Insecticides Basics 101

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U.W. Insect Diagnostic Lab

- ALL THINGS ARE POISONS

Examples- Water in lungs kills people-

- The dose makes the poison- Aspirin
- Differences in animals can be because of target site, individual sensitivity

BT affects insects with certain PH in gut

- Insecticides are among most toxic products - biologically active at low dosages

How to kill

- Stop breathing (oxygen)
- Shut down digestive system
- Shut down nervous system
- Prevent the conversion of food to energy (metabolic disruption)
- Hormonal disruption
- Loss of water

How Insecticides Kill

- Stomach poison- must be eaten
- Contact poison- includes residuals adsorbed from contact
- Fumigants or “vapor action”- gasses- most are very toxic

How insecticides work

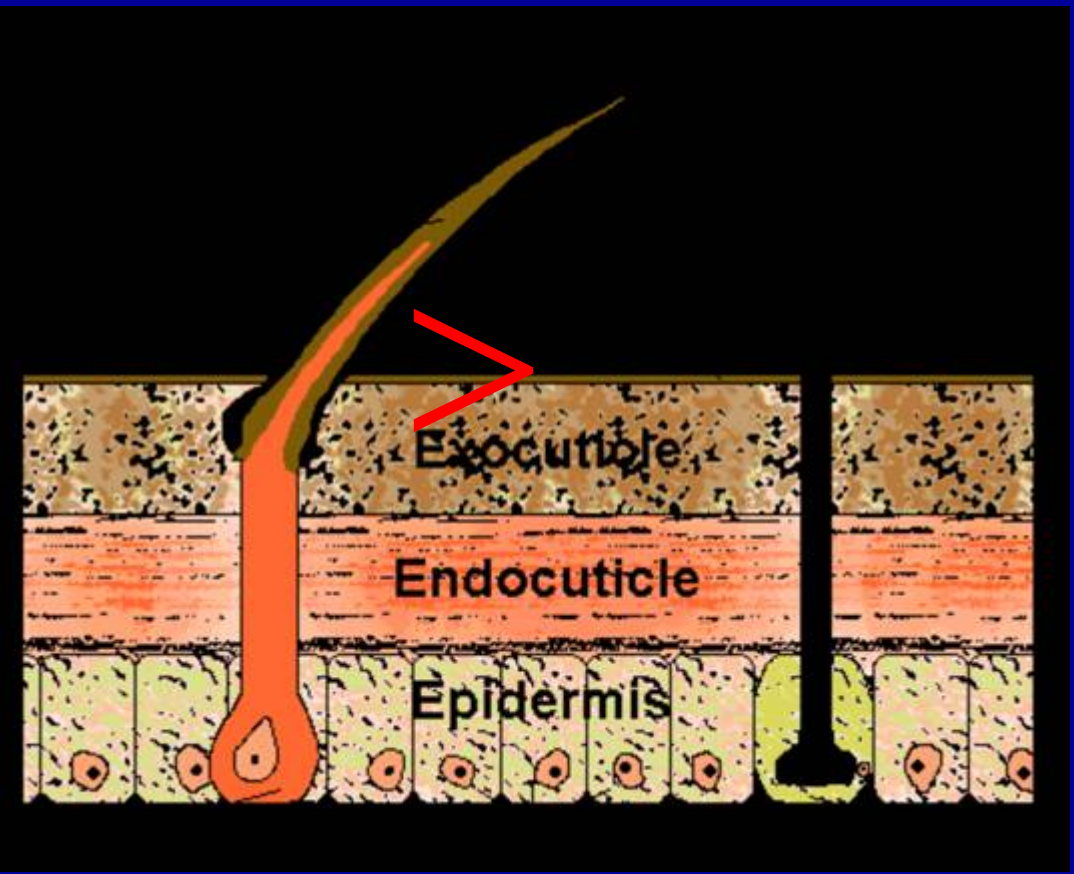
- **Systemic** -taking up by plant and translocated by vascular system (roots and foliar) best for sucking insects- not mites
- **Translaminar**- move into plant - a local systemic- “soak into cells” has mite activity

General characteristics

- Most insecticides are nerve poisons
- Most insecticides kill by contact including residual contact
- Most insecticides are lipo-philic(fat loving)

  Insects adsorb when they walk on a treated surface

Insect cuticle



- Epicuticle on surface is a waxy- fatty covering
- Abrading cuticle will cause insect to desiccate

DIATOMACOUS EARTH -fine sand. Dusts

Mode of action- How they kill

- Nervous system poisons- over 90% of registered products affect the nervous system

WHICH ONES ARE NERVE POISONS?

