Earth's Rotation and Revolution

Teacher's Guide

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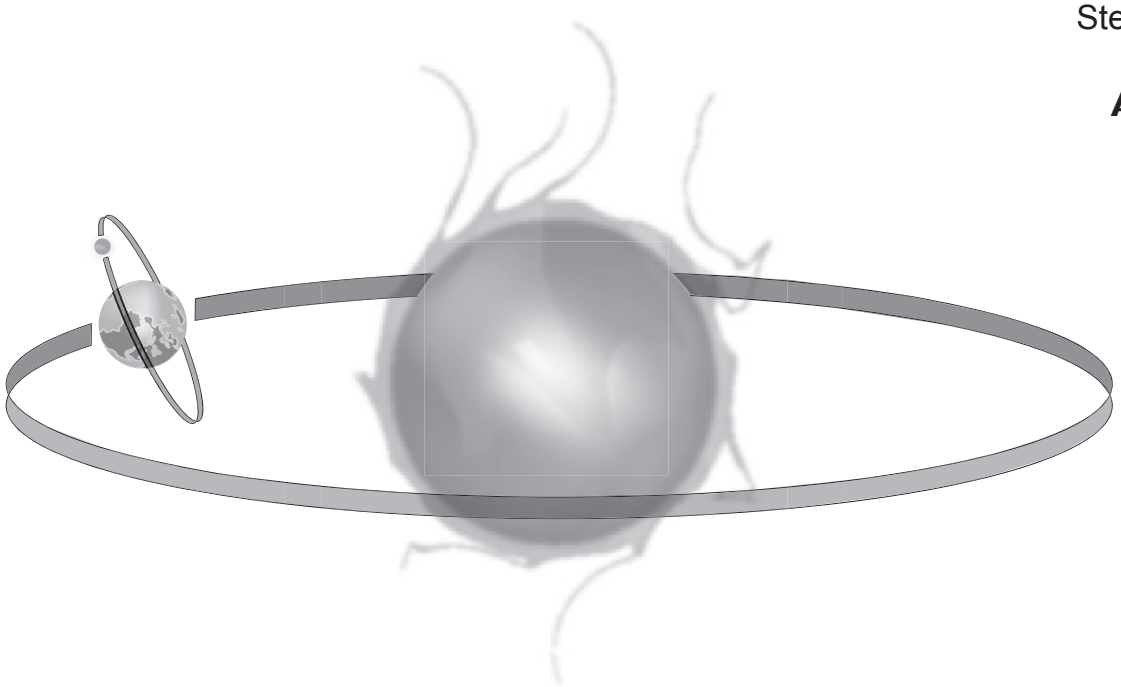

Elementary Science

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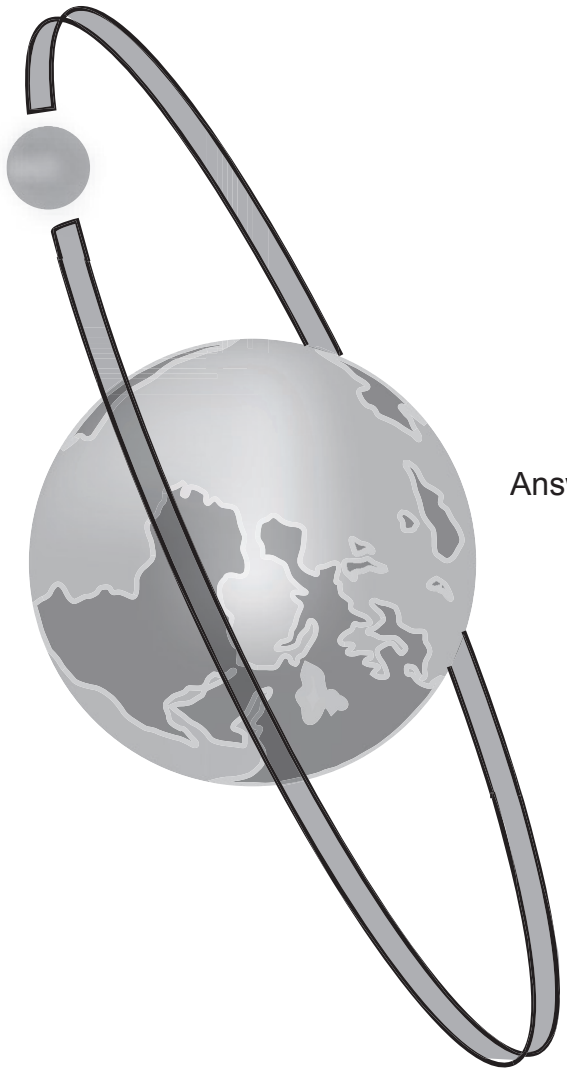
Table of Contents



National Standards Correlations

Benchmarks for Science Literacy
(Project 2061 – AAAS), Grades 3–5

By the end of the fifth grade, students should know that:

The Universe (4A):

- Things on or near the earth are pulled toward it by the earth's gravity.
- Like all planets and stars, the earth is approximately spherical in shape. The rotation of the earth on its axis every 24 hours produces the night-and-day cycle. To people on earth, this turning of the planet makes it seem as though the sun, moon, planets, and stars are orbiting the earth once a day.

