



TOXICOLOGY IN THE CLASSROOM

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Preface

Project: Training of school children on pesticides and health -
“Toxicology in the classroom”

OBJECTIVE

The project aims to raise awareness among young students about potential side effects of chemicals and help to reduce careless use and handling of pesticides and other chemicals. The teaching tool will help to provide basic understanding of toxicology and awareness of the need for protective and precautionary measures to minimise adverse effects on human health and the environment.

This teaching tool is for use by chemistry/biology/science teachers in the early years of secondary school. The material is targeted to pupils at the end of primary school and/or the beginning of secondary or middle school to teach them to understand the action and hazards of pesticides, the importance and principles of safe handling, protection of themselves and others from harmful effects of pesticides.

INTRODUCTION

Infants and children are particularly vulnerable to pesticides and other toxic chemicals because their bodies are smaller and still developing. Children also face greater exposures than adults due to their hand-to-mouth behaviours. Children living in farming areas or whose parents work in agriculture suffer greater pesticide exposure than other children.

Non-chemical methods exist to prevent or manage pests. Integrated Pest Management (IPM) and Integrated Vector Management (IVM) apply different methods, trying to reduce the use of chemicals to a minimum. Despite this, pesticides are much used in farming economies of today, and for managing vectors of disease, especially in developing countries and countries with economies in transition. Pesticides are applied to kill pests, but they can also adversely affect non-target organisms, including humans.

Who developed the tool?

This teaching tool has been developed by the United Nations Environmental Programme (UNEP) and the World Health Organisation Regional Office for Europe (WHO EURO) and the National Poison Centre of Universiti Sains Malaysia (NPC-USM) with initial support from the International Union of Pure and Applied Chemistry (IUPAC).

Acknowledgement

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Overview

This teaching tool aims at making students more aware of the dangers of chemicals, and what they can do to avoid them. Poisonous chemicals are more dangerous for children because their bodies are smaller and still developing. Children living on farms may be affected by pesticides.

Depending on the time available, the teacher will decide which sections should be studied at a minimum. The questions and activities may be used to check if students have understood the content of the teaching tool. Difficult words are explained in the glossary.

In **What are chemicals?** students will be introduced to the chemicals around them. More information can be found in **What are potentially hazardous chemicals?** Students can check what they have learned in **Poisons in the house.**

What are the dangers of chemicals? See **What is poisoning?** for an introduction, and for more

information **Effects of pesticides** on people.

Who studies poisons? In **What is toxicology,** students will learn more about the science of poisons. Students can also do (virtual) **Experiments** on the role of the dose in poisoning.

Pesticides are chemicals. See **What is a pesticide?** for a first introduction and **Use of pesticides** for more information on what they are used for.

In **What to do in case of poisoning?** Students will learn what to do if poisoning occurs.

In **How poison can get into your body?** students will learn how poisons move through the body. In **Pathways through the environment** they will learn how poisons move through the environment.

To avoid dangers of toxic chemicals, students need to know **How to identify a toxic product, understand the label?** and what are **Risky situations with toxic**

chemicals/pesticides. What can be done to protect people from toxic chemicals and pesticides? See **Personal protection when using pesticides** and **Protecting younger children, sisters and brothers.**

What can be done to protect the environment? See **Protecting the environment.** One important thing that can be done is separating wastes containing chemicals, see Disposal of toxic wastes.

If you have time, you can go to **Story Telling, Animation** or **Game** or look for more information on the **Teacher's References.**

Course Content

Course goals

1. to make students aware that pesticides and (other household chemicals) can be harmful to health and the environment
 2. to educate students on protecting themselves, others and the environment from the harmful effects of pesticides
 3. to develop a safety culture and environmental awareness among students and their families
- protective equipment, better personal hygiene, etc.) and on the potential dangers, to themselves, their families and the environment.

Course Objectives

1. The course will provide a foundation of knowledge about potential adverse effects of chemicals found in households with a focus on pesticides. It can serve as part of an introduction to Basic Environmental Health at school. Educating young people about needs for protection from exposure to chemicals and especially pesticides is important world-wide. The tool focuses to a large extent on pesticides, the adverse effects they may have and how to minimize the risks by personal protection and protection of the environment.
2. Attention is given to raise awareness of students on a range of options on how to avoid exposures (use of

3. This instructional courseware targets pupils at the end of primary and beginning of secondary schools. They should be encouraged to take their newly acquired knowledge home and discuss the dangers and judicious use of pesticides and household chemicals with their parents and other family members, especially if they are involved in farming operations. Small scale farmers do not always have the required training or capacity to use and handle pesticides in a judicious manner. Many are not even aware of the toxic properties and potential risks of these chemicals. Pesticides are often misused for purposes they are not intended for. Teachers are encouraged to discuss with the school children how the pesticides and other chemicals are stored and handled in their homes/family farm and advise them how they may raise awareness within their family, of measures that would improve the safety in their homes and on the family farm.

Knowledge and skills

The teaching materials build on the basics of science, chemistry and biology that students are normally getting at the end of primary and the beginning of secondary school: handling chemicals with care, functions of the main organs of the human body, food chains and food webs. The course includes general facts about chemistry, chemicals, pesticides, poisoning, how chemicals, especially pesticides and POPs can affect human health and the environment, protection of themselves and others and the environment from harmful effects.

Teaching materials

The teaching materials are in the form of Instructional Interactive Multimedia (IIM) courseware (CD-ROM format) as well as a hard-copy booklet. A user manual is available. In addition a pdf will be placed on internet. Teachers can also use pages by copying and pasting them from the CD-ROM or printing the pdf.

Teachers can choose to follow the entire course or select more basic sections according to the level of the students. Each chapter includes learning goals. There are numerous illustrations and a number of animations which the students can discuss in class.

To take in information into long-term memory, pupils need to be actively engaged. Therefore

multiple choice questions, open-ended questions, study activities and virtual experiments are provided. Additional information is available in the form of a glossary and a selection of further references. Games, stories and discussions enliven the course.

Target audience/students

Age group at school

Target groups are school children between upper primary school and lower secondary school. These children are in the transition from guarded childhood to more independent youth and might be at higher risk because of independent activities. Also students of this age group might be responsible to look after their sisters and brothers and influence behaviour of younger children.

Regions (countries, societies) of interest

The Instructional Interactive Multimedia (IIM) courseware is designed and developed primarily for developing countries in Asia, South America and Africa. The basic material is written in English, in a simple wording which is easily translated into other national or regional languages.

Contents of the Instructional Interactive Multimedia (IIM) courseware

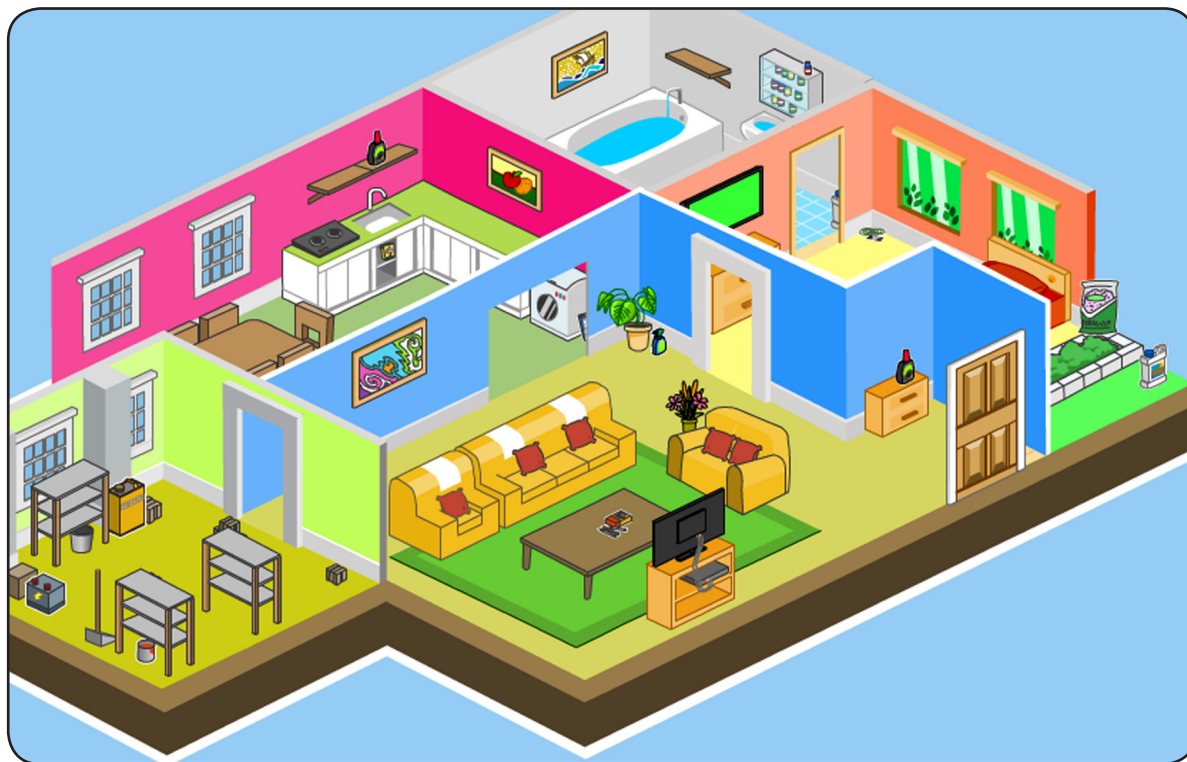
1. What are chemicals?
2. What are potentially hazardous chemicals?
3. What is poisoning?
4. What is toxicology?
5. What is a pest?
6. What is a pesticide?
7. Use of pesticides
8. Effects of pesticides on people
9. What to do in case of poisoning?
10. How poison can get into your body?
11. Pathways through the environment
12. How to identify a toxic product and understand the label?
13. Risky situations with toxic chemicals/pesticides
14. Personal protection when using pesticides
15. Protecting younger children, sisters and brothers
16. Protecting the environment
17. Disposal of toxic waste

What are Chemicals?

Learning Outcomes

The student is able to:

- state at least three (3) examples of chemicals used in everyday life.



Chemicals around us

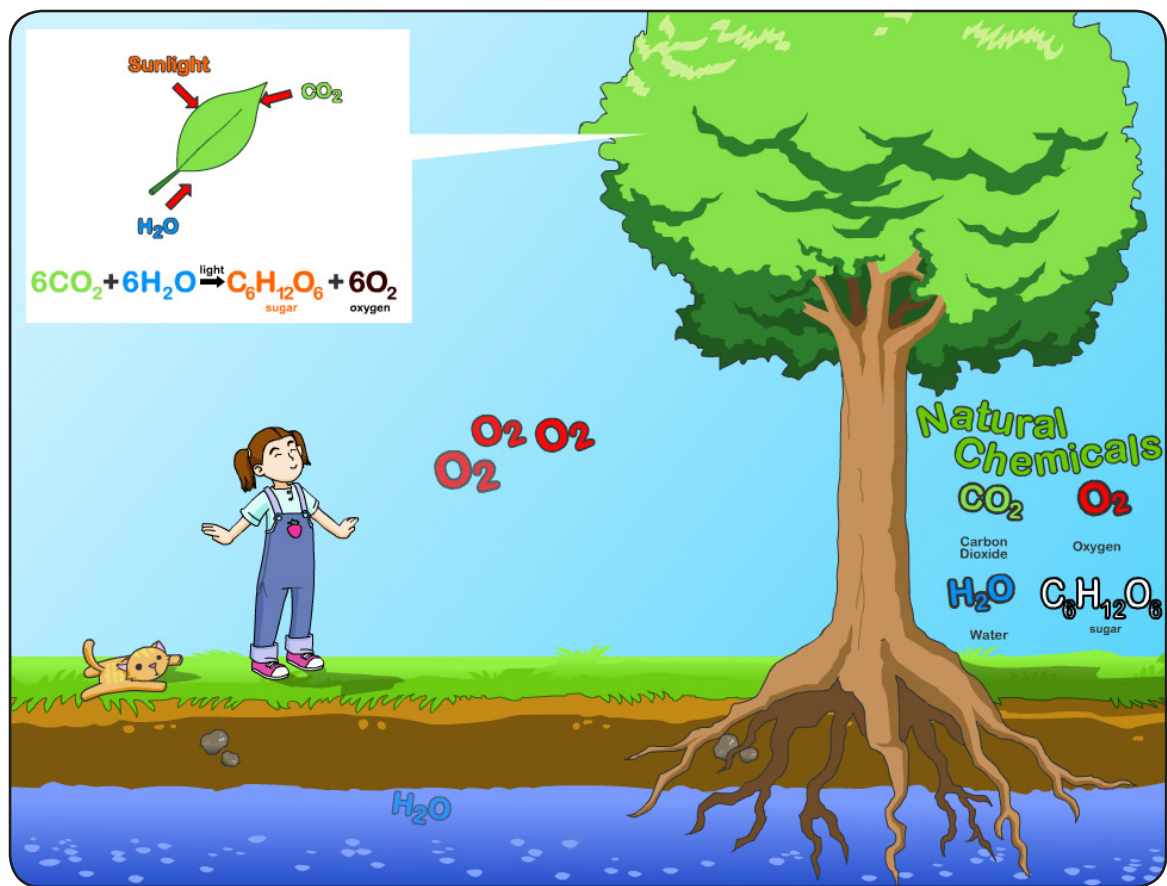
Do you know that all of us are exposed to chemicals everyday?

Chemicals everywhere

Everything is made of chemicals. We are all made of chemicals. There are many chemical processes going on in our bodies.

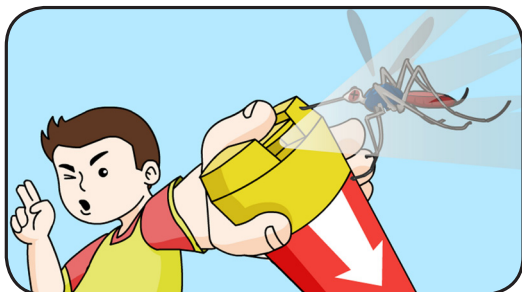
Plants can transform simple chemicals like carbon dioxide (in the air around us), water and minerals from the soil into the building stones of life. Those are more complicated chemicals like sugars, proteins and fats.

