Material:
Three test tubes in a rack,
a piece of Plexiglas or thick frosted glass (with edges taped for safety, if necessary),
a pan to catch drips; oil,
water and honey in separate test tubes.

Demonstration:
One by one pour the liquids so they run down the glass into the pan. Begin with water, then oil, then honey.

Follow-up activity:
Heat the viscous liquid, which will then flow more quickly.
When heat is applied to a liquid, its viscosity is decreased and its liquidity is increased.

The Sun and the Earth

The Movements of the Earth

Remember God With No Hands? We are going to continue with the story of the earth and its movements.

Tie a bolt or other weight to the end of a string. Twirl it around over your head.

The earth was so happy to be born that it went around and around the sun. What do you think my hand represents? This bolt is like the earth, going around the sun. The string is like the attraction the sun has for the earth. My hand is like the force of the sun's gravity, keeping the earth from spinning off into space. Since this pull is so strong, have you ever wondered why the earth doesn't fall into the sun. This is called centripical force.

Fill a bucket 1/3 (no more than 1/2) with water. Tie a rope to it or hold it with your hand and swing the bucket in a wide circle around and over your head.

What keeps our world from falling into the sun is the same force that pushes out on the water. This is called centrifugal force.

It takes the earth a whole year to make a complete run around the sun. That is not the earth's only movement though. The earth also rotates around itself. You know how hot it gets in summer?

Show chart 7A

We are going to spend some time speaking about the movement of the earth as it rogates around its poles.

The sun is very hot, hotter than you can even imagine. But it is very far away and the heat radiates in all directions. If you divided the sun's heat into a billion parts, the heat the earth receives would only be two parts of that billion.

Even with only that two-billionth part of the sun's heat, the earth would burn up if it were not for the turning of the earth.

Show chart 8A

The side facing the sun would be so hot that everything would be in flames. The side not facing the sun would be unbearably cold. Everything would freeze.

Demonstrate the two movements of the earth by placing a bare light bulb in the center of an open space. Have a small globe or ball to represent the earth. Walk around the light bulb (sun) in an elliptical fashion, tilting the sphere representing the earth to simulate the earth's axis and rotating the sphere.

As the earth goes on turning around, part of it goes into shadow, and that part cools off. As the cooled portions return to the light, they become warmer. Then again the warmed part returns to shadow and cools off.
Put a finger or tape a dot onto a given spot on the globe and show its movement into light and shadow, day and night.

If the earth were not turning on itself, we would not have any day and night. Some parts would always be dark and some parts would always be light. Indicate the marked spot again.

Show chart 9A

It is just coming out of shadow now and it is dawn. As the earth rotates, this part becomes lighter and lighter until it is noon. Then the earth continues turning into shadow and we have sunset, then night.

Again, take up the globe or sphere representing the earth.

At any moment it is always dawn somewhere and sunset somewhere. Using your finger, draw an imaginary line from "pole" to "pole". Now all these places are having dawn. There are also places where it is either noon, afternoon, sunset, night, and midnight. In reality, we don't see or feel the earth moving. We seem to see the sun going up and down.

Think about when you travel in a car. Sometimes it seems that the scenery is moving as well as you. In the same way, because the earth is moving, we seem to see the sun moving.

Show chart 10A.

It takes the earth 24 hours to take a complete turn. We divide this in half – 12 hours of day and 12 hours of night. When the sun comes up, the earth begins to get warmer. The coldest part of the day is just before dawn because the earth has had a long time to lose it heat. You might think the warmest time of the day would be when the sun was directly overhead at noon. But the hottest part is between 1 and 2 in the afternoon because the earth has absorbed the sun's heat for 8 hours. Gradually the earth begins to cool off again. When the sun's rays are perpendicular they are hotter and more intense because they are more concentrated.

The power of the sun's rays may be demonstrated with a magnifying glass and piece of paper. Perpendicular rays are hotter than slanting or oblique rays. At noon is when each area receives the most perpendicular rays of the sun. Our use of AM and PM comes from the position of the sun. The highest point reached by the sun during the day is known as the meridian.

Take marker, crayon, or string to indicate meridian on sphere.

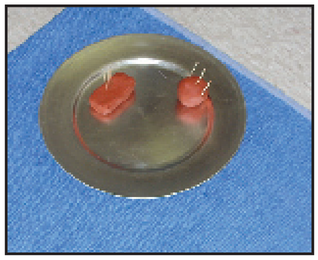
Humans have measured the earth in many ways. After each degree of the globe, humans have drawn imaginary lines going around.

