Course Information

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Course Website

http://www2.nau.edu/~shuster/shuster.htm
Current Teaching -> BIO 300

All course information and updates will be posted there.
Lectures pdfs will be available there also, usually the day of the lecture.

Course Description

This course is a survey of films that use **invertebrate animals as central plot devices**, and in particular, that focus on invertebrate animals as **monsters**.

Lectures will concentrate on organizing and interpreting information about the animals featured in each film.

Laboratories held during class periods will feature screenings of selected examples of these films, followed by group discussion of lectures and of films.

Course Objectives

The **three primary objectives** of this course are to provide students with:

1. An understanding of the conceptual framework that unifies biological science.
2. The physical and evolutionary forces that appear to limit the form of invertebrate life on this planet.
3. An appreciation for the devices and themes that film makers have used to depict and exploit human attitudes, prejudices and fears regarding invertebrate animals.

Course Approach

Class meetings will consist of lectures and films presented by the instructor in LA 135 (or BS 234), at 10:00-12:30 MTWTh, May 11-14 and TW, May 19-20.

The first class session (M) will consist of an introductory lecture on the biology of the animals featured in the films.

The next 4 sessions (TWThT) will consist of a film presentation, followed by a brief discussion.

The final session (W) will consist of a final essay exam and a showing of any student produced U-tube videos.

Course Evaluation

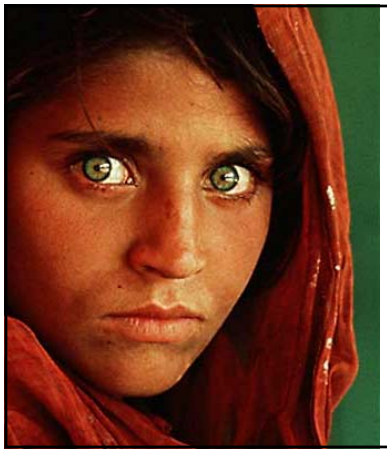
There is no textbook for this course.

This course will require a single, succinctly written essay worth 100 points ***written during the class period*** and due at 12:00 on the morning after the last day of class (20 May 2009).

This paper must be a well thought out essay with care given to the development and progression of your ideas, as well as to style and spelling. .

Course Grades

Grades will be assigned according to a straight scale: 90% -100% of the total points = A; 80%-89% = B; 70%-79% = C; 60%-69% = D; 59% or lower = F. The fraction of the class in each category will depend on the quality of the papers submitted.



What is Scary to You?

What is Fear?

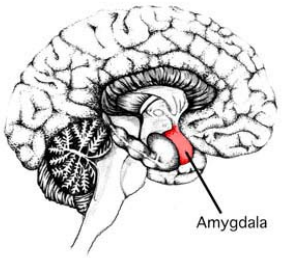
Where does Fear come from?

What kinds of fears exist?

A Definition of Fear

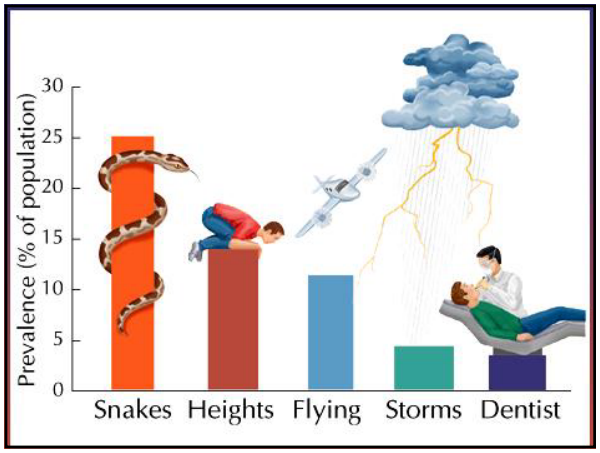
1. Fear is the thought that something ***might happen.***
2. It is a "disease of what-ifs."

Where Does Fear Come From?



According to an increasing number of studies fear arises within the brain.

The **amygdala** receives signals of the potential danger and begins to set off a series of reactions that will help you protect yourself,.



Arachnophobia – The fear of spiders

What Makes Fear Most Intense?

Something is new and unknown.

The situation cannot be predicted or controlled.

People rather than nature have caused the danger.

