

# Pesticides and Animal Health

K. Marcia Murphy, DVM, Dip ACVD  
North Carolina State University

# Outline

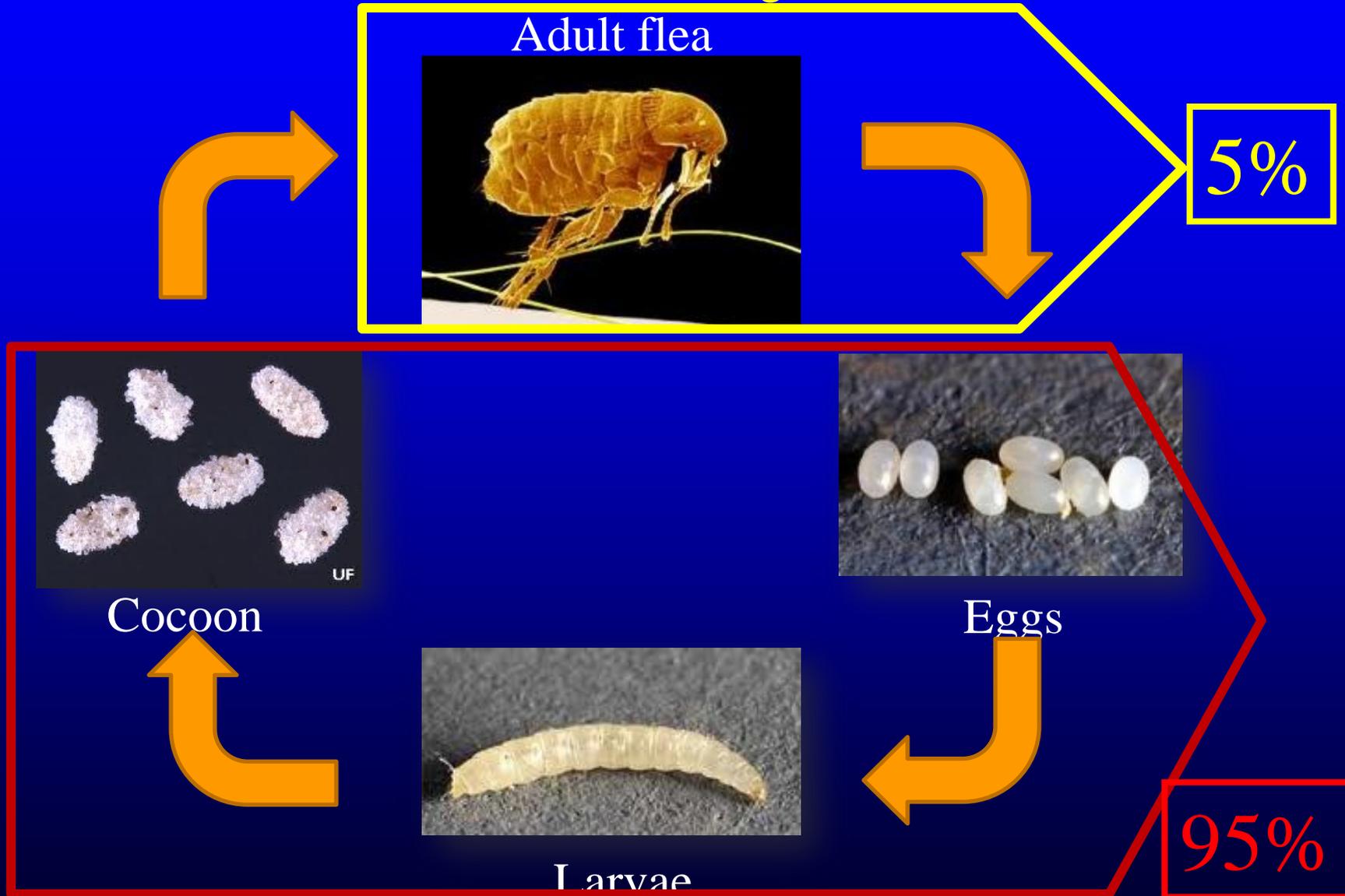


- ❖ Flea biology
- ❖ Flea associated diseases in animals & humans
- ❖ Flea control products
- ❖ Flea control strategy

# Flea Life Cycle

- *Ctenocephalides* spp. are of greatest medical concern
- *C. felis felis* most common species
  - >92% in dogs
  - > 97% in cats
- *Pulex irritans*
  - Human flea

# Flea Life Cycle



# Flea Life Cycle

- In most households *C. felis felis* takes 3-4 weeks to complete its cycle
- Extremes of 12-174 days have been recorded

# Flea Life Cycle

- Adult flea begins feeding within minutes of landing on host
- Female flea begins egg production 24-36 hours after first blood meal
- Reproduction will continue for over 100 days
- Peaks of 40-50 eggs per day

# Flea Life Cycle

- Under environmental conditions that allow for 21 days life cycle:
  - One mating female flea who lays 20 eggs per day, 50% of which hatch females, can be responsible for an infestation of > 20,000 adults and more than 160,000 pre-adult forms in just 60 days

# Outline



❖ Flea biology

❖ **FLEA ASSOCIATED DISEASES IN  
ANIMALS & HUMANS**

❖ Flea control products

❖ Flea control strategy

# Flea & Animal diseases- Flea Allergy Dermatitis



# Flea & Animal diseases- Flea Allergy Dermatitis



# Flea & Animal diseases- Flea Allergy Dermatitis



# Flea & Animal diseases- Flea Allergy Dermatitis



# Flea & Animal diseases- Iron deficiency anemia



# Flea & Animal diseases

- *Dipylidium caninum* (tapeworm)



