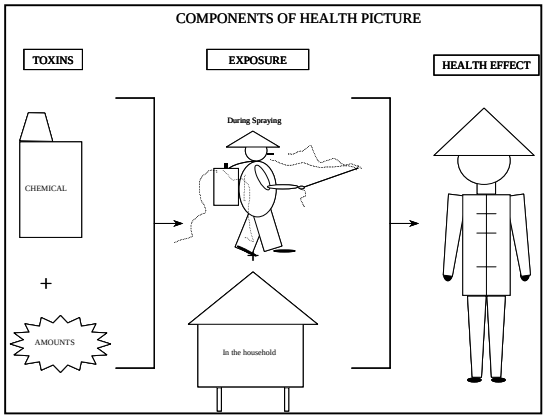
FARMER AND SCHOOL CHILDRENS CROSS SECTIONAL SURVEYS ON THE HEALTH EFFECTS OF PESTICIDES

Farmer-to-Farmer Studies



School Children's Studies

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I. Rationale

There is heavy indiscriminate use of pesticides in most developing countries. This promotes the propagation of resistant pests, degrades the environment, and reduces farmer profit margins. Many products that are in use are highly toxic to human health. For example in Thailand and Cambodia, one popular pesticide used on cabbage crops is *methyl parathion*, an organophosphate. This product is restricted and banned in many countries, because it has an LD_{50}[1] level of 14mg/kg and is classified by World Health Organization as a Class 1a "extremely hazardous" substance.[2]

Efforts to reduce toxic pesticide use in developing countries through national policies have, for the most part, failed. This is due to the power and marketing strength of chemical companies. Therefore, the focus of attention must turn to the consumer-farmer and his children to help them on their own reduce pesticide use.

Integrated pest management (IPM) promotes traditional non-chemical methods for crop protection. It operates in many developing countries primarily through grass-roots farmer groups and educational systems, such as primary schools in Thailand. Using adult learning methods, farmers and school children learn to solve pest-control problems by understanding natural eco-systems. This is accomplished through observation and experimentation on their own crops. Using non-chemical pest control strategies, farmers not only witness healthier crops that leave the environment safer, but they also assess the economic benefits by spending less of their profits on expensive chemicals.

An additional component to the study of ecology and economics in IPM is the issue of health. Studies in Indonesia demonstrate that up to 21% of all spray operations result in 3 or more signs and symptoms of acute pesticide poisoning. The frequency of spraying, hazard level of pesticides used, and skin contamination while spraying either through direct contact or wet clothing all are highly associated to poisonings.[3] Furthermore, unsafe pesticide storage and disposal pose considerable risks of accidental poisonings in children and contaminate water and food supplies.

The consumer-farmer needs better education about these personal and community health hazards to further make informed decisions about the use of pesticides. Rather than being fed the information, we have put epidemiology in the hands of farmers and school children. Consistent with the IPM discovery-learning model, they learn how to conduct their own studies on the health effects of pesticides. This along with ecology and economics drives the decision on continued pesticide use as illustrated below:

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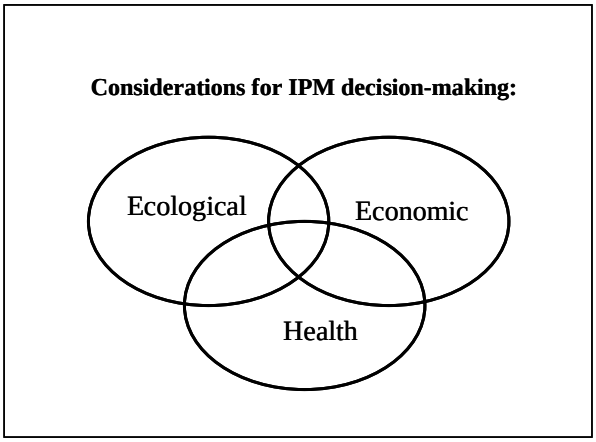
[1] The LD_{50} value is a statistical estimate of the number of mg of toxicant per kg of body weight required to kill 50% of a large population of test animals.

[2] International Programme of Chemical Safety. The WHO Recommended Classification of Pesticides by Hazard and Guidelines to Classification 1998-1999. WHO/PCS/98.21.

[3] Kishi M. et al. Relationship of pesticide spraying to signs and symptoms in Indonesian farmers. *Scan J Work Environ Health* 1995;21:124-33.



If farmers study the problem on their own, they not only reach a better understanding of the health hazards of indiscriminate pesticide use but can also take immediate action.

If school children study the problem there are a number of further benefits. First, we are educating a future generation who will be the primary beneficiaries of good personal health, a preserved natural environment, and a sound food-producing economy. Second, children can have an influence on protecting the health of their parents and themselves. With hands on experience they can act as powerful change agents by making all parties aware of the health hazards of pesticides. And third, the self-discovery learning that comes through conducting health studies in school children's communities can increase the student's skills in 5 learning areas:

* art
* math
* language
* teamwork
* critical thinking

This manual describes how farmers and school children can conduct these studies on the health effects of pesticides and how the process can operate through an IPM program or as classroom student projects. The survey topics farmers and school children investigate are those risk factors found in the formal Indonesian study referred to above. They include data collection on the pesticides in use, the amounts applied per year, exposure during spraying and at home, and finally the acute effects. The investigating farmers and school children then present the results back to those they interviewed and observed as well as the community for discussion.

The methods and training techniques have been well tested and implemented in the IPM programs of Vietnam, Cambodia, Indonesia, Thailand, and Sri Lanka. Studies with school children have been conducted in Cambodia and Thailand, the latter of which has been published. [4]

[4] Wichanee S, Tianponkrang M, Jakiet M, Murphy HH. ***Thai School Children's Studies on the Health Hazards of Pesticides***. World Health Organization (in press).

II. Objectives

- Educate farmers, communities, teachers and school children (as future farmers) about the hazards and adverse effects of pesticide use.
- Provide the educational system a model for more relevant, non-formal, community- based training methodologies
- Provide government authorities (health, agriculture, etc) information on:
  - The kinds of pesticides in use
  - Spray frequencies
  - Number and types of pesticides applied together in a single spray operation
  - 'Normal use' pesticide application practices
  - The rate of adverse effects
  - Problems with pesticide storage and disposal
- Motivate farmers to join IPM farmer field schools.
- Reinforce IPM farmer field school graduates to continue with non-chemical pest control measures.
- Measure the impact IPM programs by conducting health surveys before and after introducing community IPM.

III. Methods

The participating farmers (usually IPM graduates) and school children select their pesticide using friends, neighbors or parents to serve as respondents- a minimum of 30. The survey assesses:

- ***Pesticides in use***: Inventories are made in household stores, local pesticide shops and fields. The pesticides are then classified by trade name, common name, chemical family, and WHO human health hazard levels.
- ***Amounts of pesticides used*** (liters and days exposure per year). Estimates are calculated by interviewing farmers based on their last full year of pesticide use.
- ***Pesticide spraying practices***. Farmers are observed in the field for one full spray session, noting all contamination routes.
- ***Pesticide household storage and disposal practices***. Households and garbage areas are inspected and analyzed for hazards to children, food, water and livestock.
- ***Acute signs and symptoms of pesticide poisoning***. A simple health history and examination is performed before and after spraying as well as on the following day.

After collection, the data is tabulated and presented at community meetings in a format similar to the following on newsprint charts and graphics:

Pesticides: are presented first by WHO health hazard level to inform the community which ones are most dangerous to human health. The second table demonstrates the pesticides by chemical family. This is used to describe the health effects; specifically those which are toxic to the nervous system. As many farmers use more than on pesticide per application, the additive toxic effects (double dosing) is emphasized. In some cases (Cambodia) the label is glued to the last column for better recognition or the actual

containers are pile sorted. Those chemicals, which have been banned or restricted, are pointed out during the meetings.