Plants and animals are continuously making and breaking down chemicals. They use chemicals to send messages from one part to another, or to prevent animals from eating them. People use many naturally made chemicals.

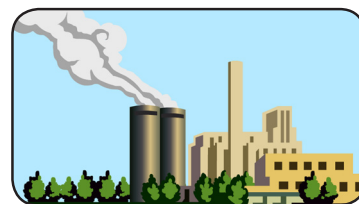


What are chemicals?

During the past century, people became very good at making chemicals. We make clothes from artificial fibres and dyes to colour them. We have detergents to clean our house and use flame retardants to stop things from burning. There are chemicals in the cosmetics we use every day, from nail polish to hand lotions. We make pesticides to kill pests.



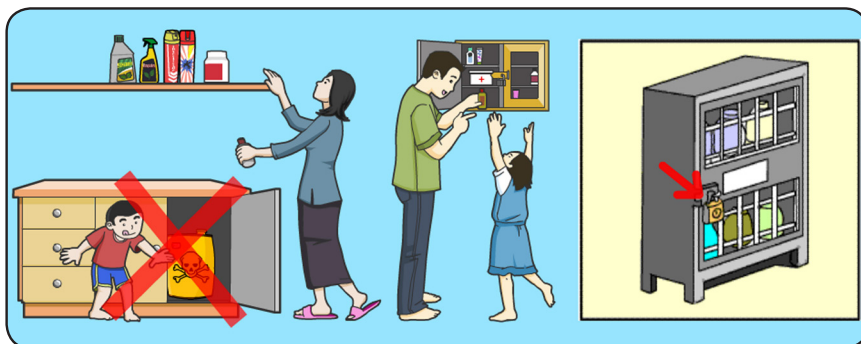
We use chemicals in many products, for example mercury in energy saving lamps. We use chemicals when making products like electronics or during processes like dry cleaning. Sometimes we make chemicals without really wanting to, like dioxins which form when burning chlorine containing materials such as PVC plastics and municipal waste at low temperatures.



All in all, we use several hundred thousand different kinds of chemicals. Some of these turned out to be dangerous to our health. They interfere with the chemical processes going on in our body.



Chemicals such as those that are used to kill pests, to clean the toilets, sinks and drains, as well as those for washing are potentially dangerous.



Chemicals should be stored out of reach of children, preferably in a locked cabinet.



You may also be exposed to chemicals outside your house in places where you play. Beware of garbage with unused chemicals or empty containers, and freshly sprayed fields. You can be harmed by these chemicals!

TEACHER'S GUIDE

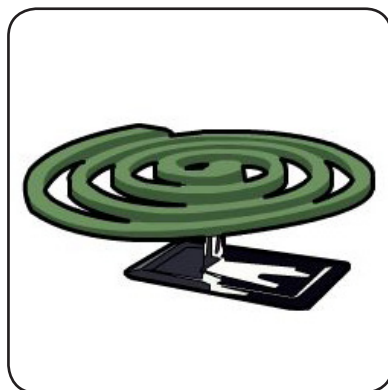
Discuss the text and visual display.
 Recall a real-life experience seeing and noticing chemicals in the surroundings.
 Ask students to recall occasions where they may have had a bad experience with chemicals.

What are Potentially Hazardous Chemicals?

Learning Outcomes

The student is able to:

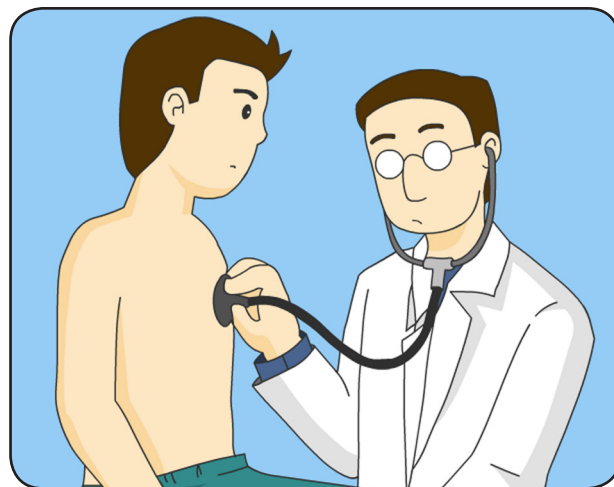
- describe the characteristics of toxic chemicals
- describe how we can tell if a chemical is toxic
- name at least three examples of toxic chemicals or pesticides that could be found in the:
 - a. house.
 - b. garden or play area
 - c. farm or work place



What are toxic chemicals?

Chemicals can be toxic to both humans and the environment. Toxic chemicals have the risk of causing harmful health and environmental effects. Their effects can be seen immediately or may occur after sometime. Some chemicals are hazardous because of their physical properties: they can explode, burn or react easily with other chemicals.

Chemicals that are persistent, bio-accumulative, carcinogenic, mutagenic or toxic to reproduction are of high concern. Persistent Organic Pollutants (POPs) are examples of toxic chemicals (see What is a pesticide).



How do we know which ones are toxic?

Scientists study the toxic effects of chemicals on lab animals, ecosystems and people who are exposed to them. Toxicity of a chemical is usually determined with tests on animals and ecosystems. After such tests chemicals are classified and labeled according to their toxicity.

Some people and age groups such as children, elderly, pregnant women and fetus maybe more sensitive to some chemicals. These issues should be taken into consideration when classifying chemicals. Use of highly toxic substances is often under state control and may be restricted to certain uses.



What chemicals should people be concerned with at home?

Pesticides are examples of toxic chemicals found at home that people should be concerned with. These include:

- rodenticides (poisons for rats and mice)
- insecticides, for example sprays and baits against cockroaches, termites, ants or moths
- shampoos against lice
- insect repellents

- weed killers (herbicides)
- products used against mould or mildew (fungicides)
- flea and tick shampoos, powders, and dips for pets

Agricultural pesticides are often more dangerous than household pesticides and should not be used at home.



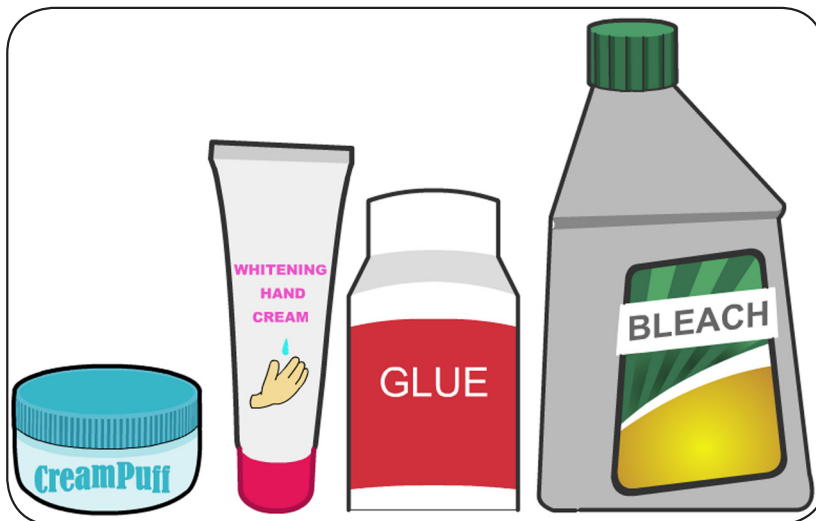
What chemicals should people be concerned with at home?

Other toxic household chemicals are:

- bath and kitchen cleaners and disinfectants, detergents, bleach, caustic soda and lamp oil
- drain cleaners, paints, solvents, glues, windshield washer fluid for the car
- beauty care products such as hair and nail products
- medicines

These chemicals should be used according to instructions on use of the product.

Objects that contain toxic chemicals such as energy efficient lamps and old thermometers with mercury, may also be found in the home.



TEACHER'S GUIDE

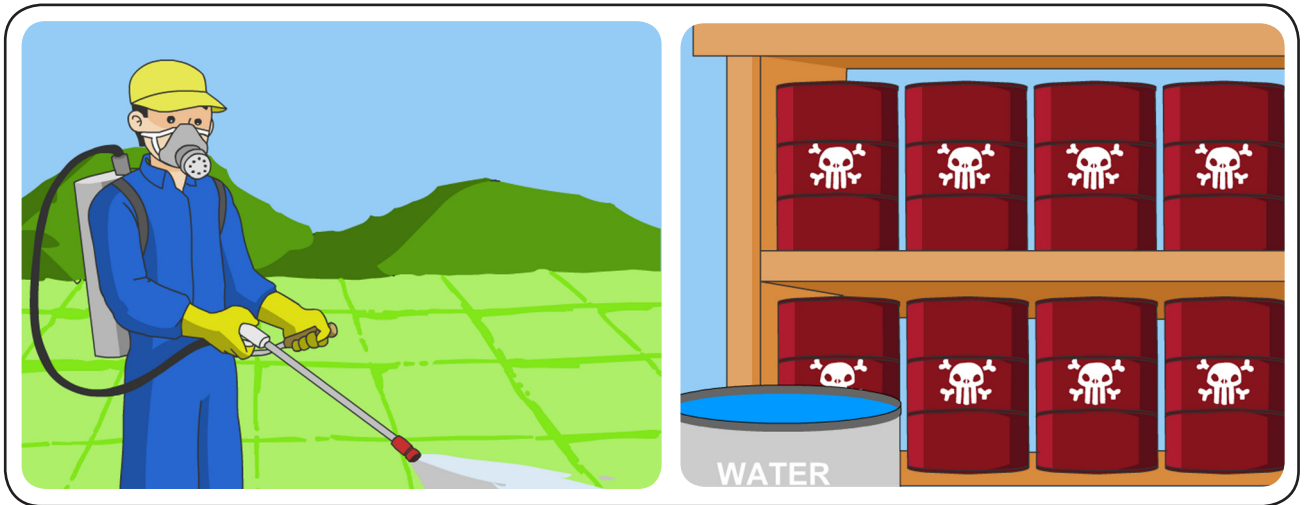
Discuss chemical substances commonly found at home. Use "Poison in the House" as a guide for discussion with the students.

What is poisoning?

Learning Outcomes

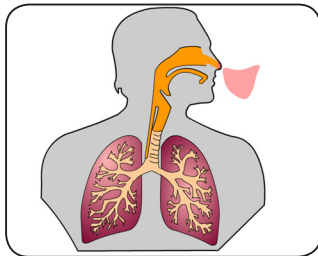
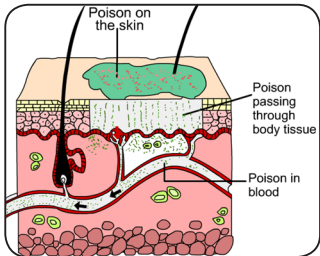
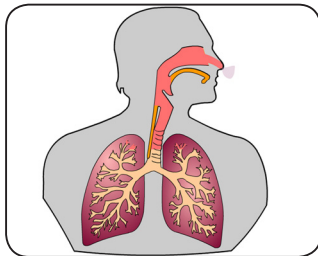
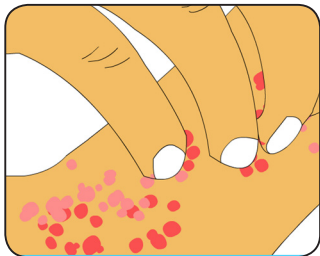
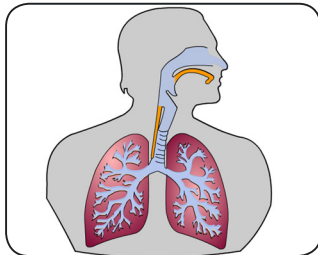
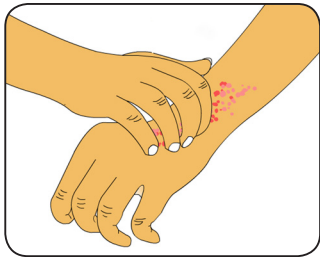
The student is able to:

- state the meaning of poisoning
- state at least three (3) toxic chemicals that can cause poisoning
- describe the effects of poisoning on human health



What is poisoning?

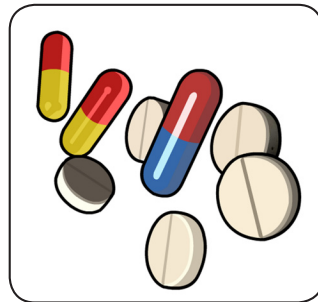
Poisoning occurs when a substance adversely interferes with normal body functions after it is swallowed, inhaled, injected, or absorbed.



Chemicals that can cause poisoning

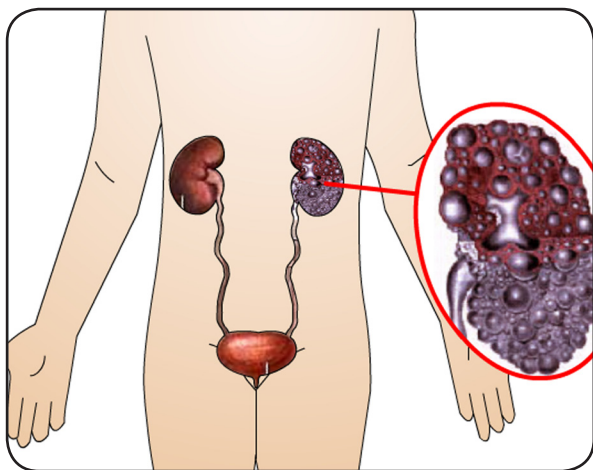
There are different types of chemical substances that we can be exposed to in the home and workplace. Products that are not meant to be ingested or inhaled, such as shampoos, paint thinner and pesticides will also make you ill if ingested.

Other products can be ingested in small quantities but are harmful if taken in large amounts, such as medicines, medicinal herbs, or alcohol. Naturally occurring chemical substances include some plants, bacterial toxins that can cause food poisoning such as Salmonella and the venom found in the bites and stings of some animals and insects.



Poisoning disrupts the normal functioning of the body. Different poisons have different effects. Poisons often affect the nervous system, respiratory system, gastro intestinal tract (GIT) and/or liver and kidneys.