Families of insecticides

- Pyrethrin and synthetic pyrethroids-

Capture ,Warrior, Asana, Force

- Carbamates

Furadan, Sevin

- Organophosphates

Fortress, Lorsban, dimethoate, malathion

Families of insecticides

- Avermectins

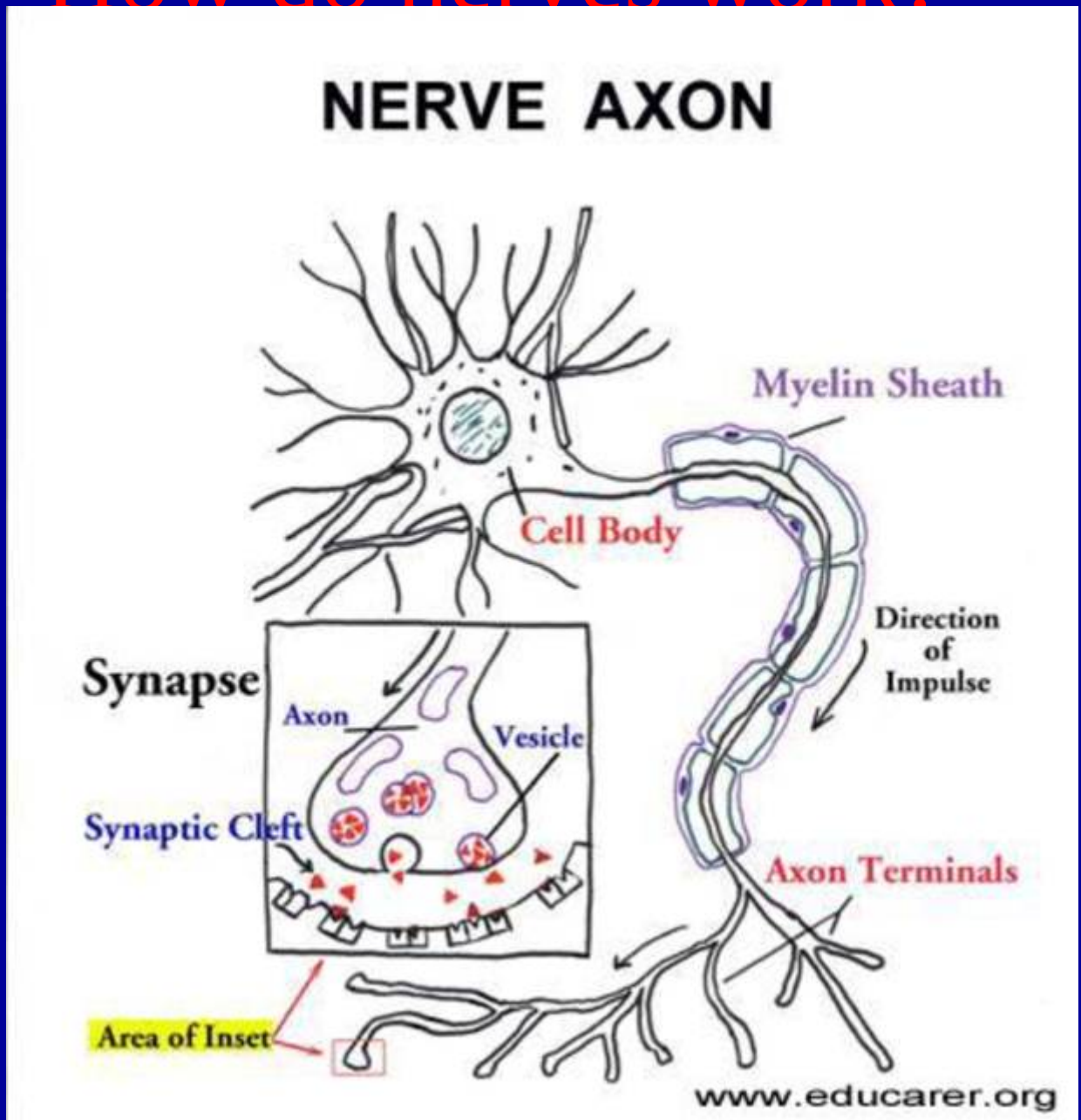
  Avid, Agramek
- Neoniconyls

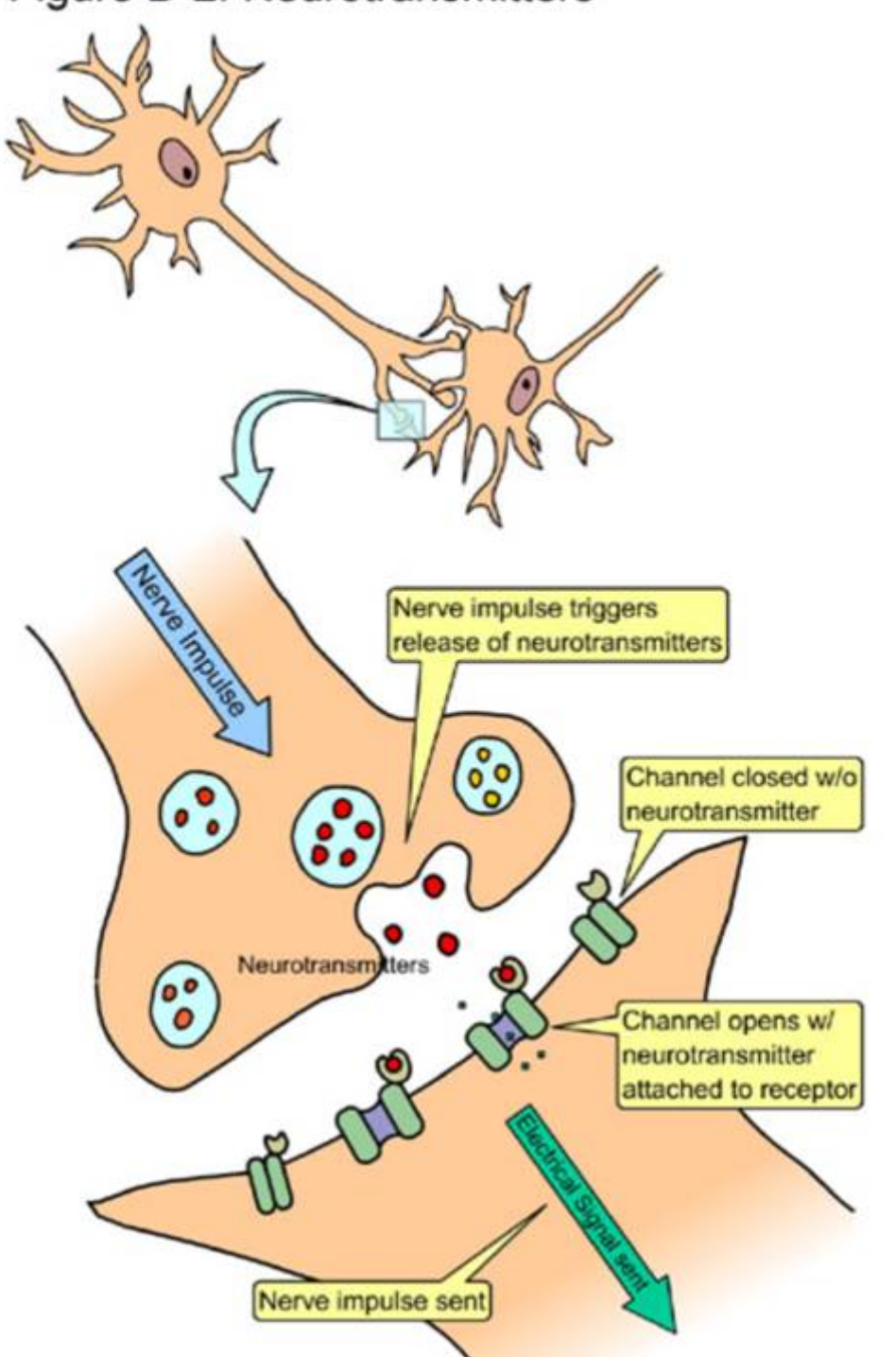
  imidacloprid Merit

  thiamethoxan Flagship,Actara
- Fipronils

  Regent

How do nerves work?

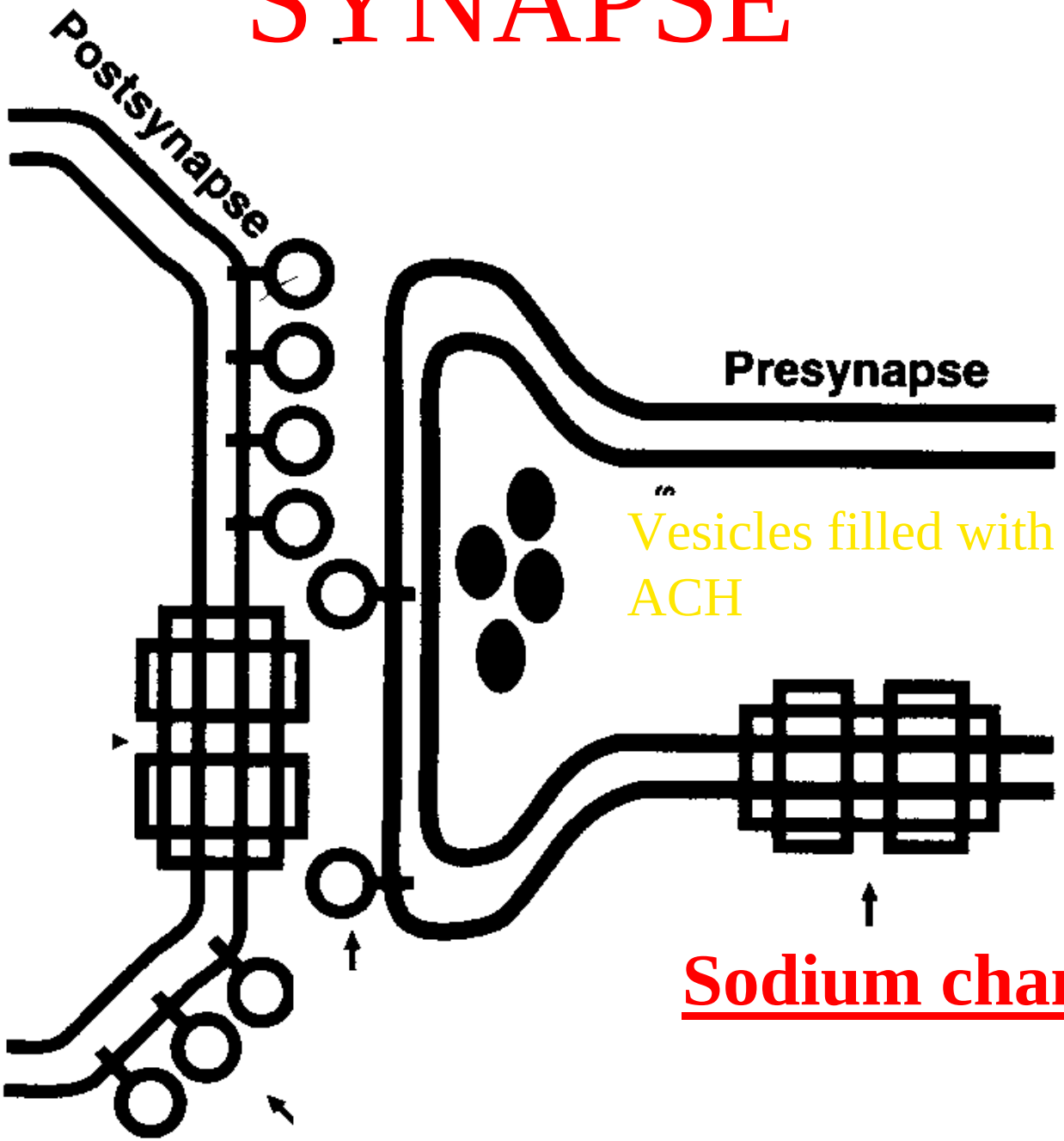



Nerve Impulse
Nerve impulse triggers release of neurotransmitters
Channel closed w/o neurotransmitter
Neurotransmitters
Channel opens w/ neurotransmitter attached to receptor
Electrical Signal sent
Nerve impulse sent

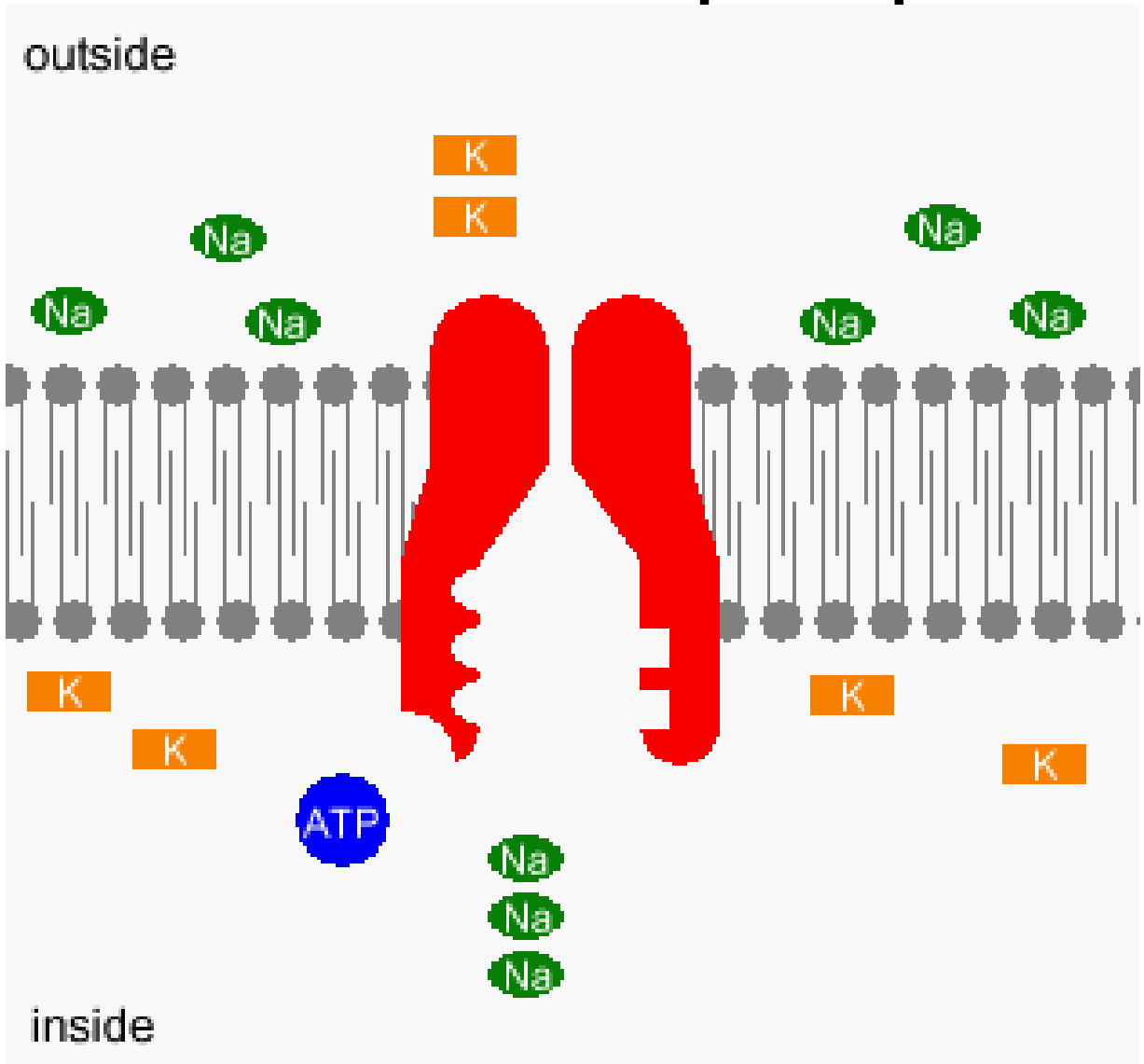
Nerve functions

- Axons like an insulated copper electrical wire- ARM
- Neurotransmitter moves signal from nerve to another nerve or muscle (BALL)
- Receptor on muscle or nerve captures the neurotransmitter (BASEBALL GLOVE)

