

## **LESSON 10: HAIRY, SCARY, EEEK!!!**

Spiders, like humans, are part of the natural world. In some fundamental ways, we face the same challenges. But spiders make their way in the world so differently from us that it is easy for us to view them icky and scary.

### **SUBJECTS: HEALTH, SCIENCE, GEOGRAPHY, LANGUAGE ARTS**

#### **OVERALL OBJECTIVE:**

To explore attitudes and to recognize differences between people, and to appreciate uniqueness in both animals and humans.

#### **TIME OF YEAR:**

Late spring or early fall (before the first frost) if you are using live spiders; otherwise, anytime

#### **MATERIALS:**

1. Magazine photographs of arthropods
2. *The Icky Bug Alphabet Book* by Jerry Pallotta, *Be Nice to Spiders* by Margaret Graham, *Someone Saw a Spider* by Shirley Climo, *The Adventures of Spider: West African Folk Tales* retold by Joyce Cooper Arkhurst, *Native American Animal Stories* told by Joseph Bruhac, or any additional fiction and non-fiction literature (see bibliography)
3. Drawing materials and paper

#### **PREPARATION:**

- **Activity 1:** Set up a world map.
- **Activity 2:** Collect assorted photographs of arthropods from magazines or books. Try to find pictures of beautiful spiders, such as jumping spiders.

### **ACTIVITY 1: SPIDERS AROUND THE WORLD, (GRADES 3-6)**

Read stories from *Someone Saw a Spider*, by Shirley Climo, *The Adventures of Spider: West African Folk Tales* retold by Joyce Cooper Arkhurst, or *Native American Animal Stories* told by Joseph Bruhac, focusing on those in which the spiders are clever and well liked. Ask the students about other spider stories and what role the spiders play. Do other cultures (people in other lands) have different attitudes towards spiders? Mark on a map the origins of these stories. Discuss with the students their feelings about spiders. Have their feelings changed as they became familiar with spiders? Did they like spiders better as they became more comfortable with them? Did their feelings change after they saw other images of spiders or heard other stories about them? Read *Be Nice to Spiders* by Margaret Graham. Ask the students to describe their feelings during the story when the people tried to get rid of the spider and when the spider helped everyone at the zoo.

### **ACTIVITY 2: WHAT'S ICKY?, (GRADES 3-6)**

Read to the class *The Icky Bug Alphabet Book* by Jerry Pallotta. Ask the students which arthropods in the book they liked or disliked and why. Which are 'icky'? Record responses.

Have the students conduct interviews with each other about arthropods and spiders. Help the class develop a questionnaire. Photocopy the questions so each student has a copy. Sample questions can include: How do you really feel about spiders? Are you afraid of them? Do you like them? If so, why? Do you think spider webs are beautiful? When you find spiders in their home, what do you usually do? Have you actually been bitten by a spider? Have you seen a living black widow spider or a tarantula? Where?

Explain how to conduct an interview using the questionnaire and how to record the answers accurately and efficiently.

After the interviews are completed, help the students summarize their findings and present them to the class. Discuss both how they feel and what they think most people feel about spiders. If people have negative feelings about spiders, are these feelings justified? Are their feelings due to lack of knowledge? Did your feelings change? What caused that change? What could be done to help change these attitudes?

# TEACHER REFERENCE

## WHAT IS A SPIDER?

Phylum, Arthropoda; Class Arachnida; Order, Araneae

Living animal and plant organisms display certain characteristics in their body form and functions. By comparing various organisms, particular similarities among them can be detected, e.g., all mammals have fur and nurse their offspring. We classify organisms according to group similarities and often give the group a name (mammal, for example).

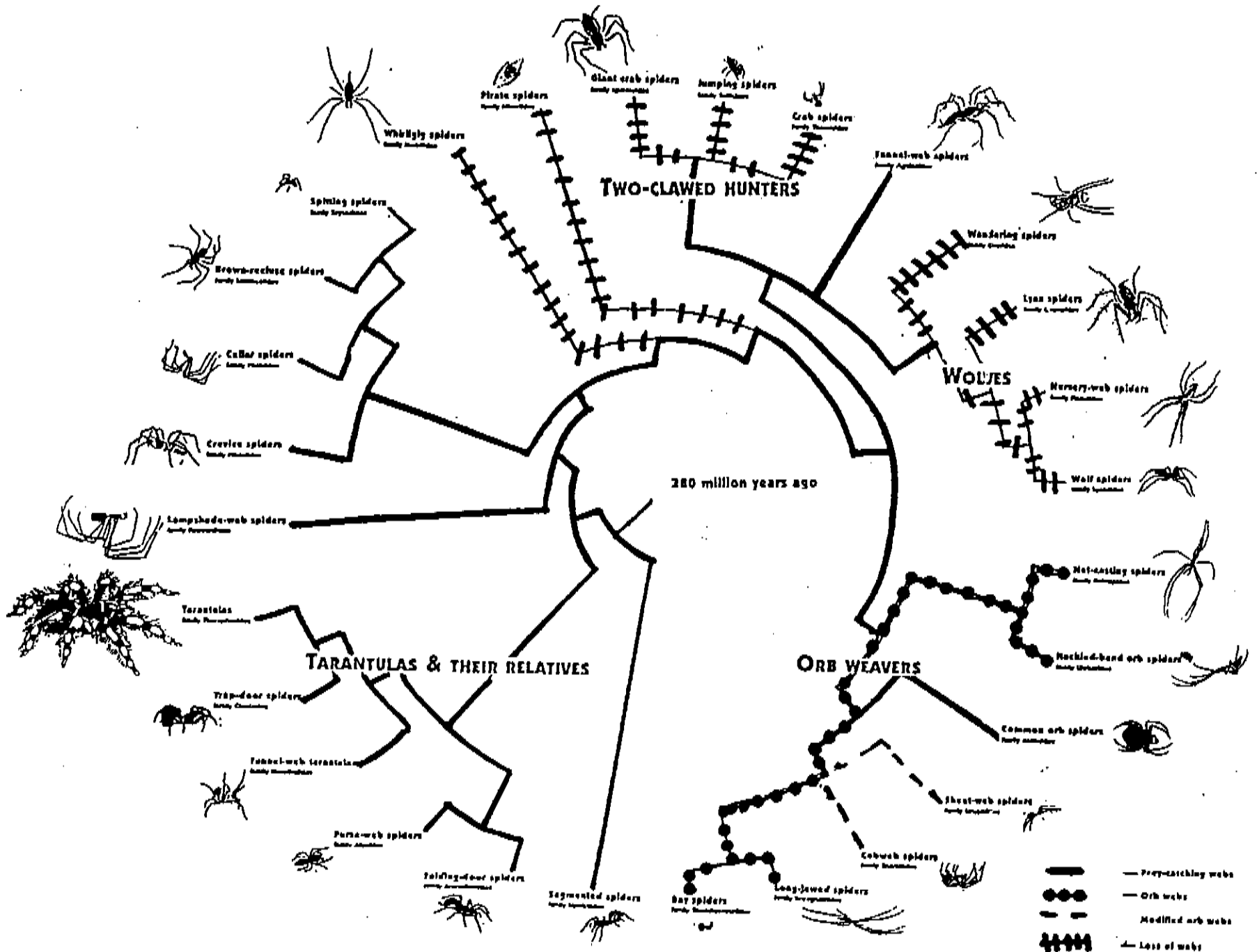
Spiders belong to the large group, or phylum, of animals called Arthropoda. All arthropods have numerous jointed legs (in fact, the term arthropod means jointed foot). In addition to spiders and their kin, other arthropods include insects with six legs, millipedes and centipedes, and crabs and crustaceans.

Spiders share a number of important characteristics with other arthropods, such as an exoskeleton and jointed legs. They share certain features, such as eight walking legs and book lungs, with only their relatives, scorpions and arachnids. Some features, such as spinnerets and complex sexual organs, are unique to spiders and help us to recognize them.

Spiders form an ancient animal group that reflects a long and successful history. Early spiders lived on earth in the middle Devonian period, 360 million years ago. Scientists estimate that over the course of at least 380 million years, spiders have evolved into 105 families containing as many as 170,000 species. They have identified only about 34,000 species.

Spiderologists (or arachnologists) reconstruct spider history by tracing a cladogram, a branching pattern of evolutionary 'forks in the road.' Organisms evolve in three ways that are all coded in their genes: new features arise, features change, features disappear. Every branch in a cladogram represents evidence of at least one of these events. Spiderologists hypothesize that spiders evolved first from webless hunters, starting with tarantulas and their relatives, to spiders with some form of prey-catching web. Evolution of the orb web, a new style in prey-catching webs, marked the origin of the orb weavers' lineage. Later, some descendant lines modified the orb web into sheet webs or cob webs. Several lines, which evolved later than tarantulas, entirely lost the habit of using webs for hunting.

There are five main groups of spider families: two-clawed hunters, orb weavers, wolves, tarantulas and their relatives, and cellar spiders and their relatives. The largest spider family is Salticidae, or jumping spiders. Over four thousand different species have already been described by spiderologists, with many more to come.



## LIFESTYLES

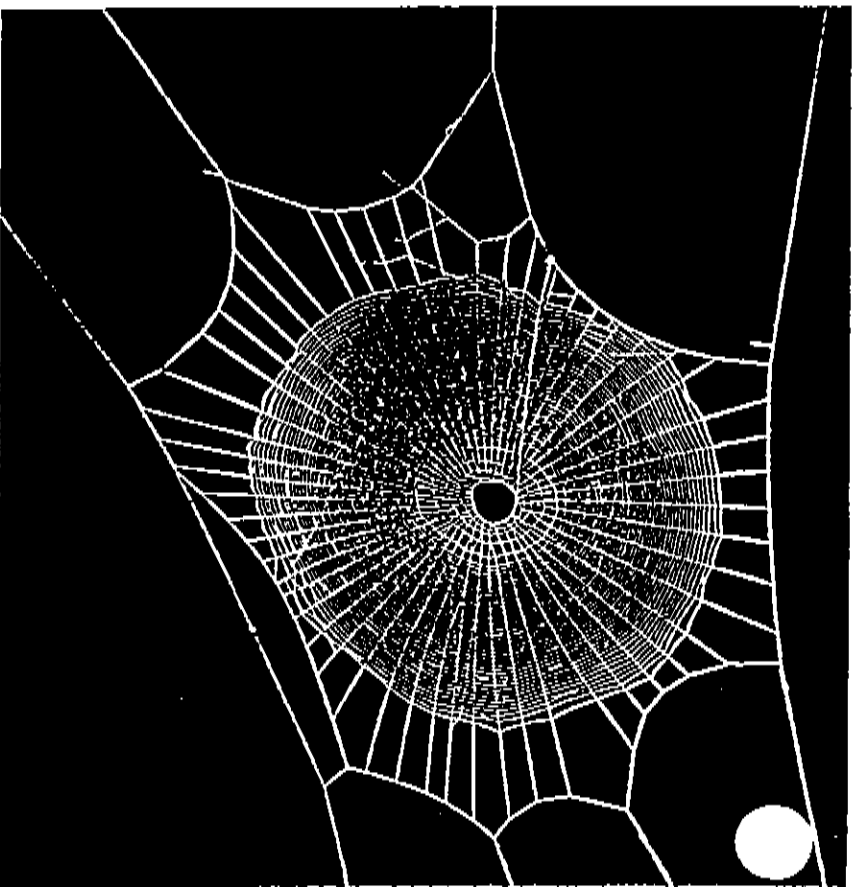
As important predators of insects, spiders are nature's very own insect population control mechanism. Without spiders, the world would be overrun by insects.

**Predatory lifestyle:** All spiders, and most of their arachnid relatives, practice a predatory lifestyle. Spiders depend on live insect prey. Only a few spiders will eat animals other than insects. A few large spiders, such as tarantulas, may occasionally prey on small birds. One small group of spiders is specialized to eat nothing but other spiders (family Mimetidae). Spiders are not vegetarians.

