

سُبْحَانَ اللَّهِ عَمَّا يُشْرِكُونَ



Insecticide

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



لماذا نقسم المبيدات الحشرية؟

ما أساسيات التقسيم؟



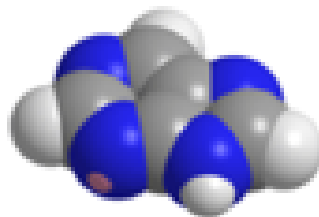
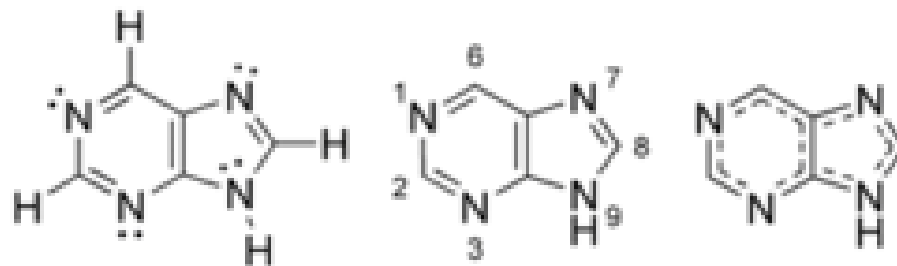
التقسيم حسب الحشرة



التقسيم حسب العائل؟



التقسيم حسب المبيد؟



لماذا نقسم المبيدات الحشرية؟

insecticide...??

“choice of insecticide”



Chemical Control: Insecticides



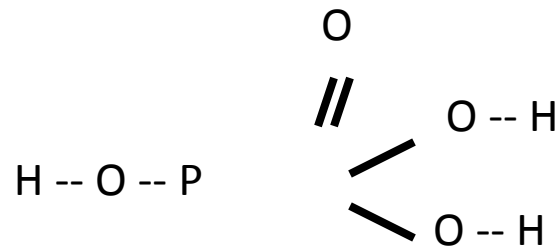
Botanical Insecticides



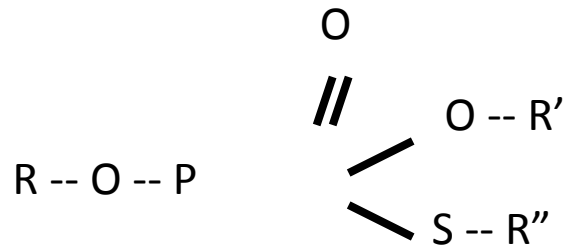
Secondary compounds

- Alkaloids
- Terpenoids
- Phenolics
- Glucosinolates
- Etc.

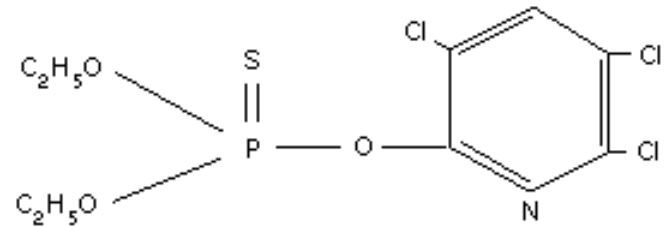
Organophosphates



Phosphoric Acid



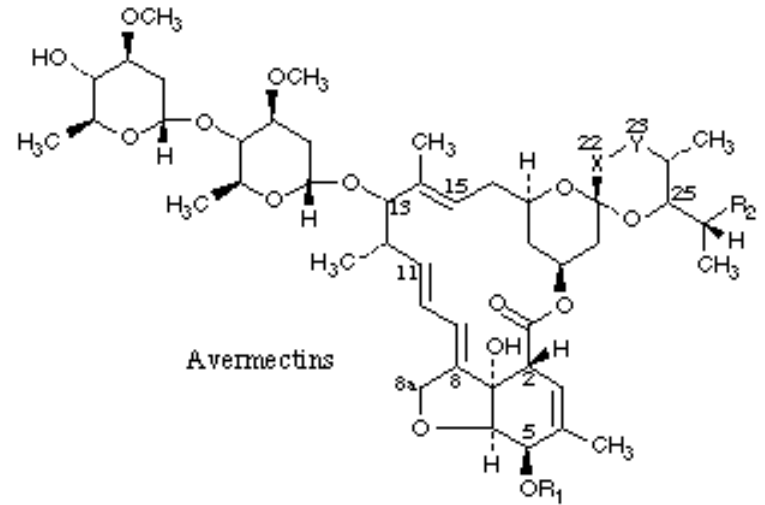
Phosphorothioate



Chlorpyrifos ((Dursban))

Avermectins

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



Produced from soil microbials. Stomach poison for ants and cockroaches

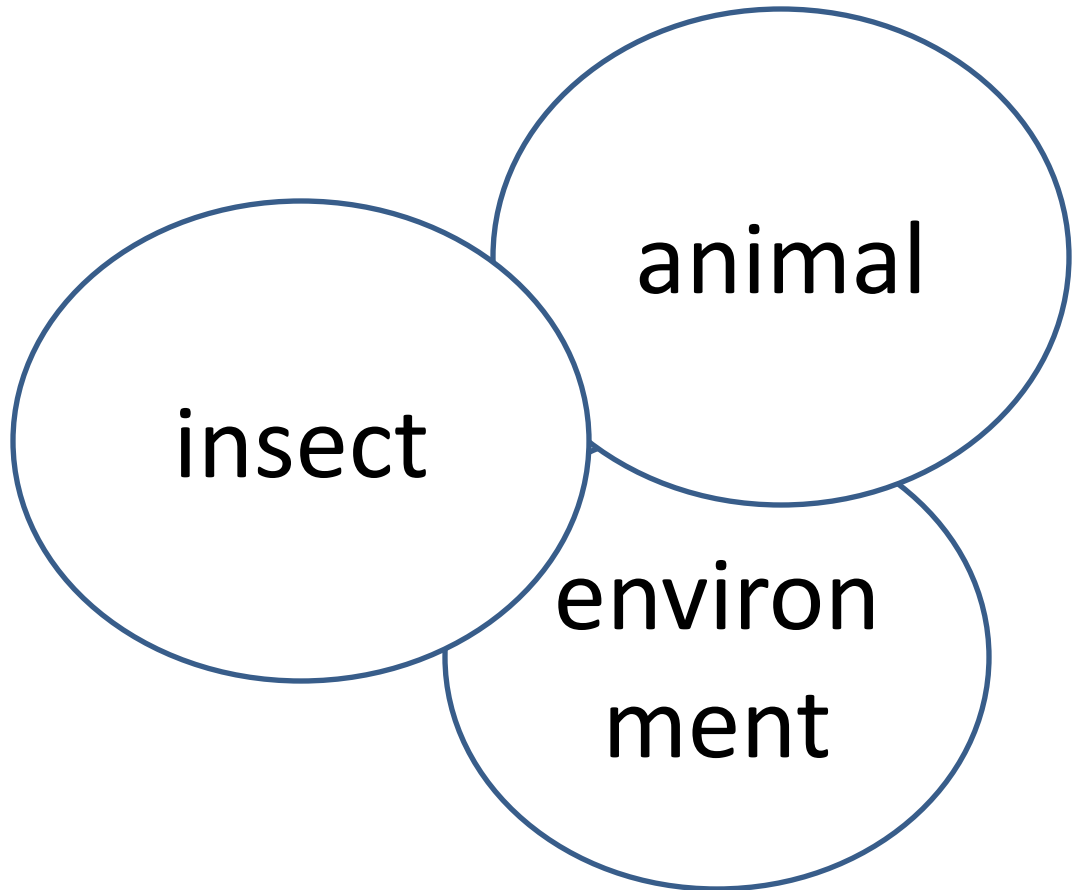
slow acting

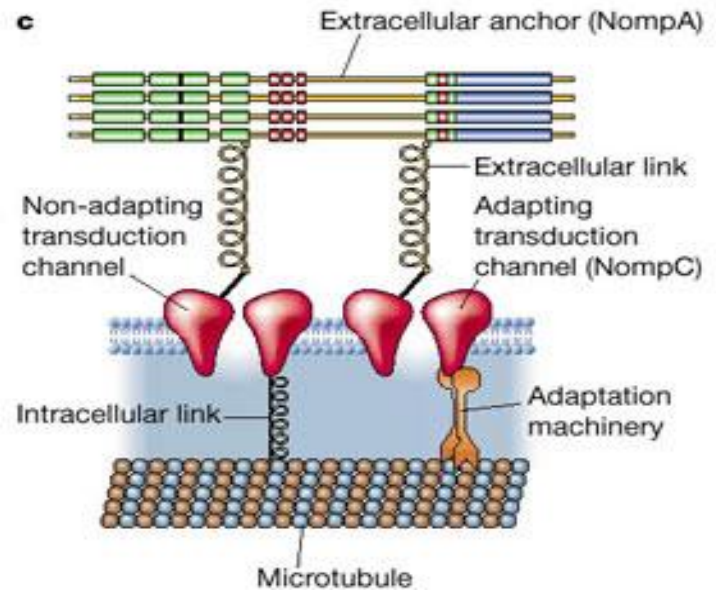
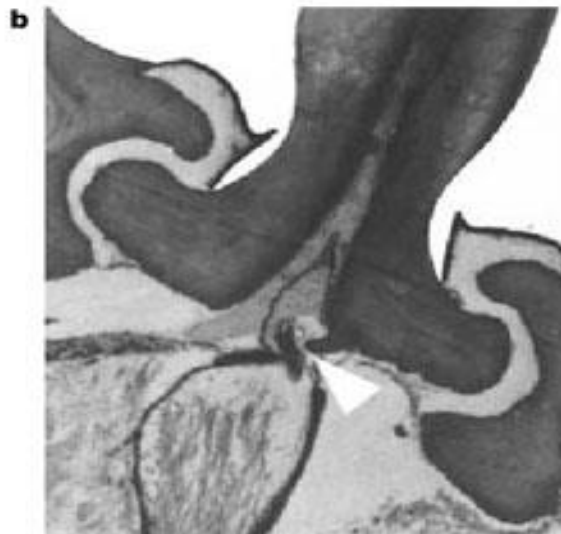
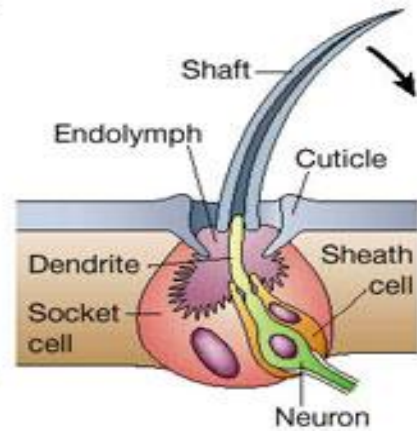
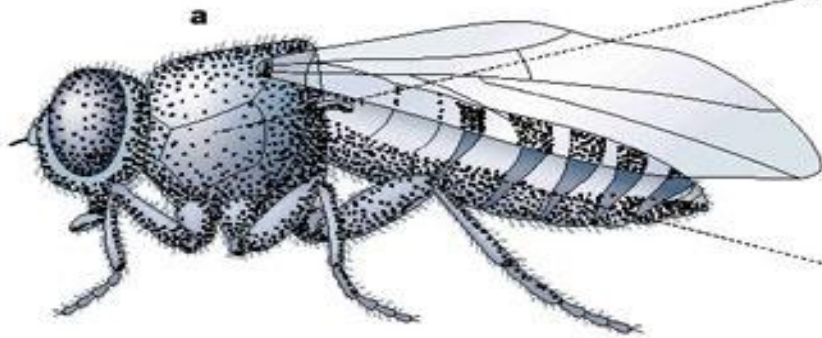
low toxicity to mammals

