Grasshopper diagram

cladogram. The Ensifera crickets, etc. In evolutionary terms, the split between the Caelifera and the Ensifera is no more recent than the Permo-Triassic boundary ; [9] the earliest insects that are certainly Caeliferans are in the extinct families Locustopseidae and Locustavidae from the early Triassic, roughly million years ago. The group diversified during the Triassic and have remained important plant-eaters from that time to now. The first modern families such as the Eumastacidae, Tetrigidae and Tridactylidae appeared in the Cretaceous , though some insects that might belong to the last two of these groups are found in the early Jurassic. This information is not available from fossil specimens, and the palaentological taxonomy is founded principally on the venation of the hindwings. The Caelifera includes some 2, valid genera and about 11, known species. Many undescribed species probably exist, especially in tropical wet forests. The Caelifera have a predominantly tropical distribution with fewer species known from temperate zones, but most of the superfamilies have representatives worldwide. They are almost exclusively herbivorous and are probably the oldest living group of chewing herbivorous insects. The most diverse superfamily is the Acridoidea , with around 8, species. The two main families in this are the Acrididae grasshoppers and locusts with a worldwide distribution, and the Romaleidae lubber grasshoppers , found chiefly in the New World. The Pauliniids are nocturnal and can swim or skate on water, and the Lentulids are wingless. Grasshoppers have the typical insect body plan of head, thorax and abdomen. The head is held vertically at an angle to the body, with the mouth at the bottom. The head bears a large pair of compound eyes which give all-round vision, three simple eyes which can detect light and dark, and a pair of thread-like antennae that are sensitive to touch and smell. The downward-directed mouthparts are modified for chewing and there are two sensory palps in front of the jaws. The thorax and abdomen are segmented and have a rigid cuticle made up of overlapping plates composed of chitin. The three fused thoracic segments bear three pairs of legs and two pairs of wings. The forewings, known as tegmina , are narrow and leathery while the hindwings are large and membranous, the veins providing strength. The legs are terminated by claws for gripping. The hind leg is particularly powerful; the femur is robust and has several ridges where different surfaces join and the inner ridges bear stridulatory pegs in some species. The posterior edge of the tibia bears a double row of spines and there are a pair of articulated spurs near its lower end. The interior of the thorax houses the muscles that control the wings and legs. The abdomen has eleven segments, the first of which is fused to the thorax and contains the tympanal organ and hearing system. Segments two to eight are ring-shaped and joined by flexible membranes. Segments nine to eleven are reduced in size; segment nine bears a pair of cerci and segments ten and eleven house the reproductive organs. Female grasshoppers are normally larger than males , with short ovipositors. Those species that make easily heard noises usually do so by rubbing a row of pegs on the hind legs against the edges of the forewings stridulation. These sounds are produced mainly by males to attract females, though in some species the females also stridulate. Grasshoppers may be confused with crickets, but they differ in many aspects; these include the number of segments in their antennae and the structure of the ovipositor, as well as the location of the tympanal organ and the methods by which sound is produced. Most grasshoppers are polyphagous , eating vegetation from multiple plant sources, [18] but some are omnivorous and also eat animal tissue and animal faeces. In general their preference is for grasses, including many cereals grown as crops. Carbohydrates are digested mainly in the crop, while proteins are digested in the ceca of the midgut. Saliva is abundant but largely free of enzymes, helping to move food and Malpighian secretions along the gut. Some grasshoppers possess cellulase , which by softening plant cell walls makes plant cell contents accessible to other digestive enzymes. Grasshoppers have a typical insect nervous system, and have an extensive set of external sense organs. On the side of the head are a pair of large compound eyes which give a broad field of vision and can detect movement, shape, colour and distance. There are also three simple eyes ocelli on the forehead which can detect light intensity, a pair of antennae containing olfactory smell and touch receptors, and mouthparts