Table 1: Pesticides in Use by Health Hazard Level

WHO Hazard Levels	**# / % of farmers**	**Trade (*common name)***
Ia (extremely hazardous)	25/100%	Folidol (*methyl parathion)*
Ib (highly hazardous)	15/60%	Monitor (*methamidophos)*
II (moderately hazardous)	25/100%	
* Only one	1/4%	Thiodan *(endosulfan)*
* Two	15/60%	Furadan *(carbofuran)*
* Thee	5/20%	Gramoxone *(paraquat)*
* All four	4/20%	Decis *(deltamethrin)*
III (slightly hazardous)	3/12%	Malate (*malathion)*
IV (unlikely if used safely)	5/20%	Delfin (BT)

Table 2: Pesticides by Chemical Family

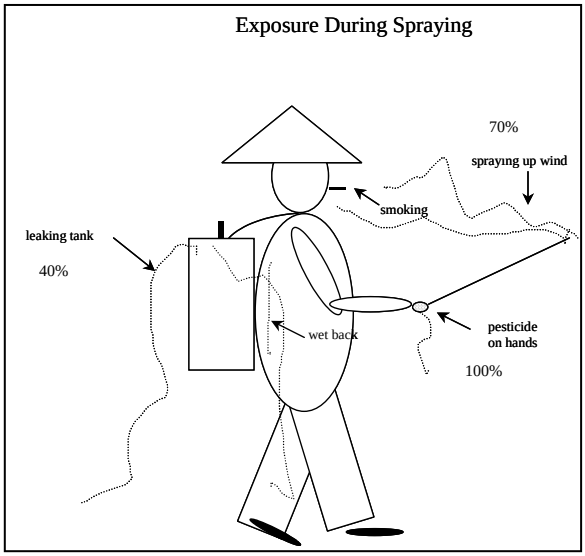
Chemical family	**# / % of farmers**	**Trade (*common name)***
Organophosphates (Op)	25/100%	
* Only one	5/20%	Folidol (*methyl parathion)*
* Two	15/60%	Monitor (*methamidophos)*
* All three	5/20%	Malate (*malathion)*
Carbamates (C)	12/48%	Furadan *(carbofuran)*
Organochlorines (Oc)	15/60%	Thiodan *(endosulfan)*
Pyrethroids (Py)	25/100%	Decis *(deltamethrin)*

Amounts used on average last year and with IPM: Amounts per year are calculated for each farmer. Either each farmer's totals and or the community average are displayed. The amount of liters solution per year with IPM is then calculated and displayed to demonstrate how IPM can reduce pesticide exposure. Some groups estimate this in grams of pesticides (Vietnam) and others also calculated costs pre and post IPM.

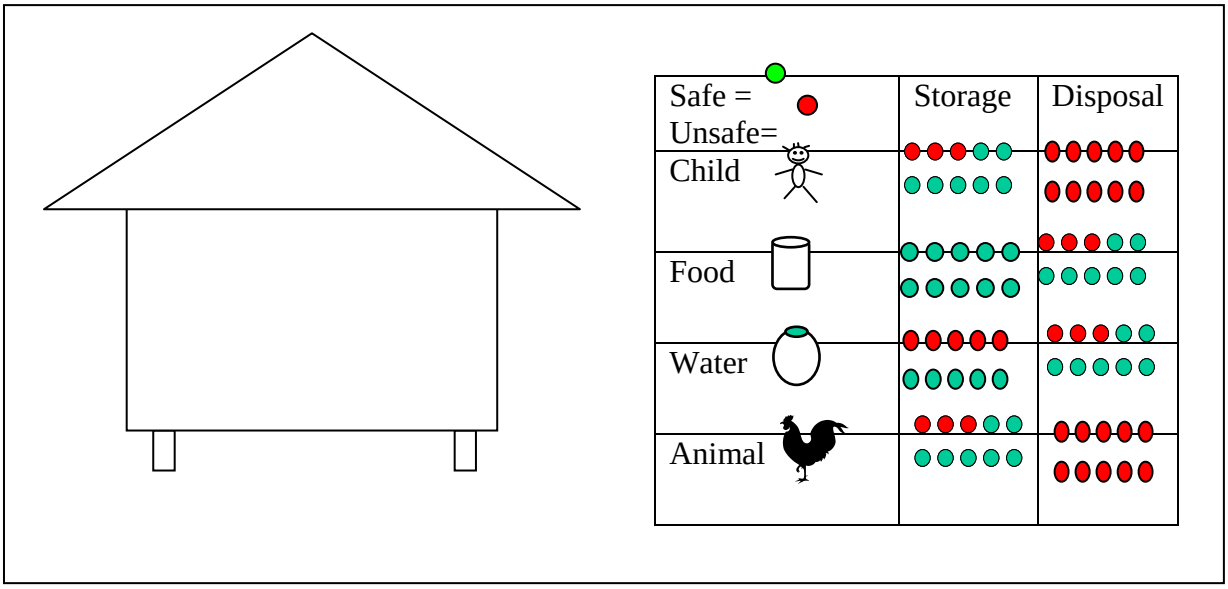
Table 3: Amount Of Pesticide Solution Sprayed By Farmers

Average Farmer 1.crop 2.crop	a. Tank size lt.	b. tanks /session	c.♦ sessions per week	d.♦ # weeks per season	e. sessions/ season (c*d)	f. seasons per year	Days per year exposed (e*f)	Liters exposure per year a*b*e*f
Last year								
rice	15	10			4	2	8	1200
beans	15	5	3	12	36	4	134	10800
Total							**142**	**12000**
With IMP								
rice	15	10			0	2	0	0
beans	15	5			3	2	6	450
Total							**6**	**450**

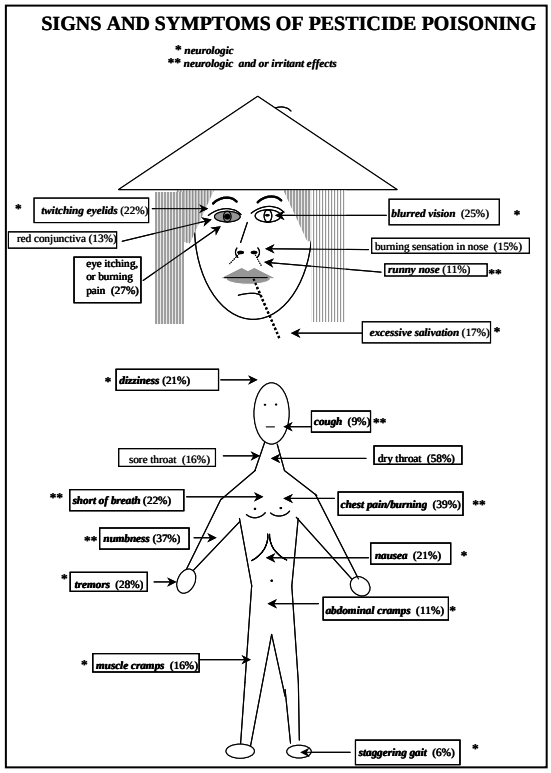
Exposure During Spraying: Pesticide contamination of the various body parts is colored in red. The importance of skin as the most critical route of exposure, especially during mixing, is highlighted. Groups also discuss why personal protection is rarely used.



Household Storage and Disposal: This picture would show a typical household that demonstrates the safe and unsafe storage and disposal methods found during the survey. The percentages can be displayed at colored pie charts (Sri Lanka) or simple colored buttons depending on the sample size.



Signs and Symptoms: are usually displayed on a body map drawn by the children or farmer data collectors. Those signs and symptoms that are related to toxicity of the nervous system are highlighted, referring back to the pesticide table by chemical family. Farmers are warned that if they notice any of these effects they should stop spraying immediately and take a full bath with soap.



IV. Means of Evaluating Impact of Farmer-to-Farmer and School Children's Health Studies

The following indicators can be used to measure behavior change after the health surveys and community meetings. . The **same** respondents must be surveyed again after at least 6 months. These practices are only those, which we expect to change.

- #/% Farmers joining IPM farmer field schools (assuming the latter is available).
- #/% Farmers using a pesticide that is Ia (extreme) and Ib (highly hazardous).
- Average spray frequency/week (vegetables) or per season (rice).
- Average spray days and liters of pesticide solution used per year (one year needed, post survey).
- #/% Households not child, water, food, and livestock safe in their pesticide storage and disposal practices.
- Average number of signs and symptoms per farmer post spray session.

