



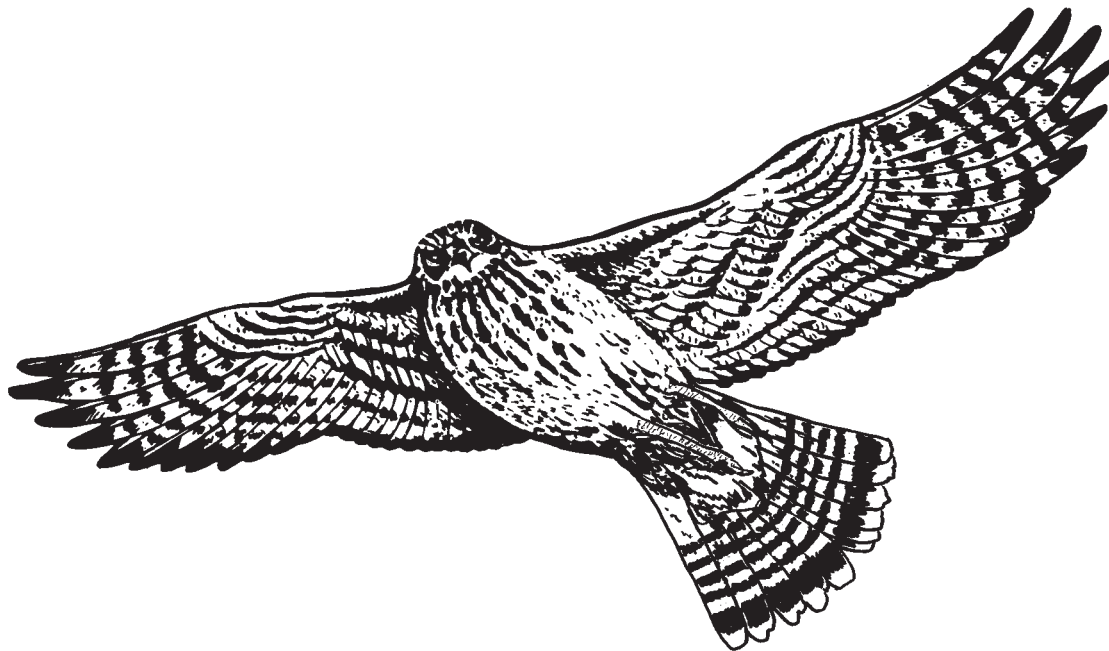
State of Illinois
Illinois Department of Natural Resources

Prairie Primer



Illinois
Department of
Natural
Resources

Prairie Primer



The exercises and activities included in this guide are designed to help teachers familiarize their students with the prairie and open habitat resources of Illinois. Although the materials are best suited for students in **grades four through eight**, most of the activities can be easily adapted to other grade levels.

Note to Teachers

Students will need to record their answers to the questions and activities on a separate sheet of paper or in another format. Some of the pages are suitable for copying. Teachers in Illinois have permission to copy the pages for use with students in the classroom. They may not be used in any other manner or converted in any way without the written permission of the Illinois Department of Natural Resources.

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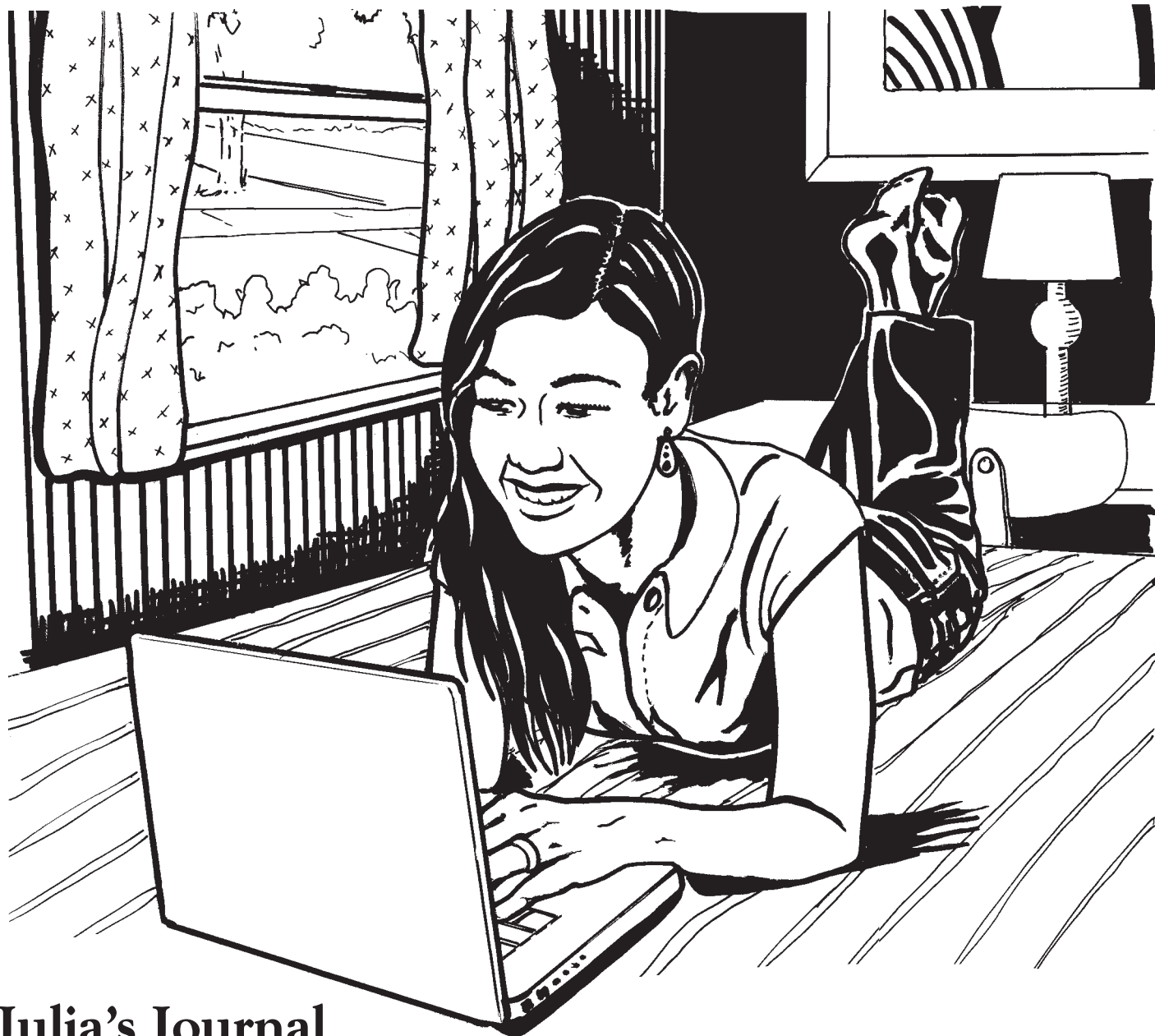
Scientific Names

A scientific name is the official name for each organism. It is assigned after careful research and is made up of two parts: the genus name (written first) and the species name. The name is always in Latin because when the naming process began, nearly all scientists understood the Latin language. The scientific name should be underlined or

italicized. Often, it tells you something about the organism or someone who studied it. Listed below are the common names of all the organisms mentioned in the *Prairie Primer*. It is your task to find the most current scientific name for each one. You can use field guides, the Internet or other resources to help you.

American bison _____
American carrion beetle _____
American toad _____
aphid _____
badger _____
big bluestem _____
black-eyed Susan _____
blue-eyed grass _____
bumble bee _____
bur oak _____
Canada goose _____
coyote _____
crawfish frog _____
deer mouse _____
dickcissel _____
digger wasp _____
downy gentian _____
earth star _____
eastern cottontail _____
eastern meadowlark _____
elk _____
false indigo _____
flesh fly _____
foxsnake _____
Franklin's ground squirrel _____
gophersnake _____
greater prairie-chicken _____
Indian grass _____
killdeer _____
least shrew _____
least skipper butterfly _____
little bluestem _____
little brown bat _____
loggerhead shrike _____
mound ant _____
mourning dove _____
needle grass _____

New England aster _____
nodding wild rye _____
northern harrier _____
ornate box turtle _____
painted lady butterfly _____
partridge pea _____
pasque-flower _____
plains pocket gopher _____
prairie avens _____
prairie dropseed _____
prairie violet _____
prairie vole _____
prairie willow _____
praying mantis _____
puffball _____
purple prairie clover _____
racer _____
rattlesnake master _____
red fox _____
red-legged grasshopper _____
robber fly _____
rosinweed _____
shooting-star _____
short-eared owl _____
side-oats grama _____
six-lined racerunner _____
smallmouth salamander _____
spotted cucumber beetle _____
stiff goldenrod _____
striped skunk _____
switch grass _____
thirteen-lined ground squirrel _____
tumblebug _____
turkey vulture _____
upland sandpiper _____
white fringed orchid _____
white-tailed deer _____



Julia's Journal

Dear Journal,

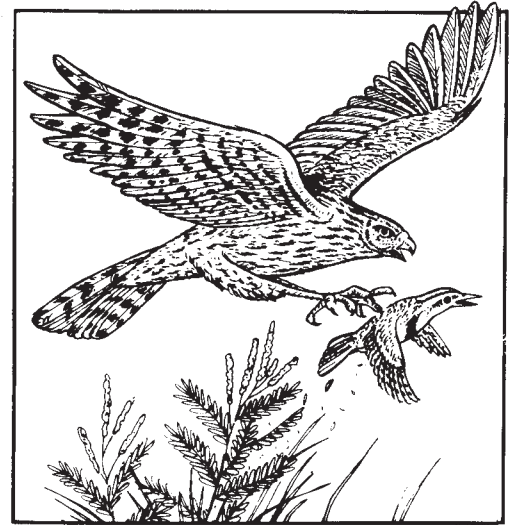
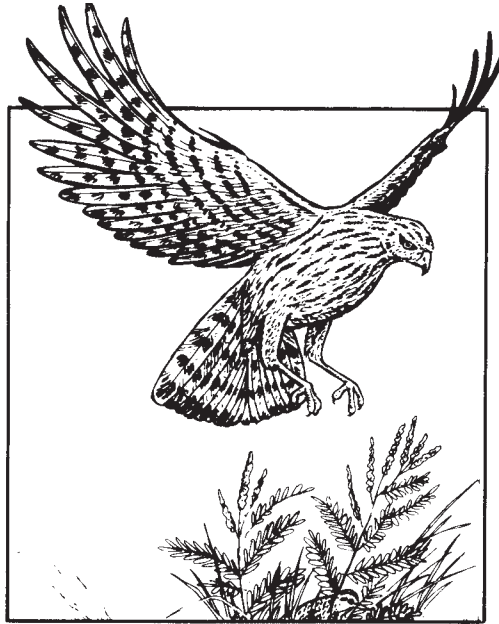
During December, the snow covered the prairie like a giant white blanket. Just the tops of the tallest grasses, like big bluestem and Indian grass, poked up through the snow to brave the winter wind. One bright, sunny day, the white prairie floor was glistening, and I found the tracks of a red fox and an eastern cottontail. Another day, I discovered a small opening in the snow. The opening was the beginning of a tiny tunnel that made a little bulge in the snow's surface. I followed the bulge to the foot of a bur oak tree at the edge of the prairie. The teeth marks on the tree trunk told me that a prairie vole had traveled through the tunnel and gnawed on the bark. As I walked home from the prairie that afternoon, I was happy to be heading for a good dinner and a fire in the fireplace, but I was disappointed that another year had passed without seeing a northern harrier.

The snow melted in February. Without its pretty, white blanket, the prairie looked dark and bare. I waited for the big bird to come. The month of March came, and the prairie began to awaken. By the 15th day of the month, the little pasque-flower's blue-purple flowers brought the first splash of color to the prairie. One month later, the first petals of shooting-star burst loose to form beautiful pink blossoms. I knew that many species of wildflowers and grasses would come into bloom every week on the prairie until November. Soon the prairie would be a warm world of lavender, green, indigo, pink, gold, crimson, orange and yellow. Yet even with all the excitement, I was still waiting to see the big brown bird.

Finally, Journal, I saw one. I was out in the prairie early this morning. The sun was just beginning to

rise, and the prairie grasses were covered with a silvery coating of frost. I had my usual equipment – a pair of binoculars, a field guide, a pencil, a sketchbook and my laptop computer. I was walking

of the time it cruised through the air. Prairie birds have vision eight times greater than people, and I could tell that this bird had its eyes glued to the ground looking for a bird or mouse for breakfast.



through some needle grass, when all of a sudden about 20 feet ahead, a big bird lifted from the ground and took off through the air. I could see that it had a brown back and a streaked brown belly, but I couldn't see if it had a white rump – the one clue I was really looking for. I was afraid I would scare the bird away so I crouched down, waited and watched.

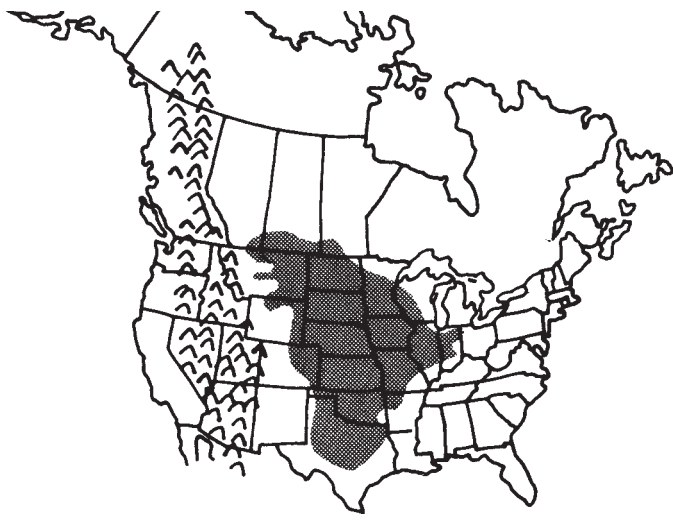
The bird flew slow and low over the prairie. My heart sank as it continued to fly away from me, but then it dipped one of its slender wings a bit and made a graceful turn back toward me. The flight of this bird was perfect. Once in a while it took a few soft strokes with its long, slender wings, but most

Suddenly, the bird stopped in mid-air and hovered about 10 feet over a shrub. I heard a rustle coming from the shrub, and I figured it was probably a deer mouse hiding in the leaves. The patient bird kept hovering. Then in a flash of a second, I saw a meadowlark shoot out of the shrub like a rocket. The meadowlark was barely airborne when the big bird snagged it with its razor-sharp talons. The captor then rose in the air and flew across the prairie with its prey. I jumped up and tried to catch sight of the bird with my binoculars. It had turned its wings down and was gliding to the ground. Before it disappeared into the grasses, I saw it – the big clue – the white rump. I had finally seen a northern harrier.



I sat down in the grass. It was a wonderful morning. Nestled there in the needle grass, I felt like I was a part of the prairie and its beauty. Just two feet to the left of me, a prairie willow was in bloom, while to my right, I could touch the tiny blue blossoms of blue-eyed grass. With the tips of my toes I could barely nudge the green stalk of a prairie violet. Overhead, an upland sandpiper was flying high in the sky. The entire prairie was listening to the musical trill of an American toad.

