

# Environmental Literacy Framework

## Biome Sorting

### Focus Questions:

How do organisms respond to changes in climate patterns?

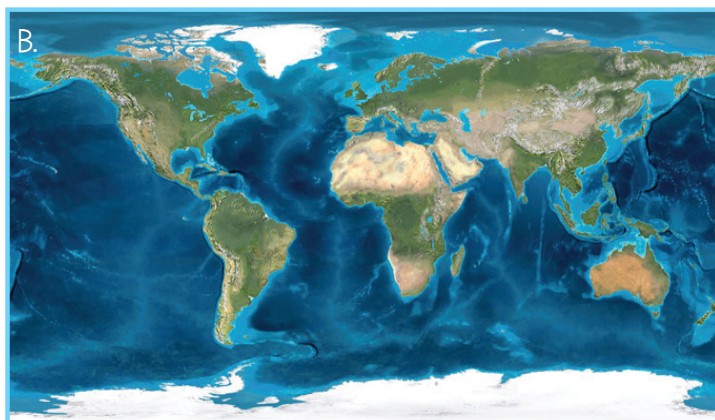
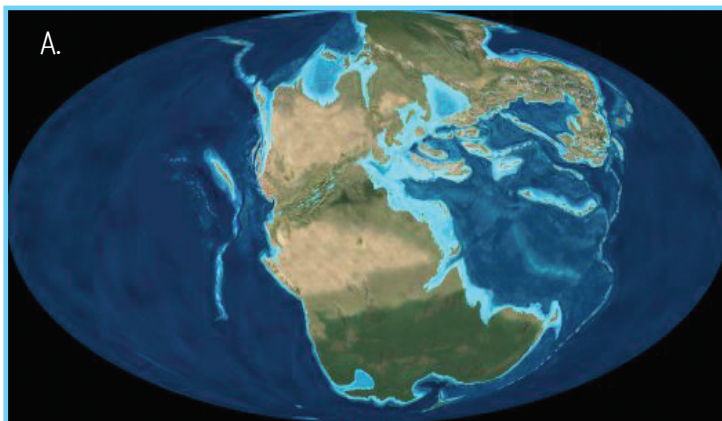
How has Earth's climate affected biomes?

Can biomes move/change?

### Preview

Although the forces of plate tectonics are slow, they are not gentle. As the plates move, mountain ranges are uplifted, ocean basins are ripped apart, and continents that were once near the Equator are now near the Poles. Oceans that were once warm are now cold. Areas that once received heavy rainfall now receive little; regions that were covered in oceans are now above sea level and dry.

Look at the maps below. Map 'A' shows the position of the continents 225 million years ago (mya) and map 'B' shows the position of the continents now. As the continents moved to new latitudes through the process of plate tectonics, the climate zones changed. These movements in the Earth's crust caused changes in ocean currents, as well as wind and rain patterns, which determine regional climate.



## Unit-1 ENERGY



### Time

90 minutes

### Materials

- Plant & Animals Cards
- Fossil Cards
- Scissors
- World Biome Map
- Colored pencils
- Blackline master of the Biome Chart
- Fossil Key

### Vocabulary (Terms)

- Abundance
- Adapted
- Biome
- Climate
- Distribution
- Diversity
- Ecosystem
- Evolved
- Extinct
- Fossil
- Trilobite

# Activity 1B-Biome Sorting

## Prepare

1. The amount of energy received from the Sun is less near the Poles than at the Equator.
2. As continents moved poleward, or away from the Equator, organisms that enjoyed a warm climate became extinct or evolved adaptations to the cold.
3. Look again at Maps 'A' and 'B' on the previous page. Make a list of the continents in Map 'B' that have changed latitudes.
4. These movements in the Earth's crust also cause changes in ocean currents, wind, and rain patterns which determine regional climate. Although there are many defined climate ranges on Earth, we will explore only five.

