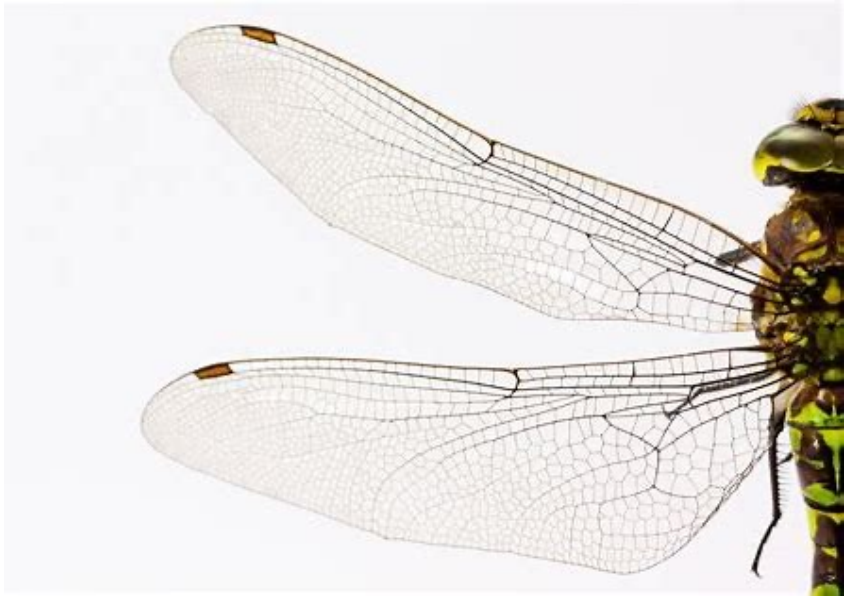
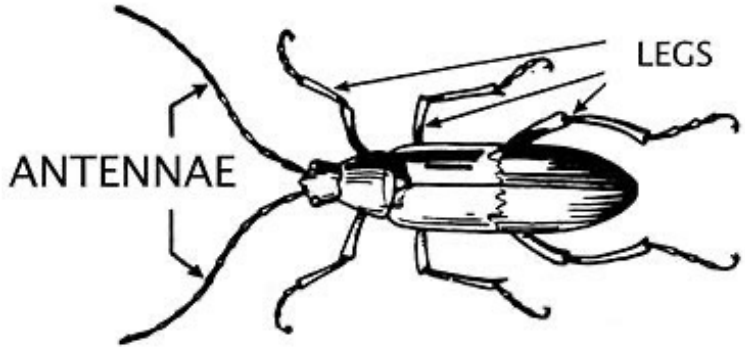


Winged Insects

And insect wings!

Insects are arthropods--



- Segmented body
- Head, thorax abdomen
- Exoskeleton made of chitin
- 6 segmented legs
- 2-4 pairs of wings
- 2-5 eyes
- Most have antennae

Winged Insects facts:

- *Migration distance — Painted Lady Butterfly, from North Africa to Iceland, a distance of 4,000 miles.*
- *Fastest flight in insects — Sphinx Moths, speed of 33 mph.*
- *Fastest wingbeat — Midge, at 62,760 beats per minute.*
- *Slowest wingbeat — Swallowtail butterfly -- 300 beats/minute.*
- *Highest altitude — Some butterflies have been observed flying at altitudes up to 20,000 feet.*
- *Largest wings, modern — Wingspans of some butterflies and moths are the largest of all modern insects. Largest wings, extinct — The wingspans of fossil dragonflies, existing millions of years ago, were more than two feet*

Why insects fly

Flight is one of the primary reasons that insects have been successful in nature. Flight assists insects in the following ways:
Escaping from danger
Finding food
Locating mates
Exploring for new places to live

Insect Wings

Apart from bats and birds, insects are the only other group of animals to have evolved flight. The wings are composed of two membranes of cuticle pressed together and supported by veins. The pattern of veins, the venation, is very regular. The wings are mainly triangular in form.