When I got to school that morning, I told my classmates about seeing the northern harrier, and I showed them some of the drawings I made. Our teacher asked me to tell more about the prairie, and I just couldn't stop talking once I started my story.



I began by telling the class about Illinois. Illinois is called "the Prairie State" because it lies on the eastern edge of what was once a vast grassland. The grassland stretched from Indiana to the Rocky Mountains and from Canada to the Gulf of Mexico.

In the Illinois country, the grassland covered 21 million acres of land. Most of the Illinois grasses were tall varieties, like big bluestem and switch grass. These tall grasses grew on the flat, level land in the river bottoms along the Illinois and Mississippi rivers. During summer and fall, the big grasses grew up to 10 feet tall, and a person could easily get lost trying to walk through them. Not all of the grasses were so big. Mid-sized grasses such as little bluestem and side-oats grama grew on the steep slopes of river bluffs and on flat sandy plains. Many beautiful wildflowers, such as purple prairie clover and white fringed orchid, grew alongside the grasses, making the Illinois country a colorful place.

When European explorers came to the Illinois country in the 1600s, they were amazed at what they saw. They had seen oceans of water, but they had never seen land that looked like an ocean of grass. Since they had no word to call this land, they used the French word "prairie," which means meadow, to describe the great grassland ocean.

The Europeans were not the first people to see the prairie, though. Native Americans were living on the prairie and had been for many years. Life on the prairie was not easy. It was hot and dry in summer and extremely cold in winter. Severe storms of rain, snow and sleet ravaged the land on a regular basis, and the great prairie wind blew strongly year round. The land, though, was good to the Native Americans. They plowed small garden plots and raised crops of maize (corn), beans and squash in the fertile prairie soil. Twice a year, once after spring planting and again in winter, the Native Americans migrated to the best hunting grounds where they took American bison, deer and small game. Lacking horses and guns, they chased game on foot and used spears and arrows as weapons. Often, they set the prairie on fire to chase big herds of bison.

The Native Americans took only what they needed from the prairie. As a result, the prairie remained an untamed place where people as well as wildlife thrived. Great herds of bison and elk roamed the prairie freely. In spring, millions of prairie-chickens "boomed" and danced on the ground while mighty birds of prey, like the northern harrier and short-eared owl, patrolled its skies.

When the first European settlers came to the Illinois country in the early 1800s, they were impressed with the beauty of the prairie. They had come from the eastern United States where the land was rolling and covered with forests. Many of the settlers felt hemmed in by the hills and trees, and as they walked out onto the flat, sunny prairie and faced the prairie wind, they felt a rush of freedom.

Then, Journal, I shared with the class a letter I had found in an old book about the prairie. The letter was written by a woman named Lucinda Rutherford, shortly after she settled in eastern Illinois. She wrote the letter to her mother in Pennsylvania to tell her about the Illinois country.

"The prairies here are delightful, they are from 12 to 20 miles wide, and 150 long, instead of the timber surrounding them, they surround the timber, at this season they are most beautiful. The green grass has sprung up and covered the whole bosom of these wastes; with that grass there springs up a multitude of flowers of every hue, form, and scent. It is delightful to ride over this level land and every step, tramping those gems of nature underfoot. Their beautiful heads can be seen as far as the eye can reach waving in the summer wind."



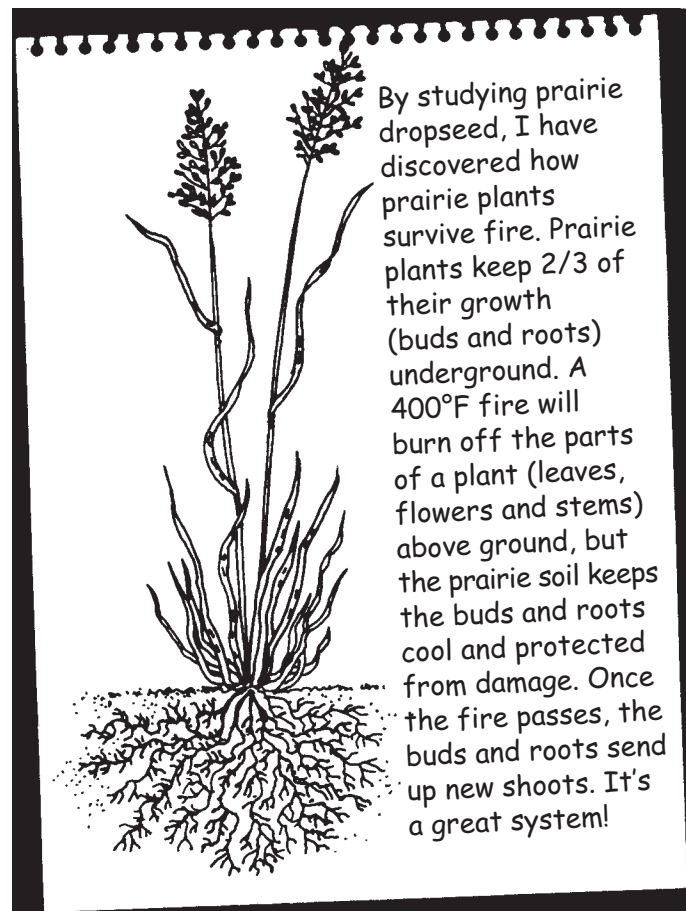
Then, Journal, one of my classmates raised his hand and told the class about a poem his great-grandmother had written about the prairie. The poem, he said, told about how the prairie would catch on fire and burn for miles. He asked me if that was true.

I answered that fire was very common on the prairie. Sometimes, the prairie fires were set by Native Americans to chase herds of bison. Other times, lightning struck the grasses, and like a match, set the prairie ablaze. Records show that 50

to 60 square miles of prairie would burn at one time. The flames would rise up to 40 feet high, and the entire sky as far as one could see would be bright red. The wind drove the flames like giant waves over the prairie. Remember how the European explorers thought the prairie looked like an ocean of grasses? Well, the prairie on fire looked like an ocean of fire.

Another friend asked a good question. She wanted to know why fire didn't destroy the prairie. I told her that fire is the best friend of the prairie. Fire burns any young trees trying to grow on the prairie. If those trees were allowed to grow, they would soon overshadow the prairie grasses, and the prairie would become a forest. Fire helps the prairie in other ways, too. It burns off the dead layers of grasses, thereby clearing the prairie floor so that the delicate stems of new plants will have room to grow. In the ashes left by the fire there are important nutrient elements. Those nutrient elements enter the soil and are used to help new plants grow.

Prairie plants, unlike trees, can survive fire. I discovered how prairie plants survive fire by studying prairie dropseed, and I showed the class this page from my sketchbook.



Sharon raised her hand and asked, "If prairie plants are so good at surviving, why isn't there more prairie in Illinois? I've never seen a prairie." Then,

Journal, I had to tell the class a sad story. I had to tell how the Illinois prairie met something much more ferocious than fire – the plow.



Settlers brought the plow to the Illinois country in the early 1800s. They thought the prairie was magnificent, but they needed crops to feed their family and were afraid of prairie wildfires. Prairie fires often engulfed people, houses, barns and livestock. Settlers worked hard to come to Illinois, and they were determined to tame the land and make it work for them. So, the settlers "broke" the prairie by plowing up the prairie grasses and wildflowers and planting seeds of corn and wheat. If they didn't plow a piece of prairie, they grazed cows on it. The delicate prairie plants soon became "eaten out." The hungry cows broke the prairie as surely as the sharp blades of the steel plow.

As more and more settlers arrived, the prairie and its native peoples were doomed. By 1835, bison had fled their Illinois home for the still untamed lands of the west. About the same time, the last Native Americans were removed from their ancestral home in Illinois and herded to western reservations. By 1860, nearly all of Illinois' 21 million acres of prairie had been cleared and were being used as farmland, towns and roads. With the absence of fire, trees were growing on many prairie patches that had escaped the plow.

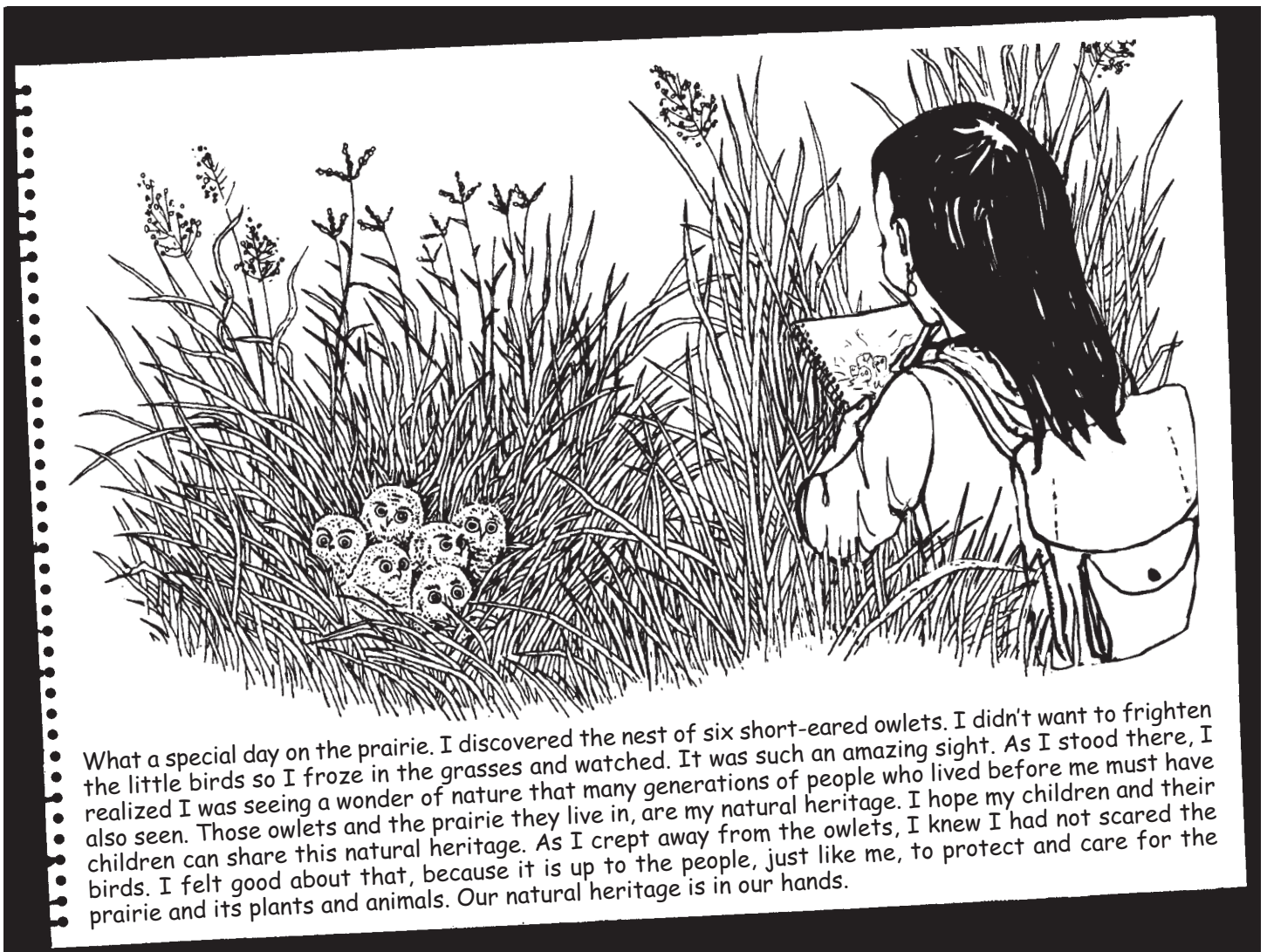
Felicia raised her hand and said "but there must be some prairie left, you saw the northern harrier in a prairie." I answered that there is some prairie left in Illinois, about 2,000 acres. Fortunately, most of this prairie is within Illinois Nature Preserves. The prairie I visit is in a nature preserve, and it is protected by law from being plowed or harmed in any way. There are smaller tracts of prairie along roadsides, railroad beds and in pioneer cemeteries. These little prairies are unprotected and can be destroyed at any time. It is estimated that only one-hundredth of one percent of the prairie is left in the prairie state.

After I told the class how much prairie is left in Illinois, Roberto said, "one hundredth of one percent, that's not very much prairie – where do all of the prairie animals live?" I told him that some prairie animals, like dickcissel, meadowlark and thirteen-lined ground squirrel, have been able to substitute other open grassy habitats for their prairie home. They have learned to live in pastures, old fields, grassy roadsides, cemeteries, golf courses, fencerows, parks and lawns.

Most prairie animals, however, have not been so lucky. These animals, like the bison and elk, must have a large prairie home to survive. They no

longer live in Illinois. Other animals, like the prairie-chicken, upland sandpiper and northern harrier, are endangered in Illinois. These animals, along with many prairie plants, are in danger of extinction because there is so little prairie habitat left for them.

Then, Journal, Ms. Wade asked the last questions. She wanted to know what is going to happen to the prairies in Illinois and all the plants and animals that live in them. Who is in charge of taking care of our prairies? To answer Ms. Wade's question, I showed the class this page from my sketchbook.