containing gustatory taste receptors. There are numerous fine hairs setae covering the whole body that act as mechanoreceptors touch and wind sensors , and these are most dense on the antennae, the palps part of the mouth , and on the cerci at the tip of the abdomen. The receptors convey information to the central nervous system through sensory neurons, and most of these have their cell bodies located in the periphery near the receptor site itself. Like other insects, grasshoppers have an open circulatory system and their body cavities are filled with haemolymph. A heart-like structure in the upper part of the abdomen pumps the fluid to the head from where it percolates past the tissues and organs on its way back to the abdomen. This system circulates nutrients throughout the body and carries metabolic wastes to be excreted into the gut. Other functions of the haemolymph include wound healing, heat transfer and the provision of hydrostatic pressure, but the circulatory system is not involved in gaseous

exchange. Larger insects may need to actively ventilate their bodies by opening some spiracles while others remain closed, using abdominal muscles to expand and contract the body and pump air through the system. For the escape jump in particular there is strong selective pressure to maximize take-off velocity, since this determines the range. This means that the legs must thrust against the ground with both high force and a high velocity of movement. A fundamental property of muscle is that it cannot contract with high force and high velocity at the same time. Grasshoppers overcome this by using a catapult mechanism to amplify the mechanical power produced by their muscles. The jump is a three-stage process. Second, there is a period of co-contraction in which force builds up in the large, pennate extensor tibiae muscle, but the tibia is kept flexed by the simultaneous contraction of the flexor tibiae muscle. The extensor muscle is much stronger than the flexor muscle, but the latter is aided by specialisations in the joint that give it a large effective mechanical advantage over the former when the tibia is fully flexed. The third stage of the jump is the trigger relaxation of the flexor muscle, which releases the tibia from the flexed position. The subsequent rapid tibial extension is driven mainly by the relaxation of the elastic structures, rather than by further shortening of the extensor muscle. In this way the stiff cuticle acts like the elastic of a catapult , or the bow of a bow-and-arrow. Energy is put into the store at low power by slow but strong muscle contraction, and retrieved from the store at high power by rapid relaxation of the mechanical elastic structures. Male grasshoppers spend much of the day stridulating, singing more actively under optimal conditions and being more subdued when conditions are adverse; females also stridulate, but their efforts are insignificant when compared to the males. Late-stage male nymphs can sometimes be seen making stridulatory movements, although they lack the equipment to make sounds, demonstrating the importance of this behavioural trait. The songs are a means of communication; the male stridulation seems to express reproductive maturity, the desire for social cohesion and individual well-being. Social cohesion becomes necessary among grasshoppers because of their ability to jump or fly large distances, and the song can serve to limit dispersal and guide others to favourable habitat. The generalised song can vary in phraseology and intensity, and is modified in the presence of a rival male, and changes again to a courtship song when a female is nearby. In most grasshopper species, conflicts between males over females rarely escalate beyond ritualistic displays. Some exceptions include the chameleon grasshopper Kosciuscola tristis , where males may fight on top of ovipositing females; engaging in leg grappling, biting, kicking and mounting. The newly emerged female grasshopper has a preoviposition period of a week or two while she increases in weight and her eggs mature. After mating, the female of most species digs a hole with her ovipositor and lays a batch of eggs in a pod in the ground near food plants, generally in the summer. After laying the eggs, she covers the hole with soil and litter. After a few weeks of development, the eggs of most species in temperate climates go into diapause , and pass the winter in this state. Diapause is broken by a sufficiently low ground temperature, with development resuming as soon as the ground warms above a certain threshold temperature. The embryos in a pod generally all hatch out within a few minutes of each other. They soon shed their membranes and their exoskeletons