Animal Adaptations

Grade: 2nd **Season**: Spring **Time**: 1-1/2 hours
Group Size: 1 class **Ratio**: 1 adult to 5 students

For the Teacher:

Overview	Students conduct a prairie animal field investigation based upon their own questions. Through observing, collecting, and recording data, they investigate signs of two burrowing rodents, 13-lined ground squirrels and plains pocket gophers. They compare and contrast the adaptations each animal needs to live in the prairie.
Subjects Covered	Science, Math, Language Arts
MN Science Standards Supported	Helps support four standards. See section "Minnesota Academic Standards in Science."
Skills Used	Questioning, reflecting, synthesis, data collection, observation, measuring, counting, comparing and contrasting, investigating, exploring, identifying, team work, following directions, listening, respectful treatment of animal homes
Performance Objectives	After completing this activity, students will be able to… • Define the word "adaptation" as something that helps an animal fit in to its environment (such as burrows protect gophers from predators) • Correctly match pictures of the plains pocket gopher and 13-lined ground squirrels with their names • Match plains pocket gophers with sign for their burrows (earthen mounds) • Match 13-lined ground squirrels with sign for their burrow (entrance hole) • List two adaptations each for the 13-lined ground squirrel and plains pocket gopher • Name two reasons why these rodents are important for the prairie (soil mixing, food chain)
Vocabulary	Adapt, adaptation, structure, behavior, rodent

For the PWLC Instructor:

PWLC Theme	The Prairie Pothole Region
Primary EE Message	The prairie pothole region is valuable and in need of restoration and protection.
Sub-message	Wildlife: The prairie pothole region is home to a variety of resident and migratory wildlife.
PWLC EE Objective	Describe and apply basic ecological concepts such as energy flow, community, biodiversity, change, interrelationships, cycles, and adaptations. (Wildlife and Habitat)
Materials	Clipboards, paper, pencils, rulers, meter sticks, laminated photos of 13-lined ground squirrels and plains pocket gophers (several copies so each chaperone has one)
Locations	Indoors: Classroom or dining hall or barn Outdoors: Barn lawn and Mallard Marsh Trail or Tatanka Trail (where many known gopher mounds exist)

Background Information

During this field investigation, students have the opportunity to search for and observe the signs of two prairie animals (and hopefully one of the animals themselves): the 13-lined ground squirrel and the plains pocket gopher. The purpose of the investigation is

to compare and contrast the adaptations these two animals have for living in the prairie. Students also have the opportunity to ask and answer their own questions during the investigation.

An animal **adaptation** is a characteristic that significantly helps the animal survive in its habitat. A structure, behavior, or aspect of physiology may all be considered types of adaptations. For example, the 13-lined ground squirrel transports food in cheek pouches (a structure). It communicates the presence of danger with its voice (a behavior) and hibernates to survive the winter (physiology). Adaptations influence all aspects of an organism's life and reduce competition for resources between animals. Without adaptations, it would be hard for an animal to fit in and survive in its environment. Technology makes it possible for humans to adapt rapidly to environmental change and to change the earth's environment. For most animals, though, adaptation is a slow process. Entire species can become extinct because they cannot adapt quickly enough to the rapidly changing environment.

Outside of the burrow, the perky and slender-bodied **13-lined ground squirrel** stands up straight on its haunches with front feet pointing downward, surveying its territory for danger. This position is called the picket pin posture. Also called the federation squirrel, it wears 13 solid whitish or light brown "stripes" plus about 10 dashed lines broken into "stars" on a dark brown background. The 13-lined ground squirrel is the animal referred to in Minnesota's nickname, the Gopher State. It is technically not a gopher, though, but a ground squirrel.

The 13-lined ground squirrel has many adaptations for living in the prairie as summarized in the chart below. For more information about their life cycle and natural history, please see section, "Instructor Info -- 13-Lined Ground Squirrel."

Adaptations of 13-Lined Ground Squirrels

Adaptation	Advantage
Streamlined body shape: long body, short legs, flat skull, short fur	facilitates movement through burrows
Vocal communication	Alert others to danger
Long fore claws	Dig burrows for rest, protection, hibernation, feeding, and food storage
Large eyes on sides of head	Detect predators all around
Striped markings	Camouflage with grasses
Picket pin posture	See over short grasses and hear better to survey for danger
Hibernation	Survive winter when food is not available
Food caching	Food availability when fresh food is scarce
Speed – running and digging	Avoid being captured by a predator
Detect scent	Identify individuals
Internal cheek pouches	Storing and transporting food to burrow
Rootless, continuously growing incisors	Continuous chewing would otherwise excessively wear down incisors

Front of incisors covered with hard enamel; soft dentine on rear of incisors is not	Effective self-sharpening system: soft dentine on rear of tooth wears away as incisors grind against each other, creating a chisel-edge

Thirteen-lined ground squirrels are important prey species for carnivores (red-tailed hawks, Coopers hawks, nothern harriers, bull snakes, weasels, badgers). They also host many parasites (fleas, lice, mites, ticks and others). Thirteen-lined ground squirrels impact plant communities by eating seeds and foliage. They help aerate the soil and recycle soil nutrients through their burrowing activities. While they eat farm crops like corn, wheat, oats and sunflowers, damage is limited to the harvest season, not winter storage. Some may damage crops but they are beneficial by eating weed seeds and harmful insects.

