20. Bosque Bugs Boogie

Description: Students search for arthropods on their school grounds and then participate in relay teams while mimicking bosque arthropods.

Objectives: Students will:

- discover some of the arthropods that live in their schoolyard (or backyard);
- learn about anatomical structures of arthropods that help in their survival; and
- learn some differences between insects, spiders, and other arthropods.

Materials:

- Cone or other target for bug turn-around spot
- Bug boxes, jars or other containers for temporary housing of arthropods
- Magnifying glasses
- Eight boxes or large paper grocery bags (fit over team members' heads)
- Optional: Bug eyes. Poke several holes in the bases of two paper cups or use commercially-purchased bug-eye toys (2 sets of 2); straws (2)
- Yarn or string (2 balls)

Phenomena: Arthropods are all around us, and they have a variety of shapes and sizes.

Lesson Questions:

- *What adaptations (structures) help arthropods survive?*
- *How do arthropod structures help them survive?*

20. Bosque Bugs Boogie

Grades: K-6

Time: 20 minutes outdoors (Bug Hunt), then 20 minutes for each round of relays (80 minutes total for relays)

Subjects: science

Terms: *antennae, appendages, arthropod, compound, exoskeleton, metamorphosis, segmented*

Optional: *chelicerae, elytra, gills, halteres, marsupium, nymph, ocelli, proboscis, spinnerets, tymbals, xylem*

New Mexico STEM Ready! / Next Generation Science Standards

NGSS DCIs

1.LS1.A Structure & Function
1.LS1.D Information Processing
3.LS2.D Social Interactions & Group Behavior
4.LS1.A Structure & Function
4.LS1.D Information Processing

NGSS CCCs

Patterns; Structure & Function

NGSS SEPs

Asking Questions & Defining Problems; Developing & Using Models; Planning & Carrying Out Investigations*; Analyzing & Interpreting Data*; Constructing Explanations & Designing Solutions; Engaging in Argument from Evidence*; Obtaining, Evaluating & Communicating Information*

***indicates extension activity**

Background:

Did you know that most animals on earth are arthropods? These invertebrate (without backbones) animals have **exoskeletons**, **segmented** bodies, and paired, jointed **appendages**. They include insects, spiders, crustaceans, centipedes, and millipedes. They are highly successful at surviving in a wide variety of habitats. **Arthropods** (ARE-throw-pods) are everywhere, including in our backyards, school grounds, and city parks! They make excellent subjects for observation due to their abundance, small size, and ease of capture. All students will have some personal experience observing arthropods, so they will quickly get excited about this activity.

Estimates vary widely but there are nearly 7 million species of arthropods on Earth. Insects comprise the largest group of arthropods, by far. In fact, some scientists estimate that up to 80% of all animal species may be insects! In addition to the tremendous number of species, insects include the greatest biomass (amount by weight) of terrestrial animals on Earth. Simply put, there are many of types of insects and many, many individuals.

When we say "bugs", just what do we mean? The term "bug" is frequently used colloquially to refer to any "creepy crawly critter" (i.e., arthropods). To an entomologist (a scientist who studies insects), a "bug" is a member of the order Hemiptera, or true bugs. These include cicadas, aphids, leaf hoppers, bed bugs, and more. It's fine to use the term "bugs," but remember that officially, while all bugs are insects, not all insects are bugs!