Poisoning can cause skin rashes, tiredness, dizziness, muscle weakness, headache, stomach cramps, vomiting, nausea, fainting and/or coma. These may occur within a short time.

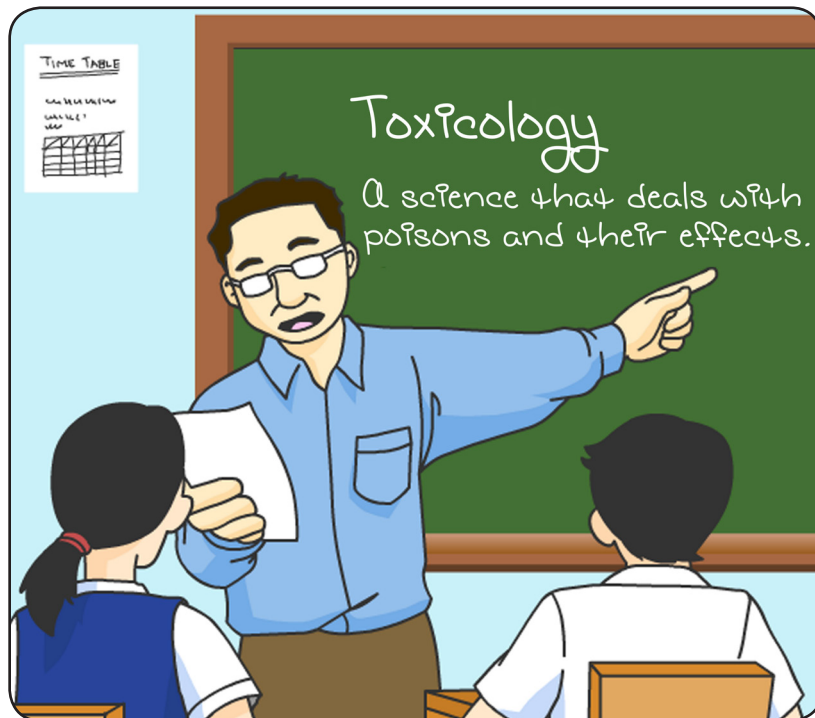


What is toxicology?

Learning Outcomes

The student is able to:

- explain what Paracelsus said about poisons
- state the meaning of toxic, toxicity and toxicology
- describe two factors that affect toxicity
- state the meaning of dose, acute exposure and chronic exposure
- perform a (virtual) experiment on the dose response relationship



Paracelsus

A well-known scientist who defined **POISON**

Paracelsus said:

- all substances are poison
- the DOSE will determine whether it can cause poisoning or not



Toxicology

- A science that studies poisons and their effects.
- It is through toxicology that we know which chemicals are toxic and how they work.



TEACHER'S NOTE

Recall what we have learnt in "How do we know which chemicals are toxic?"

Toxic: Poison

Substances that can make you feel sick or even cause death.



Nausea



Diarrhoea



Dizziness



Headache



Vomiting



Illness



Weakness



Shivering

Toxicity: Dose

- Toxicity is the ability of the chemical to cause injury, illness, death.
- Toxicity depends upon the dose which is the amount your body takes in
- The higher the toxicity, the more harmful or dangerous the chemical is.

TEACHER'S GUIDE

Relate the degree of toxicity and dose to human health. Relate effects of amount on response using example. Use dose-response experiments as an aid to thinking about pesticide use in everyday life.

Go to the Experiment

TEACHER'S NOTE

Care must be taken when taking medicines because some are very toxic even in small amounts. Instructions must be followed carefully.

The cells of some plants e.g. diffenbachia contain calcium oxalate crystals. If leaf is chewed can cause temporary burning sensation and erythema (redness of the skin).

VERY TOXIC CHEMICALS

Dose: a small amount makes you ill

Examples



Rat Poison



Pesticide & Insecticides

LESS TOXIC CHEMICALS

Dose: a large amount makes you ill

Examples



Mosquito Mat



Mosquito Coil

OTHER TOXIC CHEMICALS

Dose: an excessive amount makes you ill

Examples



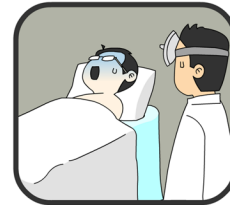
Vitamin



Plant

Toxicity: Duration

Acute Exposure: Short term exposure

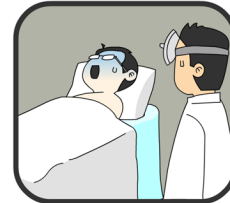


Acute toxicity shows up more quickly and can be fatal. Commonly, children are more sensitive to toxic substances.

For many substances the acute toxic effects observed from a single exposure, (one time contact with it), may be quite different from that of repeated exposures.

An example is alcohol, acute effects are getting drunk or even falling into a coma.

Chronic Exposure: Long term exposure



Chronic toxicity shows up after a long period of time. People can appear healthy despite having high levels of poisonous substances such as pesticides in their blood.

Chronic poisoning is much more complex and its signs are difficult to see and can develop after a long time, repeated or continuous exposure to small amounts of a substance.

In our example of alcohol, chronic effects are liver cells dying (cirrhosis) or dementia in old age.

TEACHER'S GUIDE

Discuss and differentiate between dose and duration of exposure.

TEACHER'S NOTE

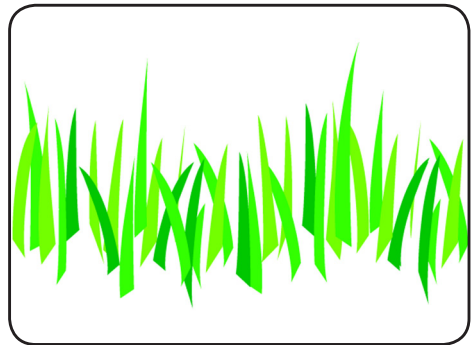
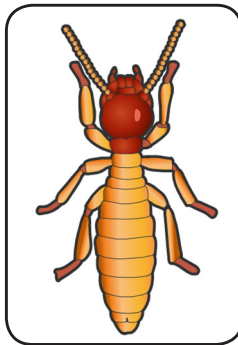
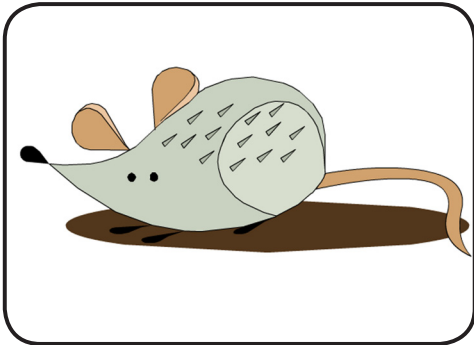
The difference between acute and chronic poisoning is the time between exposure to the poison and the effects. Acute poisoning occurs very quickly (normally within 1 to 2 days) whereas chronic poisoning symptoms manifest much later (months to years).

What is a Pest?

Learning Outcomes

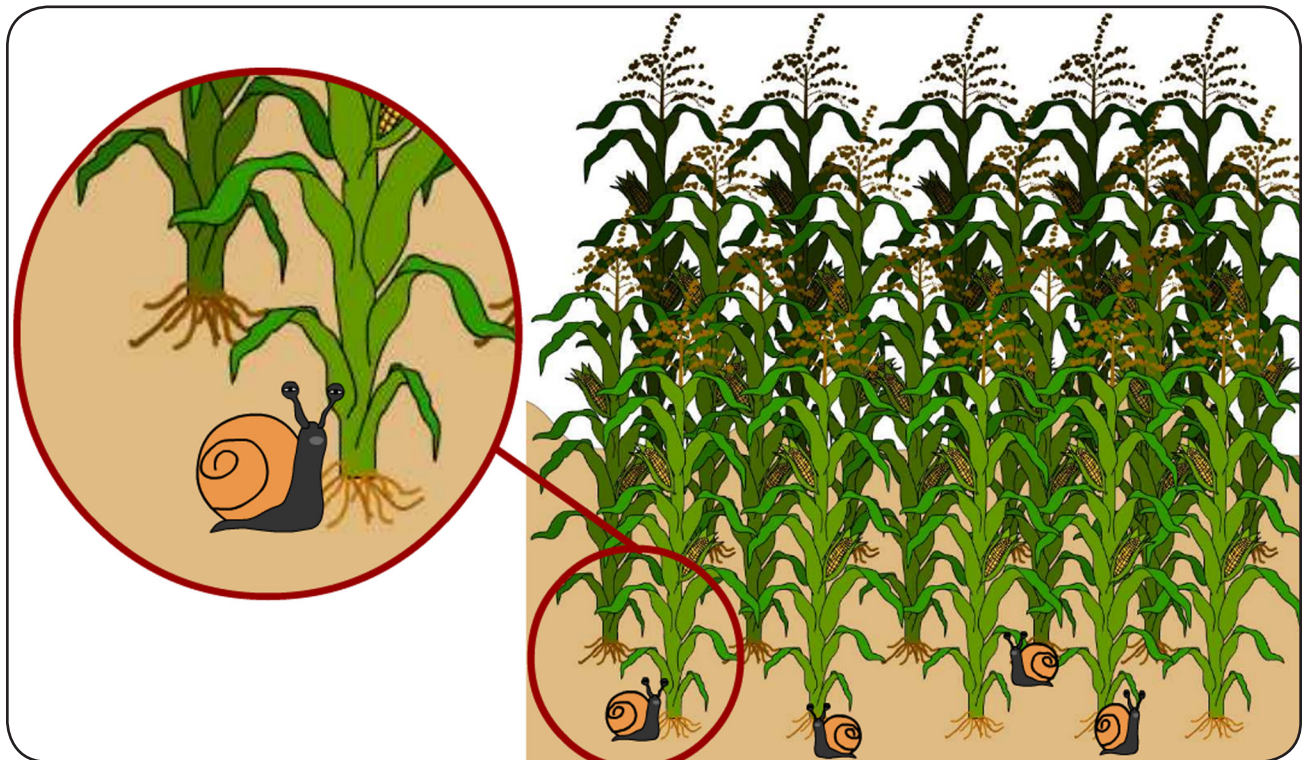
The student is able to:

- state what a pesticide is
- state at least three (3) examples of pesticides
- describe briefly the types/classes of pesticides and their uses
- describe what to do before using pesticides



What is a pest?

Pests are organisms that can cause harm to crops, humans and constructions. Snail is an example of a pest. It feeds on crops.



TEACHER'S GUIDE

Discuss how other pests such as termites and cockroaches can cause harm to crops, humans and buildings. Ask children to name pests they know.