Although they are active day and night and year-round, people seldom see **plains pocket gophers** above ground for they spend almost their entire life in a network of dark burrows beneath the surface. However, their large dirt mounds, evidence of burrow excavations, are easily found at the PWLC with most new mounds formed in spring and fall.

Besides its range in the plains states, the plains pocket gopher also gets its name from its external cheek pouches (pockets) lined with fur. They are reversible and open on either side of the mouth. These gophers have tiny, weak eyes and ear flaps reduced to a ridge of skin. The fur of their pudgy bodies is mostly some shade of brown or black which varies regionally with the color of the soil. Their large incisors are always exposed even when their lips are closed together. They have longer, thicker front claws than 13-lined ground squirrels for efficient digging, and their fore claws grow rapidly. Their naked tail helps with navigating backwards through tunnels because the skin can more easily feel the space and soil around them than if it was covered with hair.

The plains pocket gopher has many adaptations for living in the prairie. The chart below provides a summary of their adaptations. For more information about their life cycle and natural history, please see section, “Instructor Info - Plains Pocket Gopher.”

Adaptations of Plains Pocket Gophers

Adaptation	Advantage
Long body, short legs, flat skull, short fur, small ears	Streamlined body shape facilitates movement through burrows and plowing of soil
Long, strong front claws	Dig burrows for travel, rest, protection, foraging, feeding, storing food, and raising young
Rapidly growing fore claws	Replace fore claws quickly as they wear from digging
Small, weak eyes	Vision needed less for dark, underground life
Incisors outside of mouth	Eat and dig using teeth with mouth closed to avoid eating soil
Rootless, continuously growing incisors	Continuous chewing would otherwise excessively wear down incisors
Front of incisors covered with hard enamel; soft dentine on rear	Effective self-sharpening system: Soft dentine on rear of tooth wears away as incisors grind against each other, creating a

of incisors is not	chisel-edge
External cheek pouches	Storing and transporting food in burrow
Brown fur	Camouflage with soil color
Large, sensitive whiskers	Navigate in burrows by touch, sense movement
Naked, sensitive tail	Navigation backwards in tunnels and sensing vibrations of other gophers digging
Naked tail, long, stiff hairs on faces and wrists, long guard hairs	Detection of vibrations caused by other gophers when digging; avoidance of contact and aggression
Vocal communication	Alert others to their presence
Active in winter	Food source is available in winter
Food caching	Food availability when fresh food is scarce
Scent of scat sign posts in burrows	Identify presence of individuals and ownership of burrows
Reuse of burrows	Saves energy needed for digging burrows
Earth plug in burrow opening	Harder for predators to find opening
Common ownership of some burrows	Easier to travel in burrows without confrontation and aggression
Agonistic behavior	Maintain population at carrying capacity, spacing individuals and allowing enough food
“Crop rotation”	Ensuring sustainable food supply

Where there are high populations of gophers, they concentrate feeding in areas of dense vegetation, allowing other areas to build back up, and then shift back to formerly sparse sites. Plains pocket gophers therefore practice their own version of crop rotation.

In agriculture, pocket gophers often build their burrows in the most productive non-tilled field areas that have the most available food supplies, especially hay fields. Pocket gophers are considered harmful especially in alfalfa fields as they eat some of the plants including root crops; but the biggest problem is that their mounds hinder harvesting and can damage mowing and baling equipment and may inhibit cropping or grazing.

However, in many ways, plains pocket gophers also benefit the environment. One adult gopher may put up 200 soil mounds in a year and move more than four tons of soil, bringing about 2 ¼ tons of soil to the surface. As they dig, gophers "swim” through the dirt forming tunnels up to 300 feet in length, preferring slightly moist soil that is easy to work. Because of their burrows…

- They are important in assisting with soil formation since their burrowing activities turn soil over, bringing soil to the surface, which also helps increase water infiltration and conserve water.
- Digging and burrowing loosens and aerates soil and reduces soil compaction.
- Their burrows provide some flood control by improving drainage.
- Their feces and urine accumulates in tunnels, which, along with decomposing plants, increase nitrogen in soil.
- Mounds of loose soil create a disturbance to the prairie canopy, openings where sun can easily reach the soil allowing seeds of pioneering annuals to germinate.

