
بسم الله الرحمن الرحيم

New trends in veterinary insecticides

By

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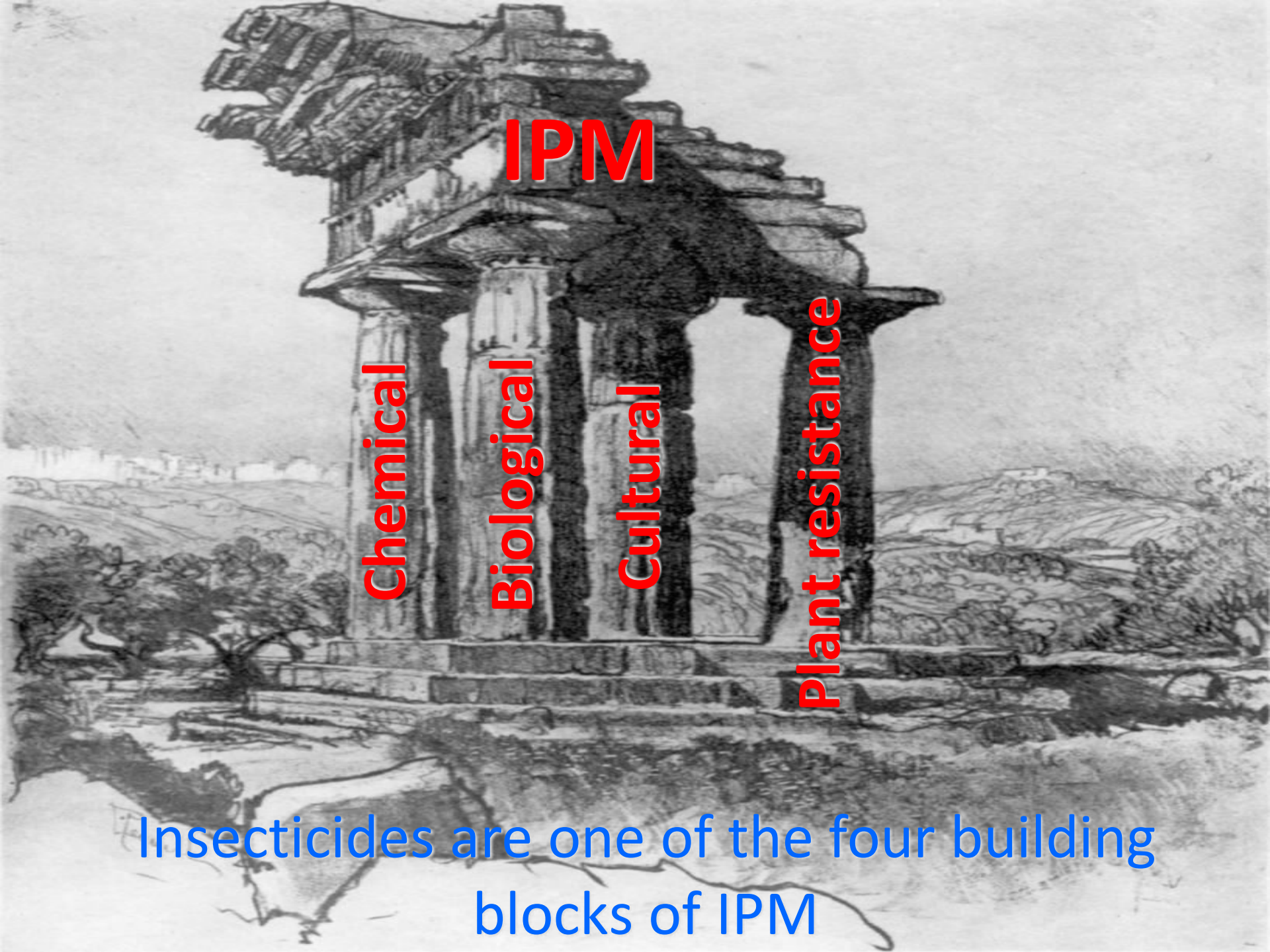
Which product should I use

Insecticide

Any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating insects.

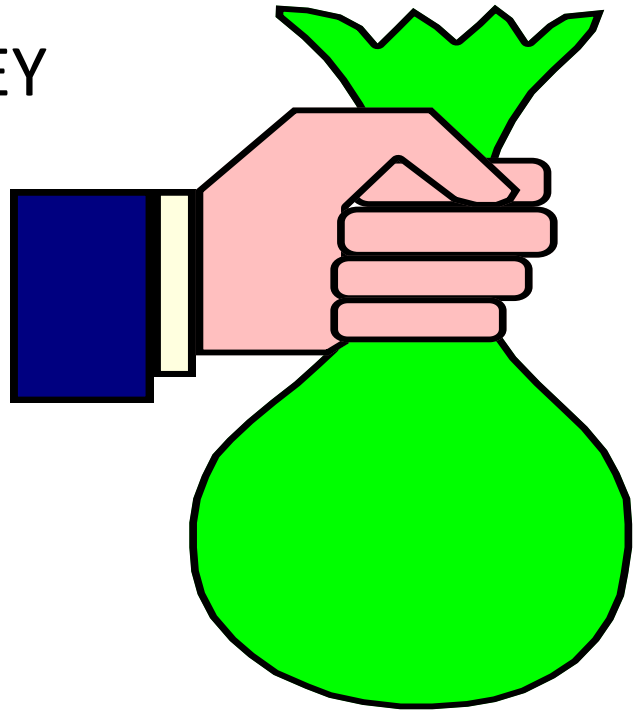


Insecticides are one of the four building blocks of IPM

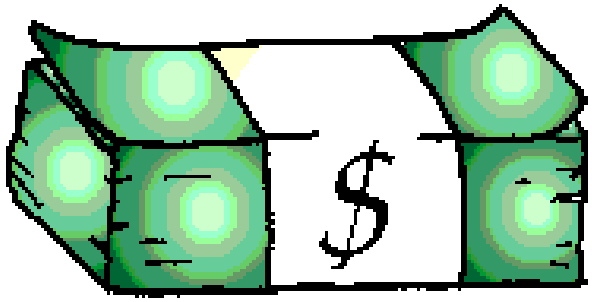
Chemical Control: Insecticides

We use insecticide For Only One Reason

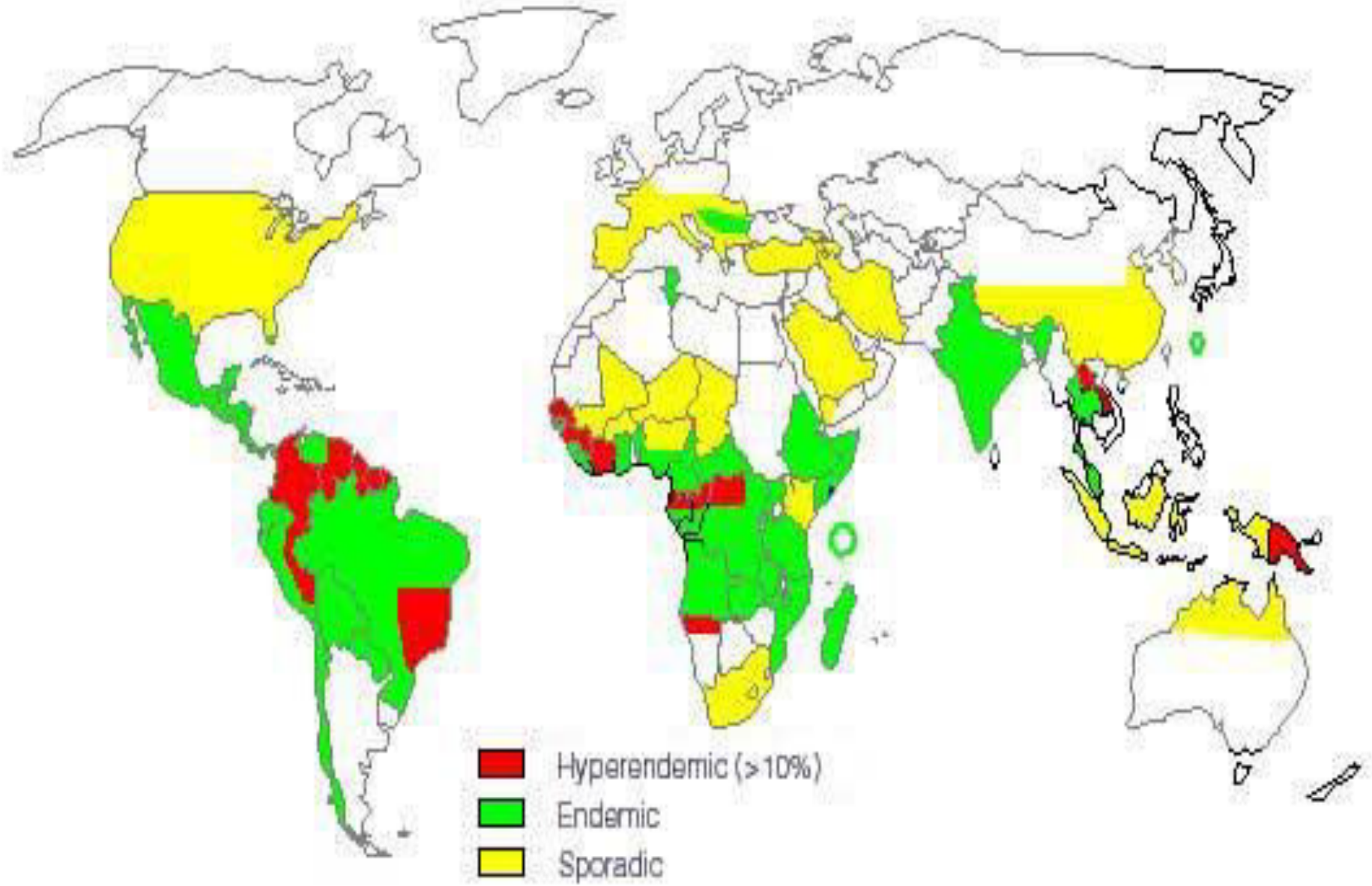
- FOR THE MONEY

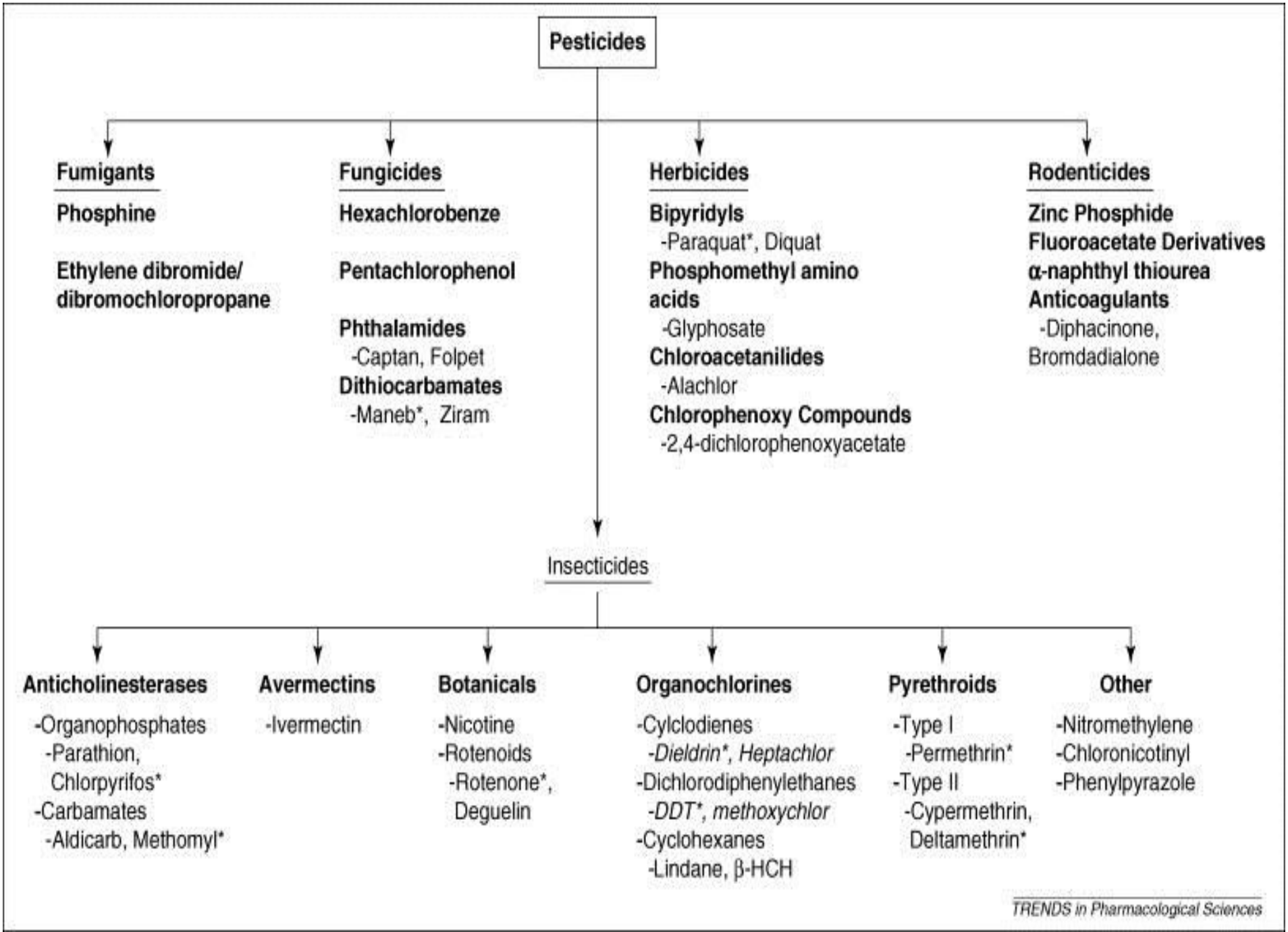


Insecticides represent an $ 8 billion industry



Epidemiology




Pesticides
Fumigants
Phosphine
Ethylene dibromide/ dibromochloropropane
Fungicides
Hexachlorobenze
Pentachlorophenol
Phthalamides
-Captan, Folpet
Dithiocarbamates
-Maneb*, Ziram
Herbicides
Bipyridyls
-Paraquat*, Diquat
Phosphomethyl amino acids
-Glyphosate
Chloroacetanilides
-Alachlor
Chlorophenoxy Compounds
-2,4-dichlorophenoxyacetate
Rodenticides
Zinc Phosphide
Fluoroacetate Derivatives
α-naphthyl thiourea
Anticoagulants
-Diphacinone, Bromdadialone
Insecticides
Anticholinesterases
-Organophosphates
-Parathion, Chlorpyrifos*
-Carbamates
-Aldicarb, Methomyl*
Avermectins
-Ivermectin
Botanicals
-Nicotine
-Rotenoids
-Rotenone*, Deguelin
Organochlorines
-Cylclodienes
-Dieldrin*, Heptachlor
-Dichlorodiphenylethanes
-DDT*, methoxychlor
-Cyclohexanes
-Lindane, β-HCH
Pyrethroids
-Type I
-Permethrin*
-Type II
-Cypermethrin, Deltamethrin*
Other
-Nitromethylene
-Chloronicotinyl
-Phenylpyrazole
TRENDS in Pharmacological Sciences

Other pesticide terms

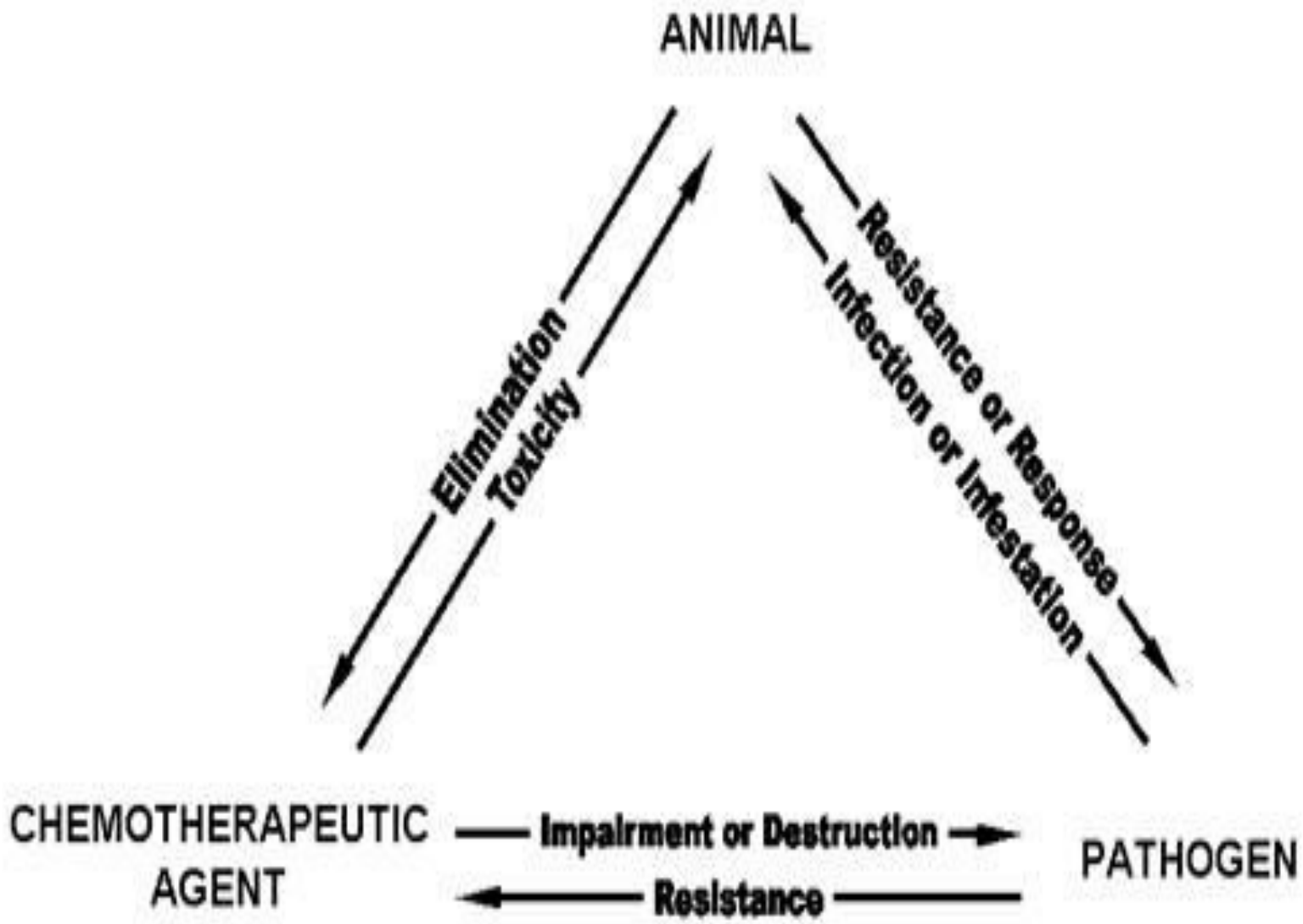
- Ovicide -- kills eggs
- Larvicide -- kills larvae
- Adulticide -- kill adults
- Insect growth regulator -- disrupts normal growth and development of insects
- Dessicants -- cause insect death by dehydration
- Repellents -- repel insects and other arthropods
- Attractants -- attract insects and vertebrates
- Synergists -- chemicals used to enhance the insecticidal activity of other chemicals

Pesticide terms for route of entry

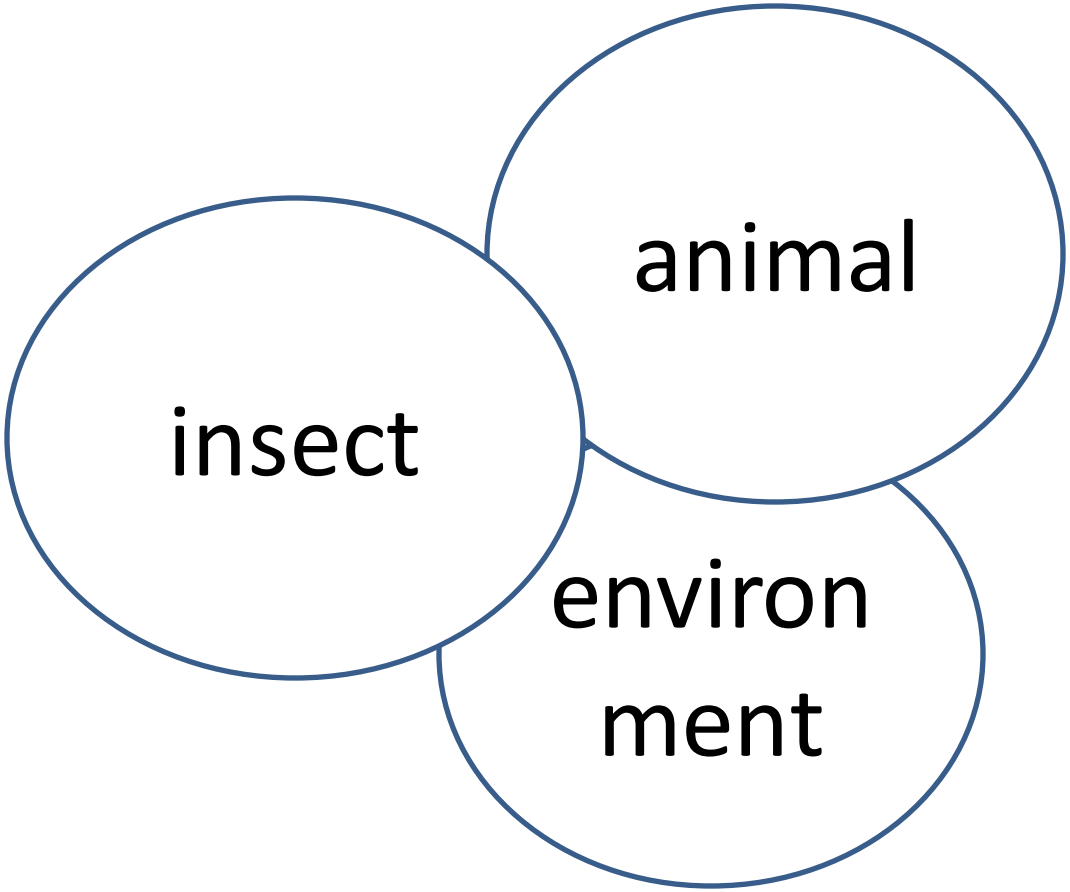
- **Stomach poison** -- enter orally usually in a food material
- Insect baits -- composed of attractive food and a toxicant
- Dusts -- applied to surfaces pests contact, pest crawls through residue, grooming results in ingestion
- Liquid baits -- boric acid and some rodenticides are water soluble and can be put in water sources of pests

