DISSECT IT®

SYNTHETIC DISSECTION KIT

BAT LAB

STEM.ORG
AUTHENTICATED™
EDUCATIONAL PRODUCT

Contents of This Kit

2X DISSECT-IT POWDER REFILL PACKETS

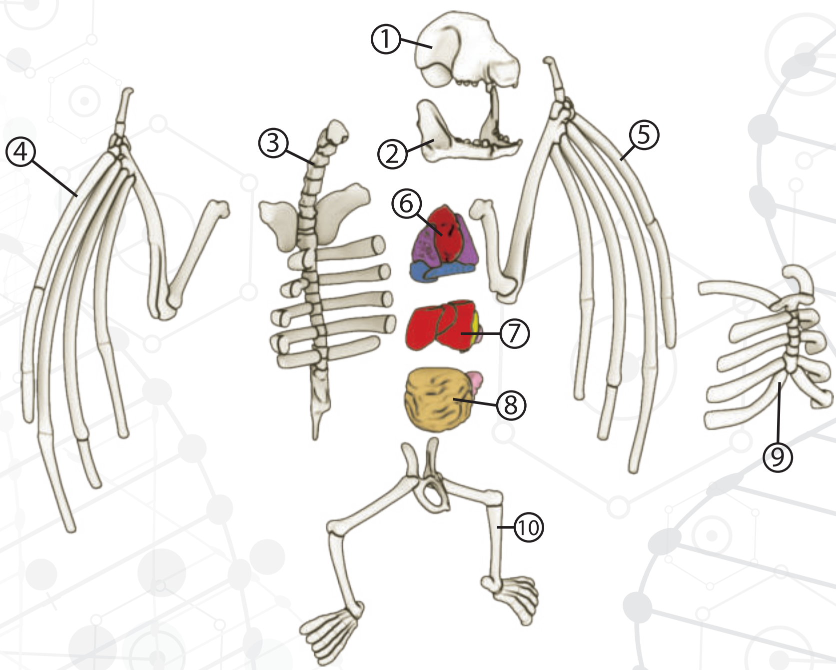
BAT

SCALPEL

TWEEZER

You will also need a measuring cup, and a plastic spoon or small wooden spatula for mixing (not included).

Assembly



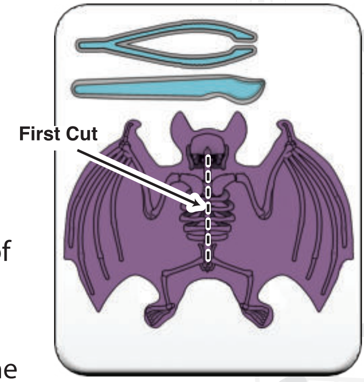
1. **SKULL** – Connects to 2 and 3
2. **JAW** – Connects to 1
3. **SPINE** – Connects to 1, 4, 5, 6, 9 and 10
4. **RIGHT WING** – Connects to 3
5. **LEFT WING** – Connects to 3
6. **HEART, LUNGS, AND DIAPHRAM** – Connects to 3 and 7
7. **KIDNEY, LIVER, STOMACH AND SPLEEN** – Connects to 6 and 8
8. **SMALL AND LARGE INTESTINE** – Connects to 7
9. **RIBS** – Connects to 3
10. **LEGS** – Connects to 3

Getting Started

Your bat is ready to dissect right out of the box.
Simply peel back the plastic film, remove the bat from the mold, and place it with the belly facing down onto the dissecting table (see figure below).

Keep the bat mold in a safe place. You will need it for molding future bat.

First Cut



Now that you have laid out your bat like the figure to the right, you can use your provided scalpel and probe to cut away sections of the skin to reveal the internal organs and skeleton of your bat. Usually, the first cut should be in the middle of the back of the bat beginning just below the skull all the way to the caudal (tail) end of the bat. Side incisions may be made to the sides of the midline (central) incision toward each side distally (toward each side) to allow a flap of skin to be laid back to expose the position and location of the internal organs.