كيف يمكن أن نقسم المبيدات الحشرية ؟



Considerations in use of insecticides







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,
Bromdialone

Insecticides

Anticholinesterases

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

Avermectins

-Ivermectin

Botanicals

-Nicotine
-Rotenoids
-Rotenone*,
Deguelin

Organochlorines

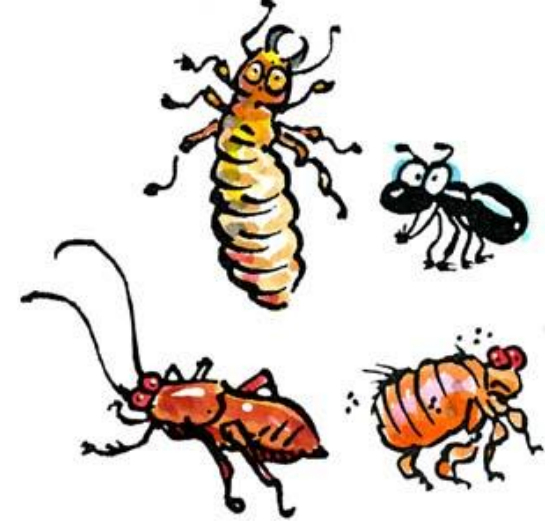
-Cyclodienes
-Dieldrin*, Heptachlor
-Dichlorodiphenylethanes
-DDT*, methoxychlor
-Cyclohexanes
-Lindane, β -HCH

Pyrethroids

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

Other

-Nitromethylene
-Chloronicotinyl
-Phenylpyrazole



Insecticides

Anticholinesterases

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

Avermectins

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Botanicals

- Nicotine
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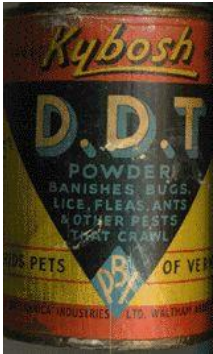
Pyrethroids

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

Other

- Nitromethylene
- Chloronicotinyl
- Phenylpyrazole

Examples



Organochlorines

- DDT
- Aldrin
- Dieldrin
- Endosulfan
- Gamma HCH
- Gamma BHC

Organophosphates

- Diazinon
- Fenitrothion
- Dichlorvos
- Dimethoate
- Malathion



Carbamates

- Aldicarb
- Carbofuran



Pyrethroids

- Tefluthrin
- Deltamethrin
- Lambda
- cyhalothrin
- Permethrin
- Cypermethrin

Neonicotinoids

- imidacloprid
- nitenpyram
- acetamiprid
- thiamethoxam

Examples

Juvenile Hormones

- Methoprene
- Tebufenozone
- Fenoxycarb
- Pyriproxifen

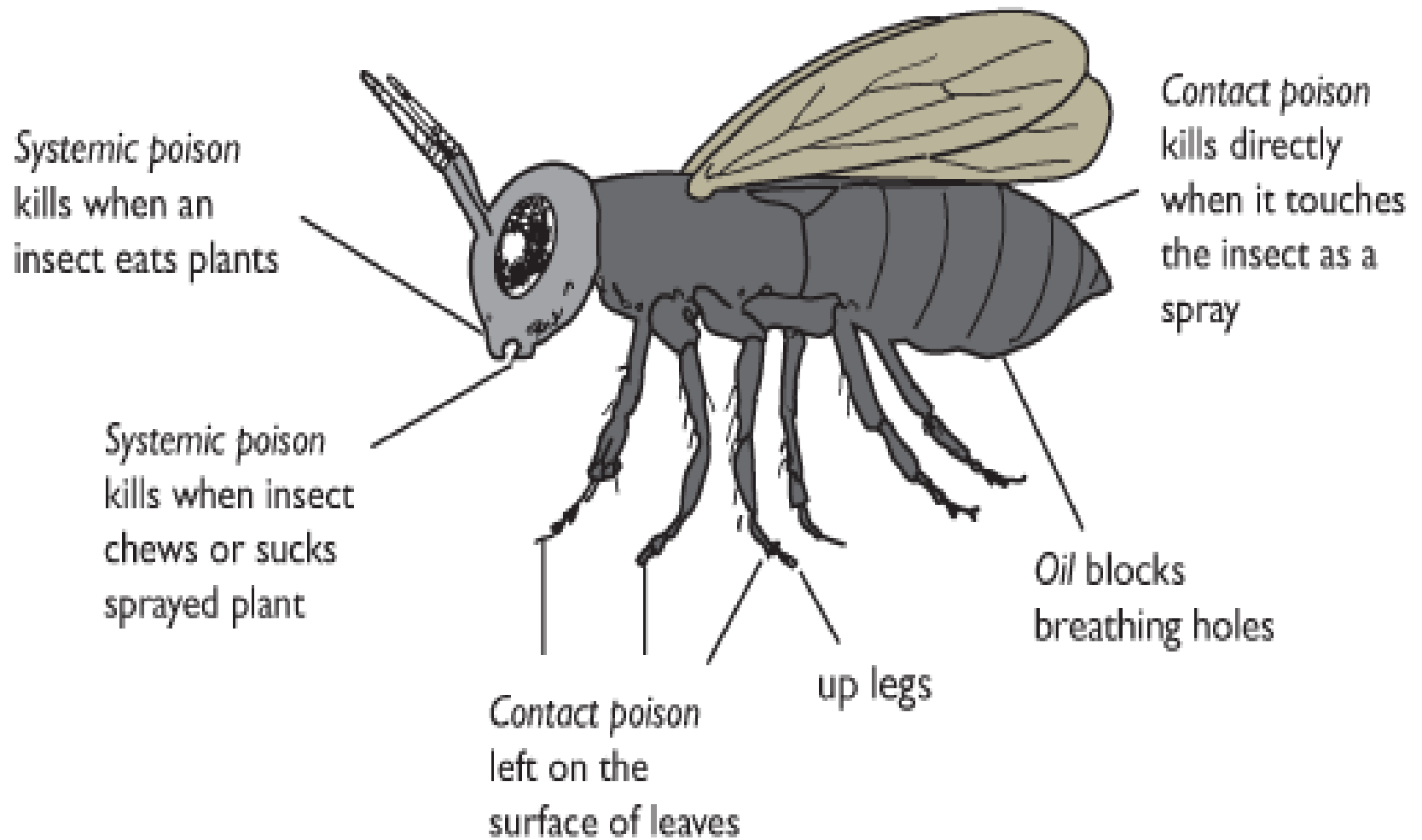


Chitin Synthesis Inhibitors

- Diflubenzuron
- Hexaflumuron
- Triflumuron

Triazine Derivatives

- Melamine
- Cryomazine



Systemic poison
kills when an
insect eats plants

Systemic poison
kills when insect
chews or sucks
sprayed plant

Contact poison
kills directly
when it touches
the insect as a
spray

Oil blocks
breathing holes

Contact poison
left on the
surface of leaves

up legs

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

MOA: GABA Antagonist

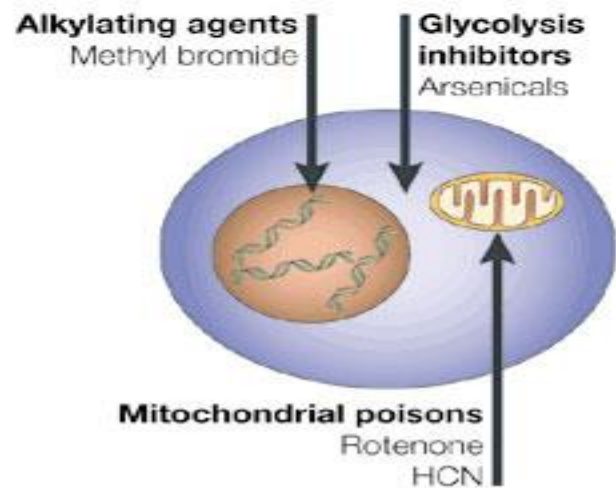
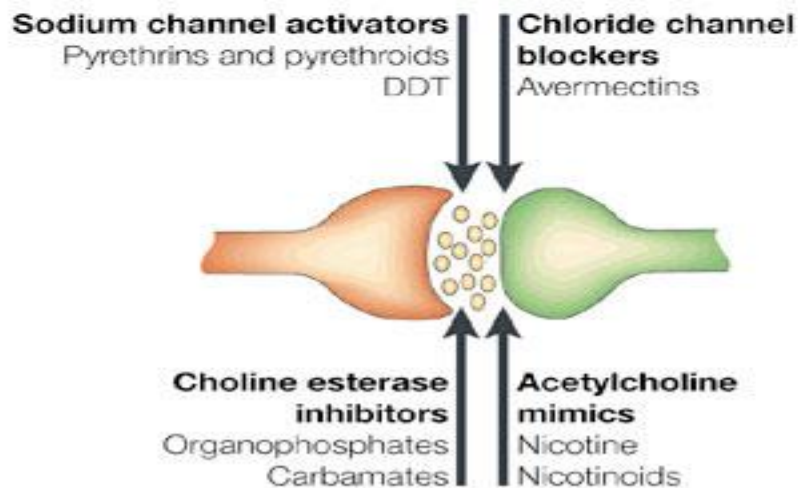
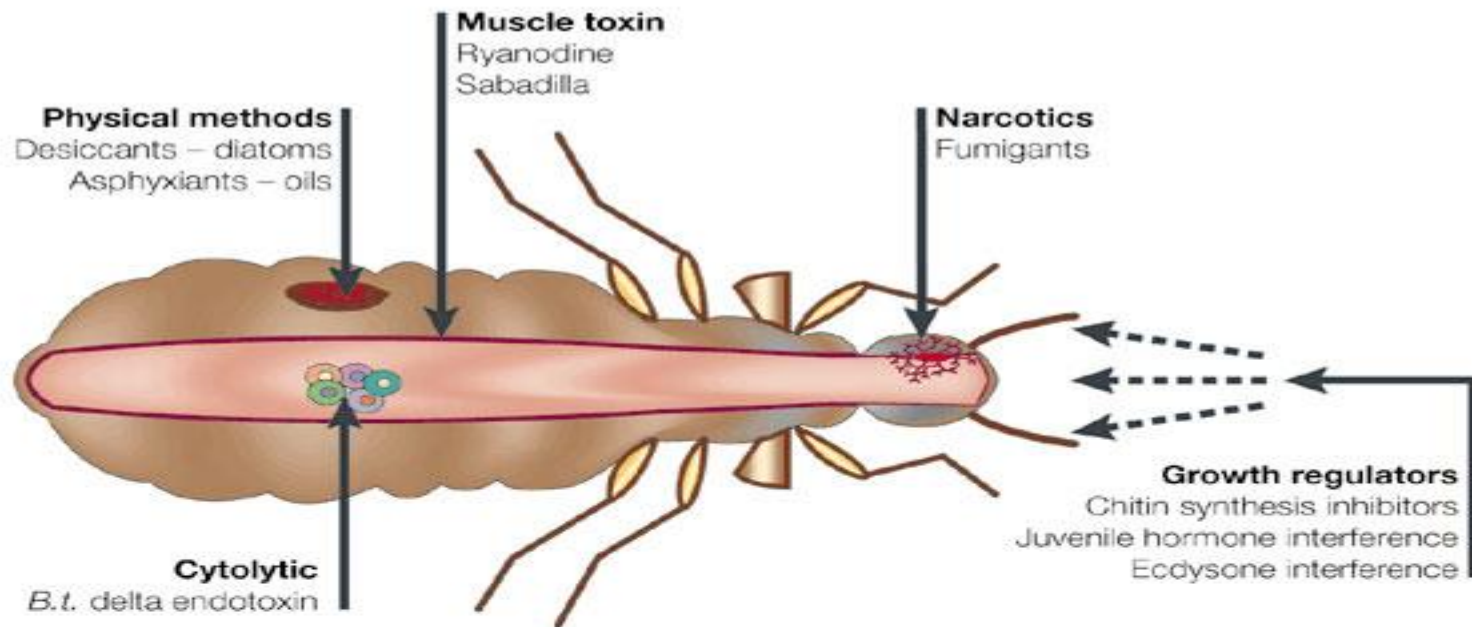
- Phenylpyrazole (fipronil), cyclodienes
- Antagonists of GABA activated chloride channels
- GABA Antagonists: chemicals that bind to but do not activate GAMMA-AMINOBUTYRIC ACID receptors, thereby blocking the actions of endogenous GAMMA-AMINOBUTYRIC ACID or GAMMA-AMINOBUTYRIC ACID agonists.
- GABA can't 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

