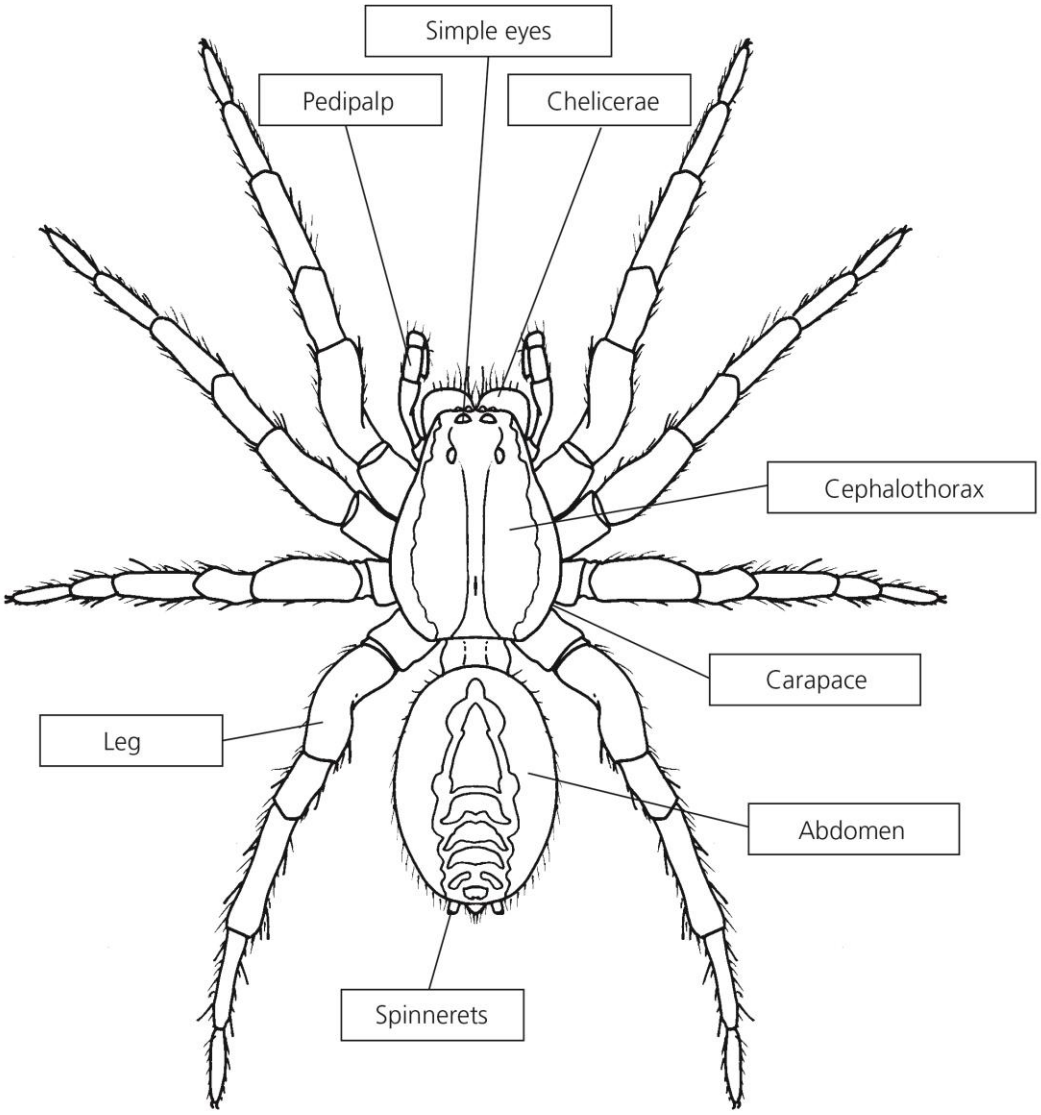
Pre-visit Activities



Cephalothorax
A main body part consisting of the fused head and thorax.

Abdomen
A main body part at the posterior end of the body.

Legs
Spiders have four pairs of jointed legs.

Pedipalps
Appendages between the front legs and jaws. They are used to handle and crush prey, move objects and males use them to transfer sperm to females.

Carapace
A hard exoskeleton covering the surface of the cephalothorax. It provides support, protection and a site for muscle attachment.

Chelicerae (Jaws) tipped with fangs
Used to paralyse prey.

Spinnerets
Silk spinning organs.

Simple eyes
Spiders generally have eight eyes.