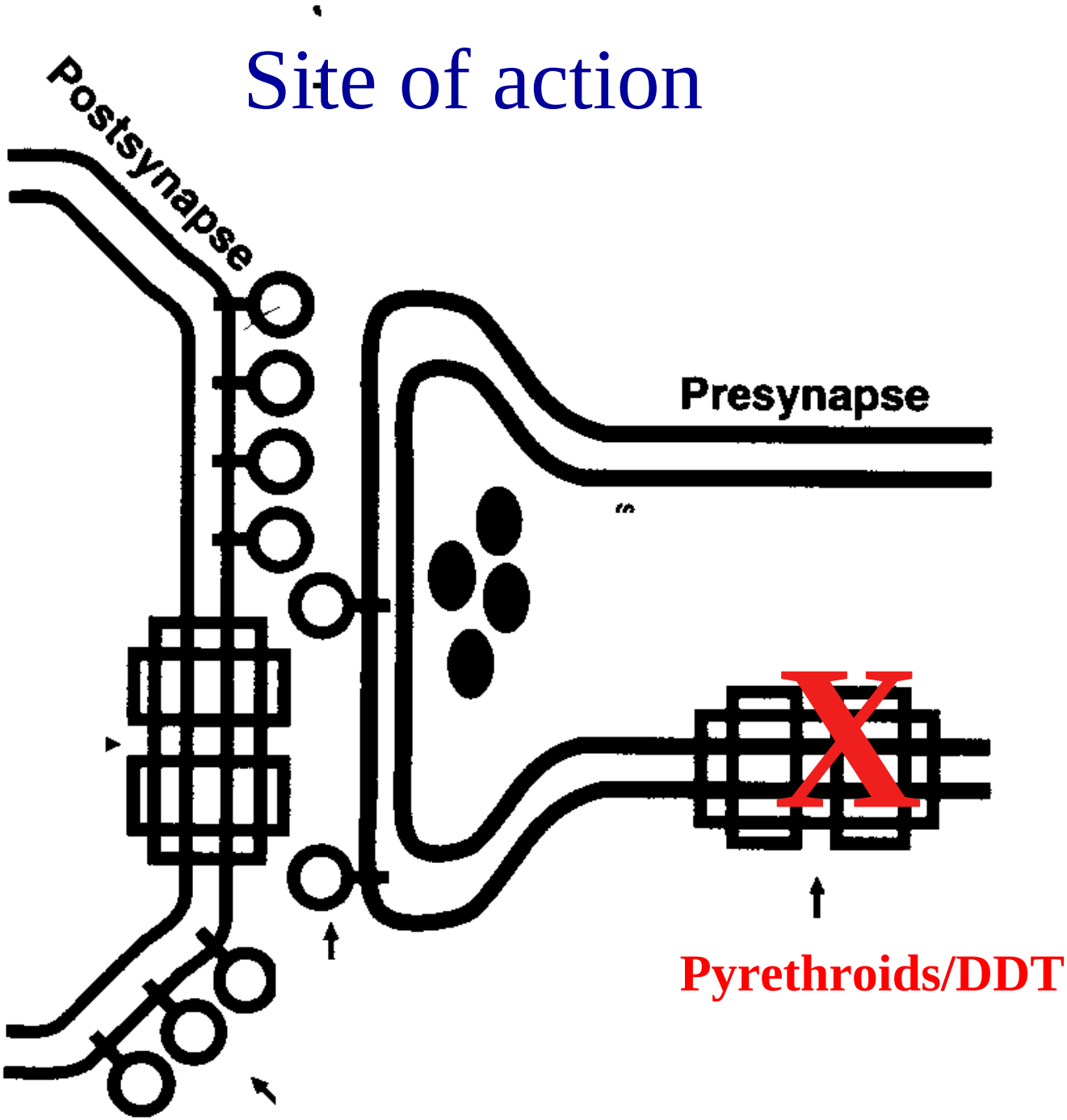
SYNAPSE


Postsynapse
Presynapse
Vesicles filled with ACH
Sodium channel

Sodium pump



Site of action



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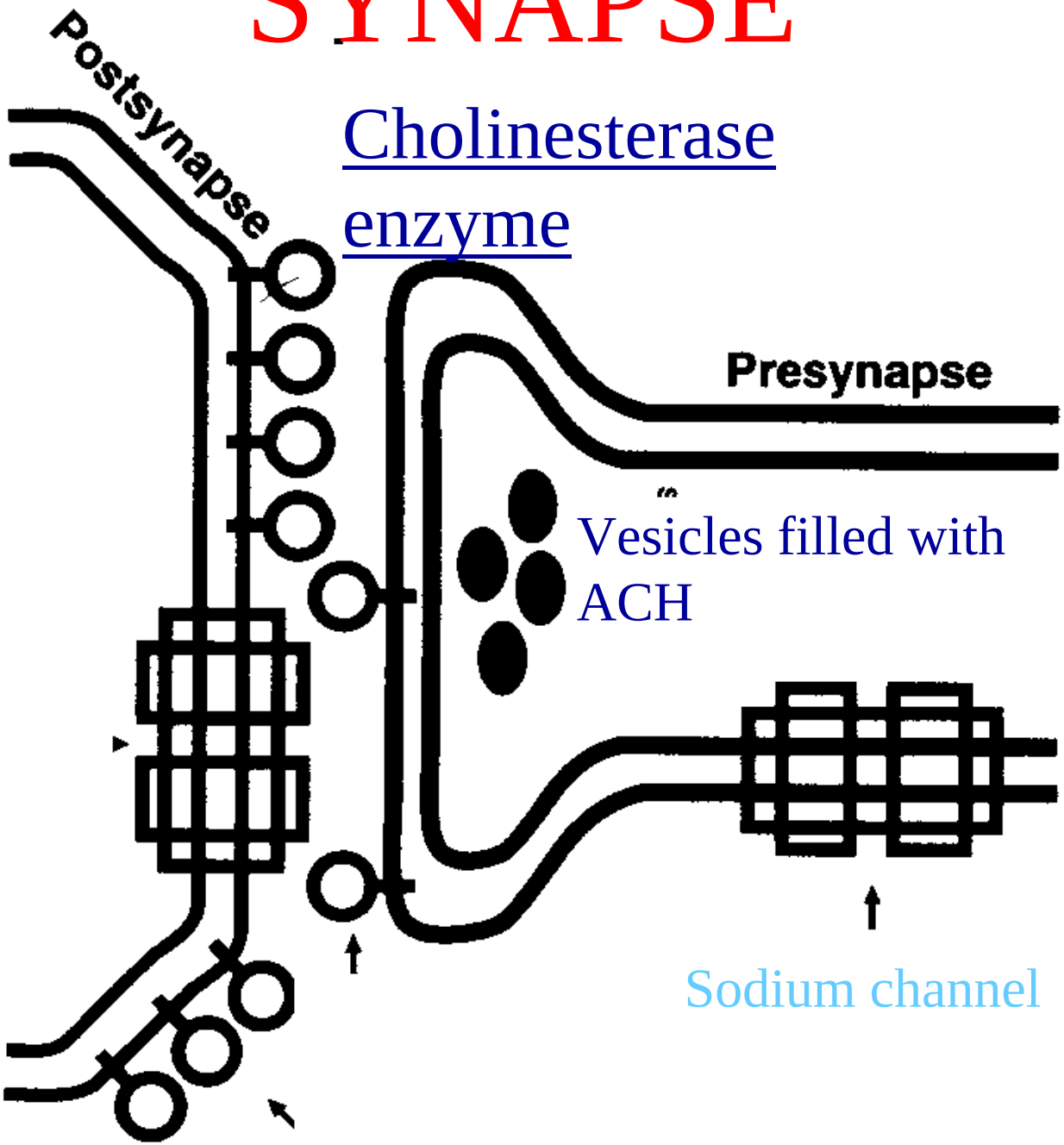
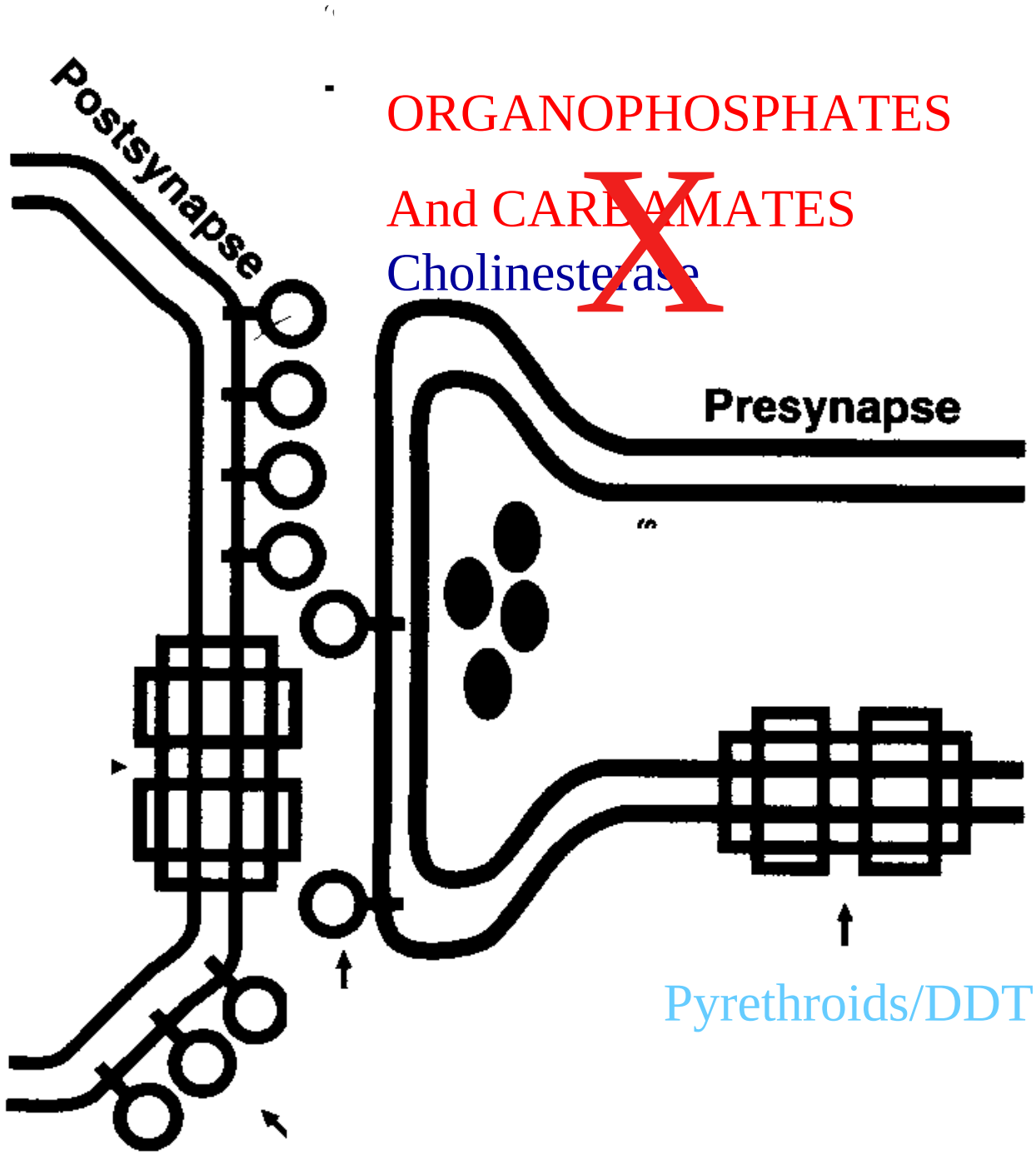