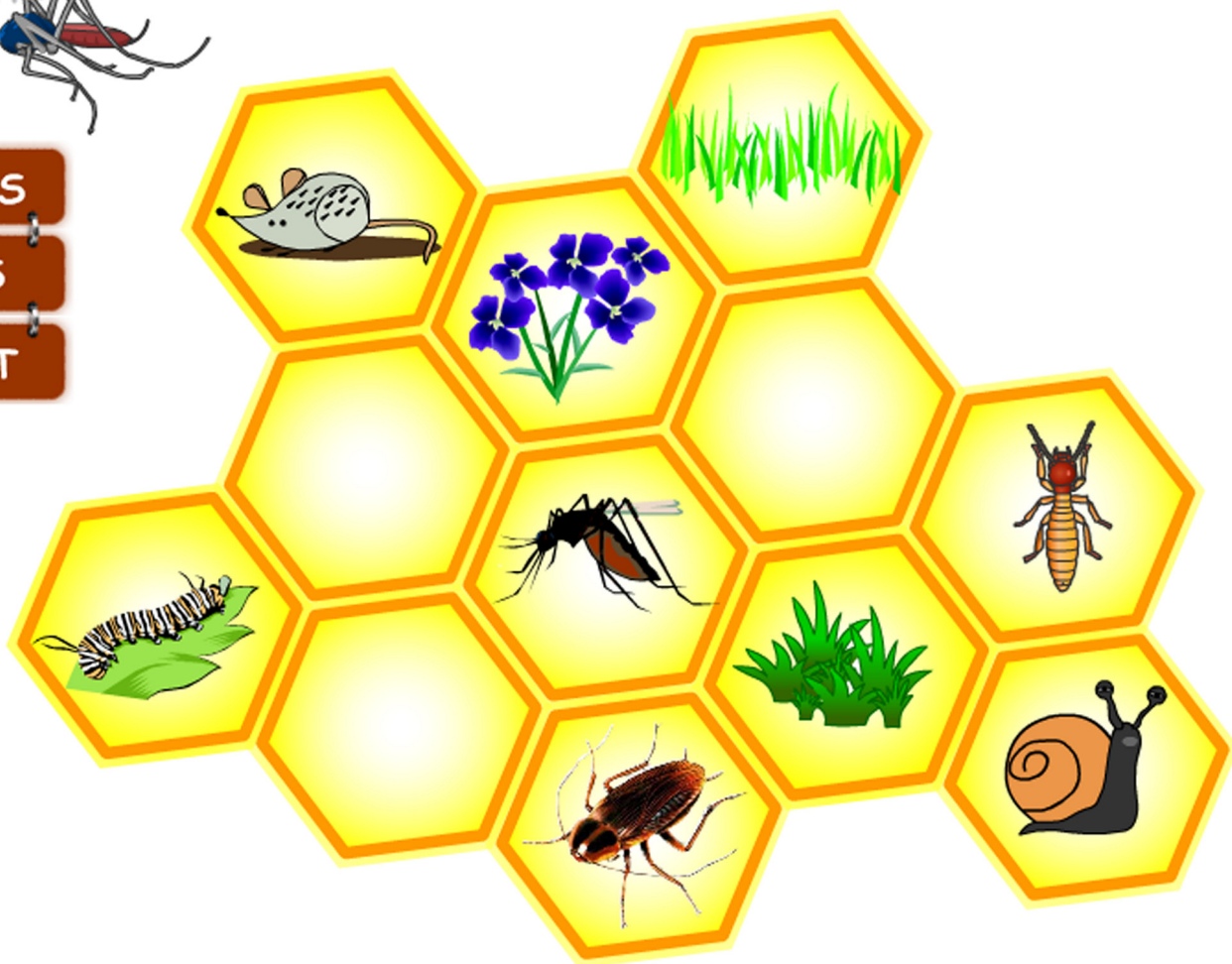
Examples of pests



INSECTS

WEEDS

RODENT

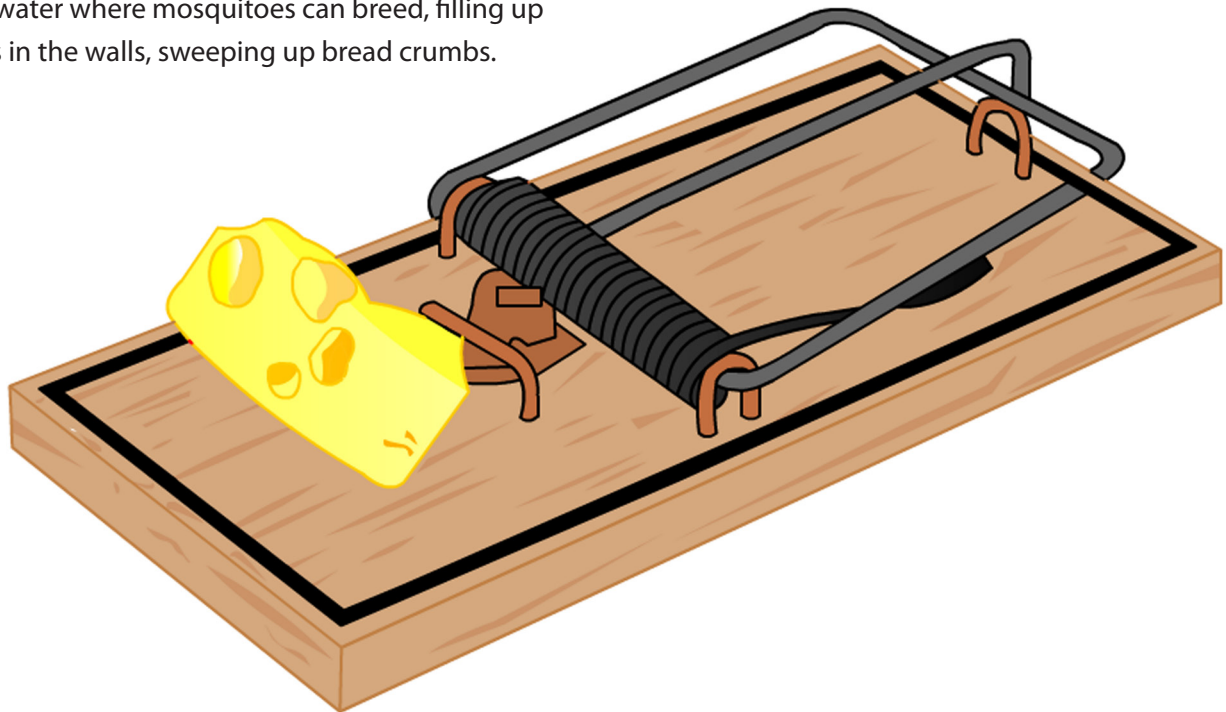


Managing pests

There are several ways of managing pests. Integrated Pest Management (IPM) uses different methods, chemical (pesticides) and non-chemical, trying to minimise the amounts of chemicals used.

The reason is that chemicals can have harmful effects on people and animals. Sometimes the pest becomes resistant to them, spraying pesticides does not help any longer.

Examples of non-chemical methods for in/around the house are: prevention by removing breeding places/ food/water where mosquitoes can breed, filling up cracks in the walls, sweeping up bread crumbs.

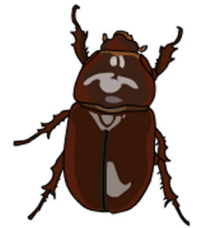
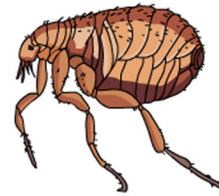


What is a Pesticide?

Learning Outcomes

The student is able to:

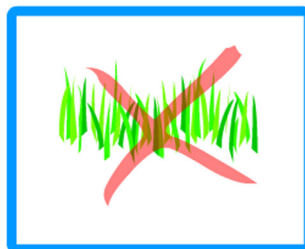
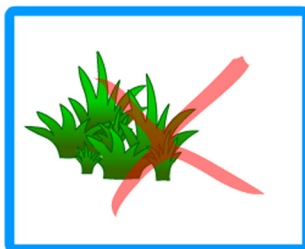
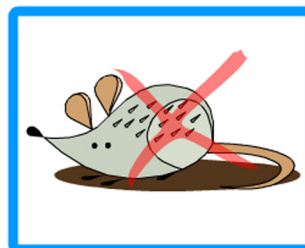
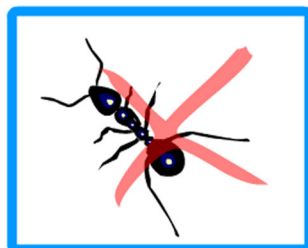
- state what a pesticide is
- state at least three (3) examples of pesticides
- describe briefly the types/classes of pesticides and their uses
- describe what to do before using pesticides



What is a pesticide?

Pesticides are chemicals used to PREVENT or KILL PESTS.

PREVENT OR KILL PEST



Types of pesticides



Insecticides

Kill insects and other arthropods.

Rodenticides

Control mice and other rodents.



TYPES OF PESTICIDES



Herbicides

Kill weeds.

Fungicides

Kill fungi causing plant diseases.



Which are very toxic pesticides?

The classification used in many countries is the World Health Organization (WHO) recommended classification of pesticides by hazard.

Pesticides are classified by toxicity from Class **Ia** being the extremely hazardous to **U** unlikely to present acute hazard.

TEACHER'S GUIDE

WHO Class	LD ₅₀ for the rats (mg/kg body weight)	
	Oral	Dermal
Ia Extremely hazardous	< 5	< 50
Ib Highly hazardous	5-50	50-200
II Moderately hazardous	50-2000	200-2000
III Slightly hazardous	Over 2000	Over 2000
U Unlikely to present acute hazard	5000 or higher	

The LD 50 is the dose that kill half (50%) of the animals tested (LD = lethal dose). The animals are usually rats or mice although other animals such as rabbits are sometimes used.

Some pesticides are POPs

POPs are Persistent Organic Pollutants. Persistent means that they remain intact in the environment for long periods, they are not easily degraded.

They accumulate in body fat, concentrate through food webs, cause harmful effects on wildlife, and pose a risk for human health.

They travel far from where they have been used. For example high concentrations have been found in the blood of Inuit peoples in the Arctic, where such chemicals have never been applied.

Examples are insecticides like DDT and dieldrin and several industrial chemical products (some brominated flame retardants) or byproducts (PCDD dioxins).

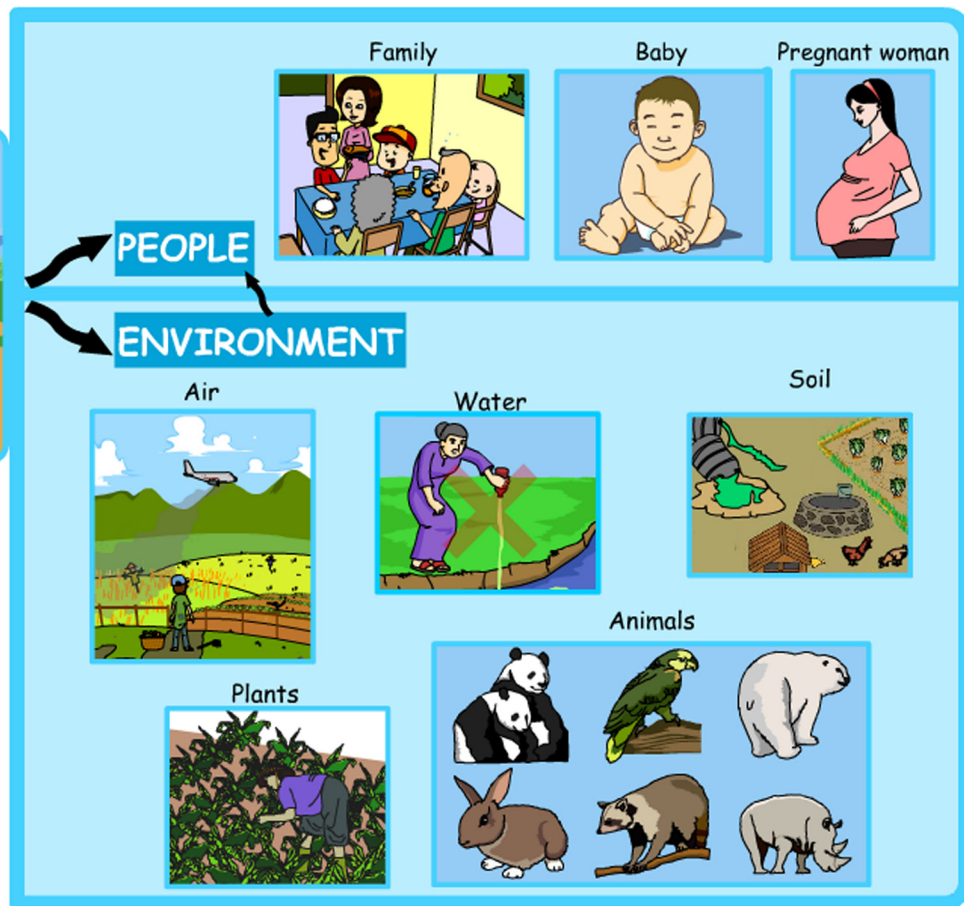
The Stockholm Convention (SC) is a global treaty that aims at protecting human health and the environment from POPs by reducing or eliminating their release. A majority of countries have now signed the convention.

DDT was very widely used and caused problems for wildlife, for example eggshell thinning in predatory birds. It was found everywhere, even in human milk. DDT may now only be used exceptionally for disease vector control, under certain conditions, for example indoor residual spraying.

TEACHER'S GUIDE

Go to "Pathways through the environment" and discuss how pesticides move from one place to another and how they accumulate in the food chain.

Exposure to pesticides



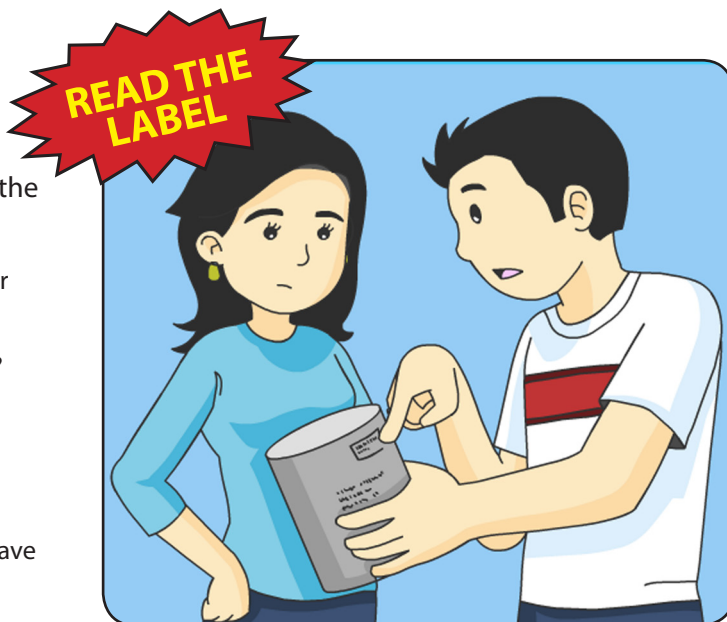
TEACHER'S NOTE

Widespread use and disposal of pesticides (by farmers, agricultural related institutions and the general public) provide many possible sources of pesticides in the environment.

What to do before using pesticides?

Before buying/using pesticides or toxic chemicals, the following questions should be answered:

- Is it really necessary to buy/use this chemical, or are there other solutions?
- Is there a less toxic product which can be used?
- Is this the right product for the problem?
- What does the label say about protective measures? What is the right amount to apply?
- How much should I buy/ prepare so as not to have leftovers?



Use of Pesticides

Learning Outcomes

The student is able to:

- explain the role of pesticides in agriculture, vector control and the house
- describe briefly two problems with pests that can occur with pesticide use
- state ways in which pesticide use can be minimised
- explain briefly what integrated pest management is
- explain the meaning of the restricted use of pesticides



Use of pesticides in agriculture

In agriculture, pesticides are often used against weeds, fungi causing plant disease and insects. Rodenticides can be used against mice or rats which eat stored grain.

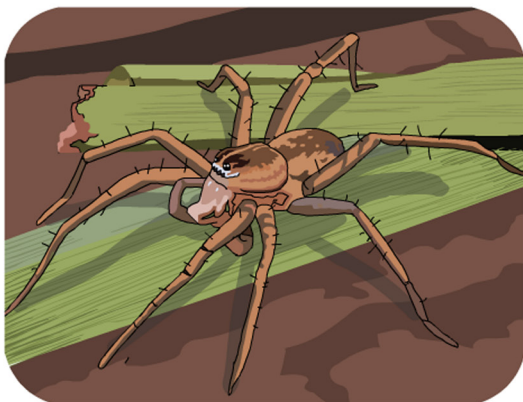
Pesticides can have adverse effects on health and the environment. They may harm other plants and animals than those they are intended for.

Pesticides also do not always work. For example: insects can become resistant to them, they can

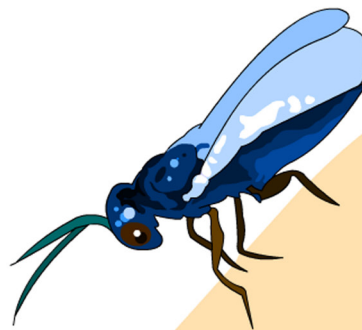
survive after being sprayed. Sometimes other insects, which were not a problem before, increase and cause unacceptable damage. This can happen when predators which used to eat them are killed. Predators can be other insects, or spiders for example.

Pesticides are also expensive. They should not cost more than the loss of money caused by the pest.

Because of this, pesticides should be used as part of an Integrated Pest Management Programme.



Spiders are important predators, for example of rice pests. This one will eat as many as 20 rice pests per day.



Parasitic wasp on rice pests' eggs.

Integrated pest management

With Integrated Pest Management farmers try and use less chemicals. They combine different ways to manage pests. Often they earn more money that way because they spend less on pesticides.