AUSTRALIAN MUSEUM

(a) Use the dichotomous key to identify the following leaf litter arthropods:

A 

Beetle

B 

Centipede

C 

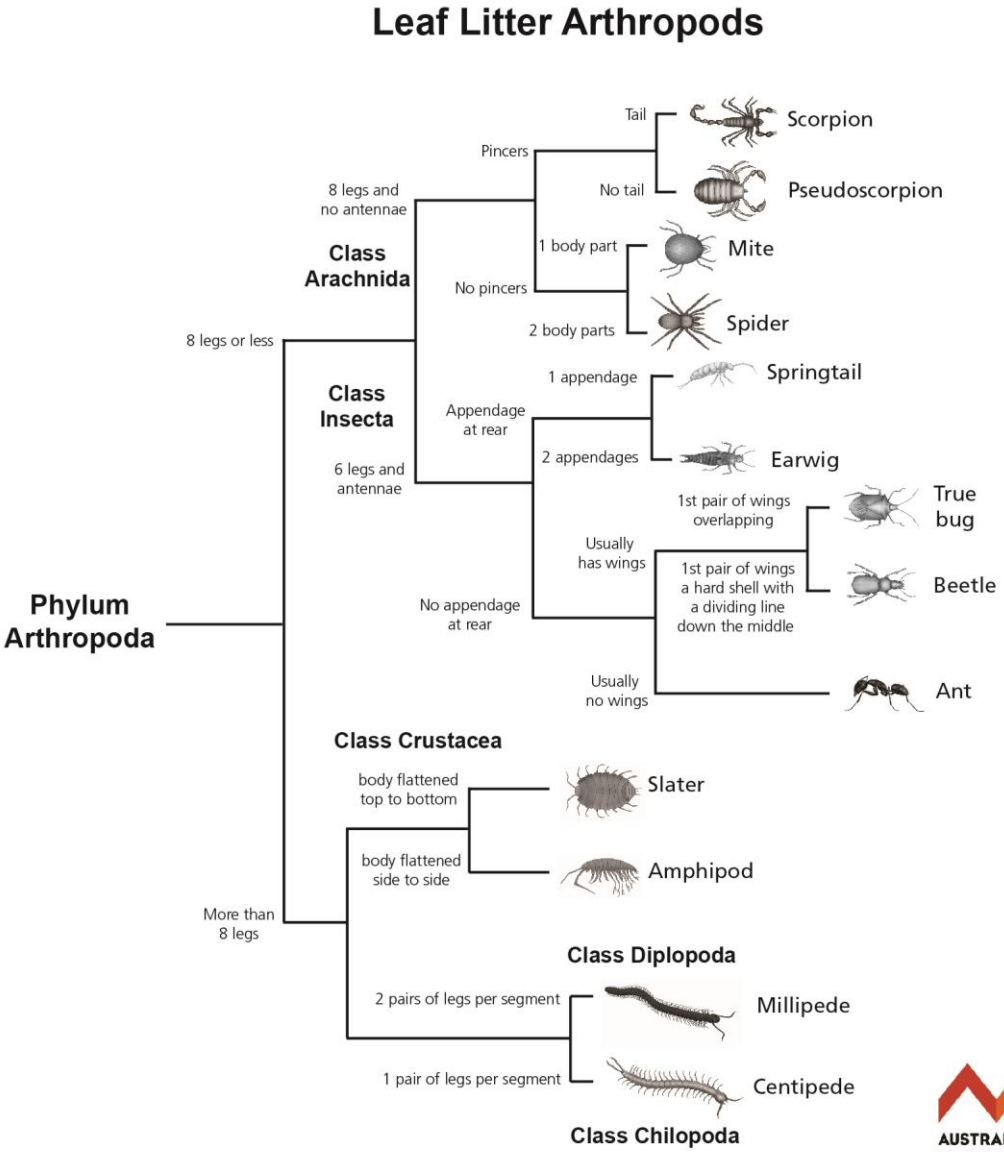
Spider

D 

Mite

E 

Scorpion



(b) Use the dichotomous key to describe the features of a spider.

Spiders are a type of arthropod that belong to the class of animals called arachnids.

Spiders have eight legs and two body parts. They have no antennae or pincers.

Post-visit Activities

Spider Crossword Puzzle

Across

1. A ball made of silk that protects spider eggs
2. Body colouring that makes me hard to see
8. The organ through which silk is produced
9. Most spiders have this number of eyes
11. The name for spider jaws
12. Hunters have large _____ to find prey
13. A type of microscopic arachnid
15. Found on the body and detect vibrations
16. A type of spider web often seen in the garden
17. Burrowers fangs close in this direction
22. The Huntsman is in this group of spiders
26. Injected by fangs to paralyse prey
27. A main body part of a spider
28. Spiders are ___ vertebrates
29. Spiders make these to catch prey
31. Spiders can't fly because they never have these
33. This spider throws it web over its prey
35. This spider spins a sticky blob on a silk thread
36. The central body part of an insect

Down

1. A skeleton on the outside of a body
3. Found on the tip of spider jaws
4. Spiders can produce this material their whole life
5. Some arachnids have only _____ body part
6. Spiders belong to this class of animals
7. Specialised silk _____ make silk in the abdomen
10. An appendage located between the jaws and front legs
14. The ___back is a venomous species of weaver
19. The Funnelweb belongs to this spider group
20. Invertebrates with three body parts and wings
21. The St. Andrew's Cross Spider is a _____
23. A bite from this spider can kill a human
24. Spider silk is stronger than this material
25. This spider is named after a dog that hunts in a pack
30. A blood-sucking arachnid
32. Crustaceans usually have this many legs
33. Insects are ___ arachnids
34. Insects have ___ legs

A phylogenetic tree shows the evolutionary relationship between species. Read the following paragraph and 'Silk: the Spider's Success Story', and refelct on your visit to the Spiders exhibition to help you complete the phylogenetic tree of spiders.

