SAFETY PROTOCOLS

FOR

WORKING WITH

VENOMOUS

SNAKES AT

SOUTHEASTERN

Last Revised 20 November 2006*
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***Protocol to be reviewed every 3rd Year**

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Venomous Reptile Safety Protocol

The following protocol is valid for all venomous reptiles that are being kept in the facilities of Southeastern Louisiana University.

Definitions

Venomous reptiles are defined as all species that are currently recognized as members of the taxonomic families Helodermatidae, Viperidae, Elapidae, Atractaspididae, and all species of the genera *Dispholidus*, *Thelotornis*, and *Rhabdophis* among the Colubridae only.

Envenomations are defined as incidents in which venom reaches the bloodstream. This includes bites, venom coming into contact with open wounds, and venom coming into contact with the eyes.

Overall Safety Protocol

1. **Authorized Personnel – see Appendix 1**
    a. Personnel will be authorized by a special Science and Technology Safety Committee, whose members will be determined by the Dean, Assistant Dean, and Department Head of Biology. The Committee must include at least one expert on venomous reptiles.
    b. At any time, if an authorized person does not follow the established protocol, that person's authorization must reviewed by the Safety Committee.
    c. Failure to follow established protocol can lead to the removal of authorized status.
    d. Unauthorized personnel are prohibited from handling venomous snakes. Do so will result in disciplinary action.
    e. To become authorized, the individual must go through training policies and procedures for working with snakes and obtain a training certification for working with venomous snakes (completed in-house, see Appendix 1)

2. **Housing – see Appendix 2**
    a. Venomous reptiles must be housed in designated rooms that are lockable and inaccessible to unauthorized parties.
    b. The designated rooms should be keyed so a general building key does not open it.
    c. A telephone should be in any designated room.
    d. Unauthorized personnel may access the room(s) only in the company of authorized personnel. A list of authorized personnel must be displayed on the outside of the door.
    e. Designated rooms must exhibit a sign that warns unauthorized parties from accessing them.
    f. All venomous reptiles must be housed in escape-proof enclosures that are labeled with the content of species and the number of specimens contained in each enclosure.

g. The escape proof enclosures must be approved by the special Safety Committee.
h. The space between the bottom of the door and the floor must be such that animals cannot crawl out of the room.

3. Curating – see Appendix 2

a. Curating duties must be performed by designated personnel (i.e. authorized, determined by the special Safety Committee as noted above) that are deemed to be experienced in working with live venomous reptiles.
b. Curators must use extreme caution and minimize direct physical contact when handling venomous reptiles.
c. Curators must work in pairs whenever direct contact with venomous reptiles is necessary.
d. Curators must maintain a real time inventory of the specimens. This includes species as well as number of individuals of each species. This must be updated upon any change in inventory, with the update dated and initialed. The inventory must be kept in a visible location in the vivarium.

4. Envenomations

i. Potential envenomations must be treated with appropriate first-aid, including pressure-immobilization (bites & open wounds) and washing and rinsing (open wounds & eyes). **See Appendix 3 for HOW NOT TO TREAT SNAKEBITE.**
j. The potential victim must seek appropriate medical treatment, if deemed necessary.
k. Call the SELU police (549 2222) so the proper university officials can be notified.
l. A folder containing snakebite protocols must be kept in the collection at all times. Protocols may be used to assist physicians in treatment.
m. Miami-Dade Fire Rescue Antivenom Bank must be consulted for treatment and antivenin for any non-native snake bite. Contact: 1-305-596-8576 (see Appendix 3 for other emergency contact numbers in case Miami-Dade cannot be reached) with the following information:
    - Species bitten by
    - Location of bite
    - Symptoms of patient
    - Hospital location or being transported to
    - Return phone number or contact information
f. CroFab Antivenin is being stored by North Oaks Hospital (985-345-2700), and can be utilized for the treatment of envenomations caused by all domestic pitvipers (water moccasins, rattlesnakes, copperheads)
g. **See Appendix 4 and 5 for additional information on signs and symptoms of envenomation (App. 4) and for details of venom composition**.