National Science Education Standards
(Content Standards: K–4, National Academy of Sciences)
Earth and Space Science – Content Standard D:

As a result of their activities in grades K-4, all students should develop an understanding of:

- The sun, moon, stars, clouds, birds, and airplanes all have properties, locations, and movements that can be observed and described.
- Objects in the sky have patterns of movement. The sun, for example, appears to move across the sky in the same way every day, but its path changes slowly over the seasons. The moon moves across the sky on a daily basis much like the sun. The observable shape of the moon changes from day to day in a cycle that lasts about a month.

Student Learning Objectives

Upon viewing the video and completing the enclosed student activities, students will be able to do the following:

- Explain that the planets in our solar system revolve around the sun.
- Describe rotation as the process of Earth spinning on its axis.
- Define a day as the amount of time (about 24 hours) it takes Earth to make one complete rotation.
- Understand that while Earth is rotating on its axis, it is also revolving around the sun.
- Explain that Earth revolves around the sun every 365.25 days which we refer to as a year.
- Describe why every fourth year an extra day is added to the month of February, resulting in a leap year.
- Understand that the different seasons are the result of the position of Earth's tilting axis relative to the sun.
- On a diagram of Earth and the sun label the various seasons the northern hemisphere is experiencing.
- Differentiate between the terms solstice and equinox.
- State when the winter and summer solstices occur in the northern hemisphere, and describe how the amount of daylight differs between the two.
- Cite when the autumnal and vernal equinoxes occur.

Assessment

Preliminary Test (p. 14–15):

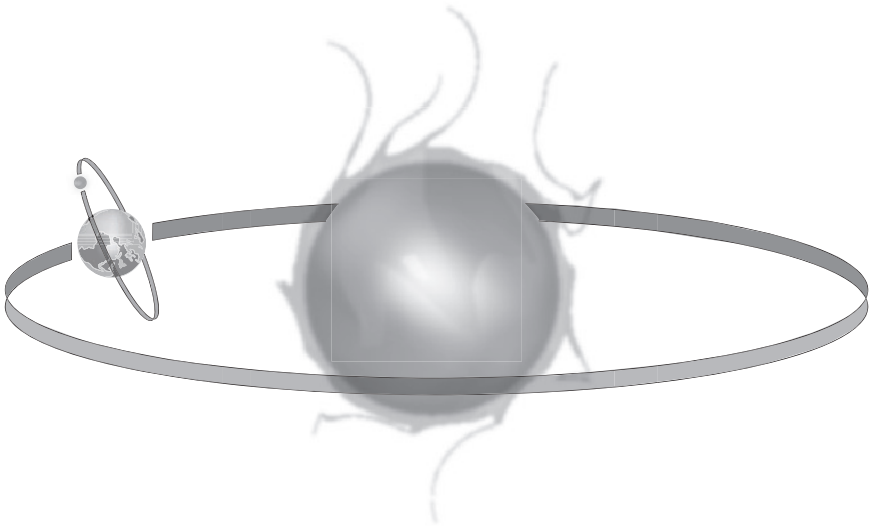
The Preliminary Test is an assessment tool designed to gain an understanding of students' preexisting knowledge. It can also be used as a benchmark upon which to assess student progress based on the objectives stated on the previous pages.

Post-Test (p. 16–17):

The Post-Test can be utilized as an assessment tool following student completion of the program and student activities. The results of the Post-Test can be compared against the results of the Preliminary Test to assess student progress.

Video Review (p. 18):

The Video Review can be used as an assessment tool or as a student activity. There are two sections. The first part contains questions displayed during the program. The second part consists of a five-question video quiz to be answered at the end of the video.



Introducing the Program

Before showing students the video program, ask them what time sunrise occurred this morning. Next, ask them what happens in a sunrise. Is the sun moving or is Earth moving relative to the sun? Explain to students that Earth is rotating around a central point called its axis at this very moment.

While the Earth is spinning, it is also moving through space at the amazing speed of 109,000 kilometers per hour! Ask students where Earth is moving in space. Write their answers on the board. Tell students to pay close attention to the video to find out where Earth is moving in space. Also, tell them to explain how the movement of Earth is responsible for the changing seasons. Following the program, ask students to answer these questions.

Program Viewing Suggestions

The student master "Video Review" is provided (p. 18) for distribution to students. You may choose to have your students complete this Master while viewing the program or do so upon its conclusion.

The program is approximately 14 minutes in length and includes a five-question video quiz. Answers are not provided to the Video Quiz in the video, but are included in this guide on page 12. You may choose to grade student quizzes as an assessment tool or to review the answers in class.

The video is content-rich with numerous vocabulary words. For this reason you may want to periodically stop the video to review and discuss new terminology and concepts.