Spiders (Order Araneae) are divided into the two main groups called the Mesothelae and Opisthothelae. The Mesotheles are the most ancient spiders and are nocturnal burrowers. The abdomen of mesotheles have visible segments and the spinnerets are in the middle of the underside of the abdomen.The Opisthotheles are the more recently evolved spiders that have spinnerets on the tip of their abdomen. The Opisthotheles are further divided into two groups, the Mygalomorphae and the Araneomorphae. Mygalomorphs generally have large and dark coloured bodies, well developed mouthparts for digging burrows and their fangs move in a vertical direction which restricts them to catching prey on solid surfaces. Araneomorphs have physical and behavioural adaptations.The fangs of these spiders close in a horizontal direction; some have long, thin legs for life on a web, while others have large eyes to hunt their prey.

Write each of the following words in the correct box

Araneae, Araneomorphae, Mesothelae, Mygalomorphae, Opisthothelae

Draw a line to connect each spider to the correct box

Blue Mountains Funnelweb

Golden Orb-weaver

A segmented spider

Present

Mygalomorphae

Araneomorphae

Mesothelae

Opisthothelae

Araneae

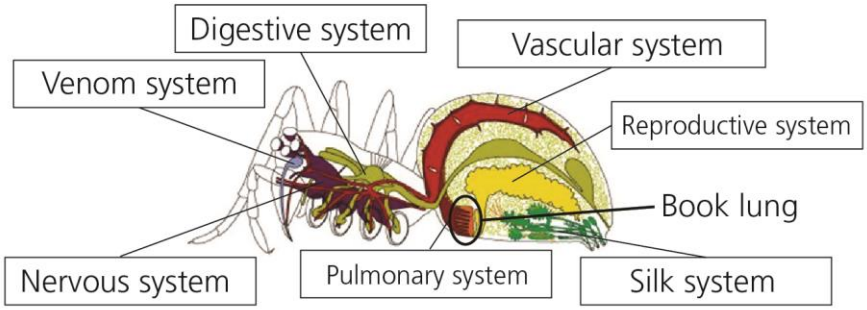
Past

b. Name three pieces of evidence used to make the phylogenetic tree of spiders.

1. Physical features 2. Behavioural features 3. Genetic evidence

Stage 4 Answers
Burrower

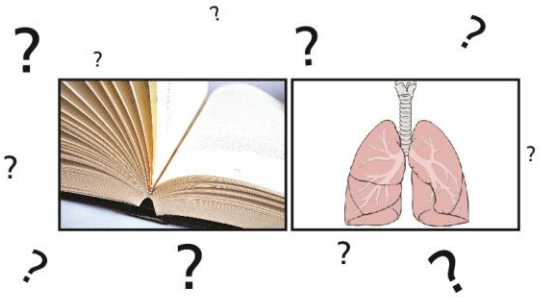
B1. (a) Spiders have organ systems that carry out specialised functions that enable them to survive and reproduce. Go to the **spider anatomy touch screen** in **WHAT ARE SPIDERS?** to help you label the organ systems on the diagram below.



(b) Help the spider to connect a piece of silk between each organ system on the left to the correct function on the right.

Venom system	Tranfers haemolymph around the body.
Digestive system	Produces venom to paralyse prey.
Vascular system	Produces silk for webs and egg sacs.
Reproductive system	Breaks down food and absorbs nutrients.
Silk system	Detects touch, olfactory and visual stimuli.
Pulmonary system	Produces sperm or eggs.
Nervous system	Exchanges oxygen with haemolymph.

(c) Cryptic question!