**Habitat:** Spiders live in every habitat: on the land, in the soil, in caves and rock crevices, in human settlements, in the vegetation, on trees, under snow, and on the surface of water. Although spiders at the seashore hunt at low tide among rocks, there are no truly marine spiders. Only one group of spiders has successfully invaded fresh water ponds: the European water spider *Argyroneta*, which hunts, lives, and mates underwater. Its retreat is a large air bubble trapped by silken threads and vegetation. The spiders come to the surface from time to time to replenish the air supply in their retreat.

**Making a living:** A spider hunts in one of two ways: by building and maintaining a web, or by crawling on the ground, under bark, and among rocks, vegetation, litter, and flowers. The latter hunting spiders are called cursorial spiders.

The nest of a web builder is usually near locations where insects will fly, such as in moist areas or near flowers. Some web spinners build their nests on the ground to catch walking insects and other arthropods. A retreat area may be placed just off the web in a crevice or rolled leaf, or on a twig. Species that burrow into the soil may situate nests under a log, a rock, or in a crevice. Jumping spiders, one of the largest families of spiders, do not make webs but actively hunt for prey.

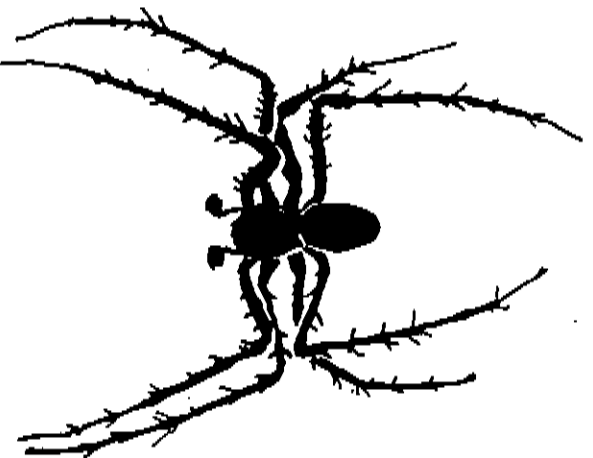


**Web builders:** All web builders have three claws at the end of each of their eight feet and can walk and run on their silken homes with ease. The many different types of webs range from orb webs to trapdoors.

**Orb web:** The best known and most admired web is the orb web. Frame threads anchor the web among vegetation. Radii run from the center of the web to the periphery like spokes in a wheel. After the frame and the radii are established, the spider constructs a temporary spiral in the web, starting at the hub. Then, the orb weaver builds a sticky silk spiral between the radii, starting at the periphery. While the spider fills the web with the sticky spiral, the temporary spiral is removed.

When insects fly into the web, they are stuck and captured by the spider. Many orb weavers wrap their prey in silk and consume it at a later time. Orb weavers replace their web once every twenty-four hours. They either work the day shift (and are considered diurnal) or the night shift (nocturnal). Thus, the same habitat and even the same web site may be used by different species of orb weavers.

**Cob web:** Cob web spiders build their irregular snares not only in the corners of houses but also outside among vegetation and rocks. Although cob webs are less elegant than orb webs, they serve their owners well. After insects entangle themselves in the threads, the cob web spider runs towards its prey and throws sticky silk onto it, without ever touching the insect. Once the prey is immobilized, the cob web spider bites the prey with its chelicerae and injects the poison. Cob web spiders are also called comb-footed spiders. The setae on their hind legs are serrated and form a comb, with which the spider pulls out the sticky silk.



**Funnel webs and Sheet webs:** Funnel web spiders build a horizontal triangular web that ends in a funnel shaped retreat. The common European house spider, found in many basements, is a funnel web spider. Sheet web spiders are small and rarely live in houses. They build a flat sheet web, with irregular threads above and below, under which they hang upside down. In the fall, a male and a female share a web to mate. Both funnel web and sheet web spiders are easily found in bushes around the school yard.

**Web-reductions:** Over thousands of years some spiders have reduced the size of their webs and consequently have changed their hunting behavior. Orb weavers may build only half a web. The Bolas spider uses a single thread of silk, equipped with a drop of sticky glue at its end, and swings its thread against flying insects.

**Hunters:** Many spiders do not build a web to capture prey. Although they produce silk, they use it for draglines, retreats, and egg sacs. Spiders have developed numerous different hunting techniques. Some wait where insects congregate, such as ant trails, and pounce on their prey. Others jump from leaf to leaf to catch insects. Some change color to match a specific flower and lie in wait until a bee arrives to gather nectar.

**Jumping spiders:** Jumping spiders have the best developed eyes among spiders and hunt by sight, pouncing on their prey with wide, precise jumps. Most of their courtship depends on visual stimuli as well.

- **Fishing spiders:** Several spider species hunt on the surface of the water, where they catch insects that have fallen onto the water, and also tadpoles and small fish that swim just below the surface. The vibrations of the water guide the spiders to their prey.

**Crab spiders:** Crab spiders are often green, yellow, or pink. They are 'sit-and-wait' predators that hunt on flowers and ambush their prey. They remain motionless on flowers, camouflaged in the vegetation by their matching coloration, with their enlarged and powerful front legs stretched out, ready to pounce.

**Wolf spiders:** Wolf spiders are a widely distributed spider family that hunts on the ground, in the litter, on the surface of the water, and in trees. Some wolf spiders dig deep, tube-like burrows in which they sit and wait for approaching insects.

**Tarantulas:** Many tarantulas are cursorial spiders that will catch whatever prey of appropriate size they can find. Some tarantulas live on trees; others live under stones and logs, hunting on the ground. Some types of tarantulas dig tube-like burrows that are covered by silken trapdoors.

**Sticky feet:** Many cursorial spiders, including tarantulas and jumping spiders, possess thick, iridescent brushes around their claws and under their tarsi, called claw tufts and scapulae. These brushes consist of numerous, specialized setae that allow a spider to cling safely even to very smooth surfaces, such as glass. They can run with great speed across the ceiling.

## HOW TO STAY ALIVE

Spiders have many enemies. Snakes, birds, toads, shrews, and insects all like to eat spiders. To reduce the risk of predation, many spiders have cryptic colorations of brown, tan, and black to blend in with their surroundings. In addition, they have developed behaviors that discourage predators. When frightened, many spiders will drop out of their web and “play dead.” A few rather poisonous spiders, such as the black widow, have warning coloration: strong contrasting colors of red and black. Some orb weavers have black and yellow patterns similar to wasps, which may act as a warning sign to would-be predators.

The eye arrangement of spiders allows them to see in all directions at one time and detect any suspicious movements. Spiders are best in reading vibration patterns of prey or of potential danger. Their trichobothria sense any air movements in the vicinity, which the spider’s brain analyzes to distinguish between rain, prey, mates, and predators, including larger animals who are just walking by (you, for example).

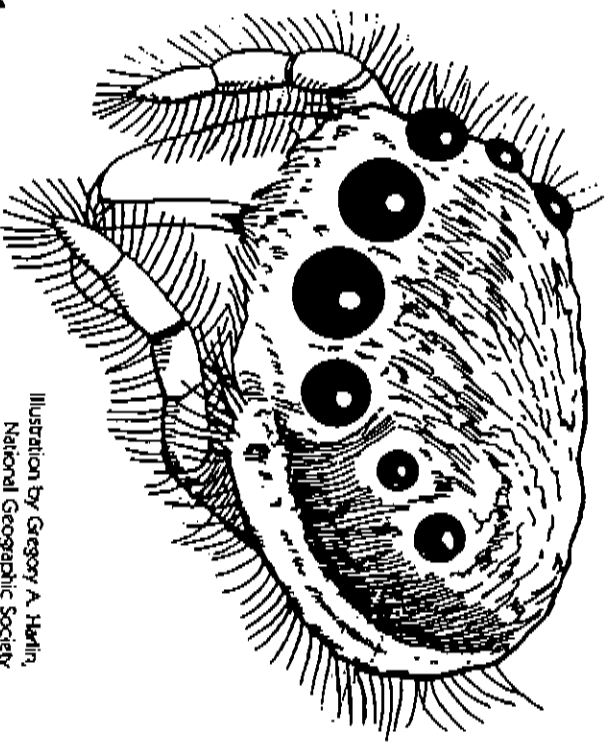


Illustration by Gregory A. Hartig,  
National Geographic Society

## EXTERNAL MORPHOLOGY

**Exoskeleton:** Unlike all vertebrates, who have their bones inside their bodies, all arthropods are invertebrates and are covered with a hard integument, the exoskeleton. Before you can eat shrimp, you peel away the exoskeleton. Several layers make up the exoskeleton of arthropods. The outer layer contains wax and functions like a waterproof raincoat. The inner layers are very tough. In crabs, they are hard and contain calcium much like our bones.

The strong outer covering protects the internal organs and serves as an anchor for the muscles that move the body (in humans, the muscles are anchored to the skeleton). The integument within each leg joint is flexible, enabling the arthropod to move its legs and other body parts. In spiders, the hind body part, the abdomen, is soft and expandable, which allows the spider to eat a lot at one time.



**Body parts:** A spider's body has two parts: the front (anterior) section, or prosoma, and the hind (posterior) part, or abdomen. In the prosoma, sometimes called the cephalothorax, the head (cephal) and the breast (thorax) are fused together, covered by a hard, molded plate called the carapace. The ventral (front) hard, plate-like cover of the prosoma is called the sternum. The prosoma and the abdomen are joined together by a narrow, flexible stalk, the pedicel, which allows the spider to move the abdomen in all directions, thus facilitating web construction.

**Eyes and organ placement:** The prosoma carries the eyes, the legs, the pedipalps (hand-like appendages), and mouth parts. The mouth parts include the chelicerae, with their fangs and opening of the poison gland. Surrounding the mouth opening are the maxillae, which are attached to the base of the pedipalps, and the labium, which is attached to the sternum. The prosoma contains the brain and stomach of the spider. The abdomen harbors the book lungs, heart, most parts of the digestive system, the gonads (ovaries or testes), and several different silk glands that open on the spinnerets at the end of the abdomen.

**Eyes:** Most spiders have eight eyes that are arranged in characteristic patterns over the head area of the prosoma. A spiderologist can often identify a spider by its eye pattern. Except for jumping spiders, spiders do not see very well, but are able to detect movements. In many spiders, the eyes are arranged in such a way that the spider can detect movement all around her without shifting her body.

**Legs:** All spiders have eight walking legs. A leg consists of seven distinct segments (coxa, trochanter, femur, patella, tibia, metatarsus, and tarsus). The tarsus carries at its end two or three claws. In many hunting (cursorial) spiders, the metatarsus and tarsus possess thick brushes of specialized setae, that allow the spider to cling to smooth surfaces.

A spider under attack can escape by deliberately breaking off her leg. A shut-off valve at the joint seals the wound. A young spider can usually regenerate the leg during later molting cycles.

**Pedipalps:** The spider uses its pedipalps like hands, utilizing them to clean and handle prey, to hold the egg sac, and to assist in making the web. Some spiders use them for communication. A male may wave his pedipalps and/or front legs towards a female during courtship. In adult males, the tarsus of the pedipalp is developed into a sexual organ.



Illustration by Bob McCleod,  
Maverick Entertainment Group, Inc.

**Chelicerae:** Two chelicerae are located right in front of the spider's mouth. They consist of two segments, with one being a movable, pointed fang with an opening of the poison duct. The spider pierces its prey with the fang and injects the poison. Nearly all spiders have poison glands.

A spider's chelicerae open up and down (as in tarantulas) or sideways (as in most spiders). The sideways movement produces a proportionately bigger gape, so that smaller spiders can catch insects that are relatively large compared to their own size. Tarantulas must be bigger in size to kill large prey because their jaws do not open as wide.

