Not All Bees Who Wander Are Lost

The Role of Pesticides in Memory and Foraging

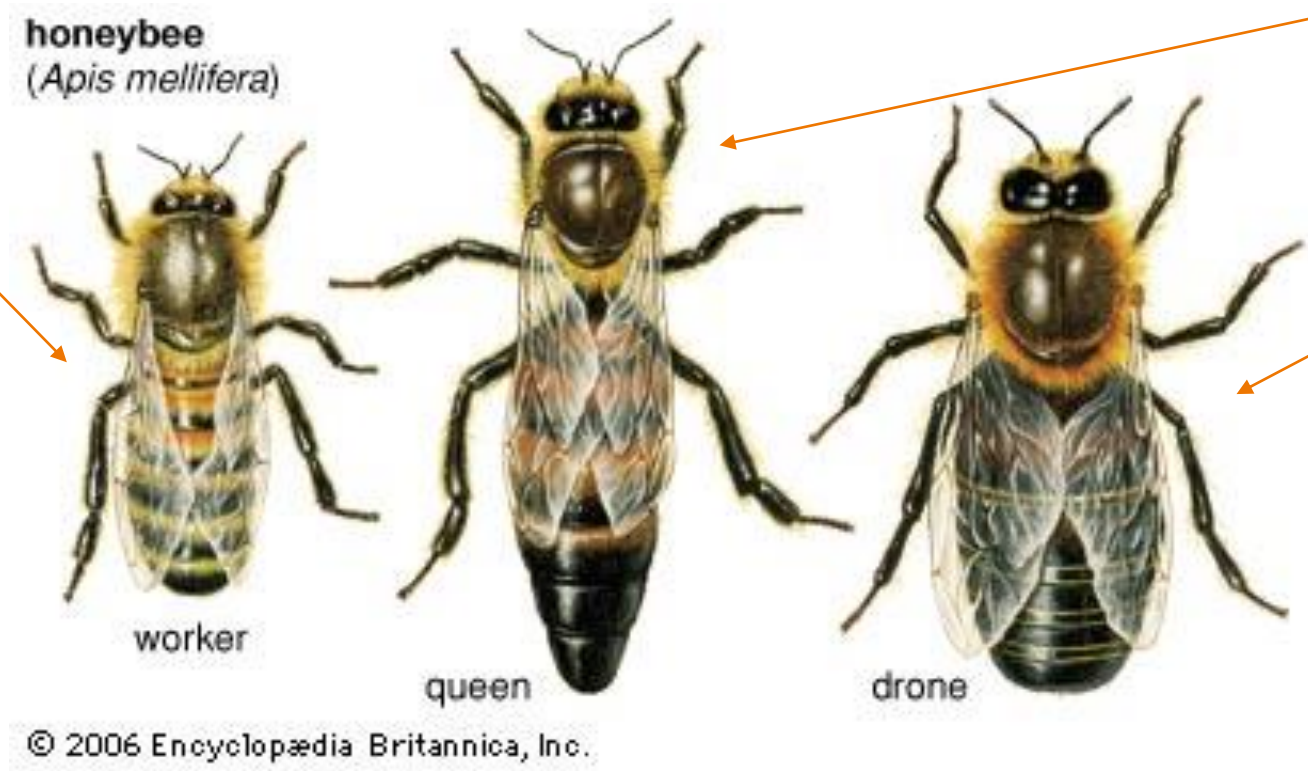
ch2m SM

Into the Life of a Bee

- Honeybees are social insects
- Colonies contain up to 60,000 bees
- Highly complex social order, each bee works for the good of the hive
- Life centers around the queen, a fertile female capable of laying 1000 eggs every day

Into the Life of a Bee

- Hive contains about 1000 male bees, or drones
- Majority are the worker bees, non-reproductive females
- Female honeybees are equipped with a venomous sting



6 weeks – summer
4-9 months - winter

2-5 years

90 days or
until he mates

Into the Life of a Bee

- Bees collect:
  - Nectar
  - Pollen
  - Propolis
  - Water
- A well-populated honeybee colony in a good location may collect 1000 lbs of nectar, water, and pollen per year

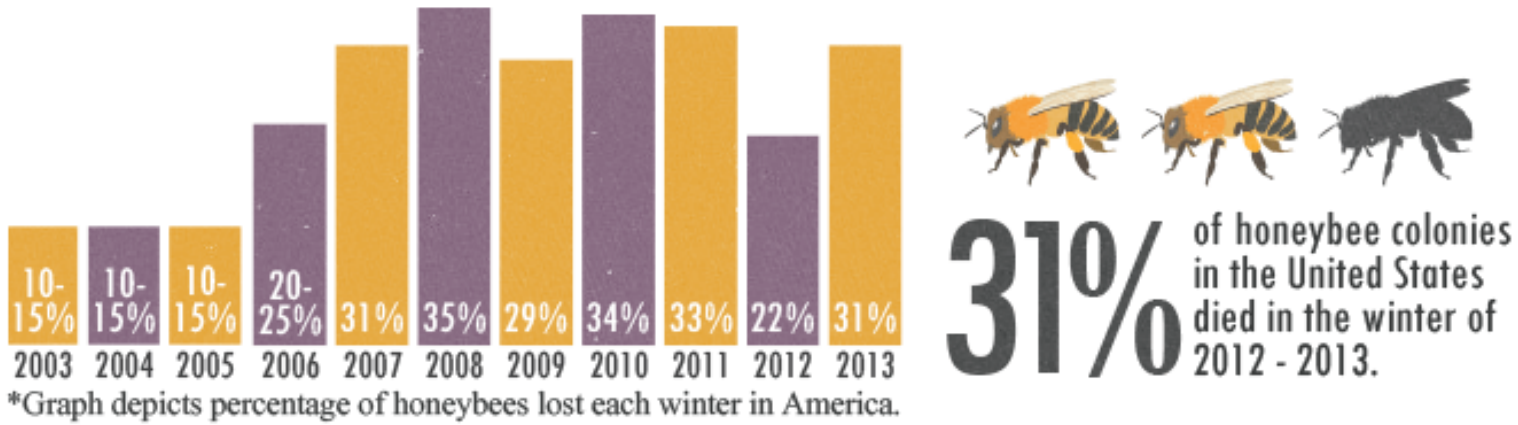
- **Nectar:** watery solution of fructose, glucose, and sucrose; also contains proteins, salts, acids, and essential oils
  - Ripened into honey by inversion of sucrose into fructose and glucose and by the removal of excess moisture
- **Pollen:**
  - Beebread – fermented pollen
  - Fed to the larvae
- **Royal Jelly:** proteins, amino/fatty acids, sugars, minerals, enzymes, vitamins B and C, antibiotic and antibacterial components

Into the Life of a Bee

- Swarming – “the birthing of a hive”
- Mature queen leaves, taking 5000 worker bees
- After a few minutes flight, the queen stops and the swarm settles in a tight ball around her
- Scouts search the surrounding area for a suitable place for the new hive
- Swarming normally takes place in the middle of a warm day

What is Colony Collapse Disorder?