Video Script

1. Most people sleep at night when it is dark,
2. ...and go to school or work during the day when it is light.
3. We take day and night for granted because there hasn't been a time in our lives when night and day hasn't existed.
4. But, what exactly causes day and night?
5. And, what causes the amount of daylight and darkness to vary throughout the year?
6. If you live in a northern area such as Canada,
7. ...or the northern United States, you are very aware that the weather in July,
8. ...is quite different than the weather in January.
9. Even if you live in a southern place such as Florida, you still notice an overall change in weather throughout the year.
10. What forces are responsible for these changes?
11. During the next few minutes, we are going to answer these questions and others,
12. ...as we explore Earth's rotation and revolution.
13. **Graphic Transition- Earth and the Solar System**
14. When watching a sunrise, is the sun moving, or is the earth moving relative to the sun?
15. This is not an easy question to answer. In fact, for thousands of years people thought the sun and other planets in our solar system moved around the earth.
16. It wasn't until the 1500's that a Polish astronomer named Nicolaus Copernicus developed the idea that Earth,
17. ...and the other planets in our solar system, actually revolve around the sun.
18. Revolve means to travel in an orbit around the sun.
19. An orbit is the path of a planet around the sun.
20. But how does Earth's orbit explain why the sun appears to travel across the sky from morning to evening?
21. This is not related to Earth revolving around the sun, but rather has to do with the way the Earth spins or rotates.
22. Notice how this coin appears to be spinning around a central point.
23. Earth too spins around a central point called an axis. Rotation is the process of Earth spinning on its axis.
24. Let's see how the rotation of Earth causes day and night.
25. **Graphic Transition - Day and Night**
26. Stand still for a moment. Do you feel Earth spinning?
27. Of course you don't, but depending on your location on Earth you could be rotating as fast as 1,600 kilometers per hour!
28. That's faster than a jet plane.
29. We cannot feel ourselves spinning because the planet on which we stand is so massive.
30. But we can see the result of Earth spinning when the sun rises and sets.

Video Script

31. Earth rotates around an imaginary line called an axis which goes through Earth from the north pole to the south pole.
32. Earth makes a complete rotation on its axis every 23 hours and 56 minutes, which we commonly round up to 24 hours.
33. **You Decide!** What do we call one 24 hour rotation?
34. We refer to one 24 hour rotation as a day.
35. **Graphic Transition- Earth Revolving**
36. We just described how Earth is always rotating on its axis.
37. At the same time, Earth is also revolving around the sun.
38. In fact, Earth is moving through space around the sun at the remarkable speed of 109,000 kilometers per hour!
39. Even at this high speed it still takes Earth a year, or more precisely 365.25 days, to make a complete revolution around the sun.
40. Notice that 365 is not an even number. There is 25/100th of a day extra for every revolution of Earth.
41. Over four years, this adds up to one extra day.
42. Therefore, every four years we add on the extra day to the end of February, as February 29. When this extra day is added, we call it a leap year.
43. So every 4th year has 366 days, and not the usual 365.
44. **Graphic Transition - Seasons**
45. A season is a term used to describe a certain time of the year.
46. New England, for example, is a place with four distinct seasons. Winter is a time of cold weather, snow, and limited daylight.
47. In spring, as the days grow warmer, the snow melts, grass grows, and flowers bloom. The amount of daylight increases.
48. In the summer season the daylight is long, and the days are warm.
49. And in the fall the weather cools, daylight shortens, and...
50. ...leaves turn brilliant colors before falling to the ground.
51. What is responsible for the changing seasons?
52. As we mentioned earlier, Earth is not positioned with the poles straight up and down, but rather is tilted on its axis at an angle of 23.5 degrees.
53. As Earth revolves around the sun, its axis always points at the same angle, but the direction it points relative to the sun changes.
54. Throughout the course of the year, different parts of Earth are angled more toward the sun than at other times of the year.
55. Therefore, different parts of Earth receive varying amounts of light and heat throughout the year.
56. North America receives less daylight due to the fact that the axis is pointed away from the sun. The winter season begins.
57. As Earth revolves, the axis begins to point more toward the sun as seen here in March and the spring season begins.

