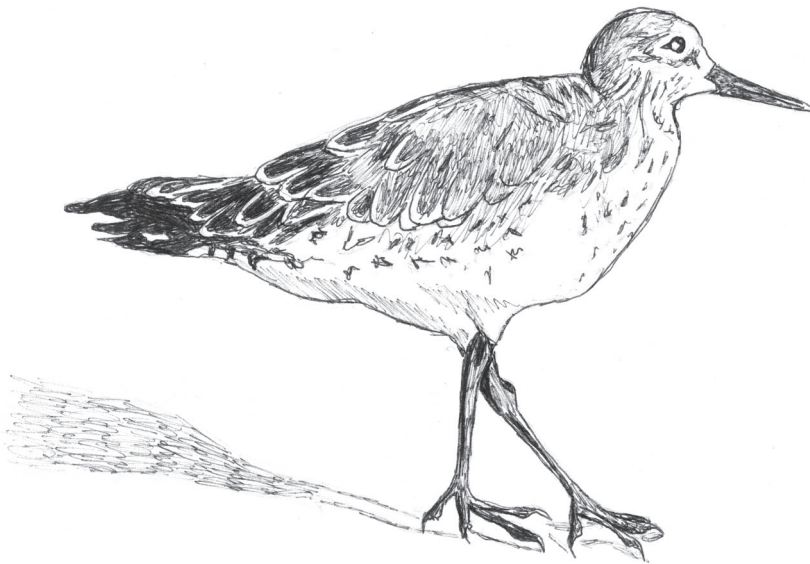


# Natural Cycles

## Teacher's Guide Middle School

Editors:

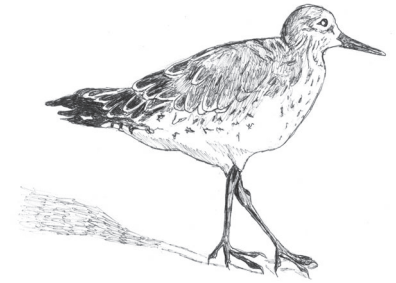
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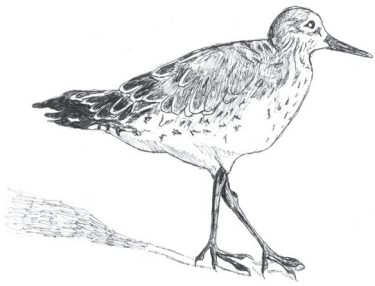
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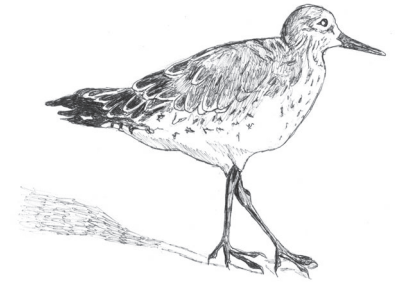
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# Viewing Clearances

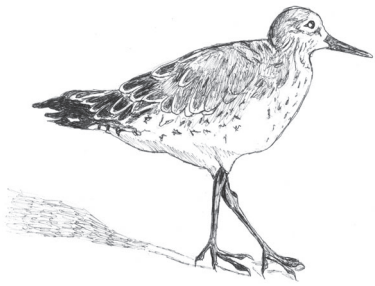
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# **A Message from our Company ...**

Dear Educator:

Thank you for your interest in the educational videos produced by the *Visual Learning Company*. We are a Vermont-based, family owned and operated business specializing in the production of quality educational science videos and materials.

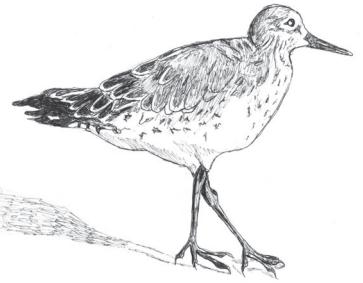
We have a long family tradition of education. Our grandmothers graduated from normal school in the 1920's to become teachers. Brian's mother was an elementary teacher and guidance counselor, and his father was a high school teacher and superintendent. This family tradition inspired Brian to become a science teacher, and to earn a Ph.D. in education, and lead Stephanie to work on science educational programs at NASA.

In developing this video, accompanying teacher's guide, and student activities, our goal is to provide educators with the highest quality materials, thus enabling students to be successful. In this era of more demanding standards and assessment requirements, supplementary materials need to be curricular and standards based - this is what we do!

Our videos and accompanying materials focus on the key concepts and vocabulary required by national and state standards and goals. It is our mission to help students meet these goals and standards, while experiencing the joy and thrill of science.

Sincerely,

Brian and Stephanie Jerome



# National Standards Correlations

## National Science Education Standards

(Content Standards: 5-8, National Academy of Sciences, c. 1996)

Life Science - Content Standard C:

As a result of their activities in grades 5-8, all students should develop an understanding that:

- An organism's behavior evolves through adaptation to its environment. How a species moves, obtains food, reproduces, and responds to danger are based on the species' history.

Earth and Space Science - Content Standard D:

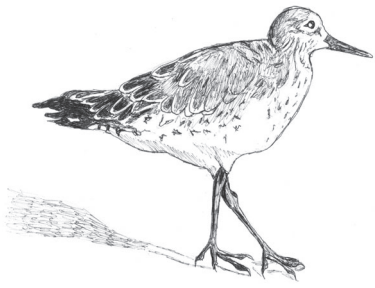
- Water, which covers the majority of the earth's surface, circulates through the crust, oceans, and atmosphere in what is known as the water cycle.

## Benchmarks for Science Literacy

(Project 2061 - AAAS, c. 1993)

The Physical Setting - The Earth (4 B)

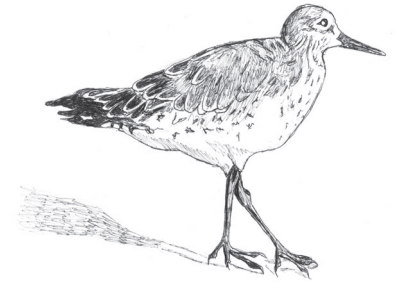
- The cycling of water in and out of the atmosphere plays an important role in determining climatic patterns. Water evaporates from the surface of the earth, rises and cools, condenses into rain or snow, and falls again to the surface. The water falling on land collects in rivers and lakes, soil and porous layers of rock, and much of it flows back into the ocean.



# Student Learning Objectives

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

- List three examples of natural cycles.
- Define the term circadian rhythm.
- Differentiate between nocturnal and diurnal cycles.
- Provide an example of living things that are predominately nocturnal or diurnal.
- Provide three examples of annual rhythms.
- Explain how many living things go through a state of dormancy, and differentiate between hibernation and estivation.
- Describe why some living things migrate, and provide a few examples of migratory animals.
- Diagram the various phases of the water cycle utilizing the terms evaporation, condensation, and precipitation.
- Explain how oxygen and carbon dioxide are continually cycled between plants and animals.
- Briefly describe some of the key points of the nitrogen cycle.