harden. These first instar nymphs can then jump away from predators. Grasshoppers undergo incomplete metamorphosis : they repeatedly moult , each instar becoming larger and more like an adult, with the wing-buds increasing in size at each stage. The number of instars varies between species but is often six. After the final moult, the wings are inflated and become fully functional. The migratory grasshopper, Melanoplus sanguinipes , spends about 25 to 30 days as a nymph, depending on sex and temperature, and lives for about 51 days as an adult. Locusts are the swarming phase of certain species of short-horned grasshoppers in the family Acrididae. Swarming behaviour is a response to overcrowding. Increased tactile stimulation of the hind legs causes an increase in levels of serotonin. The transformation of a solitary individual into a swarming one is induced by several contacts per minute over a short period. Following this transformation, under suitable conditions dense nomadic bands of flightless nymphs known as "hoppers" can occur, producing pheromones which attract the insects to each other. With several generations in a year, the locust population can build up from localised groups into vast accumulations of flying insects known as plagues, devouring all the vegetation they encounter. Grasshoppers have a wide range of predators at different stages of their lives; eggs are eaten by bee-flies , ground beetles and blister beetles ; hoppers and adults are taken by other insects such as ants , robber flies and sphecid wasps , by spiders , and by many birds and small mammals including dogs and cats. The eggs and nymphs are under attack by parasitoids including blow flies , flesh flies, and tachinid flies. External parasites of adults and nymphs include mites. The grasshopper nematode Mermis nigrescens is a long slender worm that infects grasshoppers, living in the insect's hemocoel. Adult worms lay eggs on plants and the host becomes infected when the foliage is eaten. When

the worms are sufficiently developed, the grasshopper is persuaded to leap into a nearby body of water where it drowns, thus enabling the parasite to continue with the next stage of its life cycle , which takes place in water. Grasshoppers are affected by diseases caused by bacteria , viruses , fungi and protozoa. The bacteria Serratia marcescens and Pseudomonas aeruginosa have both been implicated in causing disease in grasshoppers, as has the entomopathogenic fungus Beauveria bassiana. This widespread fungus has been used to control various pest insects around the world, but although it infects grasshoppers, the infection is not usually lethal because basking in the sun has the result of raising the insect's temperature above a threshold tolerated by the fungus. This ensures wide dispersal of the fungal spores liberated from the corpse. The fungal pathogen Metarhizium acridum is found in Africa, Australia and Brazil where it has caused epizootics in grasshoppers. It is being investigated for possible use as a microbial insecticide for locust control. It has to be consumed by mouth and is the basis for a bait-based commercial microbial pesticide. Various other microsporidians and protozoans are found in the gut. Grasshoppers exemplify a range of anti-predator adaptations , enabling them to avoid detection, to escape if detected, and in some cases to avoid being eaten if captured. Grasshoppers are often camouflaged to avoid detection by predators that hunt by sight; some species can change their coloration to suit their surroundings. Several species such as the hooded leaf grasshopper Phyllochoreia ramakrishnai Eumastacoidea are detailed mimics of leaves. Stick grasshoppers Proscopiidae mimic wooden sticks in form and coloration. Some species are genuinely aposematic , having both bright warning coloration and sufficient toxicity to dissuade predators. Dictyophorus productus Pyrgomorphidae is a "heavy, bloated, sluggish insect" that makes no attempt to hide; it has a bright red abdomen. A Cercopithecus monkey that ate other grasshoppers refused to eat the species. Gaudy grasshopper, Atractomorpha lata , evades predators with camouflage. Lubber grasshopper, Titanacris albipes , has deimatically coloured wings, used to startle predators. Leaf grasshopper, Phyllochoreia ramakrishnai , mimics a green leaf. Painted grasshopper, Dactylotum bicolor , deters predators with warning coloration. Spotted grasshopper, Aularches miliaris , defends itself with toxic foam and warning colours. Grasshoppers are occasionally depicted in artworks, such as the Dutch Golden Age painter Balthasar van der Ast 's still life oil painting, Flowers in a Vase with Shells and Insects , c. Another orthopteran is found in Rachel Ruysch 