stink bug - true bug

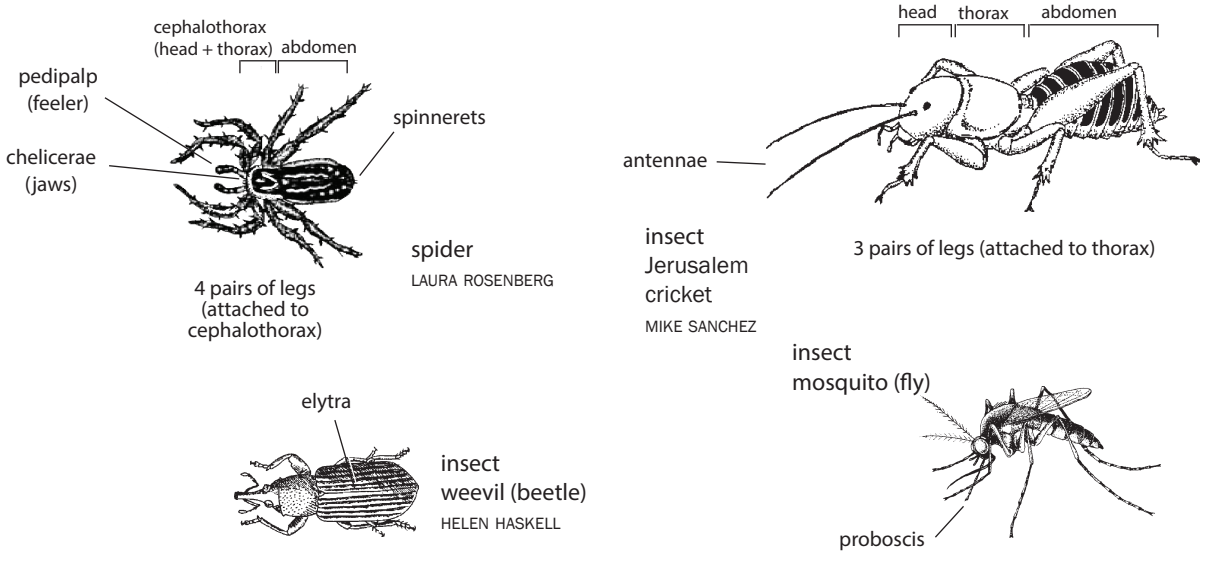
ladybird beetle
"ladybug" - beetle

Although one million species of insects have been named, estimates are that over 80% of existing insect species remain to be discovered and described. This is exciting news to share with students! There is a real need for more scientists all over the world who are trained to study insects before many species go extinct.

Arthropods, like all organisms, have a variety of internal and external structures that help the animal grow, survive, and reproduce. **(1.LS1.A; 4.LS1.A; Structure & Function)** For example, their jointed appendages are specialized in various ways for locomotion, feeding, and sensing the external world. Most insects have wings, specialized structures used for flight and other purposes. Arthropod mouthparts are specialized in ways that reflect the type of food each species eats. Some types of arthropods have structures that produce silk, which may be used to capture prey (spiders) or to protect larvae during **metamorphosis** (met-a-MOR-fuss-es) (moths and others). The variety of structural adaptations among arthropods is tremendous!

This activity focuses on some basic structural characteristics of arthropods, including their legs, wings, mouthparts, and other simple structures. Paying attention to these details helps develop observational skills and increase awareness of the amazing diversity of species of life on Earth. It's also a foundational step toward learning about animal classification.

For more information on arthropods, see Appendix E.



Pronunciation of Arthropod Terms:

antennae ann-TEN-ee
chelicerae ki-LI-sir-ee
elytra EL-e-tra
halteres HALT-tears
marsupium mar-SUE-pee-um
metamorphosis meta-MOR-fuss-es
nymph NIM-f
ocelli oh-SELL-eye
proboscis pro-BOS-kes
spinnerets spin-er-ET
tymbals TIM-bulls
xylem ZEYE-lem

Procedure:

Step 1: Bug Hunt

- Guide students through a discussion about arthropods. Use this to develop KWL charts. *What do the students **Know** about arthropods? What do they **Want** to know about arthropods?* You may return to these at the end of the activity and ask *What have they **Learned** about arthropods?*
  (Asking Questions & Defining Problems)

- Begin with a "Bug" Hunt around the school yard, or if learning remotely, in the child's yard, nearby park, or anywhere that is safe in the neighborhood. Arthropods really are everywhere, and close observation will quickly lead to many discoveries. You may collect individual arthropods for observation back in the classroom or at home using commercially-made bug boxes, glass jars with holes poked in the lids, or other similar containers. Encourage students to make their observations and then return the animal to where it was found (they can write the location on the container at the time of collection with a marker to help with remembering). It is a good habit to release the animals back where they were found while they are still healthy and able to survive (such as within 30 minutes). Minimize direct handling, both for the safety of the animal and of the student. Make sure students know about potentially dangerous arthropods, including centipedes, scorpions, black widow spiders, harvester ants, bees, and wasps. These are interesting and wonderful to observe but caution must be taken if capturing! At the collection site, record the habitat where each animal was found and any other interesting information (such as the presence of a web or burrow, feeding behaviors, if/how the animal was moving). Alternately, students may make all observations in the field rather than capturing the arthropods, or they may take photos to study in the classroom. Binoculars focused as close as possible may allow "spying" on arthropods without disturbing them.

- Back in the classroom or while outside ask the students to look closely at each arthropod. Record observations about each animal in their field notebooks, including the number of legs, the number of body parts (if possible; this can sometimes be difficult to determine), presence and number of wings, description of mouthparts, and any other interesting structures. Have the class develop a list of descriptive words about bugs to help with their writing.

- Next, focus the discussion on arthropod body parts. Animals have evolved behavioral and structural adaptations that enable them to grow, move around, find food, avoid predators, and find mates. Ask students, *What types of structures did you observe on the arthropods collected? What do you think each structure is used for?* **(1.LS1.A; 4.LS1.A)**

- Now consider arthropod legs. **Arthropods** belong to the Phylum Arthropoda, which is named from the Greek *arthros* (=jointed) and *poda* (=foot). All arthropods have jointed **appendages**. Arthropod legs come in many shapes and sizes and help the animals move in a variety of ways, including walking, climbing, and swimming. They also use legs or modified legs for feeding, sensing the environment, defending against predators, and capturing prey.