# Assessment

## Preliminary Test:

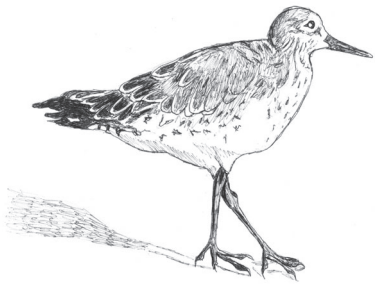
The Preliminary Test, provided in the Student Masters section, is an assessment tool designed to gain an understanding of student preexisting knowledge. It can also be used as a benchmark upon which to assess student progress based on the objectives stated on the previous pages.

## Video Review:

The Video Review, provided in the Student Masters section, can be used as an assessment tool or as a student activity. There are two main parts. The first part contains questions titled “You Decide” that can be answered during the video. The second series of ten questions consists of a video quiz to be answered at the conclusion of the video.

## Post-Test:

The Post-Test, provided in the Student Masters section, can be utilized as an assessment tool following student completion of the video and student activities. The results of the Post-Test can be compared against the results of the Preliminary Test to assess student progress.



# Introducing the Video

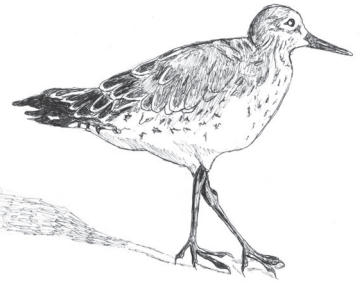
Before showing the video, ask students if they have ever seen geese or other birds migrating. Next, ask them to describe how plants in their community change over the course of a year. List these on the blackboard. Explain to students that these are all examples of cycles found in nature called natural cycles. Also, tell students there are many other natural cycles we often do not notice. These include the cycling of water, as well as the cycling of the gases oxygen and carbon dioxide. Tell students to pay close attention to the video to learn more about natural cycles we encounter everyday.

## Video Viewing Suggestions

The Student Master “Video Review” is provided for distribution to students. You may choose to have your students complete this Master while viewing the program or to do so upon its conclusion.

The program is approximately 20-minutes in length and includes a ten-question video quiz. Answers are not provided to the Video Quiz on the video, but are included in this teacher’s guide. 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.



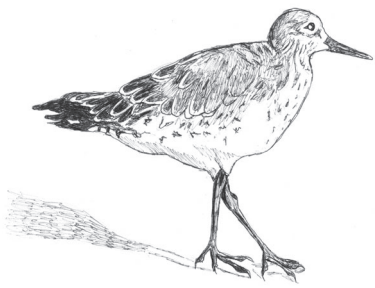
# **Student Assessments And Activities**

## **Assessment Masters:**

- Preliminary Test
- Video Review
- Post-Test

## **Student Activity Masters:**

- Water Cycle in a Jar
- Cycles in Biosphere 2
- A Migrating Marvel
- Vocabulary of *Natural Cycles*



# Video Script: Natural Cycles

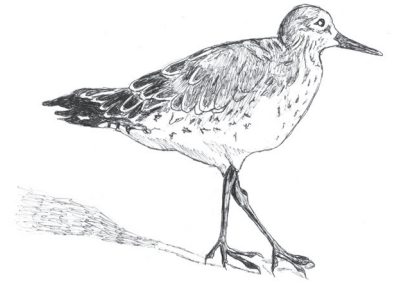
1. Have you ever seen geese flying south in the fall or north in the spring?
2. Or have you ever noticed Monarch butterflies flying south toward Mexico in early fall?
3. Or squirrels storing food for the long winter ahead?
4. Or perhaps you have seen trees in their brilliant fall colors?
5. These are all examples of living things going through cycles.
6. During the next few minutes we are going to take a closer look at cycles carried out by living things
7. We are also going to explore other cycles that are vital to our existence,...
8. ... those relating to the water we drink,...
9. ... the air we breathe,...
10. ... and the food we eat.

## **11. Graphic Transition – Cycles**

12. Think about some of the activities you carry out everyday.
13. Chances are you wake up in the morning at roughly the same time everyday.
14. You eat breakfast, lunch, and dinner at about the same time everyday.
15. And you go to sleep at around the same time every evening.
16. You repeat these activities with slight variation day after day, and year after year.
17. The repetition of behaving in a regular pattern can be referred to as a cycle.  
Another word often used to describe cycles is the term rhythm.
18. For example, at approximately the same time every fall in New England, the leaves of trees turn brilliant colors and eventually drop. This is a type of natural rhythm.
19. And in the spring, trees bud . . .
20. . . . and flowers on the forest floor bloom, exhibiting another example of natural rhythms.

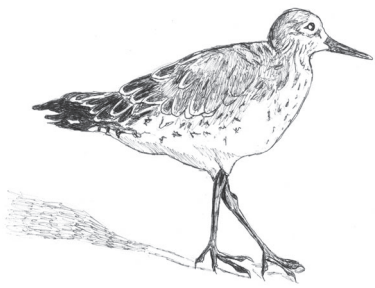
## **21. Graphic Transition – Circadian Rhythms**

22. As we already discussed, most of us carry out repetitive activities on a daily basis.
23. Behavior that is based on a daily or 24-hour cycle is called a circadian rhythm.
24. For example, animals such as deer and elk tend to remain concealed in forests during daylight hours
25. But they are more active at dawn and dusk, feeding mostly when it is darker and safer.
26. Many animals such as owls,...
27. ... moths,...
28. ... and bats are most active at night.
29. **You Decide!** What is the term used to describe living things that are most active at night?