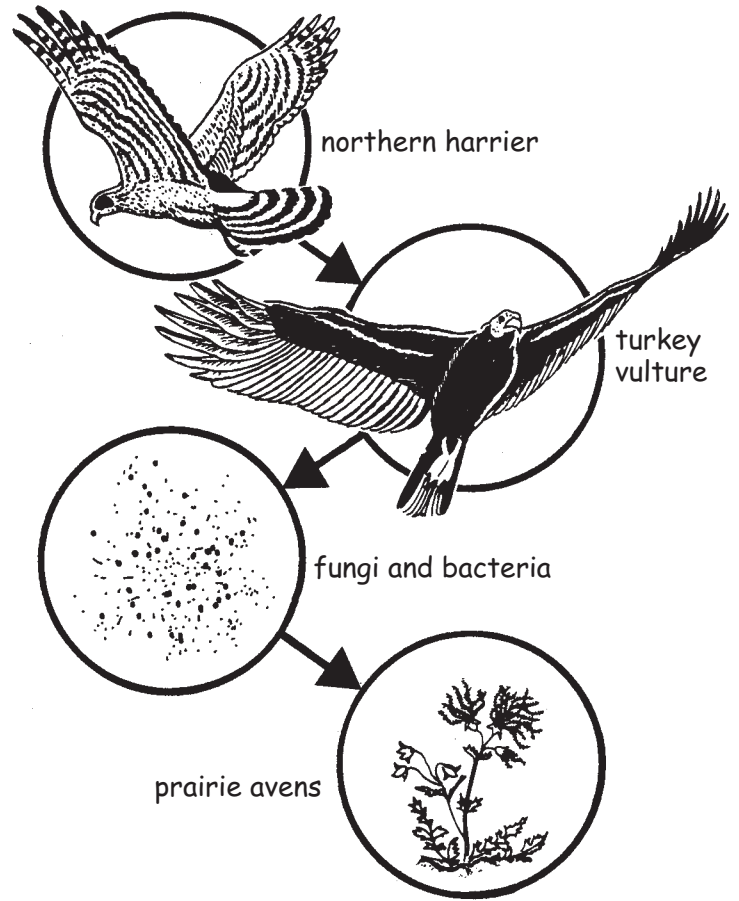
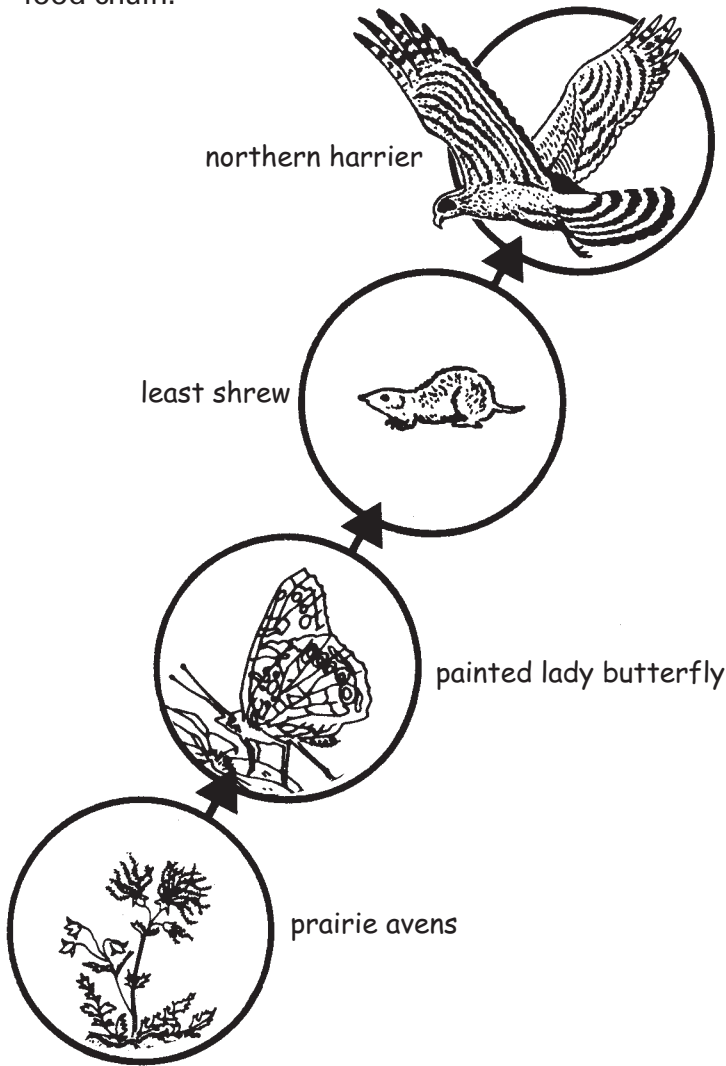
What a special day on the prairie. I discovered the nest of six short-eared owlets. I didn't want to frighten the little birds so I froze in the grasses and watched. It was such an amazing sight. As I stood there, I realized I was seeing a wonder of nature that many generations of people who lived before me must have also seen. Those owlets and the prairie they live in, are my natural heritage. I hope my children and their children can share this natural heritage. As I crept away from the owlets, I knew I had not scared the birds. I felt good about that, because it is up to the people, just like me, to protect and care for the prairie and its plants and animals. Our natural heritage is in our hands.

Answer the following questions.

1. Describe differences in the prairie during the months of December, February and March.
2. How was the perception of the prairies by European settlers different from that of the Native Americans?
3. Why is fire important to the prairie?
4. Who is responsible for protecting our prairie heritage? How can we ensure that our prairies are protected and preserved?

The Great Food Chase

Food is first produced in the ecosystem by plants. The plants are eaten by animals that in turn are eaten by other animals. The flow of food energy from a plant to an animal to another animal is called a food chain. In the prairie ecosystem, there are many food chains. Here is an example of one food chain.



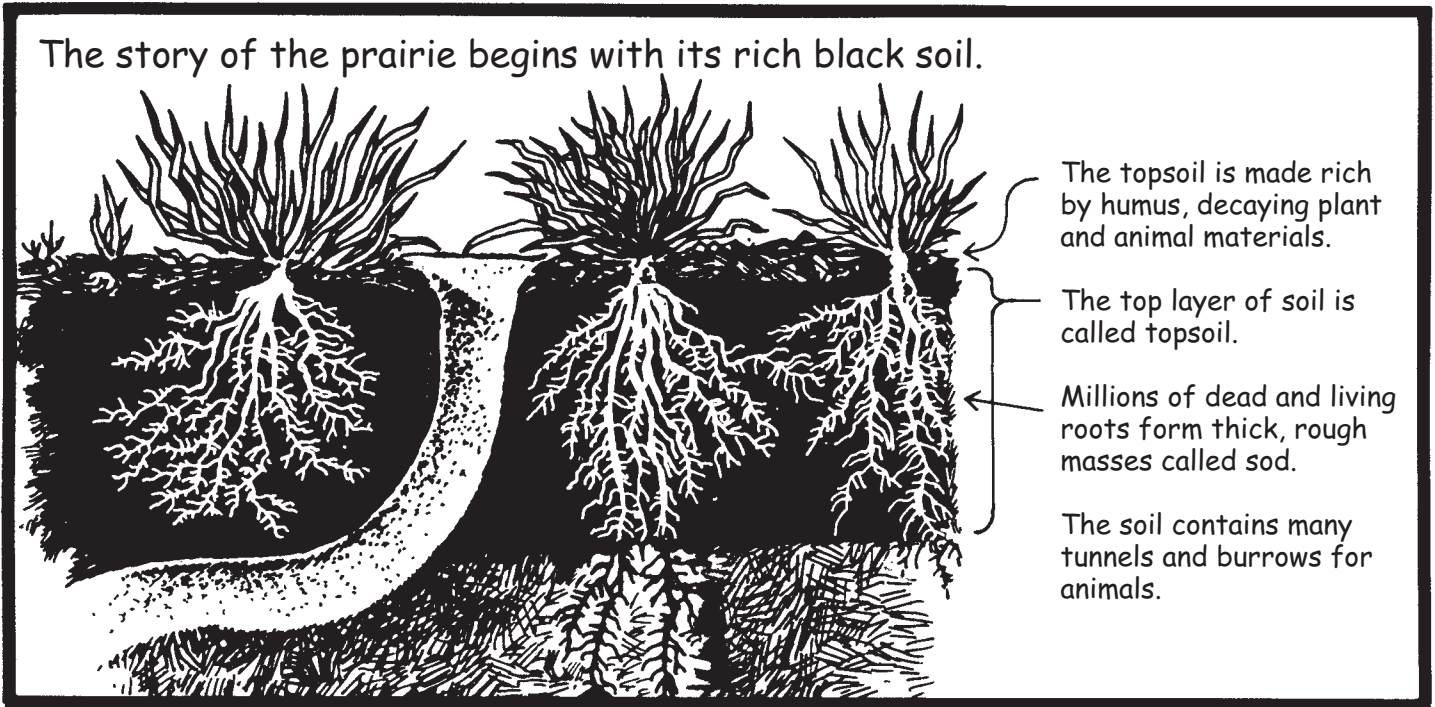
In this food chain, the northern harrier is at the top of the chain. An animal at the top of its food chain has no natural predators. Animals at the top of their food chain contribute to the chain when they die. Their body is eaten by scavengers, such as the turkey vulture and American carrion beetle. When scavengers die, their body is consumed by fungi and bacteria. The fungi and bacteria break down the body parts into important nutrient elements, such as carbon, nitrogen and potassium. The nutrient elements are stored in the soil until they are taken into the roots of a plant and used to help the plant grow.

Throughout this activity book you will be able to follow the flow of food through a food chain in the prairie ecosystem. Each section of this unit will provide a food chain box like the one shown below. On page 31 is an activity that will test your understanding of the food chain process.

SAMPLE

The short-eared owl preys upon the Franklin's ground squirrel. Food energy is transferred from the squirrel to the owl.

Prairie Soil



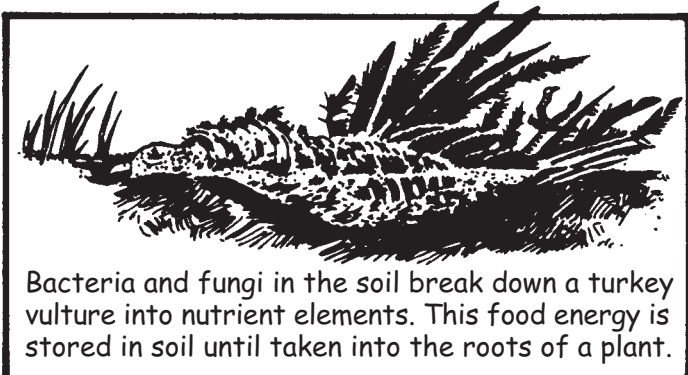
The Role of Soil in the Prairie Ecosystem

The tough prairie sod is a great conservator of water and soil. When it rains on the prairie, the sod acts like a giant sponge catching and holding the rain water. As a result, the amount of water runoff from the prairie is small compared to other lands where there is no strong network of roots to absorb the rain. Those same roots also bind the soil tightly to the earth, protecting it against erosion or the washing or blowing away of soil from the forces of water and wind. Plant roots in the soil are strong and numerous. A square yard of soil 4 inches deep may contain roots that would stretch for 20 miles if they were placed end to end.

In or on the prairie soil, as many as 641,000 fungi and more than 20 million bacteria per acre are at work breaking down dead organisms into nutrient elements, such as carbon and nitrogen. The nutrient

elements are stored in the soil until they are taken in through the roots of plants. Dead materials are recycled into nutrient elements that can be used to help plants grow, the process of nutrient element cycling.

Prairie soil provides shelter. When harsh weather or fire sweeps across the prairie, the roots and buds of plants are safe in the soil. When plant parts above ground wither and die in late summer and fall, the roots or buds live on. Animals, too, depend on the soil as a refuge. The deer mouse builds its small nest underground and hoards seeds for winter use in burrows near its nest. The badger uses its burrow in spring as a nest chamber where it raises its young and sometimes in winter as a place to sleep for several days, although it does not hibernate. Franklin's ground squirrel hibernates in its burrow throughout the winter months. Many birds, reptiles and amphibians also find refuge and/or food at the soil level.



Working with the Prairie Soil

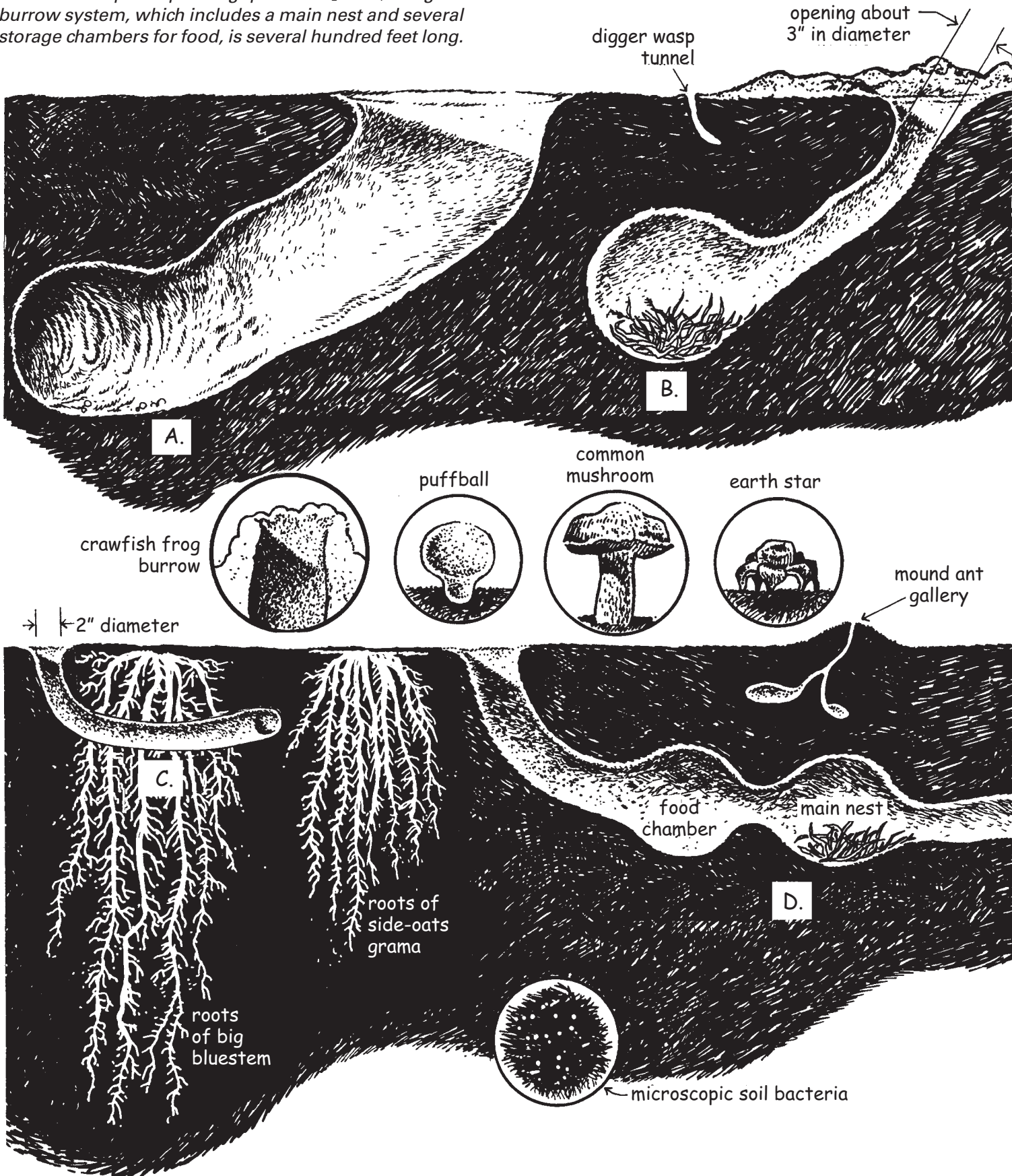
1. Explain what is meant by nutrient element cycling. Why is it important?
2. Several prairie soil elements are shown on page 12. On your paper, name the animal associated with each burrow (A, B, C, D).

CLUE #1: The badger is 28-30" long from head to tip of tail.