- Mounds also provide warm and moist daytime hiding places for tiger salamanders and prairie skinks.
- Meadow voles are attracted to pocket gopher mounds, for either a behavioral reason or for dietary reasons. The exact reason is unknown.
- Plains pocket gophers are part of the food chain. Their burrows are used by fox and bull snakes which eat both adults and young gophers. They are also eaten by badgers and parasitized by fleas, lice, ticks, and nematodes.

Ecologically, plains pocket gophers have a great impact on the remaining tallgrass prairies found in Minnesota, including the Prairie Wetlands Learning Center.

Teacher Preparation

We highly recommend conducting one or more of the suggested extensions before your visit in order to integrate this field investigation into the classroom study of animals, mammals, life cycles, adaptations, prairie, habitat, or other topics. We believe such integration enhances student motivation for learning in other curricular areas. Please see section, "Teacher-Led Extensions/Adaptations/Assessment Ideas."

PWLC Staff Preparation

Scout and choose an appropriate site for investigating plains pocket gopher mounds, one with plenty of mound access from the trail and within a reasonable walking distance from the barn. Gather and organize materials.

Field Investigation Procedure

1. In the amphitheater or classroom, welcome students, teachers, and chaperones to the Prairie Wetlands Learning Center. Review rules for the trail.
2. Organize students into small groups, each led by a chaperone.
3. Explain to students that they will have the opportunity to investigate animal adaptations for two prairie animals, the 13-lined ground squirrel and the plains pocket gopher.
4. To start the investigation, ask students what they already know about these animals' adaptations for living in the prairie. Begin a KWHL chart on the white board and ask the teacher to record their answers under the K column. Some helpful prompting questions might include: what does the word adaptation mean? What kinds of adaptations do these animals have? What else can you tell me about them? Have they seen them before? What did they see them doing?
5. Ask the students what they would like to find out about these animals' adaptations today. What do they wonder about them? If they don't get to see the actual animals while out in the prairie today, what could they investigate *about* them? The teacher can record their questions in the Wonder column. If needed, remind students that questions could start with the following words, what, where, how, do, and others. A few possible questions they might think up are: *What do they look like? Where do they live in the prairie? How are far apart are their burrows? How many will we see?*

6. What kinds of tools should they bring outside to conduct the investigation? Tools can be recorded under the H column (for How will we find out the answers?).
7. Direct students to open their journals or science notebooks to the next blank page. Assist students in setting up their page to match the most appropriate questions for the field investigation. (It may be appropriate to answer only a few questions.) For example, they can use two blank pages and title one 13-Lined Ground Squirrel Adaptations and the other one Plains Pocket Gopher Adaptations. Then they can quarter each page in to quadrants and label each quadrant to help answer one of the questions. Using the possible questions listed in step 6, the quadrants might be titled: Habitat (for where do they live), Burrow Size (to record the measurement of the hole size), Sketch (for what they look like), and Count (to tally how many are seen). A quadrant may also be reserved for Surprises, Beauty, or Joy to help foster the sense of wonder, or for other ideas suggested by the teacher, like soil, weather, or habitat.
8. Provide needed equipment and explain its appropriate use. Distribute equipment to chaperones to provide to their small groups.
9. Line up in small groups at the door. Before heading out, review the rules of respect for the trail – just the same as at school, plus special trail rules (such as no picking plants, follow the leader, be kind to animals, stay on the trail, etc.) Also ask, what should we do if we actually get to see one of these animals? (be quiet and still, sit down, watch, wait, wonder)
10. Walk to the barn lawn and search for 13-lined ground squirrel holes. Allow chaperones to guide their small groups in examining, measuring, counting and describing the burrow entrances and trails.
11. Then ask each group to step about 15 big steps away from one of the holes, sit quietly, and watch and wait for gophers to appear. If any are observed, are they adults or young or both? What do they do? (run, hide, eat, watch, chatter) What could they be doing underground? Help them use their sense of wonder to fully appreciate these interesting creatures.
12. If none are observed, provide chaperones with laminated photos of 13-lined ground squirrels so students can complete any data recording if necessary. Wonder together why they did not see any of the 13-lined ground squirrels? (Students were too fidgety and loud, it was raining, they are resting in their burrows, etc.)
13. Next walk to the selected location for investigating plains pocket gopher mounds. Repeat the procedure in step 10 but for plains pocket gophers. Students should be careful not to sit or walk on the mounds. They may carefully feel and smell the soil and note its color or smudge a small pinch of soil on their paper.
14. Return to the classroom. To wrap-up, share discoveries and answer the questions students generated for the investigation. Guide students in making a Venn diagram in the science notebook to compare and contrast the adaptations and habitats of these two animals. (See section, “Venn Diagram.”) Ask students if they think adaptations are important for these animals? If so, why? How do they think these rodents might be important to the prairie? Collect materials and thank them all for coming!