Show a regular globe, indicating lines of latitude or longitude.

This is a natural point for breaking off in the study of latitude (Latin, length) and longitude (Latin, long).

Introduction to the Zones

When the sun is directly overhead, the sun's rays fall more or less perpendicular. However, there are parts of the earth where the sun's rays never fall perpendicular. How could this be? It is because the earth is a sphere.



Put three toothpicks parallel into a slab of plasticene.

Are these rays perpendicular? Yes.

Put three toothpicks into a ball of plasticene.

Are these perpendicular? No.
It is so with the earth. Where the rays fall perpendicular, they get concentrated in a small area. Where the rays fall obliquely, they spread out in a large area.

Show chart 11A

Use a flashlight with a strong beam. Shine it on black paper with the lights out in the room. Straight down, the rays are concentrated in a small area. Keep slanting to see the result when the rays are oblique. They cover a much larger area. You can remind the children of the demonstration with the magnifying glass, if that was done.

Show chart 12A

In one area, there can be more perpendicular rays. This chart shows that the same number of oblique rays will not fit into the same area.

Show chart 13A

The part of the earth receiving the direct rays all year long receives the most intense heat. At the equator the earth bulges out somewhat and is nearer to the sun.

Show chart 14A

The rays must come through layers of air to reach the earth. Some heat is absorbed by this air. The oblique rays have so much air to pass through that by the time they reach earth, they have lost much heat. The vertical rays carry more heat because they pass through less air. This is another reason why the areas of the earth that do not receive the perpendicular rays are much colder.

With the human tendency toward a mathematical mind, we have tried to find the exact limits of the point beyond which the rays never fall perpendicular. There are two of these imaginary lines. The one in the north is given the name of Tropic of Cancer. The line in the south is called the Tropic of Capricorn. Exactly in the middle of these two lines is the equator.

These may all be located on a globe.

Time Zone Chart

Layout beginning in our time zone.

Here we have a world map divided into 24 sections. There are 24 clocks to accompany this chart, 12 with a red border to indicate day and 12 with a black border to indicate night.

Lay out the clocks in sequence from left to right. Begin with 6 p.m., which is black. Continue through the night. After 5 a.m. lay out 6 a.m., which is red. Then arrange the clocks over the chart.

Let's suppose it's 8 a.m. in (your hometown). What time would it be in London?

Locate London on the map. Put the red 8 a.m. clock over your own town and a white strip over that longitude to represent day. The next zone to the right is one hour later – 9 a.m. (Lay out white strip).

Continue until reaching London. Change to black strips for night when a night time period is reached. One can also work backward, moving towards the left and demonstrating to the child that as one travels west one moves an hour earlier per time zone.

It is 12:00 midnight - the clock is black.
It is 1:00 am - it is still night so the clock is black.
It is 2:00 am - it is still night so the clock is black.
...
It is 6:00 am - it is dawn - the clock is red.
It is 7:00 am - it is light now - the clock is red.

The Solstices and Seasons

We have looked at the rotation of the earth and its consequences. There is another movement of the earth – that of the earth around the sun. In olden times, when humans still believed it was the sun and not the earth which moved, they noticed that the sun seemed to rise in a slightly different place every day.

From a certain place where it rose in spring, it seemed to move north. It traveled just so far north, then seemed to stand still a day before beginning its return journey. Again it would reach the point where it had started, then went south until it reached another point of standing still and started north again. This day when the sun seemed to stand still is called the solstice. (L. sol, sun; stare, to stand)

There are 2 solstices: June 21 – summer solstice
December 21 – winter solstice

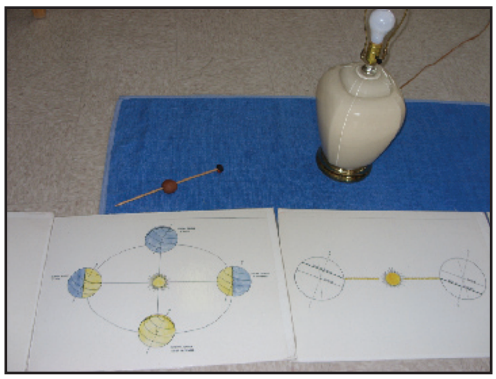
On the day of the summer solstice the sun's rays fall perpendicular to the Tropic of Cancer.

On the day of the winter solstice the sun's rays fall perpendicular to the Tropic of Capricorn.