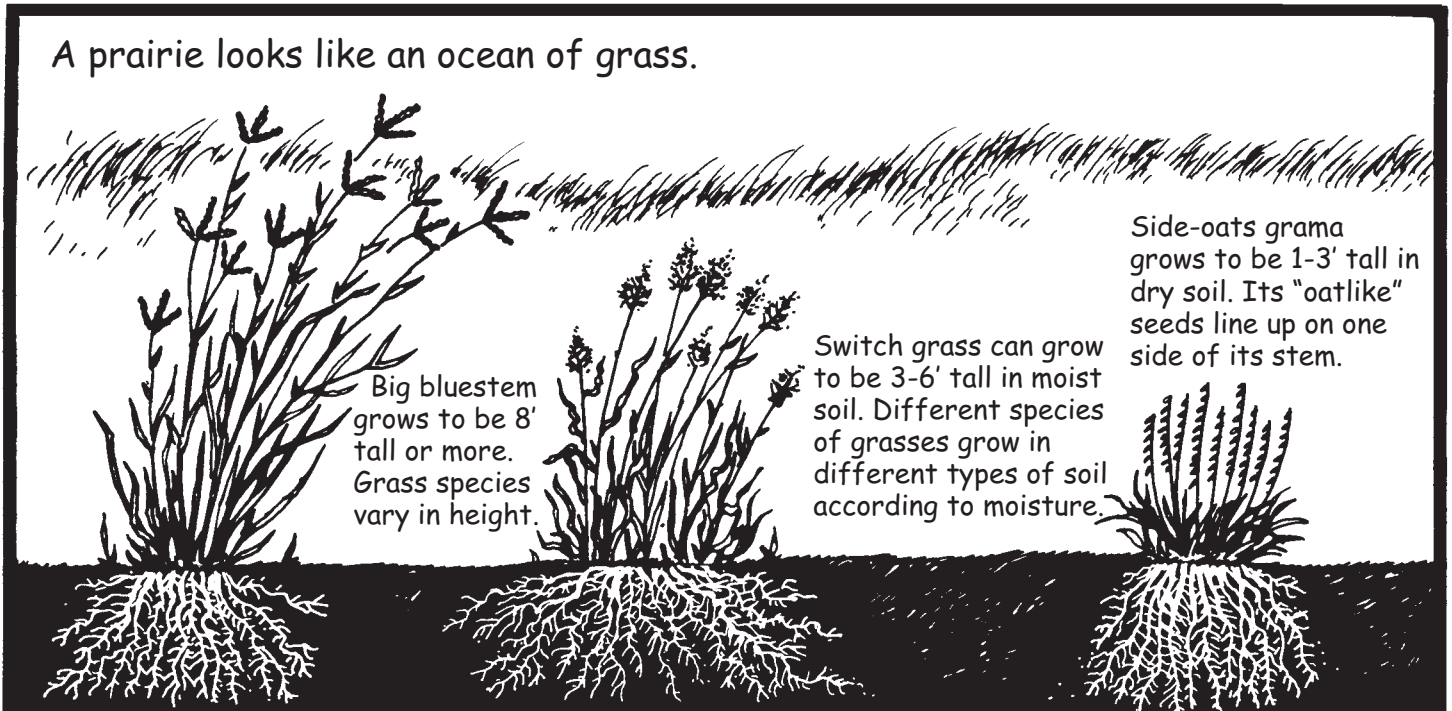
CLUE #2: The least shrew is 2 1/2-3 1/8" long, and its underground tunnels are about 2" in diameter.

CLUE #3: The plains pocket gopher is 9 1/2-12 3/4" long. Its burrow system, which includes a main nest and several storage chambers for food, is several hundred feet long.

CLUE #4: Franklin's ground squirrel is 14-16" long. Its burrow is usually about 3 inches in diameter and leads to a larger next chamber.



Prairie Grasses



The Role of Grasses in the Prairie Ecosystem

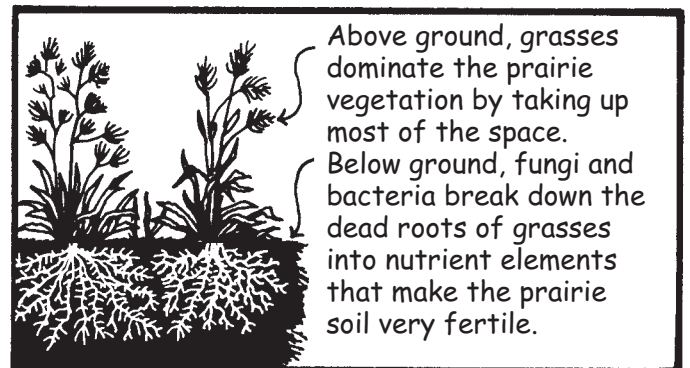
The importance of grasses to the ecosystem begins underground. A massive network of grass roots anchors the soil, preventing erosion. The roots, combined with the soil, form a tough mass called sod that works like a sponge to absorb rain. Nutrient elements in dead grass roots remain in the soil until they are used by living plants.

Working with Prairie Grasses

1. Describe the importance of grasses in prairies.
2. Several prairie grasses are shown on page 14. On your paper, name each grass.
3. Make a table to illustrate the height of the 8 prairie grasses described in this activity.

big bluestem: This grass grows to a height of 8' or more. It begins growing in late April and flowers in late summer. The seed head of its flower has three parts, looking something like a "turkey's foot." Big bluestem grows mainly in moist soil.

little bluestem: Reaching 2-4' tall, little bluestem grows from May until the first frost in fall. During spring and summer, the bottom shoots of the plant are blue-green but by fall, they are a mixture of rust and gold. Its flowers are "feathery" and covered



with short, white hairs. Little bluestem grows in upland areas of dry to moist soil.

needle grass: This grass grows to 2-4' tall in dry soil. It begins growth in April and flowers by June. It is sometimes called "needle and thread" because of its pointed seed that is as sharp as a needle.

side-oats grama: Side-oats grama may reach 1-3' tall and flowers during the summer. Its small ($\frac{1}{4}$ " "oatlike" seeds line up on one side of its stem, giving this dry-soil grass its common name.

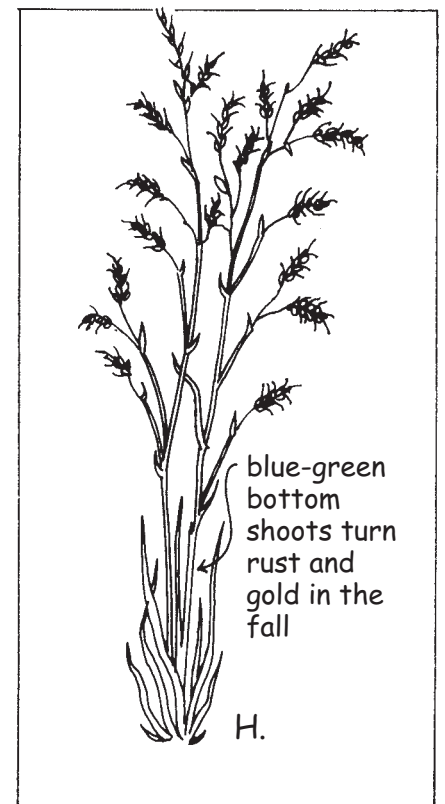
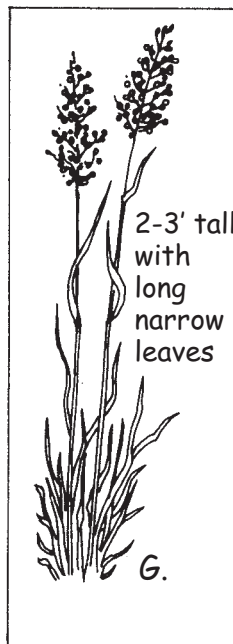
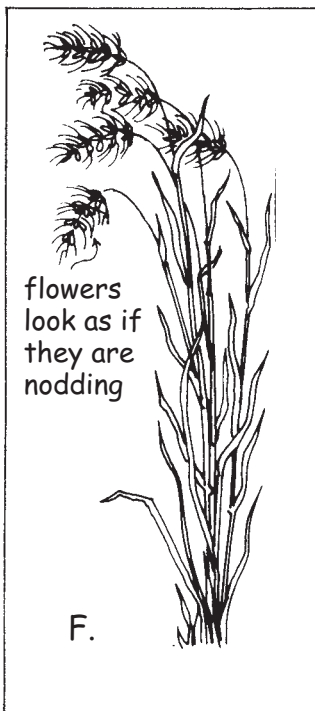
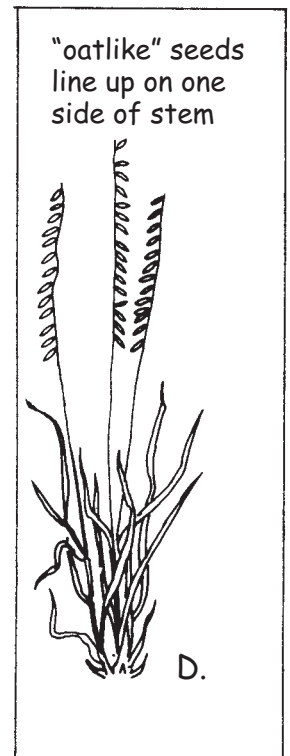
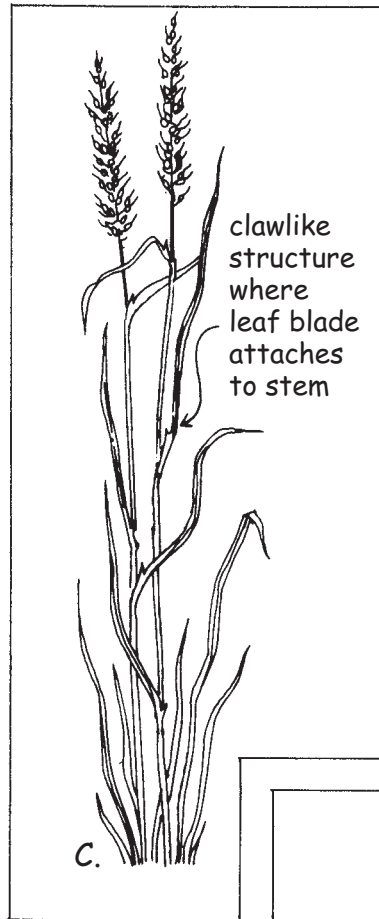
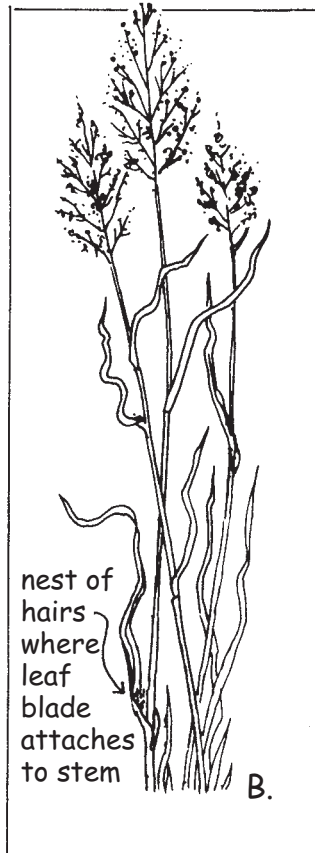
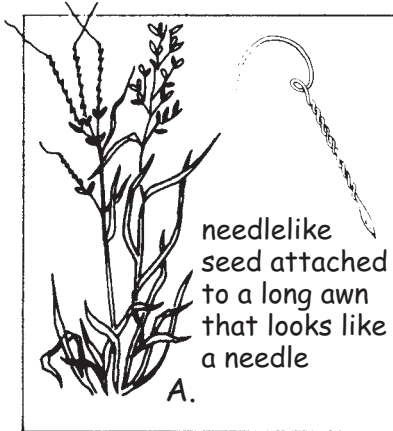
switch grass: A prominent nest of hairs where the leaf blade attaches to the stem helps to identify switch grass. It grows well in moist, bottomland soil and may reach 3-6' in height.

Indian grass: This 4-8' tall grass begins growing in dry to moist soil about the first of May and flowers during late July and August. Indian grass can be identified by the presence of a clawlike structure where the leaf blade attaches to the stem.

nodding wild rye: Growing to 3½' at maturity, this

grass matures by July. Its dense flowers look like they are nodding as they curve downward. Nodding wild rye grows in dry to moist soil.

prairie dropseed: This plant reaches 2-3' tall and has long, narrow leaf blades. Prairie dropseed grows in dry soil and flowers in the fall.



Prairie Forbs

Forbs are the wildflowers of the prairie.



New England aster, like most forbs, is a perennial, which means it lives from year to year even though the above-ground parts of the plant die each fall. The underground parts, bulb and roots, live many years as they are protected in the soil.

Forbs, like this pasque-flower, may have colorful, showy flowers. Pasque-flower blooms in March. Different forb species come into bloom each week during the growing season.



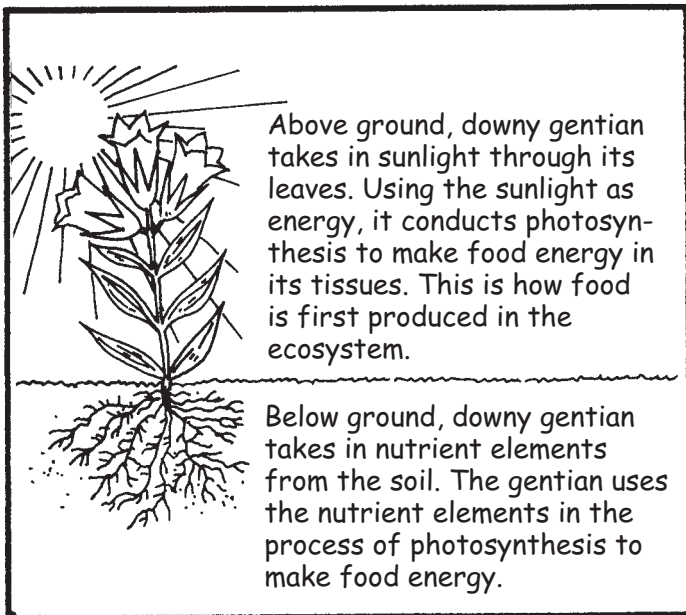
False indigo is a forb that begins blooming in June in moist soil. Different forb species grow in different soil types according to moisture.

The Role of Forbs in the Prairie Ecosystem

Since forbs must occupy the same space on the prairie as grasses, they have adapted methods to guarantee their share of water and sunlight. Most forbs send their roots deeper into the soil than grass roots, allowing them to use water the grasses cannot reach. The shortest forbs bloom early in the spring before the grasses have had time to grow and overshadow them. During summer and fall, forbs flower that can stand as tall as or taller than the grasses.

Reaching tall enough to capture sunlight is not only

important for the survival of forbs, it is necessary for the well-being of the prairie ecosystem. Using sunlight as energy, plants combine water and carbon dioxide in the presence of chlorophyll to make glucose (food molecules). The process of making food molecules is photosynthesis. Since animals cannot use the energy of the sun to make food, animals depend upon plants as the food producers in the prairie ecosystem. Oxygen is produced as a by-product during photosynthesis. Forbs and grasses produce most of the oxygen in the prairie ecosystem.



pasque-flower: This forb grows in dry soil and begins blooming in March. Its leaves are deeply cut into narrow lobes and are covered with long, silky hairs. The plant reaches a height of 4-10."

false indigo: False indigo grows in moist soil and may reach 3 1/2' in height. It begins blooming in June. Its delicate pea-shaped flowers are white.

prairie avens: One of the short forbs, prairie avens grows from 6-16" tall. It blooms in May and grows in dry to moist soil. The long, feathery hairs in its seed head give it the look of a "puff of smoke."

Like grasses, forbs contribute to the richness of the prairie soil. The legume forbs, those that produce a beanlike fruit, add nitrogen to the soil. When the deep roots of forbs die and decay, they leave channels in the soil that provide for the passage of air and moisture.

Working with Prairie Forbs

1. Describe the contributions that forbs make to the prairie ecosystem.
2. For each of the 8 prairie forbs shown on pages 16-17 that is not named, on your paper, list the following items: its common name; the name of the month in which it blooms; and the type of soil it grows in.

