Science on the Tallgrass Prairie National Preserve

Overview:

In these lesson plans students will perform scientific research on the Tallgrass Prairie National Preserve in Chase County, Kansas. Students will learn details about the tallgrass prairie ecosystem and the importance of grasshoppers, fire and aquatic invertebrates to the prairie. There are three research projects included here. Teachers may use one, two, or all three as any can "stand alone" or be used in conjunction with each other for a full day of study on the prairie. Each project may take 2 -3 hours.

Learning objectives:

Learn and follow research protocol to collect data.

Draw conclusions based on data collected.

Gain a greater appreciation of the tallgrass prairie ecosystem.

Standards:

NGSS National/State Standards: MS-LS2-1, MS-LS2-2, HS-LS2-1, and HS-LS2-2English/Language Arts Standards: CCSS.ELA-Literacy.WHST.6-8.10, CCSS.ELA-Literacy.WHST.9-10.10

Reservations

There is no charge to visit Tallgrass Prairie National Preserve or attend any of our many programs and activities.

Free guided tours for schools and organized groups, limited by ranger availability, may be reserved a minimum of two weeks in advance by calling (620) 273-8494.

When you contact us to arrange a tour, please provide the following information:

- Trip dates
- Number of students
- Number of chaperones
- Desired activities
- Arrival and departure times
- Number and type of vehicles
- Any special needs
- Contact person
- Contact phone number and email address

Special Needs - To help us accommodate your group, please inform us of any students with special needs in advance. Students on an Individual Education Plan (IEP) for behavior should be personally accompanied by a paraprofessional or other adult. Teachers should also make arrangements for individual supervision of students with behavioral difficulties.

Cancellation - If you anticipate being more than 10-minutes late or need to reschedule the trip, please call the preserve visitor center at (620) 273-8494.

- Weather - Please watch the weather forecast. We may need to rearrange trip itinerary or cancel for heavy rain, storm warnings, or water saturated soils. Indoor activities in case of inclement weather are extremely limited. If there are questions concerning your visit, please call us before you cancel, even the morning of the trip. If you need to make corrections or adjustments for your visit, please contact the visitor center as soon as possible. Please visit the links below to see the current weather forecast at the preserve.
- NOAA Weather Link
- Tallgrass Prairie's Weather Station Link

Guidelines for Student and Group Tours

Please review the appropriate sections with your chaperones and students in advance.

Chaperones. A minimum 1 adult to 10 student ratio is recommended.

Discipline. Discipline on-site is the responsibility of the teachers and other chaperones, including during guided tours, restroom breaks, and lunch.

Preserve Rules: You are guests of The Nature Conservancy and the National Park Service. Your help in preserving this natural environment and protecting the research conducted on the Tallgrass Prairie National Preserve is greatly appreciated. **For some activities that require removal of insects or other species, a research permit is required in advance. Please contact the preserve staff, so that we may help in obtaining these permits.**

- Collection or removal of **anything** (except with research permit) is prohibited.
- Pack it in, pack it out. Disposal receptacles and picnic areas are not available on the trail. There are trash and recycling containers near the barn and visitor center.
- Quiet voices are important, especially for a chance to see wildlife!
- All wildlife at the park is protected. The preserve is home to venomous snakes, such as massasauga rattlesnakes and copperheads. For your safety, please watch where you are walking and do not put your hands anywhere you cannot see. Be cautious around rock walls, fences, and in tall grass.

Outdoor Preparation. Please prepare your students to experience the prairie environment. There is no water available on the trails, little shade and often a lot of wind. Be sure students bring plenty of water. Check the weather forecast and dress appropriately. Long pants, close-toed walking shoes, layered tops and a hat are recommended. Other important outdoor protection includes: insect repellent and sunscreen. We recommend you bring extra supplies for your students, including water.

Restroom Facilities. Restroom facilities with drinking fountains are available at the visitor center and across from the historic limestone barn.

Picnic Plans. Picnic tables are available outside near the barn and administration/visitor center, if you choose to bring sack lunches or a snack. Picnics are not allowed on the trails. No concessions are available on-site. We encourage groups to pack a trash-free lunch. For your convenience, trash cans, and aluminum and plastic recycling bins are available at the barn and picnic area near the barn. Please ask students to remove liquids and lids before recycling these items.

Thank you for your cooperation and for bringing your students to

Tallgrass National Prairie Preserve.

ACTIVITY 1 - <u>Inventory of Grasshoppers on Tallgrasss Prairie National Preserve</u>

PURPOSE: Students will collect data on grasshopper populations and analyze data they have collected. Trends can be analyzed by **archiving** the results and referring back to them. Preserve staff work toward maintaining a long-term inventory of species composition and abundance. Student collections will benefit the National Park Service and The Nature Conservancy researchers by analyzing grasshopper populations in a **quantitative** measure that can be referenced when evaluating park management.