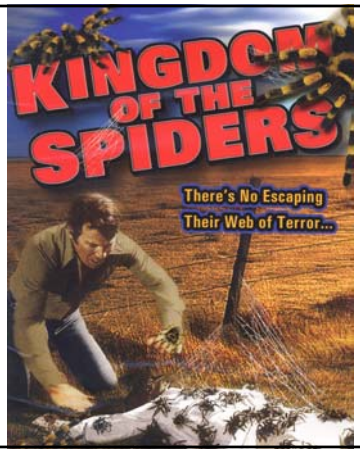
The chance that the danger could be *real*.

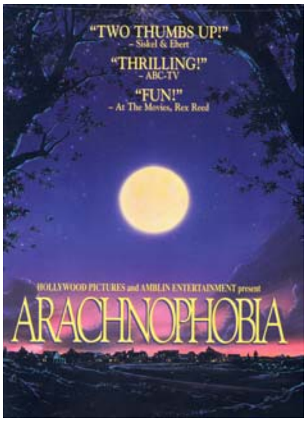
In This Course,

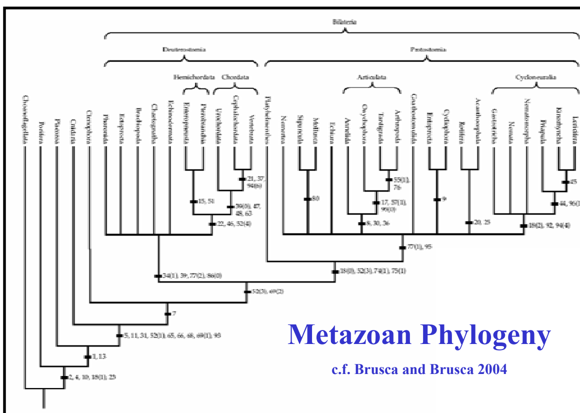
We will explore these possible causes of fear as they relate to invertebrate animals.

Course Schedule

WK	Date	Lecture Topic	Films of the Week
1	5/11	Introduction: Biology of Arachnida	
	5/12	Why spiders?	***Tarantula***
	5/13	Spiders of Arizona	***Kingdom of the Spiders***
	5/14	Really nasty spiders	***Arachnophobia***
2	5/19	Biology of the Arachnida	***Eight Legged Freaks***
	5/20	Final Exam and U-tubes	



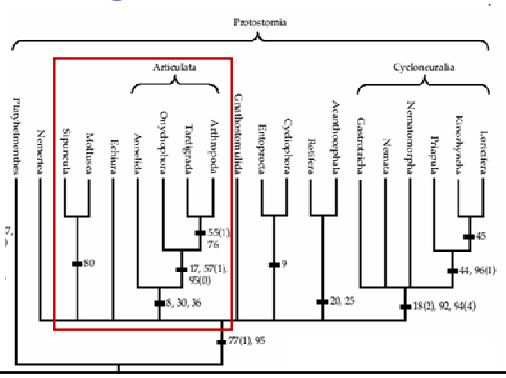


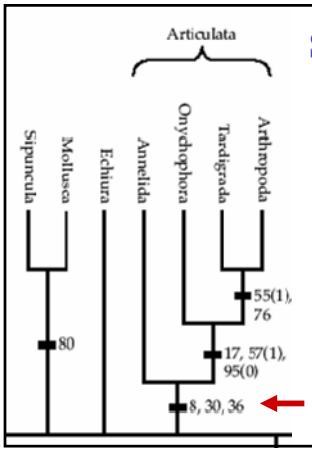


Metazoan Phylogeny

c.f. Brusca and Brusca 2004

"Higher Protostomes"





Synapomorphies: Articulata

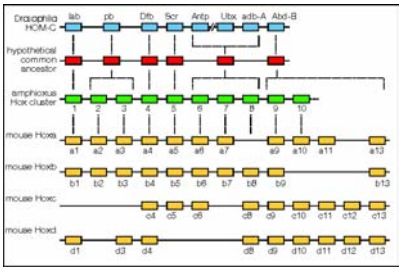
8. Engrailed (*en*) controls segmentation during development.

30. "Brain" with mushroom bodies.