This pattern may be modified, such as fusion of veins, loss of veins or even the development of additional ones. Primitively these main veins are connected by a series of cross veins. Insects have one of two different arrangements of muscles used to flap their wings.

Insect flight muscles

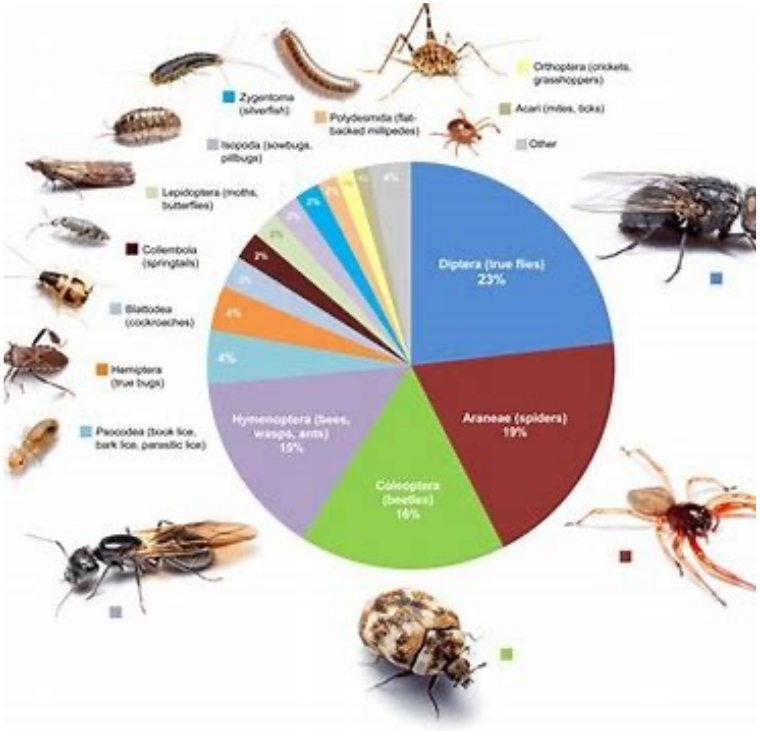
Direct flight muscles are found in insects such as dragonflies and cockroaches. The wings pivot up and down around a single pivot point. The wings are raised by a contraction of muscles attached to the base of the wing inside (toward the middle of the insect) the pivot point. The wings are then brought down by a contraction of muscles that attach to the wing outside of the pivot point.

Indirect flight muscles are found in more *advanced* insects such as true flies. Indirect flight muscles are connected to the upper (tergum) and lower (sternum) surfaces of the insect thorax. A second set of muscles attach to the front and back of the thorax. The wings are raised by the muscles attached to the upper and lower surface of the thorax contracting. This brings the top surface of the thorax down and, along with it, the base of the wings. As a result, the wing tips pivot upwards. The wings are then lowered by a contraction of the muscles attached to the front and rear of the thorax. This forces the upper surface of the thorax to raise and the wings pivot downwards.

How insects fly

Insects that beat their wings less than one hundred times a second use synchronous muscle that contracts once for every nerve impulse.

Insects that beat their wings more rapidly use asynchronous muscle that contracts more than once per nerve impulse. The muscle is stimulated to contract again by a release in tension in the muscle. This can happen more rapidly than through simple nerve stimulation alone.



Some orders of insects*--

Beetles *Coleoptera* (“sheath wings”)

Moths, Butterflies *Lepidoptera* (“scaly wings”)

Bees, Wasps, Ants *Hymenoptera* (“membrane-winged”)

Flies, Mosquitoes, Gnats *Diptera* (“two wings”)

Crickets, Grasshoppers, Locusts *Orthoptera* (“straight wings”)

Dragonflies, Damselflies *Odonata* (“tooth wings”)

Aphids, Cicadas, Leafhoppers *Homoptera* (“same wings”)

Bugs, Backswimmers, Water Striders *Hemiptera* (“half-wings”)

**optera*=winged

How insects fly fingerplay

There are different kinds of insect wings (patting shoulders)

Flight muscles and other kinds of things. (making muscle)

The wings evolved from ancient crustacean hand changing)

To give more flight with animation! (arms flapping)

How wings evolved

Insect wings evolved from an outgrowth or "lobe" on the legs of an ancestral crustacean! Once this marine animal transitioned to land-dwelling about 300 million years ago, the leg segments closest to its body became incorporated into the body wall during embryonic development, perhaps to better support its weight on land. The leg lobes then moved up onto the insect's back, and those later formed the wings.