Weather Alternatives

Field investigations take place rain or shine. Everyone should dress appropriately for the weather. In the event of unsafe weather (lightning, high winds) or pouring rain, everyone must come indoors. PWLC staff make every effort to make your travel worthwhile despite the weather and prepare indoor, age-appropriate plans. PWLC staff welcome teacher input into these plans. Some possible alternatives might include:

- Go outside for a very short amount of time, even if only between the deck and barn, to search for mounds and holes to examine.
- Tour the exhibit area and watch prairie wetlands videos with the objective of observing rodents. Can the students find any 13-lined ground squirrels and plains pocket gophers?
- Read about Laura and Mary's observations of "brown striped gophers" in Little House on the Prairie, the chapter called "Prairie Day." Prompt discussion with questions. Which animal did the girls see, 13-lined ground squirrels or plains pocket gophers? How do you know? How could the author have written such an accurate description of the gophers? Who are the predators in the story? (Mary and Laura and the hawk) What adaptations helped the gophers survive its predators? (speed, burrows) How do they think the gophers knew when the hawk was gone and it was safe to come out?
- For more possibilities, see section, "Teacher-Led Extensions/Adaptations/Assessment Ideas."

Teacher-Led Extensions/Adaptations/Assessment Ideas

- If time at the PWLC is short, then guide students through the Venn diagram back at school.
- Provide computer lab time for students to write and submit Animal Adaptations Reports on the Scholastic web site, http://teacher.scholastic.com/dirtrep/animal/index.htm
- Read books or visit internet sites to learn more about these animals. See section, "References and Resources," for ideas. Unfortunately, there seems to be few books about these two mammals already in existence. Your class may wish to write and illustrate your own book about them to share with other classes.
- Ask students if they could be either animal (13-lined ground squirrel or a plains pocket gopher), which would they rather be and why? They may write or share their thoughts orally.
- Provide blankets for students to hide under and pretend they are one of the prairie rodents. How will they detect danger? How will they communicate with each other if there is danger? Where will they hide? How will they move from hole to hole? Who in the class is wearing the striped or dotted pattern of the 13-lined ground squirrel in their clothes? The brown color? Use paper grocery bags to make a "shirt" with scissors. For 13-lined ground squirrels, use markers to make stripes.
- Draw two pictures, one of the 13-lined ground squirrel and one of the plains pocket gopher, each in its appropriate habitat. Label some of the adaptations of each animal. Compare and contrast the adaptations of each animal.

- Walk to a local, wooded park and expand this investigation to include a third animal, the eastern chipmunk. Set up a third data collection page for this animal. Look and listen for chipmunks and their burrows. Repeat the procedure outlined in step 10. Compare and contrast the results of this excursion with those gathered at the PWLC. How are chipmunks like the other two rodents? How are they different? Do they live in the same kind of habitat? How might chipmunks be important for the woods?
- Visit the PWLC during the month of February with your class to crawl through a cardboard burrow in the barn and to search for signs of active winter wildlife. What are 13-lined ground squirrels and plains pocket gophers doing in the winter? Call 218-998-4480 to book your reservation.
- Research other burrowing animals that live on the prairie. Possibilities include Formica and other ants, prairie mole cricket, American burying beetle, pocket mouse, kangaroo mouse, kangaroo rat, bull snake, plains garter snake, burrowing owl, prairie dog, badger, and black-footed ferret. How might they be important to the prairie?

Minnesota Academic Standards in Science

This lesson helps support the following state standards.

Strand I. HISTORY AND NATURE OF SCIENCE
Substrand B. Scientific Inquiry
Standard The student will raise questions about the natural world, make careful observations and seek answers.
Benchmark 1. The student will use appropriate tools to gather and organize data.
Benchmark 2. The student will recognize and describe patterns in data.

Strand IV. LIFE SCIENCE
Substrand B. Diversity of Organisms
Standard The student will recognize that plants and animals have life cycles.
Benchmark The student will describe life cycles of plants and animals.
Substrand C. Interdependence of Life
Standard The student will understand that organisms live in different environments.
Benchmark 1. The student will observe and describe some features of plants and animals that allow them to live in specific environments.
Substrand F. Flow of Matter and Energy
Standard The student will investigate feeding relationships among organisms.
Benchmark 1. The student will observe and describe predator and prey relationships.
Benchmark 2. The student will compare and contrast plant eaters and meat eaters.