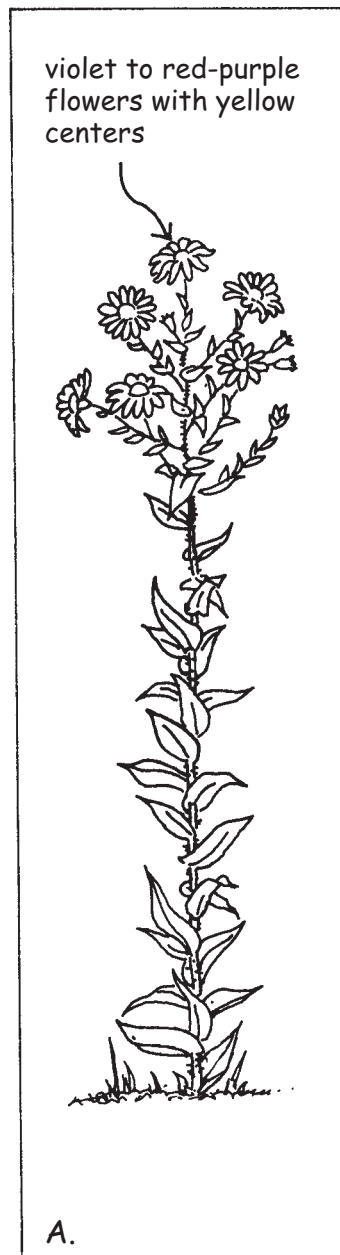
downy gentian: This dry-soil forb grows to 8-16" tall, blooms in September and has deep blue, tubular-shaped flowers with five petals.

rattlesnake master: Growing 3-4' tall, this plant begins blooming in July. It thrives in dry to moist soil. The spherical flower clusters are white, hard and prickly.

shooting-star: Shooting-star grows in dry to wet soil and begins blooming in April. Its petals are white to pink and curve sharply upward. This plant grows from 8"-2' tall.

partridge pea: Sandy soil is the preferred habitat for this forb. It blooms in August and may grow to 2' or more in height. Unlike most legume forbs, its flower is not pea-shaped but is very showy and yellow in color

New England aster: New England aster (18-40" tall) grows in moist soil and blooms in October. Its large, violet to red-purple flowers have a yellow center.

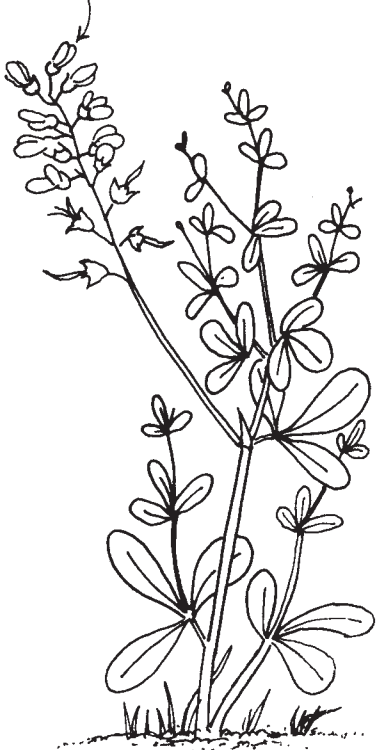


deep blue, tubular-shaped flowers



C.

white, pea-shaped flowers



F.

More prairie forbs

purple prairie clover



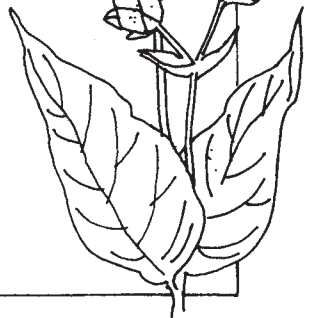
black-eyed Susan



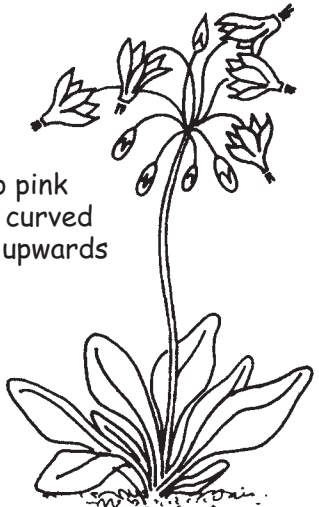
stiff goldenrod



rosinweed

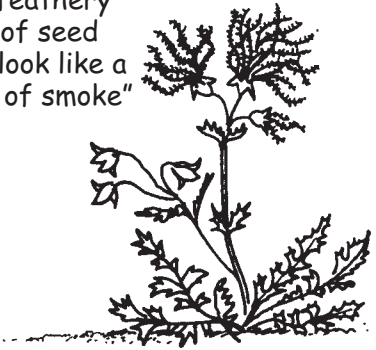


white to pink flowers curved sharply upwards



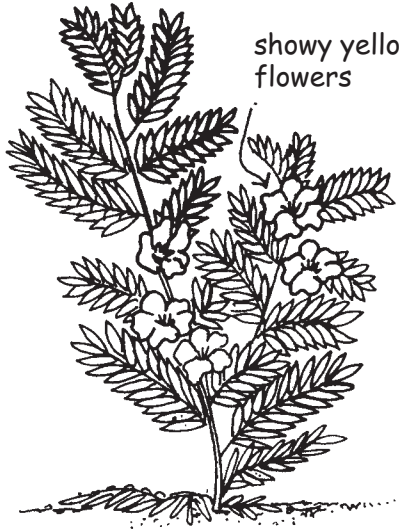
D.

long, feathery hairs of seed head look like a "puff of smoke"



G.

showy yellow flowers



E.

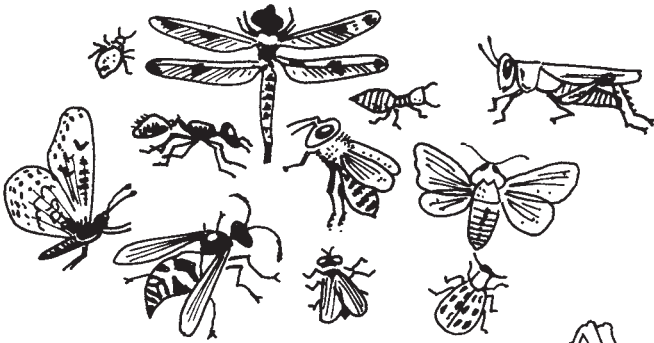
deeply cut leaves covered with long, silky hairs



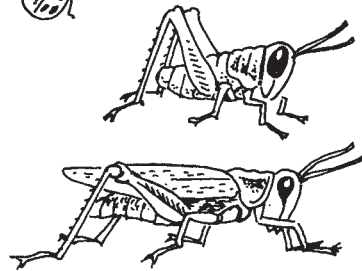
H.

Prairie Insects

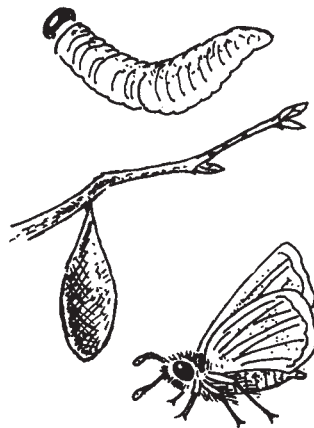
The prairie is home for millions of insects.



The most common prairie insects are dragonflies, wasps, ants, bees, grasshoppers, termites, beetles, aphids, butterflies, moths and flies.



Insects exist on the prairie in many forms, first as immature stages and later as adults. Immature insects may be nymphs or larvae. Nymphs, such as this immature grasshopper, look rather like their parents and grow by a series of molts until they reach the size of the adult. The development of a nymph into an adult is called incomplete metamorphosis.



Larvae, such as this least skipper caterpillar, look nothing like their parents. Larvae also grow by a series of molts, but then they rest as a complete metamorphosis changes them into an adult. This resting period is known as the pupal stage. For its pupal stage, the least skipper caterpillar spins a protective cocoon where it changes into a least skipper butterfly.

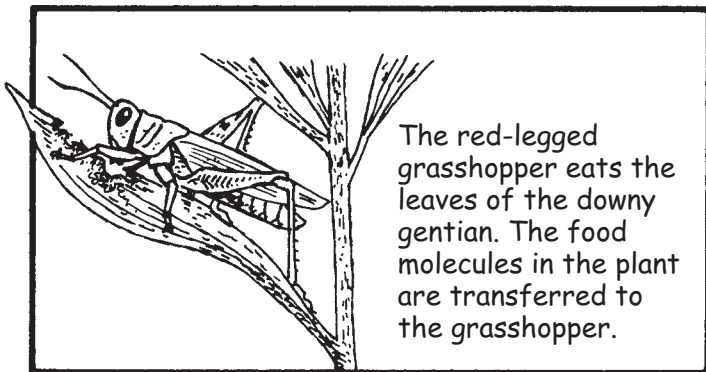
The Role of Insects in the Prairie Ecosystem

The prairie ecosystem could not exist without the important work performed by insects. Their jobs include: 1) pollination; 2) food processing; 3) decomposition of dead organisms; and 4) soil tillage.

Example 1: The gold and black bumble bee demonstrates how insects help carry out pollination. Pollination is the transfer of pollen from the male part of a flower to the female part of another flower. The pollen fertilizes the seeds inside the ovary of the female flower, and they begin to ripen and mature.



Wind carries the pollen of grasses, but most forbs depend upon insects to move their pollen. Bees are attracted to the showy and fragrant flowers of forbs. When a bee settles into the flower, it begins feeding on the nectar and/or pollen of the flower. Some of the pollen rubs off onto the hairy body of the bee. When that same bee visits another flower, some of the pollen from the first flower rubs off onto the second. Without the help of the bumble bee and other insects that feed on pollen and nectar, pollination would not be possible, and most plants would not be able to reproduce. Both plants and insects benefit.



Example 2: The red-legged grasshopper shows how insects process food on the prairie. Forbs and grasses are the primary producers of food energy. The red-legged grasshopper makes direct use of that energy by eating grasses and leaves of forbs. With the plant food it eats, the grasshopper builds tissues in its body. Eventually, the grasshopper will be eaten by another animal, maybe the American toad. When that happens, the food energy that was once in the plant eaten by the grasshopper is transferred to the toad. Because the grasshopper and many other insects process plant food into animal food, they are said to be the primary consumers in the ecosystem. It is important to note, however, that some insects prey upon other insects. The praying mantis, for example, is a fierce predator of other insects. Thus, some insects are not primary consumers but rather secondary consumers.

Example 3: The small American carrion beetle demonstrates how insects help decompose organic material. The adult beetle flies about the prairie and locates a dead animal by scent. The adult lands beside the body, crawls into the soil beneath it and lays eggs. The eggs hatch in a few days, and the larvae feed on the carcass until nothing is left but nutrient elements. The nutrient elements are stored in the soil until they are taken into the roots of

plants. In this way the carrion beetle and all other scavenger insects help with the decomposition of dead material. In addition to cleaning up rotting debris, these insects help recycle nutrient elements.

Example 4: The tiny mound ant demonstrates how insects till the soil. Mound ants dig elaborate tunnels leading to galleries in the soil. In the galleries, the ants live in a colony that includes a queen ant and worker ants who attend to the larvae. The mound ants and all other insects that burrow into the soil help keep the soil loose enough to absorb water and air.

Working with Prairie Insects

1. Explain how nymphs mature into adults and how larvae mature into adults.
2. On page 20 are illustrations of 14 insects. Write the common name of each insect on your paper. For each insect, also indicate which of the following ecosystem tasks it performs. If both the immature and the adult insect are described, base your answer upon the activities of both.

- 1) pollination
- 2) food processing
- 3) decomposition
- 4) soil tillage

flesh fly: This black fly has gray markings. Its larvae feed on decaying vegetation and dead animal parts. The adult feeds on flower nectar.

robber fly: The robber fly is a fierce predator. It can capture another insect on the wing, drop to the ground and suck the prey dry in a matter of seconds. The larva of the robber fly is also a predator, feeding on tiny insects in the soil.

least skipper butterfly: This golden-brown butterfly sips nectar from flowers and also eats decaying plant materials.

painted lady butterfly: Orange to gray wings that are marked by splashes of pink, black markings and white spots help to identify the painted lady butterfly. It visits the flowers of prairie forbs as it searches for nectar.

spotted cucumber beetle: The green-yellow spotted cucumber beetle is covered with 11 black spots. Its larvae feed on dead roots of grasses and forbs, while the adult eats leaves and flowers of forbs.

digger wasp: This hairy, black wasp has red-orange markings on its abdomen. The adult wasp feeds on flower nectar. The female adult burrows into the soil in search of beetle larvae, sometimes tunneling a few feet deep. Upon finding a beetle larva, it stings it and then digs a tiny cell around the body. It then lays one egg on the back of the beetle larva. When the wasp larva emerges, it feeds on the body of the beetle larva.

aphid: This small, pear-shaped insect sucks liquids from plant stems and leaves. The aphid discharges a clear, watery liquid, called honeydew. Ants feed on the honeydew.

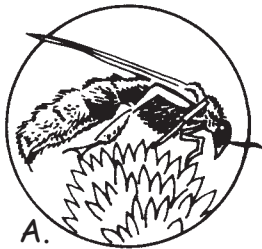
praying mantis: The folded forelegs of this green

insect give the impression it is "praying." It actually uses the legs to prey upon grasshoppers, crickets, bees, caterpillars and flies. The nymph also preys upon other animals, including plant lice.

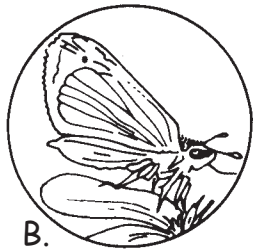
least skipper caterpillar: This larva is grass-green with a dark-brown head. It moves up and down grasses, munching on the tender shoots as it goes.

tumblebug: The $\frac{3}{4}$ " black, adult tumblebug is sometimes tinged with green or copper. The male and female adults roll a ball of animal dung across the prairie. After the dung is pressed and round, they dig a tunnel in the soil and drag the ball of dung into it. The female then lays an egg on the dung. When the larva hatches, it feeds on the dung.