Examples of ways of using less chemicals are:

- Preventing pests. Keeping plants healthy. Planting at the right time, right distance between plants.
- Using kinds of plants which do not get disease (“resistant/tolerant plant varieties”).
- Preventing the development of pests by changing crops from year to year (“crop rotation”) or combining different crops on a field (“multiple cropping”).



More ways of using less chemicals are:

- Helping/using predators which eat the pest. “The enemies of your enemies are your friends”
- Taking measures to stop rodents from reaching food stores.
- Only using chemicals when there is a forecast that there will be unacceptable damage by the pest.



TEACHER'S NOTE

Integrated Pest Management (IPM): The careful consideration of all available pest control techniques and subsequent integration of appropriate measures that discourage the development of pest population and keep pesticides and other interventions to levels that are economically justified and reduce or minimize risks to human health and the environment. IPM emphasizes on the growth of a healthy crop with the least possible disruption to agro-ecosystems and encourage natural pest control mechanisms.

Use of pesticides in vector control

Vectors of disease are organisms (often insects) transmitting disease. An example is mosquitoes transmitting malaria or dengue fever.

Insecticides are often sprayed against mosquitoes. Care is taken to choose insecticides which are least toxic to people.

Recently there has been much success in combating malaria by using treated bed nets.

It is important to integrate insecticide use with other measures, like eliminating breeding places, for example clean still standing water in which the mosquitoes can multiply. This way of minimising pesticides use is called IVM, Integrated Vector Management.



Use of pesticides in the house

Pesticides should only be used as a last resort. It is better to prevent pests, for example by using screens so that they cannot enter the house. There are other ways of getting rid of them. For example, ants can be killed with boiling water or soap, and fly paper used for flies.

When pesticides are applied:

- Choose the right pesticide for the pest. Not every pesticide is suitable for every pest. Never use agricultural pesticides in the house and garden.
- Choose the least toxic chemical available. It is not the most “powerful” chemical that will do the job best.
- During spraying, people, pets, food and drinks should be removed.
- Do not enter the sprayed rooms before opening the windows.
- Use the amount written on the label. Using more might destroy what you are trying to protect!
- Use less pesticide by using baits.

TEACHER'S NOTE

The WHO definition of IVM is: Integrated vector management is a process for managing vector populations in such a way as to reduce or interrupt transmission of disease. Characteristic features of integrated vector management include methods based on knowledge of factors influencing local vectorbiology, disease transmission and morbidity; use of a range of interventions, often in combination and synergistically; collaboration within the health sector and with public and private sectors that impact on vectors; engagement with local communities and other stakeholders; and a public health regulatory and legislative framework.

Restriction or ban of pesticide use

When adverse effects of chemicals/pesticides have been found, governments can restrict and/or ban their use.

Some pesticides can only be used for certain purposes and under certain conditions. For example:

- Some pesticides are allowed for cotton but should not be used for other crops.
- Some can only be handled by persons who have taken a special course on how to apply them.
- Some can only be used by someone wearing protective gear, a respirator etc.



Effects of Pesticides on People

Learning Outcomes

The student is able to:

- state at least three examples of the effects of poisoning by pesticides
- state at least three examples of signs and symptoms of acute and chronic poisoning by pesticides



Signs and symptoms of poisoning with pesticides

Different pesticides may lead to different symptoms.

Acute poisoning

Some common signs and symptoms of acute poisoning with pesticides are:

- skin rashes
- headaches
- dizziness
- nausea and vomiting
- diarrhoea
- stomach cramps
- muscle weakness and numbness
- tremors
- seizures
- coma



Diarrhoea



Dizziness



Nausea



Vomiting



Weakness



Illness



Shivering



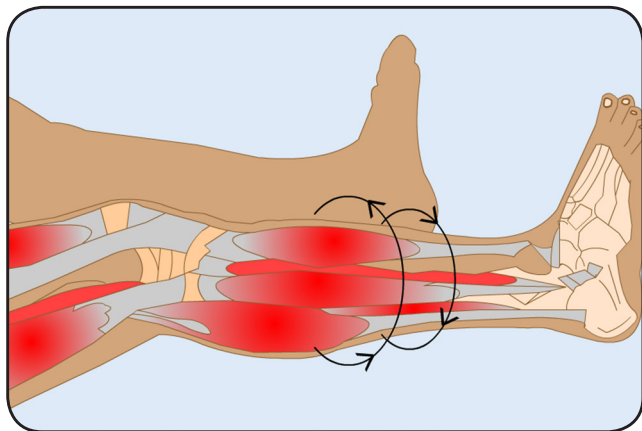
Headache

Chronic poisoning

Over time, problems as the following may arise:

- muscle weakness and numbness
- loss of memory, sight or ability to think clearly
- behavioural problems
- reproductive disorders

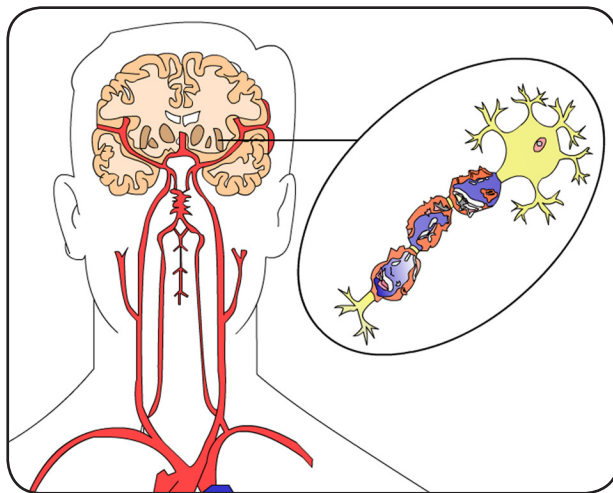
These symptoms are often similar to those of other illnesses. It may be hard to relate these with pesticide exposure.



Effects of pesticides

Many pesticides are toxic, some are very hazardous. Pesticides often affect the nervous system, the sending of messages from brain and spinal cord to muscles and organs.

Not all effects are known. It is always better to be careful when using pesticides, and only to use them when absolutely necessary, in the right amount.



Acute poisoning with delayed effects

Effects are not always immediate. One pesticide, paraquat, can cause lung damage a week after exposure, and can kill.



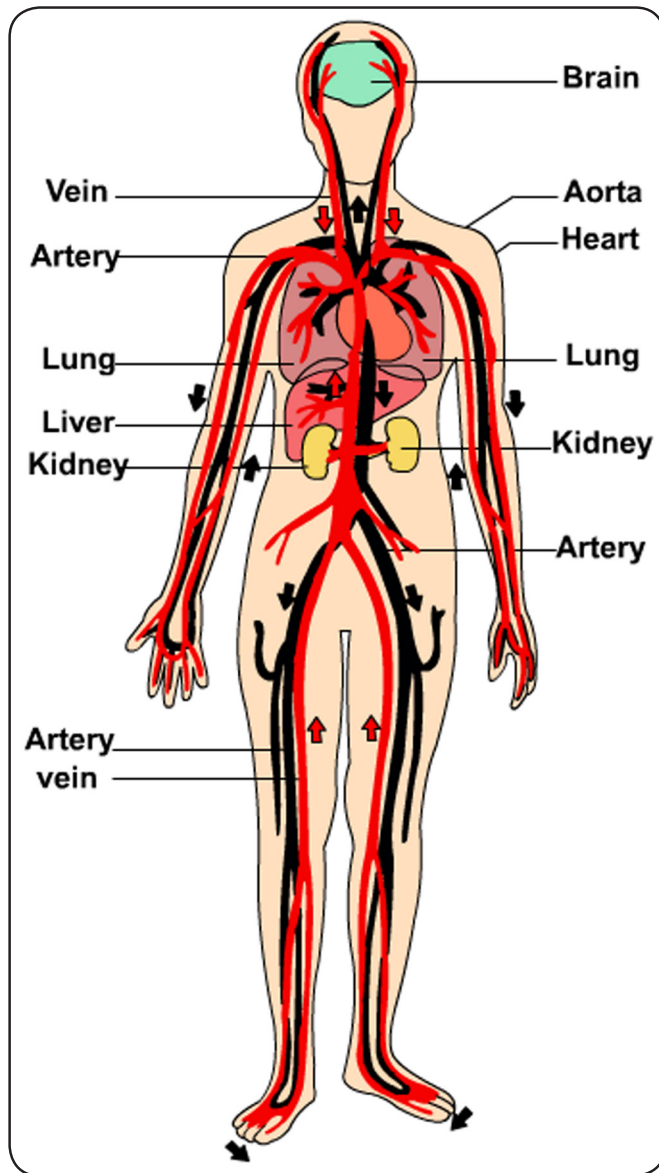
after exposure to a chemical. Some cancers in children have been linked to exposure to pesticides.

Chronic poisoning

For some (organophosphorous) pesticides, the effect of repeated small doses cannot be seen but continuous exposure can ultimately result in serious effects at a later stage, for example on the nervous system.

They can also affect reproduction, fertility, birth defects, and development, the ability to have healthy children and for them to grow up in a normal way. Some are similar to hormones, the chemical messengers of the body, and may disrupt the hormonal system by sending messages which are stronger, or at a wrong time.

Some pesticides may cause cancer, the growth of tumours which consist of cells which are not under control. These may take up to 20 years to develop

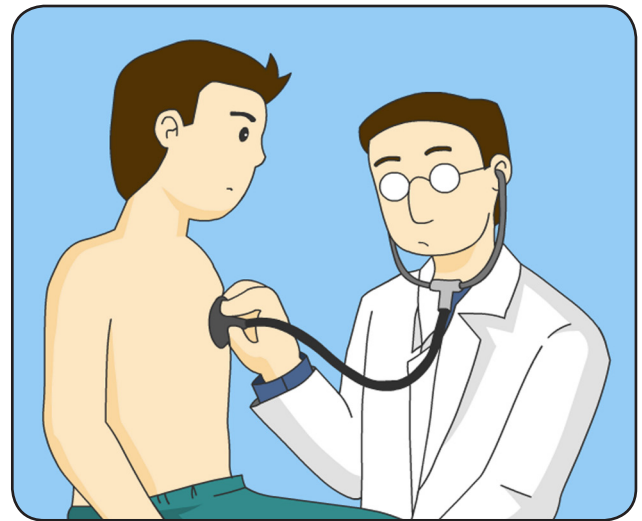


What to do in Case of Poisoning?

Learning Outcomes

The student is able to:

- explain the general steps that should be taken if poisoned.



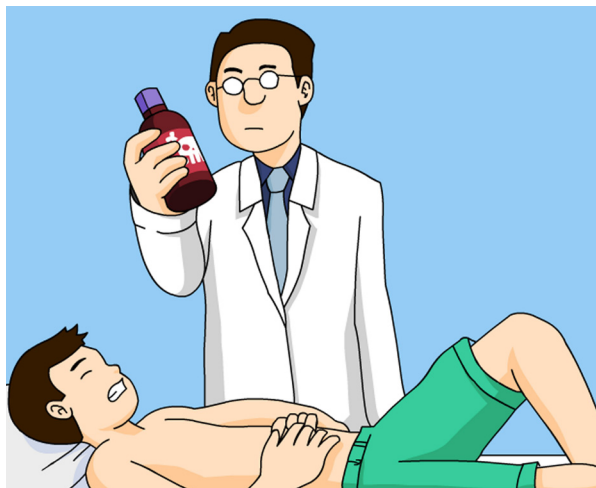
What to do in case of poisoning?

All poisoning cases should be seen by a doctor as soon as possible. It is important that the doctor knows which pesticide the person was exposed to. If the container is available, it should be sent with the poisoned person for the doctor to see. At least, the trade and approved names of the pesticide should be copied from the label.

The label might include important notes on the treatment of poisoning, which should be followed.

TEACHER'S GUIDE

Ask students if they know the telephone number of the poison centre, if the country has one.



If pesticide poisoning occurs....

- Refer the patient to a doctor as soon as possible
- It is important for the doctor to know what pesticide the person has been exposed to



If pesticide poisoning occurs....

- Call the Poison Centre for advice

What to do in case of poisoning?

Swallowed poison

Remove anything remaining in the mouth. Unless the victim is unconscious, having a seizure, or cannot swallow, give a small amount of water to drink. Call the poison centre for advice.

Do not try to neutralize a poison by giving milk, raw eggs, salt water, mustard, vinegar or citrus fruit juices as an antidote or to cause vomiting. Never attempt to induce vomiting by sticking your fingers anywhere in the patient's mouth; this procedure can be very dangerous.

Syrup of ipecac

Syrup of Ipecac is NOT recommended for treatment of poisoning.

Activated charcoal

Activated charcoal is not recommended for home use. It is used to bind drugs and chemicals before they are absorbed. Activated charcoal does not bind all drugs or chemicals and has some risk when given.

Poison in the eye

Remove all foreign materials from the eyes including contact lenses if worn. Gently flush eye for 10 minutes, using slightly warm water. Do not use any eye drops. Call the poison centre.

Poison on the skin

Remove any contaminated clothing. Rinse the affected area thoroughly with large amounts of water. Wash the same area gently with hand soap and warm water to remove all remaining chemicals on the skin. If exposed, remember to wash hair and under fingernails. Call the poison centre.

Inhaled poison

Get the exposed person to fresh air as soon as possible. Avoid breathing fumes. Call the poison centre.