References and Resources

For Adults

- Animal Tracks by Olaus J. Murie (Peterson Field Guides)
- Aquatic Project Wild, Aquatic Education Activity Guide by the Western Association of Fish and Wildlife Agencies and the Council for Environmental Education.
- Little House on the Prairie by Laura Ingalls Wilder
- Mammals by William H. Burt and Richard P. Grossenheider
- Minnesota's Natural Heritage, an Ecological Perspective by John R. Tester
- Prairie, a Natural History by Candace Savage
- Arthropod and Helminth Parasites from the Plains Pocket Gopher, Journal of Parasitology, BioOnline, http://www.bioone.org/doi/full/10.1645/0022-3395%282000%29086%5B0153%3AAAHPFT%5D2.0.CO%3B2
- Background Information: Animal Adaptations, Scholastic, Dirtmeister http://teacher.scholastic.com/dirtrep/animal/tguide.htm#background
- Factors Influencing Meadow Vole Distribution in Minnesota, University of Minnesota, http://campus.pc.edu/~jwhittak/Factors_Influencing_Meadow_Vole.pdf
- Habitat Model for the Plains Pocket Gopher, Kansas State University, http://www.k-state.edu/kansasgap/KS-GAPPhase1/finalreport/SppModels/Mammals/Plains_Pocket_Gopher.pdf
- Internet Center for Wildlife Damage Management, Thirteen-Lined Ground Squirrels and Their Control http://icwdm.org/handbook/rodents/13linedgroundsquirrel.asp
- Minnesota Mammals, University of Minnesota, http://gisdata.nrri.umn.edu/MNMammals/Genus/Geomys/Species/bursarius/view/spp
- Plains pocket gopher and pocket mice, Minnesota Department of Natural Resources, http://www.dnr.state.mn.us/mammals/pocketgophers_pocketmice/index.html
- Plains Pocket Gopher Social Behavior, University of Minnesota, http://images.library.wisc.edu/EcoNatRes/EFacs/NAPC/NAPC13/reference/econatres.napc13.kzinnel.pdf
- Pocket Gophers in Colorado, http://www.denvergov.org/AnimalControl/Wildlife/Wildlife7/tabid/377866/Default.aspx
- Weeds and Pocket Gophers, Minnesota Department of Agriculture, http://www.mda.state.mn.us/plants/pestmanagement/weedgphr.htm

For Children

- Getting to Know Nature's Children, Chipmunks by Merebeth Switzer
- Rabbits, Squirrels, and Chipmunks by Mel Boring (Take-Along Guide)
- Animal Diversity Web, University of Michigan Museum of Zoology, 13-Lined Ground Squirrel, http://animaldiversity.ummz.umich.edu/site/accounts/information/Spermophilus_tr

idecemlineatus.html
Plains Pocket Gopher,
http://animaldiversity.ummz.umich.edu/site/accounts/information/Geomys_bursarius.html
Rodents,
http://animaldiversity.ummz.umich.edu/site/accounts/information/Rodentia.html

- EEK! Environmental Education for Kids, Critter Corner, 13-Lined Ground Squirrel http://www.dnr.state.wi.us/org/caer/ce/eek/critter/mammal/13squirrel.htm
- Investigate and Report on Animal Adaptations, Scholastic, Dirtmeister http://teacher.scholastic.com/dirtrep/animal/index.htm
- State Animals, http://www.stateanimals.com/states/minnesota/index.html

Credits

This field investigation was developed and written by Prairie Wetlands Learning Center Staff, U.S. Fish and Wildlife Service. Thanks to Prairie Science Class naturalist Deb Strege for reviewing this lesson. Thanks to the following teachers for reviewing this lesson plan: Barb Bratvold, 2nd grade, Evansville Elementary; Renee Larsen, Lynn Hjelman, and Barb Sullivan, 2nd grade, Adams Elementary School, Fergus Falls; and Gay Eckberg, West Central Area Schools.

Instructor and teacher materials follow.

Instructor Info: 13-Lined Ground Squirrels

Rodents

Rodents are small to medium-sized gnawing mammals and include the following families: squirrel, chipmunk, pocket gopher, mouse, rat, beaver, vole, and porcupine. The squirrel family includes woodchucks, prairie dogs, chipmunks, tree squirrels, and ground squirrels. Both tree and ground squirrels live in Minnesota. We commonly observe tree squirrels in the woods, including the fox squirrel, grey squirrel, and red squirrel. However, the 13-lined ground squirrel lives in the prairie. It is commonly called the striped gopher. It is actually a squirrel, though, not a gopher, which is a separate family.

Tree and Ground Squirrels

Six species of ground squirrels occupy the Great Plains, three in Minnesota. Ground squirrels typically have shorter, skinnier tails and communicate with their voice more than tree squirrels, using whistles, buzzes, and squeaks. Ground squirrels live in burrows instead of trees and have very small ears. Their digging claws are longer and straighter than those of tree squirrels and can quickly dig an emergency escape burrow when necessary. Minnesota's species include Franklin's ground squirrel, Richardson's ground squirrel, and the most common, 13-lined ground squirrel. All three live in the same areas, but Franklin's and Richardson's are larger and lack stripes.