5. IN CASE OF ESCAPE

a. Call Campus Police (549 2222)
b. Call LA Wildlife and Fisheries, specifically Jeff Boundy (225-765-2815)
c. Check all doors to rooms and buildings for possible openings for escape routes. Check ceiling tiles in vivarium for the same.
Close any open doors in the building, including offices and labs.
d. Call all three people below.

Dr. David Sever: 985 370 7601 Home; 985 215 1779 Cell
Dr. Brian Crother: 985 345 9130 Home; 985 981 3977 Cell
Dr. Cliff Fontenot: 225 587 4408, Home; 985 351 4816 Cell

To Be Posted In Room

SNAKE BITE
EMERGENCY PROCEDURES

1) **Call 911**
   a) **Arrange pickup at front of the Biology Building on North Pine St.**
      (DO NOT drive yourself or take any personal vehicle)
   b) **Notify North Oaks Hospital (985-345-2700) of rattlesnake, moccasin or copperhead bite**
   c) **Go to North Oaks Hospital**
   d) **Ask campus police (549 2222) to inform Biology Department Head (Dr. Sever)**
      Ask campus police (549 2222) to inform College of Science and Technology Dean (Dr. Dan McCarthy)

2) **Stay calm**
   a) Immobilize the limb at approximately heart level
   b) Remove watch, jewelry, or constricting clothing item from bite area

   DO NOT make any incision.
   DO NOT try to suck out the venom.
   DO NOT use a tourniquet or otherwise constrict the bite area.
   DO NOT apply ice or any kind of cooling to the patient
   DO NOT use any form of electric shock
   DO NOT wait for symptoms before calling 911

3) **Secure the snake if possible (in large trash can or cage).**
   a) If not possible, leave snake in room, lock door, & post sign indicating loose animal inside

4) **Take protocol binder containing snakebite treatment info to hospital**
   a) Give to ER physician, ESPECIALLY APPENDIX 3.

5) **GO TO THE HOSPITAL**

Appendix 1

Student training policies & procedures for working with snakes

General policies & precautions:

[This training module probably will be required when the IACUC committee (being organized by Dr. Penny Shockett) is in place. The url below is an example from ULL.] The federal Animal Welfare Act requires that the university provide training for all personnel participating in animal care and use. Accordingly, the university has subscribed to an on-line training program sponsored by the Laboratory Animal Training Association. This program consists of interactive modules with text and graphics. The base module applies to us and deals with the humane care and use of laboratory animals in general. The IACUC is automatically notified when an individual completes a module; the certificate of completion is valid for one year. All individuals involved with research or other activities requiring IACUC approval must at least the base module. The URL is *http://hazel.forest.net/latanet/client/ull/introduction.htm*. The username is … and the is password ….

Use only with snakes you are authorized to work with. E.g., if you are not authorized to work with venomous snakes, then do not (ever) open any cage that houses a venomous snake.

NEVER look down into a cage that contains a venomous snake without wearing eye protection.
NEVER place hands inside a cage that contains a venomous snake.
NEVER leave a cage lid open when it is not being watched continuously.
NEVER leave snakes unsupervised in the main lab (even for short breaks such as bathroom breaks), except under specific permission by Dr. ….
NEVER allow anyone into the animal room. University officials (police, fire, department head, etc.) or IACUC inspectors are allowed to enter the animal room using their own keys.
NEVER remove a snake from the lab without Dr. …'s permission.

ALWAYS keep door to animal room closed, even while you are working in the room. Lock the door to the animal room when you leave the main lab.
ALWAYS use snake hook or tongs to move venomous snakes
ALWAYS make sure *every* venomous snake cage is properly closed when not in use
ALWAYS enter animal usage, acquisitions, & permanent removal in the log book in the animal room.
ALWAYS set out sign on lab counter, just inside main lab door, to indicate when you are working on harmless/venomous snakes in the main lab. Close the main lab door when snakes are being studied in the main lab.

ALWAYS put a post-it note saying "one specimen temporarily removed" on each cage from which you remove an animal for research. There are post-it notes for this purpose on the side of the closet above the built-in desk. If you remove an animal permanently (e.g., if one dies), then be sure to enter this into the animal log book and update the cage label (update the number of animals, or remove the label if there was only animal in the cage).