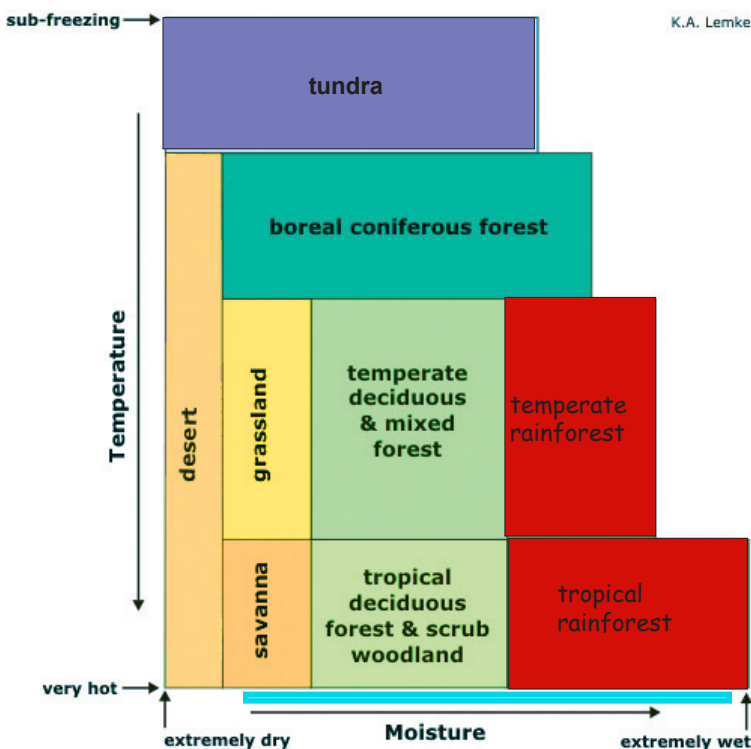
fig 1 Biome Key

List of Biomes

- Hot and dry – deserts and grasslands (A)- brown/yellow
- Warm and wet – tropical swamps and rainforest (B) - red
- Cold and dry - tundra and Arctic (C) - purple
- Cool and wet – coniferous forest (D) -green
- Marine – oceans and seas (E) -light blue

### Directions:

1. Using the five biomes on the List of Biomes, locate and color-code them on the world map by lightly shading each with the matching color from the Biome chart. (World Biome Map next page)
2. Cut and paste the Climate Biomes Chart by following the directions on those pages.
3. Cut out the plant and animal cards.
4. Use your colored pencils to color-code the animals and plants to the biomes they live in.
5. Sort the plant and animal cards on the Climate Biomes Chart.



Hint: Life forms which adapt to climate conditions follow similar patterns in form and function. For example, animals that live in cold regions all developed heavy coats of fur or hair, or thick layers of fat to keep warm. Plants that live in dry, hot climates tend to have thick, fleshy leaves to conserve water.

Based on your knowledge of these patterns, place the animal and plant cards in the five boxes of the Climate Biomes Chart.



A Chaparral, grasslands, desert, savanna  
 B Tropical rainforests  
 C Arctic, alpine tundra and Antarctic  
 D Temperate forests  
 E Ocean

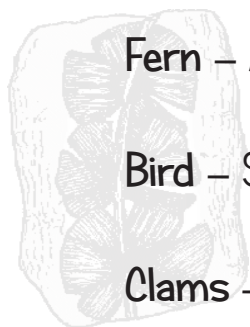
 Make a copy and cut along the thick outside black border.

## Plant and Animal Card Key

Cold/Wet	Cold/Dry	Warm/Wet	Warm/Dry	Marine
Pine tree	Polar bear	Fern	Cactus	Clam
Tall Grass		Toucan	Coyote	Fish
Deer		Moss	Ostrich	Kelp
Songbird		Lizard	Turtle	
			Grass	
			Oak tree	

 Make a copy and cut along the thick outside black border.

## Fossil Key



**Fern** – Antarctica

**Bird** – Sahara Desert

**Clams** – California Desert

**Crocodile** – Wyoming

**Trilobite** – Morocco

**Gingko** - North Dakota, British Columbia, and northern Russia

# Biomes Chart

Copy A and B, then cut on the dotted lines, and attach A to B at arrow on line.  
Note \*cut black line off in center of A before attaching- so that there is no line showing in the middle.



A.

