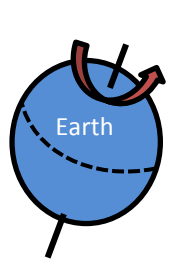
Name: _____ Teacher: _____ Pd. ___ Date: _____

STAAR Science Tutorial 27
TEK 8.7A: Earth's Seasonal & Day-Night Cycles

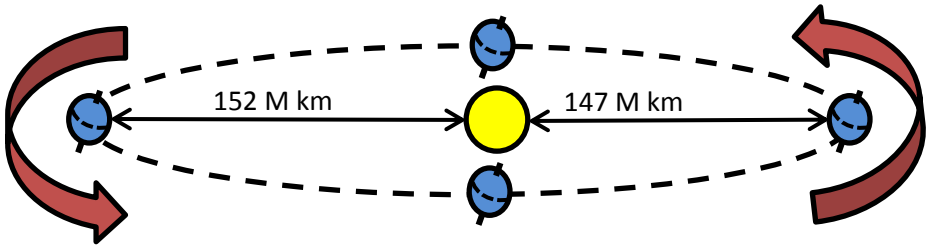
TEK 8.7A: Model and illustrate how the tilted Earth rotates on its axis, causing day and night, and revolves around the Sun causing changes in seasons.

The Earth spins, or rotates, on its axis once a day. This is the cause of the day—night cycle on Earth. In fact, the Earth's counter-clockwise rotation, not any motion of the Sun, is what makes the Sun seem to rise in the East and set in the West.

The Earth orbits, or revolves, around the Sun once in a year (365.25 days), also in a counter-clockwise direction, as viewed from over the North Pole. The shape of that orbit is almost a perfect circle, but is slightly "elliptical" (oval) in shape. The Earth is slightly closer to the Sun (147 million km) on about January 3rd each year, and slightly further away from the Sun (152 million km) on about July 4th each year. This 3% difference in the Earth to Sun distance during the year does NOT make any real difference in the temperature of our seasons.



ROTATION



REVOLUTION

The real cause of the seasons is the tilt of the Earth's axis, about 23.5 degrees. If the Earth's axis was not tilted, there would be no seasons on Earth—every day would be about the same temperature in any one place. Without tilt, every day and every place on Earth (except the poles) would have exactly 12 hours of daylight and 12 hours of night. It is the tilt that causes seasonal differences in the length of night and daylight—longer nights in winter and longer days in summer. It is the tilt that causes the Sun to be high in the sky in summer and low in the sky in winter. It is the combination of longer daylight hours and more direct sunlight that causes the heat of summer, and the combination of shorter daylight hours and less direct sunlight that causes the cold of winter.

The angle of the Earth's tilt does not change during the year. The Earth's North Pole axis always points to Polaris, the North Star. But the hemisphere of Earth that faces the Sun more directly DOES change during the year, as the Earth orbits around the Sun. On one day a year (the summer solstice, June 21st), the northern hemisphere is tilted