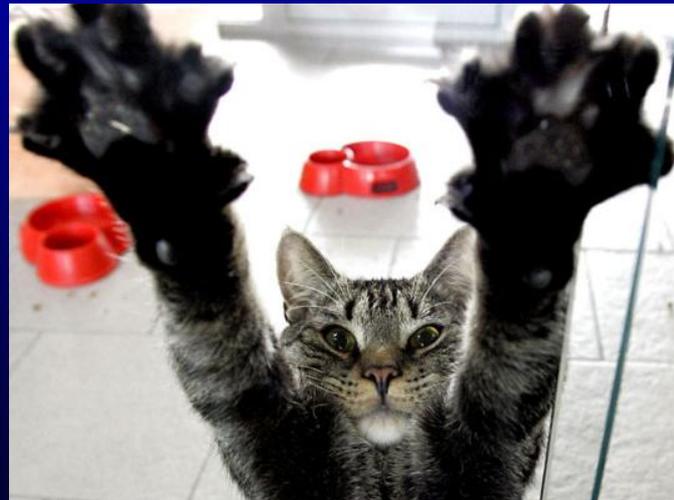
# Flea & Human diseases

- Flea allergy dermatitis (FAD)



# Flea & Human diseases

- Cat-scratch disease (*Bartonella henselae*)



# Cat Scratch Disease (CSD)

- *B. henselae*, gram negative bacterium
- Cats are inapparent carriers
- *C. felis* is the primary arthropod vector
- Fleas acquire infection when taking a bloodmeal from a bacteremic animal
- They then shed the infectious organisms in their feces

# Cat Scratch Disease (CSD)

- Bacteria are transmitted between animals and from animals and humans by inoculation with contaminated flea feces
  - Via an open wound, such as a scratch or bite
- First noticed as erythema or pustule at the site of the scratch, or bite
  - Occurs 7-10 days following exposure

# Cat Scratch Disease (CSD)

- Patient may also experience a fever and mild headache
- Common feature is regional lymphadenopathy, which may last several months
- Atypical symptoms include encephalitis, retinitis and endocarditis

# Cat Scratch Disease (CSD)

- Immunocompromised patients
  - Typically present with systemic bartonellosis
  - Manifests as bacillary angiomatosis (growth of blood vessels on external skin surface) and bacillary parenchymal peliosis (hepatitis)
- Veterinary professionals
  - 7.1% are seropositive for *Bartonella* spp.

# Flea & Human diseases

- Murine typhus (*R. typhi*)



# Murine typhus

- *Rickettsia typhi*, Gram-negative bacterium
- Maintained primarily in rodent reservoirs
- Transmitted to humans through an intermediate flea vector
  - Most commonly the rat flea (*Xenoplylla cheopis*)
  - Alternate transmission cycles involve opossums, domestic cats and cat fleas

# Murine typhus

- *Rickettsia felis*
  - Thought to be cause of human illness clinically similar to murine typhus
  - May circulate among opossums and cats in concert with *R. typhi*
  - *C. felis felis* is considered to be the primary vector and reservoir

# Murine typhus

- Infected fleas pass the organism to progeny through transovarial transmission
- Cats serve as mechanical vehicle and bloodmeal source to support flea population
- Little documentation of cats developing clinical illness associated with infection

# Murine typhus

- Probably cause human infection following inoculation of abraded skin with infectious flea feces
- Accumulation of infectious flea feces within rodent nests increase risk of inhalation routes of exposure to *R. typhis*

# Murine typhus

- Fever, headache, chills, malaise
- Onset typically 6-14 days after exposure to reservoir animals and fleas
- Maculopapular rash develops in > 50%
- Respiratory, gastrointestinal and neurologic involvement common
- *R. felis* cases report similar presentation

# Flea & Human diseases

## ■ Plague (*Yersenia pestis*)



**HealthDay**  
News for Healthier Living

Contact HealthDay  
Tel: 203.855.1400 or E-mail  
- Select Department -

Home | Physician's Briefing | HealthDay en Español | HealthDay TV | Wellness Library | License Our News

September 28, 2012

Archive Search  
By Keyword: SEARCH HEALTHDAY  
By Category: SELECT GO  
By Topic: SELECT GO

### The Plague: It's Still With Us

Colorado girl likely the fourth infected in this 'average year,' CDC says

By Steven Reinberg  
HealthDay Reporter

THURSDAY, Sept. 6 (HealthDay News) -- When Sierra Jane Downing's fever shot up to 107 degrees and she suffered a seizure, her parents knew their 7-year-old daughter had more than the flu.

Thanks to a persistent doctor, the little girl is recovering in a Denver hospital from a case of bubonic plague, the first identified in Colorado in more than six years. It's thought she was bitten by infected insects -- probably fleas -- while trying to bury a dead squirrel on a family camping trip.

Hers is the fourth case of plague reported in the United States this year, the U.S. Centers for Disease Control and Prevention (CDC) said. "Over the last 10 years we have had an average of five cases a year," said CDC epidemiologist Kiersten Kugeler. "So this year is quite average."