A. Warm/Wet Tropical Swamps and Rainforest	Warm/Dry Desert Grassland	Cold/Wet Coniferous Forest
---	------------------------------	----------------------------------

17



Do not cut this line. Attach C here



B.

Overlap section A. with section B.  
at this line.

Attach (A) at this line



Cold/Dry  
Tundra, Arctic  
Antarctic

Marine

B.

18

Do not cut this line.

Overlap chart "C" here and match to chart "D"





Copy C and D cut out and attach to the bottom of chart A and B- match up the lines and tape together to create one large chart. Cut the center lines off of A and C before attaching so there is no middle line showing.



C.





D.



Copy C and D cut out and attach to the bottom of chart A and B- match up the lines and tape together to create one large chart. Cut the center lines off of A and C before attaching so there is no middle line showing.



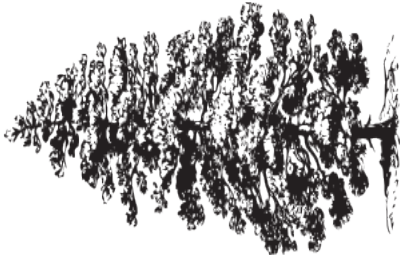
Chart D



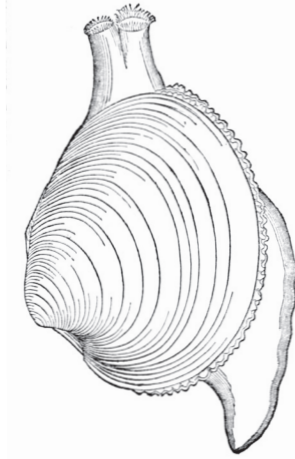


# Plant and Animal Cards

Make copies, then cut along the solid black lines.



Pine Tree



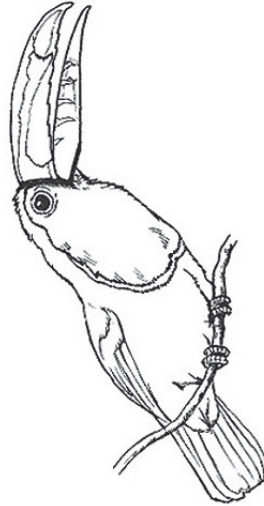
Clam



Fish



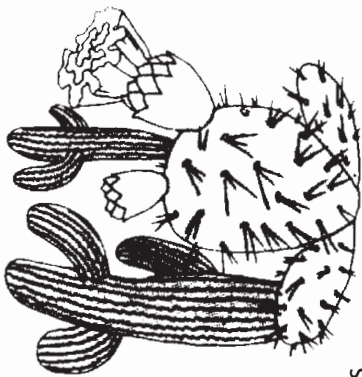
Fern



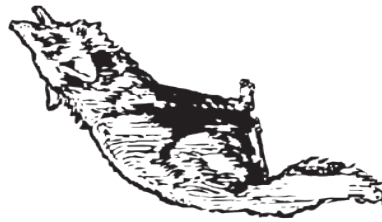
Toucan



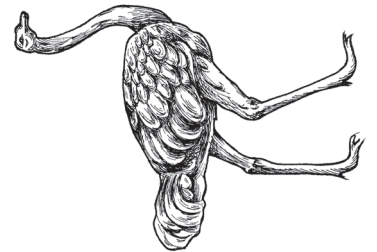
Polar Bear



Cactus



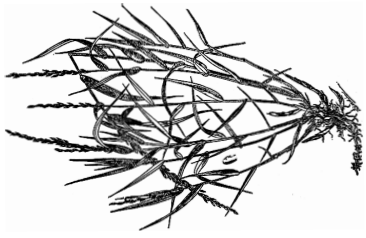
Coyote



Ostrich

# Plant and Animal Cards

Make copies, then cut along the solid black lines.