Pesticide terms for route of entry

- **Contact poisons** -- enter through cuticle of insects
  - most pesticides are contact poisons
  - most are lipophilic and enter the insect through the cuticular waxes and oils
- **Fumigants** -- vapors enter the insect through the spiracles during respiration
  - are true gases at room temperature
  - methyl bromide, sulfuryl fluoride, paradichlorobenzene, napthalene are true fumigants

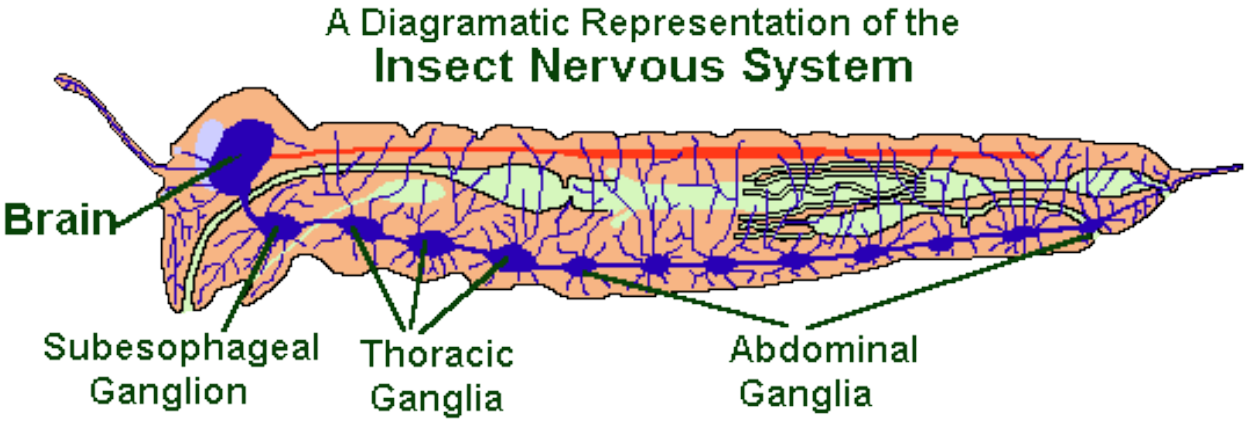

ANIMAL
Elimination
Toxicity
Resistance or Response
Infection or Infestation
CHEMOTHERAPEUTIC AGENT
Impairment or Destruction
Resistance
PATHOGEN

Considerations in use of insecticides

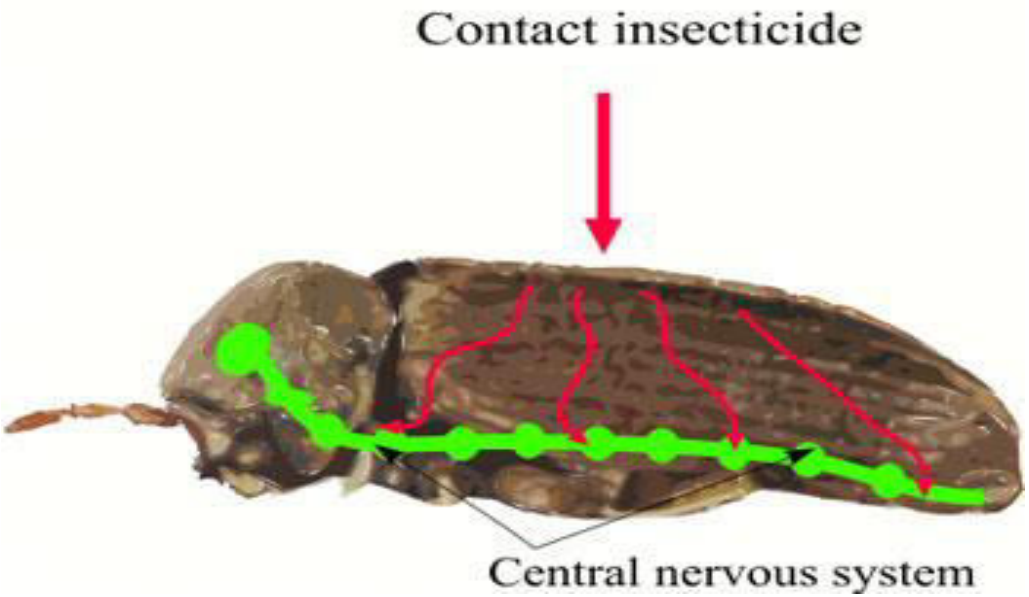


وَعَلَّمَ ءَادَمَ ٱلْأَسْمَآءَ كُلَّهَا ثُمَّ عَرَضَهُمْ
عَلَى ٱلْمَلَٰٓئِكَةِ فَقَالَ أَنۢبِـُٔونِى بِأَسْمَآءِ
هَٰٓؤُلَآءِ إِن كُنتُمْ صَٰدِقِينَ ﴿٣١﴾ قَالُوا۟
سُبْحَٰنَكَ لَا عِلْمَ لَنَآ إِلَّا مَا عَلَّمْتَنَآ ۖ إِنَّكَ
أَنتَ ٱلْعَلِيمُ ٱلْحَكِيمُ ﴿٣٢﴾

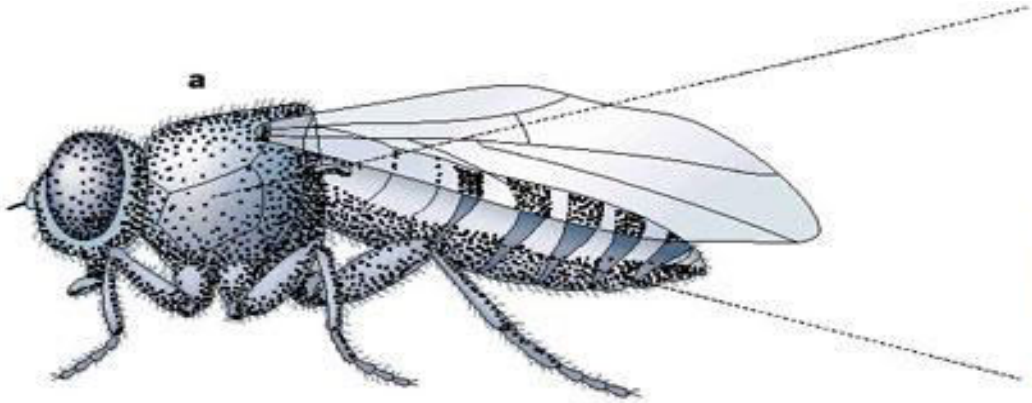
Nervous system

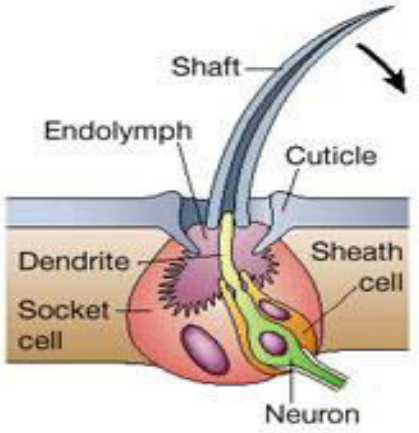


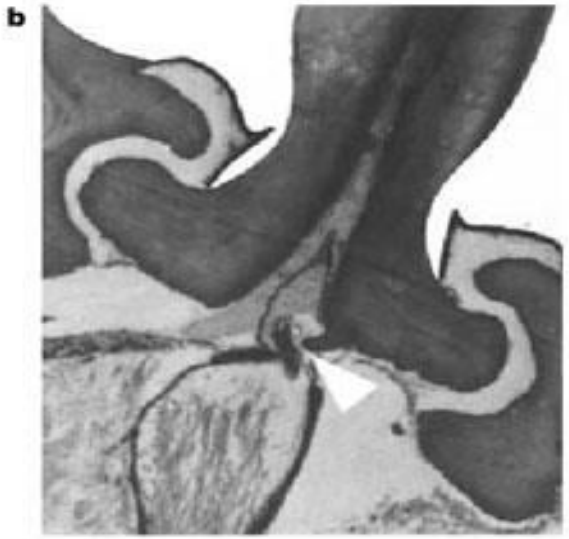
CONTACT INSECTICIDES

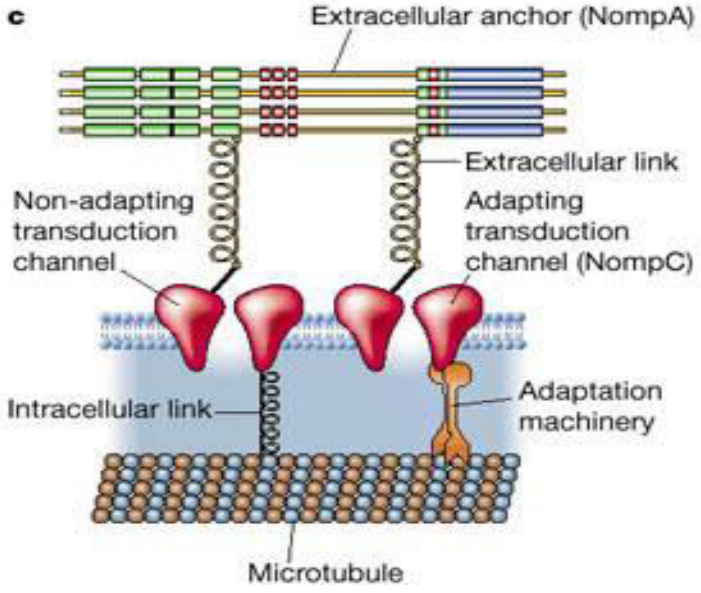


Cuticale

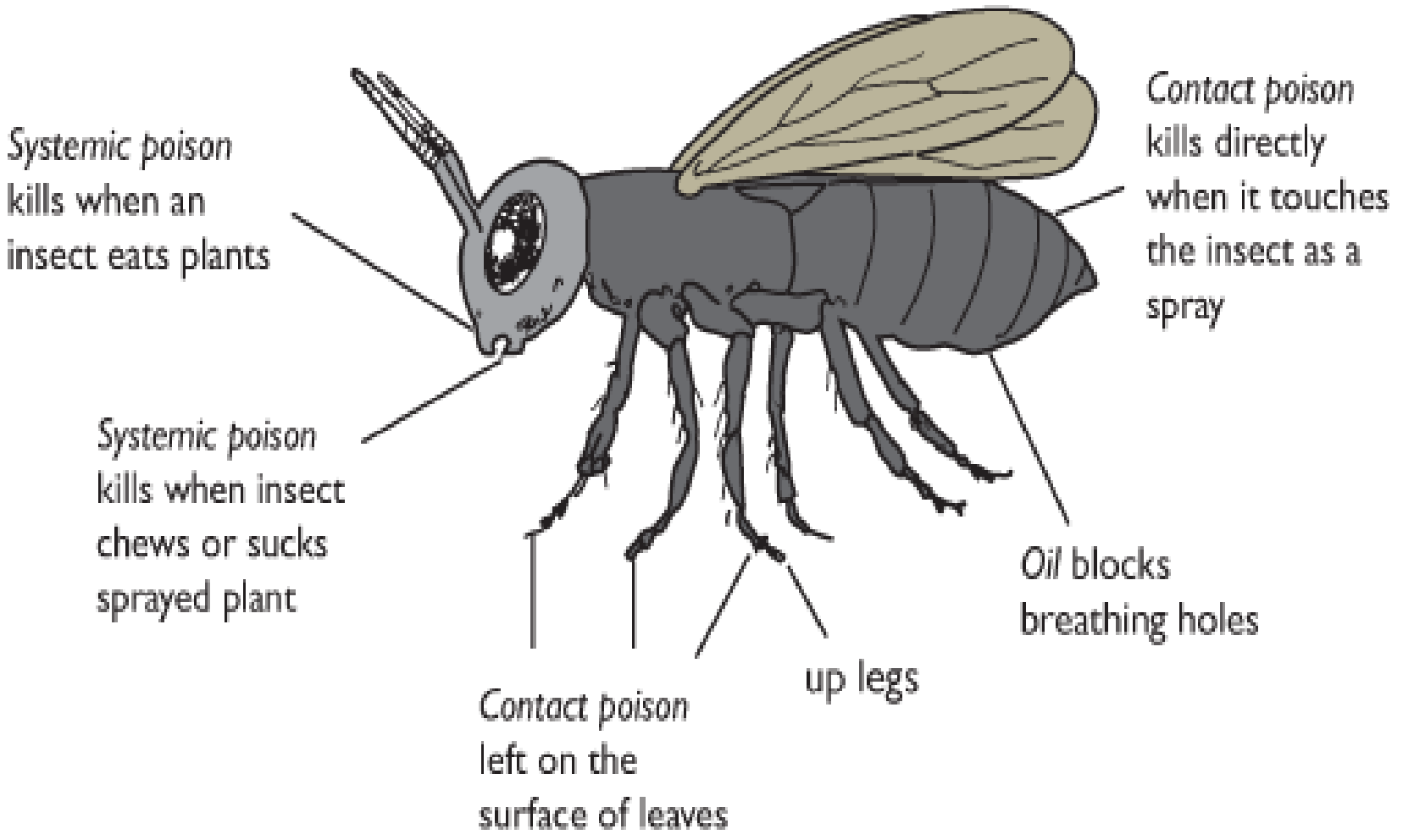

a


Shaft
Endolymph
Cuticle
Dendrite
Sheath cell
Socket cell
Neuron

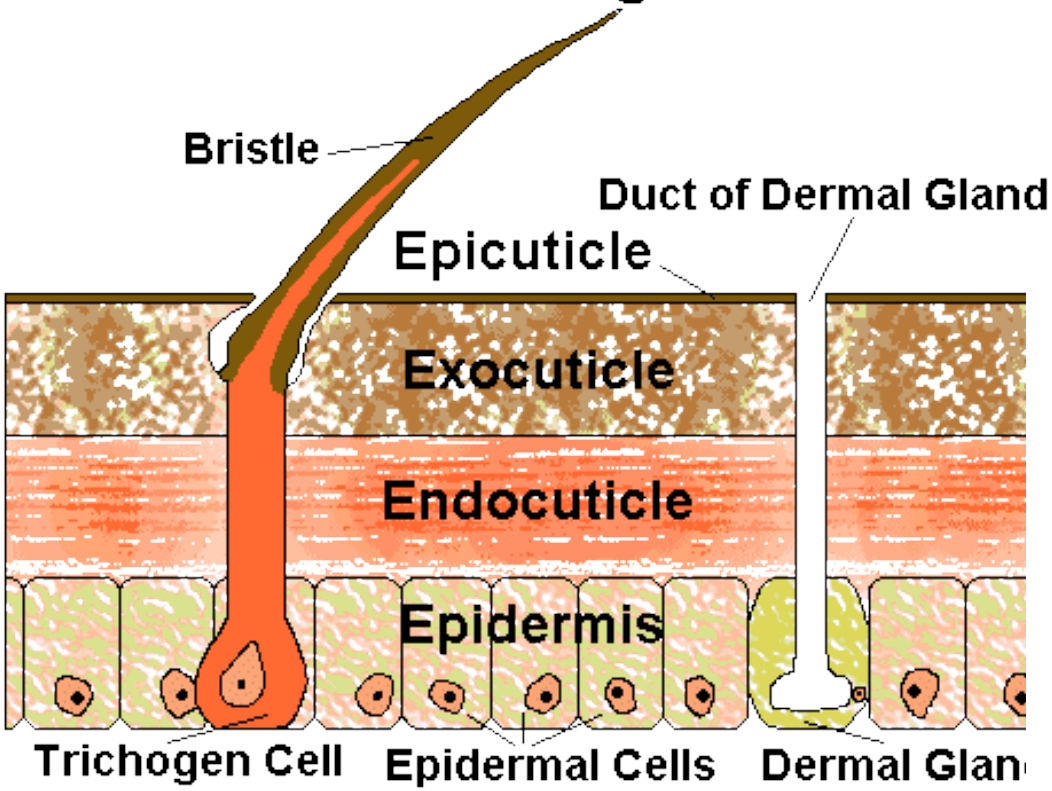

b

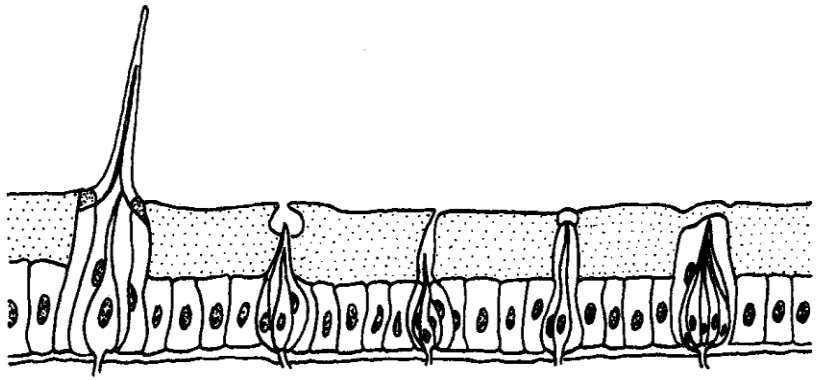

c
Extracellular anchor (NompA)
Extracellular link
Non-adapting transduction channel
Adapting transduction channel (NompC)
Intracellular link
Adaptation machinery
Microtubule

Insects


Systemic poison kills when an insect eats plants
Contact poison kills directly when it touches the insect as a spray
Systemic poison kills when insect chews or sucks sprayed plant
Oil blocks breathing holes
up legs
Contact poison left on the surface of leaves