Arrows note *Yersinia pestis* bacteria in blood.  
Photo: U.S. Centers for Disease Control and Prevention

HealthDay TV



<http://consumer.healthday.com/Article.asp?AID=668423>; Sept 6, 2012

# Plague

- *Yersinia pestis*, G-negative coccobacillus
- Endemic in the western USA, Asia, Africa and South America
- Circulates in US primarily among rock squirrels, ground squirrels, chipmunks and other wild rodents

# Plague

- Rodent fleas are the principal means of transmission among rodents and to humans
- Humans may also become infected through exposure to tissues, secretions or respiratory droplets of infected animals

# Plague

- Fleas become infected after feeding on mammal host harboring bacteria
- Rodents become infected when bitten by infected fleas
- Cats become infected by flea bites or by consumption of infected rodents

# Plague

- Cats are highly susceptible to plague
  - Can transmit infection directly to humans via scratches, bites and respiratory secretions
  - Can indirectly contribute to human infection by transporting infected fleas or rodent carcasses into the home

# Plague

- Life-threatening illness
- Bubonic plague most common presentation
  - Results from cutaneous exposure
  - Presents as painful, severely inflamed lymph nodes, known as a bubo
  - Fever, headache, extreme exhaustion
  - Clinical signs seen within 2-10 days of exposure

# Plague

- Without prompt antibiotic therapy, infection will spread via bloodstream to lungs
  - May then spread person-to-person through respiratory droplets
- Primary or secondary pneumonic plague is fatal within 3-4 days without appropriate treatment

# Outline



❖ Flea biology

❖ Flea associated diseases in animals & humans

❖ **FLEA CONTROL PRODUCTS**

❖ Flea control strategy

# Flea Control Products

## ❖ Mechanism of action

Acetylcholine receptor agonist

Na<sup>+</sup> channel modulator

Cl<sup>-</sup> channel modulator

GABA inhibitors

Insect growth regulators

## ❖ Method of administration

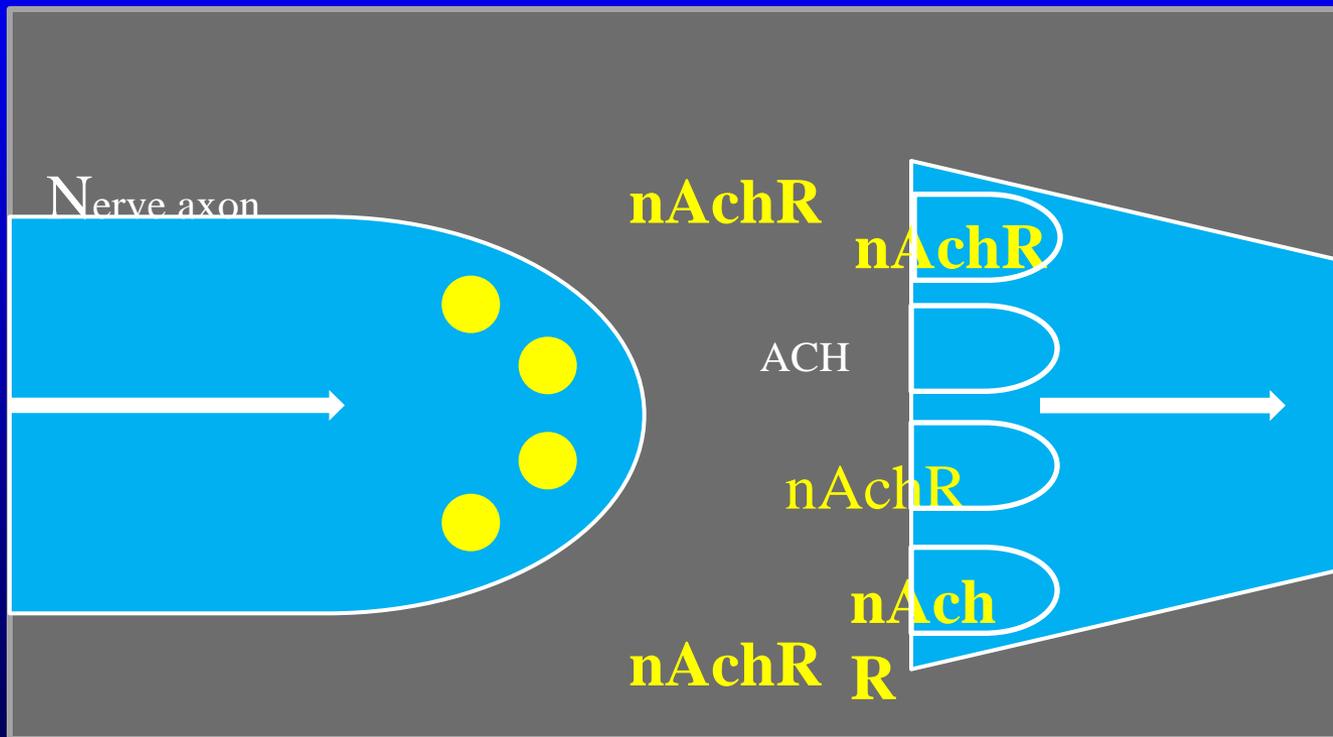
Topical (monthly)

Oral (daily, monthly)



# Mechanism of action

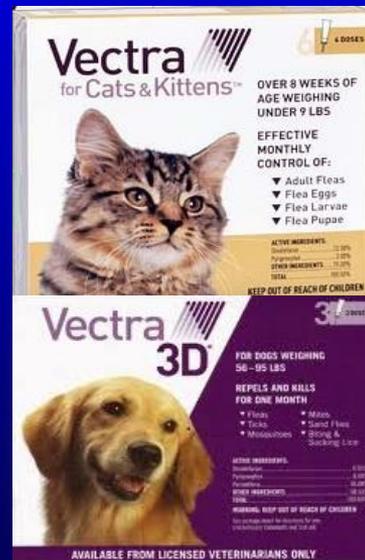
## Acetylcholine Receptor Agonist (nAChR)