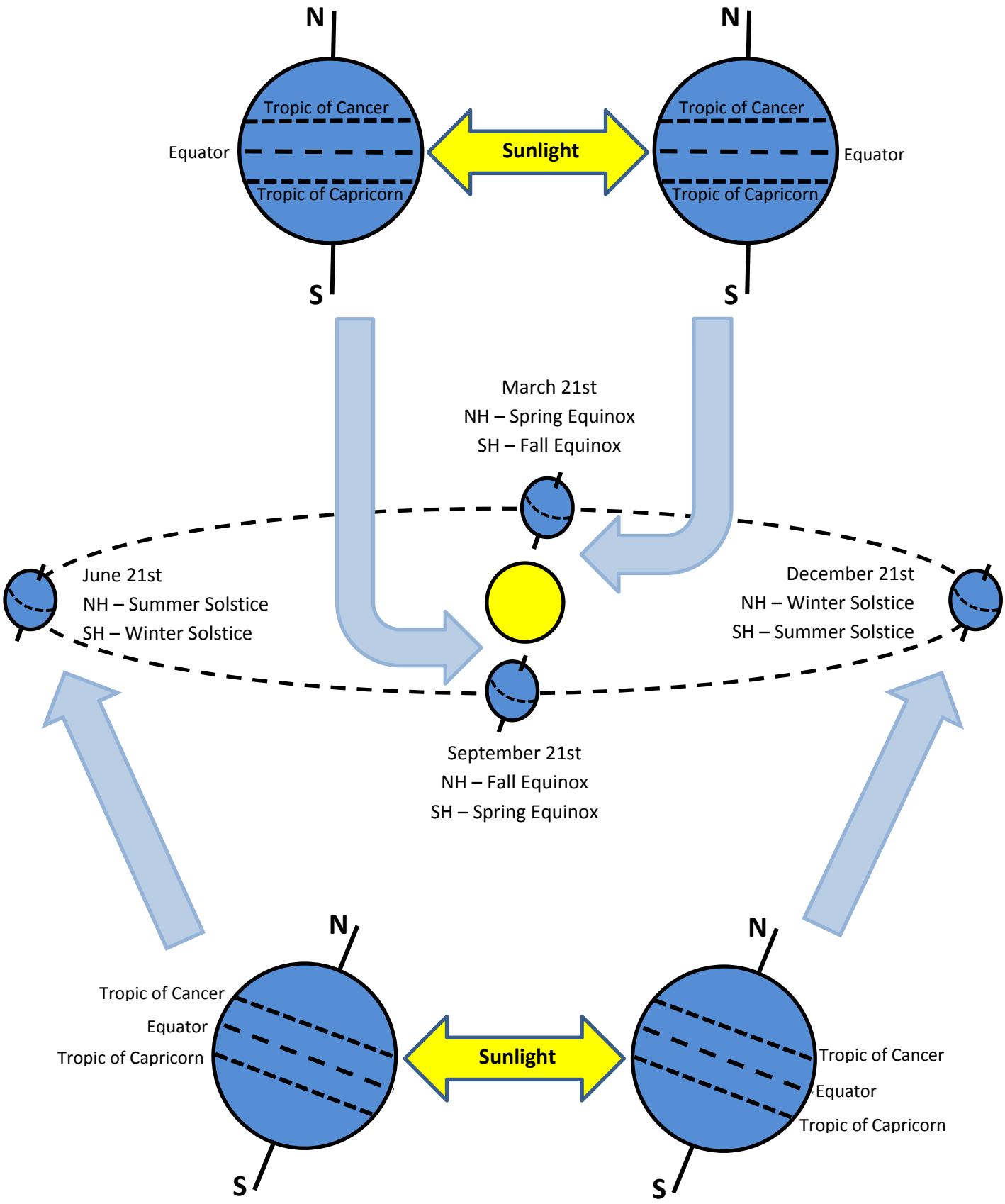
directly towards the Sun, and the Sun is directly overhead at the Tropic of Cancer, 23.5 degrees north latitude. Six months later (on the winter solstice, December 21st), the northern hemisphere is tilted directly away from the Sun, and the Sun is directly overhead at the Tropic of Capricorn, 23.5 degrees south latitude. On the two days halfway between those dates, both hemispheres face the Sun equally, the Sun is directly over the equator, and the length of day and night everywhere on Earth is exactly 12 hours each. These are called the spring (or "vernal") equinox (on March 21st in the northern hemisphere) and the fall (or "autumnal") equinox (on September 21st).

The seasons in the north and south hemispheres are the opposite of one another. In January, when it is winter in the northern hemisphere, it is summer in the summer hemisphere. In April, when it is spring in the northern hemisphere, it is fall in the southern hemisphere. In July, when it is summer in the northern hemisphere, it is winter in the southern hemisphere. In October, when it is fall in the northern hemisphere, it is spring in the southern hemisphere. Likewise, summer solstice in the northern hemisphere is the winter solstice in the southern hemisphere.