Prairie Insects



A. hairy and black, red-orange markings



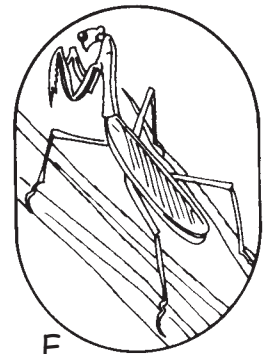
B. golden brown, sips flower nectar



C. marked by splashes of pink, black and white



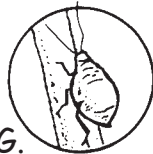
D. black and gold, important in pollination



E. forelegs look like praying hands



F. brown fly, fierce predator



G. pear-shaped body, discharges honeydew



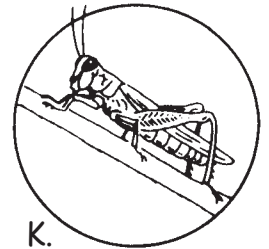
H. dull black, buries dung



I. has 11 black spots



J. tiny black ant, burrows tunnels



K. one inch long, red-green



L. black fly with gray markings



M. small black beetle



N. grass-green coloration, dark brown head

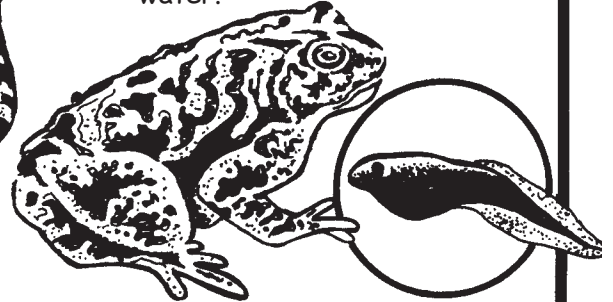
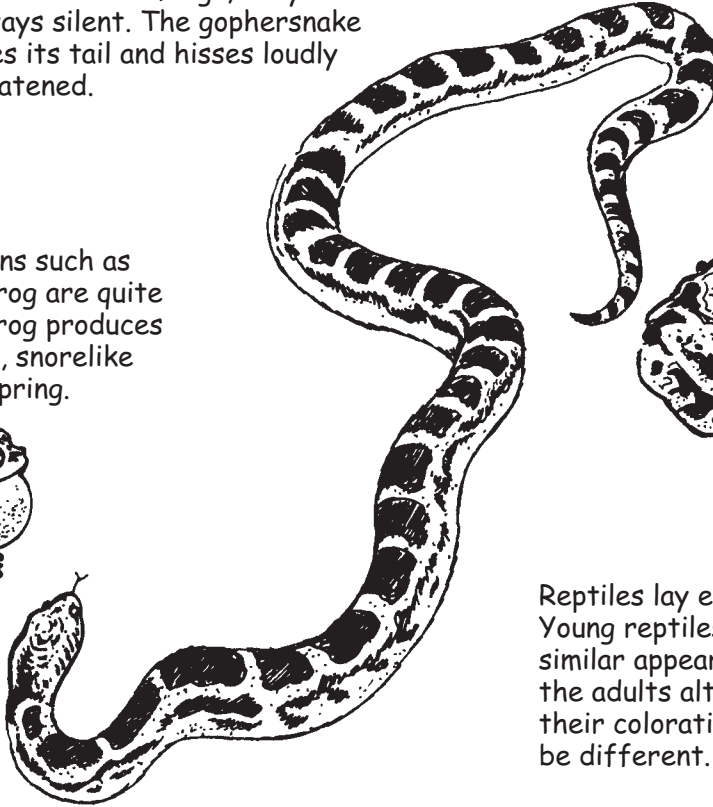
Prairie Amphibians and Reptiles

Amphibians and reptiles bring music and variety to the prairie.

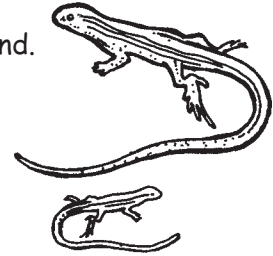
Though reptiles do not vocalize as much as toads and frogs, they are not always silent. The gophersnake vibrates its tail and hisses loudly if threatened.

Amphibians, such as the American toad, exist in two forms, first as a larva (the tadpole) and after metamorphosis as an adult. Amphibians lay eggs in water.

Some amphibians such as the crawfish frog are quite musical. This frog produces a deep, roaring, snorelike mating call in spring.

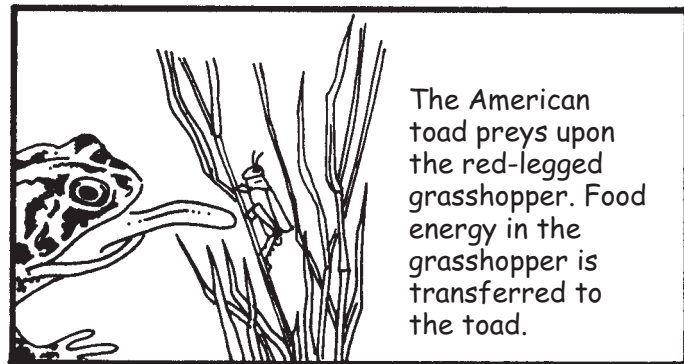


Reptiles lay eggs on land. Young reptiles have a similar appearance to the adults although their coloration may be different.



The Role of Amphibians and Reptiles in the Prairie Ecosystem

Amphibians and reptiles play important roles in the ecosystem. As predators, amphibians and reptiles help control populations of insects and rodents. As prey, they serve as food for birds, mammals and other amphibians and reptiles.



The American toad preys upon the red-legged grasshopper. Food energy in the grasshopper is transferred to the toad.

Working with Prairie Amphibians/Reptiles

1. Explain how amphibians exist in two forms. Do reptiles have two forms?
2. On page 23 are illustrations of 8 prairie amphibians and reptiles. Read the following descriptions carefully. On your paper, list the common name of each species. Also list all the sheltered locations that each of these animals finds for itself, its eggs and its young.

racer: This slender, blue snake has a white chin and throat and is from 36-60" long. It often stays under a rock but will climb a shrub or take to the water if being pursued or searching for food. The racer preys upon insects, amphibians, reptiles and small birds and mammals. In June and July, the racer lays its 19 to 25 white eggs under a rock.

ornate box turtle: This dark brown (4-5") turtle is decorated with golden lines radiating outward from the middle of its shell. It carries one of its shelters with it. If threatened, it pulls in its head and feet and closes its shell so tightly that the prying beak, claws or teeth of a predator cannot get in. In spring, the turtle crawls out of its burrow in the soil. By June and July, the female buries her clutch of eggs in the soil. The turtle travels across the prairie floor in search of fungi, fruits, seeds and tiny animals. In the severe heat of midsummer, it seeks refuge by burrowing into the soil. During fall, the turtle emerges again for several weeks, and the young turtles hatch. As the days turn colder, the turtle begins digging into the soil a short distance each day. By the time of the first freeze, the turtle has worked its way deep enough in the soil to avoid freezing.

American toad: During the day, this brown to olive toad (2-3 1/2") hides in thick clumps of grass stems. At dusk, it ventures out to feed on insects and worms. The female lays several thousand eggs in long strings in the bottom of a prairie pond. In only a week's time, small, black tadpoles hatch. These tadpoles have gills and swim about looking for tiny aquatic plants and animals for food. When they transform into adults, they lose their gills and tail, breathe with lungs and live on land.

foxsnake: This yellow-gray snake is marked with red-brown spots and may be 36-50" long. In search of small mammals and birds, the foxsnake makes its way about the prairie floor. Occasionally, it rests in a clump of grasses. Other times, the agile snake may climb a dead standing tree or stump at the edge of the prairie and find shelter underneath the loose bark. The female snake lays her eggs in the soil beneath a rock and hatching occurs in late summer.

smallmouth salamander: This salamander (4 1/2-7") is named for its tiny mouth and head. Its skin is dark brown to black and marked by gray-yellow patches. The adult salamander finds shelter in the soil beneath rocks. At night, it travels the prairie floor in search of earthworms, slugs and insects,

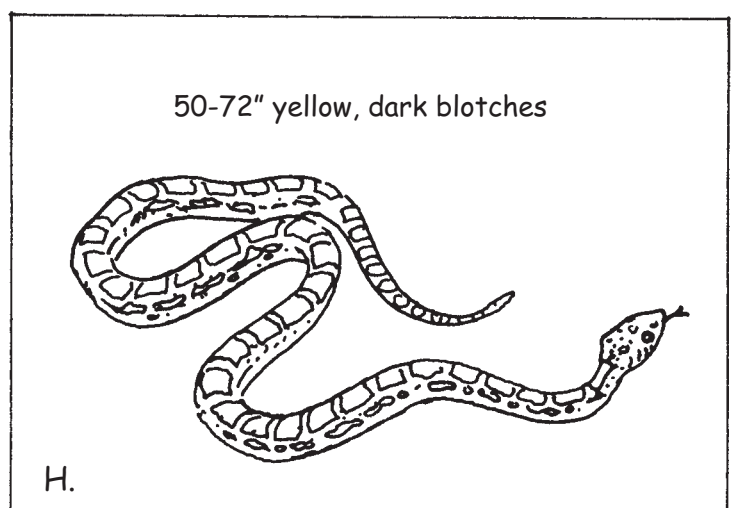
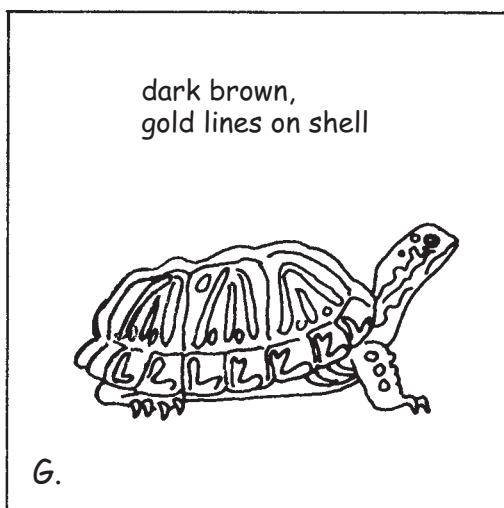
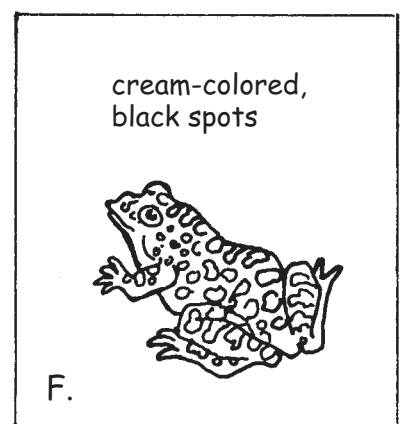
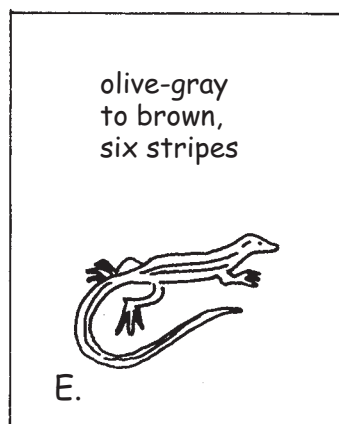
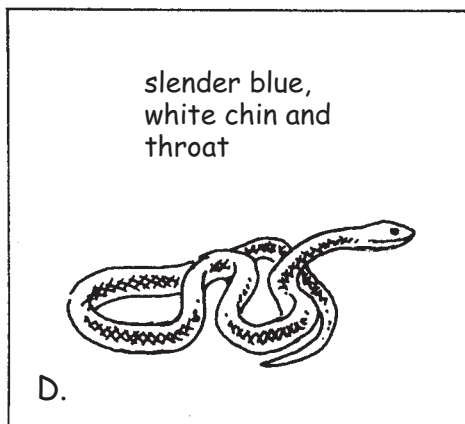
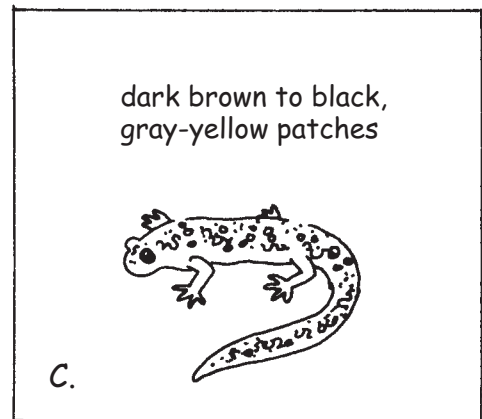
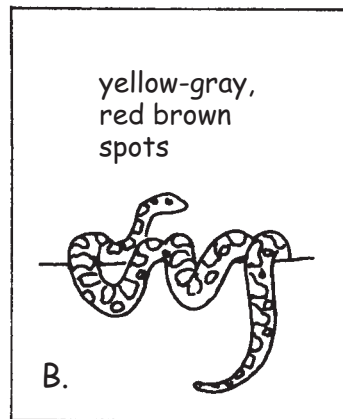
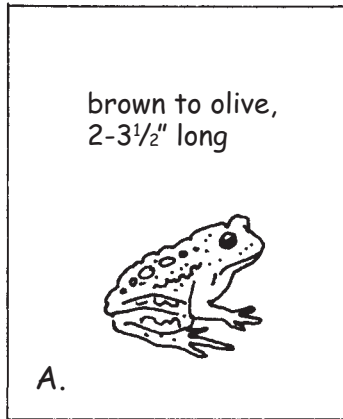
sticking close to the protective cover of the vegetation. In spring the female finds a pond or ditch and deposits a sticky mass containing 6-30 eggs onto the stem of an aquatic plant. The eggs hatch in a few days. Larvae stay in the water, often seeking shelter beneath rocks, until they have transformed into adults, usually by July.

gophersnake: This large (50-72") yellow snake is marked by dark-colored blotches. The powerful gophersnake travels about the prairie in search of small birds and mammals. It ambushes its prey from a hiding place, like a clump of grasses or mammal burrow. The gophersnake is a constrictor. It wraps tightly around its prey to keep it from breathing until the prey eventually dies. The gophersnake helps control rodent populations. Gophersnake eggs are often laid beneath a rock.

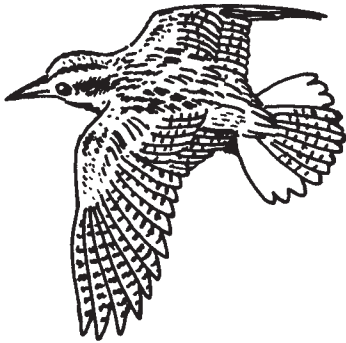


crawfish frog: This cream-colored frog (2 1/2-4 1/2") with black spots only ventures above ground during the spring mating season. The crawfish frog hibernates in soil beneath a pond during winter. In summer and fall, it lives by day inside a crayfish hole dug into a pond bank. At night, the frog darts out to capture crayfish and aquatic insects. The female frog lays 5,000 eggs in shallow water and occasionally attaches the egg mass to the stems of plants. The larvae swim in the water, finding refuge from time to time under decaying vegetation until they have transformed into frogs by July.

six-lined racerunner: This olive-gray to brown lizard (6-9 1/2") has six lightly colored stripes from its head to the base of its tail. The racerunner is often seen during the day basking on a rock. On cool days, the lizard seeks shelter beneath a rock. The racerunner is a quick predator and has little problem snagging spiders. Racerunner eggs are sheltered in the soil until they hatch in July.



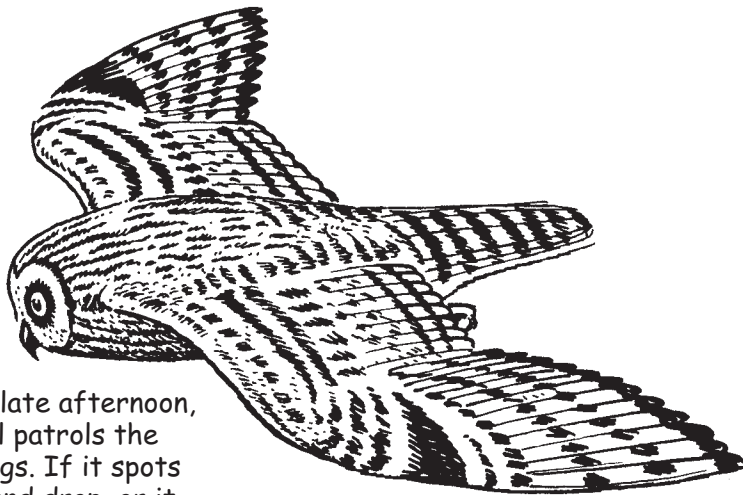
Prairie Birds



The chunky brown meadowlark sports a brilliant yellow throat and vest crossed by a black "V." When this bird flies, two broad patches of white can be seen on either side of the tail.