V. Training

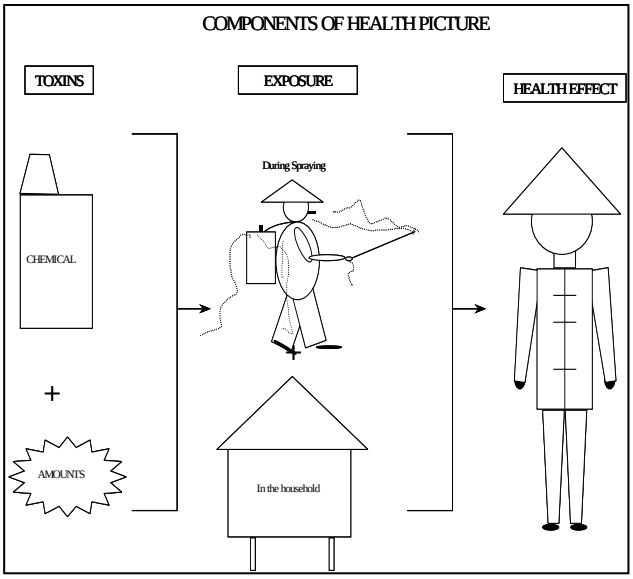
Training is conducted in a workshop setting (25-30 participants) over 5 days. Participants are trained through group exercises with ***very little lecturing***. One day needs to be set aside for practice data collection. At the end of the workshop, a community meeting must be arranged to supply the respondents with the results.

Training materials:

- Newsprint paper
- 8 x10 white paper
- Marker pens (red, blue, black and green)
- A local pesticide list (or WHO IPCS book[5]) with trade and common names, WHO health hazard levels and chemical families.
- A body map in local language.

Introduction-Conceptual Framework

Introduce the workshop by showing the factors that lead to pesticide poisoning (conceptual framework) with the following graphic:



Using toxic chemicals + spraying frequently + exposure during spraying and mixing + unsafe household storage and disposal = potential illness

[5] International Programme of Chemical Safety. The WHO Recommended Classification of Pesticides by Hazard and Guidelines to Classification 1998-1999. WHO/PCS/98.21.

Describe ***known risk factors*** from the Indonesian study[6]

- Using a Ia, Ib or II class pesticide (extreme, high or moderately hazardous pesticide as defined by the World Health Organization)
- Using a premixed pesticide 'cocktail' concentrate of more than one product.
- Spraying frequently during one week.
- Skin contact and especially ***wet*** clothing.

- These practices increase a sprayer's chance of getting sick.
- In Indonesia ***21% of all spray operations resulted in 3 or more signs and symptoms of pesticide poisoning***.

[6] Kishi M. et al. Relationship of pesticide spraying to signs and symptoms in Indonesian farmers. *Scan J Work Environ Health* 1995;21:124-33.

1. Signs and symptoms:

Body mapping

- Break the participants into small groups
- One person in each group should lie down on two taped together newsprints.
- Outline his/her body to make the body map.
- Cut up 31 pieces of paper.
- The group should brainstorm the signs and symptoms (S&S) of poisoning they have either experienced or seen in another farmer.
- They should write down each S&S on the pieces of paper and attach them to the body map. *[this first picture gives the instructor an idea of how much pesticide poisoning is occurring in the community[7]]*
- Distribute the body map (see Annex 9) to let each group correct their body map
- Take each S&S card they thought was pesticide poisoning and discuss why it is not included on the form [these may be unknown effects or work related problems like back or joint pain]

Difference between a sign and symptom (Annex 3)

- Label 2 newsprints and label one SIGNS and the other SYMPTOMS
- Ask the class if they know the difference
- Define SIGN: an health effect you can SEE (like vomiting, tremors, staggering gait)
- Define SYMPTOM: a health effect you cannot see but the person FEELS (like nausea, headache, dizziness)

Sign and Symptom game

- Organize the class into a circle.
- One by one each participant chooses one S&S card out of a hat
- Each participant should either act out the S&S or describe it **without using the actual word** for the group to guess.
- Write the word on either the sign or symptom newsprint paper (actor and class to decide)
- Instructor demonstrates how to examine for the following signs: tremor, staggering gait, eye twitching, blurred vision and red eyes. (See Annex 4 for details)
- Next to the word, the class must list all the other illness or conditions that are ***not*** from pesticides that also can result in the sign or symptom. For example, staggering gait and being drunk. See Annex # 5 for more examples. *[This exercise insures everyone understand the definition and that other conditions can cause the same S&S]*

Homework: distribute a body map to each participant. That evening they must find one person who sprays to interview on each S&S 'ever experienced. The next day in their groups they practice summarizing the data on one body map. (See example under III. Methods: Signs and Symptoms*)*

[7] For instance in Cambodia where very hazardous chemicals are used, farmers list all known S&S including those that are most serious. But in Sri Lanka where all class Ia and Ib are banned, farmers list only a few minor S&S like dry throat and headache.

2. Amounts of yearly exposure (liters of solution used per year)

* The instructor should do a sample calculation with one participant using the below table.

AMOUNT OF PESTICIDES USED BY FARMERS								
Farmer 1.crop 2.crop	a. Tank size lt.	b. tanks /session	c.♦ sessions per week	d.♦ # weeks per season	e. sessions /season (c*d)	f. seasons per year	Days per year exposed (e*f)	Liters exposure per year a*b*e*f
1.Sokdai								
rice	15	10			4	2	8	1200
beans	15	5	3	12	36	4	134	10800
Total							**142**	**12000**

♦ fill in column 'c.' and 'd.'only if spraying on a weekly basis. Otherwise use column 'e.' showing how many spray sessions per season.

* Break the class into groups. Each person calculates their days and liters of exposure during the last year. (or use a sample friend or know farmer)
* Among the group of 5, add up the total solution used by these 5 farmers and the average days of exposure and liters per farmer.

Homework: Interview one farmer. Gather and calculate days and liters per year. In class the next day, recalculate days and liters that can be reduced using IPM. Summarize the group data on one newsprint paper. (See example under III. Methods: Amounts used on average last year and with IPM)

3. Household storage and disposal practices.

Divide the participants into teams.

Game:

* Each team must collect 10 items: something round, from a plant, smelling good, long/sharp, a wrapper… etc.
* The team that brings in the completed list of items first wins.
* With collected materials, each team must build a replica of their community (include the cotton seed producing fields) on newsprint paper. They then must draw where:
  1. pesticides/tanks storage sites
  2. pesticide disposal sites
  3. food growing areas
  4. water sources
  5. where animals wander
  6. where children play

Class Analysis: Finally the class analyzes each community picture to determine if pesticide storage and disposal is: child, food, water, livestock safe. Draw the following table on the household picture using the following symbols, checking each box: yes (+) or no (O):

SAFE	Storage	Disposal
Child safe?	O	O
Food safe?	O	+
Water safe?	+	O
Animal safe?	+	O

Homework: Each participant draws his or her own household (or a farmer friend's). The next day, the class by groups scores each picture and summarizes data on a table like above showing: #/total = % child, food, water and animal safe households for both storage and disposal. (See example under III. Methods: Household Storage and Disposal) During the homework household inspection, each participant must list by Trade name and common name (if legible) the pesticides found (or bring in the container or label to class).

4. Pesticide classification

a. Before the household observation homework, the instructor shows the class 6 samples of commonly used pesticides. (S)he demonstrates how to find the Trade and common name on one bottle.
b. The remaining bottles are distributed outside the classroom at stations numbered 1-5 (or more depending on how many samples are brought in for training). In a relay race, each participant has one minute to move from station to station, writing down the Trade and common name. [Rubber gloves must be at each station for safe handling]
c. The instructor then displays the correct list on a table like below for the class to correct their lists.