Summary - Students use insect sweep nets and killing jars to collect grasshoppers from selected areas that can include native, restored, grazed or ungrazed, and burned or unburned prairie. A sample of 100 sweeps is taken on a **transect** line; each team of students taking 10 sweeps before carefully transferring the collected insects to the killing jar and alternating with a partner. In the laboratory, grasshoppers will be sorted by life stage (nymph or adult) and type (**band-winged**, **slant-faced**, **spur-throated**, or really big (Lubbers)) using a **dichotomous key** and then counted.

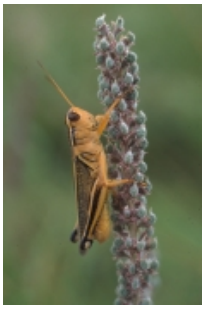
PREVISIT INFORMATION

A PowerPoint introduction to the tallgrass prairie from the Konza Environmental Education Program can be found at Ecology of the tallgrass prairie

GRASSHOPPER FACTS

Grasshoppers make up the largest amount of above ground **biomass** of plant feeders on the tallgrass prairie, with the exception of bison and cattle (Konza Prairie Biological Station). This makes them the second most important **grazer** on the tallgrass prairie. The impact of grasshoppers on the tallgrass prairie ecosystem and their great abundance, have made them an important **species** to monitor.

LIFE CYCLE



Let's begin with the egg. Female grasshoppers lay their eggs in the soil as a batch or cluster, protected by a foamy substance that hardens to form an egg pod. The eggs hatch after a period of incubation, often after passing the winter underground before development is complete. The newly hatched grasshopper digs its way to the soil surface and **molts**, or sheds its old skin to change into a **nymph**. This is an active form capable of walking, hopping, and eating. Several molts follow until the last molt to the adult. Some grasshoppers hatch in the fall and over winter as nymphs or adults. In Kansas you can find grasshoppers out sunning or **basking** on a warm winter afternoon. They particularly enjoy basking on a rock outcropping or bare soil exposed to the sun. When the last molt is complete, the fully formed and reproductively capable adult appears. Adults mate and produce eggs, which the female places in the soil using their ovipositor. There is one generation each year. Each species hatches, develops, and reproduces on its own life cycle.

HABITAT

Grasshoppers thrive in open, sunny environments, like prairies, pastures and fields. They are affected by the weather, especially temperature, wind speed and cloud cover. Their body temperature depends to a great extent on the surrounding air. Body temperatures can be maintained 10-15 degrees C higher than **ambient** temperature. The best temperature for digestion is 38° C (the same as in humans and other animals). Grasshoppers seek out sunny sites and bask to keep an optimal temperature.

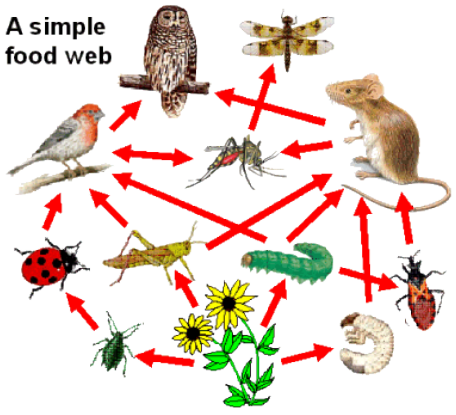
DIET

Grasshoppers usually feed on plants including **grasses** and/or **forbs**. They graze on many kinds of plants from different families, several species of plants in one family or in a few cases, on only one species of plant. Some kinds of grasshoppers feed on dead plant and animal material, and some are **carnivorous** on other insects.

WHY ARE GRASSHOPPERS SO IMPORTANT?

Grasshoppers are ecologically significant in the prairie. The highest number of species is present in the Great Plains and grasslands of western North America. There are more than 100 species in Kansas and probably more than 40 species on the Tallgrass Prairie National Preserve. They may be the most abundant insects seen. By their numbers, they are the most important plant feeders in the ecosystem. Their combined biomass often reaches or exceeds that of large mammalian grazers, like bison and cattle. Damage to native prairie habitats is rare, unlike the possibility of serious damage in field crops, especially in drought years. Grasshoppers recycle **nutrients** by dropping clipped plant material and **frass** (insect excrement), which quickly is degraded by soil organisms. The released nutrients are rapidly available to plants for new or continued growth.

Grasshoppers are important food for other animals. Many birds **forage** for grasshopper nymphs to feed their young. Grasshoppers are an important food source for wild turkeys, prairie chickens, and quail. Grasshoppers are eaten by fox, coyotes, mice and other small mammals. Insect predators, such as dragonflies, robberflies and the praying mantis also eat grasshoppers.



Vocabulary: Students should be familiar with these terms before participating in this activity.

Archive – to file or collect as records or documents

Ambient temperature - The temperature of the air surrounding an organism.

Band-winged - The hind wings of this grasshopper are brightly colored with a band of different color along the edge.

Basking - To expose the body to sunlight and warmth.

Biomass - The amount of living matter in a unit area or volume of a habitat; total animal or plant material produced in a season.

Carnivorous - Feeding on animal tissue, flesh-eating.