  Think about bugs you have seen. *Give an example of a type of bug leg and how it helps that bug.*

  Legs are also used by scientists to help in classifying arthropods. Noting the number of legs an arthropod has will tell you the type of arthropod it is. This is a practical application of patterns observed in nature **(Patterns)**.

  Insects – 3 pairs of legs

  Spiders, scorpions, ticks, mites, etc.– 4 pairs of legs

  Lobsters, shrimp, crabs – 5 pairs of legs

  Isopods – 7 pairs of legs

  Centipedes – one pair of legs per body segment

  Millipedes – two pairs of legs per body segment

Step 2: Relays - Round 1: Legs

- Determine the turn around target for the arthropod teams.

- Tell the students that they will be learning more about arthropods as they participate in relay laps while pretending to be arthropods.

- Divide the group into two teams. Ideally, each team should have at least ten members. Team members should line up single file, with teams side-by-side. Both teams will be the same arthropod in the same lap.

  Explain that each team will represent a particular arthropod using the appropriate number of students each time to form an animal group (see arthropod descriptions below). Focus first on the number of **legs**.

  How many legs does this arthropod have?

  How many students does it take to make this animal with this number of legs?

  Each team will need to determine how many legs the assigned arthropod has and how many students they will need to make an animal with that many legs. For example, if the arthropod is an **insect**, three students will be needed (three pairs of legs; use arms to hold on to waist or shoulders of the student in front and do not count them in the total number of appendages). For each lap, have a short discussion about the arthropod and then have students form groups to represent that animal. Groups must stay together, move in the manner outlined in the arthropod description (see below), and go out to and back from a designated target.

- Repeat the laps as many times as time and interest permit, but try to include at least one lap with each type of arthropod (insects, spiders, isopods, centipedes, millipedes). Again, the focus for this initial round is on legs. For younger students, you may want to stop here.

- Note that in these and other rounds of the relay, the students are acting as **models** of arthropods.

  How are models useful and what are their limitations?

  Models can help us learn, but they have limitations. For example, when three students are used to represent insects, we can note that insects have three body parts. However, this does not hold when four students represent a spider, as spiders have two body parts. This can be used for a discussion about the use of models. **(Developing & Using Models)**

  Tips for Relay: Choose 4 or 5 arthropods. Start with an insect—they have 3 pairs of legs/first three students; then spider with 4 pairs of legs/next four students; finish with either centipede or millipede that will use the entire line of students!

Relays - Round 2: Wings

- Next, repeat the relays for some of the arthropods but now include wings (see examples below). Start with a short discussion about insect wings. Think of examples of arthropods with wings at least part of their lives.

  What are the advantages of having wings?

  What functions do wings serve?

  You may want to add questions to students' KWL charts.

  Most, though not all, adult insects have wings. Wings allow insects to fly or glide, which increases the options available for finding food, mates, nesting locations, or resting places and has allowed insects to diversify into a wide variety of habitats. Insects are the only arthropods (and indeed the only invertebrates) that can fly. Wings serve other functions as well. The patterns on some wings (such as butterflies and moths) may provide camouflage, communicate warnings, or help to attract mates. Wings may aid in thermoregulation (butterflies and moths), auditory communication (crickets and katydids) or protection (beetles). **(1.LS1.A; 4.LS1.A)**

- Use the insect descriptions that include wings to set up groups for relays. Note that only insects have wings, so you will be working with three students per group for each of these animals. Insects typically have two pairs of wings. The front student in each group can flap both arms as wings. Since the students still need to hold on to each other, each of the middle and back students in the group can contribute one wing while holding on to the student in front with the other. All members of the Order Diptera (flies and their relatives) have only one pair of wings (Diptera is Greek for *di* [=two] and *ptera* [=wing]), so when representing mosquitos, only the front person in each group will flap their arms.

- Repeat the relay using examples that have wings (see below). Remember, these are all insects!

Relays - Round 3: Mouthparts (optional)

- Next, for older students, discuss the mouthparts of arthropods.

  How does the structure of the mouth influence the type of food it can eat?
  How does this affect survival?

  Arthropods don't have teeth! Mouth types provide information about the types of food arthropods eat. The diversity of arthropod species in part reflects the diversity of feeding habits. Sometimes, the different stages of development within a species have different mouth types, such as a caterpillar and a butterfly. There are a variety of mouth types, but here we will focus on those adapted for chewing, piercing, and sucking. Start this section with a short discussion of arthropod mouthparts, and add to KWL charts, if desired.

- Repeat the relays using information provided below and adding mouthparts to the student in front of the animal group. Students may simply pretend to suck, pierce or chew, or you may use tools such as a straw for sucking. This is a good time to include a brief discussion about the type of food the animal eats.**(1.LS1.A; 4.LS1.A)**

Relays - Round 4: Other Interesting Features (optional)

- **Arthropods have many fascinating structures!** A few of these other features are included with the information below. You can do additional rounds incorporating other structures. For example, when mimicking a garden spider, have the students move to a location where they must spool out yarn from their **spinnerets** (spin-er-ET) to create a simple web or wrap up a "prey" item in silk (use one ball of yarn or string for each team.)

