

Perfect Design by a Perfect Designer

“The heavens are the heavens of the LORD, But the earth He has given to the sons of men.”

Psalm 115:16

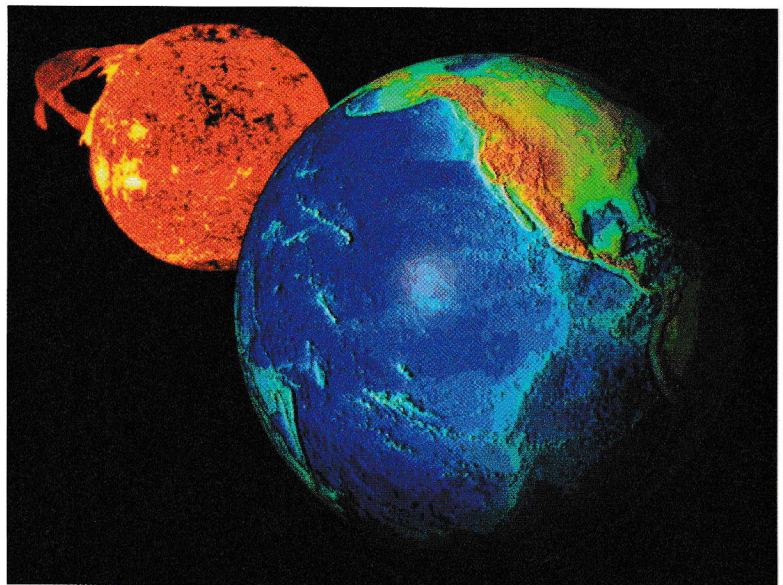
Now we get to take a closer look at the most fabulous planet in the entire solar system! I know, I know, the earth may seem a bit boring since you see it every day and already know a lot about it. But it's actually the most amazing planet in our whole solar system! God's fingerprints are all over the earth. In other words, when we look at the details that make the earth so perfect for us, it's obvious that only a very wise and wonderful God could have made it. Our planet is so special, so perfectly suited for people, plants, and animals to live, that it would be impossible for it to have happened by accident. In fact, scientists say it would be next to impossible for another planet like ours to exist anywhere in the whole universe! There are many factors that God wove together to create the earth so that it supports life. If one of those things were missing, life could not exist. This means that the earth is almost certainly the only planet in the whole universe that has any life on it.

The Bible tells us that God made the earth. Genesis 1:1 says, “In the beginning God created the heavens and the earth.” Remember we talked about how God makes everything for His glory? Well, if the beautiful heavens declare his glory, the earth must be screaming His glory, because it is the most glorious of all.

Perfect Distance

Earth is in the zone! There's a small zone around the sun where life can exist. God placed the earth right in that zone - the most perfect place in the entire universe for us. We're not too far away or too close to the sun. The earth has plenty of water, which is the main ingredient for life to exist. Water is everywhere on earth. There is even water inside of you!

Do you know that if we were closer to the sun, the oceans would disappear? They would just dry up! The atmosphere covering earth would also be destroyed, and the harsh rays from the sun would burn us until we died. We could not survive on this planet if it were much closer to the sun.



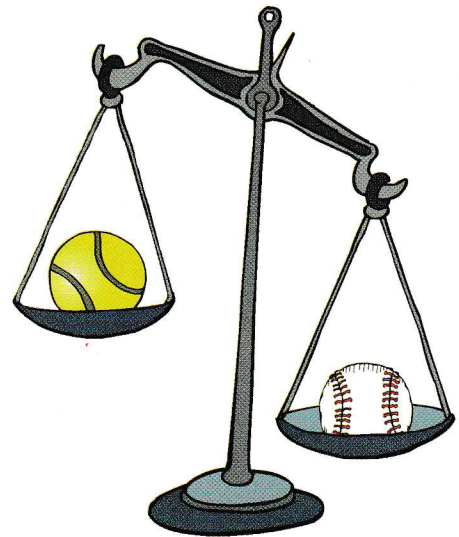
This is a model of the earth in front of a picture of the sun.

