PEELING AN ONION

Chapter 2

When I was a child, I liked looking into folks' windows as we drove by in late evenings. What hung on the walls inside those houses? (We used to drive by one home that had a huge star quilt sprawled over one whole wall!) What colors glowed from within the homes? (One of the grand, formal houses in town had brilliant fire-engine red walls!)

But there were some houses I never got to see inside—their curtains were always drawn disappointingly shut. I could only imagine what surprises lay behind those heavy blinds.

Our earth home has its own curtains. Earth is shrouded in curtains of air. Before we can explore our home of Earth, we first need to examine these curtains! These curtains of air are part of Earth, just like the skin of an onion is part of the onion.

We have a big word for that curtain of air wrapping up the Earth. We call it our "***atmosphere.***" Even though it is a big word, we can break it down into its parts to figure it out. "***Atmos***" comes from the Greek language and means "*vapor.*" That is what our clouds and air are made of, water vapor. "***Sphere***" comes from the Latin language, meaning "*ball.*" So atmosphere is literally the vapor wrapped around our ball. Just like an onion needs its skin to protect it, God made our atmosphere to keep everything in our home alive!

What ingredients did God use when He made our atmosphere? Simply, God organized the most perfect combination imaginable when He created the atmosphere! The atmosphere surrounding our Earth is composed of gases. This is not the kind of gas you fill the fuel tank of your car with, but these gases are the precise gases God knew life on Earth needed to live. A **gas** is a substance with no fixed volume or shape but expands to fill any volume of space available. Our atmosphere is composed of 78% nitrogen, 21% oxygen and trace amounts of other gases.

When I was a baby, my mother swaddled me in a blanket. You, too, probably have baby pictures of you sweetly tucked in a blanket. God wrapped up Earth in these gases because they too act like a protective blanket around us. They keep the heat the Earth needs inside the atmosphere. These gases also guard the Earth from much of the sun's dangerous rays called ultraviolet radiation. Isn't it amazing how God made our atmosphere perfect for life on Earth?

But there is more! God provided exactly the right amount of each of these gases in our atmosphere. What do we need to breathe? That's right—oxygen. There is 21% oxygen in the atmosphere. Why didn't God include more? Wouldn't that have been a good idea? NO! Oxygen easily reacts with other gases. If there were even an increase of only 1 percent more of oxygen—to 22%—there would be a 70 percent increase in the likelihood of forest fires flaming across the planet! Wasn't God a Master Builder when He made our home Earth?

Can you see Earth's curtain of atmosphere from this space-side seat? NASA

Have you ever taken the skin off an onion? In the midst of rubbing your eyes (for onions can really sting your eyes!), what did you notice? Did you notice that there were several layers of skins wrapped around your onion? The atmosphere that wraps itself around our Earth is made up of more than just one layer, just like that onion you peeled had more than one layer of skin. (But thankfully, our atmosphere does not cause our eyes to tear up!)

Tell the folks at home all about it!

*Tell me about this atmosphere that wraps itself around Earth. (**Memory Joggers**: What does the word "atmosphere" mean? What is our atmosphere made of? Why did God wrap Earth in these gases? What did God create in the atmosphere that we need to breathe to live? Why did He not create more oxygen?) Don't you marvel at the wisdom of our Creator?*

Like that very first layer of onion, the one closest to the center, or core, of the onion, let's take a peek at the first layer of atmosphere, the layer we actually walk around in every day here on Earth. The layer that first blankets Earth is called the "***troposphere.***" Do you have any ideas why the first layer of vapor around our earth is called troposphere? Let's again be detectives and figure out its meaning. "***Tropos***" stems from the Greek word meaning "*turning*" or "*mixing.*" Can you guess what is turning and mixing in the layer of air around our sphere?

Yes, you can look up and actually see those vapors turning and mixing—the clouds right above your head! It is in this layer of the atmosphere that all of our storms and rain clouds and lightning occur. The troposphere certainly has a lot of weather happening in it, for it extends from the floor of our home, the Earth's surface, to 5-9 miles (8-14 km.) high over our ball home!