Between the Arctic Circle (66.5 degrees north latitude) and North Pole, and the Antarctic Circle (66.5 degrees south latitude) and South Pole, the apparent movement of the Sun across the sky daily and seasonally is different from the rest of Earth. At each pole, the Sun rises on the spring equinox and sets six months later on the fall equinox. Each 24 hour day during the summer, the Sun completely circles the horizon. At the Arctic or Antarctic Circles, the Sun does not set at all on one day, the summer solstice. In other words, on the summer solstice there is 24 hours of daylight and no night. Between 66.5 degrees latitude and the pole, the number of 24 hours days without a sunset increases as one moves towards the pole. In winter, the opposite occurs, with one or more 24 hour days with no sunrise, and 24 hours of darkness.

The greatest seasonal variation in daylight and night hours occurs at the North Pole and South Pole, and the lowest seasonal variation in daylight and night hours occurs in the tropics, between the Tropic of Cancer and Tropic of Capricorn, including the equator. In the tropics, the longest daylight period is 13 hours and shortest is 11 hours. In Dallas, the longest daylight period is about 14.5 hours and the shortest 9.5 hours. In southern Alaska, the longest daylight period is 19 hours, and shortest 5 hours.

The diagram on the next page shows an angled view down on the Earth's orbit, with the Sun in the center. (The shape of the orbit is not really this elliptical (oval)—the low angle of view needed to show the tilt in each season just makes it seem elliptical.) A close-up of the Earth in each position shows the latitude where the Sun's light is directly overhead. (A side view of Earth at the two equinox positions is used to show the angle of sunlight falling on Earth.) The solstice or equinox at each location is noted, as well as the season starting at that position and date.


N
Tropic of Cancer
Equator
Tropic of Capricorn
S
Sunlight
N
Tropic of Cancer
Equator
Tropic of Capricorn
S
March 21st
NH – Spring Equinox
SH – Fall Equinox
June 21st
NH – Summer Solstice
SH – Winter Solstice
December 21st
NH – Winter Solstice
SH – Summer Solstice
September 21st
NH – Fall Equinox
SH – Spring Equinox
N
Tropic of Cancer
Equator
Tropic of Capricorn
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Sunlight
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Practice Questions

1. The day and night cycle on Earth is caused by the Earth's _____ or r_____ on its axis.
2. The yearly cycle of seasons on Earth are caused by the _____ of the Earth's axis and the _____ or r_____ of the Earth around the Sun.
3. On January 3rd of each year, the Earth is _____ **(closest / farthest)** from the Sun, _____ million kilometers.
4. On July 4th of each year, the Earth is _____ **(closest / farthest)** from the Sun, _____ million kilometers.
5. The varying distance from the Sun to the Earth _____ **(is / is not)** the reason for the seasons.
6. On about December 21st, the _____ hemisphere is tilted directly towards the Sun, and it is their _____ solstice.
7. On about December 21st, the _____ hemisphere is tilted directly away from the Sun, and it is their _____ solstice.
8. On about December 21st, the Sun is directly overhead at the Tropic of _____, 23.5 degrees _____ latitude.
9. On about March 21st, the Sun is directly overhead at the _____, 0 degrees latitude, and it is the _____ equinox in the northern hemisphere and the _____ equinox in the southern hemisphere. On this day, there are _____ hours of daylight and _____ hours of night everywhere on Earth.
10. On about June 21st, the _____ hemisphere is tilted directly towards the Sun, and it is their _____ solstice.
11. On about June 21st, the _____ hemisphere is tilted directly away from the Sun, and it is their _____ solstice.
12. On about June 21st, the Sun is directly overhead at the Tropic of _____, 23.5 degrees _____ latitude.
13. On about September 21st, the Sun is directly overhead at the _____, 0 degrees latitude, and it is the _____ equinox in the northern hemisphere and the _____ equinox in the southern hemisphere. On