36. Teloblastic growth.

Hox Genes

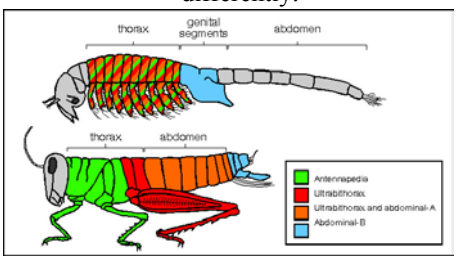
A cluster of regulatory genes, the Hox genes, control segment identity in arthropods, and comparisons of the sequences and functions of Hox genes can reveal evolutionary relationships.



Hox Genes

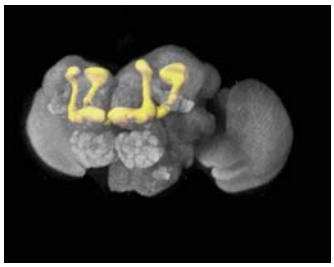
Hox genes specify positional identity not a specific structure.

Different species of embryos interpret the values differently.

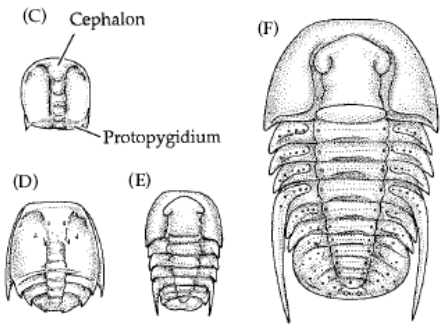


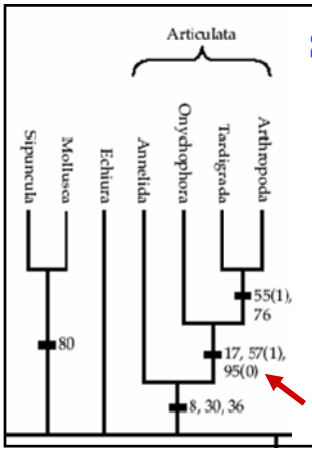
Mushroom Bodies

Paired structures associated with olfaction and memory (Corpora pedunculata).



Teloblastic Growth in Trilobites





Synapomorphies: Onychophora +

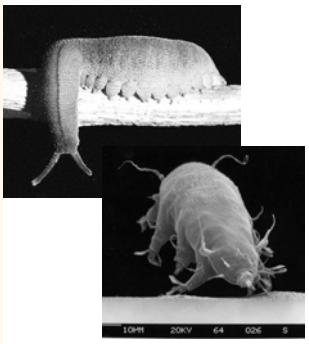
17. Ecdysis mediated by ecdysone.

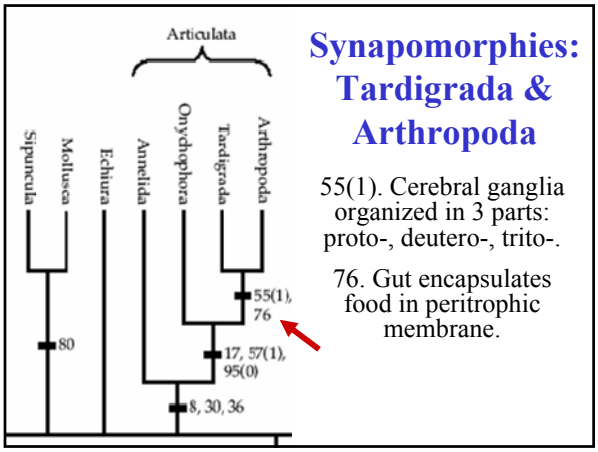
57(1). "Mixocoel" present - semi-open circulation.

95(0). Eyes not compound.

Phylum Arthropoda and Relatives

	Estimated numbers of described living species
Annelida	16,500
Onychophora	110
Tardigrada	800
Arthropoda, Crustacea	67,829
Arthropoda, Hexapoda	948,000
Arthropoda, Myriapoda	11,460
Arthropoda, Cheliceriformes	70,000
Arthropoda, Trilobitomorpha	4,000 (all extinct)