Video Script

58. As Earth continues to revolve, the axis points more toward the sun. In June the north end of Earth's axis is tilted toward the sun.
59. North America receives a lot of daylight and experiences the summer season.
60. As summer progresses, the days get shorter, as the axis begins to point away from the sun.
61. This is the position of Earth in late September.
62. **You Decide!** What season follows?
63. That's right, the fall season will take place over the next several months as the days shorten and grow cooler in North America.
64. **Graphic Transition- Solstices and Equinoxes**
65. On December 21st and 22nd this town in Vermont only experiences about nine hours of daylight and over 15 hours of darkness.
66. In the northern hemisphere, December 21st or 22nd is referred to as the winter solstice.
67. The shortest day of the year, in terms of daylight, occurs on the winter solstice.
68. On June 20th or 21st, in the northern hemisphere, is the summer solstice, the longest day of the year.
69. Between the two solstices are two equinoxes.
70. An equinox occurs when the sun is directly over the equator.
71. During an equinox the hours of daylight and darkness are equal everywhere on Earth.
72. In the northern hemisphere on March 20th or 21st is the vernal equinox. On the vernal equinox there are 12 hours of daylight and 12 hours of darkness.
73. **You Predict!** When do you think the other equinox occurs?
74. That's right, it occurs halfway between the summer solstice and the winter solstice.
75. The autumnal equinox occurs on September 22nd or 23rd...
76. ...which marks the beginning of the fall season.
77. **Graphic Transition- Summing Up**
78. During the past few minutes we have explored the fascinating topic of Earth's rotation and revolution.
79. We discussed how Earth revolves around the sun in an orbit.
80. And that a single complete revolution takes 365.25 days.
81. We then explored how Earth rotates on its axis every 24 hours, giving us day and night.
82. And we discussed how the tilt of Earth on its axis at an angle of 23.5 degrees accounts for the different seasons.
83. In summer, the northern hemisphere is tilted more toward the sun, providing long, warm days.
84. Whereas in winter months, the northern hemisphere is tilted away from the sun giving rise to shorter days and cooler temperatures.
85. Last, we discussed that the winter solstice is the shortest day of the year in the northern hemisphere,...
86. ...and the summer solstice is the longest day of the year.

Video Script

87. The equinoxes occur halfway between the two solstices when there are equal periods of darkness and daylight.
88. So the next time you admire a sunset,
89. ...or notice the change in seasons,
90. ...think about some of the things we discussed during the past few minutes.
91. You just might think about Earth's rotation and revolution a little differently.
92. **Graphic Transition- Video Assessment**

Fill in the correct word to complete the sentence. Good luck and let us get started.

1. Earth _____ around the sun.
2. Day and night are the result of Earth's _____.
3. Seasons are the result of Earth _____ toward or away from the sun.
4. In summer, North America is tilted _____ the sun.
5. In North America, the _____ solstice is the shortest day of the year.

Answers on page 12

Answer Key to Student Assessments

Pre-Test (p. 14-15)

1. b - revolution
2. a - orbit
3. c - rotation
4. a - axis
5. d - year
6. b - four
7. d - winter
8. b - decreases
9. c - winter solstice
10. a - equinox
11. false
12. true
13. true
14. false
15. true
16. In a sunset the sun is not moving, but Earth is rotating on its axis. When this occurs, a portion of Earth is spinning away from the sun, making it appear as if the sun is setting.
17. A day is the amount of time required for Earth to make one complete rotation. This takes about 24 hours.
18. Throughout the course of the year, different parts of Earth are angled more toward the sun than at other times of the year. This causes more or less sunlight to influence climate and weather patterns, thus causing different seasons.
19. An equinox is the time of year when there are equal periods of daylight and darkness.
20. The summer solstice, which occurs in late June in North America, is the longest day of the year.

Post-Test (p. 16-17)

1. b - four
2. c - winter solstice
3. d - winter
4. b - decreases
5. a - equinox
6. b - revolution
7. c - rotation
8. a - axis
9. a - orbit
10. d - year
11. true
12. true
13. false
14. true
15. false
16. An equinox is the time of year when there are equal periods of daylight and darkness.
17. The summer solstice, which occurs in late June in North America, is the longest day of the year.
18. In a sunset the sun is not moving, but Earth is rotating on its axis. When this occurs, a portion of Earth is spinning away from the sun, making it appear as if the sun is setting.
19. Throughout the course of the year, different parts of Earth are angled more toward the sun than at other times of the year. This causes more or less sunlight to influence climate and weather patterns, thus causing different seasons.
20. A day is the amount of time required for Earth to make one complete rotation. This takes about 24 hours.

Video Review (p. 18)

1. We refer to one 24 hour rotation as a day.
2. The fall season will take place over the next several months as the days shorten and grow cooler in North America.
3. The autumnal equinox occurs halfway between the summer solstice and the winter solstice (September 22nd or 23rd).

1. Earth ***revolves*** around the sun.
2. Day and night are the result of Earth's ***rotation***.
3. Seasons are the result of Earth ***tilting*** toward or away from the sun.
4. In summer, North America is tilted ***toward*** the sun.
5. In North America, the ***winter*** solstice is the shortest day of the year.

Answer Key to Student Activities

Vocabulary (p. 19)

1. day
2. rotation
3. revolution
4. year
5. 365.25 days
6. season
7. axis
8. summer solstice
9. equinox
10. winter solstice

Writing Activity (p. 20)

In the 1500's a Polish astronomer named Nicolaus Copernicus developed the idea that Earth and the other planets ***revolve*** around the sun. Today, we know it takes Earth 365.25 days, also called a ***year*** to orbit the sun. While Earth is orbiting around the sun, it is also ***rotating*** on its ***axis***. It takes Earth about 24 hours to make a complete rotation. We refer to this period of time as a ***day***. Earth is not positioned straight up and down, but is tilted at an angle of ***23 ½°*** on its axis. During the course of the year different parts of Earth are angled more toward the sun than at other times of the year which accounts for the different ***seasons***.