Station #	Trade Name	Common Name	Type	WHO Hazard Level	Chemical Family
1	Folidol	*methyl parathion*			
2	Monitor	*methamidophos*			
3	Thiodan	endosulfan			
4	Furadan	carbofuran			
5	Decis	deltamethrin			
6	Gramoxone	*paraquat*			
7	Malate	*malathion*			
8	Delfin	BT (*bacillus thuringiensis)*			

d. The next day each group lists the pesticides they found on their household survey on the same type of table.
e. Instructor explains WHO hazard levels (See Annex #1)
f. Using a local pesticide reference book, each group must next add to their list the type (insecticide, fungicide, herbicide) and WHO hazard level. For unknown products check on internet www.pesticideinfo.net (PAN)

# houses	Trade Name	Common Name	Type	WHO Hazard Level	Chemical Family
5	Folidol	*methyl parathion*	In	Ia	
5	Monitor	*methamidophos*	In	Ib	
3	Thiodan	endosulfan	In	II	
4	Furadan	carbofuran	In	II	
3	Decis	deltamethrin	In	II	
2	Gramoxone	*paraquat*	He	II	
1	Malate	*malathion*	In	III	
1	Delfin	BT (*bacillus thuringiensis)*	In	Unlikely (IV)	

g. Class makes a summary list of pesticides found in households in each group by WHO hazard level (e.g. Ia, Ib, II, III, IV)

WHO Hazard Levels	**# / % in houses**	**Trade (*common name)***
Ia (extremely hazardous)	25/100%	Folidol (*methyl parathion)*
Ib (highly hazardous)	15/60%	Monitor (*methamidophos)*
II (moderately hazardous)	25/100%	
* Only one	1/4%	Thiodan *(endosulfan)*
* Two	15/60%	Furadan *(carbofuran)*
* Thee	5/20%	Gramoxone *(paraquat)*
* All four	4/20%	Decis *(deltamethrin)*
III (slightly hazardous)	3/12%	Malate (*malathion)*
IV (unlikely if used safely)	5/20%	Delfin (BT)

* Instructor explains chemical families.
* Start with the organophosphates (Op), describe that this family of chemicals affects the nervous system; primarily the peripheral ones (nerves outside the brain) and the central ones (the brain).
* List the body systems they affect:
  - body organs: eyes, lungs, digestive system
  - glands
  - muscles
  - brain
* Refer back to the body map and ask students to guess which S&S would be an example of the above body systems being over-stimulated.
* Continue using the same methods with each chemical family: carbamates (C), organochlorines (Oc), pyrethroids (Py), and paraquat (if commonly used). See Annex # 2 for details.
* Ask each group to complete their table adding the chemical family (if known) to each pesticide. A final group tables may look like this:

# houses	Trade Name	Common Name	Type	WHO Hazard Level	Chemical Family
5	Folidol	*methyl parathion*	In	Ia	Op
5	Monitor	*methamidophos*	In	Ib	Op
3	Thiodan	endosulfan	In	II	Oc
4	Furadan	carbofuran	In	II	C
3	Decis	deltamethrin	In	II	Py
2	Gramoxone	*paraquat*	He	II	-
1	Malate	*malathion*	In	III	Op
1	Delfin	BT (*bacillus thuringiensis)*	In	Unlikely (IV)	biological

h. Finally the class should make another summary list of pesticides found in households in each group by chemical family (Op, OC, C, Py, paraquat)

Chemical family	# / % in houses	Trade (*common name)*
Organophosphates (Op)	25/100%	
* Only one	5/20%	Folidol (*methyl parathion)*
* Two	15/60%	Monitor (*methamidophos)*
* All three	5/20%	Malate (*malathion)*
Carbamates (C)	12/48%	Furadan *(carbofuran)*
Organochlorines (Oc)	15/60%	Thiodan *(endosulfan)*
Pyrethroids (Py)	25/100%	Gramoxone *(paraquat)*

5. Exposurethrough pesticide handling during mixing and spraying.

* Ask participants to list the ways pesticides enter the body
    - Through the skin
    - Through breathing
    - Through the mouth
* Ask the class to develop a checklist of things they want to observe showing a farmer being exposed through these three routes (e.g.)
    - Hand contact during mixing
    - Rubbing eyes with contaminated hands
    - Leaking tanks, wands
    - Wet clothing
    - Bare feet
    - Spraying up wind
    - Smoking, eating, drinking, wiping face with contaminated hands
* Ask which is the most common and critical way that pesticides enter the body during spraying
    - Through the skin: pesticides are designed to penetrate the hard covering of insects. Human skin is softer and more permeable. Therefore skin easily absorbs pesticides and is the most common route of exposure.
* Ask during which step of a spray operation is skin contamination most dangerous and why
    - During mixing
    - This is because the sprayer is handing the **concentrated pesticide**.
* Class should observe a sprayer dressed in ***white*** with white ***socks*** and white ***gloves*** mix and spray an entire field with red dye.
* Each group should draw and present their observations to the class at large:

Sample Training Agenda for School Children's Health Studies

Monday	Tuesday	Wednesday	Thursday	Friday
MORNING	MORNING	MORNING	MORNING	MORNING
Household: 1. Scavenger hunt 2. Build a house with materials from hunt 3. Add places of: ♦ Food: storage, use, consumption ♦ Water: source, storage, use ♦ Animal: shelter ♦ Pesticide storage, disposal ♦ Tank storage	<u>Household homework</u>: 1. Score each picture for safety. 2. Summarize data on one newsprint picture that shows safe and unsafe findings 3. Each group present picture and support safety conclusions. <u>Yearly pesticide use:</u> 1. Estimate your parent's yearly use with the table. 2. Put group totals and averages on a newsprint. 3. Present your findings.	<u>Review observing exposure:</u> 1. 3 routes 2. Most critical routes 3. Ways of exposure • Fingers-hands • Spraying up wind • Wet clothes • Mixing with bare hands • Blowing out wand <u>Data collection from Farmers:</u> -Household evaluation -Liters/year -S&S before spraying -List of pesticides used -Observe spray session -S&S after spraying <u>Summarize data by group:</u> Show findings on newsprints	<u>Finish Data Collection</u> 24 hours post spray S&S Summarize pre/post/24hr S&S data <u>Chemical classification of pesticides</u> Finish explaining effects of major chemical families. <u>Group Homework analysis</u>: S&S 'ever experienced' of parent Amounts of pesticides used/year	<u>Presentation for Parents</u> Present data and interpret meaning Class-parent discussion Plan community interventions
AFTERNOON	AFTERNOON	AFTERNOON	AFTERNOON	AFTERNOON
4. Analysis each picture for household safety: ♦ Child? ♦ Food? ♦ Water? ♦ Animal	<u>Signs and symptoms:</u> 1. Outline the body of one classmate on two newsprints. 2. Make a card for each sign and symptom of pesticide poisoning that you know about 3. Correct your body map with the correct S&S. 4. Each student take one S&S. Act out the S&S, and another cause of the S&S for the others to guess	<u>Classifying pesticides</u>: 1. Make a list of the pesticides used by observed farmers by brand, common and local name. 2. From the reference list, add WHO level and chemical family. 3. Teacher explains WHO level. 4. Make a summary list of pesticides used by WHO level. 5. Teacher explains symptoms of the major chemical families. 6. Make a summary list of pesticides by chemical family	<u>Data analysis:</u> (homework + observed farmers) 1. Household storage and disposal 2. Amounts of pesticides used/yr 3. Pesticides used by • WHO level • Chemical family 4. Signs and symptoms 5. Exposure hazards <u>Practice Presentation for Parents</u> Student practice presenting each newsprint and interpreting results	Teacher-Student Planning for Future Health Activities
HOMEWORK	HOMEWORK	HOMEWORK	HOMEWORK	HOMEWORK
1. Draw your own household showing places of storage as above. 2. List (or bring to class) the pesticides found in your home.	1. Interview your parent about S&S 'ever experienced'. 2. Gather information about his liters of pesticide use per year.			

TECHNICAL INFORMATION

1. WHO Hazard Classification

LD $_{50}$: Human toxicity level. It is based on experiments with animals and is the number of mg of toxicant per kg of body weight required to kill 50% of a large population of test animals.(optional information)

WHO Hazard Classifications: World Health Organizations classifies most pesticides by common name in terms of their potential human health effects. These classifications are usually based on the acute oral LD $_{50}$ levels.