Appearance

The adult measures about 11 inches long and weighs about ½ pound. The stripes on its body may be counted in a variety of ways: (1) seven broad dark brown stripes alternating with six thin tan bands or (2) seven narrow yellow stripes alternating with six broader dark brown stripes. Its belly is whitish or light brown, also.

Diet

Diurnal, 13-lined ground squirrels emerge frequently from their two-inch-wide burrows to forage for food including seeds, green shoots, leaves, vegetables, fruits, and flowers (grass, clover, oats, wheat, beans, sunflowers, dandelions, cottonseed, goosefoot, knotweed, and buffalo-bur). Transporting food in their internal cheek pouches, they cache large amounts of seeds and grass to eat during inclement weather or when food is scarce in early spring and late fall. Surprisingly perhaps, more than half of its diet includes animal matter. An omnivore, then, it also consumes crickets, ants, beetles, June bug larvae, caterpillars, cutworms, wireworms, insect eggs, and occasionally meat (frogs, toads, mice, small birds, carrion – even of their own kind). Thirteen-lined ground squirrels rarely pass up the opportunity to pounce on their favorite food: grasshoppers, which are available in early spring through mid-fall. They are most commonly observed on sunny days compared to cloudy, damp, or dark days or at night. Coming above ground when the sun is high and the ground is warm, they retreat to their safe, warm burrows well before sunset.

Habitat and Burrows

At the PWLC, 13-lined ground squirrels, their burrows and runways, are easiest to

observe in the mowed lawn surrounding the barn or in taller grass after a prescribed fire. They also live in golf courses, along roadsides, on farms, yards, fields, brushy areas, and in short grass prairies, the most widely ranging ground squirrel in North America. Thirteen-lined ground squirrels prefer well-drained sandy or loamy soils for burrows. Solitary and not colonial, 13-lined ground squirrels may gather together where soil conditions are favorable for burrowing. The burrow entrance may be concealed by grass, and there may be more than one opening. Dirt is thrown out of only one opening and is not mounded. The entrance is kept tidy and clear of loose soil by sweeping with the back feet. The burrow turns in an L-shape about six inches beyond the entrance to hopefully confuse predators into thinking they have reached a dead end. Emergency burrows do dead end and are shallow, but they also dig complex, deeper burrows for nesting and hibernation.

Senses and Communication

Thirteen-lined ground squirrels have excellent senses of vision, touch, and smell. They attentively watch, listen, and possibly feel for predators and prey nearby. When sensing danger, they give alarm calls and run quickly, tail held horizontal, to the nearest burrows and disappear underground. Then they poke their noses out and make a bird-like noise. They give a single, sharp note in alarm, and from the den, a chattering series of notes. Listen for its high-pitched “chirr” whistle. It uses alarm calls and other sounds, as well as special scented secretions, to communicate with others. Like cats, they rub glands around their mouth on objects to leave scent. They also greet one another by touching noses and lips.

Hibernation

In late summer and early fall, the 13-lined ground squirrel gains weight quickly to help them survive winter dormancy as true hibernators. When hibernation begins in about September, it will seal its entrance shut. While hibernating, its body temperature sinks to the temperature of the frozen ground. As its heart beat decreases from 200 beats per minute to 20, it does not eat, awaken, or drink during the whole period, sleeping curled up in a ball. When emerging from its six month hibernation in about April, they weigh about half as much as they did in October. They emerge when snow drifts are still melting, and they eat food they cached in fall. Males begin hibernation and emerge in spring earlier than females.

Life Cycle and Home Range

Females mate within about five days of emerging from hibernation. Hairless, blind, and toothless young are born 28 days later and nursed and cared for by the mother in the burrow, with an average of eight to nine kits per litter and only one litter per year. Their eyes open at about 13 days old, and they leave the burrow for the first time at 28-35 days old. They are weaned and on their own between six and 12 weeks of age and dig their own burrow within about 100 meters of where they were born. Full grown at 90 days, they can mate for the first time the following spring. However, about 90% of the young succumb to predation prior to hibernating for the first time. The lifespan is probably two to three years. Home ranges may vary considerably in size depending upon the source from a few tenths of an acre to over 11 acres. Likewise density varies from one to 20 squirrels per acre.

Instructor Info: Plains Pocket Gopher

Rodents
Rodents are small to medium-sized gnawing mammals and include the following families: squirrel, chipmunk, pocket gopher, mouse, rat, beaver, vole, and porcupine.

Pocket Gophers
Ten species of pocket gophers live in North America. Their ranges typically are relatively small with the exception of the two species found in Minnesota: the northern pocket gopher and the plains pocket gopher. The northern pocket gopher lives in the western and central plains states and Rocky Mountains while the plains pocket gopher inhabits the eastern, central, and southern plains states. In Minnesota their ranges overlap in the northwestern part of the state. Only the plains pocket gopher has been observed at the PWLC.