**Poison:** The spider's bite may cause pain, but in most cases, the venom is usually harmless. Avoid black widow spiders and brown recluse spiders in classroom and field study. Their venom can cause more adverse reactions in humans than other types of spider venom. Medical research using spider venom has yielded several chemicals that may be useful to control or treat diseases in people.

- **Spinnerets:** Most spiders have six moveable spinnerets; tarantulas have four. Each spinneret carries spigots, the openings for the silk glands. Spiders produce different types of silk for various purposes, such as constructing a catching snare or web, a retreat, an egg sac, and draglines.

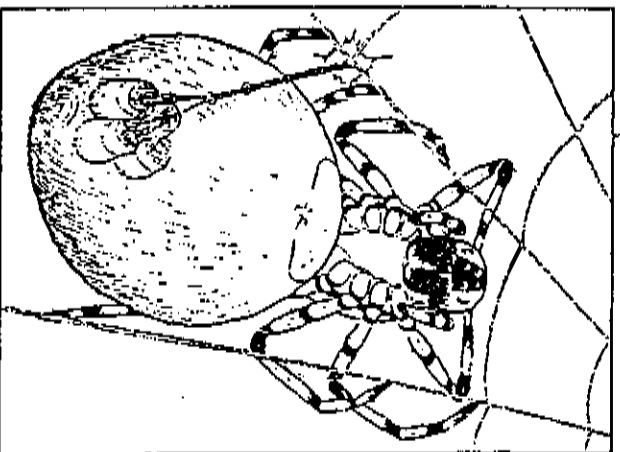


Illustration by Bob McCleod,  
Marvel Entertainment Group/Inc.

Some spiders have a special plate, called a cribellum, in front of their spinnerets. These spiders produce a special kind of sticky silk, called Velcro-style sticky silk, from the cribellum, which spins the extremely fine woolly silk from thousands of tiny spigots. The spider uses its hind legs to comb this woolly silk onto the strong stretchy threads. Velcro-style silk clings to anything, even glass, but the mechanism of this incredible apparatus is mysterious.

**Sexual organs:** The simple genital opening of males and females lies between the two slit-like openings of the book lungs. The external sexual organs are among the most complex organs in the entire animal kingdom. In fact, every one of the 34,000 species of spiders that have been identified so far can be recognized by the unique form of its sexual organs.

The sexual organs are fully developed once the spider reaches adulthood. The males carry their sexual organ at the end of their pedipalps. Spiders with thick, often darkened pedipalps can thus be recognized as males. The adult females have a set of ducts and sperm storage containers between their book lungs on the ventral side of their abdomen. The female sexual organ, the epigynum, is visible as a darkened spot.

## **INTERNAL MORPHOLOGY AND PHYSIOLOGY**

**Book lungs:** Many spiders have one pair of book lungs; some spiders (e.g., tarantulas) have two. The book lungs are located in the abdomen, with their slit-like openings on the ventral or underside of the spider.

**Tracheae:** Most spiders also have tracheae similar to insects. Tracheae are air-filled hollow tubes with many fine branches that bring air and oxygen to each organ. The opening to the tracheae is located in the front of the spinnerets and is very difficult to see.

Compared to insects, spiders run on a much less powerful "engine." While insects have as many as fourteen tracheae, spiders generally have only three openings. Spiders also have a much slower rate of gas exchange than insects, and consequently they have less ability to keep moving.

Spiders are sprinters, not marathoners. After only about ten to thirty seconds of movement, a spider slows down by half. Because she doesn't have a strong engine to deliver oxygen, her leg muscles run on anaerobic respiration, which produces lactic acid and causes muscles to slow down.

## **GROWING UP**

**Spiderlings:** In cooler climates, spiders may spend the winter as eggs, hatching with warmer weather in the spring. Other species hibernate as immatures. Just-hatched spiders, called spiderlings, look just like their parents and can build webs or hunt from their first day. They feed, grow, and molt until they reach adulthood. With the final molt, the sexual organs will be developed. Most spiders reach the natural end of their one- to two-year lifespan after reproduction. Only tarantulas are known to live for many years.

**Molting:** Since the exoskeleton is hard, it cannot grow with the spider. Spiders, as well as all other arthropods, shed their skins in order to grow. They molt periodically, including once within the egg sac. If a spider consumes a lot of food, it needs a short amount of time between each molt, sometimes just a few weeks. Shortly before the spider is ready to molt, it will stop feeding. Spiders either molt in retreats or suspended by a silk thread. It is very difficult to pull all those legs out of the tight old skin. Spines on the legs prevent them from slipping back into the skin. After the spider emerges from its old skin, it starts to move its legs to keep the joint membranes flexible. Often it drinks a lot of water as long as the new skin is still expandable. The skin will harden in a few hours. During molting, spiders are very vulnerable to predators.

**Growing up:** Most spiders molt eight to twelve times until they reach adulthood. With the final molt, their sexual organs are fully developed. The female will continue to feed, but many males give up hunting. They spend the rest of their natural lifespan in search of females to mate.

**Courtship and copulation:** Adult males spin small triangular webs on which they release a drop of semen. The sperm is taken up into the complex sexual organ at the end of the male's pedipalps. Males search for receptive females, often guided by pheromones (chemical 'messages') released by the female. Once a male encounters a female, he has to communicate to her that he is not her next meal, but a mate. During courtship, the male approaches the female or her web. He sends vibratory signals, such as pulling at the threads of her web or drumming on the substrate, or in some cases he transmits visual signals, such as waving his legs and pedipalps. The male awaits a species-typical answer before he proceeds to touch her legs and body. The male mounts the female in a species-typical fashion and inserts parts of his pedipalps into openings of the female's epigynum.

**Egg production and a mother's care:** After copulation, the female continues to hunt and feed. Despite legends to the contrary, female spiders rarely eat males after mating. (The male New Zealand 'katipo' black widow spider, however, ritualistically thrusts his abdomen between the female's outspread fangs and always dies in her embrace.)

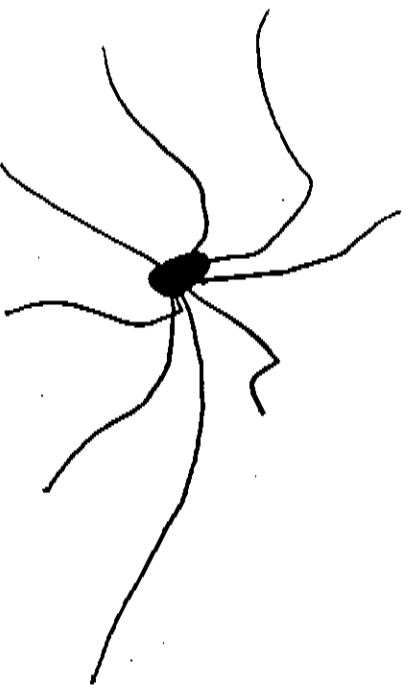
The female makes a silken egg sac and deposits hundreds of eggs in it. If insect prey is abundant and it is favorable weather, spider females make several egg sacs in one season. For most species, building a strong egg case is the extent of maternal care. Most spiderlings emerge from the egg cases completely on their own. A few mother spiders do take a greater interest in their offspring. They may carry the egg sac around or deposit it in a safe place, under bark or in crevices. Some guard the egg sac in their retreats. Wolf spiders carry the spiderlings on their abdomens. Cob web spiders may even feed their offspring, who live with their mother for a short period in the same web. The female regurgitates food droplets that the spiderlings take from their mother's mouth.

**Ballooning:** In certain species, the spiderlings may balloon. Spiderlings climb up bushes and tall grasses and release silk from their spinnerets. An uplifting current then carries them into the air. The so-called gossamer (floating silk in the air) seen in the fall are masses of ballooning spiders attached to their silk threads.

## RELATIVES

Spiders and their relatives are classified as arachnids. All arachnids have eight legs, a pair of pedipalps, and chelicerae. All arachnids, excluding mites, are carnivorous and terrestrial. Spiders are the best known members of the arachnids.

Harvestman or daddy-longlegs are common arachnids that are widely distributed throughout North America. They often occur in great numbers and are especially abundant in the fall. Some are scavengers; most harvestmen feed on a variety of invertebrates. They have short, round bodies, two eyes, and their head and thorax are joined with the abdomen.



Mites are usually very small. The numerous species of mites have adapted to every habitat and environment on earth—land, fresh water, and oceans. Ticks, blood-sucking mites, are among the largest mites. Many mites are parasites, living continuously on or in another animal's body. Numerous mite species are harmful to humans, because they may transmit diseases and damage crops and livestock. Others help decompose and recycle organic material. Mites are the only arachnids that have developed plant-eating forms, usually by sucking plant juices.

Pseudoscorpions are small (less than 2/5 inch or 5 mm), and only a few people ever see them. They live under bark, in soil, and in leaf litter. They do not have a slender tail or a poisonous stinger, and they are harmless to humans. All feed on the body juices of other invertebrates, primarily insects and mites. Many hitch rides on an insect, a traveling behavior called phoresy. Pseudoscorpions have pedipalps with two pincers; some have poison glands. Silk glands are located in their chelicerae. Pseudoscorpions use silk to build elaborate retreats. The book scorpion actually feeds on insects that destroy old books and bindings and is one of the larger pseudoscorpions.

Scorpions are among the largest living arachnids, reaching a length up to 7" (18 cm) in length. Scorpions are restricted to warmer climates (although one species is found in Alberta, Canada). Their ancestors were among the first animals to move from the water to the land during the Silurian period (435 million years ago). Their pedipalps carry crab-like claws with which they handle their prey. The tail is long and slender, equipped with a poison gland and a stinger at the end. Some scorpions, especially those living in deserts, may be quite poisonous. All scorpions give birth to living young that are carried by the female on her abdomen.

Wind-scorpions (solifugids) are very fast, in fact they—you guessed it—run like the wind. They have huge, forward-pointing chelicerae and are heavy eaters (some even consume lizards). They can be found in southwestern Canada but are especially abundant in Arizona and the Great Basin.

Vinegarroons are members of the whip-scorpions (Uropygi). Their pedipalps are modified to form a catching apparatus. The first pair of legs is modified into long, slender feelers, equipped with numerous sense organs. Their slender tails do not have poisonous stingers. When threatened, vinegarroons aim a vinegar scented mist at the aggressor. Vinegarroons and their relatives are found largely in warmer climates, including some parts of the southern United States.

Tailless whip scorpions are very similar in appearance to vinegarroons, except they lack the slender tail. They are common in Arizona and neighboring states.

## **SPIDERS AND PEOPLE**

As nature's very own insect population control system, spiders are very beneficial to us. By preying on insects, they help to keep the population growth of many insects in balance. Spiders consume great numbers of various insects, and studies are underway to use spiders as a biological insect control.

A number of spider species share our homes. Cob webs high up in corners testify to their presence. These common house spiders live with us because food is available, thus they rid our houses of insects. Every country has its own set of common house spiders. None of the more common North American house spiders is dangerous to humans.

**American house spider (Arachnaeranea tepidariorum):** This small spider belongs to the cob web family. We generally don't notice them until their webs attract dust and turn gray. Even these somewhat untidy webs do not pose any danger of disease, since spider webs are free of bacteria and germs.

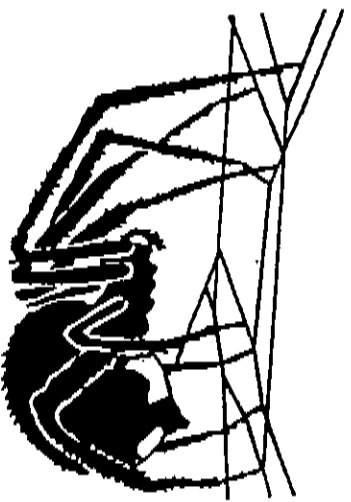
**Cellar spider (Pholcus phalangoides):** Found in basements, garages, and sheds, this long legged spider lives in irregular webs. The cellar spider shakes its web vigorously when disturbed.