## Script (cont.)

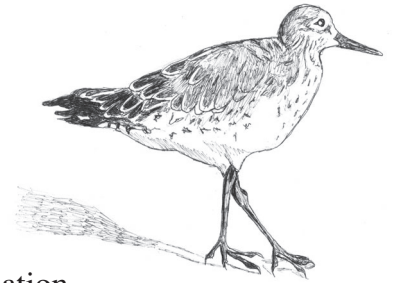
30. Organisms most active at night are said to be nocturnal.
31. Whereas other organisms such as insects and...
32. ... many plants are most active during the day.
33. Living things that are most active during daylight, such as many birds, are said to be diurnal.
34. Most people are diurnal – being very active during the day...
35. ... and sleeping at night
- 36. Graphic Transition – Annual Rhythms**
37. Believe it or not, these beautiful lush flowers are located in the desert.
38. They bloom for a short period of time, doing so only in the spring.
39. They bring a vibrant splash of color to the landscape,...
40. ...which at other times of the year appears rather bleak and lifeless.
- 41. You Decide!** How often do most flowers bloom in the desert?
42. Generally speaking, flowers in the desert bloom once a year, or on an annual basis.  
This is referred to as an annual rhythm.
43. There are many annual rhythms we can observe around us.
44. For example, many animals bare their young in the spring.
45. And during winter months, many plants and animals quietly rest. Let's take a closer look at this process.
- 46. Graphic Transition – Hibernation and Estivation**
47. Hibernation is a resting state which many animals go into during the winter.
48. In cold climates, animals such as salamanders...
49. ...and frogs hibernate in the mud in ponds.
50. Many animals have amazing adaptations, which enable them to hibernate for many months.
51. The body tissue of many frog species contains an antifreeze or glycol-like material, which prevents the tissue from being destroyed by freezing temperatures.
52. Some living things go into a state of dormancy in the summer instead of the winter.
53. Here in California the summers are hot and dry, making life difficult for some plants, such as these grasses.
54. Even though these grasses appear dead, they are merely going through a state of dormancy or a resting state called estivation.
55. When rain falls on these grasses in the fall and winter they begin to thrive once again.
- 56. Graphic Transition – Migration**
57. What do the following animals have in common:...
58. ...monarch butterflies,...
59. ...these birds called red knots,...
60. ...and these elephant seals?



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# Script (cont.)

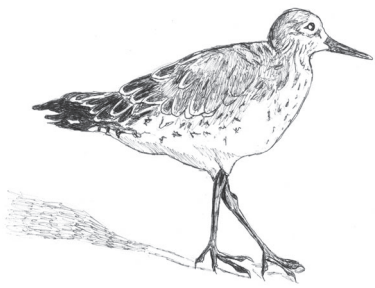
61. That's right – all these animals are migratory animals.
- 62. You Decide!** What is a migratory animal?
63. Migrating animals travel in cyclic intervals between breeding grounds and their winter habitats.
64. Animals, such as these birds called red knots,...
65. ...spend the cold months of fall and winter in Central and South America. In spring they travel thousands of kilometers north, finally nesting in the high Arctic, then returning to Central and South America in the late summer and fall.
66. Quite often animals, such as these geese, migrate from seasonably warm areas where food is abundant in winter months...
67. ... to their breeding grounds in the spring where they...
68. ...breed and raise their young.
69. Similarly, elephant seals spend a good portion of the year within the open ocean where they feed on squid, octopus, and fish.
70. They migrate from the sea to certain California coastal areas to breed, deliver and raise their young.
71. Other animals, such as horseshoe crabs, here in the Delaware Bay, migrate lesser distances.
72. In the spring of each year these crabs come ashore in enormous numbers from deeper water.
73. They come ashore in places such as the Delaware Bay to lay millions of eggs. The eggs in turn provide food for migrating birds.
74. These are just a few examples of the migrating habits of animals.
- 75. Graphic Transition – Water Cycle**
76. Have you ever wondered where the water running in a stream came from,...
77. ... or where rain comes from?
78. Water is vital to our existence,...
79. ... as it is to all living things
80. While you may not notice it, water is continually cycling from one form to another all around us.
81. The water cycle involves the process of evaporation, condensation, and precipitation.
82. Even though you can't see it, the water in this glass...
83. ... and the water in this lake are evaporating.
84. Evaporation is the process of liquid water turning into water vapor – a gaseous state.
85. Evaporation is an important process in that it causes puddles to dry up...
86. ... and clothes to dry.



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# Script (cont.)

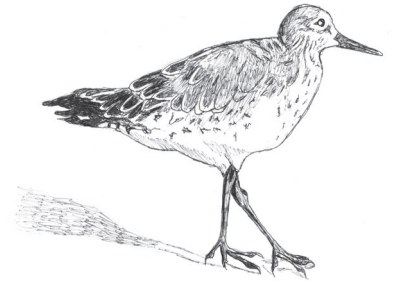
87. Water vapor returns to a liquid phase via the process of condensation.
88. This commonly occurs in the atmosphere where water vapor cools, forming clouds.
89. When water droplets in clouds become heavy, they fall in the form of rain,...
90. ...snow,...
91. ...or perhaps even hail.
92. This diagram illustrates the water cycle in which water evaporates, then condenses and returns to earth in the form of precipitation which collects in bodies of water, starting the cycle all over again.
- 93. Graphic Transition – Oxygen and Carbon Cycle**
- 94. You Decide!** What do all these animals need from the air?
95. That's right – they all need oxygen.
96. Oxygen is an extremely important gas needed by most animals that live on the land...
97. ...and even animals that live in the water.
98. The air around us contains approximately 21% oxygen.
99. Have you ever thought about what prevents animals from using up all the oxygen on the planet?
100. The answer lies in the fact that plants and...
101. ...other plant-like organisms, such as algae, continually resupply the air around us with oxygen.
- 102. You Decide!** What gas do plants breathe in?
103. Plants take in a gas called carbon dioxide.
104. Plants use carbon dioxide, water, and light from the sun to produce energy, water vapor, and oxygen.
105. People and other animals breathe out carbon dioxide.
106. Oxygen and carbon dioxide are continually cycled between plants and animals.
107. Unlike plants, animals cannot produce their own energy but must eat other things to produce energy.
108. The majority of the body's energy is obtained through carbohydrates. Carbohydrates contain carbon that is broken down by the body to create energy we need to carry out basic body functions.
109. A by-product of this energy creation process is carbon dioxide, which is expelled through the air we breathe out.
110. In turn, carbon dioxide is taken up by plants, completing the cycle.
- 111. Graphic Transition – Nitrogen Cycle**
112. We usually think of oxygen being the most important gas in the atmosphere because we breathe it.