If we were farther away from the sun, it would cause other terrible problems. The water would all freeze, and we would have frigid, icy weather every single day of the year. Spring would never bring new plants, and the animals would eventually die of starvation. Even a small change in the earth's temperatures would cause worldwide disaster. God placed us exactly where we need to be. He made the earth a perfect place for people to live!

Perfect Mass

Do you have a baseball and a tennis ball around the house? If so, go get them. Hold the tennis ball in one hand and the baseball in the other. These two balls are almost the same size, but as you hold them, you should notice that the baseball is heavier than the tennis ball. Why is that? If they are pretty much the same size, why is one so much heavier than the other? The answer is that there is more **matter** in the baseball than there is in the tennis ball.

What is matter? It is the "stuff" that makes up everything around you. Everything you can touch or smell (including yourself) is made of matter. The more matter that is in something, the heavier it is. Since the baseball is heavier than the tennis ball, the baseball must have more matter in it. Now remember, these two balls are pretty much the same size. So, if the baseball has more matter in it, what does that tell you? It tells you that matter is "packed" into a baseball more tightly than matter is packed into the tennis ball. Think about putting toys into a box. If you put a ball and a squirt gun into the box, it wouldn't be very hard to lift. However, if you took all of your toys and stuffed them into the box, it would be a lot heavier, wouldn't it? Why would the box be heavier? It didn't change size. It just had more things packed into it. In the same way, the baseball has more matter packed into it than the tennis ball, so it is heavier than the tennis ball, even though it is pretty much the same size.



This balance tilts towards the baseball because the baseball has more mass than the tennis ball.

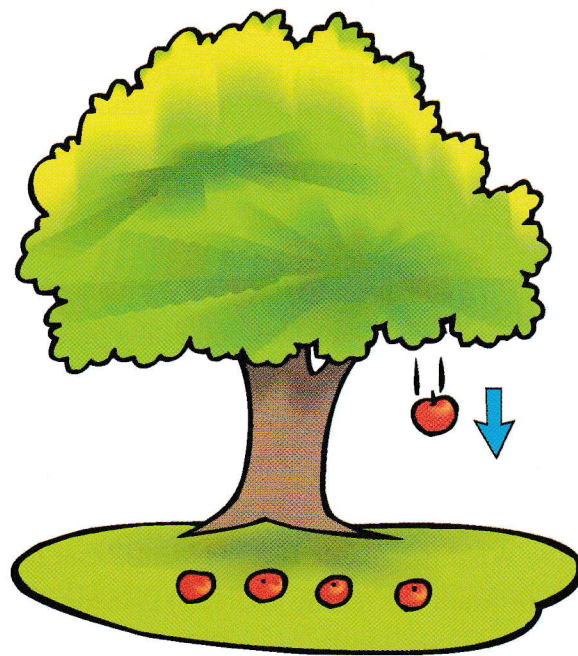
Well, the amount of matter in an object is a pretty important thing to know. Because of that, scientists have come up with an idea called **mass**. Mass is a measure of how much matter is in something. If something has a large mass, it has a lot of matter in it. If something has a small mass, it has only a little matter in it. This tells us that the baseball's mass is greater than the tennis ball's mass, because we already figured out that the baseball has more matter in it.

Why am I telling you about mass? Well, the mass of a planet is important because it determines the amount of gravity the planet has. Do you remember what gravity is? We talked about it in Lesson 1. It is a force that planets use to pull on things. The sun's gravity pulls on the planets,

keeping them in their orbits. The earth's gravity pulls on you, keeping you on the ground so that you don't go flying off into space. Even if you try to jump as high as you can, you won't go very high, because the earth's gravity pulls you back down to the ground.

Now think about what would happen if God had made the earth with less mass. If the earth had less mass, it would have less gravity. This would mean it wouldn't pull on us as hard. We would be much lighter. Running a mile would be easy. We could jump onto the roof of our home without any effort. We could jump up into any tree and if we fell, it wouldn't hurt very much.

However, it wouldn't be all fun and games for us if the earth had less gravity. Remember, gravity keeps things on the ground. The wind would be able to blow things like cars and people right off the ground and into space! The earth would not be able to pull rain out of the clouds and onto the ground, so it would never rain! That would cause severe droughts and famines over the whole world. Phew! It's a good thing earth doesn't have less gravity. Since the amount of mass determines the amount of gravity, we can also say it's a good thing that earth doesn't have less mass.