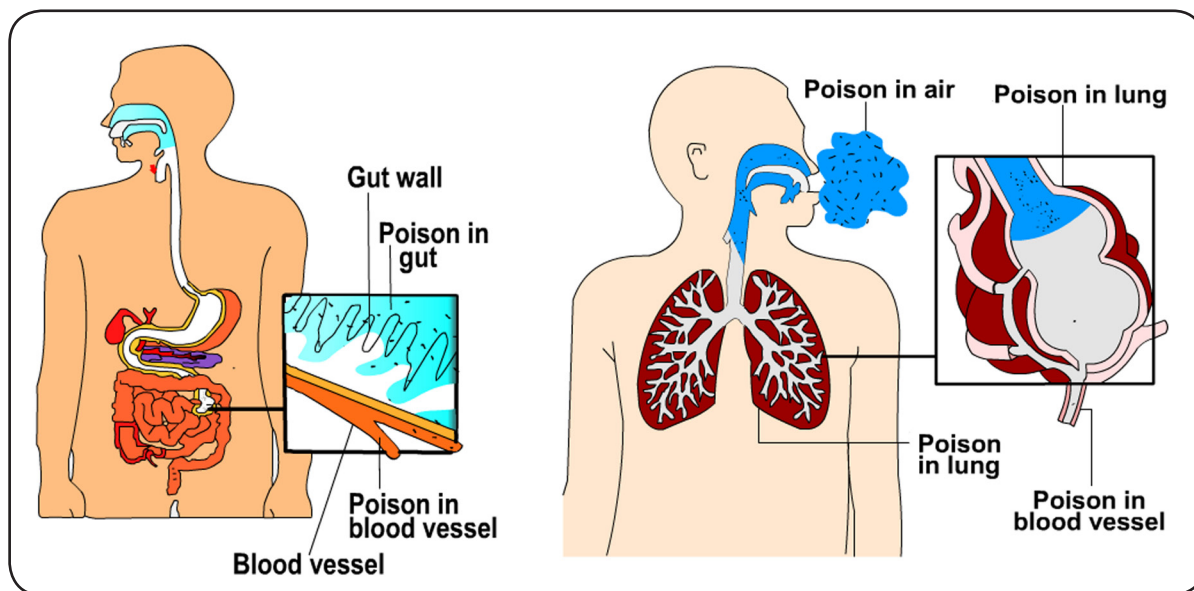
Do NOT Panic!

How Poisons Can Get Into Your Body?

Learning Outcomes

The student is able to:

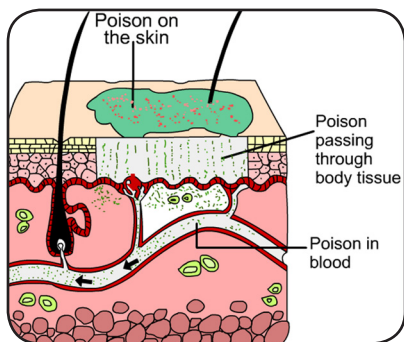
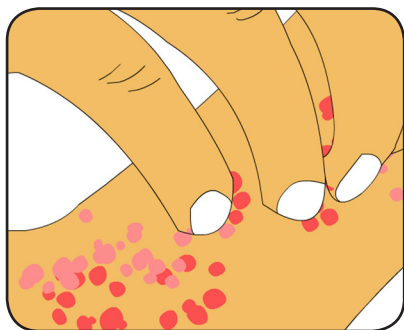
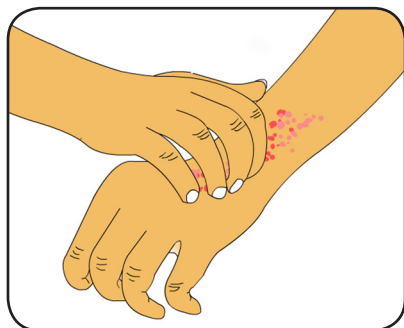
- state three ways in which poison can get into the human body



Route of entry

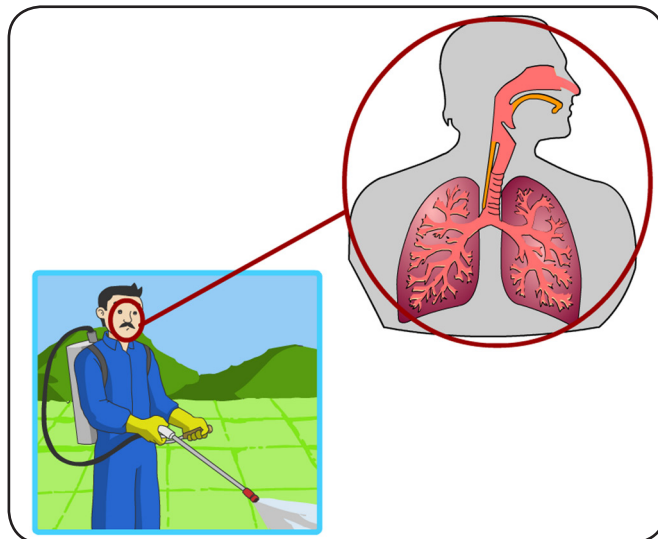
Route 1: Skin

Some pesticides go through the skin or eyes easily and this can lead to poisoning.



Route 2: Inhalation

Inhalation (breathing in) is a common route of exposure for pesticides.



TEACHER'S GUIDE

Observe the illustrations and discuss the process.

TEACHER'S NOTE

The lungs have about 37 times more surface for contact compared to the skin. They are also made up of thin membranes that do not serve as a good protective barrier.

Route 3: Ingestion



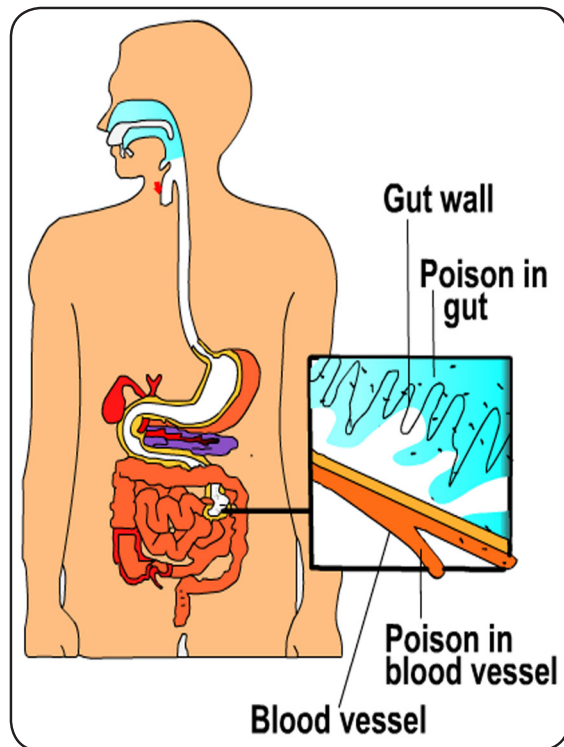
Eating with contaminated hands



Smoking in contaminated work area



Eating/drinking when spraying



Ingestion is the pathway for entry of substances eaten or drunk. Chemicals may enter the body by absorption from the gastrointestinal tract.

Pathways Through the Environment

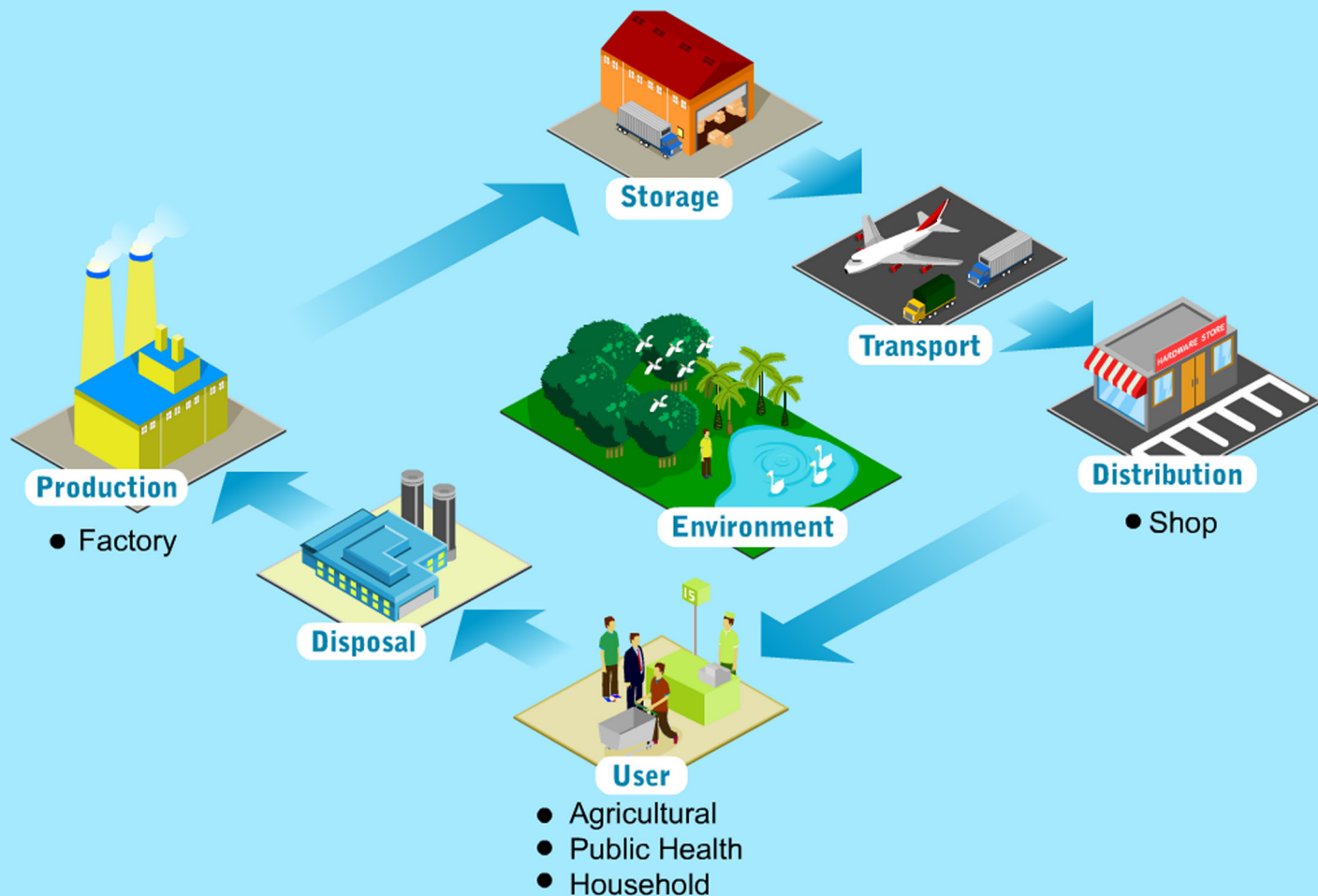
Learning Outcomes

The student is able to:

- state the components in the pesticide life cycle
- describe briefly how pesticides can be transferred through the three pathways



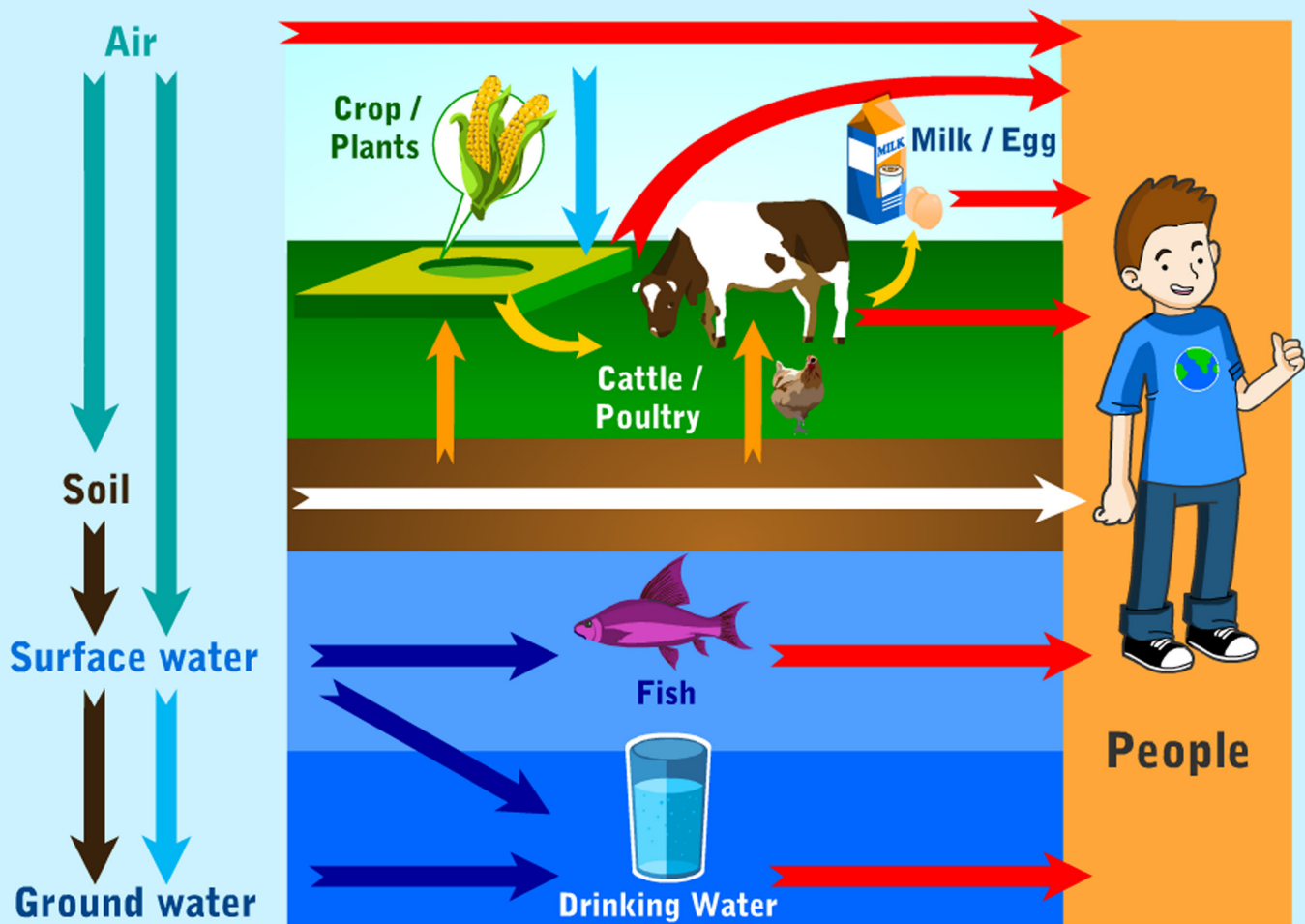
Life cycle of chemicals



TEACHER'S GUIDE

Observe the picture and discuss components of the pesticide life cycle and their implications for the environment.