# Mechanism of action- Acetylcholine Receptor Agonist



Imidacloprid



Dinotefuran



Nitenpyram

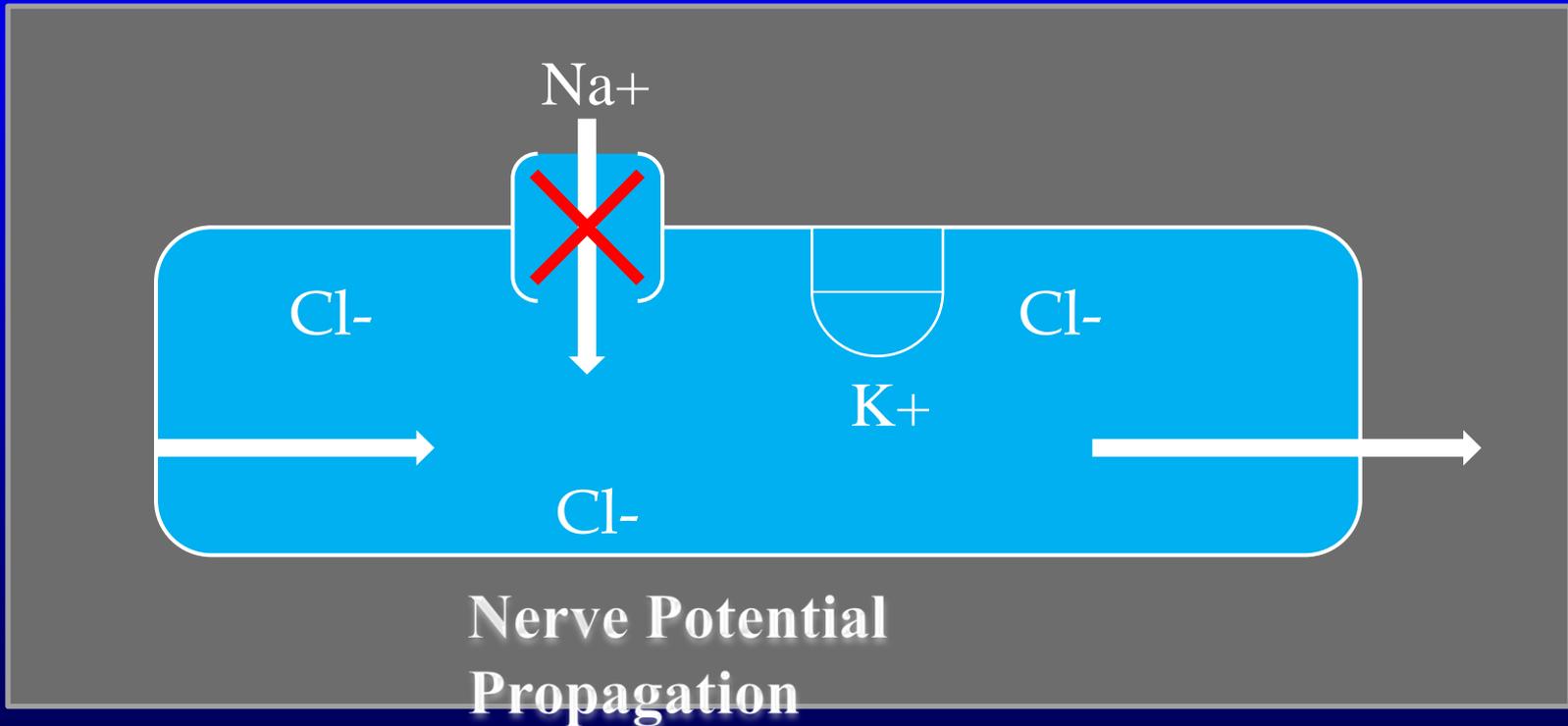


Spinosad



# Mechanism of action

## Na<sup>+</sup> channel Modulator



# Mechanism of action- $\text{Na}^+$ channel Modulator Permethrin



**bio SPOT**

6 MONTH SUPPLY  
LARGE (12.5 FL OZ) OVER 60 LBS

**SPOT ON<sup>®</sup>**  
FLEA & TICK CONTROL FOR DOGS

- 60 monthly applications
- Each application kills 4 heartworm, 100% & repels for up to 28 days
- Contains Insect Growth Regulator (IGR) to kill flea eggs and prevent reproduction

**CAUTION**  
KEEP OUT OF REACH OF CHILDREN



over 55 lbs

**K9 advantix<sup>®</sup> 100**

Topical prevention and treatment of ticks, fleas, mosquitoes, biting flies and ear mites for monthly use on dogs and puppies 7 weeks of age and older, weighing 55 lbs or more.