's still life Flowers in a Vase , c. The seemingly static scene is animated by a "grasshopper on the table that looks about ready to spring", according to the gallery curator Betsy Wieseman, with other invertebrates including a spider, an ant, and two caterpillars. Grasshoppers are also featured in cinema. The film Beginning of the End portrayed giant grasshoppers attacking Chicago. Grasshoppers are sometimes used as symbols. When grasshoppers appear in dreams, these have been interpreted as symbols of "Freedom, independence, spiritual enlightenment, inability to settle down or commit to decision". In some countries, grasshoppers are used as food. In recent years, with the search for alternative healthy and sustainable protein sources, grasshoppers are being cultivated by commercial companies operating grasshopper farms and are being used as food and protein supplements. Grasshoppers eat large quantities of foliage both as adults and during their development, and can be serious pests of arid land and prairies. Pasture, grain, forage, vegetable and other crops can be affected. Grasshoppers often bask in the sun, and thrive in warm sunny conditions, so drought stimulates an increase in grasshopper populations. A single season of drought is not normally sufficient to stimulate a major population increase, but several successive dry seasons can do so, especially if the intervening winters are mild so that large numbers of nymphs survive. Although sunny weather stimulates growth, there needs to be an adequate food supply for the increasing grasshopper population. This means that although precipitation is needed to stimulate plant growth, prolonged periods of cloudy weather will slow nymphal development. Grasshoppers can best be prevented from becoming pests by manipulating their environment. Shade provided by trees will discourage them and they may be prevented from moving onto developing crops by removing coarse vegetation from fallow land and field margins and discouraging thick growth beside ditches and on roadside verges. With increasing numbers of grasshoppers, predator numbers may increase, but this seldom happens rapidly enough to have much effect on populations. Biological control is being investigated, and spores of the protozoan parasite Nosema locustae can be used mixed with bait to control grasshoppers, being more effective with immature insects. Insecticides can be used, but adult grasshoppers are difficult to kill, and as they move into fields from surrounding rank growth, crops may soon become reinfested. Some grasshopper species, like the Chinese rice grasshopper, are a pest in rice paddies. Ploughing exposes the eggs on the surface of the field, to be destroyed by sunshine or eaten by natural enemies. Some eggs may be buried too deeply in the soil for hatching to take place. Locust plagues can have devastating effects on human populations, causing famines and population upheavals. They are mentioned

in both the Koran and the Bible and have also been held responsible for cholera epidemics, resulting from the corpses of locusts drowned in the Mediterranean Sea and decomposing on beaches. Timely application of pesticides can prevent nomadic bands of hoppers from forming before dense swarms of adults can build up. In February , researchers from Washington University in St. Louis announced they had engineered "cyborg grasshoppers" capable of accurately detecting explosives. In the project, funded by the US Office of Naval Research , researchers fitted grasshoppers with lightweight sensor backpacks that recorded and transmitted the electrical activity of their antennal lobes to a computer. According to the researchers, the grasshoppers were able to detect the location of the highest concentration of explosives. The researchers also tested the effect of combining sensorial information from several grasshoppers on detection accuracy. The pharaoh Ramesses II compared the armies of the Hittites to locusts: "They covered the mountains and valleys and were like locusts in their multitude. The ant works hard all summer, while the grasshopper plays. In winter, the ant is ready but the grasshopper starves. Somerset Maugham 's short story "The Ant and the Grasshopper" explores the fable's symbolism via complex framing. The name is said to have originated when Major General Innis P. Swift saw a Piper making a rough landing and remarked that it looked like a grasshopper for its bouncing progress. Grasshopper beam engines were beam engines pivoted at one end, the long horizontal arm resembling the hind leg of a grasshopper. The type was patented by William Freemantle in From Wikipedia, the free encyclopedia. This is the latest accepted revision , reviewed on 21 February For