Apples fall from trees because of gravity. If the earth had more mass, apples would fall more quickly. If it had less mass, they would fall more slowly.

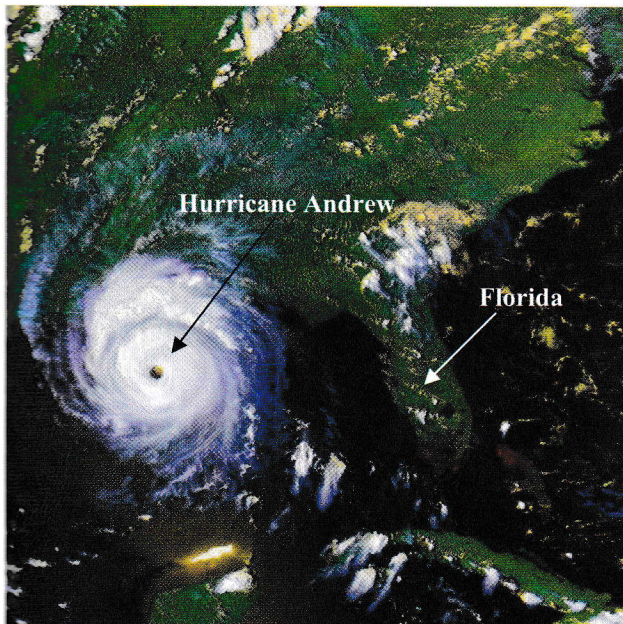
It's also a good thing that the earth doesn't have more mass. If it did, the gravitational pull would be too strong. It would be a lot of work just to walk around. We would tire very easily. Going up a flight of stairs would make us pant and need a long rest. Many dangerous chemicals that are harmful to breathe, like methane and ammonia, would just sit here on the earth instead of rising up into the atmosphere and floating into space. Have you ever smelled ammonia? If the earth had more mass and you spilled a bottle of ammonia in your house, it would poison your home because the fumes would stay low to the ground where you are. They would spread throughout your house. Have you ever smelled a freshly painted house? If the earth had more mass, that terrible smell would never go away. Because of the earth's perfect mass, many dangerous chemicals rise up out of the atmosphere and into space, leaving us with clean, safe air to breathe.

Can you explain in your own words all that you have learned about the earth so far?

Perfect Rotation

Another special feature of the earth is its **rotational period**. A rotational period is how long it takes a planet to rotate a complete turn. Since a planet's rotation turns night into day, a planet's rotational period is the length of one full day on that planet. The earth's rotational period is perfectly timed so that when we get tired, it gets dark outside. When we have slept enough, the sun comes up, making it light again. We have a 24-hour day, with about 12 hours of daylight and 12 hours of darkness. That's not the best thing about the earth's perfect rotational period, however!

Do you realize that how quickly or slowly a planet turns also affects the weather? If earth rotated more quickly, the winds would be so strong that there would be tremendous hurricanes



This is a satellite image of Hurricane Andrew on August 25, 1992. If earth's rotation were faster, more hurricanes would occur.

everywhere. Survival would be difficult. On the other hand, if the earth rotated too slowly (giving us longer days and longer nights) the temperature shift would be extremely hard on the environment. You see, the longer the nights, the colder they get, and longer the days, the hotter they get. A long rotational period, then, would result in cold, cold nights and hot, hot days. The rotational period that God ordained for the earth keeps the temperature in balance to protect the people, animals, plants, and other creatures that He created for His glory.