In Your Own Words (p. 20)

1. If you lived in Point Barrow, Alaska, there would be daylight for nearly 24 hours on the summer solstice (around June 21st). But, on the winter solstice (around December 21) there would be darkness for nearly 24 hours.
2. At a given point in time half the Earth is in darkness and half is in the sun's rays. Therefore, while New York is experiencing darkness, on the opposite side of Earth, Beijing is experiencing light. But, as Earth rotates New York will be exposed to the sun's rays and Beijing will fall into darkness.
3. Earth is tilted at an angle of 23½˚ on its axis. As Earth revolves around the sun throughout the course of the year, different parts of Earth are angled more toward the sun than at other times of the year. Therefore, different parts of Earth receive varying amounts of light and heat throughout the year, causing the different seasons.

The Reasons for the Seasons (p. 21–22)

Position	Season	Description
#1	Summer	The Earth's axis is pointed toward the sun. The daylight is long and the days are warmer.
#2	Fall	The fall season has begun. The Earth is tilted slightly away from the sun. The weather cools and daylight shortens.
#3	Winter	Winter has started because the Earth's axis is pointed away from the sun. In New England, there is cold weather, snow, and limited daylight.
#4	Spring	The Earth revolved and its axis has begun to point more toward the sun. The days grow warmer and daylight increases.

Heliocentric and Geocentric (p. 23)

1. A person living in the Middle Ages would think the sun was revolving around Earth causing day and night. They would see the sunrise, the sun move across the sky during the day, and the sunset. Therefore, they would think the Earth was the center of the solar system.
2. Nicolaus Copernicus proposed that Earth and the other planets revolved around the sun, and the moon revolved around Earth. He also explained that the Earth spins on its axis in a process called rotation which gave the appearance of the sun moving around Earth. These ideas were important because it gave scientists the basis of the sun-centered model of the solar system which allowed them to learn more about the solar system.
3. In the Geocentric Model it is believed that Earth is the center of the solar system where the sun and planets revolve around it. In the Heliocentric Model it is believed that Earth and the other planets revolve around the sun.

Sunrise and Sunset (p. 24–25)

Fairbanks, Alaska

DATE	SUNRISE (am)	SUNSET (pm)	LENGTH OF DAYLIGHT
Jan 15	10:26	3:36	5 hours 10 min
Feb 15	8:49	5:22	8 hours 33 min
March 15	7:09	6:52	11 hours 43 min
April 15	5:16	8:28	15 hours 12 min
May 15	3:28	10:09	18 hours 41 min
June 15	2:02	11:42	21 hours 40 min
July 15	2:53	10:58	20 hours 5 min
Aug 15	4:38	9:10	16 hours 32 min
Sept 15	6:13	7:17	13 hours 4 min
Oct 15	7:44	5:28	9 hours 44 min
Nov 15	9:27	3:44	6 hours 17 min
Dec 15	10:52	2:41	3 hours 49 min

Quito, Ecuador

DATE	SUNRISE	SUNSET	LENGTH OF DAYLIGHT
Jan 15	6:06	6:13	12 hours 7 min
Feb 15	6:11	6:18	12 hours 7 min
March 15	6:06	6:12	12 hours 6 min
April 15	5:57	6:03	12 hours 6 min
May 15	5:53	6:00	12 hours 7 min
June 15	5:57	6:04	12 hours 7 min
July 15	6:02	6:10	12 hours 8 min
Aug 15	6:01	6:08	12 hours 7 min
Sept 15	5:52	5:58	12 hours 6 min
Oct 15	5:43	5:49	12 hours 6 min
Nov 15	5:41	5:48	12 hours 7 min
Dec 15	5:51	5:59	12 hours 8 min

Des Moines, Iowa

DATE	SUNRISE (am)	SUNSET (pm)	LENGTH OF DAYLIGHT
Jan 15	7:39	5:09	9 hours 30 min
Feb 15	7:10	5:48	10 hours 38 min
March 15	6:26	6:21	11 hours 55 min
April 15	5:35	6:55	13 hours 20 min
May 15	4:55	7:27	14 hours 32 min
June 15	4:40	7:50	15 hours 10 min
July 15	4:53	7:47	14 hours 54 min
Aug 15	5:23	7:14	13 hours 51 min
Sept 15	5:55	6:24	12 hours 29 min
Oct 15	6:27	5:33	11 hours 6 min
Nov 15	7:03	4:54	9 hours 51 min
Dec 15	7:34	4:45	9 hours 11 min

1. Fairbanks, Alaska had the longest and the shortest days during the year.
2. Quito, Ecuador had relatively constant amounts of daylight throughout the year.
3. The days in Alaska and Iowa were longer in June than December because the Earth was tilted more toward the sun. Therefore, this part of Earth is exposed to more daylight in June than December.
4. The days in Ecuador were a more constant length than Alaska because it is located near the equator and is held in a relative constant position relative to the sun.

Pre-Test

Name _____

Circle the best answer for each of the following questions.

