It's Time to Look UP!

We've spent a lot of time with our noses to the ground examining the earth's surface (or geosphere) with geology. Now it's time to take a look UP! The next area of earth science we will explore is meteorology. The word "meteor" makes up the first part of the word and is Greek for "things high up" and "ology" means "the study of," so **meteorology** is the study of things high in the air. More specifically, it is a study of the earth's atmosphere, weather, and weather forecasting. Scientists who study meteorology are called **meteorologists**.

You have already been introduced to the word atmosphere in our first lesson in discussing the four spheres that make up our awesome planet Earth: the geosphere, atmosphere, hydrosphere, and biosphere. In the word atmosphere, the Greek root word "atmos" means steam or vapor, meaning air. The **atmosphere** is the mixture of gases or air that surrounds a planet.

In order to study meteorology you must first have a good understanding of the nature of air and our atmosphere. You can't see air or the atmosphere, but you know it's there, always surrounding our planet, because we can't breathe without it! For something seemingly invisible, it is really quite fascinating and powerful even beyond filling our lungs to breathe. Let's learn more about what makes up the atmosphere and why another part of God's Design for our planet is beyond the simple and so intricately interconnected with everything else around us!

What Holds it in Place?

If you remember last year's study of chemistry you learned that EVERYTHING is made of matter (atoms and molecules), matter is ALWAYS moving, and that it can be in the form of a solid, a liquid, or a gas. The atoms and molecules in a solid are so closely packed together that they are only able to move in a vibration. Atoms and molecules in a liquid are less packed together and are able to flow and move about more freely while still staying somewhat close. However, the atoms and molecules in gases, such as AIR, move and bounce around rapidly, preferring to float up, up, and away, spreading out as far as they can possibly go. If this is so, why doesn't our air supply simply keep floating away into space? The answer is **gravity**. Remember, gravity is that invisible force that pulls everything towards the center of the earth. The earth has just the right amount of gravity to hold our atmosphere in place and keep it from floating away into space!

The Atmosphere has Weight

Even though air is a gas, it does have "weight" because it is made up of atoms and molecules of matter, which is anything that has mass and takes up space. The air we breathe is made up of 78% nitrogen, 21% oxygen, and 1-4% water vapor. So even though we can't see the air, it has a weight or mass that is very important.

The Atmosphere Exerts Pressure

You just learned that air has weight, but it doesn't just stop there. The weight of that air is constantly pressing down on us, and everything else on earth, coming in from all directions. This is called **atmospheric pressure or air pressure** and it is a magical thing! Without this pressure, weather would not exist, planes would not be able to fly, we could not drink through a straw, nor could we draw air into our lungs! The amount of air pressure exerted on us is about 14.7 pounds of pressure per square inch of our bodies. This pressure does not crush us because of Newton's Third Law of Motion, for every action (or force in nature) there is an equal and opposite reaction (force)! For as

much as the atmosphere is pushing in on our bodies, our bodies are pushing right back at the same rate, canceling each other out, creating a net force of balance. Nature likes a balance! This is why we don't feel the pressure even though it most definitely exists. However, a change in temperature, altitude, and moisture in the air can affect atmospheric pressure and cause changes we can feel. Have you ever been in an airplane or a car ride up a mountainside and feel your ears "pop?" This is our body's way of creating a balance between the lower pressure outside our body in a higher altitude with the higher pressure inside our body. Our ears release enough air to get it back in balance again, thus making a pop! We will learn a lot more about atmospheric pressure and its changes as we go deeper into our study of meteorology since it is the driving force of weather.

The Atmosphere Has Layers

Due to temperature differences as you move up through the atmosphere, it breaks up into five main layers, each with different characteristics. Let's take a trip up through the atmosphere to discover what is going on in each layer and discover what else our atmosphere does for us to keep us alive and safe, like a giant force field. As we travel up from the earth's surface, we will be increasing in **altitude**, which is the height of something in relation to the ground. Ready? Up, up, and away!

Troposphere (4-10 miles)

This layer begins where the surface of the earth ends. It is the most dense layer containing 80% of all the atmosphere's air, therefore placing it at the bottom! It's a good thing that this is the layer we live in since we need that densely-rich air to breathe!

The troposphere is known as the weather layer. Most all weather occurs here because there is a constant mixing of warm and cold air. The earth's surface absorbs the heat from the sun and it gets cooler as you move away from it, so the higher up you go in the troposphere the lower the temperature. However, because of cloud cover in the troposphere, the sun's heat is blocked enough in the day to keep us from getting too hot and they help trap enough heat in the night to keep us from being too cold. We'll talk more about clouds in a few weeks!

Stratosphere (30-35 miles above surface)

Continuing upward, the stratosphere layer contains the ozone layer, which protects us from the harmful UV rays of the sun. It is very dry in this layer with hardly any clouds. This layer gets its heat directly from the sun so it is the opposite of the troposphere since the temperature rises as you rise in altitude. Being free of air and weather disturbances, the stratosphere is the ideal level for airplanes to fly, just above the clouds. Have you ever been on a plane trip and experienced how it can be a somewhat bumpy ride until the plane levels off and the captain turns off the seatbelt sign? That's usually a sign you've arrived in the stratosphere!

Mesosphere (50 miles above surface)

"Meso" means middle, so naturally, this is the middle layer. There is almost no breathable air here, being very thin. It is the coldest layer because there are hardly any air molecules to absorb the heat of the sun. You can also remember it as "M" for meteor since this is the layer where you are likely to see meteors. Despite the thin air, there are enough air molecules to cause friction when meteors pass by which produce heat and burn them up before they can reach the earth's surface. Another way our atmosphere protects us!

Thermosphere (up to 400 miles from earth's surface)

The root word "therm" means heat, and is an appropriate term since this is technically the hottest layer. However, the air feels very cold because the particles in the air are so far apart they hardly touch to transfer their energy, which is what creates heat. The lower part of this layer is known as the **ionosphere** where many atoms become ionized giving off electrical charges and mixing with solar winds to create colorful auroras. These ions also help transmit radio waves. This is the layer to find orbiting satellites and an occasional space shuttle!

Exosphere (6200 miles from earth's surface)

"Exo" means outer, so this is the outermost layer of our atmosphere. It is the last layer you can be in before exiting into space and leaving our cozy planet. The "line" between the exosphere and outer space is very blurry and hard to distinguish. We will look beyond the exosphere next semester when we study astronomy.