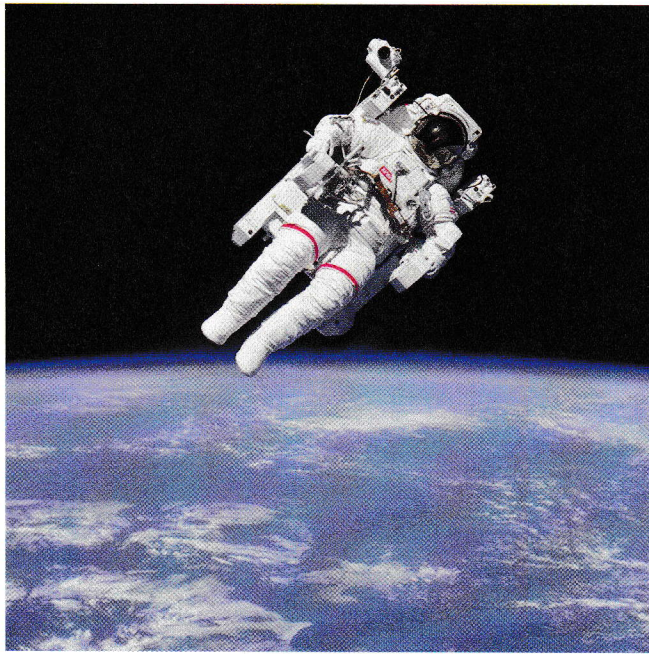
The Bible says in Isaiah 45:18, "He is the God who formed the earth and made it, He established it and did not create it a waste place, but formed it to be inhabited." It isn't by random chance or accident that the earth has the perfect rotational period, the perfect mass, and the perfect position in

space. All the other planets were made to be empty, but not the earth. God designed the earth to be inhabited. That means it was made for people, animals, plants, and other creatures.

Perfect Atmosphere

Another wonderful thing about earth is the special chemicals that God placed in the atmosphere. We've already talked a little bit about what an atmosphere is. In Latin *atmos* means water vapor or *steam*, and *sphere* means *ball*. If you put those two words together, you have *ball of steam*. That's why we call the mist and gases surrounding a planet the atmosphere of the planet. On earth, we often call our atmosphere the "air."

Even though you cannot see the atmosphere, it is definitely there! Take a deep breath. Do you realize you just sucked in lots and lots of **oxygen** (ox' uh jen) molecules? Oxygen is the most



This is a photograph of an astronaut in space. Note the spacesuit (which has the oxygen tanks) and the earth below.

important thing in our atmosphere. Without oxygen, we would not be able to breathe.

Astronauts take huge tanks of oxygen with them when they go out of our atmosphere. Their spacesuits pump this oxygen into their helmets so they can breathe it. If they did not have these oxygen tanks, astronauts would not be able to breathe in space.

Have you ever been inside a **greenhouse**? A greenhouse is a "house" where gardeners grow plants. Young plants are often grown in greenhouses, because they are very fragile and must be protected from hot or cold temperatures. Most greenhouses have a roof that is milky white but at the same time somewhat clear. This allows the sun to shine on the plants, while at the same time, protecting the plants from getting too hot. A

greenhouse also keeps the plants from getting too cold. Our atmosphere is like an invisible greenhouse that protects us from very high temperatures and very low temperatures.

This is another reason astronauts must wear spacesuits when they are in outer space. The spacesuits keep them warm. It is freezing in outer space, because once you leave our atmosphere, you leave the comfort and warmth that God has provided us. Without a spacesuit, astronauts would freeze in outer space.

Our atmosphere goes very high up in the sky: about 800 miles. That is very high. It's more than 4 million feet. Airplanes don't even go up that high. Only spaceships and astronauts leave our atmosphere.

None of the other planets have the kind of atmosphere that we need to stay alive. Remember, Mercury doesn't have an atmosphere, and because of that, it freezes at night and burns hot during the day. Venus, on the other hand, has an atmosphere that would kill us if we tried to breathe it. Also, Venus is always extremely hot whether it is day or night, because the heat cannot escape its atmosphere. As you learn about the other planets in our solar system, you will find that none of them has an atmosphere that would keep us alive. That's okay, because the Bible says that the highest heavens belong to God. God did not make any other planet to be inhabited by people. No other planet has the protection and security of an atmosphere the way earth does.

Imagine going outside one day to find that rocks were falling out of the sky. What if this happened every day? We wouldn't want to leave our homes, and if we had to, we would need steel umbrellas to protect ourselves! We would be afraid to look up at the sky, and our houses and buildings



would have to be much stronger than they are now. Well, the fact is that rocks of every size - giant boulders, little pebbles and teeny tiny grains of sand - are constantly flying into earth everyday! Thankfully, the atmosphere that God has given earth causes most of these rocks to burn up before they reach the ground. This protects us from falling rocks every single day. Most of these rocks become nothing but dust before they land on the ground. If God had not created our atmosphere just as He did, we would have to worry about getting hit by space rocks.