- Majority of worker bees leave the colony
- Leave behind a queen, plenty of food and nurse bees to care for the queen and immature bees
- No significant presence of dead bees



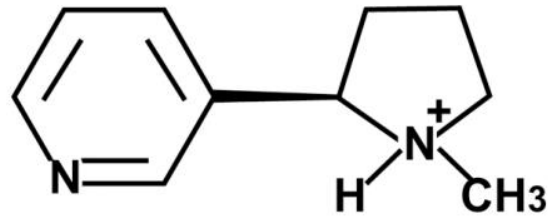
Why is CCD Happening?

- Varroa mite
- Nosema parasite
- Israeli Acute Paralysis virus
- Pesticide poisoning
- Stress due to transportation and management
- Changes to the habitat where bees forage
- Inadequate forage resulting in poor nutrition
- Immunity suppression caused by a combination of one or more of these factors

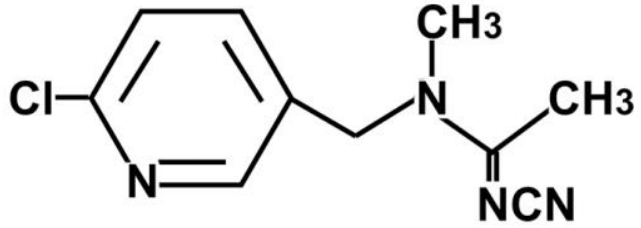
The Role of Pesticides

- Acute exposure (pile of dead bees) is not CCD
- Neonicotinoids affect the central nervous system, resulting in paralysis and death
- Neonicotinoids may make honey bees more susceptible to parasites and pathogens, including the intestinal parasite, Nosema
- Imidacloprid impairs memory and brain metabolism, particularly the area of the brain that is used for making new memories

