SPIDERS: Fear & Fascination

Descriptive Audio Guide

Stop 1 – Welcome & Conquer Your Fears

Welcome to the Royal Ontario Museum, and thank you for visiting *Spiders: Fear and Fascination*.

This exhibition comes to the ROM from the Australian Museum, and looks at what makes spiders so unique and beneficial. The ROM has added some cultural objects and stories from our beloved collection alongside the natural history specimens from Australia.

There are seven interactive sections in the exhibition. As you explore, this descriptive audio guide will introduce the main theme of each section, highlight some feature specimens and models, and offer a little bit extra along the way.

How do you feel? Are your spidey senses tingling? Don't be afraid, arachnophobes! Nothing will hurt you in here. Enter now, overcome your fears, and let this exhibition weave a web of fascination.

Stop 2 – What are Spiders?

The first thing you need to know is this: spiders are not insects. They are arachnids. What's the difference? Well, insects have six legs. Spiders have eight. Insects have three parts to their body. Spiders have two body parts. Insects have antennae and wings. Spiders don't. Spiders are also the only animals with glands in their abdomens that produce silk.

Insects and arachnids are both part of a group called arthropods. This group actually has four subgroups: insects, arachnids, myriapods, and crustaceans. All of them have legs with joints, hard external skeletons, and segmented bodies. To understand the difference, let's get to know our first crawly friend, a centipede. Centipedes are myriapods. In the wall in front of you is a terrarium with a live giant desert centipede.

This wriggly critter is approximately 17 centimetres long and about the diameter of your forefinger. Its gleaming black exoskeleton is broken up into a dozen or so segments that allow it to bend in any direction. Lining both sides are over a dozen bright orange legs, one set for each body segment. These jointed legs are also incredibly dexterous – allowing the centipede to cling to, and navigate all sorts of textured surfaces.

What might be most noticeable to you though, is its red head! Standing in stark contrast to the centipede's black body, this red head extends into two antennae which it uses as sense organs when moving about.

In a case to the right of the centipede are three spiders: a weaver, a burrower, and a hunter. Weavers entangle prey in intricate webs of silk. Hunters usually roam their habitat in search of prey. Burrowers eat, rest, and lay their eggs in hollows. They pounce on prey as it wanders past. The spider at the top of this window is a burrower, a desert blond tarantula.

From the front of its head to the tip of its abdomen, this spider is about 5 and a half centimetres long. Unlike the centipede, the tarantula has just *two* body parts that are fairly equal in size. Both the bulbous abdomen, and the fused head and thorax, called a cephalothorax, are covered in fine hair in shades of brown, tan, grey and white.

The only not fuzzy spot you'll find on this critter is the smooth tan plate, called a carapace, which covers most of the cephalothorax. The carapace is divided in two by a spine of sorts, from which small ribs fan out across the back, almost resembling the shell of a crab.

But one of the most distinctive features of spiders are their legs. All eight of them! Branching off of the spider's cephalothorax, the desert blond tarantula's legs are covered in fine hairs that sprout out like bristly fibres. Where the legs meet the body, the hair is dark brown in colour before transitioning to a soft beige and fading to a creamy white at the creature's feet.

Where did spiders come from? If you'd like to hear about spider evolution, find the next stop nearby. Otherwise, keep exploring the exhibition.

Stop 3 – Spider Evolution

Dinosaurs are old. Spiders are older. Venom and silk have helped spiders survive for over 300 million years. Ancient spider fossils are rare, because spiders have mostly soft body parts that aren't easily preserved. But based on the few fossils we do have, their anatomy hasn't changed much in the last 150 million years. And that's given them a lot of time to evolve body forms and behaviours to flourish in different environments today. Some spiders, their silk, egg sacs, and prey have even been perfectly preserved in amber from up to 125 million years ago!

The fossil in front of you is a new discovery! It's from the Burgess Shale, where ROM scientists have been studying ancient life. This is a new species, called *Habelia optata*. It is 508 million years old and is the ancestor of spiders and other closely-related arthropods, like scorpions and horseshoe crabs. Its body forms show the origins of many features on spiders.

When it was alive, *Habelia* had a striped exoskeleton in various shades of brown and simultaneously resembled a spider, a crab and a lobster. Despite its somewhat intimidating look it was only about 2 centimetres long. Scientists and artists worked with a number of small fossils of *Habelia* to reconstruct how this tiny creature would have looked and moved when it was alive.