Procedures for working with venomous snakes:

1. Always wear goggles when working with venomous snakes, and put them on before approaching a cage. The snakes can strike upward and eject venom through the screen cage top, & thus damage your eyes.
2. Always wear regular shoes, and preferably long pants when working with venomous snakes.
3. Move large plastic trash can next to cage to be opened.
4. Unlock cage lid & open lid toward yourself; *NEVER* put your hand into the cage.
5. Use hook or tongs to transfer snake from the cage into trash can & place lid on top.
6. Immediately close the cage if other snakes are inside.
7. Place tubes, tongs, hook, Rubbermaid container, and velcro tape near trash can for handling.
8. Open trash can lid & use hook to guide .
9. *NEVER* put your hands into the trash can when a snake is in it.
10. Use the hook to guide the snake into the tube.
11. Once the snake has crawled at least 1-2 ft into the tube, then reach down and grab the snake's body where it exits the tube; hold the body firmly in place.
12. Thread the snake's tail through the opening in the Rubbermaid container from the inside out, *while still holding the snake firmly in the tube.*
13. Place velcro tape around the snake's body just anterior to the cloaca & gently pull the tail back into the hole so that the Velcro fixes the tail in the hole.
14. Place the container & snake (still held in the tube) back into the trash can.
15. Release the snake at the tube & let it come back out of the tube and coil into the container.
16. If the snake does not immediately coil into the container, use the hook and/or tongs to make it coil in the container.
17. Use the hook to place the lid on the container and snap it down firmly into place—be sure you hear that "snap of freshness" that indicates the lid has sealed.
18. Now it is safe to reach down into the trash can and pick up the container.
19. If extra security is needed (such as for large snakes), wrap duct tape around the container to hold the lid on with extra strength.

TRAINING CERTIFICATION FOR WORKING WITH SNAKES

Briefly describe previous experience with snakes, including venomous species. If you are new to working with snakes, include observations of & assistance to Dr. … or graduate students while working with the animals.

I have taken the base module of the online training for personnel involved in animal care. I have read the Procedures for working with snakes compiled in the red binder in the animal room (or the copy immediately outside the animal room), and have read the policies described above. I have also been trained by Dr. _____at Southeastern to work with harmless and venomous snakes, and to handle a snake-bite emergency according to the procedures described above.

Approved by: _____ Trainee: _____
[PI's name]

Date: _____ Date: _____

Appendix 2

POLICIES FOR WORKING WITH SNAKES AT SOUTHEASTERN

ANIMAL ACQUISITION AND TRANSPORTATION

- Snakes obtained from the wild or, if necessary, from commercial suppliers.
- Snakes brought to the laboratory in sealed and insulated containers.
  - Transported by …
  - Or shipped via air freight to the New Orleans airport & picked up by authorized personnel
- Snakes shall *not* be shipped directly to any office or destination at the University
  - And shall not be handled by any unauthorized departmental or university staff.

ANIMAL HOUSING

Location: Vivarium, Biology Building

- Dedicated animal room
  - Sealed against animal escape using screening to block all points of entry/exit, including the ceiling and airspaces under doors

Security:

- Room access limited to authorized personnel, department head (Dr. Sever), and campus safety officials
- No access to public hallways
- Room opens only to vivarium hallway
- Animal room door kept closed at all times; locked at all times when a person is not working inside

Labels on room door:

- Kinds of animals contained
- Instructions for gaining access if necessary by medical, fire department, or other emergency personnel
- Emergency contact information for persons authorized to enter room

Inspections:

- Biannual inspection by IACUC representatives

Cages:

- designed specifically for venomous snakes
  - Individual cages with locking plexiglass doors
- Additional cages may be glass aquaria with tight-fitting screen or solid acrylic lids with ventilation holes (for small venomous snakes) or plastic “sweater box” containers with plastic locking lids (harmless snakes only).

Cleaning:

- Cages cleaned after snakes defecate
- Only authorized persons can clean the animal room and cages.
    - During cage cleaning, animals are removed from cages safely using tongs or a snake hook stored in a large plastic trash can with a self-locking lid.
- During room cleaning, the animals remain locked in their cages.