We recommend reading the manual as you dissect your bat so you can learn about exciting facts about bat anatomy.

The Anatomy

Here are the major bones of the bat which you will encounter during your "dissection." The bones help support the bat's body and protect the vital organs.

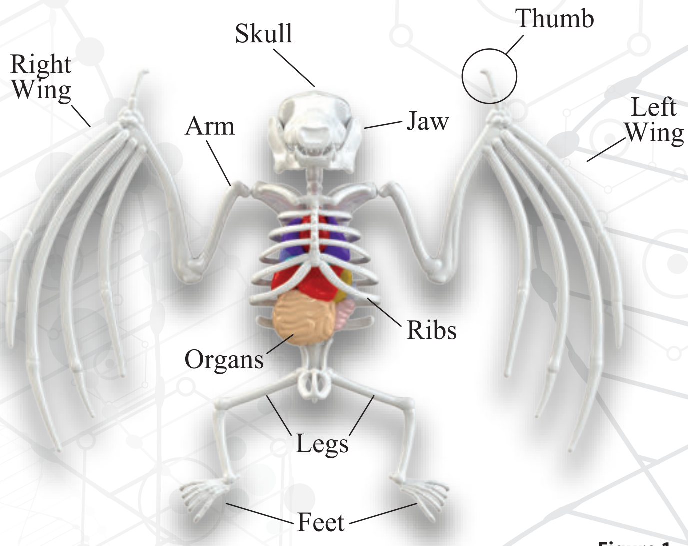


Figure 1

Skeletal System

The skeletal system has reduced size and thickness compared with other mammals. Bats have many bones, especially in their wings. Without some of these wing bones, they would be unable to fly. There are 206 bones in a bat's body.

It was believed that bat bones are less dense than that of mammals, but recent studies have found that the bone material is actually denser but thinner. Bat bones are light and very thin. Some bones are reduced; e.g. ulna (one of the two parallel bones supporting our forearm) and fibula (one of the two parallel bones supporting your lower leg) are shortened and thin. Bats, like birds, also have fused cranial (skull) bones for additional lightness.

Skin

The skin on the body of a bat consists of two layers, epidermis and dermis. It holds hair follicles, sweat glands and a fatty layer. Glands secrete odorous substances called pheromones that help other bats to know each other's species or sex. Some glands also secrete oils for conditioning the skin or waterproofing the fur.

Bat skin provides multiple functions. It enables flying, protects the inner body from injury, helps in temperature regulation, and has cells (Merkel cells) that gives the sense of touch, heat, cold, pressure, pain, and itch (very similar to our skin).

Heart

Bats have an efficient circulatory system. They make use of particularly strong venomotion, which is a rhythmic contraction of venous wall muscles. In most mammals, the walls of the veins mainly provides passive resistance, maintaining their shape as deoxygenated blood flows through them, but in bats they appear to actively support blood flow back to the heart with this pumping action. Since their bodies are relatively small and light-weight, bats are not at risk of blood flow rushing to their heads when roosting.

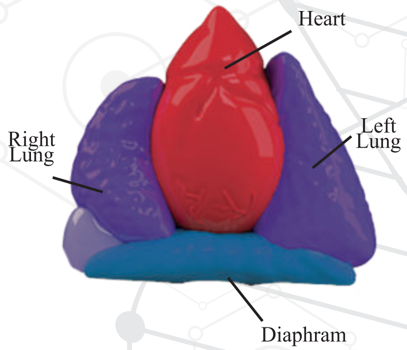


Figure 2

Lungs

Bats possess a highly adapted respiratory system to cope with the demands of powered flight, an energetically taxing activity that requires a large continuous output of oxygen. In bats, the relative alveolar (lung) surface area and pulmonary capillary blood volume are larger than in most other small quadrupedal mammals. During flight, the respiratory cycle has a one-to-one relationship with the wing-beat cycle. Because of the restraints of the mammalian lungs, bats cannot maintain high-altitude flight.