---

## Script (cont.)

113. But, oxygen is not the dominant gas in the air around us.
- 114. You Decide!** What is the most dominant gas in our atmosphere?
115. Nitrogen is the most dominant gas, making up about 78% of the atmosphere around us.
116. Living things need nitrogen to function.
117. Animals obtain nitrogen, not from breathing it in, but by eating other things such as plants or other organisms that contain nitrogen.
118. Certain types of bacteria, however, are able to take nitrogen from the air to make nitrogen compounds. This process is called nitrogen fixation.
119. Nitrogen fixing bacteria may live in the water,...
120. ...in the soil...
121. ...or inside root structures of plants such as alfalfa or clover.
- 122. Graphic Transition – Summing Up**
123. During the past few minutes we have taken a look at some fascinating examples of natural cycles.
124. We saw how many living things exhibit patterns of behavior on 24-hour cycles, which are referred to as circadian rhythms.
125. We saw how some nocturnal animals tend to be more active at night,...
126. ...and how other diurnal animals tend to be more active during the day.
127. We also explored how many living things carry out rhythms on an annual basis, such as flowers blooming in the desert once a year.
128. We also saw how some animals such as geese seasonably migrate.
129. Birds, such as red knots, also migrate from their winter home in South America to their summer breeding ground in the Arctic.
130. Instead of migrating, many living things, such as frogs, go into a state of dormancy or hibernation, during cold winter months.
131. In some cases where summers may be hot and dry, some living things go into a state of dormancy referred to as estivation.
132. We also studied some natural cycles which affect all of us, including...
133. ...the continual cycle of water, involving the processes of evaporation, condensation, and precipitation. This process is referred to as the water cycle.
134. We also took a general look at how important the oxygen and carbon cycle is to all living things, both plants and animals, continually supplying oxygen, carbon dioxide, and energy for these organisms.
135. And we briefly discussed another important cycle – the nitrogen cycle.
136. So the next time you see leaves turn color in the fall,...
137. ...or the next time you admire flowers blooming in the spring,...
138. ...think about some of the cycles we have discussed during the past few



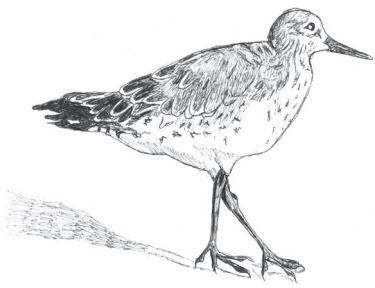
# Script (cont.)

minutes.

139. You just might look at the world around you a little differently.

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

1. Bird migration is an example of a \_\_\_\_\_ cycle.
2. Behavior based on a daily or 24 hour cycle is called a \_\_\_\_\_ rhythm.
3. Living things which are active during the day are \_\_\_\_\_.
4. The desert bloom is an example of an annual \_\_\_\_\_.
5. The period of winter inactivity for some animals is called \_\_\_\_\_.
6. Water vapor returns to a liquid phase via the process of \_\_\_\_\_.
7. \_\_\_\_\_ is the process of liquid water turning into a gaseous state.
8. The air around us contains about \_\_\_ percent oxygen.
9. Plants produce \_\_\_\_\_, which we breathe in.
10. Animals obtain \_\_\_\_\_ by eating plants or organisms.



# Answers to Student Assessments

## Preliminary Test (pgs. 20-21)

1. natural rhythm
2. oxygen
3. precipitation
4. cycle
5. estivation
6. migrating
7. carbon dioxide
8. plants
9. nocturnal
10. diurnal
11. true
12. false
13. true
14. false
15. true
16. false
17. false
18. false
19. true
20. true

## Video Review

### You Decide (pg. 22)

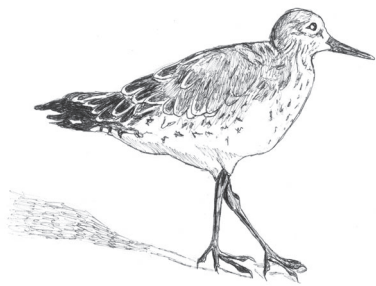
1. Organisms most active at night are said to be nocturnal.
2. Generally speaking, flowers in the desert bloom once a year, or on an annual basis.
3. Animals that travel in cyclic intervals between breeding grounds and their winter habitats are called migratory animals.
4. All of the animals need oxygen.
5. Plants take in a gas called carbon dioxide.
6. Nitrogen is the most dominant gas.

## Video Quiz: (pg. 22)

1. natural
2. circadian
3. diurnal
4. rhythm
5. hibernation
6. condensation
7. evaporation
8. 21
9. oxygen
10. energy

## Post Test (pgs. 23-24)

1. true
2. true
3. true
4. false
5. true
6. false
7. false
8. false
9. false
10. true
11. estivation
12. diurnal
13. oxygen
14. nocturnal
15. natural rhythm
16. carbon dioxide
17. precipitation
18. migrating
19. cycle
20. plants



## Answers to Student Activities

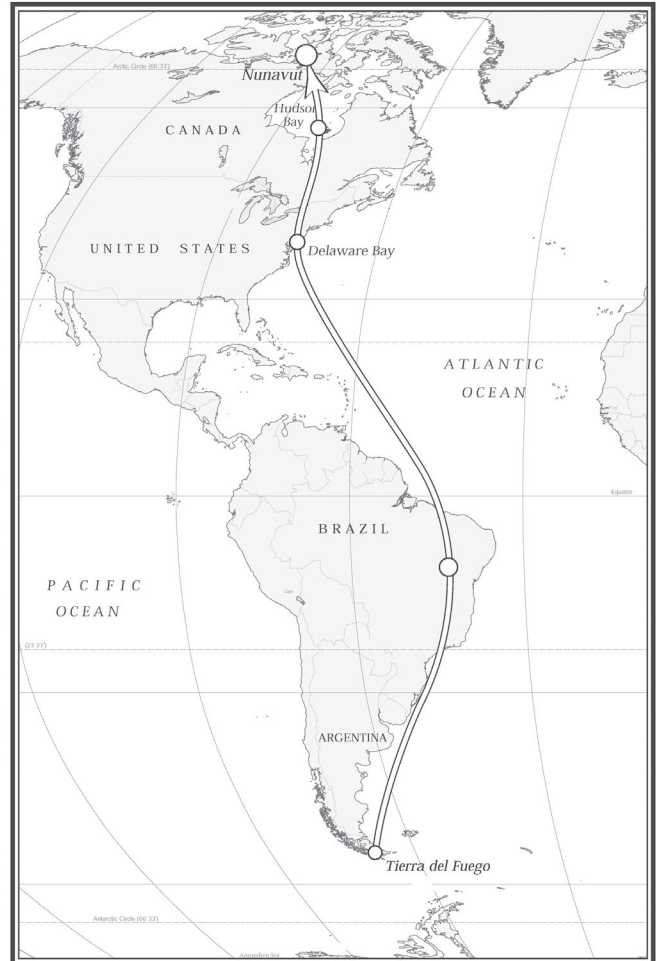
### Water Cycle in a Jar: (pg. 25)

1. The warm water begins to evaporate and the water vapor rises. Then, the water vapor condenses by returning to a liquid state. The condensation forms on the sides and top of the jar where it is cooler. When water droplets get heavy enough they fall in the form of precipitation. The precipitation then falls as “rain” when the jar is tapped.
2. The ice cubes symbolized the cold air higher up in the atmosphere, and caused the water vapor to condense.
3. a. Boiling water in a teapot. When the water boils, it evaporates in the form of steam.  
b. A long, hot shower. The water in the shower heats up and begins to evaporate (steam). The water condenses on the cooler mirror and windows.
4. We need to conserve water because although it is continually recycled, we can use more than is readily available. Water also needs to be kept clean. Polluted water cannot be used for drinking, cooking, etc.
5. Temperature, air, sunlight, and wind are abiotic factors that can affect the water cycle.