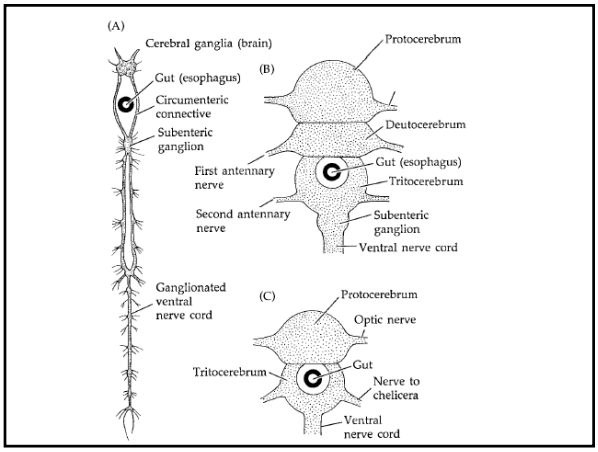


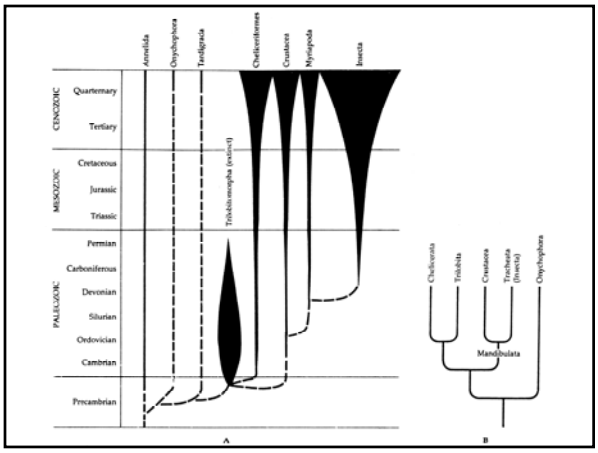


Synapomorphies: Tardigrada & Arthropoda

55(1). Cerebral ganglia organized in 3 parts: proto-, deutero-, trito-.

76. Gut encapsulates food in peritrophic membrane.





Subphylum Cheliceriformes

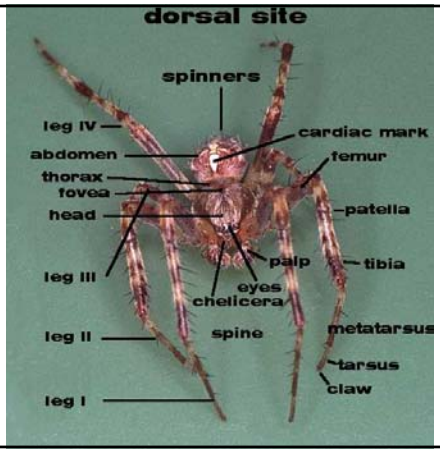
Spiders, ticks, mites, scorpions, horseshoe crabs

General Characteristics

Body composed of two tagmata; the *prosoma* and *opisthoma.*

Appendages on prosoma are:

1. Chelicerae
2. Pedipalps
3. 4 pairs of walking legs (uniramous)
4. No antennae



General Characteristics

Gas exchange by book gills, book lungs or trachaea

Simple median and lateral compound eyes.

Gut with 2-6 pairs of digestive cecae.

Most are gonochoristic.

Major Taxa

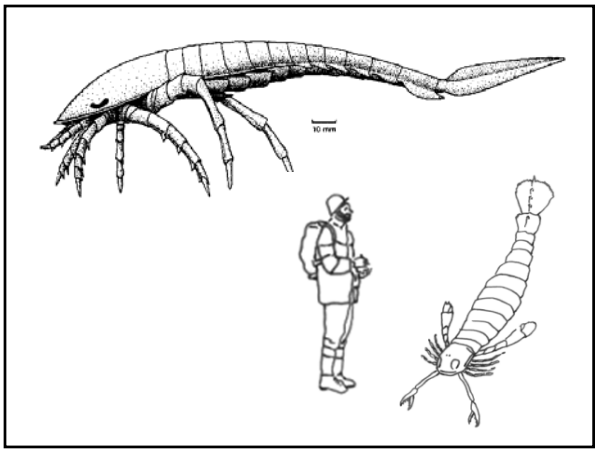
1. Class Chelicerata

a. Subclass Merostomata

1. Order Eurypterida - extinct water scorpions

a. up to 6 feet!

b. possible context for armored Devonian fish



Class Chelicerata

1. Subclass Merostomata
2. Order Xiphosura
   a. horseshoe crabs

Subclass Arachnida

1. Characteristics
   a. Prosoma with carapace
   b. Lots of variation in opisthoma
   c. eyes - median and lateral
      1. Medians are not compound;
      2. Secondary eyes have lens with reflective surface.
   d. Opisthomal appendages (stings, spinnerets, etc.
   e. Nearly all terrestrial - with attendant adaptations

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Order Scorpiones

1. Probably among the most ancient terrestrial arthropods

a. invaded land during Carboniferous (355 myr)

b. 1,200 species in varied habitats

c. can be big - 18 cm!!!!!