Liver and Kidney

The liver synthesizes or stores many of the vital substances used throughout the bat's body. It also absorbs substances from the blood that may be toxic to the animal, and breaks them down into harmless components. Liver cells produce bile, which is carried by a system of bile ducts to the gallbladder, where it is stored. (See Figure 3)

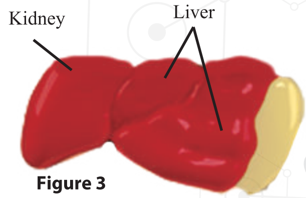


Figure 3

The adaptations of the kidneys of bats vary with their diets. Carnivorous and vampire bats consume large amounts of protein and can excrete concentrated urine; their kidneys have a thin cortex and long renal papillae. Frugivorous bats lack that ability and have kidneys adapted for electrolyte-retention due to their low-electrolyte diet; their kidneys accordingly have a thick cortex and very short conical papillae. Bats have higher metabolic rates associated with flying, which lead to an increased respiratory water loss. Their large wings are composed of the highly vascularized membranes, increasing the surface area, and leading to cutaneous evaporative water loss. Water helps maintain their ionic balance in their blood, thermoregulation system, and removal of wastes and toxins from the body via urine. They are also susceptible to blood urea poisoning if they do not receive enough fluid.

Digestive System

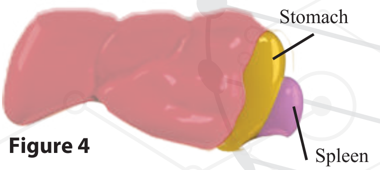


Figure 4

This bat has a very common digestive system. It has an esophagus that transports the food from its mouth to its stomach. The food is broken down there and sent into one long intestine that takes care of absorbing nutrients and making waste. It is then sent to the tube that goes to the anus , and the waste is excreted. Bats, dogs, and humans have very similar digestive systems.The digestive system of bats has varying adaptations depending on the species of bat and its diet. As in other flying animals, food is processed quickly and effectively to keep up with the energy demand. Insectivorous bats may have certain digestive enzymes to better process insects, such as chitinase to break down chitin, which is a large component of insects. Vampire bats, likley due to their diet of blood, are the only vertebrates that do not have the enzyme maltase, which breaks down malt sugar, in their intestinal tract. Nectivorous and frugivorous bats have more maltase and sucrase enzymes than insectivorous, to cope with the higher sugar contents of their diet.

Intestinal Tract

Most digestion occurs in the small intestine. Partially digested food from the stomach enters the small intestine and mixes with powerful digestive enzymes secreted by the pancreas. The enzymes break the food down into very small particles that can be absorbed by the intestinal walls. Then the particles are secreted into the blood stream and carried to the liver for processing.

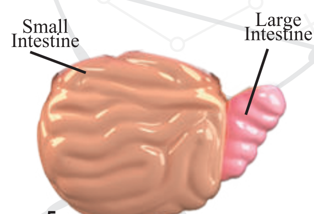


Figure 5

Bat Head


Figure 6

Perhaps more than any other group of mammals, bats display a wide range of variation in the shape of the head. This is due to a wide variation in diet and food capture. Additionally, roosting and flight habits affected the evolution of the head shape. Associated with the head are a number of other features that add to the wide range of appearances of bats. These include the ears, eyes, nostrils, and noseleaves. The senses of taste, smell, and touch in bats do not seem to be strikingly different from those of related mammals. Smell is probably used as an aid in locating fruit and flowers and possibly, in the case of vampire bats, large vertebrates. It may also be used for locating an occupied roost, members of the same species, and the differentiation of individuals by sex.