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

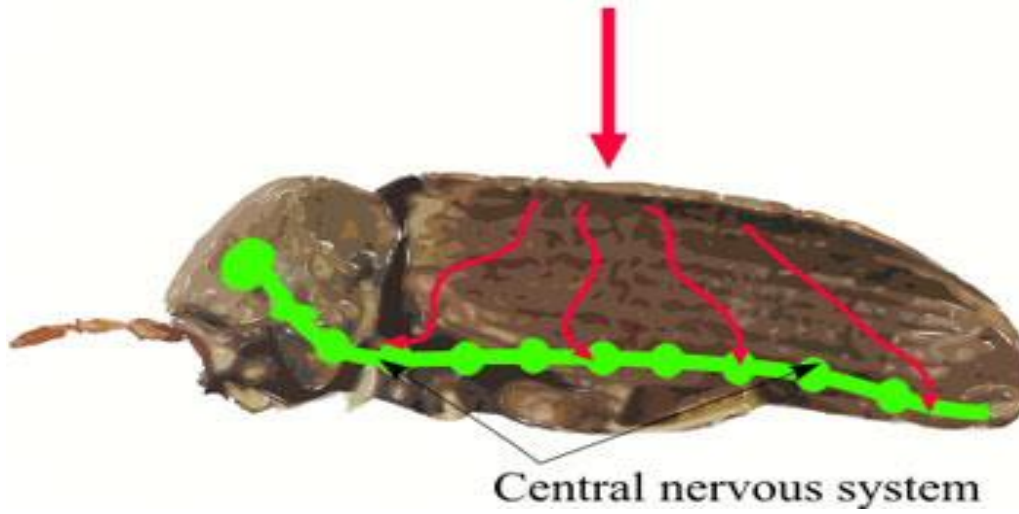
Pesticide terms for route of entry

- **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, naphthalene are true fumigants