But small can be mighty. Dark brown tiger stripes run across the large rounded beige shell – like the back of a horseshoe crab – which forms the creature's head. Peering from beneath the front bottom rim are two tiny, wide-set eyes. Protruding from the top are 5 spikey horns.

Trailing off the back of the head is a segmented abdomen that resembles the tail of a lobster. It's intermittently ribbed with a cartilage-like material that allows for bendability and movement; and features a single spike-like appendage off the tip. On its underside, are several spidery legs in bright shades of blue. Under the eyes and around the mouth, *Habelia* has a spray of lighter blue feelers that look like whiskery antennae.

These complex appendages and jaws made *Habelia* a fierce predator for its size. It was likely very mobile and efficient in tearing apart its prey.

Feel free to launch the 3-minute video here and learn how artists reconstructed a 3D model of *Habelia* from the original fossils. When you're ready to continue exploring the exhibition, continue on to the next stop in the section called "Where are Spiders".

Stop 4 – Where are Spiders?

Spiders lives everywhere in the world, except the poles. Most prefer humid, sheltered areas with lots of prey. Over 100,000 species are thought to exist today, but less than half that are documented. Some hitchhike on ships and planes, and end up in new areas. In Canada, there is a variety of landscapes, so many species have adapted to living in intertidal zones along Canada's coast, in the cold of its mountain tops, and even its dry lands. Some species find homes in our houses, sheds, gardens, and even the windows of our tallest skyscrapers.

Tarantulas live mostly in the warmer regions of the world. North America has 29 native species. Even though they're often depicted as deadly, this just isn't true – at least, not for humans. Tarantulas rarely bite—most flick barbed hairs into the face of an attacker!

Many water spiders live along the banks of streams, rivers, and ponds. They have long hairs on their legs and a water-repellent exoskeleton, which allow them to float on top of the water and move quickly. They can also dive and stay submerged for a few minutes if danger is present. In nature they feed on insects, tadpoles, and small fish.

Caves are home to around 1,000 species of spiders, and it's likely that there are more to be discovered. Some species have adapted to life underground, often losing their eyes and colouring to save energy in a prey-poor environment. They are called troglobites. Cave spiders feed on insects and cave crickets. Like their surface relatives, some make webs while others are free-ranging hunters.

Many insects are active at night, making it a perfect time for spiders to hunt. The cool nights are also more comfortable for patching up webs and burrows. Instead of sight, nocturnal spiders use structures on their bodies to detect vibrations and taste chemical signals in their environment. During the day they hide in burrows, under bark, inside leaves, or inside tents of silk, avoiding predators like birds and small mammals.

Here in Toronto, we have a number of spider species across the city, which help sustain our beautiful biodiversity. And even though the bite of a widow or wolf spider may be painful, Toronto's spiders won't kill you. The most common is #9 in this display, the cross orbweaver. You'll find them a lot outside in late summer and early fall, when the females are laying their eggs.

The orbweaver is overall light brown in colour with mottled markings across its body and legs. It has a much smaller fused head and thorax than abdomen and the entire creature is covered in short spikey hairs.

Adults females of this spider range in length from 6.5-20 mm, with an abdomen that looks like an intricately-painted Easter egg. A frilled line along the outer curves of the egg make it look like it's been cut open, revealing textured innards and a sliver of white spine. The creature's fused head and thorax, called a cephalothorax, is 1/3 the length of its body and is framed by two bristly appendages called pedipalps. These are beside the spiders small fangs.

Two tarantula-like legs splay out behind the spider with two stubby legs supporting its mid-frame. Four more, tarantula-like legs sprout out around the head. All the legs feature subtle darker striping and tiny spiked hairs that shoot out at every angle, helping it cling to its web creations.

When you're ready to continue exploring the exhibition, continue on and find the next stop in the section called "Reproduction and Growth".

Stop 5 – Reproduction & Growth

Spiders grow by shedding their exoskeletons. This is called moulting. For some species, it takes years to reach adulthood, but for others, they're full grown after only weeks. Females live longer than males because they have to fatten up and lay eggs.