Dichotomous key - A series of descriptions which allows you to identify the group an insect belongs to.

Forage - To search for and feed on plant or animal material.

Forbs - A non-woody plant other than a grass, sedge, rush, in contrast to bryophytes, ferns and graminoids.

Frass - Insect excrement.

Grasses - Any plant of the family Gramineae, having jointed stems, sheathing leaves, and seed-like grains.

Graze – An animal that feeds on plants.

Molt - To shed or cast off the outer layer of skin.

Nutrients - Food substances that promote growth and cell repair.

Nymph - A young, immature insect that resembles the adult, except in wing development and reproductive capability.

Quantitative - How much there is of something you can measure and represent with numbers.

Slant-faced - A grasshopper with a head shaped like a cone with the point on the top.

Species - A class of individuals having common attributes and designated by a common name.

Spur-throated - A grasshopper having a small peg, spine or spur between the front pair of legs, usually visible with the naked eye.

Transect - A straight line where observations or data are taken.

IN THE FIELD

Materials: 1 Insect sweep net, euthanizing jar, data sheet and clipboard per group (2 students/ group)

Sampling is done by sweeping with an insect net. Sweeping provides good estimates of relative abundance of individual **species** present at any one place and time.

Step 1 - A sample of 100 sweeps is taken on a **transect**. A sweep is taken at each step by tracing a figure eight with the net through the top layer of vegetation. Students will work in teams of 2, each taking 10 sweeps before carefully transferring the collected insects to the killing jar. The team alternates the sweeping process. After the first student empties his net with the help of his partner, the other will continue down the line doing ten sweeps, and so on, until a total of 100 sweeps per team have been taken.

Step 2 - Information about weather conditions is important when collecting grasshoppers and should be noted on your data sheet. Their behavior and activity are dependent on the temperature, wind speed and cloud cover. Generally, clear, calm, warm days (cloud cover less than 50%, winds less than 24 km/hr (15 mph), and ambient air temperature 25-40^{o}C) are the best for grasshopper collection (Konza Prairie Biological Station).

IN THE LABORATORY

Step 3 - The insects are removed from the killing jars once back at the classroom, according to teacher instruction and the grasshoppers separated from the debris and other insects.

Step 4 - Grasshoppers are identified as to life stage (adult or **nymph**) and counted. A data sheet is provided to report each team's findings. Identification **keys** and reference specimens are provided for comparison. Unknowns are set aside to be identified later.

Grasshopper Inventory Data Sheet

Date (mm/dd/yy) ___/___/___ School _____

Researchers (Last name and Initial) 1._____, ___
2._____, ___ and 3._____, ___

Transect # (a number) ____ Time (circle one): a.m. or p.m.

Location (circle one) Upland native prairie or Lowland restored prairie

Was your site burned this year? yes no

Number of sweeps (total) _100_

If you did not collect any hoppers, please enter zeros ("0")

Number of katydids (Tettigoniidae) _____

TRUE GRASSHOPPERS (Acrididae) ONLY BEYOND THIS LINE!

Number of grasshopper NYMPHS (Acrididae) _____

ADULT GRASSHOPPERS (Acrididae) ONLY BEYOND THIS LINE!

a. Number of Band-winged Grasshoppers _____

b. Number of Spur-throated Grasshoppers _____

c. Number of Slant-faced Grasshoppers _____

d. Number of Really Big Grasshoppers _____

TOTAL Grasshopper ADULTS (Add a, b, c, & d) _____

Number of grasshopper adults pinned _____

Weather Data:

Air Temperature _____ F. or C. (circle one)
Wind Speed _____ m.p.h.
Cloud Cover _____ % (estimate)

This data sheet was checked by: _____

POSTVISIT EXTENSION ACTIVITIES:

1. Using dichotomous keys found in literature or on the web, have students further identify the grasshoppers they collected. Students may be able to classify each as to its family or even genus and species (advanced classes

2. Have students graph the occurrence of each type of grasshopper either using the general categories noted on the data sheet or the more specific identifications from extension 1.

3. Have students hypothesize/speculate as to what environmental conditions would lead them to collect more grasshoppers and/or fewer grasshoppers. Hint: have students think about temperature, wind speed, recent weather (dry, wet, cold, warm) etc.

4. Have students quantify the amount of area surveyed (example: 2 meters by 100 meters) and then quantify the estimated number of grasshoppers per acre or weighing the grasshoppers and estimating the grasshopper biomass and comparing to bison or cattle biomass.

5. When finished with the day, have students take 5 minutes in quiet reflection. Have them write a sentence or two on the sights, sounds and smells of the tallgrass prairie.

6. Have students write a paragraph on their experience collecting grasshoppers on the Tallgrass Prairie National Preserve.