Tall grass



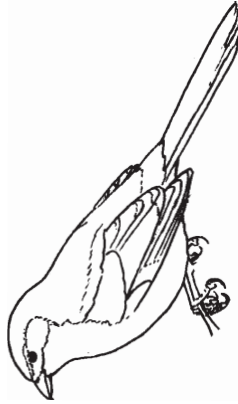
Lizard



Kelp



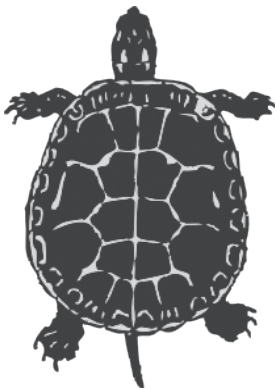
Moss



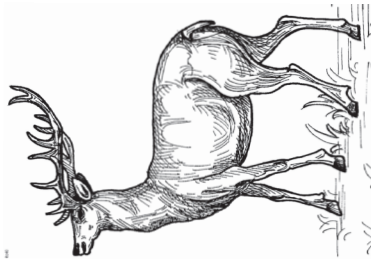
Songbird



Oak tree



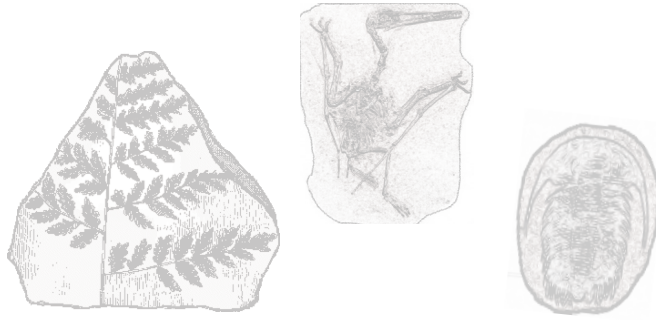
Tortoise



Deer






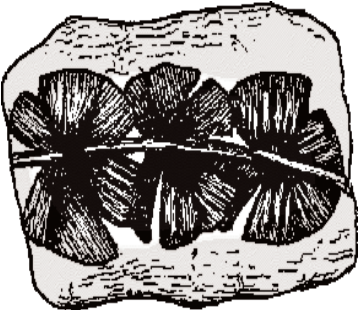
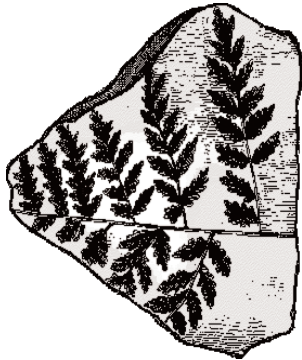

Grass



### Fossil Cards

Make copies, then cut along the solid black lines.



 <p>Flying reptiles-lived in swamps</p>	 <p>Trilobite from the ocean</p>	 <p>Marine clam shell</p>
 <p>Ginkgo tree found today in small, warm regions of China</p>	 <p>Ferns, typically live in a moist temperate climate</p>	 <p>Crocodiles found in swamps and rainforests</p>

### Part 2: Fossil Cards

When plants and animals die, most of the material decomposes; however, sometimes parts are preserved. Over time, these preserved parts form fossils. When discovered, these fossils offer clues to past climates based on the kinds of plants or animals that lived there.

1. Look at each fossil card. Based on the climate condition clues indicated, color-code the fossil card according to the biome key, then place the organism in its appropriate biome on your sorting chart.
2. Obtain the 'Fossil Key' from your teacher to see where these fossils were actually found, and then place them on the Biome Sorting Chart in the correct location.
3. Do the colors match?

How can it be that these organisms lived in places that are not the correct climate?

