return to Earth—before *you* float off into outer space! Ready to drift back down through the curtains of air wrapped around our home?

Here we go! Down through the **exosphere** (don't want you to soar out of the atmosphere!)... falling now through the **ionosphere** layer (see God's love lights? Hear the radio stations?)...now back down through the rest of the **thermosphere** (feeling hot—but NOT!?)...falling now down into the **mesosphere** (catch a glimpse of any meteors over the scarf wrapped around your face?)...tumbling now back to the stratosphere (stay out of the ozone net!), and finally into the **troposphere**...where we plunk down onto a storm cloud!

We've fully explored the curtains of air draped around Earth called our atmosphere! And now that we've inspected the curtains shrouding our home, don't you marvel at the God who **“stretches out the heavens as a curtain”** (Isa. 40:22)! Aren't you eager to draw back the curtains and take a peek into the rooms of our home, Earth! But don't peek just yet—that is our *next* tour!



## **POSTCARD HOME**

*As you catch your breath from today's Upper Atmosphere tour, why don't you jot down what you've seen on your postcard-size piece of cardstock? Sketch a picture on the front of your postcard of the different stops you made through the Upper Atmosphere (can you remember them all?) Then write a vivid letter about the amazing, nearly unbelievable, things you've seen as an atmospheric tourist! Now punch a hole in your postcard and put it on your ring! This is one trip you'll want to remember!*

*(Postcard templates are available on the CD-ROM in the back of your book)*

# *Reaching Out to His World*



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Look at a radio in your home. Did you know that for many people living around the world that a radio is like their Bible? The voice that speaks through their radio tells them about the love of God! **Trans-World Radio** is an organization that broadcasts the gospel in over 190 languages all over the world! And they rely on the ionosphere to do it!

Using short waves aimed at the ionosphere, the radio signal is bounced from one point on Earth to another—all around this planet, 24 hours a day! A radio wave beam enters the ionosphere, the ionosphere “bends” it—and sends it back to Earth! Since the ionosphere changes in height and density, Trans-World Radio short-wave radio broadcasts are heard differently at different times of day. And for millions of people living in non-Christian countries, the ionosphere sending those radio waves of God’s love into their homes, has changed their lives!

So **what can you do to reach out** to God’s world using the radio? You can help support a ministry like Trans-World Radio!

- Pray right now for Trans-World Radio! That God would continue to use people, radios—and the ionosphere—to bring many more people into the family of faith!
- Check out Trans-World Radio’s website and read the online diaries of people who are missionaries using the radio to share the Good News!  
<http://www.twr.org>
- Subscribe to their free magazine and read how radio is taking the love of God all around the world!

Aren’t you thankful for the ionosphere?





## *Further Explorations*

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### **The Northern Lights** *by Lucy Jago*

*(For older students)* An exceptionally well-written work, this book chronicles the life of Kristian Birkeland and his quest to understand the aurora borealis. An intriguing tale of a little-known, extraordinary man who led a life full of intellectual and physical adventures. Take up the adventures with Birkeland!

### **Northern lights** *by D.M. Souza*

*(Read aloud to younger students, independent reading for Gr. 4-6)* Large, mysterious pictures of skies in dazzling light and color accompany Souza text, explaining the action of solar-wind particles, magnetic fields, and atmospheric gases in common terms, relating difficult ideas to occurrences familiar to young people. A glossary, a folklore section of interesting facts, and specific details of the how and when of auroras rounds out this volume.

### **Auroras : light shows in the night sky** *by Donna Walsh Shepherd*

*(Read independently Gr.3-5)* What are auroras? Where are they found? How do they occur? This book answers these queries and more. Beginning with the story of a young Alaskan Native boy recalling various legends and stories his grandmother has told him about the auroral lights in the Arctic sky, weaving other tales from around the world of how people have tried to explain the phenomena and scientific discoveries.

### **The Radio** *by Gayle Worland*

*(Gr. 2-4)* Who is Guglielmo Marconi? He has nothing to do with macaroni! In 1901, he became the first person to send radio signals over a long distance. Explore the history of the radio, and discover how this great invention developed into the radios we use today. (Includes directions on how to create your own radio waves!)



## *Too-Fun-to-Resist Excursion!*



### **MAKE A MODEL OF THE ATMOSPHERE!**

God created our atmosphere with us in mind! With just the right amount of oxygen in the troposphere, with the layer of ozone in the stratosphere, the meteor showers in the mesosphere, the shield of the ionosphere in the thermosphere and finally the exiting of the exosphere, our atmosphere perfectly allows us to live on this planet! Why not make a model of the atmosphere so you can show folks the wisdom of our Creator God?

#### **Materials Needed:**

- ~ the most narrow glass jar or cup you can find  
(it must be able to hold 1000 ml or 1 qt)
- ~ white flour
- ~ white sugar
- ~ brown sugar
- ~ yellow cornmeal
- ~ measuring cup
- ~ small white labels or sections of masking tape

#### **Ready To Go? Let's Head Out!**

(Now, please keep in mind that these are relative proportions and not exact points of departure for the individual layers of the atmosphere.)

~ Measure out 1 tablespoon (15 ml) of white flour. Pour it into your jar and lightly shake your jar so that the flour is lying evenly on the bottom of the jar. Write "Troposphere" on your small label or section of masking tape and stick it on your glass jar where the white flour lies.

~ Now measure out 3 tablespoons (45 ml) of brown sugar. Pour it carefully into your jar, over top of the layer of white flour. Gently even out this layer in your jar. Write "Stratosphere" on your small label or section of masking tape and stick it on your glass jar where the brown sugar lies.

~ Next measure out 3 tablespoons (45 ml) of yellow cornmeal. Again, pour this into your jar, creating a layer of yellow over your brown sugar layer. Even this layer out. Label this layer "Mesosphere."

~ Finally, measure out 3 cups (895 ml) of white sugar and pour it into your jar. Gently shake your jar to even out this layer. Write "Thermosphere" on your small label or section of masking tape and stick it on your glass jar where the white sugar lies.

There! You've just created a model of our atmosphere! Now, can you find someone to show how God created such grand curtains for our Earthly home!

## *Too-Fun-to-Resist Excursion!*



### **TURN THE RADIO ON!**

Do you recall what layer of the atmosphere allows us to listen to the radio? You cannot see the ionosphere—but you could *listen* to the effects of the ionosphere!

#### **Materials:**

~ an AM radio

~ a map of your region or state or province

#### **Ready To Go? Let's Head Out!**

~ Turn on your radio and open your atlases. Locate the most distant station you can hear and its distance in miles from your home.

~ Then select a location on the band on the low end (between 540 AM and 640 AM) that is *between* stations. (That is, you will not be hearing an actual station.) What kind of noises do you hear? Write down in a journal the times when noises change and the various kinds of noises. If you hear occasional pops and crackles, that is an indication of a lightning storm. Humming and buzzing would be due to electronic noise.

~ The make-up of the ionosphere changes near sunset and sunrise. And even though you cannot see the ionosphere, you can hear those changes! Near sunset or sunrise there may be a sudden change in the volume of background noise. Far-away, distant stations may now be heard! Can you be a good detective and note the time of these changes? Can you find the location of these far-away stations on your map?

Your radio has just let you listen into the invisible changes in the ionosphere!



**“With whom did He consult and who gave Him understanding?  
And who taught Him the path of justice and taught Him knowledge,  
and informed Him of the way of understanding?  
Behold, the nations are like a drop from a bucket,  
and are regarded as a speck of dust on the scales;  
behold He lifts up the islands like fine dust.”**

Isaiah 40: 14-15