- Ia = extremely hazardous
- Ib = highly hazardous
- II = moderately hazardous
- III = slightly hazardous
- IV (U) = unlikely if used safely

This table* below can be used optionally:

Class	LD $_{50}$ for the rat (mg/kg body weight)	
	Oral	
	Solids	Liquids
Ia = extremely hazardous	5 or less	20 or less
Ib = highly hazardous	5-50	20-200
II = moderately hazardous	50-500	200-2000
III = slightly hazardous	500-2000	2000-3000
IV = unlikely if used safely	over 2000	over 3000

* Adapted from International Programme of Chemical Safety. The WHO Recommended Classification of Pesticides by Hazard and Guidelines to Classification 1998-1999. WHO/PCS/98.21.

2. Chemical families of pesticides

Each pesticide generally belongs to a chemical family on which general health effects are known.

- **Organophosphates:** disturbs the peripheral nervous system (long acting)
- **Carbamates:** disturbs the peripheral nervous system (short acting)
- **Organochlorines**: disturbs the central nervous system (long acting)
- **Pyrethroids**: irritant to eyes, skin, and respiratory tract
- **Thiocarbamates**: irritant to eyes, skin, and respiratory tract
- **Paraquat:** irritant to skin and upper respiratory tract, if enters blood stream (through skin or ingestion) causes lung and kidney failure

Organophosphates affect the central nervous system (brain) and peripheral nervous system (nerves found outside of the brain or spinal cord). Organophosphates attach themselves to the enzyme (acetylcholinesterase- AChE) that stops nerve transmission. Therefore, there is suppression of AChE and continuous electrical nerve transmission. This particularly affects the muscles, glands and smooth muscles that make the body organs function. Farmers may have the following symptoms that can appear 30 minutes after exposure and may last up to 24 hours:

General central nervous system	• Fatigue • Dizziness • Headache • Hand tremors • Staggering gait • Convulsions • Loss of consciousness • Coma
From muscle over stimulation:	• Muscle weakness • Muscle cramps • Twitching eyelids
From gland over stimulation:	• Salivary gland- excessive salivation • Sweat gland- excessive sweating • Lacrimal gland-excessive eye tearing
From organ over-stimulation: Eyes Gastrointestinal Pulmonary (Lungs)	• Blurred vision (constricted pupils) • Stomach cramps • Nausea • Vomiting • Diarrhea • Chest tightness • Wheezing • Cough • Runny nose

Carbamates: behave the *same* way as the organophosphates in that they suppress AChE, and cause over-stimulation of the nerves. The effect comes on *sooner* after exposure (as fast as 15 minutes) and *does not last as long* (3 hours). Symptoms are the same with the exception of these symptoms below which are *rare*:

- Convulsions
- Loss of consciousness
- Coma

Organochlorines: affect the central nervous system. They are absorbed by fat so they can stay in the body a long time. As the fats cells in breast tissue can store organochlorines, it can measured in breast milk. The effects can occur within one hour after absorption and acute effects can last up to 48 hours. Some organochlorines (endosulfan) are rapidly and easily absorbed through the skin. The nerves stimulating glands are *not* affected so you will not see:

- excessive salivation
- excessive sweating
- excessive eye tearing

(or over-stimulation of small muscles like)

- twitching eyelids

But you will see symptoms that are from disruption of central nervous:

- Muscle Weakness
- Dizziness
- Headache
- Numbness
- Nausea
- Loss of consciousness
- Convulsions
- Vomiting
- Hand tremors
- Staggering gait
- Anxiety/restlessness
- Confusion

Pyrethroids: are irritants to the eyes, skin and respiratory tract. The symptoms last from 1-2 hours. The symptoms from spraying can be:

Normal use:	* Numbness (hypersensitivity of skin) * Shortness of breath (wheezing) * Dry throat * Sore Throat * Burning nose * Skin itching
If ingested:	* Loss of consciousness/coma * Convulsions
High doses:	* Vomiting * Diarrhea * Excessive saliva * Twitching eyelids * Staggering gait * Irritability

Thiocarbamates: are similar to the pyrethroids in that they also are irritants to the eyes, skin and respiratory tract. The symptoms came appear immediately when spraying and can be:

Respiratory tract:	* Dry throat * Sore Throat * Burning nose * Cough
Eyes:	* Eye irritation (burning, itching) * Red eyes
Skin:	* Skin itching * White spots on skin * Scaling skin rash * Red rash

Paraquat: is very toxic to the skin and mucous membranes (inside of mouth, nose, eyes). Particles are too large to get deep into the lungs*, but once paraquat is in the blood it collects in the lungs. If ingested (drink) it is very lethal

Skin:	* dryness, cracks * erythema (redness) * blistering * ulcerations
Nails:	* discoloration * splitting nails * loss of nails
Respiratory tract:	* cough * nosebleeds * sore throat
Eyes:	* conjunctivitis (irritation) * ulceration, scarring, blindness
Ingestion:	* lung fibrosis (stiff lungs) * multi-system organ failure, specifically ⇒ respiratory failure ⇒ kidney failure

* Manufacturer claims

3. Definitions of signs and symptoms.

The difference between a sign and a symptom:

- Sign: something you can observe or see that *requires an examination*
- Symptom: something a person feels but you cannot see. So one must ask questions to elicit the story about the symptoms.

For **signs** there are special exams. On the table below, each sign is bolded and next to it are listed ways to look for the sign. In training it is a good idea to either bring in pictures, a video showing the condition, or find a person in the community with the condition. This will be useful in identifying red eyes, the skin conditions, tremors and staggering gait.

For **symptoms** stories are important. One cannot simply ask…"have you felt x, y, or z"…It is important to use probing to get the information with descriptions about how the symptoms feel. So in questioning, use words to probe…"After spraying have you ever felt short of breath which *feels like* you cannot get enough air?"
On the table below an example of 'feels like' is given for each symptom. But the class must develop their *own feels-like list,* which is more appropriate to their own experience and language.

4. Signs: How to examine for signs.

SIGNS	HOW TO OBSERVE
* **Tremors**	Hands and fingers shake when holding a piece of paper
* **Twitching eyelids**	Ask the farmer to close his eyes and pretend he is sleeping. Look for twitching of the eyelids side to side
* **Excessive sweating**	Look at the forehead and upper lip to see beads of sweat
* **Redness of the eyes**	Both whites of the eye look red
* **Runny nose**	Look to see if the farmer rubs his nose a lot. This is different than a cold. The discharge should be clear while with a cold it is yellow or green.
* **Cough**	Listen to hear if he is coughing a lot (this could be from smoking so ask if this is worse after spraying)
* **Wheezing**	The person makes a whistling sound when they breathe
* **Staggering gait**	Ask farmer to walk in a straight line heel to toe with his arms out to the side. If he cannot walk straight this is staggering. Looks like he is drunk
* **Diarrhea**	too many stools with water
* **Skin redness**	Ask if he has noticed any rashes and look at hands, arms, feet and legs
* **White patches on skin**	Ask if any rashes and look at hands, arms, feet and legs
* **Skin scaling**	Ask if any rashes and look at hands, arms, feet and legs (like fish scales)
* **Loss of consciousness/coma**	Farmer faints, drops to ground and you cannot wake him up
* **Convulsions**	Seizure, all the muscles contract, like babies sometime do when they have a high fever. The eyes roll back and the teeth are clenched, the whole body becomes stiff
* **Vomiting**	everything from the stomach comes out

Some conditions may appear before and after spraying because they could be **chronic** conditions from using pesticides for a long time. The following conditions may be chronic:

- Staggering gait
- Twitching eyelids
- Tremors
- Skin lesions: redness, white patches, scaling etc.