- **Focus on sensory organs:** Arthropods use a variety of sensory organs to sample their environment, including sight, smell, taste, sound, touch, pressure, vibration, humidity, and temperature. **(1.LS1.D; 4.LS1.D)**

  How do arthropods use different types of sensory information to go about their daily activities?

  - Most arthropods have one of two types of eyes (and many have both): **compound** eyes and simple eyes (**ocelli**/ oh-SELL-eye). Large, bulging compound eyes may include up to thousands of individual lenses, providing an increased field of vision, good light and dark detection, and good motion detection. Ocelli contain only single lenses, used for detecting movement and changes in light. Most (but not all) adult insects have compound eyes, as well as two to three ocelli. Spiders usually have eight simple eyes (some have fewer), but they generally don't have very good eyesight. Spiders rely more on touch, vibration, and taste to find prey. Include eyes in your arthropod relays. Compound eyes can be made using two paper cups with many holes poked in the bottom or you can get commercially-made bug-eye toys with multi-faceted lenses.
  - **Antennae** (ann-TEN-ee) are important sensory organs for all adult arthropods except spiders and their kin (who have none). Antennae can be used to smell, taste, touch, and communicate. They come in many shapes and sizes! The first student in the arthropod group can wave their arms around like antennae, or have them close their eyes and feel their way along using "antennae" to determine where they are going. Do it safely!

- **Group living:** Being part of a group helps animals obtain food, defend themselves, and cope with changes. **(3.LS2.D)** Insects such as ants, bees, and termites live together in groups, sometimes including millions of individuals.

  What are advantages of living in a large group?

  Ants are completely dependent on group living, with individuals specialized into several different castes within a colony and each having a particular job to perform. Ants cannot live alone! Worker ants share in collecting food, protecting the nest from invaders, caring for young (produced by the single queen and a small number of males), keeping the nest clean, and so on. This extreme social behavior has allowed ants to become the most successful of all insect groups. See Harvester Ant below, for a group-living relay.

Assessments:

- Revisit the KWL charts. *What have students **Learned**? What else do they want to **Know**?* **(Asking Questions & Defining Problems)**
- Choose a bosque arthropod. Make a 3D-model, drawing, write a poem, or otherwise represent the arthropod showing the external structures that help this animal survive. Indicate the purpose of each of the structures, and provide an explanation for how each structure helps the animal survive. **(Developing & Using Models; Constructing Explanations)**

Modifications:

For remote learning, have students build arthropod models with pipe cleaners, sticks, Play-Doh clay or other material.

For safe-distancing when doing the relay, have students hold a rope, instead of each other.

Extensions:

- **Ant Investigations**

  Ants are everywhere and provide a convenient subject for investigations. Students can design their own projects to study ants either at home or in your schoolyard. Some possible questions to address:
  - *Where do ants build their nests?* Look for differences in locations of nest holes, such as in dirt, in grass, under trees, under pavement, under rocks. *What benefit do you think ants get from each location?*
  - *Does time of day affect ant activity?*
  - *Does temperature affect ant activity?*
  - *For harvester ants, where on the mound is the hole located*? Imagine the nest as a compass and record which direction the nest opening points. *Do you find any patterns?*
  - *Do ants have food preferences?* Test for differences by offering different foods, such as sugar, salt, citrus, seeds, berries, meat. Compare responses by different types of ants.
  - Follow a worker ant to see where she goes and what she does. **(Asking Questions & Defining Problems; Planning & Carrying Out Investigations; Analyzing & Interpreting Data)**

- Compare the structure and function of arthropod bodies to those of vertebrate animals. *What is it about arthropods that have made them so successful and much more diverse than vertebrates?*
    - Compare the exoskeleton of arthropods to the vertebrate skeleton. *What are the advantages and disadvantages of each?*
    - Arthropod **exoskeletons** are made up of chitin, while vertebrate skeletons are made of bone. Compare these materials. *What are the advantages and disadvantages of each?*
    - Compare the material and structure of insect wings with those of bird wings. *What are the advantages and disadvantages of each?* **(Patterns; Structure & Function; Engaging in Argument from Evidence; Obtaining, Evaluating & Communicating Information)**

NGSS Connections to Bosque Bugs Boogie - Disciplinary Core Ideas

1.LS1.A Structure and Function *All organisms have external parts. Different animals use their body parts in different ways to see, hear, grasp objects, protect themselves, move from place to place, and seek, find, and take in food, water and air.*

Arthropods have a variety of structures that allow them to survive in various habitats, including the bosque and river. Focus on particular structural adaptations of arthropods, including legs, wings, eyes, antennae, spinnerets or other structures. Consider how these adaptations help the animal grow, get food and water, survive predators or competitors, reproduce or endure seasonal changes.
What features does each species have that allow it to live in the bosque or river?
How do these structures increase the animal's chance of surviving?