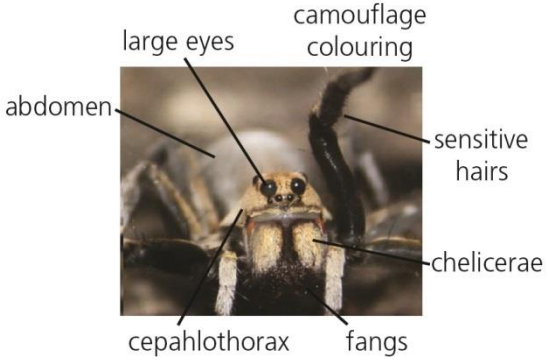
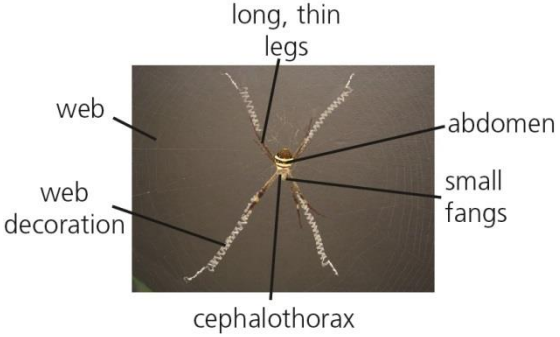


Spiders use these to breathe

Book lungs

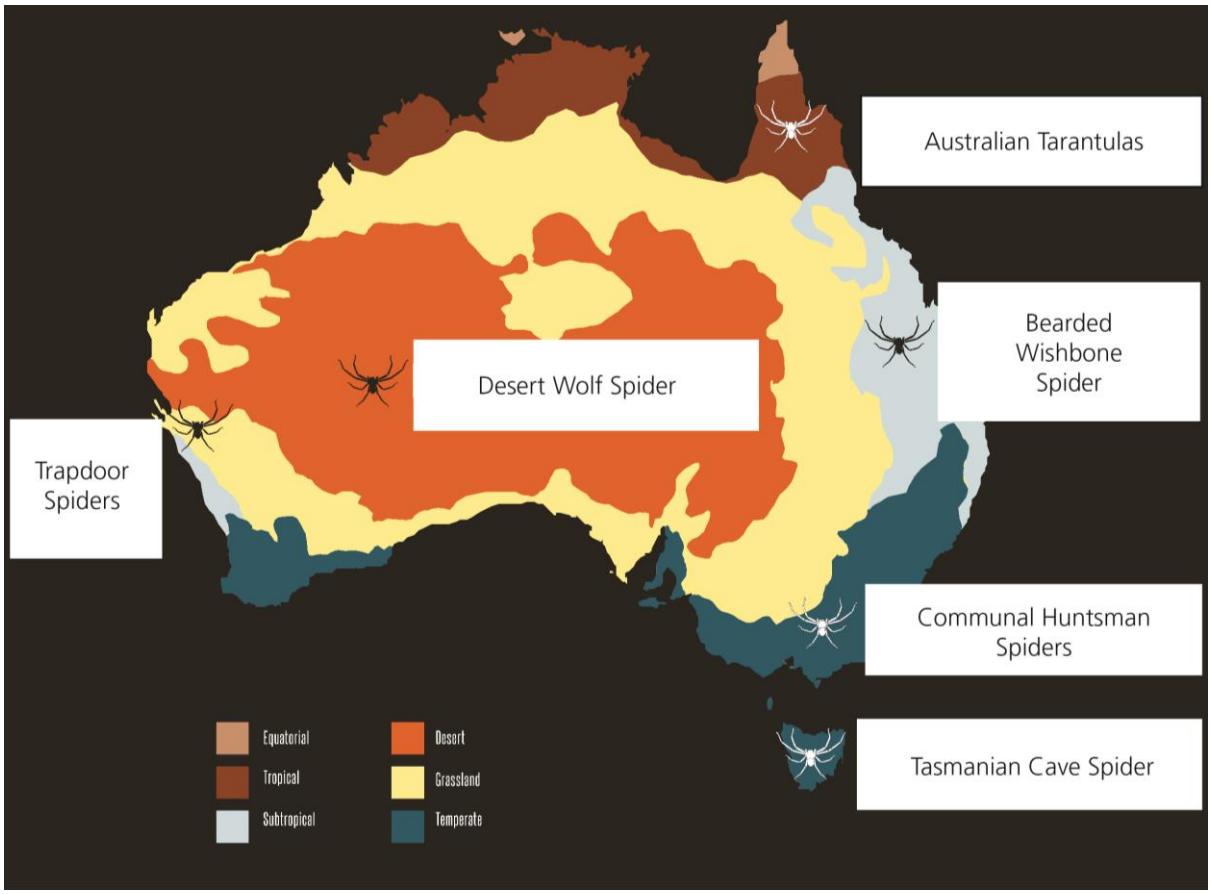
Circle me on the spider diagram above

B2.