Postsynapse
Cholinesterase enzyme
Presynapse
Vesicles filled with ACH
Sodium channel

- ACETYLCHOLINESTERASE =

  enzyme that breaks down one type of neurotransmitter (ACH)- if not degraded will continue to stimulate the nerve or muscle

Cholinesterase test- measures level of enzyme in blood


Postsynapse
ORGANOPHOSPHATES
And CARBAMATES
Cholinesterase
X
Presynapse
Pyrethroids/DDT

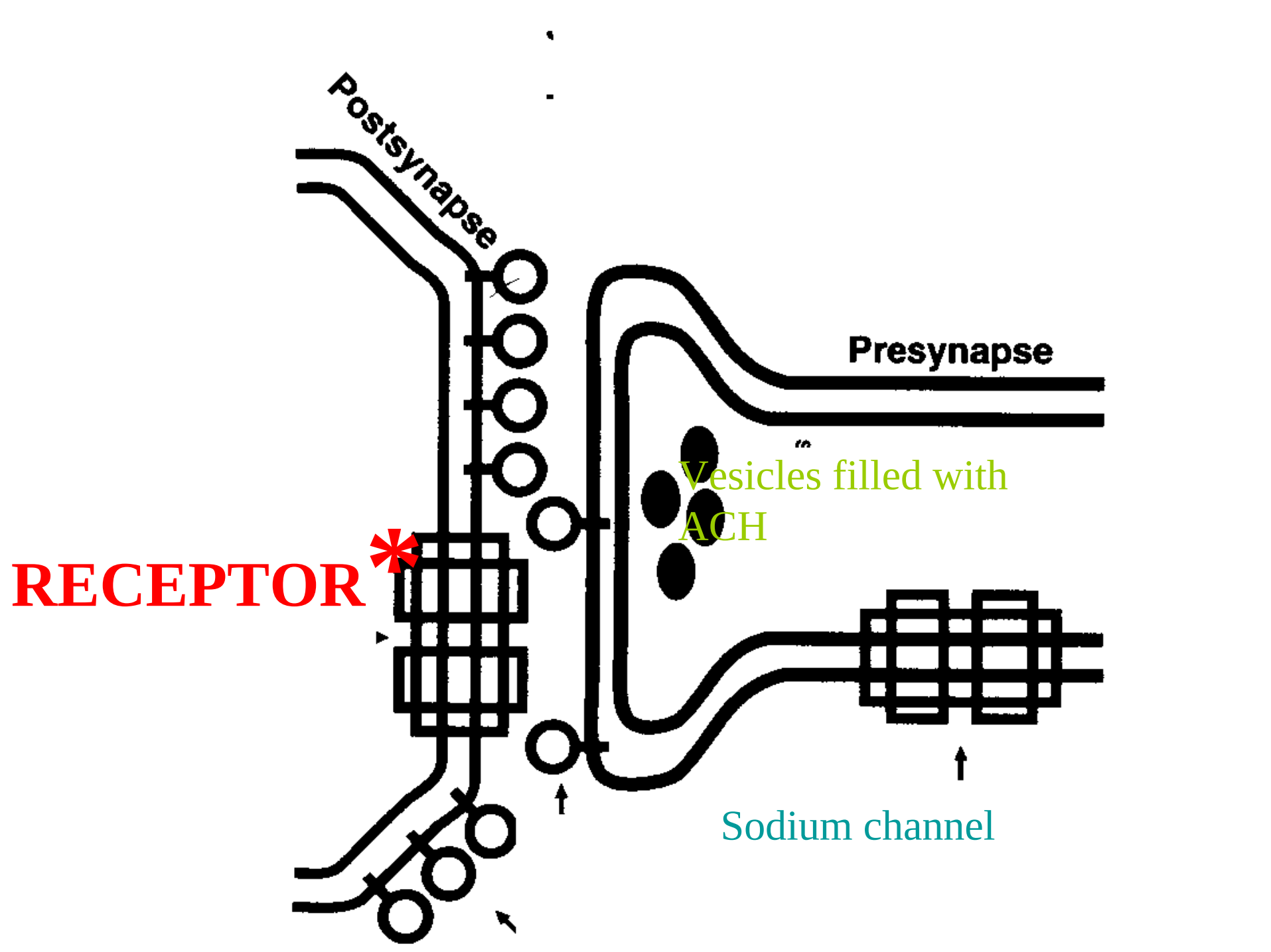
Enzyme test for OP exposure

- **Cholinesterase test-** measures level of enzyme activity in your blood-
- Only works for organo-phosphates

Types of Neuro -transmitters

- Acetylcholine(esp muscle)
- Dopamine
- GABBA (g-aminobutyrate)
- Serotonin, epinephrine, norpinephrine
- 50 different peptides- (hunger, sex drive)
- CAN DIFFER IN INSECTS VS PEOPLE

Do you have the right ball and glove to play the game?


Postsynapse
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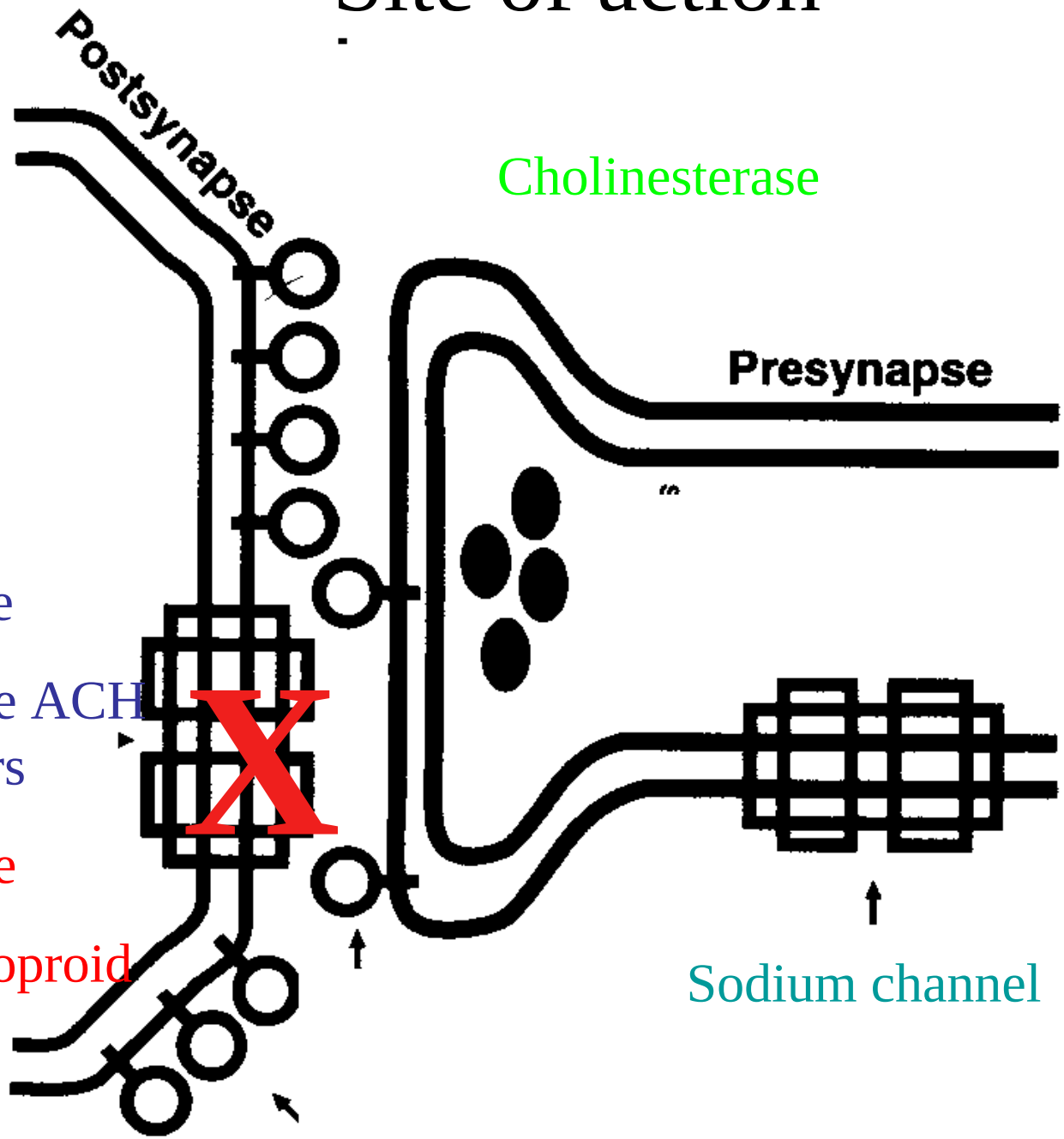
Vesicles filled with ACH
RECEPTOR
Sodium channel