**Jumping spiders:** The potted plants in your home are often inviting spots for these little tigers among the hunting spiders. In northern and temperate zones, a variety of small species works hard to rid your plants of insects. In warmer climates, jumping spiders may be quite large, and they search in other places of the house for food and water. Since their feet are equipped with scapulae, they stick to smooth surfaces and can easily enter your kitchen sink for a drink of water.

**Large basement spider:** The largest North American spider, *Dolomedes tenebrosus*, is a relative of the fishing spiders. The females are very large (1" or 2.54 cm in body length), whereas the males are small. The females prefer moist basements and never hunt in webs. Despite their size, they are harmless.

**Florida house spider:** These very large, brown hunting spiders search for cockroaches throughout the subtropical areas of the world. They are active only at night and hide at the slightest noise or light. Though these spiders are large, they are not known to harm people.

**Black widow spider:** A member of the cob web family, this spider rarely enters houses but is often attracted by garages, wood piles, and sheds. The fangs of the larger females can penetrate human skin. The black widow spider is not aggressive and only bites as a last resort in self-defense. They rarely leave their webs and move only clumsily on the ground. Black widow spiders are found throughout the United States and in southern Canada.



**Brown recluse spider:** Living in the Southwest, these spiders enter houses and live behind furniture. Bites occur when the spiders are disturbed while they rest among clothing and towels. Brown recluse spiders build flat, irregular sheets of webbing covered with fine, bluish silk.

All other spiders in the United States and Canada are harmless to humans.

Some people are afraid of spiders. In fact, only a handful of spider species are dangerous to humans. In North America, the black widow spider and the brown recluse spider are the most poisonous ones. Every year more people are harmed by stings and bites from insects than by all spider bites. If you are bitten by a spider, try to catch the spider and preserve it in rubbing alcohol, so the spider can be identified. Call the nearest poison control center if symptoms such as pain and redness at the bite area, nausea, cramping, or sweating occur.

Research on spiders often yields results beneficial to people. Silken threads of cob web spiders have been used in optical instruments. Spider venom may be a base product for the development of drugs and is used in pharmaceutical research. Spiders have also been used in scientific studies to see the effects of weightlessness in space or test substances such as caffeine.

## **FINDING SPIDERS**

Finding spiders 'in the field' requires an eye for detail. It is often easier to do after you have had some experience and know where to look. The best way to start is to find a friend who is interested in the natural world and take walks together with the specific aim of finding as many different spiders and other arthropods as possible. Make notes of where they are found, and the time of year and the day. You may also find assistance at your community's naturalist center or in a large park.

Spiders are seasonal and may be abundant at one time and completely absent at other times. Timing is therefore critical to success.

Walking field trips in the early fall are often very successful as most spiders are abundant and in the adult stage. Frost usually marks the end of all spiders. If trying to find spiders is too time consuming and frustrating, ask your students to bring in spiders from home or around the school grounds. Spiders are also available through commercial science supply stores, such as Carolina Biological Supply (telephone 1-800-334-5551).

**Habitat:** Spiders are found in the soil, beneath stones, in leaf litter, on flowers, in meadows and gardens, in basements and garages, and in bushes. Look particularly in corners and on branches or grasses that can support a web.

**Suggested tools:** To catch a spider safely, have the following: bulb baster loaded with cornstarch and a nylon stocking secured over the tip (to identify webs), forceps, small vials or glass jars, sweep net, and an aspirator.

Make sure that the spider can breathe by punching tiny holes in the lid (small enough so the spider cannot escape) or cover the lid with cheesecloth. A moist paper towel can provide enough water until the spider is transferred to an appropriate habitat. Do not place different species in the same container--spiders have been known to eat other spiders.



## SPIDER CONTAINER

Start with a wide-mouthed jar covered with a net held in place by several rubber bands, or a jar closed by a lid with small air holes punched in it.

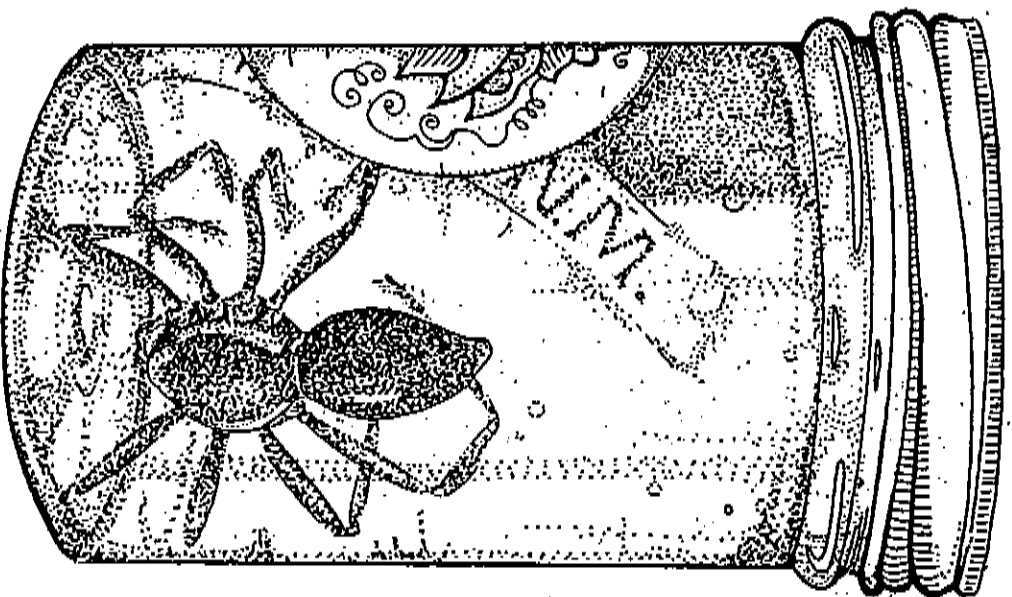
For ground nesting species of spiders, supply a cap filled with water, 1-2" of soil or sand in the bottom of the jar, and a broken flower pot or piece of bark for shelter. A crumpled piece of paper toweling can be used instead of soil for some species.

For web building species, provide a stick for the spider to secure its web. Stand the stick in modeling clay so it doesn't move around.

Provide adequate light and air. Make sure that the spider's container does not receive direct sunlight. Do not place the container under a heating/cooling vent because it will dry too quickly.

**Food:** Most spiders eat live insects. Many trap insects for food using a sticky web that can be a beautiful spiral or an apparently unorganized mass of threads. Provide food for the spiders by trapping flies or other insects and releasing them into the container. Insects used for food must be alive and not dramatically bigger than the spider. Feeding a 2" long grasshopper to a 1/2" spider will only destroy the spider's web and traumatize both animals. Spiders will not accept dead insects; they inject enzymes into live prey that liquify the tissue. Providing an insect once a week should be sufficient, but you can offer insect prey more often to determine the dietary needs of spiders.

**Water:** Spiders generally obtain all the water they need from the insects they eat, but spiders in captivity do need additional water. For ground nesting species, supply a cap filled with water. If the spider is smaller than the cap, add rocks to the cap so the spider does not drown. For spiders that have spun a web, gently mist the web every week, depending on the level of humidity in the container. The spider will gather water off of the web. An alternative for both types of spiders is to place a wet cotton ball in the container.



## **TAKING CARE**

**Cleaning:** Remove dead insects at the bottom of the container. Use long forceps to disturb the spider and its home as little as possible. If the spider droppings cover the glass, clean them off with a wet paper towel. Make sure that the water cup does not become slimy or remain dirty. Rinsing out the water dish once a week is sufficient. If a paper toweling is used, replace it periodically when it becomes soiled.

**Handling:** Most species of spiders are delicate. Do not pick them up with your fingers as they will often lose legs in the process. If dropped, the abdomen usually bursts, and the spider dies. Spiders can run rapidly. Chilling them briefly in a refrigerator prior to moving them may be helpful.

**Raising young:** Sometimes female spiders will lay egg sacs in the container. In most species the egg sac is closely guarded by the female. Continue to care for the female as usual, but take care not to feed her insects that will break up the web and endanger the egg sac. Tiny spiderlings will emerge from the egg sac after a period of time. If the holes in the lid are too large, they may find their way out. To prevent this, cover the top of the container with a piece of nylon stocking held in place with a rubber band. If there is enough space, the spiderlings will set up small webs in the container. They will feed on each other if additional prey is not provided. If the spiders are local, you can remove and release them outside. If they are not, you can set them up in other containers.

**Precautions:** Most spiders are harmless to people. Some of the larger species may be able to bite through skin, but most cannot. The bite of a few spiders (including the black widow spider and the brown recluse spider) can inject harmful venom. Do not keep these spiders in the classroom. If you are keeping a tarantula, be aware that it has urticating hairs, which can be irritable. If the tarantula is bored, it will brush off these hairs on a regular basis, leaving bare spots on its vulnerable abdomen. A tarantula will lay on its back while molting.

**Special considerations:** Spiders are fun to watch. Their webs are intricate and fascinating. Many spiders destroy and replace their webs regularly and the process can be fascinating to watch. Some spiders make a refuge of silk into which they retreat. Spiders often wrap their prey in a thick coat of silk.

Before you begin the classroom project, inform your principal, other teachers, and custodians that you will be using live spiders in the classroom. Communication with the custodian is particularly important so that toxic chemicals are not used around the room or outside areas.

It is not recommended that spiders be sent home with the students without prior communication with their parents. Also, if students bring in spiders from home, parents should be notified of the proper collection, care, and transportation of these fragile animals.

Make sure that the spiders have proper care during school vacations. If you leave the spider at the school, the temperature in the building should not be too hot or cold. Spiders should not be affected by your absence over short weekends.

Spider deaths are unavoidable. Some spiders will die from improper care or old age. Some may be difficult to maintain outside their natural habitat.

If you want to release the spiders outside after your classroom observation is complete, make sure that they are local and are returned to their natural habitat. Do not release them outside if you ordered them from a supply house. Releasing animals to an area can be detrimental to the surrounding space. Instead, pass them on to another interested teacher, parent, or naturalist center. If you cannot find someone who is willing to assume responsibility for the spiders, keep them as preserved specimens for future use in the classroom. You can kill all spiders by placing them in the freezer for an extended period of time.

## **SPECIMENS AND SLIDES**

- **Care of specimens:** Preserved specimens can be purchased from scientific supply companies such as Carolina Biological Supply. These specimens are usually preserved in rubbing alcohol which makes the specimens brittle. Purchased specimens should be transferred into glass tubes containing a solution of 70% ethanol. For identification labels, write the name of the specimen on a small piece of paper in water-proof ink and add the paper to the specimen bottle. Always return specimens and labels to the correct container. Only teachers should handle and present the preserved spiders.

Use Petri dishes to present preserved spiders. Fill the bottom of the Petri dishes with 70 percent alcohol and place the spider in it. Handle the specimens gently using forceps. The specimen should be completely submerged. Otherwise, there will be too many reflections to see details properly.

Gently arrange the spider's legs stretched out. Study the preserved specimens either with magnifying lenses or position them under dissecting microscopes. Make sure the specimen is well illuminated. Select the required magnification and focus the microscope prior to classroom use. The specimens can be set up early in the Petri dish if the dish is kept covered with its lid. Remove the lid only when it is time to view the specimen. This prevents fumes and the formation of vapor. Return the specimens to their own containers as soon as you are finished with them.

**Safety note:** The spider specimens are preserved in ethyl alcohol (ethanol), which also contains small amounts of methanol and ipso-propyl alcohol. The fluid is flammable and toxic when swallowed.

Keep the spider specimens and alcohol away from sparks, heat, or open flame, and use with adequate ventilation. Store in tightly closed containers and keep out of the reach of children. Students need to be supervised at all times while preserved specimens are in the classroom.