Species	Draw and label your spider	Describe the spider's adaptations (physical and behavioral)	Explain how the adaptations help survival and reproduction
 Common name: **Sydney Funnelweb Spider** Scientific name: ***Atrax robustus***		- Black and shiny colouring - Long spinnerets - Aggressive when threatened - Large jaws and fangs - Live in burrows - Robust legs and body - Build funnwelwebs - Lay trip-lines at burrow entrance - Small eyes	- Large jaws to dig burrows - Long spinnerets to make funnelweb - Trip-lines detect prey - Large eyes not required for life underground - Large size to tackle prey - Vertically closing fangs to catch prey on ground - Life undergound prevents dehydration
 Common name: **Garden Wolf Spider** Scientific name: ***Lycosa godeffroyi***		- Agile, fast moving - Hunt their prey - Strongly patterned (grey, brown, white and black) - Large eyes - Nocturnal - Mother carries eggs sac - Spiderlings ride of mother's back	- Fast to catch prey - Camouflage helps to stalk prey - Large eyes detect prey - Mother's protection increases chance of eggs and spiderlings surviving
 Common name: **St Andrew's Cross Spider** Scientific name: ***Argiope keyserlingi***		- Long, thin legs - Bristly feet - Build orb-webs with patterns - Females have a coloured abdomen - Produce several types of silk - Drop off web or shake it violently when threatened	- Legs give reach across web - Bristly feet don't get tangled - Web catches flying prey - Web pattern might attract prey or deter predators - Silk catches prey/protects eggs - Escape predators by dropping off or shaking web

Burrows generally have larger and more robust bodies compared to other spiders. Their jaws close in a vertical rather than a horizontal direction and they have small eyes.

B3. (a)



(b) Desert.

(c) Deserts are dry habitats caused by a low level of precipitation. They have sparse vegetation and have high daytime temperatures. Animals and plants that live in the desert have evolved adaptations to surive in the harsh habitat.

(d) Burrowers spend a lot of time underground. This behavioural adaptation allows spiders to avoid high temperatures and dry air conditions at the surface.

B4. (a) Scientists can use spider jaws to classify spiders into major groups. Burrowers are an ancient group of spiders compared to the more recently evolved weavers. Burrowers (also known as Mygalomorphs) generally have jaws that close in a vertical direction. This restricts them to catching prey on a fixed surface. Weavers (also known as Araneomorphs) usually have jaws that close in a horizontal direction which is an adaptation for catching prey in webs.

(b) 1, Cancer; 2, Heart disease; 3, Falls; 4, Car accident; 5, Homicide; 6, HIV/AIDS; 7, Snake; 8, Sharks; 9, Bees and wasps; 10, Spiders.

(c) Spiders do not pose a significant threat to our lives when compared to the other factors on the list.

(d) The most appropriate medical treatment can be given if the spider is identified.

Hunters

H1. White Flower Spider

H2. (a) Consumers

(b) Similarities: all three spider species eat other invertebrates.

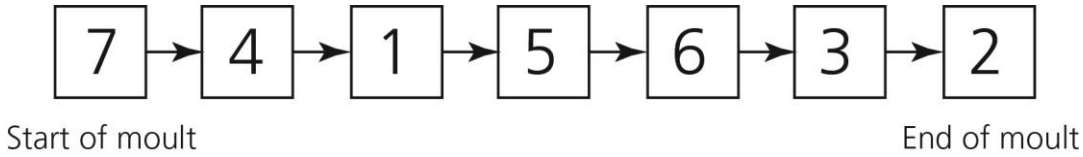
Differences: a spider's diet will depend on where it lives and how it obtains its food. Most spiders are generalists but a few species have highly specialised diets. The Funnelweb spider catches prey such as millipedes, bugs and beetles on the ground. The Huntsman Spider catches prey such as crickets and moths that land or climb up tree trunks, rocks and walls. The Golden Orb-weaving Spider catches flying prey such as bees and flies.

(c) Burrowers like the Funnelweb Spider spend most of their life in burrows and sense the vibrations produced by invertebrates that touch silk trip-lines near the burrow entrance. Hunters like the Huntsman Spider catch a diversity of prey because it hunts ground dwelling invertebrates and catches flying insects that land. The weavers such as the Golden Orb-weaving spider specialise in catching flying insects with their webs.

(d) Spiders maintain insect populations and also serve as prey for other predators.

H3. See next page

H4. (a) Correct order:



(b) Vertebrates have an internal skeleton (endoskeleton). Vertebrate skeletons are mainly made of a protein called collagen as well as calcium minerals (calcium phosphate and calcium carbonate) that provide additional strength. Spiders have an external skeleton (exoskeleton) made of a polysaccharide (a type of carbohydrate) called chitin.

(c) Spiders need to moult so they can grow. Their exoskeleton prevents them from growing and the only opportunity to grow is before their new exoskeleton hardens.