Spiders lay their eggs in silk sacs, which are often hidden or camouflaged. Some spider species only lay one egg per sac, while others lay a few thousand. The eggs range in size from almost invisible to pea-sized. Inside each fertilised egg is a developing spiderling, feeding on yolk for nourishment. Some might also feed on unfertilised eggs.

On the table below is an enlarged model of a garden spider's egg sac that has been cut open.

This replica egg sac resembles a rather large avocado; however, the actual size of a spider's egg sac would measure between 12 and 15 millimeters.

The outer layer of the sac is a textured and husky. Inside, the sack is lined with a cushion of silk that creates a platform for the developing spiderlings. Dozens, if not hundreds, of miniscule eggs are clustered at the centre of the pillowy cocoon where they will be protected until they hatch.

For some species, when the babies hatch, they disperse to new areas by releasing silk and floating through the air like balloons. In other species, the mother trains her spiderlings to hunt by sacrificing herself as their first meal. There are videos in this section that show both of these scenarios. Find them if you'd like to learn more.

Male and female spiders look quite different. Males generally have smaller bodies with longer legs, making them agile enough to find a mate and avoid becoming her lunch! Females have larger bodies to make eggs, with stouter legs to catch bigger prey.

During courtship, males find females by detecting her chemical signals, called pheromones. To make sure he is not mistaken for prey, he makes his identity clear by using a courtship ritual. Male orb-weaving spiders pluck tunes on the female's web. Male jumping spiders perform elaborate dances, or drum signals on a leaf. Some provide gifts of food. Others cheekily give web packages with nothing inside, hoping she won't notice. After mating, some males become a meal if they don't leave quickly, while others sacrifice themselves, giving their offspring a better chance.

Are you still scared of spiders? Find the next stop to bust some myths about spider venom. Spoiler alert: they're not as venomous as you think!

Stop 6 – Diet, Jaws & Venom

The use of venom has helped spiders hunt and protect themselves for over 300 million years. The powerful concoction of chemicals in spider venom paralyses and even liquefies their prey. Almost all spiders are carnivorous, though some supplement their diets with plant material. They prey mostly on invertebrates. But larger spiders sometimes eat small vertebrates—bats, birds, frogs, snakes... all might be on the menu if they find themselves in the wrong place at the wrong time.

Some species first mash up their prey with serrated teeth. Others deliver digestive juices to liquify their prey through their fangs, leaving their victim intact. The spider then sucks the fluid into its stomach, filtering it through hairs around the mouth.

Spiders have two types of fangs. Some are vertical like daggers, while others close sideways like pincers. On the wall are two enlarged models of these jaws.

On the left is a set of Mygalomorph jaws. These are the parallel jaws found in more primitive spiders, such as burrowers. The fangs strike downward onto prey, so these spiders need a firm footing before striking.

This model is featured in gleaming black. The jaws protrude from a solid face where eight, minute eyes dot the surface. The side-by-side bulbous jaws protrude down from the face like two large teeth; and each is capped with a sharp hooked fang. Since these jaws move up and down, the fangs never touch in the middle. Small spiked hairs line the underside of the tooth toward the mouth.

On the right are Araneomorph jaws. These are the ones found in more modern spiders, such as weavers and hunters, and behave more like pincers with a sideways gripping action. These types of fangs work well on springy webs and on firmer surfaces.

This model is orange and dark brown in colour. Again, the jaws protrude from a solid face mottled with tiny eyes across the surface. Two much larger eyes at the top of the face look like they're bulging out, staring at the viewer. Like the other jaws, parallel pincers protrude from the face like bulbous teeth with a single clawed fang at the end of each. But unlike the others, these fangs move side to side and come together in the middle when grasping prey. The underside of the tooth is lined with tiny spiked hairs, closer to the fangs tha the mouth.

Play the interactive game behind you to see how good of a spider you'd be with these jaws. When you're ready, continue to the next stop to learn about the most venomous spiders in North America.

Stop 7 – Venomous Spiders

The venom of most spiders doesn't really affect humans—the average spider bite is less severe than a bee sting. In Canada, dogs and other mammals are responsible for an average of two deaths per year. Spiders are responsible for none. Most spider bites can be treated at home with soap and water, antiseptic cream, a cold compress, and an antihistamine. If symptoms are severe, go to a doctor.