Teacher Resources:

Recommended Books:

- *Field Guide to Grasshoppers, Katydids, and Crickets of the United States*. John L. Capinera, Ralph D. Scott and Thomas J. Walker

- *Insects in Kansas*. G.A. Salsbury and S.C. White

Recommended Websites:

- Ecology of the tallgrass prairie

- Grasshoppers and Crickets

ACTIVITY 2 - Plant Diversity and Fire on Tallgrass Prairie National Preserve

Purpose: Students will interpret and analyze data relative to prairie land management techniques. Students will describe **ecosystem** processes such as fire, grazing, and climatic conditions. Sampling the kinds of plants present on the Tallgrass Prairie National Preserve helps researchers and preserve managers determine the effect of fire on the diversity of plant life.

Summary:

Sampling the kinds of plants present in the different burn areas can help determine the effect of fire on the diversity of plant life. Comparing burn treatments from one area to another can help determine the best burn program for maintaining a healthy and diverse grassland ecosystem. Sampling the kinds of plants found in any native prairie can help us understand the natural **diversity** present in the grassland ecosystems.

PREVISIT INFORMATION

A PowerPoint introduction to the tallgrass prairie from the Konza Environmental Education Program can be found at Ecology of the tallgrass prairie

Background on Prairie Grasses and Fire

Tallgrass Prairie National Preserve, located 2 miles north of Strong City, Kansas, is part of the Flint Hills region, the largest contiguous area of unplowed, native tallgrass prairie in North America. The Flint Hills stretch from near the Nebraska border south into northeastern Oklahoma. Most tallgrass prairie ecosystems have been plowed and are currently in agricultural use. Less than 4% of the original tallgrass prairie remains.

The tallgrass prairie is dominated by **grasses**. The most notable of these are Big bluestem, Indian grass, Little bluestem, and Switch grass. The relatively low annual **precipitation** combined with the cold winters and hot summers creates conditions that favor this grassland **biome**.

Before the arrival of European settlers the prairies of North America were maintained by climate, fire, and large grazers such as bison. Occasional fires swept through the plains ignited from lightning strikes and Native American Indians. Depending on the timing and intensity, these fires could damage non-grass species of plants, such as woody shrubs andtrees. The root system of most prairie grasses and **forbs** are not destroyed by these fires, so the above-ground parts grow back readily. One of the possible effects of fire on grasses is the increase in growth and nutritional value.

The presence of a variety of non-grass species on the prairie may indicate the condition of the ecosystem. A variety of plants is necessary to maintain a healthy grassland. Some plants are **exotic**, or **non-native**, and can be quite aggressive in competing with **native** prairie plants. Certain types of plants, such as trees, may be undesirable and can be managed with fire.

Vocabulary: Students should be familiar with these terms before participating in this activity.

biome - major geographical area known by the climate and kinds of plant and animal communities that characterize it (example: hardwood deciduous forest)

dicot – Short for dicotyledons. One of two major groups of flowering plants that are traditionally recognized. Dicot seedlings have two seed-leafs.

diversity - the variety of different kinds or species of organisms in a habitat

ecosystem - the complex of interactions between living (plant, animal) and non-living (soil, water) elements in a particular area

forb - broad-leaf herbaceous plant, usually with net-like veins; not a grass

exotic - plant or animal species introduced into an area where they do not occur.

grass - a family of monocot plants with slender sheathing leaves and parallel veins

monocot – Short for monocotyledons. One of two major groups of flowering plants that are traditionally recognized. Monocot seedlings typically have one seed-leaf in.

native - originating in a particular place; naturally occurring

non-native – originating from another place, yet relocated and surviving in a new environment

precipitation - rainfall, snowfall, hail, sleet; any form of water from the atmosphere that falls to the earth

woody shrub - any plant whose stems develop a woody and persistent quality as the plant develops

IN THE FIELD

Materials: 1 sampling frame (1meter x 1 meter) or 1 hula hoop, and 2 (or more) data sheets/clipboard per group (2 students/ group)

METHODS:

Teams of at least two students are assigned to an area to be sampled. Each of these plots is characterized by its location or a specific grazing or burn treatment (this spring, last year, 2 years ago, etc.).

Step 1 - Equipped with a sampling frame, or hula hoop, that encompasses a known area (1 meter X 1 meter etc.) the students randomly place the frame inside the test plot.

Step 2 - Each team identifies, counts, and records the number of each kind (grass, forb, or woody shrub) of plant inside the sampling frame. This procedure is repeated within the same test plot.

Step 3 - Averages of several samples and comparisons of these averages from teams within the same class allow students to interpret the meaning of the data they have collected.

Effect of Fire on Plant Diversity Data Sheet

Field Area

School: _____ Teacher: _____

Student Researcher 1: _____ Date: _____ mm/dd/yy

Student Researcher 2: _____ Group #: _____ Team #: _____

PLOT Information Plot #: _____ Soil Temperature: _____ C° or F°

Burn Treatment in years: _____ Season: _____

	Grasses (# of stems)			Forbs (# of stems)			Woody Plants (# of stems)		
Sample 1									
	TOTAL			TOTAL			TOTAL		
Sample 2									
	TOTAL			TOTAL			TOTAL		
	AVERAGE (of 2 samples)			AVERAGE (of 2 samples)			AVERAGE (of 2 samples)		

This data sheet was checked by: _____

Please use a new data sheet when you move to a different plot.