Site of action



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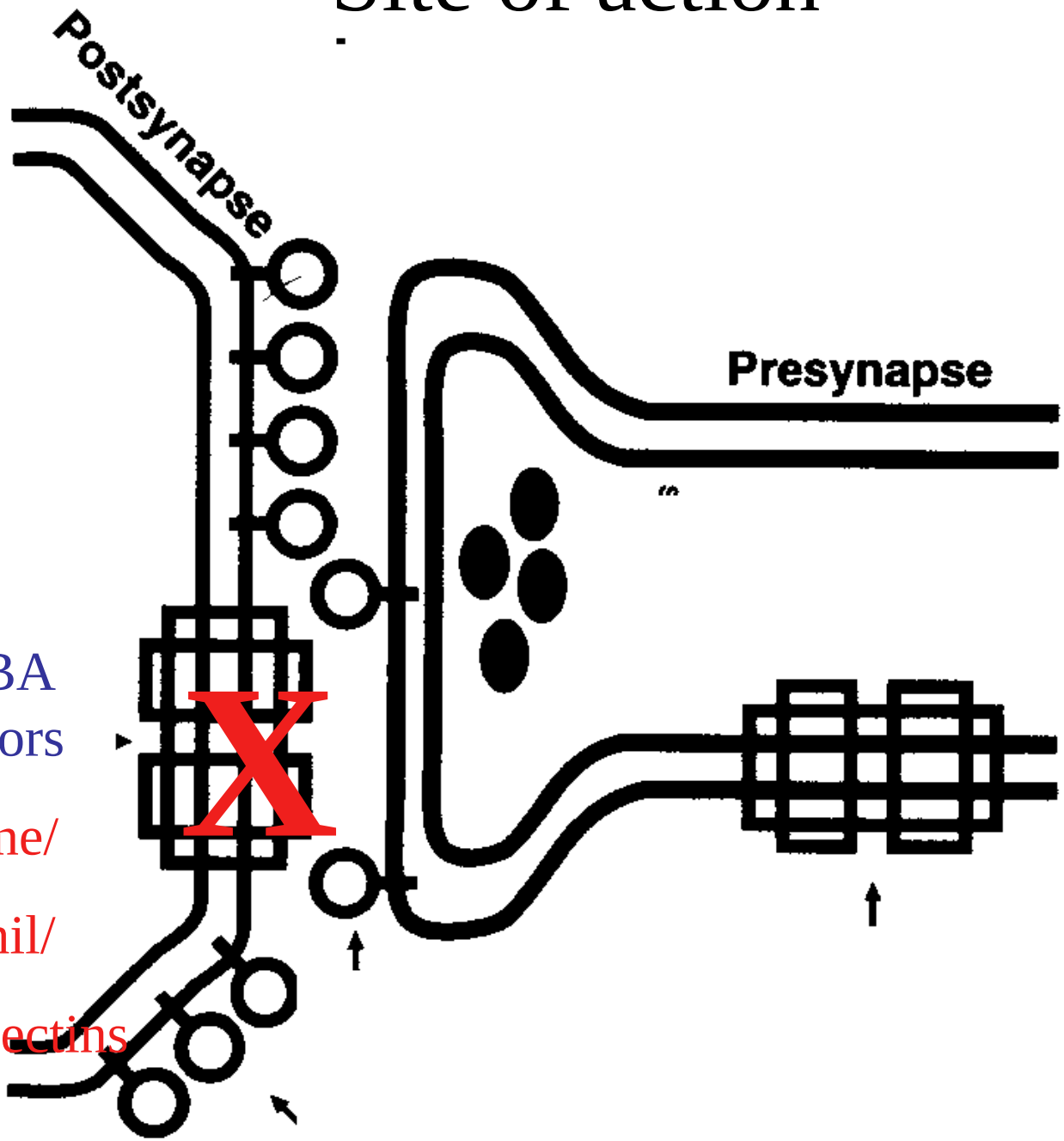


GABBA receptors

Lindane/

Fipronil/

avermectins

New nerve poisons-

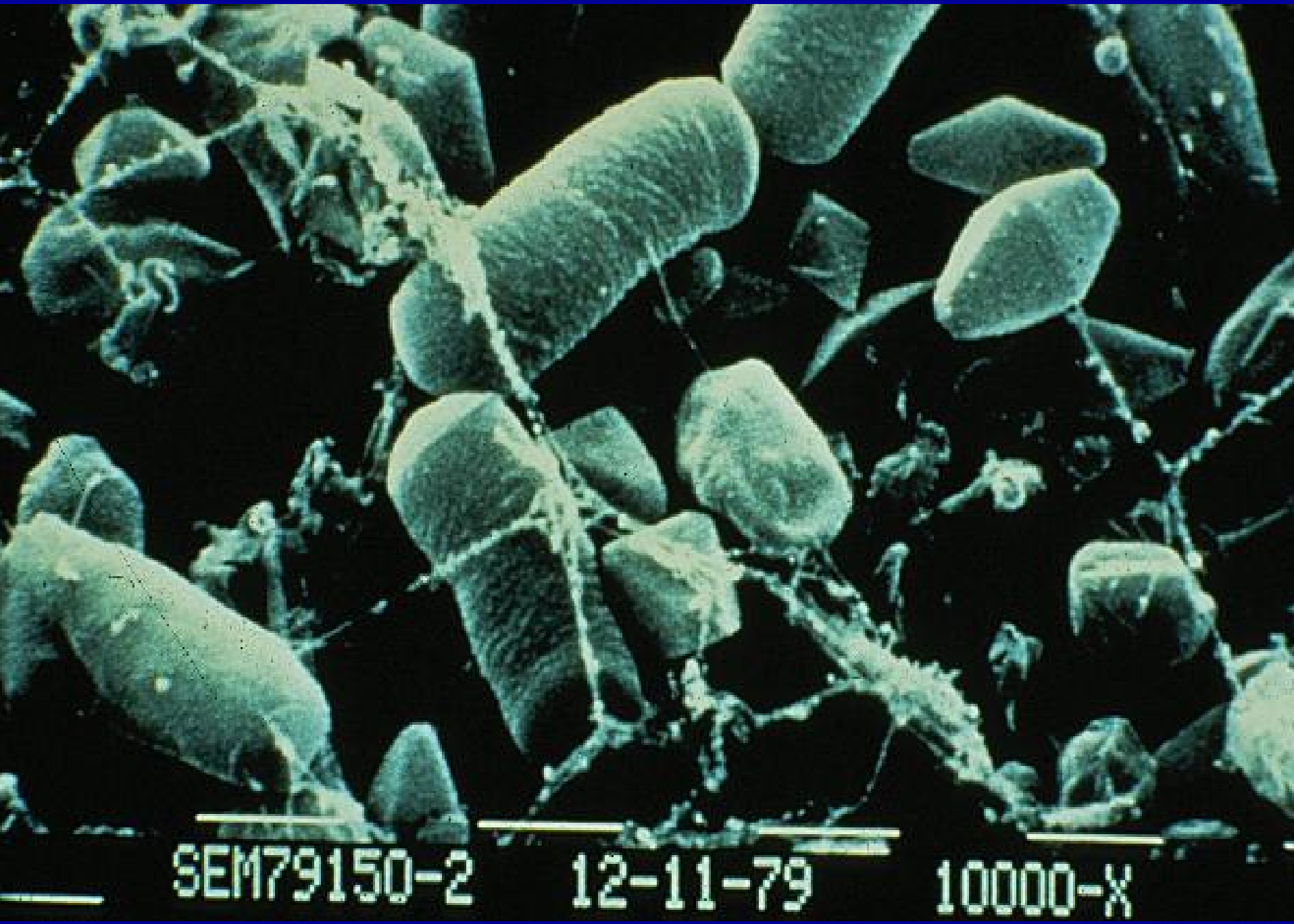
- Fiproles--synthetic-Gabba blocker
- Avermectins-anti-biotic from fungus

  chloride channels
- Nicotinoid-synthetic-like nicotine
- Spinosyns- soil fungus -antibiotic(rum still)
  nicotinic acetylcholine receptors

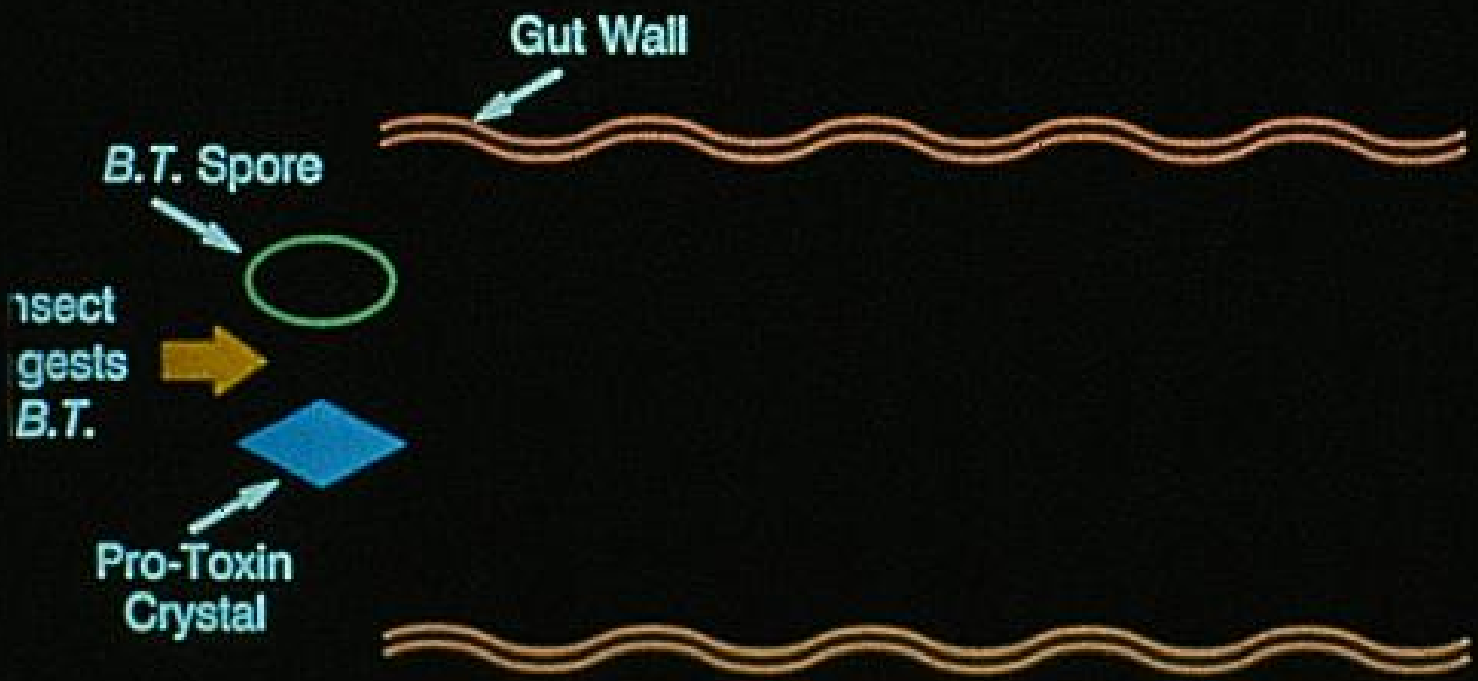
Symptoms of nerve poisoning

- Twitching,cramps ,headache
- Dizziness,blurred vision,nausea
- Constricted pupils(OP’s and CARB)
- Chest discomfort
- Unconsciousness,breathing problems
- Coma and death

Bacillus thuringienses
B.T.