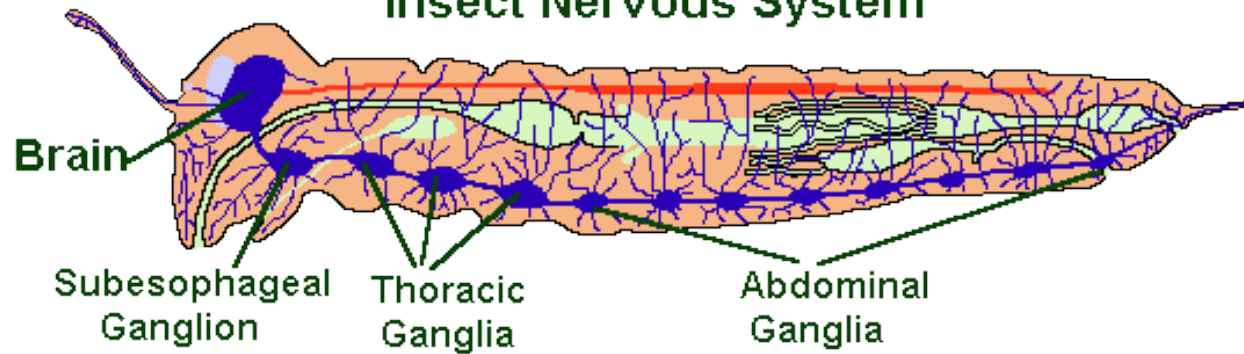
CONTACT INSECTICIDES

Contact insecticide



Nervous system

A Diagrammatic Representation of the
Insect Nervous System



Mode of Toxicity in Insects

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

Modes of Action of Insecticides

```
graph TD; A[Modes of Action of Insecticides] --> B[Nervous System]; A --> C[Energy Production]; A --> D[Cuticle Production]; A --> E[Endocrine System]; A --> F[Water Balance];
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Nervous System

Energy Production

Cuticle Production

Endocrine System

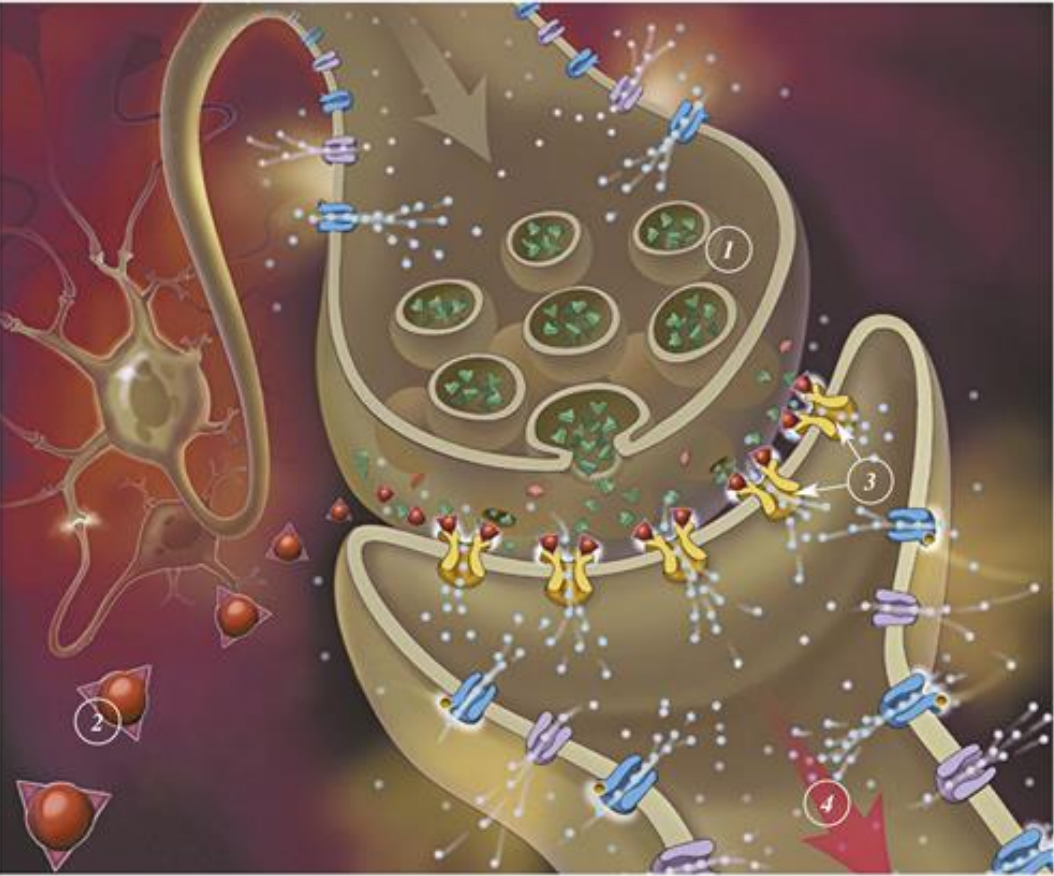
Water Balance

Nervous System

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

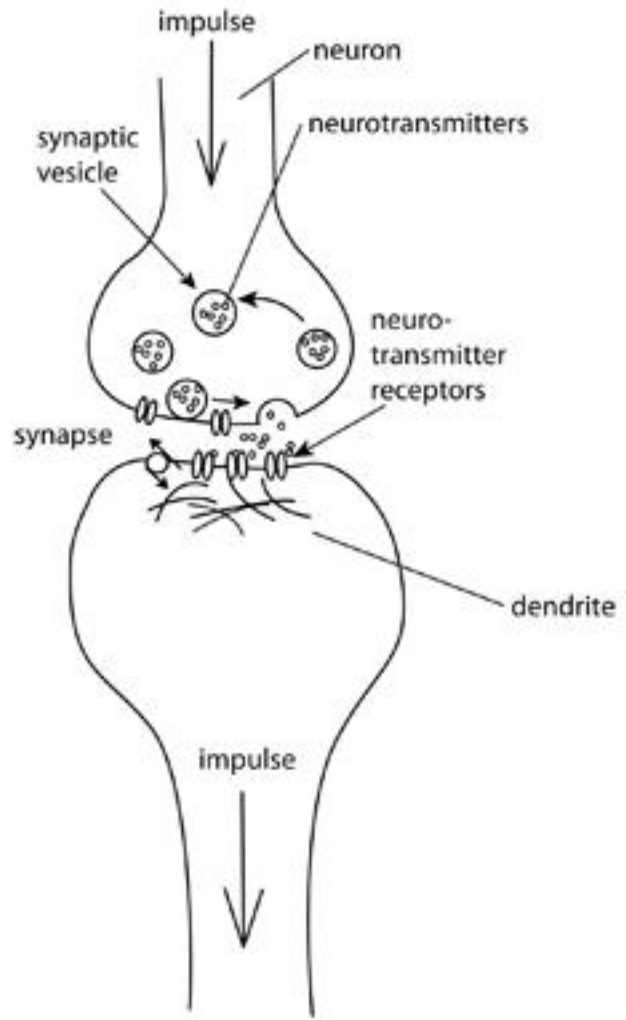


Affect synaptic transmission



1 Vesicles of acetylcholine
2 Imidacloprid

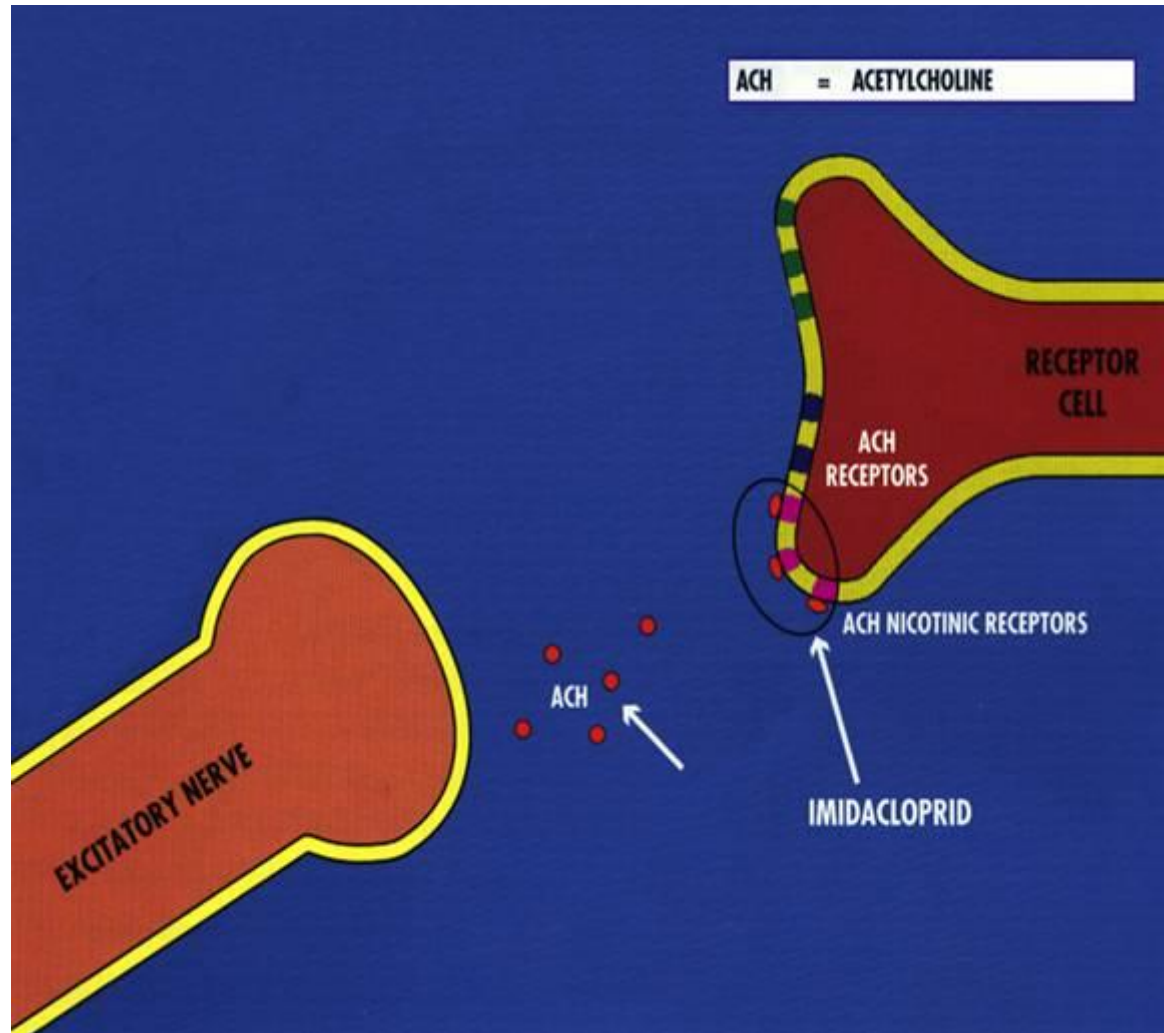
3 Nicotinic receptors blocked open
4 Constant neuromuscular stimulation



impulse
neuron
synaptic vesicle
neurotransmitters
neuro-transmitter receptors