**KEEP OUT OF REACH OF CHILDREN  
WARNING**

**DO NOT USE ON CATS**

6 MONTH SUPPLY



**Vectra<sup>®</sup> 3D**

FOR DOGS WEIGHING 56-95 LBS

REPELS AND KILLS FOR ONE MONTH

- Fleas
- Ticks
- Mosquitoes
- Mites
- Sand Flies
- Biting & Sucking Lice

**ACTIVE INGREDIENTS**

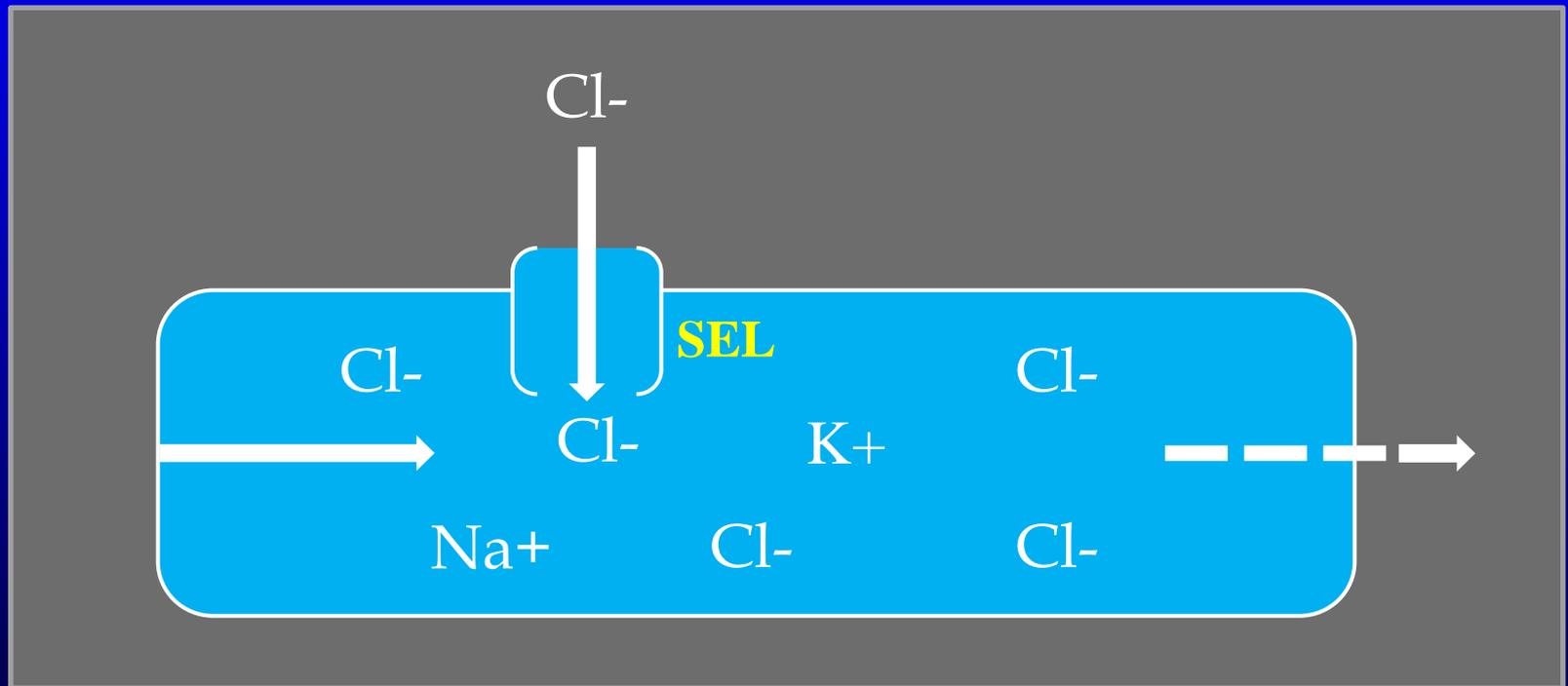
Imidacloprid	0.50%
Pyrethrin	0.05%
Permethrin	0.05%
<b>OTHER INGREDIENTS</b>	<b>99.40%</b>
<b>TOTAL</b>	<b>100.00%</b>

**WARNING: KEEP OUT OF REACH OF CHILDREN**  
See package insert for directions for use and other important information.

**AVAILABLE FROM LICENSED VETERINARIANS ONLY**

# Mechanism of action

## Cl<sup>-</sup> channel Modulator -**SEL**



# Mechanism of action- Cl-channel Modulator Selamectin

For **cats 5.5-15 lbs** in weight and at least 6 weeks of age

See original box for details. Each containing 0.75 ml (100 mg) of selamectin.



Administer once a month for protection against fleas and heartworm disease and treatment and control of hookworms, roundworms, and ear mites.

**6 Doses**

revolution (selamectin)

**Pfizer**

Small text: See original box for details. Each containing 0.75 ml (100 mg) of selamectin. For use in cats only. See end of box for details. See original box for details.

**OPEN HERE**

For **dogs 65.5-150 lbs** in weight and at least 6 weeks of age

See original box for details. Each containing 3.0 ml (300 mg) of selamectin.



Administer once a month to prevent heartworm disease and prevent and control flea infestations.

**3 Doses**

revolution (selamectin)

