

Name: _____ Section: _____ Date: _____

EXERCISE A: EARTH MOTIONS AND EARTH-SUN RELATIONS

REFERENCE: Textbook: Geosystems: An Introduction to Physical Geography Ch.1 Essentials of Geography and Ch.2 Solar Energy to Earth and the Seasons , or on the links related to lab A [LINKS](#)

PURPOSE: The purpose of this laboratory exercise is to review the concepts of earth movements and the relationships between earth, its movements, and the sun. Earth movements and earth-sun relationships are critical to understanding why and when we experience day or night and summer or winter. They have direct influence on the seasons and climates experienced at different locations on earth and, indirectly, they influence the distribution of vegetation and fauna on earth as well.

KEY TERMS AND CONCEPTS:

*Hint: Be able to define and compare-contrast each of these terms for your exams!

equator	rotation
Arctic circle	rotational and angular velocity
Antarctic circle	revolution
Tropic of Cancer	perihelion
Tropic of Capricorn	aphelion
great circle	axial tilt (inclination)
small circle	axial parallelism
latitude	polarity
longitude	circle of illumination
parallels	solstice
meridians	equinox

Part I. Earth - Where are we?

The earth is the third of nine planets in our solar system. The shape of earth is not perfectly spheroid. It is oblate-spheroid, meaning it is slightly flattened pole-to-pole making the equator the largest circumference on earth. To help us understand and communicate about positions on earth, a grid system has been developed to identify specific locations. Lines of latitude and longitude make up the grid. Lines of latitude mark positions north and south of the equator. Latitudes are parallel to each other and are also called "parallels". Important parallels are the equator, Tropics of Cancer and Capricorn, Arctic and Antarctic Circles and north and south poles. Lines of longitude are also called "meridians". They mark positions east and west of the "prime meridian" which has a longitude of 0° and runs through Greenwich, England.

Part II. Earth Motion

The motion of earth turning on its axis is termed rotation. The motion of earth moving around the sun is termed revolution. The two motions are concurrent but have entirely different effects on the earth and on life on earth.

1. Fill in the following information about earth and its motions:

- (a) One rotation of the earth takes _____ hour(s) or _____ day(s).
- (b) The earth revolves around the _____.
- (c) The earth makes _____ revolution(s) per year.
- (d) The earth is tilted on its axis _____ degrees from perpendicular.
- (e) Label (name and degrees of latitude) the 5 important parallels in Figure 1 (p.7).

2. Listed below are 8 phenomena concerning earth environment. They are in no particular order, but they can be attributed to either earth rotation or revolution. Beside each phenomenon indicate whether it is due to rotation or revolution:

Time of year _____	Time of day _____
Seasons _____	July 4 _____
Direction (E/W) of sunrise _____	Day and Night _____
Noon _____	Midnight _____

Part III. Earth Rotation

1. Two ways to describe the direction of earth's rotation are:

_____ when looking down at the North Pole
_____ when looking at the equator

2. The circumference of the earth at the equator is about 24,900 miles or 40,075 km. Since the earth makes one rotation in 24 hours, a person at the equator moves with the earth at what rotational velocity? (HINT: rotational velocity = distance ÷ time)

_____ miles per hour
_____ km per hour

3. A person anywhere on earth other than the equator travels at a lesser speed. Why?

4. At the latitude of Boulder (40°N 105°W), one degree of longitude is approximately 53 miles or 85 km. At what velocity is a person in Boulder moving due to earth's rotation?

_____ miles per hour
 _____ km per hour

5. What other latitude would have the same velocity, in km per hour, as Boulder?

6. Rotation velocity is distance traveled over time. Questions (2) to (5) have demonstrated that places on earth with different latitudes have different rotational velocities. However, they all have the same angular velocity. Angular velocity is the number of degrees of rotation with time. All latitudes rotate 360 degrees in 24 hours and, therefore, they have an angular velocity of:

_____ degrees per hour

7. Calculate the rotation velocity for each of the following latitudes:
 (HINT: You need the angular velocity in Question (6) to calculate rotation velocity)

Latitude (N or S)	Approx. Length of 1° Longitude		Rotational Velocity	
	(miles)	(km)	(miles/hour)	(km/hour)
80°				
60°				
40°				
20°				

Part IV. Earth's Orbit of Revolution

1. The earth's orbit around the sun is not a perfect circle; it is elliptical. The closest distance from the sun to earth is called perihelion and the largest distance is called aphelion (Figure 2, p.8).
2. The date (month and day) of perihelion is _____ and the date of aphelion is _____. To summarize the distance between the earth and the sun, the distance is increasing from the months of _____ to _____ and the distance is decreasing from the months of _____ to _____. The average distance from the sun to earth is _____ miles or _____ km and the variation from perihelion to aphelion is _____ km.

Part V. The Annual March of the Seasons

1. Figure 2 shows four key positions of the earth as it moves around the sun. Each position marks a change in seasons. Indicate the date (month and day) and the name of each of the four positions.
2. There are three important features of Figure 2 which account for the change of seasons:
 - i. The earth revolves around the sun in a counter clockwise direction.
 - ii. The earth is tilted relative to its orbital path, called "axial tilt".
 - iii. The earth's tilt is always pointing in the same direction, called "axial parallelism" or "polarity".