synapse
dendrite
impulse

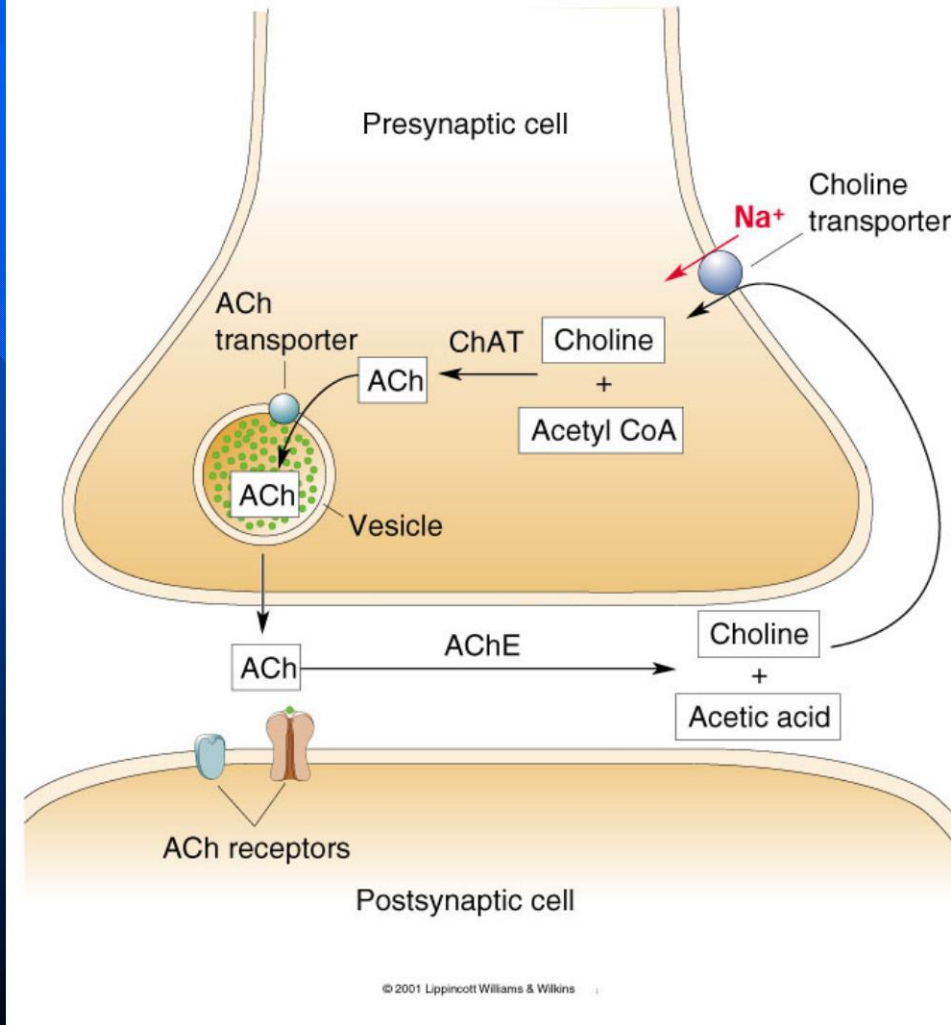
Acetylcholine Receptor

- 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

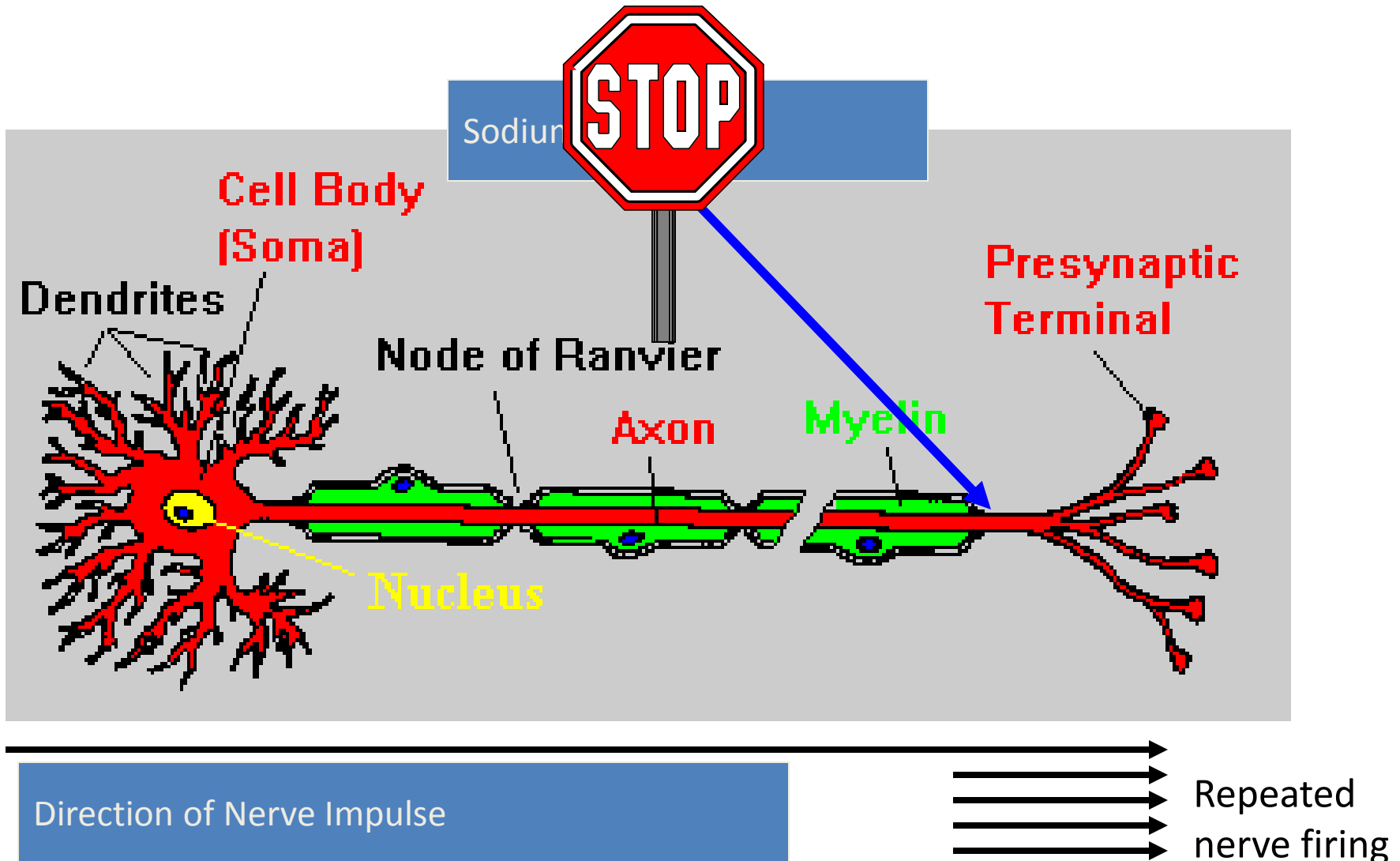


Acetylcholine System

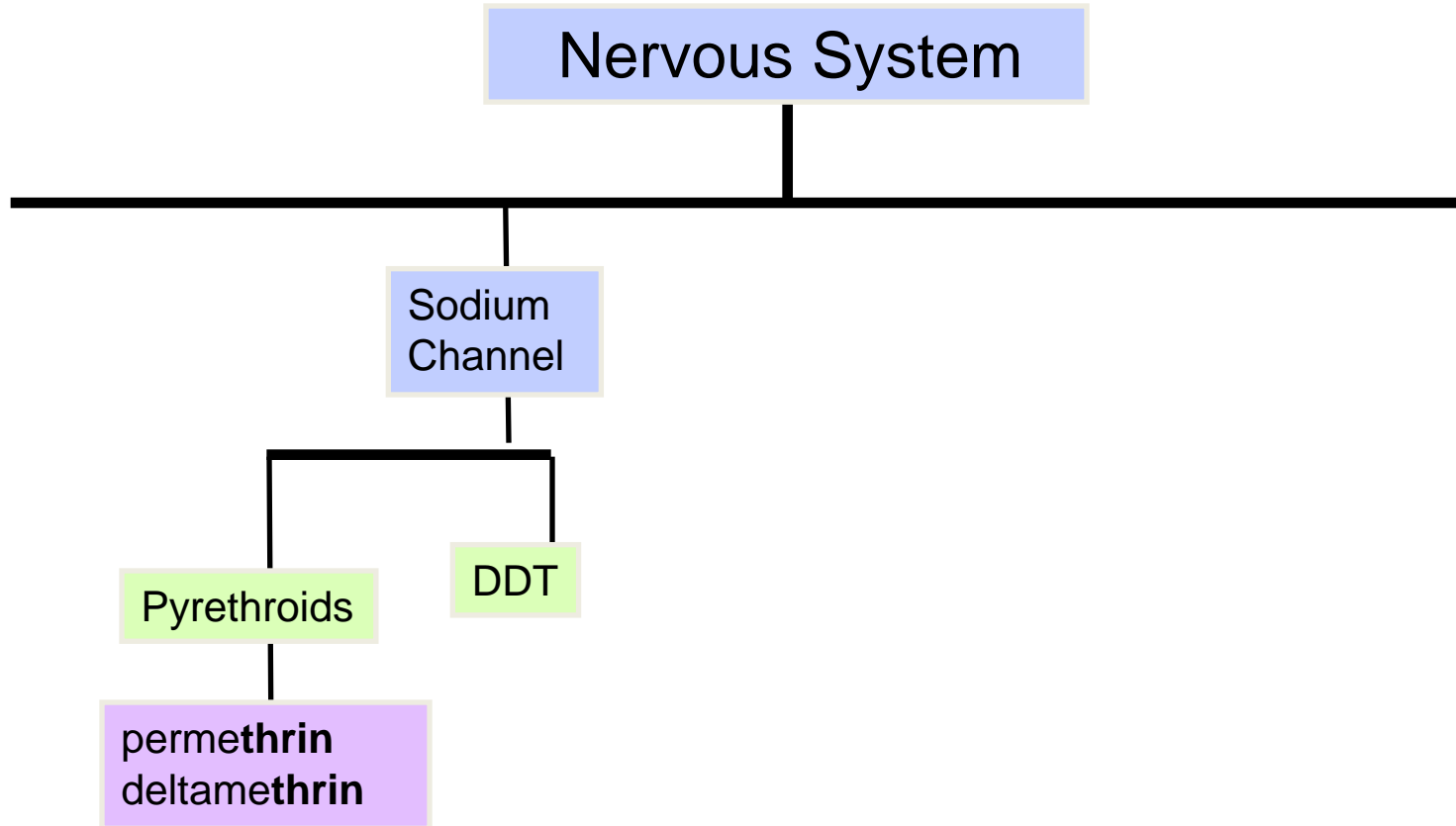
Figure 6.10
The life cycle of ACh.



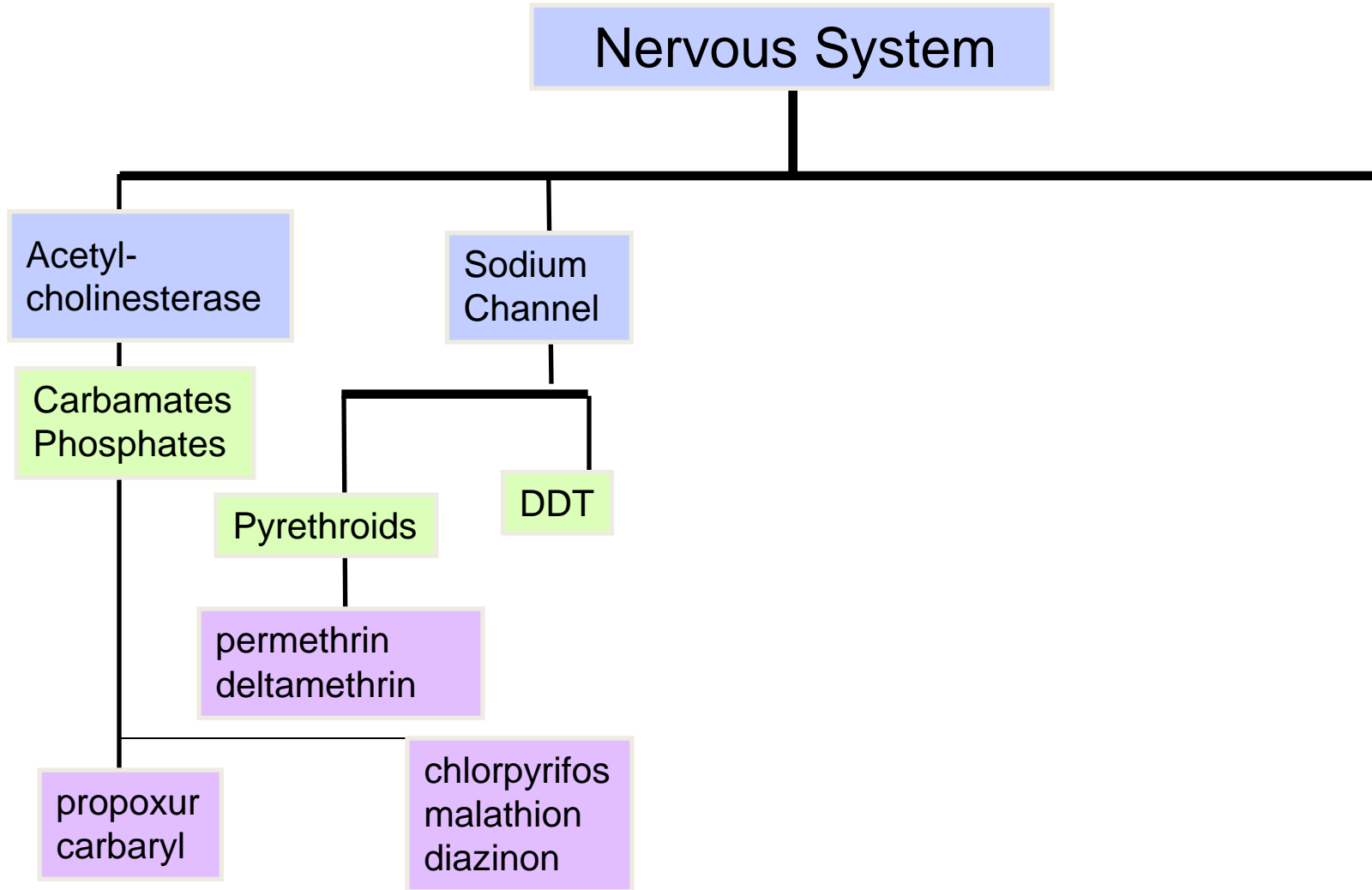
Nerves and Pyrethroids



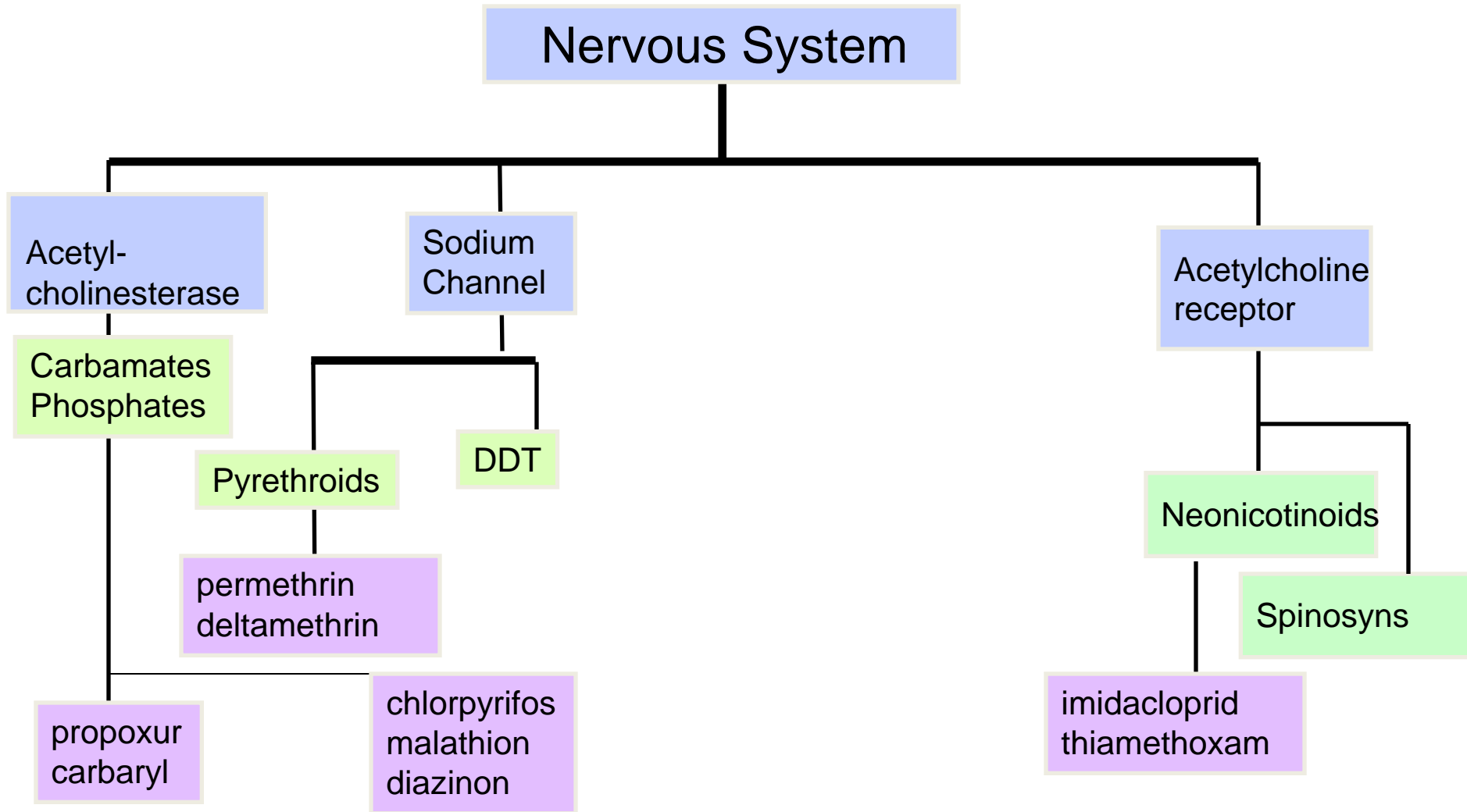
Insecticides that Affect the Nervous System



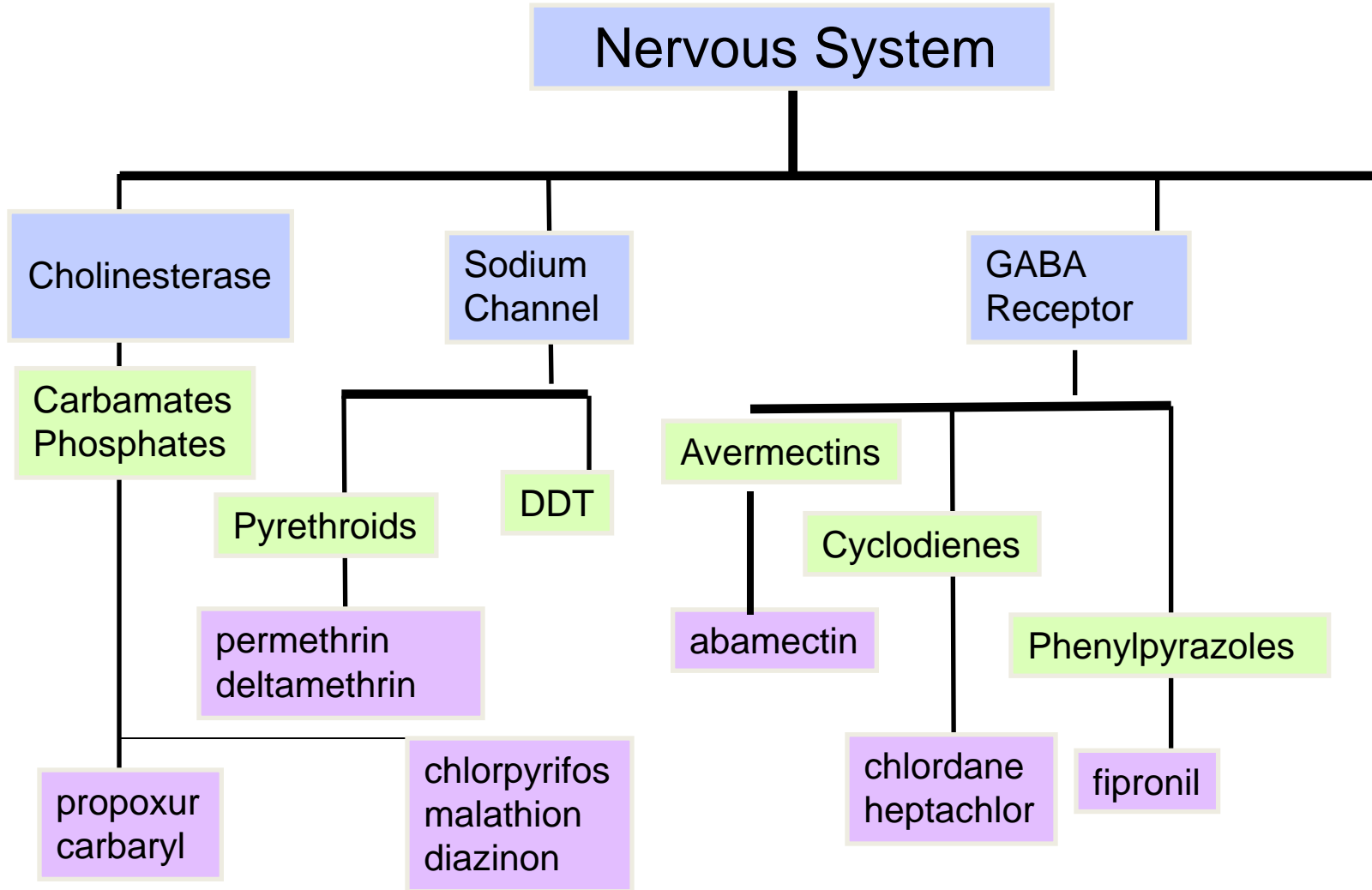
Insecticides that Affect the Nervous System



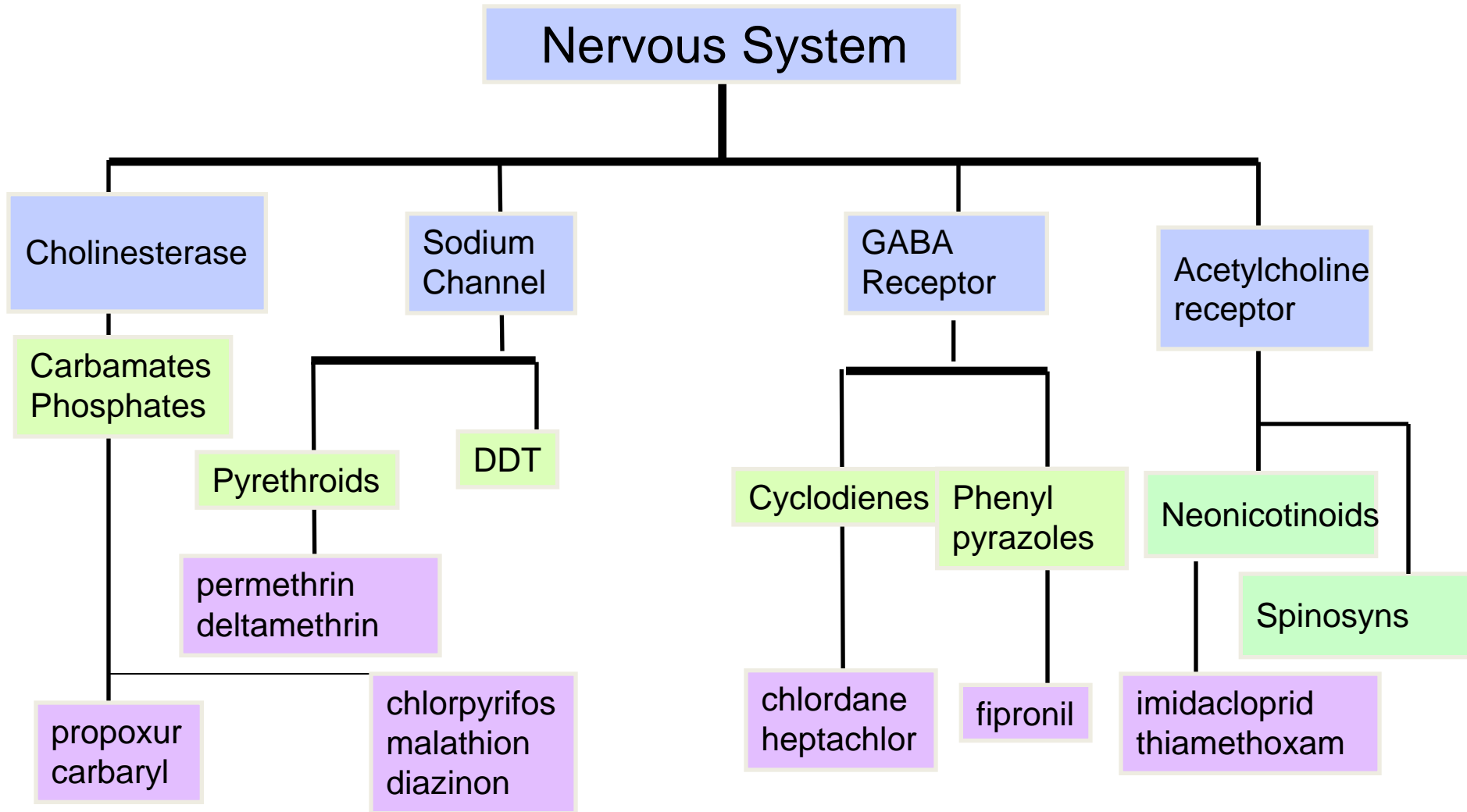
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Insecticides that Affect the Nervous System

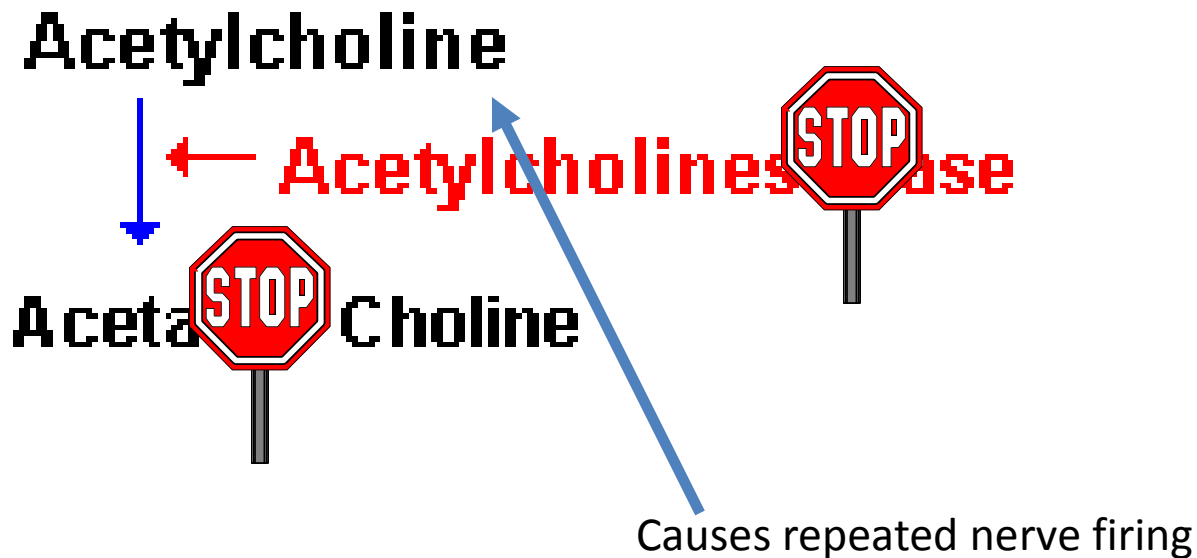


Insecticides that Affect the Nervous System



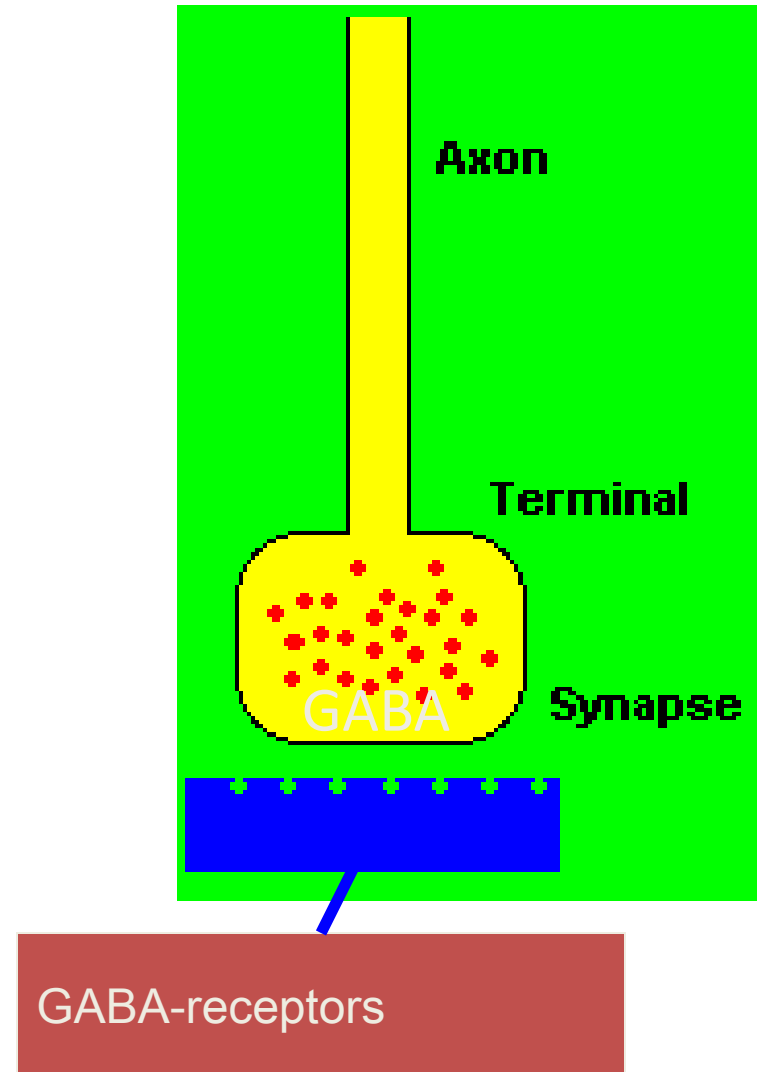
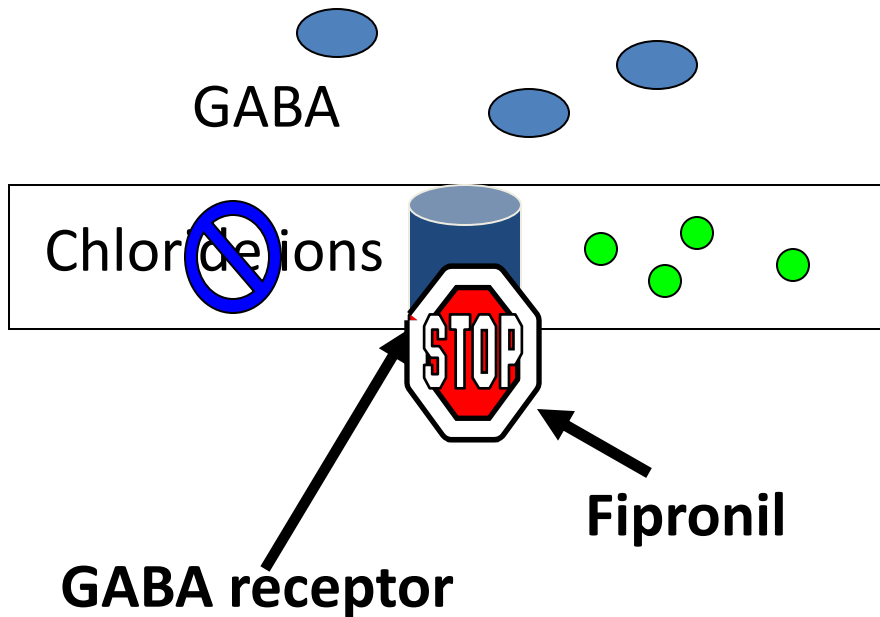
Cholinesterase Inhibitors

- Organophosphates
- Carbamates



GABA Receptor in Central Nervous System

- Phenylpyrazoles or
- Fiproles



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