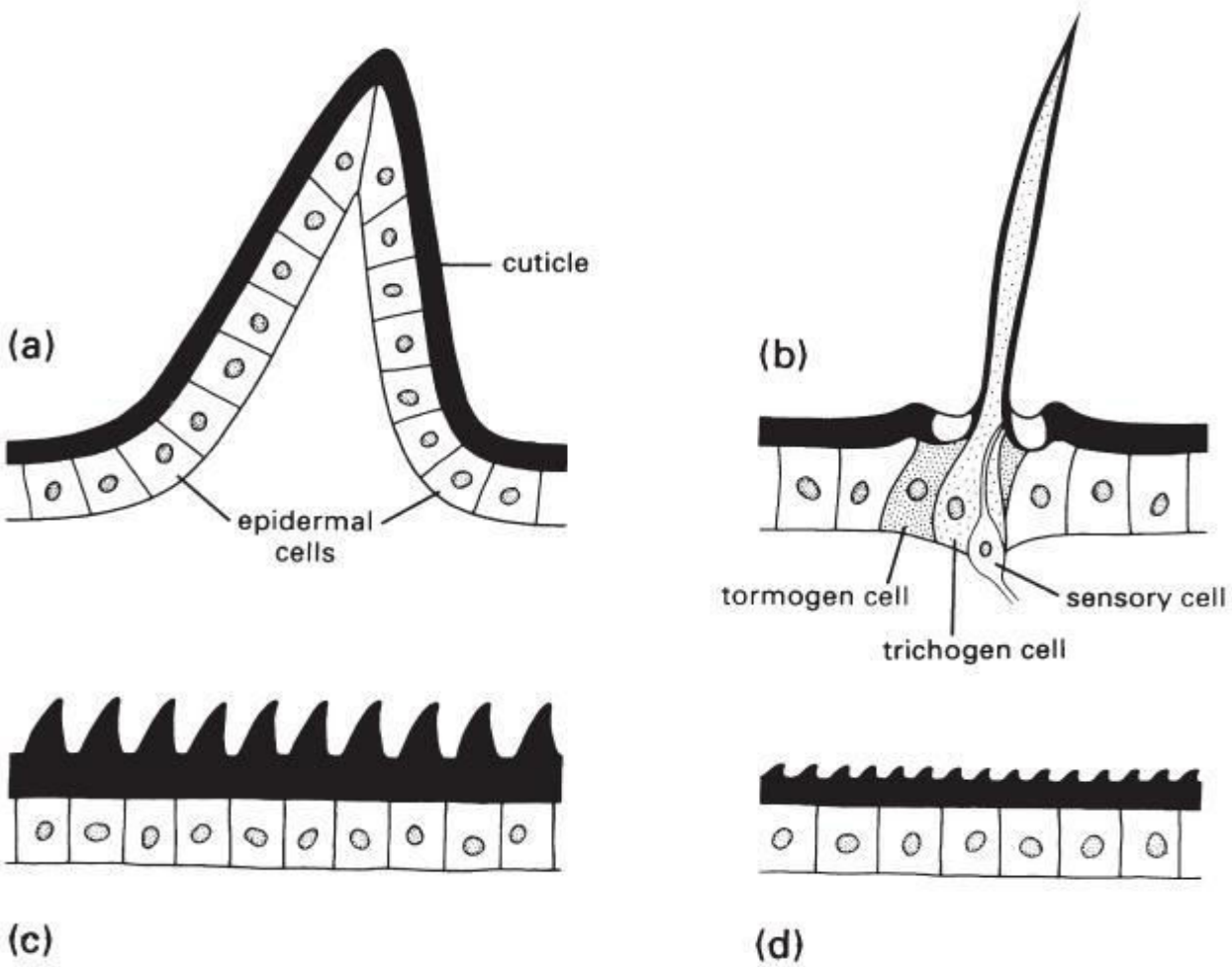
The Insect Integument

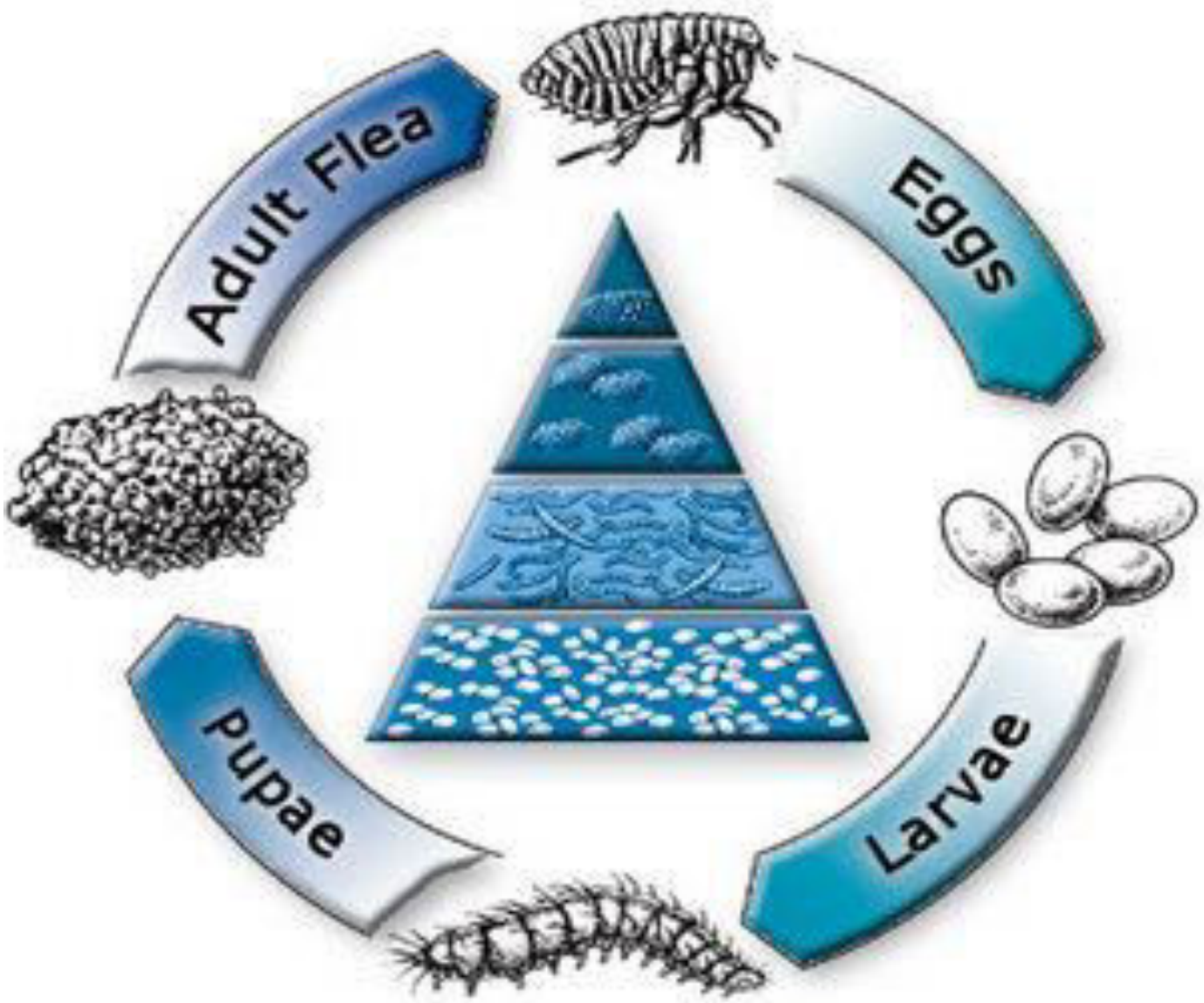




Iy/99

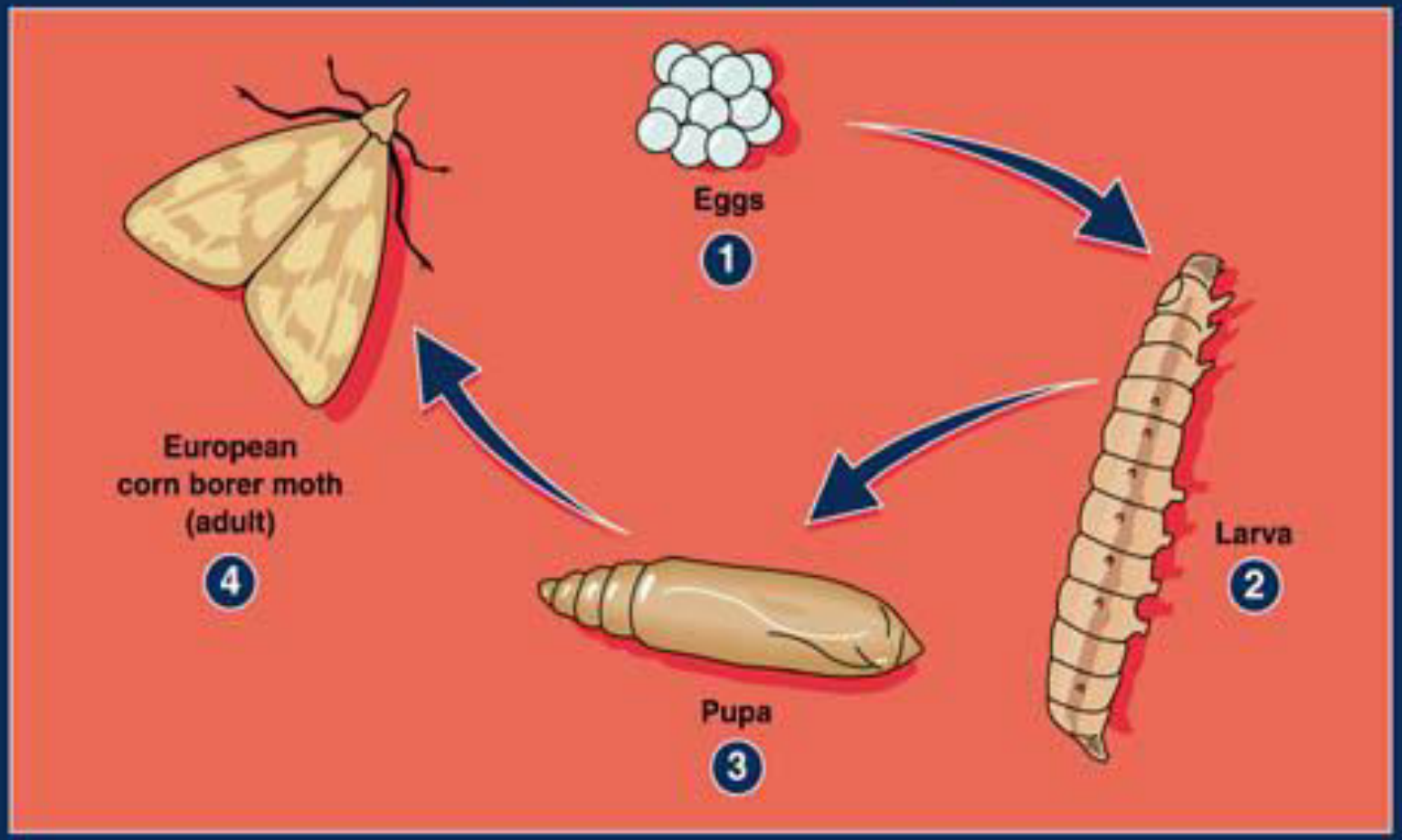
cuticle


(a)
cuticle
epidermal cells
(b)
tormogen cell
sensory cell
trichogen cell
(c)
(d)

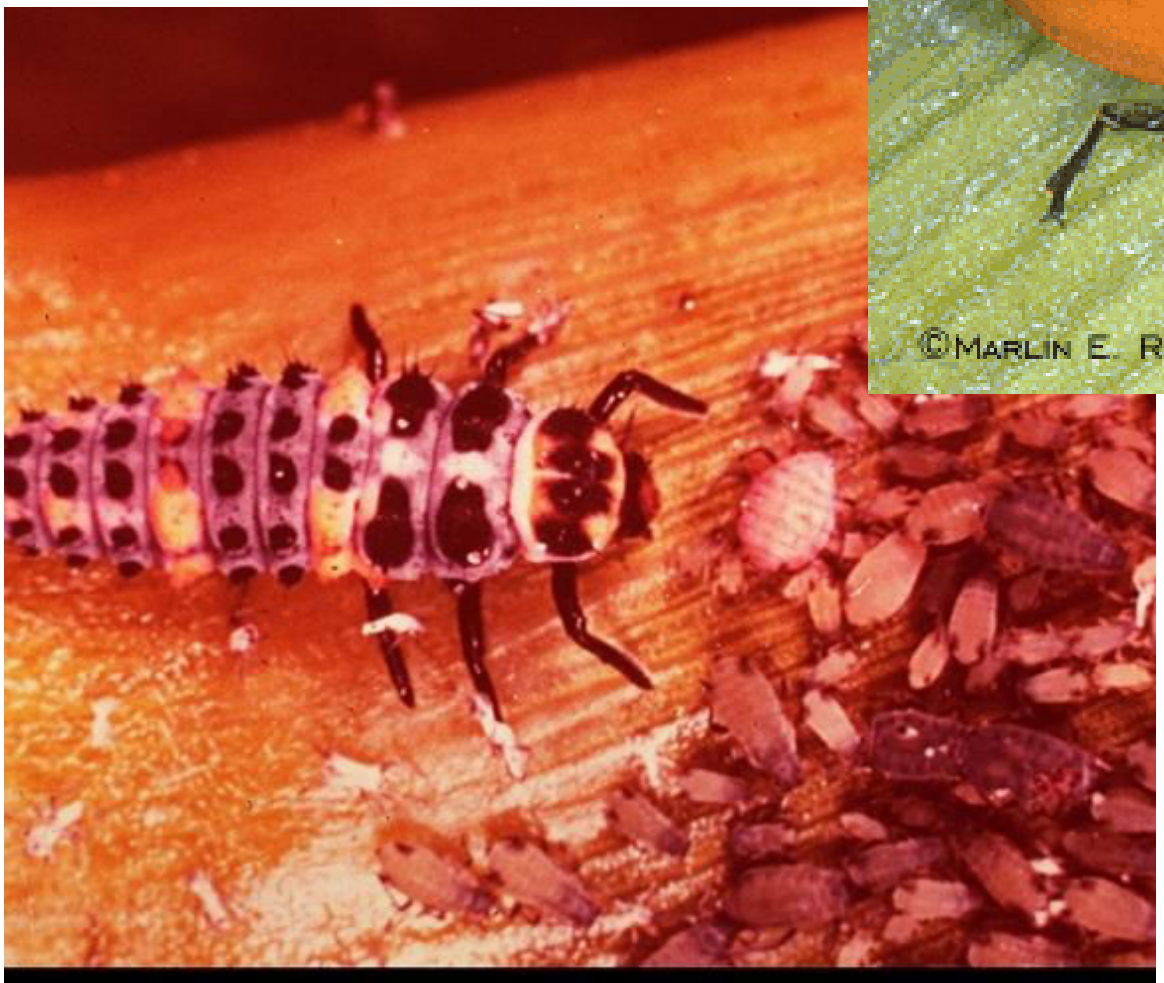

Adult Flea
Eggs
Larvae
Pupae

Regal Moth - adult of Hickory Horned Devil

Stages of insect development



Lady bird beetle
(ladybug)

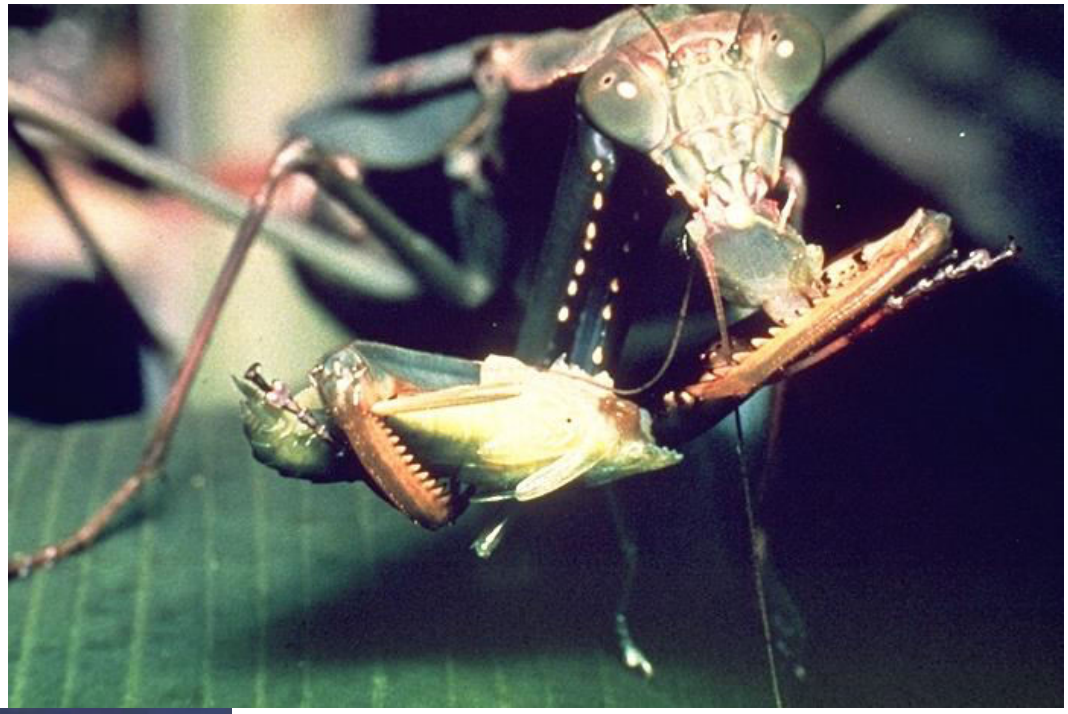


Larva
eating
aphids

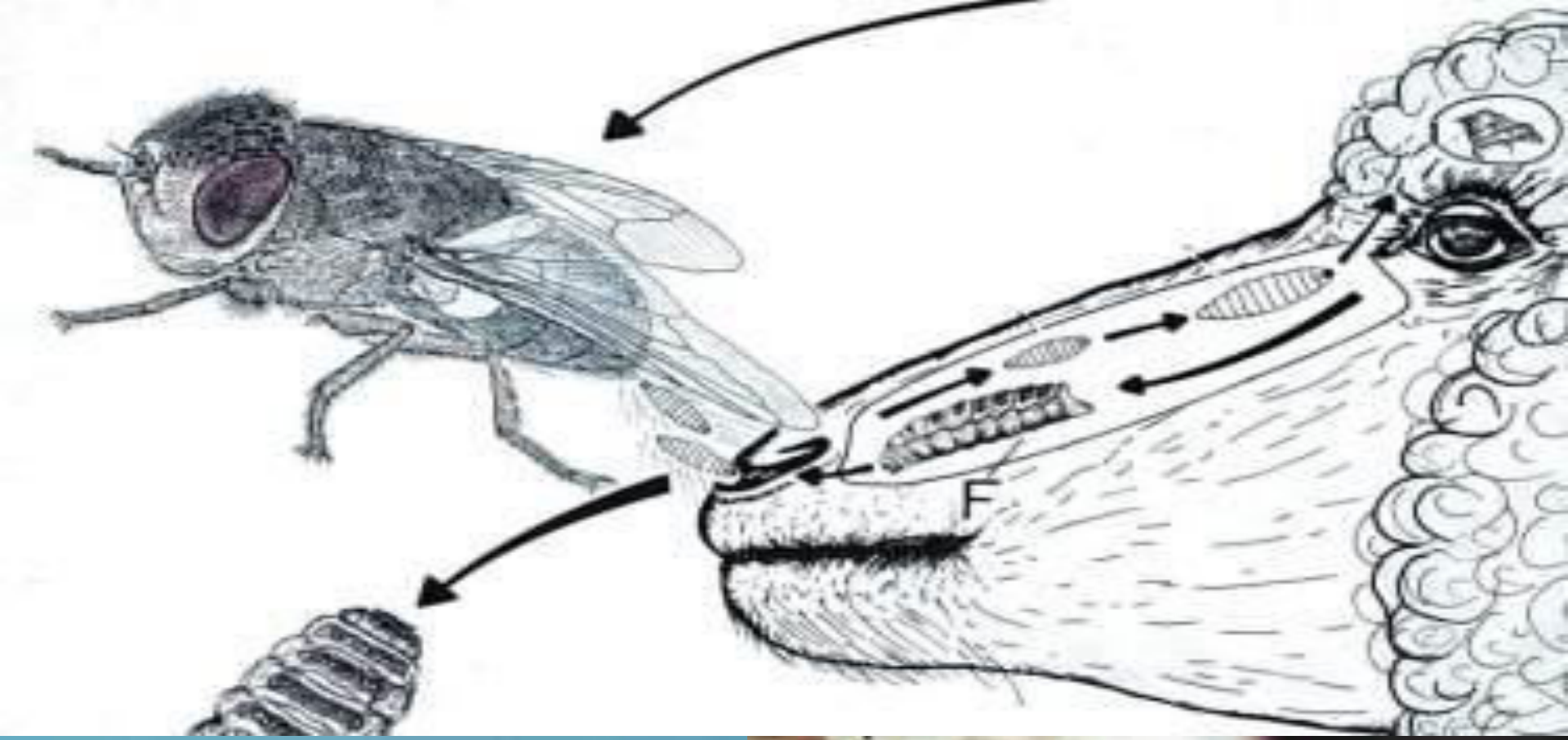
Hickory Horned Devil

"Hold it right there, young lady! Before you go out, you take off some of that makeup and wash off that gallon of pheromones!"

Preying mantid



Lacewing adult


F

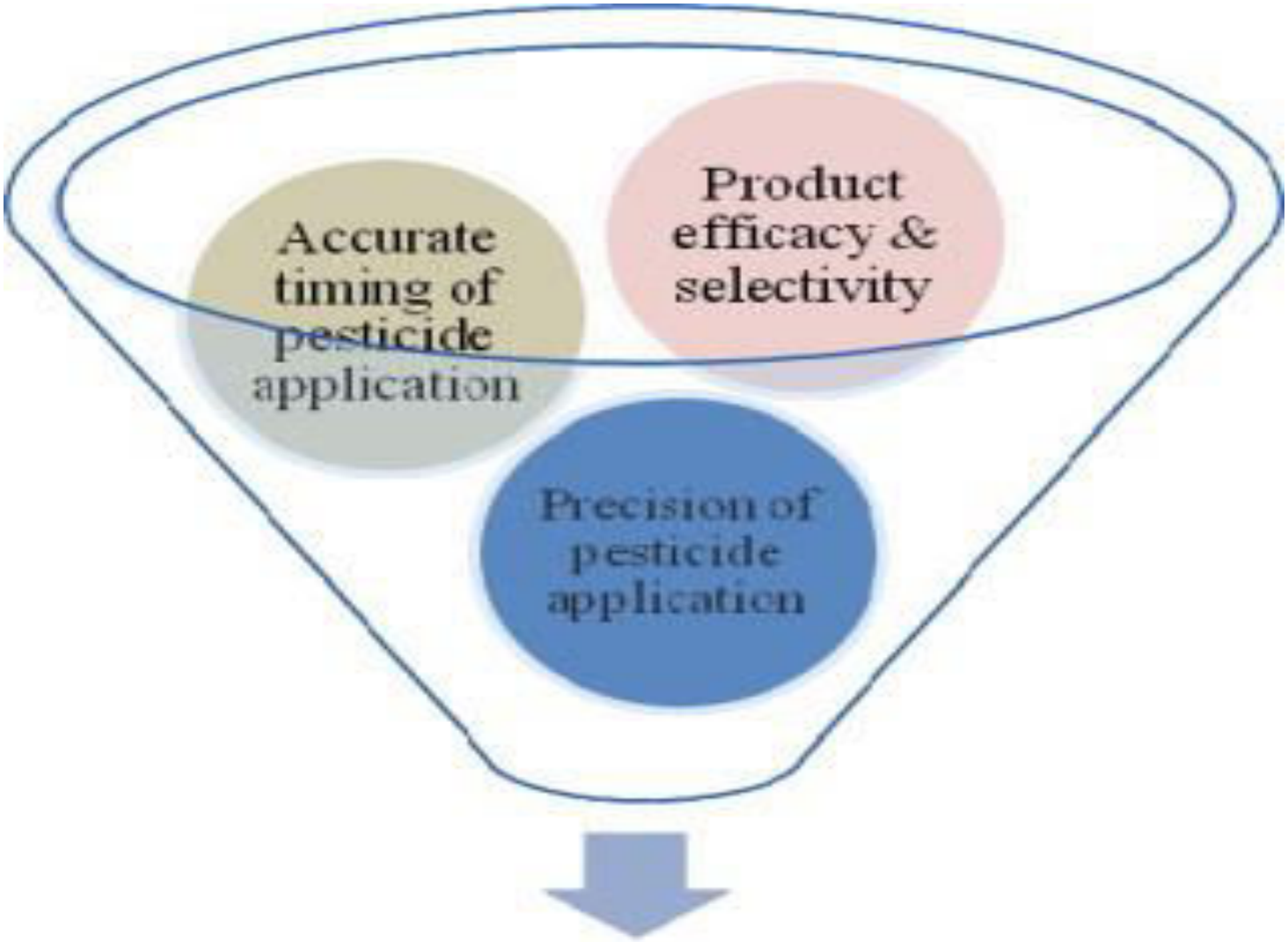
Flystrike

Myiasis


TAPEWORM LIFE CYCLE
Drontal
Bayer HealthCare

insecticide…??