H3. Three examples of hunter camouflage:

Species	Description of camouflage	How camouflage helps the spider to survive
 Common name: **Ant Mimic Spider** Scientific name: ***Ligonipes* sp.**	The Ant Mimic Spider looks like an ant. Some of these spiders also smell like ants.	Ants are particularly good animals to mimic, firstly because they are very numerous and secondly because many animals find them distasteful or dangerous to eat. By looking like an ant, the spider mimic is less likely to be noticed or eaten. These spiders are such good mimics that they trick not only animals that eat ants but they trick the ants as well. These spiders are able to enter the ant nest unchallenged and steal their young.
 Common name: **Bird Dropping Spider** Scientific name: ***Arkys curtulus***	The Bird Dropping Spider resembles bird poo! It has brown, black and white colouring.	This is an effective strategy against being eaten by day-active predators like birds and wasps. Its colouration and immobile posture fools predators into thinking that the spider is a blob of dung rather than a healthy meal.
 Common name: **Leaf Curling Spider** Scientific name: ***Araneus dimidiatus***	Leaf-curling Spiders are fat, oval-shaped spiders with red-brown legs and body and a cream coloured pattern on their backs. They hide in a curled leaf they incorporate into their web.	The Leaf-curling Spiders are day-active orb weaving spiders. They hoist a leaf from the ground and, using silk threads, curl it to form a protective cylinder, silked shut at the top and open at the hub. They then sit in this cylinder with only their legs showing, feeling for the vibrations of a captured insect. The curled leaf protects them from birds and parasitic wasps.

Weavers

W1. (a) Two examples are the Silver Orb-weaving Spider (*Leucauge* sp.) and the Redback Spider (*Latrodectus hasselti*).

(b) Possible answers include:

Weaver (e.g Silver Orb-weaver)	Whistling Spider
Long, fine legs	Strong, stocky limbs
Small, pincer-like fangs	Large, dagger-like fangs
Short spinnerets	Long, flexible spinnerets
Weaves a web	Lays down silk in a burrow
Uses many types of silk	Uses simple types of silk

(c) The weavers have evolved into many different body shapes and use silk in a variety of ways. Weavers sometimes have long legs to give them better reach across their web and bristly feet that don't get tangled. Their protective features such as hard spiky bodies or camouflage also protect them from predators and help to avoid detection by prey. Webs have also enabled this group of spiders to move off the ground to catch flying insects.

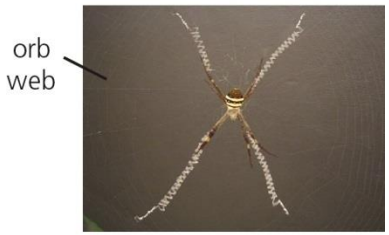
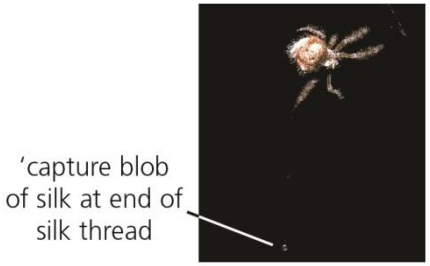
(d)

Weavers have many different body shapes	True
Weavers sometimes have long, fine legs	True
Weavers have short, stocky legs to better reach across their web	False
Weavers have smooth feet to help them move across their web	False
Weavers sometimes have protective features such as hard, spiky coverings	True
Weavers have poor camouflage	False
The Sydney Funnelweb Spider is a weaver	False
The Golden Orb-weaving Spider is a burrower	False

W3. See next page

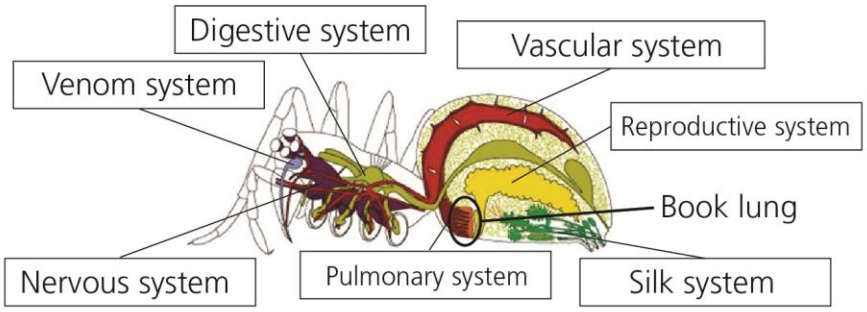
W4. Spiders are successful predators because they produce **silk** throughout their lives. Unlike some species of **insect** that produce one simple type of silk, spiders can make many types of silk proteins in specialised organs called **spinnerets** on their abdomen. Each spinneret consists of two or three spinneret pairs. Spinnerets consist of microscopic **spigots** that control the **thickness** of the silk filament. The spinnerets combine the silk strands to make a sturdy silk fibre.

W3.