Order Scorpiones

2. Body divided into 3 regions

a. prosoma - head

1. with median eyes

2. legs come from this segment

3. chelicerae are reduced

4. pedipalps are enlarged, chelate

b. mesosoma - thorax region of body

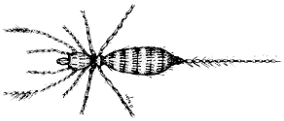
c. metasoma

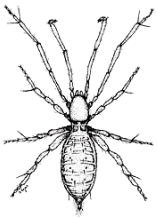
1. long, thin, with sting at the end, poison gland

Order Uropygi

Subclass Arachnida

c. Order Palpigradi
d. Order Schizomida
e. Order Ricinulei





Order Amblypygi

Order Pseudoscorpionida

1. Prosoma with carapace like shield
2. Resemble scorpions without long opisthoma

Order Solpugida

1. Enlarged chelicera - jawlike
2. Pedipalps elongated held forward
3. Predators, can get large!

Subclass Arachnida

h. Order Opiliones

1. daddy longlegs
2. prosoma and opisthoma broadly joined
3. pedipalps long and leglike
4. often with mite
5. male parental care in tropical species

Subclass Arachnida

Order Araneae - spiders

1. general chracters

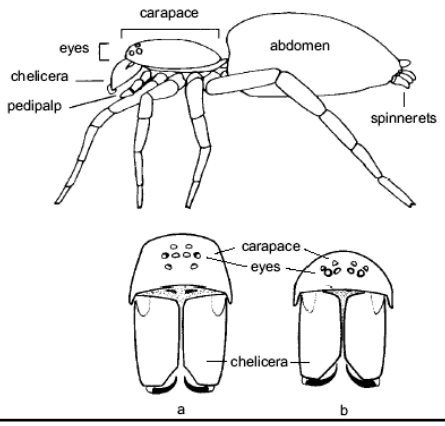
2. systematics

a. two major suborders

1. Suborder Mesothelae - the segmented spiders

2. Suborder Opisthothelae - modern spiders

a. most of what looks like spiders



Subclass Arachnida

3. Two Superfamilies of modern spiders

a. Superfamily Mygalomorphae

1. Tarantulas

a. Have fangs that move parallel with body axis

b. Often large bodies

c. Can have powerful venom

Superfamily Mygalomorphae

a. Theraphosidae – tarantulas

d. breeding biology of tarantulas

1. males go searching, usually in fall

2. have to hold females upright to insert pedipalp.

A female and male tarantula

Superfamily Mygalomorphae

b. Ctenizidae - trap door spiders

b. Dipluridae - funnel web spiders - *Atrax* - Australia

Subclass Arachnida

b. Superfamily Araneomorphae

1. typical spiders

a. have fangs that move perpendicular to body axis

b. usually smaller, with some exceptions

Subclass Arachnida

Families

a. Loxoscelidae - brown spiders (brown recluse)

b. Theridiidae - widow spiders (black widow)

Agelenidae – “funnel web” spiders

b. Uloboridae, Araneidae - orb weavers

c. Tetragnathidae - orbs too

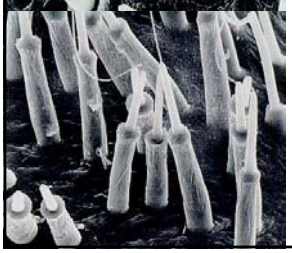
d. Lycosidae - wolf spiders - some nasty ones

e. Salticidae - jumping spiders

Spider Silk

1 to 4 pairs of spinnerets release the silk.

