

Toxicity & Communication Issues for Common Herbicides

Environmental & Molecular Toxicology



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Outline

I. General Toxicology, Fate & Transport

II. Common Herbicides Used by the Public

I. Messaging and Risk Communication

Herbicide Toxicology, Fate & Transport

Pesticide Toxicity

Risk = f (Toxicity, Probability of Exposure)

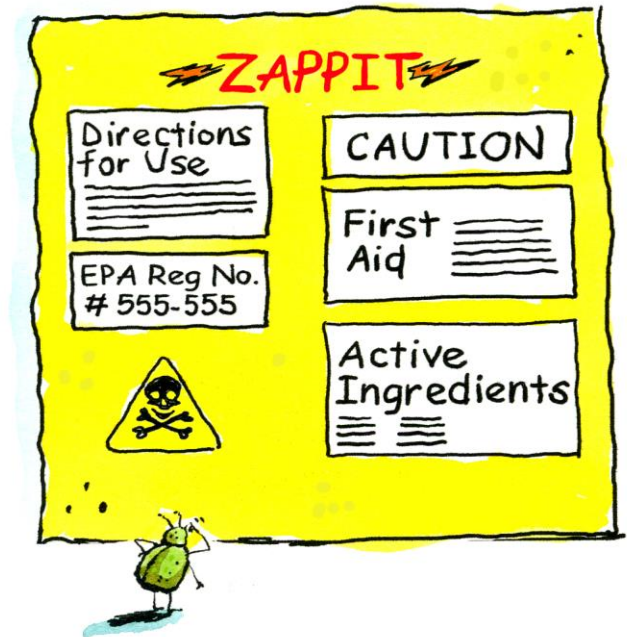
Toxicity is influenced by:

Active Ingredient

Concentration

Formulation

Other ingredients



At 20,000 feet, is this risk?



**What about
this?**



Exposure

Three Main Routes:

Dermal/Ocular

Inhalation

Ingestion



Steps can be taken to reduce exposure. Remember, risk includes the probability of exposure. You can lower your risk by making exposure reduction a priority.



Factors that Influence Exposure



Ingestion

- Intentional or accidental
- A.I. & carrier
- Amount



Dermal

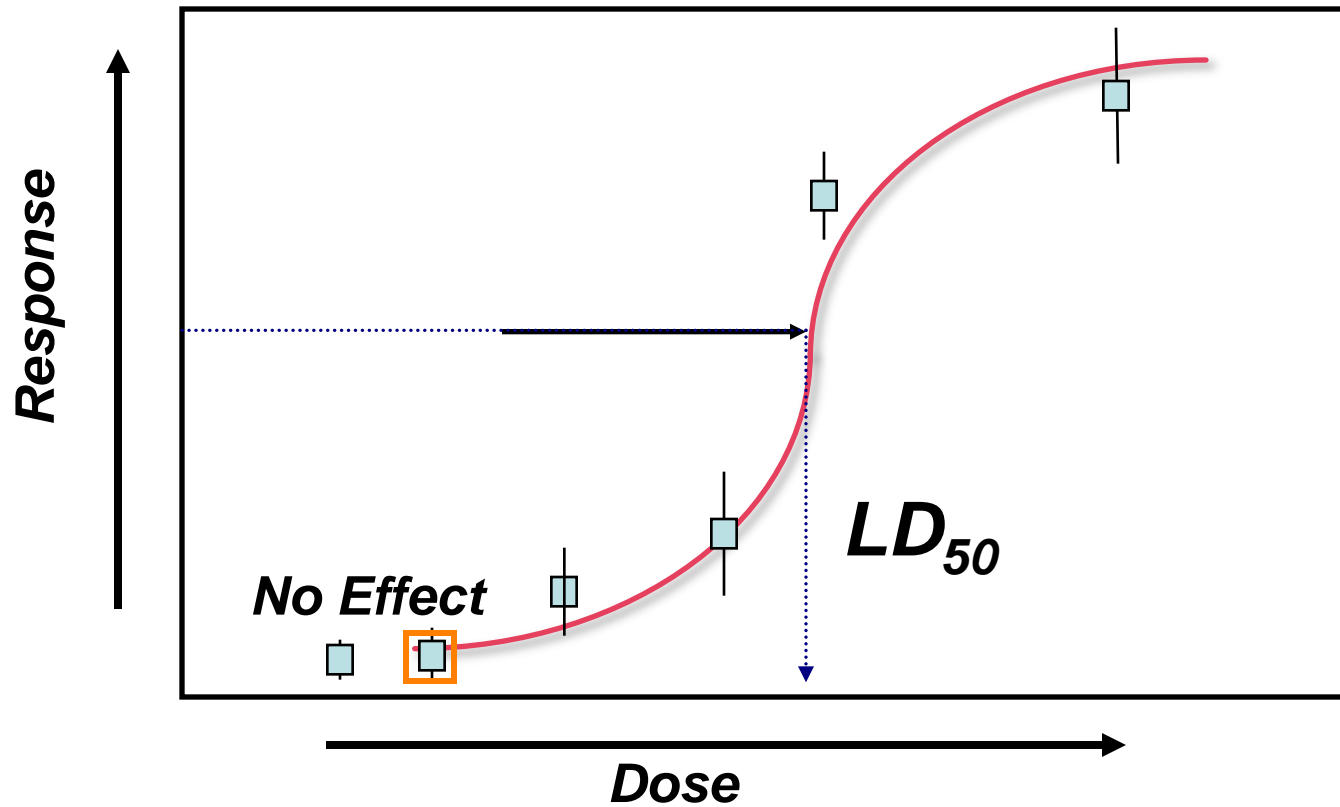
- Contact time
- Location
- A.I. & carrier
- Clothing