SEM79150-2 12-11-79 10000-X

How *B.T.* Kills



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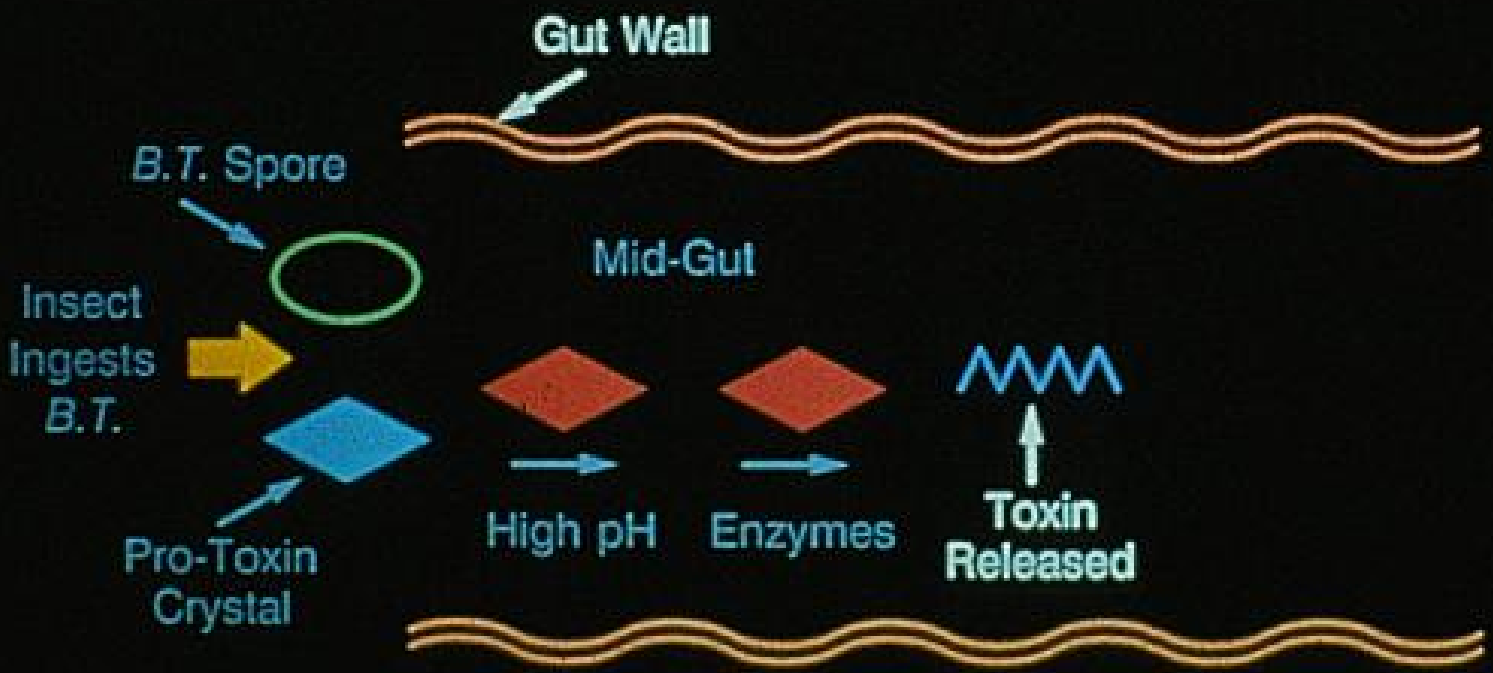
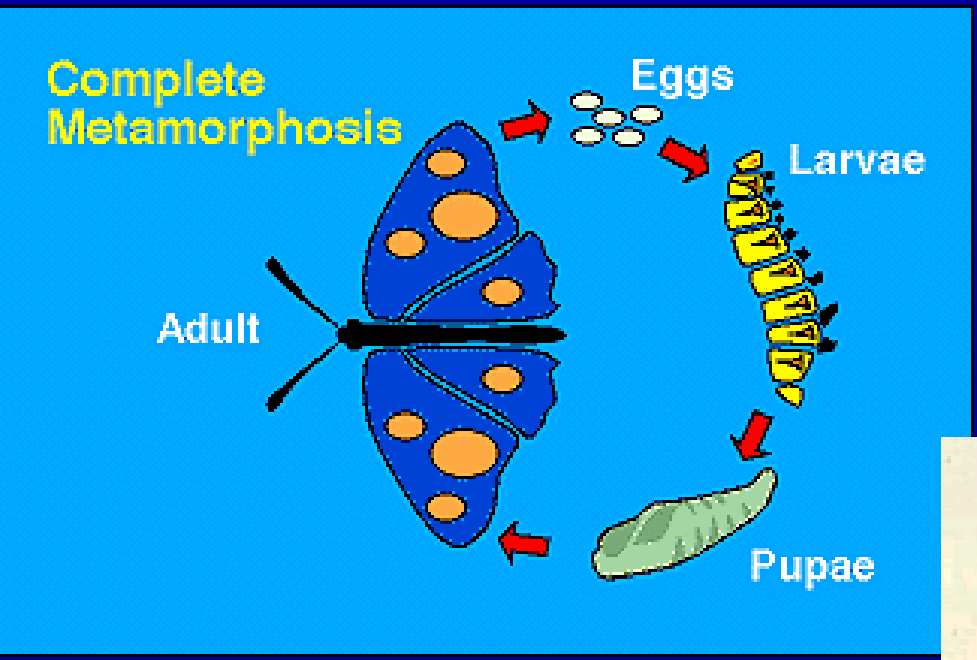
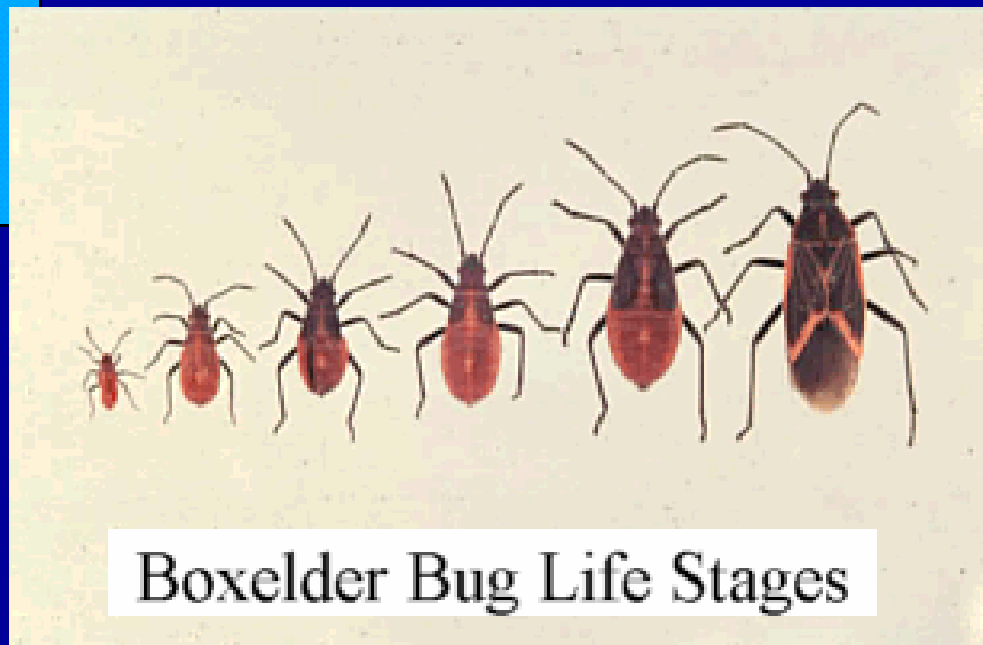

Gut Wall
B.T. Spore
Mid-Gut
Insect
Ingests
B.T.
High pH
Enzymes
Toxin
Released
Pro-Toxin
Crystal

Different strains of B.T.

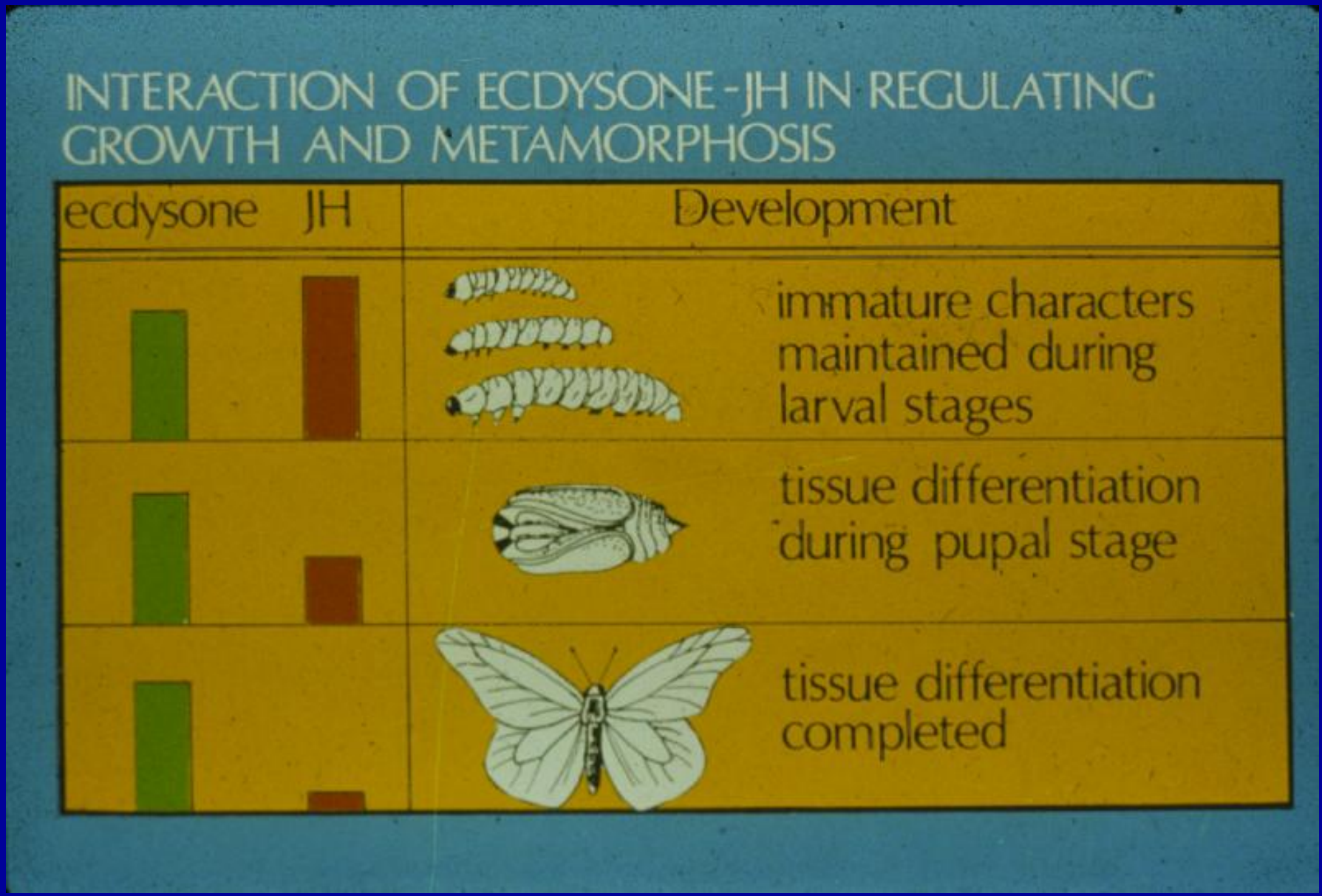
- Strain kills caterpillars
- Strain kills some beetles
- Strain kills mosquitoes and other flies