Pathways through the environment



TEACHER'S GUIDE

Discuss different pathways for pesticides to reach people, e.g.:

- air-soil-crops-animal (cattle/poultry)
- air-soil-water-aquatic organisms (fish)
- air-soil-drinking water

TEACHER'S NOTE

Care should be taken to emphasise these are potential pathways. Mostly tiny amounts of chemicals are involved and there is no danger. The message should not be that food is dangerous: contents of pesticides in food are/should be monitored, in rural areas waiting times (between spraying and harvesting) should be respected.

Air, soil, water, aquatic organisms



TEACHER'S GUIDE

Observe the picture and discuss the topics below:

- how pesticides can be transferred through at least three pathways
- wrong practices shown in the pop-up pictures.

How to Identify a Toxic Compound, Product, Understand the Label?

Learning Outcomes

The student is able to:

- state that toxic chemicals can be identified by the hazard symbols on the container
- state at least three types of information which are found in the text on labels, and give examples
- link hazard symbols to their meaning



How to identify a toxic product and understand the label?

The Food and Agricultural Organization (FAO) recommends the following as the essential parts of a label, written in the local language text :

1. Identification of contents

- ◆ product or trade name
- ◆ type of formulation
- ◆ active ingredient name
- ◆ net content of the product

2. Safety information

- ◆ a clear warning on the label covering reading the safety instructions before opening the pack, handling, transport and storage warning symbols; and hazard classification and symbol;
- ◆ a safety text covering:
 - product-specific advice,
 - good agricultural practice,
 - relevant protective clothing,
 - precautions when handling the concentrate (if applicable),
 - precautions during and after application,
 - environmental safety during and after application,
 - safe storage,
 - safe disposal of product and used container and
 - how to clean equipment (if a potential risk exists).
- ◆ safety pictograms
- ◆ warning
- ◆ first-aid and medical treatment advice

3. Instructions for use

- ◆ how to mix and apply the product and rate of use;
- ◆ when to use the product, including timing and frequency (including maximum number of

applications per use season), or when not to use it, e.g. during flowering of the crop;

- ◆ where to use the product: which crops, targets, areas;
- ◆ any limitations, such as susceptible crops or varieties, weather conditions, harvest interval; compatibility with other products, where appropriate; and
- ◆ how to avoid harming beneficial insects, such as bees and natural predators, or wildlife

4. Other information

- ◆ name, address and telephone number of local distributor;
- ◆ registration number, if any;
- ◆ manufacturer's name and company logo;
- ◆ trade mark acknowledgment;
- ◆ date of manufacture and formulation and batch number; and
- ◆ shelf life.



Hazard symbols for chemicals (pesticides)

- Hazard is the adverse health effect the chemical is capable of causing
- Hazard are identified by symbols

TEACHER'S NOTE

Use as examples national hazard symbols, colour bands and pictograms

TEACHER'S GUIDE

The hazard symbols shown are those recommended by the United Nations, which may or not be used in your country.

GHS Pictograms and Hazard Classes

Oxidizers	Environmental Toxicity	Acute toxicity (severe)	Corrosives	Gases Under Pressure
Carcinogen Respiratory Sensitizer Reproductive Toxicity Target Organ Toxicity Mutagenicity Aspiration Toxicity	Irritant Dermal Sensitizer Acute toxicity (harmful) Narcotic Effects Respiratory Tract Irritation	Flammables Self Reactives Pyrophorics Self-Heating Emits Flammable Gas Organic Peroxides	Explosives Self Reactives Organic Peroxides	

Transport "Pictograms"

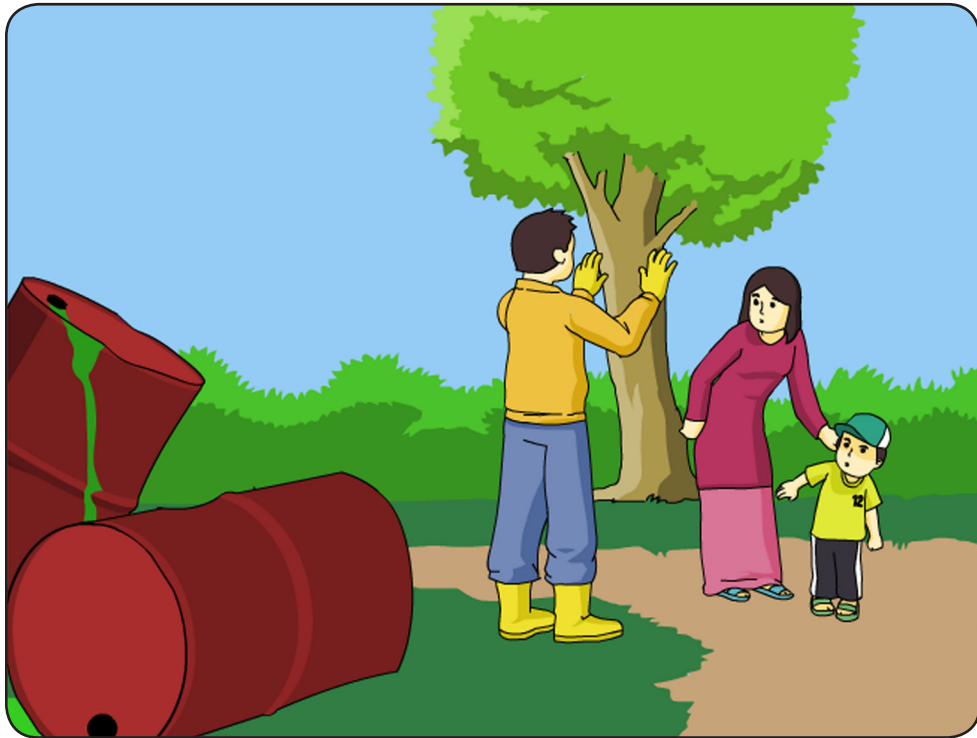
Flammable Liquid Flammable Gas Flammable Aerosol	Flammable solid Self- Reactive Substances	Pyrophorics (Spontaneously Combustible) Self- Heating Substances	Substances, which in contact with water, emit flammable gases (Dangerous When Wet)	Oxidizing Gases Oxidizing Liquids Oxidizing Solids
Explosive Divisions 1.1, 1.2, 1.3	Explosive Division 1.4	Explosive Division 1.5	Explosive Division 1.6	Compressed Gases
Acute Toxicity (Poison): Oral, Dermal, Inhalation	Corrosive	Marine Pollutant	Organic Peroxides	

Risky Situations with Chemicals/ Pesticides

Learning Outcomes

The student is able to:

- describe at least three risky situations where people can be exposed to pesticides/chemicals
- suggest ways to avoid risks



Children and family members may accidentally ingest the pesticides if....



pesticides are mistaken for water or drinks



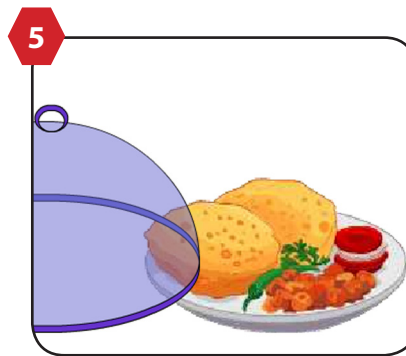
food is contaminated by a leaking container during transportation or storage



used or empty pesticide containers are left around where children might play with them



empty pesticide containers or bottles are used for other purposes, such as storing milk



food is left uncovered during indoor residual spraying in public health operations



equipment and/or pesticides-ridden clothes are left accessible to children

Personal Protection when Using Pesticides

Learning Outcomes

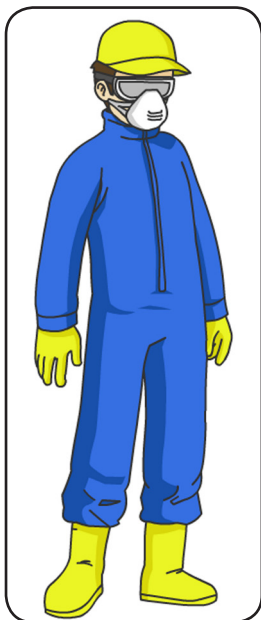
The student is able to:

- state that skin as possible should be protected from contact with pesticides and that three parts of the body need extra protection



Personal protection when using pesticides

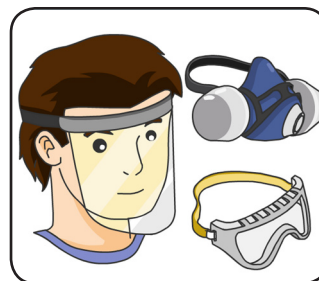
- When handling pesticides, contamination should be prevented by wearing overalls or shirts with long sleeves and trousers (not shorts).



- The head and neck must be protected.



- Eyes must be protected when mixing and loading pesticides or when spraying above shoulder level. Visors, goggles or safety spectacles can be used for this purpose.



- A respirator should be worn to avoid inhalation of dusts, vapours and gases.



- Pesticides must not be applied by persons in bare feet or wearing sandals.



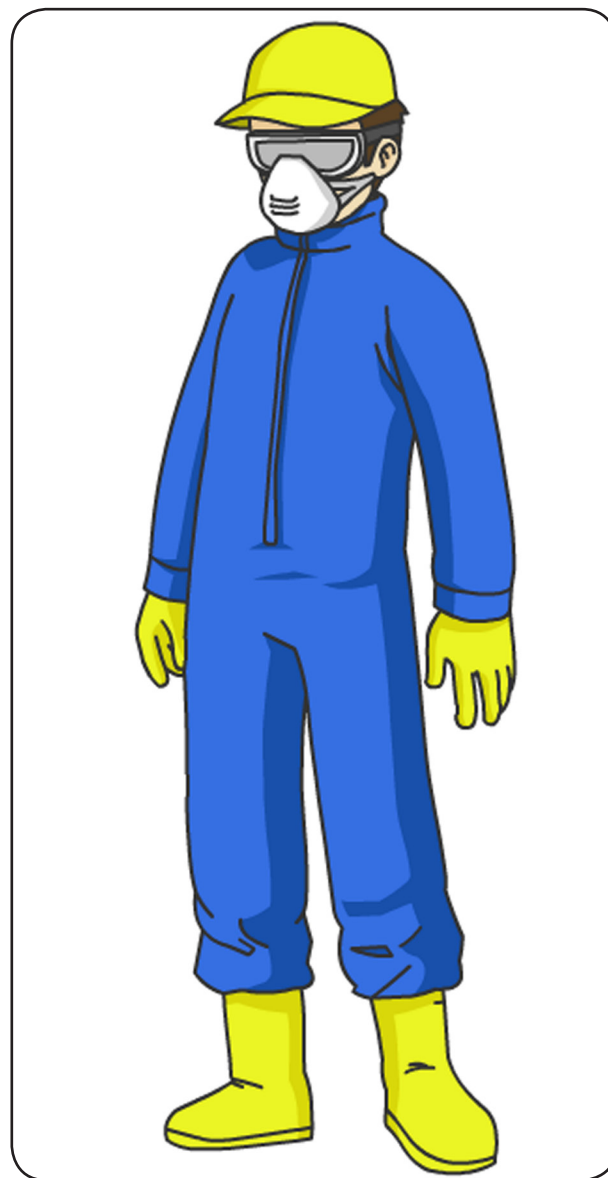
- Hands must be protected by gloves during handling of concentrates, while applying hazardous pesticides and when washing or maintaining application equipment.



- At the end of each working day all equipment and work clothing must be washed. Work clothes should never be washed with the clothes of the rest of the family.



- Very hazardous pesticides should only be applied by persons wearing full personal protective equipment. These applicators must have received extra training in this area.



Protecting Younger Children, Sisters and Brothers

Learning Outcomes

The student is able to:

- state at least three (3) ways of protecting children, sisters and brothers while they are (e.g playing, sleeping, eating, etc) in the:
 - a. house
 - b. garden or other places where they play
 - c. farm
- evaluate and suggest ways to protect children, sisters and brothers in a given case scenario.
- state 3 reasons why children are vulnerable to toxic chemicals.

Children are vulnerable to toxic chemicals

Children and infants are especially vulnerable to pesticides (and other toxic chemicals) because:

- their bodies are smaller in relation to their body weight and they eat and drink more than adult
- their organs are still developing, may be more sensitive to and/or less capable of coping with toxic substances
- they are more likely to come in contact with pesticides because they tend to put things in their mouth, crawl/play on floors or soils which may be contaminated



Most childhood poisoning incidents reported by poison centres worldwide occur in children less than three years old. Most frequent causes are:

- medicines
- household cleaning products
- cosmetics (products people use to make themselves more beautiful), like perfume and nail polish, deodorant and soap,
- lamp oil
- pesticides
- poisonous plants and venomous creatures

All chemicals in the house should be kept out of reach of children, preferably in locked cabinets.



Protection of young children in the house

What can be done to protect young children in the house?

- keep chemicals out of reach of children
- try using other ways of controlling pests instead of using pesticides
- use the safest possible chemicals
- if you are using chemicals and you are interrupted by a phone call or doorbell, don't forget to put the chemicals out of reach
- do not put toxic chemicals in empty food or drink containers
- when applying pesticides make sure no children are present, remove toys, food etc.
- do not let children re-enter sprayed rooms before they have been properly ventilated
- never use pesticides which are meant for another purpose



Protection of young children on a farm and other playing areas

Children living in rural areas, or whose parents work in agriculture will be more likely to come in contact with pesticides.

What can be done to protect young children on a farm?

- use pesticides only as a last resort in an IPM programme
- no children present during mixing and spraying
- keep children out of pesticides spray drift
- clean up spills immediately
- respect waiting times for re-entry of fields and for eating sprayed food
- wash clothes and equipment after spraying and keep work clothes separate from family wash
- store pesticides, leftovers, wastes, containers, equipment or pesticide ridden clothes locked in a shed

TEACHER'S GUIDE

Ask students to recall occasion where they may have had bad experiences with chemicals.

Protection of young children on a farm and other playing areas

What can be done to protect young children in other playing areas?

Children living in urban areas should not play in areas where toxic wastes have been dumped.