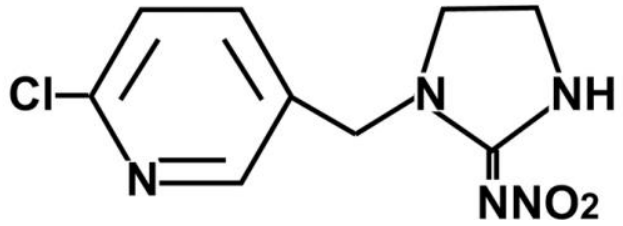
A. Nicotine



B. Neonicotinoid ACE

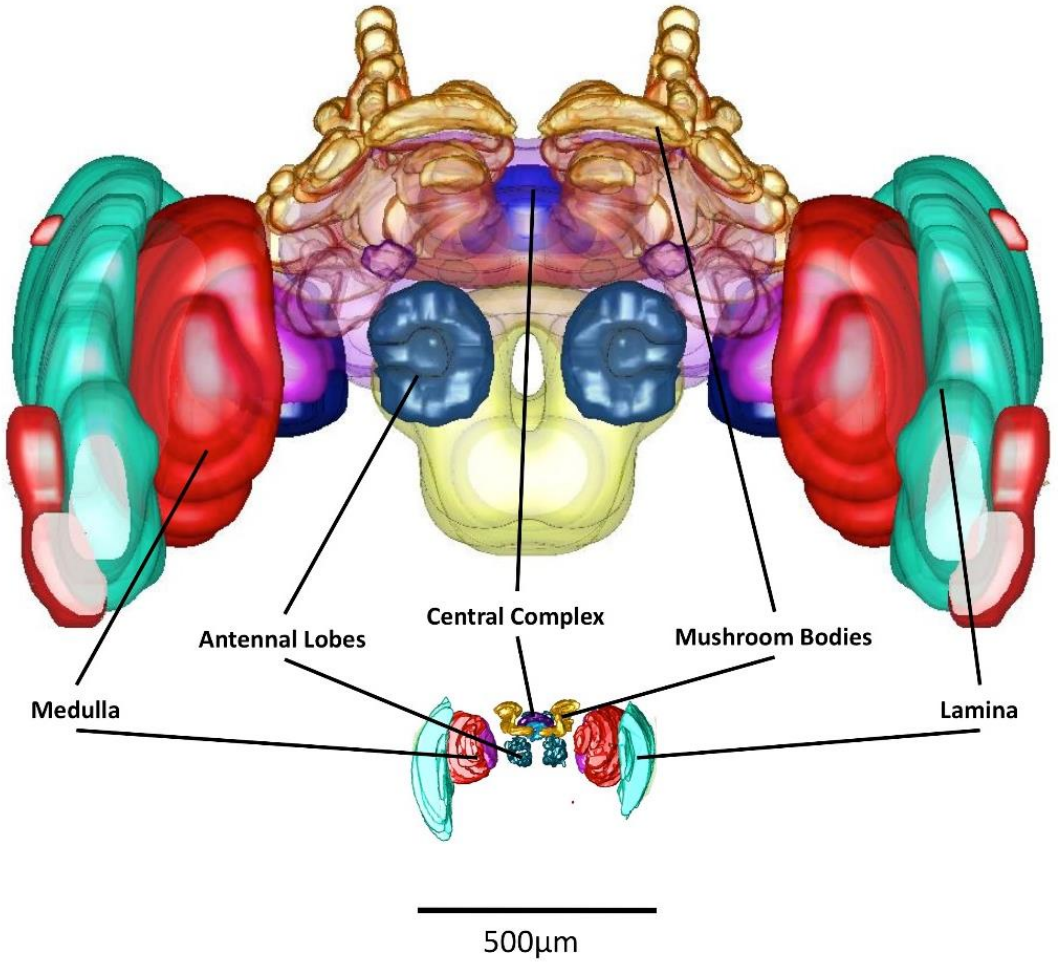


C. Neonicotinoid IMI

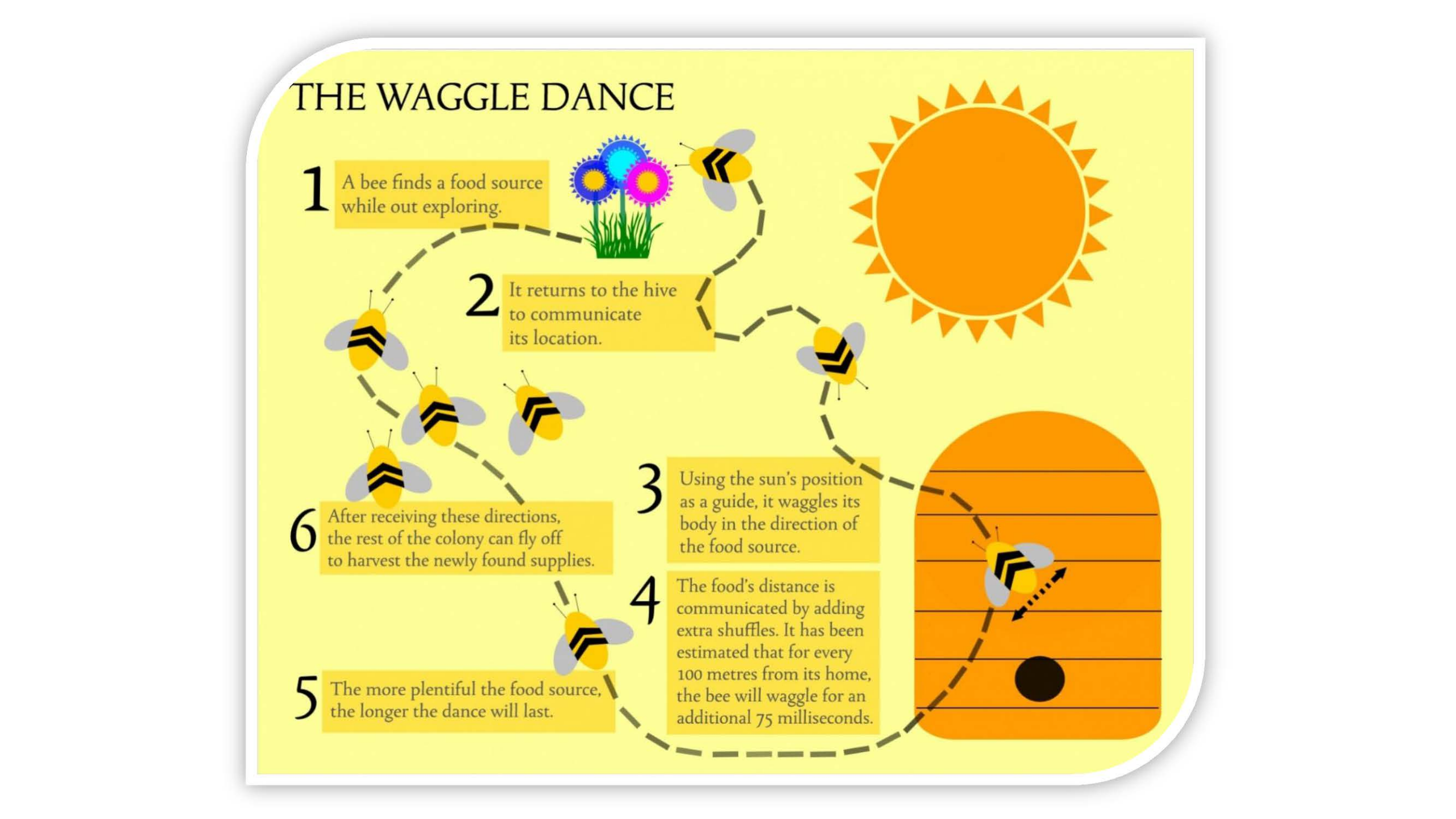


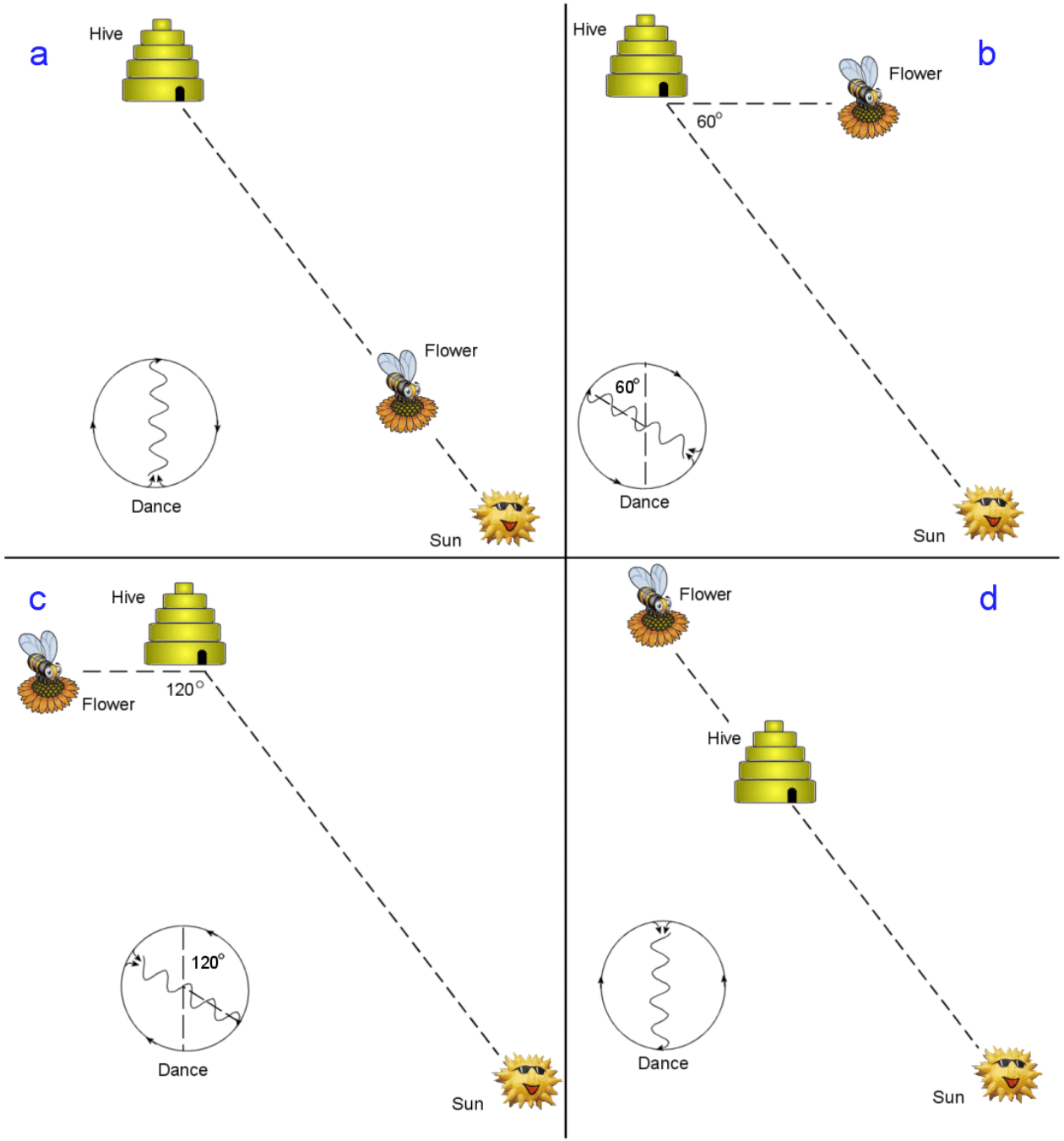
Normal Neural Activity

- The honey bee brain has an oval shape and is about the size of a sesame seed 1mm^3
- Computers - 16 billion computations per second
- Honey bee - 10 trillion computations per second
- Humans - 1 quintillion computations per second