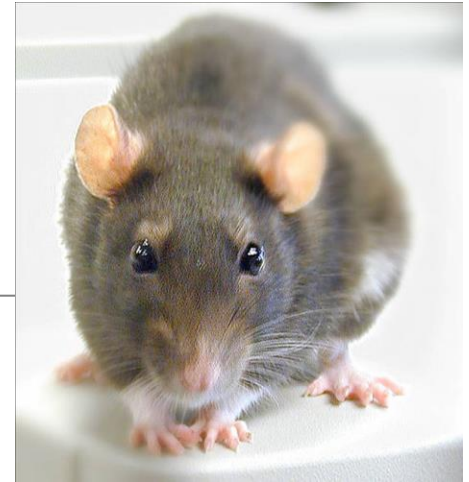
Inhalation

- Duration & aspiration
- A.I. & carrier
- Confined space

Dose & Response



Pesticide Toxicity Testing: Health Endpoints



- Acute and 90 day oral, dermal & inhalation tests
- Acute eye irritation and skin sensitization tests
- Reproductive/developmental testing
- Carcinogenicity, gene mutation, chromosomal aberration
- Absorption, distribution, metabolism and elimination
- Immunotoxicity and neurological testing

Toxicity Categories

	Danger I	Warning II	Caution III	Caution IV
Eating (oral)				
Breathing (inhalent)				
Skin Contact (dermal)				
Eye Irritation				
Skin Irritation				