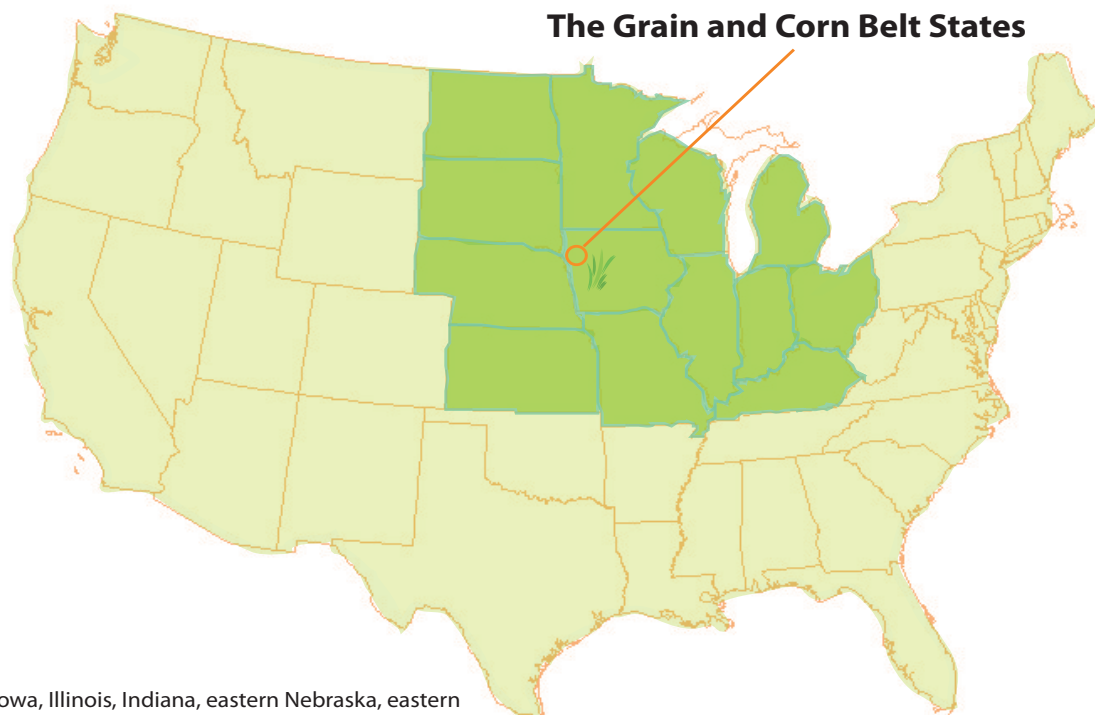
As global climate patterns change, what happens to the location, diversity, and number of organisms?



### Practice

#### Got the Big Idea?

Plate tectonics is a slow process, and although Earth's land masses have undergone climate change over geologic time due to their movement, today's climate change is now occurring due to changes in our atmosphere. Look at the map of the United States (U.S.) showing where most of the corn and grain is grown in the U.S. Corn and wheat are the two largest crops in the U.S. Many important foods are made using these grains. For about the last 10,000 years, the climate in these areas has been just right for growing these grains that provide food to a large percent of the world's population.



Iowa, Illinois, Indiana, eastern Nebraska, eastern Kansas, southern Minnesota and parts of Missouri. Sometimes included are South Dakota, North Dakota, Ohio, Wisconsin, Michigan, and Kentucky.

Rita Thomas: ANDRILL [www.andrill.org](http://www.andrill.org)  
Source: Department of Agriculture

1. Describe what is meant by the term 'corn and wheat belt.'
2. What do you think would happen if global climate change were to alter the growing conditions of the corn and wheat belt?
3. What changes will humans have to make if climate change alters where we can grow our food crops?

# Activity 1B-Biome Sorting

## Unit-1 ENERGY

Watch the animation at the website below to see how hardiness zones for plants in the U.S. have changed in the last 16 years.

<http://www.arborday.org/media/mapchanges.cfm>

4. What affects would this regional climate change have on the corn industry?

## Ponder

The fossil record provides information about how the Earth's climate has changed over time and how organisms have evolved, adapted and become extinct.

As current climate patterns change, what do you think will happen to the species of plants and animals that live in your area?

## Get ready to present

In your notebook, describe the climate biome where you live and make a list, or chart, of common crops that are grown in your area. Which of these crops could not be grown if your region experienced a shift in the climate toward hotter summers? Colder winters? More rain? Less rain?

Optional: Research crops that grow in your region and prepare a visual to show your audience the biome that you live in and the foods that grow there. Indicate the average rainfall and temperature as well as the extremes. Predict how increasing or decreasing one climate change variable could alter your climate region and affect the crops in your community. Look at the list of crops you created. Which crops would be suitable in a warmer, drier, or wetter biome than the one you live in today?