POSTVISIT EXTENSION ACTIVITIES:

1. Using pictures or dichotomous keys found in literature or on the web, have students identify five of the most abundant plants they observed.

2. Have students graph the occurrence of each type plant either using the general categories noted on the data sheet or by using their work from extension 1. They can then compare their results with other groups on the trip.

3. Have students hypothesize/speculate, based on data collected, as to what environmental conditions would lead them to observe more or less of each plant type. Hint: have students think about when the plot was last burned, recent weather (dry, wet, cold, warm) etc.

4. Have the students hypothesize/speculate, based on data collected, as to why more/less plant species would be good/bad.

5. When finished with the day, have students take 5 minutes in quiet reflection. Have them write a sentence or two on the sights, sounds and smells of the tallgrass prairie.

6. Have students write a paragraph on their experience investigating plant diversity on the Tallgrass Prairie National Preserve.

Teacher Resources

Recommended Books:

- *Trees and Woody Vines in Kansas*. H.A. Stephens
- *Wildflowers and Grasses of Kansas.* Micheal John Haddock
- *Konza Prairie: A Tallgrass Natural History.* O.J. Reichman
- *Where the Sky Began*. J. Madson

Recommended Websites:

- Ecology of the tallgrass prairie
- Kansas Wildflowers and Grasses

ACTIVITY 3 - Stream Invertebrates on Tallgrass Prairie National Preserve

PURPOSE:

Students will collect and identify prairie stream **macro-invertebrates**. They will then infer the "health" of the stream. Students will also be able to study long-term trends in the surveyed areas as records are archived. Preserve staff maintain a long-term inventory of species composition and abundance. Student collections will benefit the National Park Service and The Nature Conservancy researchers by **archiving** these organisms in a **quantitative** measure that can be referenced when assessing park management and health.

Summary: Students use **Surber bottom samplers** to collect stream invertebrates from selected **riffles** along Fox Creek or one of the other creeks on the Tallgrass Prairie National Preserve. Samples will be examined on white- bottomed trays used to carefully separate and identify the specimens. This process is called "picking".

PREVISIT INFORMATION

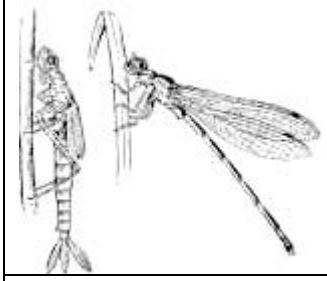
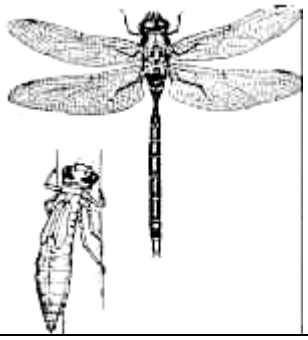
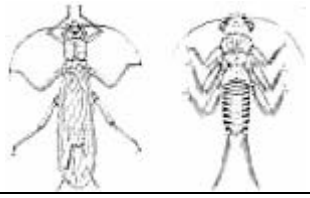
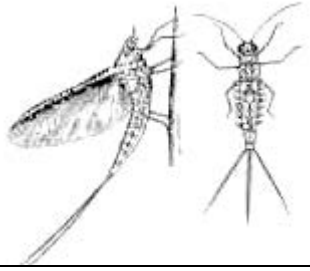
A PowerPoint introduction to the tallgrass prairie from the Konza Environmental Education Program can be found at Ecology of the tallgrass prairie

Background on organisms found in tallgrass prairie streams

Several creeks and streams on the Tallgrass Prairie National Preserve offer an interesting look at the **diversity** of organisms found in tallgrass prairie streams. Prairie stream **fauna** include fishes, **crustaceans**, **molluscs**, insects, and other non-insect **invertebrates**.

Fish species common to Tallgrass Prairie National Preserve include the creek chub, central stoneroller, green sunfish, and orangethroat darter. Non-insect stream inhabitants include crustaceans like the crayfish or crawdad, and the too small to see with the naked eye (micro-invertebrate) microscopic water flea. Some other non-insect invertebrates include small **oligochaetes**, **turbellarians**, and molluscs.

There are approximately 200 species of **aquatic** macro-invertebrates, mostly aquatic insects, on the tallgrass prairie (Konza Prairie Biological Station). Some of the known insect orders include **mayflies**, **stoneflies**, **caddisflies**, **true flies**, **dragonflies**, **damselflies**, and **beetles**. **Midges**, belonging to the true fly order, are very common in prairie streams.