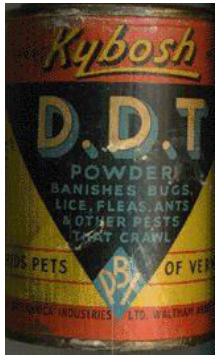
“choice of insecticide”


Accurate timing of pesticide application
Product efficacy & selectivity
Precision of pesticide application
Rational Pesticide Use (RPU)

Drugs used

Tornel.
LABORATORIOS

Examples



Organochlorines

DDT - Endosulfan

Aldrin - Gamma HCH

Dieldrin - Gamma BHC

Carbamates

- Aldicarb -Carbofuran

Pyrethroids

-Tefluthrin

- Deltamethrin
- Lambda
-cyhalothrin
- Permethrin
- Cypermethrin

Organophosphates

-Diazinon

-Fenitrothion

-Dichlorvos

-Dimethoate

- Malathion

Neonicotenoids

-imidacloprid

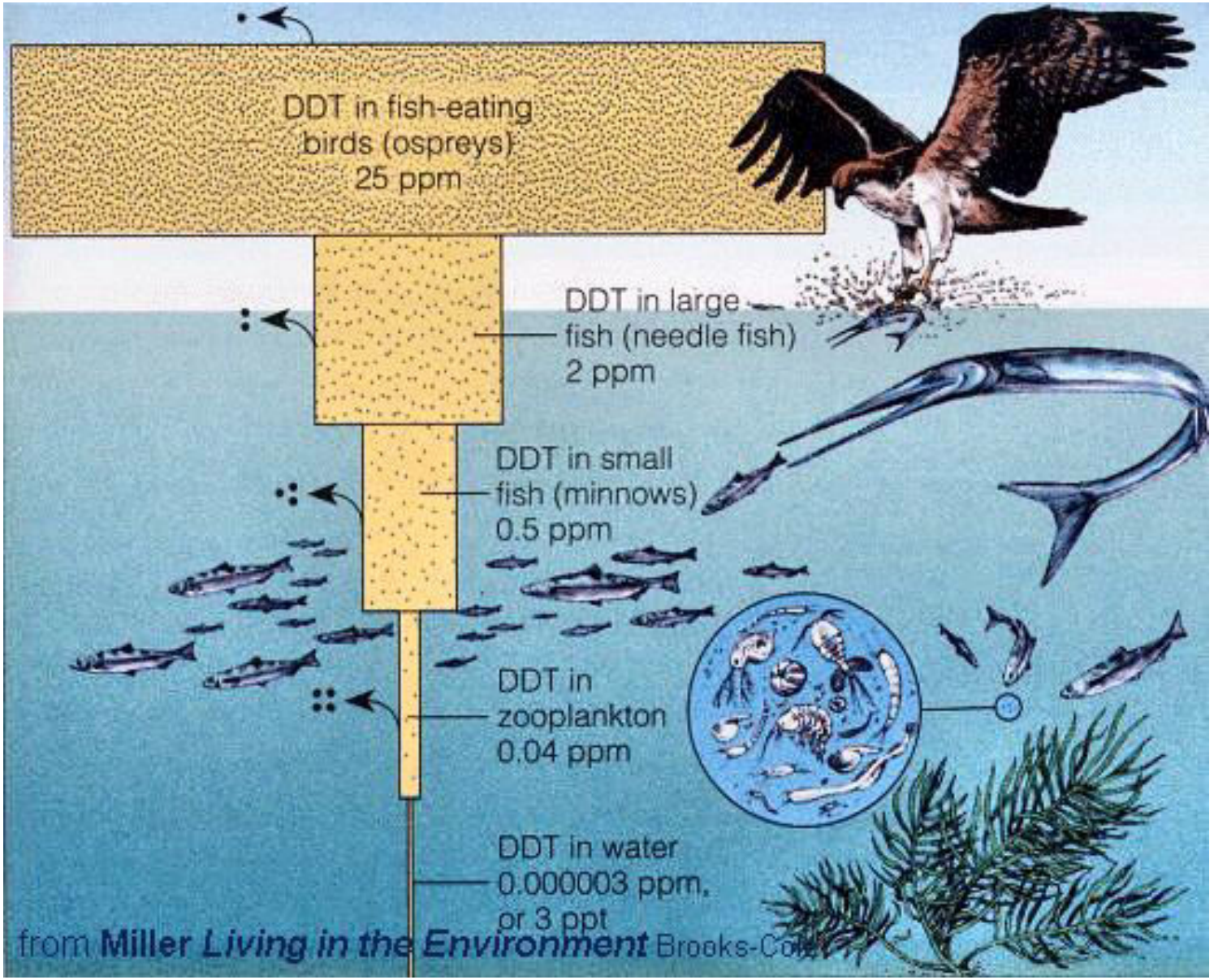
-nitempyram

- acetamiprid

- thiamethoxam


AMDRO
Hi-Yield
IMPORTED
Fire Ant
CONTROL GRANULES
ROACH & ANT KILLER
GUARANTEED TO WORK
FREE!
HOT SHOT
ROACH & ANT
ROACH DESTROYER
VELOCITY
Hi-Yield
Roach
Blaster
ANT ROACH & SPIDER
SPRAY-KILL

Which product should I use


DDT in fish-eating birds (ospreys) 25 ppm
DDT in large fish (needle fish) 2 ppm
DDT in small fish (minnows) 0.5 ppm
DDT in zooplankton 0.04 ppm
DDT in water 0.000003 ppm, or 3 ppt
from Miller Living in the Environment Brooks-Cole

Public concern about Insecticide use

~100% of us have some insecticide residue in our bodies

For the Correct use of insecticides, we need to consider:

Ease of use

Insecticide resistance

Economics

Safety

Insect behavior

Way of delivery

Ecotoxicological impact

Toxicology

Insecticides

- Inorganics
  - Ex. Bora-Care, Disodium Octaborate Tetrahydrate
- Botanicals
  - Ex. Pyrethrum
- Synthetic Organics
  - Ex. Pyrethroids
- “Natural”
  - Ex. Avermectins

Insecticides

Anticholinesterases
- -Organophosphates
  - -Parathion, Chlorpyrifos*
- -Carbamates
  - -Aldicarb, Methomyl*

Avermectins
- -Ivermectin

Botanicals
- -Nicotine
- -Rotenoids
  - -Rotenone*, Deguelin

Organochlorines
- -Cyclodienes
  - *-Dieldrin*, Heptachlor*
- -Dichlorodiphenylethanes
  - *-DDT*, methoxychlor*
- -Cyclohexanes
  - -Lindane, β-HCH

Pyrethroids
- -Type I
  - -Permethrin*
- -Type II
  - -Cypermethrin, Deltamethrin*

Other
- -Nitromethylene
- -Chloronicotinyl
- -Phenylpyrazole

TRENDS in Pharmacological Sciences

Botanical Insecticides

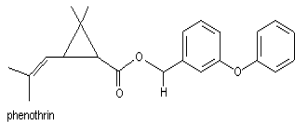
Secondary compounds

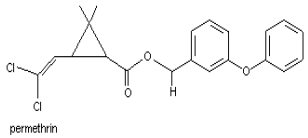
- Alkaloids
- Terpenoids
- Phenolics
- Glucosinolates
- Etc.

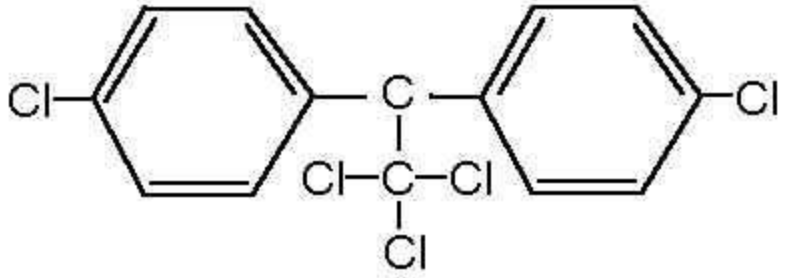
Synthetic Insecticides

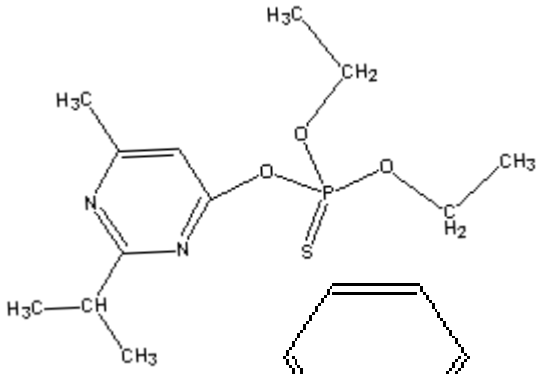
Synthetic Insecticides

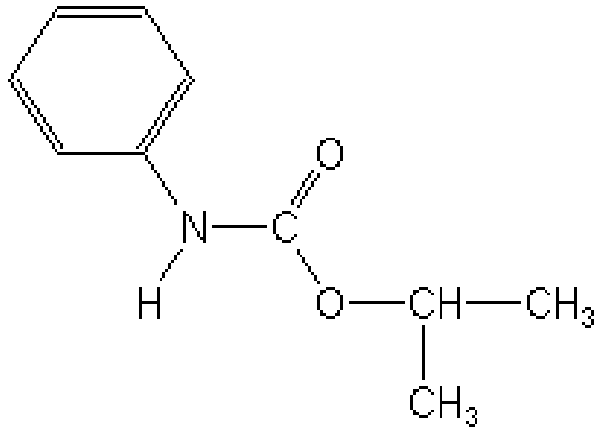
- Organochlorines
- Organophosphates
- Carbamates
- Pyrethroids
- Neonicotinoids







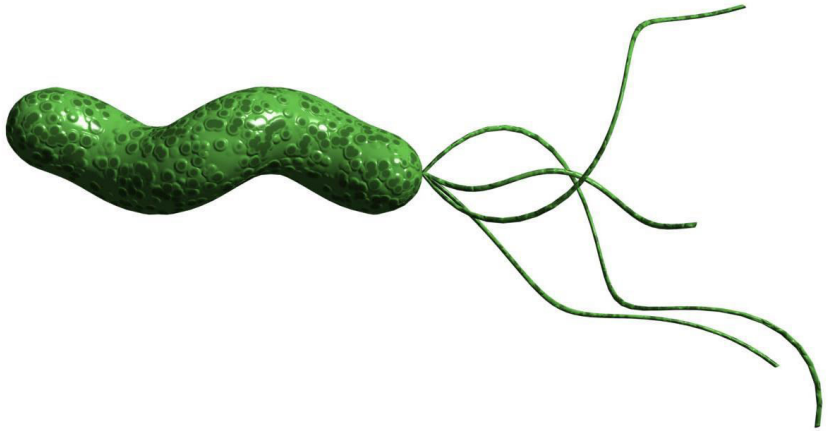




Biorational Formulations

Biorational Formulations

- Growth regulators
- Pheromones
- Microbial formulations

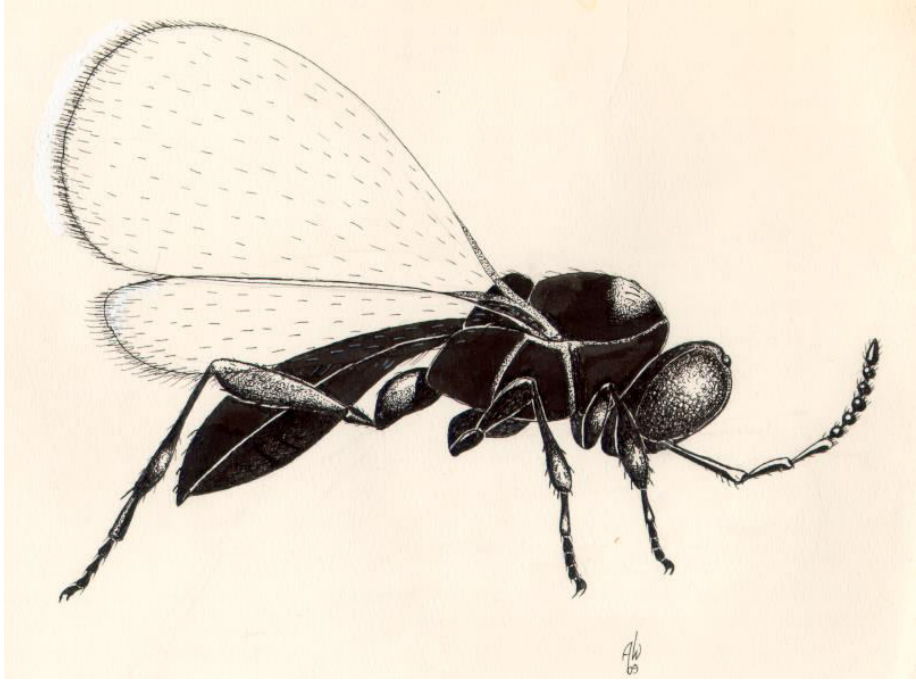


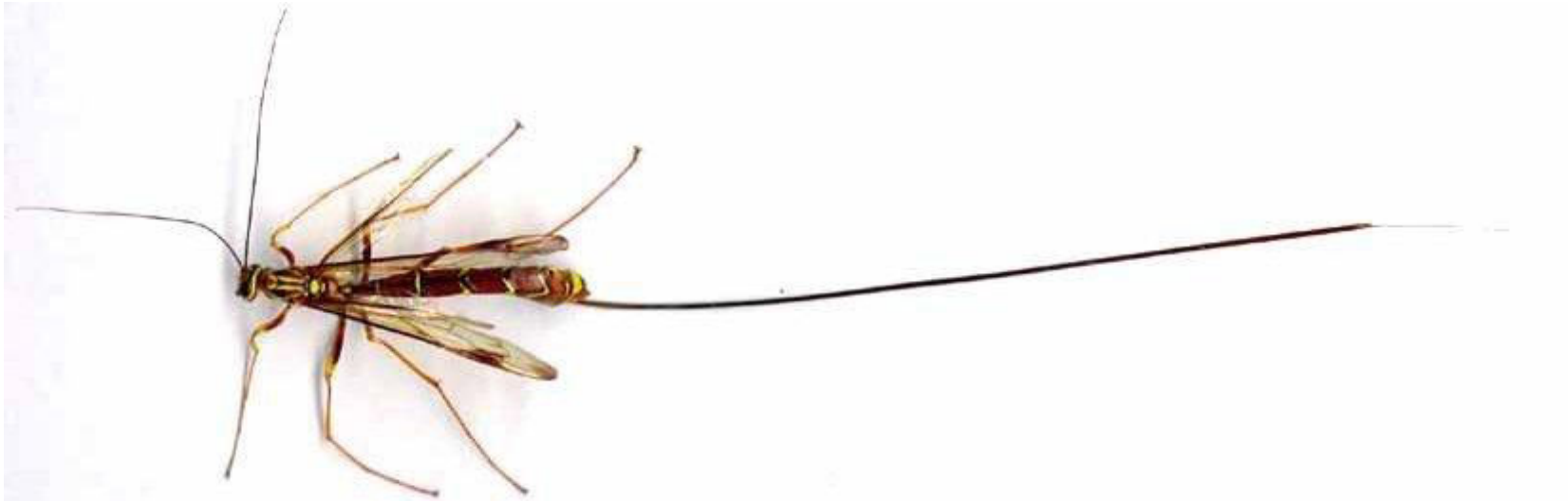
Microbial Formulations

- Uses bacteria, fungi, nematodes, protozoa and viruses
- Mostly used as inundative releases
- Specific for arthropods

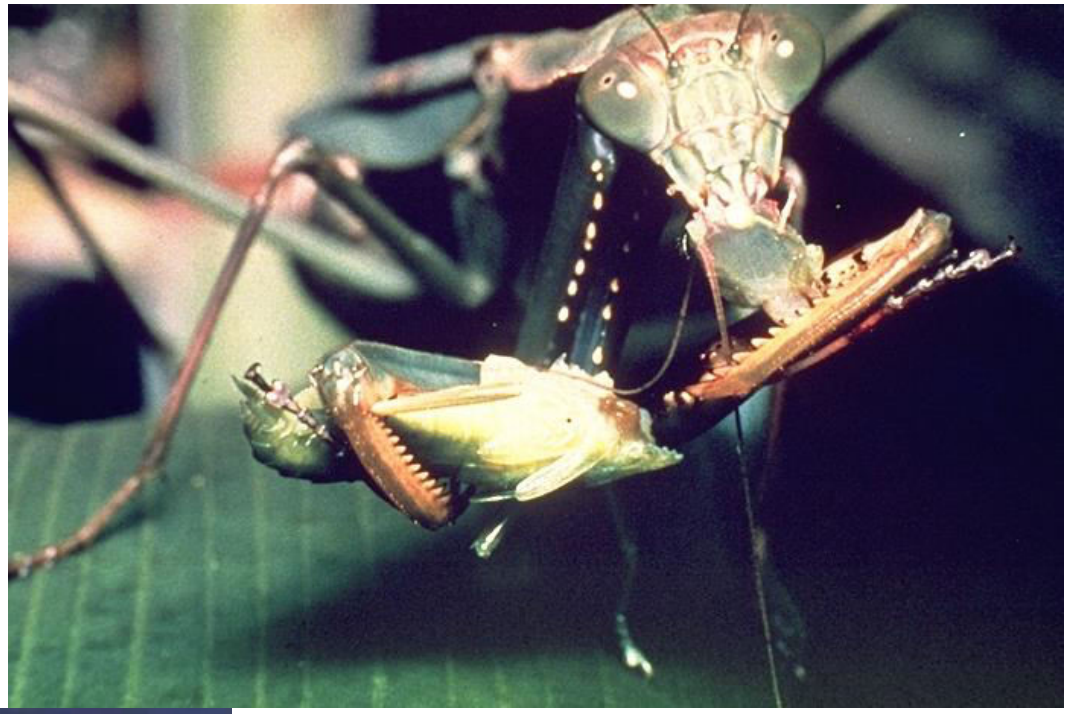
Parasitoids –

- Chalcid wasps
- Cynipid wasps
- Ichneumonid wasps
- Numerous Diptera





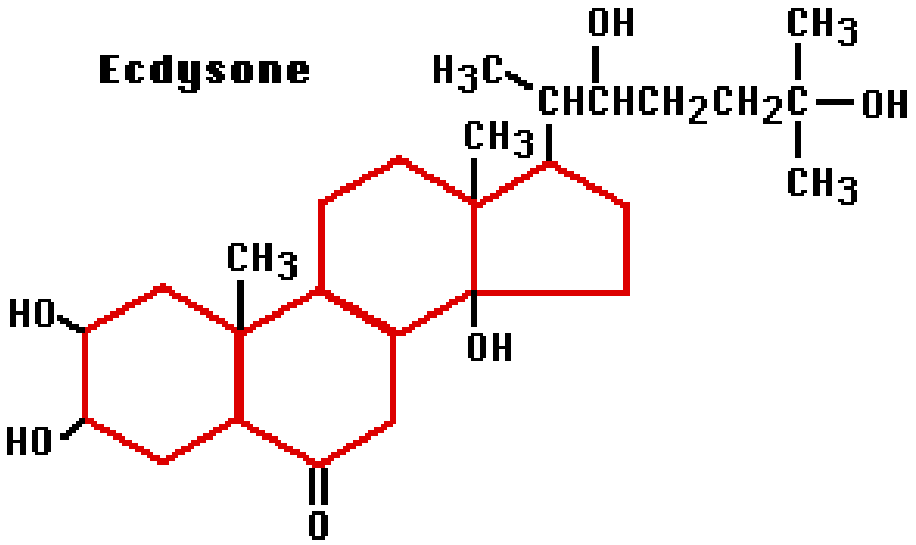
Preying mantid



Lacewing adult

Growth Regulators

- Interfere with development
- Disrupt metamorphosis and reproduction
- Specific for arthropods

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www.butterfliesetc.com

Pheromones

- Mediate intraspecific interactions
- Around 50 available for IPM
- Mostly use in association with traps

Classes of Insecticides

Botanical Insecticides

- **Sabadilla**
- **Nicotine**
- **Quassia**
- **Unsaturated isobutylamides**
- **Ryanodine**
- **Naphtoquinones**
- **Rotenone**
- **Sweet flag**
- **Marigolds**
- **Pyrethrum**
- **Azadirachtin**
- **Essential oils**
- **Botanical insecticides**