1.LS1.D Information Processing *Animals have different body parts that capture and convey different kinds of information needed for growth and survival. Animals respond to these inputs with behaviors that help them survive.*

Arthropods have specialized sensory organs designed to sample a variety of types of information in their environment. Eyes and antennae provide good examples of sensory organs in arthropods.
In what ways do sensory organs of arthropods differ from those of vertebrate animals?
How does sensory input affect an animal's ability to survive? How might an animal's behavior be affected by certain types of sensory inputs?

3.LS2.D Social Interactions and Group Behavior *Being part of a group helps animals obtain food, defend themselves, and cope with changes. Groups may serve different functions and vary dramatically in size.*

Several types of insects are specialized to live in groups, including ants, honey bees and termites. Harvester ants provide a good example of this in the bosque. Individuals in these groups are specialized to perform certain behaviors that benefit the entire colony; this specialization requires that the individuals remain part of the group to survive.
In what ways does living in a group help harvester ants?
How do individual members contribute to survival of the entire colony?

4.LS1.A Structure and Function *Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction.*

Arthropods have a variety of structures that allow them to survive in various habitats, including the bosque and river. Focus on particular structural adaptations of arthropods, including legs, wings, eyes, antennae, spinnerets or other structures. Consider how these adaptations help the animal grow, get food and water, survive predators or competitors, reproduce or endure seasonal changes.
What features does each species have that allow it to live in the bosque or river?
How do these structures increase the animal's chance of surviving?

4.LS1.D Information Processing *Different sense receptors are specialized for particular kinds of information, which may then be processed by an animal's brain. Animals are able to use their perceptions and memories to guide their actions.*

Arthropods have specialized sensory organs designed to sample a variety of types of information in their environment. Eyes and antennae provide good examples of sensory organs in arthropods.
In what ways do sensory organs of arthropods differ from those of vertebrate animals?
How does sensory input affect an animal's ability to survive? How might an animal's behavior be affected by certain types of sensory inputs?

Summary of Arthropods for Relays

Name	Arthropod Class	# Body Segments	# Legs [# students = # legs / 2]	# Wings (larvae/adult)	Mouth Parts	Eyes	# Antenna
Tarantula	Arachnida	2	8	0	piercing	8 simple	0
Garden Spider	Arachnida	2	8	0	piercing	8 simple	0
Jumping Spider	Arachnida	2	8	0	piercing	8 simple	0
Centipedes	Chilopoda	many	many (one pair per body segment)	0	piercing	many simple	2
Millipedes	Diplopoda	many	many (two pairs per body segment)	0	chewing	simple (poorly developed)	2
Isopods	Isopoda	many	14	0	chewing	2 compound	4
Mayfly	Insecta	3	6	0/4	chewing; none in adult	2 compound 3 simple	2
Field Cricket	Insecta	3	6	4	chewing	2 compound 3 simple	2
Plains Cicada	Insecta	3	6	4	piercing & sucking	2 compound 3 simple	2
Darkling Beetle	Insecta	3	6	4	chewing	2 compound	2
Harvester Ant	Insecta	3	6	0/4	chewing	2 compound 3 simple	2
Monarch Butterfly	Insecta	3	6	0/4	larvae chewing; adult sucking	larvae 12 simple; adults 2 compound, 2 simple	2
Mosquito	Insecta	3	6	0/2	piercing & sucking	2 compound 3 simple	2

The Bosque Education Guide

Tarantula

Description: Eight legs requires four students. Eight eyes; the male is near-sighted, so the students must wear a box or bag over their heads so it is hard for them to see; back students keep their hands on the hips or shoulders of the student in front of them. Males live eight to ten years in burrows; when a male is sexually mature, it goes looking for a mate. Females generally never leave their burrows.

Wings: None

Mouthparts: Piercing (**chelicerae**/ ki-LI-sir-ee). Tarantulas inject a venom that kills their prey, but they cannot chew it. Instead, they inject digestive enzymes that break down the prey, and then the tarantula slurps up the liquid meal. Prey includes other arthropods and small vertebrates. The tarantula's stomach works like a pump to suck up the liquified prey, so they can eat animals much bigger than themselves.

Other Interesting Features: Tarantulas have **spinnerets** (spin-er-ET) but they don't spin webs to catch their prey. Instead, they use their silk to line their burrows and protect their eggs. Tarantulas also have spigots on their feet that produce silk; this silk is used to help prevent the spider from slipping on steep and slippery surfaces.