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

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

MOA: GABA Antagonist

- Phenylpyrazole (fipronil), cyclodienes
- Antagonists of GABA activated chloride channels
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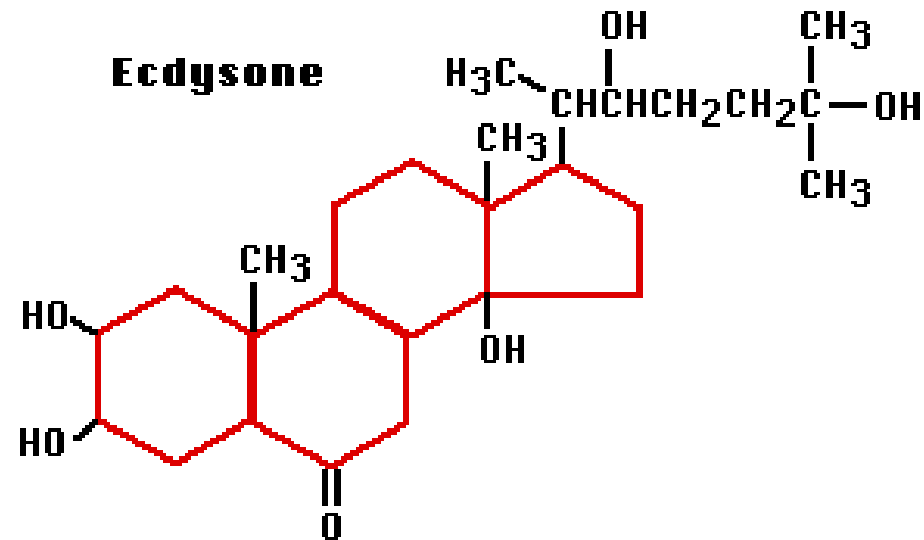
Pheromones

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



Growth Regulators

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



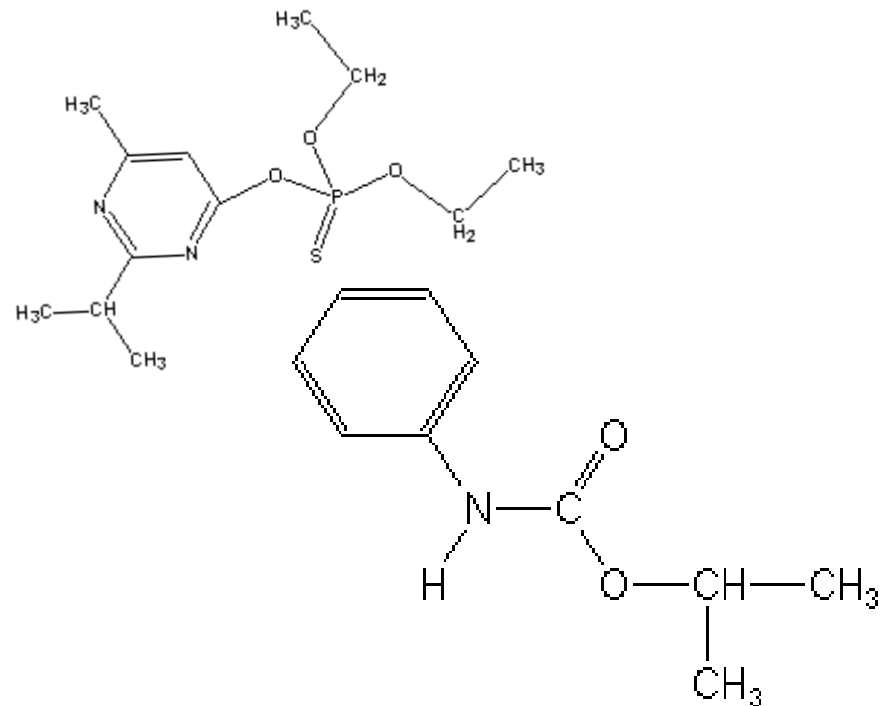
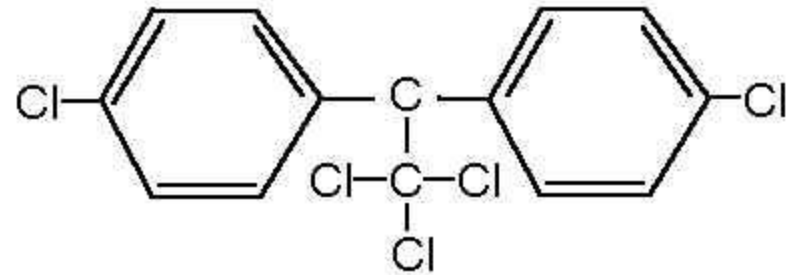
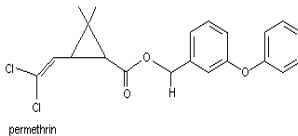
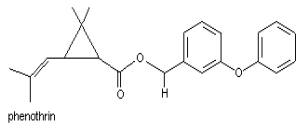


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Synthetic Insecticides

Synthetic Insecticides

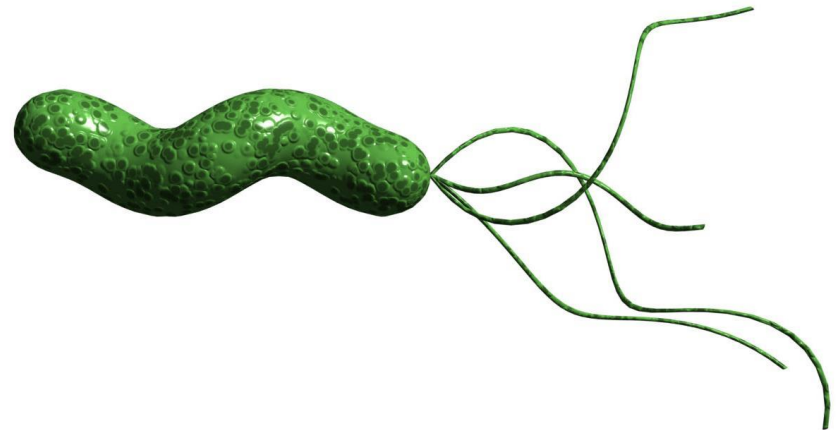
- Organochlorines
- Organophosphates
- Carbamates
- Pyrethroids
- Neonicotinoids



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

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**



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