**Care of microscope slides:** Microscope slides with spider specimens can also be purchased from scientific supply companies such as Carolina Biologics. These slides are meant to be used under a dissecting scope or with a magnifying lens. Compound microscopes are not suitable for these slides. Touch the glass slides only at the rim. Avoid dust, fluids, and scratches. Teachers should consider setting the slides in place under the microscope to avoid rough treatment that may crack the slide. Polish the slides gently with a soft, lint-free cloth or lens paper.

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# GLOSSARY

The Glossary is divided into three parts: General Terms, the Book of Spider Records and the Alphabetical Glossary.

Terms defined in all three parts of the Glossary are preceded by an \*.

## GENERAL TERMS

**ventral**—Belly side, underside of an animal.

**dorsal**—Opposite of ventral side, upper side of an animal, in \*vertebrates towards the spinal cord.

**anterior**—Towards the head region of an animal.

**posterior**—Towards the hind end of an animal.

**carnivorous**—Meat eating animals, all \*arachnids except \*mites, are exclusively carnivorous.

**morphology**—The features comprised in the form and structure of an organism, e.g. the morphology of spiders.

## BOOK OF SPIDER RECORDS

**bites**—Only larger spiders are able to penetrate human skin. Venom of most spiders is not poisonous to humans. The large \*tarantulas actually have rather small \*poison glands and small quantities of poison, although their bite would be felt. Far more people die each year from bee or wasp stings than from spider bites, (see also \*poisonous spiders in Records).

**ballooning**—Aerial dispersal by small spiders and spiderlings of many species, releasing silk strands from spinnerets, using uplifting air currents for transportation over great distances.

**diving**—Performed by \*fishing spiders that climb down logs or rocks and hide under water to avoid \*predation. Fishing spiders can stay under water for up to 40 minutes (see \*diving).

**fasten your seat belt**—All activities of spiders are performed while securely attached to a \*dragline.

**fatigue**—Some spiders can run very fast (see \*running speed in records) but are exhausted after only 30 seconds of running.

**jumping abilities of jumping spiders**—20 times its own body length. A six foot tall person (1.80 meters) would have to leap over more than 40 yards (36 meters).

**Killing males**—Some, but by far not all, spider females kill their mates after copulation. The remaining natural life span of an adult male is very short. Often adult males do not capture prey once they reach adulthood. In some species, e.g., the black widow spider, the female bites the male prior to copulation. Without this bite, the male is unable to copulate. (This is an opportunity to discuss spider behavior and anthropocentric viewpoint!).

**largest spider**—Body length approximately 3.5" (up to 9 cm). A \*tarantula from the Amazon basin (South America). In the U.S.: female *Dolomedes tenebrosus* (family of \*nursery web spiders), often occurring in basements.

**life span**—Usually one to two years. Spiders hibernate as juveniles in crevices and under logs and rocks. Spiders life span ends after reproduction. Exception: female \*tarantulas can live up to 30 years.

**non-slip feet**—Spiders, whose legs are equipped with \*claw tufts, can run on smooth surfaces, even glass. Spiders seen running across the ceiling are using their claw tufts.

**poisonous spiders**—In the U.S.: \*black widow spider and \*brown recluse spider. In South America: Phoneutria; In Australia: Atrax.

**recycling**—In numerous spider groups, especially many orb web spiders. The web is taken down after a certain period or after damage and rebuilt. The web material is eaten by the spider. Considerable amounts of the protein are presumably not digested in the normal way, but reappear after only 30 minutes in newly produced silk and thus are truly recycled.

**relatives of spiders**—Other animals grouped in the class \*Chelicerata: these are \*scorpions, \*pseudoscorpions, \*vinegarroones, \*mites, \*opiliones (harvest men), \*solifuges (wind scorpions).

**running speed**—Some spiders can cover up to 330 times their own body length in 10 seconds. A half inch spider (a little over 10 mm in length) would cover a distance of 4 1/2 yards (about 4 meters) in 10 seconds. The maximum speed of a human is roughly 50 times his/her body length in 10 seconds. A six foot tall person (1.80 m) may be able to cover a distance of 10 yards (91 meters) in 10 seconds, but would out compete the spider only if he/ she could cover 660 yards (for 603 meters) in ten seconds.

**silk strand strength**—A steel thread of same thickness would be only 1/3 as strong. Communal webs, built by many African \*Nephila females living together, are used by some native African people as fishing nets.

**smallest spiders**—Astonishingly, there is a great diversity of several hundred different species of dwarf spiders (belonging to various spider families) in North America alone. As adults, most of them are less than (0.1") 2 mm long, some less than 1 mm. They are abundant in, but not restricted to, the leaf litter.

**stealing**—Certain spiders (e.g. Argvrodes, called a kleptoparasite) and some insects steal food out of webs of spiders.

## ALPHABETICAL GLOSSARY

**abdomen**—Hind body part of spider, carries spinnerets at its end.

**adult spider**—Animal after its final molt, with sexual organs fully developed in both sexes (\*epigynum, \*genital bulb).

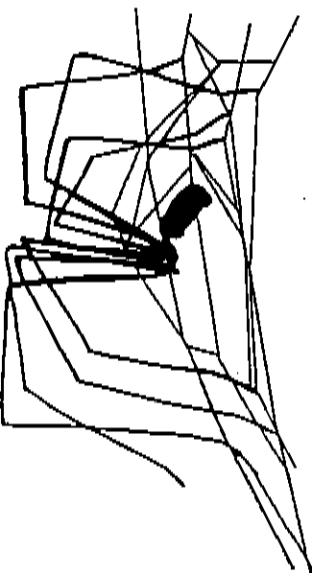
**Arachne**—Greek mythological figure who challenged the goddess Athena to a weaving contest. Athena transformed the dying Arachne into a spider (name

\*Arachnida derived from Arachne).

**arachnids**—Subclass Arachnida, includes spiders and their kin (see relatives in Records).

**building time for orb-webs**—About an hour or less (20 minutes for the \*sticky spiral).

**Araneidae**—Family of \*orb web spiders with many common species, \*garden spider.



**araneomorph spiders**—True spiders, vast majority of spiders, around 34,000 species, \*position of fangs: labidognath, \*life span: one to a few years; See \*mygalomorph spiders.

**Arachnida**—Spiders and their \*relatives. (see Book of Spider Records, p. 80).

**arboreal spiders**—Spiders living on trees and in the canopy.

**arthropods**—The Phylum Arthropoda contains all animals without a back bone that possess a hard outer exoskeleton and articulated legs, consisting of joints and segments. Crustaceans (crabs and shrimps), isopods (wood lice), insects, arachnids, centipedes and millipedes are all arthropods.

**ballooning**—See Book of Spider Records, p. 80.

**black widow spider**—Poisonous cob web spider, family Theridiidae (\*comb-footed spiders), usually non-aggressive. Only the larger and/or adult females are dangerous to humans. Black widow spiders are common all over the US and southern Canada.



**body parts**—Spiders have two body parts, front body part: \*prosoma or \*cephalothorax, and hind body part: \*abdomen.

**Bolas spider**—Member of the family \*Araneidae (orb web spiders); web reduced to one thread equipped with a drop of glue at its end, which the spider huris towards its prey.

**book lungs**—One (rarely two) pair of lungs on the ventral side of abdomen, numerous thin leaflets for gas exchange, \*inside gills.\*

**brown recluse spider**—Poisonous spider, wounds heal very slowly, occurs southern and western U.S.

**calamistrum**—Comb of curved spines on hindlegs (\*metatarsus) of spiders that possesses a specialized spinning field, the \*cribellum. The \*ogre-faced spider has a \*cribellum.

**carapace**—hard shell in one piece covering the dorsal side of the \*prosoma.

**cephalothorax**—See \*prosoma. Cephal=head, thorax=upper body (rib cage in vertebrates).

**chelicerae**—One pair in front of mouth, also called jaws, pincers—like mouth parts of spiders, consist of moveable base segment and moveable fang with poison gland opening near its tip, see \*position of fangs.

**Chelicerata**—All \*arachnids, the horse-shoe crab, and \*sea spiders are classified as the Class Chelicerata.

**circulatory system**—Open instead of closed (as in vertebrates), consists of \*heart, some major blood vessels, and open sinuses (no capillaries).

**claws**—Two or three claws, armed with teeth, at the tip of each walking leg, see \*claw tufts.

**claw tufts**—Bunches of setae at tips of legs, occur in about 50% of all spiders; setae have special adhesive properties enabling spiders to walk on smooth vertical surfaces, and also upside down across horizontal surfaces (even glass).

**cob web**—Irregular meshwork of silk threads, built by \*comb-footed spiders (family Theridiidae). The common American House spider makes cob webs in corners and ceiling of rooms and basements.

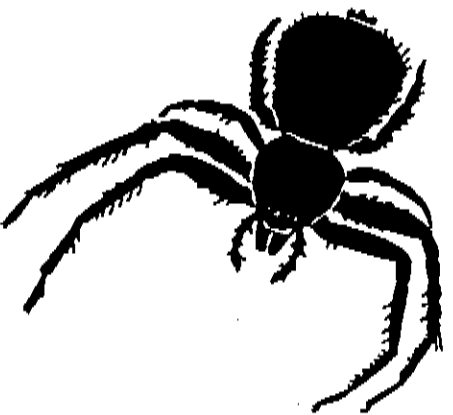
**cob web spiders**—Family of \*comb-footed spiders. Examples: common American house spider, black widow spider.

**cocoon**—See \*egg sac.

**coloration**—Either coloration of body integument, guanine (whitish), silver, gray to black pigment shining through integument and/or differently colored setae (scale-like, white, black, iridescent (\*jumping spiders).

**comb-footed spiders**—Spider family Theridiidae with many species. American house spider and black widow spiders. Name derived from specialized setae forming a comb at terminal segment (tarsus) of fourth leg.

**courtship**—Performed in some form by all spiders in order to ensure that conspecific male and female recognize each other and mate. Females show species-typical response. Web-building spiders: courtship consists of vibratory signals, e.g., pulling at threads of female's web, trembling abdomen. \*Cursorial spiders: pedipalps and front legs drumming on substrate. \*Jumping spiders and \*wolf spiders: visual signals such as waving of front legs and pedipalps. In general, courtship proceeds to touching female's legs and finally mounting female to insert part of \*genital bulb for sperm transfer into female \*epigynum.



**crab spiders**—Family Thomisidae (\*cursorial spiders). First pair of legs is long and powerful; spiders are ambush hunters who often wait on flowers for \*prey. Some species take yellow, pink, green, or whitish coloration of flower.

**cribellum**—Spinning plate, occurs in one fourth of all spiders. Thousands of spigots produce an incredibly fine, bluish silk, which is pulled out by the \*calamistrum, a row of curved spines on the hind legs. Insects entangle themselves in the fine velcro-like silk.

**cursorial spiders**—Build no webs for prey capture, but hunt for \*prey on vegetation or the ground (e.g., \*wolf spiders, \*jumping spiders, \*nurseweb spiders, \*fishing spiders). Some hunt by wandering around, but many are ambush hunters that lay in wait for their prey (e.g., \*crab spiders).

**daddy-longlegs**—Spider relatives with body in one piece. Conspicuous ones often with very thin, long legs. Approximately 200 species in North America; also called harvestman (Opiliones).

**daddy-longleg spider**—Common term for spiders of the family Pholcidae, very common in basements; also called cellar spider.