How did moths and butterflies evolve?

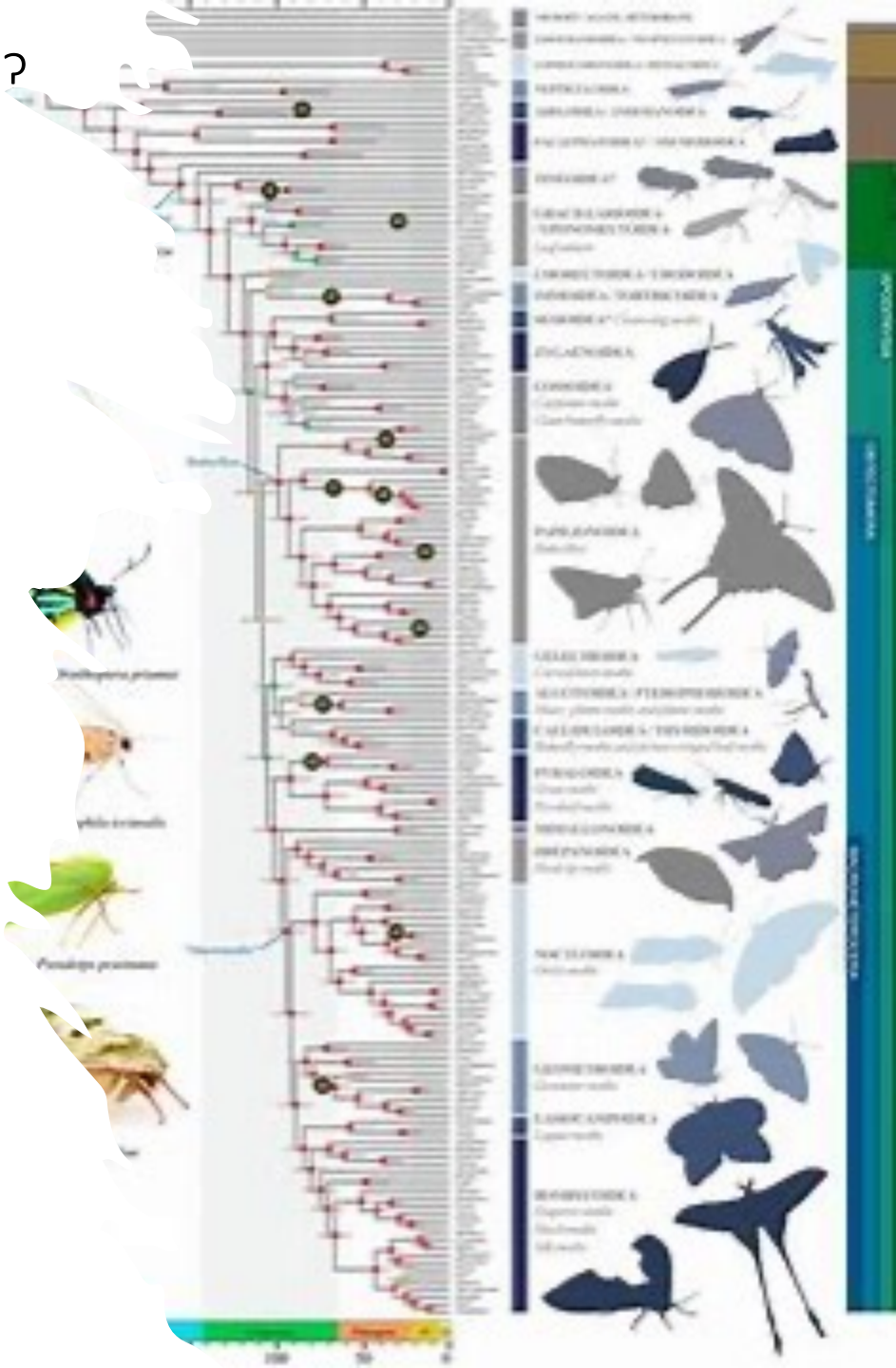
It is thought that moths might have developed from an aquatic insect or crustacean—a mandibulate creature eating nonvascular plants. The common ancestor of Lepidoptera goes back to the late Carboniferous period, around 300 million years ago. The proboscis appeared approximately 240 million years ago in the Middle Triassic period, when flowering plants began to diversify. Then around 100 million years ago some moths became active during the day.