5. Symptoms: How to interview for symptoms.

SYMPTOMS	FEELS LIKE
* Dry throat	Feels like when you wake up in the morning if you have slept with your mouth open
* Fatigue/tired	Feels like after climbing a mountain all day long
* Insomnia (disturbed sleep)	Bad dreams, cannot sleep through the night
* Chest pain/burning feeling	Like it feels when breathing in chilies or smoke
* Numbness	Feels like after you sit on your foot too long…like ants or pins and needles in the skin
* Burning/stinging eyes	Feels like smoke or soap in the eye
* Itching eyes	Feels like when you have pollen in your eyes
* Blurred vision	This is like looking at a movie or picture that is out of focus
* Shortness of breath	Look to see if the farmer is breathing in fast or does he feel he cannot get enough air
* Dizzy	Feels like after you spin around many times
* Nausea	the feeling just before you vomit or how you feel if driving on a curvy road or on a boat in rough seas
* Excessive salivation	Notice if the farmers spits a lot and ask him if he feels there is a lot of spit, like after one eats a lemon
* Sore throat	It hurts to swallow.
* Burning nose	Feels like when you are in the kitchen when someone is frying chilies
* Muscle cramps	Like after playing football all day and the leg muscles seize up, become stiff and hurt
* Headache	A sharp or squeezing pain in the head
* Stomach cramps/pain	Pain like you feel just before having diarrhea
* Skin itching	Like many mosquito bites

One can also ask if the farmer has ever experienced the sign or symptoms. Because a farmer may not want to admit to getting sick from pesticides the wife can be asked for a more accurate story.

6. Other conditions that mimic pesticide poisoning.

There are other illness or conditions have the same sign or symptoms of pesticide poisoning. Because of this it is useful to interview and examine the farmer before and after spraying to know if these things are related to the pesticide or another condition or illness. If the signs or symptoms appear only **after** spraying they are more likely from the pesticide. Here are some examples of other conditions that can cause the same signs or symptoms that the farmer may have **before** spraying: **(Signs are in bold)**

SIGNS OR SYMPTOMS	OTHER CONDITIONS OR ILLNESSES
* Fatigue	not enough sleep
* Insomnia	stress, too many thoughts, worried
* **Staggering gait**	drinking too much whiskey
* **Loss of consciousness/coma**	
* **Convulsions**	
* Dizzy	flu, anemia, heart condition
* Headache	flu, dengue fever, too much whiskey
* **Excessive sweating**	fever, wearing too many clothes on a hot day
* Blurred vision	chronic eye conditions (glaucoma, cataracts)
* Burning/stinging eyes	allergy
* Itching of the eyes	allergy
* **Redness of the eyes**	eye infection
* **Twitching eyelids**	
* **Excessive salivation**	
* **Runny nose**	flu, common cold (discharge yellow or green)
* Burning nose	
* Dry throat	thirsty, dehydration
* Sore throat	flu, common cold, throat infection
* Chest pain/burning feeling	heart condition (occurs with exercise)
* Shortness of breath	too much smoking, heart condition
* **Wheezing**	too much smoking, allergies
* **Cough**	too much smoking, flu, common cold
* Nausea	food poisoning, flu, too much whiskey
* Stomach cramps/pain	food poisoning, flu
* **Diarrhea**	food poisoning, flu
* **Vomiting**	food poisoning, flu
* **Skin redness**	other skin disease (psoriasis)
* **White patches on skin**	other skin disease (psoriasis)
* **Skin scaling**	other skin disease (psoriasis)
* Numbness	
* Itching of skin	scabies
* Muscle cramps	
* Muscle weakness	flu
* **Tremors**	too much whiskey

7. Determining If Signs And Symptoms Are Pesticide Related Or From Another Pre-Existing Condition.

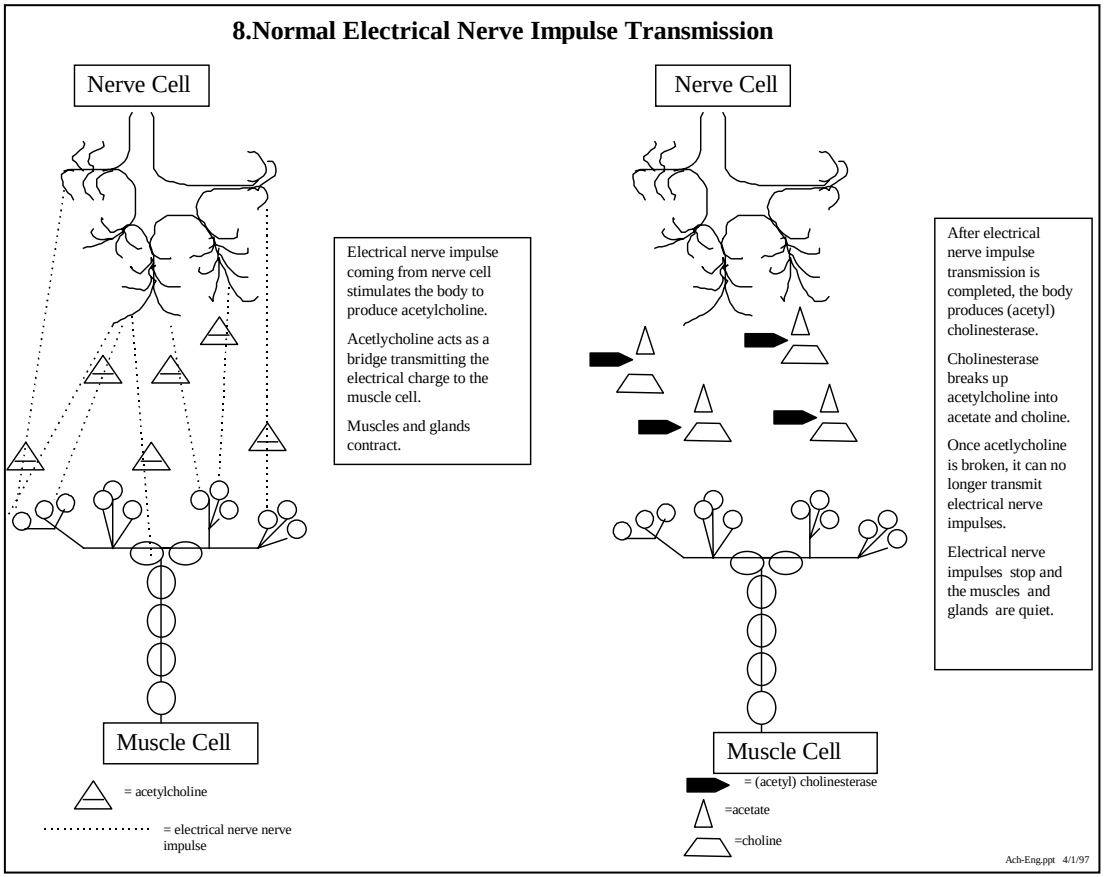
Farmers must be questioned before spraying in case they have signs and symptoms from another ***pre-exiting*** condition that can mimic pesticide poisoning. Also they should be visited the next day in case other signs and symptoms develop later in the day or during the night. For your results, only use the last column which would be more likely to be pesticide related. The exception would be those possible chronic effects:

- Staggering gait
- Twitching eyelids
- Tremors
- Skin lesions: redness, white patches, scaling etc.

Use this table to interpret your before, after and next morning results.

Before spray	After spray	Next morning	=	Pesticide related?
+	+	+	=	No or chronic effect
+	+	0	=	No
+	0	+	=	Unclear maybe (late effect or another problem)
+	0	0	=	No
0	0	0	=	No
0	0	+	=	Yes (late effect)
0	+	0	=	Yes (short effect)
0	+	+	=	Yes (prolonged effect)

(+) = yes
(0) = no


8.Normal Electrical Nerve Impulse Transmission
Nerve Cell
Electrical nerve impulse coming from nerve cell stimulates the body to produce acetylcholine.
Acetlycholine acts as a bridge transmitting the electrical charge to the muscle cell.
Muscles and glands contract.
Muscle Cell
= acetylcholine
= electrical nerve nerve impulse
Nerve Cell
After electrical nerve impulse transmission is completed, the body produces (acetyl) cholinesterase.
Cholinesterase breaks up acetylcholine into acetate and choline.
Once acetlycholine is broken, it can no longer transmit electrical nerve impulses.
Electrical nerve impulses stop and the muscles and glands are quiet.
Muscle Cell
= (acetyl) cholinesterase
=acetate
=choline
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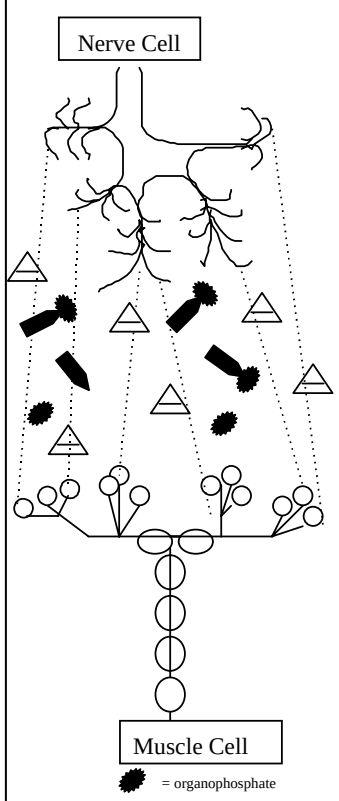
9.Organophosphate-Carbamate Disruption of Electrical Nerve Impulse Therapeutic Effect of Atropine