		
Damselfly	Dragonfly	Stonefly
		
Caddisfly	Mayfly	Midge Fly Larva (True Fly)

Macro-invertebrates live in the water and the **substrate** of the stream bottom. They are an important part of the stream **food web**. The sun provides energy for plant growth in and around the stream. Bacteria and fungi feed on dead plant material. **Herbivorous** invertebrates feed on bacteria, fungi, algae, and partially decomposed leaves. These invertebrates provide food for predators, such as other invertebrates, fish, reptiles, amphibians, and birds.

The location of stream invertebrate **communities** varies between the prairie stream habitats. As a creek flows from the upland **headwaters**, to the middle **reaches**, and through a **gallery forest**, the stream channel, stream bed and streamside vegetation changes. Invertebrates prefer particular habitats depending on how they feed. The upper reaches of a stream generally are surrounded by grassland. Little organic debris falls into the stream, so organisms called **collectors** must filter fine organic matter from the water. Other organisms called **scrappers** or grazers feed on **diatoms** and algae. The mid-reaches of the stream are surrounded by grasses and shrubs, and the lower reaches of the stream are surrounded by a gallery forest. In the gallery forest, trees such as bur oak, hackberry and elms shade the stream and drop their leaves into the water. Organisms called **shredders** dominate in the lowerreaches and feed on the larger leaf and woody debris. **Predators**, which feed on animal tissue, such as insects, crustaceans, and fish live throughout the various reaches.

Other factors that may affect the **dispersion** of stream invertebrates are patterns of stream flow and water temperature. Floods affect stream invertebrate **populations** because the fast moving water **scours** the stream bed. Up to 95% of the macro-invertebrate population can be washed downstream in a high water event. Depending on the frequency of high water events, plant life, such as algae, and macro-invertebrates often fully recover within two weeks (Konza Prairie Biological Station).

The life cycle of aquatic macro-invertebrates can span days to years, and while some species spend their whole lives in the water, others do not. Aquatic macro-invertebrates, such as caddisflies, true flies and beetles undergo complete metamorphosis, which includes four stages of growth: egg, larvae, pupa and adult. During complete metamorphosis, larval insects look very different from the adult and then go through a non-feeding pupal stage before emerging as adults. Stoneflies, mayflies, and dragonflies undergo incomplete metamorphosis and pass through three growth stages: egg, nymph and adult. All insects change and grow during metamorphosis. They molt, or shed their **exoskeleton**. Some aquatic insects emerge from the water as adults and live on the land, such as dragonflies and mosquitoes. Other adult aquatic insects continue to live in the water, like water striders.

Macro-invertebrates act as **biological indicators** because they react quickly to changing water quality conditions. Ecologists can determine if a stream is ecologically healthy by knowing which species live in a particular reach of the stream. For example, an abundance of pollution tolerant species such as oligochaetes, midge fly larvae, and leeches may indicate a high level of unwanted pollutants in the water. On the other hand, a healthy stream will have numerous pollution sensitive species such as mayflies, caddisflies and stoneflies.

Vocabulary: Students should be familiar with these terms before participating in this activity.

Aquatic - Refers to an organism that grows or lives in water.

Archiving - Collecting and preserving specimens or information for future reference.

Biological indicator - An organism whose occurrence in a particular area indicates whether or not that environment is ecologically healthy.

Collector - Aquatic insects that feed on fine material. Types of collectors include filterers and gatherers.

Community - Group of interacting organisms in a particular ecosystem.

Crustacean - An aquatic organism with jointed limbs, segmented body and an exoskeleton made of chitin.

Diatom - A microscopic one-celled alga whose walls are made of silica.

Dispersion - Spreading out or scattering.

Diversity - Number of different kinds of species in a particular habitat; a measure of biological differences.

Exoskeleton - The hard outside covering of an insect.

Fauna - Animals or animal life of a region or ecosystem.

Food web - The pathway of food sources between communities of different organisms where energy and nutrients are passed from one organism to another.

Gallery forest - Forested or wooded area that lines a stream or river.

Headwaters - The source of a stream.

Herbivorous - An animal that feeds on plants.

Invertebrate - Animal without a backbone or internal skeleton, but with an external skeleton made of chitin.

Macro-invertebrate - An invertebrate large enough to be seen without magnification.

Mollusc – Any of a large group of invertebrate animals with a soft unsegmented body usually enclosed in a shell

Oligochaete - Any of a class of segmented worms such as the earthworm.

Population - Group of organisms of the same species living in a particular region.

Predator - An organism that hunts and kills other animals for food.

Quantitative - How much there is of something you can measure and represent with numbers.

Reach - A uniform section of stream with a repeating chain of physical characteristics and habitat types, such as pool-riffle-pool.

Riffle – a shallow area over a streambed with noticeably moving or broken water

Scours - Erosive action of flowing water in streams that removes and carries away material from the streambed and stream banks.

Scrapper - Organisms that feed by removing organic material from objects in the creek.

Shredder - Organisms that feed by cutting and tearing organic matter.

Substrate - Inorganic material that forms the stream bed.

Surber bottom sampler - Specialized net with a defined sample area used to collect stream invertebrates.

Turbellarian - Any of a class of free-living flatworms such as planaria.