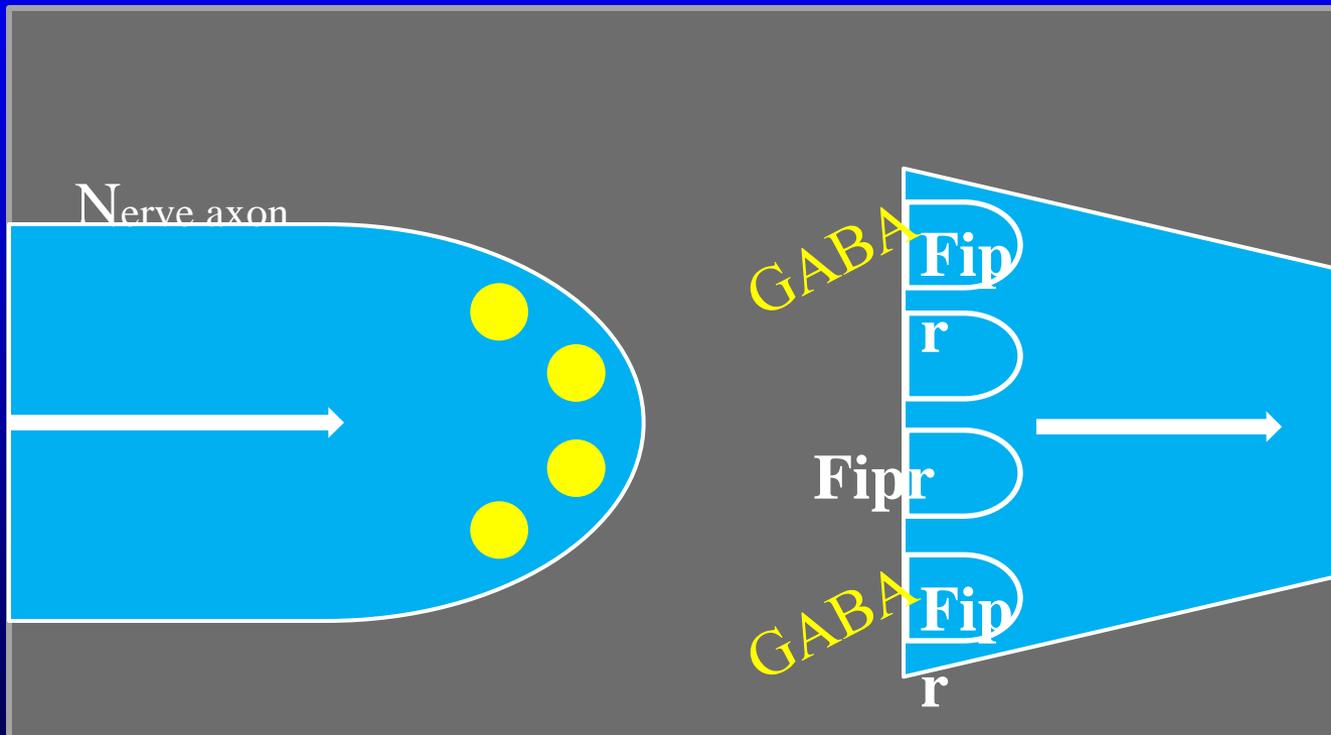
**Pfizer**

Small text: See original box for details. Each containing 3.0 ml (300 mg) of selamectin. For use in dogs only. See end of box for details. See original box for details.

**OPEN HERE**

# Mechanism of action

Gama amino-butyric acid (**GABA**) inhibitor



# Mechanism of action-GABA inhibitor Fipronil

**FRONTLINE** <sup>3</sup> monthly doses

**Kills fleas, flea eggs & ticks**

*Plus*  
for cats

- Fast-acting
- Kills ticks including those that may transmit Lyme disease
- Waterproof

For Cats & Kittens  
8 weeks or older

ACTIVE INGREDIENTS:  
Fipronil 0.1% (1.0%)  
S-methoprene 0.01% (0.1%)

KEEP OUT OF REACH OF CHILDREN  
CAUTION

Contains 3 (3) pipettes in 1 (1) 3.0 mL application



From the makers of FRONTLINE

**CERTIFECT** <sup>3</sup> monthly doses

Rapidly starts killing ticks within 6 hours

**Kills fleas, flea eggs & chewing lice**

- Detaches ticks when applied to infested dog
- Kills adult fleas, flea eggs & flea larvae
- Long-lasting & Waterproof
- For 1 month against ticks

For Dogs **ONLY** **45-88 LBS**

Kills ticks that may transmit tick-borne diseases including Lyme Disease, Anaplasmosis, Ehrlichiosis, Babesiosis and Rocky Mountain Spotted Fever

Contains 3 (3) 145.8 g or 3 (3) 2.6 mL applications

DO NOT USE ON CATS



FOR USE ONLY ON CATS & KITTENS 12 WEEKS OR OLDER

**FRONTLINE** *TRITAK* FOR CATS

Fast Acting. Long Lasting. Triple Action.

**Kills fleas, flea eggs and larvae**

Also kills ticks (starts killing in as little as 1 hour) including those that may transmit Lyme disease and chewing lice.

Fast-acting • Long-lasting • Waterproof

**3 DOSES** (3 MONTHS)

ACTIVE INGREDIENTS:  
Fipronil 0.1% (1.0%)  
S-methoprene 0.01% (0.1%)  
Spinosad 0.05% (0.5%)

KEEP OUT OF REACH OF CHILDREN  
WARNING: KEEP OFFICE, SCHOOL, AND HOMEWORK DESKETS



**CAUTION**  
KEEP OUT OF REACH OF CHILDREN  
READ SAFETY DIRECTIONS  
FOR ANIMAL TREATMENT ONLY

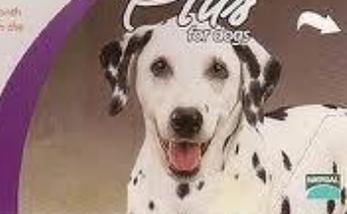
**FRONTLINE** <sup>3</sup> monthly doses

*Plus*  
for Dogs

(Fipronil plus (S)-methoprene)  
100 g/L fipronil, 90 g/L (S)-methoprene

- Kills fleas for at least 7 months - including all flea stages in the pet's surroundings
- Controls and treats flea allergy dermatitis
- Controls pemphigus lesions for up to 2 weeks
- Water fast

For **LARGE DOGS**  
20 to 40kg  
3 x 2.6mL pipettes



**FRONTLINE** *TRITAK* FOR DOGS

Fast Acting • Long Lasting • Triple Action

**Kills fleas, flea eggs and flea larvae**

Also kills ticks (starts killing in as little as 1 hour) including those that may transmit Lyme disease and chewing lice. Controls flea bite hypersensitivity (itching).