Metamorphosis

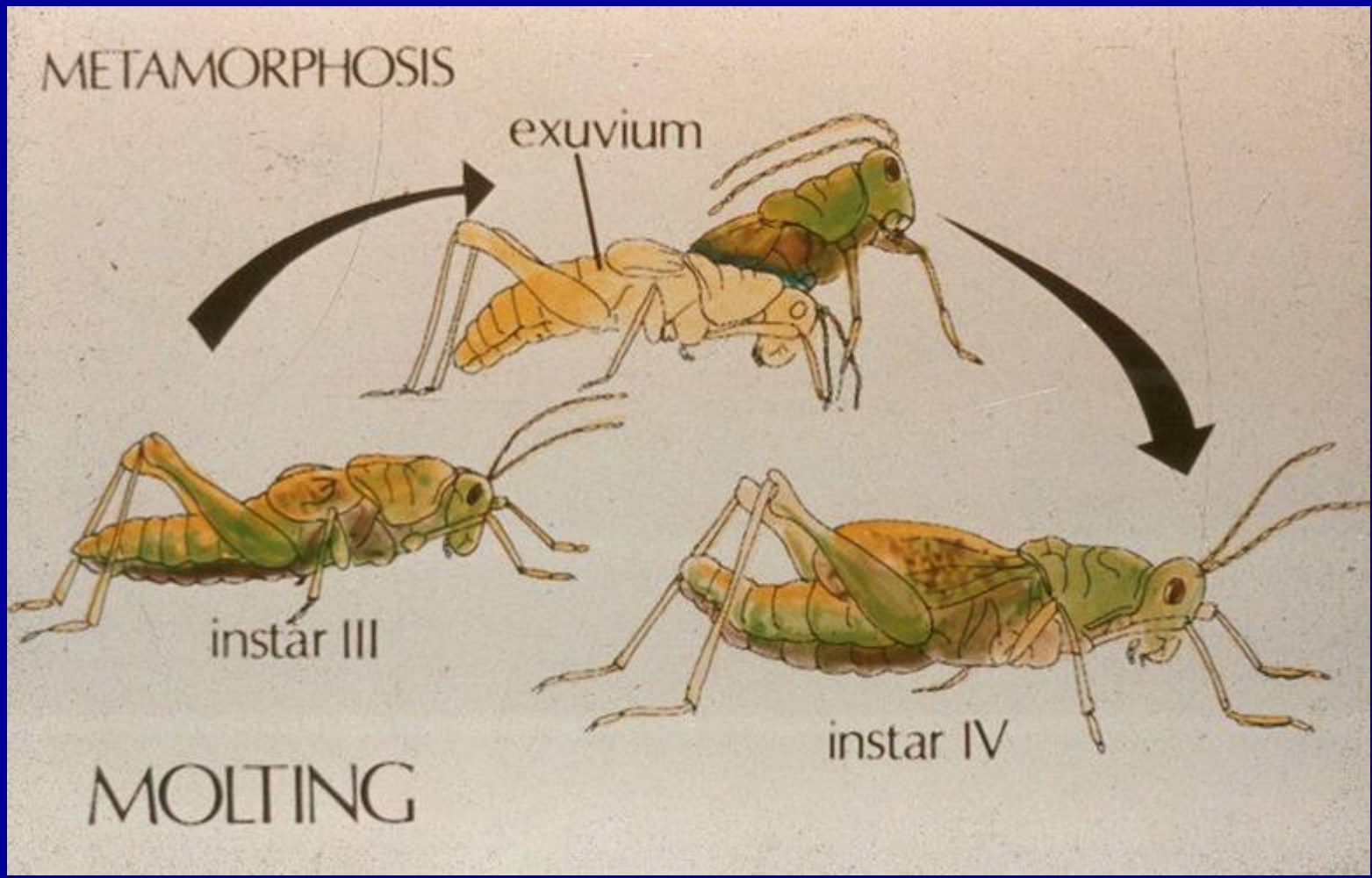




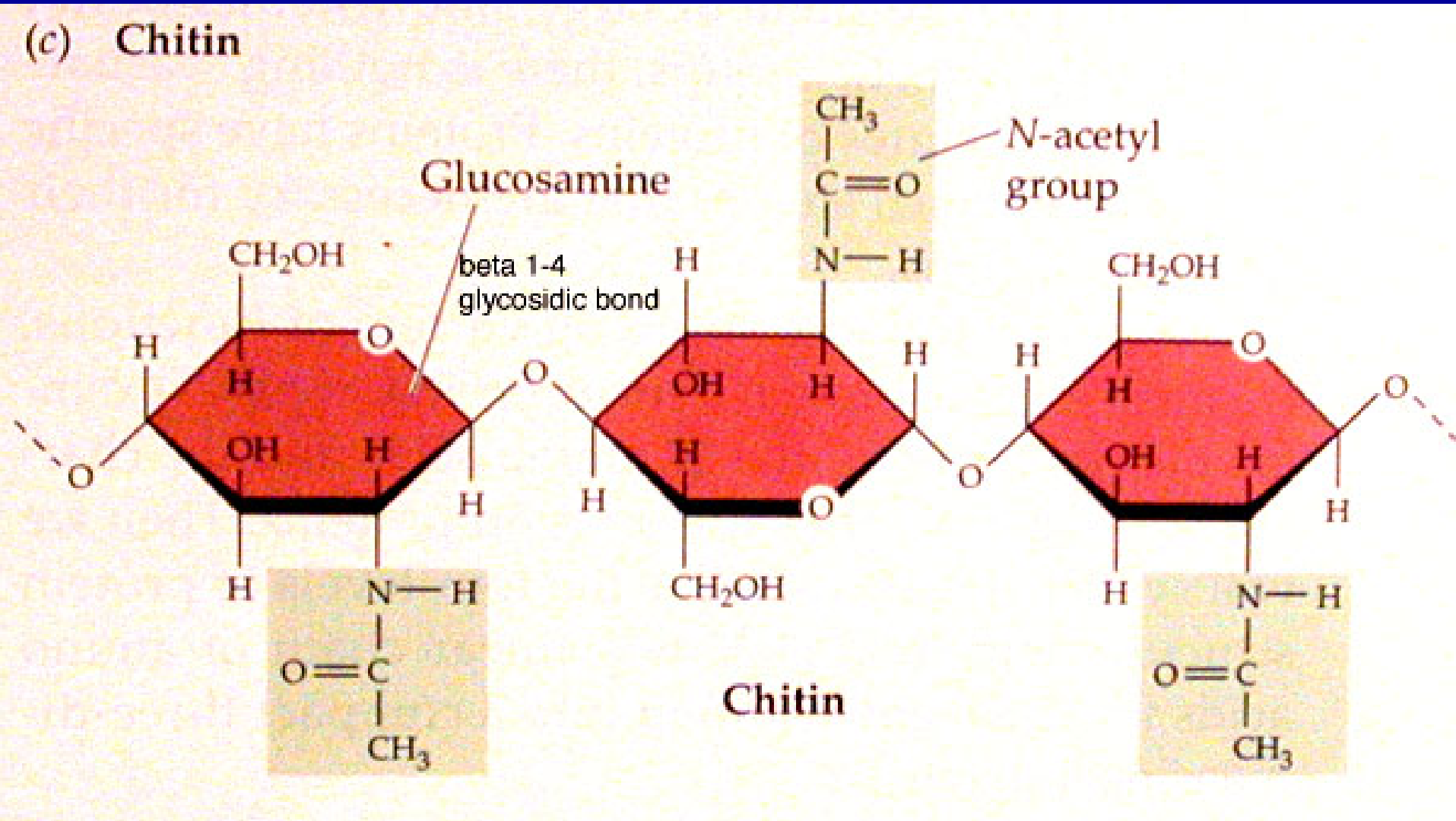
Juvenile Hormone



Molting



Insect skin made from chitin



Novel mode of actions

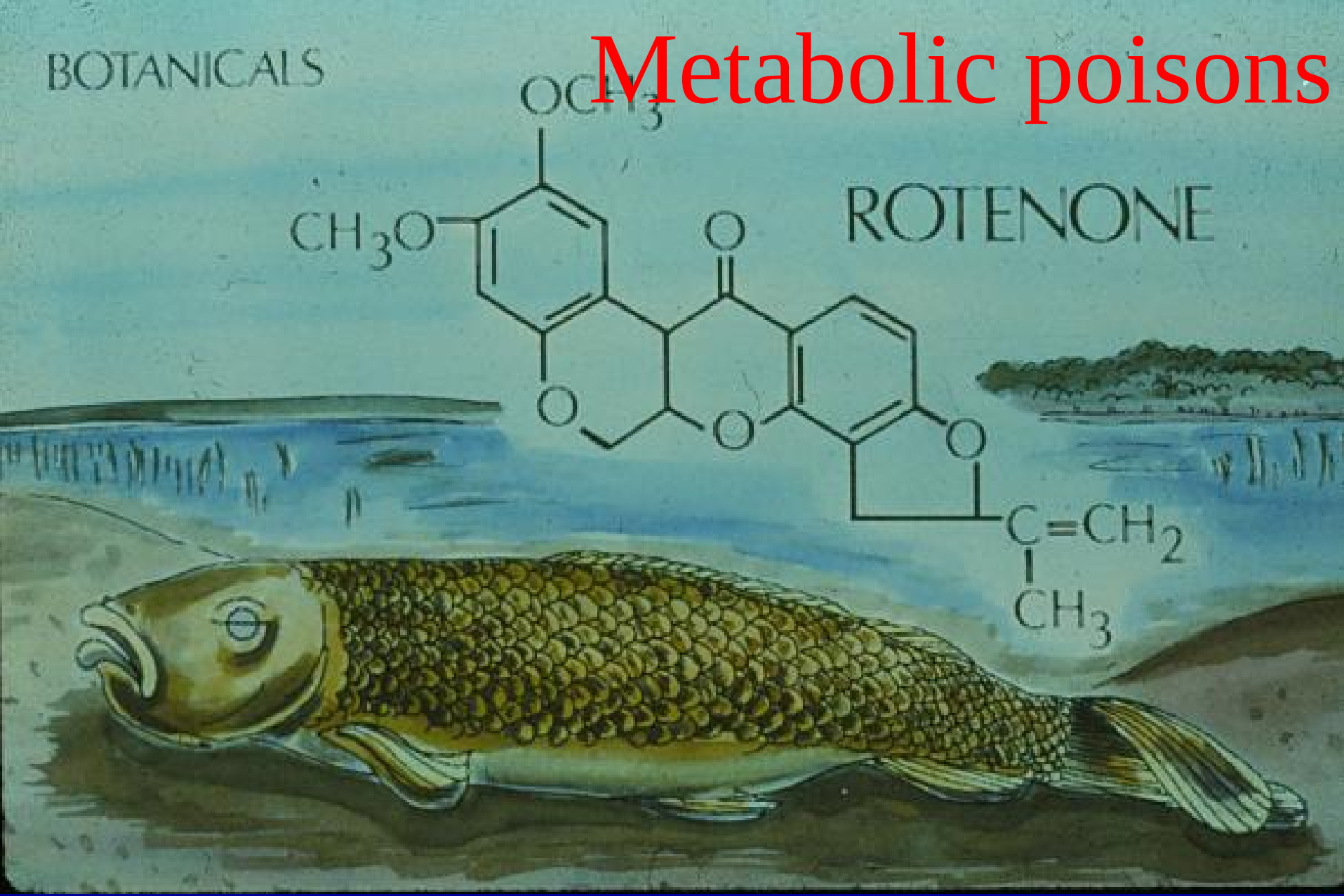
- Insect hormone mimics- methoprene.pyriproxyfen,hydroprene

Flea control

- Benzoylphenyl urea -(Program, Sentricon)- chitin production

  Termite , roach and ant baits, gypsy moth sprays

Metabolic poisons



Oils as insecticides

- Suffocation- Dormant, summer oils
- Natural plant oils can have many modes of action

  Canola, catnip , tea tree, Mint ,Clove oil
- Food additives used as insecticides but ECO - Exempt

not always sure how work and can be toxic to people

Insecticidal soaps

- Potassium salts of fatty acids- long chained

  SUFFOCATION?

Disrupts the permeability of cell membranes

How keep straight?

Insecticide Mode of Action Classification

Insecticide Resistance Action Committee(IRAC)- has divided chemicals into 28 - groups

Insecticide Mode of Action Classification:

Diversity is a key to successful resistance management

IRAC
INSECTICIDE RESISTANCE ACTION COMMITTEE

IRAC website: www.plantprotection.org/irac

Introduction

IRAC promotes the use of a Mode of Action (MoA) classification of insecticides as the basis for effective and sustainable insecticide resistance management (IRM). Insecticides are allocated to specific groups based on their target site. Reviewed and re-issued annually, the IRAC MoA classification list provides farmers, growers, advisors, extension staff, consultants and crop protection professionals with a guide to the selection of insecticides or acaricides in IRM programs. Effective IRM of this type preserves the utility and diversity of available insecticides and acaricides.

Effective IRM strategies: Alternations or sequenc

All effective insecticide (and acaricide) resistance management (IRM) strate minimise the selection for resistance from any one type of insecticide or ac practice, alternations, sequences or rotations of compounds from different provide sustainable and effective IRM. This ensures that selection from co same MoA group is minimised. Applications are often arranged into MoA s blocks that are defined by the stage of crop development and the biology o concern. Local expert advice should always be followed with regard to spr timings. Several sprays of a compound may be possible within each spray generally essential to ensure that successive generations of the pest are no compounds from the same MoA group.

Moulting & Metamorphosis

Group 18 Ecdysone agonist / disruptor
Tebufenozide
Group 7 Juvenile hormone mimics
Fenoxycarb, Methoprene, etc

Midgut

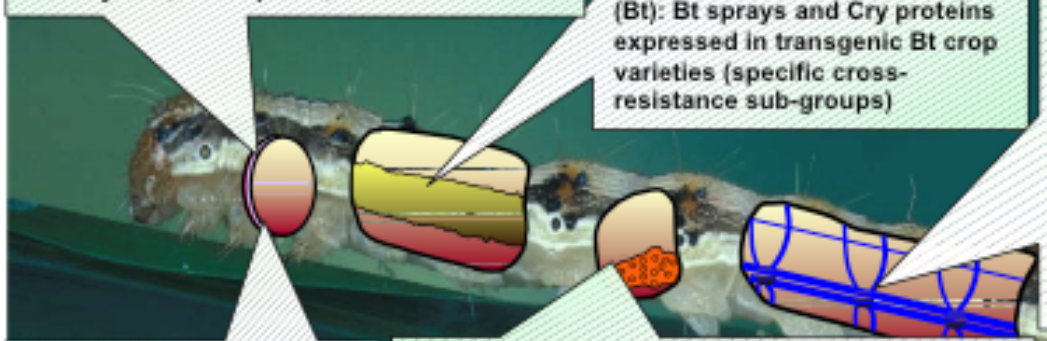
Group 11 Microbial disruptors of insect midgut membranes