Appearance
Plains pocket gophers measure 13 inches long and weigh 19 ounces. See section, "Background," for a description of their appearance.

Habitat and Range
Plains pocket gophers are found in grasslands of many kinds including tallgrass and mixed grass prairies, savannah, and non-native grasslands. They adapt well to living in developed and cultivated land such as weedy uplands, lawns, golf courses, alfalfa fields, pastures, roadsides, railroad rights-of way, waste areas between irrigated corn fields, edges of farm fields, and drainage ditches. Their range extends from northwestern Minnesota through the Twin Cities, south to Texas and northeastern Mexico, between the Mississippi River and the Rocky Mountains. Their distribution is patchy and depends on two things: first, food availability and second, preference for sandy or loamy, deep, crumbly soil types which lack clay.

Burrows
Pocket gophers develop a large, multi-branched burrow system for foraging, food storage, protection, and raising young. Burrows are two to 3 ½ inches in diameter, relatively shallow in the summer (20-30 cm), and somewhat deeper in the winter with some chambers located up to six feet below the surface. Their burrow system is more elaborate than ground squirrels because ground squirrels obtain their food above the ground. Deep nest chambers, food caches, and many shallow feeding tunnels require a lot of energy to construct and are re-used year after year by the same or different gophers. New burrows are also being dug and old tunnels closed off, making for a dynamic network. One adult pocket gopher inhabits one tunnel system. To begin a new tunnel, a gopher kicks soil behind it, loosening soil and rocks with the back feet. Then it turns and uses its front feet, chest, and flat forehead to shove the materials back along the burrow and out onto the surface, forming fan-shaped mounds. It will not leave the burrow open for very long but fills the opening with an earth plug on the inside curve.

Senses and Communication

They appear to be aware not only of their own burrow system but of others as well, especially their neighbors. Some burrows are mainly common property, allowing them to find their way to other burrows without getting into a death match. Several methods exist for detecting the presence or absence of neighboring plains pocket gophers.

- Fresh scat may prevent occupancy of a burrow as gophers leave fecal scent at sign posts where tunnels connect with each other. Conversely, the absence of fresh scat or the presence of scat more than at least two hours old is like putting out the "Tunnel for Rent" sign.
- Vibrations caused by digging may be sensed by their naked tails and by long, stiff hairs on their faces and wrists as well as by long guard hairs.
- Communication by gophers making a loud clicking sound easily travels through loose soil because the intensity of low frequency sound falls off more slowly in a burrow than in open air.

Note that none of the methods is related to the sense of sight. Plains pocket gophers do not have to come into direct, physical contact to be aware of their neighbors. Vibrations from clicking or digging are probably detected at distances of six meters, even through soil or tunnel walls.

Social Behavior

Males maintain larger territories than females in general, and their boundaries may share a common border. Solitary for most of life, pocket gophers fight other pocket gophers unknown to them, and males fight each other during the breeding season which may be related to guarding or defending females. This behavior is called agonistic, an aggressive or defensive social interaction between individuals (fighting, fleeing, or submitting). Gopher population density may be maintained near or at carrying capacity by this form of aggression. Its purpose is twofold: 1) it appears to space individuals and ensure they have a year-long food supply and 2) it protects immature females by giving them ownership of the natal burrow system.