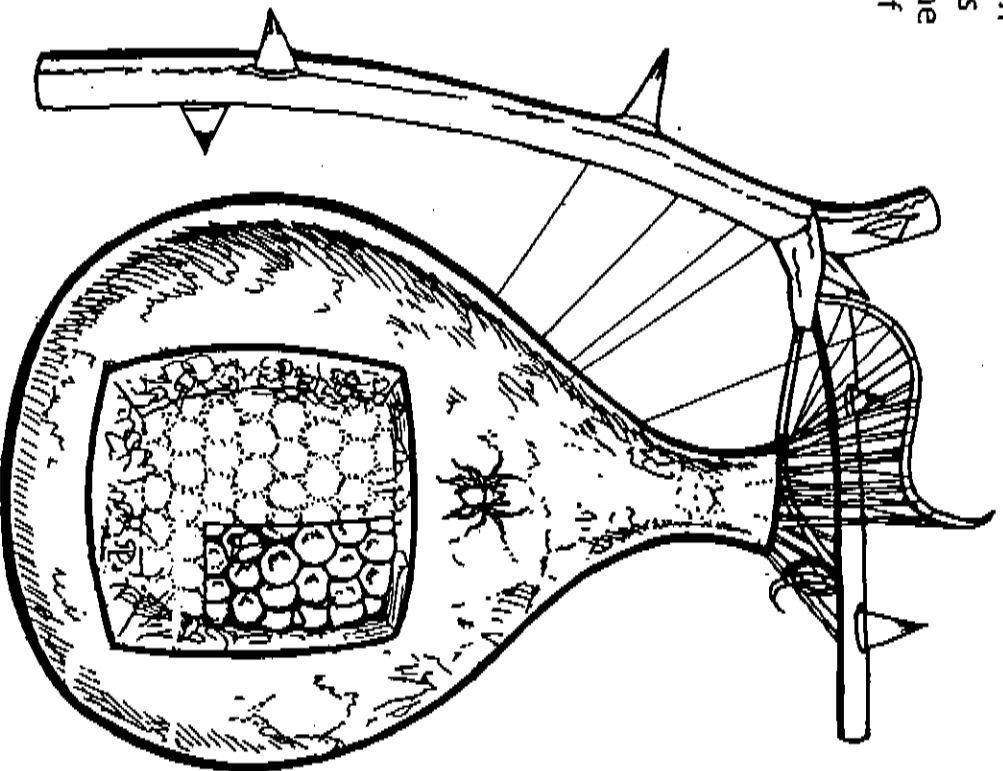
**digestion**—Spiders spit digestive enzymes on/ in prey to liquefy tissue. They then suck this liquid in together with the prey's body fluids; see \*stomach.

**diving**—Performed by \*fishing spiders that climb down logs or rocks and hide underwater to avoid \*predation. Only the European \*water spider *Argyroneta* can dive and swim freely under water. Spiders of both groups take an air supply with them while submerged. The air is trapped in the fine setae on their abdomen. Fishing spiders can stay under water for about 35 minutes.

**diving bell**—Built by the European *Argyroneta* ("water spider") under water, silk threads loosely woven together with water plants trap air bubbles brought down by the spider, used as retreat for eating, mating, and egg laying.

**dragline**—Silk line released while walking and climbing, fastened to substrate at regular intervals as a safety line or to retrace a path.

**egg sac**—Silken container produced by female to protect the eggs; also called cocoon or egg case, many egg sacs are ball-shaped round, some have a seam and consist of two disks. A few have a specialized forms.



**enemies**—See \*predation. Predators are toads, snakes, birds, and shrews. Spiders of the family Mimetidae hunt only other spiders. Parasites: several wasp families hunt spiders as food for their young. Pompilid wasps and \*mud daubers deposit eggs on spiders. Flies parasitize spider's egg sacs. Stealing of prey: wasps and other spiders of the genus *Argyrodes* (\*cob web spider).

**epigynum**—Female genitalia located ventrally in the middle of the abdomen, consist of spermatheca for sperm storage and ducts.

**exoskeleton**—Hard outer covering of \*arthropod body, consists of chitin; see also \*molting, \*integument.

**eyes**—Usually eight; in some spiders reduced to six, four, two or none (spider living in leaf litter); usually in two to three rows in the head region; in \*tarantulas often on dorsal, median tubercle.

**fangs**—End segments of \*chelicerae; carry openings of \*poison glands.

**female spider**—Often larger than male; adult female possesses an \*epigynum.

**fishing spider**—Large spiders (20mm), worldwide in distribution. Several species live in the U.S. Spiders hunt on the surface of the water, catch the insects that have fallen onto the water surface; also feed on small fish and tadpoles; can climb under water (\*diving); genus *Dolomedes*, largest *Dolomedes* species, can live in basements in the U.S. and belong to the family of \*nursery web spiders.

**flying**—See \*ballooning in Book of Spider Records, p. 80.

**garden spider**—*Araneus diadematus*, \*orb-web spider of the family \*Araneidae.

**genital bulb**—Male genital organs to store sperm and transfer sperm to female, located at end segment of pedipalp in adult males.

**heart**—Longitudinal in shape with several openings, in dorsal part of abdomen.

**"hairs"**—See \*setae.

**harvestman**—See \*daddy-longlegs; occur in great numbers at the time of harvest.

**hearing**—Long, thin erect setae (\*trichobothria) are located on legs. Each trichobothrium is connected to a nerve ending. Bending of trichobothria through air currents results in nerve impulses.

**hibernation**—Depends on climate. Spider species living in Canada may hibernate twice as juveniles before becoming adults. Same species may only hibernate once in Virginia and never in Florida, thus resulting in a shorter life span.

**horseshoe crab**—Not a crustacean (crabs and shrimps), but a marine \*arachnid relative. Considered a living fossil. Tail does not contain poison, but is used for turning when flipped over. One species occurs at US east coast (Maine to West Indies). Their enormous amounts of eggs, placed in nests in very shallow water, are an important nutritious food for many thousands of migrating birds that rest and feast along US east coast; see \*Chelicerata.

**hub**—Center of the orb-web. There are various types of hubs: open (silk removed), containing only \*radii, containing spiral threads. Some orb weavers may rest in hub. Other orb web species hide in a retreat and hold onto a signal thread connected to the hub.

**hunting**—Various strategies. Web spiders: type of web, mesh-size, strength, and position of web determines \*prey items. \*Cursorial spiders: often specialized to hunt on the ground, within the soil or litter (litter faunal), among vegetation and on trees (\*arboreal spiders). Ambush predators: lay in wait.

**integument**—Hard skin or body covering, functions as an \*exoskeleton; must be shed for the animal to grow (\*molting).

**invertebrates**—Animals without a backbone. The majority of animals living on earth are invertebrates. Their diversity is far greater than those of vertebrates. 30% of all living animals are beetles.

**jaws**—See \*chelicerae.

**jumping spiders**—Family

Salticidae (\*cursorial spiders).

Capture \*prey by jumping.

Have excellent \*vision, best eyesight of spiders, recognize

colors and clear images; see

\*jumping in Book of Spider Records, p. 80.

**labium**—Lower lip in spiders.

Small rectangular sclerite

attached to \*sternum. Flip the spider upside down to see it.



**legs**—Eight jointed walking legs consisting of seven segments (coxa, trochanter, femur, patella, tibia, metatarsus, and tarsus). Tips of tarsi equipped with two or three \*claws and sometimes with \*claw tufts and \*scopulae; lost legs are sometimes regenerated in subsequent molts.

**male spider**—Often smaller than female, carries sexual organ (\*genital bulb) after final molt. When adult, often stops hunting and searches exclusively for females. Males are rarely sometimes eaten by females after mating, although it does occur regularly in some spider species. If male is attacked by female before mating, she mistook him for prey.

**marine spiders**—Family Desidae, consists of a few species, distributed worldwide in subtropical and tropical regions, restricted to rocky shores; survives high tide in air chambers in empty sea shells and barnacles; hunts during low tide.

**mating**—Mounting of the male onto female after \*courtship; male inserts syringe needle-like structure of his \*genital bulb into opening in the female's \*epigynum and transfers the sperm. Several different mating positions occur.

**maxillae**—Attached to base of pedipalps and located on both sides of the \*labium. Flip the spider over to see them.

- mites**—Acarina; diverse and species rich. Many mites are parasites on and in animals (e.g., ticks) and plants (ecto- and endoparasites). Mites have modified mouthparts that can bite, suck, or chew, depending on species. Many mites carry diseases and are harmful to man and damage livestock and crops.

**molting**—All arthropods shed their hard \*exoskeleton periodically in order to grow. Most spiders become \*adult after eight to twelve molts. During molting spiders are very vulnerable to predation. Spiders perform leg gymnastics (bending and stretching of legs) after molting to keep joints moveable; also see \*spines. Once adult, spiders will not molt again (exception: tarantulas).

**money spider**—Family Linyphiidae, small sheet web builders.

**motherhood**—See \*parental care.

**mouth**—Located behind \*chelicerae. Very narrow opening, only liquefied tissue and body fluids of prey can be sucked in.

**mud daubers**—Predatory wasp. Hunts spiders and paralyzes them. Places eggs on living spider and encloses spider in mud nests built by wasp. Hatching wasp larvae then feed on the still living spider.

**mygalomorph spiders**—Often called \*tarantulas or bird spiders. \*Position of fangs: orthognath; live up to 30 years; about 100 species in North America (see \*araneomorph spiders).

**Nephila**—Golden-silk spider: family Tetragnathidae; builds orbwebs; produces reflecting (hence "golden") and strong silk threads.

**nursery web spider**—Family Pisauridae; female builds a nursery web for hatching spiderlings.

**ogre-faced spider**—Family Deinopidae, occurs in Florida and other subtropical and tropical countries; builds specialized web that is held stretched between the front legs and thrown over the prey like a casting net.

**opliiones**—See daddy-longlegs.

**orb web**—Resembles a wagon wheel. Web consists of frame threads, radii (\*radius) (\*spokes of the wheel) and a spiral of sticky threads to capture prey. Center of the "wheel" is called a "hub which is surrounded by a free zone that contains no sticky spiral, allowing the spider to cross from one side of web to other. Several spider families build orb webs.

**orb web spiders**—Several different spider families, largest family: \*Araneidae with numerous species nocturnal and diurnal; webs often built only for one day or one night. The silk is then eaten by the spider when the web is taken down, see \*recycling. Common U.S. garden spiders are generally orb web spiders.

**palps**—See \*pedipalps.

**parasites**—Ischneumon fly, eggs laid on living, active spider; grub feeds on spider, other species also parasitize egg sacs. Numerous parasites prey on spiders (e.g., nematomorpha worms) and spider eggs (e.g., flies); see \*enemies.

**parental care**—Protection of eggs and care of spiderlings is provided by the female. Spiders care for eggs: production of egg sac, carried attached to spinnerets (\*wolf spiders) or in chelicerae (\*nursery web spiders). Some spiders guard the egg sac. Certain spiders provide care for spiderlings: \*nursery web; spiderlings are carried on back of \*abdomen (\*wolf spiders); spiderlings are fed by mouth (\*comb-footed spiders); spiderlings devour mother (\*Eresidae).

**pedicel**—A spider's waistline.

**pedipalps**—First pair of appendages at prosoma, shorter than walking legs, used for prey, handling, cleaning, etc. Site of sexual organ in adult male spiders (\*genital bulb).

**pheromones**—Any chemical released and used for communication between animals, especially important for sexual behavior.

**phoresy**—Animals that hitch a ride on other animals perform phoresy.

**poison**—See \*venom poison glands—Usually within the prosoma; in tarantulas restricted to base segment of \*chelicerae, Opening of poison gland at tip of fangs. All spiders possess poison glands except for the family \*Uloboridae.

**pompilid wasps**—Hunt spiders, paralyze them, and lay eggs on living spiders, the which will serve as food for wasp off-spring.

**position of fangs**—Pointing down: orthognath position. Occurs in all tarantulas and relatives (see \*mygalomorph spiders). Pointing inward and moving sideways: labidognath position. Occurs in most spiders (all \*aranemorph or true spiders).

**predators**—Toads, frogs, lizards, snakes, birds, \*pompilid wasps; see also \*parasites.

**prey**—Consists nearly exclusively of live insects. Some spiders may occasionally catch fish and tadpoles (water spiders). Large tarantulas may catch birds or mice occasionally. Most spiders are not specialized on any particular prey group among insects and catch any live insect of appropriate size. exception: family Mimetidae is specialized on spiders; family Dysderidae is specialized on wood lice. Many spiders have problems with the formic acid of ants.