Ventilation:

- Animal room fully compliant with the guidelines specified in the Guide for the Care and Use of Laboratory Animals

Feeding:

- Acclimated snakes fed pre-killed mice, purchased frozen from commercial suppliers
- Newly acquired snakes may be fed live mice during period of acclimation to the new environment.
    - Live mice obtained from animal suppliers, and will be fed to snakes immediately
    - Mice placed in cages with tongs
    - All feedings with live mice monitored directly; uneaten mice removed after 20 minutes
    - Live mice will not be housed in the laboratory or animal room

ANIMAL HANDLING

Harmless snakes may be handled directly. Venomous snakes are handled only by mechanical means until they are completely restrained. All handling will be done in a dedicated, locked animal room using techniques that are established practice in zoos around the world and that have been used safely in laboratory and field research for over 30 years (See Murphy, 1971, listed above). Procedures for restraining venomous snakes are as follows:

Venomous snakes will be transferred from their locked cages first into a large plastic trash can for intermediate handling, then into a clear acrylic tube, and finally into a Rubbermaid container. The following specific steps will be used to prevent any contact between the snake and the experimenter during these steps:

1. First, snake tongs or a hook are used to transfer a snake from its cage into a large plastic trash can. The trash can is too tall for snakes to reach the top, and tongs and hooks are used to keep animals safely out of striking distance.
2. While the snake is in the trash can, it is induced with a hook to crawl up into a long clear acrylic tube of appropriate diameter, which safely restrains the front 2/3 of the body. The top end of the tube is sealed closed; the snake's tail protrudes from the bottom of the tube.
3. Once the snake is in the tube, its body can be held where it enters the tube. The animal cannot strike or bite in this position. The tail is then threaded through an opening in the side of a Rubbermaid container and fixed into place in the opening using Velcro tape.
4. The container and snake (still safely restrained in the tube) are then placed back into the trash can, and the snake is released from the tube so that it coils up in the container. The snakes naturally seek to hide, and readily curl themselves up into the container.

5. The container lid is lowered into place and snapped onto the container using the long tongs. The container can be firmly taped closed for additional security.
6. The snake is now safely sealed in the container, and the container can be picked up and handled without any risk of bites.

BACKUP PERSONNEL

Dr. Sever, Dr. Crother, and Dr. Fontenot have been trained in animal safety and handling associated with this project and have agreed to deal with the snakes if called upon to do so. All are members of the Department of Biology, and so are available regularly. They all have extensive laboratory and field experience in biology. Whenever necessary, they will be able to obtain keys to the animal room and cages from the department head, Dr. Sever. Dr. Sever has agreed to this arrangement. Contact information is as follows (and is also posted on the animal room door):

Names and contact info:

Dr. David Sever: 985 370 7601 Home; 985 215 1779 Cell
Dr. Brian Crother: 985 345 9130 Home; 985 981 3977 Cell
Dr. Cliff Fontenot: 225 587 4408, Home; 985 351 4816 Cell

TRAINING CERTIFICATION

The Committee chair maintains a file containing signed statements from each person trained to handle snakes in the lab indicating that the person has been trained to follow the safety and handling procedures approved in the Animal Procedure Statement.

The training procedure involves (A) instructing the student about the restrictions on room and cage access, (B) emergency procedures, including the location of the emergency procedure information described in the Animal Procedure Statement, and (C) applying the animal handling steps described in the Animal Procedure Statement to harmless snakes in several training sessions before applying them with any venomous snakes. Only after each person has shown appropriate experience and responsibility in handling the animals will that person be allowed to work with venomous snakes.

SAFETY APPROVAL

In preparing the animal protocol, I have consulted with University Safety Committee and the University Safety Office and they indicated approval of the safety measures that will be used. IACUC approval is kept current at all times.

Appendix 3

EMERGENCY PLANS
Advance preparation for the unlikely event of a venomous snake bite

1. I have contacted emergency room physicians at local hospitals to notify them of venomous snakes being studied here, and to assure that they have experience treating snake bites.