Species	Draw the spider showing how it uses silk to catch prey	Describe the behavioural adaptations of the spider
 Common name: **St. Andrew's Cross Spider**		St Andrew's Cross Spiders are named for their bright web decorations - zig-zag ribbons of bluish-white silk that form a full or partial cross through the centre of the orb web. They build orb webs and sit still in the middle of their web awaiting prey. When prey hits the web the spider runs towards it and bundles it up in silk before biting it. When threatened, the St Andrew's Cross Spider responds either by dropping from the web or shaking it so vigorously that both spider and stabilimentum become a blur, confusing its attacker.
 Common name: **Jumping Spider**		Many jumping spiders daylight hunters, using their excellent vision to track, stalk and calculate distance, before suddenly leaping on their prey, propelled by their strong back legs. Males are often more strikingly coloured, patterned or adorned with leg or body hair tufts than are females. They use these adornments to impress the females during often elaborate courtship displays. No group illustrates this better than the Peacock Spiders of the genus *Maratus* (= *Saitis*).
 Common name: **Bolas Spider**		Bolas spiders capture their prey by deception. At night they spin a short line of silk with a sticky globule of silk at the free end - the bolas (named after a South American throwing weapon made of rope and weights). This sticky silk globule may contain pheromones that mimic the scent of a certain female noctuid moth species, attracting unwary male moths within range. The Bolas Spider is very sensitive to vibrations, twirling its thread when it senses the approach of a moth's beating wings. The moth eventually flutters close enough to be hit by and become stuck to the globule. The spider then pulls up the strand, bites and immobilises the moth, and either eats it straight away or stores it for later, wrapped in silk.

Stage 5 Answers

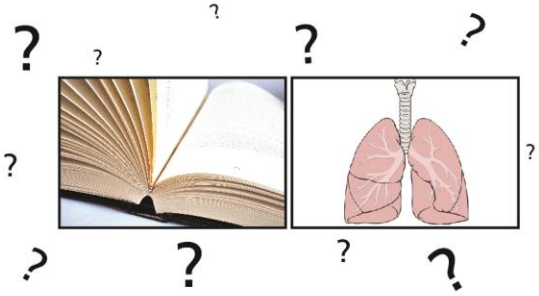
1. (a) Spiders have organ systems that carry out specialised functions that enable them to survive and reproduce. Go to the **spider anatomy touch screen** in **WHAT ARE SPIDERS?** to help you label the organ systems on the diagram below.



(b) Help the spider to connect a piece of silk between each organ system on the left to the correct function on the right.

Venom system	Tranfers haemolymph around the body.
Digestive system	Produces venom to paralyse prey.
Vascular system	Produces silk for webs and egg sacs.
Reproductive system	Breaks down food and absorbs nutrients.
Silk system	Detects touch, olfactory and visual stimuli.
Pulmonary system	Produces sperm or eggs.
Nervous system	Exchanges oxygen with haemolymph.

(c) Cryptic question!

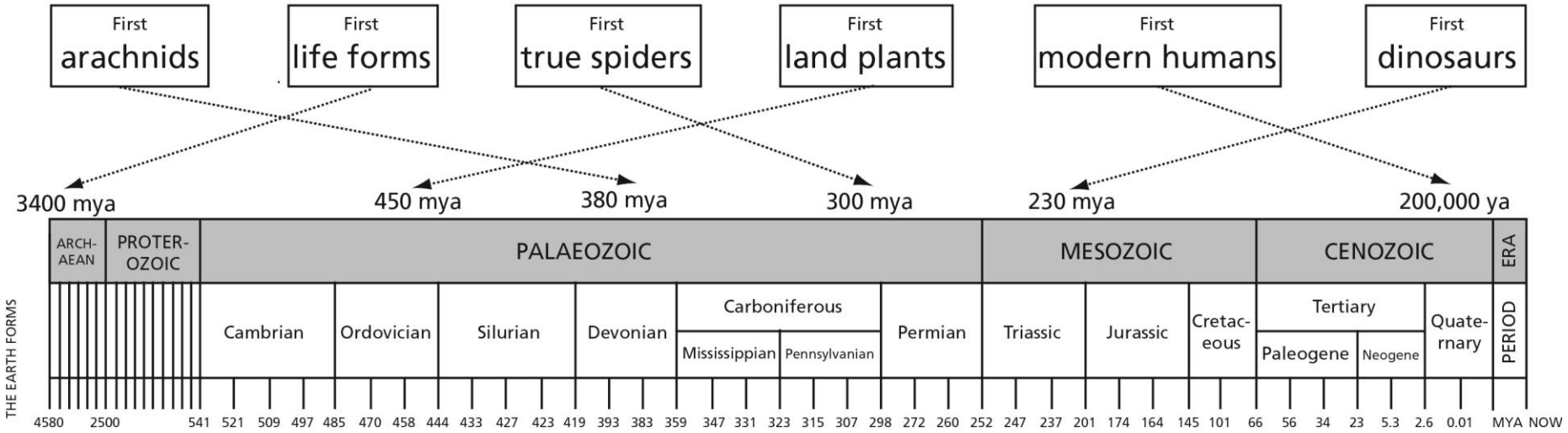


Spiders use these to breathe

Book lungs

Circle me on the spider diagram above

2. (a)



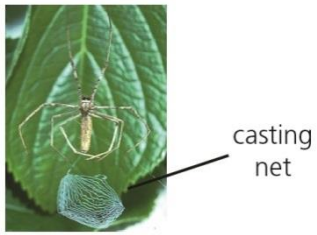
(b) 155-147 million years ago in the Jurassic period.