The song of the upland sandpiper is one of the most beautiful and mysterious sounds on the prairie. While circling slowly in the sky, the sandpiper sings a long rolling whistle: whoo/eeeeee whee/ooooo.



In the morning and late afternoon, the short-eared owl patrols the prairie on silent wings. If it spots prey, it may hover and drop, or it may snatch prey from the ground and pass on without even checking its speed, so swift and skillful is its stroke.

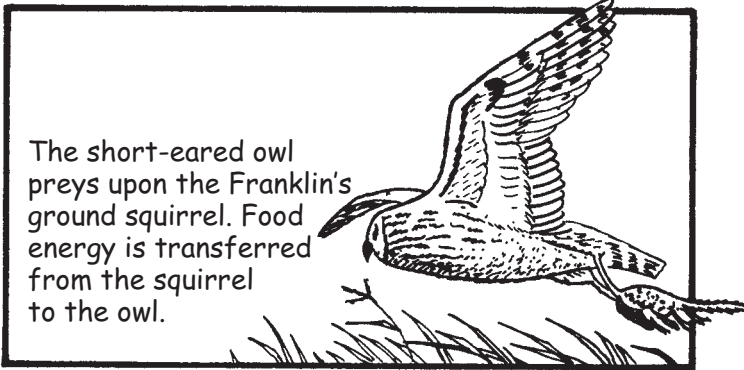
The Role of Birds in the Prairie Ecosystem

Birds help the ecosystem function smoothly. Birds that pick apart the fruits of plants scatter the seeds that will someday grow as new plants. Birds that eat only plant parts are herbivores.

Other birds on the prairie eat both plant parts and animals. These birds, known as omnivores, are

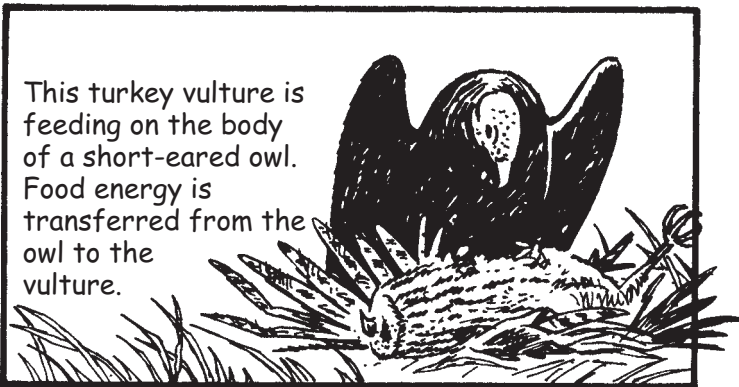
important because not only do they help scatter seeds, but they also help control insect populations.

Birds of the prairie that are equipped with sharp talons and/or beaks are usually carnivores, meaning that they eat other animals.



The short-eared owl preys upon the Franklin's ground squirrel. Food energy is transferred from the squirrel to the owl.

Birds not only take from the prairie food supply, they add to it. Small birds, like the meadowlark and the dickcissel make their contribution when they are preyed upon by a larger bird or mammal. Large birds, like the northern harrier or short-eared owl, make their contribution when they die. At that time, their body serves as food for scavengers, such as the turkey vulture. The body parts not eaten by scavengers decay and add nutrients to the prairie soil.



This turkey vulture is feeding on the body of a short-eared owl. Food energy is transferred from the owl to the vulture.

Working with Prairie Birds

1. Describe the color of the meadowlark, the movement of the short-eared owl, and the song of the upland sandpiper.
2. Several prairie birds are shown on page 26. A description for each bird is provided below. On your paper, list the common name of each bird. Tell whether each bird is an omnivore, carnivore or herbivore. Describe the location of its nest.

mourning dove: This handsome bird (12") is mostly gray to brown with white spots on its tail. It feeds on the seeds of plants and builds its nest in shrubs or trees at the edge of the prairie.

upland sandpiper: This brown bird (11 1/2") has a white belly streaked with black. When not flying or tending to its nest on the ground, it commonly perches on a fence post. It eats insects, worms and plant seeds.

Canada goose: This large bird (16-25") has a black head and neck with a white patch, or "chinstrap," on the side of the head. The Canada goose feeds on plant parts, especially roots, and builds its nest on the ground near water.

dickcissel: The male dickcissel (6-7") has a black "bib" on a yellow chest. The female is much paler in color and has just a touch of yellow on the chest. This bird feeds on insects and plant parts. It nests near or on the ground.

killdeer: This brown-backed, white-bellied bird (9-11") can be identified by two black breast bands and its loud shrill call: "kill-dee, kill-dee." The killdeer feeds on insects, worms and snails and makes its nest in a small hollow on the ground.

eastern meadowlark: The eastern meadowlark (9") eats insects and plant parts and builds its nest on the ground.

greater prairie-chicken: This large bird (17-18") is brown with dark bars. The male has an orange air sac on each side of the neck. During courtship, the male inflates the air sacs and then releases the air, creating "oo-loo-woo" sounds, known as "booming." The greater prairie-chicken feeds on insects and plant parts and nests on the ground.

loggerhead shrike: This gray, black and white bird (9") has a black mask. The loggerhead shrike preys only upon animals, including insects, reptiles, amphibians, birds and small mammals. Lacking sharp talons to hold its food, the shrike hangs the body of its prey on a thorn or fence barb so it can tear away at the flesh with its bill. The loggerhead shrike builds its nest in a shrub or small tree.

turkey vulture: This black bird (26-32") soars on wings that spread 6 feet. It has a red head. The vulture is the clean-up bird of the prairie, feeding upon dead animals. It nests on the ground.

short-eared owl: This streaked brown owl (13-17") is named for the 2 short tufts of feathers on its forehead. It preys upon insects, amphibians, reptiles, birds and small mammals and nests on the ground.

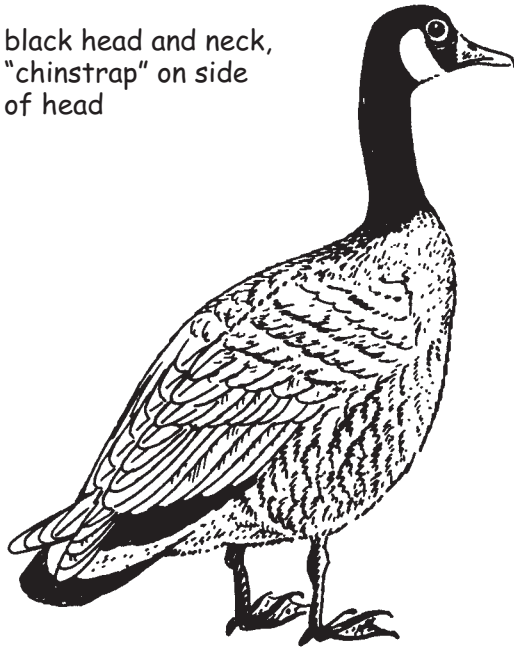
northern harrier: The female northern harrier (17 1/2 -24") is streaked brown. The male is gray. Both birds have a white rump patch that is visible in flight. This slim hawk hunts low over the ground for insects, reptiles, amphibians, birds and small mammals. It nests on the ground.

black bib on
yellow chest

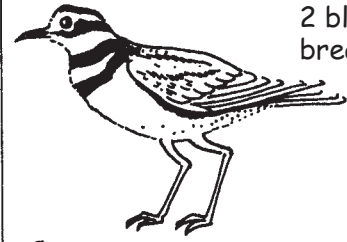


A.

black head and neck,
"chinstrap" on side
of head



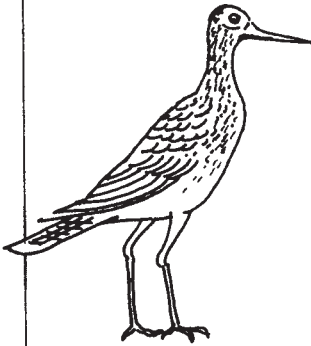
B.



2 black
breast bands

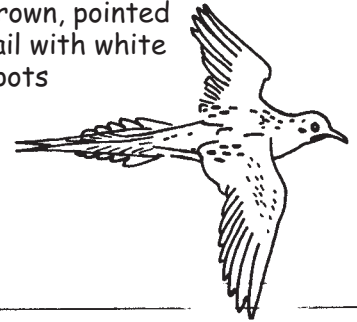
C.

brown, white
belly streaked
with black



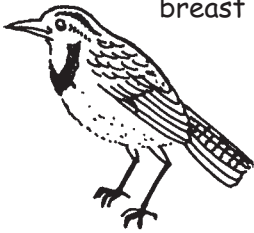
D.

brown, pointed
tail with white
spots



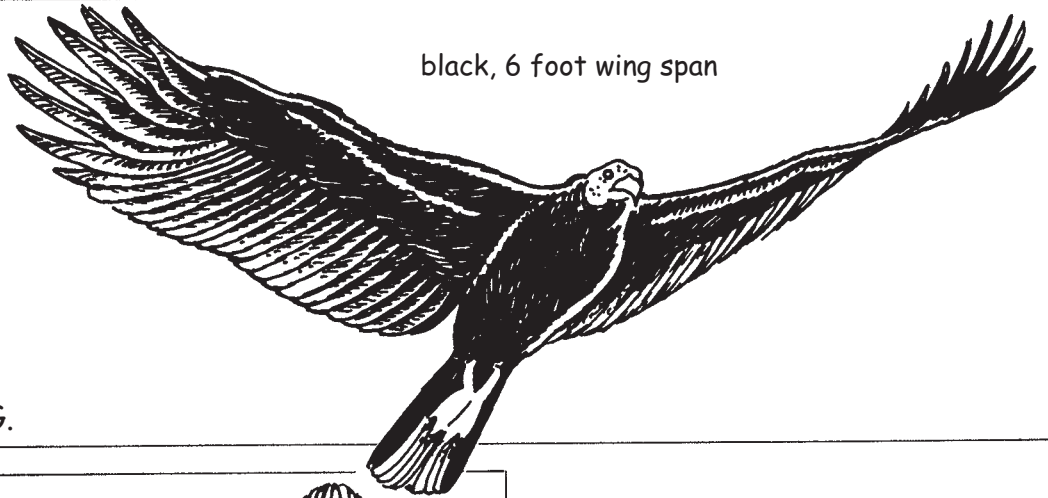
E.

brown, yellow
throat and breast,
black "V" crosses
breast



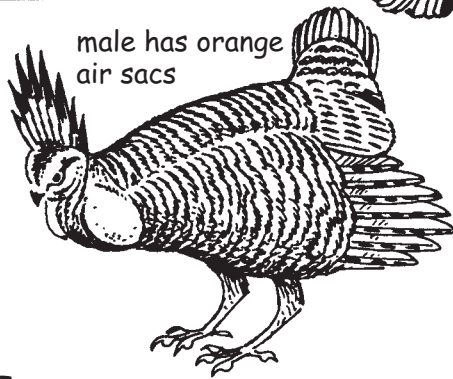
F.

black, 6 foot wing span



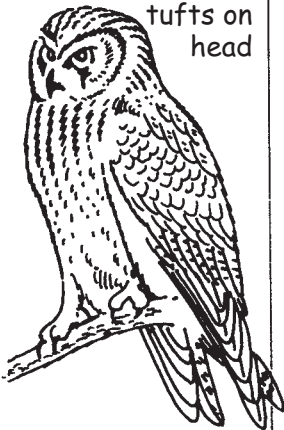
G.

male has orange
air sacs



I.

streaked brown,
two short feather
tufts on
head



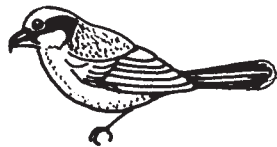
H.

streaked brown or gray,
white rump



K.

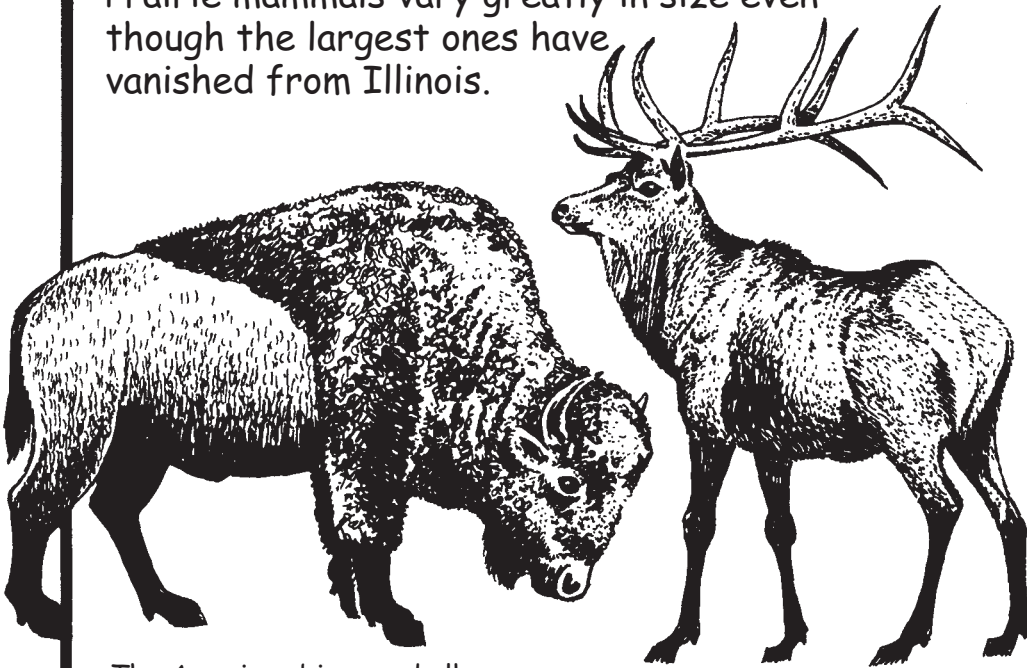
gray, black and white, black mask



J.

Prairie Mammals

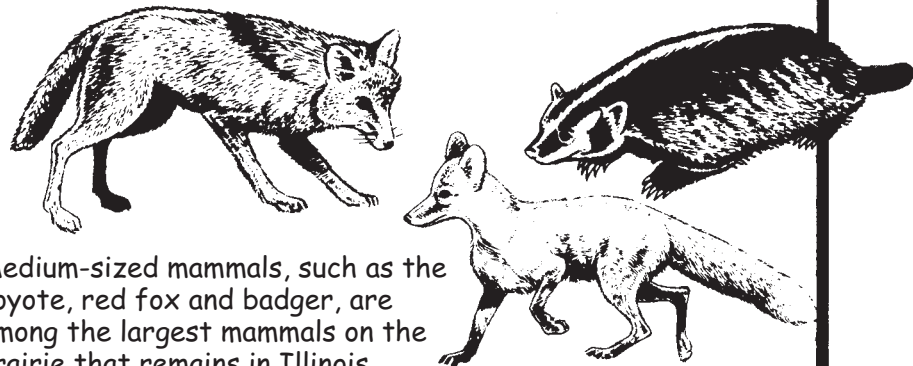
Prairie mammals vary greatly in size even though the largest ones have vanished from Illinois.