If you could walk UPWARDS (which none of us can, of course, but let's pretend), it would take you several hours of steady walking to walk up through the troposphere! But before you head out as a tourist in the Earth's atmosphere, remember your coat, hat and mittens, because the further you walk through the troposphere, the colder the temperatures! That's because the surface of our earth warms up the air. As you walk away from earth, the air cools. For every mile up walked through the troposphere, the temperature falls by 18 degrees F! (6.5 degrees C per kilometer) At the coldest, it would be -63 degrees F (-52 C). That is much colder than the inside of your freezer! Better pull your hat down! And you would be walking up through billowing, swirling clouds and zooming jets—so watch your step up there!

Mount Everest peaks halfway up into the troposphere—and has two thirds less oxygen than outside your front door! *NASA*

As you keep walking through the troposphere layer of the atmosphere, you might be gasping for breath! That's because the higher you travel in the Earth's atmosphere, the less oxygen there is available for you to breathe. As you reached the 5-mile mark in the troposphere (halfway through the troposphere) you would have climbed as high as Mount Everest and there would be 2/3 less oxygen for you to breathe than when you hiked out your front door!

You also would be walking much slower. For every four steps you were treading when you started out on this journey, you now are only making one step! When you can't breathe very well, you can't walk very fast either! So, be sure when you grab your hat and mittens, to haul some tanks full of oxygen and an oxygen mask out the door with you as you begin your tour through the atmosphere!

Are you ready to peel another layer of the atmosphere off of Earth, just like peeling a layer of skin off an onion? If you were still feeling energetic and up to more walking, you would now walk into the next layer of our earth's atmosphere called the "***stratosphere.***" What do you think stratosphere means? Remember that atmosphere means vapor around our ball, and troposphere means the turning (of vapor) around our ball. Stratosphere means a spreading out (***stratus*** means *spreading out* in Latin) around our ball.

You would be getting pretty far away from your front door by now! The stratosphere is the second layer wrapped around earth and it extends 30 miles (50 km) above the ground of our home, Earth. But the further you kept on walking, you might even take *off* your hat and mittens! (It is not because you have worked yourself into a sweat, either!) The temperature would have risen from –63 F (-52C) in the troposphere to a balmy, much warmer 27F (-3C) up here in the stratosphere!

Hey, wait a minute! Wasn't it that the *further* away you got from earth, the *colder* the air became? So why are you getting *warmer* up here in the stratosphere, if you are further away from Earth?

The stratosphere has another layer spread out within it (remember *stratus* means spread out?) called an ozone layer. ***Ozone*** comes from the Greek word "***ozein***" which means "*to smell.*" If you took a deep whiff up here in the ozone layer, you'd notice a very unusual odor. It is this layer of ozone that causes the temperature to become *warmer* in the stratosphere.

Tell the folks at home all about it!

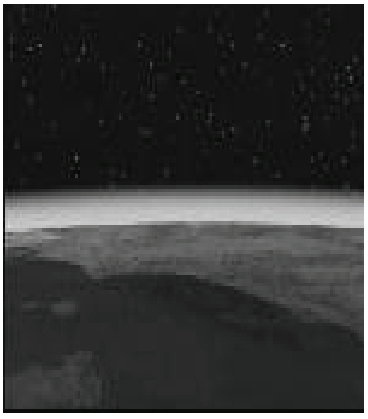
*What can you tell us about the troposphere and the stratosphere? (**Memory Joggers**: What is the layer of atmosphere called that we live and walk around in everyday on Earth? What does "**tropos**" mean? What occurs in the troposphere? What happens to the temperature as you travel up through the troposphere? What does stratosphere mean? Do you remember how far from Earth the stratosphere extends? And what is the temperature like in the stratosphere? What does the word "ozone" mean?) Let's discover more now about ozone!*

Have you ever used a net to catch fish? You may have scooped up some little minnows and a tadpole or two. But still on the surface of the water may be some water striders or smaller minnows that your net didn't catch.

The ozone layer up in the stratosphere is much like a big net, catching some ultraviolet rays from the sun but still allowing some ultraviolet rays to reach earth. This layer of ozone, absorbing a great deal of the ultraviolet rays from the sun, dramatically heats up the stratosphere and *that* is why you are much warmer here than you were back in the troposphere!

Why do some ultraviolet rays from the sun need to be trapped in the intricate net of the ozone layer while other rays reach earth? Without the filtering effect of the ozone layer, the sun's *full* radiation would reach earth and harm plants, animals, and people. Have you ever had a nasty sunburn after a day of making sand castles at the beach? Then you have experienced the harmful, painful effect of the sun's radiation.