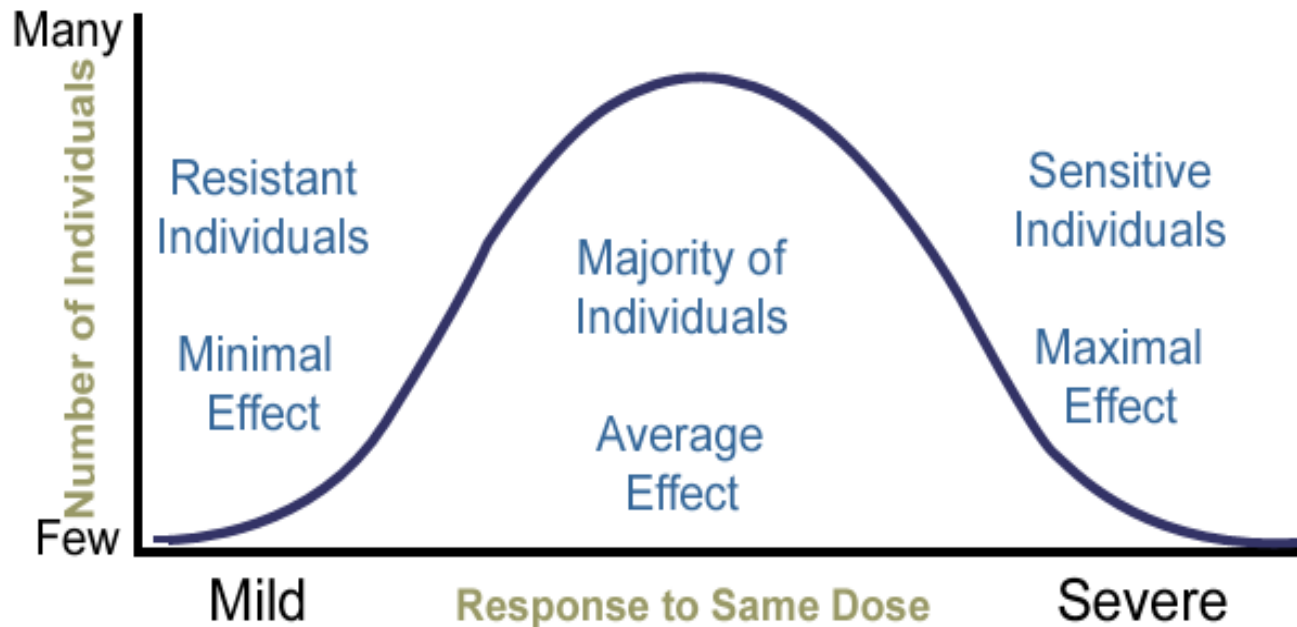
Reported poisonings

- Approximately 5% of all poisonings are pesticide-related (some intentional)
- Insecticides most common by far (>58,000 incidents/year)
 - Pyrethrins and pyrethroids, organophosphates, insect repellants
- Rodenticides (>15,000 incidents/year)
 - Long-acting anticoagulants
- Herbicides (>9,000 incidents/year)
- Fungicides (>1,000 incidents/year)



Sensitive populations

- Pregnant and nursing mothers
- Infants, young children & the elderly
- People with pre-existing medical conditions and disease
- Emerging role of genetics; -PON



General Toxicology of Herbicides

In general, herbicides are not very toxic to people since herbicides target pathways or physiology that is specific to plants. However, there are some notable issues in which herbicides can harm people.

Human toxicity to herbicides can involve:

- 1) indirect toxicity not related to the mode of action
- 2) dermal irritation from strong acids, salts
amines, esters, and phenols
- 3) inhalation of sprays or particles
- 4) role of inert ingredients.

Acute Toxicity

Substances where dangerous exposure can occur without warning signs

Substances with non-selective mechanisms of toxicity (can effect more than the target)

Substances that can cause toxicity from skin absorption & inhalation pathways

Substances that are directly irritating or caustic from contact exposure (skin, eyes)

Herbicides and the eye

All herbicides (and other pesticides) should be considered harmful to your eyes. Effects can range from mild irritation to permanent damage, depending on the active ingredient and formulation. Personal protection and first aid equipment should be always be on or nearby.

A common exposure pathway is rubbing eyes with a contaminated glove or sleeve.



Fate & Transport of Pesticides

Solubility and environmental mobility

Persistence and breakdown products

Formulation

Regulatory status (GUP vs. RUP, restrictions)

Use patterns (pre-emergents, systemics, broadcast)