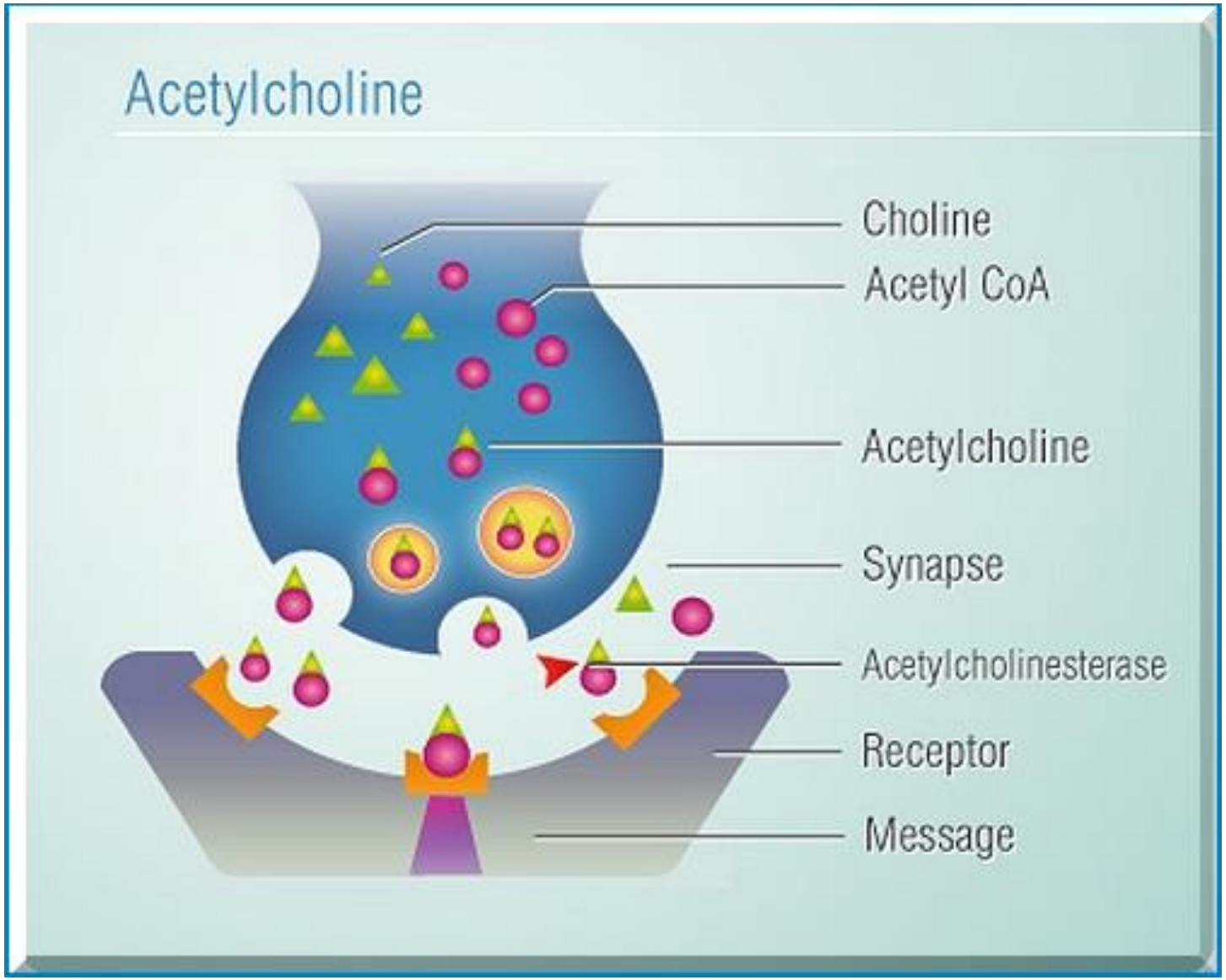
THE WAGGLE DANCE

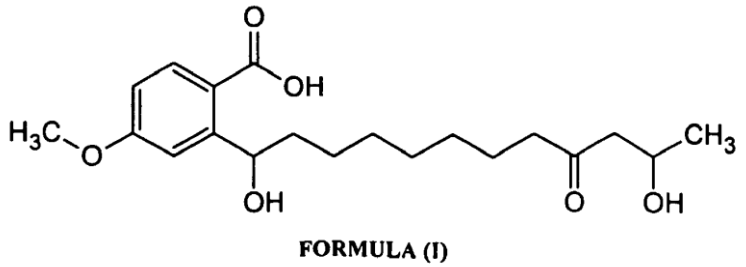




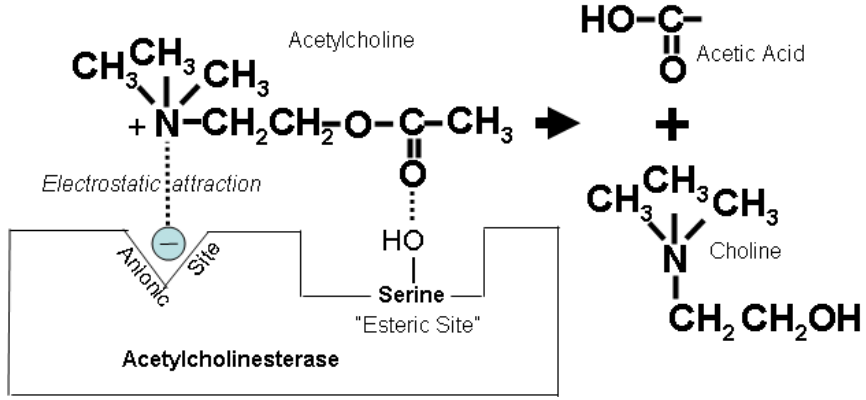
- The bee performs a waggle dance to indicate the location of food
- The direction and duration of the dance will tell the other bees where the food is in relation to the position of the sun
- The bee dances in a figure eight with the center waggle line being the angle of the flight path
- If the bee dances in a circle the food is less than 100 meters away
- Can even account for the change in the sun's position by the time it returns to the hive

Normal Neural Activity





FORMULA (I)

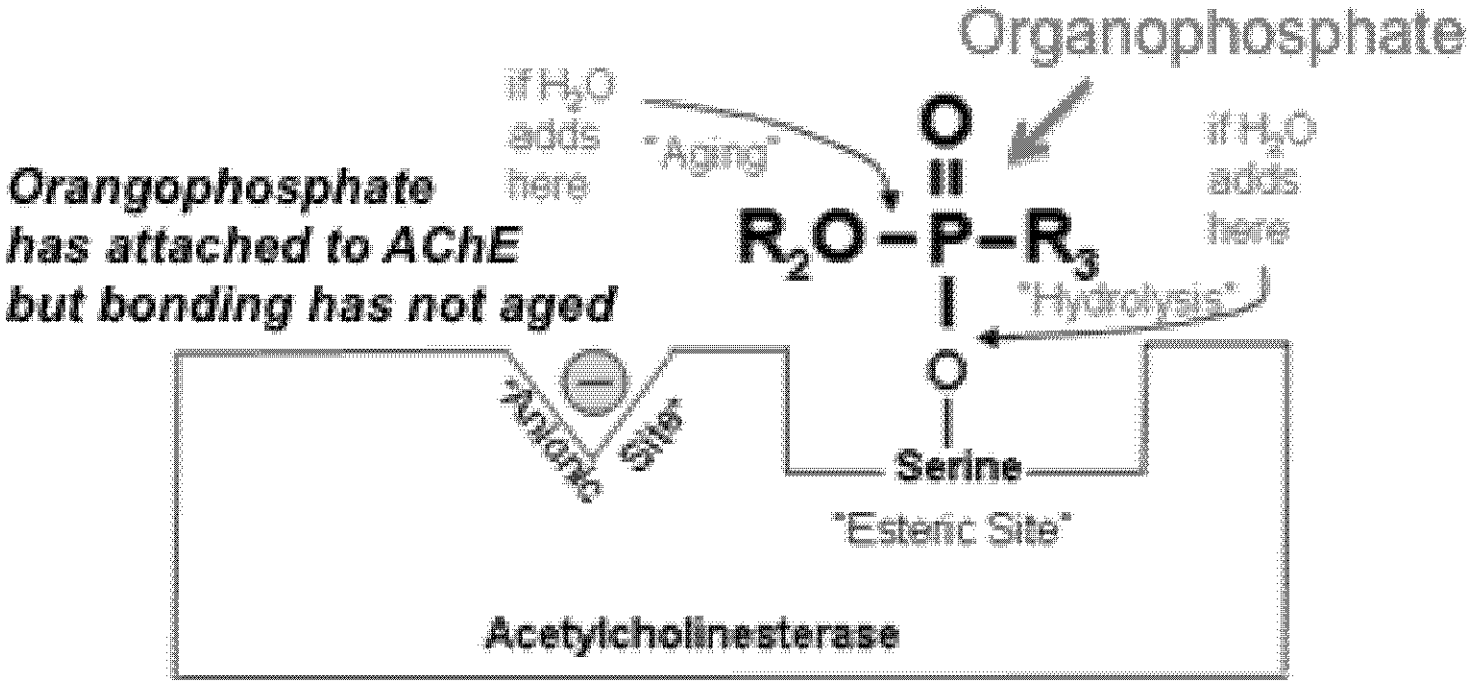