In between these two points in the journey are the two days when the sun's rays fall perpendicular to the equator. These days are each called an equinox (L. aequus, equal; nox, night) because these days have an equal day and night. The day part is the same length as the night part.

On the day of the winter solstice, the night is very long and the day is short. As the sun moves north, the days begin to get longer until the equinox when the day and night are of equal length. Then the sun's journey continues, with the days getting longer, until the summer solstice, when the day is very long and the night short. The days then become shorter, the nights longer until day and night are equal again at the next equinox. This is a cycle that never ends.

But why does this happen? Why are the days and nights not always equally long? This happens because the earth moves through space tilted on itself.



Not like this:

Put a knitting needle or dowel through a plasticene ball and rotate upright.

Like this:

Tilt the ball on the imitation axis. If possible, have a bare bulb shining in the middle of a large space.

If the earth moved through space vertically, we would have exactly half day and half night. *(Move "earth" around "sun" vertically).* But that is not how it happens. *(Tilt and move around sun. Be sure to point to the Northern Hemisphere.)*

As the earth moves toward the longest day, the place where we live is getting warmer. We are exposed to more of the sun's rays. This is our summer. The shortest, coldest days are our winter.

Show chart 15A
Show chart 16A

Imagine that you are watching the sun's perpendicular rays strike the Tropic of Cancer. If you drew an angle from the Tropic of Cancer to the center of the earth and back to the equator, the measure of that angle would be 23 1/2 degrees. That is how we get the latitude for the Tropic of Cancer. The Tropic of Capricorn is also 23 1/2 degrees from the equator.

Show chart 17A

The sun's rays are perpendicular to the equator at the equinoxes, but at other times of the year, as you know, they are north or south. On December 22, they are perpendicular to the Tropic of Capricorn, on March 21, the equator, on 21, the Tropic of Cancer, and on September 21 they are back at the equator.

What happens at the poles is different. During the summer solstice, it is day at the North Pole all the time. During the winter solstice, the North Pole is night all the time. It is the other way around for the South Pole.

The Zones

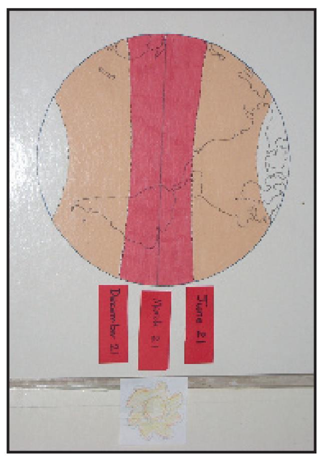
Remember that we said there are parts of the earth where the sun does not rise for days at a time? Humans wanted to measure these places, so they drew imaginary lines through all the places where for one day a year the sun does not rise. These are places where it is night for a long time. This imaginary line, which is the limit of the zone where the sun never sets, is the Artic Circle in the Northern Hemisphere and the Antarctic Circle in the Southern Hemisphere.

Use a good globe to point this out.

The sun never rises one day at the circle. Then it does not rise for more and more days until we reach the Pole where there are six months of night.

Show chart 18A

We have given names to these zones: Torrid Zone – torredoes, dried up
Temperate Zones – receive oblique rays
Frigid Zones – the coldest



Work Chart:
Have a mute work chart with a cut out sun and four cards: dates on one side, names of solstices and equinoxes on the other. Have the child lay out, explaining relation of the zones to the movements of the earth and the perpendicular rays of the sun.

Work Chart for the Seasons

Material:

Chart divided into rectangles corresponding to the zones of the earth, labeled with the names
Colored strips:
    2 each dark red, red, white;
    1 each blue, brown, green
Moveable sun
Date cards similar to Zone work chart

Presentation:

Begin by noticing the zones on the chart. The red line in the center is the equator.
Point out strips and sun with dates.
We'll put the sun by the Tropic of Cancer. What day is this? (June 21)
What is the Temperature like in our zone? (North Temperate has summer)
We'll use the red strips to show summer because it's hot.
Now at the equator (indicate N. Tropic zone) it's very hot, so we'll put this one (deep red) there.
What about the Arctic? (Cold, but the warmest it gets – pink strip)
Below the equator is hot (deep red).
The South Temperate is having winter (white strip).
In the Antarctic it is very cold indeed (blue strip).

Do the Northern Hemisphere first, beginning with the child's location. Move the sun to the Autumn Equinox and repeat the exercise. Green strip represents spring, brown strip is autumn.

Repeat with the sun in all positions. Get the child thinking about what happens in other parts of the world. Relate both to where the sun is now and the previous season.