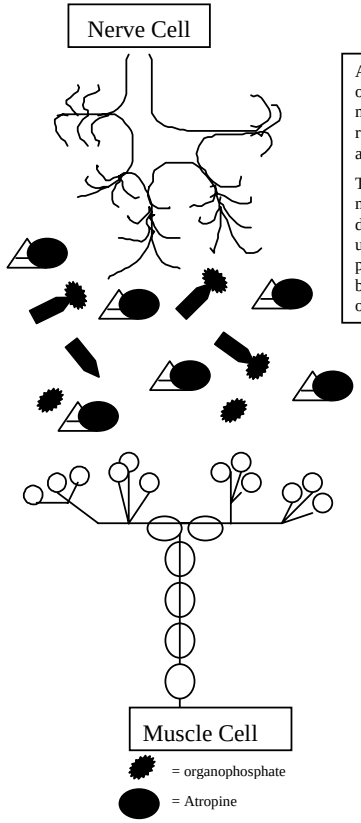


If an **organo-phosphate** or **carbamate** is present, they bind with cholinesterase.

Cholinesterase cannot penetrate acetylcholine to break it up.

The body continues to produce acetylcholine unimpeded.

This results in a build up of acetylcholine with continuous electrical nerve impulse transmission and over stimulation of muscle and glands.



Atropine relieves the over stimulation of the muscles and glands by reducing the amounts of acetylcholine.

The effect only lasts 15 minutes. Therefore the dose must be repeated until the organo-phosphate or carbamate binding effect has worn off.

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Pesticide Chemicals Classified by US EPA as Known,Probable or Possible Human Carcinogens

Group A - Known Human Carcinogens

Arsenic, inorganic
Chromium VI
Ethylene Oxide Group I

Group B1 - Probable Human Carcinogens
(with limited human evidence)

Acrylonitrile
Cadmium
Creosote
Ethylene Oxide
Formaldehyde

Group B2 - Probable Human Carcinogens*
(with sufficient evidence in animals and inadequate or no evidence in humans)

Acetochlor
Aciflurofen, sodium salt
Amitrole
Cacodylic Acid
Captafol
Captan
Chlordimeform
Chloroaniline
Cyproconazole
Daminozide (Alar)
1,2-Dichloropropene (Telone)
1,1-Dimethyl hydrazine (UDMH)
Dipropyl isocinchomeronate (MGK 326)
Fenoxycarb
Folpet
Furmecyclox
Haloxyfop-methyl
Lactofen
Mancozeb
Maneb
Metam Sodium
Orthophenylphenol
Oxythioquinox
Procymidone
Pronamide
Propargite
Propoxur (Baygon)
Propylene Oxide
Terrazole
Thiodicarb
Triphenyltin hydroxide

Group C - Possible Human Carcinogens

Amitraz
Asulam
Atrazine
Benomyl
Bifenthrin
Bromacil
Bromoxynil
Calcium Cyanamide
Carbaryl
Clofentezine
Cyanazine
Cypermethrin
Dacthal
Dichlobenil
Dichlorvos (DDVP)
Diclofop-methyl
Dicofol
Difenoconazole
Dimethenamid (SAN 682H)
Dimethipin (Harvade)
Dimethoate
Dinoseb
Ethalfluralin
Ethofenprox
Fenbuconazole
Fipronil
Fluometuron
Fomesafen
Hexaconazole
Hexythiazox (Savey)
Hydramethylnon (Amdro)
Hydrogen cyanamide
Imazalil
Isoxaben
Linuron
2-Mercapto benzothiazole
Methidathion
Methyl 2-benzimidazole carbamate (MBC)
Metolachlor
MolinateNitrofen
Norflurazon
N-Octyl bicycloheptene dicarboximide (MGK-264)
Oryzalin
Oxadiazon
Oxadixyl
Oxyfluorfen
Paradichlorobenzene
Parathion
Pendimethalin
Pentachloronitrobenzene

Group B2 - Probable Human Carcinogens** *(with sufficient evidence in animals and inadequate or no evidence in humans)*	Permethrin Group C - Possible Human Carcinogens
Acetaldehyde Aramite Azobenzene Bis(chloroethyl) ether Carbon Tetrachloride Chlordane Chloroform 1,2-Dibromo-3-chloropropane (DBCP) Dibromoethane, 1,2 (EDB) -ethylene dibromide] Dichloro diphenyl trichloroethane (DDT) 1,2 - Dichloroethane Dicloromethane Dieldrin Di(2-ethylhexyl)phthalate Epichlorohydrin Ethylene thiourea Heptachlor Heptachlor epoxide Hexachlorobenzene Hexachlorocyclohexane, tech. Lindane Methylene chloride (see dichloromethane) Mirex Pentachlorophenol Perchloroethylene Polychlorinated biphenyls (contaminants Propiolactone Toxaphene Trichloroethylene Trichlorophenol 2,4,6	Phosmet Phosphamidon Piperonyl butoxide Prochloraz Prodiamine Propazine Propiconazole 4-Pyridazine carboxylic acid, 2-(4-chlorophenyl)-3-ethyl-2,5-dihydro-5-oxo-,potassium salt (MON 21200)-post FQPA Pyrithiobac-sodium Simazine Tebuconazole Terbutryn 2-(Thiocyanomethylthio) benzothiazole (TCMB) Triadimefon Triadimenol Triallate Tribenuron methyl Tridiphane Trifluralin Triflusulfuron-methyl Uniconazole Vinclozolin

**** Classified by the Office of Pesticide Programs ** Not Classified by the Office of Pesticide Programs***

Source: U.S. Environmental Protection Agency. Pesticidal Chemicals Classified as Known, Probable or Possible Human Carcinogens. Office of Pesticide Programs. Washington, D.C. 1998.

Compiled by Dr. Marion Moses, Pesticide Education Center, San Francisco CA., 1999.

Pesticides that are Possible Endocrine Disruptors

Alachlor	Fenchlorfos
Aldicarb	Fenitrothion
Aldrin	Fenvalerate
Amitrole	Fipronil
Atrazine	Flucythrinate
Benomyl	Heptachlor
Bifenthrin	Hexachlorobenzene
Bromoxynil	Hexachlorocyclohexane oxynil
Cadmium	Lindane
Carbaryl	Malathion
Carbofuran	Mancozeb
Chlordane	Maneb
Chlordecone (Kepone)	Mercury
Chlorpyrifos	Methomyl
lambda-Cyhalothrin	Methoxychlor
Cypermethrin	Methyl parathion
2,4-D	Metiram
DBCP	Mirex
DDE	Nabam
DDT	Nitrophen (TOK)
Deltamethrin	Ortho-phenyphenol
Dichlorvos (DDVP)	Parathion
Dicofol	Pentachlorobenzene
Dieldrin	Permethrin
Dienochlor	Picloram
Dimethoate	Pyrethrins
Dinitrophenol	Simazine
Dinoseb	2,4,5-T
Endosulfan (thiodan)	Toxaphene
Endrin	Tributyltin
Esfenvalerate	Trifluralin
Ethafluralin	Triphenyltin
	Vinclozolin
	Zineb

Source: Based on data found in U.S. EPA (Environmental Protection Agency) Fact Sheets, RED (Registration Eligibility Documents), and CalEPA (California Environmental Protection Agency) Toxicology Summaries of selected pesticides.

Compiled by Dr. Marion Moses, Pesticide Education Center, San Francisco CA., 1999.