### Biosphere 2 Center: (pgs. 26-27)

1. The oxygen and carbon cycles are described in the first paragraph of the reading.
2. Plants continually resupply the air around us with oxygen.
3. The soil was too rich with microorganisms. The microorganisms were consuming too much oxygen.
4. The human inhabitants needed an atmosphere with an oxygen level of approximately 21% for optimal respiration.
5. The excess CO<sub>2</sub> was found in the Biosphere 2 Center’s cement.
6. The structure is made of glass, steel and cement. There are 6,000 glass panels in the structure.
7. The Biosphere 2 includes a desert, forest, rain forest, grassland (savannah), and an ocean biome.
8. There are many possible answers to this question. One advantage of Biosphere 2 Center is that it creates a miniature model of Biosphere 1 (earth), enabling scientists to manipulate variables in a closed system.

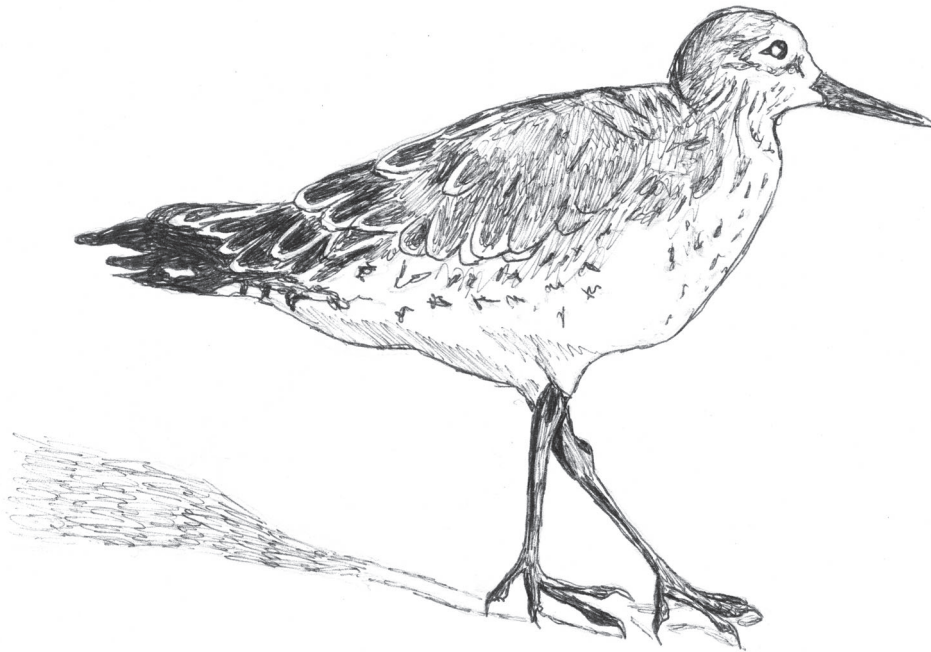
### A Migrating Marvel: (pgs. 28-29)

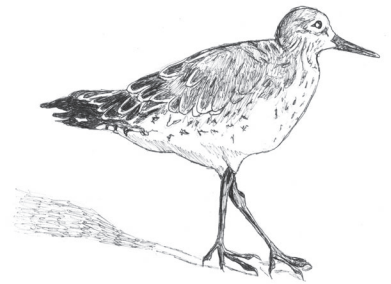


### Vocabulary: (pg. 30)

1. estivation, d
2. hibernation, i
3. circadian rhythm, h
4. evaporation, f
5. migration, a
6. nocturnal, c
7. water cycle, j
8. annual rhythm, g
9. diurnal, e
10. condensation, b

# Assessment and Student Activity Masters





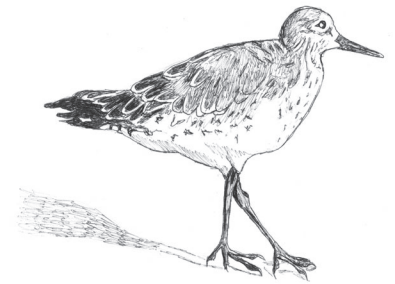
# Preliminary Test

**Directions:** Fill in the blank with the correct word. A list of possible answers is provided at the bottom of the page.

1. Leaves changing colors in the fall is an example of a \_\_\_\_\_.
2. \_\_\_\_\_ is an important gas needed by most animals.
3. Snow, rain, and hail are all forms of \_\_\_\_\_.
4. The repetition of behaving in a regular pattern can be referred to as a \_\_\_\_\_.
5. During long, hot summers some living things enter a state of inactivity or dormancy called \_\_\_\_\_.
6. \_\_\_\_\_ animals travel in cyclic intervals between breeding grounds and their winter habitats.
7. People and other animals breathe out \_\_\_\_\_.
8. Oxygen and carbon dioxide are cycled between animals and \_\_\_\_\_.
9. Owls, moths, and bats are \_\_\_\_\_ animals because they are most active at night.
10. Animals that are most active during the day are said to be \_\_\_\_\_.

precipitation  
cycle  
nocturnal  
plants  
diurnal  
oxygen

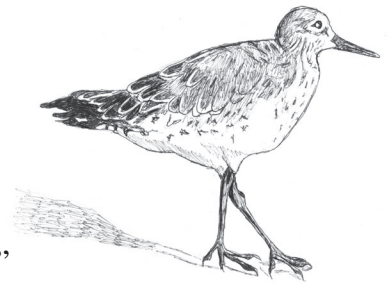
natural rhythm  
estivation  
diurnal  
migrating  
condensation  
carbon dioxide



# Preliminary Test

**Directions:** Decide whether the answer is True (T) or False (F).

- |   |   |   |
|---|---|---|
| 11. The water cycle involves the processes of evaporation, condensation, and precipitation. | T | F |
| 12. Bats, owls, and moths are diurnal animals.  | T | F |
| 13. Some animals have adaptations, that enable them to hibernate for several months.        | T | F |
| 14. A circadian rhythm is behavior based on an annual cycle.                                | T | F |
| 15. Monarch butterflies, red knot birds, and elephant seals are migratory animals.          | T | F |
| 16. Water vapor returns to a liquid phase through the process of evaporation.               | T | F |
| 17. During the cold winter months most frogs die from freezing temperatures.                | T | F |
| 18. Eventually, animals will use up all the oxygen on earth.                                | T | F |
| 19. Oxygen and carbon dioxide are continually cycled between plants and animals.            | T | F |
| 20. Certain bacteria are able to take nitrogen from the air to make nitrogen compounds.     | T | F |



# Video Review

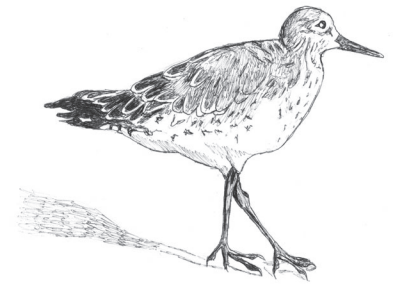
**Directions:** During the course of the program, answer the “You Decide” questions as they are presented in the video. Answer the Video Quiz questions at the end of the video.