Eyes

Most bats (Microchiroptera) rely almost exclusively on acoustic orientation and, therefore, usually have rather small to minute eyes. The small size of most bats' eyes, and the fact that they are often hidden in the fur of the face has led many people to the common notion that bats either have no eyes or they are necessarily blind. This misconception is far from true, although the degree to which visual orientation is utilized by bats is not well understood.

Ears

For bats, the majority of which hunt, or otherwise orient in their environment by means of acoustic perception (echolocation), hearing is of paramount importance. Here we will examine the variation in size and shape of the pinnae (external ears) and associated structures. Ear shape among the megachiropterans is not especially variable, nor very spectacular. The ears of these bats are usually short and generally rounded. Some species, such as those of the genera Pteropus and Dobsonia, may have long, somewhat pointed ears.

For the most part, the ears of these bats are not strikingly disproportionate in size compared to the head and body. At their base, where they join the head, the ears of megachiropterans form a complete ring; that is, they are tubular. The external pinnae of these bats are never connected and a wide array of voluntary integumental (skin) muscles allows a considerable range of independent movement of the ears.

While hanging in the roost, or being held in a captor's hand, the ears will constantly twitch and moving about. Megachiropterans are thought to orient primarily by vision and this may account for the lack of specially adapted ears. Even the ears of Rousettus, which is known to have a crude form of echolocation, are not noticeably different from those of other megachiropterans. In contrast to the Megachiroptera, the Microchiroptera display a wide range of variation in ear shape and size. Some are quite bizarre.

Molding a New Bat

To familiarize yourself with the preparation process, read steps 1 through 7 first, before actually preparing the bat.

1. Prepare the bones and organs by cleaning off any excess gel material from your last bat.

2. Now assemble the bat skeleton system and organs as shown in the sequence in the drawing below. After you have assembled the skeleton and internal organs, place the assembly into the cavity of the clear plastic bat mold. Be sure to place the skeleton-organ assembly so that the vertical (underside) of this assembly faces downward in the bat mold.

3. Then place the clear plastic bat mold, with the internal structure assembly inside onto the clear plastic dissecting table so that the mold is level.

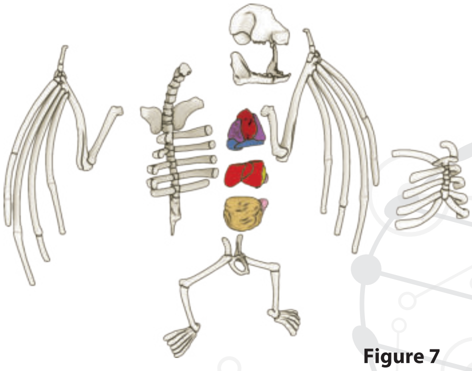


Figure 7

4. Since some of the compound may spill over the edge if you pour too much, it is important to make sure that you are working over newspaper or a towel.

5. Mixing the bat body: You will need a medium sized bowl, a plastic spoon or wooden spatula for mixing, and a measuring cup for the water. Take the bag of powder, and with adult supervision, carefully cut open the bag. Now take the open bag of powder and empty it into the bowl. Using your measuring cup measure around a cup (160ml) of warm (40°C/104°F) water. Then, take the water and slowly pour it into the bowl with the powder and stir until the parts are well combined.

6. Once your mixture is a smooth pudding-like consistency, pour it into the bat mold. Stop pouring once the material has reached the first lip of the bat mold as pictured below. Store in a refrigerator for one hour or until the gel has solidified.

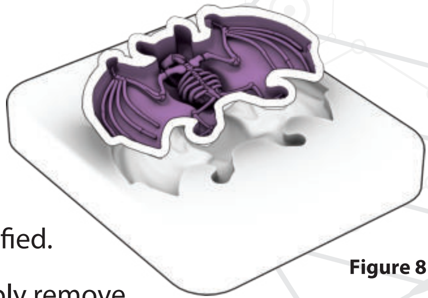


Figure 8

7. Now your bat is ready to dissect. Simply remove the bat from the mold and place it with the belly facing down onto the dissecting table. Since the bat is not real, it is not possible to dissect as a real bat. However, using your provided scalpel and probe, cut sections of the skin to reveal the internal organs and skeleton of your bat.