**prosoma**—Front body part, consists of head and thorax region joined together; carries chelicerae, pedipalps, and legs; also called: \*cephalothorax.

**pseudoscorpions**—Common and small; many live in leaf litter. Common house pseudoscorpions feeds on moths and other house insects; about 200 species in North America.

**pycnogonids**—See \*sea spider.

**radii (singular: radius)**—Radial threads attached to the outer frame threads and converge in the \*hub, thus forming the \*spokes of the \*orb web. The number of radii is often characteristic of specific species.

**raft spider**—See \*fishing spider.

**retreat**—Built in all thinkable places, but often location is species-typical. Retreats on trees, under logs and rocks, in crevices, within the vegetation under leaves and debris attached to each other by silk threads. In web spiders: retreat and web connected by signal thread on to which the spider holds. Specialized retreat: the \*diving bell built by the European water spider. Numerous types of silklined tubes and borrows in the soil are constructed.



**resting**—Often in \*retreat. Spiders either nocturnal (resting during the day, active at night) or diurnal (resting during the night, active at day). When seen in the \*resting position\*, spiders are actually often hunting, e.g., remaining motionless at center of \*hub; in \*retreat but hanging on to \*signal thread; on the surface of the water (\*fishing spider).

**scopulae**—Thick brushes of specialized setae on the underside of tips of legs, the tarsi and metatarsi. Enable a spider to cling to smooth surfaces, even walking over a vertical glass surface or across the ceiling.

**scorpions**—An \*arachnid and spider relative. Pedipalps carry large pincers, tail carries poison spine. All scorpions give birth to living young, which are carried on female's back.

**sea spiders**—Strange marine creatures that are not spiders; may belong to the class \*Chelicerata.

**senses**—\*smell, \*taste, \*hearing with specialized setae called \*trichobothria, \*eyesight often poor (exception \*jumping spiders). \*Vibration sensation is the best developed sense in spiders; is their main method of recognizing the environment (e.g., prey, mate, etc.).

**setae**—Often numerous, covering spider body and legs at varying densities; may be colored, iridescent (\*jumping spiders). Serve numerous functions in various spider groups. Spiders have different types of tactile setae to sense vibrations and sound (e.g., long, thin setae = trichobothria; see \*hearing). Taste setae are on tips of legs. Urticating setae in tarantulas are used for defense. Serrated bristles in \*comb-footed spiders draw out sticky silk. Plumose setae in \*fishing spiders trap around abdomen (see \*diving). See also \*claw tufts.

**Shamrock spider (Araneus trifolium)**—Large orb web weaving spider, family Araneidae, widespread in the U.S.

**signal thread**—Silk line connecting spider in retreat and center of hub. Enables the spider to monitor vibrations of the web while remaining in the retreat.

**silk**—Produced by \*silk glands, released through \*spinnerets, consists of protein. Liquid within the spigots of spinnerets turns into solid strands by the mechanical force of pulling. Different types of silk are used for or during various activities (see \*dragline, \*egg sac, \*web, \*retreat, \*mating, also see \*recycling and \*silk strand strength in Book of Spider Records).

**silk glands**—Up to six different types of silk glands are located in the hind end of the abdomen. Silk is released through \*spinnerets.

**silk use**—Capture webs and \*trip wires, \*wrapping prey, retreats, draglines, mating webs, egg sacs, and nursery webs.

**smell**—Spiders can smell with tiny holes in front feet.

**soilfuges**—Wind scorpions; 120 species in North America, reach north to Canada, abundant in Arizona and the Great Basin.

**species**—About 34,000 species of spiders known so far worldwide in a little over 100 families. Presumably many more species are undiscovered.

**spermatophore**—Container with sperm, both produced by the male.

**spiderlings**—Very young spiders, when they hatch from the "egg sac.

**spines**—Strong, black, stout quills, especially on legs of many spiders. Prevent legs from slipping back into old skin during "mouling.

**spinnerets**—Located at end of abdomen, usually six present, highly moveable. Spinnerets carry spigots, which are the openings of the silk ducts of the "silk glands. Spiders have different spigots for different types of silk glands. In some spiders there is an additional spinning plate ("cribellum).

**spitting spider**—Family Scytodidae. Have a large, vaulted prosoma containing modified poison glands that produces a sticky substance which glues prey to the ground or substrate.

**stabilimentum**—Silken zigzag bands added to the radii close to the hub; function unknown; occurs in "orb webs of certain "Araneidae.

**sternum**—Hard piece of integument covering the ventral side of the prosoma.

**sticky spiral**—Dense spiral of silk threads carrying glue droplets, laid down from the web's periphery towards the "hub at the same time that the "temporary spiral is removed by spider. Sticky spiral often contains often many turning points, making it a time-consuming part of the web to build.

**stomach**—Located in prosoma, acts as a sucking pump. Special muscle arrangement around stomach allow digestive enzymes to be pressed out and liquefied tissue to be sucked in (see "digestion).

**swimming**—Only the European water spider *Agryroneta* can swim freely underwater.

**tarantula**—Name used in the Americas; also called bird spider; in Africa termed baboon spider). Very "hairy", often large "mygalomorphs, living for up to 30 years. Name "tarantula" originally used for large Italian "wolf spider ("araneomorph spider) occurring around the city of Taranto. Bite of that spider was supposed to cause sickness that could only be healed by continuous dancing (Tarantella).

**taste**—Many taste setae are located at tips of legs; see "setae.

**temporary spiral**—Wide spiral built during orb web construction from center of web towards periphery. Removed when the sticky spiral is built from periphery towards center of web.

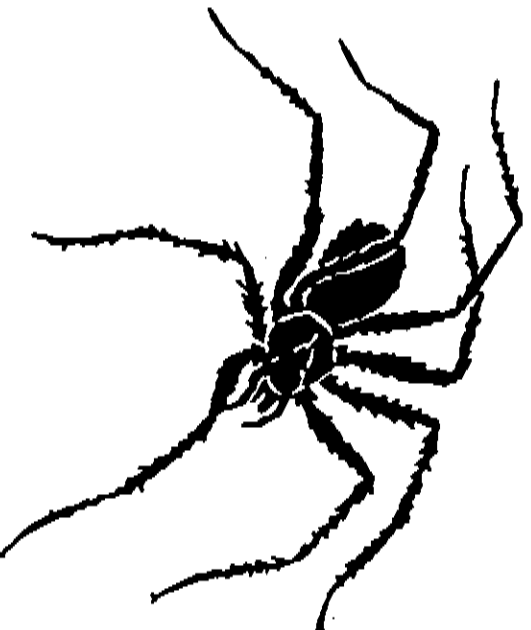
**trapdoor spiders**—Several groups of spiders construct burrows closed by various types of trapdoors. Design and function of trapdoors are species typical.

**triangle spider**—Family \*Uloboridae; builds only one triangle shaped sector of a full round orb-web.

**trichobothria**—Long, thin hair-like setae on legs, inserted in a socket in integument, connected to nerve ending. Bending of trichobothria results in nerve impulses. See \*hearing.

**Uloboridae**—Family of small orb web spiders which have no poison glands. Triangle spider forms a living bridge between two parts of her web, lets web collapse over prey.

**venom**—Produced in \*poison glands. Except for \*Uloboridae, all spiders possess venom glands. Venom of most spiders is a nerve toxin, which acts on the synaptic vesicles; see \*black widow spider and \*brown recluse spider.



**vertebrates**—All the animals that have a backbone such as fishes, frogs, reptiles, birds, and mammals. There are far more species of \*invertebrates on earth than vertebrates.

**vibrations**—Best developed sense in spiders, distinguish frequencies of various vibration sources (e.g. struggling prey, courtship, rain, predators).

**vinegarroones**—Whip scorpions; a few species exist in the southern parts of the U.S.

**vision**—well developed only in \*jumping spiders that see sharp images and color. Most other spiders see movements but do not have color vision. See \*eyes.

**water spider**—European genus *Argyroneta*, lives in fresh water ponds with unpolluted water, swims and dives freely, builds \*diving bell, catches aquatic insects.

**webs**—Often species typical. Each spider species can only build its particular type of web; there are very many web forms (e.g., purse webs, orb webs, sheet webs, cob-web, trap doors); many reductions of webs (see \*Bolas spider, \*triangle spider).

**whip scorpions**—See \*vinegarroones.

**wind scorpion**—See \*softfuges.

**wolf spiders**—Family Lycosidae (\*cursorial spiders). Numerous species, some large. Female attaches egg sac to spinnerets and carries spiderlings on back of abdomen.

**wrapping**—Many web spiders wrap their caught prey in silk, which is digested and ingested together with liquefied tissue and body fluids of prey.



# RESOURCES

## MATERIALS AND PROGRAMS

**American Biological Supply Co.** 2922 Industrial Dr., Unit A-1, Finksburg, MD, 21048. (410) 526-0382. Extensive catalog of science and biology related materials, including entomology equipment.

**Bioquip Products.** 17803 LaSalle Avenue, Gardena, CA, 90248-3602. (310) 324-0620. FAX (310) 324-7931. Specializes in quality entomological equipment and books. Extensive catalog available.

**The Bottle Biology Project.** University of Wisconsin-Madison, Dept. of Plant Pathology, 1630 Linden Drive, Madison, WI. (608) 263-5645. Funded by the National Sciences Foundation, this project has developed materials on how to reuse soda bottle containers in innovative science experiments and investigation. Many activities include insects.

**Discovery Scope, Inc.** P.O. Box 607, Green Valley, AZ, 85622. (602) 648-1401. A *Discovery Scope* (trade mark) is a hand held microscope using viewing chambers which hold live insects, aquatic life and other objects. An excellent tool for classroom activities.

**Entomological Society of America.** 9301 Annapolis Road, Lanham, MD, 20706-3115. (301) 731-4535. A professional entomological organization publishes *American Entomologist* and other publications. Catalog of insect books and related materials available.

**Entomology Departments at the State University.** Most State Universities curate insect collections for research and teaching. Graduate students may be available for class visits. Many departments have insect identification services for the public. Tours may be available.

**Local Cooperative Extension Offices and 4-H Programs.** Information about garden insects, honey bees, and agricultural insects are supported by these programs.

**Orkin: BUGS! A Closer Look.** Public Relations Dept. Orkin Pest Control, 2170 Piedmont Rd., NE, Atlanta, GA, 30324. Orkin provides representatives for 30 minute educational programs. Write for additional information.

**Sonoran Arthropod Studies, Inc.** P.O. Box 5624, Tucson, AZ, 85703. (602) 883-3945. An educational organization focused on increasing public awareness and understanding of the arthropods. Publishes *Backyard Bugwatching*, conducts teacher training workshops, field tips and other educational programs.

**Warren Publishing House, Inc.** P.O. Box 2250, Everett, WA, 98203. (206) 353-3100, FAX (206) 355-7007. Publishes Piggy back Songs and other open ended hands on materials for early childhood. Free catalog available.

**Young Entomologists' Society, Inc.** 1915 Peggy Place, Lansing MI, 48910-2553. (517) 887-0499. An educational organization publishing valuable insect related information. Catalog of insect books, publications, puppets and other educational aids available.

**Amateur Entomology Societies.** Many amateur entomologists have organized societies around the country. Some groups are formal with newsletters and involvement of professional entomologists.

## **SOURCES OF INSECTS**

\*=This company also sells quality science equipment, books and other insect related equipment.

**Local pet stores and bait stores.**

Insects available: Crickets; Mealworms (larvae).

**ARBICO (Arizona Biological Control, Inc.)**

P.O. Box 4247 CRB

Tucson, Arizona 85738

800-825-9785

Insects Available: Ladybird beetles (larvae, adults); Paring mantid egg cases.