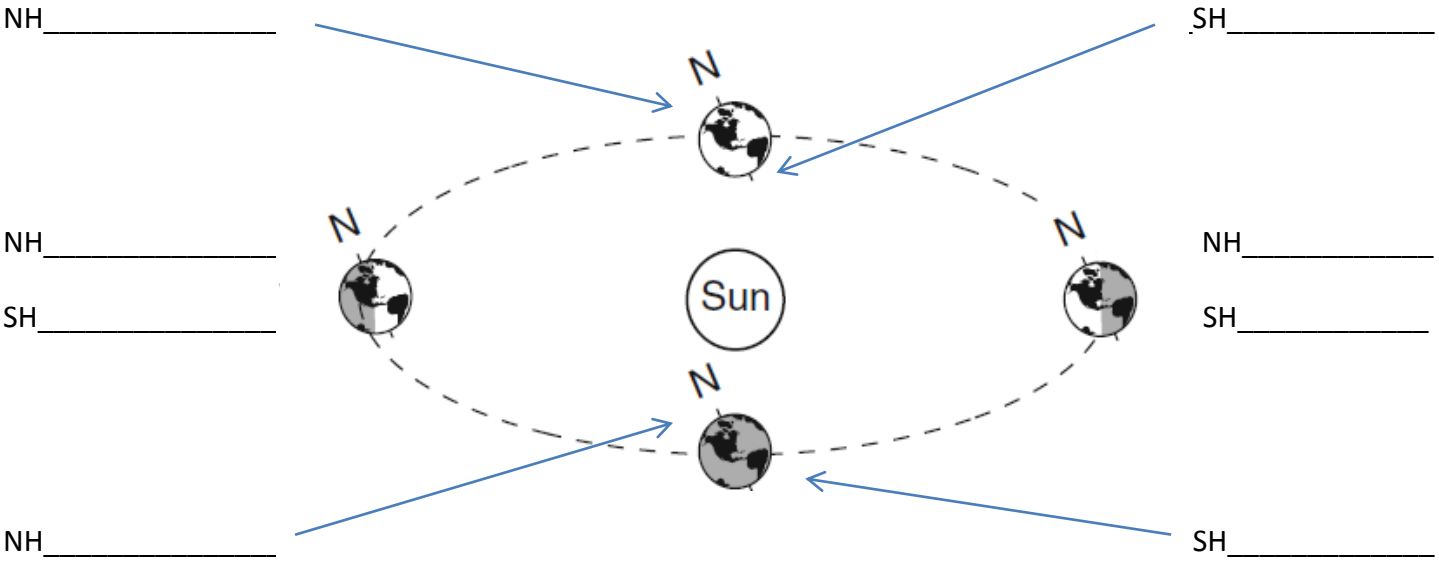
this day, there are _____ hours of daylight and _____ hours of night everywhere on Earth.

14. The Sun is highest in the sky during the _____ season, and lowest in the sky during the _____ season.

15. The number of daylight hours is the greatest during the _____ season, and the lowest during the _____ season.

16. The greatest seasonal variation in daylight and night hours occurs at the _____ and _____, and the lowest seasonal variation in daylight and night hours occurs at the _____.

17. In the diagram below, label the position of Earth at the start of each season for each hemisphere, in the blanks provided. (NH = northern hemisphere; SH = southern hemisphere) Also label with arrows the direction of Earth's spin (rotation) and orbit (revolution). Note that this diagram has a different viewpoint than the one in the explanatory text above—it is shown from the opposite side, reversing the direction of the Earth's tilt.



18. Label the Equator, Tropic of Cancer, Tropic of Capricorn, Arctic Circle and Antarctic Circle on the diagram below.

_____ Hemisphere

_____ Hemisphere