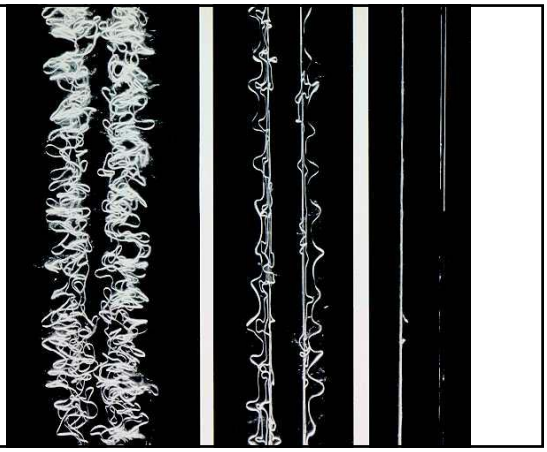
The cribellar glands are only found in the cribellate spiders and this area contains small tubes (100 to even 50000) from which a strand is released with a smallest diameter of 0.00002 mm.



Spider Silk

The scientific name of this region is: *cribellum*.

Depending of the type of silk that is to be made the spider mixes the fluid from the different glands and regulates the speed and volume of release.

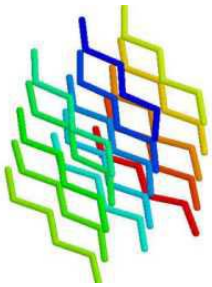


Spider Silk

•Silk is for more than 50% a polymerized protein called fibroine with a molecular weight of 200.000 - 300.000. At a molecular scale the proteins strands are regularly orientated.

•The silk is produced by the silk glands in the form of a liquid with a molecular weight of 30,000.

•Before the silk is released from the spinnerets it hardens (polymerizes). At least seven types of glands have been recognized. But there is no known family with all seven types.



Spider Silk

A special gland (*glandula aggregata*) that produces the sticky material. The other six are:

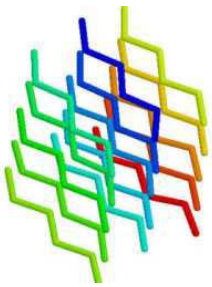
gl. Ampulleceae major and minor for the production of the walking threads

gl. Pyriformes for the attaching threads

gl. Aciniformes produces silk for the encapsulation of the prey

gl. Tubiliformes for the silk of the egg-sac

gl. Coronatae threads for the axis of the sticking threads.



Spiders of Arizona

***Loxosceles* sp**

Arizona Brown Spiders have toxic venom that can cause renal failure in very rare cases, and because the venom is necrotizing, it can eat away your flesh, causing ulceration and permanent scarring. These spiders are brown in color with a violin-shaped, dark marking on the cephalothorax with the neck of the violin pointing away from the head. They have 3 pairs of eyes, and their leg span is about 1 inch (2.54 cm).

Spiders of Arizona

Latrodectus hesperus

Black Widows are found in natural habitats, but commonly occur in and around people's houses, buildings, and woodpiles. They build strong, irregular webs which they use to capture their arthropod prey. Females usually do not venture from their web, are quick to retreat, but will bite in self-defense.

Spiders of Arizona

Olios giganteus

The giant crab spider. Length 1" (25mm) or more and leg span to 3" (75mm). Light brown in color Y shaped marking on the top of its abdomen and dark fangs in front. Like other crab spiders, it often holds its legs at right angles to its body. The giant crab spider walks around in search of prey at night, but usually hides during the day. Females hide in and guard their giant egg bags. Despite its appearance, the giant crab spider is not dangerous to humans (but the bite is painful).

Spiders of Arizona

Olios giganteus

Jumping Spiders (Salticidae). Length to about 1/2". Color variable (often brightly colored), depending on species. Jumping spiders characteristically have two, large, shiny, forward-facing eyes (in addition to other, less conspicuous eyes).
Jumping spiders pounce on their prey and are generally quite animated. Their relatively good, forward-facing eyes, give them the the depth perception needed to jump on their prey from a distance.