Environmental Characteristics

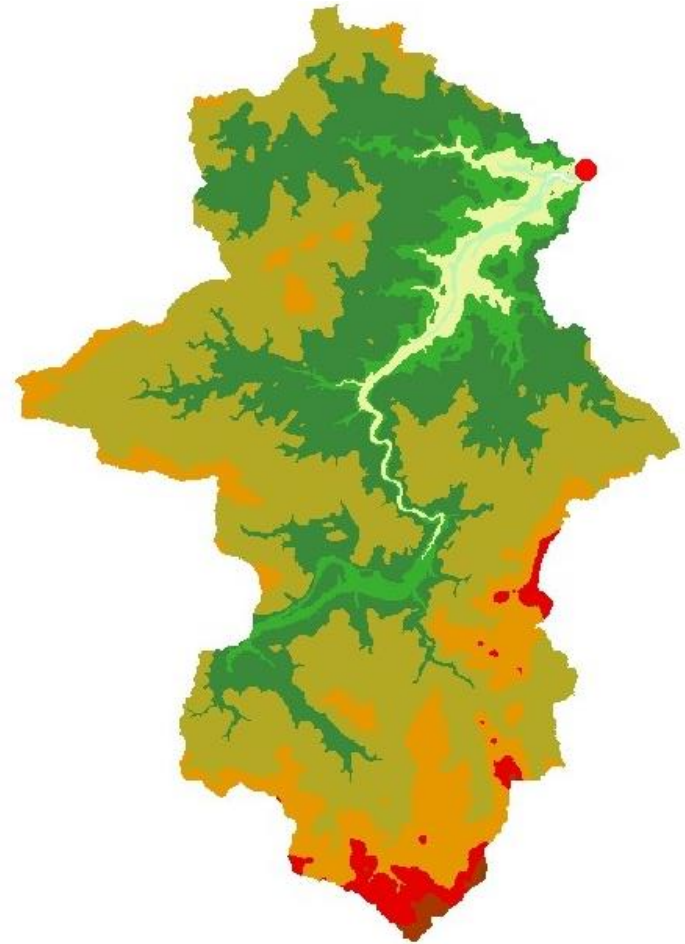
Water chemistry and pH

Microbial activity

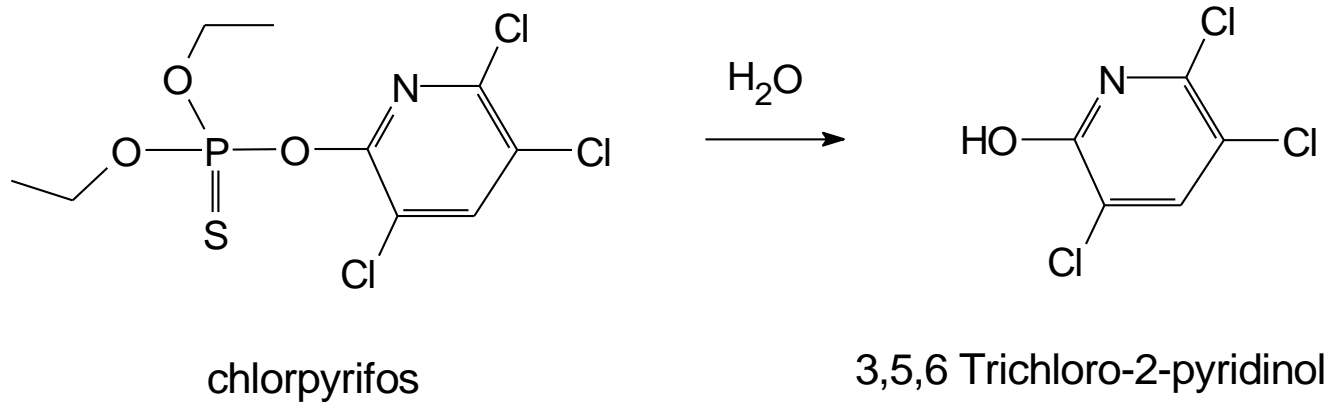
Natural organic matter

Temperature and light intensity

Topography and hydrology



Breakdown products



Examples of metabolites that are likely to be more prominent than their parent compounds:

- deethylatrazine (from atrazine)
- DDE (from DDT)
- 4-hydroxybifenthrin (from bifenthrin)