Butterflies first evolved from moths when they were able to feed on new species of flowering plants available during the day. That allowed these insects to become colorful.

Butterflies evolved on the Western side of a splitting Pangaea.

Early butterflies fed on legumes in North America and spread to South America, Antarctica, the Bering Land Bridge to Russia, Asia, Australia, India, Africa and finally, 30 million years ago, Europe.

Moths evolved to have earthy colors to camouflage them while sleeping during the day. Butterflies have both original and structural color which can serve various purposes—camouflage attraction, warning, mimicking. The genetics of color is quite complicated!



Insect song

Membranes make the insect wings (hands sliding)

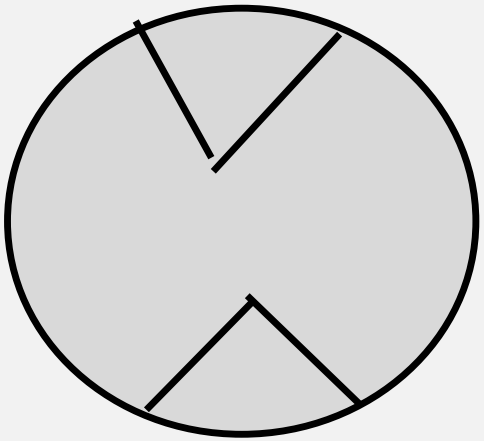
And ovipositors make the stings. (patting rear)

The wings are patterned with lots of veins (touching veins)

And carry them over forests and plains. (hand moving high)

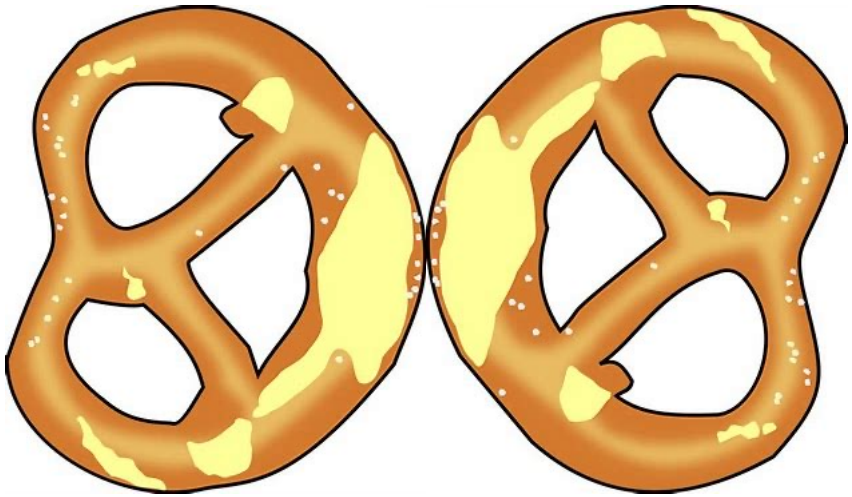
You can make wings out of coffee filters or muffin cups!

Just make V-shaped cuts on opposite sides!



You can make pretzel wings!

Connect two pretzels!




WINGS
Katrine Crow