1. Which term describes the motion of the planets around the sun?
   a. rotation ***b. revolution*** ***c. completion*** ***d. galaxy***

2. The path of a planet around the sun is called an:
   a. orbit ***b. rotation*** ***c. moon*** ***d. galaxy***

3. The process of Earth spinning on its axis is referred to as:
   a. revolution ***b. ionization*** ***c. rotation*** ***d. ellipse***

4. Earth is tilted on its:
   a. axis ***b. side*** ***c. oval*** ***d. pole***

5. The amount of time it takes Earth to revolve around the sun is a:
   a. day ***b. 24 hours*** ***c. month*** ***d. year***

6. In the northern United States and Canada, there are how many distinct seasons?
   a. six ***b. four*** ***c. five*** ***d. two***

7. In what season is the northern hemisphere angled away from the sun?
   a. summer ***b. fall*** ***c. spring*** ***d. winter***

8. During the fall season in North America daylight gradually:
   a. increases ***b. decreases*** ***c. lengthens*** ***d. brightens***

9. The shortest day of the year in North America is the:
   a. New Year ***b. summer solstice*** ***c. winter solstice*** ***d. equinox***

10. When the hours of daylight and darkness are equal everywhere on Earth, the following occurs:
    a. equinox ***b. solstice*** ***c. summer*** ***d. eclipse***

Pre-Test

Name _____

Write true or false next to each statement.

11. _____ The sun revolves around Earth.

12. _____ Earth is tilted at an angle of 23 ½° on its axis.

13. _____ The rotation of Earth is responsible for day and night.

14. _____ In a leap year one day is subtracted from the calendar.

15. _____ An equinox occurs when the sun is directly over the equator.

Write a short answer in complete sentences for each of the following.

16. Describe what is occurring in a sunset.

17. What is a day?

18. What is responsible for the changing seasons?

19. What is an equinox?

20. What is the summer solstice?

Post-Test

Name _____

Circle the best answer for each of the following questions.

1. In the northern United States and Canada, there are how many distinct seasons?

   a. six ***b. four*** ***c. five*** ***d. two***

2. The shortest day of the year in North America is the:

   a. New Year ***b. summer solstice*** ***c. winter solstice*** ***d. equinox***

3. In what season is the northern hemisphere angled away from the sun?

   a. summer ***b. fall*** ***c. spring*** ***d. winter***

4. During the fall season in North America daylight gradually:

   a. increases ***b. decreases*** ***c. lengthens*** ***d. brightens***

5. When the hours of daylight and darkness are equal everywhere on Earth, the following occurs:

   a. equinox ***b. solstice*** ***c. summer*** ***d. eclipse***

6. Which term describes the motion of the planets around the sun?

   a. rotation ***b. revolution*** ***c. completion*** ***d. galaxy***

7. The process of Earth spinning on its axis is referred to as:

   a. revolution ***b. ionization*** ***c. rotation*** ***d. ellipse***

8. Earth is tilted on its:

   a. axis ***b. side*** ***c. oval*** ***d. pole***

9. The path of a planet around the sun is called an:

   a. orbit ***b. rotation*** ***c. moon*** ***d. galaxy***

10. The amount of time it takes Earth to revolve around the sun is a:

    a. day ***b. 24 hours*** ***c. month*** ***d. year***

Post-Test

Name _____

Write true or false next to each statement.

11. _____ An equinox occurs when the sun is directly over the equator.

12. _____ The rotation of Earth is responsible for day and night.

13. _____ The sun revolves around Earth.

14. _____ Earth is tilted at an angle of 23 ½° on its axis.

15. _____ In a leap year one day is subtracted from the calendar.

Write a short answer in complete sentences for each of the following.

16. What is an equinox?

_____

_____

_____

17. What is the summer solstice?

_____

_____

_____

18. Describe what is occurring in a sunset.

_____

_____

_____

19. What is responsible for the changing seasons?

_____

_____

_____

20. What is a day?

_____

_____

_____

Video Review

Name _____

While you watch the video, answer these questions:

You Decide!

1. What do we call one 24 hour rotation?

_____

_____

_____

You Decide!

2. What season follows?

_____

_____

_____

You Predict!

3. When do you think the other equinox occurs?

_____

_____

_____

After you watch the video, test your knowledge with these questions.

1. Earth _____ around the sun.
2. Day and night are the result of Earth's _____.
3. Seasons are the result of Earth _____ toward or away from the sun.
4. In summer, North America is tilted _____ the sun.
5. In North America, the _____ solstice is the shortest day of the year.

Vocabulary

Name _____

Use these words to fill in the blanks next to the sentences below.

Words					
365.25 days	revolution	winter solstice	day	year	
season	summer solstice	rotation	axis	equinox	

1. _____ The amount of time for Earth to make a complete rotation.

2. _____ The process of Earth spinning on its axis.

3. _____ The process of Earth orbiting the sun.

4. _____ The amount of time it takes Earth to completely orbit the sun.

5. _____ The number of days in a year on Earth.

6. _____ Term used to describe a certain time of year.

7. _____ An imaginary line that runs through the center of Earth from the North Pole to the South Pole.