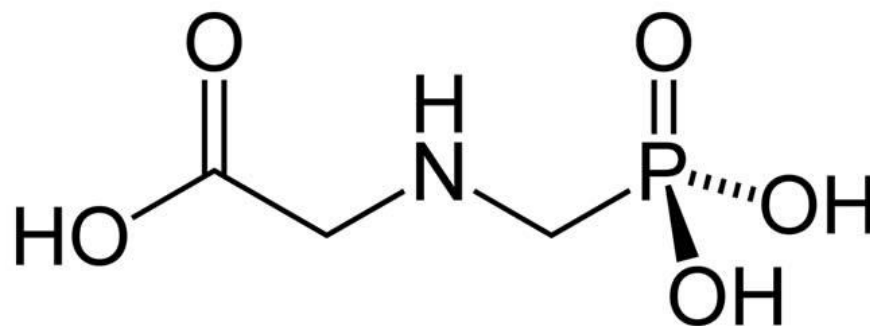
Stormwater



Common Herbicides Used by the Public

Glyphosate

Common product name:
Roundup®; Rodeo®



Use: non-selective systemic herbicide with activity on all annual and perennial plants

Pesticide Movement Rating*: **EXTREMELY LOW**

Soil half-life: 47 days

Notes on Glyphosate

Glyphosate itself is considered moderately toxic to fish. However, it is the surfactants in formulated Roundup that are toxic. While Rodeo does not have surfactant and is registered for aquatic use, it is often applied with surfactants that may impact aquatic life.

Some glyphosate formulations can cause skin and eye effects and contact should be avoided.

Chlorophenoxy Herbicides

Mode of Action

These herbicides disrupt hormone balance and protein synthesis in plants, leading to a variety of plant growth abnormalities.

Chemical Families

Phenoxy Acetic Acids: 2,4-D, mecoprop, MCPA

Benzoic Acids: dicamba

Chlorophenoxy Toxicology

Some of the chlorophenoxy acids, salts and esters are moderately irritating to skin, eyes and the respiratory system. These herbicides are well absorbed by GI tract, less from the lung and skin.

There are reports of burning sensations and coughing after inhalation of sprays, which may be related to the “inert” ingredients. Fatal outcomes from deliberate ingestion have been noted for 2,4-D and mecoprop, as a result of kidney failure, acidosis and electrolyte imbalance.

Reminders for the Public

Read the label directions before purchase

- pest or pest life cycle
- watering in pesticide
- cutting lawn first, etc...

Do not spray when it's windy

Do not stand underneath anything just sprayed

Do not walk over a wet or newly treated surface

More Reminders for the Public

More is not better!

If possible, purchase ready-to-use (RTU) pesticides that avoid mixing/diluting

Do not stockpile. Buy only as much as you need to do the job.

Consider where your children, pets, neighbors, etc. go in the yard, as well as the pathways into your home.

Inert Ingredients



Can be > 99% of a product

They are often referred to as “other ingredients”

Inert Ingredients

- Non active ingredients in a pesticide product are called "inert" or "other" ingredients
- An inert ingredient means any substance (or group of similar substances) other than an active ingredient that is intentionally included in a pesticide product.
- Called "inerts" by the law, the name should not be implied as **non-toxic**
- Certain pesticide ingredients can be an inert in one product and an active ingredients in another

Type of Inerts

- Solvents
- Fertilizers
- Wetting agents
- Foaming agents
- Defoaming agents
- pH buffers
- Surfactants
- Stickers
- Thickeners
- Water conditioners
- And more....



Toxicity of Inerts

Though called inert, some of these compounds may have potential to disrupt normal biological functions:

- Alter biochemical processes
- Cause adverse dermal reactions
- Cause adverse respiratory issues
- Increase toxicity of active ingredient

Given that inert/other ingredients are typically unknown caution is important.