IN THE FIELD

Materials: 1 Thermometer, Surber Bottom Sampler, set Data identification sheets (per location) & keys/clipboard, Pipette (eye dropper), Forceps (tweezers), 4 Petri dishes, divided tray, a Hand lens (magnifying glass) per group (3-4 students), and water bottles.

Method:

Step 1 – Completely fill out the information requested, such as school name, date, student name, water temperature, etc. Students need to be encouraged to tally invertebrates as they capture and identify them.

Step 2 - Take temperatures in both Fahrenheit and Celsius and record on data sheet.

Collection Behavior: Each student should have a pair of rubber boots. Only two or three students will enter the water to take the collection at one time. It is important students do not step directly in front (upstream) of the Surber sampler collection frame. This will contaminate the sample by adding organisms from outside the defined area and by kicking up organic material and debris from outside the collection area. Students should walk and stand downstream from the Surber sampler frame at all times.

Step 3 – Place the Surber sampler in the riffle in a random place. The Surber sampler's horizontal frame, which defines a boundary for the collection area, is placed under the water, on the stream bed. The net is placed downstream from the collection area to allow the current to push the sample into the net.

Step 4 - Rinse the Surber net: The Surber bottom sampler containing the stream macro-invertebrate sample is brought onto the bank staff. The net is turned inside-out over a white pan. Students use water bottles to rinse invertebrates clinging to the net into a white pan for examination.

Step 5 – Identify the macro-invertebrates in the field and release back to area caught.

Description of use of Surber Bottom Sampler:

Use of a Surber sampler gives researchers a quantitative method to study stream macro-invertebrates. The 12" x 12" horizontal frame is the collection area and serves as the experimental control, which allows the researcher to estimate the number of macro-invertebrates in the riffle beyond the collection frame. The 24" long net attached to a vertical frame catches macro-invertebrates from the collection area.

Placement for Collection: Riffles are an ideal place to study stream macro-invertebrates due to the shallow, rapidly flowing water. Rocks on the stream bed covered in algae and debris provide food and protection for aquatic insects.

Collection Procedure: Collect from within the defined collection area of the horizontal frame only. Rinse all material within the frame and then place the material outside the collection area so

someone else doesn't rinse it again. Rinse material such as rocks, plants, dead leaves, and sticks. To rinse, lightly rub the surface and swish the object in the water to dislodge the invertebrates. Rinse and swish the material within the collection area directly in front of the net, while holding the object underneath the water so the current will force the invertebrates directly into the net. Do not dislodge rocks imbedded in the stream bed, which will contaminate or pollute the sample with organic debris and mud.

Lab Equipment Skills:

Identification sheets & keys: Familiarize students with Stream Insects & Crustaceans and the student Datasheet before you visit.

Pipette (eye dropper): Squeeze bulb, aim tip over invertebrate, place tip underwater, release bulb slowly to capture invertebrate with a small amount of water. To release invertebrate in Petri dish, squeeze bulb to expel invertebrate and water. (Many students squeeze the air out of the bulb under the water, which pushes away the invertebrate.)

Forceps (tweezers): To use, gently grasp invertebrate between tips. Use to catch invertebrates that are too big to be picked up by the pipette.

Petri dish and divided tray: Students will organize invertebrates by species within the divided tray, placing the same type of invertebrate together. This will make identification easier, as well as recording the correct quantity on the data sheet.

Stream Invertebrate Inventory

Date (/ /) School _____Group # _____ Sample # _____

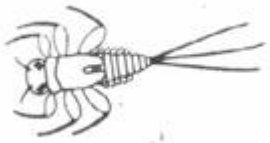
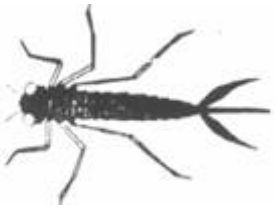
Scientists: Last name: _____ First initial: ____ Grade: _____

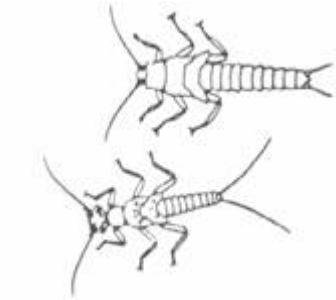
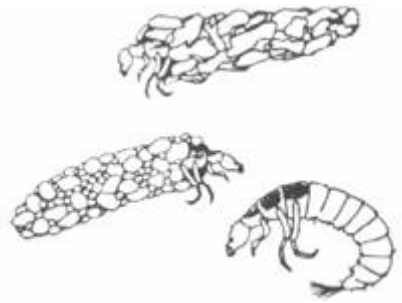
Last name: _____ First initial: ____ Teacher:_____

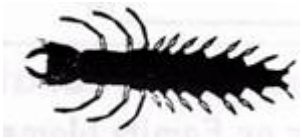
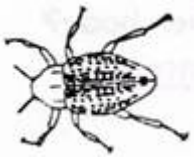
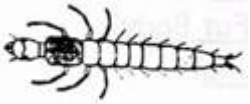
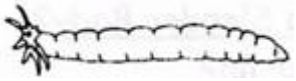
Air Temperature _____°F _____°C Water Temperature ____°F ____°C