**You Decide:**

- 1. What is the term used to describe living things that are most active at night? Answer \_\_\_\_\_
- 2. How often do most flowers bloom in the desert? Answer \_\_\_\_\_
- 3. What is a migratory animal? Answer \_\_\_\_\_
- 4. What do all these animals need from the air? Answer \_\_\_\_\_
- 5. What gas do plants breathe in? Answer \_\_\_\_\_
- 6. What is the most dominant gas in our atmosphere? Answer \_\_\_\_\_

**Video Quiz:**

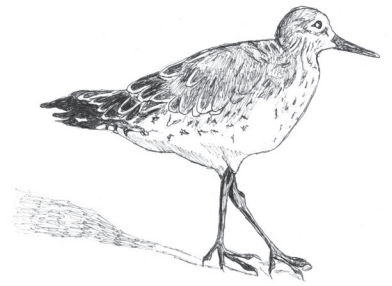
- 1. Bird migration is an example of a \_\_\_\_\_ cycle.
- 2. Behavior based on a daily or 24 hour cycle is called a \_\_\_\_\_ rhythm.
- 3. Living things which are active during the day are \_\_\_\_\_.
- 4. The desert bloom is an example of an annual \_\_\_\_\_.
- 5. The period of winter inactivity for some animals is called \_\_\_\_\_.
- 6. Water vapor returns to a liquid phase via the process of \_\_\_\_\_.
- 7. \_\_\_\_\_ is the process of liquid water turning into a gaseous state.
- 8. The air around us contains about \_\_\_\_\_ percent oxygen.
- 9. Plants produce \_\_\_\_\_, which we breathe in.
- 10. Animals obtain \_\_\_\_\_ by eating plants or organisms.



# Post Test

**Directions:** Decide whether the answer is True (T) or False (F).

1. Monarch butterflies, red knot birds, and elephant seals are migratory animals. T F
2. Certain bacteria are able to take nitrogen from the air to make nitrogen compounds. T F
3. The water cycle involves the processes of evaporation, condensation, and precipitation. T F
4. Water vapor returns to a liquid phase through the process of evaporation. T F
5. Oxygen and carbon dioxide are continually cycled between plants and animals. T F
6. Bats, owls, and moths are diurnal animals. T F
7. During the cold winter months most frogs die from freezing temperatures. T F
8. A circadian rhythm is behavior based on an annual cycle. T F
9. Eventually, animals will use up all the oxygen on earth. T F
10. Some animals have adaptations that enable them to hibernate for several months. T F



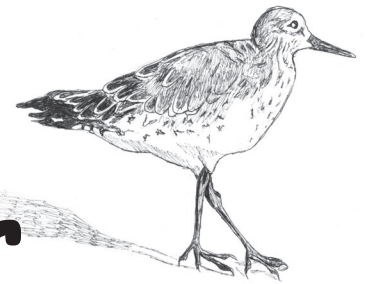
# Post Test

**Directions:** Fill in the blank with the correct word. Choose from the list of possible answers at the bottom of the page.

11. During long, hot summers some living things enter a state of inactivity or dormancy called \_\_\_\_\_.
12. Animals most active during the day are said to be \_\_\_\_\_.
13. \_\_\_\_\_ is an important gas needed by most animals.
14. Owls, moths, and bats are \_\_\_\_\_ animals.
15. Leaves changing colors in the fall is an example of a \_\_\_\_\_.
16. People and other animals breathe out \_\_\_\_\_.
17. Snow, rain, and hail are all forms of \_\_\_\_\_.
18. \_\_\_\_\_ animals travel in cyclic intervals between breeding grounds and their winter habitats.
19. The repetition of behaving in a regular pattern can be referred to as a \_\_\_\_\_.
20. Oxygen and carbon dioxide are cycled between animals and \_\_\_\_\_.

precipitation  
cycle  
nocturnal  
plants  
diurnal  
oxygen

natural rhythm  
estivation  
diurnal  
migrating  
condensation  
carbon dioxide



# Water Cycle in a Jar

**Objective:**

The students will demonstrate the water cycle by completing the water cycle in a jar activity. The students will identify the components of the water cycle.

**Background:**

Water, water everywhere . . . above us, below us and next to us. We live in an ocean of water vapor, and liquid water covers three-fourths of the Earth’s surface area. The water you drink each day is not brand new, perhaps it is purified and chlorinated, but it has been around before. Water is continuously cycling from one form to another all around us. The process by which water moves in a continuous cycle between the earth’s surface and the atmosphere is called the water cycle. Evaporation is the process by which liquid water changes into a gas or water vapor. This water vapor rises into the atmosphere and cools where it condenses, forming clouds. Condensation is the process by which water vapor returns to a liquid state. Eventually the water falls in the form of precipitation, such as rain, snow, hail, or sleet.

**Materials:**

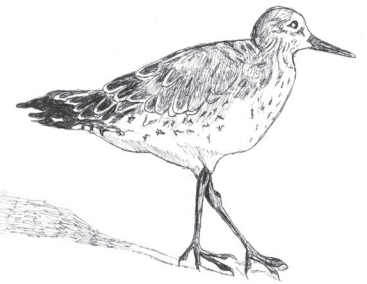
Clear glass jar or plastic jar, plastic wrap, rubber band, hot tap water, ice cubes, pencil

**Directions:**

1. Fill the jar 1/3 full of very hot tap water (SAFETY CAUTION - as a precaution, your instructor may need to fill the jars for you).
2. Put the plastic wrap over the mouth of the jar and secure it with a rubber band.
3. Place 2 ice cubes on top of the plastic wrap.
4. Observe the changes that occur over the next 10 to 15 minutes.
  - a. What is the cloudy layer forming on top of the jar?
  - b. Why does this layer form?
5. After 10 minutes observe the area under the plastic without lifting the jar.
6. Tap the top of the jar with a pencil. What happens to the water?