Messaging and Risk Communication

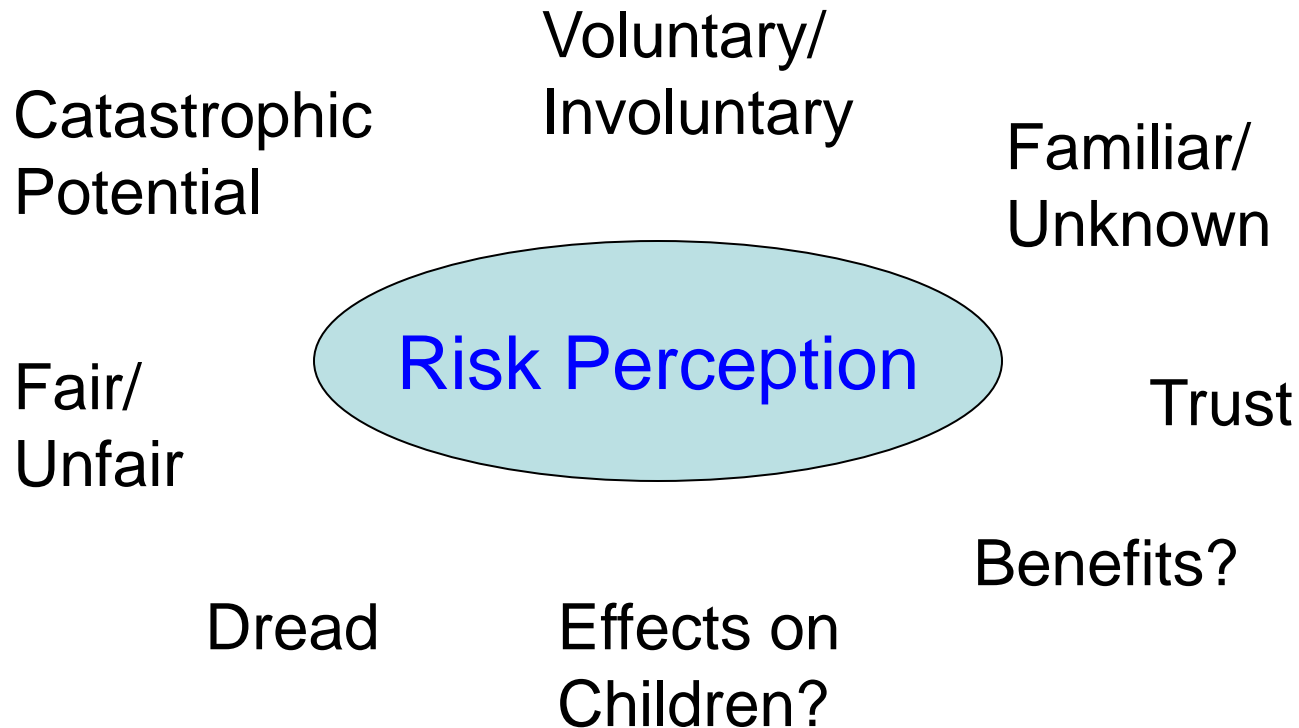
Risk Perception

Perception may not be reality,
but it is how people will:

- base their opinions & decisions
- take or not take actions
- support or not support activities
- recall how events transpired



Elements of Risk Perception



Messaging Risk

To the receiver:



From the receiver:

- Need to convey critical information
- Need to correct misinformation
- Need to build trust/rapport

- Need to build trust/rapport
- Need to capture relevant information
- Need to archive, organize, retrieve & report information

Challenges with Pesticides

Visibility & widespread use

DDT Legacy

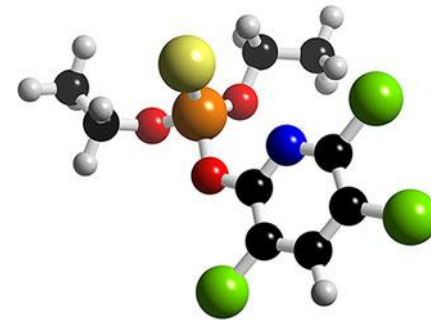
Intentional application

Limited stakeholder dialogue

Determined advocacy

Media attention

High profile misuse cases



“Pesticides = DDT & Agent Orange”

Translation:

- ✓ Pesticides are all dangerous, cancer-causing, and harmful to the environment
- ✓ Pesticide regulations and science have not evolved – we are stuck in 1960s thinking
- ✓ The benefits of pesticides don't outweigh the risks
- ✓ We don't have good information about pesticides before we use them
- ✓ Pesticides are too risky....PERIOD.