Some ultraviolet radiation, however, still does need to reach our Earth home. First, some of those rays are needed to reach our home to keep Earth's temperature warm enough for us—and plants and animals. Secondly, some of those ultraviolet rays from the sun are needed to encourage the working of vitamin D in our bodies. Vitamin D helps turn the calcium in our bodies into hard bones. Otherwise, our bones would break much easier! (If you have ever had your arm or leg in a cast, you certainly can appreciate the importance of strong bones—and the sun's rays!) God perfectly balanced how much ultraviolet radiation from the sun should reach earth when He designed the ozone layer up in the stratosphere!



Can you see the bad ozone hovering over our earthly home? *NASA*

You are the same kid, wherever you are. But if we caught you with your hand stuck in the cookie jar, we might say, "Bad!" And if we later found you embracing your crying baby brother, we might say "Good!" Whether we said bad or good would depend on where we found you! And the same is true of ozone!

What are these factories spewing?

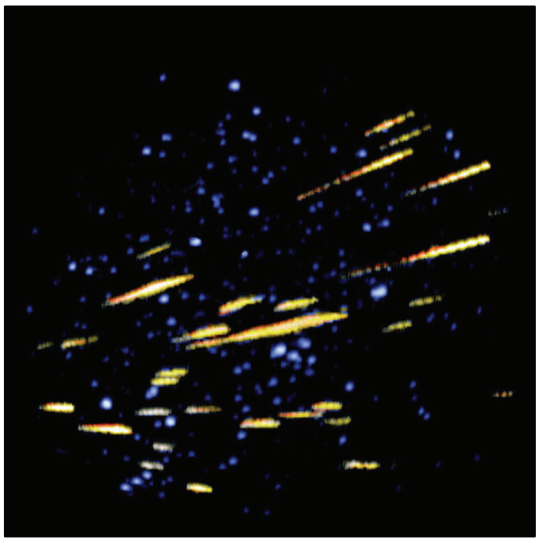
National Parks Service

No matter where one finds ozone, its composition, what it is made of, remains the same. But, depending where ozone is *found*, ozone is either "bad ozone" or "good ozone." Ozone is "good ozone" if one finds it where God created ozone to be—in the stratosphere. Ozone is "good" here because high up in the stratosphere it protects us and all of Earth from harmful ultraviolet radiation from the sun. But ozone that is found lower, down here in the troposphere where we walk around, is "bad ozone." Just like God did not create

you to be found with your hand stealing out of the cookie jar, God also did not create ozone to be found down here in the troposphere! Instead, it is *people* on Earth who have created the "bad ozone" of the troposphere. All of us on Earth create "bad ozone" when we drive cars and build large factories that spew fumes and exhaust out into our troposphere. Then the powerful ozone reaction that is meant to happen way up in the stratosphere against dangerous ultraviolet rays happens down here in the troposphere on *us*! That bad ozone reacts powerfully on you and me, making us sick to our stomach, causing us to cough or making it hard for us to breathe (which is an ailment called asthma). All of which God *never* intended for ozone to do. So think of ozone this way: Good up high, bad nearby.

Now that we have examined the good ozone of the stratosphere, let's take a look around the rest of the stratosphere. Since the warmer air lies *above* the nippier air in the stratosphere, the air doesn't turn around much in the stratosphere like it did back in the troposphere. Can you guess what you might see as a tourist of the stratosphere? You might notice debris floating around from volcanoes that exploded down on Earth years and years ago—when you were just a really little kid!

If we now stomp right out of the stratosphere, we will find ourselves in the ***mesosphere.*** It is time to pull down that knitted hat of yours and wrap yourself in a scarf because it is going to get REALLY COLD! The mesosphere, which begins just above the stratosphere and extends to 53 miles (85 km) high, has temperatures that again fall as low as –135 F (-93 C)! That is nearly TWICE as cold as the troposphere—and MUCH colder than your freezer!