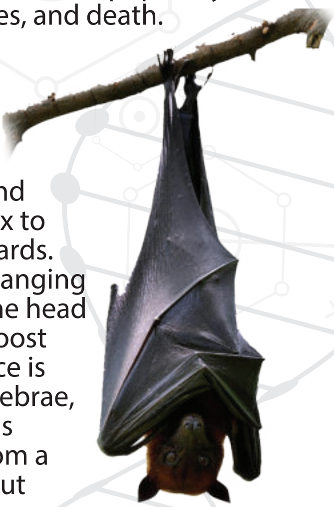
Bat Facts

Megabats and Microbats

Bats are the second largest order of mammals after rodents and comprise about 20% of all classified mammal species worldwide, with over 1,400 species. These were traditionally divided into two suborders: the largely fruit-eating megabats, and the echolocating microbats. But more recent evidence has supported dividing the order into Yinpterochiroptera and Yangochiroptera, with megabats as members of the former along with several species of microbats. Many bats are insectivores, and most of the rest are frugivores (fruit-eaters) or nectarivores (nectar-eaters). A few species feed on animals other than insects; for example, the vampire bats feed on blood. Most bats are nocturnal, and many roost in caves or other refuges; it is uncertain whether bats have these behaviours to escape predators. Bats are present throughout the world, with the exception of extremely cold regions. They are important in their ecosystems for pollinating flowers and dispersing seeds; many tropical plants depend entirely on bats for these services.

The smallest bat, and arguably the smallest extant mammal, is Kitti's hog-nosed bat, which is 1 1⁄8–1 3⁄8 in (29–34 mm) in length, 6in (150 mm) across the wings and 1⁄16–3⁄32 oz (2–2.6 g) in mass. The largest bats are the flying foxes and the giant golden-crowned flying fox, Acerodon jubatus, which can weigh 3 1⁄2 lb (1.6 kg) and have a wingspan of 5 ft 7 in (1.7 m). Depending on the culture, bats may be symbolically associated with positive traits, such as protection from certain diseases or risks, rebirth, or long life, but in the West, bats are popularly associated with darkness, malevolence, witchcraft, vampires, and death.

Roosting



When not flying, bats hang upside down from their feet, a posture known as roosting. The femurs are attached at the hips in a way that allows them to bend outward and upward in flight. The ankle joint can flex to allow the trailing edge of the wings to bend downwards. This does not permit many movements other than hanging or clambering up trees. Most megabats roost with the head tucked towards the belly, whereas most microbats roost with the neck curled towards the back. This difference is reflected in the structure of the cervical, or neck vertebrae, in the two groups, which are clearly distinct. Tendons allow bats to lock their feet closed when hanging from a roost. Muscular power is needed to let go, but not to grasp a perch or when holding on.

Some flying foxes, such as Pteropus, roost in trees and are exposed to the high temperatures of the noonday sun. These bats have adopted a behavioural use of the cooling ability of their expansive wing surfaces. Under high heat stress, they urinate on their wings, which are tightly folded around their bodies, and use the effect of evaporation to cool themselves. This blade, however, has two edges. Certainly, the dissipation of excess heat is to the bat's advantage. On the other hand, the uncontrolled loss of heat could be a marked disadvantage, especially during flight on cool nights.

The Wings

When bats fly, they don't just flap up and down. If you watch them closely, it almost looks like they're pulling themselves through the air -- the movement is similar to the butterfly stroke in swimming.

Another function of the wings is one of gas exchange. During the flight, a great deal of carbon dioxide is generated as a by-product of the high metabolic activity of the flight muscles. Some bats exchange up to 12% of their total carbon dioxide production through the wing membranes (thin membranes and rich blood supply).