Have you ever seen a **shooting star**? Some people might call it a "falling star." Well, it turns out that shooting (or falling) stars are not really stars at all! They are actually space rocks that hit the earth's atmosphere and burn up. Occasionally, a piece of one of these space rocks will actually survive the burning process and make it to the surface of the earth. Sometimes, the piece is big, but usually it is small. If a piece does survive and reach the surface of the earth, it is called a **meteorite** (me' tee or eyet). Since oceans cover most of the earth, meteorites usually fall into the sea. It is rare for one to hit land. We will discuss meteorites and space rocks in Lesson 8.

Try to put into your own words the things you have learned about the earth's rotation and atmosphere.

Perfect Tilt

What is the temperature usually like in the summer? What is it like in the winter? It feels warmer in the summer and colder in the winter, doesn't it? In fact, you probably already know that we have four seasons on earth: winter, spring, summer, and fall. Many people don't understand why we have different seasons. They think that maybe it's hot in the summer because we are closer to the sun in the summer. That is not true. Earth is actually a tiny bit further away from the sun when it is summer in the United States! The real reason it's hotter in the summer is that the sun's light is shining more directly on us during the summer. It's the concentration and aim of the sun's light that makes it hot. In the other seasons of the year, the sun's light is not shining directly on us. Because of this, the sun does not warm our portion of the earth as well, so the weather is not as warm.

Why does this happen? Why doesn't the sun's light shine directly on us all of the time? Well, the earth is permanently tilted in one direction. The North Pole is not straight up north, and the South Pole is not straight down south in relation to the sun. Everything is at a tilt, so the parts of earth that get direct sunlight change with each season, as earth revolves in its orbit around the sun. If you have a globe, you will see that it is tilted. When you turn it, the countries close to the bottom of the globe come up toward the middle just a bit, and the ones near the top of the globe come down toward the middle just a bit.



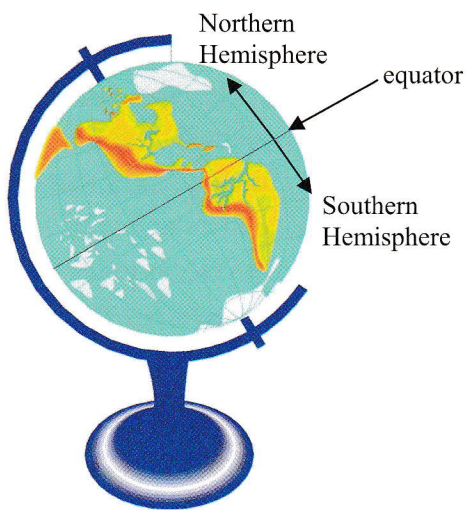
A good globe shows the tilt of the earth as it rotates.

Do this experiment. Get a flashlight. Pretend the flashlight is the sun. Take it into a dark room and lay it on a table. Take a piece of paper and hold it right in front of the flashlight. When you do that, the paper gets direct light. In other words, the light is intense, concentrated in one spot. Now tilt the paper so that the flashlight shines on it at an angle.

Notice that when you tilt the paper, the light is not as intense. It still shines on the paper, but the light is more spread out and less concentrated. That is what happens in the seasons. In the winter, the sun is not shining straight down on us. We are tilted away from the intense sun rays. The spread-out rays that hit us give us less heat, which results in cooler temperatures. The direct, concentrated rays that we get in the summer give us more of the sun's energy, resulting in higher temperatures.

Do the same thing with your globe that you did with the paper. Shine the flashlight directly on the globe, and then tilt the flashlight up, so that the rays spread out. There is more intense heat when the sun's rays are straight and direct.

The **equator** (ih' kway tur) is the imaginary line that divides the entire earth in half. The sun shines almost directly on this middle line all the time. The top half of the earth is called the **Northern Hemisphere** (hem' uh sfear), and the bottom half is called the **Southern Hemisphere**.