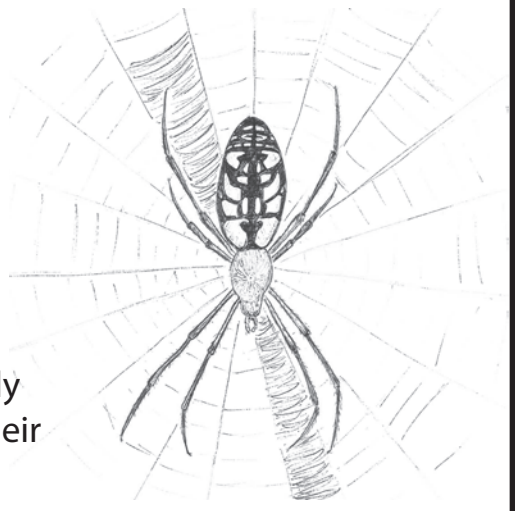
Garden Spider

Description: Eight legs requires four students. Eight eyes, all students keep their heads up, stand side to side with arms on waist or shoulder of student next to them and walk to move.

Wings: None

Mouthparts: Piercing (**chelicerae**/ ki-LI-sir-ee). Produce venom, with which they kill insects that are trapped in their web.

Other Interesting Features: Garden spiders have **spinnerets** (spin-er-ET) that produce silk, with which they produce large orb webs used to capture prey. Webs have a characteristic zigzag pattern; the spider is usually sitting near the center of the web. The spiders wrap their prey in silk before biting and feeding on them.



MIKE SANCHEZ

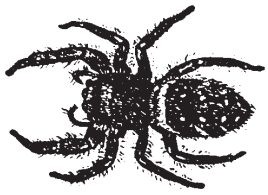
Jumping Spider

Description: Eight legs requires four students. Eight eyes (very good vision); have students line up side-by-side with arms linked across shoulders. Students must jump forward to move.

Wings: None

Mouthparts: Piercing. Jumping spiders are active predators. They do not hunt in webs but rather actively seek out prey on the ground and in vegetation. They produce venom from fang-like structures (**chelicerae**/ ki-LI-sir-ee).

Other Interesting Features: Although they don't spin webs, jumping spiders do have **spinnerets** (spin-er-ET) that produce silk, which they use as a safety line to stabilize their large jumps. They also produce silk "pup tents" for shelter.



jumping spider

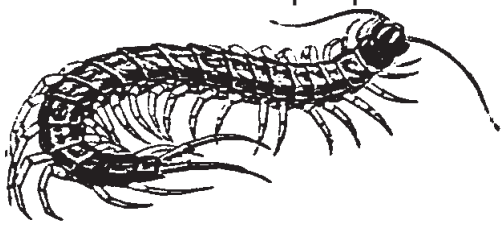
Centipede

Description: Many legs; all team members participate. Since the centipede is flat with one pair of legs per body segment, students will bend over at the waist, the back students holding onto the waist of the student in front of them. The legs are extended to the sides of the centipede, so students run with their legs spread wide apart. Centipedes are flat, which enables them to easily crawl underneath rocks and logs. Two clusters of simple eyes. One pair of long **antennae** (ann-TEN-ee).

Wings: None

Mouthparts: Piercing. Centipedes are predators that eat small insects and other arthropods.

Other Interesting Features: The forelegs are modified into fangs that deliver venom with which they paralyze their prey. This poison is also venomous to people and can cause a painful bite. The appendages on the rear of the centipede are modified for sensory functions but can also pinch.



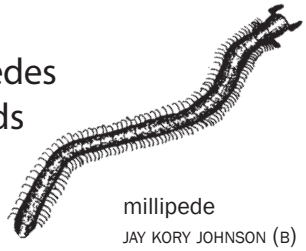
Millipede

Description: Many legs; all team members participate. Millipedes have poor eyesight from poorly-developed eyes. They tap the ground with **antennae** (ann-TEN-ee) (one pair) when they move, so the front student uses arms to feel in front while other students keep heads down. A millipede is round and has two pairs of legs per body segment; the back students keep their hands on the shoulders of the student in front of them and hunch their shoulders. All students must shuffle their feet.

Wings: None

Mouthparts: Chewing. Millipedes feed on decaying leaves and other dead plant material.

Other Interesting Features: When handled or disturbed, millipedes may coil up and release a foul-smelling, toxic fluid from glands located on the tops of the legs. This is used for protection.



millipede
JAY KORY JOHNSON (B)

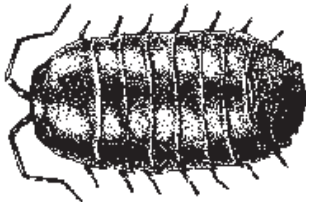
Isopod (Pill bugs)

Description: Fourteen legs requires seven students. Two compound eyes mean that the back six students must keep their heads down while the front student may use imitation compound eyes (two paper cups with many holes poked in the end or commercially-produced bug eye toys). Back students keep hands on hips or shoulders of students in front of them. Two pairs of jointed **antennae** (ann-TEN-ee).

Wings: None

Mouthparts: Chewing. Isopods eat decaying wood and leaves. Note that isopods were introduced to this continent long ago with dirt that was used to stabilize sailing vessels but was then removed to make room for cargo space on return trips. They are now the major consumers of dead plant material in the bosque.