TEACHER'S GUIDE

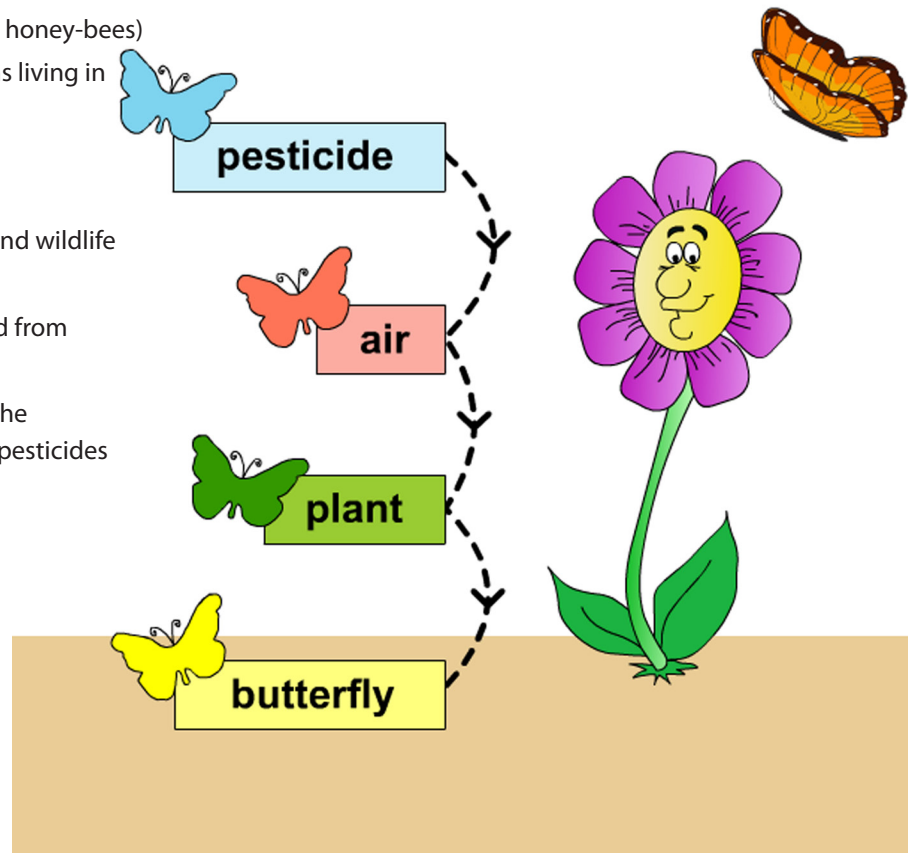
Discuss on the importance of not playing in dumpsites.

Protecting the Environment

Learning Outcomes

The student is able to:

- describe at least one implication of pesticides that affect:
 - ◆ aquatic organisms, fish
 - ◆ pollinators (e.g. bees, butterflies)
 - ◆ predators (e.g. predatory insects, spiders, bats, birds, amphibians eating insects)
 - ◆ beneficial insects (silkworms and honey-bees)
 - ◆ micro-organisms/small organisms living in the soil (e.g. earthworms)
 - ◆ other wildlife
 - ◆ domestic animals
- explain the need to protect animals and wildlife from an ecological perspective
- name places that should be protected from pesticides
- suggest and evaluate ways in which the environment can be protected from pesticides



Roles of non-target organisms

Pesticides are toxic and can also adversely affect non-target organisms. Low levels of pesticides in the environment can affect many different kinds of living creatures, including humans. For example, studies on predatory birds, aquatic mammals (e.g. dolphins and whales) and laboratory rodents have shown effects on reproduction, the endocrine and immune systems and development of cancer.

Examples of non-target organisms:

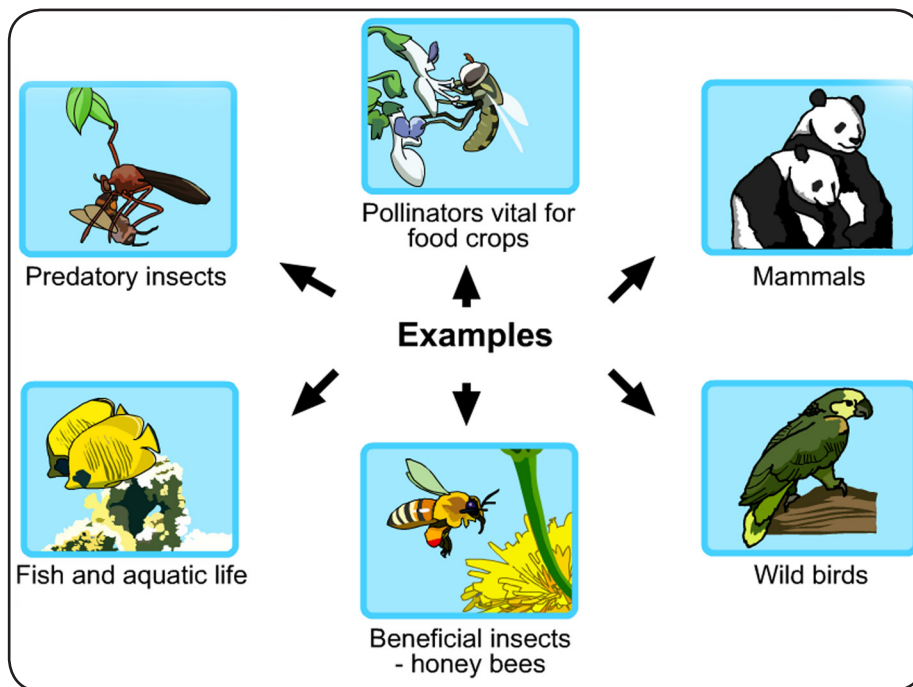
- aquatic organisms (e.g. shrimp), fish
- pollinators (e.g. bees, butterflies)
- predators (e.g. predatory insects, spiders, bats, birds, amphibians eating insects)

- beneficial insects (silkworms and honey-bees)
- micro-organisms/small organisms living in the soil (e.g. earthworms)
- other wildlife
- domestic animals

All of these organisms can be affected by pesticides.

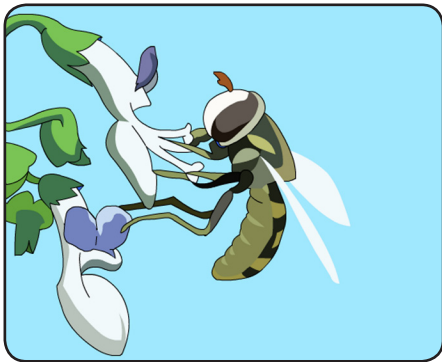
There are wild animals we enjoy watching, like beautiful butterflies or birds.

Some of the organisms listed are useful to people because they supply food (fish, honey etc.) or silk.



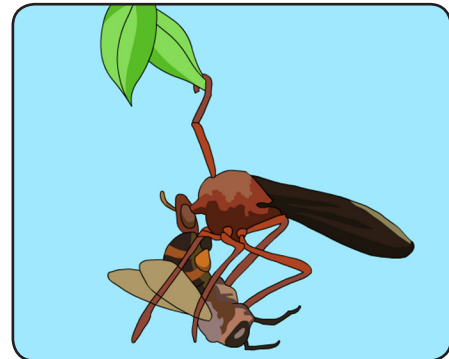
Other organisms have an important role in ecosystems. Micro-organisms and earthworms in the soil help break down dead plants and animals into the nutrients that plants need to grow. In turn, plants and trees growing on hills can protect against erosion.

Pollinators are needed for many tree species to produce fruit. An example is the oil palm in Malaysia. When it was first introduced, it did not bear much fruit, till a pollinating insect (a weevil) was imported from Cameroon.



Harmful insects can be kept under control by other insects, for example tiny wasps that grow in their eggs. Predators such as predatory insects and spiders are important for agriculture because they eat the insects that eat the crops. When predators are affected by pesticides, plant eating insects often increase, leading to damage to the crop.

DDT almost eliminated predatory birds in several regions in the 1970s. These birds help control rodents and other pests, such as quelea weaver birds which eat crops in Africa. Reef-building corals can be affected by pesticides. Corals play an important role in protecting the coast in tropical countries.



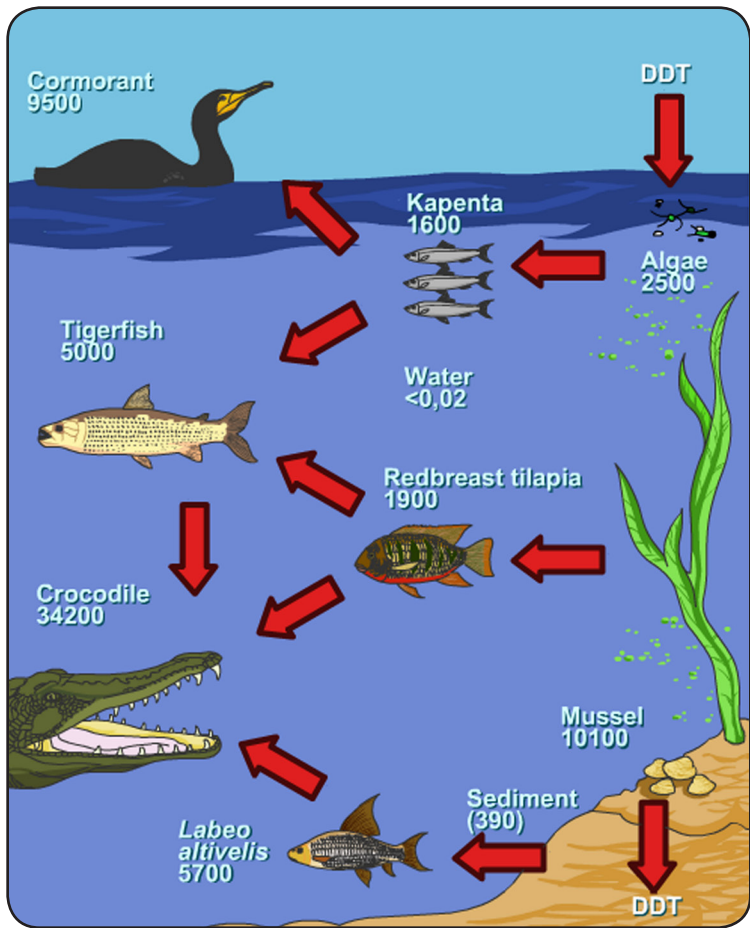


TEACHER'S GUIDE

Discuss possible effects of aerial spraying on non-target organisms.

Some pesticides such as POPs do not easily break down. Their use has led to their long term presence in the environment. POPs often accumulate in body fat of different organisms. Concentrations increase in food webs. See the example below for DDT.

TEACHER'S GUIDE
Discuss the different food chains in this food web, how DDT accumulates in body fat, and increases in the different steps of the food chain. People are also on top of food chains.

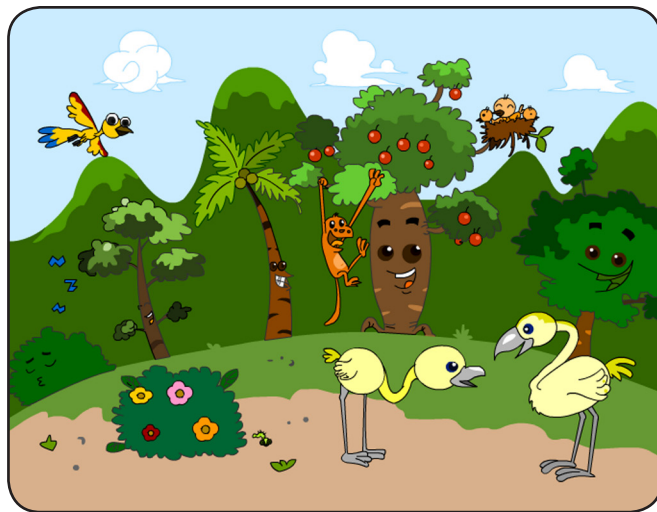


Source from UNEP/FAO/WHO 2002

Places sensitive to pesticides

There are some places and resources in particular that are sensitive, and should be protected from pesticides:

- schools, houses
- places where food is stored for people and domestic animals
- water, surface water and groundwater
- national parks/nature reserves/natural areas/wildlife.



Protecting the environment when using pesticides

Contamination of water should be avoided when:

- mixing, filling the spray
- spraying pesticides
- washing equipment and clothes
- storing and disposing pesticide wastes, containers and wash water

Even a few millilitres of a pesticide can kill fish and other aquatic organisms and contaminate large volumes of drinking or irrigation water.

It is important to clean up spills immediately.

The farmer should take care in choosing the day he will spray: it should not be windy to avoid drift to sensitive areas. Rain or irrigation will increase run-off to water.

Disposal of Toxic Wastes

Learning Outcomes

The student is able to:

- state that to reduce the amount of toxic wastes, it is necessary to avoid buying more than what is needed
- state that it is important to separate toxic wastes from other wastes
- explain how to dispose of them in a correct manner



Disposal of toxic wastes

When toxic waste are dumped without care and not disposed of correctly they can cause severe health problems and death and even contaminate water and land for decades.



TEACHER'S GUIDE

What chemicals, products containing chemicals and empty containers does your family throw away?

Are these separated from the garbage in the back of your house?

Are they kept in a covered bin which cannot be opened by children or behind lock and key?

Discuss in the class.

Chemical wastes should be separated from other household wastes.

Prevention: not buying too much if not absolutely necessary.

Chemical waste should be separated from other household waste.

Prevention: not buying too much if not absolutely necessary.

Separation of waste as practiced in some developed countries



toxic waste



toxic waste



**separate glass, paper,
metal, oil etc.**



Plastic, organic waste, anything else

What is the best way of disposing of chemical wastes?

They should be disposed of only in approved, appropriately constructed and maintained toxic waste disposal sites. The best way is destroying them in a high temperature incinerator facility or cement kiln.

Burning them is not recommended because dangerous fumes can be released at lower temperatures. Burying them is also not recommended because they can contaminate soil and/or water.

Store them behind lock and key so that they are out of reach till they can be disposed of.

What is the best way of disposing of chemical containers? Different countries have different regulations. Possibilities are: puncturing them so that they cannot be reused, and/or bringing them to a recycling programme.



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