   The treatment protocol I prepared for use by the physicians is derived from procedures used by the Arizona Poison Control Center, the UCSD Surgery Center, and Loma Linda University School of Medicine.

   CroFab Antivenin is being stored by North Oaks Hospital (985-345-2700), and can be utilized for the treatment of envenomations caused by all domestic pitvipers (water moccasins, rattlesnakes, copperheads)

2. Copies of snakebite treatment protocol adopted from experienced physicians will be posted in the animal room and laboratory. In case of a snake bite, a copy of the treatment protocol will be taken to the hospital with the patient.

Procedures to be followed in case of a venomous snake bite
The following procedures will assure fast, careful, and safe treatment:

1. The snake will be secured if possible. If this is not possible, then the animal will be closed and locked in the animal room. If a snake remains loose in the locked animal room, then a ready-made note will be placed on the door indicating that a venomous snake is loose inside.

2. If a snake bite occurs, Call the SELU police (549 2222) so the proper university officials can be notified. Immediately call 911 and/or arrange for transportation to the hospital; there is a phone immediately adjacent to the animal room door.
   n. A copy of the snakebite treatment protocol that is posted in the animal room and laboratory will be taken with the patient to the hospital. These protocols may be used to assist physicians in treatment.
   o. Miami-Dade Fire Rescue Antivenom Bank must be consulted for treatment and antivenin for any non-native snake bite. Contact: 1-305-596-8576 with the following information:
      - Species bitten by
      - Location of bite
      - Symptoms of patient
      - Hospital location or being transported to
      - Return phone number or contact information

If Miami-Dade cannot be reached, call the Arizona Poison Control Center. Their physicians have extensive experience treating venomous snake bites are available and willing to consult with local physicians for treatment procedures at any time (1-800-362-0101 or 1-520-626-6230, attn: Jude McNally).

What to tell them at the hospital

Tell them the kind of snake bite
Rattlesnake or Moccasin (copperhead or cottonmouth)
(**All treated by same antivemon--CroFab**)

For any other venomous snake bite call Miami-Dade Fire Rescue Anti-venom Bank 1-305-596-8576

Ask for

[Physicians we have contacted]…

If Miami-Dade cannot be reached:

Ask Staff to contact a Poison Control Center Immediately for consulting:

Arizona Poison Control Center—has the most experience w/ snake bites
520-626-6230 (Attn: Dr. Jude McNally)
520-626-6016
520-626-6230
800-362-0101
1-800-222-1222 (Nationwide poison control center referral)

Loma Linda University Medical Center
(909) 558-4444 (Attn: Dr. Sean Bush, M.D.)

San Diego Regional Poison Control Center: 800-876-4766

Texas Poison Control Center: 800-764-7661

Rocky Mountain Poison Control: 800-726-3737

Jacobi Hospital, Bronx, NY—Hotline for exotic snakebites: 718-430-6494

How NOT to Treat a Snakebite

Though U.S. medical professionals may not agree on every aspect of what to do for snakebite first aid, they are nearly unanimous in their views of what not to do. Among their recommendations:

- **No ice or any other type of cooling on the bite.** Research has shown this to be potentially harmful.
- **No tourniquets.** This cuts blood flow completely and may result in loss of the affected limb.
- **No electric shock.** This method is under study and has yet to be proven effective. It could harm the victim.
- **No incisions in the wound.** Such measures have not been proven useful and may cause further injury.
- **DO NOT WAIT FOR SYMPTONS BEFORE CALLING UNIVERSITY POLICE AND 911**

Arizona physician David Hardy, M.D., says part of the problem when someone is bitten is the element of surprise. "People often aren't trained in what to do, and they are in a panic situation." He adds that preparation--which includes knowing in advance how to get to the nearest hospital--could greatly reduce anxiety and lead to more effective care.

John Henkel is a staff writer for FDA Consumer.

FDA Consumer magazine (November 1995)

Appendix 4

UCSD Surgery Center
Summary for Human Bite by United States Rattlesnakes, Copperheads & Cottonmouths

Signs and Symptoms of Envenomation: The specific signs and symptoms which may manifest in a patient who has been envenomated will vary in presence and in severity, depending on several factors noted in the General Considerations below. The time course of development will also vary considerably from case to case. The following list of signs and symptoms represent a general compilation enumerated from a series of 100 cases of rattlesnake envenomation (Russell, 1983). Not all of the symptoms will necessarily develop, even with severe envenomation.