other uses, see Grasshopper disambiguation. Common name for a group of insects. Temporal range: Ma â€"Recent. Further information: Digestive system of insects. Grasshopper stridulation. Main article: Locust. Further information: Anti-predator adaptation. Encyclopedia of Life. Archived from the original on 11 April Retrieved 4 August Archived from the original on 4 August Archived from the original on 5 August Evolution of the Insects. Cambridge University Press. Archived from the original on 2 August Richards O. Methuen pp. Molecular Phylogenetics and Evolution. Zoological Studies. Fossil Orthoptera Ensifera. British Museum Natural History. Archived from the original on 27 November Journal of Paleontology. Tree of Life web project. Archived from the original on 8 April Retrieved 3 April Archived from the original PDF on 20 December Cricket Radio. Harvard University Press. Australian Museum. Archived from the original on 18 April Retrieved 6 April Aims and Methods in Neuroethology. Manchester University Press. Arizona-Sonora Desert Museum. Archived from the original on 7 May Retrieved 4 May Environmental Entomology. Insect Molecular Biology and Biochemistry. Academic Press. Invertebrate Zoology, 7th edition. Cengage Learning. General Entomology. NC State University. Archived from the original on 3 January Retrieved 12 April January University of St Andrews. Archived from the original on 19 March Retrieved 13 April Archived from the original on 24 September Archived from the original on 18 November Retrieved 5 May Journal of Comparative Physiology A. Structural specialisations of the metathoracic tibiae" PDF. Journal of Experimental Biology. Archived PDF from the original on 19 October The Journal of Experimental Biology. Animal Locomotion. Oxford University Press. Princeton University Press. Bulletin of the Amateur Entomologists' Society. Bibcode : PLoSO Spencer, Neal R. Montana State University: â€" Archived PDF from the original on 20 December BBC News. Archived from the original on 10 October Retrieved 31 March Archived PDF from the original on 24 September New York Times. Archived from the original on 3 April Basic Books. Evolutionary Ecology Research. Featured Creatures. Archived from the original on 2 April Retrieved 28 March Renaud, F. May Journal of Evolutionary Biology. Zoologischer Anzeiger. Retrieved 1 April Journal of the Kansas Entomological Society. Latin American Insects and Entomology. University of California Press. Barry Journal of Herpetology. Transactions of the Entomological Society of London. The National Gallery. Betsy Wieseman: Well, there are two caterpillars that I can see. I particularly like the one right in the foreground that's just dangling from his thread and looking to land somewhere. It's this wonderful little suggestion of movement. There's a grasshopper on the table that looks about ready to spring to the other side and then nestled up between the rose and the peony is a wonderful spider and an ant on the petals of the rose. Princeton Buffer Retrieved 30 March Elizabethan Silent Language. University of Nebraska Press. New American Library. Times Higher Education Supplement. Archived from the original on 29 November A review". Archived from the original on 31 May Oaxaca al Gusto: An Infinite Gastronomy. University of Texas Press. Lonely Planet. Archived from the original on 11 March UMKM Jogja. Archived from the original on 6 March St John's College, Oxford. Dead Sea Discoveries. There is no reason, however, to question the plausibility of Mark c. that John regularly ate these foods while in the wilderness. Environmental Protection Agency. October Archived PDF from the original on 17 August Retrieved 6 August Archived from the original on 23 May Retrieved 16 December Locusts in Caucasus and Central Asia. Food and Agriculture Organization of the

United Nations. Archived from the original on 4 April Retrieved 2 April Annual Review of Entomology. Retrieved 20 February Archived from the original on 1 April Studies in Short Fiction. The Cambridge Introduction to Chekhov. The New York Times. The Museum of Flight. Archived from the original on 23 November Retrieved 11 December World War II Database. Lava Development. Military Factory. Archived from the original on 1 January The Beam Engine. Animated Engines. Archived from the original on 10 December A short history of the steam engine. Extant Orthoptera families. Suborder Ensifera. Gryllidae crickets Gryllotalpidae mole crickets Mogoplistidae Myrmecophilidae ant crickets. Prophalangopsidae grigs. Rhaphidophoridae cave, camel and spider crickets; cave wetas. Schizodactylidae dune crickets or splay-footed crickets. Anostostomatidae wetas, king crickets Cooloolidae Cooloola monster and relatives