

Weather Watcher

SEASON, one of the four divisions of the year: spring, summer, autumn, and winter. The main factors in the march of the seasons are the length of the day and the angle at which the sun's rays strike the earth. Thus, the earth's movements in relation to the sun determine the seasons. Surprisingly, the distance of the earth from the sun is not the important factor in the seasons, for the earth (because its orbit of revolution around the sun is elliptical) is slightly closer to the sun during the winter of the Northern Hemisphere than during the summer.

The earth is inclined $23\frac{1}{2}$ degrees from an upright position, that is, a position perpendicular to the plane of the orbit of the earth. The direction and angle of this inclination do not change, but as the earth revolves around the sun its axis will be inclined at different angles in relation to the sun.

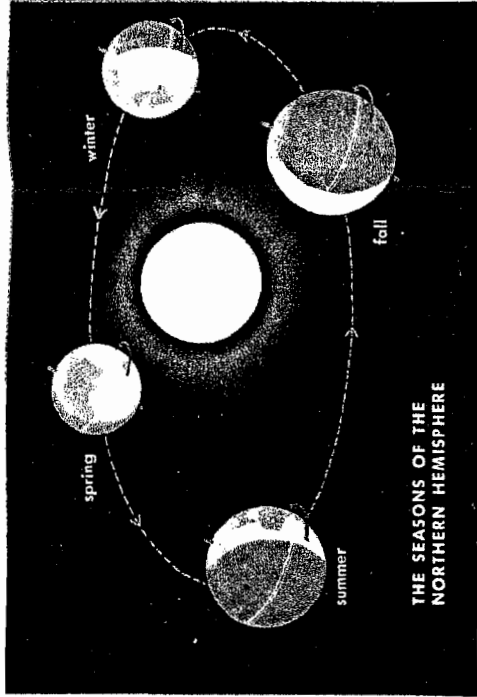
June 21, the summer solstice, is the beginning of summer in the Northern Hemisphere. On this day the North Pole of the earth's imaginary axis is inclined $23\frac{1}{2}$ degrees toward the sun. The rays of the sun are more nearly vertical, and hence more warming, in the Northern Hemisphere, because a unit cross section of rays passes through a lesser thickness of atmosphere and is concentrated on a smaller section of earth. This inclination of the earth also brings the parallels above the Equator into the sunlight, making the days longer everywhere in the Northern Hemisphere. In fact, all areas above the Arctic Circle will have a 24-hour day of sunlight on the summer solstice. The sun's rays are directly vertical at noon above the Tropic of Cancer, which is at $23\frac{1}{2}^{\circ}$ N latitude.

After June 21 the inclination of the earth's axis will shift in relation to the sun, so that the North Pole recedes from the sun, and on September 22, the autumnal equinox, the sun's rays will be vertical over the Equator at noon. The length of daylight on all the earth's parallels will be 12 hours. This is the begin-

What causes the seasons?

Investigation 3

name _____ class _____ team _____ seat _____ date _____



The cause of the seasons is the tilt of the earth's axis from a position perpendicular to the plane of its orbit. This inclination causes the North Pole to appear tilted away from the sun during the winter of the Northern Hemisphere and toward the sun in summer. At the equinoxes the sun's rays are distributed equally over both hemispheres.



sun at noon
December 22



sun at noon
June 22



The length of daylight and the angle at which the sun's rays strike the earth are the reasons why summer is warmer than winter. Above is the position of the sun at the solstices in relation to a house in the latitude of Washington, D.C. In winter the sun is lower on the horizon, and its east-west path is shorter than in summer.

ning of autumn in the Northern Hemisphere and of spring in the Southern Hemisphere.

The tilt of the earth's axis will continue to change in relation to the sun until the South Pole is toward the sun on December 21, the winter solstice. The North Pole will then be away from the sun, and the entire area above the Arctic Circle will be in darkness for 24 hours. All the earth above the Equator will be inclined away from the sunlight, so that the period of nighttime will be longer than the period of daytime.

The angle of the sun's rays will be vertical at noon over the Tropic of Capricorn, which is $23\frac{1}{2}^{\circ}$ S latitude, and the sun's rays will strike all the areas of the Northern Hemisphere more obliquely than in warmer seasons.

The North Pole will then begin to incline once more toward the sun; and by March 21, the spring equinox, the sun will once again be directly overhead at noon over the Equator.

These movements of the earth's axis in relation to the sun explain

If the Earth is closer to the sun in the winter, why is it colder?

What are the two main factors in the cause of seasons?

What is this angle of inclination they are talking about?

Standard S3a, S3b, S3c, S4b, S5a, S5c, S5d, S6d, S7c

Our goal is to gather background information that will help us understand why the Earth has seasons.