8. _____ The day of the year which experiences the greatest amount of daylight.

9. _____ Occurs on two days in the year when the hours of daylight and darkness are equal everywhere on Earth.

10. _____ The day of the year which experiences the least amount of daylight.

Writing Activity

Name _____

Words	seasons	revolve	rotating	23½°	axis	day	year

Use the correct words from above to complete the sentences in the following paragraph.

In the 1500's a Polish astronomer named Nicolaus Copernicus developed the idea that Earth and the other planets _____ around the sun. Today, we know it takes Earth 365.25 days, also called a _____, to orbit the sun. While Earth is orbiting around the sun, it is also _____ on its _____. It takes Earth about 24 hours to make a complete rotation. We refer to this period of time as a _____. Earth is not positioned straight up and down, but is tilted at an angle of _____ on its axis. During the course of the year different parts of Earth are angled more toward the sun than at other times of the year which accounts for the different _____.

In Your Own Words

1. If you live in Point Barrow, Alaska, describe what the day would be like on June 21st. Contrast this to what a day would be like on December 21st. Use the terms daylight, darkness, summer solstice, and winter solstice.

_____

_____

_____

2. Explain why it can be dark in New York City, and sunny in Beijing, China at the same point in time. Use the terms rotation, sun, and Earth.

_____

_____

_____

3. Using the terms revolves, axis, tilt, sun, and angled, generally describe why the different seasons occur.

_____

_____

_____

The Reasons for the Seasons

Name _____

If you live in the northern United states or in Canada, you are quite familiar with the changing seasons. You certainly would not wear shorts and a t-shirt in winter. And, you probably would not wear a heavy coat, hat, and gloves in summer. Generally speaking, there are four main seasons: spring, summer, fall and winter. Each of these seasons has its own unique characteristics. Chances are you enjoy doing certain activities in each of the different seasons.

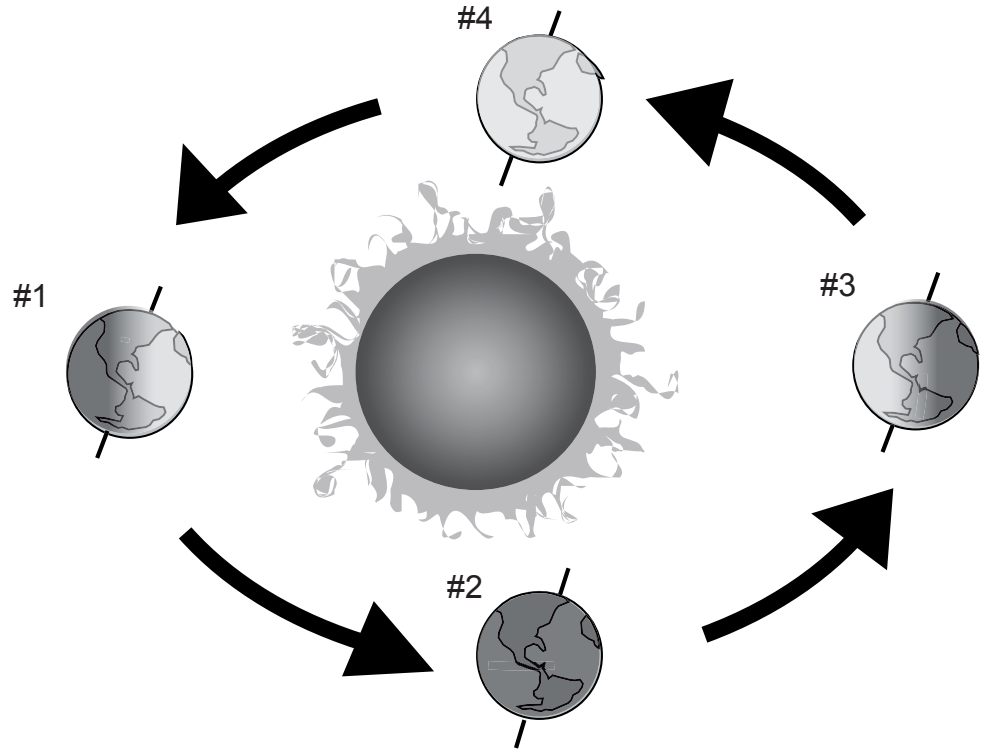
What forces are responsible for the different seasons? As you know, Earth is not positioned with the poles straight up and down. Instead, it is tilted on its axis at an angle of 23.5 degrees. As Earth revolves around the sun its axis always points at the same angle, but the direction it points relative to the sun changes. Throughout the course of the year different parts of Earth are angled more toward the sun than at other times of the year. This causes different parts of Earth to receive varying amounts of light and heat during the course of the year. For example, in winter, North America is tilted away from the sun thus receiving less light and heat. In summer, North America is tilted toward the sun receiving more light and heat.

Directions:

On the following page is a simple diagram (not drawn to scale) which shows Earth at four different locations during the course of a year as it revolves around the sun. Notice that next to each of the four different images of Earth there is a number. Each position of Earth corresponds to a different season in North America. In the chart below the diagram state the season and describe why you think it is the season you decided upon.