The American bison and elk were once the largest mammals on the Illinois prairie. During settlement of Illinois, however, huge numbers of bison and elk were killed by people, and the prairie was plowed and converted to farmland and cities. Bison and elk vanished from Illinois.



Small mammals, like the prairie vole and Franklin's ground squirrel, are also represented on the prairie. Regardless of size, each mammal species has its own special place to live and role to play in the prairie ecosystem. That special place and role is the species' niche in the ecosystem.

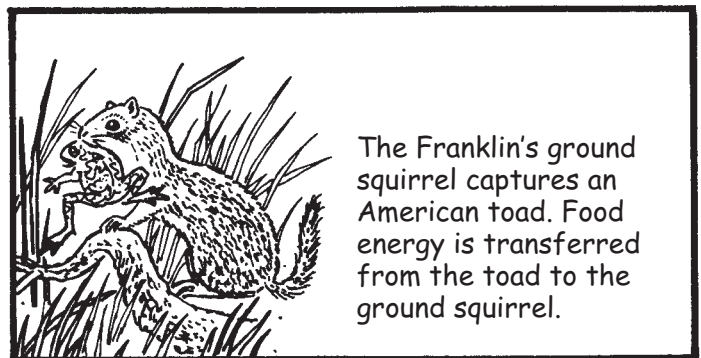


Medium-sized mammals, such as the coyote, red fox and badger, are among the largest mammals on the prairie that remains in Illinois.

The Role of Mammals in the Prairie Ecosystem

Mammals are vital to the flow of food energy in the prairie ecosystem. Some mammals, like the badger, coyote and red fox, are predators, keeping insect and rodent populations under control. Other mammals, like the eastern cottontail and prairie vole, are important food sources for other members of the ecosystem. Still other mammals, such as the little brown bat and Franklin's ground squirrel, are important as both predators and prey.

The niche of an animal is very important because it guarantees each species a place to live and food to eat. With each species having its own niche, there is less competition between species for space and food. If an animal loses its niche, it cannot survive. To define the niche of an animal, one must consider where, when and how it travels, what it eats and



The Franklin's ground squirrel captures an American toad. Food energy is transferred from the toad to the ground squirrel.

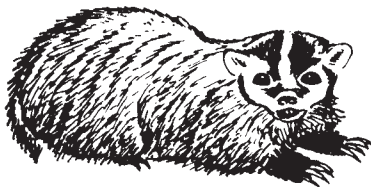
what eats it, when and where its young are born and what defenses it has against predators. Although the niche of some species may be somewhat similar, they are never exactly the same. Each species has its own special chance for survival.

Working with Prairie Mammals

1. Name two mammals that are important both as food sources and predators.
2. On your paper, describe the niche of each the badger and the red fox. Be sure to include information about habitat, food, shelter and predators.
3. On your paper, write the common name of each of the mammals on page 30. After reading the descriptions on page 29, also briefly describe the niche of each species.

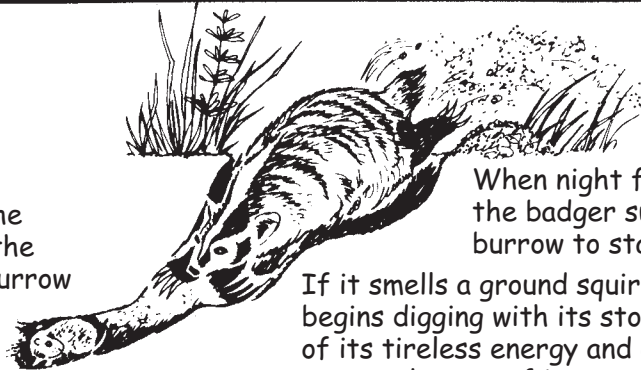


Short-bodied and short-legged, the badger lives in a burrow beneath the ground. During spring it uses its burrow as a nest chamber to bear and raise its young.



badger

With its strength and sharp teeth and claws, the badger defends itself against all predators, except man.



When night falls on the prairie, the badger surfaces from its burrow to stalk its prey.

If it smells a ground squirrel or mouse, it begins digging with its stout claws. Because of its tireless energy and amazing speed, it can catch most of its prey before they can escape their burrows.



By day this handsome, yellow-red fox sleeps concealed in a clump of grasses.

red fox

Four to nine young foxes, called "kits," are born in March and raised in an underground den.



It defends itself against enemies with its speed and cunning. It is taken by only a few predators, including man.

At night, the fox travels the prairie stalking its prey of rabbits, mice, birds and insects. Once prey is spotted, the fox takes slow, deliberate steps or crouches and wiggles toward it. It then rushes its victim and kills it with a bite from its powerful jaws. In summer, the fox also feeds on plant berries.

little brown bat: The body of this mammal (3 $\frac{1}{8}$ -3 $\frac{3}{4}$ ") is covered with fur, but the tail membrane ears and wings are nearly free of hair. During winter, this bat hibernates in caves but in spring and summer, it lives in a variety of habitats, including prairies. The edge of a prairie is where a little brown bat might roost beneath the loose bark of a tree. At sunset, the bat flies across the prairie to capture insects. The little brown, like all bats, navigates by means of a sonar system. As the bat flies, it emits ultrasonic sounds. The bat hears the echoes those sounds make as they hit objects. The bat then knows to steer clear of the object. Young bats are born in spring. They cling to the breast of the female who hangs by her hind feet in any place that affords shelter. When the female leaves to hunt for food, the young bats hang by themselves. The little brown defends itself against predators by flying skillfully and swiftly. Sometimes a hawk, owl or weasel will catch this bat.

Franklin's ground squirrel: Standing 8 $\frac{1}{2}$ -9 $\frac{1}{2}$ " tall, this mammal is mostly gray in color with black specks on its back. The underground burrow of Franklin's ground squirrel would most probably be at the prairie's edge. It spends 90 percent of its time in its burrow, resting at night through the warm months and hibernating during the winter. During the bright daylight hours, it feeds on grasses and wildflowers. It can also take animal food, including toads, frogs, insects, mice, bird eggs and young rabbits. Four to five young ground squirrels are born about mid-May and raised in a nest chamber of the burrow. Though Franklin's ground squirrel protects itself by sticking close to its burrow and heavy cover, it is preyed upon by many predators including hawks and badgers.

prairie vole: The upper parts of this vole (4 $\frac{1}{2}$ - 6") are mostly brown-gray while the under parts are washed with yellow or rust. Winter and summer, night and day, the prairie vole tunnels out surface runways that have been known to cover 160 feet. While traveling through these runways, usually either right at the surface of the prairie or a few inches beneath, the vole finds bits of grasses, seeds and roots for food. These surface runways lead to deeper, underground burrows where the vole has a nest and storage chambers for food. Because the vole can do little to defend itself, it rarely lives longer than one year without being eaten by a hawk, owl or fox. Since prairie voles are so heavily preyed upon they must reproduce quickly

and in large numbers. The female vole produces litters of 3 to 6 young throughout the year except during the coldest months. A female vole is ready to start a new family at the age of 3 to 4 weeks.

plains pocket gopher: This gray to black gopher (9 $\frac{1}{2}$ -12 $\frac{3}{4}$ ") lives almost continuously in burrows that run for several hundred feet just beneath the prairie floor. The burrows contain storage chambers for food, a main nest chamber and many side tunnels that lead to plant roots. Only rarely does the gopher surface from its burrow to search for stems and leaves to eat. It has adapted certain physical traits to help it move about in its dark, narrow burrows. It has a highly sensitive tail which acts like a guide when it backs down a tunnel. Its loose skin and velvety soft fur allow it to turn around in a tight space. Its lips can close behind its front teeth, thus keeping dirt out of its mouth as it is gouging out soil or cutting roots. Its long, curved claws are used to dig and push dirt from the burrows. The gopher protects itself by keeping the entrance to its burrow solidly blocked with plugs of dirt at nearly all times. For badgers and some snakes, however, this protective door is no obstacle.

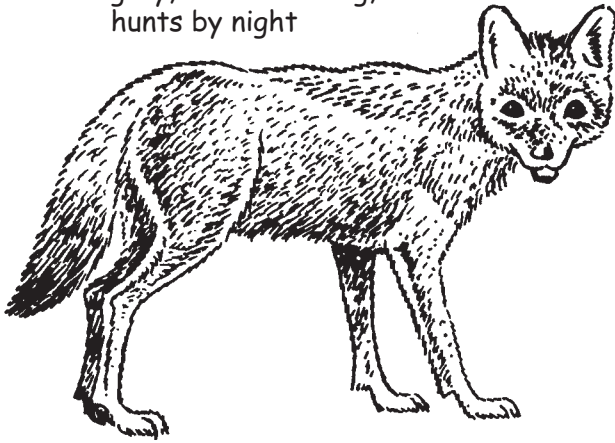
coyote: From its muzzle to the tip of its bushy tail the coyote is 44-54" long. The fur along the coyote's back is gray, but its breast and belly fur is white or cream-colored. By night, the coyote may travel many miles in search of prey, usually rabbits and mice but also birds, insects, plants, fruits and dead animals.

striped skunk: This black and white, short-legged animal is 22-26" long. Usually at night, the skunk digs into the soil where it finds insects, mice, moles, shrews and young rabbits for food. It fends off most enemies by shooting out a bad-smelling stream of fluid, or "musk," from glands located on each side of its anus.

eastern cottontail: From its brown nose to its powder-puff tail, the eastern cottontail rabbit is 15 $\frac{1}{2}$ -18" long. The upper part of its body is buff to rust-brown, and the under parts, except for the buff-colored throat, are white. The cottontail eats the stems of wildflowers and grasses.

least shrew: This tiny brown shrew (3") hunts day and night for insects, worms and the dead bodies of small animals.

gray, 44 to 54" long,
hunts by night



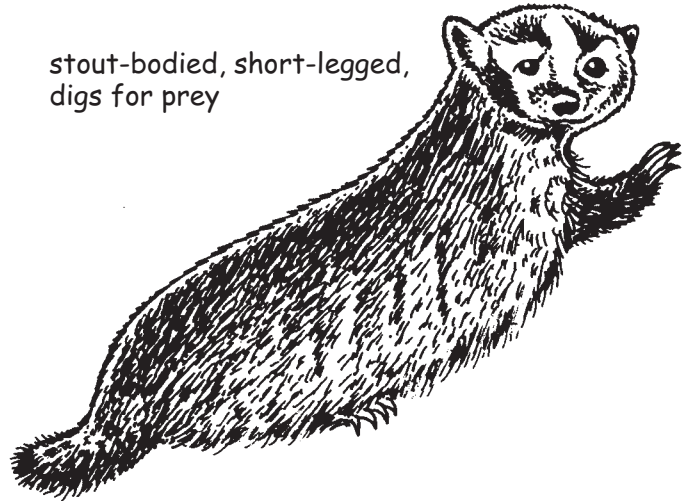
A.

yellow-red stalks prey by night



B.

stout-bodied, short-legged,
digs for prey



E.

gray to black, adapted
to live underground



C.

3" long brown,
travels in tiny
burrows



D.

black and white, unusual
and powerful defense
strategy



F.

brown, guides itself by
sonar system



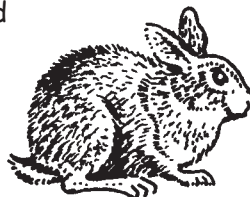
G.

brown-gray, travels
long surface
runways



H.

buff to rust-brown,
feeds morning and
late afternoon



I.

gray with black specks,
hunts by day




J.

Prairie Food Chain

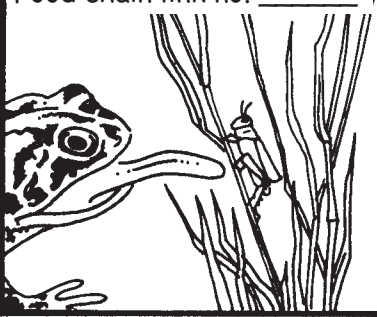
The illustrations on this page show the steps in a simple prairie food chain. Number them in sequence from one (capturing sunlight) through seven (decomposition).

Food chain link no. _____



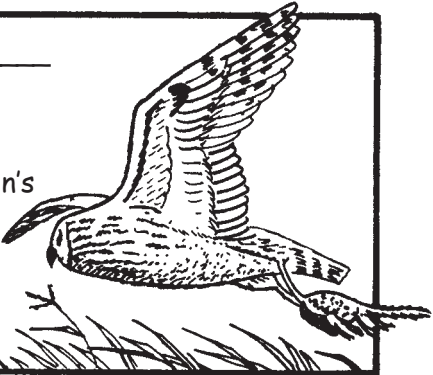
Bacteria and fungi in the soil break down a turkey vulture into nutrient elements. This food energy is stored in soil until taken into the roots of a plant.

Food chain link no. _____



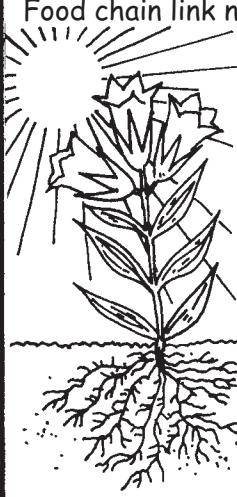
The American toad preys upon the red-legged grasshopper. Food energy in the grasshopper is transferred to the toad.

Food chain link no. _____



The short-eared owl preys upon the Franklin's ground squirrel. Food energy is transferred from the squirrel to the owl.

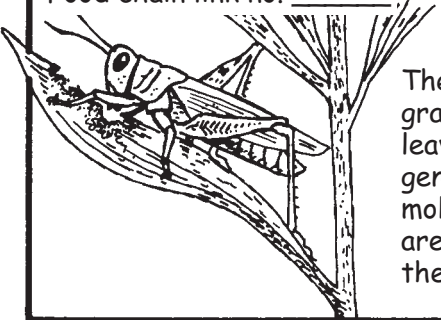
Food chain link no. _____



Above ground, downy gentian takes in sunlight through its leaves. Using the sunlight as energy, it conducts photosynthesis to make food energy in its tissues. This is how food is first produced in the ecosystem.


Below ground, downy gentian takes in nutrient elements from the soil. The gentian uses the nutrient elements in the process of photosynthesis to make food energy.

Food chain link no. _____



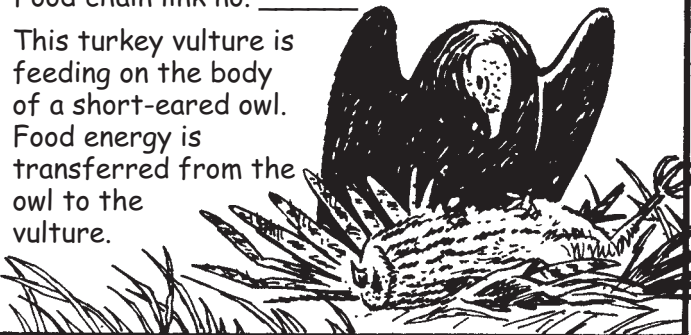
The red-legged grasshopper eats the leaves of the downy gentian. The food molecules in the plant are transferred to the grasshopper.

Food chain link no. _____



The Franklin's ground squirrel captures an American toad. Food energy is transferred from the toad to the ground squirrel.

Food chain link no. _____



This turkey vulture is feeding on the body of a short-eared owl. Food energy is transferred from the owl to the vulture.

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