**3 DOSES** (3 MONTHS)

ACTIVE INGREDIENTS:  
Fipronil 0.1% (1.0%)  
S-methoprene 0.01% (0.1%)  
Spinosad 0.05% (0.5%)



# Flea Control Products-Insect Growth Regulators (IGRs)

1. Methoprene
  2. Pyriproxifen
  3. Lufenuron
- } Juvenile Hormone Analogue



# Flea Control Products- Juvenile Hormone Analogues



**bio SPOT**

3 MONTH SUPPLY  
FOR CATS 5 LBS & OVER

SPOT ON  
FLEA & TICK CONTROL FOR CATS

Kills fleas, flea eggs and larval ticks  
Set up to bite wounds

Kills & repels mosquitoes (that may transmit heartworm disease)  
Contains a natural coat conditioner

ACTIVE INGREDIENTS  
S-methoprene 0.01%  
Permethrin 0.45%  
Pyrethrins 0.45%  
Piperonyl Butoxide 1.00%  
Total 2.91%

KEEP OUT OF REACH OF CHILDREN  
NET CONTENTS: Three (3) 0.175 fl. oz. Application



**Vectra 3D**

FOR DOGS WEIGHING  
56-95 LBS

REPELS AND KILLS  
FOR ONE MONTH

- Fleas
- Ticks
- Mosquitoes
- Mites
- Sand Flies
- Stomach & Stomach Lice

ACTIVE INGREDIENTS  
Diflufenican 0.01%  
Cyfluthrin 0.01%  
Permethrin 0.45%  
Piperonyl Butoxide 1.00%  
Total 1.47%

KEEP OUT OF REACH OF CHILDREN  
To apply, rub in between the ears and between the legs.

AVAILABLE FROM LICENSED VETERINARIANS ONLY



**FRONTLINE Plus**

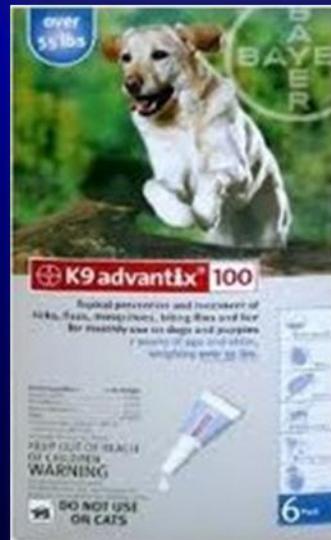
Kills fleas, flea eggs & ticks

- Fast-acting
- Kills ticks including those that may transmit Lyme disease
- Waterproof

For Cats & Kittens  
8 weeks or older

ACTIVE INGREDIENTS  
Spinosad 0.05%  
Cyfluthrin 0.05%  
Permethrin 0.45%  
Piperonyl Butoxide 1.00%  
Total 1.55%

KEEP OUT OF REACH OF CHILDREN  
CAUTION  
Contents: 3.0 (1.0) fl. oz. (30.0 mL) application



over 55 lbs

**K9 advantix 100**

Spinal penetrates and penetrates of  
ticks, fleas, mosquitoes, biting flies and lice  
for monthly use on dogs and puppies  
7 months of age and older  
weighing over 55 lbs

KEEP OUT OF REACH OF CHILDREN  
WARNING  
DO NOT USE ON CATS



# Outline



❖ Flea biology

❖ Flea associated diseases in animals & humans

❖ Flea control products

**❖ FLEA CONTROL STRATEGY**

# Flea Control Strategy

- Treat ALL animals
- Maintain prevention throughout the year
- During peak season, may increase frequency to q2-3 weeks
- Alternate between products with different mode of action
- TREAT THE ENVIRONMENT

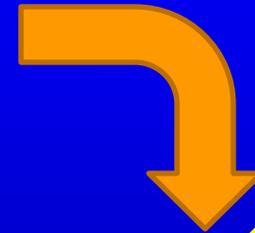
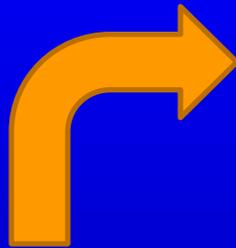