- The active site of AChE comprises 2 subsites: anionic and esteratic
- Each molecule of AChE degrades about 25,000 molecules of ACh per second

Organophosphate Pesticides and 2-PAM:
Understanding the Inhibitory Effect

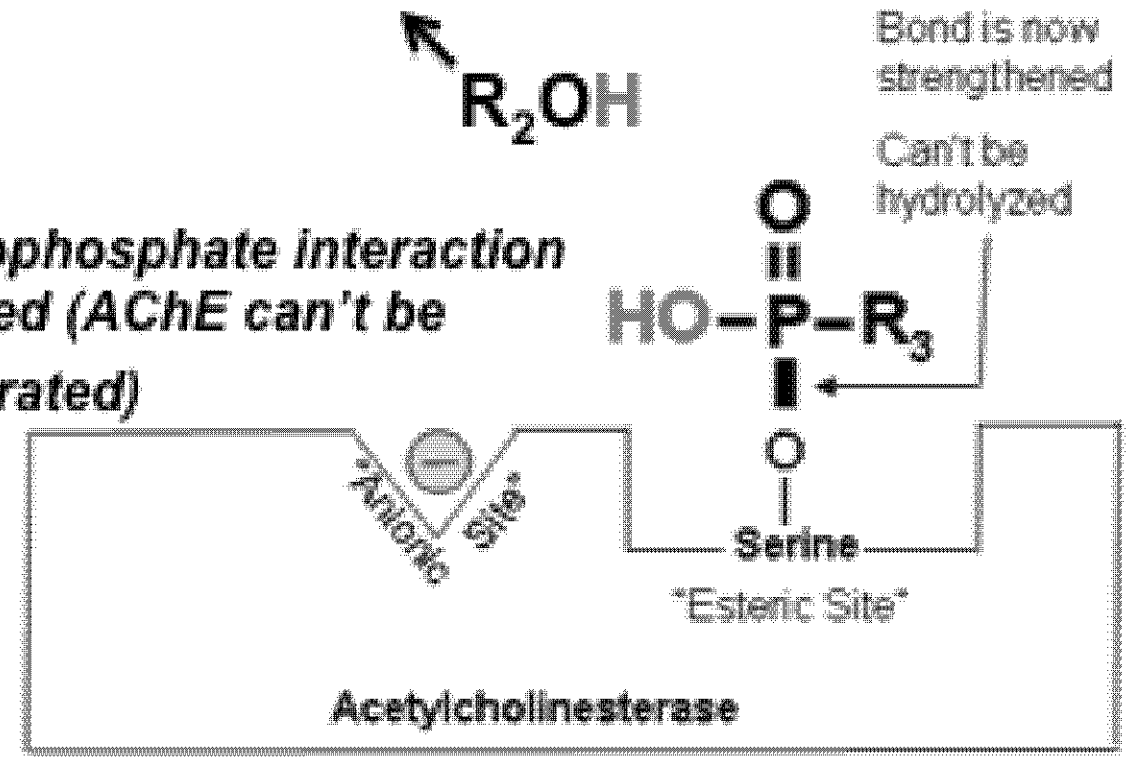
- 2-pyridine aldoxime methyl chloride, or Pralidoxime
- Reverses the binding of ChE inhibitors with AChE
- Antidote for Nerve Agent and OP poisoning
- OP forms a bond with the Serine at the Esteric site of the enzyme
- Time allows an ‘aging’ process to occur which strengthens the bond
- Aging of the bond renders the site irreversible
- Antidote would be ineffective after aging occurs
- The aging varies from minutes to days