**Berkshire Biological Supply Company\***

P.O. Box 404

Florence, MA 01060

(413) 586-6149

Insects Available: Crickets; Ladybird beetles; Mealworms (larvae and adults); Painted lady butterflies.

**The Biology Store**

P.O. Box 2691

Escondido, CA 92033

(619) 745-1445

800-654-0792

Insects Available: Crickets; Isopods; Mealworms (larvae, pupa, adults); Mosquito larvae.

**Carolina Biological Supply Company Biology/Science Materials \***

Main Office and Laboratories

Burlington, NC 27215

800-334-5551

**Powell Laboratories Division**

Gladstone, OR 97027  
800-547-1733

Insects Available: Ants; Crickets (nymphs and adults); Isopods; Ladybird beetles; Mealworm larvae; Milkweed bugs (eggs and adults); Mosquitoes; Praying mantis egg cases; Silkworm eggs.

**Connecticut Valley Biological Supply Co., Inc.\***

P.O. Box 326, 82 Valley Road  
Southampton, MA 01073  
800-628-7748

Insects Available: Ants; Crickets (nymphs and adults); Ladybird beetles; Milkweed bugs (adult); Milkworms (larvae and adults); Painted lady butterflies and other butterfly species.

**Delta Education, Inc.\***

P.O. Box 915  
Hudson, NH 03051  
(603) 889-8899

Insects Available: Mealworm larvae and beetles; Painted lady butterflies.

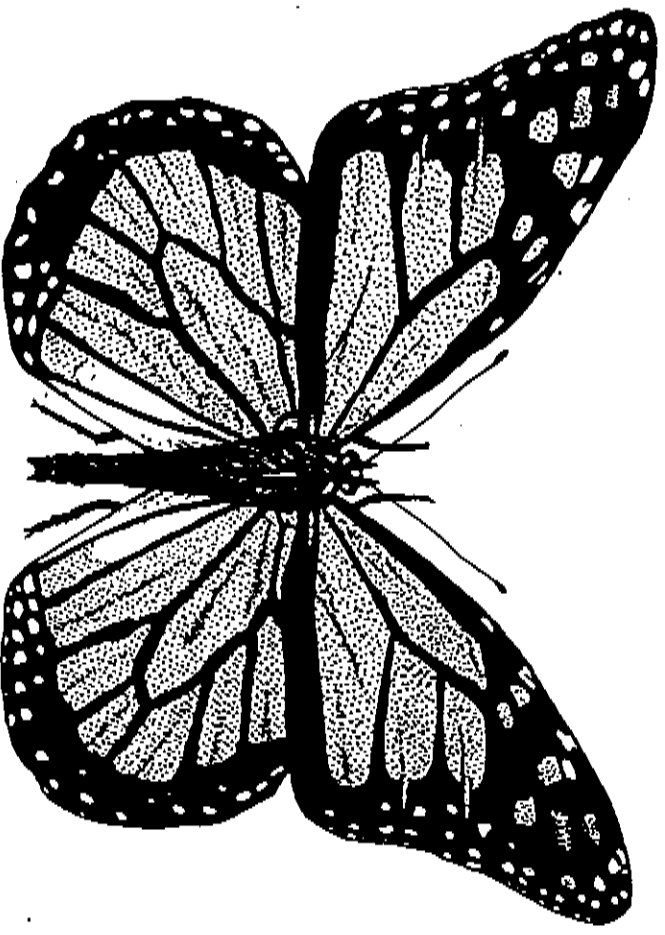
**Fluker's Cricket Farm, Inc.**

P.O. Box 378  
Baton Rouge, LA 70821-0378  
(504) 343-7035

Insects Available: Crickets; Mealworm larvae.

**Insect Lore Products\***

P.O. Box 1435  
Shafter CA 93263  
Insects Available:  
Painted lady  
butterflies.



**Nasco Science\***

901 Janesville Ave.  
Fort Atkinson, WI 53538-0901  
(414) 563-2446  
1524 Princeton Ave.  
Modesto, CA 95352-3837  
209-529-6957  
800-558-9595

Insects Available: Ants; Crickets; Ladybird beetles; Mealworms (larvae, pupae, adults); Painted lady butterflies; Praying Mantid egg cases.

**Science Kit and Boreal Laboratories\***

777 East Park Drive  
Tonawanda, NY 14150-6781  
(716) 874-6020

Insects Available: Milkweed bugs (adults and eggs); Mealworm (larvae); Praying Mantis egg cases.

**Ward's Biology 1992 •**

5100 West Henrietta Road  
P.O. Box 92912  
Rochester, New York 14692-9012  
Fax: (716) 334-6174  
Phone: 800-962-2660

Insects Available: Ants; Isopods; Lady bird beetles; Mealworm (adult, larvae, eggs, pupa); Praying mantid egg cases; Silkworm egg;



## MATERIALS

*4-H Entomology Leader's Guide to Study of Insects.* Contact your local extension office and 4-H agents.

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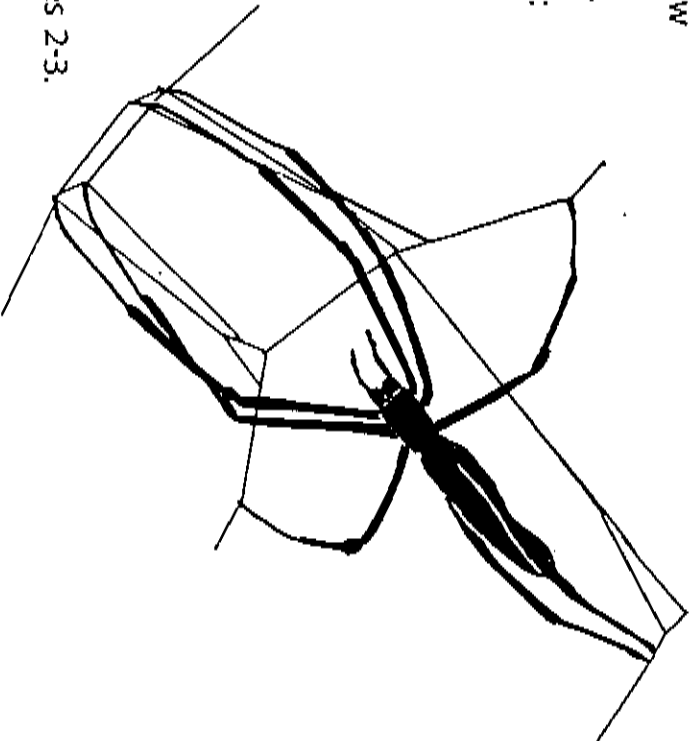
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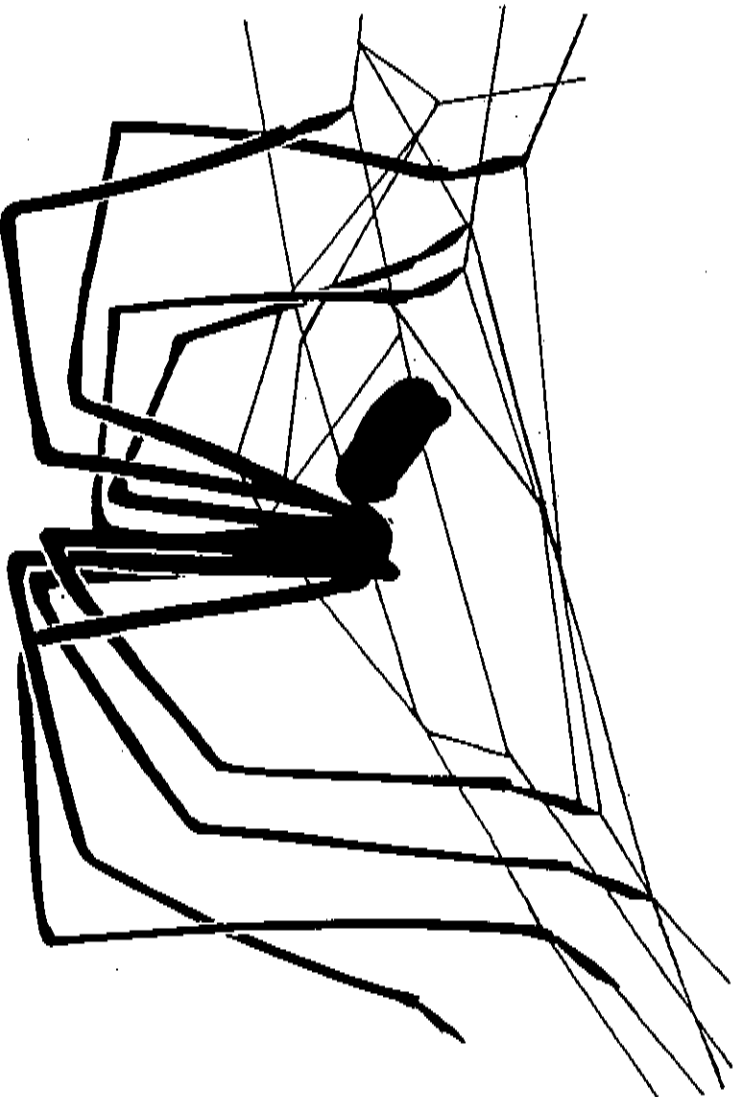
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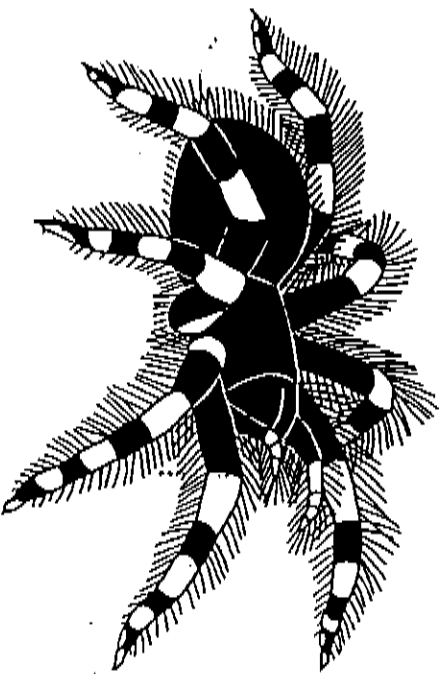
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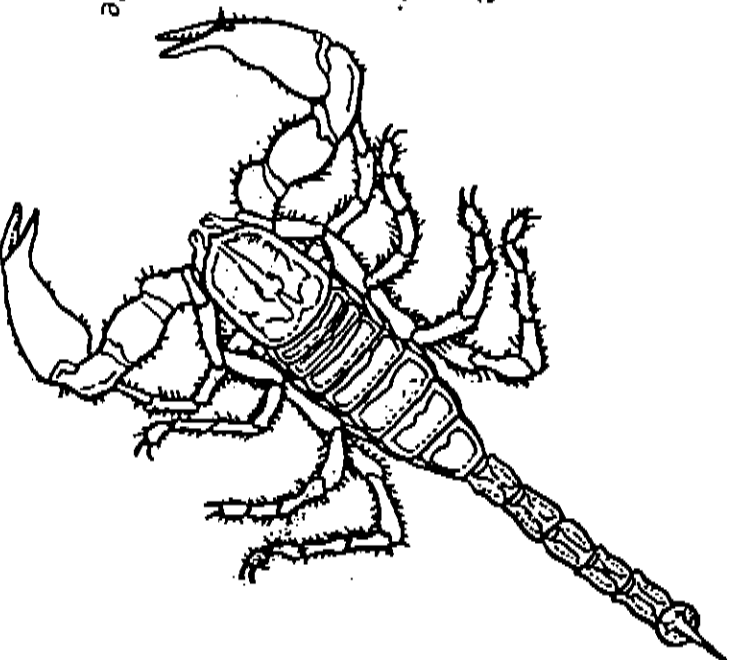
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