The Reasons for the Seasons

Name _____



Position	Season	Description
#1		
#2		
#3		
#4		

Heliocentric and Geocentric

Name _____

Directions: Read the following and answer the questions below.

If you lived in Europe in the Middle Ages, you would think that the sun rotated around Earth. And, why not? Everyday you would see the sunrise, notice the sun change positions as it moved across the sky during the day, and set on the horizon in the evening. If you were interested in observing the night sky, you would notice that the planets change their positions over the course of time. With this information it was widely thought that Earth was the center of the solar system with the sun and planets revolving around it. The term given to this earth-centered way of thinking about the solar system is referred to as the Geocentric Model. (the word "geo" means Earth, and "centric" means center).

The Geocentric Model was held for centuries until a Polish astronomer by the name of Nicolaus Copernicus in 1543 wrote about a new model of the solar system. Copernicus proposed that Earth and the other planets revolved around the sun. He also stated that the moon revolved around Earth. Copernicus explained that what appeared as the sun moving around Earth was actually the result of Earth spinning on its axis in a process called rotation. These ideas are the basis of the sun-centered model of the solar system, also called the Heliocentric Model. Since the time of Copernicus, scientists have learned a great deal more about the solar system including the exact orbits of the planets, and the presence of many moons which orbit around many of the planets.

Questions:

1. If you lived in the Middle Ages, describe how you would explain the cause of day and night.

2. What ideas did Nicolaus Copernicus propose and why were they important?

3. In a few sentences explain the differences between the Geocentric Model and the Heliocentric Model of the solar system.

Sunrise and Sunset

Name _____

Background: At some point in your life you have probably seen a sunrise or sunset. As you know, in a sunrise or sunset the sun itself is not actually moving, but instead Earth is moving relative to the sun. Earth is continually rotating on its axis. As Earth rotates, different parts of Earth come into daylight and other parts fall into darkness.

Have you ever noticed that sunrises and sunsets occur at different times throughout the course of the year? For example, if you live in a northern place such as Canada or Alaska, sunset occurs after 9:00 pm in the evening in June. But, in December sunset occurs in mid to late afternoon. The time of sunrises also varies. The time between sunrise and sunset is the amount of daylight. Therefore, the amount of total daylight also fluctuates. Sometimes the amount of daylight varies greatly throughout the course of a year depending on your location on Earth.

Directions:

1. In this activity you will take a look at the times of sunrises and sunsets throughout the course of the year at three different locations on Earth: Fairbanks, Alaska; Des Moines, Iowa and Quito, Ecuador. Locate these places on a globe.
2. Calculate the amount of daylight for each of the cities. Your teacher will show you how to calculate the hours and minutes of daylight using the sunrise and sunset times provided.
3. After you have completed the amount of daylight calculations for each of the three locations, take a few minutes to look at the information you just computed. Compare the amount of daylight between the months at a given location. Also, compare the amount of daylight between the different locations.
4. Answer the questions below on a separate piece of paper.

Questions:

1. Which location had the longest days and the shortest days during the course of the year?
2. Which location had days that had a relatively constant amount of daylight throughout the year?
3. Explain why the days in Alaska and Iowa were longer in June than in December.
4. Explain why the days in Ecuador were a more constant length than those in Alaska.

Sunrise and Sunset

Name _____

Fairbanks, Alaska

DATE	SUNRISE (am)	SUNSET (pm)	LENGTH OF DAYLIGHT
Jan 15	10:26	3:36	
Feb 15	8:49	5:22	
March 15	7:09	6:52	
April 15	5:16	8:28	
May 15	3:28	10:09	
June 15	2:02	11:42	
July 15	2:53	10:58	
Aug 15	4:38	9:10	
Sept 15	6:13	7:17	
Oct 15	7:44	5:28	
Nov 15	9:27	3:44	
Dec 15	10:52	2:41	

Des Moines, Iowa

DATE	SUNRISE (am)	SUNSET (pm)	LENGTH OF DAYLIGHT
Jan 15	7:39	5:09	
Feb 15	7:10	5:48	
March 15	6:26	6:21	
April 15	5:35	6:55	
May 15	4:55	7:27	
June 15	4:40	7:50	
July 15	4:53	7:47	
Aug 15	5:23	7:14	
Sept 15	5:55	6:24	
Oct 15	6:27	5:33	
Nov 15	7:03	4:54	
Dec 15	7:34	4:45	

Quito, Ecuador

DATE	SUNRISE	SUNSET	LENGTH OF DAYLIGHT
Jan 15	6:06	6:13	
Feb 15	6:11	6:18	
March 15	6:06	6:12	
April 15	5:57	6:03	
May 15	5:53	6:00	
June 15	5:57	6:04	
July 15	6:02	6:10	
Aug 15	6:01	6:08	
Sept 15	5:52	5:58	
Oct 15	5:43	5:49	
Nov 15	5:41	5:48	
Dec 15	5:51	5:59	