## Present

Show the visual to your visitors and explain how climate change has altered biomes around the world in the past. Indicate to them how one climate variable (i.e. an increase or decrease in rain or temperature) could alter the biome and therefore the crops in your community. Explain that although these changes have occurred slowly in the past, there is much evidence that these changes are happening more rapidly today.

Here are questions we still do not know about how organisms will adapt to changes in climate patterns.

- How much climate change can the plants and animals adapt to that live in your local region?
- How fast will regional climate changes occur?
- Will the animals be able to eat the new plants that move into the area?

## Background Information for the Teacher

Activity	NSES 5-8	CLEP	ELF
<p><b>Biomes</b> In this hands-on activity, learners sort organisms into different biomes based on their adaptations to the climate of that ecosystem. <b>In Part 2:</b> learners sort fossils based on the same criteria to discover that habitats and biomes have changed over geologic time.</p>	<p><b>Life Science Standard C:</b> A population consists of all individuals of a species that occur together at a given place and time All populations living together and the physical factors with which they interact compose an ecosystem.</p> <p>The number of organisms an ecosystem can support depends on the resources available and abiotic factors such as light, water, temperature and soil.</p> <p>Extinction of a species occurs when the environment changes and the adaptive characteristics of a species are insufficient to allow its survival.</p>	<p><b>3a:</b> Individual organisms survive within specific ranges of temperature, precipitation, humidity and sunlight. Organisms exposed to climate conditions outside their normal ranges must adapt or migrate, or they will perish.</p> <p><b>3c.</b> Changes in climate conditions can affect the health and function of the ecosystem and the survival of entire species.</p> <p><b>4a.</b> Climate descriptions can refer to areas that are local, regional or global in extent.</p> <p><b>4c.</b> Climate change is a significant and persistent change in an area's average climate conditions or their extremes.</p> <p><b>6e.</b> Scientist and economists predict that there will be both positive and negative impacts from global climate change.</p> <p><b>7e.</b> Ecosystems will continue to be disturbed by climate change. [Organisms] will migrate to new areas with favorable climate conditions.</p>	<p><b>Biosphere 2:</b> The biosphere consists of marine and terrestrial ecosystems.</p> <p><b>Biosphere 5:</b> Life's relationship with climate consists of a web of complex interactions and feedbacks. All life on Earth is affected by climatic conditions while simultaneously impacting those conditions.</p>

**NSES: National Science Education Standards**

(<http://www.csun.edu/science/ref/curriculum/reforms/nses/index.html>)

**CLEP: Climate Literacy Essential Principles** (<http://www.climatescience.gov/Library/Literacy/>)

**ELF: Environmental Literacy Framework** ([www.andrill.org/education/elf](http://www.andrill.org/education/elf))

### **For more information:**

**Introduction to the biomes of the world with maps**

<http://www.radford.edu/~swoodwar/CLASSES/GEOG235/biomes/intro.html>

<http://earthobservatory.nasa.gov/Experiments/Biome/>

### **Background Information**

A biome is a large geographical area distinguished by the climate, and classified by the plants and animals that are predominate in, and adapted to, that particular environment. There are many systems of biome classification. Widely accepted major biomes include deserts, forests, grasslands, tundra, and aquatic environments. Each biome consists of several ecosystems whose organisms have adapted to small differences in regional climates and the environmental variations within the biome.

The biomes of the world have changed and moved many times throughout geologic history as the continental plates have shifted position. With this shift, the continents and oceans alter climate patterns and the plant and animal species that can survive in regions change.

Living organisms are closely related to their environment and the other organisms that live there. Large or small, simple or complex, no single species can live alone. Each depends in some way on the other living organisms as well as the nonliving factors of its surroundings. Any changes in a region's climate, or changes in the types of plants and animals, cause a chain reaction in other parts of the environment. If one species of plant can no longer live in a region, the animals that depend on that plant will have to move or die out.