Spiders of Arizona

Aphonopelma spp

Tarantulas Length up to 3-4" (75-100mm). The species most commonly found here have females that are overall tan and males that are dark brown to black and thinner-bodied than the females. Both males and females have stout, hairy legs and a hairy abdomen. Mature males have hooks on their front legs (see in upper picture).
NATURAL HISTORY: Venomous, but only mildly toxic to humans, and they usually do not bite humans unless handled roughly. Urticating hairs on abdomen may be brushed off by the spider and can cause severe

Spiders of Arizona

Hogna carolinensis

Wolf Spiders. Length up to 1". Color is variable from dark brown to light gray. Wolf Spiders have a light, peach-colored stripe down their cephalothorax (combined head and thorax).
NATURAL HISTORY: This spider may be found crawling on the floor (it is not a climber) in homes, but is not dangerous to people. In fact, they eat insects and other arthropods that may be a pest in the home. They are nocturnal hunters; use a headlamp or flashlight held close to your head to see the eyeshine of Wolf Spiders at night

Spiders of Arizona

Funnel Web Spiders. Length to 1/2" (12mm). Color is brown to gray with various markings on body. These spiders are easily identified by their funnel-shaped webs.
NATURAL HISTORY: The spiders tend to stay hidden in the funnel of their web until an insect (or wiggled twig) enters the web. The vibrations on the web are felt by the spider who then rushes out to seize its prey.

Spider Venom

sphingomyelinase D.

symptoms ranging from minor localized effects, to severe dermonecrotic lesions, up to and including severe systemic reactions including renal failure, and in some cases, death

Spider Venom

Latrotoxins.

cause the release of the neurotransmitter acetylcholine, stimulating muscle contractions. This can affect the body in several ways, including causing painful abdominal cramps, as well as interfering with respiration, and causing other systemic effect

Spider Venom

Neurotoxins and Serotonin.

Cause the opening sodium and other ion channels, causing excessive neural activity which interferes with normal bodily function; also extreme pain.

Really Nasty Spiders

Brazilian Wandering Spider - *Phoneutria nigriventer*

Really Nasty Spiders

Sydney Funnel Web Spider – *Atrax robustus*

Really Nasty Spiders

Latrodectus sp. **– Widow and redback spiders**

Really Nasty Spiders

Missulena sp. **– Mouse spiders**

Really Nasty Spiders

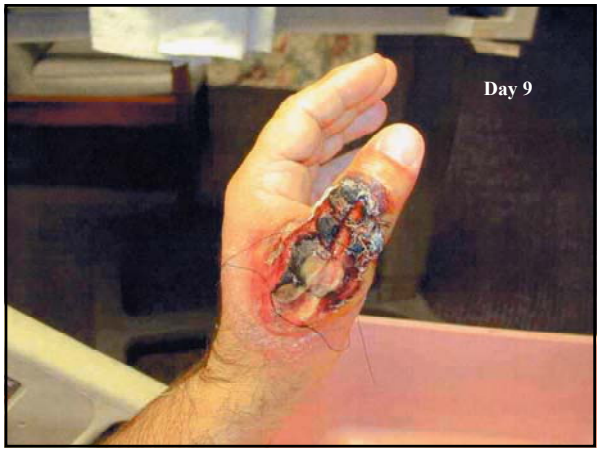
Loxosceles reclusa **- The Brown Recluse**


spiders.ucr.edu
Photo by Gary Phillips


Day 3


Day 4

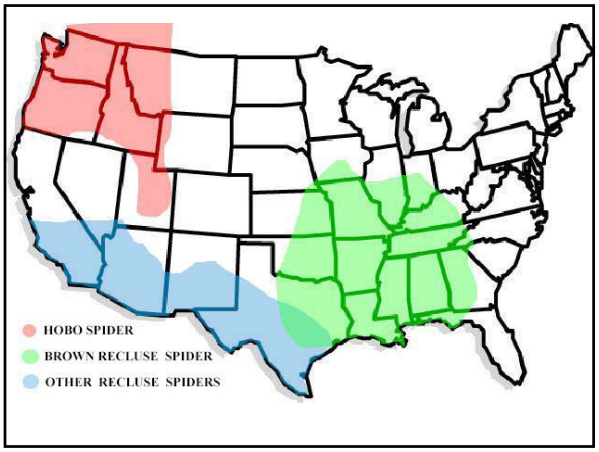

Day 6


Day 9


Day 10

Spider Limitations

Movement limited by cuticle thickness and hydraulic movement.


HOBO SPIDER
BROWN RECLUSE SPIDER
OTHER RECLUSE SPIDERS

Biology 300
Invertebrates in Film

Arachnid Biology