As the earth revolves around the sun, the hemisphere that points towards the sun gets direct sunlight, while the hemisphere that points away from the sun gets less direct sunlight. In June, for example, the Northern Hemisphere tilts toward the sun. As a result, the sun's rays strike the Northern Hemisphere directly, and it is warm there. How do you suppose it feels in the Southern Hemisphere during this time? Since the Northern Hemisphere points towards the sun during this time, the Southern Hemisphere points away from the sun. Because of this, the Southern Hemisphere experiences *winter* in

June. In December, on the other hand, the Northern Hemisphere tilts away from the sun. This causes the sun's rays to strike the northern half of earth less directly. This makes it cooler in the Northern

Hemisphere, which is why the Northern Hemisphere experiences winter in December. Of course, at the same time, the Southern Hemisphere points *towards* the sun, so during December, it is *summer* in the Southern Hemisphere!

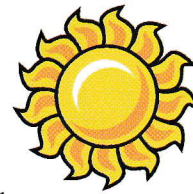
To better understand this, do an activity with your globe. Take the shade off a lamp and place it in the center of a dim room. The lamp is your sun. Walk your globe around the lamp, as if it is the earth orbiting the sun. As you walk around the lamp, notice the four walls in your room. Each wall will represent a different season. Start so that your globe is between the lamp and the center of one of the walls. We will say that this wall represents winter, so you need to hold your globe so that the Northern Hemisphere is pointing away from the lamp. Notice how the light from the lamp hits the Southern Hemisphere of the globe more directly than it does the Northern Hemisphere. This is why it is summer in the Southern Hemisphere while it is winter in the Northern Hemisphere.



spring in the Northern Hemisphere, fall in the Southern Hemisphere



summer in the Northern Hemisphere, winter in the Southern Hemisphere



winter in the Northern Hemisphere, summer in the Southern Hemisphere



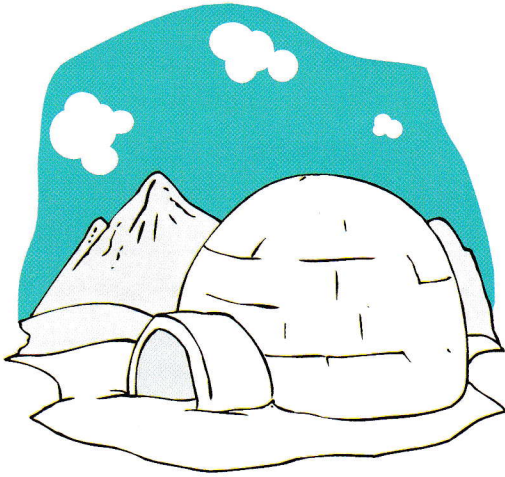
fall in the Northern Hemisphere, spring in the Southern Hemisphere

Now walk around to the lamp counterclockwise (that means in the opposite direction from the way the hands on a clock move). Do not change the tilt of the globe. Just watch how the light hits the globe differently as you walk. When you reach the center of the next wall, you will see how light hits the earth when it is spring in the Northern Hemisphere and fall in the Southern Hemisphere. Continue to walk around the lamp counterclockwise, once again making sure that you don't change the tilt of the globe. When you reach the center of the next wall, you will see how light hits the earth when it is summer in the Northern Hemisphere and winter in the Southern Hemisphere. Notice how the lamp's light is hitting the Northern Hemisphere directly now. That's why it is summer in the Northern Hemisphere and winter in the Southern Hemisphere. Continue walking around the lamp until you reach the center of the next wall. At that point, you will see how light hits the earth when it is fall in the Northern Hemisphere and spring in the Southern Hemisphere. The changes that you have seen in how light hits the earth at different points in its orbit around the sun are why we have different seasons on earth.

Remember that the sun shines more directly on the equator as compared to most of the other parts of the earth. This means that countries that are near the equator get the most direct sun rays. What do you think the temperature is like in those countries? They are nice places to go on vacation, because they are usually warm. Find the countries close to the equator on your globe. Places that are close to the equator are warmer than those that are further away. If you live in the southern United States, for example, you are closer to the equator than those who live in the northern United States.

This means you get more direct sunlight, which means all of the seasons are warmer for you. In the southern United States, summer is very hot compared to the northern United States, and winter is reasonably warm compared to the northern United States.