This photograph captures the Alpha-Monocerotid meteor outburst in 1995. Aren't you grateful that God created Earth with an atmosphere to protect us from these rock debris? *NASA*

Don't pull your scarf too high over your nose! Firstly, there is not enough oxygen to breathe up here in the mesosphere so you'll definitely be wearing your oxygen mask. Secondly, you don't want to miss anything up here in the mesosphere. Do you know what the mesosphere's main attraction is? Shooting stars! Meteors, pebble-size fragments floating around in space, glow with the heat of friction as they collide with gases in the mesosphere. Whizzing by at 30 miles (48 km) per second towards Earth, these "falling stars" usually burn up before they reach our Earth home way below. This is a good thing because no one wants to get hit by meteors that come flying Earth's way! God's atmosphere again protects us in marvelous ways. (But you don't have to gallivant through the mesosphere to catch

a glimpse of these "meteor showers." At certain times of the year, especially in August and December, you can spot cascades of gleaming meteors right in your own backyard on earth—which would be a lot warmer than up here in the mesosphere!)

Well, congratulations! You've just walked through the troposphere, the stratosphere and the mesosphere, all of which is called "**Lower Atmosphere**"! Wasn't it an "out-of-this-world" adventure?! Quite the traveler, you are! Give yourself a pat on the back! And rest up for our next expedition when we head up through the Upper Atmosphere!

Tell the folks at home all about it!

Tell me more about where we have explored today. (**Memory Joggers**: Why did God create an ozone layer in the stratosphere? Why does some ultraviolet radiation need to reach Earth? What can you tell us about good ozone and bad ozone? What else might you discover floating in the stratosphere? What layer of the atmosphere lies above the stratosphere? What can you share about the mesosphere?)

POSTCARD HOME

Have you ever visited somewhere and sent a postcard home to a friend? What did you write in your letter home? World travelers often send home postcards telling of the grand sites they've seen and their adventures in new places!

Why don't you draw a picture of your atmosphere adventure on the front of a piece of postcard size piece of paper. Make sure you draw in all the layers you've toured in the atmosphere, so your friend knows where you've been! Then on the back of your postcard, why not write down some of the highlights from each layer in the Lower Atmosphere—what did you see or experience in the troposphere, the stratosphere and the mesosphere?

Punch a hole in the top corner of your card and place it on a ring. Soon you'll have more postcards to add on that ring of all of your travels! Oh, the places you'll go! (Postcard templates are available on the CD-ROM in the back of your book)

Reaching Out to His World

Have you ever lived in a home that wasn't yours but you rented from the owner? Perhaps you live in an apartment or home where you pay monthly to the owner for the freedom to live there. Did you know that all of us live on our home of Earth and we don't own it? And we don't even have to pay rent!

God made our Earthly home in glorious and wise ways—and it is His! The Bible says: **"The earth is the Lord's and all it contains"** (Ps. 24:1). Those of us living on Earth need to remember that the Earth is not actually ours. It belongs to Him.

And we need to be wise caretakers and stewards of this home He has provided for us to live in. God has given us the privilege of living here"[T]**he earth He has given to the sons of men"** (Ps. 115:16). How we need to show Him our gratitude for the magnificent gift of Earth that He has given for our use!
So **what can you do to reach out** and take care of the Earth that belongs to God and He has allowed us to live in?

Ride a bike instead of driving!

We can make efforts *not* to make "bad ozone" —because bad ozone hurts people, crops and every thing alive in God's world. (Did you know that bad ozone can damage leaves so that the leaf dies or becomes spotted? Bad ozone kills the plants God has given us on Earth!)

Perhaps you can decide to do one of the following to take care of the Earth we live in:

~Burn calories and energy—not fuel. Walk whenever you can instead of driving. Every vehicle driving down all the roads all over our Earth emits gases that react with sunlight to create "bad ozone." So every time you decide not to drive somewhere, you make less bad ozone….and take good care of God's Earth.
~ Take the bus whenever you can or carpool with another family.
~Use water based paints since oil-based paints emit bad ozone-forming pollutants.

"**As each one has received a special gift** [like the privilege of living on this home, our Earth], **employ it in serving one another as good stewards**…" (I Pet. 4:10-11). So let's not make "bad ozone" nearby but preserve the "good ozone" up high!

Further Explorations

Atmosphere: sea of air *by Roy A. Gallant*

What causes violent storms, awe-inspiring rainbows, sunsets, and the sky's deep blue color? This book offers answers to such queries! With nearly conversational prose, Gallant's facts are thorough while the ideas are clearly explained for curious explorers.

