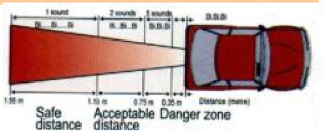
The four Poles of the compass to manage the challenges without losing sight of the north!

Pole 1
Identify the HAZARD:
Intrinsic properties

Pole 4 :
Integrate EXPECTATIONS
between tolerated risks and expected benefits

Pole 2
Evaluate the RISK
related to the exposure to the hazard

Pole 3 :
Decide (regulate) the level of SAFETY
to be taken into consideration



1st pole :
Identify the intrinsic hazards

1st pôle : Identify the hazard(s)

- The hazard describes the undesirable properties intrinsically associated with the nature of an element: microbes which kill, a salt which corrosives, speed is dangerous, dioxin which is toxic;
- For biological agents this dangerous nature is not linked to the intensity of the exposure to this effect.
- For physical or chemical agents, it is a combination of the dose and the duration or frequency of exposure to this adverse effect.
- Technical and (eco)toxicological tests make it possible to determine for most chemical, biological and physical agents a "*no effect level* ".

About acceptable limits and safety factors

- To define an *acceptable exposure limit value* for a dangerous biological agent and certain physical agents (eg radiation), the guidelines generally recommend safety distances and isolation measures;
- *For chemicals*, a safety margin is always included to take into account, for example, the possible differences between observations on animals and the reality and diversity of human exposures;
- These are generally between 100 and 1000, depending in particular on:
  - the type of effect : *irreversible or not*;
  - the degree of knowledge of the hazardous properties: *number and types of test studies carried out, etc..*

About the levels of safety factors

- **By comparison, on some highways, the following warning signs appear about safety distances between two vehicles:**

« One mark : danger ; two marks : safety »

The safety factor applied there is 2.

- **Given that a mark length is 25 m, should a safety factor of 100 be applied, what would be the distance between two vehicles?**

Among major health hazards that appeared in the 20th century

- Influenza, leprosy, malaria, polio, tuberculosis and other “age-old” diseases are now often fought with vaccines but continue to cause millions of victims;
- Among the dangerous viral and bacteriological agents presenting major risks which appeared in the 20th century are those of AIDS, Ebola, Chykungunya;
- Others also affect plants, such as the *Xylella Fastidiosa* bacteria that destroy olive trees or *Fomes annusus* for pine;

The challenge is always to identify the *hazard*(s) for everyone, measure the *risks* and take the appropriate *safety* measures

Methods for identifying infectious hazards

- Traditional methods of identifying a dangerous property for a species of an infectious agent rely on the multiplication in the laboratory of the potentially pathogenic agent in order to be able to identify it;
- These methods, such as giving birth to vaccines, are time-consuming and sometimes very expensive;
- Genetic engineering now makes it possible to identify many pathogens in a faster and more reliable way;
- Other methods are based on the identification of antibodies produced in reaction to the pathogenic effect.

Multidisciplinary toxicology: to identify the dangerous properties of chemical substances

This implies, to collect data rom the multiple disciplines of human and veterinary medicine:

- **Pharmacology including pharmacokinetics, (histo)pathology, hematology,…;**
- **analytical toxicology, "in vivo" and "in vitro"; experimental toxicology and clinical toxicology: toxicology of acute and repeated dose exposures: subacute, subchronic, chronic, multigenerational;**
- **clinical chemistry, cell toxicology, genetics (and "omics");**
- **immunotoxicity and toxicology of reproduction, carcinogenicity;**
- **Mechanistic toxicology and epidemiological toxicology;**
- **Biostatistics and mathematical modeling.**
- **…**

For hazards towards the environment, a complementary science: *ecotoxicology*

- **For "generic" substances, the ecotoxicity is tested in the laboratory and in a reproducible manner on representative type organisms of each trophic level:**
  - **For plants: micro-algae (blue - green algae, diatoms);**
  - **For crustaceans and molluscs: duckweed (daphnia);**
  - **For mammals: fish: (rainbow trout, exotic aquarium fish);**
  - **For the microorganisms in charge of biodegradation: specific bacteria or sample of wastewater treatment plant.**