Climate change has altered the environment of the continents as they have shifted their positions around the globe. The fossil record has given us clues to how environments on the continents were in the past. Fossil remains of marine organisms are found in areas that are now deserts. Tropical fern fossils are found in regions now covered with glaciers. Biomes that were once contiguous are now isolated from each other. Related species are found in the isolated regions indicating the areas were once connected.

The geographic distribution of biomes has been altered over geologic time due to the movement of the continental plates and changes in ocean currents. Presently, climate patterns are changing due to man's activity on the planet. As the temperature warms or cools, precipitation increases or decreases, wind patterns get stronger or weaker, and regional climate patterns change causing plants and animals to adapt or migrate. Some species move into a region; others move out. Some increase in numbers; others decline.

As climate patterns continue to change worldwide, human populations will have to make decisions regarding where to live, what crops to grow, and how to manage resources.



### Teacher's notes for this activity

#### Part 1:

Students sort plants and animals onto the Biome Chart based on their adaptations. Some species may overlap biomes. Don't correct students as long as their decisions are logical. For instance, the coyote may be placed in the grasslands or forest biomes as their range overlaps both these environments.

Identifying the location of these biomes on the world map is important so students can determine where these organisms are found.

#### Part 2:

Student learners are given a set of fossil cards to place in the biomes chart based on their adaptations to that environment. After they have made their decisions, provide them with the key to where these fossils were actually found. The take-home message is that the environments, climates and biomes around our planet have changed over time and will change again in the future. When they do, the plants and animals that live in a region will also change.

Key to questions on pp. 19-20

1. Describe what is meant by the term 'corn and wheat belt.'

A: The area of the US where the climate is optimal for growing corn and wheat.

2. What do you think would happen if global climate change were to alter the biome of the corn and wheat belt?

A: It may not be possible to grow corn or wheat in the same areas it is grown now. It may change where it can be grown and perhaps will affect the amount that can be grown.

3. What changes will humans have to make if climate change alters where we can grow our food crops?

A: Food crops that are better adapted for the new climate will have to be planted, or people will have to buy their food from biomes that is in different locations.

4. What effects would this regional climate change have on the corn industry?

A: No one knows for sure, but the corn and wheat industries may have to shift their ranges, similar to what animals and plants are doing already. Perhaps corn and wheat will grow better farther north. If the biome shifts far enough north, the crops could be grown in Canada instead of the US, which could help the economy of Canada, but hurt that of the US.

### Glossary

Unit	Activity	Vocabulary Word	Definition
Energy	Biome Sorting	Abundance	A component of biodiversity indicating how common or rare a species is relative to other organisms in an ecosystem
Energy	Biome Sorting	Adapted	The capacity of an organism to thrive in its ecosystem. (Ex. Desert plants have thick leaves that hold water, an adaptation to hot and dry climate.)
Energy	Biome Sorting	Biome	Communities of plants and animals that are defined geographically and climatically. (Ex. Rainforests are a biome defined as warm all year round with plenty of rain and sunlight, generally found near the equator with lush plant growth and a diversity of animals.)
Energy	Biome Sorting	Climate	A region's seasonal average weather elements such as temperature, rainfall, humidity, and air pressure. The climate generally determines what kind of plants will grow in that region.
Energy	Biome Sorting	Distribution	How biological organisms, plants or animals, are geographically arranged. The distribution of some species may be continent wide or limited to a specific valley or mountain.
Energy	Biome Sorting	Diversity	The number of species, plant and animal, existing in a region as well as their relative abundance.
Energy	Biome Sorting	Ecosystem	A geographical region defined by all the living organisms (biotic) as well as the nonliving (abiotic) components such as climate, topography, and geology.
Energy	Biome Sorting	Evolved	Incremental change in an organism over time
Energy	Biome Sorting	Extinct	Species of organisms that once lived on Earth but are no longer present. (Examples are the large dinosaurs as well as more recent additions to the list: passenger pigeons and the great auk.)
Energy	Biome Sorting	Fossil	Preserved remains or evidence of plants and animals from the past.
Energy	Biome Sorting	Trilobite	Well-known and common fossil from a group of extinct arthropods. The fossil record shows their presence on Earth from about 530 million years ago (mya) until about 250 mya.