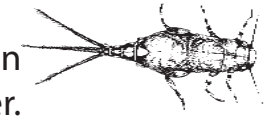
Other Interesting Features: Female isopods carry their eggs and tiny juveniles in a special pouch called a **marsupium** (mar-SUE-pee-um). Isopods breathe through **gills** and so require moist environments (but cannot survive being submerged in water). One species can roll up!



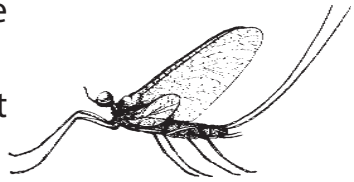
Mayfly

Description: Six legs requires three students. Two compound eyes mean that the back two students must keep their heads down while the front student may use imitation compound eyes (two paper cups with many holes poked in the end or commercially-produced bug eye toys). Back two students keep hands on hips or shoulders of students in front of them. One pair of short, bristle-like **antennae** (ann-TEN-ee).

Wings: Immature mayflies (called **nymphs**/ NIM-fs) are aquatic and have no wings. Adults have one or two pairs of wings that are held upright over the back (they can't fold their wings down like some insects do).



Mouthparts: Nymphs have chewing mouthparts. Most feed on diatoms, algae, and other plants and organic detritus under water. Adult mayflies live only a few hours to a few days. They have vestigial mouthparts and do not feed.



Other Interesting Features: Mayflies have three long tails that provide stability during flight.

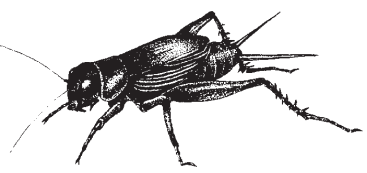
Field Cricket

Description: Six legs requires three students. Two compound eyes mean that the back two students must keep their heads down while the front student may use imitation compound eyes (two paper cups with many holes poked in the end or commercially-produced bug eye toys). Back two students keep hands on hips or shoulders of students in front of them. One pair of long **antennae** (ann-TEN-ee). All of the group must jump.

Wings: Field crickets have two pairs of functional wings, though they spend more time walking or jumping than flying. In addition to flight, wings function in communication. Male crickets rub their wings together to chirp to attract mates. One wing has a scraper and one wing has a file and when these are rubbed together, they make the chirping sound. (Note that some types of crickets, such as camel crickets, do not have wings.)

Mouthparts: Crickets have chewing mouthparts. They eat dead leaves and insects and, before the arrival of isopods, may have been the major consumer of fallen cottonwood leaves in the bosque.

Other Interesting Features: Cricket ears are located on their front legs! Enlarged hind legs are adapted for jumping. They can jump about 30 times their body length to escape predators.

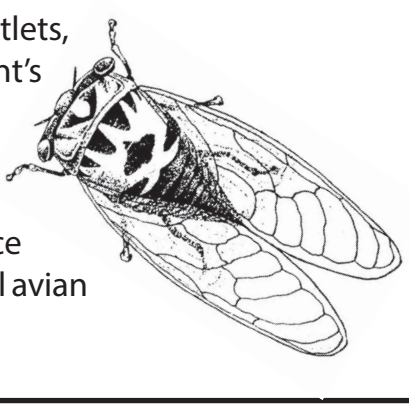


Plains Cicada

Description: Six legs requires three students. Two compound eyes mean that the back two students must keep their heads down while the front student may use imitation compound eyes (two paper cups with many holes poked in the end or commercially-produced bug eye toys). Back two students keep hands on hips or shoulders of students in front of them. One pair of short **antennae** (ann-TEN-ee).

Wings: Adult cicadas have two pairs of functional wings but they are somewhat clumsy fliers. Note that wingless **nymphs** (NIM-fs) live and grow underground for 3 to 5 years, emerging in their final nymph stage to climb up into a tree or bush, shed their skin, and become a winged adult.

Mouthparts: Cicadas use a straw-like beak that can pierce rootlets, roots, and stems of trees, allowing the cicada to suck up the plant's **xylem** (ZEYE-lem) (sap-containing transport tubes).



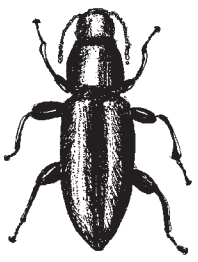
Other Interesting Features: Cicadas make a loud buzzing sound by vibrating a pair of sound organs, called **tymbals** (TIM-bulls), located on the sides of the abdomen. Males of each species produce a characteristic song. The song is used to attract mates and to repel avian predators. Some individuals will emerge every year.

Darkling Beetle

Description: Six legs requires three students. Two compound eyes (adults) mean that the back two students must keep their heads down while the front student may use imitation compound eyes (two paper cups with many holes poked in the end or commercially-produced bug-eye toys). One pair of long **antennae** (ann-TEN-ee).