# Flea Life Cycle

Adult flea



5%



Cocoon

UF

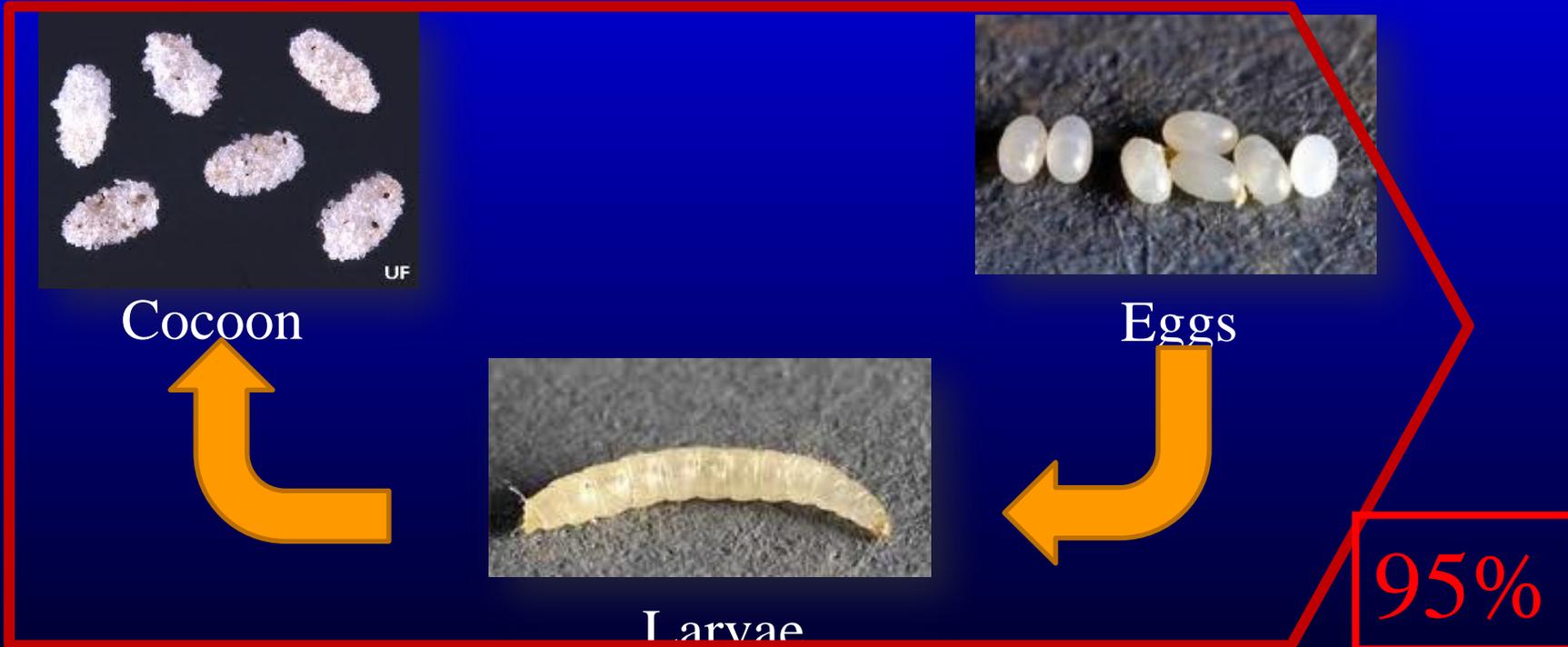


Eggs



Larvae

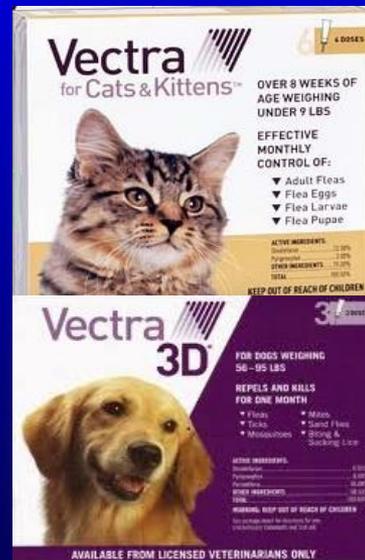
95%



# Mechanism of action- Acetylcholine Receptor Agonist



Imidacloprid



Dinotefuran



Nitenpyram



Spinosad



# Mechanism of action-GABA inhibitor Fipronil

**FRONTLINE** <sup>3</sup> monthly doses  
Kills fleas, flea eggs & ticks  
*Plus* for cats

- Fast-acting
- Kills ticks including those that may transmit Lyme disease
- Waterproof

For Cats & Kittens  
8 weeks or older

ACTIVE INGREDIENTS:  
Fipronil 0.1% (1.0%)  
S-methoprene 0.01% (0.1%)

KEEP OUT OF REACH OF CHILDREN  
CAUTION

Contains 3 (3) pipettes in 1 (1) 3.0 mL application



From the makers of FRONTLINE <sup>3</sup> monthly doses  
**CERTIFECT** FOR DOGS  
Rapidly starts killing ticks within 6 hours

Kills fleas, flea eggs & chewing lice

- Detaches ticks when applied to infested dog
- Kills adult fleas, flea eggs & flea larvae
- Long-lasting & Waterproof
- For 1 month against ticks

For Dogs ONLY **45-88 LBS**

Kills ticks that may transmit tick-borne diseases including Lyme Disease, Anaplasmosis, Ehrlichiosis, Babesiosis and Rocky Mountain Spotted Fever

Contains 3 (3) 145.8 g or 3 (3) 2.6 mL applications

DO NOT USE ON CATS



FOR USE ONLY ON CATS & KITTENS 12 WEEKS OR OLDER

**FRONTLINE TRITAK** FOR CATS  
Fast Acting. Long Lasting. Triple Action.

Kills fleas, flea eggs and larvae  
Also kills ticks (starts killing in as little as 1 hour) including those that may transmit Lyme disease and chewing lice.  
Fast-acting • Long-lasting • Waterproof

**3 DOSES**  
LOADING DOSE: 1.0 mL (0.1%)  
REGULAR APPLICATIONS: 0.5 mL (0.05%)

KEEP OUT OF REACH OF CHILDREN  
WARNING: STAY AWAY FROM OTHER ANIMALS' FEEDS



CAUTION  
KEEP OUT OF REACH OF CHILDREN  
READ SAFETY DIRECTIONS  
FOR ANIMAL TREATMENT ONLY

**FRONTLINE** <sup>3</sup> monthly doses  
*Plus* for Dogs

(Fipronil plus (S)-methoprene)  
100 g/L fipronil, 90 g/L (S)-methoprene

- Kills fleas for at least 7 months - including all flea stages in the pet's surroundings
- Controls and treats flea allergy dermatitis
- Controls pemphigus lesions for up to 2 weeks
- Water fast

For LARGE DOGS  
20 to 40kg  
3 x 2.6mL pipettes



FOR USE ONLY ON DOGS & PUPPIES 6 WEEKS OR OLDER

**FRONTLINE TRITAK** FOR DOGS  
Fast Acting • Long Lasting • Triple Action

Kills fleas, flea eggs and flea larvae  
Also kills ticks (starts killing in as little as 1 hour) including those that may transmit Lyme disease and chewing lice. Controls flea bite hypersensitivity (itch)

**3 DOSES**  
LOADING DOSE: 1.0 mL (0.1%)  
REGULAR APPLICATIONS: 0.5 mL (0.05%)

KEEP OUT OF REACH OF CHILDREN  
WARNING: STAY AWAY FROM OTHER ANIMALS' FEEDS



# Conclusion

- Flea infestation: common problem in pets
- Causes FAD, anemia and vector for animal & human diseases
- Many flea control products with different mode of action
- Need to treat both pet and environment

# Thank you

- Dr. Ben Tham
- Dermatology colleagues