Synthetic Insecticides

- Organochlorines
- Organophosphates
- Carbamates
- Pyrethroids
- Neonicotinoids

Biorational Formulations

- Growth regulators
- Pheromones
- Microbial formulations

Examples

Juvenile Hormones

- Methoprene
- Tebufenozide
- Fenoxycarb
- Pyriproxifen

Chitin Synthesis Inhibitors

- Diflubenzuron
- Hexaflumuron
- Triflumuron

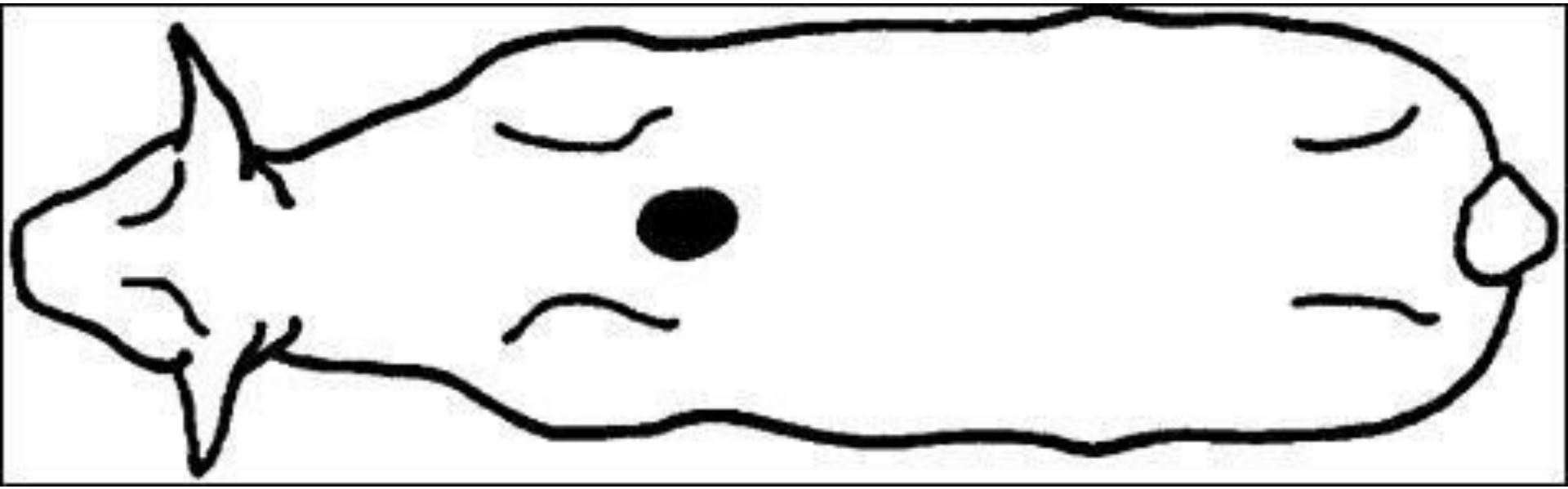
Triazine Derivatives

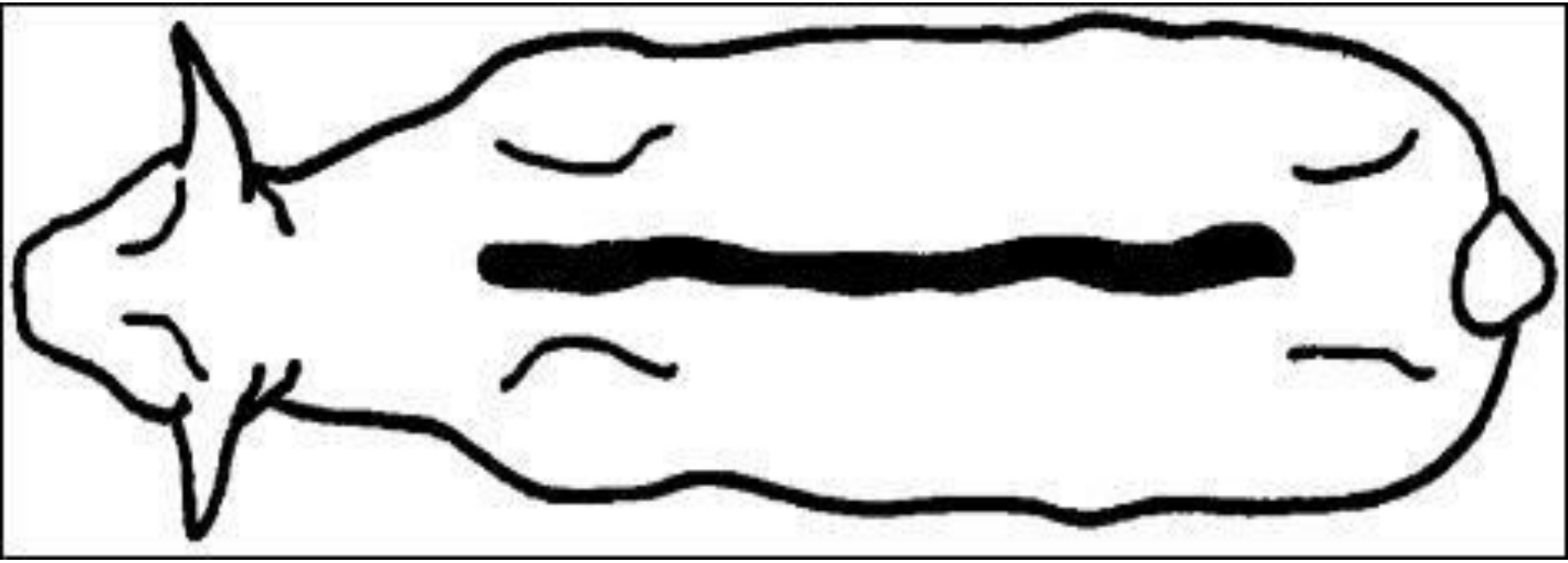
- Melamine
- Cryomazine

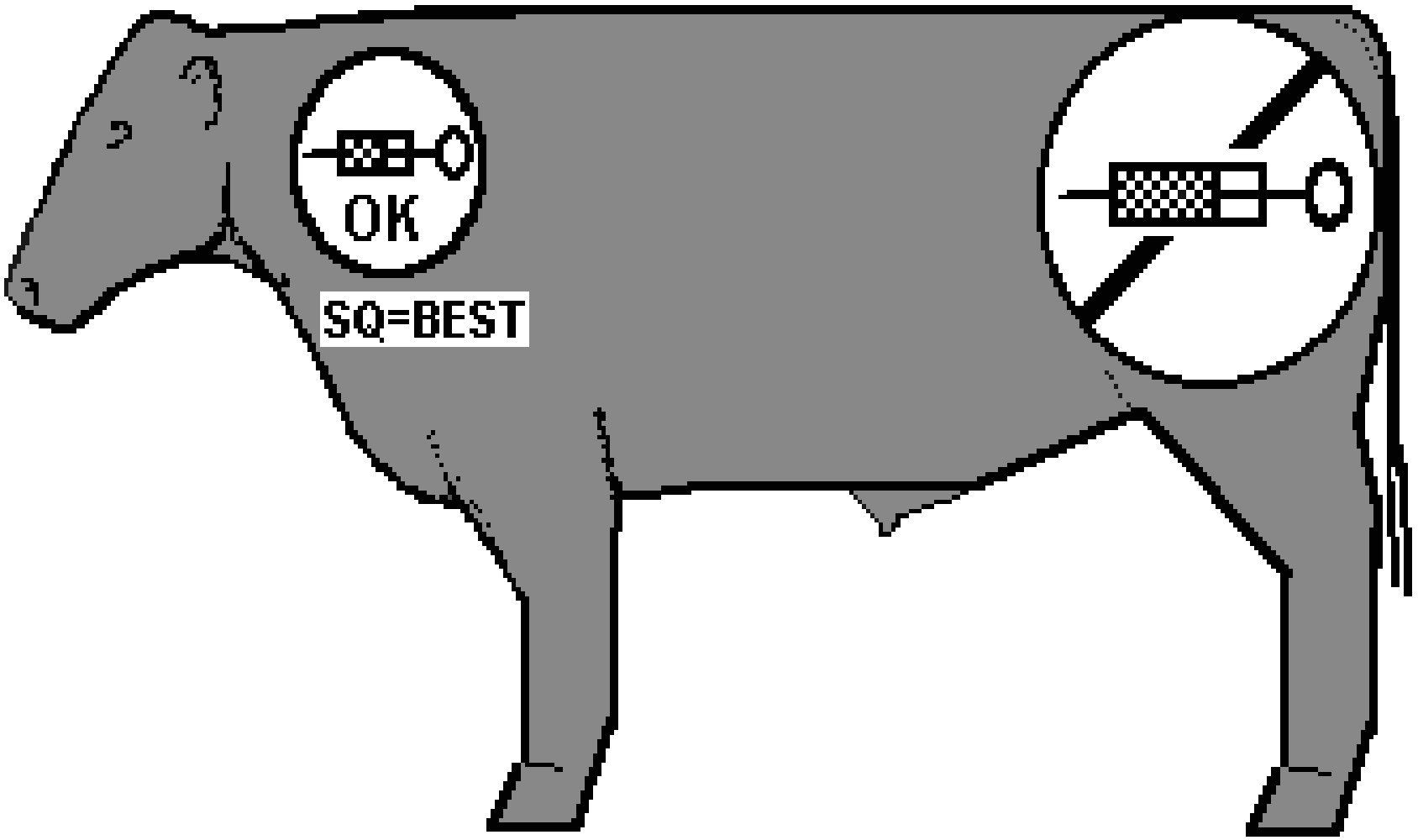
World Health Organization (WHO) Classification of Pesticides by Hazard

	LD $_{50}$ for the rat (mg/kg body weight)			
Class	**Oral**		**Dermal**	
	Solids	**Liquids**	**Solids**	**Liquids**
Ia Extremely hazardous	5 or less	20 or less	10 or less	40 or less
Ib Highly hazardous	5 - 50	20 - 200	10 - 100	40 - 400
II Moderately hazardous	50 - 500	200 - 2000	100 - 1000	400 - 4000
III Slightly hazardous	Over 500	Over 2000	Over 1000	Over 4000

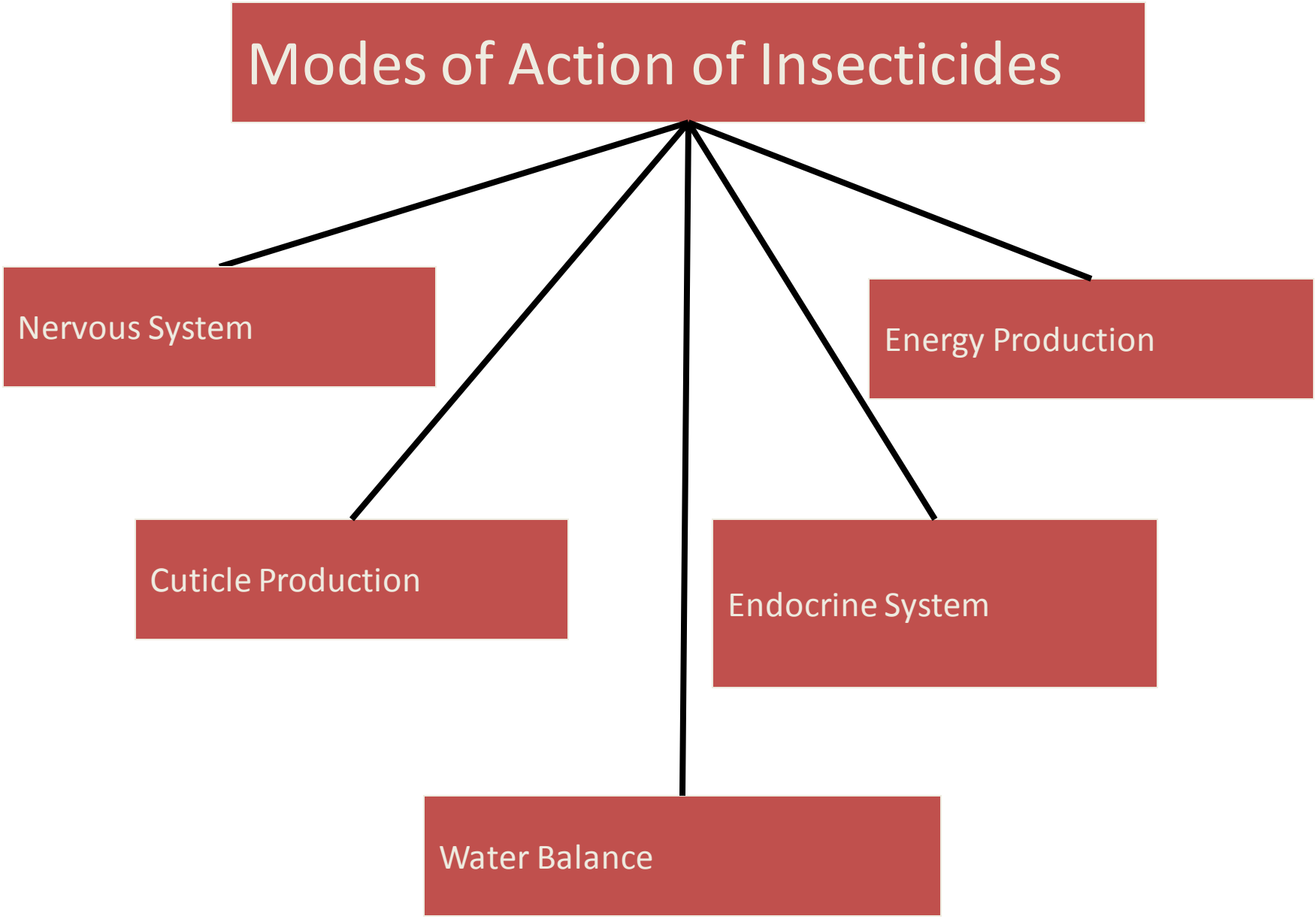
Pharmaceutical classification



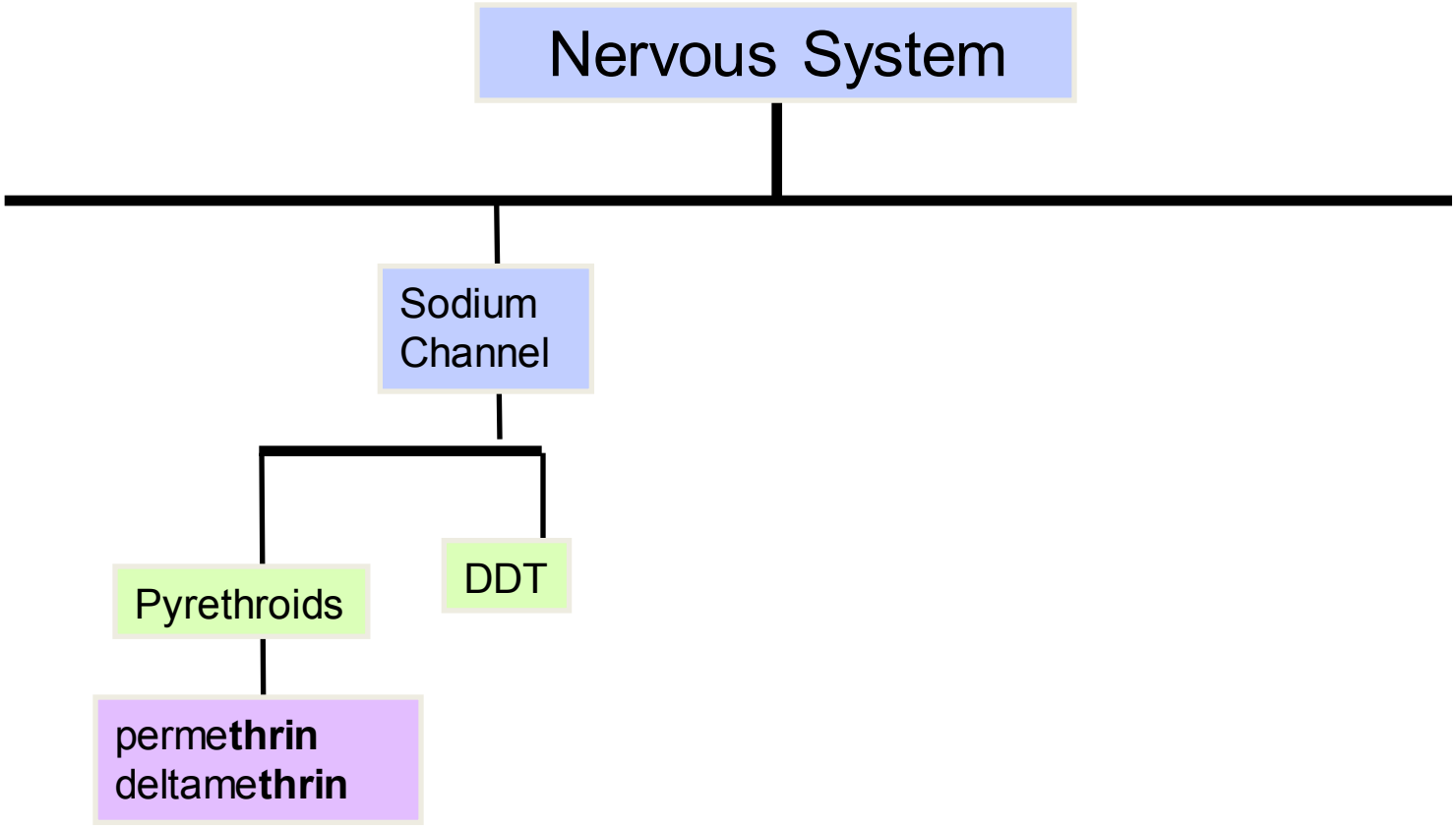




Never inject the rear. Don't Over Dose
Avoid I.M. injections if possible
Select sub-Q products when possible


Modes of Action of Insecticides
Nervous System
Energy Production
Cuticle Production
Endocrine System
Water Balance

Insecticides that Affect the Nervous System



Pyrethrins and Pyrethroids

- Pyrethrum -- dust derived from ground chrysanthemum flowers
- Pyrethrins -- chemicals within pyrethrum that have insecticidal properties

Pyrethrins and Pyrethroids

Pyrethroids -- synthetically produced chemicals with similar chemistry and mode of action as pyrethrins, axonic poisons

- Type I
  - Short residual,
  - Fast flushing, and
  - Quick knockdown,
  - Negative temperature correlation: more effective at low temps
  - Ex.: Allethrin, d-phenothrin, resemethrin
- Type II
  - Long residual,
  - Slower flushing, and
  - Slower knockdown,
  - Better killing power than type 1
  - Positive temperature correlation
  - Ex.: Permethrin, cypermethrin, cyfluthrin, lambdacyhalothrin

•Synergists -- used to deactivate mixed function oxidases (MFOs) within insects

Pyrethroids Effects

- Action on Human System - Irritant
- Systemic Effects - Minimal
- Irritation Effects - Stinging, burning, itching, tingling, numbness of skin.

MOA: Pyrethroids

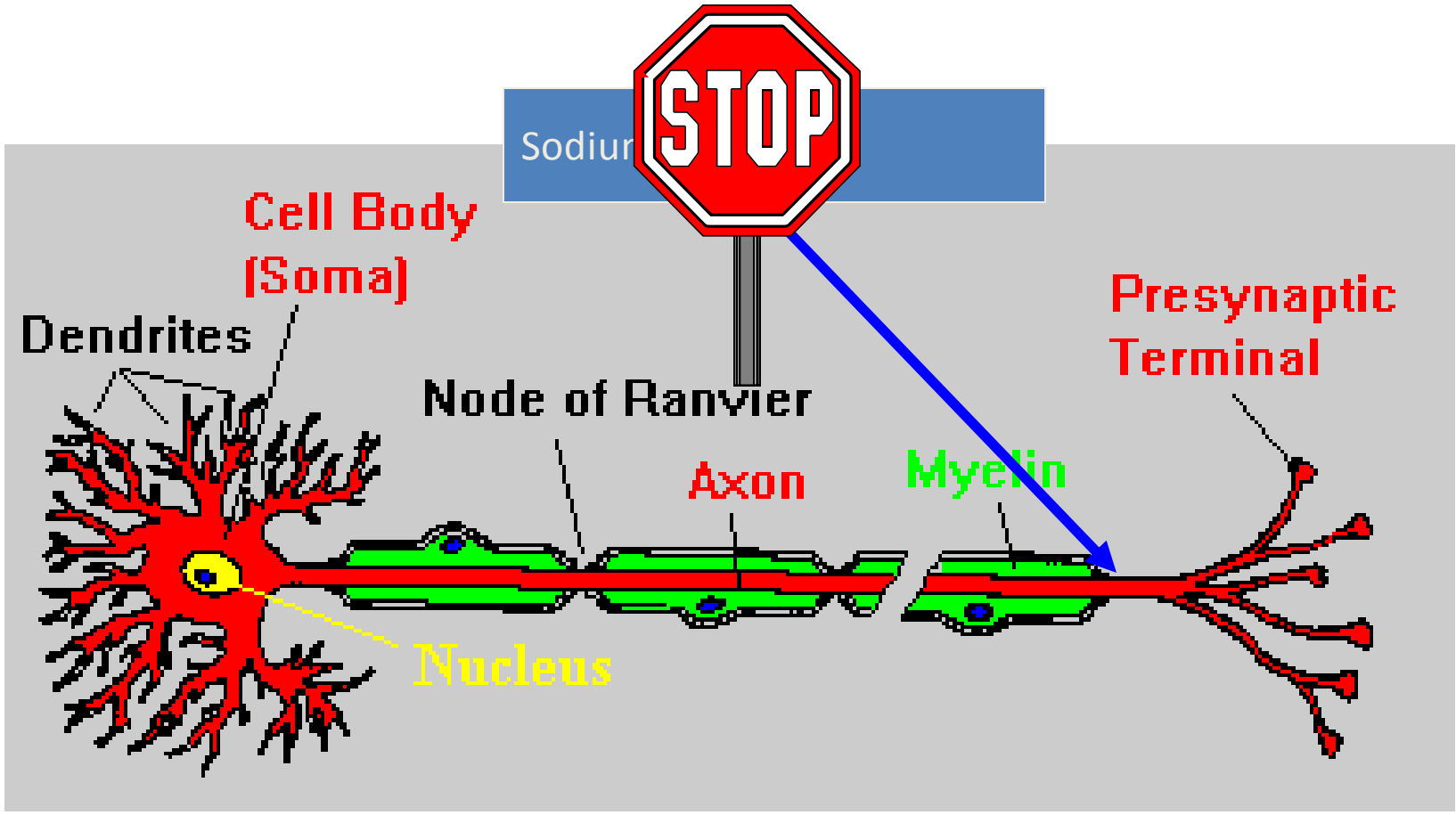
- Axonic poisons
- Bind to a protein called the voltage-gated sodium channel
- Normally, the sodium channel opens, causing stimulation of the nerve and closes to end the nerve signal
- Pyrethroids find to the socium channel and prevent it from closing normally
- Result: continuous nerve stimulation
- Symptoms: Tremors, uncoordinated movement

From Valles and Koehler. 1998. Insecticides Used in the Urban Environment: Mode of Action. ENY-282

Nervous System

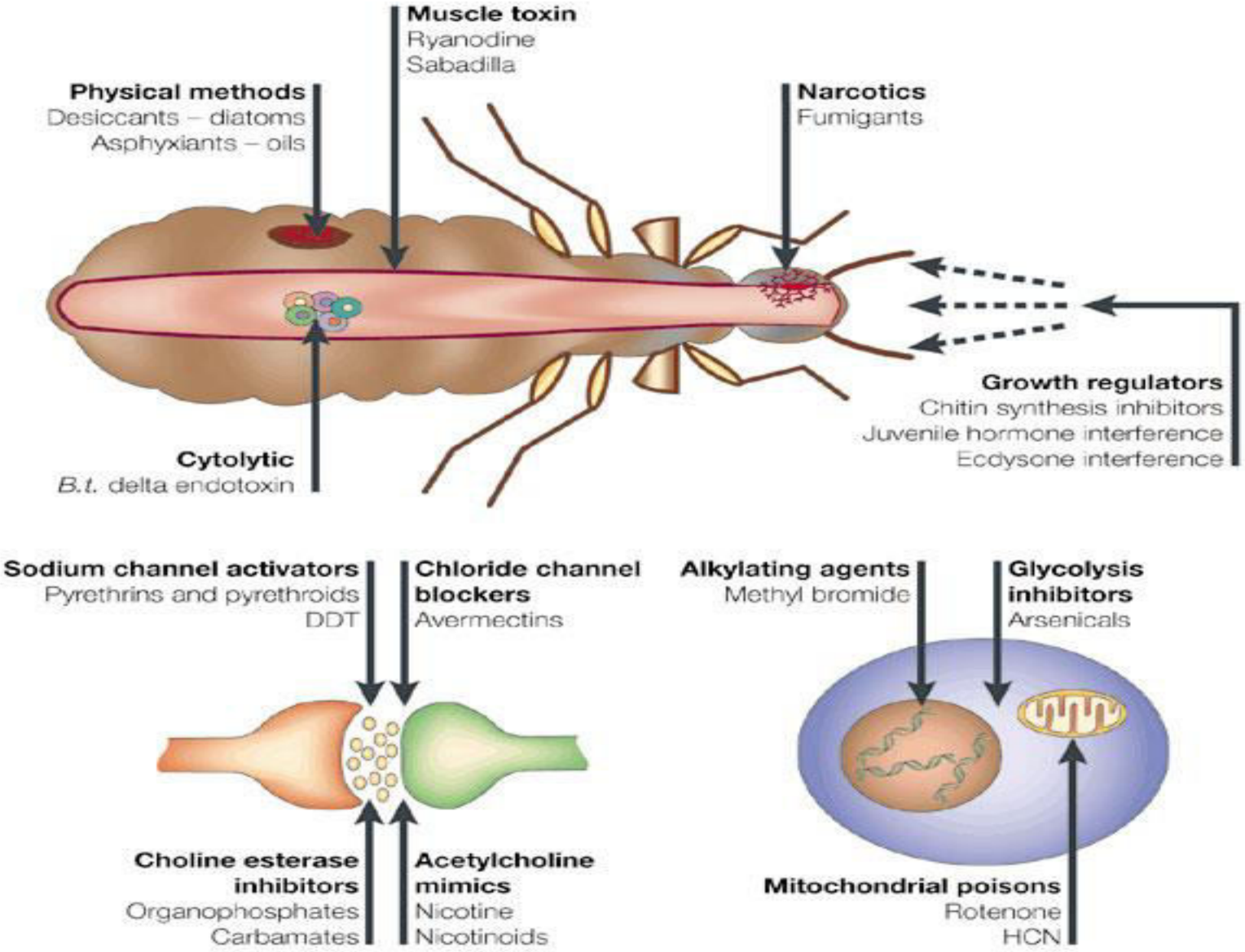
- Why does this happen?
- Let's look at a "normal" nerve impulse.