Wings: Adults have two pairs of wings. The front pair of wings in all beetles form a thick, leathery wing cover (called the **elytra**/ EL-e-tra) to protect the delicate flight wings folded underneath. Many species of darkling beetles do not fly.

Mouthparts: Chewing. Darkling beetles feed on plant material (adults feed on plants and seeds above the surface while larvae feed on plant material underground).



Other Interesting Features: When adults are disturbed, they do a headstand; to deter predators, they may spray a noxious liquid from a gland located in the abdomen.

darkling beetle
CAROLYN BARR (B)

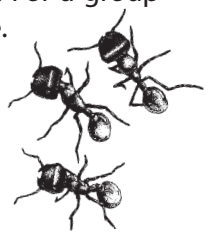
Harvester Ant

Description: Six legs requires three students. Two compound eyes mean that the back two students keep their heads down while the front student may use imitation compound eyes (two paper cups with many holes poked in the end or commercially-produced bug eye toys); back students keep their hands on the hips or shoulders of the student in front of them.

Wings: Worker ants do not have wings. During the breeding season, winged males and females form mating swarms; after mating, the females shed their wings and establish new nesting sites while the males soon die. Those with wings have two functional pairs.

Mouthparts: Chewing. Harvester ants eat seeds that they collect and bring into the nest. They chew the seeds into a mash that is stored underground for future consumption. They will also occasionally eat other small arthropods, including isopods. Note that harvester ants will bite viciously to defend their colony, and they can also inject venom by stinging.

Other Interesting Features: Harvester ants live in large colonies in burrows that can be nine feet (3 meters) deep or deeper. The workers go out to forage following scent trails left by scout ants. They communicate information about food availability with each other by touching **antennae** (ann-TEN-ee). For a group relay, each student represents one ant and the whole team will follow along in single file. Note that while the "ants" in the relay have only two legs, the real ants have six! Use arms as antennae and feel along the path to find your way or to communicate with colony-mates (brief and gentle touches only!) To be really authentic, bend arms at elbows as ants have "elbowed" antennae. Follow the path to a seed source, where each ant collects one "seed" to carry back to the colony. **(3.LS2.D)**



Monarch Butterfly

Description: Larva (caterpillar) has three pairs of true legs (near the front end) and five pairs of prolegs (leg-like appendages near the hind end); requires eight students. The caterpillar pushes and pulls its body along—inch-worm style; students have hands on hips of the team member in front of them. The first three students (the real legs) move forward as far as possible without the back team members moving. Then the front students stop while the remainder of the team moves as close to the front students as possible. Once the back person stops, front members can move again. Caterpillars have six pairs of simple eyes (12 **ocelli**/ oh-SELL-eye); adult butterflies have two compound eyes and two ocelli. One pair of **antennae** (ann-TEN-ee) (short in caterpillars, long and clubbed in butterflies).

Wings: Adult butterflies have four wings, two forewings and two hindwings, that are held together in flight to function as one wing; each wing is covered with scales and hairs. The coloration of monarch wings provides a warning to predators that they are toxic. Note that the species is known for its long migration between Canada and the U.S. to Mexico; much of the western U.S. population moves to the California coast for the winter. Larvae (caterpillars) do not have wings.

Mouthparts: Larvae: Chewing; Adults: Sucking (**proboscis**/ pro-BOS-kes). Larvae feed on milkweed leaves; adults feed on nectar from a variety of flowers.

Other Interesting Features: Monarch caterpillars have internal adaptations that allow them to eat toxic milkweed leaves without becoming sick themselves, but both adults and caterpillars can pass along the toxin to animals that eat them. Because those predators would then become sick, the colorful orange and black pattern of the monarch's wings serves as a warning that they are poisonous and thus acts as a deterrent.

Mosquito

Description: Six legs requires three students. Two compound eyes mean that the back two students keep their heads down; back students keep their hands on the hips or shoulders of the student in front of them. One pair of long **antennae** (ann-TEN-ee) (feathery in males, plain in females).

Wings: Mosquito larvae are aquatic and do not have wings. Adult mosquitoes (like all flies) have one pair of wings. Mosquito wings are long and thin and the mosquito flaps them very quickly; a structure on the wings rubs together to make a buzzing sound, which is used to attract mates.

Mouthparts: Piercing and sucking. All adult mosquitoes have a **proboscis** (pro-BOS-kes) to eat nectar or plant sap. The female's proboscis can also pierce skin and allows it to feed on blood, which it needs to produce eggs. Larvae eat algae and other aquatic microorganisms.

Other Interesting Features: A structure on the antennae is used to detect vibrations of sound; this is basically the mosquito's ear. Female mosquitoes also have structures that can detect carbon dioxide and other organic compounds released by animals; they use this to find a suitable host. Vestigial hindwings form a pair of club-like **halteres** (HALT-tears), which help stabilize the mosquito during flight.