**Questions:**

1. How does this activity illustrate the water cycle? Use the terms evaporation, condensation, and precipitation in your answer.
2. What role did the ice cubes serve?
3. List two common every day examples of the water cycle!
4. If the water cycle exists, why do we need to conserve water?
5. What are some abiotic, non-living, factors that can affect the water cycle in a specific area?



# Cycles in Biosphere 2

## Objectives:

Students will read about the oxygen and carbon cycles. The students will describe the problems that occurred during the first mission of the Biosphere 2. Students will discuss Biosphere 2's structure and some of its uses.

## Directions:

Read the story below and answer the questions that follow.

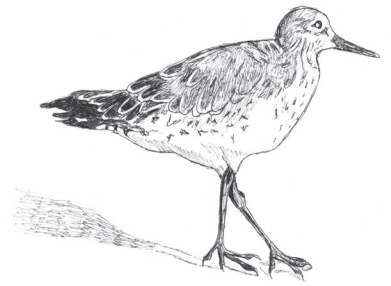
### Oxygen and Carbon Cycles

We need oxygen to survive. Oxygen is an extremely important gas needed by most animals that live on land. Oxygen, or (O<sub>2</sub>), is a tasteless, colorless gas that makes up approximately 21% of the air around us. Have you ever wondered what prevents animals from using up all the oxygen on Earth? The answer lies in the fact that plants and other plant-like organisms continually resupply the air around us with oxygen. Oxygen and carbon dioxide are continually cycled between plants and animals. People and other animals breathe out carbon dioxide, or CO<sub>2</sub>. Plants use this carbon dioxide, water, and light from the sun to produce energy, water vapor, and oxygen. Unlike plants, animals must eat other things to produce energy. A by-product of this energy creation process is carbon dioxide. Most animals breathe out carbon dioxide. In turn, carbon dioxide is taken up by plants, thus completing the cycle.

### Biosphere 2 Center

The Biosphere 2 Center is an enclosed research laboratory, located on 3.1 acres outside of Tucson, Arizona. Built in the 1980's, the structure is home to the earth's largest, controlled environment. The biosphere on Earth (Biosphere 1) consists of the layer of land, air, and water that is home to all living things. The Biosphere 2 is an enclosed ecosystem containing over 3,000 organisms living in various biomes. These biomes include forest, rain forest, ocean, grassland, and desert. The biomes include mostly plant and insect species.

The structure is made of steel, glass and concrete. The 6,000 glass panels are tightly sealed so as not to let atmospheric gasses in or out. At its tallest point, the structure is 91 feet. The water, air and soil are monitored by 730 sensors. The Biosphere 2 was originally built to see if a group of eight individuals could survive in a closed environment for an extended period of time. It was thought that applications, such as Biosphere 2, could be used for possible future survival in space. The first mission began in 1991 with a team of eight men and women who possessed expertise in various areas such as marine biology and chemistry. After several months a problem arose concerning the air composition in the structure. The oxygen level in the Biosphere had decreased from 21% to 14%.



# Biosphere 2 (cont.)

Why was the oxygen decreasing? Dr. Wally Broecker, a geochemist from Columbia University was asked to come and investigate the problem with members of the Biosphere 2 team. Geochemists are scientists who study the chemical composition and the changes that occur in the earth's crust or surface. Dr. Broecker correctly theorized that the oxygen decrease was due to the rich soil contained in the structure. The soil held too many microorganisms which were using up the oxygen. So the question of the missing oxygen was solved. Now another question emerged – where was the missing carbon dioxide? The problem was that as the oxygen level dropped, the carbon dioxide level should have risen, but it did not rise. This problem was more difficult to solve. A graduate student, Jeff Severinghaus, was asked to come and investigate the missing carbon dioxide dilemma. He explored many possibilities and then discovered that the cement used to build the structure was absorbing the carbon dioxide.

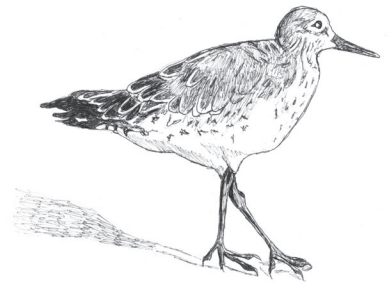
In 1996, Columbia University agreed to accept the responsibility for the research, outreach and educational programs at the Biosphere 2 Center. The center continues to be privately owned by Edward P. Bass. The nonprofit center and its staff now strive to conduct research and educate the public concerning the earth and its systems. Approximately 180,000 people visit the center each year. Perhaps someday you will visit or work at the Biosphere 2 Center.

## Questions:

1. Explain the oxygen-carbon cycle.
2. Why isn't all the oxygen on earth used up?
3. What was causing the oxygen to decrease during the first mission?
4. Why was it important to understand why the oxygen levels were decreasing?
5. Where was the missing carbon dioxide found?
6. What is the structure made of?
7. What biomes exist in Biosphere 2 Center?
8. Why do you think the research conducted in the Biosphere 2 is important?

## References:

Broecker, Wallace S. (1996). *The Biosphere and Me*. GSA Today, 6, 2-7.  
Columbia University's Biosphere 2 Center. (2003). Retrieved February 2, 2003,  
from Columbia University's Biosphere 2 Center Website:  
<http://www.bio2.edu/index.html>.



# A Migrating Marvel

## Objectives:

The students will locate, identify, and label the areas of primary importance along the red knot's migration route.

## Background:

Migrating animals travel in cyclic intervals between breeding grounds and their winter habitats. Some animals migrate relatively short distances, such as horseshoe crabs. Others, such as a bird called the red knot travel tremendous distances between their winter habitat and summer breeding grounds.

The red knot is a relatively small shorebird about the size of a robin. The breeding adults have reddish underside, face, and throat. Their upper plumage consists of a gray, dark brown and white mottled pattern. The fall and winter colors of the non-breeding red knot consist of a mostly gray upper plumage with white feathers underside. They are birds of astounding endurance. Every year these birds fly approximately 20,000 miles roundtrip between their winter habitats and their breeding grounds.

The red knot spends the winter months in southern South America. Tierra del Fuego, Argentina is one of the most popular wintering regions. Here, the birds try to put on as much weight as possible in preparation for their long journey in the spring. During the months of April or May the birds begin their 10,000 mile northern journey. Along the way they may only stop two or three times. One common stop is on the Delaware Bay. They time this stop to coincide with the massive arrival of the horseshoe crabs. The crabs come ashore, laying millions of eggs, upon which the red knots gorge themselves. The high fat eggs replenish the bodies of the red knots, providing the energy needed to complete their northern trek. Unfortunately, the number of horseshoe crabs has dramatically declined over the past few years. This is due to over fishing of the crabs, which are used for garden fertilizer and as a bait source. Scientists are currently studying the effect of the declining horseshoe crab population on the red knot population.