DO NOT WAIT FOR THESE SYMPTOMS TO APPEAR BEFORE CALLING UNIVERSITY POLICE AND 911

Sign or Symptom	Frequency
Pain	65-95/100
Swelling, Edema	74/100
Weakness	72/100
Sweating and or Chills	64/100
Numbness, tingling (circumoral, lingual, scalp, feet, etc.)	63/100
Pulse rate changes	60/100
Faintness, dizziness	57/100
Ecchymosis	51/100
Nausea and/or vomiting	48/100
Blood pressure changes	46/100
Numbness, tingling in the affected part	42/100
Decreased blood platelets	42/100
Fasciculations	41/100
Vesicles or boli	40/100
Regional lymph adenopathy	40/100
Respiratory rate changes	40/100
Increased blood clotting time	39/100
Decreased hemoglobin	37/100
Thirst	34/100
Change in body temperature	31/100
Local tissue necrosis	27/100
Abnormal electrocardiogram	26/100
Glycosuria	20/100
Increased salivation	20/100

Spearing of red cells	18/100
Cyanosis	16/100
Proteinuria	16/100
Hematemesis, hematuria, melena	15/100
Unconsciousness	12/100
Blurring of vision	12/100
Muscle contraction	6/100
Increased blood platelets	4/ 25
Swollen eyelid	2/100
Retinal hemorrhage	2/100
Convulsions	1/100

Appendix 5

The chemistry of snake venoms is complicated. Venoms are at least 90% protein (by dry weight), and most of the proteins in venoms are enzymes. About twenty-five different enzymes have been isolated from snake venoms, ten of which occur in the venoms of most snakes. Proteolytic enzymes, phospholipases, and hyaluronidases are the most common types. Proteolytic enzymes catalyze the breakdown of tissue proteins. Phospholipases, which occur in almost all snakes, vary from mildly toxic to highly destructive of musculature and nerves. The hyaluronidases dissolve intercellular materials and speed the spread of venom through the prey's tissue. Other enzymes include collagenases, which occur in the venom of vipers and pitvipers and promote the breakdown of a key structural component of connective tissues (the protein collagen) ; ribonucleases, deoxyribonucleases, nucleotidases, amino acid oxidases, lactate dehydrogenases, and acidic and basic phosphatases all disrupt normal cellular function, causing the collapse of cell metabolism, shock, and death.
Not all toxic chemical compounds in snake venoms are enzymes. Polypeptide toxins, glycoproteins, and low-molecular-weight compounds are also present in mambas and colubrids. The roles of the other components of venom are largely unknown.

Every snake's venom contains more than one toxin, and in combination the toxins have a more potent effect than the sum of their individual effects. In general, venoms are described as either neurotoxic (affecting the nervous system) or hemotoxic (affecting the circulatory system), although the venoms of many snakes contain both neurotoxic and hemotoxic components.

Venom componenets are broadly categorized by how they work to disrupt normal function.

Enxymes - found in all snake venoms-spur on physiologically disruptive or destructive process.
Proteolysins - found mostly in viper and pitviper venom-dissolve cells and tissue at the bite site, causing local pain and swelling.
Cardiotoxins - associated mostly with elapids ad vipers-have variable effects ; some depolarize cardiac muscles and alter heart contraction, causing heart failure.
Hemorrhagins - occurring in the venom of vipers, pitvipers, and the king cobra-destroy capillary walls, causing hemorrhages near and distant from the bite.
Coagulation - retarding compounds-found in some elapids-prevent blood clotting.
Thromboses - which some vipers have-coagulate blood and foster clot formation throughout the circulatory system.
Hemolysis - which are in the venom of elapids, vipers and pitvipers-destroy red blood cells.
Cytolysins - components of viper and pitviper venom-destroy white blood cells.
Neurotoxins - found in elapids, vipers, tropical rattlesnakes, and some North American Mojave rattlesnakes-block the transmission of nerve impulses to muscles, especially those associated with the diaphragm and breathing.