The sun never shines directly on the countries near the top and bottom of the world. Even when the Northern Hemisphere is tilted towards the sun, for example, the North Pole is still too far



This is a drawing of an igloo. Most people think that people who live near the North Pole live in igloos like this. That's not true. Igloos made of snow are usually used as emergency shelters, not permanent homes.

from the equator to get direct sunlight. What do you think the temperature is like there? Even during the summer, it is still pretty cold (37 to 54 degrees). At the very bottom of earth is an icy continent called Antarctica. Once again, because it never gets direct sunlight, it is also cold. Even when the Southern Hemisphere is pointed towards the sun, temperatures average around 20 degrees. When the Southern Hemisphere is pointed away from the sun, temperatures can get to be 128 degrees *below zero*. During the wintertime (which would be summertime in the Northern Hemisphere), Antarctica is tilted so far away from the sun that it's dark all day and all night for months at a time. Then when it's summer in Antarctica (winter in the Northern Hemisphere), it's tilted so that it is never facing away from the sun. Because of this, it's light all day and all night, for months at a time! Can you believe that somewhere here on earth the sun doesn't go down every night or come up

every day? Of course, even though it is light all of the time in Antarctica during the summer, it is not very bright outside. Instead, the sunlight is just a dim glow. Can you explain why the sun is up all day but only looks like a dim glow in Antarctica during the summertime?

In summer, the days are longer than the nights. This is because the sun is shining down so directly that it takes longer for the earth to rotate enough for us to get out of the sun's light. Also, the sun stays higher in the sky during the summer, because we are tilted towards it. In winter, on the other hand, the days are shorter than the nights. This is because we are tilted away from the sun, so it doesn't take long for the earth to rotate out of the sun's light. In winter, the sun seems low in the sky, because we are tilted away from it.

The earth's tilt is very important to us. If the earth were not tilted, there would be no seasons on earth. The northern United States would always be colder, while the southern United States would always be warmer. That would be a problem, because we grow our food in the summer and allow the ground to rest in the winter. This allows the land to replenish its nutrients, which are like vitamins for the crops. Many beautiful flowers, like tulips, must have a cold winter in order to bloom in the spring. It's part of what makes earth a nice place to live. We need the change of seasons. The cold winter kills the bugs that bite us and ruin our crops. The colder the winter, the fewer bugs we will have in the summer. Places that don't get cold have gigantic bugs!

What is your favorite thing about the cold winter? What is your favorite thing about the warm summer? Without seasons, you could not enjoy those things. Aren't you glad God put the earth on a tilt so that you can see a change in the season?

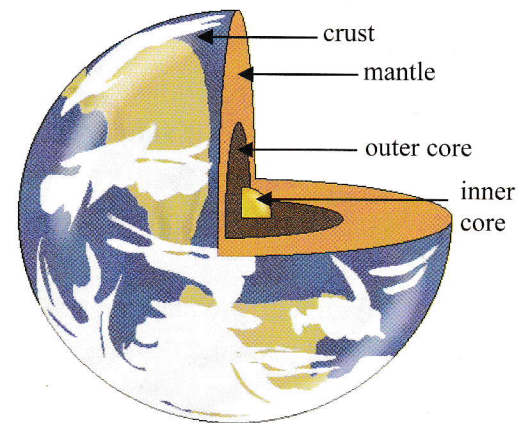
Do you think you can explain why we have different seasons in your own words? Give it a try right now. Remember to include information about Antarctica and the North Pole in your explanation.



Perfect Land

When I was a kid, my brothers and I had a great big hole in our yard that we dug deeper and deeper every day. We planned to dig until we reached China on the other side of the world. Our hole was so deep we could climb inside it. We didn't understand about the temperatures in the center of earth. We didn't know that if we *could* dig a hole far down into the center of the earth, we would have to go through thousands of miles of molten rock before we ever hit China. The hole that we dug was very deep, but we didn't even get through the *first layer* of the earth.