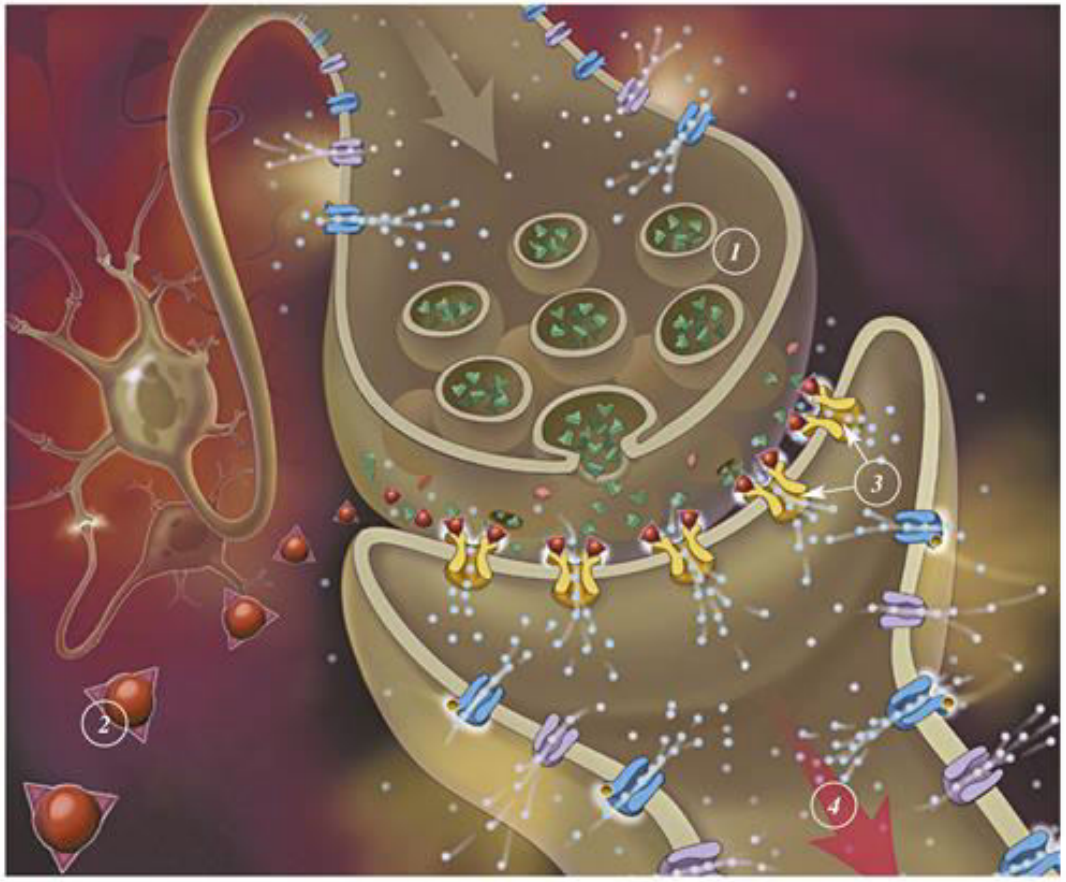
Nerves and Pyrethroids



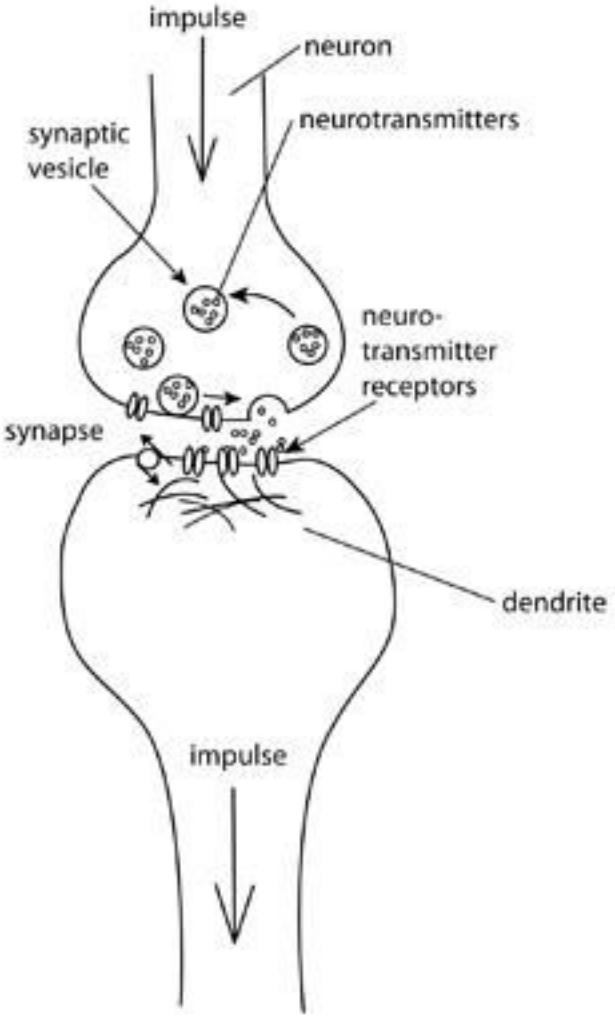
Direction of Nerve Impulse

Repeated
nerve firing


Muscle toxin
Ryanodine
Sabadilla
Physical methods
Desiccants – diatoms
Asphyxiants – oils
Narcotics
Fumigants
Growth regulators
Chitin synthesis inhibitors
Juvenile hormone interference
Ecdysone interference
Cytolytic
B.t. delta endotoxin
Sodium channel activators
Pyrethrins and pyrethroids
DDT
Chloride channel blockers
Avermectins
Choline esterase inhibitors
Organophosphates
Carbamates
Acetylcholine mimics
Nicotine
Nicotinoids
Alkylating agents
Methyl bromide
Glycolysis inhibitors
Arsenicals
Mitochondrial poisons
Rotenone
HCN

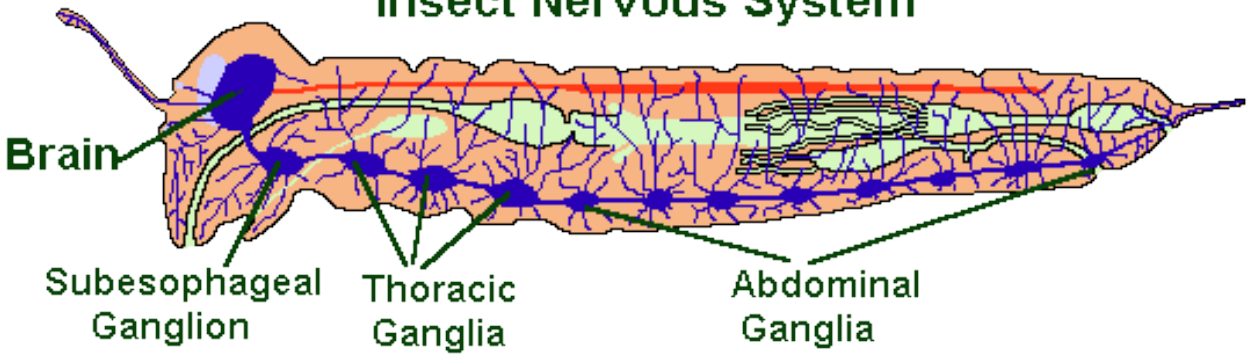


1 Vesicles of acetylcholine
2 Imidacloprid
3 Nicotinic receptors blocked open
4 Constant neuromuscular stimulation

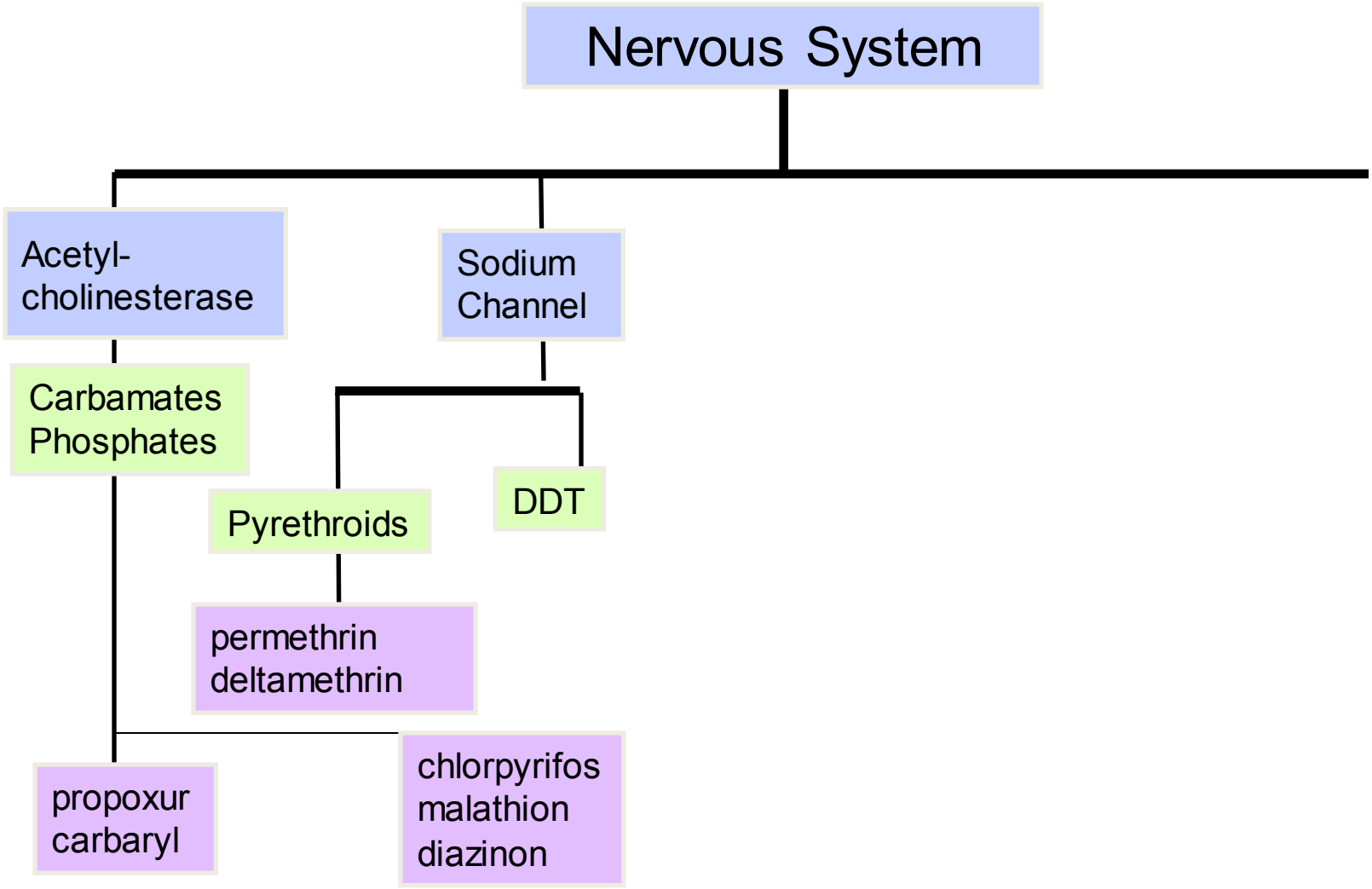


A Diagramatic Representation of the

Insect Nervous System



Insecticides that Affect the Nervous System



MOA: Carbamates and OPs

- Synaptic poisons
- Carbamates and organophosphorus insecticides bind to an enzyme called acetylcholinesterase (AChE)
- AChE is found at the nerve synapse
- AChE is designed to stop a nerve impulse after it has crossed the synapse

From Valles and Koehler. 1998. Insecticides Used in the Urban Environment: Mode of Action. ENY-282

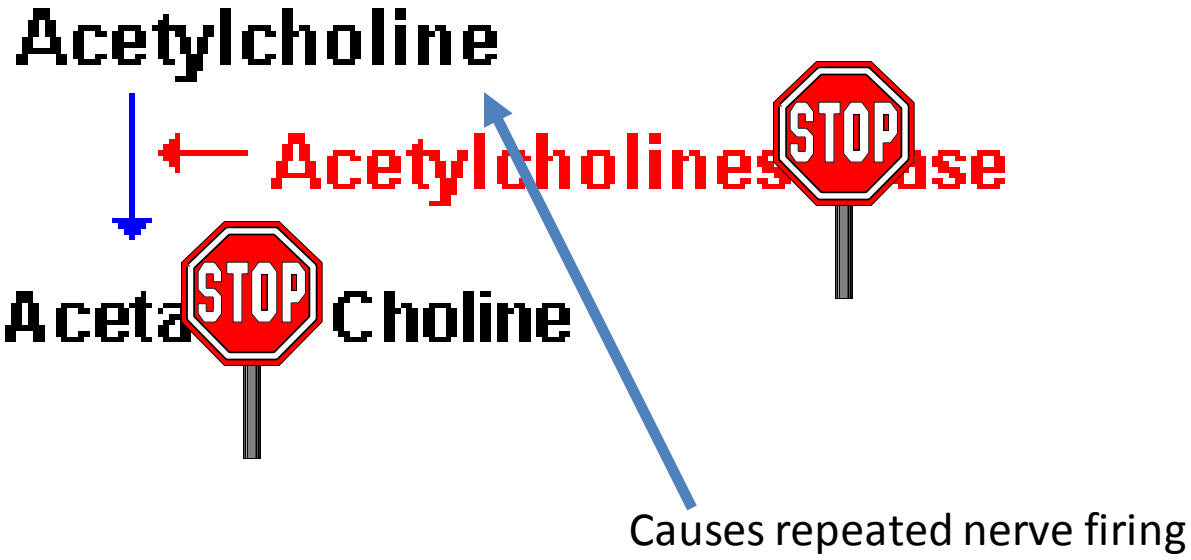
MOA: Carbamates and OPs

- OPs and carbamates bind to AChE
- This prevents AChE from working (i.e., breaking down Ach)
- Therefore, nerve impulses continue to fire across the synapse
- Symptoms similar to pyrethroid poisoning—tremors and uncontrolled movement

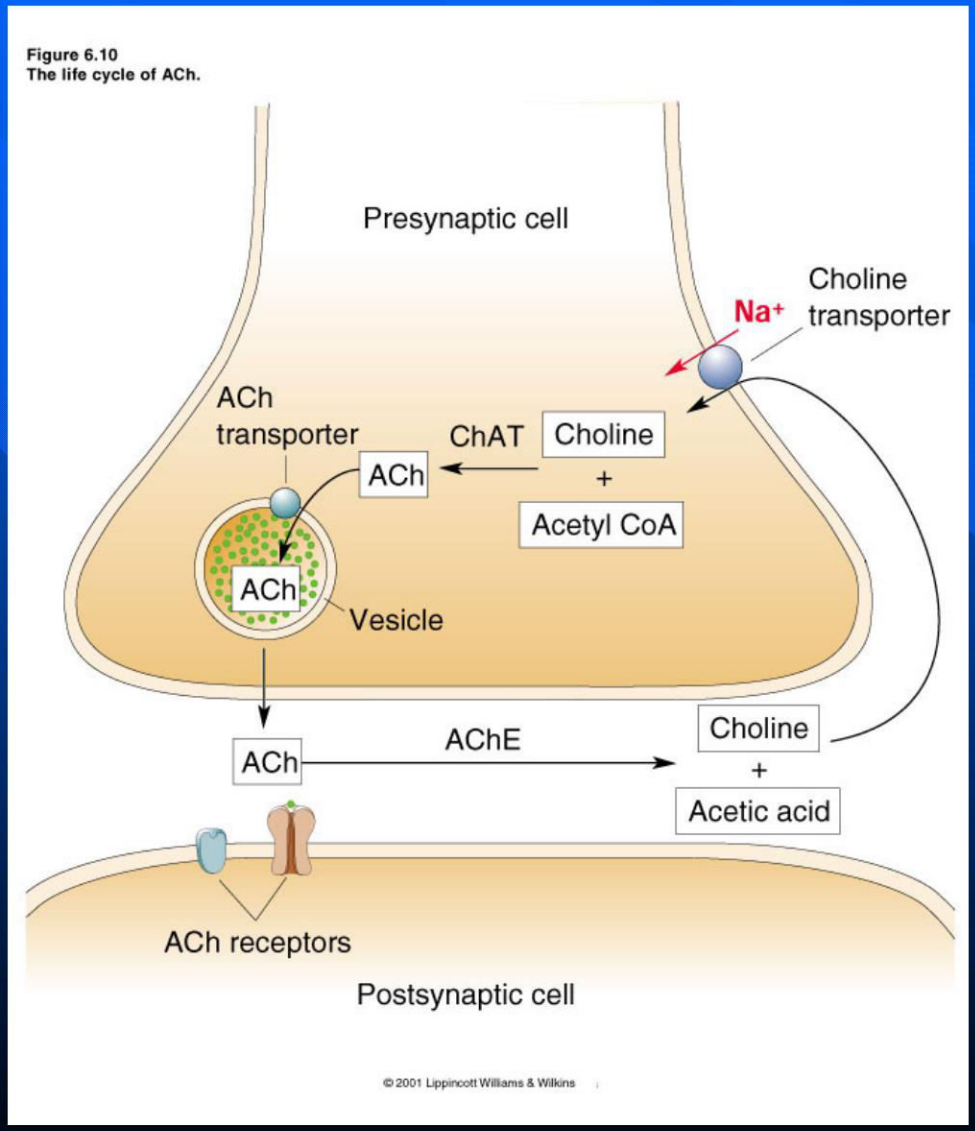
From Valles and Koehler. 1998. Insecticides Used in the Urban Environment: Mode of Action. ENY-282

Cholinesterase Inhibitors

- Organophosphates
- Carbamates



Acetylcholine System



Organophosphate Effects

- Action on Human System - Inhibits acetylcholinesterase enzyme in tissues.
- Systemic Effects - Headache, dizziness, weakness, shaking, nausea, stomach cramps, diarrhea, sweating.
- Irritation Effects - Minimal rashes, but readily absorbed through the skin.
- Delayed/Allergic Effects - Loss of appetite, weakness, weight loss, and general feeling

N-Methyl Carbamates Effects

- Action on Human System - Reversible changes in acetylcholinesterase enzyme in tissues.
- Systemic Effects - Headache, dizziness, weakness, shaking, nausea, stomach cramps, diarrhea, sweating.
- Irritation Effects - Minimal rashes, but readily absorbed through the skin.
- Delayed/Allergic Effects - Loss of appetite, weakness, weight loss, and general feeling of sickness.
- Reversible inhibition of AChE

Organophosphates and Carbamates

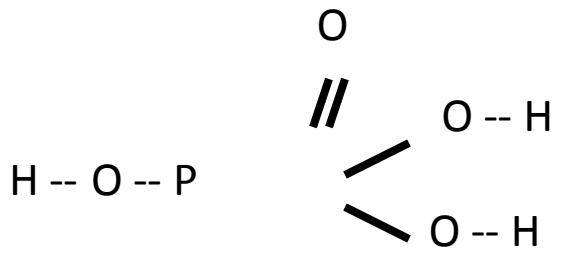
- Organophosphates
  - Chlorpyrifos*
  - Diazinon*
  - Trichlorfon*
  - Parathion*
- Carbamates
  - Carbaryl (Sevin)
  - Propoxur (Baygon)*

Chemicals which are derived from phosphoric and carbamic acid and bond with cholinesterase

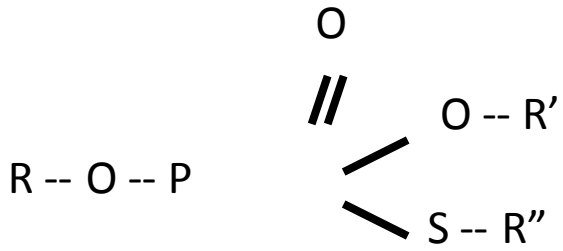
Acute toxicity
Not persistent
Hyper-excitation
Insect flips on back with legs twitching
Sulfur in formulation often causes strong odor

***EPA hit list or not common in UPM**

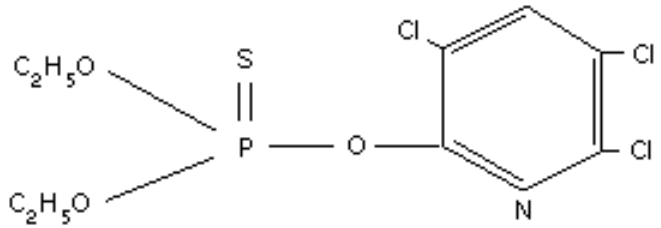
Organophosphates



Phosphoric Acid

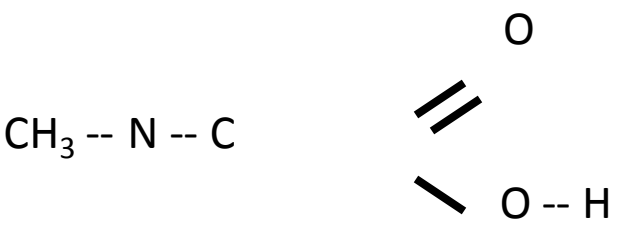


Phosphorothioate

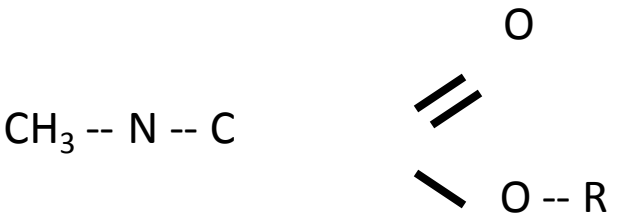


Chlorpyrifos ((Dursban)