The sky's the limit: all about the atmosphere *by Mark Rauzon*

Check out this volume for an introduction of the atmosphere. Learn the purpose of each layer of the atmosphere and the relation between air, the sky, and weather.

Earth's atmosphere *[videorecording] / a production of Schlessinger Media*

Review your knowledge of space with aspiring astronauts, Malcolm and Stanley. Curious explorers will discover more about the layers of our atmosphere. Why is each layer important to the survival of life on our planet? How is the atmosphere responsible for weather? What is a barometer and how would you build one? This episode explores the answers to these questions!

How did we find out about the atmosphere? *by Isaac Asimov*

(Gr. 5-9) Older students will find Asimov's explanation of the atmosphere most beneficial. After surveying early experiments which proved air's existence, Asimov turns to describing experiments which proved the existence of atoms, the density of air and the discovery of oxygen, nitrogen, hydrogen and gases. The volume concludes with an explanation the atmospheres of seven of the planets in our solar system.

The Sky Jumps into your Shoes at Night *by Jasper Tomkins*

(Gr. 1-3) What is the sky? Where is air? A whimsical perspective on the adventures of the sky, this fun text and watercolour illustrations foster an appreciation for our atmosphere and earth.

Too-Fun-to-Resist Excursion!

OZONE ALERT!

Recall how God created the stratosphere to include a layer of "good ozone" that protects all of us on Earth from dangerous ultraviolet radiation from the sun. But we on Earth create "bad ozone" here in the troposphere when we engage in activities such as driving cars and puffing fumes out of factories. Can you see this "bad ozone"? You may not be able to see the "bad ozone" with your eyes, but we can see the effects of this bad ozone on certain items such as a rubber band.

Materials Needed:

~ 3 glass jars
~ 3 medium size rubber bands
~ magnifying glass
~ Pen

Ready To Go? Let's Head Out!

~ Place a rubber band around the center of each glass jar. (The rubber band should not stretch too much. The results of this activity will be altered if the rubber band is stretched too greatly.)

~ Write the date and location on a piece of paper and place it in your jar.

~ Examine a section of your rubber band with a magnifying glass. Draw what you observe. Mark this section with a pen.

~ Place one jar outside in the shade, away from the direct sunlight. Place one jar on the kitchen counter. And, if at all possible, place one jar near a copy machine. (If you don't have a copy machine, perhaps you can receive permission to place your jar near a copy machine at the library or church office?) (Most copy machines use an electrostatic charging of a cylinder in the copying process. The accompanying ionization creates ozone—so placing your jar with the rubber band near a copy machine will make for a more interesting experiment.)

~ Every day for a week, examine your rubber bands with your magnifying glass. Write down your observations and sketch what you see happening. Can you see the effects of "bad ozone"? **Be a detective and hunt down the answers to these queries!**

~ Is your rubber band cracking? Or pitting?

~ At which location did your rubber band show the greatest change?

~ And at which location did your rubber change the least?

~ On which day did you see the first noticeable changes?

~ Did all the rubber bands change on the same day?

~ What do you think caused the changes of the rubber bands? (Ozone will deteriorate the rubber bands at a rate dependent upon the ozone levels in the surrounding air.)

Too-Fun-to-Resist Excursion!

HAVE A SPECTACULAR SHOWER!

Here is a shower where you will need no shampoo or a towel! Nor will you need to trek up through the atmosphere until you reach the mesosphere.

Instead of freezing way up there in the mesosphere, why not head outside for the best shower of all—a shower of meteors!

Late autumn, especially mid-October to mid-December, is the prime season of meteor showers, when God dazzles with brilliant flashes of streaking light in the night sky. And you won't want to miss it!

Ready To Go? Let's Head Out!

The only materials you will need for this too-fun-to-resist activity is perhaps a warm cup of hot chocolate to sip while standing out there under the night sky, and a blanket to snuggle in! (And, of course, a fellow geographer to share the wonder with!)