Toxicity to humans or nontarget organisms

- Most insecticides have the capacity to affect nontarget 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



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

Botanical Insecticides



Secondary compounds

- Alkaloids
- Terpenoids
- Phenolics
- Glucosinolates
- Etc.

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

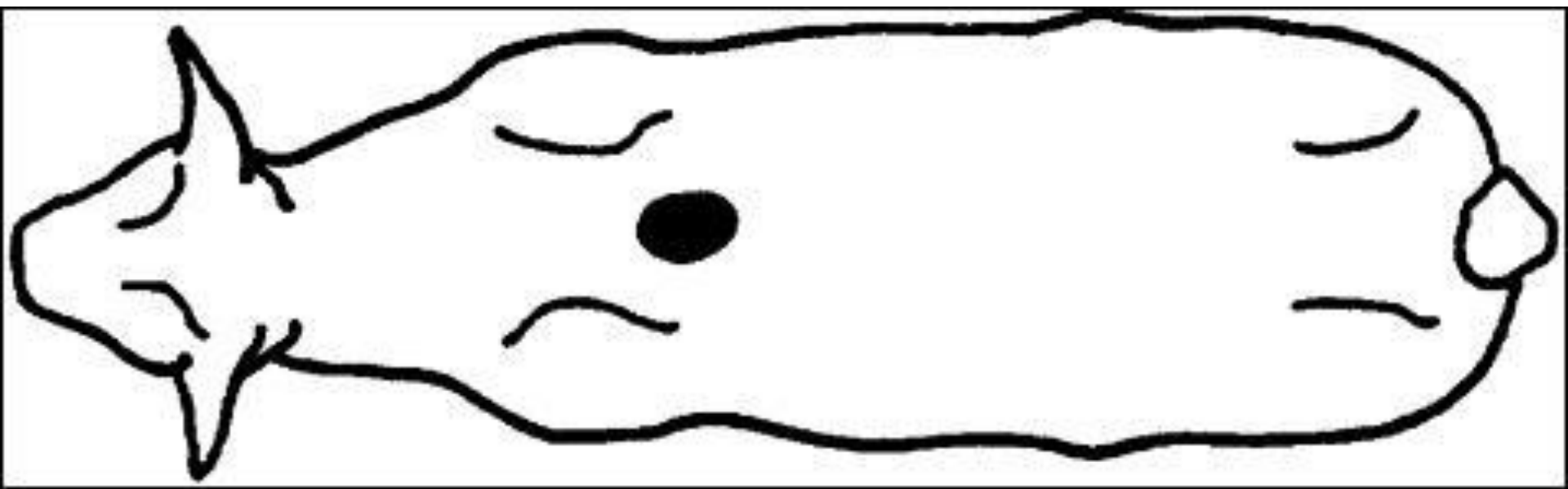
- Type I
 - Short residual,
 - Fast flushing, and
 - Quick knockdown,
 - Negative temperature correlation: more effective at low temps
 - Ex.: Allethrin, d-phenothrin, resmethrin
 - Type II
 - Long residual,
 - Slower flushing, and
 - Slower knockdown,
 - Better killing power than type 1
 - Positive temperature correlation
 - Ex.: Permethrin, cypermethrin, cyfluthrin, lambda-cyhalothrin
- Synergists -- used to deactivate mixed function oxidases (MFOs) within insects

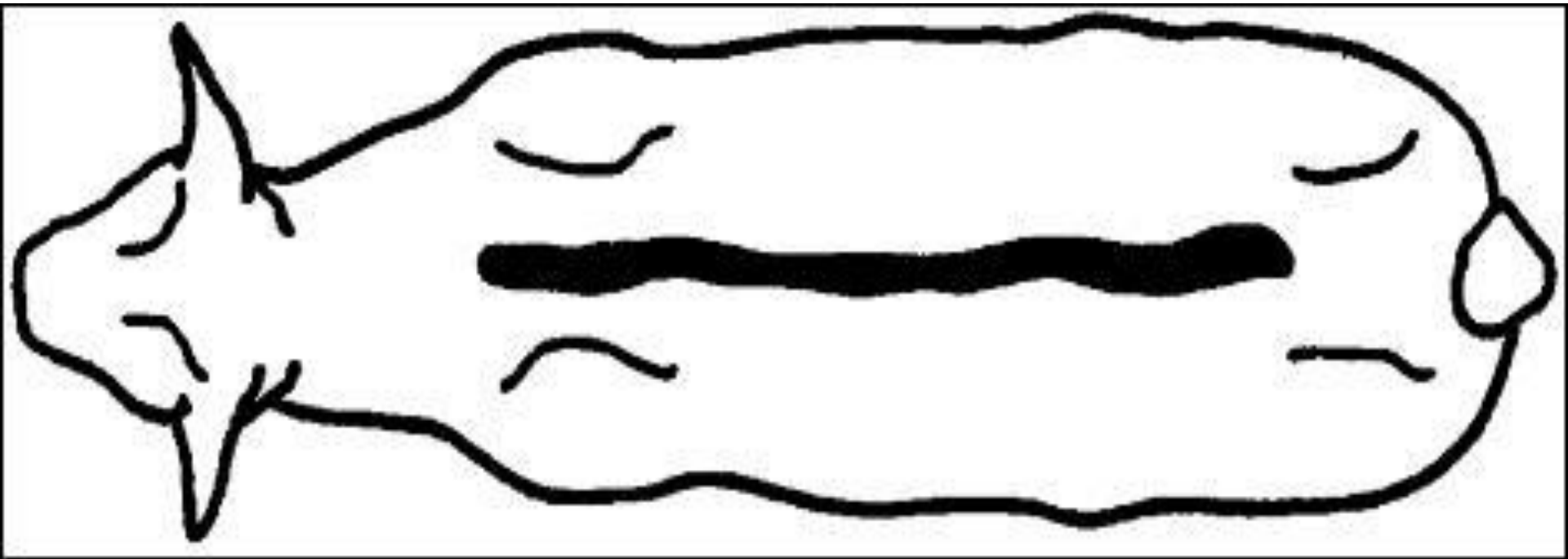
Pyrethroids Effects

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