Organophosphate Aging – chemical stabilization of phosphate bond to AChE occurs over time



The rate of aging is unique for each organophosphate compound, and can occur over minutes to days depending on the agent

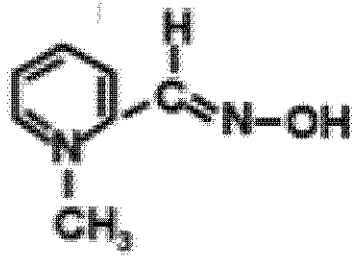
Organophosphate interaction has aged (AChE can't be regenerated)

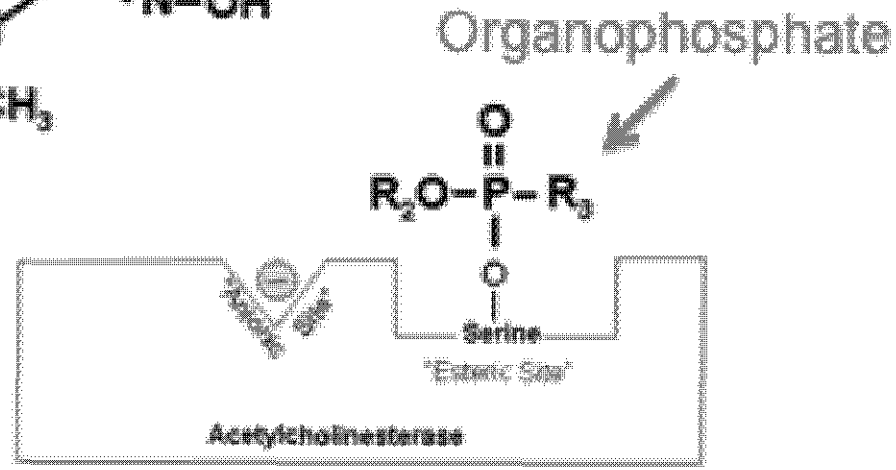


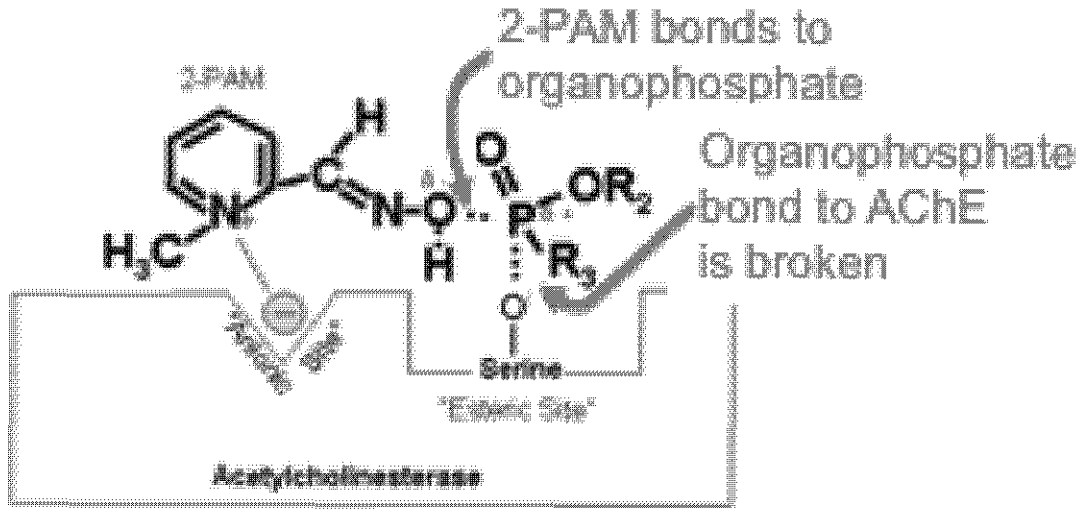
The departure of the R_2 alkyl group (aging) results in increased electron sharing between the phosphate group of the organophosphate & the serine on AChE. This bond can't be broken by 2-PAM.

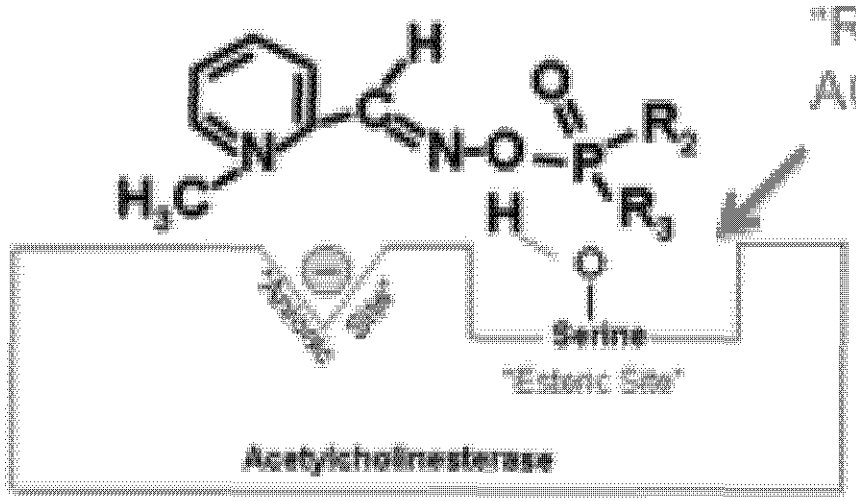
Pralidoxime (2-PAM) prevents aging by regeneration of AChE