Gryllacrididae leaf-rolling crickets Stenopelmatidae Jerusalem crickets. Tettigoniidae katydids, bush-crickets or long-horned grasshoppers. Suborder Caelifera. Acrididae grasshoppers, locusts Dericorythidae Lathiceridae Lentulidae Lithidiidae Ommexechidae Pamphagidae toad grasshoppers Pamphagodidae synonym Charilaidae Pyrgacrididae Romaleidae lubber grasshoppers Tristiridae. Chorotypidae Episactidae Eumastacidae monkey grasshoppers or matchstick grasshoppers Euschmidtiidae Mastacideidae Morabidae Proscopiidae Thericleidae. Pneumoridae bladder grasshoppers. Pyrgomorphidae gaudy grasshoppers. Tetrigidae grouse locusts, pygmy locusts or groundhoppers. Trigonopterygidae Xyronotidae. Cylindrachetidae sandgropers Ripipterygidae Tridactylidae pygmy mole crickets. Human interactions with insects. Insects in art Beetlewing Arthropods in film Insects in literature Insects in music List of insect-inspired songs Insects on stamps. Fishing bait Fly fishing Artificial fly Fly tying. Apitherapy Apitoxin Melittin Spanish fly Cantharidin. Bee mythology Cicada mythology Scarab artifact. Insect bites and stings Insect sting allergy Bed bug Woodworm Home-stored product entomology Clothes moth. Bees and toxic chemicals Colony collapse disorder Decline in insect populations Habitat destruction List of endangered insects Pesticide Insecticide Imidacloprid effects on bees Neonicotinoid Pesticide toxicity to bees. Insects and humans Insecticides Pesticides. Authority control LCCN : sh Hidden categories: Webarchive template wayback links CS1 maint: multiple names: authors list CS1 Indonesian-language sources id Wikipedia pending changes protected pages Articles with short description Short description matches Wikidata Use dmy dates from July Featured articles Use British English from May Articles with 'species' microformats Taxobox articles possibly missing a taxonbar Articles with hAudio microformats Commons category link is locally defined Wikipedia articles with LCCN identifiers. Namespaces Article Talk. Views Read Edit View history. Help Learn to edit Community portal Recent changes Upload file. Download as PDF Printable version. Wikimedia Commons. American grasshopper Schistocerca americana. Acridomorpha Dirsh, Grasshopper stridulation Several unidentified grasshoppers stridulating. Problems playing this file? See media help. Suborder Ensifera Grylloidea Gryllidae crickets Gryllotalpidae mole crickets Mogoplistidae Myrmecophilidae ant crickets. Tridactyloidea Cylindrachetidae sandgropers Ripipterygidae Tridactylidae pygmy mole crickets. In the arts Insects in art Beetlewing Arthropods in film Insects in literature Insects in music List of insect-inspired songs Insects on stamps. LCCN : sh Grasshopper Anatomy Like all insects, the grasshoppers have three main body parts â€" the head, the thorax and the abdomen. They have six jointed legs, two pairs of wings and two antennae. Their body is covered with a hard exoskeleton. Most grasshoppers are green, brown, or olive-green. The biggest Grasshoppers are about 4. Their legs are long hind legs that are used for hopping and jumping. The short front legs are used to hold prey and to walk. For a more indepth look at the anatomy of a grasshoppers body, click the image, For an indepth look at the head of a grasshopper, click the image. Abdomen â€" the segmented tail area of a grasshopper, which contains the heart, reproductive organs, and most of the digestive system. Antennae â€" like all insects, grasshoppers have 2 segmented antennae that sense touch and odours. Compound eye â€" grasshoppers have 2 faceted eyes made up of many hexagonal lenses. Head â€" the head is at the front end of the grasshoppers body a

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 nd is the location of the brain, the two compound eyes, the mouth parts, and the points of attachment of its two antennae. Mandibles â€" the jaws, located near the tip of the head, by the palps; the jaws crush the food. Spiracles â€" a series of holes located along both sides of the abdomen; they are used for breathing. Thorax â€" the middle area of the grasshoppers body â€" where the legs and wings are attached. Walking legs â€" the four, short front legs that are used for walking and holding prey while they eat. Long-horned grasshoppers and crickets have ears

in the knee-joints of their front legs. The ultimate source of this push comes from the contraction of the muscles inside the leg, this give the jump the catapulting effect. The legs have to thrust on the ground with a lot of force. If the thrust is too low, the animal does not get a fast enough take-off and it does not jump very far. If the thrust builds up too slowly, the legs will extend before the thrust reaches its maximum.