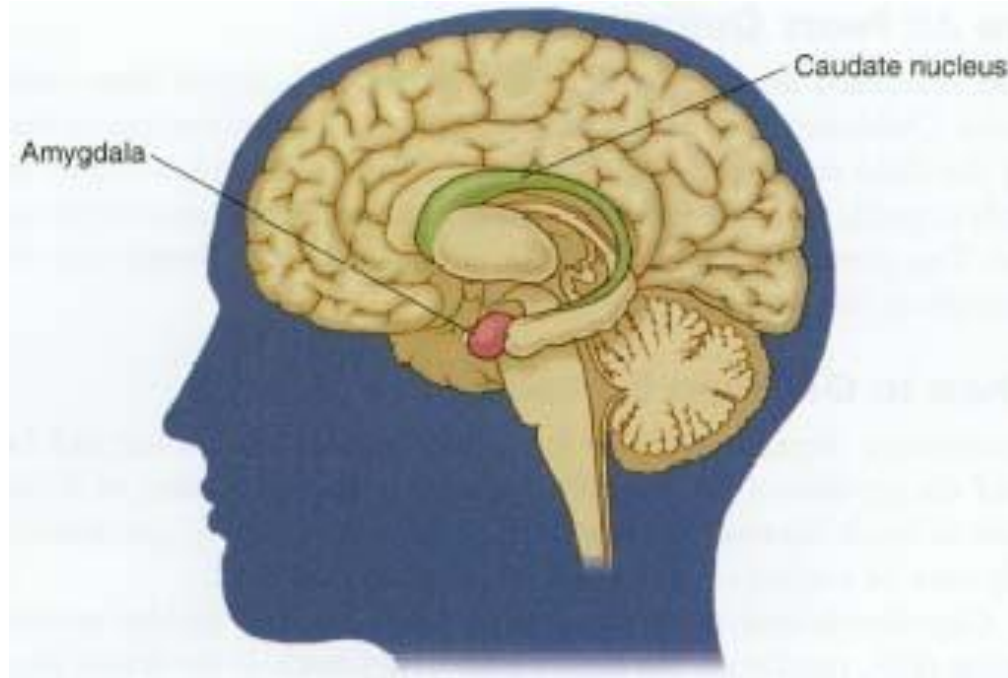
Messaging Today



ALL NATURAL
Pest Elimination

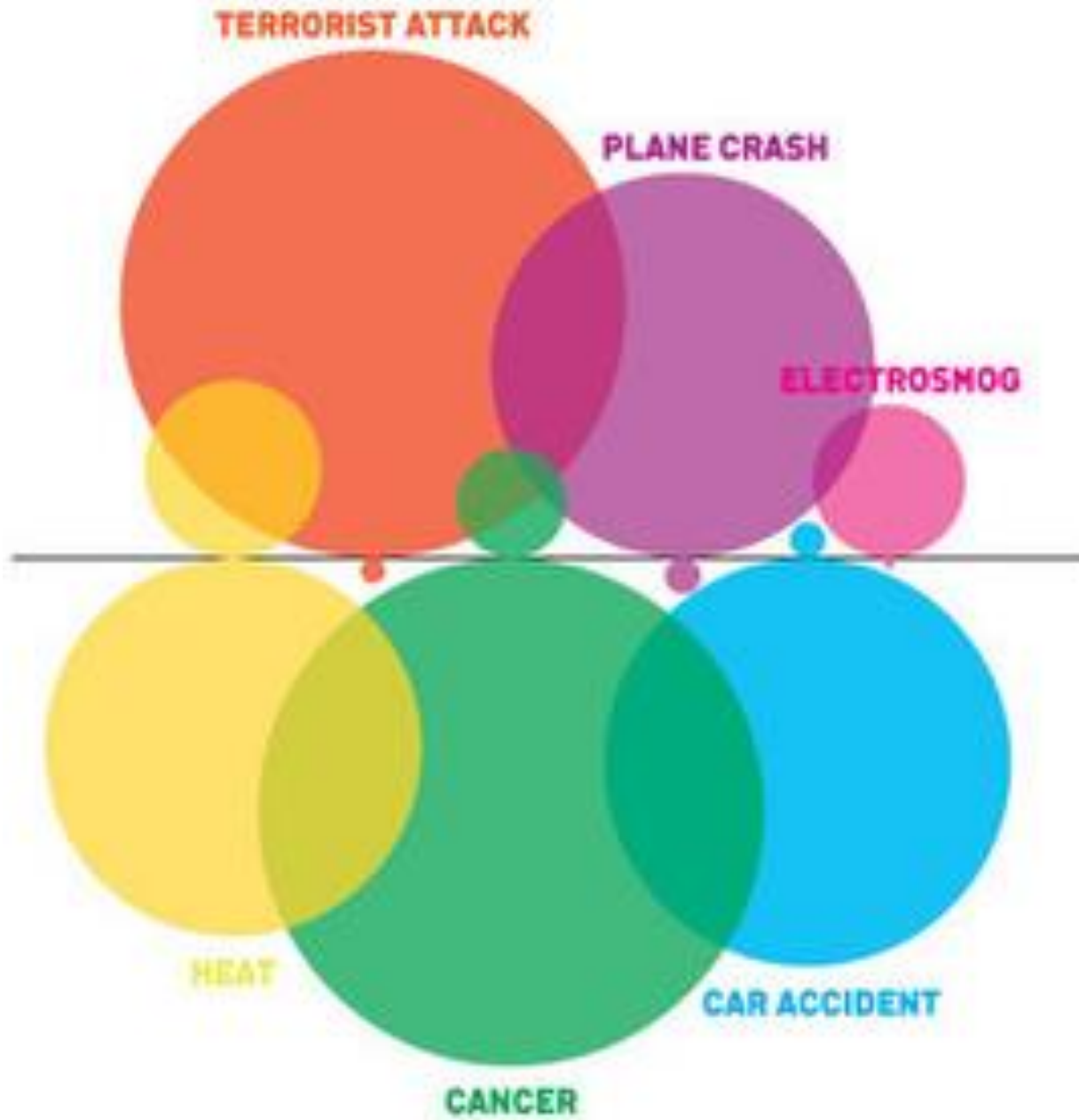


Neurologic Challenges



Triggering the amygdala (a.k.a. the “emotional brain”) can lead to denial or accentuation of feelings, immediate furor and oppositional defiance. This is often followed by lingering anger or grief. It can completely derail effective messaging and communication.

Actual Hazard **Public Outrage**



Media Challenges

“Weed-Whacking Herbicide Proves Deadly to Human Cells”

“Herbicides Linked to Depression in Farmers”

“Atrazine: A Molecular Bull in a China Shop”

All Science is Not Created Equal



Uncertainty?

Be transparent about uncertainty. Address specific concerns.

- *Why should I believe this is safe?*
- *How do we know if the residue won't accumulate in my vegetable garden?*
- *Has staff been trained to properly apply these products?*
- *What will this do to local fish and wildlife?*

Tell Your Story

Maintain certification and attend trainings

Use of modern, calibrated & targeted spray equipment

Careful/judicious with use – pesticides cost \$\$\$

Describe why the treatment is beneficial

Reiterate you are also a member of the community

Offer objective, third-party resources

Communication Tools

- Actively listen to concerns
- Do not interrupt
- Acknowledge their feelings
- Address the core concerns
- Politely correct misinformation (not emotions)
- Acknowledge when you don't know something
- Offer third-party informational resources



What to avoid

Undefined technical terms & lots of acronyms

Repeating negative allegations from the public or media

Speaking in abstractions - tell appropriate stories, examples & analogies to build a rapport

Promising unrealistic outcomes or timelines

Not involving the public as a real partner

Ignoring empathy, dedication & transparency

Communication & Messaging are...

- Your reputation
- Your attitude
- Your action
- Your inaction
- Your timeliness

...and of course, the way you are perceived.



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