(c) Spiders have soft bodies in comparison to vertebrate bones that more readily form fossils. Spider bodies are more likely to decompose, be squashed or eaten before they form fossils.

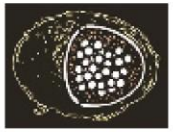
(d) Amber is fossilised tree resin (usually produced by conifers). It is often transparent so anything that fell into it when it was still sticky can easily be seen. Spiders, their silk, egg sacs and even their prey have been perfectly preserved in amber, with some dating back about 100 miliion years.

(e) Mesotheles. Mesotheles have visible segments on their abdomen called tergites indicating an evolutionary relationship with other segmented arthropods.

3. Three possible answers are:

Species	Physical adaptations (Draw or describe)	Behavioural adaptations	Explain how the adaptations help the spider to survive and reproduce
 Common name: **Sydney Funnelweb Spider** Scientific name: ***Atrax robustus***	- Black and shiny colouring - Long spinnerets - Large jaws and fangs - Robust legs and body - Small eyes - Vertically closing fangs - Sensitive hairs on legs and body (see above for diagram)	- Aggressive when threatened - Spend most of their time in burrows - Build funnwelwebs - Lay trip-lines at burrow entrance - Respond to vibrations near burrow entrance	- Large jaws to dig burrows - Long spinnerets to make funnelweb - Trip-lines detect prey - Large eyes not required for life underground - Large size to tackle prey - Vertically closing fangs to catch prey on ground - Life undergound prevents dehydration
 Common name: **Garden Wolf Spider** Scientific name: ***Lycosa godeffroyi***	- Strongly patterned body - Grey, brown, white and black colouring - Large eyes - Sensitive hairs on legs and body (see above for diagram)	- Agile, fast moving - Hunt their prey - Nocturnal - Mother carries eggs sac - Spiderlings ride of mother's back	Their agility, good vision and camouflage allow Wolf Spiders to catch prey. Their camouflage also allows them to blend in with the leaf litter and evade predators. The protection offered by mothers' increases the survival chances of eggs and spiderlings.
 Common name: **Net-casting Spider** Scientific name: ***Deinopsis* sp.**	- Stick-like appearance - Camouflage colouring 	Hangs from vegetation with its head downwards. The spider also assumes a head-down position when it is waiting for prey, except that it holds its net with the front four legs and suspends itself by the back legs and spinnerets from support lines to surrounding foliage. In order to have an aiming point, the spider often drops splashes of white faecal droppings onto the substrate over which it is poised. When an insect walks across this 'target', the spider plunges its net downward to envelop and entangle it. The spider silk-wraps the prey item, bites and paralyses it, and then feeds on it. Net strikes will also be made at flying insects. An unused net is sometimes stored by hanging it on nearby leaves for the next night's hunting, or the spider may eat it.	The Net-casting spiders' stick-like appearance and colouring enable them to blend in with their surroundings. This camouflage combined with their unique web enable them to catch unsuspecting prey. A well fed spider is more likely to survive longer and find mates to produce offspring.

4. (a) Use the information in **WEBS AND SILK** to help the spider connect a silk thread to the correct function.

Type of silk	Diagram	Gland
Capture spiral silk		Aggregate
		Flagelliform
Attachment silk		Pyriform
Auxilliary spiral silk		Minor ampullate
Egg sac silk		Cylindrical
Prey wrapping silk		Aciniform
Structural silk		Major ampullate

Function of silk
Forms the soft inner lining of egg sacs and used to wrap prey
Cements joints and attachments
Gluey, highly adhesive droplets on the capture spiral
Forms the structural fibres of the capture spiral
Forms the dragline and structure of the web
Forms the auxillary spiral (guide for making capture spiral)
Tough, insulating cover around egg sacs

(b) Extension. DNA is the blueprint of life. It is organised into chromosomes in the cells of all living things. Genes are small pieces of DNA on chromosomes that contain codes to make proteins. Spider silk is made of protein that is encoded by genes in the DNA of spiders. Each type of silk is encoded by a unique gene. Ancient spiders such as Funnelwebs can make a few types of silk, while more recently evolved spider such as the Orb Weavers with their spectacular webs can make up to seven silk types. **Explain how new silk genes evolved and how this enabled spiders to diversify and occupy new niches.**

Genetic mutations can result in new peptide sequences and proteins with different properties. New silk proteins that improved a spiders chance of surviving and reproducing would have been favoured by natural selection. The evolution of different silk types enabled spiders to evolve from ground dwelling animals to predators that occupy niches in the trees, water and skies.