The most venomous spider in Canada is the black widow. The western black widow can be found from southern Saskatchewan to British Columbia, and the northern black widow is found in southern Ontario. Widow spiders can be identified by their glossy black colour, large tear-drop shaped abdomen, tiny head and thorax, and distinctive red markings.

Widow spiders tend to make their webs in dark and undisturbed areas near the ground. Here they'll stretch out their long stick-like fore and hind legs and wait for something, or someone, to stumble into their tangled and hard-to-see webs.

Widow spiders aren't prone to bite unless you really threaten them. Even then, they won't kill you, but their bites can be extremely painful. Apply ice, but do not apply any bandages as pressure can increase the pain. Seek medical attention.

Humans are finding ways to benefit from spider venom, including possible uses in medicine. To participate in one of our programs, or to learn more from scientists working with spiders, stop by our spider lab. When you're ready to explore the next section, continue on and find the stop introducing "webs and silk".

Stop 8 – Webs & Silk

All spiders make silk. It comes from glands in their abdomen and is spun through spinnerets. Spiders use silk to build homes, ensnare prey, move around, and protect eggs. Many burrowing spiders line their burrows with silk, sometimes using it to extend the areas where they live or catch prey. Trapdoor spiders cover their burrows with a lid made of silk for strength and other natural debris for camouflage. This diverse use of silk is thought to be the key to the evolutionary success of spiders.

Silk fibres are stronger and more flexible than anything made by humans. And different spiders produce different kinds of silk. Continue on to find the stop beside the golden silk orbweaver, who produces one of the most distinctive and spellbinding types of silk.

Stop 9 – Spider Silk Robe

This is a live golden silk orbweaver spider. The spider itself is almost as big as your hand. But don't be scared, these spiders are timid and reluctant to bite humans.

This spider's actual body is quite small and void of hair. The cephalothorax is miniscule, and the abdomen resembles the smooth shell of a pecan nut. The stick-like legs extend wide from the creature's body reaching a span of 13 centimetres, and giving it an intimidating size and appearance.

As the name suggests, the orbweaver's web is spun of soft, iridescent golden silk.

The strong silk of golden silk orbweavers has been investigated for medical uses and has been used to make violin strings and cloth. In fact, continue to your right and you'll find a stunning robe woven entirely of silk from this spider.

This robe is the largest piece of cloth made entirely of spider silk in the world. The fantastic lemon yellow colour has not been modified in any way – it is pure golden orbweaver silk. The robe's construction resembles a sleeveless vest which drapes over the shoulder and cascades down the front of the body to end in a rounded hem. The front closes with a trio of tassels, in the same silk, that hang in tiers and fall slightly longer than the bottom hem. The elegant construction has been beautifully complimented by delicate textured embroidery of spiders across the whole garment. The robe is incredibly light – you almost can't feel it when it's worn.

Perhaps even more impressive that the stunning product, is that this robe took about three years and over a million spiders to produce. Each spider was captured from the wild, milked to produce 30 to 50 metres of thread, and then released back into the wild. There were about 60 or 80 people collecting the threads in Madagascar where the spiders are found.

The ROM added this robe into the existing exhibition from Australia, as a fantastic and inspiring piece that highlights the artistic potential of spiders in our culture. Just past the robe is a large video on the wall. If you like, you can stop to learn more about the making and importance of the spider silk robe. When you're ready, continue to explore the exhibition and find the next stop about spider webs.

Stop 10 – Life on a Web

Some of the most familiar spider webs are the beautiful wheel-shaped orbs made by weavers. They hang in the air like large, transparent sheets, often covered in dew drops in the early morning. The orb's intricate design and construction is complex, with each spider following a blueprint honed by millions of previous generations.

Webs are fun to study and can be distinguished by their structure to identify their maker. Some tentweb spiders gather in groups, joining their webs into a massed tangle of lines. The silk is not sticky; instead, insects become disoriented, colliding with random lines of silk and falling onto the sheet-like orbs where the spider waits to pounce.

The silk in spider webs transmits vibrations over a wide range of frequencies. The spider senses these vibrations, providing it with information about prey, potential mates, the state of the web, or if something is caught in their web. If their web is broken by something large, the spider knows to flee or drop to the ground.