2-PAM









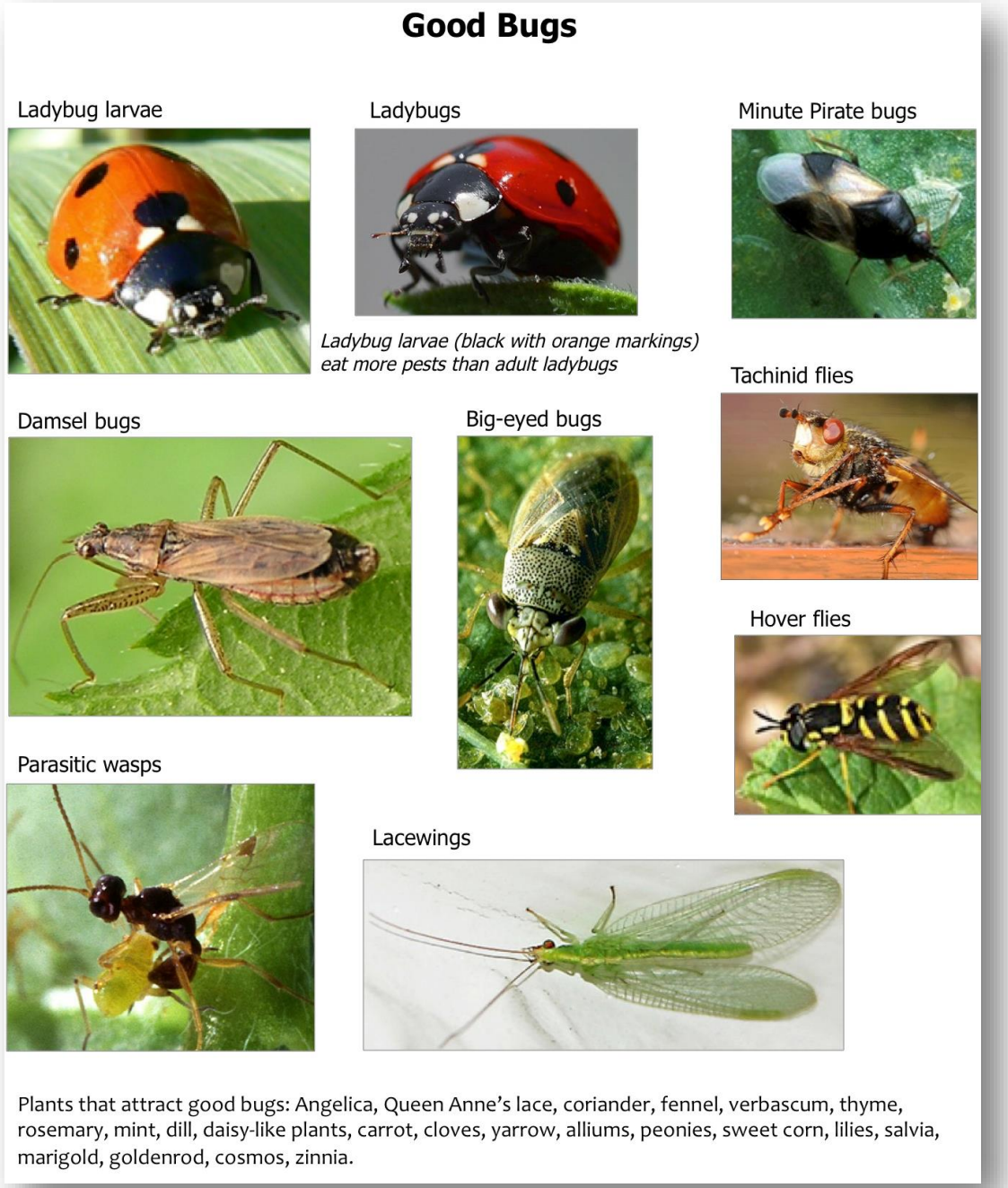
Effects of Pesticide Exposure to Pollinators

- Low level exposures do not kill bees directly
- Communication: scent and waggle dance
- Unable to remember location of pollen
- Ability to forage for nectar is impacted
- Unable to find the hive
- Combinations of pesticides
  - Impact was greater in hives treated for Varroa mite