After replenishing their bodies on the Delaware Bay, red knots continue on for about 1,000 miles to Canada. Many nesting sites can be found in the Nunavut area along the Hudson Bay. Here the female lays her eggs. When the chicks are born, the female begins the long flight back to her wintering grounds. The males stay back with newborn chicks for a few weeks. Then the newborn birds take the long 10,000 mile trip all on their own a few weeks later.

**Activity** – Follow the Migration Route of the red knot

## Class Discussion Topics:

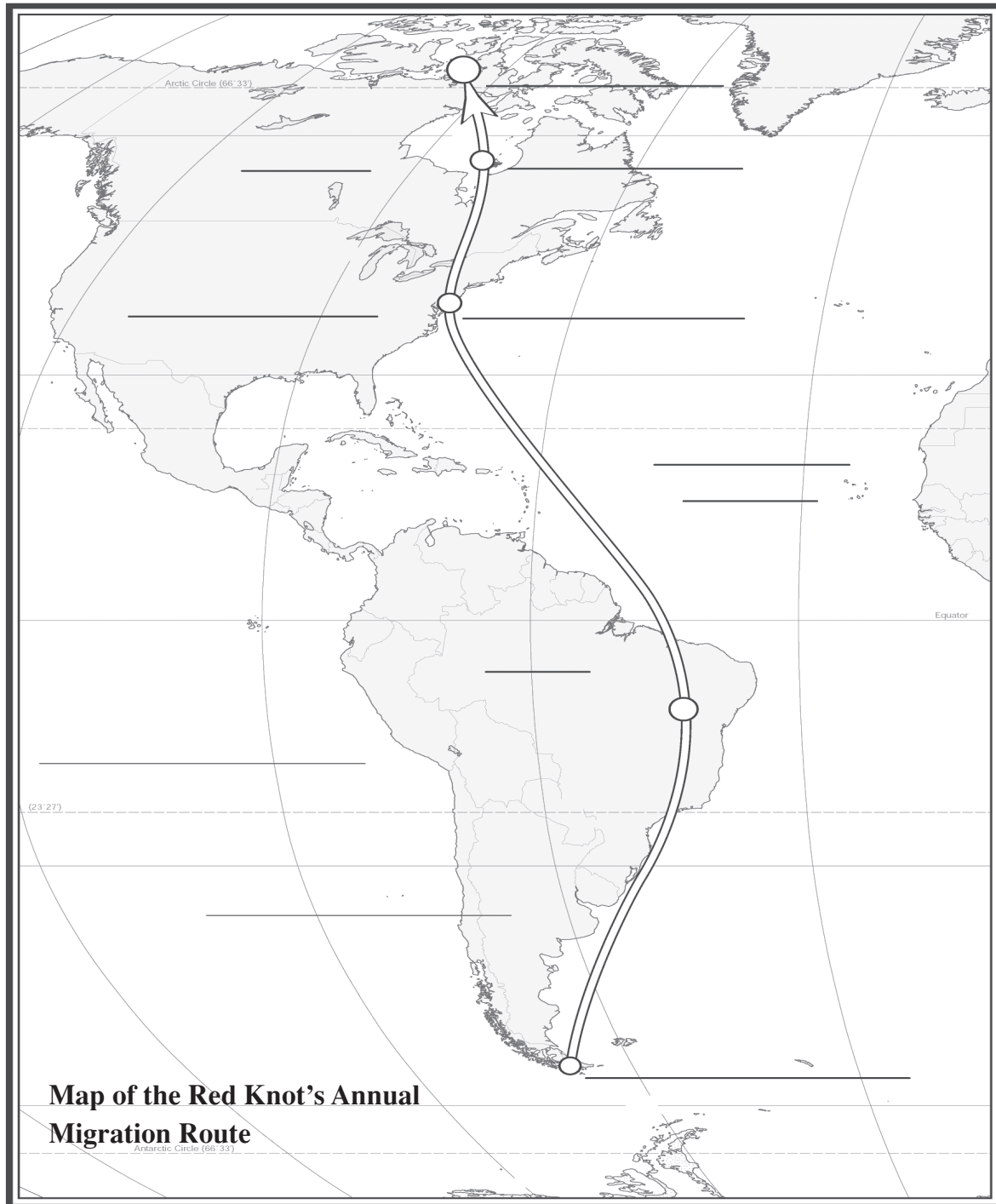
1. Describe some of the challenges and dangers of migration.
2. What are the relative advantages and disadvantages of migration?
3. Discuss what would happen to the red knot if horseshoe crabs disappeared.



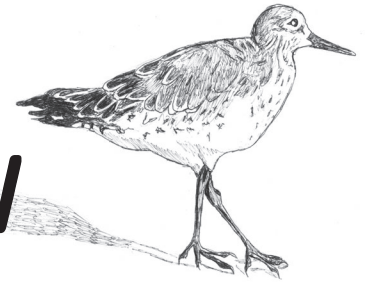
# A Migrating Marvel (cont.)

**Materials** – World atlas or globe to help label the areas.

**Directions:** Locate and label the following areas: Argentina, Tierra del Fuego, Brazil, United States, Delaware Bay, Canada, Hudson Bay, Nunavut, Atlantic Ocean, and Pacific Ocean.



Reference: Luoma, Jon, R. (2001, May/June). The Removable Feast. *Audubon*, pp. 50-52.



# Vocabulary of Natural Cycles

Directions: Unscramble the vocabulary words in the first column. Match the words to the definitions in the second column.

- |                         |   |
|-------------------------|---|
| ___ 1) ietvastoni       | a. The seasonal movement of animals between breeding grounds and their winter habitats.                     |
| ___ 2) nobihiernat      | b. The process of water vapor turning to a liquid.  |
| ___ 3) ccdaaiirn yhrmht | c. Organisms that are most active at night.   |
| ___ 4) raopavionet      | d. A state of inactivity, or dormancy, of a living thing during hot, dry summer months.                     |
| ___ 5) gramtiion        | e. Organisms most active during the daytime.  |
| ___ 6) rocnaltun        | f. The process of liquid water turning into a gaseous state.  |
| ___ 7) atrew yccele     | g. Behavior of a living thing that occurs on a yearly basis.  |
| ___ 8) nunaal thmyrh    | h. Behavior that is based on a daily or 24 hour cycle.  |
| ___ 9) liruand          | i. The resting state which many animals go into during winter.  |
| ___ 10) esncoanoidtn    | j. The continuous cycling of water involving the processes of evaporation, condensation, and precipitation. |