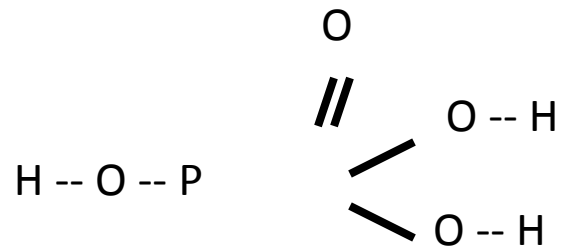
MOA: Pyrethroids

- 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 bind to the sodium channel and prevent it from closing normally
- Result: continuous nerve stimulation
- Symptoms: Tremors, uncoordinated movement

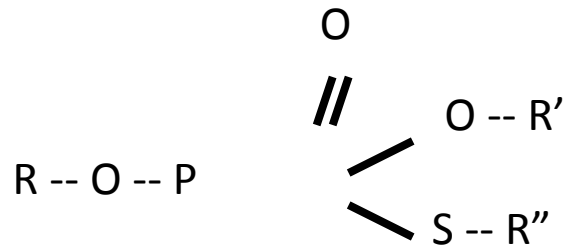




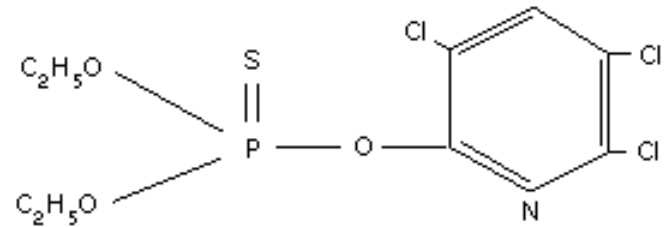
Organophosphates



Phosphoric Acid

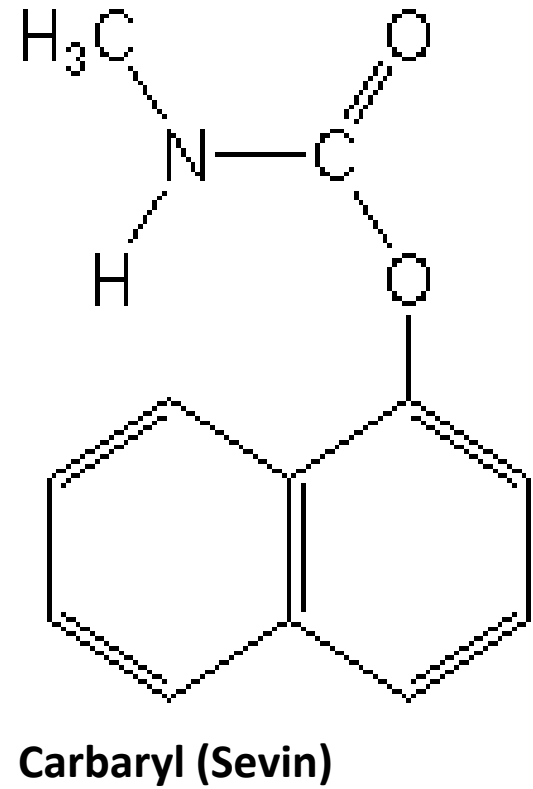
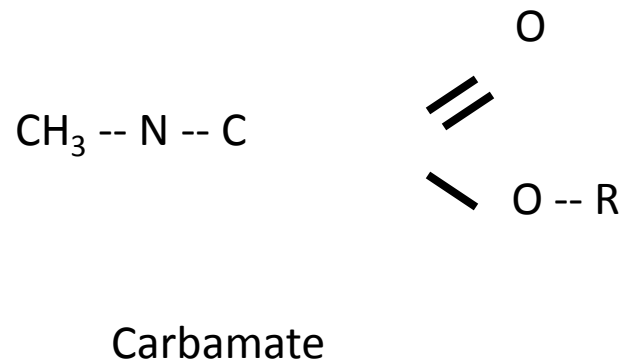
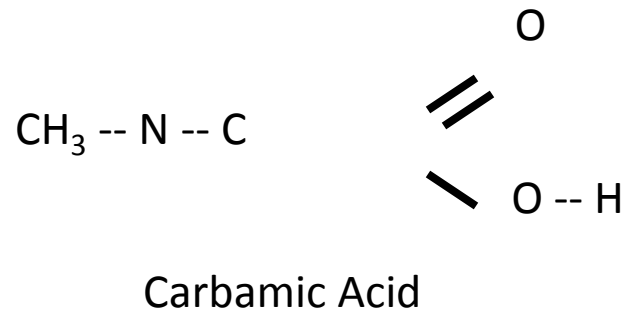


Phosphorothioate



Chlorpyrifos ((Dursban))

Carbamates

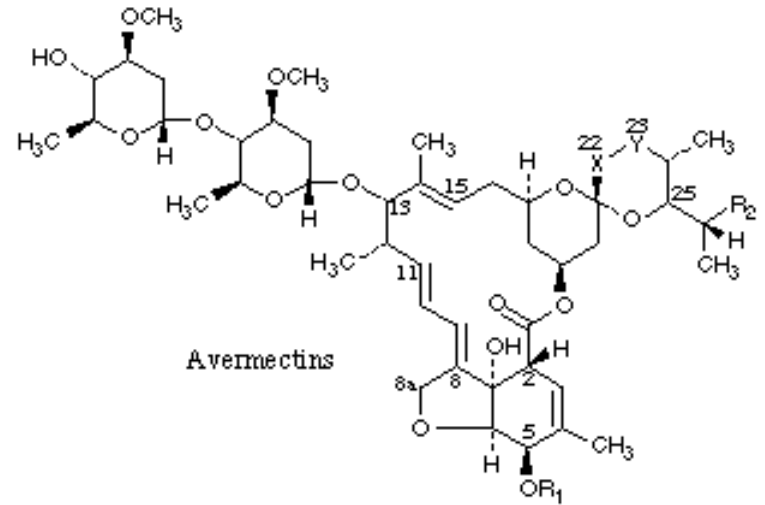


Neonicotinoids

- Imidacloprid (subgroup: pyridylmethanamine)
 - 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)

Avermectins

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



Produced from soil microbials. Stomach poison for ants and cockroaches

slow acting

low toxicity to mammals

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

اساتذتي العظام

إخواني الكرام
شكراً على صبركم
شكراً على علمكم
شكراً على اهتمامكم