Dates of meteor showers are listed at the International Meteor Organization Website:

http://www.imo.net/calendar

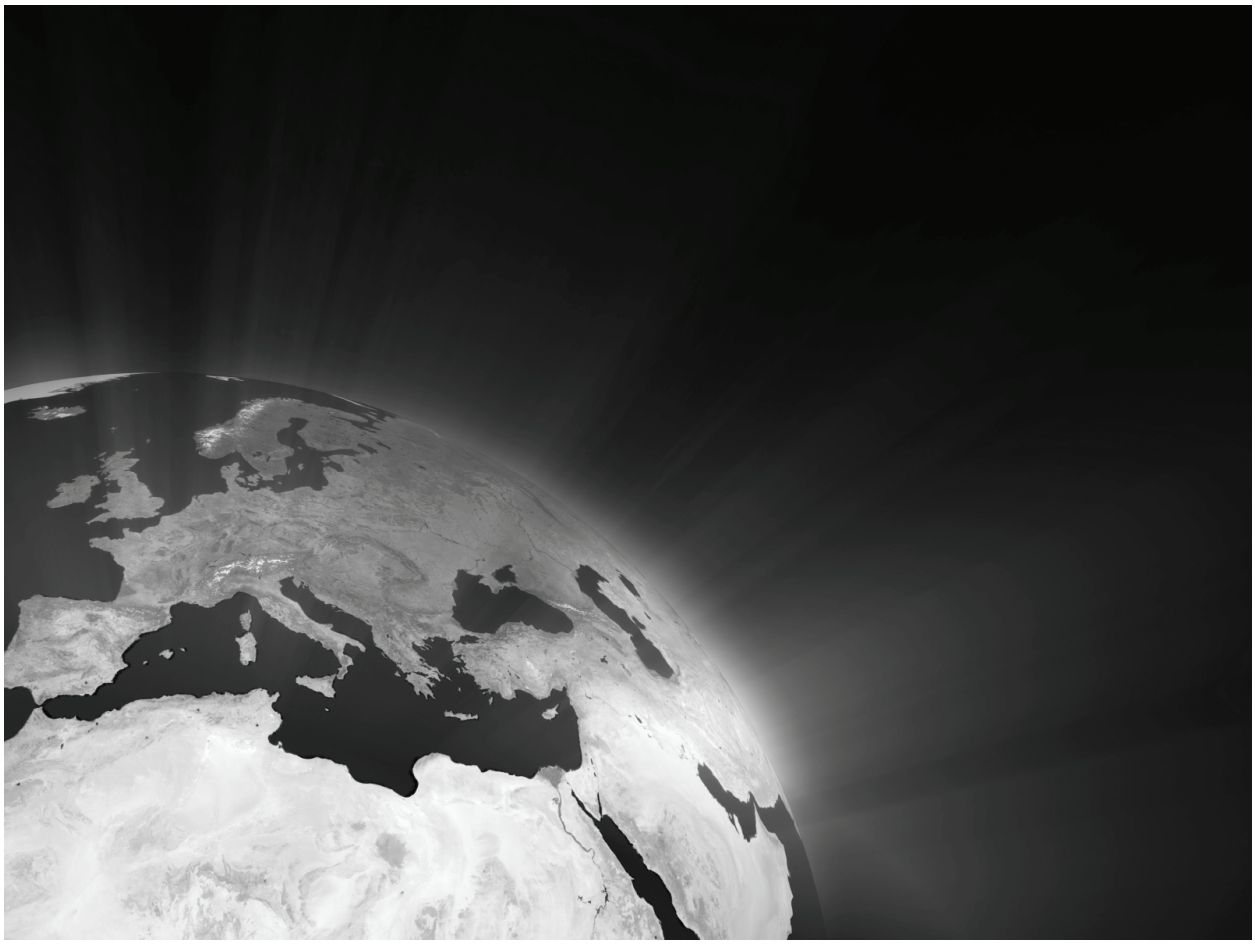
Write the appropriate dates on your calendar so you won't forget!

Set your alarm clock for the hushed hours of dark before sunrise. You can observe many more meteors near dawn than after dusk.

If you want the best seat to view a meteor shower, find the darkest location possible. Any man-made lights should be avoided if you are seeking a great showing of God's lights.

As all world-travelers do, take along your camera to capture God's wonders!

And remember: By sky gazing at meteor showers, you are actually seeing God's marvels up in the mesosphere—without even leaving your own backyard!



"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."
(Ezekiel 1:4)