Something is in your web! How will you react? In front of you is an interactive that shows you what it's like when something hits a spider's web. Put your hand on the web on the table, and select the "play" button to the left. When you feel the vibrations, select what you want to do – defeat it, greet it, or eat it!

When you're ready, keep exploring this area and find the stop that introduces the section on spidey (*cough* I mean, spider) senses.

Stop 11 – Sensing Their World

Most spiders have eight eyes; but their vision is still quite poor. They really only detect light, darkness, and movement. A few species, like some cave spiders, are totally blind. Others can see almost 360 degrees! When hunting, jumping spiders first detect blurs of movement with their side eyes. They then turn to look with their sharp middle eyes. They move closer using their front eyes to judge when they are within range... and then they leap. Now, spiders may have eight eyes, but their eight legs are really where the action is.

Imagine tasting with your fingers and hearing with your hair! A spider's limbs are covered in thousands of hairs of different types—some are for touch, taste, hearing, and probably smell, making their legs their primary sensory organs.

Hairs on a spider's legs are hollow and sensitive to chemicals, which lets them 'taste' what they touch. That's how they detect poisonous prey and know to steer clear. Spiders can also smell chemicals in the air, but arachnologists aren't exactly sure how they do this. Smell may help them detect mates, avoid predators, and hunt prey.

This model of a hunting spider's leg shows different types of hair growing from its magnificent deep purple and blue exoskeleton.

At the top, the hair is long, dense and coarse, and sprouts away from the body. These are for sensing air movements and low frequency sound vibrations. At the bottom of the leg, the hair thins out, is much shorter and finer in texture, and lies flatter. These hairs are sensitive to touch. Around the sharp claws of the foot is a bristly tuft of tiny, brush-like fibres. These hairs are used to grip onto surfaces.

On a real spider, there would be thousands of hairs and other sensory organs, and they'd be much, much smaller.

Some hairs on the spider's body allow them to 'hear' vibrations like the buzz of a flying insect! Some spiders even make sounds by rubbing body parts to deter predators or attract mates, just like crickets and other insects. Males of some spiders pluck a female's web or drum on the ground to signal he's a potential mate and not a meal. Here's what one of them sounds like… [audio clip]. To your right is an interactive about sounds spiders make. Launch the sounds with the buttons on the left and match them to the correct creature on the other buttons.

Spiders are agile and fast. Believe it or not, a spider only has four legs on the ground at any one time. Some can skate on water to chase prey; others somersault to escape predators. Many can walk on ceilings, stick to smooth surfaces, and waltz around delicate webs. All of this is possible thanks to their unique limb movements, hooks called tarsal claws and, for some, densely packed hair tufts at the tips of their legs.

Spider are important in human art and culture. To learn more about our relationship with spiders, continue on to the stop in the section called "Spiders and Us".

Stop 12 – Spiders & Us

Spiders are beneficial to humans in so many ways. Firstly, they get rid of bugs. But more importantly, scientists are discovering ways artificial spider silk could be used by surgeons to repair damage from heart attacks. And chemicals in venom are being studied to assist with pain management and produce safer pesticides. With modern technology, everyone can contribute to the body of scientific knowledge that helps us understand our world… even you!

Studying spiders is fun! And once you start, you'll notice they're all around you. Any citizen can be a scientist. If you want to be one, here are some helpful tips:

- Try to study spiders without disturbing them or their webs.
- Take photos and make notes so you can identify them later.
- Never put your hands where you wouldn't be able to see your fingers.
- If you want to keep a spider in captivity, don't keep them for too long. They do better in the wild!

- Set up the right conditions to keep your spider healthy. It will need plenty of air, water, food, and hiding spots.
- Don't keep more than one spider in your container—they'll probably eat each other!
- If you don't interfere, individual spiders will show you how they feed, build webs, nest, and groom.
- Female spiders are often carrying sperm or developing eggs in their abdomens. If one produces an egg sac, you could be rewarded with spiderlings.
- Spiders need live food. Depending on what you can find, you can experiment with their diet.
- If you find a dead spider, you can study that too! But make sure it's dead. Place it in a freezer for a couple of hours before you handle it.

Spiders have influenced cultures around the world for centuries. Continue on to the next stop to learn about spider stories from indigenous cultures.