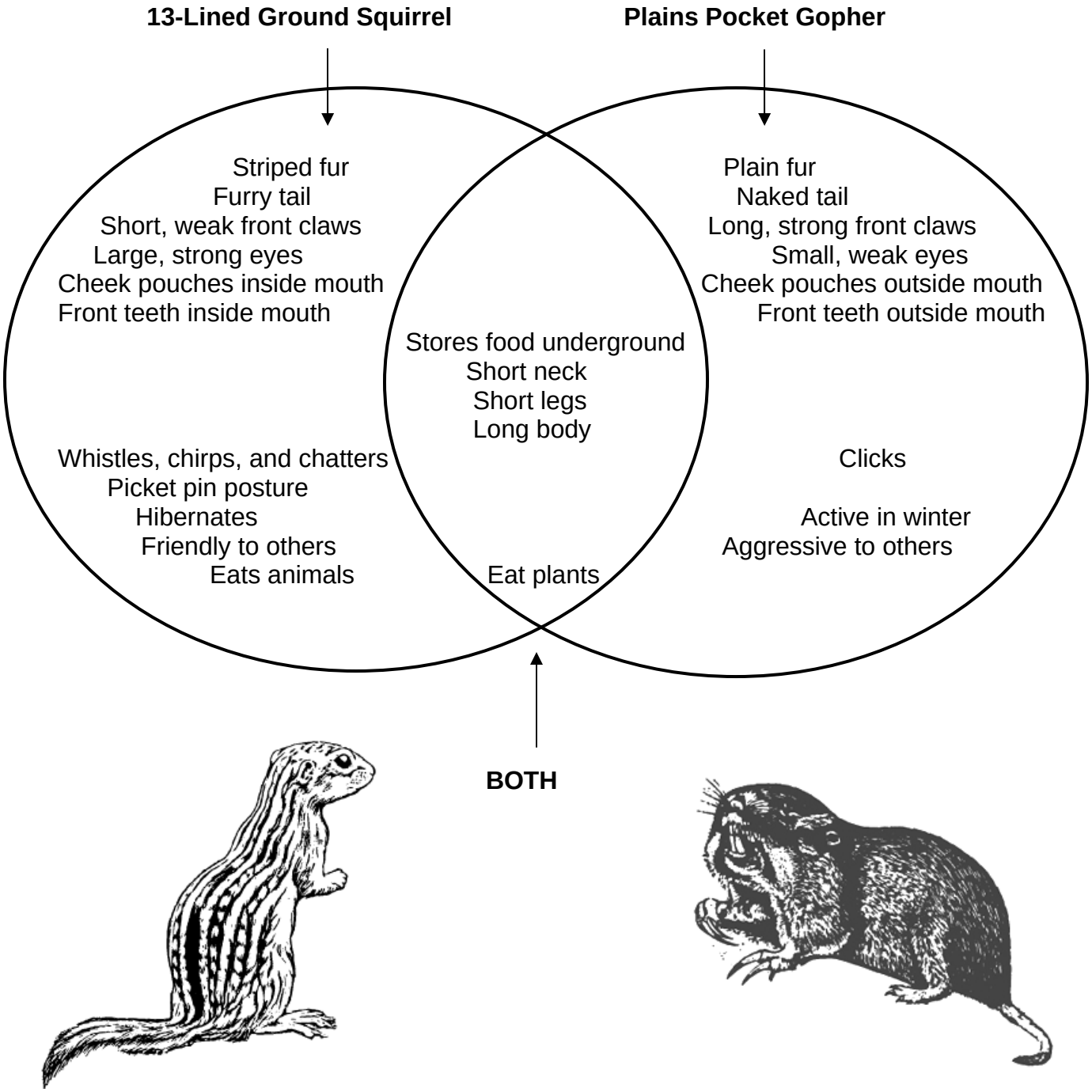
Diet

Herbivores, plains pocket gophers are specialized to eat mainly roots and tubers of perennial forbs like yarrow and goldenrod (and some stems and leaves) which they find mostly by burrowing through the ground, grasping, and pulling down the entire plant through the soil and into tunnel. They will eat or store almost every plant encountered while digging; grasses likely also make up a large portion of their diet. Exact species composition depends upon the local habitat and time of year. For instance, one study shows that grasses may be the prominent part of the diet in savannahs; silver scurf pea in tallgrass prairies; grasses like brome, wheatgrass, and bluegrass in non-native grasslands; Jerusalem artichoke in weedy uplands; and in cultivated lands, alfalfa, Sudan grass, dandelions, sorghum, grasses, oats, and hay. They seem to prefer plants of earlier successional stages such as goosefoot and quack grass. They concentrate on forb patches in summer and mostly grasses in fall and winter. Another study shows that the number of mounds is directly related to the amount of silverleaf scurf pea. Sometimes they will come above ground to forage on surface vegetation. The pocket gopher stuffs cut-up stems and roots of any plants not eaten directly into its cheeks and

carries them to caches within the burrow system. Obtaining enough moisture from plants, they rarely drink water.

Life cycle

During the breeding season, males relocate to be nearer to females. They dig straight tunnels with the sole purpose of intercepting the tunnels of females, leaving their own burrows in early spring to mate, but then returning to their territory. Female reproductive status may be discerned from fecal hormones as plains pocket gophers are coprophagus (eat feces). Male reproductive success is highly variable, with a small number of the males mating with a majority of the females. Females gestate for about 18 days with young born in May and June, dispersing in July and August. After raising a litter, about half of females may relocate, leaving the natal burrows/nest to female offspring, ensuring an adequate food supply. Polygamous, the number of females far outnumber males. Thirteen-lined ground squirrels usually produce about three young and one litter per year in the north.

Venn Diagram for Teachers

A handy graphic organizer, the Venn diagram may be used to examine similarities and differences of adaptations between the 13-lined ground squirrel and the plains pocket gopher. The example below shows just one possible way of using the Venn diagram for this purpose. Students may or may not come up with the same comparisons. The Venn diagram could also be uses as an assessment tool prior to the PWLC field investigation and then again after.