Date of last high water event (/ /)

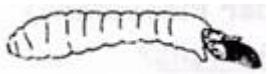
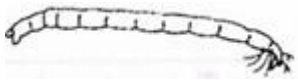
Stream Flow Rate _____ Stream appears: □ clear □ cloudy □ muddy

Aquatic Invertebrate **(Order or Family Name)**	**What does it look like?**	**How many did you find?**
Pollution Sensitive Stream Invertebrates		
Mayfly Nymph (Order Ephemeroptera) Does it have 2 or 3 thin tails? Does it have gills on its lower body? Does it have 6 legs and 2 antennae?		Tally: Total:
Dragonfly Nymph (Suborder Anisoptera) Does it have very large eyes? Does it have 6 legs and a fat body? Does it have a large lower lip?		Tally: Total:
Damselfly Nymph (Suborder Zygoptera) Does it have big eyes and three thick tails? Does it have 6 legs and a slender body? Does it have a large lower lip?		Tally: Total:

Stonefly Nymph (Order Plecoptera) Does it have 2 hairlike tails? Does it have a smooth lower body? Does it have 6 legs with hooked tips?		Tally: Total:
Caddisfly Nymph (Order Tricoptera) Does it have 6 legs on the upper 1/3 of its body? Does it have 2 hooks on its back end? Is it in some kind of a case (a stick, rock, leaves) with its head sticking out?		Tally: Total:
Pollution sensitive invertebrates—count the number of each **type** of specimen, NOT the total numbers.		Total:

Aquatic Invertebrate **(Order or Family Name)**	**What does it look like?**	**How many did you find?**
Somewhat Pollution Sensitive Stream Invertebrates		
Alderfly Larvae (Family Sialidae) Does it have one long, thin tail at the back end?		Tally: Total:
Dobsonfly Larvae-aka-Hellgramite (Order Megaloptera, Family Corydalidae) Does it have large pinching jaws? Is it dark in color with six legs? Does it have 8 pairs of feelers on the sides of its body? Does it have 2 tails and 2 pairs of hooks at the back end?		Tally: Total:
Riffle beetle (Order Coleoptera) Does it have an oval body with tiny hairs? Does it have 6 legs and 2 antennae?  Riffle beetle larva		Tally: Total:
Fishfly Larvae (Family Corydalidae) Is it reddish-tan in color or have yellowish streaks?		Tally: Total:
Crane Fly Larvae (Family Tipulidae) Is it milky-green or light brown in color? Does it have a segmented body like a caterpillar or look like a cigar? Does it have four finger-like lobes at the back end?		Tally: Total:
Somewhat pollution sensitive invertebrates—count the number of each **type** of specimen, NOT the total numbers.		Total:

Pollution Tolerant Stream Invertebrates

Blackfly Larvae (Family Simulidae) Is one end of its body wider than the other? Does it have a black head with a suction pad on the back end?		Tally: Total:
Midge Fly Larvae (Family Chironomidae) Does it have a dark head with a wormlike segmented body? Does it have 2 tiny legs on each side?		Tally: Total:
Blood Worm (Family Chironomidae) Is it red in color? Does it have a thin wormlike body?		Tally: Total:
Pollution tolerant invertebrates—count the number of each **type** of specimen, NOT the total numbers.		Total:
Other: (describe) **Unknown: (describe)**		Tally: Total:

This data was checked by: _____

POSTVISIT EXTENSION ACTIVITIES:

1. Using pictures or dichotomous keys found in literature or on the web, have students identify five of the most abundant macro-invertebrates they observed.

2. Have students graph the occurrence of each macro-invertebrate type. They can then compare their results with other groups on the trip.

3. Have students hypothesize/speculate, based on data collected, as to what environmental conditions would lead them to observe more or less of each macro-invertebrate type (deep, shallow, clear, cloudy, swift current, slow current etc.).

4. Have students discuss whether the stream water quality is in good condition or not. Should it be based on surrounding land conditions? If it is or isn't, speculate as to why it might be that way. Is it near a bridge or a highway? Discuss as a class.

5. When finished with the day, have students take 5 minutes in quiet reflection. Have them write a sentence or two on the sights, sounds and smells of the tallgrass prairie.

6. Have students write a paragraph on their experience investigating macro-invertebrate diversity on the Tallgrass Prairie National Preserve.

Teacher Resources

Recommended Books:

- *Aquatic Entomology: the Fisherman's and Ecologist's Illustrated Guide to insects and their Relatives*. W.P. McCafferty

- *Rivers and Streams*. P.A. Fink Martin

Recommended Websites:

- Ecology of the tallgrass prairie
- Guide to Freshwater Invertebrates
- The Stream Study
- Water Science for Schools

These activities have been adapted, with permission, from the Konza Environmental Education Program.