Our planet has many layers. The top layer is called earth's **crust**, and it contains the oceans, dirt, rocks, and mountains. When you dig a hole in your backyard, you are digging in the earth's crust. Under the crust, there is a layer called the **mantle**. To reach the mantle, you would have to dig a hole in your backyard that is about *20 miles deep*. The mantle is made of hot, semisolid rock, and it is thousands of miles thick. In fact, the mantle is the thickest portion of the earth. The farther down you go, the hotter and hotter the mantle gets. Do you know what magma is? Magma is melted rock. There is a lot of magma in the mantle, because it is so hot. Even below where you are sitting right now, there is hot magma. Don't worry; it is too far down for you to ever see it or feel it. In some places, holes in the crust allow magma to come up to the earth's surface from the mantle. That is where volcanoes have formed.



Below the mantle, there is a hot section of melted metals like nickel and iron called the **outer core**. This is an important part of the earth, because the earth's magnetic field is formed here. You will learn more about the earth's magnetic field in the next section of this lesson. The very center of the earth is also made of metals like nickel and iron, but those metals are solid. This solid center is called the **inner core** of the earth.

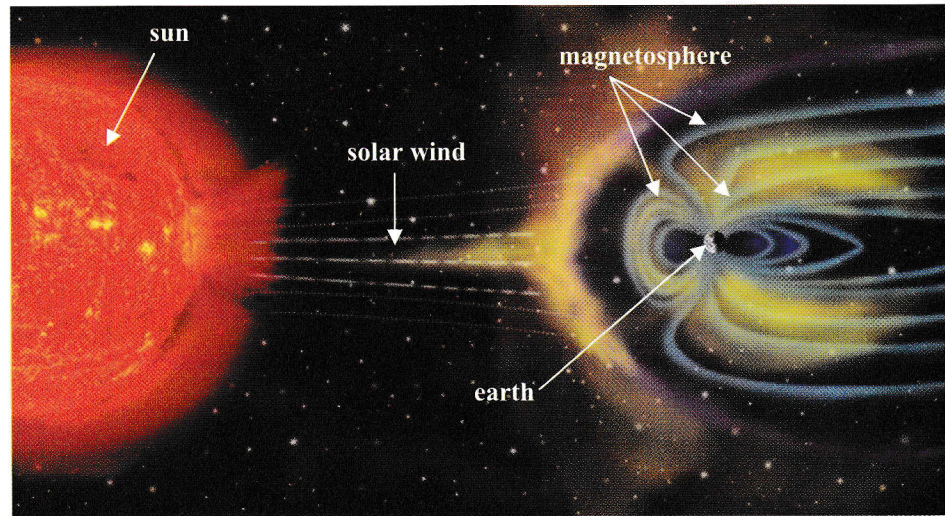
Perfect Magnetosphere

Perfect magnet-o-what? Remember that “sphere” means “ball.” Our **magnetosphere** (mag neet’ uh sfear) is like a big ball of magnetic power around earth. It’s an amazing, miraculous, mighty feature of our earth. It is simply astounding and reminds us that God thought of everything! He didn’t leave any little detail to chance.

Have you ever played with magnets? A magnet attracts certain metal objects. Have you ever noticed that when such an object gets a certain distance from the magnet, it jumps right onto the magnet? That’s because

the magnet has a **magnetic field** surrounding it, and the object is attracted to the magnet by that magnetic field. Can you believe the entire earth has a magnetic field as well? This magnetic field is produced in the outer core of the earth, and it pulls certain harmful particles away from the earth. These harmful particles make up

what scientists call the **solar wind**. Without the magnetic field, we would not survive. God placed this special magnetic field around the earth to protect us from the dangerous particles coming from the sun, keeping us alive and well. Our magnetosphere does an important and life-saving job.



This is a drawing that shows how the magnetosphere protects the earth from dangerous particles that come from the sun.

Although the magnetosphere blocks most of the solar wind coming from the sun, some of the particles that make up the solar wind get trapped in the magnetic field, mostly around the North Pole and the South Pole. As these particles travel in the earth’s magnetic field, they start hitting gases in the earth’s atmosphere. The energy of the collisions between these particles and the atmosphere’s gases produces beautiful colors in the sky. These displays of color are called **auroras** (uh roar’ uhs), and they are easiest to see if you live in the northern or southern parts of the globe.



This is a photo of an aurora as seen in the north. Northern auroras are often called the “Northern Lights.”

Explain about the earth’s magnetic field in your own words.