Harness the Power of Nature

Natural Rivals – PREDATORS

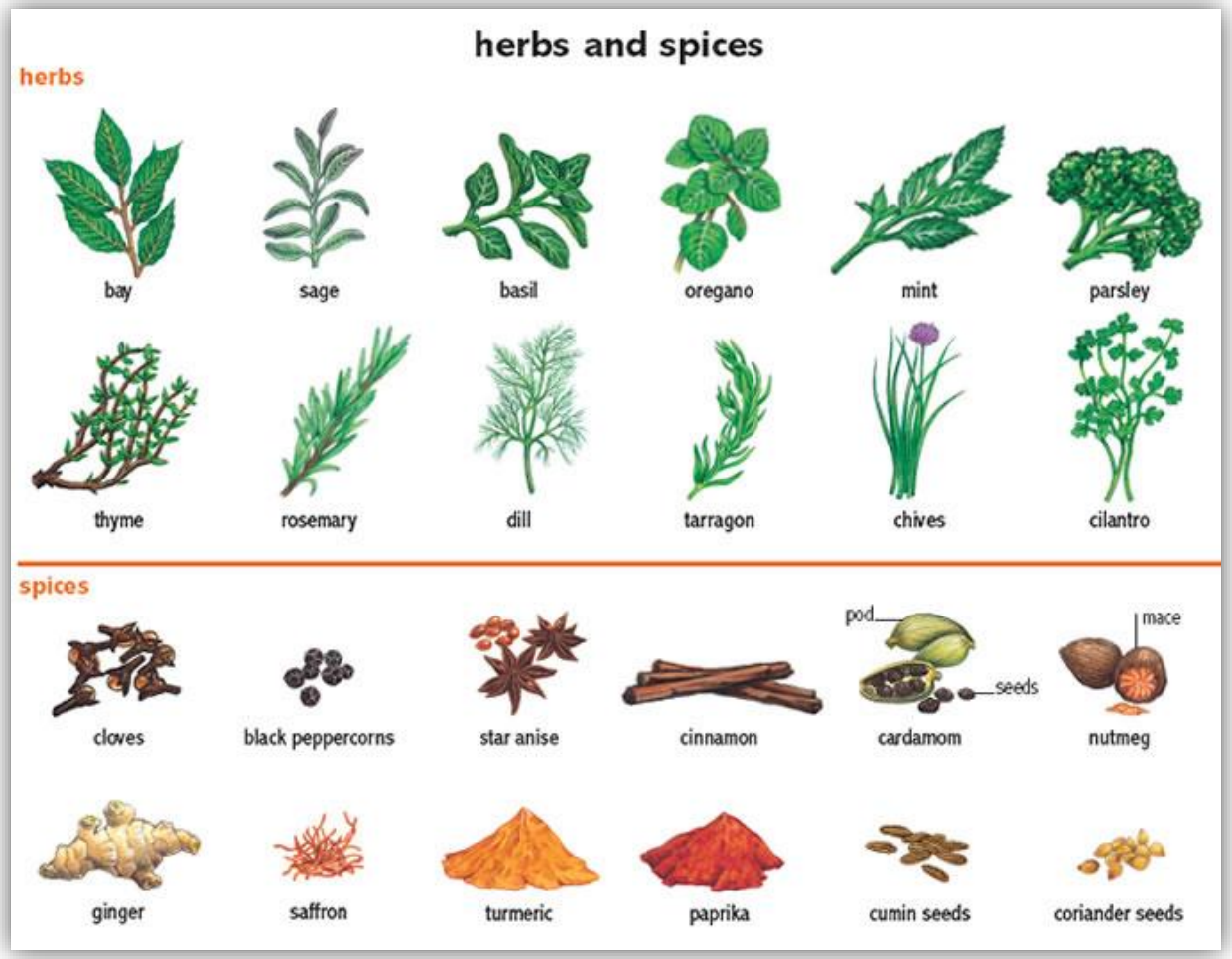
- Lady bug
- Praying mantis
- Western damsel bug
- Lady beetle
- Green lacewing
- Minute pirate bug
- Assassin bug
- Hover fly
- Tachinid fly



Harness the Power of Nature

Natural Rivals – HERBS & SPICES

- Cinnamon repels ants
- A promising spice-based pesticide: rosemary, thyme, clove and mint
- Others that fight insects: lavender, basil, bergamot and patchouli oil



Other Control Measures

Mechanical control

- Remove weeds and pests by hand
- Install netting, inverted crates, chicken wire
- Scarecrows, balloons and decoys
- Fishing line or black thread

Minimize the Risks

- If you *must* choose chemical control:
  - Choose organic alternatives
  - Choose safer chemicals
    - Sulfur, Serenade, Roundup, 2,4-D, B.T.
  - Liquids are less harmful than dusts
  - Treat in the evening when bees are less active
  - Avoid all plants in full bloom
  - Focus application to individual plants which need treatment for a known pest infestation

Creating a Pollinator Friendly Oasis

- Plant flowers that attract bees – **LILAC, MINT, WISTERIA**
- Native plants = native bees
- Learn to love the weeds and bare spots – bees do!
    - **CLOVER, DANDELION, WILDFLOWERS**
- Buy local: **RAW HONEY, FRUITS, VEGETABLES**
- **WATER** the bees – a small basin with stones for perching
- Learn how to ***BEE*** a beekeeper
- **REMAIN CALM** and don't get in their way

Planning your garden – think like a pollinator.

Bee Patient. *It takes time for native plants to grow and for pollinators to find your garden, especially if you live far from wild lands.*

Bee Gentle. *Most bees will avoid stinging and use that behavior only in self-defense. Male bees do not sting.*

Go Native. *Pollinators are "best" adapted to local, native plants, which often need less water than ornamentals.*

Bee Bountiful. *Plant big patches of each plant species for better foraging efficiency.*

Bee Showy. *Flowers should bloom in your garden throughout the growing season. Plant willow, currant, and Oregon grape for spring and aster, rabbit brush and goldenrod for fall flowers.*

Bee Chemical Free. *Pesticides and herbicides kill pollinators.*

Bee Sunny. *Provide areas with sunny, bare soil that's dry and well-drained, preferably with south-facing slopes.*

Bee Homey. *Make small piles of branches to attract butterflies and moths. Provide hollow twigs, rotten logs with wood-boring beetle holes and bunchgrasses and leave stumps, old rodent burrows, and fallen plant material for nesting bees. Leave dead or dying trees for woodpeckers.*

Bee Friendly. *Create pollinator-friendly gardens both at home, at schools and in public parks. Help people learn more about pollinators and native plants.*

Bee Aware. *Observe pollinators when you walk outside in nature. Notice which flowers attract bumblebees or solitary bees, and which attract butterflies.*

Bee a little messy. *Most of our native bee species (70%) nest underground so avoid using weed cloth or heavy mulch.*

Bee Diverse. *Plant a diversity of flowering species with abundant pollen and nectar and specific plants for feeding butterfly and moth caterpillars.*

NARROW LEAF PURPLE CONEFLOWER
LATE SPRING TO MID SUMMER
KEY NECTAR SOURCE FOR SKIPPER BUTTERFLIES AND BEES

BLANKETFLOWER
ESTABLISHES EASILY FROM SEED
SUPPORTS A VARIETY OF BENEFICIAL INSECTS
GROWS AS AN ANNUAL, BI-ANNUAL OR PERENNIAL

PRAIRIE **P**ENSTEMON
GROWS IN A VARIETY OF SOILS
BUTTERFLIES, MOTHS, BEES
HOST PLANT FOR THE DOTTED CHECKERSPOT BUTTERFLY

BUTTONBUSH
PREFERS WET OR MOIST SOIL
ATTRACTS LONG-TONGUED BEES AND BUTTERFLIES

Wetlands: a land area that is saturated with water, permanently or seasonally, such that it takes on the characteristics of a distinct ecosystem.


Pollinator
Habitat


'If the bee disappeared off the surface
of the globe then man would have only
four years of life left'

Thank You!

What do you call a wasp?

a wanna bee!

ch2m SM

"You may never know what results come from your action. But if you do nothing, there will be no result.
In a gentle way, you can shake the world."

~Mahatma Gandhi (1869-1948), spiritual leader and activist for non-violence

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