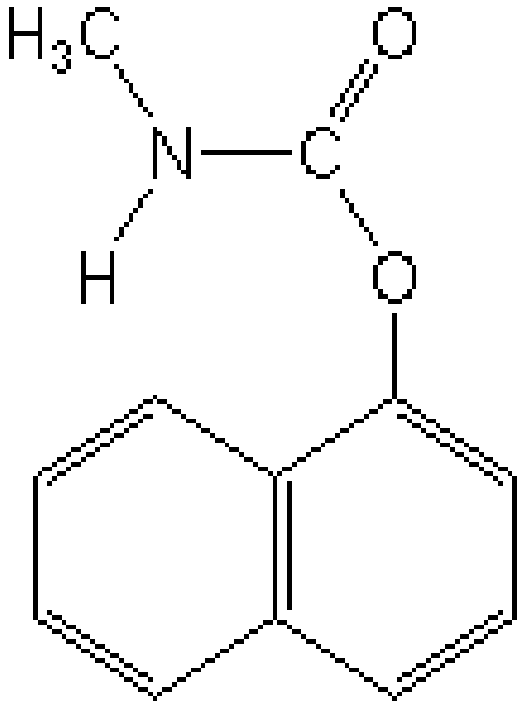
Carbamates



Carbamic Acid

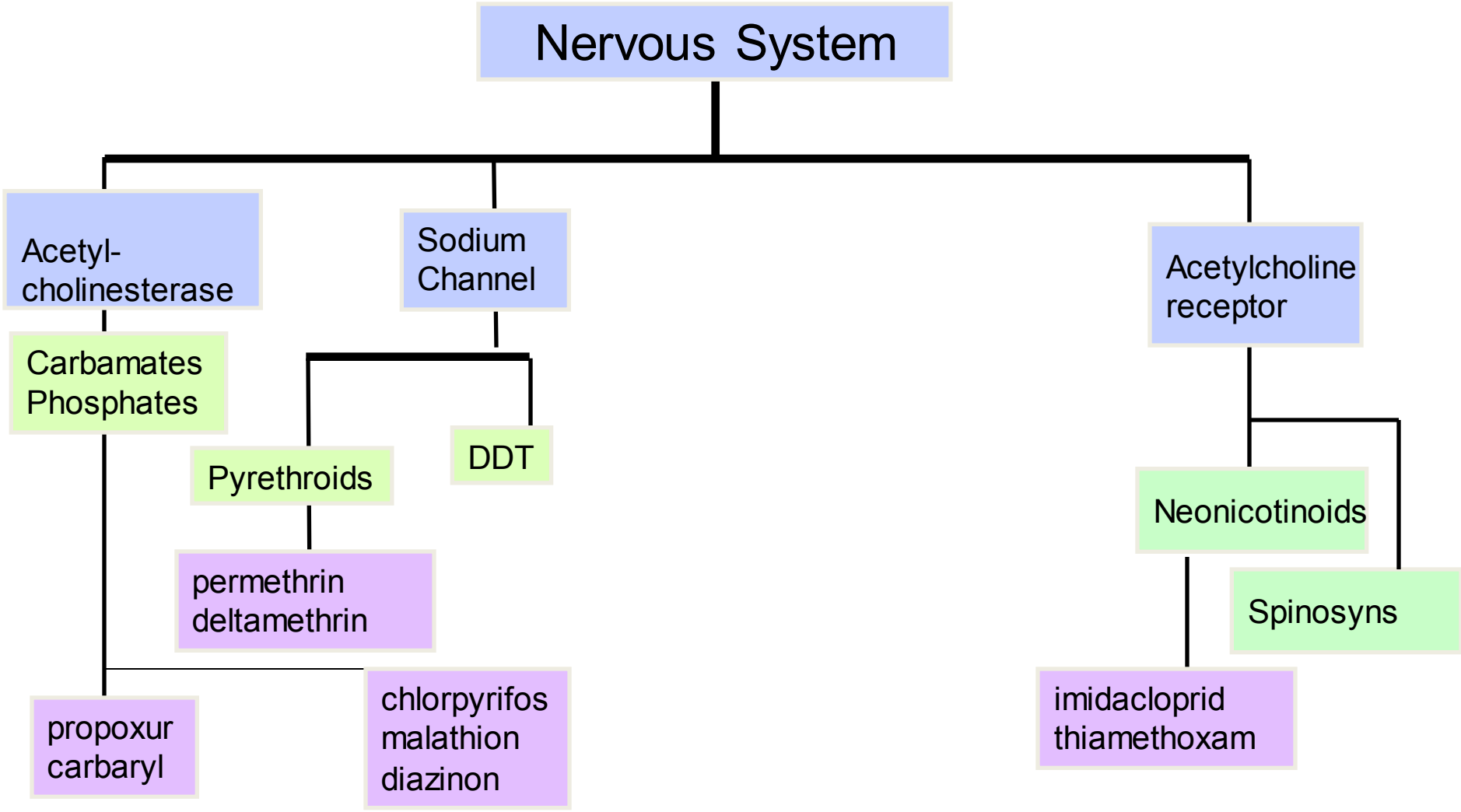


Carbamate



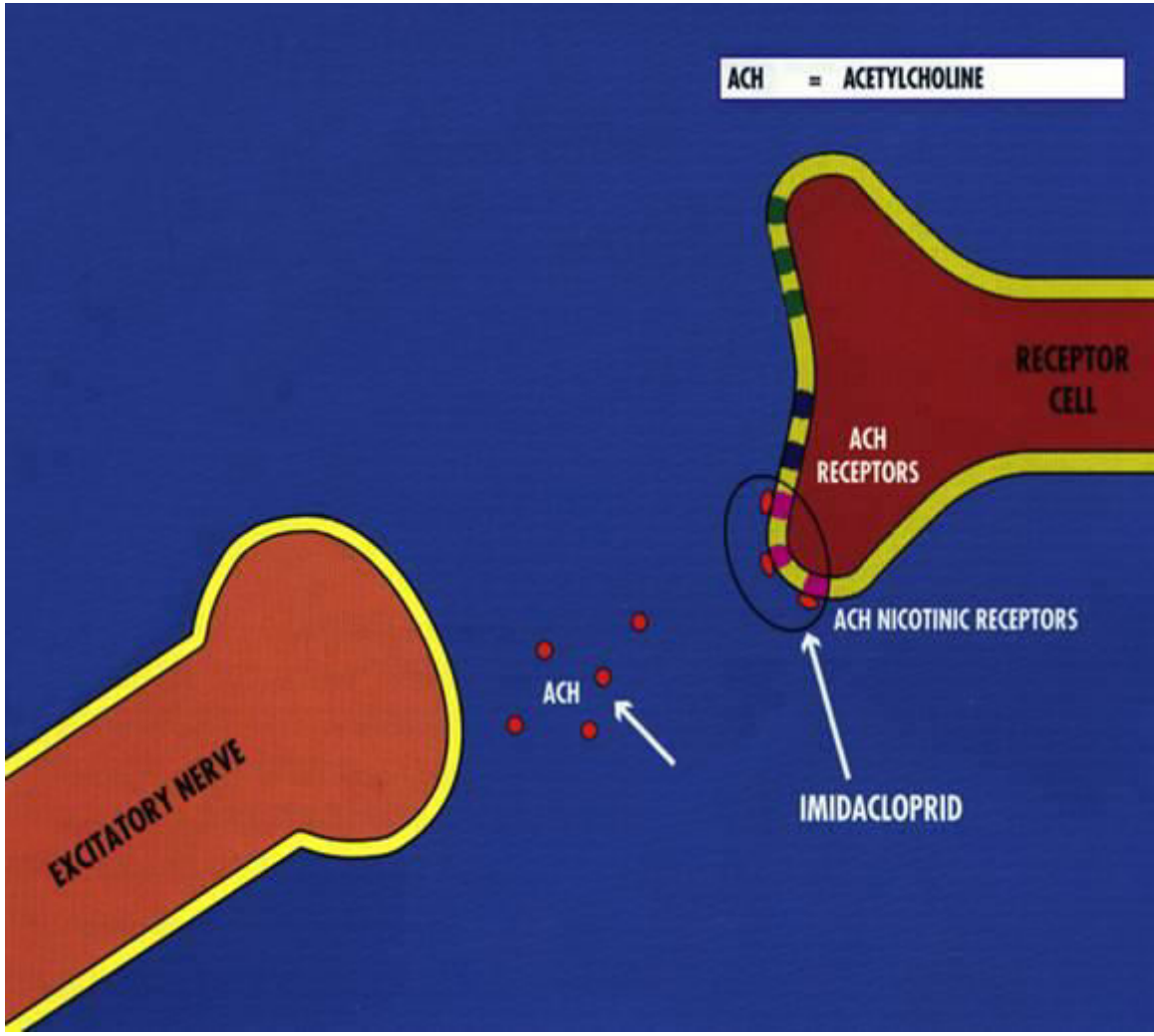
Carbaryl (Sevin)

Insecticides that Affect the Nervous System



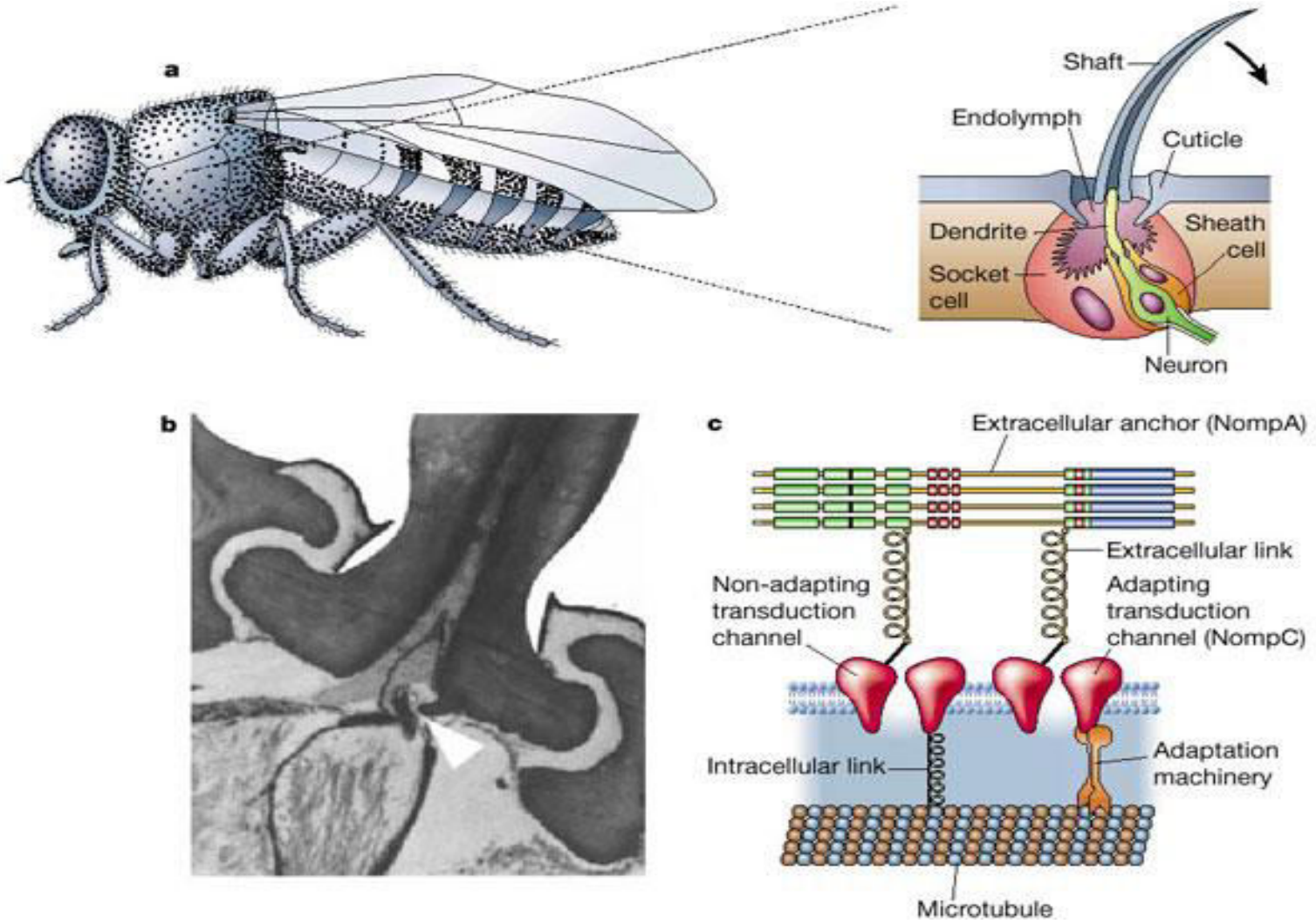
Acetylcholine Receptor

- Mimics acetylcholine on the receptor
  - Nicotinic receptor is a type of ACh receptor that is sensitive to nicotine
- Cannot be broken down by AChE
- Imidacloprid turns nerve impulse on but AChE does not degrade it
- Similar overstimulation as seen with OPs and Carbs

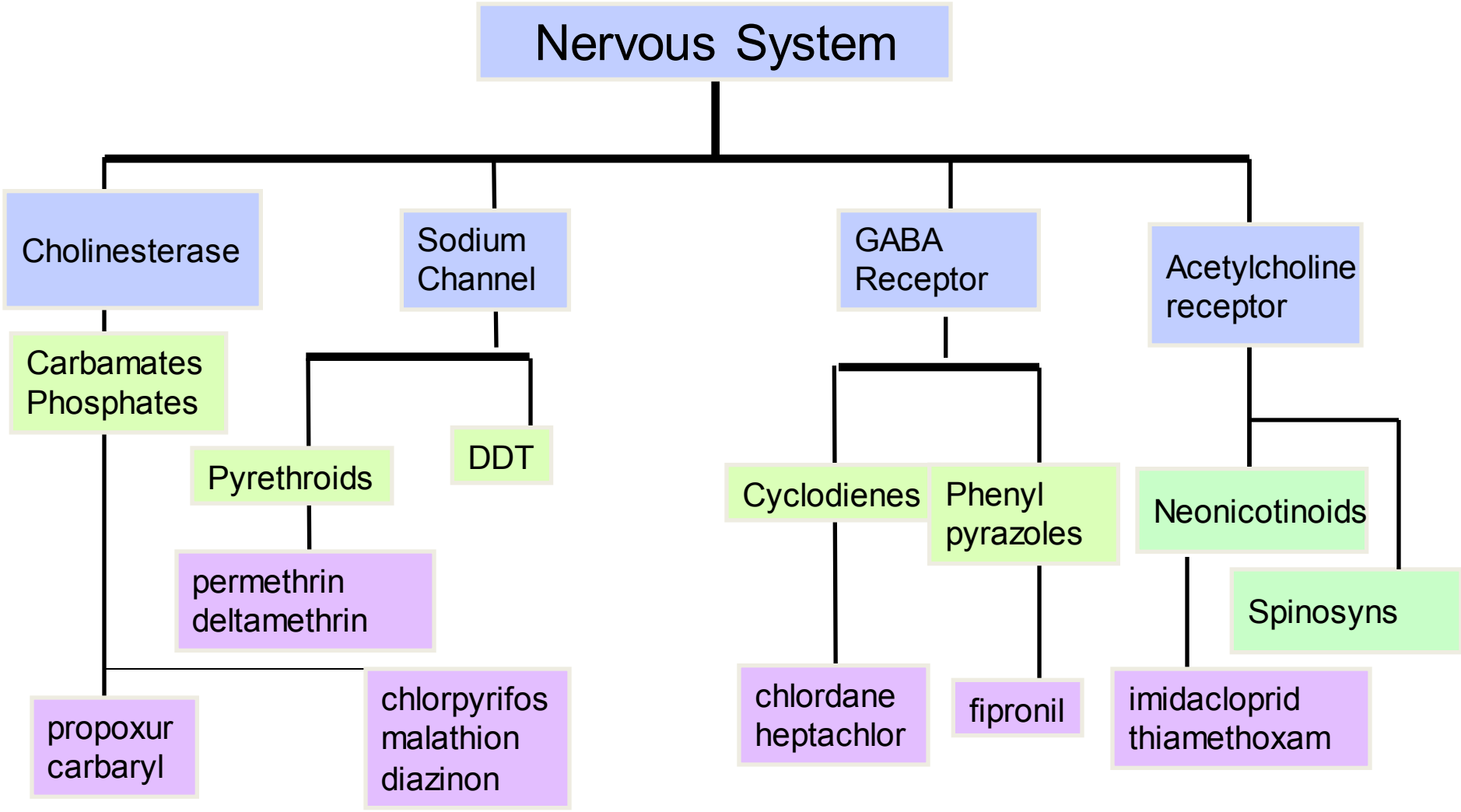


Neonicotinoids

- Imidacloprid (subgroup: pyridylmethylamine)
  - Advantage – pet treatment
  - Merit -- turf ornamentals
    - Water soluble
    - Systemic in plants
  - Premise – termites
    - Affects insects first by paralyzing mouthparts
  - Bayer Advantage OTC
- Thiamethoxam (subgroup: nitroguanidine)
  - Used in crops
  - Working on urban and landscape/turf/ornamentals label
- (Subgroup: nitromethylene)


a
Shaft
Endolymph
Cuticle
Dendrite
Sheath cell
Socket cell
Neuron
b
c
Extracellular anchor (NompA)
Extracellular link
Non-adapting transduction channel
Adapting transduction channel (NompC)
Intracellular link
Adaptation machinery
Microtubule

Insecticides that Affect the Nervous System

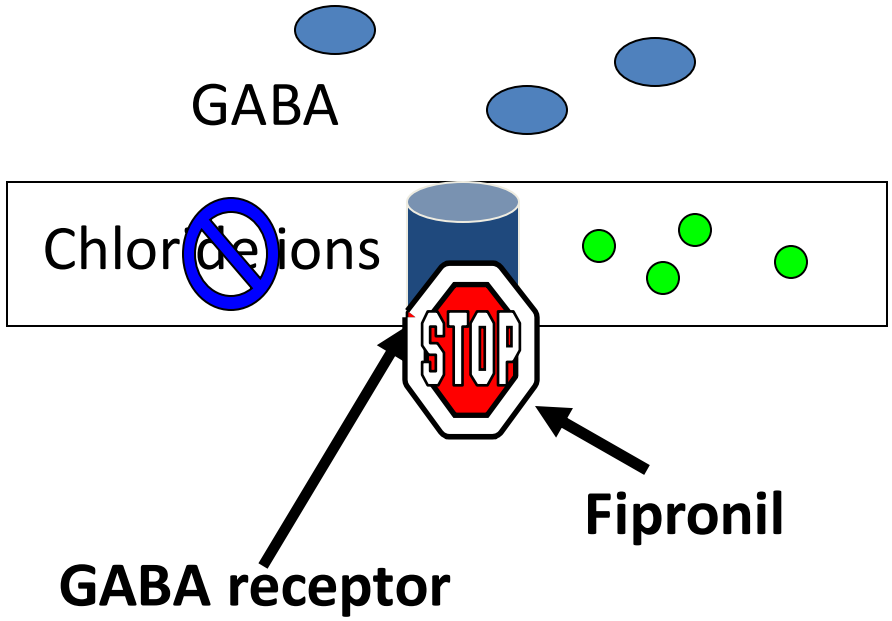


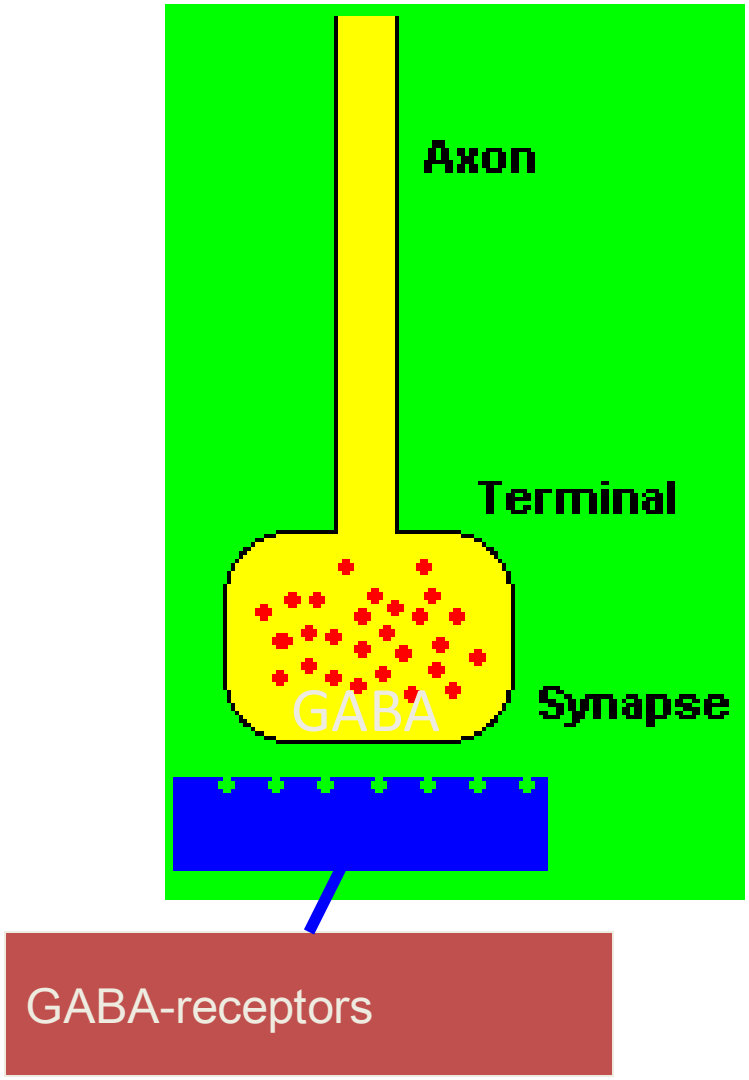
MOA: GABA Antagonist

- Phenylpyrazole (fipronil), cyclodienes
- Antagonists of GABA activated chloride channels
- GABA Antagonists: chemicals that bind to but do not activate GAMMA-AMINOBUTYRIC ACID receptors, thereby blocking the actions of endogenous GAMMA-AMINOBUTYRIC ACID or GAMMA-AMINOBUTYRIC ACID agonists.
- GABA can't bind to receptor
- Doesn't activate channel (doesn't open)
- Interferes with (prevents) the passage of chlorine ions through the channel.
- Concerns with cross resistance with other GABAergic insecticides