Day length also varies throughout the year and with the change of seasons. The "circle of illumination" is the boundary that divides day and night. In Figure 2, it indicates the length of day (white) relative to the length of night (shaded) at each of the four positions.

Based on these facts, answer the following questions:

The north pole leans most directly toward the sun during which month? _____
During the same month, which hemisphere has long days? _____

What is the angle of inclination of the earth? _____
What is latitude of the Tropic of Cancer? _____ Tropic of Capricorn? _____

Part VI: Thought Questions

1. We know that seasons are caused by tilt and revolution, (a) explain why they are not caused by the distance between the earth and sun.

(b) Why might it be more difficult to convince residents of the southern hemisphere that the distance between the earth and sun is not the cause of the seasons?

2. Refer to Figure 1 (p.7). (a) What is the date? _____

(b) What is the season in Boulder? _____

(c) Is there anything special about the length of day and of the angle of sunlight in Boulder on this day.

3. Refer to Figure 2 (p.8).

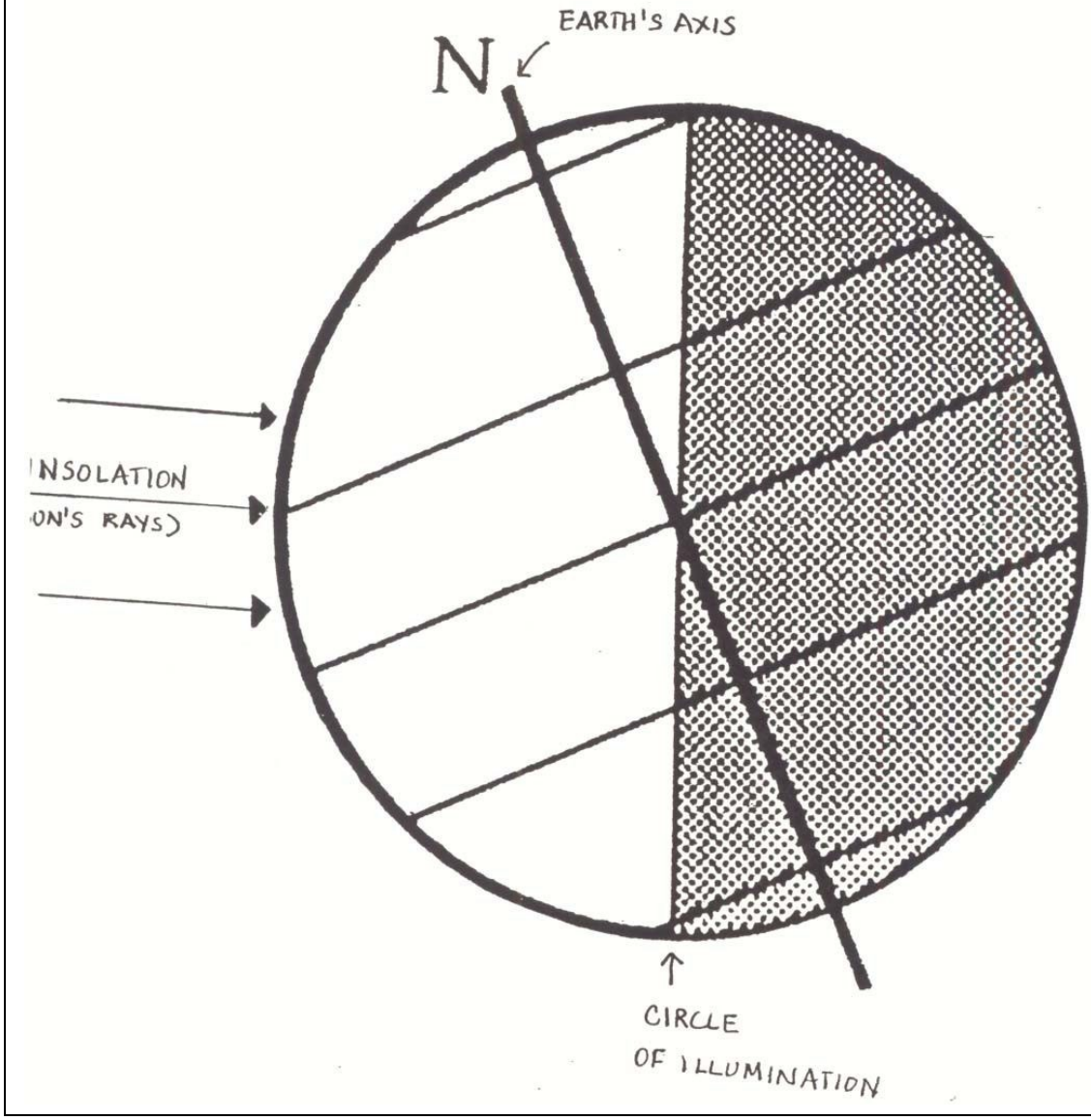
(a) What parallel is bisected (cut into two equal pieces) by the circle of illumination on both solstices?

(b) Compare the lengths of day at 23.5°N with the length of night at 23.5°S .

(c) Explain the unique position of the Arctic circle and the Antarctic circle with reference to the circle of illumination on the two solstices.

4. Today, are the varying lengths of daylight around the world becoming more equal or less equal. Explain your answer.

Figure 1



Name _____

Figure 2