Toxins produced by the bacterium *Bacillus thuringiensis* (Bt): Bt sprays and Cry proteins expressed in transgenic Bt crop varieties (specific cross-resistance sub-groups)

Nervous System

Group 1 Acetylcholinesterase (AChE) inhibitors
Carbamates and Organophosphates
Group 2 GABA-gated chloride channel antagonists
Cyclodienes and Fiproles
Group 3 Sodium channel modulators
DDT, pyrethrins, pyrethroids
Group 4 Acetylcholine receptor agonists
Neonicotinoids
Group 5 Acetylcholine receptor modulators
Spinosyns
Group 6 Chloride channel activators
Avermectin, Emamectin Benzoate and Milbemycin
Group 22 Voltage dependent sodium channel blocker
Indoxacarb

Non-spec

Group 9 Com specific mode (selective fee
Cryolite, Pym



Cuticle Synthesis

Groups 15, 16 and 17 Inhibitors of chitin biosynthesis
Benzoylureas (Lepidoptera and others), Buprofezin (Homoptera) and Cyromazine (Diptera)

Metabolic Processes

Acting on a wide range of metabolic processes including:
Group 12 Inhibitors of oxidative phosphorylation, disruptors of ATP
Diafenthiuron & Organotin miticides
Group 12 Uncoupler of oxidative phosphorylation via disruption of H proton gradient –
Chlorfenapyr

Non-specific MoA

Group 10 Compounds of non-specific mode of action (mite growth inhibitors)
Clofentezine, Hexythiazox, Etoxazole

Metabo proces

Group 20 S transport i
Hydrameth
Group 21 S transport i
Rotenone,

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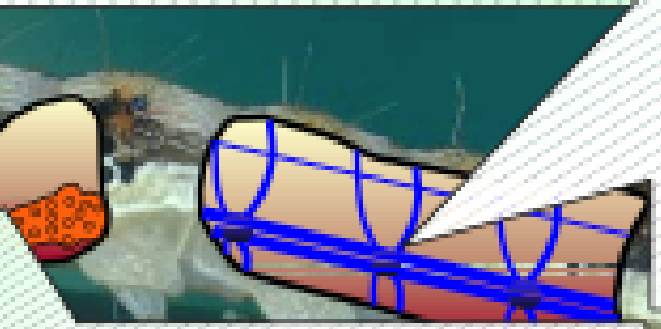
Midgut

Group 11 Microbial disruptors of insect midgut membranes

Toxins produced by the bacterium *Bacillus thuringiensis* (Bt): Bt sprays and Cry proteins expressed in transgenic Bt crop varieties (specific cross-resistance sub-groups)



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DDT, pyrethrins, pyrethroids

Group 4 Acetylcholine receptor agonists

Neonicotinoids

Group 5 Acetylcholine receptor modulators

Spinosyns

Group 6 Chloride channel activators

Avermectin, Emamectin Benzoate and Milbemycin

Group 22 Voltage dependent sodium channel blocker

Indoxacarb

Non-spe

Group 9 Co
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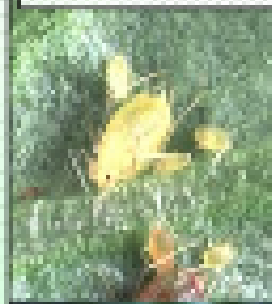
Cryolite, Pyr



Processes

e range of metabolic processes

ors of oxidative phosphorylation,
p

Organotin miticides

upler of oxidative phosphorylation
H proton gradient –

Non-specific MoA

Group 10 Compounds of non-specific mode of action (mite growth inhibitors)

Clofentezine, Hexythiazox,

Metab proce

Group 20
transport

Hydramet

Group 21
transport

Rotenone

nal rd	Notifi-cation	Resistance mngmt[a] Chemical group	Group code	REI[b] (hours)	P (da
ion	oral	chloro-nicotinyl	4A	12	7-
ion	oral	chloro-nicotinyl	4A	12	se tre m
on			22	12	

Actara®

Insecticide

For control of certain insect pests infesting various crops

GROUP **4A** INSECTICIDE

Active Ingredient:

Thiamethoxam[1] 25.0%