Chemical Components Of Snake Venoms
A. Organic Components with Role, or Potential Role, in Toxicity

Toxic high-molecular-weight compounds

Compound : Peptide bradykinin potentiators.
Action : Greatly enhance one of the body's natural responses to injury (dilation and increased permeabilty of blood vessels, stimulation of pain receptors, and contraction of some smooth muscles), thereby enhancing diffusion of venom in the bloodstream, increasing bleeding, and thwarting the ability to flee. Taxon with the compound in its venom : Bothrops, Crotalus.

Compound : Polypeptide toxins.
Action : Directly disrupt nerve-impulse transmission, usually causing heart or respiratory failure Taxon with the compound in its venom : Mambas and colubrids : Naja (cobratoxin), Hydrophis (Hydrophitoxin), Laticauda (lactocotoxin), Pelamis (pelamitoxin), Naja (cardiotoxin), Crotalus scutulatus (Mojavetoxin), Bungarus (bungarotoxin), Crotalus (crotactin), Vipera (viperptoxin).

Compound : Proteolytic enzymes.
Action : Catalyze the breakdown of structural components of tissues. Taxon with the compound in its venom : All venomous species.

Compound : Hyluronidases.
Action : Catalyze reactions that break mucopolysaccharide links in connective tissues, thereby enhancing diffusion of venom. Taxon with the compound in its venom : Several genera.

Compound : Proteases.
Action : Catalyze reactions that disrupt protein peptide bonds in tissues, causing blood-vessel wall damage and hemorrhaging and muscle-fiber deterioration. Taxon with the compound in its venom : Vipers, pitvipers.

Compound : Phospholipases.
Action : Catalyzes reactions that harm musculature and nerves. Taxon with the compound in its venom : Almost all venomous species (e. g., phospholipase A, in Agkistrodon, Bothrops, Crotalus, Naja, Vipera)

Compound : Thrombinlike enzymes.
Action : Inhibit blood clotting. Taxon with the compound in its venom : Vipers, pitvipers, a few elapids (but rare)

Compound : Nerve growth factor (an enzyme).
Action : Stimulates the growth of nerve cells. Taxon with the compound in its venom : Agkistrodon, Crotalus.

Compound : Other enzymes : ribonucleases, deoxyribonucleases, nucleotidases, amino acid oxidases, lactate dehydrogenases, acidic and basic phosphatases.
Action : Disrupt normal cellular function, causing death of the affected cells. Taxon with the compound in its venom : Vipers and elapids (occurrences vary).

Compound : Glycoproteins.
Action : Suppress normal immune response of tissues through anticomplementary reactions. Taxon with the compound in its venom : Some vipers.

Potentially toxic low-molecular-weight compounds

Compound : Nucleotides (amino acids).
Action : Not known. Taxon with the compound in its venom : Bitis, Dendroaspis, Notechis (adenosine), Bungarus (guanosine).

Compound : Biogenic amines.
Action : Disrupt normal transmission of nerve impulses and other types of signalling between cells. Taxon with the compound in its venom : Agkistrodon, Crotalus (catecholamine), Trimeresurus (histamine) Agkistrodon, Crotalus (seratonin), Trimeresurus (spermine).

Compound : Acectylcholine.
Action : Disrupts normal transmission of nerve impulses, causing heart and respiratory failure. Taxon with the compound in its venom : Several genera.

B. Other Components (Organic and Ignorganic)

Nontoxic organic components and organic components with unclear roles :
Carbohydrates : Neutral sugars, Amino sugars, Sialic acid.
Lipids : Cholesterol, Monoglycerides, Diglycerides, Triglycerides, Phospholipids.

Inorganic ions (which activate and deactivate enzymes) :
Macrocomponents : Calcium, Chlorine, Copper, Iron, Magnesium, Manganese, Nickel, Phosphate, Potassium, Sodium, Sulfate, Zinc.
Microcomponents : Bismuth, Gold, Molybdnum, Palladium, Platinum, Selenium, Silver. Water.