Annex 11: Pesticides That Are Teratogenic (cause Structural Birth Defects) in Laboratory Animals

Pesticides That Are Teratogenic (cause Structural Birth Defects) in Laboratory Animals	
Acrolein	Fenarimol
Abarmectin	Fenoxaprop ethyl
Bacquacil	Fluazifop-butyl
Bitertanol	Folpet
Benazolin-ethyl	Hexachlorobenzene
Benomyl	Kinoprene
Bentazon	Maleic hydrazide
Bromoxynil	Mancozeb
Cacodylic acid	Methyl parathion
Captafol	Methoprene
Captan	Mirex
Carbaryl (Sevin)	Fenamiphos (Nemacur)
Chloramben	Nitrofen (TOK)
Chlordimeform	Ortho-phenylphenol
Chlorpropham	Paclobutrazol
Copper sulfate	PCNB
Cyanazine	Phosmet
Cycloheximide	Picloram
Cyromazine	Propargite (Omite)
2,4-D	Sodium arsenate
Dichlobenil	Sodium arsenite
Dichlorophene	Sodium omadine
DMF	2,4,5-T
2,4-DP (Dichlorprop)	Terrazole
Dinocap (Karathane)	Triadimefon
Dinoseb	Tributyltin oxide
Diquat	Trichlorfon
Endosulfan	Trifluralin
Endothall	Triphenyltin fluoride
Ethion	Triphenyltin acetate
2-Ethyl 1,3-hexanediol	Triphenyltin hydroxide
Ethylene dichloride	Vinyzene
	Warfarin

Sources: U.S. Environmental Protection Agency. Teratogenic Pesticides (as of June 1988), Office of Pesticide Programs, Washington, D.C. 1998. California Environmental Protection Agency, 'Chemicals Known to the State to Cause Reproductive Toxicity', Office of Environmental Health Hazard Assessment, Sacramento, CA. December 26, 1997.

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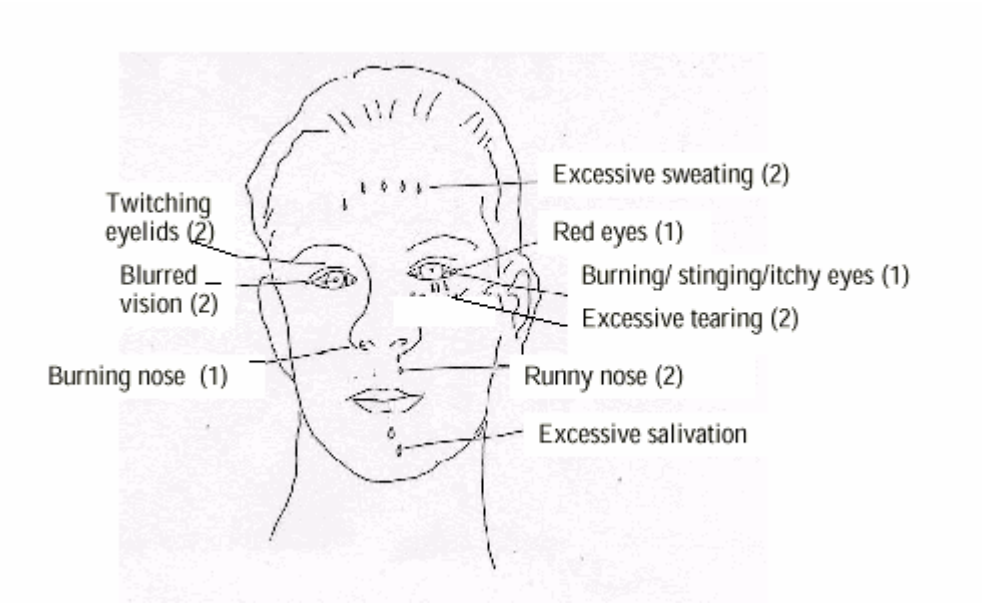
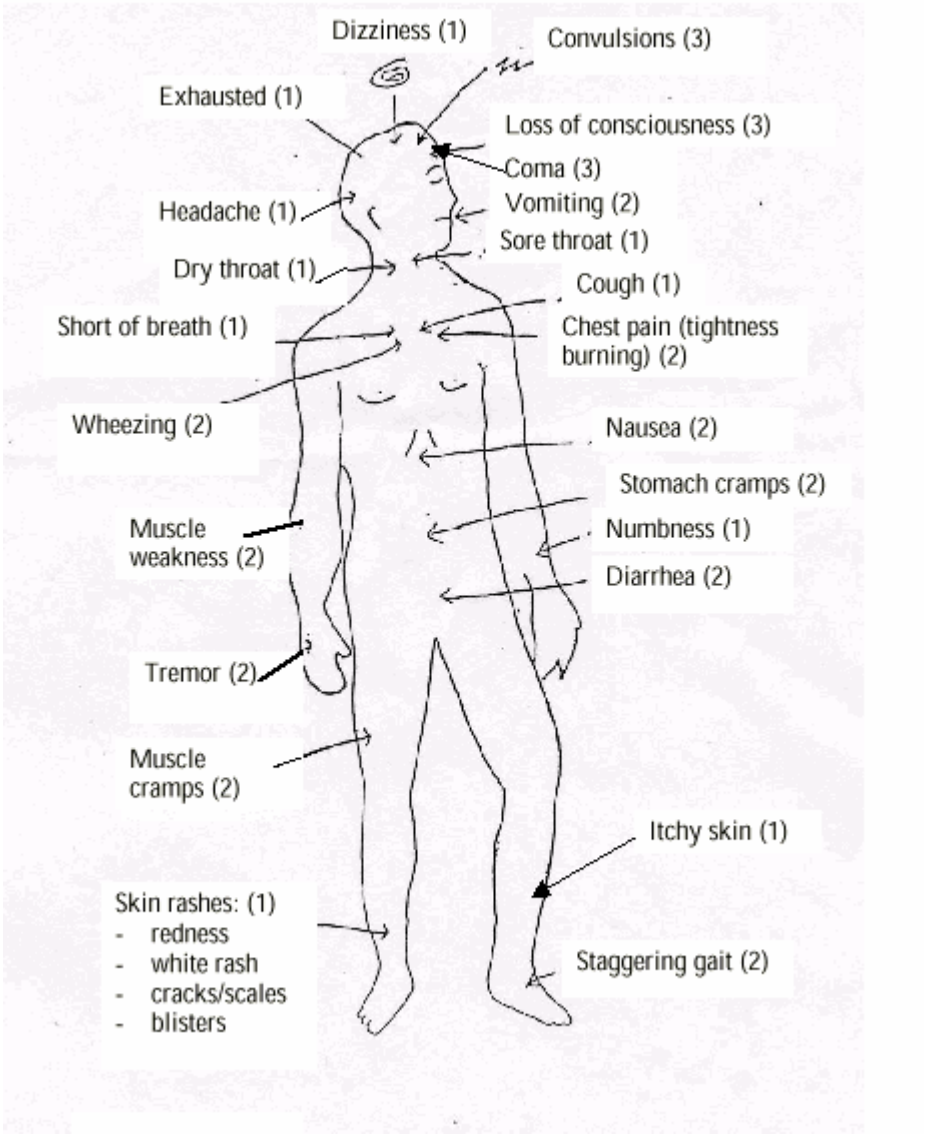

Excessive sweating (2)
Twitching eyelids (2)
Red eyes (1)
Blurred vision (2)
Burning/ stinging/itchy eyes (1)
Excessive tearing (2)
Burning nose (1)
Runny nose (2)
Excessive salivation


Dizziness (1)
Convulsions (3)
Exhausted (1)
Loss of consciousness (3)
Coma (3)
Headache (1)
Vomiting (2)
Sore throat (1)
Dry throat (1)
Cough (1)
Short of breath (1)
Chest pain (tightness burning) (2)
Wheezing (2)
Nausea (2)
Stomach cramps (2)
Muscle weakness (2)
Numbness (1)
Diarrhea (2)
Tremor (2)
Muscle cramps (2)
Itchy skin (1)
Skin rashes: (1)
- redness
- white rash
- cracks/scales
- blisters
Staggering gait (2)