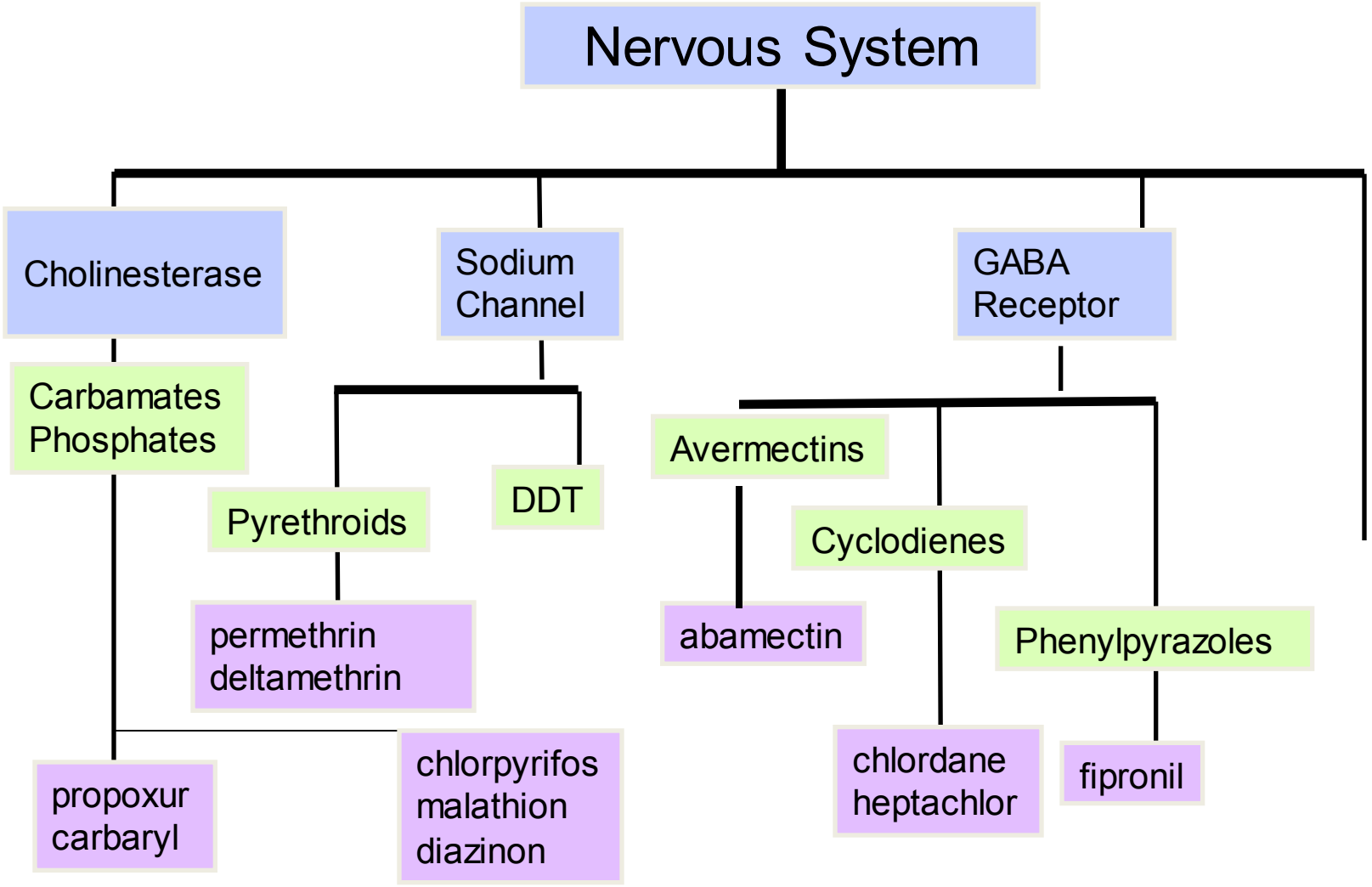
GABA Receptor in Central Nervous System

- Phenylpyrazoles or
- Fiproles





Insecticides that Affect the Nervous System

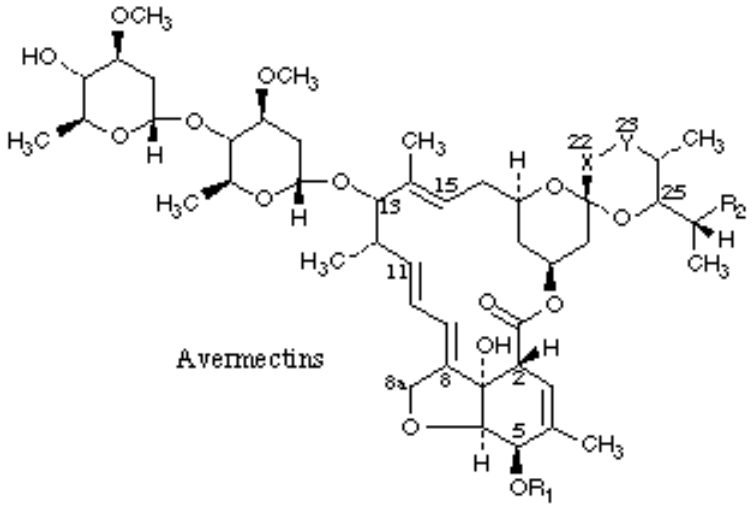


MOA: GABA Agonist

- Avermectins
- Bind to GABA (Gamma-Amino-Butyric Acid gated chloride channel
- Opens channel
- Chloride influx
- Cannot reach threshold for action potential
- Causes membrane to hyperpolarize, making it less excitatory, decreasing nerve transmission
- Result: flaccid paralysis and death

Avermectins

- Abamectin
  - Avert -- cockroaches
  - Advance -- ants



Produced from soil microbials. Stomach poison for ants and cockroaches

slow acting

low toxicity to mammals

Modes of Entrance into Insect

- Contact - dermal – through the skin
- Stomach - oral – through the mouth
- Respiration - inhalation through the nose or gills
- Systemic - combination of above

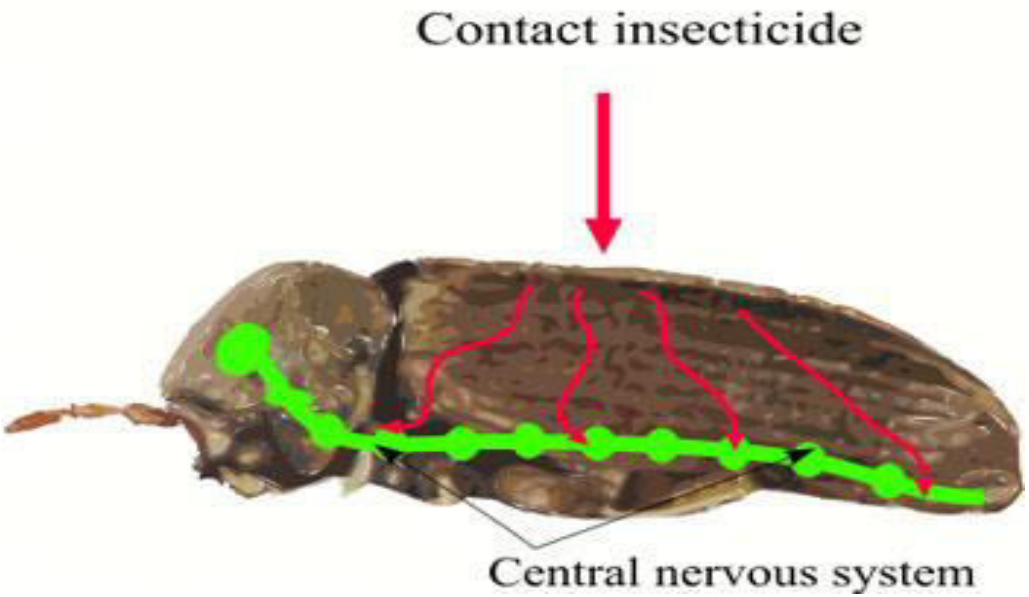
Mode of Toxicity in Insects

- Physical poison
- General protoplasmic poison
- Cellular enzyme poison
- Nerve poison
- Growth regulator
- Disease causing agent
- Repellant

Toxicity to humans or nontarget organisms

- Most insecticides have the capacity to affect non-target organisms
- Same as previously discussed
  - Highly toxic – LD_{50} 0 – 50 mg/kg
  - Moderately toxic - LD_{50} 50 – 500 mg/kg
  - Low toxicity - LD_{50} 500 – 5,000 mg/kg
  - Nontoxic - LD_{50} <5,000 mg/kg

CONTACT INSECTICIDES

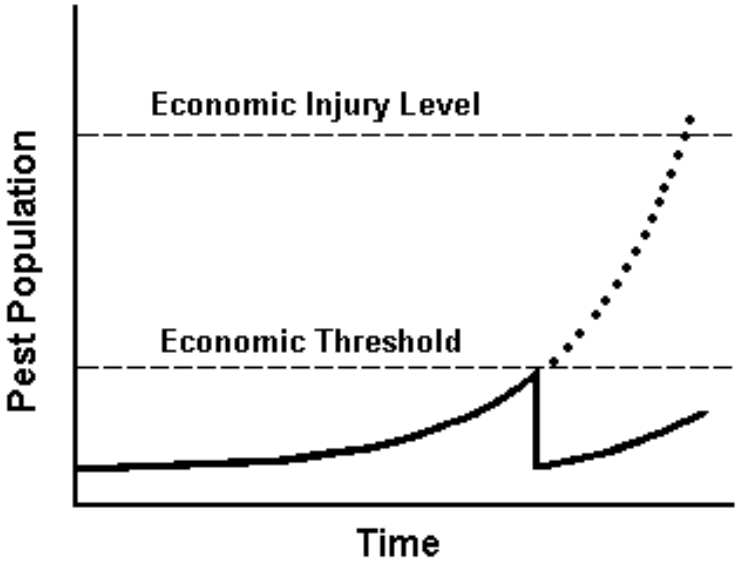


Avert Kill

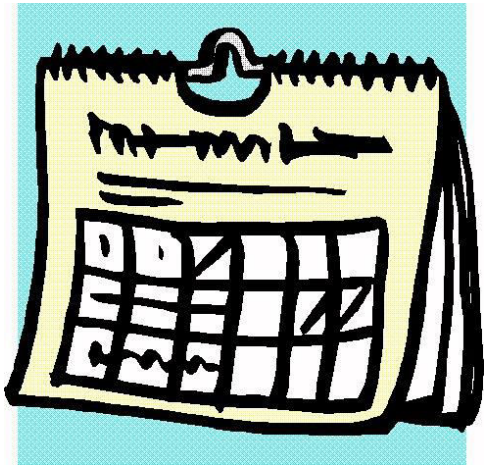
- 22 hours to nerve effects
- 40 hours to kill

When to apply?

- Thresholds

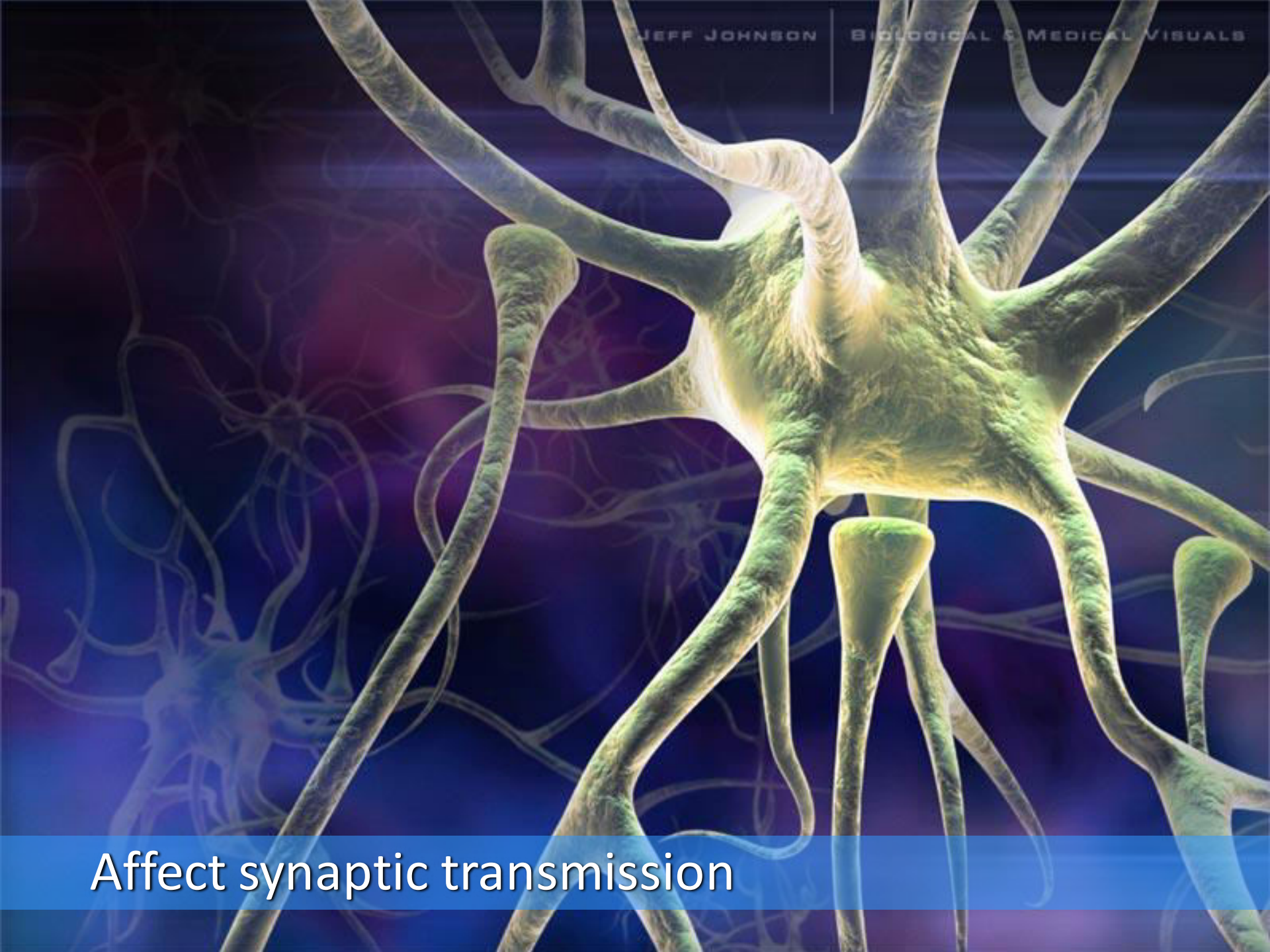


- Calendar applications



Reasons for lack of Commercial Development

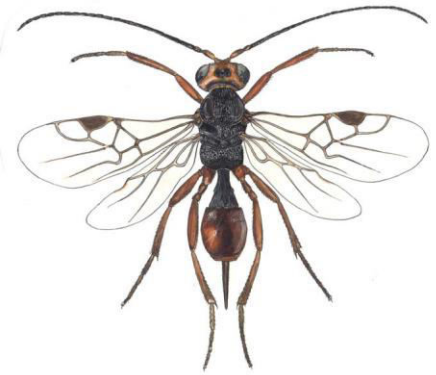
- Perceived as old fashioned
- Lack of representation on official lists
- Not as dramatic effects as synthetic insecticides
- Inactivation by exposure to air and light
- Problems due to seasonal availability
- Lack of quantitative information regarding dosages
- Lack of quantitative information regarding toxicity



Affect synaptic transmission

The Pesticide Treadmill

- Pest resurgence
- Secondary pest outbreaks
- Pesticide resistance



وَعَلَّمَ ءَادَمَ ٱلْأَسْمَآءَ كُلَّهَا ثُمَّ عَرَضَهُمْ
عَلَى ٱلْمَلَٰٓئِكَةِ فَقَالَ أَنۢبِـُٔونِى بِأَسْمَآءِ
هَٰٓؤُلَآءِ إِن كُنتُمْ صَٰدِقِينَ ﴿٣١﴾ قَالُوا۟
سُبْحَٰنَكَ لَا عِلْمَ لَنَآ إِلَّا مَا عَلَّمْتَنَآ ۖ إِنَّكَ
أَنتَ ٱلْعَلِيمُ ٱلْحَكِيمُ ﴿٣٢﴾

Toxicity to insects natural enemies

- Most insecticides have the potential to affect populations of beneficial insects.

Environmental hazard

- Environmental hazard of insecticides is generally evaluated as a function of persistence often compared to effectiveness

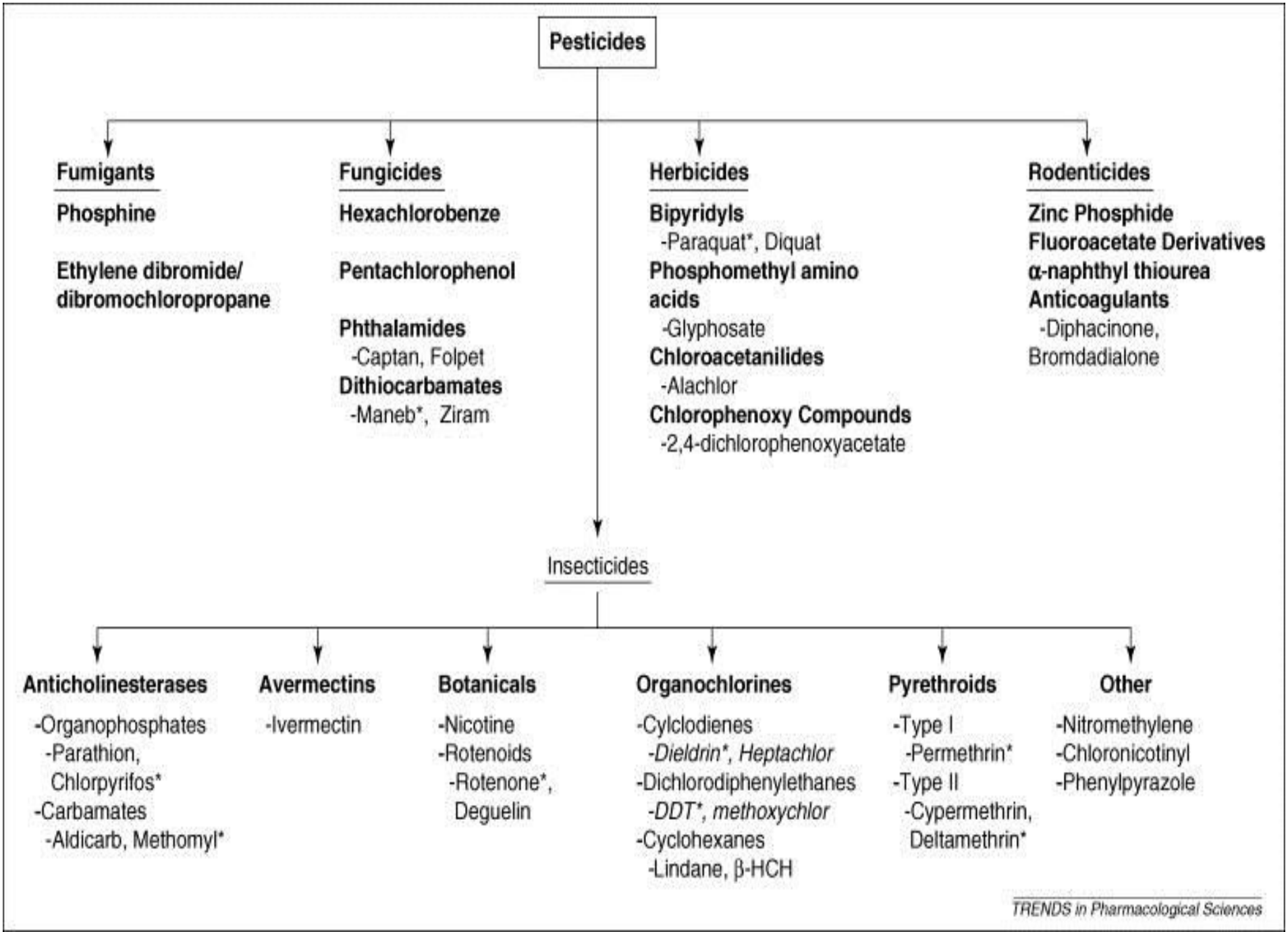
Resistance/Resurgence Hazard

- The hazard of populations developing resistance and resurging is evaluated for most insecticides

النجاح
دائماً بيدك
أنت

شكراً لحسن الإستماع

To all professors of parasitology who taught me.


Pesticides
Fumigants
Phosphine
Ethylene dibromide/ dibromochloropropane
Fungicides
Hexachlorobenze
Pentachlorophenol
Phthalamides
-Captan, Folpet
Dithiocarbamates
-Maneb*, Ziram
Herbicides
Bipyridyls
-Paraquat*, Diquat
Phosphomethyl amino acids
-Glyphosate
Chloroacetanilides
-Alachlor
Chlorophenoxy Compounds
-2,4-dichlorophenoxyacetate
Rodenticides
Zinc Phosphide
Fluoroacetate Derivatives
α-naphthyl thiourea
Anticoagulants
-Diphacinone, Bromdadialone
Insecticides
Anticholinesterases
-Organophosphates
-Parathion, Chlorpyrifos*
-Carbamates
-Aldicarb, Methomyl*
Avermectins
-Ivermectin
Botanicals
-Nicotine
-Rotenoids
-Rotenone*, Deguelin
Organochlorines
-Cylclodienes
-Dieldrin*, Heptachlor
-Dichlorodiphenylethanes
-DDT*, methoxychlor
-Cyclohexanes
-Lindane, β-HCH
Pyrethroids
-Type I
-Permethrin*
-Type II
-Cypermethrin, Deltamethrin*
Other
-Nitromethylene
-Chloronicotinyl
-Phenylpyrazole
TRENDS in Pharmacological Sciences