Echolocation

The hearing and communication mechanism of the bat is found in the inner ear. Not all of the bat species have it, but most of them do. This is called echolation and it allows them to hear and to communication through vibrations. Other animals with this ability include the dolphin.

This echolation system provides the bat with detailed information about what is going on around them in their environment. They can find prey in complete darkness due to this ability. Therefore, even bats that don't see well are still able to find their prey and to survive without difficulty.

Echolocation pulses are produced by vibrating membranes in the larynx and emitted via the nose or the mouth, depending upon species. Nose leaves in some species may serve to channel the sound.

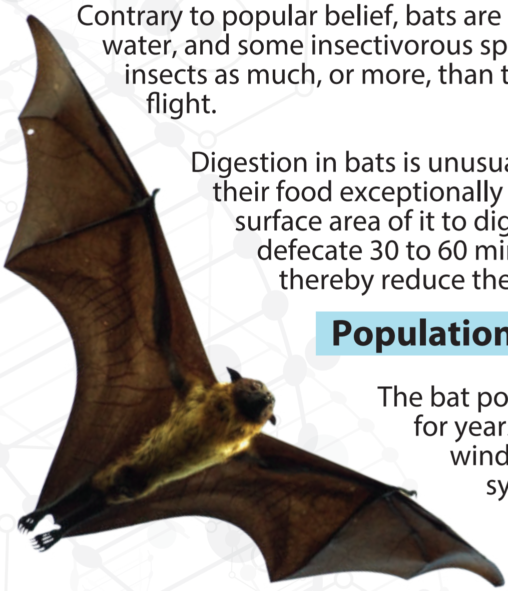
Adaptations

The entire body of the bat is covered with fur. This helps to keep it warm enough for survival. They also have very short legs with knees. The claws on their feet are very strong and that is what they use to allow them to hang upside down while they sleep. They have a small dot like nose but they have an excellent ability to smell with it.

Bats have one way valves in their arteries to prevent the blood from flowing backwards. This is why they are able to hang upside down without the blood rushing to their heads.

The tendons in the legs and feet of bats are organized in such a way that the suspended weight of the hanging bat causes the toes and claws to grip the foothold in the roost firmly, even while the bat is sleeping.

Feeding



Contrary to popular belief, bats are not helpless on the ground or in the water, and some insectivorous species feed on ground-dwelling insects as much, or more, than they feed on insects captured in flight.

Digestion in bats is unusually rapid. They chew and fragment their food exceptionally thoroughly and thus expose a large surface area of it to digestive action. They may begin to defecate 30 to 60 minutes after beginning to feed, and thereby reduce the load that must be carried in flight.

Population Decline

The bat population has been rapidly declining for years. However recent threats such has wind energy development, white-nose syndrome, hunting, damaged habitats, and diminished food supply have accelerated this decline in the US. Bats are a very important part of our ecosystem as they promote biodiversity, pollonate and dispere the the seeds of hundreds of species of plants, and consume large quantities of invasive insects and other arthropods. If bats were to go extinct, it would have a massive effect on our ecosystem, so we need to protect them in order to protect our planet.

Notes

But wait...

There's more to explore!
Check out our other Dissection Kits

Visit www.topsecrettoys.us for more great toys!

⚠ WARNING:

CHOKING HAZARD -- Small parts. Not for children under 3 yrs.

Not suitable for children under 36 months. Choking hazard (small parts). Product specifications, colors and contents may vary from those illustrated. **IMPORTANT:** Please retain packaging/illustrations and purchase details for future reference as they may contain important information.

SAFETY WARNING:

This product is to be used under the direct supervision of an adult. Do not allow material to come in contact with the eyes. Do not place material in the mouth. Keep very young children and animals away from the activity area. Store out of reach of young children. Wash hands after use. Do not use any equipment which has not been supplied with this product or recommended in the instructions for use with this product. Do not eat, drink, or smoke in the activity area.

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CE

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