Stop 13 – Spider Tales

Many cultures around the world have told stories about spiders. Many African folktales feature a spider named Anansi, who successfully completed tasks given to him by the Sky god Nyame, and became the god of all stories. You can hear one of Anansi's stories on the screen nearby. In Canada, Anishinaabeg tell a story of how a spider helped humans learn how to preserve food.

For years, people's food would spoil before they could eat it. And life was equally hard for a six-legged, pot-bellied creature called a Manitoosh. Manitoosh ate flies, but was slow and awkward and could not catch the nimble flies. It tried hiding in dark corners, hurling grains of sand at them, and even letting itself down from above on a special thread that it made. But the flies just laughed and dodged out of reach. For years, no one realized that the troubles of the people and Manitoosh were connected. One day, the humans prepared a feast for a powerful spirit named Nanabush to talk about their situation. During the meal, flies swarmed all over the food. The Manitoosh and its siblings ran and leaped to catch the flies, but weren't very successful. Nanabush felt bad for the poor bugs who were going hungry and said, "I have watched you trying to catch the flies. I know that you can make a thread to let yourself down from above. Couldn't you use the thread to make a trap for catching flies?" The Manitoosh hurried home and began weaving the thread in a criss-cross fashion. The bug worked all day and night until it was exhausted. When Manitoosh woke the next day, to its joy and surprise, it saw two flies caught in its net. Manitoosh ate its fill and hurried to tell its siblings how to make nets to catch flies. Humans too, learned

from the Manitoosh how to make nets to catch fish. Because the Manitoosh had helped the people, the Great Spirit Kitche Manitou gave each bug an extra pair of legs. He also gave the bug a new name, Supp-Kay-Shee or Net-Maker.

Beyond myths and stories, spiders have influenced artworks and cultural objects as well. In the case in front of you is an Anishinaabe cradle charm from around 1900.

Crafted from branches and wicker, this circular charm is 13cm or about the size of a grapefruit. The thick outer rim is rounded from a wooden branch and bound with thread. The interior of the circle features a spiralled webbing constructed of thread that looks like a swirling net.

Based on the trapping nature of a spider's web, these woven charms were hung over baby's cradles to keep illness, evil forces, and bad dreams from reaching the infant. It was these Anishinaabe netted hoop charms that inspired modern dream catchers.

Spider stories are still being told today. Continue on to the next and final stop to hear about another familiar web-slinger.

Stop 14 – Amazing Spider-Man

Are your spidey senses tingling? In August of 1962 Peter Parker first appeared in Amazing Fantasy #15. The teen was bitten by a radioactive spider and developed super powers. The comic character quickly received his own story. The Amazing Spider-Man debuted as its own series in 1963.

The cover of Amazing Fantasy #15 features Peter Parker in his now classic Spider-man garb. A midnight-blue leotard that fits like a second skin outlines Spidey's muscular physique with a red, web-printed overlay across his chest. A black spider motif is emblazoned at the centre.

The red overlay continues over Spidey's arms in protective gloves and over his head in an identity-obscuring mask with large bug-like eyes. The costume is accessorized with a matching red belt and knee-high boots.

Spidey swings between city skyscrapers on a web-tether he shoots from his wrist. He effortlessly swings a burly villain he has in his custody and proclaims, “Though the world may mock Peter Parker the timid teenager, it will soon marvel at the awesome might of Spider-man.”

The retail price of this enviable collectible at the time was a whopping 12-cents. Today, an original copy of this first appearance of Spider-Man is quite rare, and certainly costs much more!

The popularity of spider characters grew over the years. In 1977 we met Spider Woman, who received her own series the following year. Black Widow, a fierce character named after the famous venomous spider known for feasting on her mate, debuted shortly after Spider-Man, in Tales of Suspense #52 in 1964. She received her own graphic series recently in 2016. Clearly there is still an appetite for spider heroes! With incredibly loyal spider fans, Marvel has expanded the spider empire into movies and memorabilia, including two new films featuring Spider-Man this year.

Want to be part of the story? Now’s your chance! Get up close to Spider-Man in a life-sized comic against the wall nearby. Strike a pose and snap a pic! Hashtag ROMspiders!

Well. You did it! You made through alive. Are you feeling a little braver than when you started this exhibition? Have you gained some appreciation for our fascinating leggy friends? We hope you enjoyed the exhibition and this audio guide. Thanks for visiting Spiders: Fear and Fascination!